

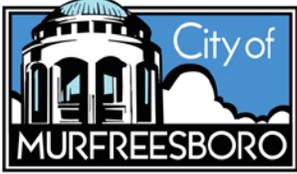
City of Murfreesboro, Tennessee Greenways, Blueways, and Bikeways Master Plan



April 2013

**CITY OF MURFREESBORO
GREENWAYS, BLUEWAYS, & BIKEWAYS MASTER PLAN**

ACKNOWLEDGEMENTS



T E N N E S S E E

The Murfreesboro Greenways, Blueways, and Bikeways Master Plan was developed by the Murfreesboro Parks and Recreation Department in concert with these City of Murfreesboro departments: Transportation, Planning and Engineering, Urban Environmental, and Legal. The Murfreesboro Parks and Recreation staff gratefully acknowledges the efforts and leadership from the following individuals in the development of this plan:

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**CITY OF MURFREESBORO
GREENWAYS, BLUEWAYS, & BIKEWAYS MASTER PLAN**

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CITY OF MURFREESBORO GREENWAYS, BLUEWAYS, & BIKEWAYS MASTER PLAN

EXECUTIVE SUMMARY

In 2011, the City of Murfreesboro initiated the development of the Greenways, Blueways, and Bikeways Master Plan to help identify and coordinate implementable improvements in recreation and non-motorized transportation over the next 25 years. This plan represents a joint effort of the associated City Departments which oversee the planning, design, and maintenance of these facilities working closely with a Study Advisory Committee consisting of various local stakeholder interests. It has also been developed around the input of Murfreesboro's residents, who contributed to the ideals of the plan on two separate occasions.

The full plan consists of a plan overview document supported by five (5) separate technical memorandums as summarized below:

Plan Overview: A condensed version of the full plan documentation which provides interested readers the key facets of the plan as well as its primary recommendations.

Technical Memorandum #1: Refined Plan Objectives. These objectives speak to the outcomes of the plan, but are really deeper reflections of what stakeholders in Murfreesboro envision for the greenways, blueways, and bikeways network as it is further developed over the planning horizon.

Technical Memorandum #2: Existing Conditions. Summarizes planning documents and policies that are pertinent to the plan and that are currently in place. It also summarizes an evaluation of the existing infrastructure located within the City and the urban growth boundary.

Technical Memorandum #3: Capital Improvement Needs. Presents the physical, capital improvement needs that have been identified through the development of the plan. Project maps, general project descriptions, phasing recommendations, and potential costs and funding resources are presented here.

Technical Memorandum #4: User Design Guide. Defines the desirable standards for construction of the City's greenways, blueways, and bikeways network. These design guidelines are intended to function as a reference for local government, engineers, planners, and others who make decisions that affect bicycle and pedestrian travel in Murfreesboro. These guidelines are intended to be used in conjunction with and as a supplement to existing local, state, and national construction standards.

Technical Memorandum #5: Plan Implementation. The focus here is on policies and programs which have been used in other communities and which may be applicable in Murfreesboro to increase greenway, blueway, and bikeway use. Such policies and programs promote bicycling and walking, educate users and potential users, and set standards to provide well designed facilities for non-motorized travel and recreation.

The participant-formed objectives of this plan find common ground in two emphasis areas of contemporary American cities: health/recreation and transportation. The advantages gained by communities that have comprehensive, safe, and well maintained facilities for recreation and transportation are immense. In the development of this plan and in its implementation in the

years ahead, the question should continually be asked, “how will our actions progress one or more of these objectives to the advantage of Murfreesboro?”

The combination of a growing Murfreesboro creating development opportunities for greenway, blueway, and bikeway infrastructure, more residents requiring additional recreation outlets and transportation options, and the City’s desire to provide a leading quality of life for existing and future residents of middle Tennessee has prompted the need for this master plan.

A total of 67 miles of off-road trails and 24 new trailheads have been recommended for development over the next 25 years. The routes focus on improving connectivity between large community parks, neighborhoods and commercial areas and on providing trails to currently underserved segments of the

population. Over 100 miles of bicycle facilities and designations are also proposed as part of the plan. These are aimed at making critical connections to key destinations and allowing more users to experience the greenway network without driving to it. Lastly, 14 blueways access locations are recommended on all three forks of the Stones River in and around Murfreesboro in addition to the seven public access locations that currently exist.

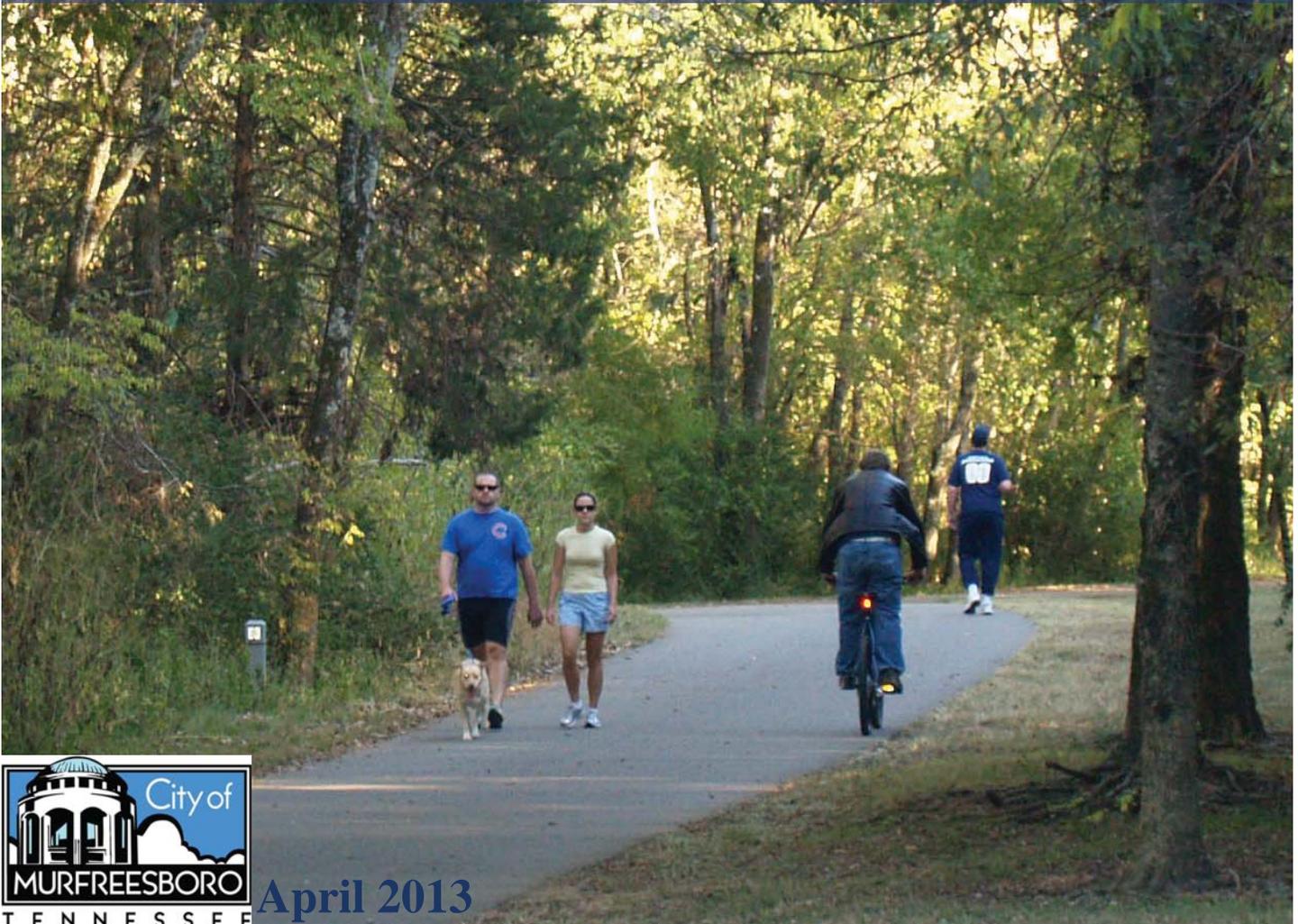
Type of Recommended Facility	Length (miles)
Greenways and Greenway Connectors	67.3
Multi-Use Paths	36.3
Bicycle Lanes	20.2
Bicycle Routes	50.0
TOTAL	173.8

Murfreesboro has taken the first step in addressing the pedestrian needs of its citizens by developing this plan. Progressive cities across the nation have long realized the close ties to economic development of their city and the quality of life offered. Our neighboring city Nashville recognizes the benefits of greenways and says in their published materials, “it seems difficult to conceive of a more efficient way to accomplish so many desirable objectives. And accomplishing these goals is essential to Nashville’s economic development. Unless growth is balanced with protection of the natural resources that contribute to our quality of life, it risks being counterproductive.” The balance between work and play is essential to the future growth of Murfreesboro.

This is an important plan and an achievable goal. Murfreesboro’s growth is both an opportunity to develop high quality infrastructure such as is proposed as well as a call to responsibility for City leaders to continue to provide the quality of life that Murfreesboro has become known for. Stretched budgets, ever-competitive federal funding, and other priorities and obligations of the city will present challenges to the fulfillment of the plan. However, remaining flexible in implementation, looking for opportunities for plan advancement as part of other projects, and engaging in non-infrastructure activities (policies and programs) will allow the City to continue to make tremendous strides over the next 25 years.

City of Murfreesboro, Tennessee Greenways, Blueways, and Bikeways Master Plan

Master Plan Overview



April 2013

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Need for a Plan

The City of Murfreesboro has a population of nearly 110,000 residents making it the sixth largest city in the State of Tennessee. Its population growth has far exceeded national averages and therefore has required the city to be very proactive about development and how it occurs. Murfreesboro has developed policies related to sidewalks, water quality, subdivision development, street construction and zoning ordinances with overlay districts protecting areas of historic significance and with

specific design intents. These policies are all geared toward providing the best possible community and quality of life for residents of Murfreesboro.

Murfreesboro also has some of the best public recreation facilities in Tennessee. These facilities have resulted in the attraction of many large-scale competitive sporting events while at the same time providing first class facilities to residents.

The combination of a growing community creating development opportunities for greenway, blueway, and bikeway infrastructure, more residents requiring additional recreation outlets and transportation options, and the City's desire to provide a leading quality of life for existing and future residents of middle Tennessee has prompted the need for this master plan.

The Objectives

These locally-developed objectives of the plan speak to the outcomes of this document, but are really deeper reflections of what stakeholders in Murfreesboro envision for the actual greenway, blueway, and bikeway system as it is further developed over the planning horizon. As such, these objectives should be used to routinely gauge not only the development of the master plan, but to act as benchmarks as various facets of the plan are considered and undertaken in the future.

The objectives are:

- 1.** Promote the increased usage of existing greenways and blueways and the construction of new greenways and blueways access points by identifying personal and community needs and benefits relating to quality of life, health, economics, and sustainability.
- 2.** Present strategies leading toward a transformational attitude of Murfreesboro’s residents and workers in which active transportation (transportation by walking or by bicycle) is regarded as a viable travel option for all.
- 3.** Assist City staff involved in facility planning and construction through the determination of future greenway and blueway routes which can be pursued through capital budgeting as well as private development processes. This may include facilities constructed as part of the renovation of current infrastructure (street renovations) as well as through new roadway development.
- 4.** Identify leverages of existing, emerging, and potential resources (funding, programs, policies, etc.) toward a cooperative approach in elevating Murfreesboro’s greenway, blueway, and bikeway system.



These participant-formed objectives find common ground in two emphasis areas of contemporary American cities: health/recreation and transportation. The advantages gained by communities that have comprehensive, safe, and well maintained facilities for recreation and transportation

are immense. In the development of this plan and in its implementation in the years ahead, the question should continually be asked, “how will our actions progress one or more of these objectives to the advantage of Murfreesboro?”

Plan Development

Murfreesboro’s Greenways, Blueways, and Bikeways Master Plan is a joint effort of the associated City Departments which oversee the planning, design, and maintenance of these facilities. The study was developed by means of a Study Advisory Committee (SAC) meeting approximately bi-monthly through the course of a year. SAC members represented the following interests:

System Users

- City of Murfreesboro
 - Parks and Recreation Department
 - Parks and Recreation Commission
 - Transportation Department
 - Planning Department
 - Planning Commission
 - Greenway Projects Committee
 - Urban Environment Department
 - Legal Department

MTSU

- Environmental Education
- Biology



At the outset of the plan development, multiple interviews were held with key stakeholders. The following stakeholder groups were included in the interviews:

- Murfreesboro City Schools
- MTSU
- Friends of the Greenway
- Stones River Watershed Association
- Tennessee Trails Association
- City Administration
- City Transportation
- City Parks
- City Planning
- County Planning
- Town of Smyrna Planning
- Town of Smyrna Parks and Recreation

The development of the plan also included two public meetings designed for input into the planning process at the outset and preliminary recommendations phases of the plan’s development. A formal public review period and public hearing also preceded the City’s adoption of this plan.

Existing Conditions

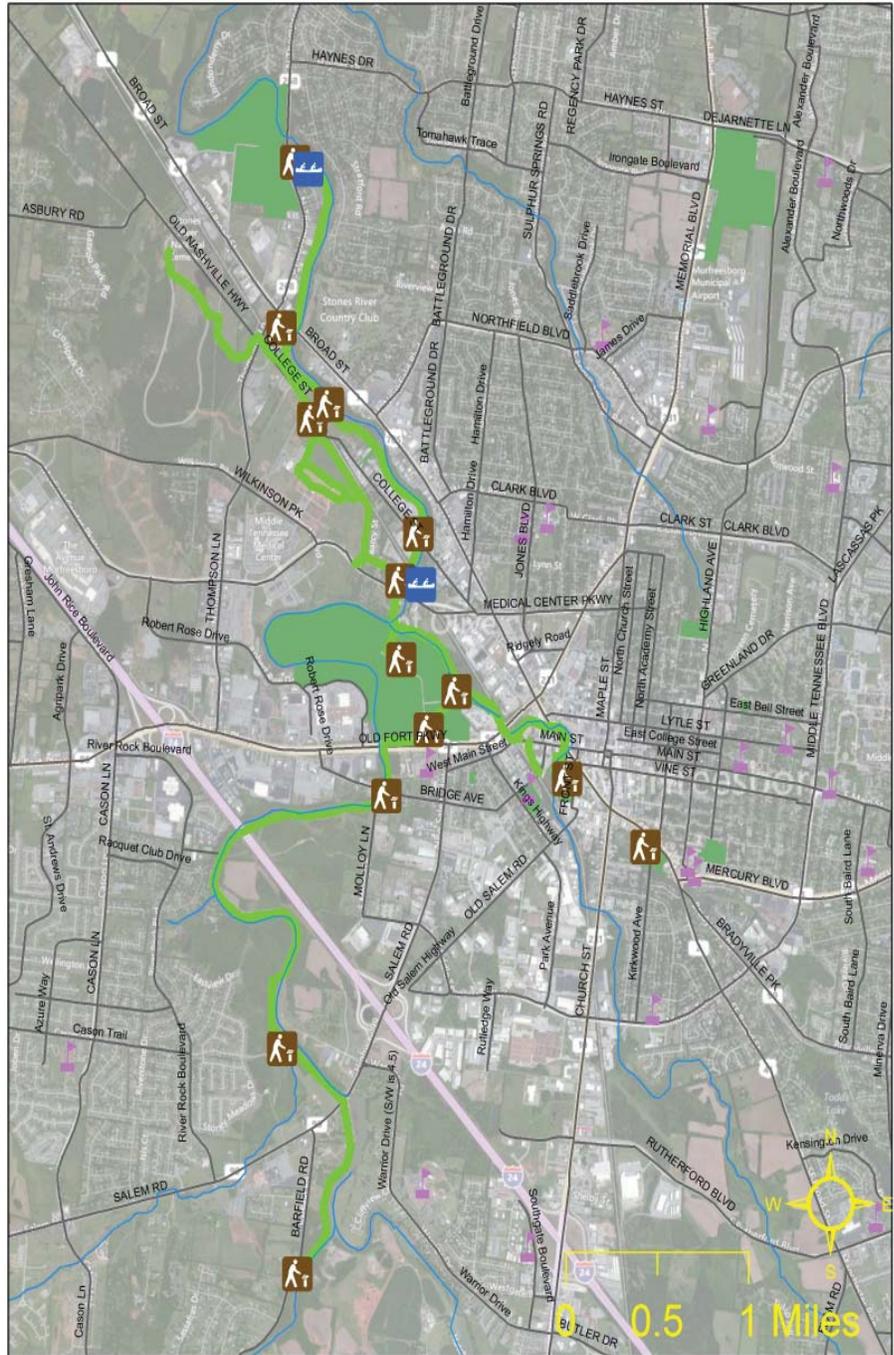
The City of Murfreesboro has 12-miles of paved asphalt trails located along the Stones River and Lytle Creek. There are 11 official trailheads that provide access to residents from various vantage points along the route and many historic points of interest and parks are connected by the trail.

Recreation opportunities for paddle sports within the City of Murfreesboro exist along the East, West, and Middle forks of the Stones River. The Middle Fork of the Stones River is approximately 19.8 miles long and joins the West Fork near Highway 99. The West Fork flows for 39.1 miles converging with the East Fork on the North side of Murfreesboro where the river then flows into J. Percy Priest Lake. Dams exist along each segment of the Stones River altering flow and requiring short portages for continuous paddling along the river.

In order to assess the current conditions of Murfreesboro’s on-street bikeways network, a comprehensive inventory and analysis was completed. The inventory included all major roadways as identified by the City’s functional classification designation, including major arterials, minor arterials, commercial collectors, community collectors, residential collectors, and residential sub collectors. In total, 311 miles of roadways within Murfreesboro’s Urban Growth Boundary were inventoried to document roadway conditions as well as the presence of sidewalks and related attributes.

Currently, there are approximately 21.7 miles of bike lanes and 7.0 miles of signed bike routes within the study area. All of the bike lane miles and 66% of the bike route miles are within the city limits.

A bicycle level of service (BLOS) analysis was used to determine the current suitability of streets within the urban growth boundary area. The BLOS



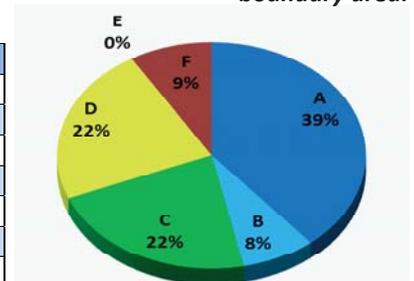
12 miles of existing greenways link several key recreation and historic sites.

ranges from most suitable (BLOS A) to least suitable (BLOS F) based on roadway conditions (number of lanes, roadway speed, traffic volume, pavement width, and shoulder width, etc.).

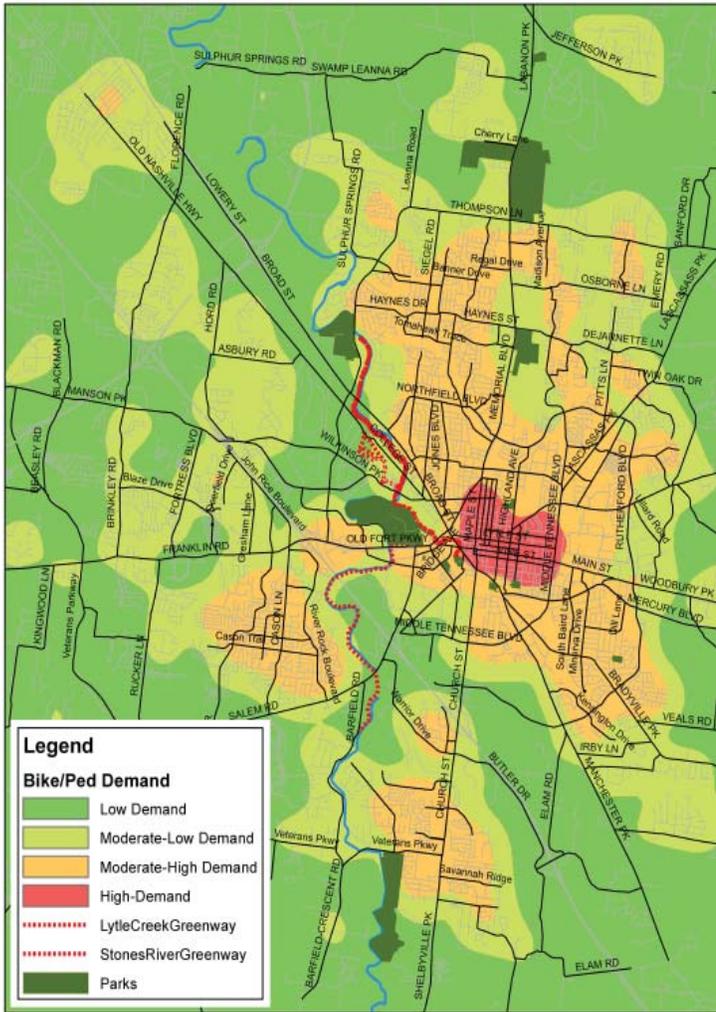
Among other findings, the BLOS analysis shows that there may be an opportunity to implement more formal bicycling infrastructure and designation with little actual construction.

BLOS breakdown for streets within the urban growth boundary area.

BLOS	Miles
A	121
B	24
C	69
D	70
E	0
F	27
TOTAL	311



Based on national trip-making averages, Murfreesboro's land use is such that over 60,000 daily walking and biking trips could be realized if adequate infrastructure were in place.



To give local planners, engineers, and Parks staff a decision tool that helps to visualize the real need for walking and biking facilities within the study area, a demand intensity map was produced. At the macro level, this is a regional bike and pedestrian model that incorporates the entirety of the transportation planning area of the Murfreesboro region. Aside from the scope of the model's planning area, however, this procedure is very much a microscopic one, producing a parcel-level analysis fit for walking and biking trips.

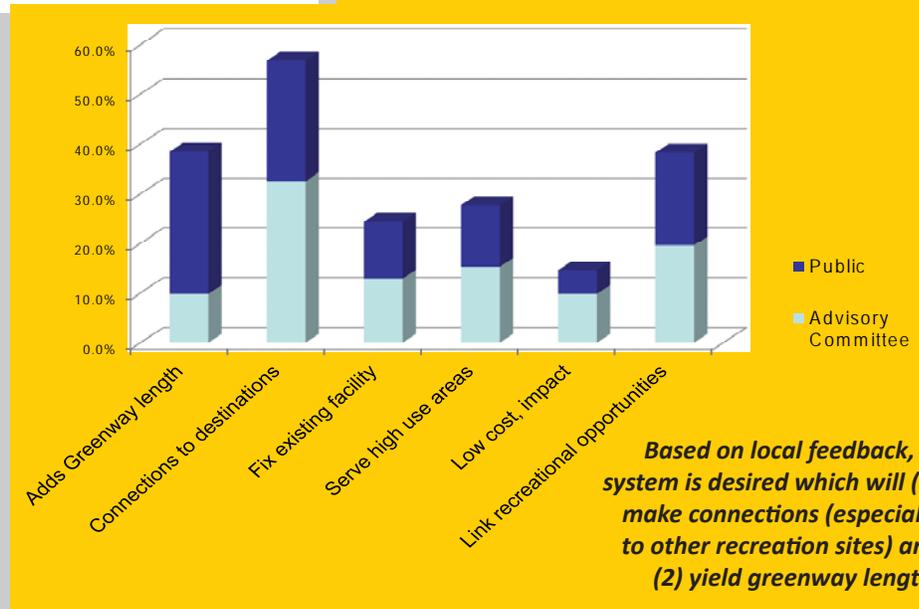
This analysis is developed by using each parcel's demographic information and proximity to other land uses to predict how many walking and/or cycling trips the parcel will likely generate under ideal conditions. This information can be used to help understand the propensity for non-mo-

torized transportation activity in an area and to help predict where transportation investments will have the greatest impact.

Determining What's Needed

Data collection and engineering analysis is one component of the needs assessment, but what really matters is what the users of the system think. The real strategy for Murfreesboro's greenways, blueways, and bikeways plan came from residents when asked to rank several important evaluation criteria for the future projects found in this plan.

- Project adds to overall length of greenway system
- Project provides connections to destinations (neighborhoods, shopping, schools, parks, etc.)
- Project retrofits existing substandard facility (ex. widen an existing greenway)
- Project is especially likely to have high usage (in a high demand area – from model)
- Project is inexpensive, limited in scope, and/or has little environmental impact
- Project links other recreational opportunities (parks, blueways, etc.)



Based on local feedback, a system is desired which will (1) make connections (especially to other recreation sites) and (2) yield greenway length.



OUR PLAN

Infrastructure Recommendations

Over the last 20 years, the City of Murfreesboro has developed a high quality greenway system that extends for over 12 miles, making it a leader in the state for its quality of off-road facilities. The GBB Master Plan was initiated to provide the City with the tools to continue the momentum of the bike and pedestrian network and to provide a road map for the next 25 years.

Taking advantage of the river and stream network found throughout the City and Rutherford County, a blue-

way component was also added to the master plan to provide improved water recreation opportunities for the system. With a public input process that included an Advisory Committee of city staff and citizens and open public forums that allowed for the general public to give input, a master plan was developed with recommendations for the next 25 years. These recommendations take into account the priorities identified in the public input process and reflect those projects that provide the highest benefit for the residents of Murfreesboro.

The proposed improvements have been identified as a result of an analysis of the existing infrastructure conditions and an identification of the needs within Murfreesboro for non-motorized transportation and recreation as identified through technical analyses and local stakeholder and public input. Successful implementation of the greenways, blueways, and bikeways master plan will address the primary needs of this type of infrastructure through the planning horizon.

Facility Types

The intent of the recommended capital projects of the master plan is to identify corridor level facilities, not necessarily to identify specific routing (for off-road improvements) or design-level details. These specific details are expected to follow this plan as certain projects move into the implementation stages including project design. General project types recommended in this master plan are:



Greenway:

A typical 10' – 16' wide paved off-street path generally following an established water course and having few or no at-grade crossings of roadways. Murfreesboro's existing greenway facilities are examples.



Greenway Connector:

A paved off-street path that usually serves to connect specific properties to a greenway. Usually planned on public or institutional properties, an 8' – 12' width is expected. At-grade street crossings will be required, and must be designed appropriately as the project is implemented.



Multi-Use Path:

Constructed within the right-of-way of a roadway, this 8' – 12' paved path is ideally separated from the edge of the road by at least 5'. Where curb-and-gutter is used and right-of-way is constrained, the path may be constructed without a buffer to resemble a wide sidewalk. At-grade street crossings (signalized and unsignalized) are common.



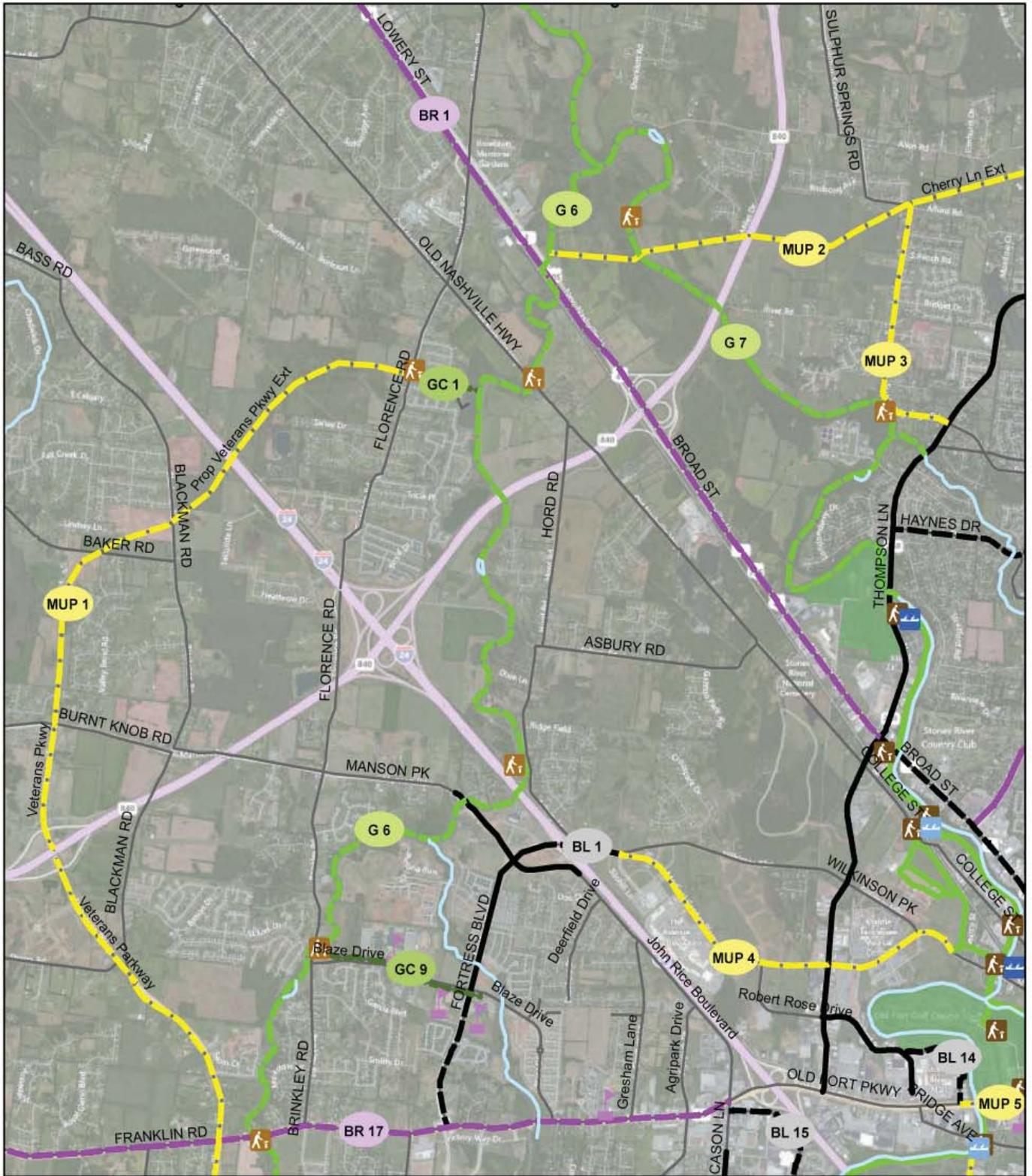
Bike Lane:

A signed, dedicated lane for cyclists on the roadway having a minimum width of 4'. Modifications to the traditional bike lane including buffered bike lanes and cycle tracks should be considered in the project's design phase.

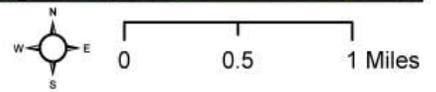


Bike Route:

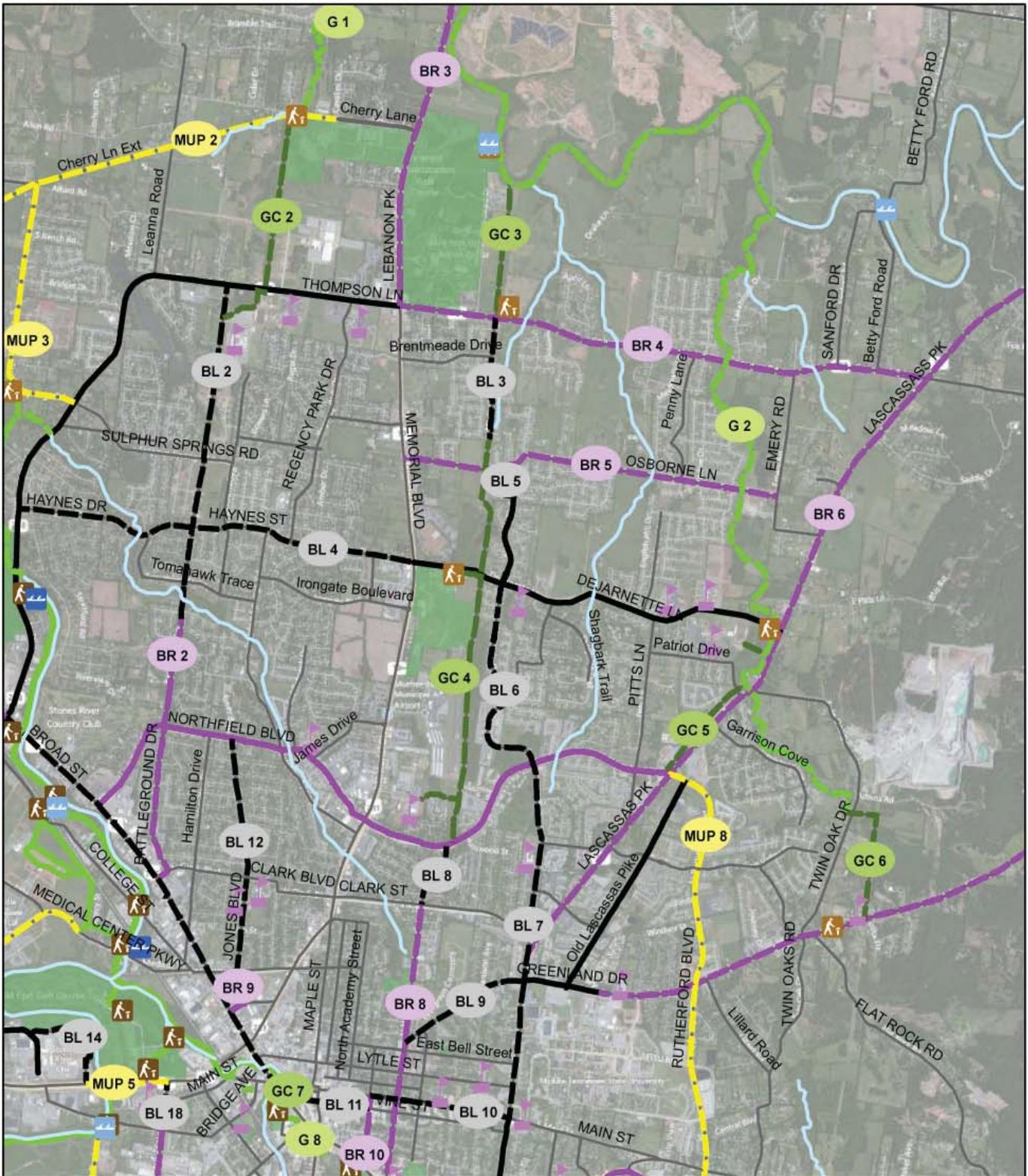
A signed route (sometimes including pavement markings) for bicycle use but with no dedicated infrastructure. Examples may be roads with wide shoulders, striped shared lanes ("sharrows"), or low-speed, low-volume streets.



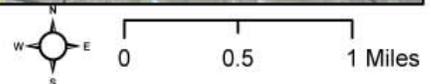
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|-----------------------|----------------------------|----------------------------|
| Exist. Trailhead | Existing Facilities | Proposed Facilities |
| Prop. Trailhead | Bike Lane | Bike Lane |
| Exist. Blueway Access | Bike Route | Bike Route |
| Prop. Blueway Access | Greenway | Greenway Connector |
| Schools | Parks | Multi-Use Path |
| | | Greenway |



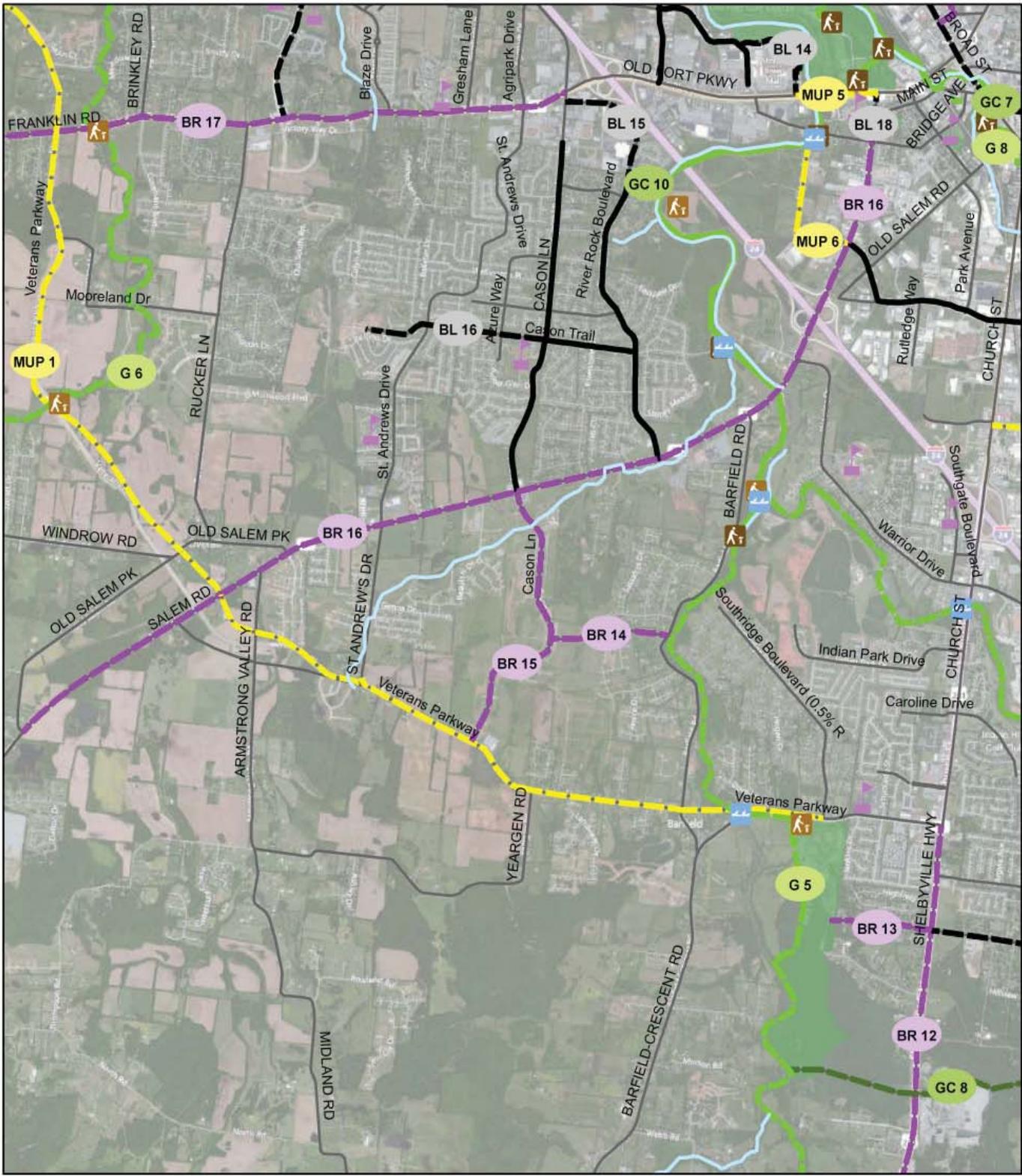
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**Greenways, Blueways,
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 Plan Recommendations -
 Northwest



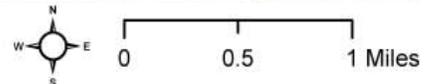
Existing Facilities		Proposed Facilities	
	Exist. Trailhead		Bike Lane
	Prop. Trailhead		Bike Route
	Exist. Blueway Access		Greenway Connector
	Prop. Blueway Access		Multi-Use Path
	Schools		Greenway
	Parks		



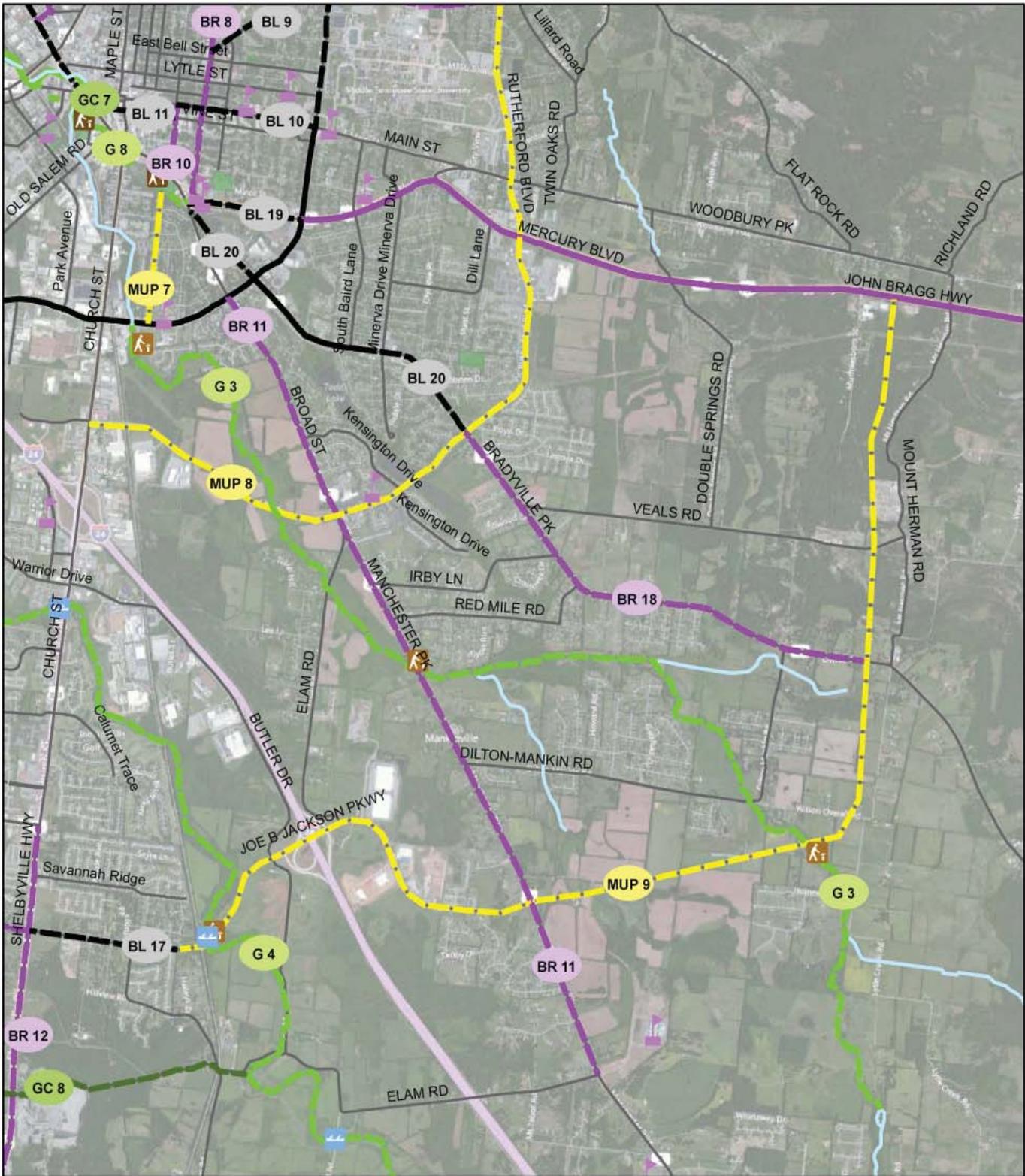
City of Murfreesboro
**Greenways, Blueways,
 and Bikeways Master Plan**
 Plan Recommendations -
 Northeast



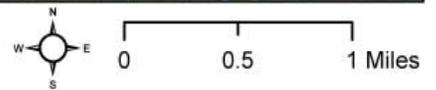
- | Existing Facilities | | Proposed Facilities | |
|-----------------------|----------------------|-----------------------|----------------------|
| Exist. Trailhead | Prop. Trailhead | Exist. Trailhead | Prop. Trailhead |
| Exist. Blueway Access | Prop. Blueway Access | Exist. Blueway Access | Prop. Blueway Access |
| Schools | | | |
| Bike Lane | Bike Route | Bike Lane | Bike Route |
| Greenway | Parks | Greenway Connector | Multi-Use Path |
| | | Greenway | |



City of Murfreesboro
**Greenways, Blueways,
 and Bikeways Master Plan**
 Plan Recommendations -
 Southwest



- | | | |
|---|--|--|
|  Exist. Trailhead | Existing Facilities | Proposed Facilities |
|  Prop. Trailhead |  Bike Lane |  Bike Lane |
|  Exist. Blueway Access |  Bike Route |  Bike Route |
|  Prop. Blueway Access |  Greenway |  Greenway Connector |
|  Schools |  Parks |  Multi-Use Path |
| | |  Greenway |



City of Murfreesboro
**Greenways, Blueways,
 and Bikeways Master Plan**
 Plan Recommendations -
 Southeast

Greenways

Project ID	From	To	Distance (mi)	Additional Information
G 1	Cherry Lane	Walter Hill Park	1.76	
G 2	Walter Hill Park	Twin Oak Dr	8.91	
G 3	Middle Tennessee Blvd	Urban Growth Boundary	7.96	
G 4	Greenway (existing - Barfield Rd)	Urban Growth Boundary	11.61	Via Middle Fork of Stones River.
G 5	Greenway (existing - Barfield Rd)	Urban Growth Boundary	8.98	"Via Stones River, along Barfield-Crescent Park."
G 6	Veterans Pkwy	Urban Growth Boundary	12.57	Via Overall Creek
G 7	Thompson Lane	Overall Creek Greenway (proposed - G 6)	5.19	
G 8	Greenway (existing - Cannonsburg)	Discovery Center	0.47	Requires crossing at S. Church

Greenway Connectors

Project ID	From	To	Distance (mi)	Additional Information
GC 1	Veterans Pkwy (prop)	Greenway (prop)	0.38	
GC 2	Siegel schools campus	Greenway (prop)	1.36	Connects Siegel schools, Miller Coliseum, and Siegel Park.
GC 3	Madison Ave	Greenway (prop)	0.75	Connects Madison Ave bike lanes to greenway via easement on MTSU and water treatment plant property.
GC 4	Northfield Blvd	Madison Ave	2.31	Part of major north-south connector route via airport property easement. May include short spur trails to SportsCom and MTCS.
GC 5	Rutherford Blvd	Greenway (prop)	0.67	Part of effort to link MTSU to future greenway via trails (via Rutherford Blvd MUP). May include spur trail to Oakland HS.
GC 6	Halls Hill Pk	Greenway (prop)	0.78	Connection to Daniel McKee school via apparent existing utility corridor.
GC 7	Vine St	Greenway (exist)	0.14	Urban GC enhancing downtown greenway access.
GC 8	Wilderness Station	Greenway (prop)	2.19	Potential for landmark bridge over Shelbyville Pk near quarry (included in cost).
GC 9	Blackman schools campus	Greenway (prop)	1.05	
GC 10	River Rock Blvd	Greenway (exist)	0.21	Bridge to greenway on old raquet club property

Multi-Use Paths

Project ID	Route	From	To	Distance (mi)	Additional Information
MUP 1	Veterans Parkway	Barfield-Crescent Park	Greenway Connector (prop)	12.2	
MUP 2	Cherry Lane	Siegel Park	Greenway (prop)	4	To be designed as part of Cherry Lane extension. ROW limitations may require use of alternative facility type.
MUP 3	Sulphur Springs Rd	Cherry Lane	Thompson Lane	1.53	To be designed as part of future Sulphur Springs Rd improvements.
MUP 4	Medical Center Pkwy	Conference Center Dr	Greenway (exist)	2.34	Retrofit on north side of Medical Center Pkwy.
MUP 5	Old Fort Pkwy	Salem Rd	Mall Circle Dr	0.49	On north side of Old Fort Pkwy only.
MUP 6	Molloy Lane	Middle Tennessee Blvd	Greenway (exist)	0.83	
MUP 7	Kirkwood Ave	Middle Tennessee Blvd	Discovery Center	0.75	Potential connection for Discovery Center to Bellwood Elementary to greenway (proposed).
MUP 8	Rutherford Blvd	Church St	Northfield Blvd	6.6	
MUP 9	Joe B Jackson Pkwy	East of I-24	John Bragg Hwy	7.57	

Bike Lanes

Project ID	Route	From	To	Distance (mi)	Additional Information
BL 1	Medical Center Pkwy	Manson Pk	Conference Center Dr	0.75	Retrofit bike lanes through I-24 interchange
BL 2	Seigel Rd/ Battleground Dr	Marymont Dr	Thompson Ln	1.92	Includes new bike/ped only connection at Battleground dead end.
BL 3	Madison Ave	Dead End	Thompson Ln	0.69	Stripe only
BL 4	Haynes Dr	Thompson Ln	Memorial Blvd	2.39	
BL 5	Peconic Pl/ Howell Dr	Alexander Blvd	Osborne Ln	0.27	Stripe only
BL 6	Alexander Blvd/ N Tennessee Blvd	Northfield Blvd	Dejarnette Ln	1.32	Stripe only
BL 7	Middle Tennessee Blvd/ N Tennessee Blvd	Main St	Northfield Blvd	2.02	
BL 8	Highland Ave	Clark Blvd	Northfield Blvd	0.39	Stripe only
BL 9	Greenland Dr	Highland Ave	Middle Tennessee Blvd	0.8	Stripe only
BL 10	Main St	Maney Ave	Middle Tennessee Blvd	0.82	
BL 11	Vine St	Greenway Connector (prop)	Maney Ave	0.48	Stripe only
BL 12	Jones Blvd	Medical Center Pkwy	Northfield Blvd	1.33	
BL 13	Broad St	Thompson Ln	Greenway (exist)	2.65	Construct as part of future Broad St improvements.
BL 14	Mall Circle Dr	Robert Rose Dr	Old Fort Pkwy	0.63	Restripe existing 3-lane section.
BL 15	River Rock Blvd	Cason Ln	Greenway Connector (prop)	0.8	Restripe existing 3-lane section.
BL 16	Cason Trl	Dead End	Cason Ln	1.07	Stripe only
BL 17	Joe B Jackson Pkwy	Shelbyville Hwy	Multi-Use Path (prop)	0.87	
BL 18	Salem Rd	Bridge Ave	Old Fort Pkwy	0.28	
BL 19	Mercury Blvd	Broad St	Middle Tennessee Blvd	0.69	
BL 20	Bradyville Pk	Broad St	Rutherford Blvd	1.33	Additional 0.8 mile bike lane from Middle Tennessee Blvd to Minerva Dr already exists

Bike Routes

Project ID	Route	From	To	Distance (mi)	Additional Information
BR 1	Broad St	Urban Growth Boundary	Thompson Lane	1.73	
BR 2	Clark Blvd/ Battleground Dr	Broad St	Marymont Dr	1.55	
BR 3	Lebanon Pk	Urban Growth Boundary	Thompson Lane	1.81	
BR 4	Thompson Ln	Lebanon Pk	Lascassas Pk	3.13	
BR 5	Osborne Ln	Memorial Blvd	Emery Rd	2.22	
BR 6	Lascassas Pk	Urban Growth Boundary	Middle Tennessee Blvd	6.28	
BR 7	Halls Hill Pk	Urban Growth Boundary	Champion Way	4.2	
BR 8	Highland Ave	Dead End	Clark Blvd	1.67	Includes new bike/ped only connection to Mercury Blvd.
BR 9	Jones Blvd/Ridgely Rd	Broad St	Medical Center Pkwy	0.32	
BR 10	Maney Ave	Broad St	Main St	0.4	
BR 11	Broad St/Manchester Pk	Middle Tennessee Blvd	Urban Growth Boundary	4.93	
BR 12	Shelbyville Pk	Veterans Pkwy	Urban Growth Boundary	2.71	
BR 13	Lynnford Dr	Barfield-Crescent Park	Joe B Jackson Pkwy	0.61	
BR 14	Unfinished Road	Barfield Rd	Cason Ln	0.7	
BR 15	Cason Ln	Veterans Pkwy	Salem Rd	1.74	
BR 16	Salem Rd	Urban Growth Boundary	Bridge Ave	6.45	
BR 17	Old Fort Pkwy	Urban Growth Boundary	Cason Ln	9.13	
BR 18	Bradyville Pk	Rutherford Blvd	Joe B Jackson Ext (prop)	3.0	

Greenway Recommendations

A total of 67 miles of off-road trails and 24 new trailheads have been recommended for development over the next 25 years. The routes focus on improving connectivity between large community parks, neighborhoods and commercial areas and on providing trails to currently underserved segments of the population. In conjunction with bike lanes and multi-use paths, the proposed greenways begin to provide a system that encompasses the entire perimeter of the City of Murfreesboro. Greenway Connector routes penetrate the central corridors of the city and link up community parks, downtown and MTSU to the perimeter.

Trailheads have been strategically placed

along primary vehicular corridors for ease of access and wayfinding to the trail. These trailheads are intended to provide parking, restrooms, picnic facilities and other amenities similar to existing trailheads found along the Stones River Greenway. They have been located approximately 3-miles apart in most locations to provide good access for all residents. It is anticipated that ancillary trailheads, on a much smaller scale, will be provided in other locations as development occurs. These trailheads will link to subdivisions and other commercial areas that develop along the trail corridor. They may or may not provide parking and in most cases will likely not have restroom facilities. These access points may be built as part of larger developments that occur along the trail or by the city as demand dictates.

Type of Recommended Facility	Length (miles)
Greenways and Greenway Connectors	67.3
Multi-Use Paths	36.3
Bicycle Lanes	20.2
Bicycle Routes	50.0
TOTAL	173.8

The planned on-street facilities were developed to provide connections between

Bikeway Recommendations

The City of Murfreesboro maintains an inventory of roadway classifications for all roads in the city, as determined by the Major Thoroughfare Plan. This roadway classification listing, as well as the existing greenway network, was used as the basis for making bikeway enhancement recommendations. On-road bikeway improvements are limited to the rights-of-way of certain functionally classified streets (major arterials, minor arterials, commercial collectors, community collectors, residential collectors, and residential sub-collectors). Local residential streets are generally adequate for non-motorized travel due to low speeds and low volumes and do not warrant special bikeway system designation.

key local destinations using the classified roadway network. Of course, one of these key destinations is the greenway system itself, so a primary strategy of the recommended bike facilities is to promote access to greenway facilities.

When is a bike lane not a bike lane?

The intent of the master plan is to identify the general, desirable type of facility for a particular corridor. As each planned project progresses, it may be found that the project type called for by this plan has obstacles that preclude constructing the facility as originally planned. In such a case, an alternative facility type, alignment change, or a new connection altogether should be considered.

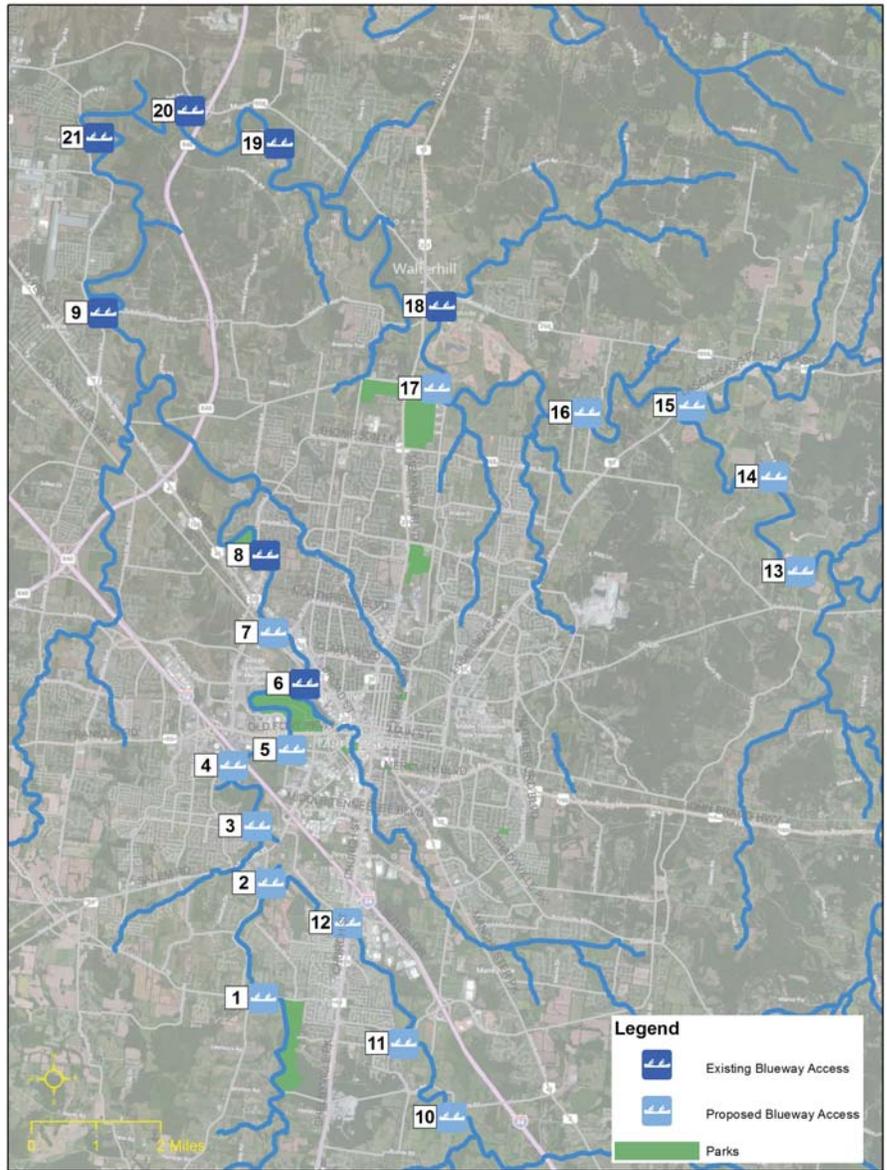
Although the planned projects have been identified to meet the expected needs of the community in a particular area, developing an alternative project may be the best way to fulfill the intent of the master plan.



Blueway Recommendations

The West, Middle and East forks of the Stones River provide excellent opportunities for recreational paddle sports. There are currently seven (7) locations for public access in and around the City of Murfreesboro. The Parks and Recreation Department currently maintains one (1) designated blueway with a put-in at the Manson Pike Trailhead along the Stones River Greenway and a take-out at the Thompson Lane Trailhead in addition to maintaining a joint put-in with the United States Army Corps of Engineers (USACE) at Walter Hill Park. Four (4) other locations are maintained and controlled by the USACE.

The Stones River Watershed Association (SRWA) has identified access points along all three forks of the Stones River in and around Murfreesboro. These sites are very limited in amenities and many cannot be considered public access because they lack formal use agreements. The planning team reviewed access points identified by the SRWA and has recommended 14 locations in addition to the seven (7) public access locations that currently exist. Some of these locations will only be seasonally accessible due to low flow during different times of year. It will be necessary for the City to monitor river levels throughout the year and close those locations that are not navigable during certain periods. The following represents the 21 locations recommended for the Murfreesboro Blueway system.



West Fork Access

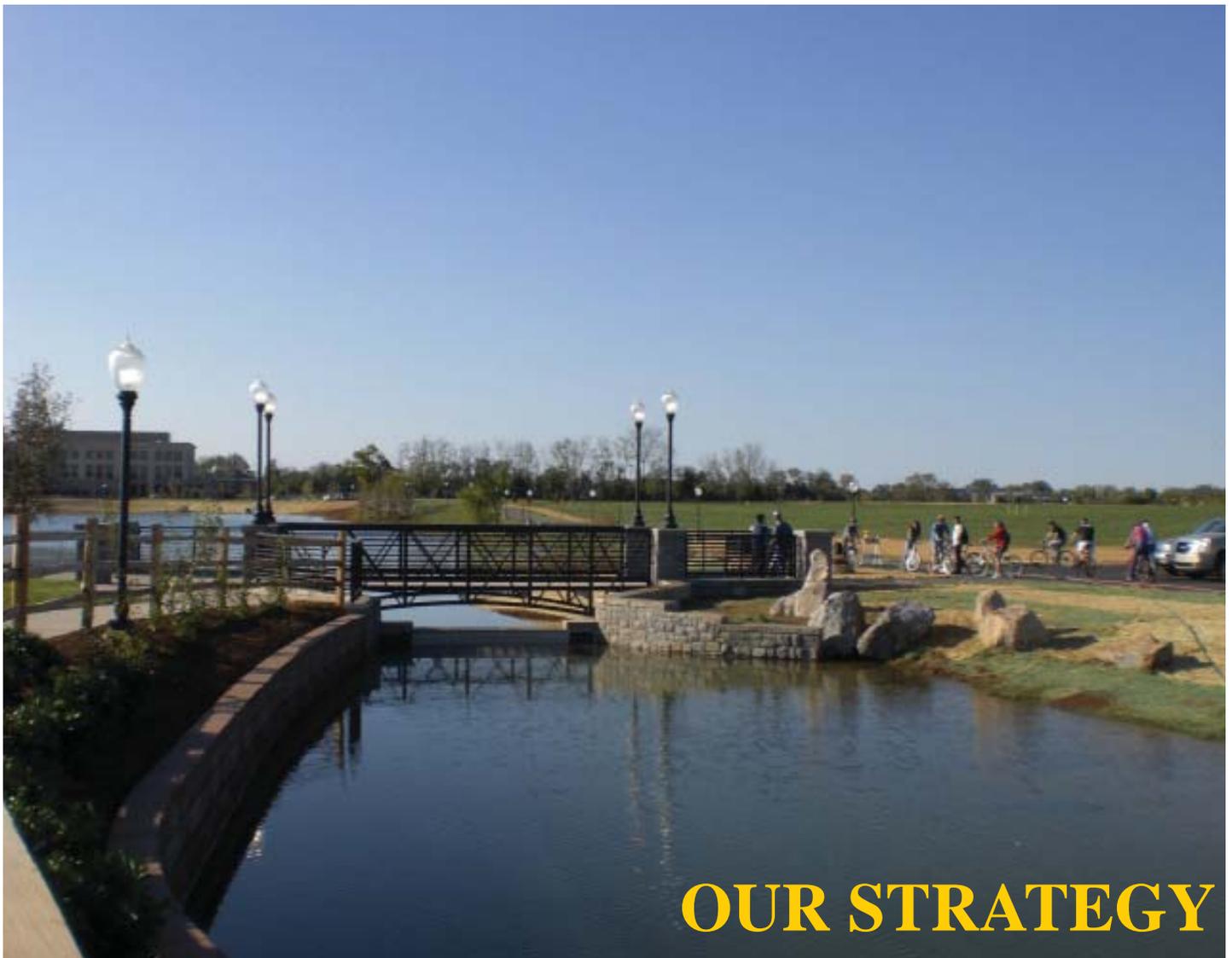
Map ID	Stones River (West Fork)
1	Veterans Pkwy
2	West and Middle Confluence
3	Cason Trail
4	River Rock Boulevard
5	Bridge Ave. & Molloy
6	Manson Pike
7	General Bragg Trailhead
8	Thompson Lane
9	Nices Mill
21	West Fork Recreation Area

Middle Fork Access

Map ID	Stones River (Middle Fork)
10	Elam Mill
11	Joe B. Jackson Trailhead
12	City Schools Office

East Fork Access

Map ID	Stones River (East Fork)
13	Guy James Road
14	Brown's Mill
15	Lascassas Pike
16	Betty Ford Road
17	VA Hospital
18	Walter Hill Park
19	Mona Recreation Area
20	East Fork Recreation Area



OUR STRATEGY

Implementation

This master plan contains proposes nearly 200 miles of new and repurposed infrastructure - all aimed at getting Murfreesboro's residents outdoors and active on a regular basis.

It is an important plan and an achievable goal. Murfreesboro's growth is both an opportunity to develop high quality infrastructure such as is proposed as well as a call to responsibility for City leaders to continue to provide

the quality of life that Murfreesboro has become known for. The City of Murfreesboro should recognize these facilities as an enhancement to the quality of life while offering an alternative transportation option, which is a growing trend in progressive cities throughout the United States. To stay competitive, the City of Murfreesboro should consider these strategies and recommendations in its overall growth and development model.

Stretched budgets, ever-competitive federal funding, and other priorities and obligations of the city will present challenges to the fulfillment of the plan. However, remaining flexible in implementation, looking for opportunities for plan advancement as part of other projects, and engaging in non-infrastructure activities (policies and programs) will allow the City to continue to make tremendous strides over the next 25 years.

Tiered Priorities

Based on greenway plans already underway and community desires, some identified greenway needs have been designated into two project tiers, or phases. Tier I projects seek to extend the existing greenway system in south Murfreesboro and initiate a

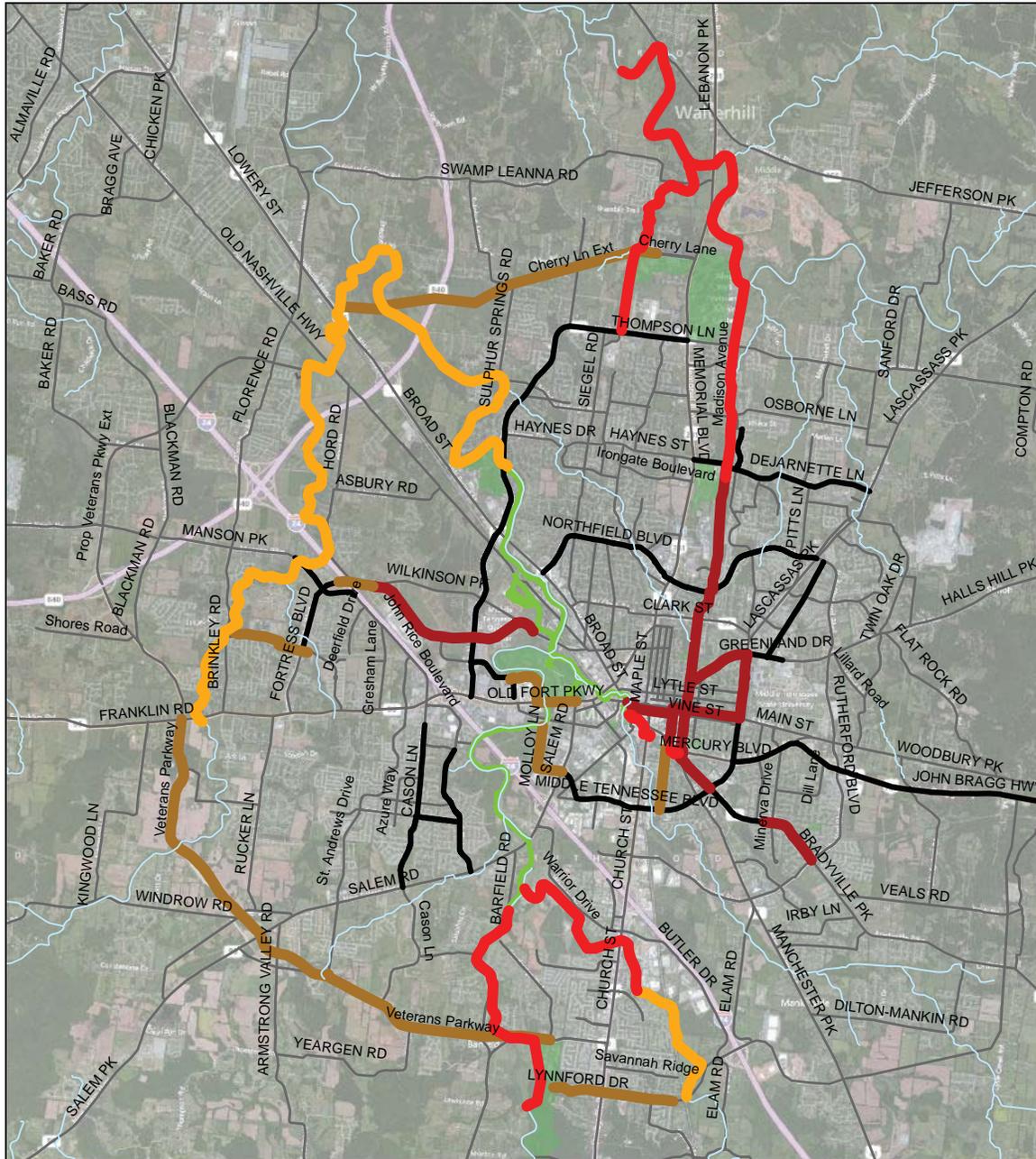
true greenway trail system in north Murfreesboro. Doing so not only increases the amount of usable trail, but also will encourage new users by linking more households and destinations along the new trail segments. Tier I roadway projects are based on critical needs such as creating better downtown access to the existing

greenway system, as well as seeking to increase the effectiveness of Tier I greenway improvements by linking these to each other and to important destinations.

Tier II greenway construction includes the major portions of the Blackman area trails. Tier II improvements also

include significant stretches of multi-use path which will result in the connection of Siegel Park in the north to Barfield-Crescent Park in the south.

Unfortunately, few on-street projects in Murfreesboro can be considered “low-hanging fruit”, ready to be implemented relatively easily with little cost. Most of these type of projects have already been implemented by the city. Those projects which can be easily implemented (e.g. signing a designated bikeway along newly reconstructed portions of Maney Avenue) generally do not link together into a bike network of any appreciable length or with an important connection. Thus, ease of construction has not been a major factor in designating priority improvements.



- Tier I Greenway Projects
- Tier II Greenway Projects
- Tier I Road Projects
- Tier II Road Projects
- Existing Greenway
- Existing Bike Facility



City of Murfreesboro
Greenways, Blueways, and Bikeways Master Plan
 Project Phasing

Costs and Funding

Project costs associated with the capital needs identified in this master plan can be easily misunderstood. This is because, particularly for the on-street projects, facilities are often implemented as part of larger roadway improvement projects, so that the estimated costs of the non-motorized facility improvements are more difficult to quantify.

The project needs costs shown here have been developed assuming that each project is a stand-alone project and are meant to provide a planning level estimate so that the scale of these projects can be understood.

Total Estimate for Full Plan Implementation*		
Type of Recommended Facility	Length (miles)	Cost
Greenways and Greenway Connectors	67.3	\$67,310,000
Multi-Use Paths	36.3	\$27,240,000
Bicycle Lanes	20.2	\$9,710,000
Bicycle Routes	50.0	\$620,000
TOTAL	173.8	\$104,880,000

*Planning-level construction costs only. Does not include right-of-way acquisition, utility relocation, or preliminary engineering costs. Assumes full construction of stand-alone projects (conservative assumption).

However, it should be noted that implementation of many of these projects will be fractional with respect to other roadway work which might be undertaken as part of a roadway project occurring along the same corridor as an identified bike facility.

In fact, many of the on-road facilities in the plan are recommended in part because of a future larger roadway need has already been identified and incorporating a bicycle connection can be done relatively easily as part of the bigger project.

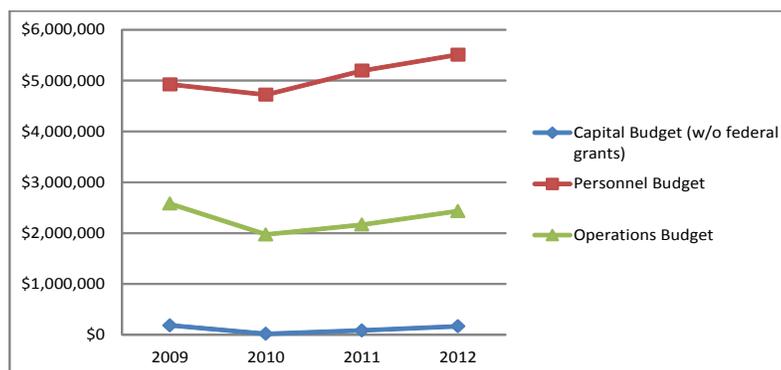
Breaking these costs out by the recommended project tiers gives funding estimates for a 10-year planning horizon, a secondary planning horizon, and further future needs. The 10-year planning horizon cost for greenways and greenway connectors is \$38.4M, or an average of \$3.8M per year. Given that the average city-funded capital expenditures budget for the Parks and Recreation Department over the past four years was approximately \$120,000 per year (when federal greenway allocations are subtracted), it is quickly evident that a different funding strategy will be required.

General Estimates* for Plan Projects by Planning Horizon						
Type of Recommended Facilities	Length (mi)	10-Year Horizon ¹ (\$1,000s)	Length (mi)	Secondary Horizon ² (\$1,000s)	Length (mi)	Future Horizon (\$1,000s)
Greenways and Greenway Connectors	38.4	\$37,310	24.6	\$24,350	4.3	\$5,650
Multi-Use Paths	2.3	\$1,760	12.2	\$9,130	21.8	\$16,350
Bicycle Lanes	5.2	\$2,270	2.3	\$1,610	12.7	\$5,830
Bicycle Routes	1.7	\$20	0.6	\$10	47.7	\$590
TOTALS	47.6	\$41,360	39.7	\$35,100	86.5	\$28,420

*Planning-level construction costs only. Does not include right-of-way acquisition, utility relocation, or preliminary engineering costs. Assumes full construction of stand-alone projects (conservative assumption).

¹Corresponds to Tier I projects

²Corresponds to Tier II projects



Four-Year Budget Trends, Murfreesboro Parks & Recreation Dept.
(Source: Annual Budget, FY 2011-12)



Transportation Funding Opportunities

Although it is likely that historic federal funding levels for facilities in Murfreesboro cannot be sustained, it should not be assumed that no state or federal funding will be available. In fact, new MAP-21 federal transportation legislation has special opportunities for funding active transportation projects. The Transportation Alternatives (TA) funds will be administered by the Nashville Area Metropolitan Planning Organization (MPO) (instead of by TDOT as in the past) and will be eligible for use by active transportation projects like those presented in this plan. The total amount of TA funds available

annually within the Nashville area is expected to be approximately \$1.5M.

As part of the 2035 Long-Range Transportation Plan, the Nashville MPO also established a nationally recognized strategy by which 15% of the region's Urban Surface Transportation Program (U-STP) funds would be dedicated to projects which encourage the development of active transportation choices and walkable communities. The revenue forecasts of this funding source shows that regional STP funding should be considered as a significant possible funding source for this plan's implementation.

U-STP Investment Strategy – Revenue Distribution by Planned Horizon Year (Source: Nashville Area MPO)

Category	Target	2011-2015*	2016-2025	2026-2035
Multi-Modal Roadway Capacity & Safety	70%	\$11,448,000	\$213,353,452	\$315,815,228
Active Transportation Enhancements	15%	\$2,500,000	\$45,718,597	\$67,674,692
Public Transportation/ Mass Transit	10%	\$1,650,000	\$30,479,065	\$45,116,461
System Management & Operations	5%	\$825,000	\$15,239,532	\$22,558,231
TOTAL URBAN STP	100%	\$16,423,000*	\$304,790,646	\$451,164,612

*FY 11-15 revenues available after prior commitments are funded.

The cost estimates presented here do not include right-of-way acquisition costs. There are many avenues to acquiring greenway rights-of-way with the first and most obvious being fee simple acquisition. Fee simple acquisition results in the direct ownership of real property; it is the most complete form of land ownership. Acquisition is not limited to purchase of land in fee simple, but also includes purchase of development rights and acceptance of donations of land and development rights.

Fee simple acquisition is a very expensive method for acquiring right-of-way but is probably the simplest form for property that is intended for public use. Alternative right-of-way acquisition methods include:

- Multi-Purpose Easements
- Easements through Private Development
- Riparian Buffers
- Roadway Buffers

The plan recommends some policy revisions that should be considered by the City as alternative ways to acquire the necessary rights-of-way for implementation, including:

- Consideration of a dedicated greenway easement for all property shown along planned corridors
- Consideration to provide density bonuses and other incentives for developers willing to construct trail segments located within their proposed developments
- Consideration to provide a stormwater variance process that incorporates the dedication of greenway easements into the variance approval
- Explore opportunities for multi-purpose easements with the water and sewer department

Non-Infrastructure Initiatives

More than just infrastructure, other efforts can be championed or supported by the City to have a positive impact on the promotion and use of the system. Some examples of effective policies and programs are:

Provide Facilities

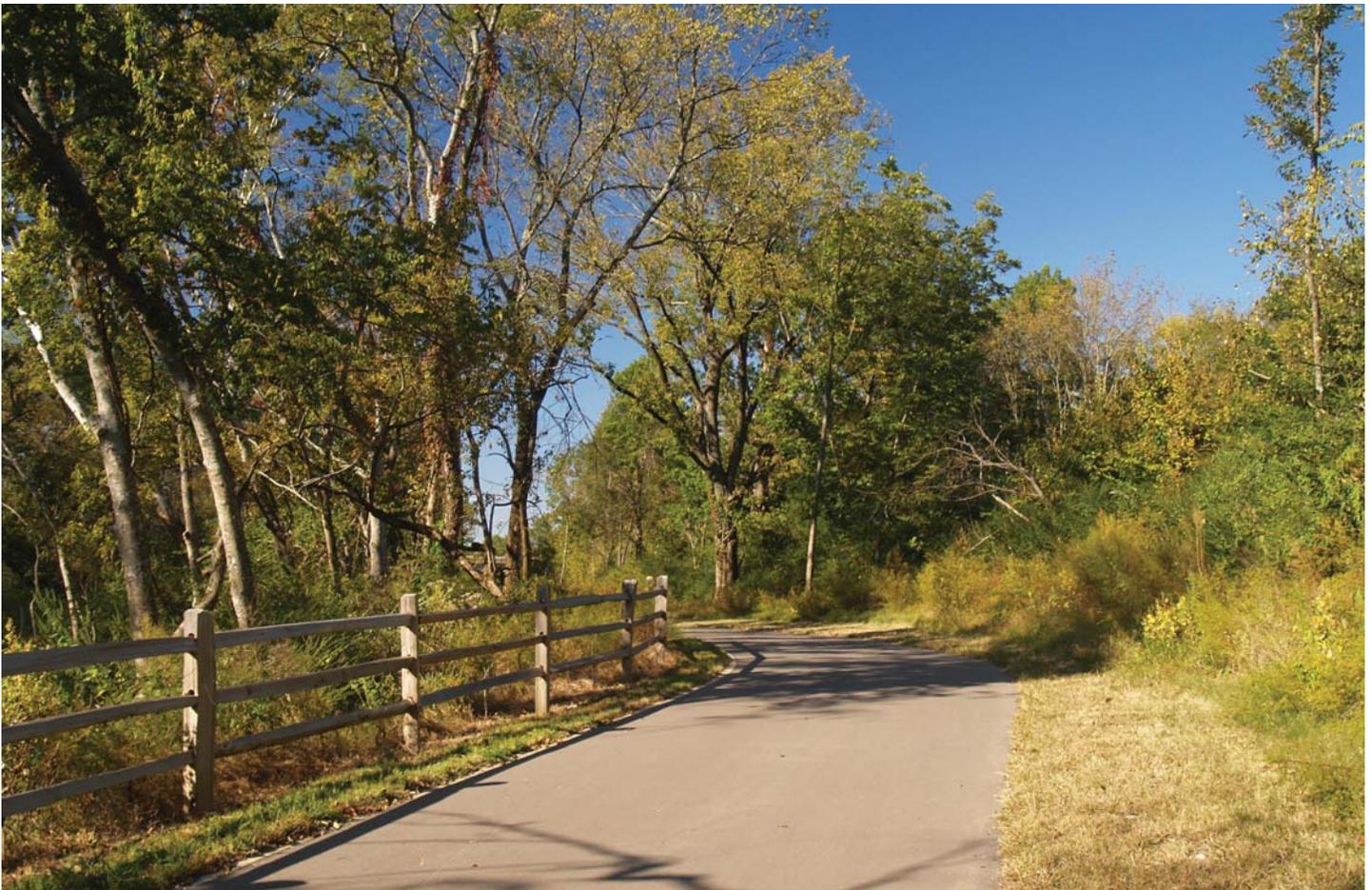
- Policies should be adopted by City agencies to provide ongoing maintenance of the network.
- Some jurisdictions in Tennessee allow “in-lieu-of” payments to the community’s infrastructure fund.
- Promote and encourage land use decisions that provide a context-appropriate mixture of uses that are supportive of increased walking and bicycling.
- Establish developer incentives for inclusion of amenities such as bike racks, lockers, showers, and other facilities in commercial and public building projects.

Build Support

- Initiate an annual bicycle and pedestrian count program consistent with the National Bicycle & Pedestrian Documentation Project (NBPD).
- Adhere to a locally developed Complete Streets policy.
- Providing continuous bicycle and pedestrian facilities across the city will require a new level of inter-agency as well as inter-jurisdictional cooperation. A recognized process by which the Parks Department has an opportunity to review and comment on new development proposals affecting the system could help facilitate this cooperation.

Increase Awareness

- Promote bicycle safety education locally, including efforts to increase understanding and awareness of the Tennessee 3-foot law for motorists passing bicyclists.
- Offer safety training opportunities for adults and children.
- An informational website should be established that contains information regarding biking and paddling in the region.
- Create promotional materials to promote walking and bicycling as a safe, healthy, cost effective, environmentally beneficial transportation choice.



**CITY OF MURFREESBORO
GREENWAYS, BLUEWAYS, & BIKEWAYS MASTER PLAN**

TECHNICAL MEMORANDUM #1: REFINED PLAN OBJECTIVES

In 2011, the City of Murfreesboro initiated the development of the Greenways, Blueways, and Bikeways (GBB) Master Plan to help identify and coordinate implementable improvements in recreation and non-motorized transportation over the next 25 years.

This technical memorandum summarizes the overall plan objectives that have been established as part of the plan development process. These objectives speak to the outcomes of the plan, but are really deeper reflections of what stakeholders in Murfreesboro envision for the actual GBB system as it is further developed over the planning horizon. As such, these objectives should be used to routinely gauge not only the development of the master plan, but act as benchmarks as various facets of the plan are considered and undertaken in the future.

The plan's objectives were developed through input from the Study Advisory Committee along with interviews of local stakeholders. The following is a list of the project objectives as developed for the project.

The GBB Master Plan should:

1. Promote the increased usage of existing greenways and blueways and the construction of new greenways and blueways by identifying personal and community needs and benefits relating to quality of life, health, economics, and sustainability.
2. Present strategies leading toward a transformational attitude of Murfreesboro's residents and workers in which active transportation (transportation by walking or by bicycle) is regarded as a viable travel option for all.
3. Assist City staff involved in facility planning and construction through the determination of future greenway and blueway routes which can be pursued through capital budgeting as well as private development processes. This may include facilities constructed as part of the renovation of current infrastructure (street renovations) as well as through new roadway development.
4. Identify leverages of existing, emerging, and potential resources (funding, programs, policies, etc.) toward a cooperative approach in elevating Murfreesboro's GBB system.

These participant-formed objectives find common ground in two emphasis areas of contemporary American cities: health/recreation and transportation. The advantages gained by communities that have comprehensive, safe, and well maintained facilities for recreation and transportation are immense. In the development of this plan and in its implementation in the years ahead, the question should continually be asked, "how will our actions progress one or more of these objectives to the advantage of Murfreesboro?"

Currently, the greenway system is almost exclusively a system of recreation. Based on public and stakeholder input through the planning process, leisure use is likely to remain the primary

focus of the system. As such, implementation of the plan towards its listed objectives can focus on individual user benefits such as the importance of leisure time, appreciation of nature, and the personal health benefits.

Though not the primary focus of the greenway system in Murfreesboro, active transportation and transportation alternatives continue to be important emphasis areas for many communities. Growing an effective and dynamic culture of active transportation in Murfreesboro will require helping travelers better understand the benefits and processes of travel by foot or bike. This can be accomplished by providing well designed bicycle and pedestrian facilities and through education and encouragement activities. To foster more of a transportation emphasis, implementation of the plan towards its listed objectives can focus on community benefits such as environmental impacts of travel, lower personal transportation costs, transportation equity, travel safety, traffic reduction, and development/re-development patterns.

**CITY OF MURFREESBORO
GREENWAYS, BLUEWAYS, & BIKEWAYS MASTER PLAN**

TECHNICAL MEMORANDUM #2: EXISTING CONDITIONS

In 2011, the City of Murfreesboro initiated the development of the Greenways, Blueways, and Bikeways (GBB) Master Plan to help identify and coordinate implementable improvements in recreation and non-motorized transportation over the next 25 years.

This technical memorandum summarizes planning documents and policies that are pertinent to the GBB plan and are currently in place. It also summarizes an evaluation of the existing facilities located within the City and the urban growth boundary. These policies play an important role in recreation and non-motorized transportation and will be critical to the future implementation of the GBB.

Murfreesboro Land Use, Zoning and Development Regulations

The 2010 census estimated the City of Murfreesboro had a population of nearly 110,000 residents making it the sixth largest city in the State of Tennessee. Its population growth has far exceeded national averages and therefore has required the city to be very proactive about development and how it occurs. Murfreesboro has developed policies related to sidewalks, water quality, subdivision development, street construction and zoning ordinances with overlay districts protecting areas of historic significance and with specific design intents. These policies are all geared toward providing the best possible community and quality of life for residents of Murfreesboro.

Sidewalk Policy

Adopted in July 2000, the Sidewalk Policy detailed the provision of sidewalks on both sides of the street for all new development. The policy provided details regarding when a developer is required to build the sidewalk as part of the overall site construction. This policy served as the guiding principal until the 2009 adoption of the subdivision regulations.

Subdivision Regulations

The Murfreesboro Subdivision Regulations detail how property can be divided and developed. Adopted on July 22, 2009, these regulations require the dedication of right-of-way to accommodate roadway development according to the major thoroughfare plan including the provision of curb and gutter, storm drainage, sidewalks and bike lanes wherever previously identified. The subdivision regulations also address the provision of drainage easements where drainage is not feasible in the public right of way. These easements, a minimum of 20 feet in width, provide for drainage to natural watercourses located within subdivisions. These easements are intended to be connected to public rights of way for ease in maintenance operations.

Street Design Specifications

Also adopted in July of 2009, the street design specifications detail standards related to new streets constructed within the City. Utilizing the guiding design principals outlined by such organizations as AASHTO, ITE, the Federal Highway Administration and others, these standards help ensure that roadways are constructed to appropriate standards and include design features suited to the street's functionality. Relative to the GBB, the street design specifications detail the construction of sidewalks in all new developments and identify where and how bicycle facilities should be accommodated. Sidewalks are required in all new developments on both sides of the street. The minimum width is four (4) feet for local streets and five(5) feet for all other streets. Bicycle facilities are required wherever previously identified within the Bicycle Master Plan. As written in the Street Design Specifications, they can be in the form of bike lanes and bicycle shared streets.

Special Overlay Districts

Special Overlay Districts have been developed within the City to address areas of historic significance or those areas with very specific design intent. The Gateway Design Overlay is one such area. The overlay district takes design requirements a step beyond the standard subdivision regulations providing for more detailed treatment of the landscape and pedestrian connections. As with the subdivision regulations, sidewalks are required on both sides of all

streets but, in this area must be set back a minimum of (6) feet behind the street curbs. The overlay district goes on to further describe pedestrian and bicycle movement within the district describing it as having an alternative transportation mode made up of a network of sidewalks, paths or trails. While the district is not specific about these provisions, it does reference the possible requirement by the planning staff or Planning Commission for the provision of these facilities within future developments within the overlay district.

Stormwater Management and Water Quality Protection Areas

Written as part of the Murfreesboro City Code, Ordinance 06-O-27 details the treatment of stormwater and water quality protection areas. The code details the required buffers that must be observed in the development of property along streams and wetlands. The buffers vary in width depending on the classifications of the stream. There are two zones identified within the code. Zone 1 represents the area directly adjacent to the stream and requires a 35' buffer from the top of bank on all streams mapped by the USGS service. An additional 15 feet is required with Zone 2 making the total stream buffer requirement 50'. Smaller streams not mapped by the USGS require only a 20' buffer for Zone 1 and 15' buffer for Zone 2. For wetlands, the required buffer is 35' from the outermost edge of the delineated wetland. The code further describes acceptable uses within the water quality protection area buffers and the provision of plant material or preservation of plant material within those undisturbed areas. Acceptable structures and activities with the WQPA include:

- In Zone 1 - Publicly accessible greenways and road, bridge and utility crossings
- In Zone 2 – Uses allowed in Zone 1 and utility right(s)-of-way.

Specific design requirements for greenways located within the WQPA are also provided in the code and include:

- The design and placement of the greenway is outside Zone 1 insofar as practicable;
- The design and placement of the greenway takes into account natural fluctuations in stream channel;
- The design and placement of the greenway takes into consideration the location of invasive, exotic plants or other undesirable vegetation or lack of vegetation;
- Grading and post-construction planting is done to maintain or establish stormwater sheet flow and infiltration of stormwater to the maximum extent practicable;
- Where watercourses cross the greenway, care is taken to provide ample culvert or channel structure to avoid scour;
- Disturbances of native vegetation and more valuable trees are minimized;
- Vegetation is reestablished where missing;
- Management of the greenway includes litter pick-up and monitoring and elimination of erosion or other polluting activities;
- Management of the greenway includes removal of invasive, exotic plants; and,
- Programs or materials to educate users about surface water quality are provided.

Existing Bikeway and Greenway Plans

The City of Murfreesboro Bicycle Plan

Completed in January 1994, the City of Murfreesboro Bicycle Plan provided recommendations for “integrating bicycling into standard transportation engineering procedures”. The plan provided design standards for implementation and identified bicycle routes for future development. This plan has provided the basis for most of the bicycle facilities that exist in Murfreesboro today.

Stones River Greenway – Master Plan

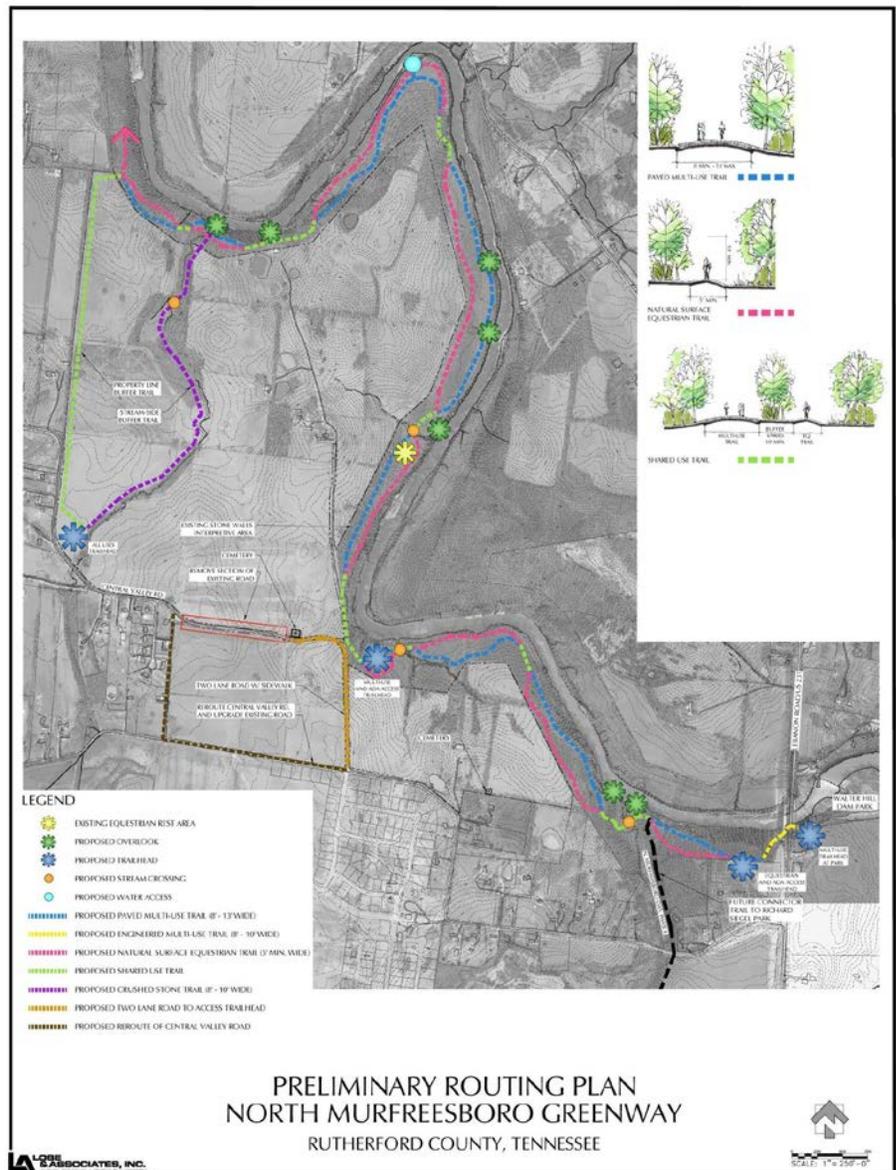
Completed in November of 1993, the Stones River Master plan provided the inventory and analysis for the eventual development of construction documents for the greenway trail. The master plan identified greenway routing and valuable points of interest along the corridor making note of all property acquisition that would be required. The plan also addressed maintenance and management of the trail along with safety and security. This master plan served as the guiding document for the built phases of the Stones River Greenway and Lytle Creek Greenway that exist today.

Stones River Greenway (Phase IV)

Phase IV Construction of the Stones River Greenway is currently underway. It will connect the Phase III terminus at Barfield Road south to Barfield Crescent Park, a distance of approximately 2.25 miles. The project is in the right-of-way acquisition phase and will be scheduled for construction once right-of-way has been secured. Funding for this project has been allocated.

North Murfreesboro Trail

A master plan was developed in 2007 for the North Murfreesboro Trail. This 3-mile segment of trail was designed along the East Fork Stones River and connects Walter Hill Dam to



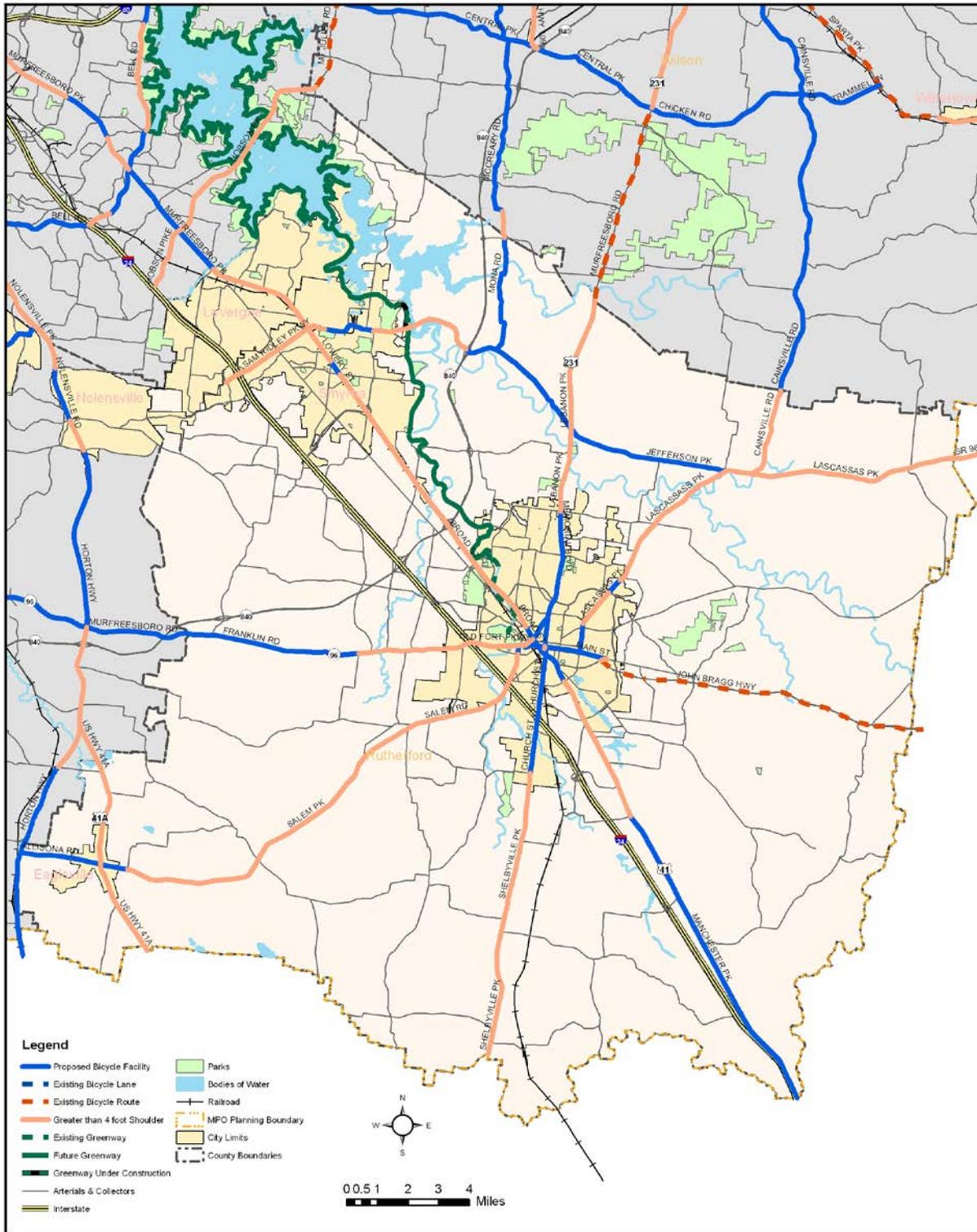
the 400-acre Coleman Farm property owned by the City of Murfreesboro. The project includes a multi-use system for pedestrians, cyclists and equestrians on both paved and soft-surface trails. A joint effort by the United States Army Corps of Engineers (USACE), City of Murfreesboro, and Tennessee Wildlife Resources Agency, the project is moving toward construction with funding from the USACE.

Regional Bicycle Plan

In 2009, the Nashville Area Metropolitan Planning Organization (MPO) established its current plan for regional bicycling infrastructure for its planning jurisdiction which includes all of Rutherford County. The MPO's Regional Bicycle and Pedestrian Study is supportive of local bicycle facility infrastructure, but places emphasis on facilities which provide regionally-scaled accommodations. Thus, the facilities which are recommended in it tend to be along major transportation corridors, generally state and federal routes. The Stones River Greenway is one of only two off-road facilities in middle Tennessee which is specifically designated as part of the Regional Bikeway Network. This is because of its existing length and its high potential for linear and regional connections in neighboring jurisdictions.

In Murfreesboro, the Regional Bikeway Network designates the following major corridors:

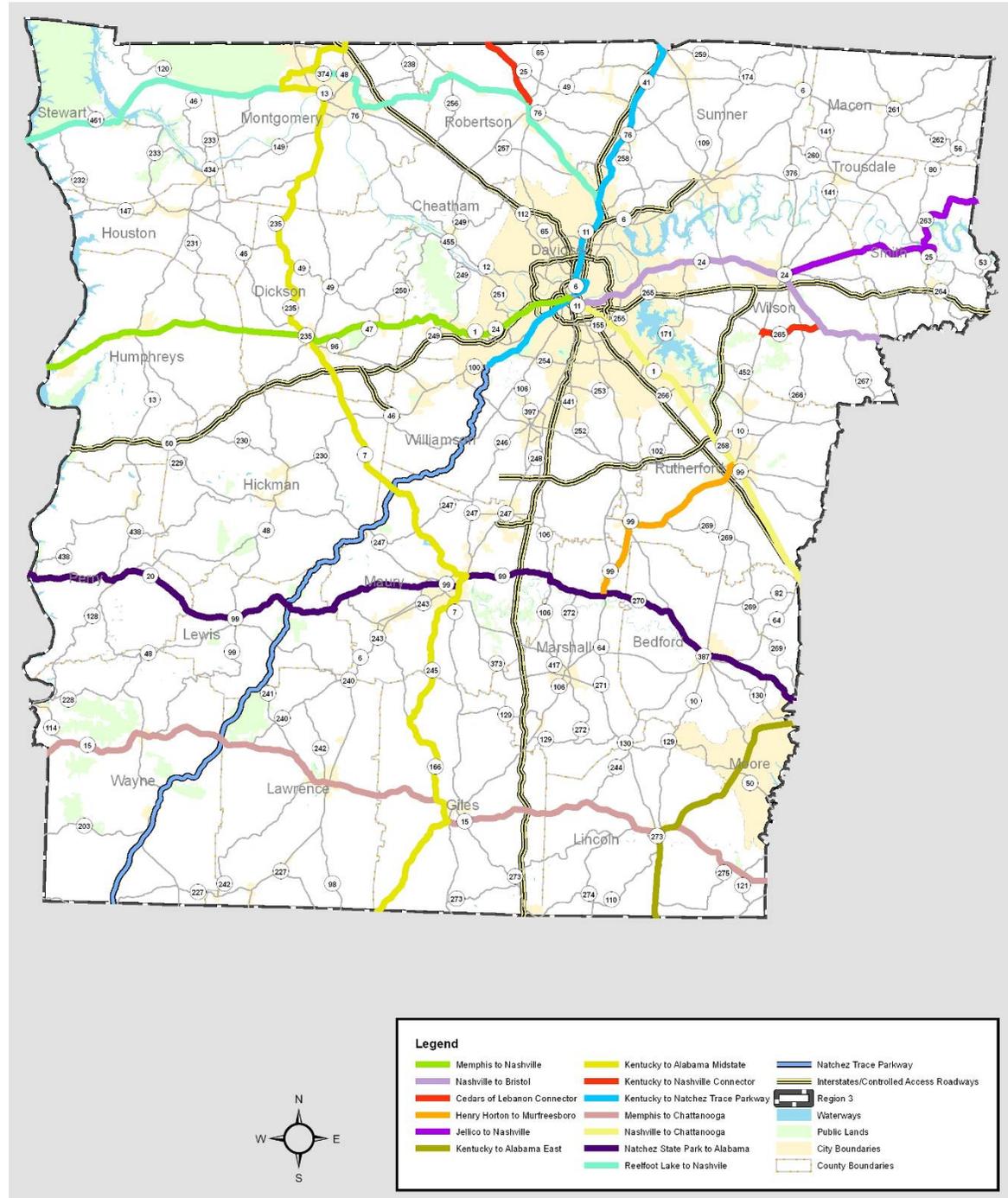
- Memorial Boulevard/Lebanon Pike
- Lascassas Pike
- Jefferson Pike
- Main Street/John Bragg Highway
- Broad Street/Manchester Pike
- Church Street/Shelbyville Pike
- Salem Pike
- Old Fort Parkway/Franklin Road



Rutherford County Regional Bike Network Recommendations (Source: Nashville Area MPO)

Statewide Bicycle Plan

On an even larger scale, the Tennessee Department of Transportation in 2011 updated its statewide bicycle plan which designates future corridors as priority routes for bicycle infrastructure. Two routes within Rutherford County appear in this plan, both having portions inside of Murfreesboro. These are Broad Street/Manchester Pike which is part of the Nashville to Chattanooga Tour and Salem Pike which is part of the Henry Horton to Murfreesboro Tour.



Proposed State Highway Bicycle Routes (Source: Tennessee Dept. of Transportation)

Infrastructure Existing Conditions

Murfreesboro Greenway System

The City of Murfreesboro has 12-miles of paved asphalt trails located along the Stones River and Lytle Creek. There are 11 trailheads that provide access to residents from various vantage points along the route and many historic points of interest and parks are connected by the trail. The trail extends from Thompson Lane approximately 1-mile north of Broad Street (U.S. 41/70) to Barfield Road just East of Highway 99. The greenway network is situated on approximately 215 acres of land, but the amount of land protected as a result of its presence is significantly larger. Points of interest along the trail include the Stones River Battlefield and Old Fort Park as well as schools, neighborhoods and commercial areas. The trailheads found along the Stones River Greenway include parking, restrooms, river access, playgrounds and picnic pavilions. The trailhead locations include:



- Thompson Lane
- Broad Street
- General Bragg
- West College
- Redoubt Brannan
- Manson Pike
- Fortress Rosecrans
- Overall Street
- Cannonsburgh
- Old Fort Park
- Cason

The Lytle Creek Greenway segment connects the Cannonsburgh Trailhead to the downtown Murfreesboro commercial district crossing under Broad Street near the intersection of West Main Street. The Stones River Greenway and Lytle Creek Greenway provide a safe pedestrian environment free from vehicular traffic. The Stones River and Lytle Creek segments of the greenway system were built in phases utilizing federal and local funding sources. The final phase of that project is under development now and will be under construction once all right-of-way has been acquired. The trail will extend from Thompson Lane north of Broad Street (U.S. 41/70) to Barfield Crescent Park on the south side of Murfreesboro.

One of the newest additions to the greenway system is the Gateway Trail. This loop system connects the newly developed Gateway Business and Medical Park to the Stones River Greenway. The Gateway Trail is the only portion of the Murfreesboro Greenway System that is lighted for night use.

Existing Blueways Network

Recreation opportunities for paddle sports within the City of Murfreesboro exist along the East, West, and Middle forks of the Stones River. The Middle Fork of the Stones River is approximately 19.8 miles long and joins the West Fork near Highway 99. The West Fork flows for 39.1 miles converging with the East Fork on the North side of Murfreesboro where the river then flows into J. Percy Priest Lake. Dams exist along each segment of the Stones River altering flow and requiring short portages for continuous paddling along the river.

The City of Murfreesboro currently maintains one designated Blueway with access at the Thompson Lane and Manson Pike trailheads along the Stones River Greenway. Additional public access points are found outside the city limits, but within the urban growth boundary. These include Walter Hill Park and Nice's Mill Dam. Walter Hill Park is found along the East Fork of the Stones River while Nice's Mill is located along the West Fork.

Other public access points found along the East and West Forks of the Stones River but outside the city urban growth boundary include West Fork Recreation Area, East Fork Recreation Area and Mona Recreation Area. The Mona Recreation Area is located approximately 5.72 river miles from the Walter Hill Park access and provides a good water recreation paddling opportunity on the East Fork of the river. The West Fork Recreation Area is located approximately 5.17 miles from Nice's Mill and provides an equal opportunity along the West Fork of the river. With the exception of the two city-operated blueway access sites along the greenway, each of these recreation areas is maintained by the United States Army Corps of Engineers (USACE).

The Stones River Watershed Organization was formed in 2003 and over the last 10 years, the organization has studied potential blueway access points along the East, West and Middle Forks of the Stones River. While some of these access points are located on public property, many are located on private property and are accessible to only those who have obtained verbal or written permission from the property owners. The sites lack developed amenities such as parking, boat launches and signage and many provide access to portions of the river that are not navigable during all seasons of the year. The planning team visited each of the potential access points that have been identified by the Stones River Watershed Organization. Our observations of those locations include:

Stones River – West Fork

West Fork Stones River – Barfield (No Public Access)

Due to the widening of Barfield Crescent Road in this location, an assessment and accessibility determination was not viable. Future public access in this general location is recommended.



Highway 99 Access, West Fork Stones River (No Public Access)

Located within TDOT Right-of-Way, this access is listed as a potential site by the Stones River Watershed Organization. It is located along a gravel road that runs parallel to the Highway 99 bridge over the Stones River. The intersection with Highway 99 is dangerous for ingress and egress. Access to the river does not exist. It is unclear if the entire road is within existing right-of-way. This location would not be recommended as a future public access point.

Confluence of West and Middle Fork (No Public Access)

The access to this point along the river would be difficult because of the distance from the river to the nearest road. It would require an easement or acquisition of a parcel of land. A new trailhead along Barfield Road could provide access to the West Fork and would offer a good alternative to the access at Highway 99 location.

River Rock Boulevard (No Public Access)

This potential access point provides a link for the greenway as well as the blueway system. The property was formerly used by an athletic club and is currently vacant and for sale. In the future, should the property undergo redevelopment, easement opportunities should be explored for the greenway and blueway access.

Bridge Avenue and Molloy Lane (Future Public Access)

Identified by the Stones River Watershed Association as an access point, there is no formal signage or parking in this location. River access is also limited to a very narrow path down to the water. The distance required to carry boats from the nearest potential parking area makes this location somewhat prohibitive as a public access point.

Manson Pike (Public Access)

Located at another greenway trailhead along the West Fork of the Stones River, this access point is well marked and provides signage and a concrete ramp down to the water's edge. The ramp provides a large staging area for put in and take out as well.

General Bragg Trailhead (Future Public Access)

This location is maintained by the Parks and Recreation Department and represents an approximate midpoint between the Thompson Lane Trailhead and the Manson Pike Trailhead on the West Fork of the Stones River. There are currently no infrastructure improvements for blueway access however there is adequate parking and room to create an access point if future demand dictates.

Broad Street/Thompson Lane (No Public Access)

Located near the intersection of Broad Street and Thompson Lane across from the Stones River Greenway Broad Street Trailhead access at 84 Lumber, this location provides a future potential access point. It is currently located within an existing utility right of way and is not considered a public access site. There is a paved walkway down to the trail but access to the river is limited with only a small gravel path cleared to the river's edge.

Thompson Lane (Public Access)

Located at the Thompson Lane Trailhead along the Stones River Greenway, this blueway access is maintained by the City of Murfreesboro Parks and Recreation Department. The site is well marked and is complete with signage and adequate space for staging. A concrete launch provides good access to the river. A safety checklist is also visible for potential users of the blueway.

Nices Mill (Public Access)

Nices Mill is located on Sulphur Springs Road along the West Fork of the Stones River. The recreation area which is maintained by the United States Army Corps of Engineers is well signed and provides a large paved parking lot. Access to the river is very easy with a gravel drive providing a connection to the riverbank.

West Fork Recreation Area (Public Access)

Located at the furthest northern point along the West Fork prior to the confluence of the East Fork, this public access area is maintained by the United States Army Corps of Engineers. It is located outside the urban growth boundary and therefore was not evaluated by the planning team.

Stones River – Middle Fork

Elam Mill Road (No Public Access)

The Elam Mill Road access point is located outside the city limits. There are no improvements with the exception of a gravel lot that provides more than adequate parking. This location is on private property and would require acquisition or an easement for use as a blueway access.

County Farm Road Bridge (No Public Access)

Located outside the city limits, the County Farm Road bridge access is located near a single lane bridge on East County Farm Road along the Middle Fork. There is a steep pull-off from the main road but it is severely eroded and not manageable by a car. There are no improvements at this location and the river is not navigable certain times of year due to low flow. This site is not recommended as a future public access site.

Murfreesboro City Schools Office (No Public Access)

This location is a future potential access site. There are currently no improvements and parking is already inadequate for the school offices. Improvements would be necessary to include additional parking and infrastructure for access to the river. The riverbank was overgrown and does not currently provide access to the river's edge.

Stones River – East Fork

Brown's Mill (No Public Access)

Brown's Mill is located along the East Fork of the Stones River outside city limits. The property is owned by the City of Murfreesboro Water and Sewer Department and is currently utilized by the Parks and Recreation Department for some water based programming. There are no improvements at this location. The Tennessee Wildlife Resources Agency is currently considering the removal of a low water dam that exists in this location. The Brown's Mill site would make a good future public access point along the East Fork.

Veterans Administration Hospital (No Public Access)

Located along Lebanon Road (U.S. 231) north of Murfreesboro, the Veterans Administration provides a potential future access point along the East Fork of the Stones River. This site could be developed in conjunction with a greenway trailhead.

Walter Hill Park (Public Access)

Located north of Murfreesboro in the community of Walter Hill, Walter Hill Park is maintained by the Murfreesboro Parks and Recreation Department with adjoining property that is maintained by the United States Army Corps of Engineers. The property provides public access to the East Fork of the Stones River via a boat launch. The Walter Hill Dam is located in this location as well. Future improvements would include the need for a defined portage to carry water craft around the dam. Cooperative efforts for renovations, improvements and future construction of a greenway trail are underway.

Other Public Access Sites (located outside the urban growth boundary)

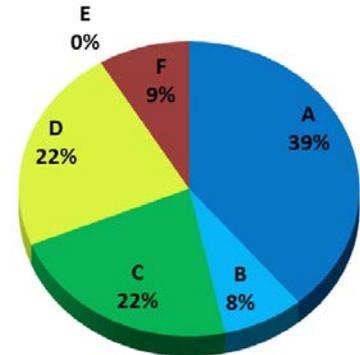
Mona Recreation Area (Public Access)

East Fork Recreation Area (Public Access)

Murfreesboro Bikeways Network

In order to assess the current conditions of Murfreesboro's bikeways network and infrastructure, a comprehensive inventory and analysis was completed. The inventory included all major roadways as identified by the City's functional classification designation, including major arterials, minor arterials, commercial collectors, community collectors, residential collectors, and residential sub collectors. The inventory process required building upon existing GIS data with measurements made in the field. In total, 311 miles of roadways within Murfreesboro's Urban Growth Boundary were inventoried to document roadway conditions (number of lanes, roadway speed, traffic volume, pavement width, and bicycle accommodations) as well as the presence of sidewalks and related attributes. Local streets are considered outside the scope of this route plan, but should be considered on a project-level basis for implementation of local bicycle and pedestrian accommodations.

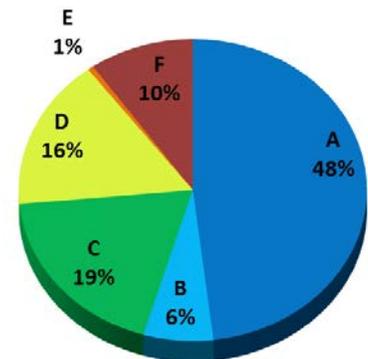
BLOS	Miles
A	121
B	24
C	69
D	70
E	0
F	27
TOTAL	311



Currently, there are approximately 21.7 miles of bike lanes and 7.0 miles of signed bike routes within the study area. All of the bike lane miles and 66% of the bike route miles are within the city limits. While these types of facilities are generally assumed to be adequate for cyclist use, there are other roads which may also be quite adequate for cyclist use based on existing roadway characteristics.

BLOS Statistics for Area Inside Urban Growth Boundary

BLOS	Miles
A	89
B	12
C	35
D	30
E	1
F	18
TOTAL	185



BLOS Statistics for Area Inside City Limits

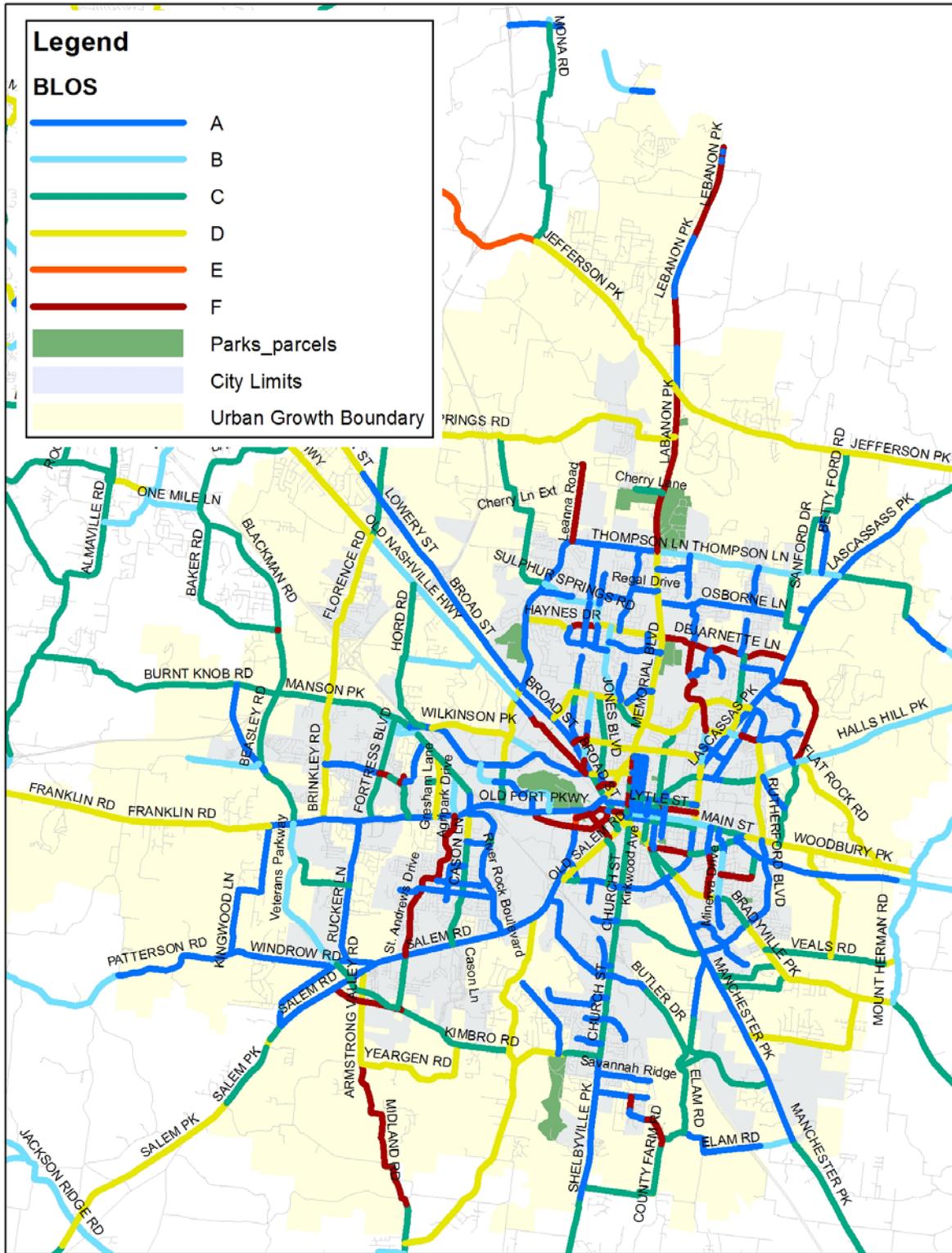
Using the procedures documented in Volume 3 of the Highway Capacity Manual (HCM), the Bicycle Level of Service (BLOS) was determined for the inventoried roads in the study area. BLOS is a way to objectively rate the quality of roadways for cyclists. The BLOS score is based on research which gauged the comfort level of cyclists of all age groups and riding capabilities when asked to ride on a variety of roadway conditions. The roadway condition factors used in the BLOS calculation include the Average Daily Traffic (ADT) volume, number of through lanes on the roadway segment, speeds, percentage of trucks, the width of the outside travel lane, shoulder, and bike lane, the condition of the pavement, and the occupancy rate of on-street parking. The result is a score ranging from A to F with A being the best conditions and F the worst conditions.

Several conclusions are drawn from the BLOS analysis in Murfreesboro:

- The overall results of the analysis would indicate that on-street bikeway conditions are predominately quite suitable within the study area. However, two aspects of this analysis may temper these findings for many cyclists.
 - The City of Murfreesboro designates a high proportion of city streets as being functionally classified. This means that a significantly high number of low volume

residential streets are included in the inventory and analysis and drives up the percentages of roads deemed adequate for cycling by the BLOS procedure.

- Secondly, the BLOS procedure does not consider access conditions such as driveways and intersections. Examples of the importance of this are Broad and Church Streets which were rated as most acceptable (LOS A) to marginally acceptable (LOS C), respectively. In reality, the conflicts along these street segments from numerous driveways and large intersections would make cycling on these streets unfeasible for many potential cyclists.
- Bicycle suitability for roads within the Urban Growth Boundary do not drastically differ from current city streets. This is encouraging, and speaks to the importance of maintaining shoulder requirements for rural roads. Adequate bike facilities should be incorporated as these roads are improved to have a more urban cross-section.
- The apparent adequacy of many of the roads in the study area indicates that there is a significant opportunity to implement more formal bicycling infrastructure and designation with little actual construction. For example, a street may have a high LOS due to a favorable combination of wide lanes and low speeds. Improving on this existing condition with just a restriping project could formally implement a bike lane which would be expected to lead to greater comfort and use by potential cyclists.
- Recent road building projects in Murfreesboro, though often not explicitly incorporating bicycle infrastructure, have left open an opportunity to retrofit these facilities. This gives the opportunity to have bike accommodations which extend over long distances and make connections which will grow in significance in the future as land uses urbanize in these areas.



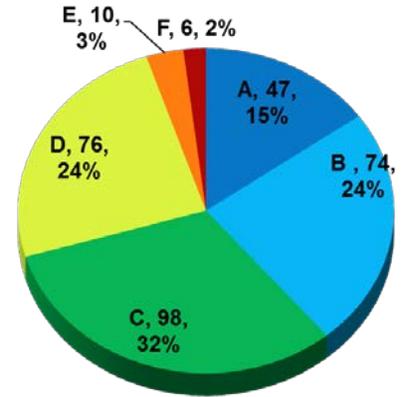
Existing Bicycle Level of Service (BLOS)

Murfreesboro Pedestrian Network

The inventory also included pedestrian facilities within the study area. Of the approximately 330 miles of classified streets within the urban growth boundary area, 96 miles (29%) currently have sidewalk. However, as described for bicycle facilities, many additional miles of road exist which, by engineering analysis, are considered to be suitable for pedestrian travel despite the lack of a sidewalk. In this analysis, 219 miles (66%) of street were found to have a pedestrian level of service (PLOS) of A, B, or C.

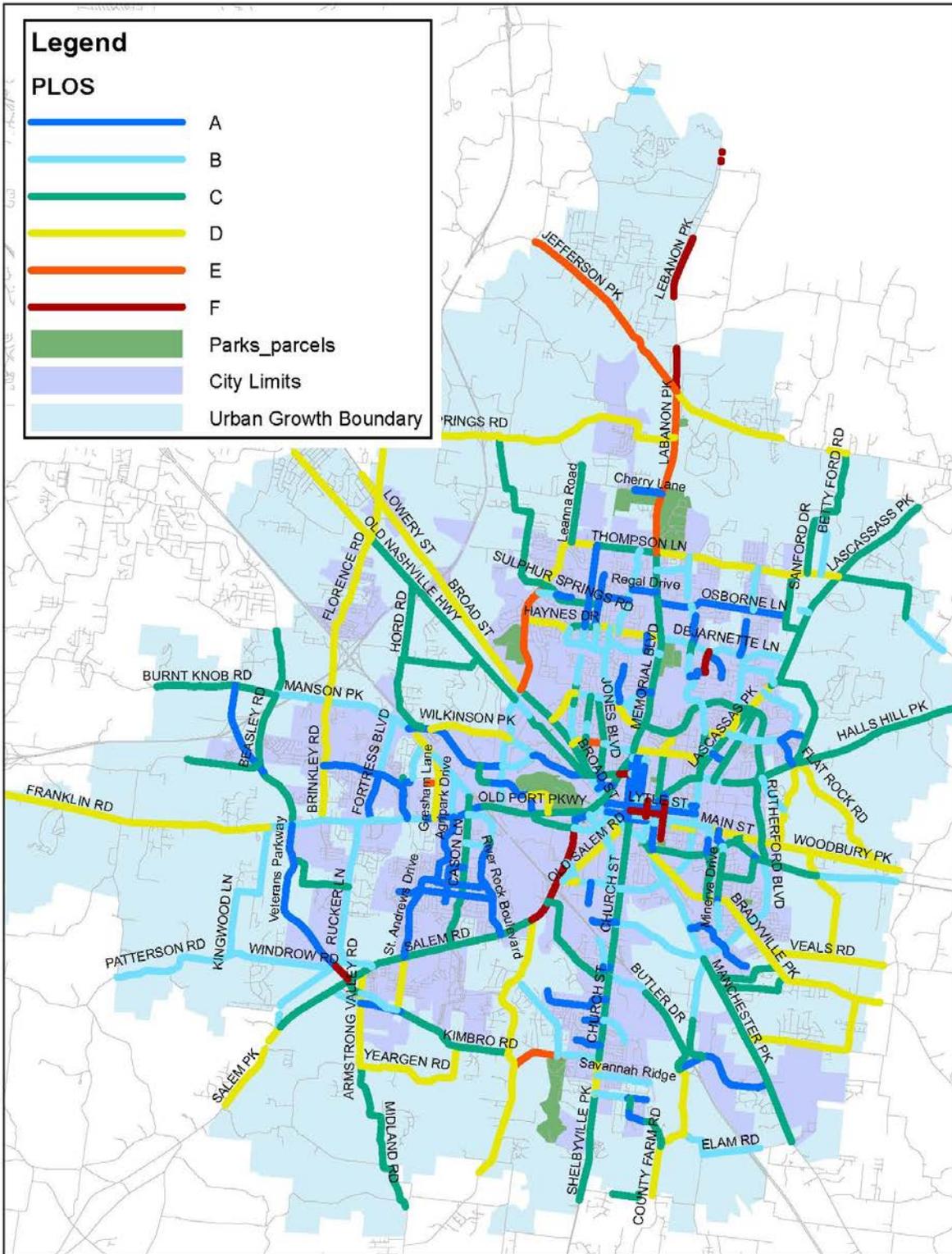
As in most cities, sidewalks in Murfreesboro are most prevalent in the core downtown area. While many relatively new or reconstructed streets have been improved with sidewalks (Middle Tennessee Boulevard, Northfield Boulevard, Church Street, etc.), other arterial and collectors streets have none (Thompson Lane, Broad Street, Old Fort Parkway, etc.).

PLOS	Miles
A	47
B	74
C	98
D	76
E	10
F	6
TOTAL	311



PLOS Statistics for Area Inside Urban Growth Boundary

The presence of adequate pedestrian facilities is always desirable, but having these accommodations becomes a critical need when deciding to make a trip by foot. As mentioned, the City's street standards require sidewalks be constructed as part of new development. Sidewalk retrofits, particularly in established residential areas will become equally if not more important in order to fully capitalize on future greenway investments. However, many primary destinations (shopping, schools, parks, etc.) in proximity to the greenway are already or can be reasonably connected by means of new greenway connectors or other facilities to promote opportunities for complete non-motorized trip making.



Existing Pedestrian Level of Service (PLOS)

Demand for Existing Facilities

To give local planners, engineers, and City staff a decision tool that helps to visualize the real need for walking and biking facilities within the study area, a demand intensity map was produced. At the macro level, this is a regional bike and pedestrian model that incorporates the entirety of the transportation planning area of the Murfreesboro region. Aside from the scope of the model's planning area, however, this procedure is very much a microscopic one, producing a parcel-level analysis fit for walking and biking trips.

This analysis is developed by using each parcel's demographic information and proximity to other land uses to predict how many walking and/or cycling trips the parcel will likely generate under ideal conditions. This information can be used to help understand the propensity for non-motorized transportation activity in an area and to help predict where transportation investments will have the greatest impact.

Some important aspects of the analysis are:

- The model predicts one-way, daily walking or biking trips from every parcel in the study area. However, the effects of trip chaining are not accounted for.
- Eight different types of walking trips are estimated and five different types of bike trips are estimated. These are: walk to school, walk to recreate, walk to shop, walk to work, walk to errand, walk to transit, walk from transit, walk from parking, bike to school, bike to recreate, bike to shop, bike to work, and bike to errand.
- The origin of the trip takes preeminence over the destination in the model. Households are the most common trip origins, but trips also originate from workplaces and transit stops. Although trips are attributed only to the originating parcel, there must be a suitable destination in proximity for the trip to occur. In other words, the model requires both an origin and a destination to generate a trip, but the trip is attributed to its origin.
- The trip model assumes ideal bike and pedestrian conditions. This includes uninterrupted connectivity of facilities at regular intervals that are in good condition. This assumption may be close to actual conditions in urban downtown settings, but is usually far from the reality in suburban and rural areas. This aspect contrasts the trip model with the LOS analysis, which considers the actual condition of the facility, but does not account for its usage.

How the Trip Model Works

To estimate the walking or cycling trips for a parcel, several things must be known about that parcel; namely, its household count, employment characteristics, and the shortest distance to the nearest school, recreational facility, retail area, and transit stop. Also, some information relative to its proximity to employment in the study area and whether any substantial public parking exists is important.

Once the distance relationships to other land uses are known, the effect of distance on making the walk or bike trip is quantified. This is done using a series of distance impedance curve equations developed by RPM from data in the National Household Travel Survey. The more proximate the land use, the more likely that the trip will be made by walking or cycling. Each parcel in the study area, then, has an impedance probability for every walking and biking trip type. The impedance probability is one factor in the total trip generation process.

Next, employment and population attributes are used in series of trip type equations. These equations follow the general formula shown below:

(No. households in the parcel)¹ x (type-specific factor series) x (impedance probability)

The first two terms in the equation quantify the number of non-motorized trips that are likely to occur based on national averages and assumptions regarding each parcel's trip making characteristics, without respect to how far the walking or cycling trip would be. The last term, the impedance probability as described above, accounts for the inverse relationship that distance has on these trips.

The result of the equation for each trip type is the expected number of walking and cycling trips by type. These trips can be reported individually by trip type. However, these trips are also summed to obtain the total number of one-way walking and cycling trips on a typical work/school day.

Specific Considerations by Trip Type

Travel to School: Only applied to residential parcels. Uses U.S. Census data to determine numbers of school-age children by parcel. Uses a proximity factor to scale down trips because not all children attend the school they live closest to.

Travel to Recreation: Only applied to residential parcels. Uses national data to factor the number of recreational trips made as a proportion of all trips made. Recreation trips are only made in the model if the household is in proximity to a park. In reality, many recreational trips have destinations other than a park, or have no destination at all, making these difficult to predict.

Travel to Shop: Only applied to residential parcels. Uses national data to factor the number of shopping (including personal service such as a haircut) trips made as a proportion of all trips made. Uses a proximity factor to scale down trips because not all shopping trips are made to the retail area closest to home.

Travel to Work: Only applied to residential parcels. Uses national data to factor the number of work trips made as a proportion of all trips made. Proximity to employment density used to estimate likelihood of trips. Uses a proximity factor to scale up trips to account for desirability to live close to work. Number of travel to work trips found to be very low because of employment density method.

Travel to Errand: Estimation of errand-type trips from work to other commercial uses. Only applied to workplace parcels where retail exists within ½ mile. Uses national data to factor the number of errand trips made as a proportion of all trips made. Proximity of employment to retail sales and services used to estimate likelihood of trips.

Walk to Transit: The first of two transit walking trips, this one estimates trips from home to the transit stop. Only applied to households within 1 mile of a transit stop. Uses national data to factor the number of all trips made using transit as a proportion of all trips made using other modes. Proximity of households to transit stops used to estimate likelihood of trips. The

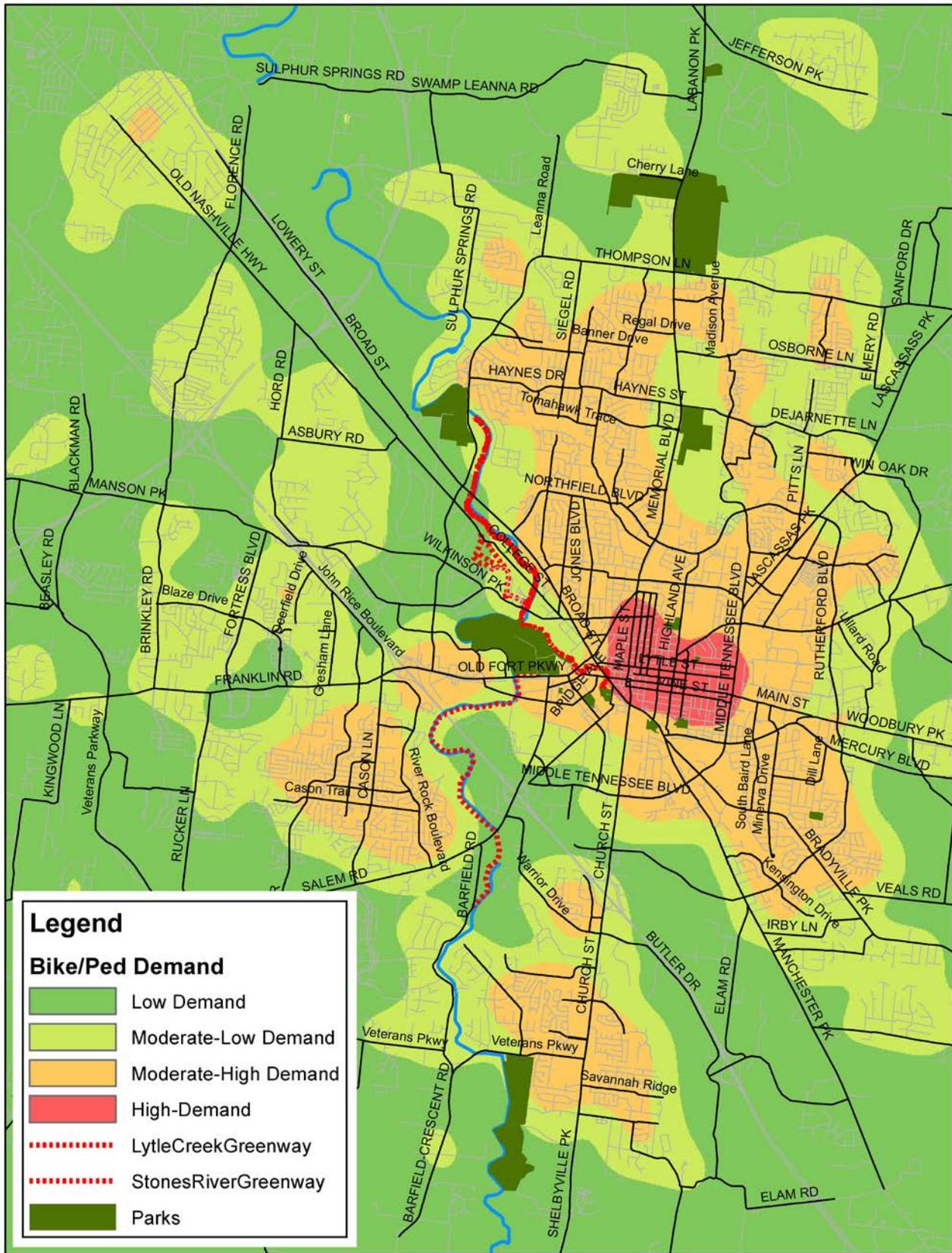
¹ This is the common equation form for trip types with households as the origin. Several trips types do not use the number of households as a determinant and would therefore have a different equation form.

impedance curve for this trip was developed using data from a transit on-board survey conducted in an urban area (Nashville, TN).

Walk from Transit: The second of two transit walking trips, this one estimates trips from the transit stop to a final destination (based on employment). This is the only destination-based trip type and is only applied to employment sites within 1/2 mile of a transit stop. Uses the number of boarding trips from the Walk to Transit trip type listed above. Proximity of employment to transit stops and the relative amount of employment at each site used to estimate likelihood of these trips.

Walk from Parking: Only applied to major public surface parking lots and/or parking garages. Assumes that walk trips will originate from all parked vehicles. Uses parking space turnover and garage occupancy factors to scale up and down trips, respectively.

Note that the last three trip types are only applicable for walking trips and were not determined for cycle trips. The Nashville MTA On-Board Survey, which was conducted in 2006, found that over 87 percent of all transit trips were made after walking to the bus stop as opposed to only 0.5 percent being made after cycling to the bus stop. Therefore, Bike to Transit was not derived in the model. Likewise, there is not expected to be a significant number of weekday bike trips made after driving to a parking lot, other than perhaps at a greenway trailhead, park, or similar area. Therefore, Bike to Parking was not derived in the model.



Non-Motorized Travel Demand (relative intensities)

**CITY OF MURFREESBORO
GREENWAYS, BLUEWAYS, & BIKEWAYS MASTER PLAN**

TECHNICAL MEMORANDUM #3: CAPITAL IMPROVEMENT NEEDS

In 2011, the City of Murfreesboro initiated the development of the Greenways, Blueways, and Bikeways (GBB) Master Plan to help identify and coordinate implementable improvements in recreation and non-motorized transportation over the next 25 years.

This technical memorandum presents the capital improvement needs that have been identified through the development of the plan. The proposed improvements have been identified as a result of an analysis of the existing infrastructure conditions and an identification of the needs within Murfreesboro for non-motorized transportation and recreation as identified through technical analyses and local stakeholder and public input. These needs are identified in Technical Memorandum #2. The proposed improvements are also recommended because they align directly with one or more of the locally-developed objectives for the GBB system as identified in Technical Memorandum #1.

Successful implementation of the GBB Master Plan will address the primary needs of this type of infrastructure through the planning horizon. The intent of this technical memorandum is to identify these needs. Murfreesboro's GBB needs can be summarized into two major categories: infrastructure and non-infrastructure. Infrastructure needs are physical elements of the built environment like greenways, river launches, and bike lanes and are described in this technical memo as capital improvements. Non-infrastructure recommendations are discussed in Technical Memorandum #5 and include policies and programs which facilitate use or implementation of a successful GBB system.

Various aspects of Murfreesboro's GBB capital improvement needs which are addressed in this technical memorandum include: a project prioritization methodology, identifying the needs themselves, providing recommendations for phased project implementation, and estimating the costs of the recommended improvements.

Project Prioritization Methodology

As capital budgets remain tight, the proposed improvements found within the GBB plan will have to be implemented over a number of years and will have to compete with other city priorities. As such, it is desirable to have an objective and predictable way in which to allocate ever-scarce funds to these projects. In the development of the GBB plan, local stakeholders and citizen participants rated the relative importance of six aspects of GBB implementation. From this information, a scoring matrix was developed.

This matrix and procedure can be used to assist the city as it considers funding citywide bicycle and pedestrian investments. It should be recognized, however, that strict adherence to such a process is not always advisable. For instance, opportunities may arise in which time is of the essence in acting for the benefit of promotion of the GBB system (e.g. purchase of available land). In such a case, subjecting these decisions to this prioritization methodology may not best serve the GBB system as intended.

An evaluation such as this should also be used within the context of the recommended tiered project phasing presented later in this technical memorandum. The recommended project tiers outline a more general strategic approach to phasing that builds system effectiveness as improvements are implemented. Rather, this matrix can be used within the tier system to help make decisions as to what type of improvements may be most cost effective given the local public and stakeholder stated objectives.

Prioritization Criteria	Evaluation Metric and Scoring				Score Multiplier	Total Score	Max Score (for reference)
Project adds to overall length of GBB system	Off Road (Greenway, Greenway Connector, Multi Use Path)		On Road (Bike Route, Sidewalk, Bike Lane)		20		200
	Greater than 2 miles	Less than 2 miles	Greater than 2 miles	Less than 2 miles			
	10	8	7	5			
Project provides connections to destinations (neighborhoods, shopping, schools, etc.)	2 x _____ (number of connected destinations - up to 5)				30		300
Project retrofits existing substandard facility (ex. widen an existing greenway) ¹	Existing facility is brought into ADA compliance		Existing facility is improved, but with no change in compliance status		10		100
	10		5				
Project is especially likely to have high usage (in a high demand area – from model)	Non-Motorized Demand (from demand map shown in Technical Memorandum #2)				15		150
	High	Moderate-High	Moderate-Low	Low			
	10	7	4	0			
Project is inexpensive, limited in scope, and/or has little environmental impact ²	Less than \$100,000 per mile		Between \$500,000 and \$100,000 per mile		5		50
	10		5				
Project links other recreational opportunities (parks, blueways, etc.) ³	Links two or more recreational facilities		Links one recreational facility		20		200
	10		5				
Total possible score (for reference)							1000

¹ No points awarded if an existing facility is not improved.

² No points awarded for projects costing more than \$500,000 per mile.

³ No points awarded if project does not connect to a recreational facility.

Recommended Capital Improvement Projects

The intent of the recommended capital projects of the GBB Master Plan is to identify corridor level facilities, not necessarily to identify specific routing (for off-road improvements) or design-level details. These specific details are expected to follow this plan as certain projects move into the implementation stages including project design.

General project types found in the proposed improvements plan are:

Greenway: a typical 10' – 16' wide paved off-street path generally following an established water course and having few or no at-grade crossings of roadways.

Greenway Connector: a paved off-street path that usually serves to connect specific properties to a greenway. Usually planned on public or institutional properties, an 8' – 12' width is expected. At-grade street crossings will be required, and must be designed appropriately as the project is implemented.

Multi-Use Path: constructed within the right-of-way of a roadway, this 8' – 12' paved path is ideally separated from the edge of the road by at least 5'. Where curb-and-gutter is used and right-of-way is constrained, the path may be constructed without a buffer to resemble a wide sidewalk. At-grade street crossings (signalized and unsignalized) are common.

Bike Lane: a signed, dedicated lane for cyclists on the roadway having a minimum width of 4'. Modifications to the traditional bike lane including buffered bike lanes and cycle tracks should be considered in the project's design phase.

Bike Route: a signed route (sometimes including pavement markings) for bicycle use but with no dedicated infrastructure. Examples may be roads with wide shoulders, striped shared lanes ("sharrows"), or low-speed, low-volume streets.

Greenway System Improvements

Over the last 20 years, the City of Murfreesboro has developed a high quality greenway system that extends for over 12 miles, making it a leader in the state for off-road facilities. The GBB Master Plan was initiated to provide the City with the tools to continue the momentum of the bike and pedestrian network and to provide a road map for the next 25 years. Taking advantage of the river and stream network found throughout the City and Rutherford County, a blueway component was also added to the master plan to provide improved water recreation opportunities for the system. With a public input process that included an Advisory Committee of city staff and citizens and open public forums that allowed for the general public to give input, a master plan was developed with recommendations for the next 25 years. These recommendations take into account the priorities identified in the public input process and those projects that provide the highest benefit for the residents of Murfreesboro.

Greenway Recommendations

The existing Stones River, Lytle Creek, and Gateway Trails provide off road recreation opportunities in a central location to the city. Input from the public and the advisory committee indicated a desire to see the overall system lengthened in mileage and to provide connections to destinations such as parks, commercial areas, neighborhoods, and schools. Providing links

from the greenways to downtown and Middle Tennessee State University were also high priorities for residents.

Review of existing planning initiatives revealed several projects that are ongoing. The Stones River Greenway (Phase IV) is under development and is currently in the right-of-way acquisition phase. The project is funded and will extend the Stones River Greenway from its current terminus at Barfield Road, south to Barfield Crescent Park. It is anticipated that this project will move to construction sometime in 2013. The North Murfreesboro Greenway Trail is another ongoing project that will provide an off-road trail network to a currently underserved area of the city. The trail is being coordinated by the United States Army Corps of Engineers and is in the design phase, awaiting release for construction. Funding for this project has been appropriated and it is anticipated it will move forward in 2013. These projects will add 2.25 and 3 miles respectively of paved trails to the system. Additional soft surface trails will also be included as part of the improvements and will accommodate equestrian users as well.

Other projects that have been studied for their feasibility include an extension of the Stones River Greenway from the confluence of the west and middle forks of the Stones River traveling southeast along the middle fork to the General Mills property along Butler Drive. The desire to provide a connection from the Children's Discovery Center at Murfree Spring on Broad Street to the Stones River Greenway at Cannonsburgh prompted a feasibility study for making that connection. The feasibility study looked at two alternatives; a crossing of Church Street via a tunnel or a bridge. The final concept design called for the addition of a tunnel under the roadway with an on-street multi-use path connecting to Cannonsburgh.

A total of 67 miles of off-road trails and 24 new trailheads have been recommended for development over the next 25 years. The routes focus on improving connectivity between large community parks, neighborhoods and commercial areas and on providing trails to currently underserved segments of the population. In conjunction with bike lanes and multi-use paths, the proposed greenways begin to provide a system that encompasses the entire perimeter of the City of Murfreesboro. Greenway Connector routes penetrate the central corridors of the city and link up community parks, downtown and MTSU to the perimeter. Wherever possible, grade separated crossings such as bridges or tunnels should be included at major thoroughfares. When road widening projects are initiated, tunnels in the location of planned greenway crossings should be considered to allow for the future connection of trails under the roadways.

Trailheads have been strategically placed along primary vehicular corridors for ease of access and wayfinding of the trail. These trailheads are intended to provide parking, restrooms, picnic facilities and other amenities similar to existing trailheads found along the Stones River Greenway. They have been located approximately 3-miles apart in most locations to provide good access for all residents. It is anticipated that ancillary trailheads, on a much smaller scale, will be provided in other locations as development occurs. These trailheads will link to subdivisions and other commercial areas that develop along the trail corridor. They may or may not provide parking and in most cases will likely not have restroom facilities. These access points may be built as part of larger developments that occur along the trail or by the city as demand dictates.

Two projects that bring very specific benefits to the system include the trailhead located at the confluence of the west and middle fork of the Stones River on Barfield Road and the trailhead located along River Rock Boulevard. Each trailhead would not only serve as a blueway access point but also provide a critical connection to other parts of the system via bridges at those locations. The bridge along River Rock Boulevard would offer direct access to the existing

Stones River Greenway and would serve as an alternate route for cyclists who wish to avoid the congested areas along Old Fort Parkway. The trailhead and bridge at the confluence of the west and middle forks would provide access to the southeast along the middle fork of the Stones River.

Blueway Recommendations

The West, Middle and East forks of the Stones River provide excellent opportunities for recreational paddle sports. As noted in the Existing Conditions Inventory, there are currently seven (7) locations for public access in and around the City of Murfreesboro. The Parks and Recreation Department currently maintains one (1) designated blueway with a put-in at the Manson Pike Trailhead along the Stones River Greenway and a take-out at the Thompson Lane Trailhead in addition to maintaining a joint put-in with the United States Army Corps of Engineers (USACE) at Walter Hill Park. Four (4) locations are maintained and controlled by the USACE. They provide parking, boat ramps and signage regarding rules and safety on the water.

The Stones River Watershed Association (SRWA) has identified access points along all three forks of the Stones River in and around Murfreesboro. These sites are very limited in amenities and many cannot be considered public access because they lack formal use agreements. The planning team reviewed access points identified by the SRWA and has recommended 14 locations in addition to the seven (7) public access locations that currently exist. Some of these locations will only be seasonally accessible due to low flow during different times of year. It will be necessary for the City to monitor river levels throughout the year and close those locations that are not navigable during certain periods. The following represents the 21 locations recommended for the Murfreesboro Blueway system.

Map ID	Stones River (West Fork)	Current Status	Ownership
1	Veterans Pkwy	No Public Access	Private
2	West and Middle Confluence	No Public Access	Private
3	Cason Trail	Future Public Access	City of Murfreesboro
4	River Rock Boulevard	No Public Access	Private
5	Bridge Ave. & Molloy	Future Public Access	City of Murfreesboro
6	Manson Pike	Public Access	Ownership
7	General Bragg Trailhead	Future Public Access	City of Murfreesboro
8	Thompson Lane	Public Access	City of Murfreesboro
9	Nices Mill	Public Access	USACE
21	West Fork Recreation Area	Public Access	USACE

Map ID	Stones River (Middle Fork)	Current Status	Ownership
10	Elam Mill	No Public Access	Private Owner
11	Joe B. Jackson Trailhead	No Public Access	Private Owner
12	City Schools Office	No Public Access	City Board of Education

Map ID	Stones River (East Fork)	Current Status	Ownership
13	Guy James Road	No Public Access	Private Owner
14	Brown's Mill	No Public Access	City of Murfreesboro
15	Lascassas Pike	No Public Access	Private
16	Betty Ford Road	No Public Access	Private
17	VA Hospital	No Public Access	Veterans Administration
18	Walter Hill Park	Public Access	USACE
19	Mona Recreation Area	Public Access	USACE
20	East Fork Recreation Area	Public Access	USACE

The 14 proposed access sites are controlled by various agencies. Those owned by the City of Murfreesboro will provide the greatest opportunity in the near future to develop river access. Those controlled by other public entities should present the greatest opportunity for negotiating easements. Those held in private ownership will require land acquisition or easements to permit development. Three (3) locations under private ownership are recommended for development as trailheads for the existing greenway and blueway system. Those locations include:

- West and Middle fork confluence (Barfield Road)
- River Rock Boulevard
- Joe B. Jackson Trailhead

With the eventual development of the greenway in these locations, river access can be provided similar to that of the Manson Pike and Thompson Lane trailheads on the existing Stones River Greenway. In addition to the easements and land acquisition required for trailheads, it will be necessary to acquire land for the development of canoe portages around the existing dams found on each of the 3 forks of the Stones River. The following provides a look at the point to point river mileage between each of the existing and proposed river access trailheads. The 21 locations provide over 50 miles of water recreation and paddling opportunities.

Stones River (West Fork)

From	To	Distance (mi)
Veterans Pkwy	Middle Fork Confluence	2.20
West and Middle Fork Confluence	Cason Trail	1.20
Cason Trail	River Rock Boulevard	1.20
River Rock Boulevard	Bridge Avenue & Molloy	1.00
Bridge Avenue & Molloy	Manson Pike Trailhead	2.22
Manson Pike Trailhead	General Bragg Trailhead	1.21
General Bragg Trailhead	Thompson Lane Trailhead	1.43
Thompson Lane Trailhead	Nices Mill	7.11
Nices Mill	West Fork Recreation Area	5.17
Total		22.74

Stones River (Middle Fork)

From	To	Distance (mi)
Elam Mill	Joe B. Jackson Trailhead	2.84
Joe B. Jackson Trailhead	City Schools Office	2.00
City Schools Office	West Fork Confluence	1.78
Total		6.62

Stones River (East Fork)

From	To	Distance (mi)
Guy James Road	Brown's Mill	2.38
Brown's Mill	Lascassas Pike	3.00
Lascassas Pike	Betty Ford Road	3.37
Betty Ford Road	VA Hospital	3.67
VA Hospital	Walter Hill Park	1.58
Walter Hill Park	Mona Recreation Area	5.72
Mona Recreation Area	East Fork Recreation Area	2.50
Total		22.22

It is anticipated that the City of Murfreesboro would develop 12 of the currently undeveloped locations due to their proximity within the city limits or just outside in the urban growth boundary. Those 12 sites include three (3) located at existing trailheads along the Stones River Greenway, three (3) located at proposed trailheads along the expanded greenway system, two (2) at locations identified on government agency controlled property, and four (4) at stand-alone facilities that would be for the specific use of the blueway system.

The existing trailheads that could be expanded to accommodate water access include General Bragg, Cason Trail and Bridge Avenue & Molloy. With the exception of Bridge Avenue & Molloy, each has existing infrastructure that could provide the necessary support amenities for the blueway trailheads. Additional improvements would be minimal to make those sites viable. The Bridge Avenue & Molloy location would require the addition of parking and a staging area as well as a boat access.

Proposed access points on the expanded greenway system include a point near the confluence of the west and middle forks of the Stones River, and new trailheads recommended at River Rock Boulevard and Joe B. Jackson. These sites should include all the amenities found at the Thompson Lane and Manson Pike Trailheads.

Two (2) locations are recommended on property that is owned by other government agencies. The location on the Veterans Administration hospital property is proposed to be a joint greenway and blueway trailhead. It is anticipated that this would be a large trailhead and include the amenities found at other joint trailheads in the system. The second location at the City Schools office site is proposed to be a blueway access site only. It is anticipated that additional parking and river access improvements would be necessary.

The four remaining sites are recommended as single purpose sites for the blueway system only. These locations include Barfield Crescent on the west fork and Brown's Mill Road, Lascassas

Pike and Betty Ford Road on the east fork. Improvements would include at a minimum, parking, staging areas, ramps and signage.

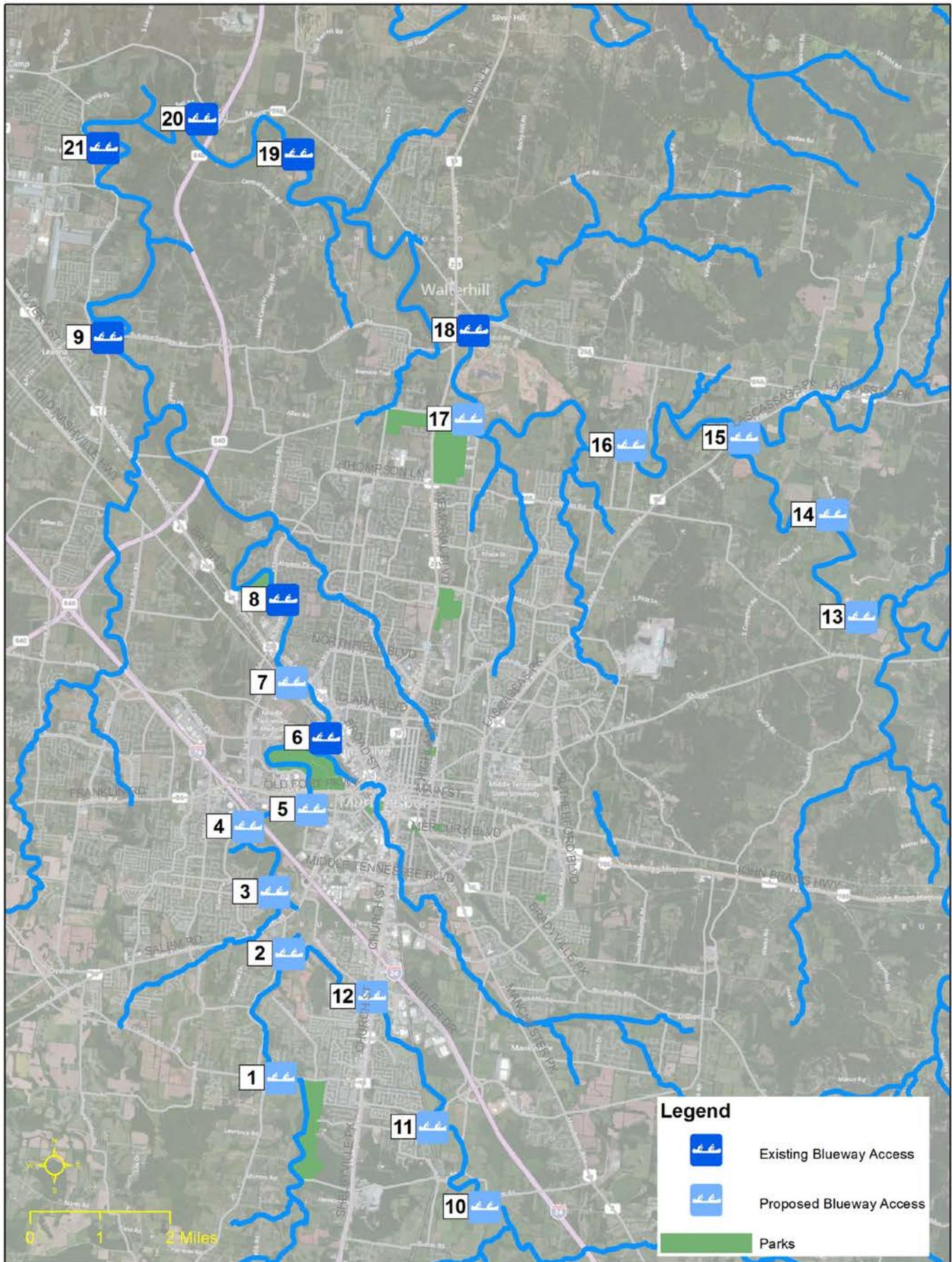
There are two remaining locations that are well outside the urban growth boundary. The location at Guy James Road and Elam Mill Road would likely be joint developments by the City and a partner agency. The location at Guy James Road is owned by Middle Tennessee State University and presents an excellent opportunity for a joint development with the city.

Blueway System Improvements

As the city looks to expand its blueway system, design elements that will be common among all sites include:

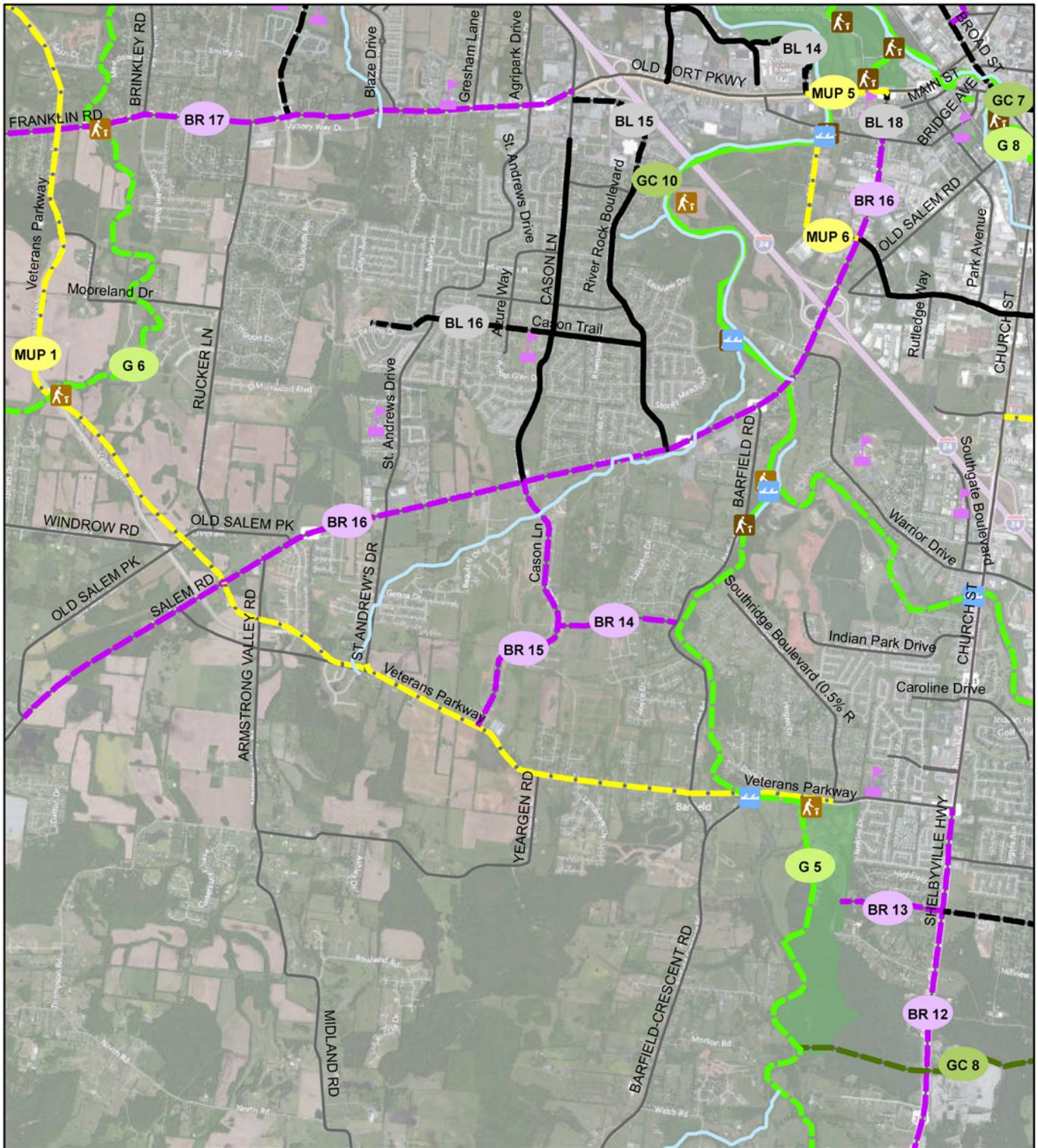
- Signage (wayfinding, safety and rules, maps, interpretive, mileage markers, etc.)
- Parking
- River access points (concrete launches, steps, slide rail for small boats, etc.)
- Amenities (trash cans, benches, pavilions, access gates, security lighting)
- Portages around dam structures and other obstacles in the river

Blueway development around the city should follow a design approach that takes into account the sensitive riverine environment where they will be constructed. Low impact development and the use of best management practices (BMP's) for handling all stormwater runoff from parking and roadway surfaces should be employed. Designs should also take into account flood-prone areas and be built to withstand heavy rain events when floodwaters may rise outside the riverbanks.

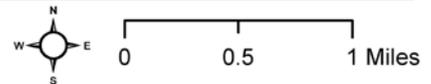


On-Street Improvements

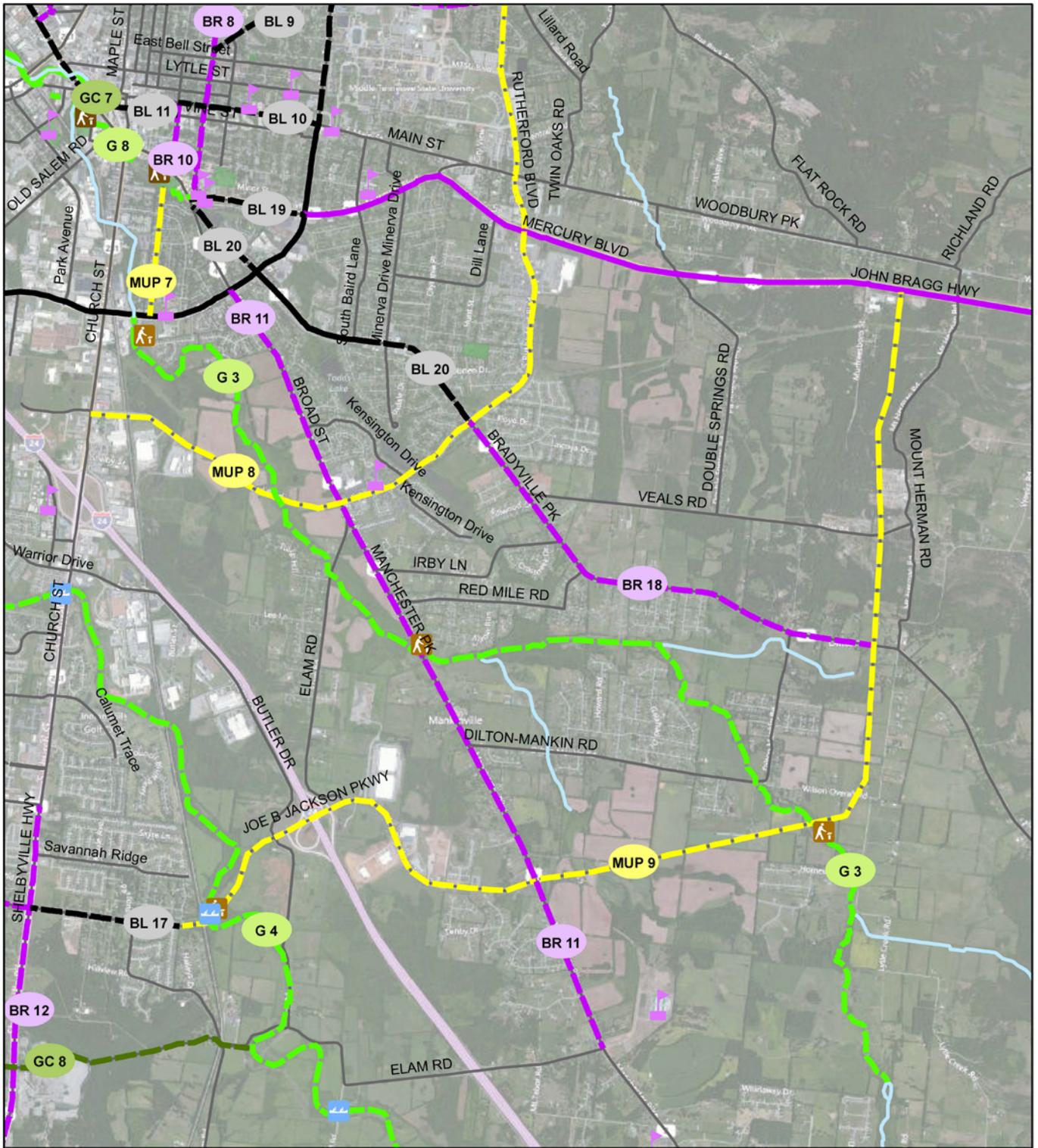
The City of Murfreesboro maintains an inventory of roadway classifications for all roads in the city, as determined by the Major Thoroughfare Plan. This roadway classification listing, as well as the existing greenway network, was used as the basis for making GBB enhancement recommendations. On-road GBB improvements are limited to the rights-of-way of certain functionally classified streets (major arterials, minor arterials, commercial collectors, community collectors, residential collectors, and residential sub-collectors). Local residential streets are generally adequate for non-motorized travel due to low speeds and low volumes and do not warrant special GBB system designation. Off-road GBB improvements have generally been constrained to the floodways of the Stones River and significant tributaries which have not been developed such that future greenway construction is precluded. Other off-road improvements such as greenway connectors do not follow water courses, but have generally been limited to publicly or institutionally owned parcels.

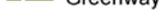
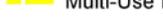


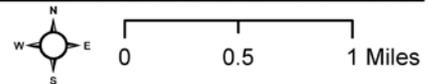
- | Existing Facilities | | Proposed Facilities | |
|---------------------|-----------------------|---------------------|-----------------------|
| | Exist. Trailhead | | Prop. Trailhead |
| | Prop. Trailhead | | Exist. Trailhead |
| | Exist. Blueway Access | | Prop. Blueway Access |
| | Prop. Blueway Access | | Exist. Blueway Access |
| | Schools | | Schools |
| | Bike Lane | | Bike Lane |
| | Bike Route | | Bike Route |
| | Greenway | | Greenway Connector |
| | Parks | | Multi-Use Path |
| | | | Greenway |



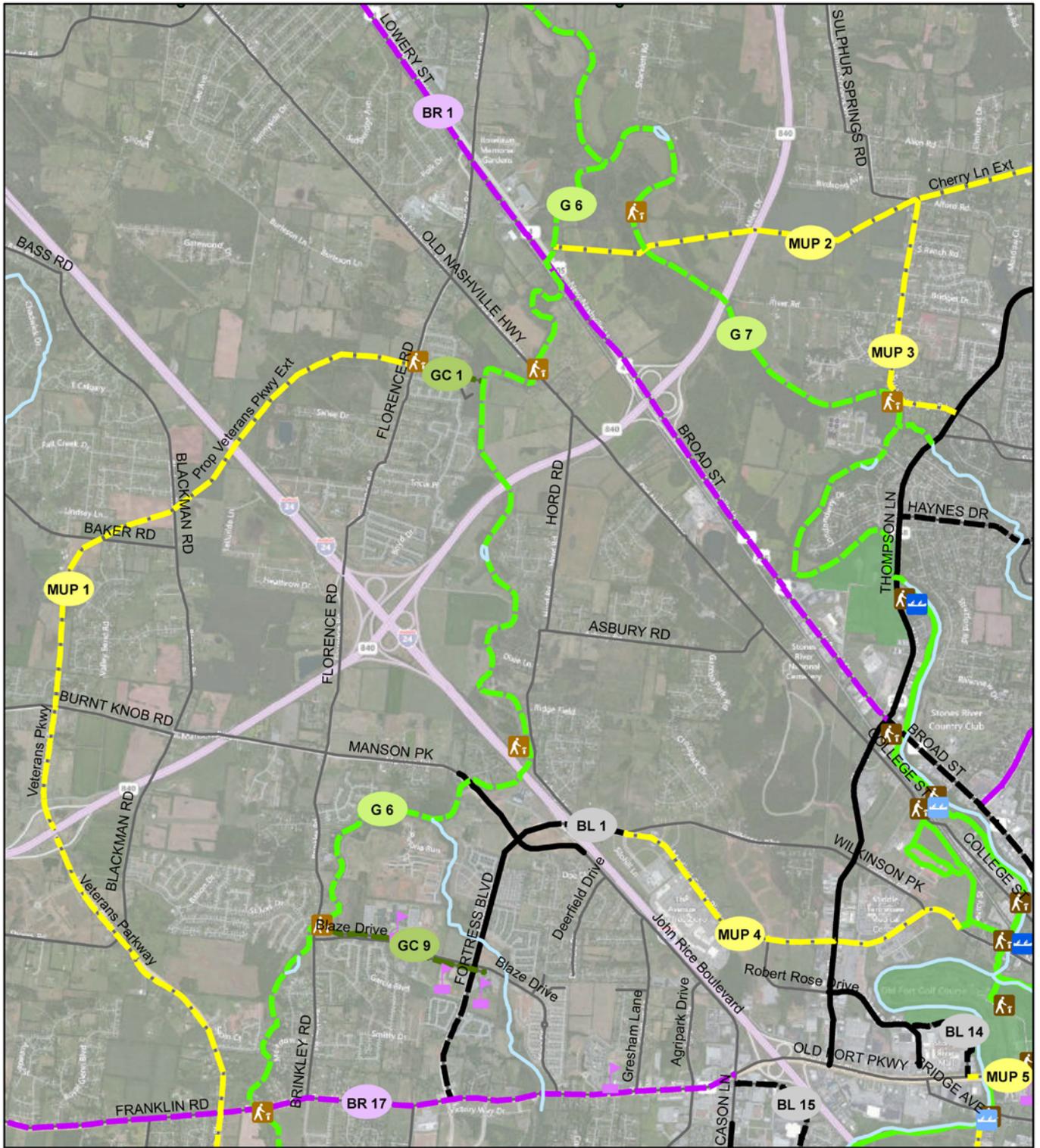
City of Murfreesboro
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 Plan Recommendations -
 Southwest



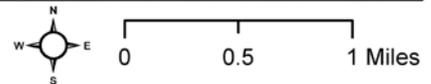
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|---|--|--|
|  Exist. Trailhead | Existing Facilities | Proposed Facilities |
|  Prop. Trailhead |  Bike Lane |  Bike Lane |
|  Exist. Blueway Access |  Bike Route |  Bike Route |
|  Prop. Blueway Access |  Greenway |  Greenway Connector |
|  Schools |  Parks |  Multi-Use Path |
| | |  Greenway |



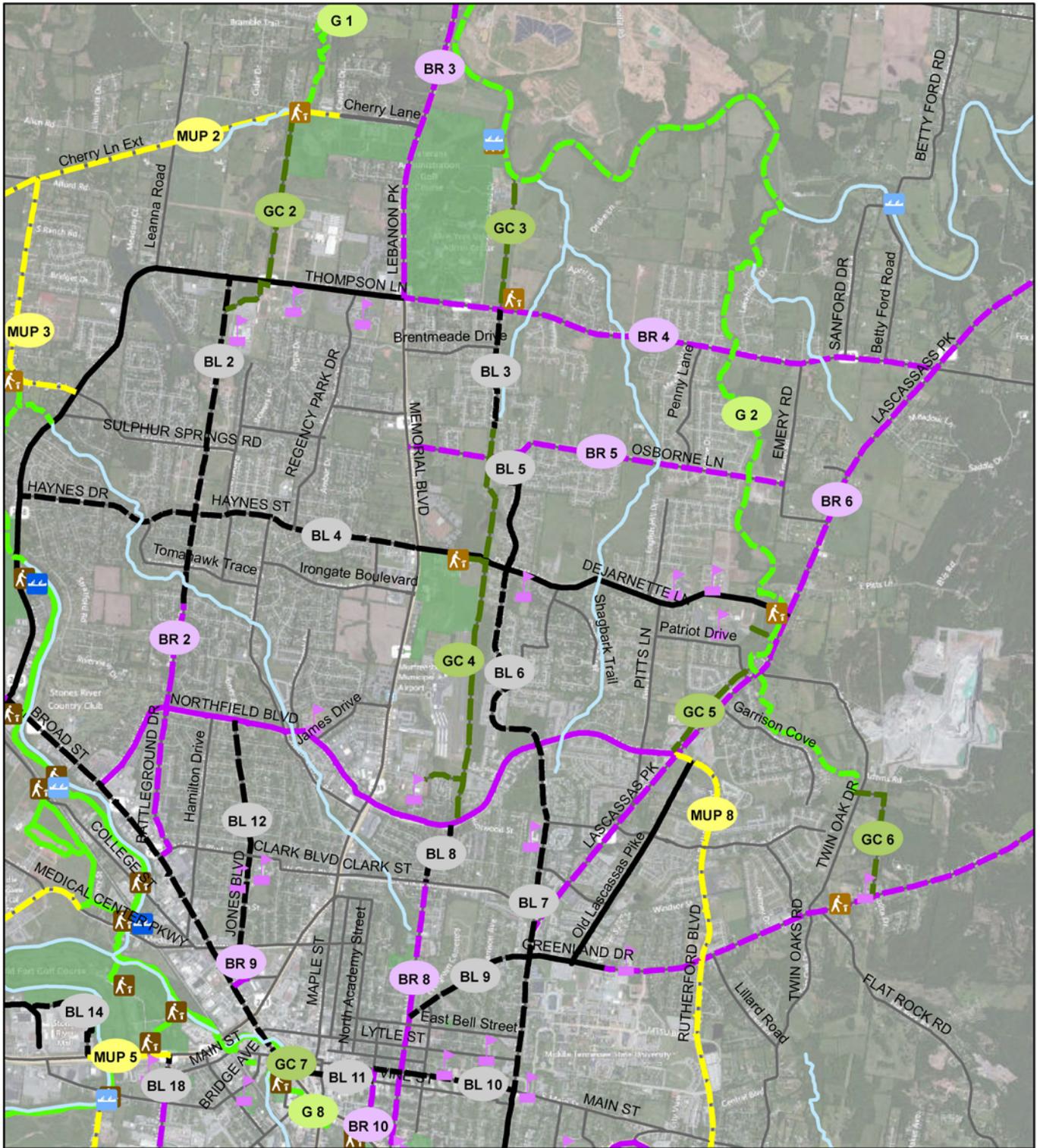
City of Murfreesboro
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 Plan Recommendations -
 Southeast



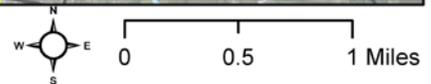
Existing Facilities		Proposed Facilities	
Exist. Trailhead	Bike Lane	Bike Lane	Bike Lane
Prop. Trailhead	Bike Route	Bike Route	Bike Route
Exist. Blueway Access	Greenway	Greenway Connector	Greenway
Prop. Blueway Access	Parks	Multi-Use Path	
Schools			



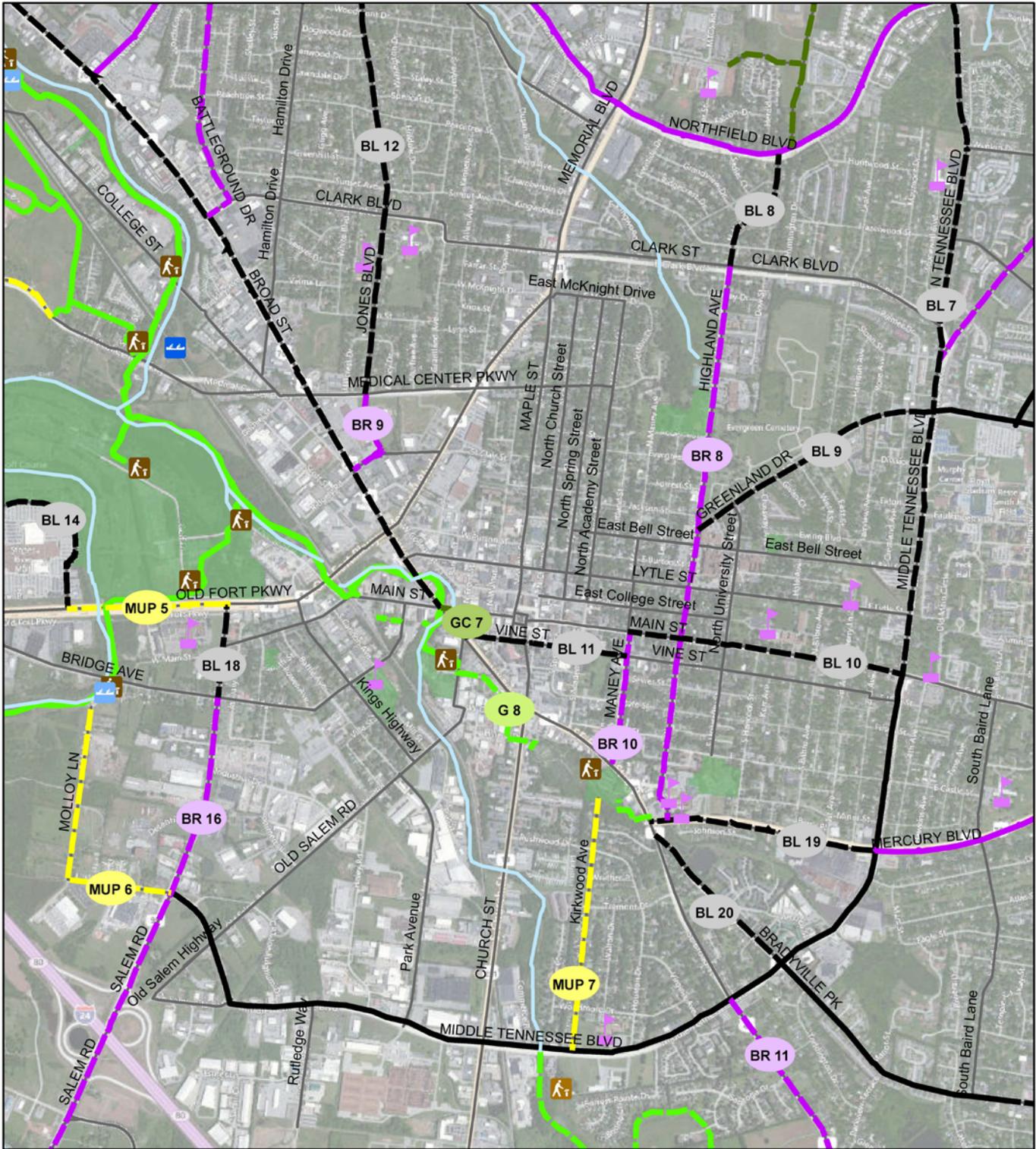
City of Murfreesboro
**Greenways, Blueways,
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 Plan Recommendations -
 Northwest



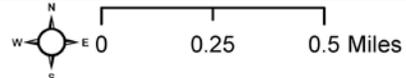
- | | | |
|-----------------------|----------------------------|----------------------------|
| Exist. Trailhead | Existing Facilities | Proposed Facilities |
| Prop. Trailhead | Bike Lane | Bike Lane |
| Exist. Blueway Access | Bike Route | Bike Route |
| Prop. Blueway Access | Greenway | Greenway Connector |
| Schools | Parks | Multi-Use Path |
| | | Greenway |



City of Murfreesboro
Greenways, Blueways, and Bikeways Master Plan
 Plan Recommendations - Northeast



- | | | |
|-----------------------|----------------------------|----------------------------|
| Exist. Trailhead | Existing Facilities | Proposed Facilities |
| Prop. Trailhead | Bike Lane | Bike Lane |
| Exist. Blueway Access | Bike Route | Bike Route |
| Prop. Blueway Access | Greenway | Greenway Connector |
| Schools | Parks | Multi-Use Path |
| | | Greenway |



City of Murfreesboro
**Greenways, Blueways,
 and Bikeways Master Plan**
 Plan Recommendations -
 Central

Greenway Projects

Project ID	From	To	Distance (mi)	Additional Information
G 1	Cherry Lane	Walter Hill Park	1.76	
G 2	Walter Hill Park	Twin Oak Dr	8.91	
G 3	Middle Tennessee Blvd	Urban Growth Boundary	7.96	
G 4	Greenway (existing - Barfield Rd)	Urban Growth Boundary	11.61	Via Middle Fork of Stones River.
G 5	Greenway (existing - Barfield Rd)	Urban Growth Boundary	8.98	Via Stones River, along Barfield-Crescent Park.
G 6	Veterans Pkwy	Urban Growth Boundary	12.57	Via Overall Creek
G 7	Thompson Lane	Overall Creek Greenway (proposed - G 6)	5.19	
G 8	Greenway (existing - Cannonsburg)	Discovery Center	0.47	Requires crossing at S. Church

Greenway Connector Projects

Project ID	From	To	Distance (mi)	Additional Information
GC 1	Veterans Pkwy (prop)	Greenway (prop)	0.38	
GC 2	Siegel schools campus	Greenway (prop)	1.36	Connects Siegel schools, Miller Coliseum, and Siegel Park.
GC 3	Madison Ave	Greenway (prop)	0.75	Connects Madison Ave bike lanes to greenway via easement on MTSU and water treatment plant property. Requires crossing of Thompson Lane.
GC 4	Northfield Blvd	Madison Ave	2.31	Part of major north-south connector route via airport property easement. May include short spur trails to SportsCom and MTCS.
GC 5	Rutherford Blvd	Greenway (prop)	0.67	Part of effort to link MTSU to future greenway via trails (via Rutherford Blvd MUP). May include spur trail to Oakland HS. Includes portion of Big Ditch.
GC 6	Halls Hill Pk	Greenway (prop)	0.78	Connection to Daniel McKee school via apparent existing utility corridor.
GC 7	Vine St	Greenway (exist)	0.14	Urban GC enhancing downtown greenway access.
GC 8	Wilderness Station	Greenway (prop)	2.19	Potential for landmark bridge over Shelbyville Pk near quarry (included in cost).
GC 9	Blackman schools campus	Greenway (prop)	1.05	
GC 10	River Rock Blvd	Greenway (exist)	0.21	Bridge to greenway on old raquet club property

Multi-Use Path Projects

Project ID	Route	From	To	Distance (mi)	Additional Information
MUP 1	Veterans Pkwy	Barfield-Crescent Park	Greenway Connector (prop)	12.2	
MUP 2	Cherry Lane	Siegel Park	Greenway (prop)	4	To be designed as part of Cherry Lane extension. ROW limitations make require use of alternative facility type.
MUP 3	Sulphur Springs Rd	Cherry Lane	Thompson Lane	1.53	To be designed as part of future Sulphur Springs Rd improvements.
MUP 4	Medical Center Pkwy	Conference Center Dr	Greenway (exist)	2.34	Retrofit on north side of Medical Center Pkwy.
MUP 5	Old Fort Pkwy	Salem Rd	Mall Circle Dr	0.49	On north side of Old Fort Pkwy only.
MUP 6	Molloy Lane	Middle Tennessee Blvd	Greenway (exist)	0.83	
MUP 7	Kirkwood Ave	Middle Tennessee Blvd	Discovery Center	0.75	Potential connection for Discovery Center to Bellwood Elementary to greenway (proposed).
MUP 8	Rutherford Blvd	Church St	Northfield Blvd	6.6	
MUP 9	Joe B Jackson Pkwy	East of I-24	John Bragg Hwy	7.57	

Bike Lane Projects

Project ID	Route	From	To	Distance (mi)	Additional Information
BL 1	Medical Center Pkwy	I-24	Conference Center Dr	0.75	Retrofit bike lanes through I-24 interchange
BL 2	Seigel Rd/ Battleground Dr	Marymont Dr	Thompson Ln	1.92	Includes new bike/ped only connection at Battleground dead end.
BL 3	Madison Ave	Dead End	Thompson Ln	0.69	Stripe only
BL 4	Haynes Dr	Thompson Ln	Memorial Blvd	2.39	
BL 5	Peconic Pl/ Howell Dr	Alexander Blvd	Osborne Ln	0.27	Stripe only
BL 6	Alexander Blvd/ N Tennessee Blvd	Northfield Blvd	Dejarnette Ln	1.32	Stripe only
BL 7	Middle Tennessee Blvd/ N Tennessee Blvd	Main St	Northfield Blvd	2.02	
BL 8	Highland Ave	Clark Blvd	Northfield Blvd	0.39	Stripe only
BL 9	Greenland Dr	Highland Ave	Middle Tennessee Blvd	0.8	Stripe only
BL 10	Main St	Maney Ave	Middle Tennessee Blvd	0.82	
BL 11	Vine St	Greenway Connector (prop)	Maney Ave	0.48	Stripe only
BL 12	Jones Blvd	Medical Center Pkwy	Northfield Blvd	1.33	

Bike Lane Projects (Con't.)

Project ID	Route	From	To	Distance (mi)	Additional Information
BL 13	Broad St	Thompson Ln	Greenway (exist)	2.65	Construct as part of future Broad St improvements.
BL 14	Mall Circle Dr	Robert Rose Dr	Old Fort Pkwy	0.63	Restripe existing 3-lane section.
BL 15	River Rock Blvd	Cason Ln	Greenway Connector (prop)	0.8	Restripe existing 3-lane section.
BL 16	Cason Trl	Dead End	Cason Ln	1.07	Stripe only
BL 17	Joe B Jackson Pkwy	Shelbyville Hwy	Multi-Use Path (prop)	0.87	
BL 18	Salem Rd	Bridge Ave	Old Fort Pkwy	0.28	
BL 19	Mercury Blvd	Broad St	Middle Tennessee Blvd	0.69	
BL 20	Bradyville Pike	Broad St	Rutherford Blvd	1.33	Additional 0.8 mile bike lane from Middle Tennessee Blvd to Minerva Dr already exists

Bike Route Projects

Project ID	Route	From	To	Distance (mi)	Additional Information
BR 1	Broad St	Urban Growth Boundary	Thompson Lane	1.73	
BR 2	Clark Blvd/ Battleground Dr	Broad St	Marymont Dr	1.55	
BR 3	Lebanon Pk	Urban Growth Boundary	Thompson Lane	1.81	
BR 4	Thompson Ln	Lebanon Pk	Lascassas Pk	3.13	
BR 5	Osborne Ln	Memorial Blvd	Emery Rd	2.22	
BR 6	Lascassas Pk	Urban Growth Boundary	Middle Tennessee Blvd	6.28	
BR 7	Halls Hill Pk	Urban Growth Boundary	Champion Way	4.2	
BR 8	Highland Ave	Dead End	Clark Blvd	1.67	Includes new bike/ped only connection to Mercury Blvd.
BR 9	Jones Blvd/ Ridgely Rd	Broad St	Medical Center Pkwy	0.32	
BR 10	Maney Ave	Broad St	Main St	0.4	
BR 11	Broad St/ Manchester Pk	Middle Tennessee Blvd	Urban Growth Boundary	4.93	
BR 12	Shelbyville Pk	Veterans Pkwy	Urban Growth Boundary	2.71	

Bike Route Projects (Con't.)

Project ID	Route	From	To	Distance (mi)	Additional Information
BR 13	Lynnford Dr	Barfield-Crescent Park	Joe B Jackson Pkwy	0.61	
BR 14	Unfinished Road	Barfield Rd	Cason Ln	0.7	
BR 15	Cason Ln	Veterans Pkwy	Salem Rd	1.74	
BR 16	Salem Rd	Urban Growth Boundary	Bridge Ave	6.45	
BR 17	Old Fort Pkwy	Urban Growth Boundary	Cason Ln	9.13	
BR 18	Bradyville Pike	Rutherford Blvd	Joe B Jackson Ext (prop)	3.0	

10-Year (Tier I) and Secondary (Tier II) Priority Needs

Based on greenway plans already underway and community desires, some identified greenway needs have been designated into two project tiers, or phases. Tier I projects seek to extend the existing greenway system in south Murfreesboro and initiate a true greenway trail system in north Murfreesboro. Doing so not only increases the amount of usable trail, but also will encourage new users by linking more households and destinations along the new trail segments. Tier I roadway projects are based on critical needs such as creating better downtown access to the existing greenway system, as well as seeking to increase the effectiveness of Tier I greenway improvements by linking these to each other and to important destinations.

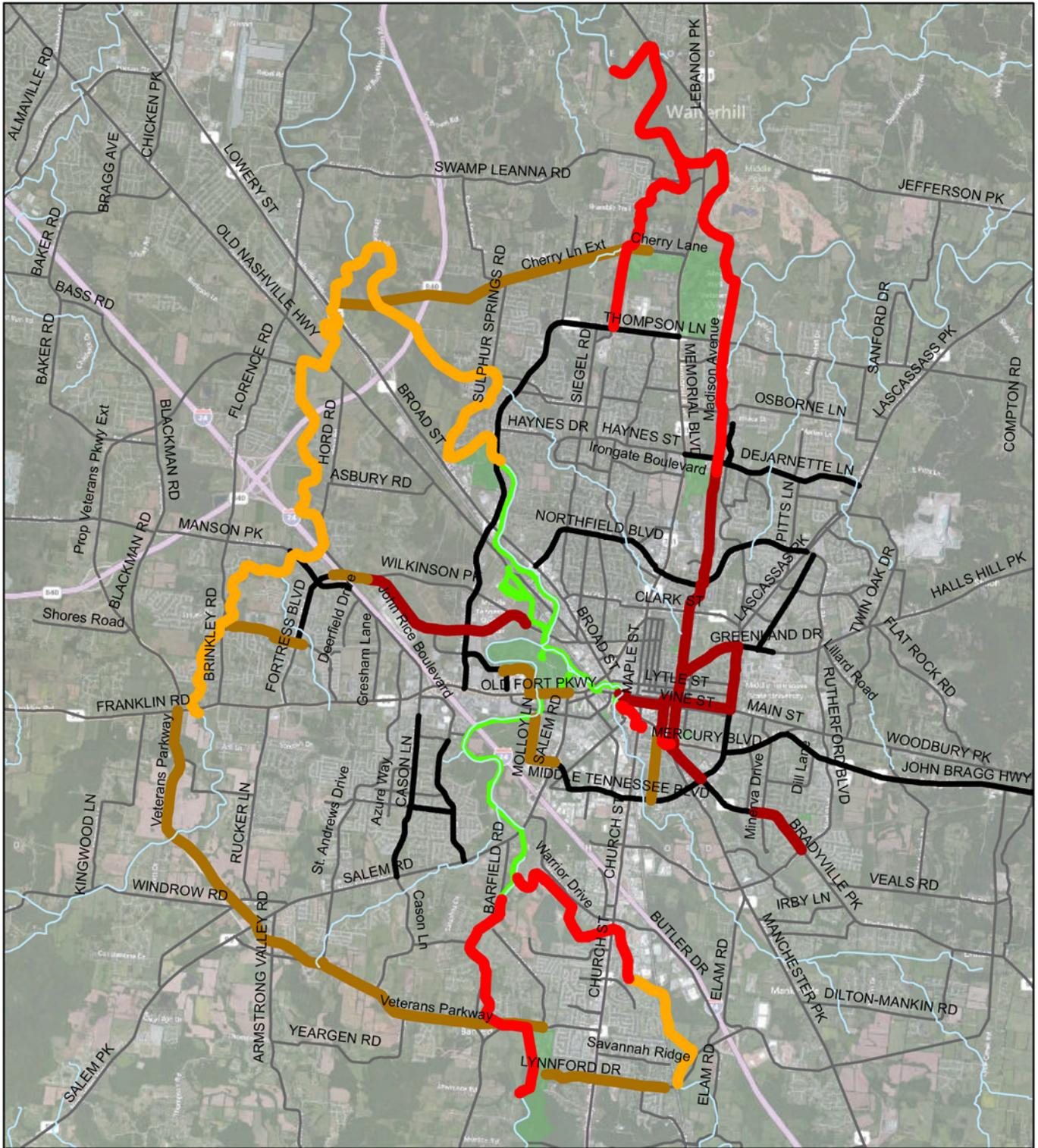
Tier II greenway construction includes the major portions of the Blackman area trails. Tier II improvements also include significant stretches of multi-use path which will result in the connection of Siegel Park in the north to Barfield-Crescent Park in the south.

Unfortunately, few on-street projects in Murfreesboro can be considered “low-hanging fruit”, ready to be implemented relatively easily with little cost. Those projects which can be easily implemented (e.g. signing a designated bikeway along newly reconstructed portions of Maney Avenue) generally do not link together into a bike network of any appreciable length or with an important connection. Thus, ease of construction has not been a major factor in designating priority improvements.

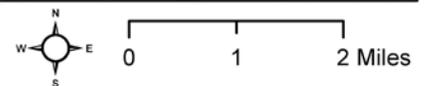
It is also important to understand the intent of the phasing designations. The recommended tier of these improvements should be used as an aid toward the strategic implementation of the ultimate GBB system with respect to user benefit. That is, the tiered approach recommends that finishing greenway plan already under development and linking downtown and downtown neighborhoods to the existing greenways are the most pressing needs from the users' standpoint.

However, there are other factors that will need to be considered that may not be inherent in the phasing strategy presented in this plan. For instance, a unique funding or land acquisition opportunity may (and often will) come about which requires timely attention. Such a circumstance will take attention and potentially funding away from an upper-tier project and give it to a lower-tier, but more opportunistic project. Within reasonable limits, taking focus off of the upper-tiered project to take advantage of these types of circumstances is encouraged for the good of the GBB system as a whole.

Several of the upper-tier projects will require substantial effort and cost to implement. As these are encountered, City leadership will have to determine the best course of action in the plan's implementation. Ultimately, the effectiveness of the GBB system as a whole will be strengthened as all projects are implemented. Furthermore, few of the recommended projects will become any easier or less expensive to implement as time passes. It is thus recommended that the upper-tier project be implemented as early as possible to make later improvements as beneficial as possible.



- █ Tier I Greenway Projects
- █ Tier II Greenway Projects
- █ Tier I Road Projects
- █ Tier II Road Projects
- █ Existing Greenway
- █ Existing Bike Facility



City of Murfreesboro
**Greenways, Blueways,
 and Bikeways Master Plan**
 Project Phasing

Project Costs

Project costs associated with the capital needs identified in the GBB Master Plan, like in any bicycle and pedestrian facilities plan, can be easily misunderstood. This is because, particularly for the on-street projects, facilities are often implemented as part of larger roadway improvement projects, so that the estimated costs of the non-motorized facility improvements are more difficult to quantify.

The project needs costs listed below have been developed assuming that each project is a stand-alone project and are meant to provide a planning level estimate so that the scale of these projects can be understood. However, it should be noted that implementation of many of these projects will be fractional with respect to other roadway work which might be undertaken as part of a roadway project occurring along the same corridor as an identified bike facility. In fact, many of the on-road facilities in the GBB plan are recommended in part because of a future larger roadway need has already been identified and incorporating a bicycle connection can be done relatively easily as part of the bigger project.

General Estimates* for All GBB Projects		
Type of Recommended Facilities	Length (miles)	Cost
Greenways and Greenway Connectors	67.3	\$67,310,000
Multi-Use Paths	36.3	\$27,240,000
Bicycle Lanes	20.2	\$9,710,000
Bicycle Routes	50.0	\$620,000
TOTALS	173.8	\$104,880,000

**Planning-level construction costs only. Does not include right-of-way acquisition, utility relocation, or preliminary engineering costs.*

By way of comparison, it was reported in the Regional Bicycle and Pedestrian Study that for the five years 2006-2011, just under \$33 million in bicycle and pedestrian projects was awarded in Rutherford County. This was 38% of the total funding in the Nashville region and was more than in any other county, including Davidson. The funding during this period was the result of special federal appropriations directly through congress and is not likely to be realized again in the near future.

Breaking these costs out by the recommended project tiers gives funding estimates for a 10-year planning horizon, a secondary planning horizon, and further future needs. The 10-year planning horizon cost for greenways and greenway connectors is \$38.4M, or an average of \$3.8M per year. Given that the average city-funded capital expenditures budget for the Parks and Recreation Department over the past four years was approximately \$120,000 per year (when federal greenway allocations are subtracted), it is quickly evident that a different funding strategy will be required.

General Estimates* for GBB Projects by Planning Horizon						
Type of Recommended Facilities	10-Year Horizon ¹		Secondary Horizon ²		Future Horizon	
	Length (mi)	Cost (\$1,000s)	Length (mi)	Cost (\$1,000s)	Length (mi)	Cost (\$1,000s)
Greenways and Greenway Connectors	38.4	\$37,310	24.6	\$24,350	4.3	\$5,650
Multi-Use Paths	2.3	\$1,760	12.2	\$9,130	21.8	\$16,350
Bicycle Lanes	5.2	\$2,270	2.3	\$1,610	12.7	\$5,830
Bicycle Routes	1.7	\$20	0.6	\$10	47.7	\$590
TOTALS	47.6	\$41,360	39.7	\$35,100	86.5	\$28,420

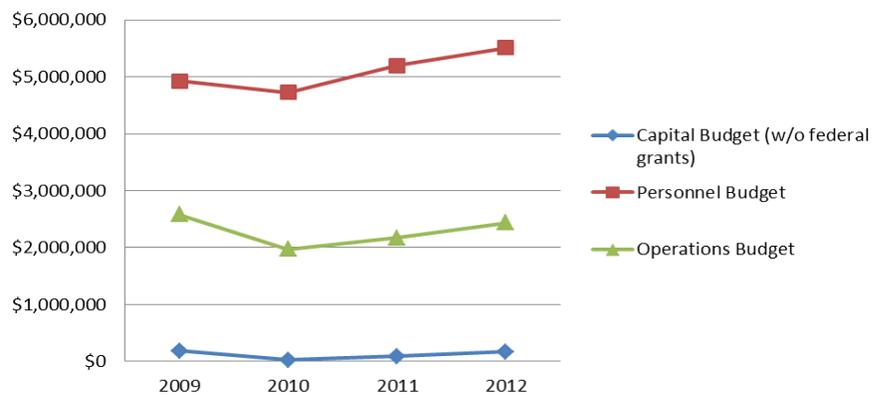
*Planning-level construction costs only. Does not include right-of-way acquisition, utility relocation, or preliminary engineering costs.

¹Corresponds to Tier I projects

²Corresponds to Tier II projects

Some considerations regarding funding strategies are as follow:

- An additional expenditure of \$3.8M would represent an approximate 3% share of the City's annual general fund expenditures. An amount this significant is not likely to be found within the existing budget. As such, it appears likely that additional revenue would be required to fund the Tier 1 projects over the 10-year near-term horizon.
 - Greenway construction should become the new leading priority of the Parks and Recreation Department. Looking at the departmental budget, it is clear that staffing and operating costs of existing park facilities are significant. As greenways become priority, the department will realize that greenway construction does not significantly increase staffing and operations costs the way traditional park facilities do. Plus, existing facilities will see more users once connected by these facilities.
- Some communities have instituted an "infrastructure adequacy" fund whereby developers of new housing and/or commercial property pay into the fund which is dedicate to greenway system expansion.



Four-Year Budgeting by Expenditure Type for Murfreesboro's Parks and Recreation Dept.

- A portion of the county hotel/motel tax is currently earmarked for greenway facilities. This portion dedicated to greenways should be evaluated and grown if appropriate.
- Although historic federal funding levels for facilities in Murfreesboro cannot be sustained, it should not be assumed that no state or federal funding will be available. In fact, new MAP-21 federal transportation legislation has special opportunities for funding active transportation projects. The Transportation Alternatives (TA) funds will be administered by the Nashville Area Metropolitan Planning Organization (MPO) (instead of by TDOT as in the past) and will be eligible for use by active transportation projects like those presented in this plan. The total amount of TA funds available annually within the Nashville area is expected to be approximately \$1.5M.

As part of the 2035 Long-Range Transportation Plan, the Nashville MPO also established a nationally recognized strategy by which 15% of the region's Urban Surface Transportation Program (U-STP) funds would be dedicated to projects which encourage the development of active transportation choices and walkable communities. The revenue forecasts of this funding source shows that regional STP funding should be considered as a significant possible funding source for this plan's implementation.

U-STP Investment Strategy – Revenue Distribution by Planned Horizon Year

Category	Target	2011-2015*	2016-2025	2026-2035
Multi-Modal Roadway Capacity & Safety	70%	\$11,448,000	\$213,353,452	\$315,815,228
Active Transportation Enhancements	15%	\$2,500,000	\$45,718,597	\$67,674,692
Public Transportation/ Mass Transit	10%	\$1,650,000	\$30,479,065	\$45,116,461
System Management & Operations	5%	\$825,000	\$15,239,532	\$22,558,231
TOTAL URBAN STP	100%	\$16,423,000*	\$304,790,646	\$451,164,611

*FY 11-15 revenues available after prior commitments are funded.

Source: Nashville Area MPO

- Another source of potential transportation funding is through public transit funds. These funds are generally made available by the Federal Transit Administration and will again be administered locally by the MPO. A greenway or bikeway project which provides bicycle or pedestrian infrastructure improvements to or in the vicinity of transit service may be eligible for these funds.
- Partnerships have begun and will continue to emerge for walking and bicycling programs and infrastructure. Often geared toward children, funding opportunities through both public health and education arenas may be capitalized on. These opportunities may be administered by public, private, or non-profit organizations.

**CITY OF MURFREESBORO
GREENWAYS, BLUEWAYS, & BIKEWAYS MASTER PLAN**

TECHNICAL MEMORANDUM #4: USER DESIGN GUIDE

In 2011, the City of Murfreesboro initiated the development of the Greenways, Blueways, and Bikeways (GBB) Master Plan to help identify and coordinate implementable improvements in recreation and non-motorized transportation over the next 25 years.

This technical memorandum sets forth the desirable standards for construction of the City's GBB network. These design guidelines are intended to function as a reference for local government, engineers, planners, and others who make decisions that affect bicycle and pedestrian travel in Murfreesboro. These guidelines are intended to be used in conjunction with and as a supplement to the construction requirements and specifications already established in the City's *Street Design Specifications* (July 2009). These guidelines are also meant to be used in conjunction with established guidelines of the American Association of State Highway and Transportation Officials (AASHTO), the current edition of the *Manual on Uniform Traffic Control Devices* (MUTCD), and the *Americans with Disabilities Act* (ADA). Other emerging guidelines such as the National Organization of City Transportation Officials (NACTO) *Urban Bikeway Design Guide* should be consulted and may be found to provide more innovative guidance that might be appropriate given specific conditions.

As is common with all design guideline documents, this document cannot provide specific guidance for every design issue that may be encountered. In situations that are not covered by this document, appropriate planning and engineering principles should be applied, but always with the intent of consideration of all modes of transportation in planning, design, and construction projects. In doing so, a continuous and consistent transportation system for bicyclists, pedestrians, and transit users will be created, resulting in a more complete implementation and greater usage of the GBB network. Including the design of facilities for alternative modes of transportation from planning to construction is more effective and less costly than having to retrofit facilities in order to provide bicycle, pedestrian, and transit accommodations.

In short, these guidelines are meant to help create a safe, efficient, and user-friendly environment that encourages ever-increasing levels of walking and biking in Murfreesboro.

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1.0 GREENWAY FACILITY DESIGN STANDARDS

Developing quality design standards is very important to the success of a greenway. The first step in defining standards is to identify who will use the greenway and what they will use it for. Different user groups have different needs and different destinations. The ultimate goal of design standards is to ensure the greenways are safe, usable and attractive to the community.

1.1 PURPOSE OF A GREENWAY

Greenways are used for recreation, transportation, therapy and education. The result of each of these uses is connection. Many connections can be developed, including people to places, people to nature and nature to nature. Providing these pedestrian and bicycle connections between neighborhoods, schools, parks and commercial areas can reduce traffic on roadways, provide environmental benefits and help slow the fast pace of life.

Connecting people to nature is becoming more difficult as our natural environment is encroached upon by development. Typically, people want to live in and enjoy the natural environment every day. This need to be surrounded by nature can be seen in the homes we purchase, the places we vacation and the ways we spend our leisure time. As our lives continue to move at a faster pace, time for enjoying our natural surroundings decreases. Incorporating natural surroundings into our daily routines through the use of greenways for daily errands and trips will provide opportunities to reconnect people and nature.

Connecting nature to nature is also a vital aspect of greenways. Small islands of forests remain in Murfreesboro. Linear corridors along streams and rivers connect many of these islands of habitat. As development in Murfreesboro continues to encroach on the natural environment, fewer areas are available for wildlife. Identifying, protecting and enhancing connections between natural areas will help protect the integrity of the natural environment currently found in the area.

1.2 USERS OF A GREENWAY

The connections created by greenways provide opportunities for several different uses. Identifying the potential users makes identifying these uses easier. There are two general categories of greenway users: pedestrians and bicyclists. Within these categories are several different subcategories that need to be considered: ages, levels of experience, physical abilities, special needs and destinations. The different facilities required to accommodate the needs of all users effectively are discussed in the following sections.

Pedestrians

The term "pedestrian" includes many different users of greenways, including walkers, runners and roller bladers. The intensity of use from pedestrians can range from a leisurely walk to enjoy the outdoors to a five-mile run to skating to work. The age and experience of users will influence how they use a greenway.

When greenways are used for transportation, walking remains the most common form of pedestrian transportation. Elements considered when choosing walking as a form of transportation include safety, convenience, travel time, physical condition, family circumstances and natural factors, including the climate and land forms. Providing safe surroundings, good connections and several rest areas can minimize deterrents to using walking as transportation; however, elements that cannot be controlled include the current weather conditions, natural land forms and travel distance and time.

Studies have shown that 80 percent of all walking trips are less than a mile in length. This indicates that if a destination is more than a 15-minute walk, people tend not to walk (calculated at 17 minutes per mile using 3.5 miles per hour as an average speed). These calculations do not include instances when the basic physical facilities are not provided for safely walking to a destination. These facilities include sidewalks, traffic signals and adequate lighting.

Providing facilities that are separate from vehicles is not always an option. This is why sidewalks remain the most common element to accommodate pedestrian transportation. Standard sidewalks are three to five feet wide and parallel to the road. Moving sidewalks away from the road, increasing the width and adding curves are techniques used to create a more enjoyable walking experience. These sidewalk enhancements can be done only if the rights-of-way are wide enough to accommodate these changes. Regardless of the type of sidewalk provided, it is necessary to provide a safe walking experience. Sidewalks that are free of large cracks, buckles and steps are the basic elements needed to provide accessibility by all pedestrians.



Grade separated greenway crossing under a roadway.

Street crossings are unavoidable if pedestrians are to move freely through a community. Traffic volumes, site distances and street widths will affect the type of crossing that is needed. Crossing a two-lane residential street may only require pavement markings. As traffic flow increases, so should safety devices to allow for pedestrian crossings. Many standard signals and traffic calming devices are available. The correct type and time of crossings will depend on the volume of traffic, number of lanes to be crossed and the number of pedestrians. These safety devices include traffic and pedestrian signals, raised crosswalks and

other traffic calming devices. If high volumes of traffic interfere with high volumes of pedestrians, it may be necessary to provide additional crossing safety measures. On roads where parallel parking is present, cars are not permitted to park within a certain distance of an intersection. Sidewalks can be extended into this parking lane to shorten the distance a pedestrian has to cross. These elements, called chokers, also make pedestrians visible to oncoming traffic. Curbed medians in the center of the road can



Raised crosswalk with chokers to reduce distance a pedestrian must cross the travel lane.

also act as a safety zone for pedestrians crossing several lanes of traffic. When room is not available for medians or chokers on busy roads, a pedestrian bridge or tunnel that completely separates vehicles from pedestrians may be necessary.

Urban areas typically offer many opportunities for both day and night activities. Areas that are well lit and minimize shadows are inviting to pedestrians at night. The opposite is true of a dark street. These areas discourage pedestrian use and turn people away because darkness

provides places for people to hide, creating a potentially unsafe space. Adequate lighting can minimize concerns of unsafe areas and situations.

Adequate sidewalks and lighting create attractive pedestrian places. Other items can be included in a pedestrian walk to make it more attractive to its users. These elements include scenic overlooks, interpretive signs for significant buildings or areas, trees and shrubs, alternative paving materials and pedestrian oriented events such as farmers' markets or street vendors. The right combination of these elements will not only provide the basic needs for pedestrian use but will also make walking more popular.

Bicyclists

Bicycling has become more popular over the past several years. According to the Bicycle Institute of America, the number cyclists increased by nearly 38 percent from 1983 to 1992. Many of these were recreation-based cyclists; however, bicycling continues to become a larger part of the transportation system. As with walking, distance continues to be a limiting factor in a person's decision to ride a bicycle as a form of transportation. A 1980 study by the U.S. Department of Transportation established that 90 percent of work trips and 84 percent of the utilitarian trips taken by bicyclists were two miles or less. A 1990 study in Denver, Colorado, found the mean bicycle trip to be 2.1 miles¹. Although the number of bicyclists has risen, the trip distance has remained relatively consistent at approximately two miles.

¹ Federal Highway Administration. "Facts and Figures: National Overview".

This Denver study also concluded that cities and communities that contain universities have a greater amount of transportation by bicycle than other communities. However, communities that are not home to universities but still maintained higher levels of bicycle transportation have “70% more bikeways per roadway mile and six times more bike lanes per arterial mile.”²

As with pedestrians, age and experience are factors for consideration when planning bicycle routes and facilities. There are typically three levels of bicyclists:

- Novice bicyclists are young or inexperienced riders who are uncertain about their abilities and become nervous when confronted with awkward or crowded riding situations. Areas best suited for novice cyclists are lightly traveled residential streets or off road, multi-use paths.
- Basic bicyclists are more experienced and comfortable with riding and know the rules of cycling safety. These riders are comfortable for shorter, leisurely rides on multi-use trails and signed, on-road facilities parallel to pedestrian walks.
- Proficient cyclists, or experienced riders, cycle for transportation, intense recreation, health and sport. These cyclists typically enjoy long distance and quickly paced rides and prefer a well-paved road with adequate width to allow cars to pass safely. Speed limits and mix of users typically deter proficient cyclists from using multi-use paths for longer rides.

Wildlife

Establishing greenways also provides and protects valuable wildlife habitat. Greenways protect valuable plant communities, food sources and linkages between vegetative cover and food that are critical to sustaining wildlife. However, greenways' impact on wildlife and plant communities can affect the makeup of these communities. Care should be taken when developing greenways through existing natural areas to reduce construction impact, protect wildlife corridors, avoid sensitive areas and be sensitive to operating practices that could affect breeding or other activities critical to the sustainability of wildlife.

1.3 TRAIL STANDARDS

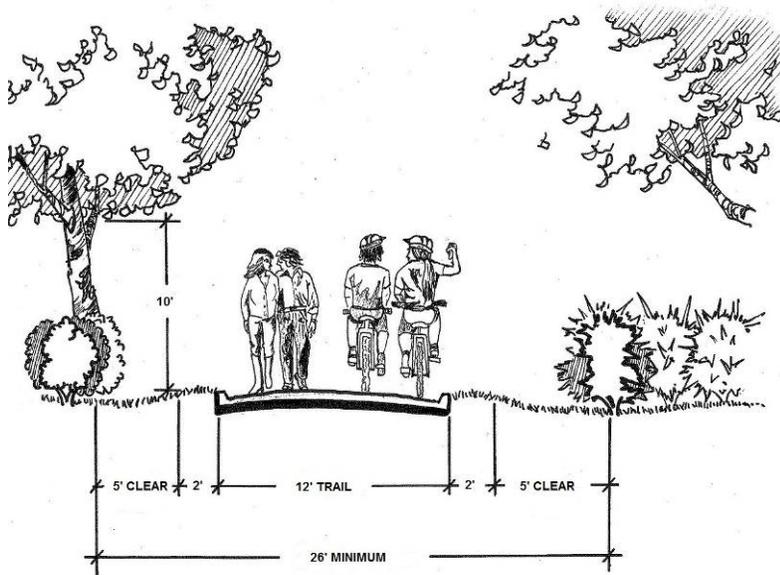
Developing a greenway can range from preserving a natural area for wildlife habitation to constructing a 12-foot path that connects heavily populated neighborhoods with downtown businesses to posting signs that indicate a bicycle route along a county road. Understanding the types of users for which a particular portion of the greenway is being developed will help to ensure proper use and inclusion of adequate facilities. The following sections outline the types of facilities to be included within the greenway for different user groups. When rights-of-way are available, lane and sidewalk widths should be increased to ensure a safe environment for users.

² Federal Highway Administration. “Facts and Figures: National Overview”.

Natural Corridors

Middle Tennessee has consistently been named one of the fastest growing regions in the country. The result has been rapid growth within the city of Murfreesboro and in the county just outside the city limits. This rapid growth has seen natural areas and undeveloped agricultural land swallowed up by commercial and residential development. Maintaining the existing integrity of the remaining natural areas requires conservation. Delineating and protecting these areas of natural beauty can be accomplished by defining them as greenways.

Establishing natural corridors can be as simple as acquiring land. This, however, is not as simple as it sounds. Purchasing natural land from private landowners can be an expensive and time-consuming, but rewarding process. Immeasurable benefits are gained from this acquisition. Plants and animals are provided a place to live and reproduce. The community also benefits because natural areas help clean air and water, provide flood storage and protection, reduce erosion and offer educational resources.



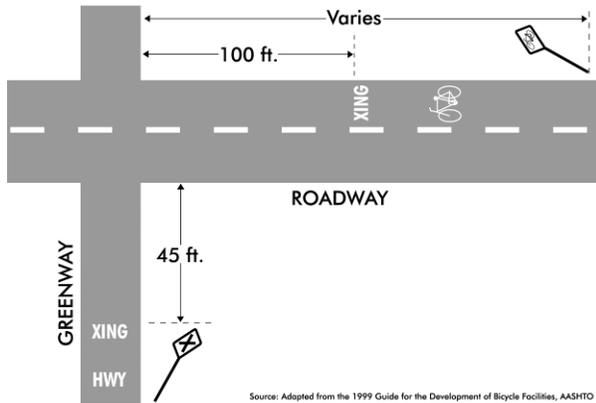
Multi-Use Trails

Multi-use trails follow linear corridors such as rivers, abandoned railroads, utility rights-of-way and other linear elements in the landscape. Multi-use trails can be within road rights-of-way; however, they are completely separated from vehicular traffic. The trail is typically 12 feet wide to accommodate several users traveling in both directions. This width can vary according to the anticipated number of users and the location of the trail.

To accommodate all types of activities, including bicycles, strollers and roller bladers, asphalt or other hard surfacing materials are used to pave a smooth surface. In areas of regular flooding or wetlands, boardwalks are constructed to protect the sensitive environment and maintain a year-round usable trail.

To avoid conflict among different users, different design features can be added to trails. A painted centerline can separate persons going in opposite directions. A two-foot cleared shoulder on both sides of the trail allows for maneuverability and emergency pull-offs. Signage is installed to inform users of trail alignments and special conditions. Many of these design features and standard requirements are included in the American

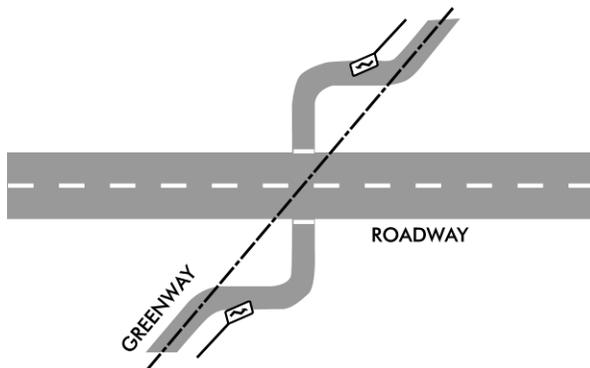
Association of State Highway Transportation Officials (AASHTO) regulations. These standards are developed to accommodate all levels of bicycle travel at a maximum speed of 20 miles per hour. To ensure proper maintenance, trails are also constructed to accommodate a 6.5-ton vehicle travelling at 15 miles per hour.



Midblock Crossing

Source: Adapted from the 1999 Guide for the Development of Bicycle Facilities, AASHTO

Multi-use trails traverse many different elevations and natural elements. Accommodations are made when possible to minimize steep grades or to access interesting landscapes. Access through some of the terrain in Murfreesboro may be difficult; however, regulations require that a certain portion of trails be accessible by all users despite physical ability. The guidelines established by the Americans with Disabilities Act should be followed during the design and construction of multi-use trails to ensure safety and accessibility to all users. ADA guidelines establish a maximum trail slope of 5 percent. Any slope higher than 5 percent and up to 8 percent is considered a ramp, which requires hand rails and landings every 30 feet. Trails will not be considered accessible if they contain slopes greater than 8 percent.



Source: Adapted from the 1999 Guide for the Development of Bicycle Facilities, AASHTO

90 Degree Crossing

Intersection Design Issues

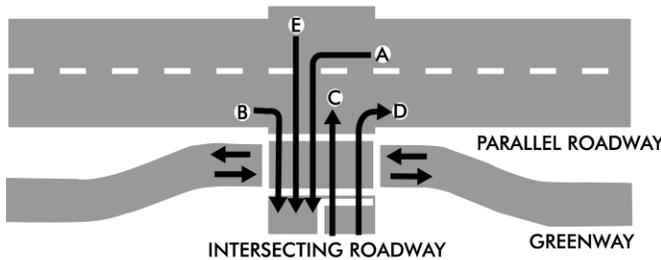
Where off-street, multi-use greenway routes intersect with surface streets; bicyclists and pedestrians must be provided with safe opportunities to enter or exit the trail, and bollards or other devices should be used to prevent motorized vehicles from entering. These intersections must also provide safe opportunities for bicyclists and pedestrians to cross or merge with traffic.

In the detailed design phases of greenway development, alternate locations for a trail are typically considered, and locations with the most appropriate intersection conditions should be prioritized. In ideal conditions, greenway crossings of roads should be removed from existing intersections in order to have better control over vehicular movements. When this is not possible, the greenway crossing should be at or adjacent to existing pedestrian crossings.

Greenway-Roadway Intersections

The most critical safety conditions on a greenway generally occur at the intersections of greenways and vehicular roadways. According to the American Association of State Highway and Transportation Officials, there are three basic categories of at-grade greenway/roadway intersections—midblock, adjacent path and complex.

Mid-block crossings should be distinctly removed from existing roadway intersections to clearly separate them from vehicular intersection activity such as merging movements, acceleration/deceleration and preparations to enter turn lanes. The figure illustrates an acceptable greenway/roadway intersection at midblock. Where greenways are aligned in such a way that they would not cross the roadway at a 90-degree angle, the configuration should be used as shown.



Source: Adapted from the 1999 Guide for the Development of Bicycle Facilities, AASHTO

Adjacent Greenway Crossing

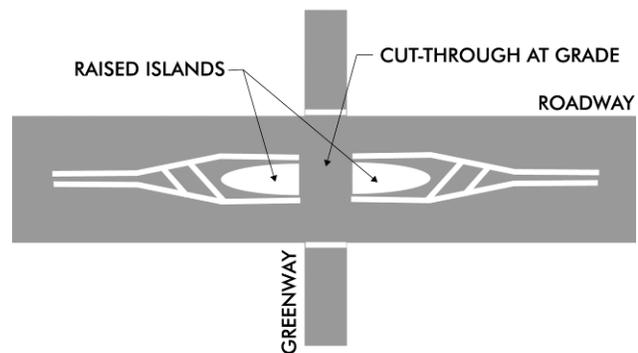
Adjacent Greenway Crossings

This category of crossing occurs when a greenway crosses a roadway at an existing intersection between two roadways, whether it is a T-intersection such as a driveway, or a four-legged intersection as shown in the illustration. This type of crossing should be developed as close as possible to the intersection so that both motorists and greenway users recognize each other as intersecting traffic. However, potential conflicts for greenway users will occur with left-turning (A) and right-turning (B) motor vehicles from the parallel roadway, and on the crossed roadway at C, D and E.

To minimize conflicts for type A turning movements, it is advisable to use protected left turn phasing on a high-volume parallel roadway and high-use greenways. To minimize conflicts for turning movement B, the turning radius should be as small as practical in order to reduce the speed of turning motor vehicles. For turning movements C and D it is advisable to prohibit right turns on red. The major roadway in the figure may be either the parallel or the crossed road. Right-of-way requirements, traffic control devices and separation distance between the road and the greenway will greatly affect this type of intersection - attention to these details must occur in the development of construction documents for specific greenway segments.

Complex Intersection Crossings

Complex intersection crossings account for all other greenway/roadway or greenway/driveway intersections. Improvements to complex crossings must be considered on an individual, site-specific basis. The obvious mitigation measures to avoid complex intersection crossings are moving the crossing to an alternate location, installation of a traffic signal, change in signalization timing, or provisions for a refuge island and a two-step crossing for greenway users as shown in the illustration. The refuge accommodates groups of users including pedestrians, bicyclists and individuals in wheelchairs. Additionally, adequate space should be provided so that users in the refuge areas do not feel threatened by passing motor vehicles while waiting to finish the crossing.



Source: Adapted from the 1999 Guide for the Development of Bicycle Facilities, AASHTO

Traffic Signals and Stop Signs

Regardless of the type of greenway/roadway intersection, a regulatory traffic control device should be installed at all greenway/roadway intersections - the individual type of control device will vary from case to case.

Under certain circumstances, traffic signals are most appropriate. The Manual on Uniform Traffic Control Devices (MUTCD) developed by the Federal Highway Administration identifies 11 situations that warrant the use of a traffic signal. The MUTCD does not address greenway crossings, but bicycle traffic on a greenway may be functionally classified as vehicular traffic and addressed accordingly. Greenway stop signs should be placed as close to the intended stopping point as possible. Four-way stops at greenway/roadway intersections are not recommended because of frequent confusion about or disregard for right of way rules. Yield signs may be acceptable on low-volume, low-speed neighborhood streets. In any event, the designer should ensure that greenway signs are located so that motorists are not confused by them, and that roadway signs are placed so that pedestrians and bicyclists are not confused by them.

Transition Zones

Where greenways terminate at existing roads, the path must be integrated into the existing roadway network. Again, as construction documents are developed, care must be taken to properly design the terminus in order to create a safe merging or diverging situation. The designer should treat each greenway/roadway intersection as a potential point of ingress or egress and the design should consider the movements of greenway users who enter the greenway from the road as well as those who will exit the trail and use the roadway from that point on.

Approach Treatments

Greenway intersections and approaches should be developed on relatively flat areas. The stopping sight distance at intersections must be evaluated and adequate warning signs should be provided to allow bicyclists to stop before reaching the intersection, especially on downgrades. Unpaved greenways should incorporate paved aprons that extend a minimum of 10 feet from paved road surfaces.

Ramp Widths

Ramps for curbs at intersections should be at least the same width as the greenway. Curb cuts and ramps should provide a smooth transition between the greenway and the roadway. A five-foot radius should be considered to facilitate right turns for bicycles.

Bridge Crossings

In some cases, such as stream crossings, bridges may be the only practical treatment—these structures should be designed to serve both pedestrians and non-motorized users. Ideally, the clear width of pedestrian bridges will match the approaching greenway including the recommended minimum two-foot wide cleared area on either side of the trail. Including the cleared area width allows for free space between the users and requisite safety railings and barriers.

When it is necessary to route a trail along an existing vehicular bridge, several alternatives can be considered. The first, if width is limited, is to align ". . . the bicycle path across the bridge on one side. This should be done where the bridge facility will connect to a bicycle path at both ends and sufficient width exists on [one] side of the bridge or can be obtained by widening or restriping lanes."³ A second alternative is to "provide wide curb lanes over the bridge. This may be advisable where the bicycle path transitions into wide outside lanes at one end of the bridge and sufficient width exists or can be obtained by widening or restriping." The third and least acceptable alternative is to use existing sidewalks. "This may be advisable where conflicts between bicyclists and pedestrians will not exceed tolerable limits, and the existing sidewalks are adequately wide. Under certain conditions, the bicyclist may be required to dismount and cross the structure as a pedestrian." Retrofitting an existing bridge will present a variety of challenges, and compromises may be required.

Railroad Crossings

Railroad grade crossings should be aligned at a right angle to the rails. The greater the crossing deviates from this angle, the greater the potential for a cyclist's front tire to be trapped in the flangeway, causing loss of control. If the crossing angle is less than 45 degrees, an additional paved shoulder of sufficient width should be provided to permit the cyclist to cross the track at a safer angle. Where this is not possible, and where train speeds are low, commercially available compressible flangeway fillers may be used.

Pedestrian Walks

Pedestrian walks are designated sidewalks that make important connections and are an integral part of the greenway system. Pedestrian walks are designed or renovated to

³ AASHTO, Guide for the Development of Bicycle Facilities, (Washington DC, 1999)

meet the needs of all pedestrians, including children, senior citizens and individuals with disabilities. Widening the walk, adding landscape and signage, using different paving materials, decorative lighting and site furnishing can create a consistency that helps define a sidewalk as an element within the greenway system.

Shared-Use Facilities

Many communities discourage using bicycles on sidewalks. Shared use facilities are designed to accommodate both bicyclists and pedestrians by combining a sidewalk, or pedestrian walk, that is separated from the vehicles and a bike lane along the edge of the roadway. The same standards outlined for pedestrian walks and bicycle lanes would be combined to develop shared-use facilities.

Retaining parallel parking along streets designated as shared-use facilities can have both positive and negative results. On the positive end of the spectrum, maintaining adequate parking in high-density business and residential settings is imperative. Parked cars can provide a physical barrier between pedestrians and moving vehicles and bicycles. Negatively, parked cars create a safety hazard for bicyclists. People are used to looking for moving vehicles prior to getting in and out of their cars; however, looking for moving bicyclists is not a common practice.

Physical barriers between automobiles and bicycles may also be appropriate to separate vehicles from cyclists along certain bike lanes. These types of barriers may be comprised of planters, mow strips, guard rails, low curbs or bollards. The type and width of barriers depends upon the number of curb cuts along the roadway, the amount of traffic flow and the availability of space within the rights-of-way.

Trail Hierarchy

Regardless of the type of trail being developed, there is a hierarchy, or priority, of trail use. A primary trail makes connections to several different elements within the community. The design elements included in a primary trail should accommodate a greater number of users and include a greater number of support facilities. Ideally, primary trails should close upon themselves or make a looped system. More specifically, a primary multi-use trail will be a 12-foot wide paved pathway with a two-foot wide shoulder on both sides. Small rest areas that include benches, trash cans and signs will be provided every half-mile and at intersections with other trails. Vegetation should be cleared a minimum of five feet on both sides, and limbs should not hang lower than 10 feet.

Secondary trails connect one element, such as a neighborhood or school, to another element or primary trail. Secondary trails typically will not need to accommodate as many users, but they are important to providing access to primary trails. Secondary trails generally are not a part of a closed, or looped, system. A secondary multi-use trail is similar to a primary trail except it is only 10 feet wide. The same clearances and paving materials are needed. Depending upon the length of the trail, benches may not be necessary, but they should be added at all intersections with primary trails.

Rustic trails are typically located in areas that will not draw a large number of users or in areas that are rural. These types of trails are typically eight feet wide and may be surfaced with a porous material such as wood mulch, compacted gravel or other types of fines. Vegetation should still be cleared five feet on both sides and 10 feet above the trail.

1.4 TRAIL SUPPORT FACILITIES

A large part of creating an attractive and safe greenway system is incorporating support facilities along the trail. These facilities should provide relaxation, education, orientation and recreation opportunities. Anticipating the needs and wants of all users is important to developing a successful greenway system, and incorporating the appropriate support facilities is necessary for this to be accomplished.

Trailheads

In simple terms, trailheads are trail access points. However, in terms of available facilities, they can be extremely diverse. Trailheads will establish the trail user's first impression of the greenway network; therefore, their detailed design will be critical as construction documents are developed for implementation. Where possible, trailheads will be located in or adjacent to existing or planned parks so that public amenities such as restrooms, telephones, parking, picnic pavilions, playgrounds and general recreation facilities are already available. Frugal use of economic resources does dictate this course. However, economy of means is not the only component of this reasoning. By clustering recreational opportunities, the community will have a greater range of choices to improve their health, quality of life and leisure time.

The size of a trailhead depends upon its location and anticipated amount of use. The basic facilities included at a trailhead are parking, trail map and access to the trail. More extensive trailhead facilities include restrooms, security lighting, signage, landscaping, site furnishings, and telephones.

Existing facilities, such as schools and parks, can also be utilized as trailheads. Existing parking can easily be supplemented with the addition of a trail map and entrance. Many other amenities typically included at trailheads are already available, including phones, lighting and restrooms. Utilizing these existing facilities as trailheads minimizes construction costs and creates important connections to the greenway system.

General Trailhead Criteria:

- 1) Circulation. Adequate, efficient and safe space must be provided for vehicles and pedestrians to maneuver.
- 2) Parking. Adequate number of spaces for the anticipated level of use of the particular facility including, where appropriate, spaces for RVs, buses, small trailers for boats and canoes, and bicycles.

- 3) Structures. Again, depending on the anticipated level of use, buildings may be required. Structures may include gazebos, picnic shelters or pavilions, restrooms, maintenance and storage facilities, information booths and kiosks.
- 4) Site furnishings, including benches and trash receptacles.
- 5) Signs.
- 6) Fences and lockable security gates.
- 7) Security lighting.
- 8) Landscaping.
- 9) Connector trails to the main trail.
- 10) River access where appropriate.

Signage

The primary purpose of trail signs is to aid and instruct users of the greenway system. Signs fall into four categories: regulatory, warning, guidance and educational.

Regulatory Signs

Regulatory signs provide operational requirements, and are used for traffic control. This category includes stop and yield signs, right-of-way signs, speed-limit signs and exclusion signs. They are normally installed where specific regulations apply.

Warning Signs

Warning signs identify existing or potentially hazardous conditions on or near the trail. Like those on roadways, warning signs on trails identify steep grades, intersections, stop or yield signs, changes in paving materials and speed limits for bicycles. These warnings are included to provide safe conditions for all users. Warning signs function as their name implies - they identify existing or potentially hazardous conditions on or near the trail, and they caution users to reduce speed or dismount a bicycle for safety reasons. They are typically used near intersections, bridges, crossings and tunnels. Following the rules and heeding the warnings identified by these signs is necessary because of the interaction of different trail user groups and unavoidable intersections with roadways.

Guidance Signs

Guidance signs instruct; they provide trailside information to orient users geographically. The typical "you are here" map is an excellent example of this category of sign. Guidance signs can be both directional and informational. Directional signs point out nearby support facilities and points of interest, such as historic sites and unique natural resources. In this respect, guidance signs are often referred to as interpretive signs.

Educational Signs

Elements in the landscape or along the trail can be identified and their significance explained with educational signs. These signs can inform trail users of historical events that took place on a hillside, the geologic forces that created the waterfall on the other side of the river, the type of wildlife inhabiting the woods in which they are walking or the importance of the trees in maintaining the water quality of the stream paralleling the trail. Hundreds of elements can be highlighted and illustrated through signage to provide

trail users with a fuller understanding of their community and the events that have taken place.

Trails are transportation corridors, and for that reason, recognizable transportation signs can be adapted for trail use. However, an independent sign "package" that coordinates all greenway-related signage should be developed in succeeding phases of the citywide trail system design. The sign package facilitates several goals; most importantly, it reinforces an overall aesthetic image that incorporates the greenway logo and colors. With consistent application of greenway sign standards, trail users will quickly learn to recognize and comprehend trail components. The trails will be more user-friendly, easier to navigate and safer.



Interpretive Sign Explaining Historic Events

Ancillary Trail Facilities

Waysides

Wayside exhibits are built adjacent to trails or at the terminus of a connecting trail. These areas contain interpretive signs that provide information on the natural environment or on cultural and historic points of interest in the vicinity. They also provide small areas where people can sit, relax and enjoy a quiet moment.



Educational Facilities

In addition to signage, hands-on educational opportunities can be developed with the greenway system. These experiences can be informal, such as access to the water's edge, or more structured, such as a nature center or guided tour along a significant portion of the trail. A combination of these different educational opportunities can exist at different locations and different seasons of the year.

1.5 LANDSCAPING AND GATEWAYS

Landscaping may be required not only at trailheads, but virtually all along the trail network. Construction of the greenway will require grubbing and clearing and some loss of existing vegetation. At first, this may seem regrettable; however, it also presents real opportunities for ecological restoration and beautification.

To the extent possible and practicable, native species should be preserved wherever possible as trails are installed. However, invasive exotic species such as privet and honeysuckle should be removed. Additionally, damaged trees should be examined by certified arborists. Trees in extreme states of decline should be removed, especially if they present safety hazards. Dominant native plants in the areas of disturbance can then be reintroduced and function to provide visual screens, walls, buffers and overhead canopies. The particular environment and intended purpose of landscaping will influence the overall plant palette, and native trees do not have to be used exclusively. Some situations will certainly benefit from more ornamental introductions. However, native vegetation should be considered wherever possible, especially in riparian areas where it can protect the environment and stabilize riverbanks. Indigenous plant material will be the most robust and will adapt best to local climate, soils and precipitation.

In most cases, a cleared area should be maintained for five feet on each side of trails. Therefore, new trees and shrubs should be planted at least ten feet from the trail. By maintaining this minimum ten-foot space, visibility will enhance user safety, and tree roots will be less likely to damage trail surfaces. For reasons of security, dense shrub plantings should be avoided adjacent to the trail. Occasional open spaces will also increase security by providing clear routes for people to exit the trail in the event of emergencies.

1.6 MAINTENANCE, SAFETY AND SECURITY MEASURES

Developing a greenway system requires both capital and operational funding to implement and maintain the system. A community can employ many techniques to maintain the trail system. One technique is to design the system with proper trash receptacles and clearly state rules of conduct for greenway users. The proper location and spacing of trash receptacles provides ample opportunity for people to dispose of refuse. Posted signs inform users of fines for littering. These regulations need to be enforced if they are to work. Another technique is to create public ownership of the trails. The community can be encouraged to assist with trail maintenance by establishing an "Adopt a Greenway" program. Similar to the "Adopt A Highway" program, a section of the trail would be kept clean by a group or organization.

Volunteer organizations and groups should not be expected to do regular routine maintenance. Regular maintenance tasks include the following:

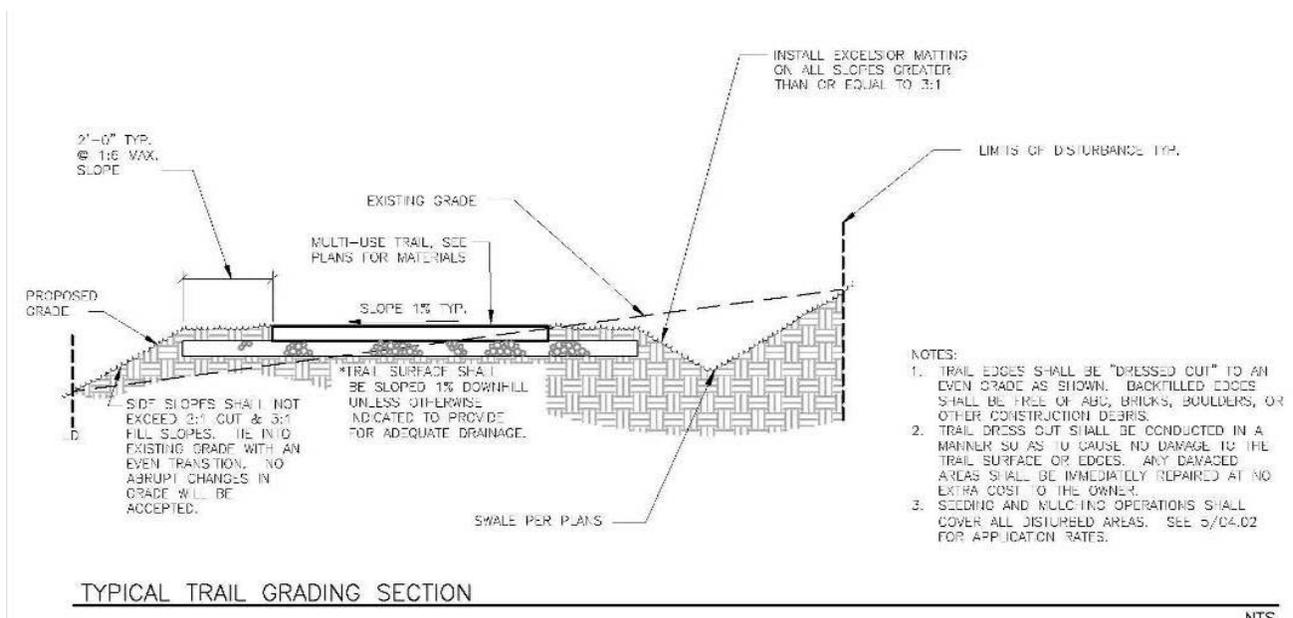
- Trash removal
- Signs and Traffic Markings for motorists and trail users must be inspected regularly and kept in good condition. Pavement markings must be kept clear and legible.
- Sight distances, especially those leading to crossings and curves should not be impaired by vegetation. Trees, shrubs, and tall grass should be trimmed to meet sight-distance requirements based on a 20-mile-per-hour design speed. Adequate clearance must also be maintained overhead and on both sides of trails.

- Trail surfaces should be patched on a regular basis-patches must be flush with the finish surface of the trail.
- Trail damage from seasonal washouts and silt or gravel washes must be repaired as soon as possible after they occur. Recurring drainage problems should be identified and remedied. Culverts, catch basins, and other drainage structures should be cleaned at least once a year.
- Regular sweeping and cleaning will be required to keep the trail free of debris, including broken glass, loose gravel, leaves, and trash.
- Structures such as pavilions and restrooms should be inspected annually to ensure they are in good condition. Special attention must be paid to wood foundations and posts to determine if rot or termites are present. At the same time, site furniture and other support facilities should be inspected.
- Mow trail shoulders and other selected areas on a scheduled basis depending upon season, species and rate of growth.
- Remove storm-tossed limbs and fallen trees as soon as possible. Inspections should also occur after significant storms to determine if any potential danger exists from tree damage.
- Habitat enhancement and control
- Graffiti removal

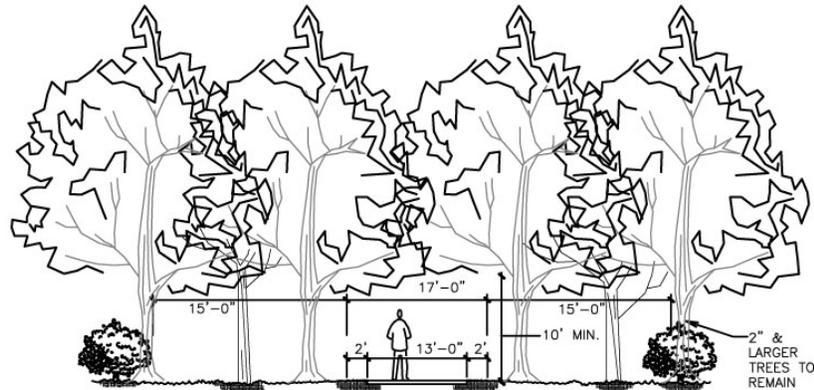
1.7 STANDARD TRAIL DETAILS

The following details represent standard design practices utilized on the Murfreesboro Greenway system. Furnishings such as benches, trash cans and bollards represent those found throughout the system. Signage is also representative of the design utilized on existing trails.

Trail Grading



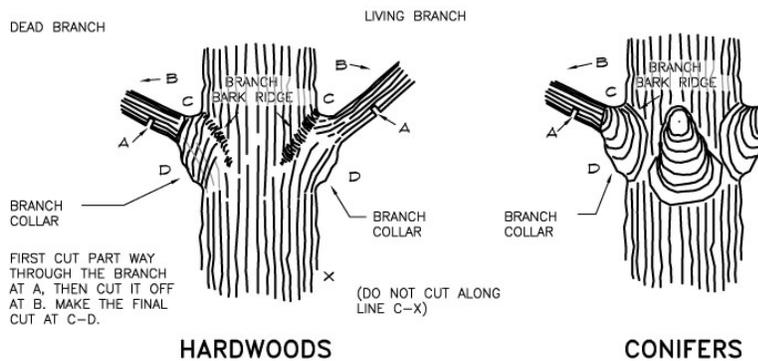
Clearing and Tree Protection



1. LANDSCAPE ARCHITECT SHALL FLAG TREES FOR REMOVAL. ADDITIONAL TREES MAY BE REMOVED BY CONTRACTOR AFTER ON-SITE CONSULTATION AND AGREEMENT OF LANDSCAPE ARCHITECT.
2. CONTRACTOR SHALL CLEAR FOREST UNDERSTORY (TREES LESS THAN 2" CAL.) AND BRUSH FOR A DISTANCE OF 15' ON BOTH SIDES OF THE TRAIL. < OF TREES SHALL BE LIMBED UP TO A VERTICAL DISTANCE OF 10' FROM THE FOREST FLOOR IN THE 15' WIDE ZONE. BRANCHES SHALL BE CUT FLUSH WITH STANDARD TREE PRUNING EQUIPMENT, AS CALLED FOR IN THE TREE PRUNING SPECIFICATION & DETAIL 2 C3.00.
3. CONTRACTOR SHALL USE WOOD CHIPPER TO DISPOSE OF LANDSCAPE CLEARING DEBRIS. WOOD CHIPS SHALL BE BLOWN INTO WOODS ADJACENT TO TRAIL. CONTRACTOR SHALL USE ALL PRACTICABLE MEANS TO REDUCE AMOUNT OF WASTE SENT FROM THIS JOB SITE TO LANDFILL.
4. IN AREAS WHERE TRAIL IS ROUTED ADJACENT TO WOODS EDGE, UNDERSTORY CLEARING SHALL EXTEND 15' INTO WOODS.
4. SEED AREA WITHIN CLEARING LIMITS AS CALLED FOR IN SPECIFICATIONS

1 VEGETATION CLEARING FOR WOODED AREAS

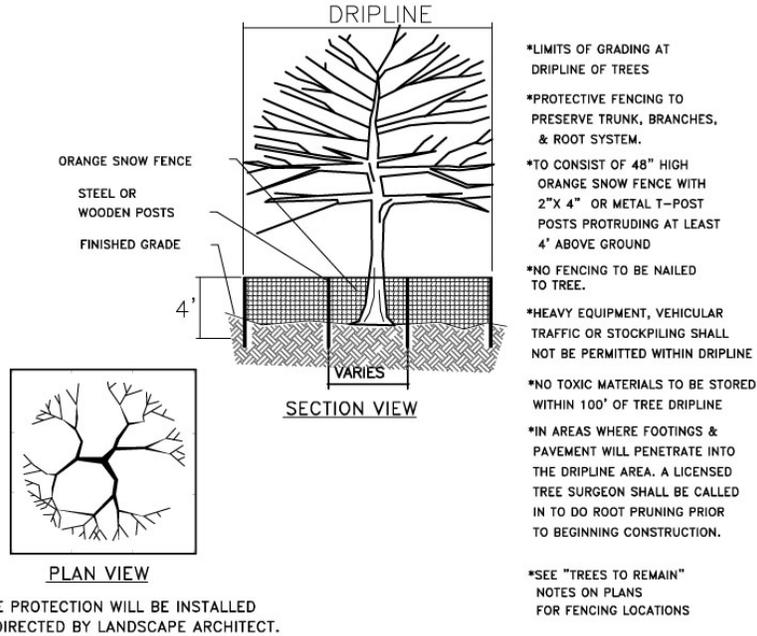
NTS



THANKS LARGELY TO THE WORK OF DR. ALEX L. SHIGO AND OTHERS SCIENTISTS AT THE USDA FOREST SERVICE'S NORTHEASTERN FOREST EXPERIMENT STATION IN DURHAM, NH, MUCH IS NOW UNDERSTOOD ABOUT A TREE'S NATURAL SYSTEM OF DEFENCE AGAINST INFECTIONS FROM WOUNDS. BASED ON THIS KNOWLEDGE, THESE METHODS OF MAKING PRUNING CUTS ARE RECOMMENDED TO HELP WORK WITH RATHER THAN AGAINST A TREE'S NATURAL TENDENCY TO WALL OFF INJURED TISSUES AND PREVENT THE SPREAD OF DECAY. IN THESE ILLUSTRATIONS, FINAL CUTS SHOULD BE MADE FROM POINTS C TO D. DO NOT CUT ALONG LINE C-X WHICH IS SIMPLY AN IMAGINARY VERTICAL LINE TO HELP YOU LOCATE C-D

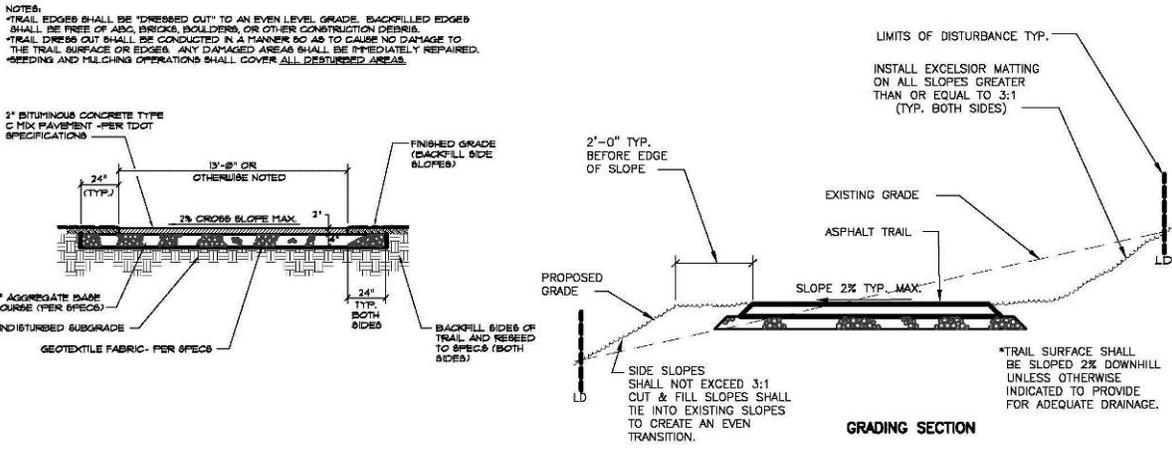
2 TREE PRUNING DETAIL

NTS

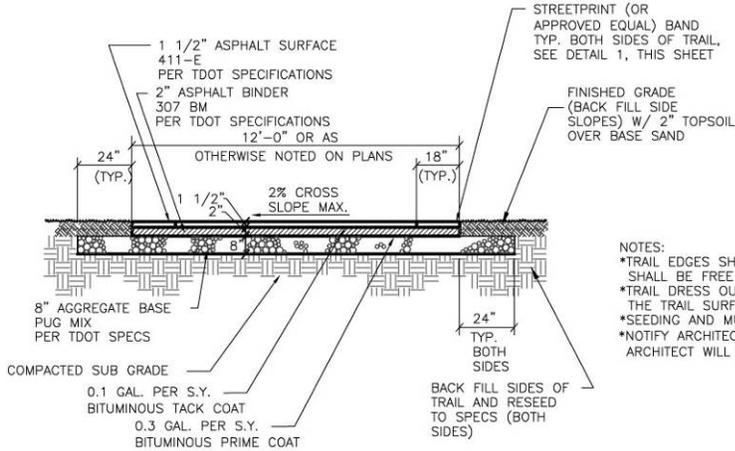


3 TREE PROTECTION DETAIL NTS

Trail Construction



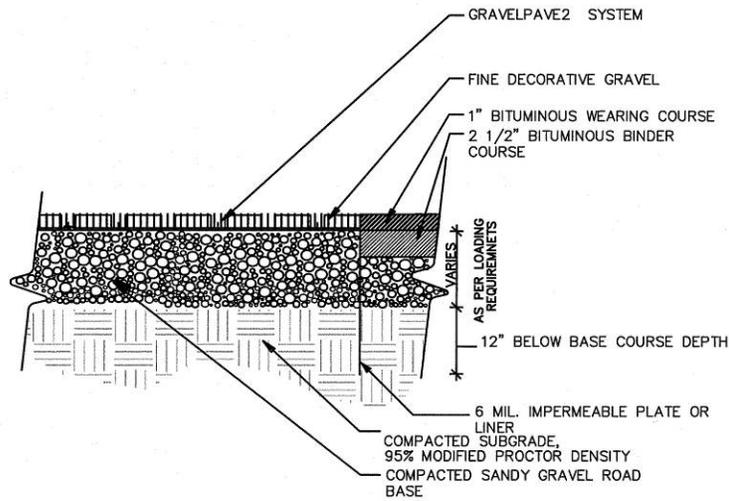
1 ASPHALT TRAIL SECTION NTS



- NOTES:
- *TRAIL EDGES SHALL BE "DRESSED OUT" TO AN EVEN LEVEL GRADE. BACK FILLED EDGES SHALL BE FREE OF BRICKS, BOULDERS, OR OTHER CONSTRUCTION DEBRIS.
 - *TRAIL DRESS OUT SHALL BE CONDUCTED IN A MANNER SO AS TO CAUSE NO DAMAGE TO THE TRAIL SURFACE OR EDGES. ANY DAMAGED AREAS SHALL BE IMMEDIATELY REPAIRED.
 - *SEEDING AND MULCHING OPERATIONS SHALL COVER ALL DISTURBED AREAS.
 - *NOTIFY ARCHITECT IF TRAIL ROUTE INTERFERES WITH SPECIMEN TREES OVER 24" D.B.H.- ARCHITECT WILL SUGGEST REROUTING TO AVOID REMOVAL OF SUCH TREES

2 HEAVY DUTY ASPHALT TRAIL SECTION

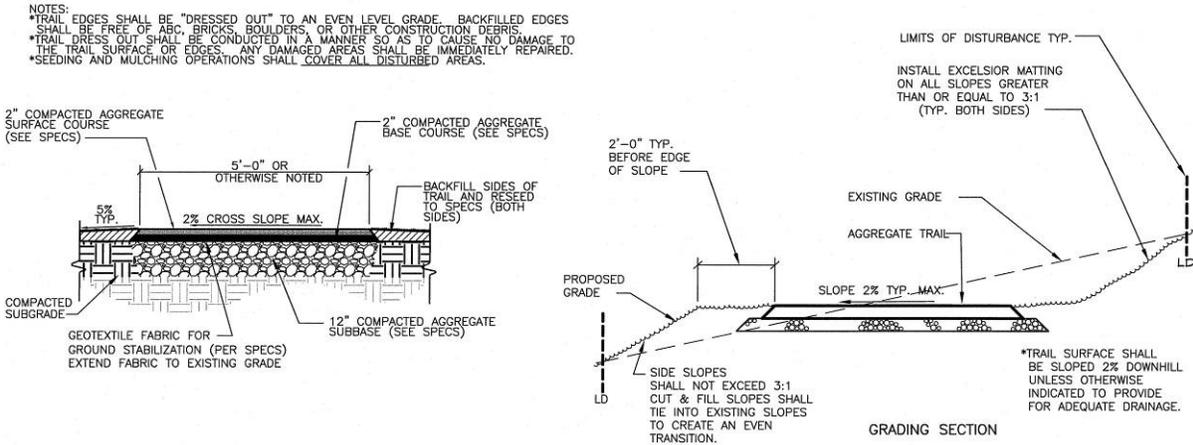
N.T.S.



NOTE: GRASS/PLANT TYPES SHALL BE SPECIFIED BY A LANDSCAPE ARCHITECT OR LANDSCAPE DESIGNER

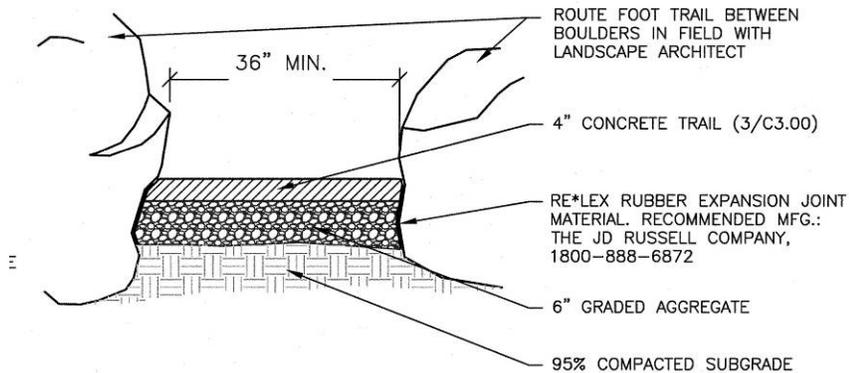
2 GRAVEL PAVE 2 @ ASPHALT

NTS



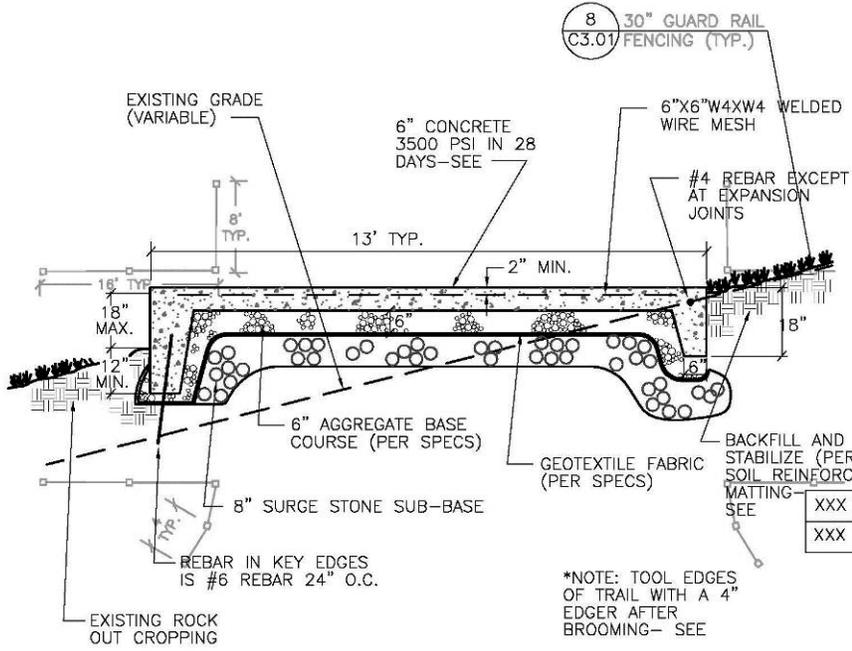
3 AGGREGATE TRAIL SECTION

NTS



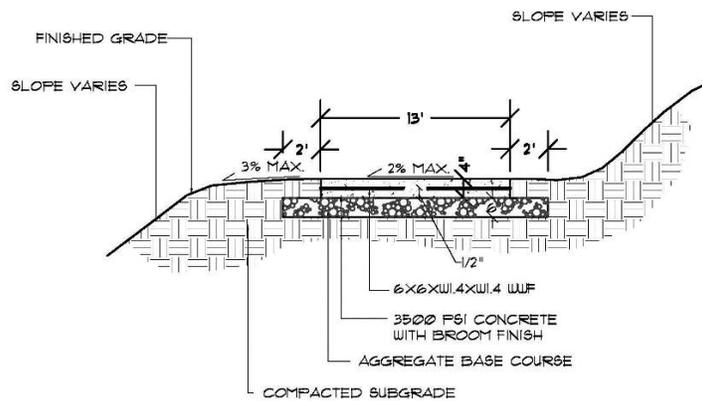
9 CONCRETE TRAIL THROUGH ROCK OUTCROPPING

N.T.S.

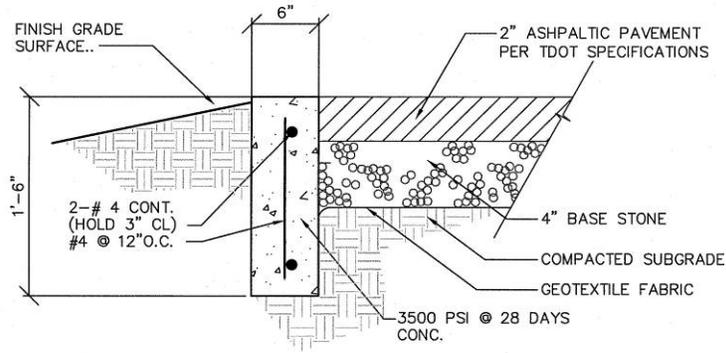


4 CONCRETE TRAIL SECTION W/ TURNDOWN EDGE
N.T.S.

*NOTE: TOOL EDGES OF SIDEWALK WITH A 4" EDGER AFTER BROOMING.



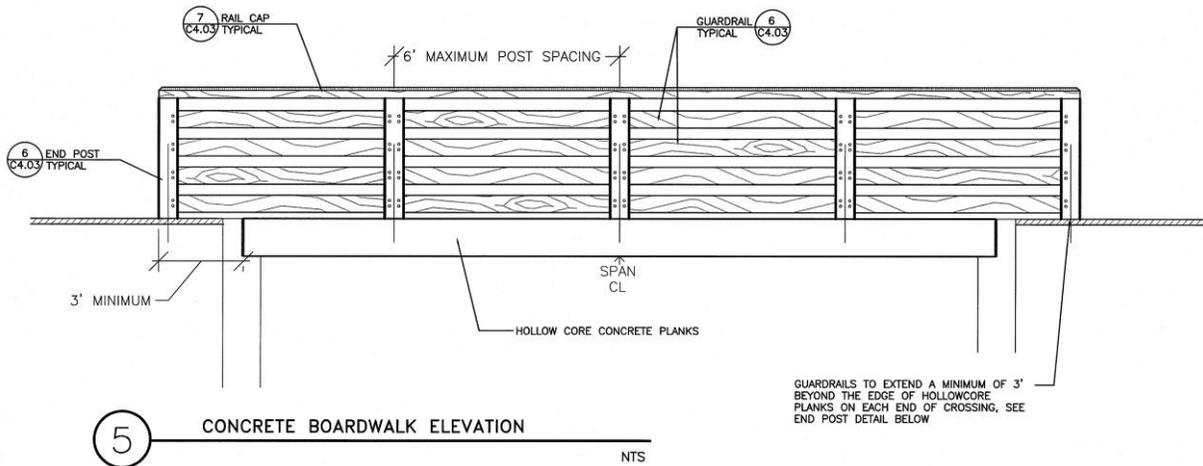
3 CONCRETE TRAIL SECTION

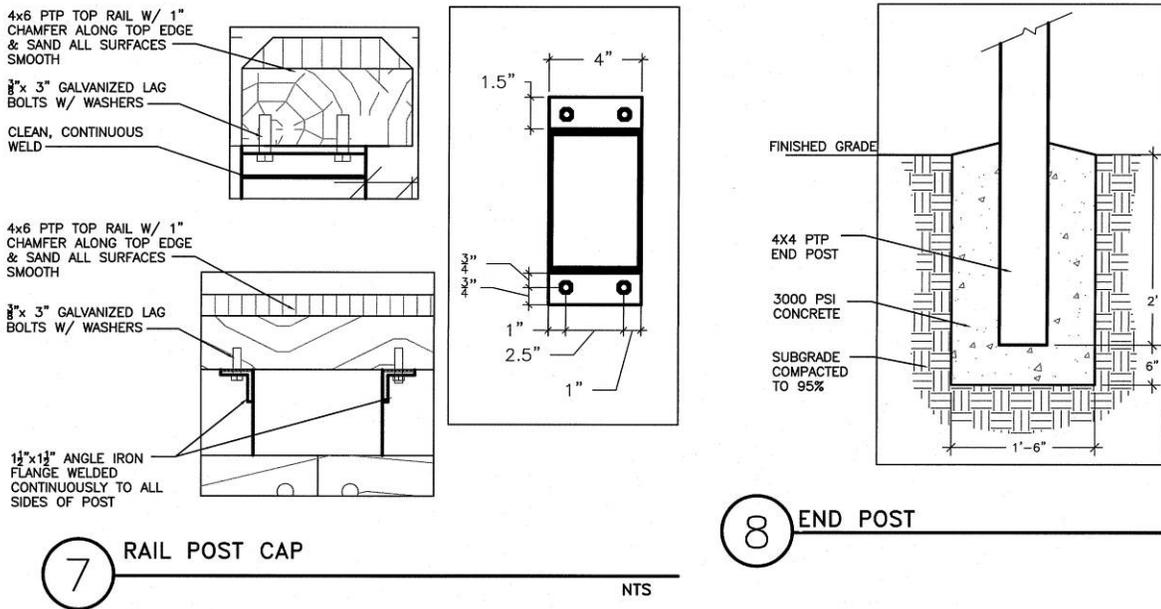
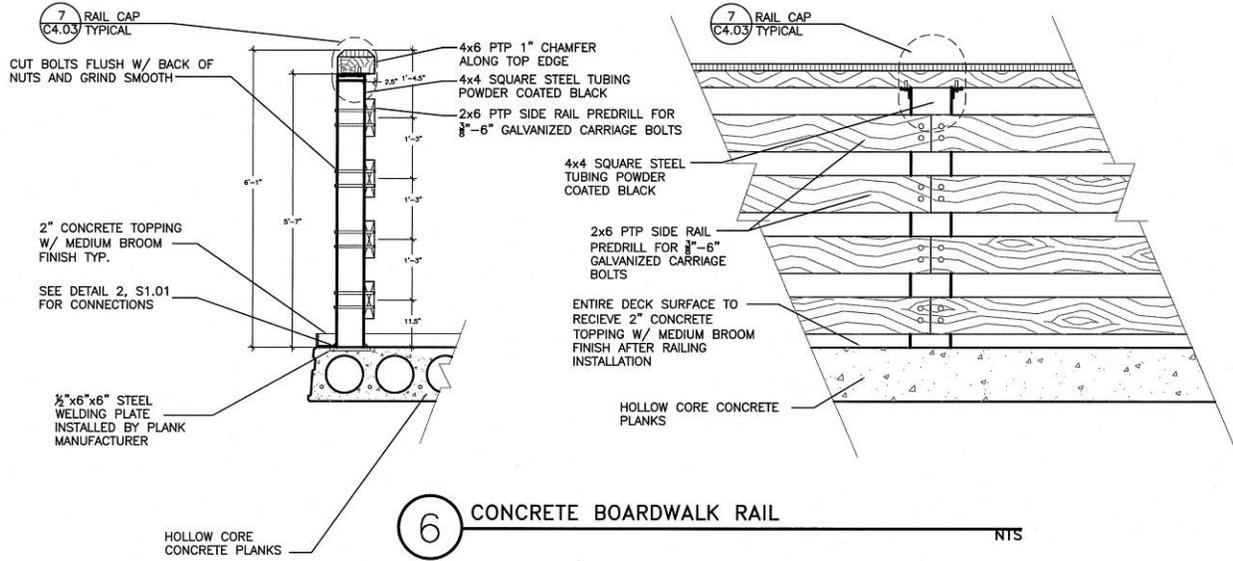


NOTE: CURB SHALL HAVE 1/4" x 1" DEEP CONTROL JOINTS @ 10'-0" O.C. AND 1/4" ASPHALTIC EXPANSION JOINTS 30' O.C.

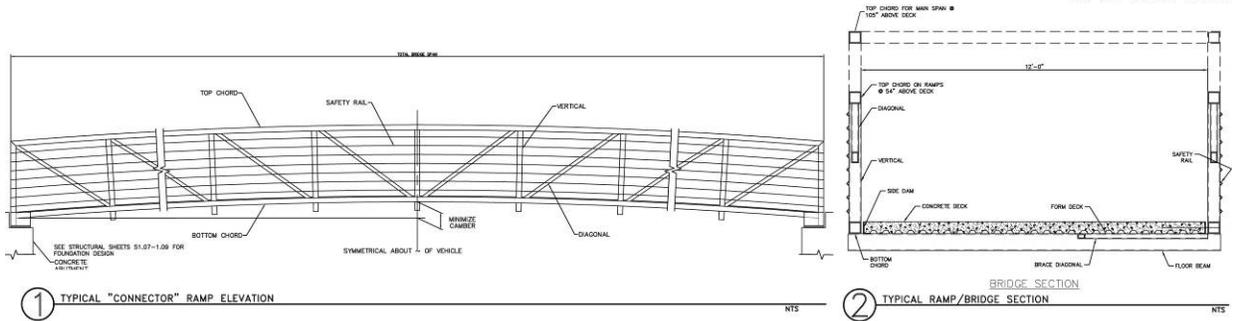
8 CONCRETE FLUSH CURB ALONG TRAIL N.T.S.

Boardwalks and Bridges



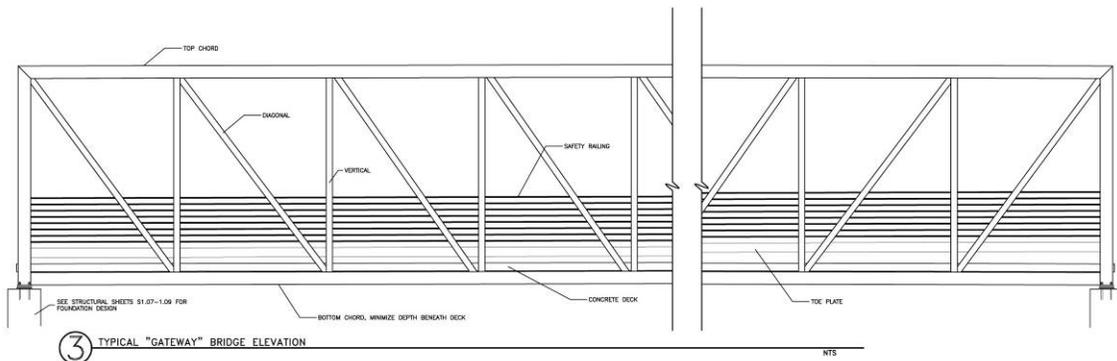


NOTE:
DRAWINGS ARE PROVIDED FOR BID PURPOSES ONLY. CONTRACTOR TO SUBMIT
SHOP DRAWINGS SEALED BY BRIDGE ENGINEER PRIOR TO BEGINNING
CONSTRUCTION.



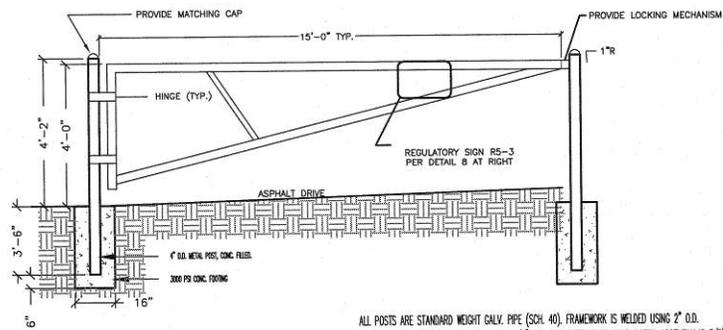
1 TYPICAL "CONNECTOR" RAMP ELEVATION NTS

2 TYPICAL RAMP/BRIDGE SECTION NTS



3 TYPICAL "GATEWAY" BRIDGE ELEVATION NTS

Fencing and Barricades



NOTE: GATE TO RECEIVE TIE BACK POST IDENTICAL TO GATE POST. PROVIDE MECHANISM FOR PADLOCK AT BOTH POSTS. SEE PLANS FOR LOCATION.

ALL POSTS ARE STANDARD WEIGHT GALV. PIPE (SCH. 40). FRAMEWORK IS WELDED USING 2" O.D. STANDARD PIPE FOR EXTERIOR FRAME & 1 5/8" O.D. FOR INTERIOR BRACING. LATCH ASSEMBLY IS 3/8" X 1" PRESSED STEEL.

PROVIDE MECHANISM FOR RECEIVING PADLOCK IN OPEN AND CLOSED POSITION. OWNER TO PROVIDE PADLOCK. COORDINATE WITH OWNER FOR MECHANISM TYPE.

ALL STEEL JOINTS TO RECEIVE CONT. WELD USE NO SPOT WELDS.

GRIND ALL WELDS SMOOTH W/ NO BARBS.

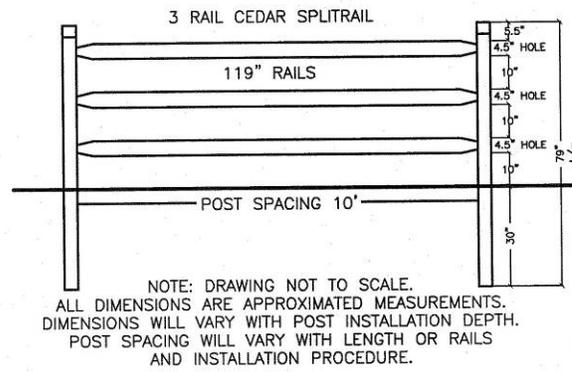
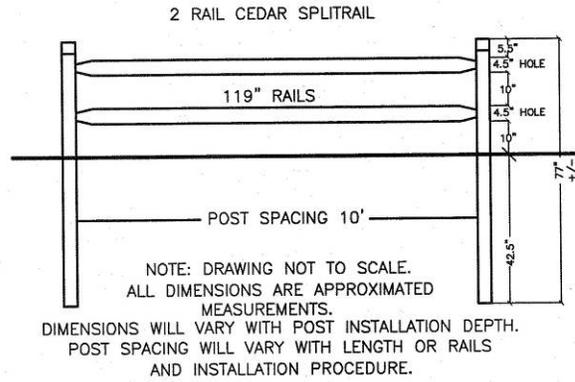
PAINT TO BE EXTERIOR SEMI-GLOSS ENAMEL. APPLY ALL PAINT PER MANUFACTURER'S SPECS. OVER PREVIOUSLY PRIMER RED PAINTED STEEL

PAINT ALL STEEL SURFACES BLACK

PROVIDE SHOP DRAWINGS FOR OWNER'S REPRESENTATIVE'S APPROVAL

6 MAINTENANCE DRIVE ACCESS GATE

NTS

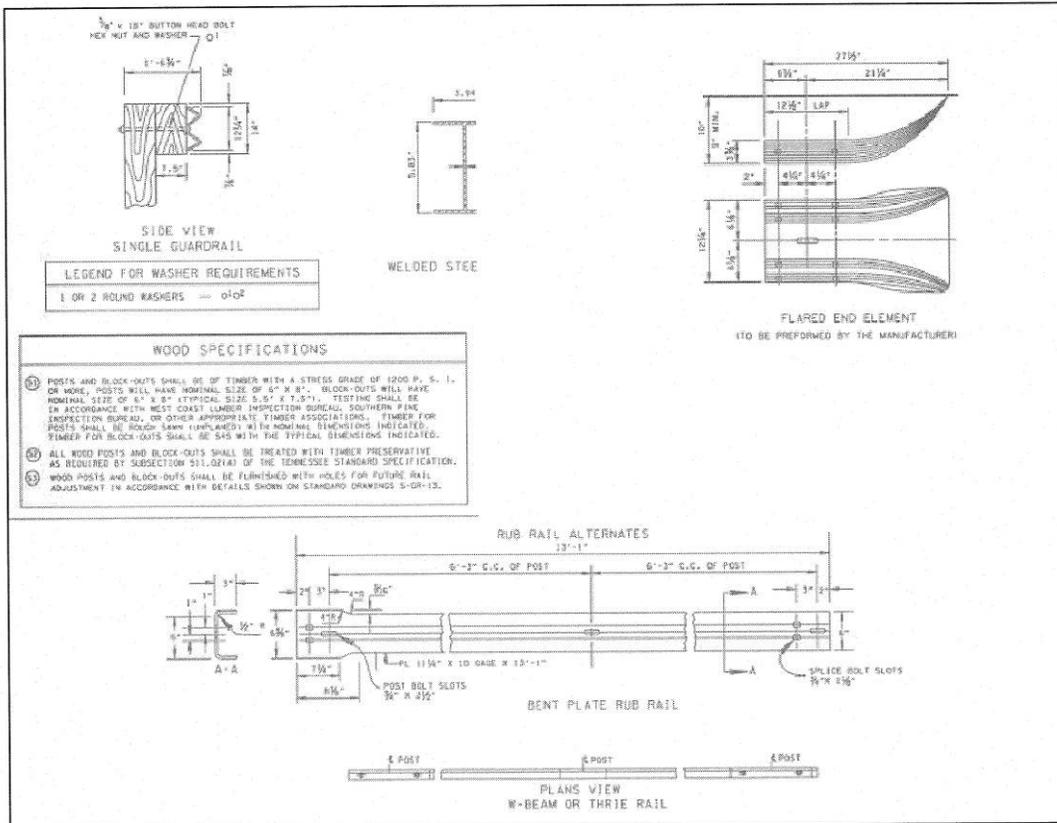


5

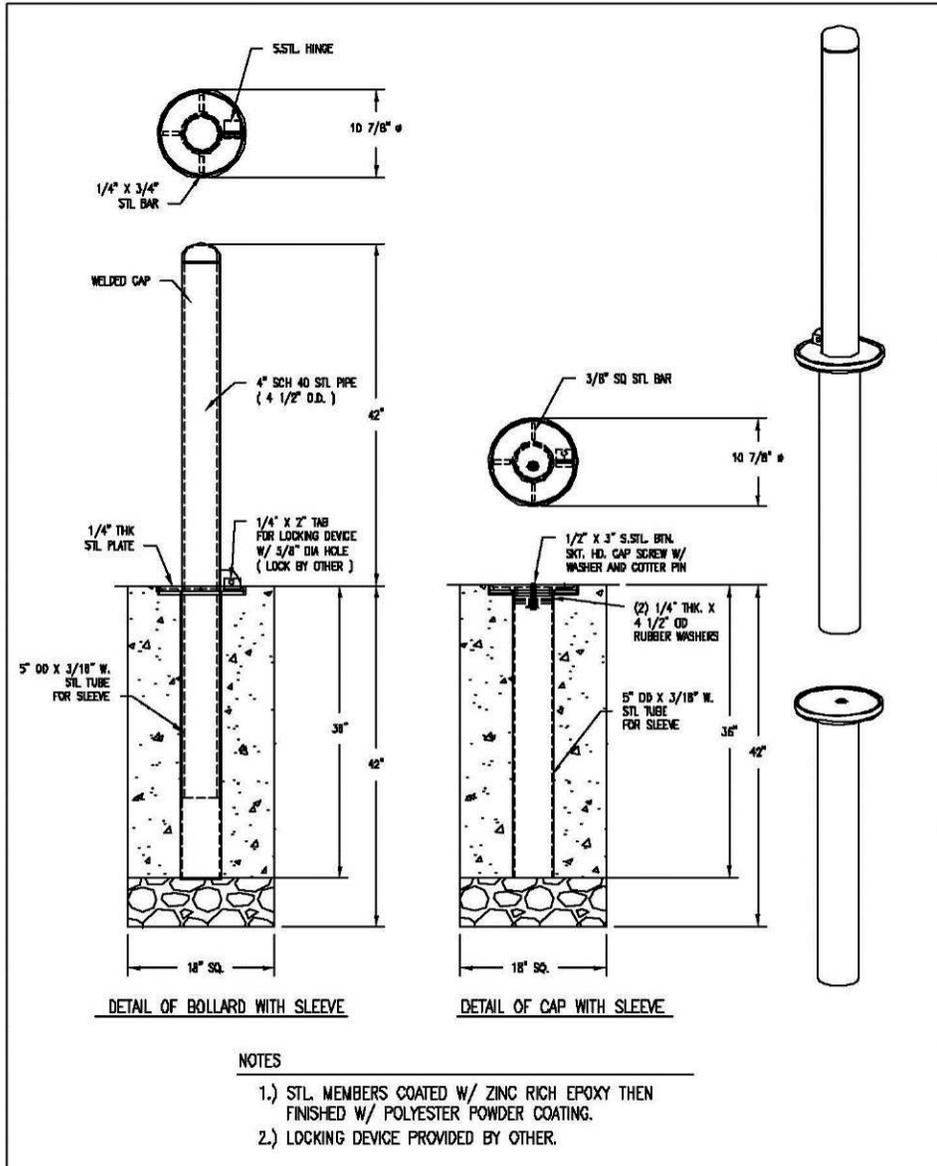
SPLIT RAIL FENCE

N.T.S

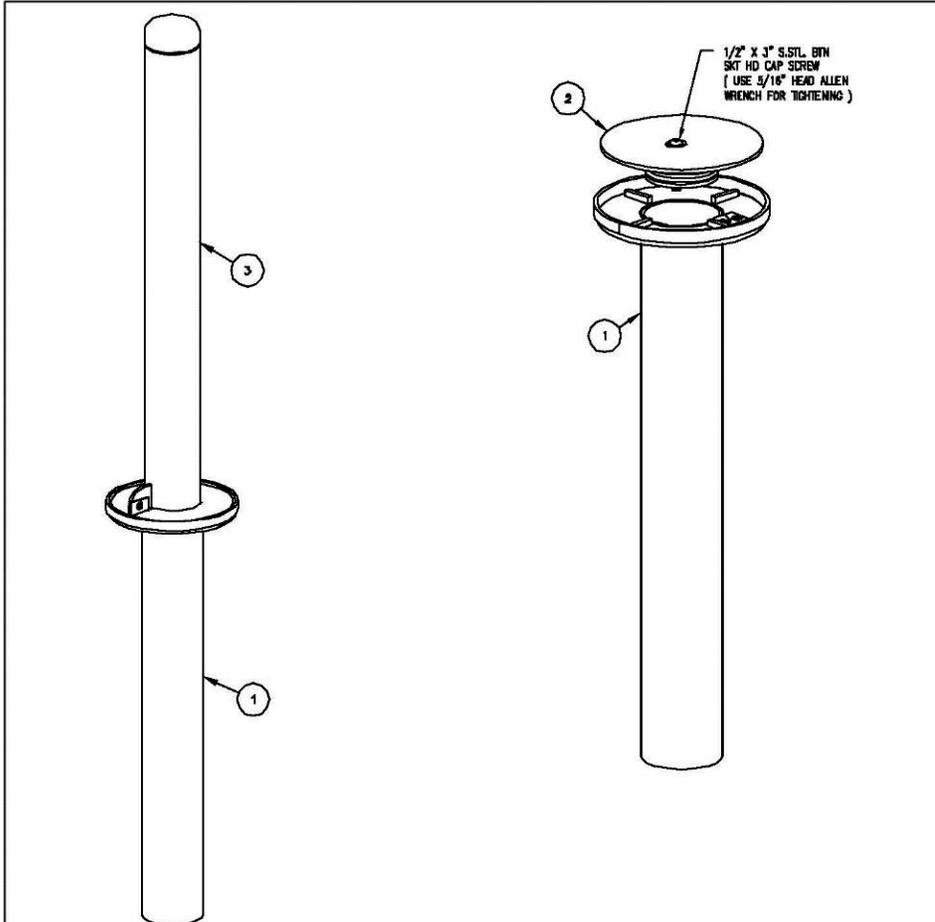
NOTE:
 DRAWINGS ARE TAKE FROM TDOT'S ENGLISH STANDARD DRAWINGS, SEE S-GR-11,12, AND 15 FOR COMPLETE LIST OF REQUIREMENTS AND NOTES.
 DRAWINGS MAY BE VIEWED ONLINE @ www.tdot.state.tn.us/Cheif_Engineer/engr_library/design/Std_Drwg_Eng.htm



6 GUARD RAIL
 NOT TO SCALE



 DuMor, inc. P.O. Box 142 Mifflintown, PA 17059-0142	SCALE : NONE	TITLE : BOLLARD	
	DATE DRAWN : 10/27/06	REV. B	DRAWING NUMBER 400-42/S-15L
	DRAWN BY : AMH1		SHEET 1 OF 2
	DATE REV. : 01/10/07		
	REV. BY : ESS		



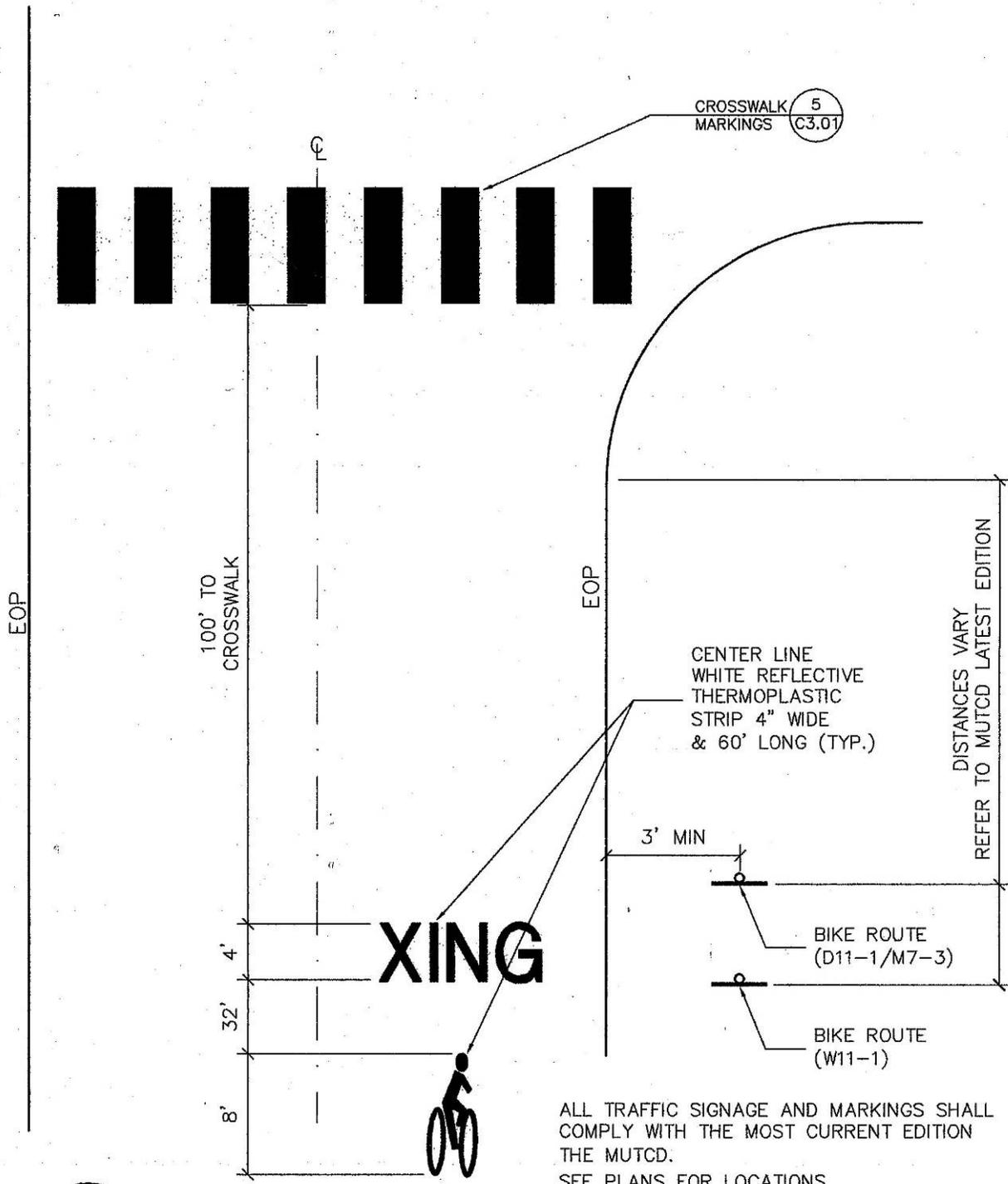
NOTES:

1. SET SLEEVE INTO FOOTER HOLDING PLUMB, SQUARE AND HEIGHT SHOWN.
2. SLIDE BOLLARD INTO SLEEVE AFTER CONCRETE HAS HARDENED. BE SURE TO HAVE HINGE TAB SLIDE INTO BOLLARD BASE PLATE SLOT FOR LOCKING.
3. FOR USE OF CAP. WHEN BOLLARD IS REMOVED, PLACE CAP INTO SLEEVE. TIGHTEN CAP BY USING 1/2" X 3" BUTTON HEAD BOLT. THIS WILL COMPRESS THE RUBBER WASHERS THICKNESS AND EXPAND THE DIAMETER TO FIT SNUG TO SLEEVE.

ITEM	QTY	PART NO	DESCRIPTION
1	1	D-400-02	STL BOLLARD SLEEVE W/ HINGE
2	1	D-400-03	BOLLARD SLEEVE CAP ASSEMBLY
3	1	D-400-42-01/1SL	42" STL BOLLARD, EMBED FOR SLEEVE

 DuMor, inc. P.O. Box 142 Mifflintown, PA 17059-0142	SCALE : NONE	TITLE : BOLLARD	
	DATE DRAWN : 10/27/05	REV. B	DRAWING NUMBER 400-42/5-1SL
	DRAWN BY : AWH		
	DATE REV. : 01/10/07		
	REV. BY : ESS		SHEET 2 OF 2

Signage

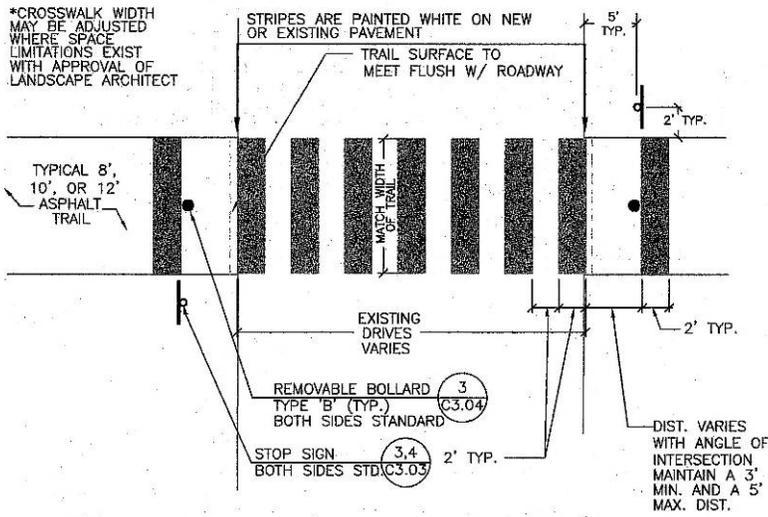


5 STOP BAR - DETAIL

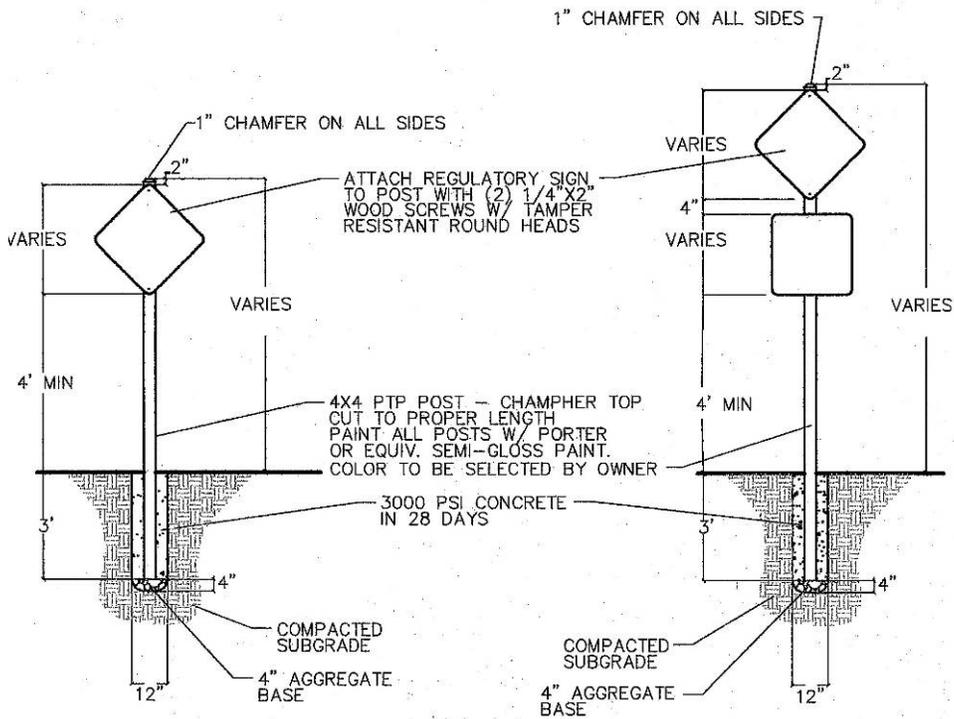
NTS

ALL TRAFFIC SIGNAGE AND MARKINGS SHALL COMPLY WITH THE MOST CURRENT EDITION THE MUTCD.
SEE PLANS FOR LOCATIONS

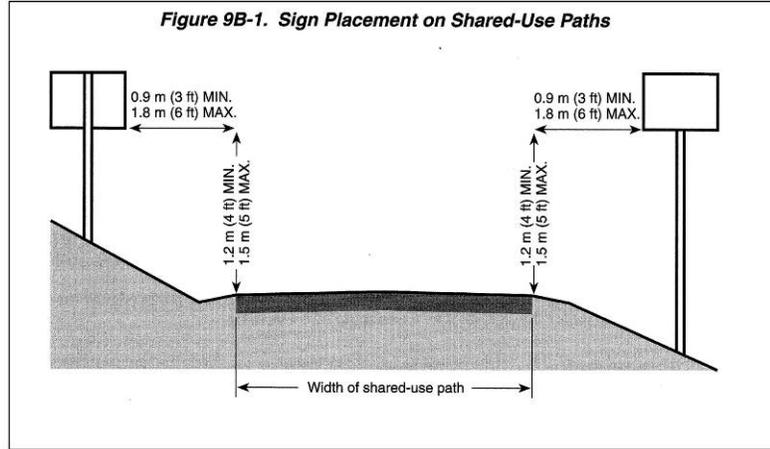
NOTE:
 CROSSWALK STRIPES SHALL BE APPLIED IN ACCORDANCE WITH
 TDOT SPECIFICATIONS SECTIONS 716.06 AND 716.07(C).
 PAINT FOR THE CROSSWALK SHALL BE WHITE REFLECTIVE
 THERMOPLASTIC PAINT



5 CROSSWALK MARKINGS AND SIGNAGE N.T.S.
 ALL SIGNS & MARKINGS TO MEET THE MUTCD (MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES)



1 TRAIL REGULATORY SIGN POST N.T.S.



FROM SECTION 9, MUTCD 2003 EDITION

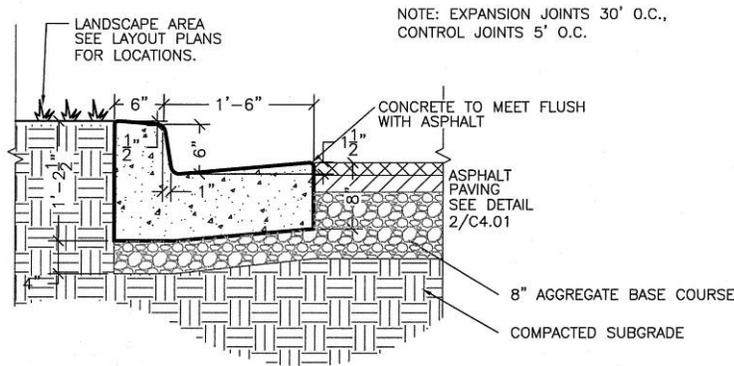
REGULATORY AND INFORMATIONAL SIGN SCHEDULE

<p>PEDESTRIANS ONLY</p> <p>NO BICYCLES</p> <p>*GREEN BACKGROUND *WHITE TEXT</p> <p>SP-1 18"x12"</p>		
 <p>ROADWAY 30"x30" BIKE TRAIL 18"x18"</p> <p>R1-1</p>	<p>NO MOTOR VEHICLES</p> <p>R5-3 24"x24"</p>	 <p>YIELD TO PEDS</p> <p>R9-6 12"x18"</p>
 <p>W1-1 18"x18"</p>	 <p>W3-1 18"x18"</p>	 <p>SLIPPERY WHEN WET</p> <p>BIKE TRAIL 18' X 18' / 12' X 9'</p> <p>W8-10</p>

NOTE:
 - ALL ALUMINIUM SIGNS ARE TO BE MANUFACTURED BY RAINBOW SIGNS OR APPROVED EQUIVELANT
 - ALL SIGNS TO MEET THE MUTCD/MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES- 2003 EDITION) NUMBERING AND SIZING SYSTEM AND SHALL BE BUILT CONFORMING TO THOSE STANDARDS.

1.8 TRAILHEAD DETAILS

Curb and Gutter

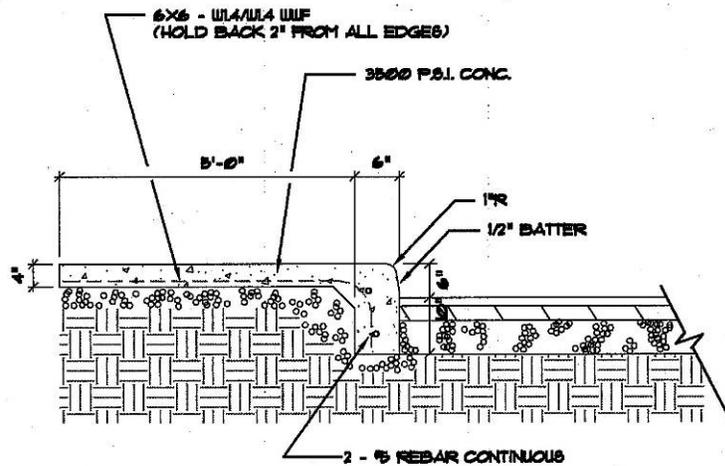


GENERAL NOTE:

- 1.) Expansion joints will also be required at tangent points, ramps, and inlets.
- 2.) Contraction joints are to be cut into curb and gutter every 10 feet to a depth of $D/4$, where D equals the thickness of the section. The spacing of 10 feet may be reduced at closures but no section of curb and gutter shall be less than 6 feet.
- 3.) There will be a minimum of 10 feet tie in at curb inlets oneach side of the inlet. An expansion joint will be used on each side of the tie in.
- 4.) Cost of joints to be included in the unit bid price for concrete curb with gutter.
- 5.) Concrete to be class "A" per Murfreesboro Standards.

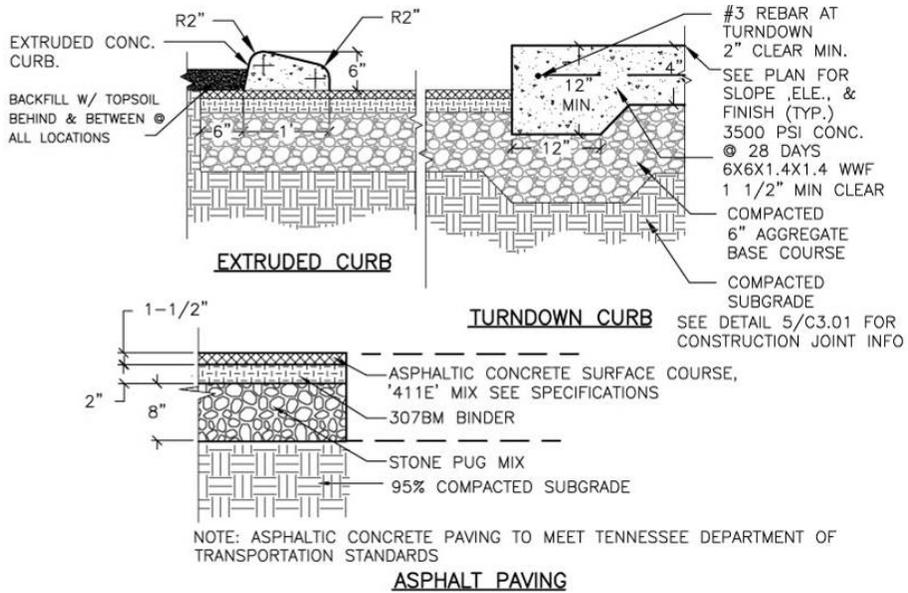
11 CURB AND GUTTER

N.T.S.

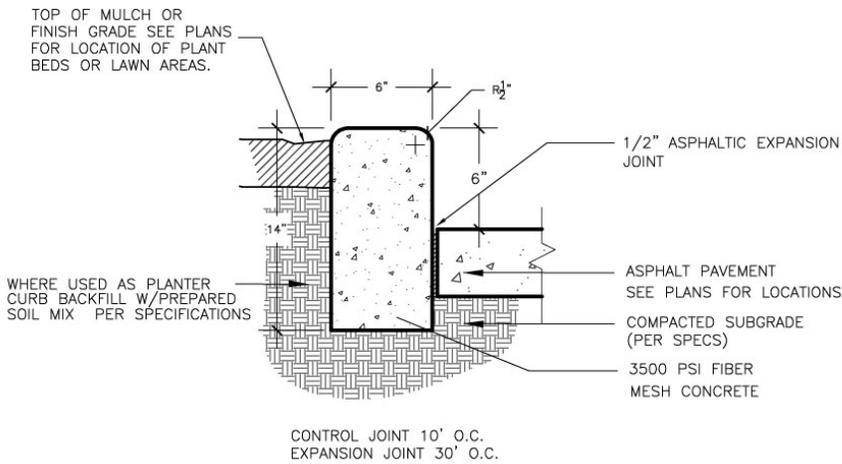


6 C3.00 SIDEWALK & CURB DETAIL

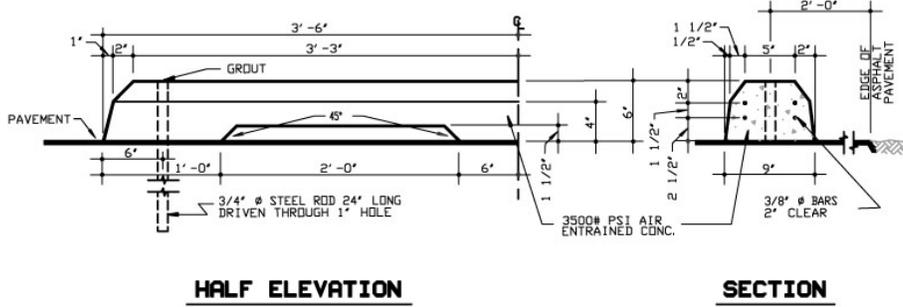
NTS



3 STD. ASPHALT PAVING W/ CURBS NTS



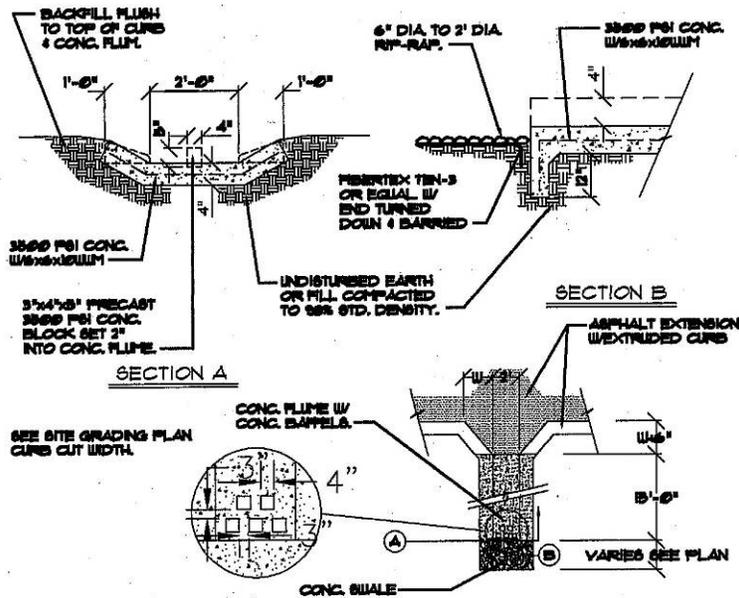
6 POST CURB NOT TO SCALE



7

PRECAST CONCRETE CURB STOP

N.T.S.



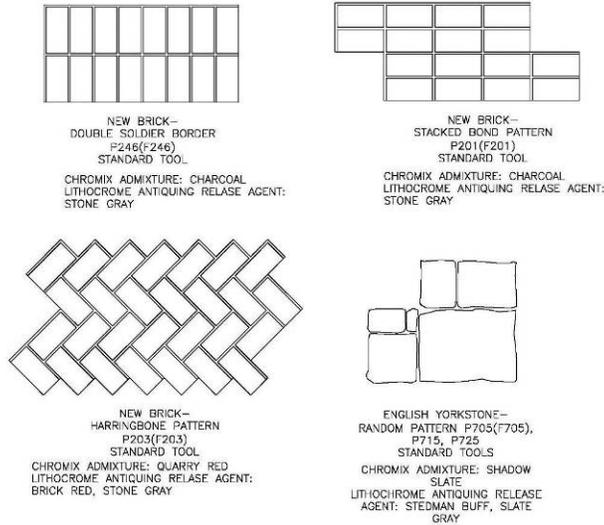
9
C3.00

CURB CUT

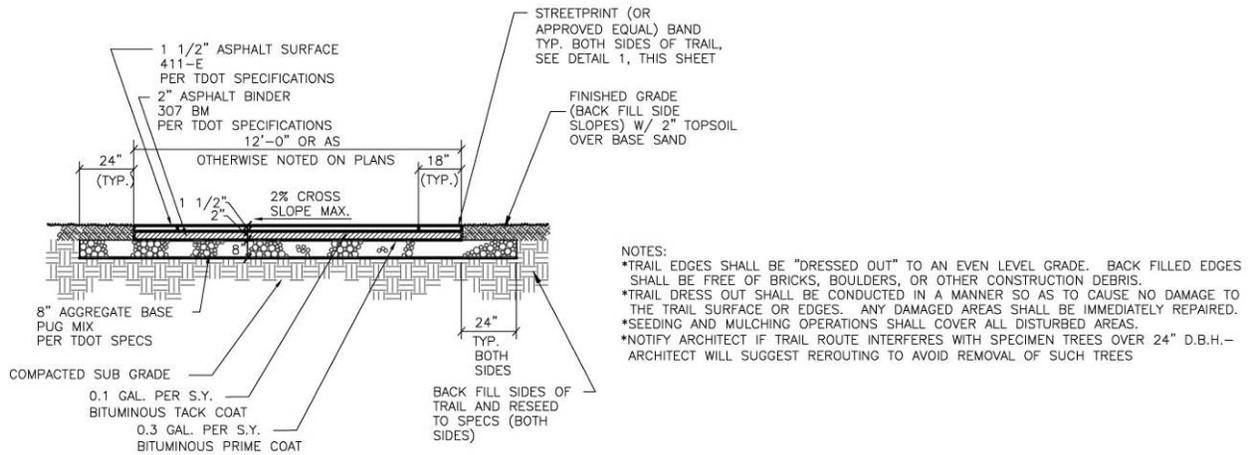
NTS

Paving

PATTERNS SHOWN ARE LITHOTEX PAVECRAFTERS BY L.M. SCOFIELD COMPANY, 1-800-800-9900, OR APPROVED EQUALS, SEE DETAIL 3, THIS SHEET FOR CONCRETE PAVING DETAIL

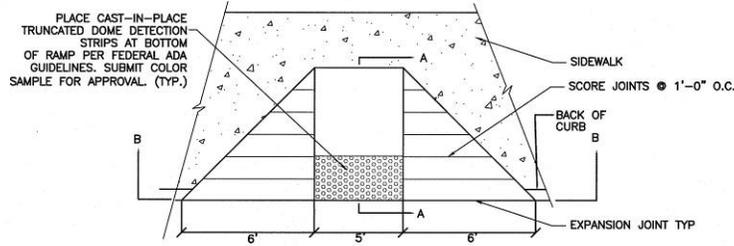
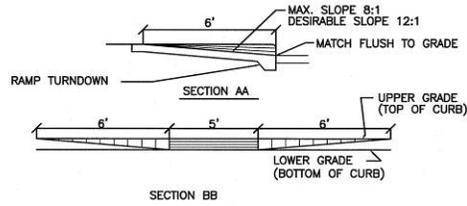


4 CONCRETE PATTERNS N.T.S.



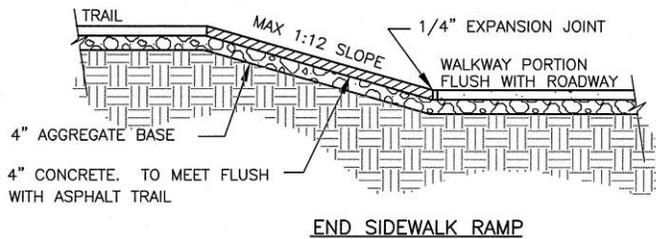
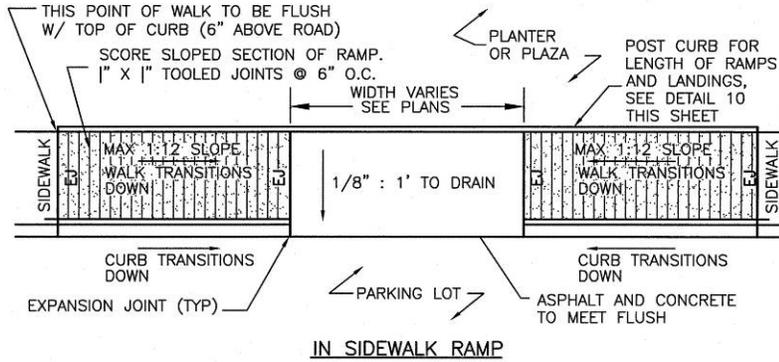
2 HEAVY DUTY ASPHALT TRAIL SECTION N.T.S.

Ramps



3 FLARED CONCRETE RAMP

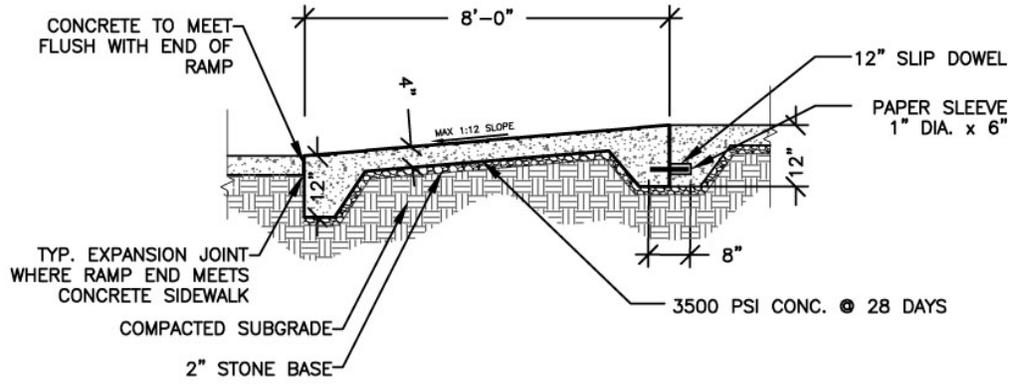
NOT TO SCALE



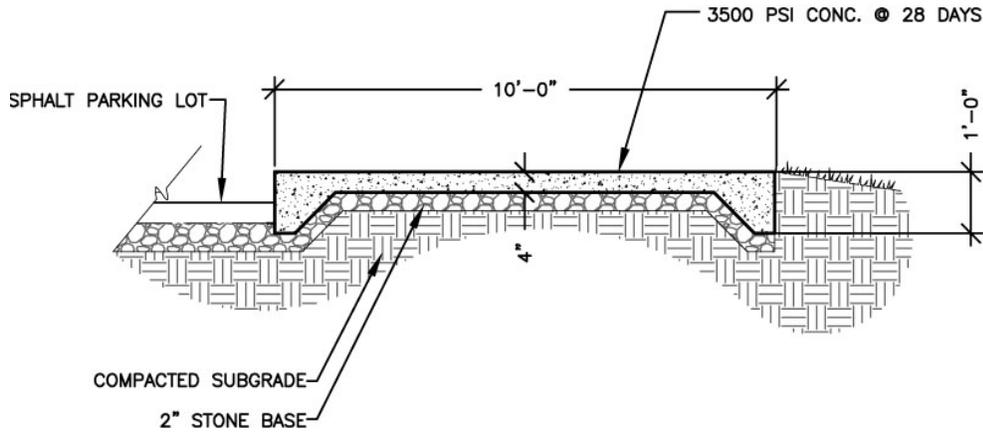
7 STD. HANDICAP SIDEWALK RAMPS

NOT TO SCALE

NTS



HORIZONTAL SECTION VIEW



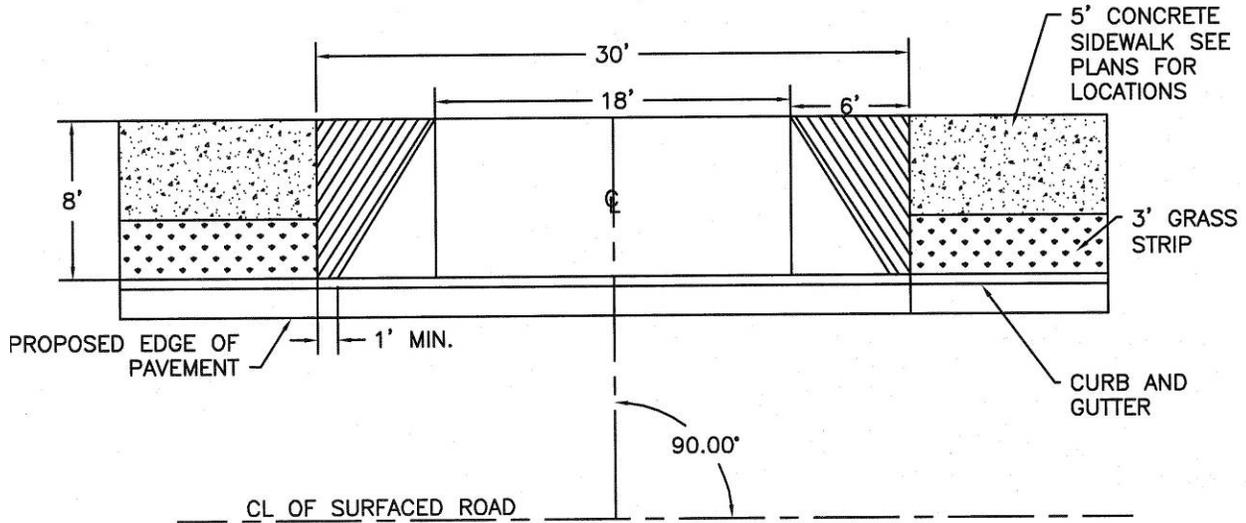
LONGITUDINAL SECTION VIEW

1

HANDICAP RAMP

N.T.S.

NOTE: ALL CONSTRUCTION AND MATERIAL SHALL COMPLY WITH THE CITY OF MURFREESBORO STANDARDS

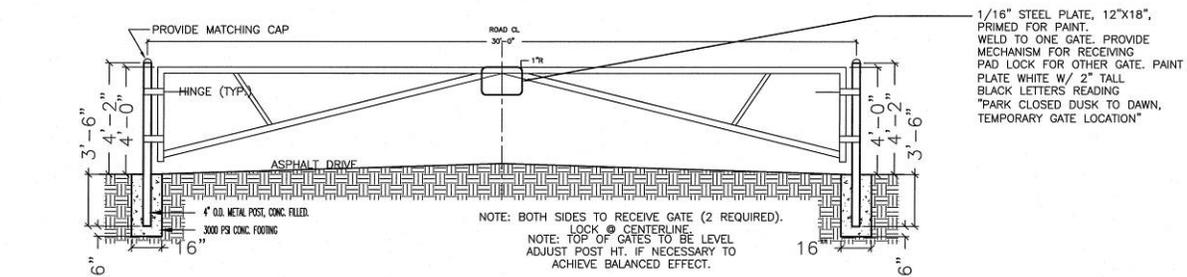


4

CONCRETE DRIVEWAY RAMP

NTS

Fencing and Barricades



NOTE: EACH GATE TO RECEIVE TIE BACK POST IDENTICAL TO GATE POST. PROVIDE MECHANISM FOR PADLOCK AT TIE BACK POSTS. SEE PLANS FOR LOCATION.

ALL POSTS ARE STANDARD WEIGHT GALV. PIPE (SCH. 40). FRAMEWORK IS WELDED USING 2" O.D. STANDARD PIPE FOR EXTERIOR FRAME & 1 5/8" O.D. FOR INTERIOR BRACING. LATCH ASSEMBLY IS 3/8" X 1" PRESSED STEEL.

PROVIDE MECHANISM FOR RECEIVING PADLOCK @ CENTERLINE OF ROAD. OWNER TO PROVIDE PADLOCK. COORDINATE WITH OWNER FOR MECHANISM TYPE.

ALL STEEL JOINTS TO RECEIVE CONT. WELD USE NO SPOT WELDS.

GRIND ALL WELDS SMOOTH W/ NO BARBS.

PAINT TO BE EXTERIOR SEMI-GLOSS ENAMEL. APPLY ALL PAINT PER MANUFACTURER'S SPECS. OVER PREVIOUSLY PRIMER RED PAINTED STEEL.

PAINT ALL STEEL SURFACES BLACK. PROVIDE SHOP DRAWINGS FOR OWNER'S REPRESENTATIVE'S APPROVAL.

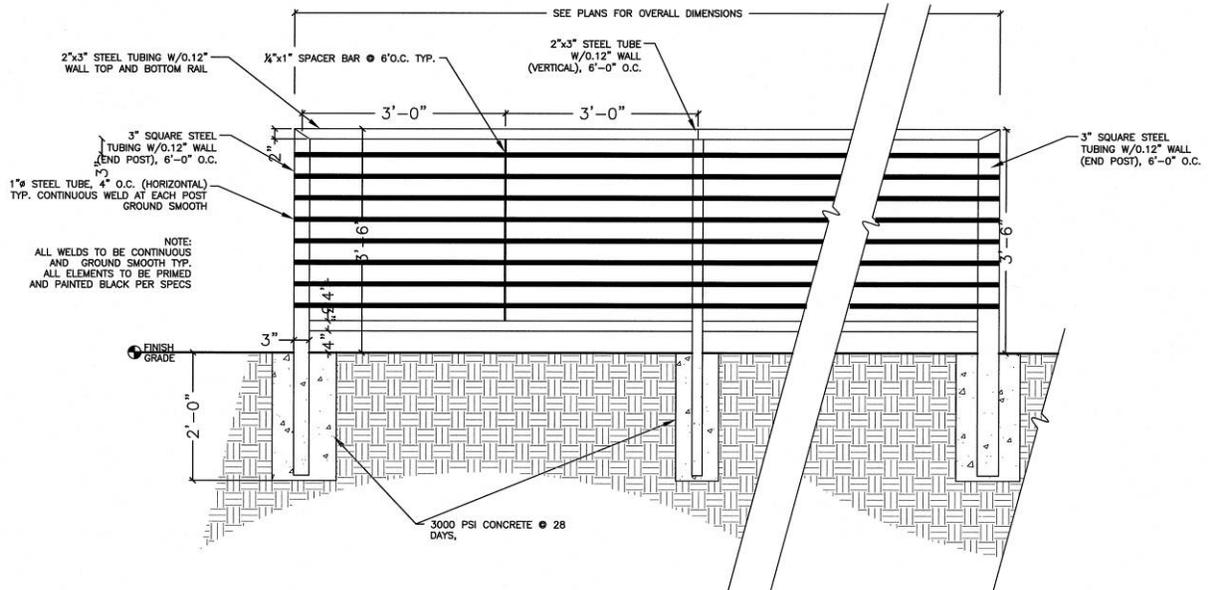
1/16" STEEL PLATE, 12"x18", PRIMED FOR PAINT. WELD TO ONE GATE. PROVIDE MECHANISM FOR RECEIVING PAD LOCK FOR OTHER GATE. PAINT PLATE WHITE W/ 2" TALL BLACK LETTERS READING "PARK CLOSED DUSK TO DAWN, TEMPORARY GATE LOCATION"

NOTE: BOTH SIDES TO RECEIVE GATE (2 REQUIRED). LOCK @ CENTERLINE. NOTE: TOP OF GATES TO BE LEVEL. ADJUST POST HT. IF NECESSARY TO ACHIEVE BALANCED EFFECT.

2

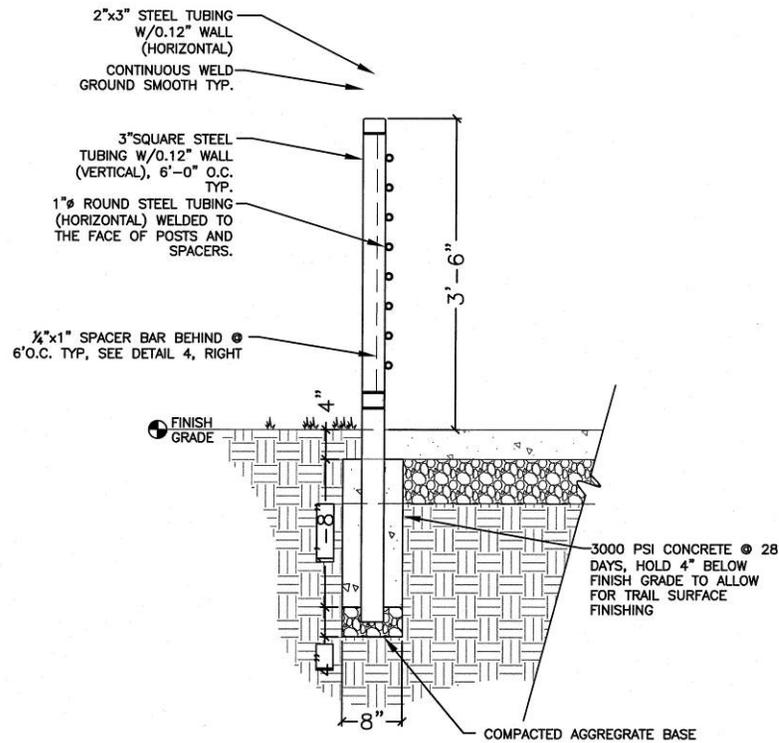
TRAILHEAD ACCESS GATE

NTS



1 HANDRAIL ELEVATION DETAIL

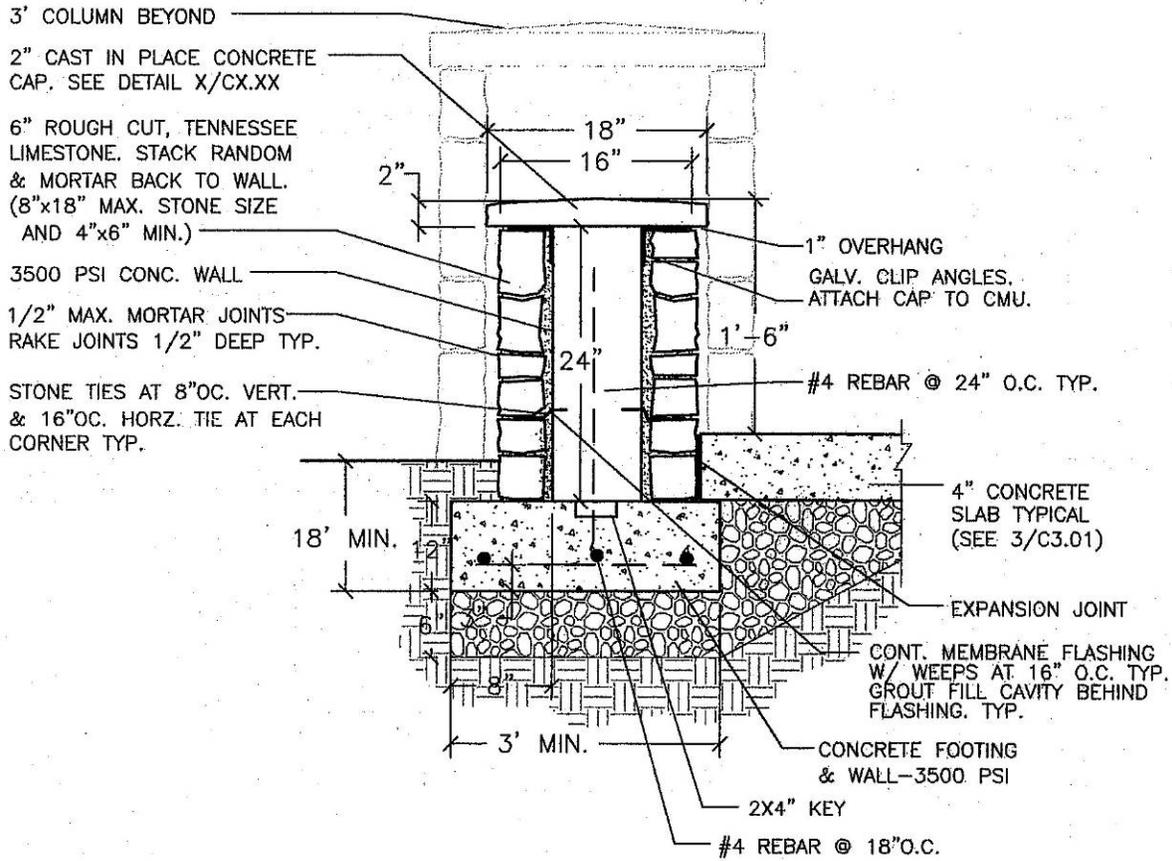
N.T.S.



3 HANDRAIL SECTION DETAIL

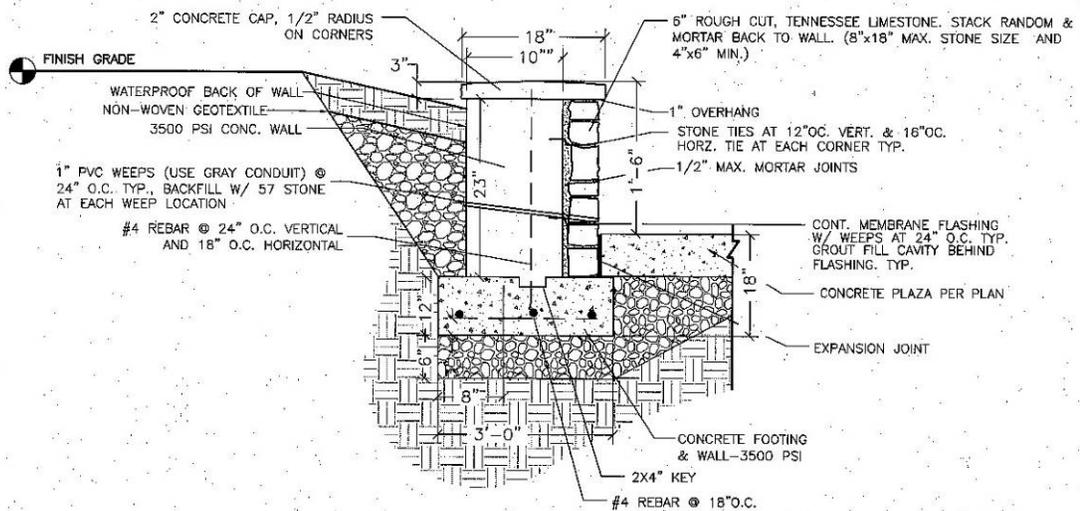
N.T.S.

Walls



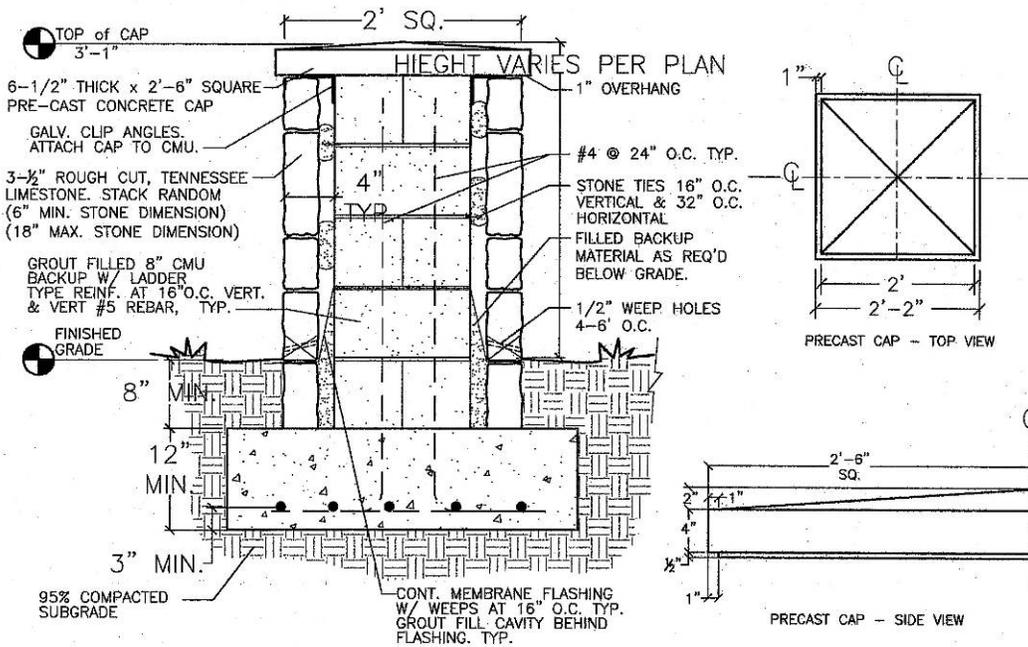
2 DIVIDER WALL

N.T.S.



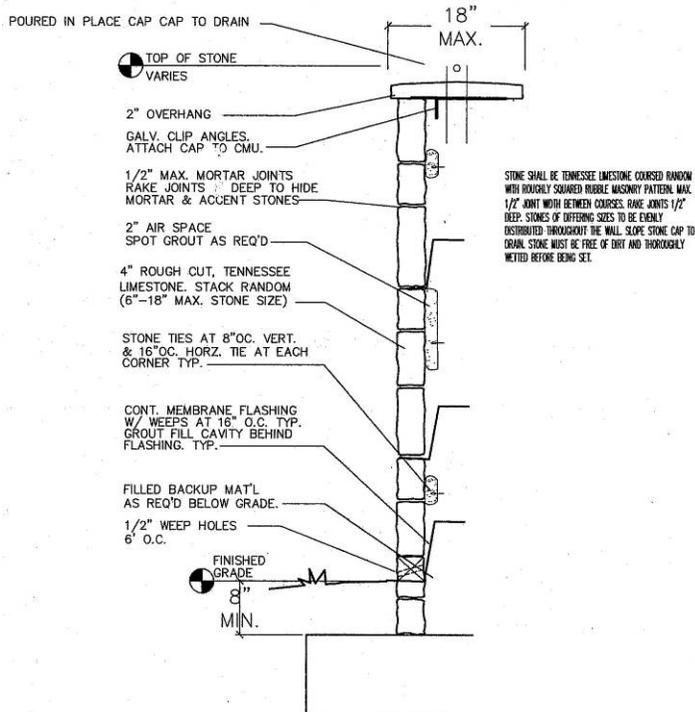
2 SEAT WALL

NTS



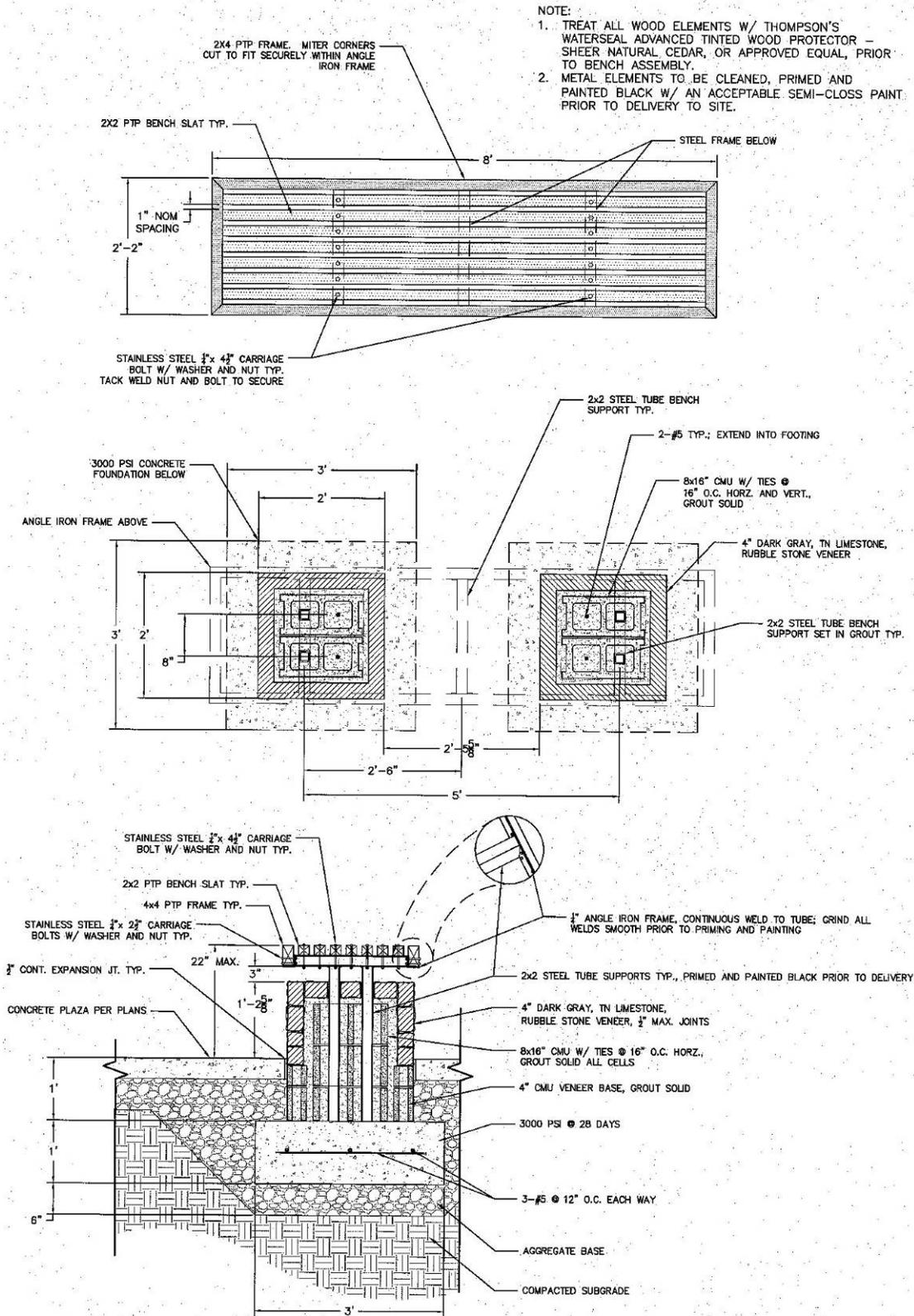
3 3' COLUMN W/ CAP

N.T.S.



4 STONE VENEER DETAIL

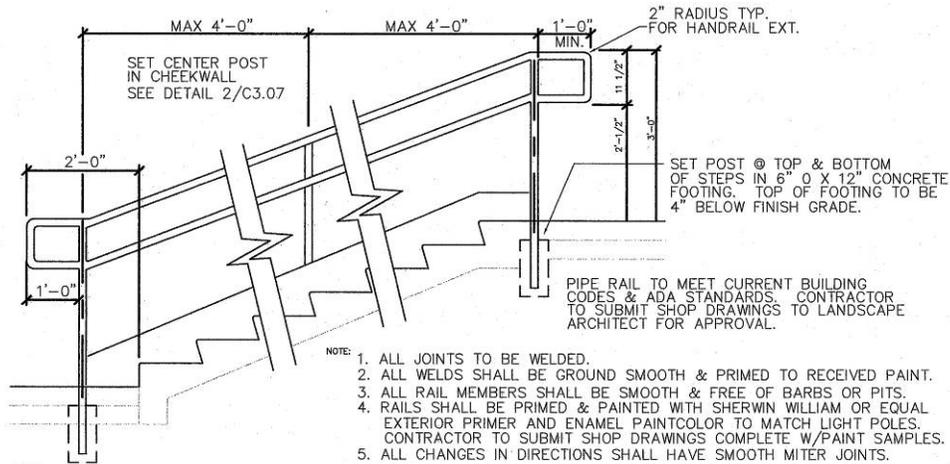
N.T.S.



3 CUSTOM 8' BENCH

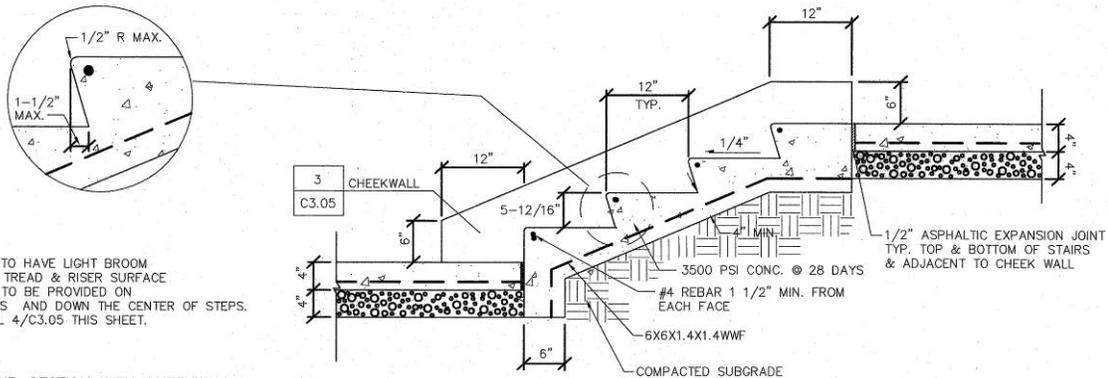
NTS

Stairs



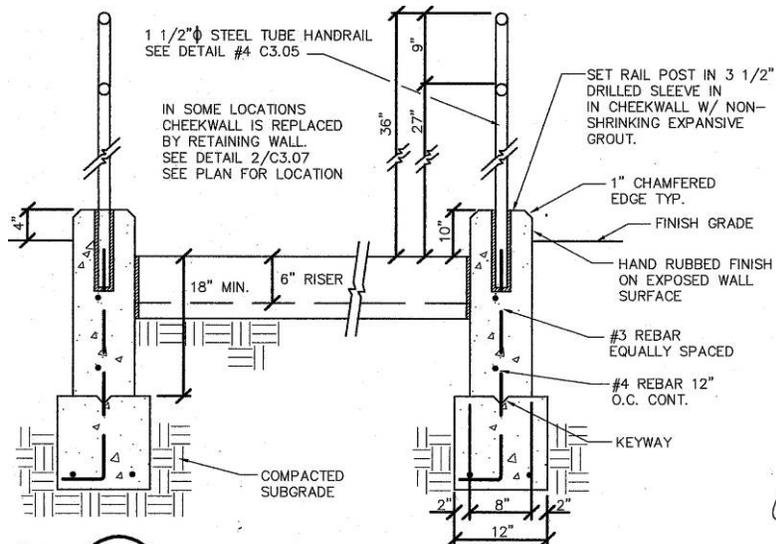
3 STAIR HAND RAIL (TYP.)

N.T.S.



1 STAIR SECTION WITH CHEEKWALL

NTS

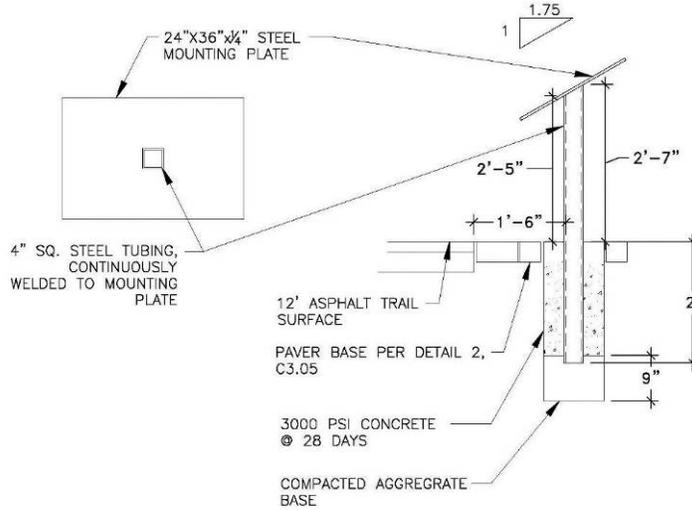


2 STAIR CHEEKWALL SECTION W/HANDRAIL

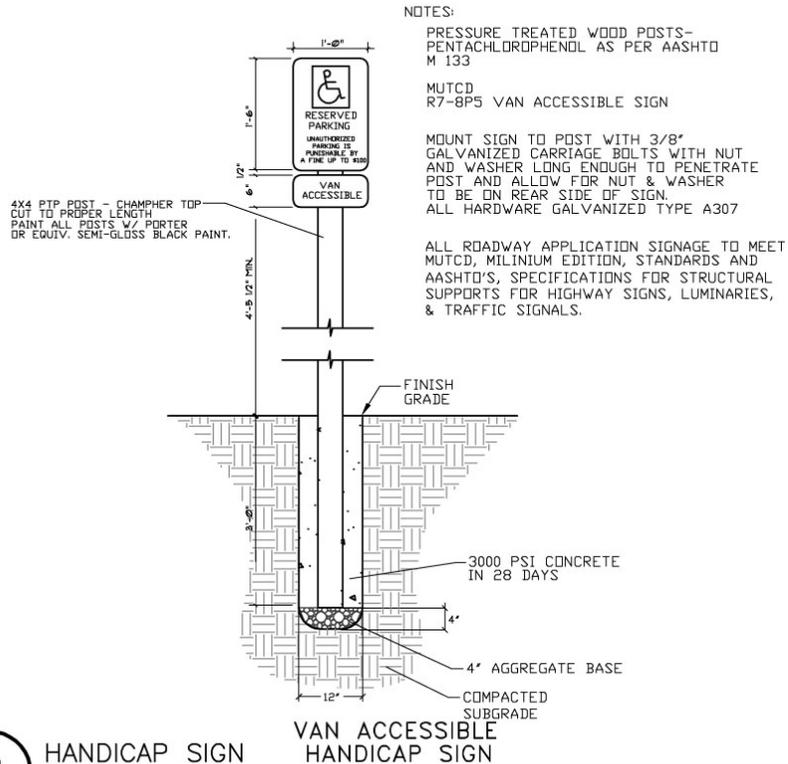
NTS

Signage

NOTE: 1/8" RESIN EMBEDDED GRAPHIC MAP TO BE MOUNTED ON STEEL MOUNTING PLATE PER MANUFACTURERS RECOMMENDATIONS, GRAPHICS TO BE COORDINATED WITH THE CITY OF MURFREESBORO PARKS DEPARTMENT.
PAINT ALL EXPOSED METAL SURFACE BLACK.



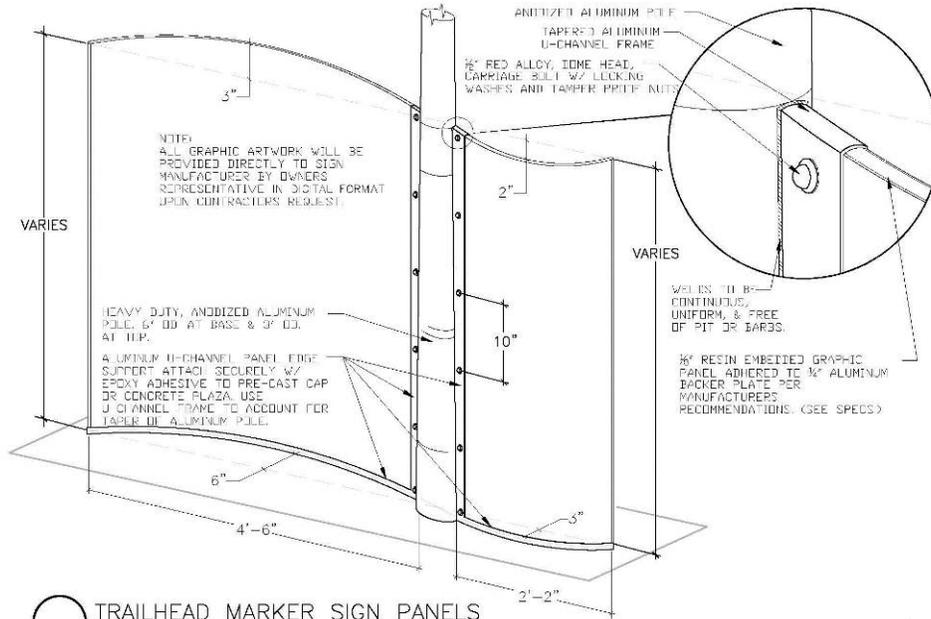
GREENWAY MAP STAND



2

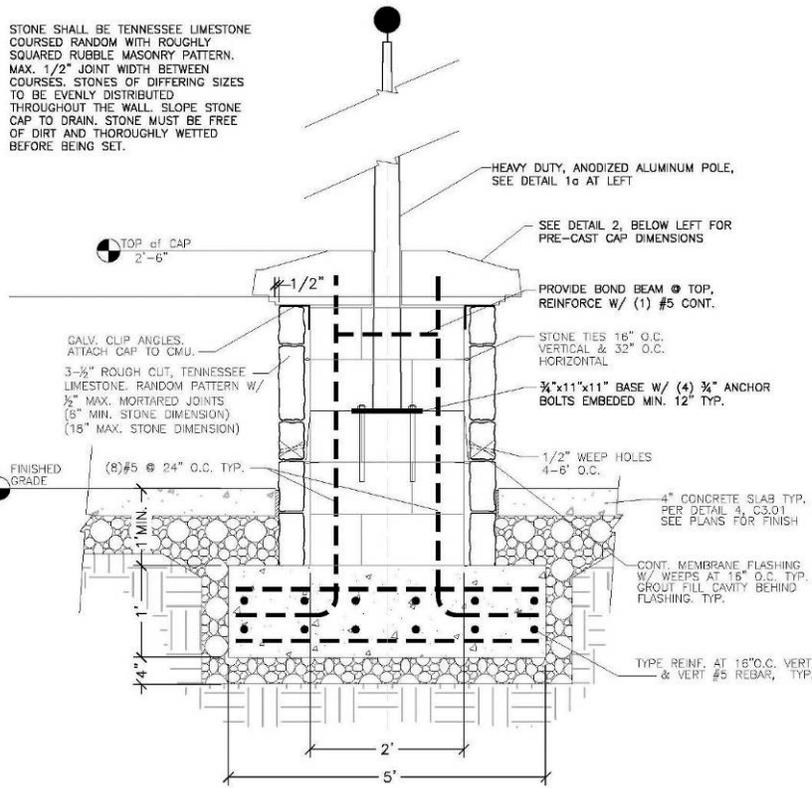
HANDICAP SIGN

NTS



TRAILHEAD MARKER SIGN PANELS

NTS

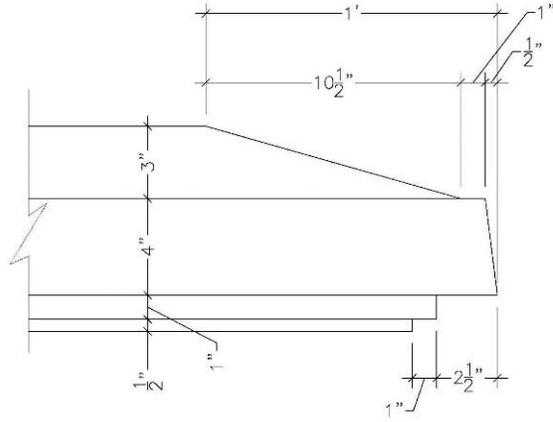


ELEVATED SIGN BASE SECTION

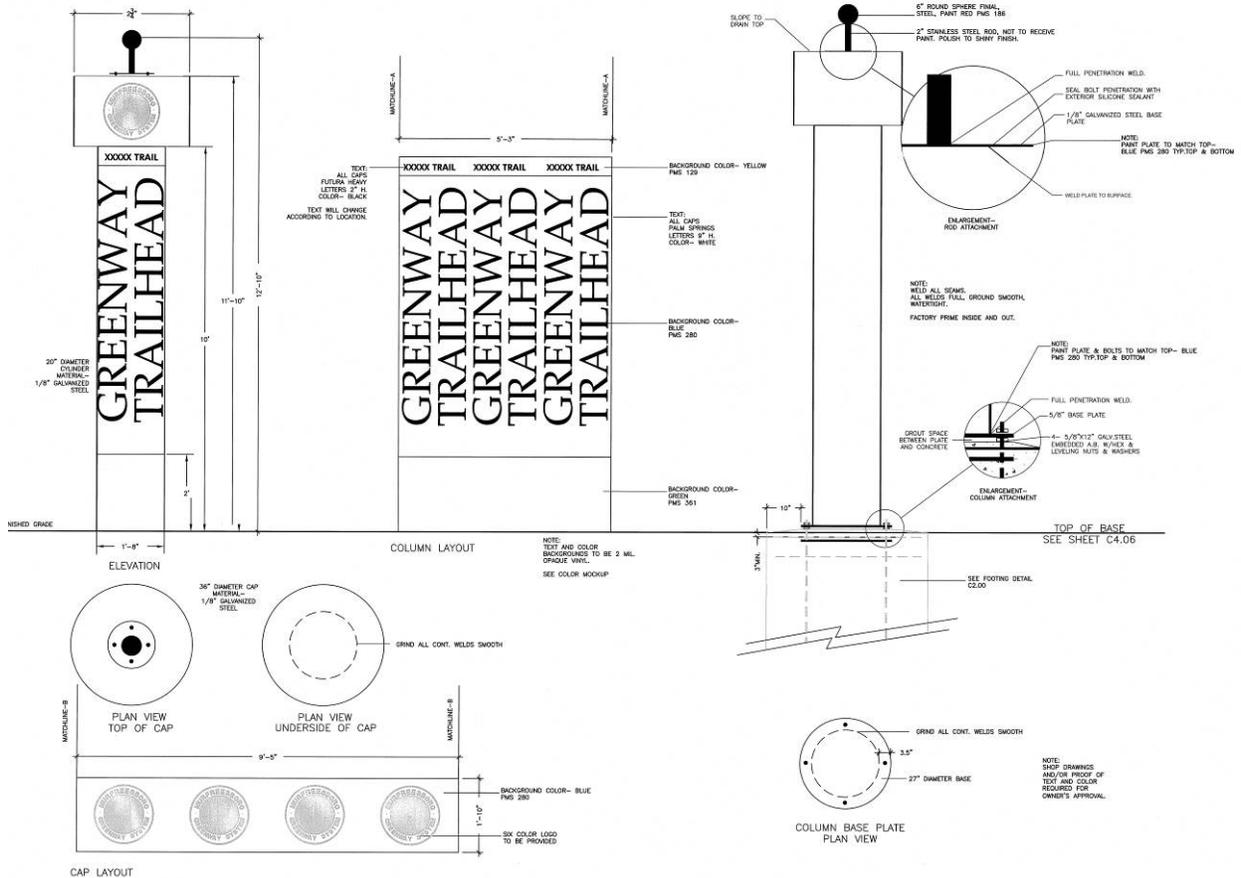
N.T.S.

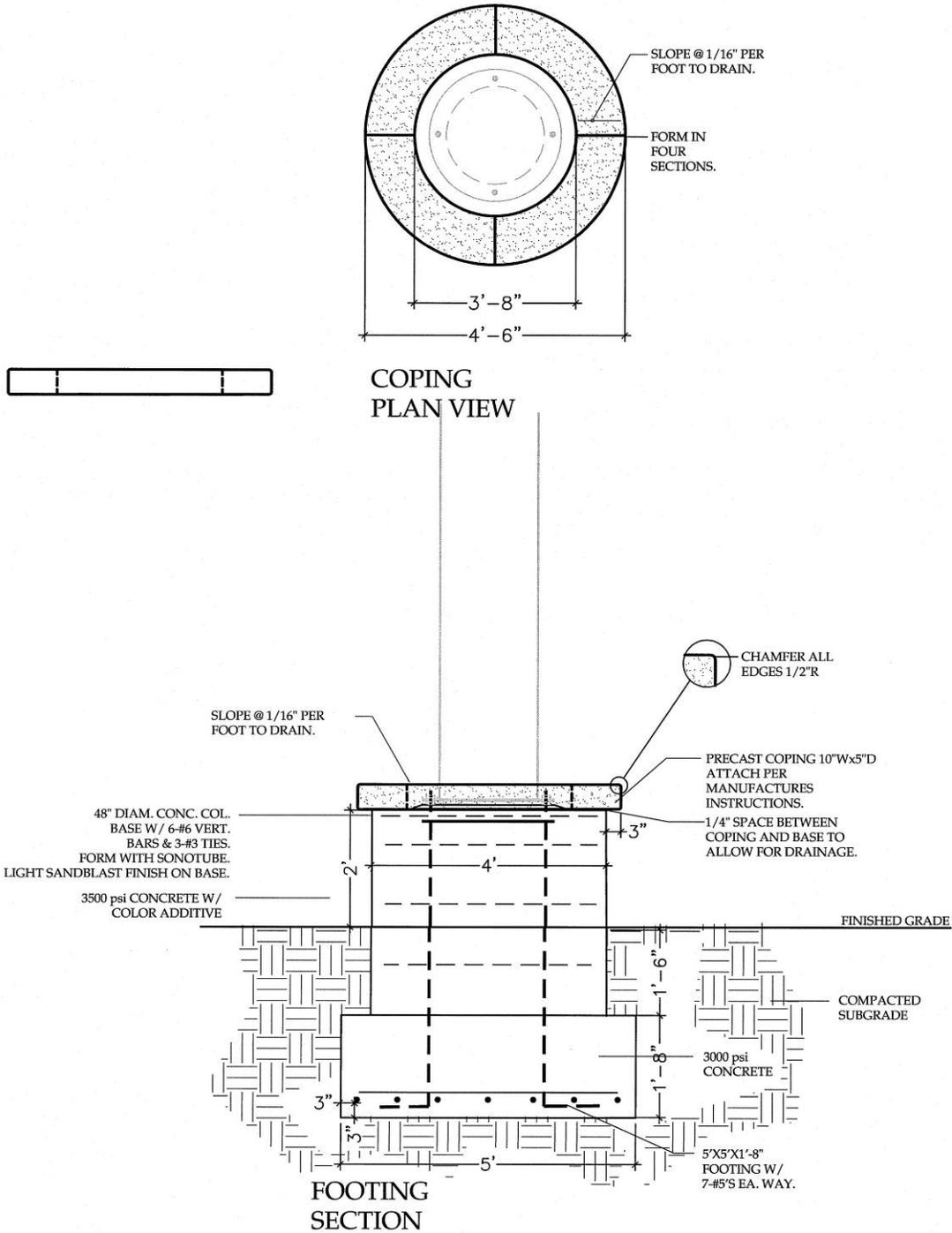
PRE-CAST STONE CAPS:

1. EACH SECTION OF PRE-CAST CAP IS TO BE SECURELY ANCHORED TO CONCRETE BASE AND NOT CLIP-TIED INTO VENEER.
2. ALL PRE-CAST STONE WORK TO MATCH AND BE UNIFORM IN COLOR.
3. ALL PRE-CAST STONWORK TO BE TREATED WITH STAIN PROTECTION PRIOR TO INSTALLATION.
4. CONTRACTOR TO SUBMIT SAMPLES FOR OWNERS APPROVAL.



STONE CAP DETAIL "A" NTS





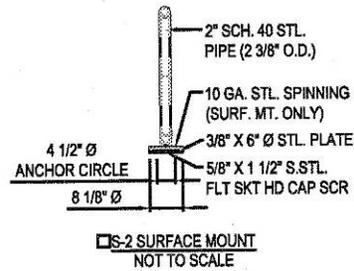
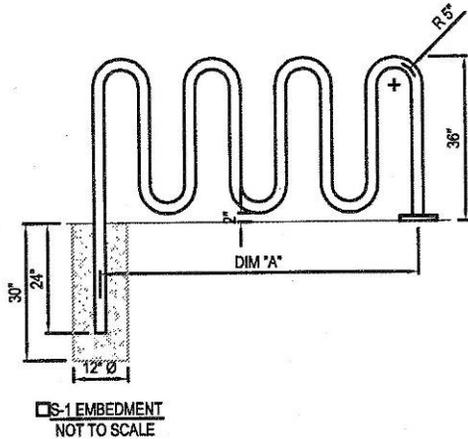
2 TRAIL MARKER FOUNDATION

NTS

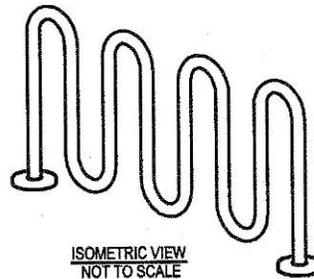
Site Furnishings



DU MOR, INC.
 15 INDUSTRIAL CIRCLE, P.O. BOX 142
 MIFFLINTOWN, PA 17059-0142
 1-800-598-4018
 PHONE:(717) 436-2106
 FAX:(717) 436-9839
 www.dumor.com



MODEL NO.	PEAKS	DIM 'A'
130-30	3	50' LG.



COATED W/ ZINC RICH EPOXY THEN FINISHED W/ POLYESTER POWDER COATING. (GREEN)
 HOT DIPPED GALVANIZED.

NOTES:

1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. 1/2" X 3 3/4" EXPANSION ANCHOR BOLTS PROVIDED FOR OPTION S-2.
4. CONTRACTOR'S NOTE: FOR PRODUCT AND PURCHASING INFORMATION VISIT www.CADdetails.com/info REFERENCE NUMBER 017-263.

4 130 SERIES DUMOR BIKE RACKS
 NOT TO SCALE

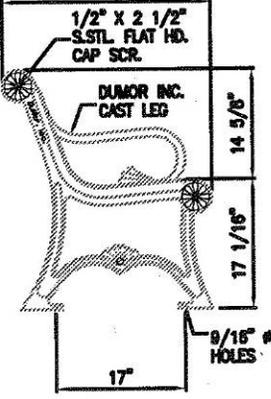
017-263



DuMor, inc.

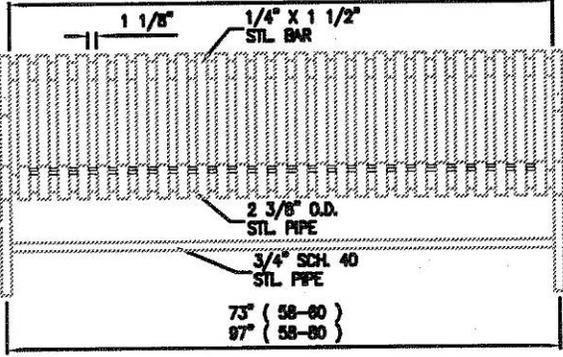
DU MOR, INC.
 15 INDUSTRIAL CIRCLE, P.O. BOX 142
 MIFFLINTOWN, PA 17059-0142
 1-800-598-4018
 PHONE: (717) 436-2106
 FAX: (717) 436-9839
 www.dumor.com
 71 3/4" (58-80)
 85 3/4" (58-80)

27 9/16"

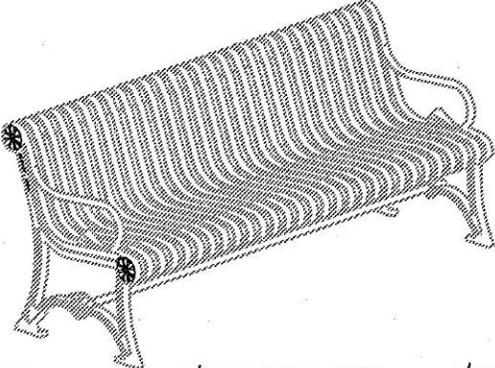


17"

1 1/8"



73" (58-80)
97" (58-80)



SELECT DESIRED CUSTOM LETTERING

_____ (37 SPACES)

SELECT DESIRED LENGTH

6' BENCH
 8' BENCH

SELECT DESIRED COLOR

<input type="checkbox"/> BLACK	<input type="checkbox"/> HUNTER GREEN
<input type="checkbox"/> BRONZE	<input type="checkbox"/> DEEP RED
<input type="checkbox"/> BLUE	<input type="checkbox"/> GREEN
<input type="checkbox"/> OTHER	

NOTES:

1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. ALL STL. MEMBERS COATED W/ ZINC RICH EPOXY THEN FINISHED W/ POLYESTER COATING (SEE COLOR OPTIONS).
4. 1/2" X 3 3/4" PLTD. EXPANSION ANCHOR BOLTS PROVIDED.
5. CUSTOM LETTERING AVAILABLE FOR RECESSED SIDE PANELS (37 SPACES TOTAL).
6. CONTRACTOR'S NOTE: FOR PRODUCT AND PURCHASING INFORMATION VISIT www.PROJECTmarketalls.com REFERENCE NUMBER 017-029



BENCH
58 SERIES, METAL

PROTECTED BY COPYRIGHT - 017-029 04/30/02

www.caddetails.com

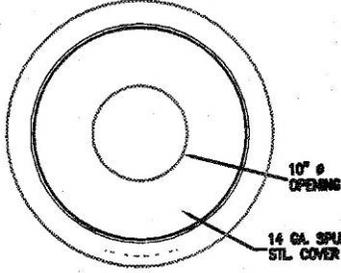
BENCH

NTS



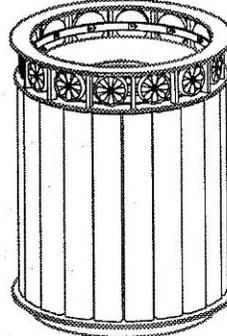
DuMor, inc.

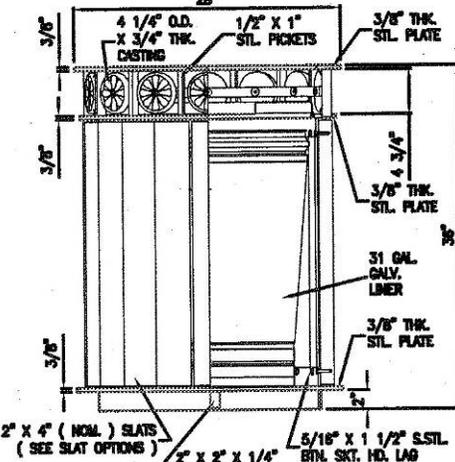
DU MOR, INC.
 15 INDUSTRIAL CIRCLE, P.O. BOX 142
 WIFFLINTOWN, PA 17059-0142
 1-800-399-4018
 PHONE (717) 436-2106
 FAX (717) 436-9839
 www.dumor.com



10" Ø
OPENING

14 GAL. SPUN
STL. COVER





28"

3/8"

4 1/4" O.D. X 3/4" THK. CASTING

1/2" X 1" STL. PICKETS

3/8" THK. STL. PLATE

3/8"

3/8" THK. STL. PLATE

31 GAL. GALV. LINER

3/8" THK. STL. PLATE

3/8"

2" X 4" (NOM.) SLATS (SEE SLAT OPTIONS)

2" X 2" X 1/4" STL. ANGLE

5/16" X 1 1/2" S.STL. BTL. NUT, HD. LAG

SELECT DESIRED SLAT OPTION

CLEAR ALL HEART REDWOOD S4S EE

PC & BTR. DOUGLAS FIR KD S4S EE

CLEAR WESTERN RED CEDAR S4S EE

OTHER

SELECT DESIRED COLOR

<input type="checkbox"/> BLACK	<input type="checkbox"/> HUNTER GREEN
<input type="checkbox"/> BRONZE	<input type="checkbox"/> DEEP RED
<input type="checkbox"/> BLUE	<input type="checkbox"/> GREEN
<input type="checkbox"/> OTHER	

NOTES:

1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. ALL STL. MEMBERS COATED W/ ZINC RICH EPOXY THEN FINISHED W/ POLYESTER COATING (SEE COLOR OPTIONS).
4. ALL STL. MEMBERS TREATED W/ CLEAR PRESERVATIVE.
5. 1/2" X 3 3/4" PLTD. EXPANSION ANCHOR BOLTS PROVIDED.
6. CONTRACTOR'S NOTE: FOR PRODUCT AND PURCHASING INFORMATION VISIT www.PROJECTmortealta.com

REFERENCE NUMBER 017-080



RECEPTACLE
 124-31-F10, 31 GAL., WOOD SLATS

PROTECTED BY COPYRIGHT - 017-080 04/30/02

www.caddetail.com

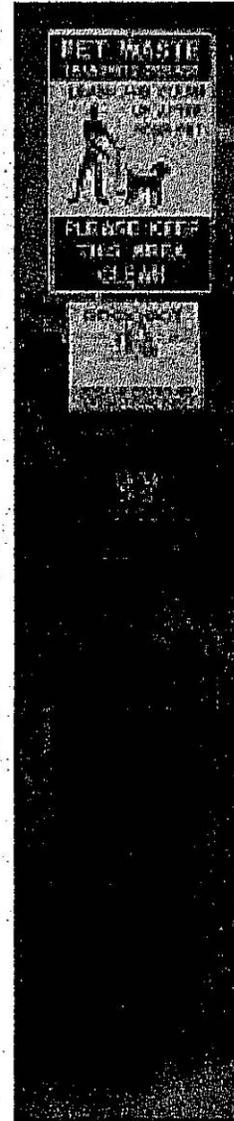
2

WASTE RECEPTACLE

NTS

BARCO PRODUCTS
OR
APPROVED ALTERNATE

MODEL # WDOG11003
INCL. 8' STEEL "U" CHANNEL POST
10GAL STEEL TRASH RECEPTACLE
50 HEAVY-DUTY TRASH BAGS,
12 X 18 ALUM. PET WASTE SIGN,
BAG DISPENSER,
400 LITTER BAGS



PET WASTE DISPOSAL STATION

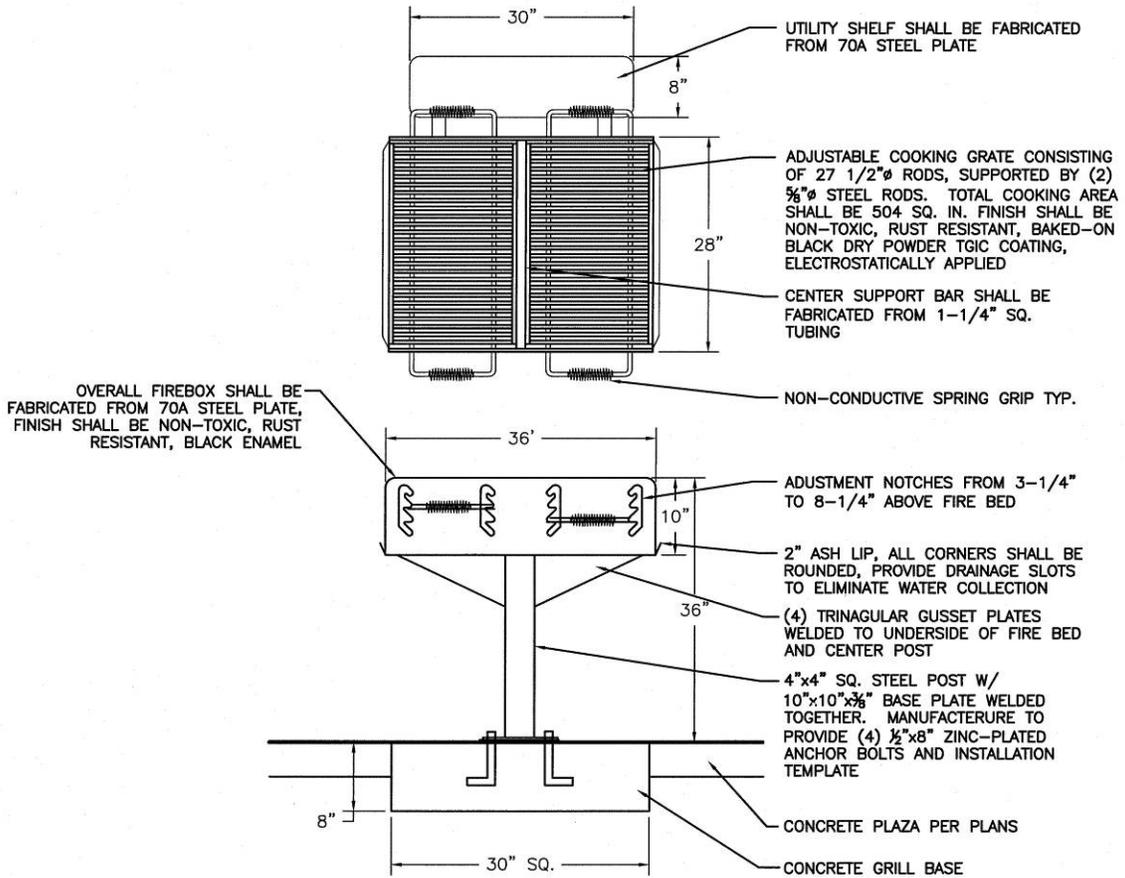
NTS

CONTACT:
 DAVID JONES @ MID-SOUTH
 RECREATION
 901-754-0905

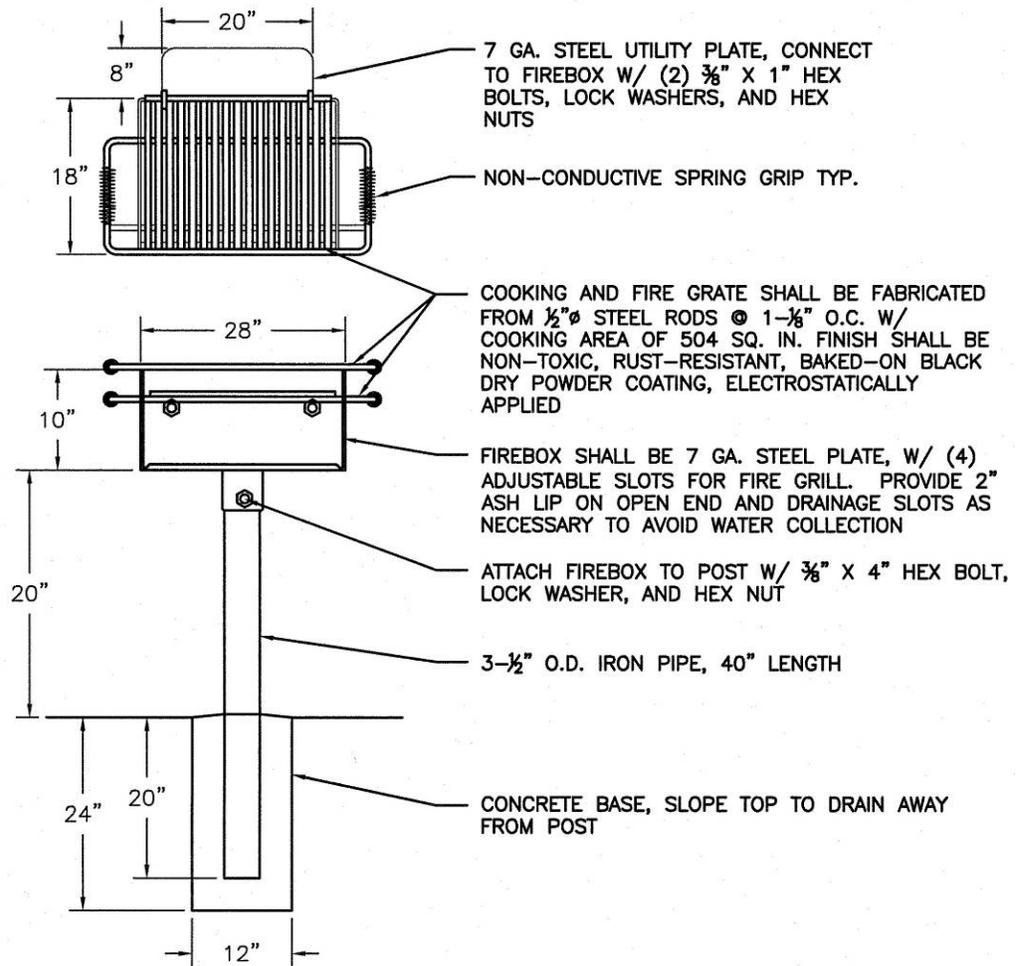


OR APPROVED EQUAL,
 SUBSTITUTIONS MUST BE SUBMITTED TO
 OWNER'S REPRESENTATIVE FOR APPROVAL AS
 SPECIFIED IN SPECS.

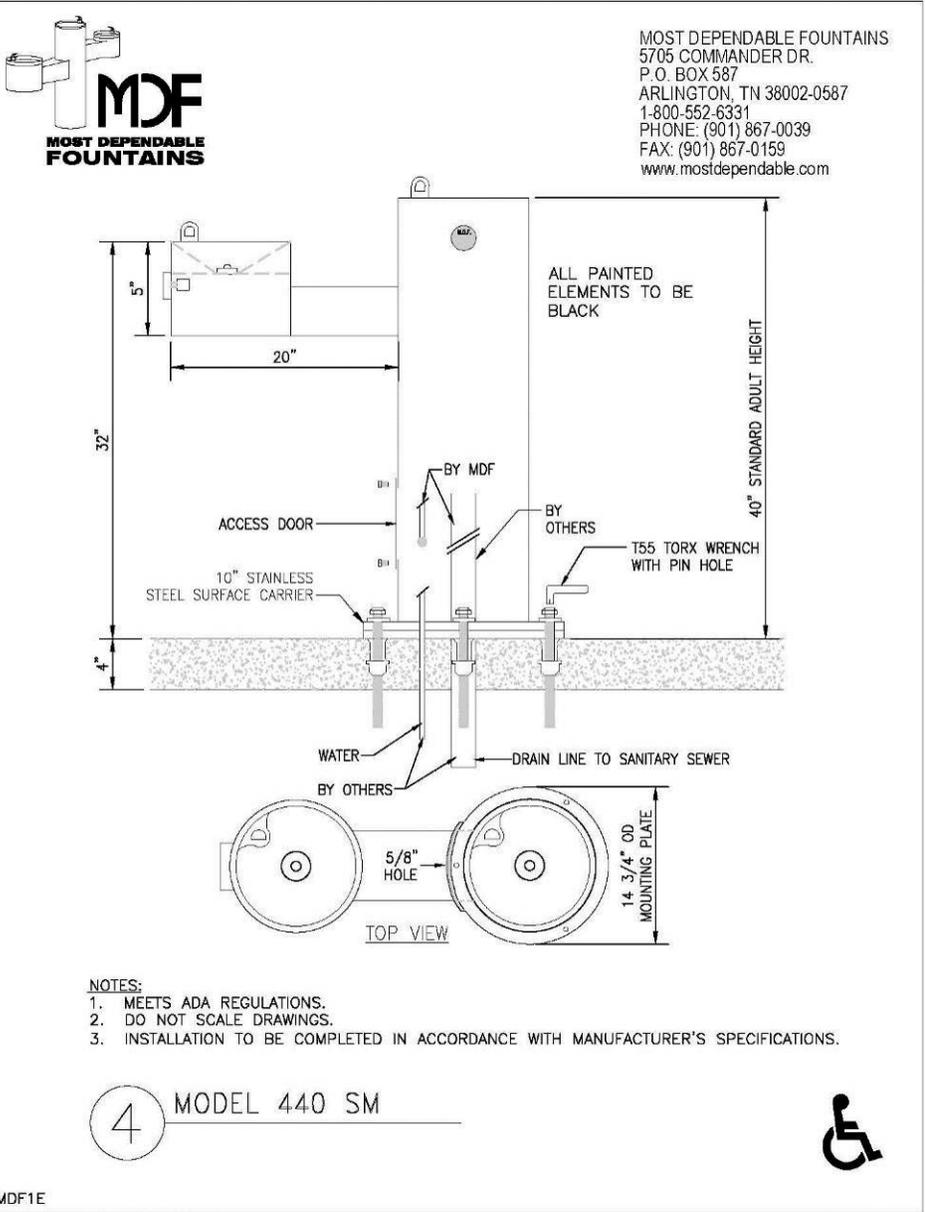
MODEL
 210-X

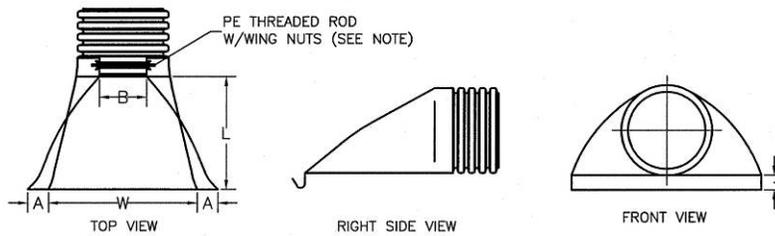


4 IRON MOUNTAIN FORGE GRILL 210-X
 NOT TO SCALE



3 IRON MOUNTAIN FORGE GRILL 205-X
NOT TO SCALE



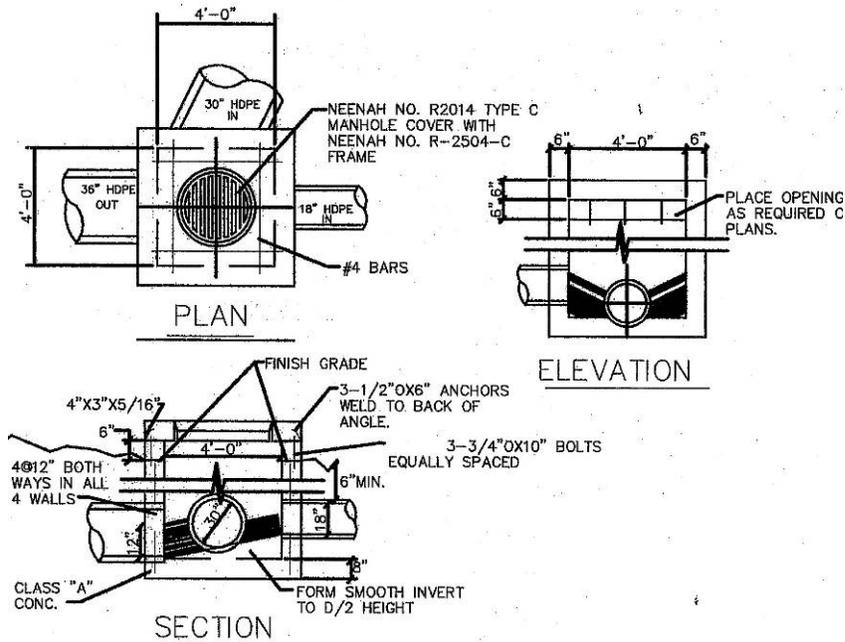


PART #	PIPE SIZE	A	B(MAX)	H	L	W
1210NP	12 in (300mm)	6.5 in (165mm)	10.00 in (254mm)	6.50 in (165mm)	25.00 in (635mm)	29.00 in (737mm)
1510NP	15 in (375mm)	6.5 in (165mm)	10.00 in (254mm)	6.50 in (165mm)	25.00 in (635mm)	29.00 in (737mm)
1810NP	18 in (450mm)	7.50 in (191mm)	15.00 in (381mm)	6.50 in (165mm)	32.00 in (813mm)	35.00 in (889mm)
2410NP	24 in (600mm)	7.50 in (191mm)	18.00 in (457mm)	6.50 in (165mm)	36.00 in (914mm)	45.00 in (1143mm)
3012NP	30 in (750mm)	10.50 in (267mm)	N/A	7.00 in (178mm)	53.00 in (1346mm)	68.00 in (1727mm)
3612NP	36 in (900mm)	10.50 in (267mm)	N/A	7.00 in (178mm)	53.00 in (1346mm)	68.00 in (1727mm)

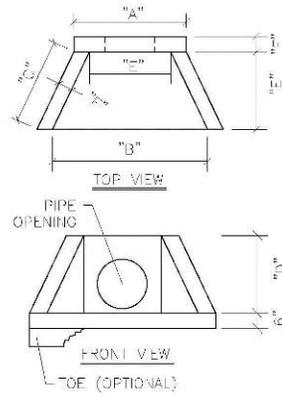
NOTE: ALL DIMENSIONS ARE NOMINAL

NOTE: PE THREADED ROD W/WING NUTS PROVIDED FOR END SECTIONS 12"-24". 30" & 36" END SECTIONS TO BE WELDED TO PIPE PER MANUFACTURER'S RECOMMENDATIONS.

10 FLARED END SECTION NTS



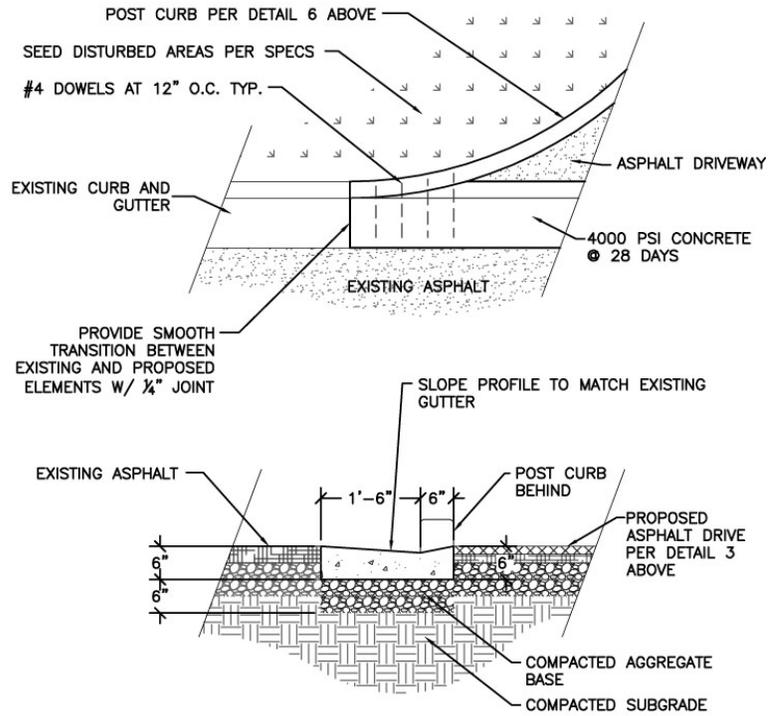
11 JUNCTION BOX NTS



DIMENSION TABLE			
SIZE	3'	4'	5'
"A"	28"	32"	36"
"B"	36"	48"	60"
"C"	22"	30"	38"
"D"	18"	25"	33"
"E"	20"	24"	28"
"F"	4"	5"	5"
MAX. OPS.	12"	18"	22"

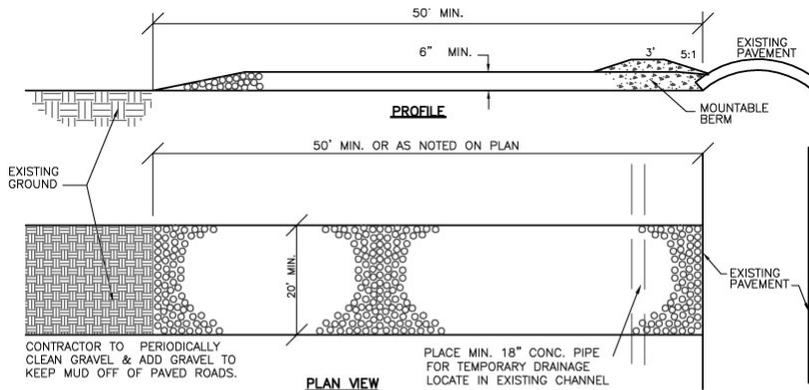
CONCRETE: 4000 PSI AT 28 DAYS REINFORCED WITH NO. 4 BARS 10" O.C. EACH WAY WITH WINGS AND TOE SLAB DOWELLED TO HEADWALL WITH NO. 5 BARS. 3/4" CHAMFER ON ALL EXPOSED EDGES.

10 PRECAST CONC. HEADWALLS



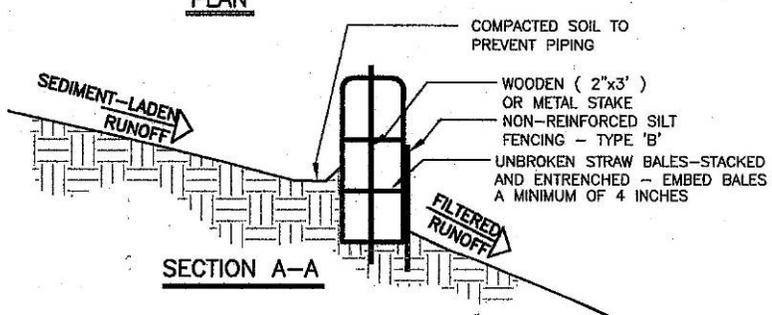
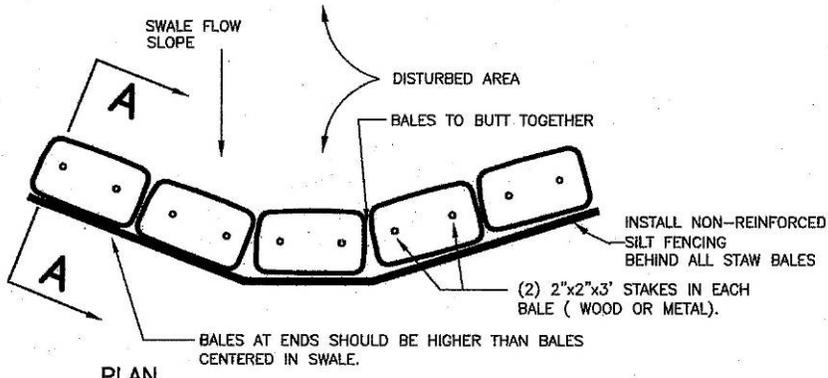
8 CHANNEL GUTTER NOT TO SCALE

Erosion Control

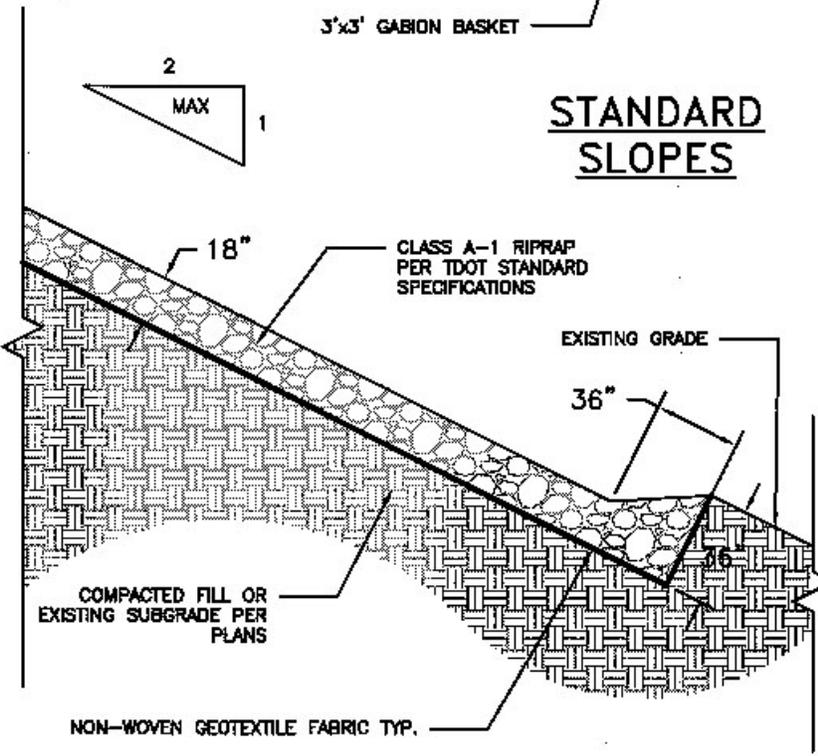
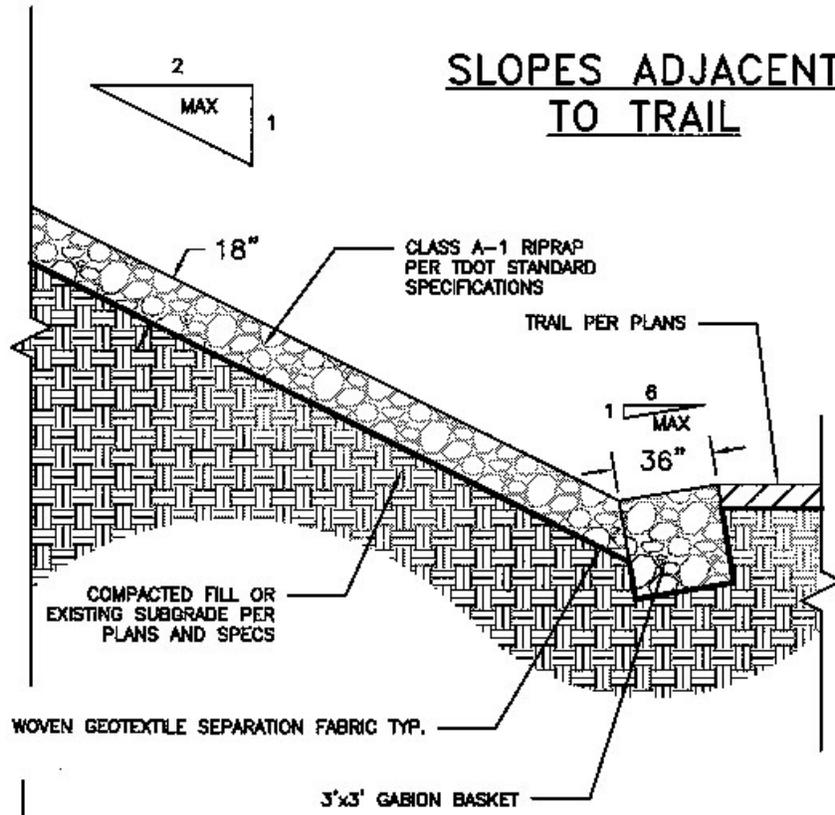


1. STONE SIZE- USE 1.5"-3.5" STONE, OR RECLAIMED OR RECYCLED CONC. EQUIVALENT.
2. LENGTH- AS REQUIRED, BUT NOT LESS THAN 50'. USE OF ENTRANCE NOT TO IMPACT EXISTING TREES, UTILITIES, OR PAVED SURFACES THROUGHOUT DURATION OF CONSTRUCTION.
3. THICKNESS- NOT LESS THAN SIX (6) INCHES.
4. WIDTH- TWENTY (20) FOOT MIN, BUT NOT LESS THAN THE FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS.
5. GEOTEXTILE BARRIER TO BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING OF STONE.
6. SURFACE WATER- ALL SURFACE WATER FLOWING OR DIVIDED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS THE ENTRANCE. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM W/5:1 SLOPES WILL BE PERMITTED.
7. MAINTENANCE- THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF EDIMENT ONTO PUBLIC RIGHT-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO PUBLIC RIGHT-OF-WAYS MUST BE REMOVED IMMEDIATELY.
8. WASHING- WHEELS SHALL BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO PUBLIC RIGHTS- OF- WAY. WHEN WASHING IS REQUIRED IT SHALL BE DONE ON AN AREA STABILIZED WITH STONE AND WHICH DONE INTO AN APPROVED SEDIMENT TRAPPING DEVICE.
9. PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED AFTER EACH RAIN.

11 STABILIZED CONSTRUCTION ENTRANCE N.T.S.



4 HAYBALE CHECK DAM NTS



6 RIPRAP SLOPE STABILIZATION

CRITICAL AREA VEGETATIVE PLAN

GENERAL:

THIS VEGETATIVE PLAN WILL BE CARRIED OUT ON CUT AND FILL SLOPES, SHOULDERS AND CRITICAL AREAS CREATED BY CONSTRUCTION. SEEDING WILL BE DONE AS SOON AS CONSTRUCTION IN AN AREA IS COMPLETED. PLANTINGS WILL BE MADE TO CONTROL EROSION, TO REDUCE DAMAGES FROM SEDIMENT AND RUNOFF TO DOWNSTREAM AREAS AND TO IMPROVE THE SAFETY AND BEAUTY OF THE DEVELOPMENT AREA. NO AREA SHALL BE CLEAR OF VEGETATION FOR MORE THAN 14 CALENDAR DAYS. SUBMIT PROPOSED SEED VARIETIES FOR LANDSCAPE ARCHITECTS APPROVAL.

SOIL CONDITIONS:

DUE TO GRADING AND CONSTRUCTION, THE AREAS TO BE TREATED ARE MAINLY SUBSOIL SUBSTRATA. FERTILITY IS LOW AND THE PHYSICAL CHARACTERISTICS OF THE EXPOSED MATERIAL ARE UNFAVORABLE TO ALL BUT THE MOST HARDY PLANTS. CONTRACTOR TO PROVIDE SOIL TESTING DATA AT A MINIMUM OF 5 LOCATIONS THROUGHOUT THE SITE AND LAB RECOMMENDED LIME AND FERTILIZER APPLICATION RATES, IF DIFFERENT FROM BELOW.

CONVENTIONAL SEEDING EQUIPMENT:

GRADE, SHAPE AND SMOOTH WHERE NEEDED TO PROVIDE FOR SAFE EQUIPMENT OPERATION AT SEEDING TIME AND FOR MAINTENANCE PURPOSES. THE LIME AND FERTILIZER IN DRY FORM WILL BE SPREAD UNIFORMLY OVER THE AREA IMMEDIATELY BEFORE SEEDBED PREPARATION. A SEEDBED WILL BE PREPARED BY SCARIFYING TO A DEPTH OF 1 TO 4 INCHES AS DETERMINED ON SITE. THE SEEDBED MUST BE WELL PULVERIZED, SMOOTHED AND FIRMED. SEEDING WILL BE DONE WITH CULTIPACKER-SEEDER, DRILL, ROTARY SEEDER OR OTHER MECHANICAL OR HAND SEEDER. SEED WILL BE DISTRIBUTED UNIFORMLY OVER A FRESHLY PREPARED SEEDBED AND COVERED LIGHTLY. WITHIN 24 HOURS AFTER SEEDING, STRAW OR HAY MULCH WILL BE SPREAD UNIFORMLY OVER THE AREA, LEAVING ABOUT 25 PERCENT OF THE GROUND SURFACE EXPOSED. MULCH WILL BE SPREAD WITH BLOWER-TYPE MULCH EQUIPMENT OR BY HAND AND ANCHORED IMMEDIATELY AS IT IS SPREAD. A DISK HARROW WITH THE DISK SET OR A SPECIAL PACKER DISK MAY BE USED TO PRESS THE MULCH INTO THE SOIL. THE PER ACRE APPLICATION RATES ARE AS FOLLOWS:

A. PERMANENT SEEDING WITH MULCH:(CONVENTIONAL SEEDING EQUIPMENT)

AGRICULTURAL LIMESTONE	2000 LBS./ACRE
FERTILIZER, 5-10-15	1500 LBS./ACRE
MULCH:	
STRAW	4000 LBS./ACRE
OR HAY	5000 LBS./ACRE

<u>SEEDING SPECIES</u>	<u>APPLICATION RATE/ACRE</u>	<u>PLANTING DATES</u>
HARD FESCUE	130 LBS.	3/1-5/1
CHEWINGS FESCUE	40 LBS.	OR 8/15-12/1
 HAY MULCH FOR TEMP. COVER	 5000 LBS.	 5/1-8/15

B. TOP DRESSING: APPLY WHEN PLANTS ARE 2 TO 4 INCHES TALL

FERTILIZER(AMMONIUM NITRATE 33.5%)	300 LBS./ACRE
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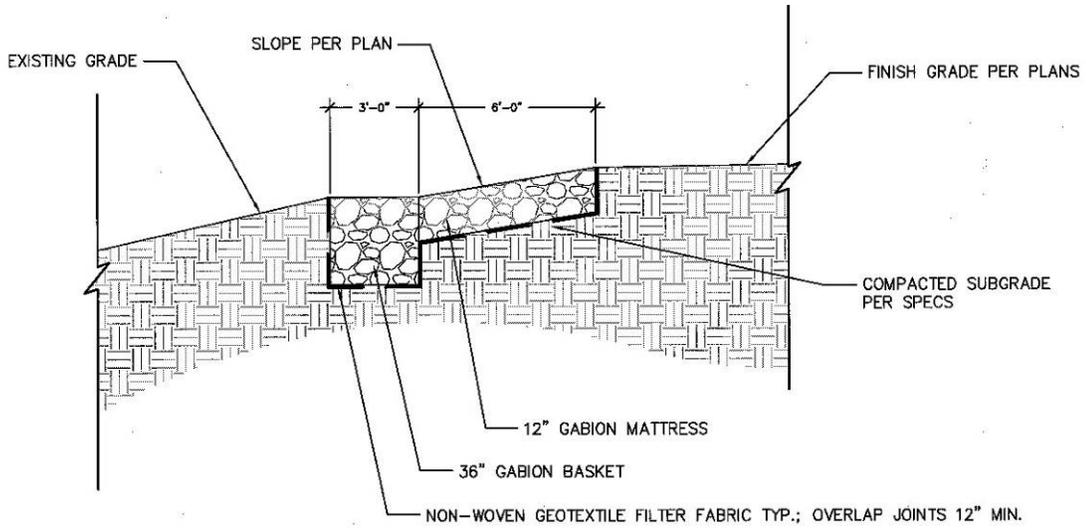
C. TEMPORARY SEEDING WITH MULCH:(CONVENTIONAL SEEDING EQUIPMENT)

AGRICULTURAL LIMESTONE	500 LBS./ACRE
FERTILIZER, 5-10-15	300 LBS./ACRE
MULCH:	
STRAW	4000 LBS./ACRE
OR HAY	5000 LBS./ACRE

<u>SEEDING SPECIES</u>	<u>APPLICATION RATE/ACRE</u>	<u>PLANTING DATES</u>
ITALIAN RYE	28 LBS.	1/1-5/1
ANNUAL LESPEDEZA	10 LBS.	
SUMMER OATS	32 LBS.	
 STAR MILLET	 40 LBS.	 5/1-7/15
 BALBOA RYE	 28 LBS.	 7/15-1/1
ITALIAN RYE	28 LBS.	

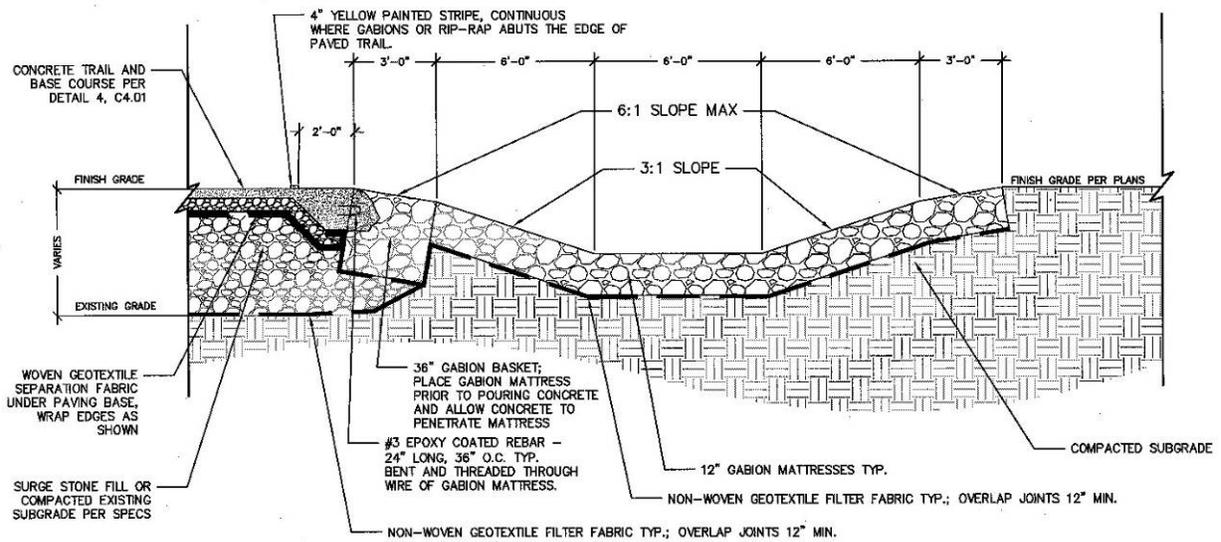


5 DISTURBED AREA STABILIZATION DETAILS



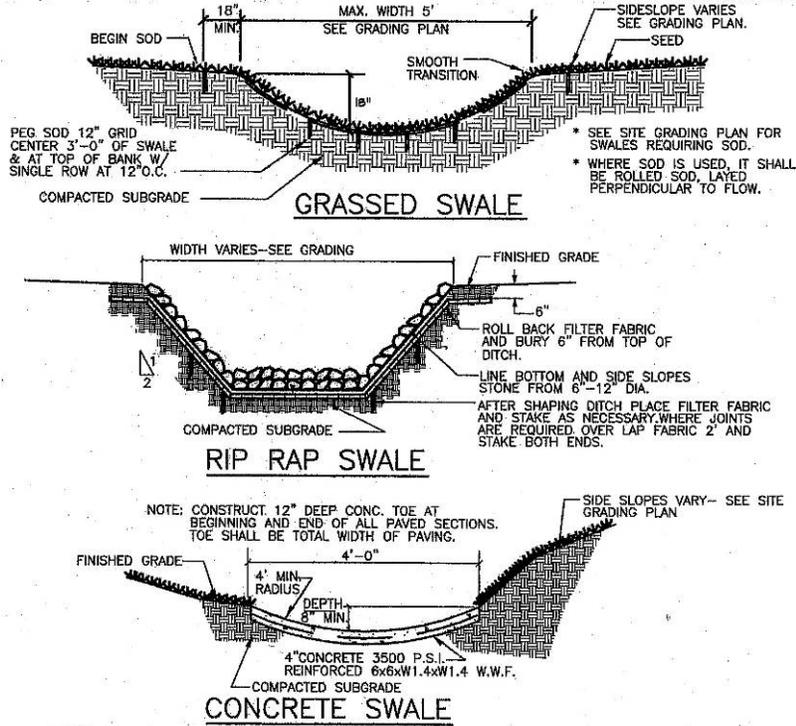
3 SHORELINE PROTECTION

NTS

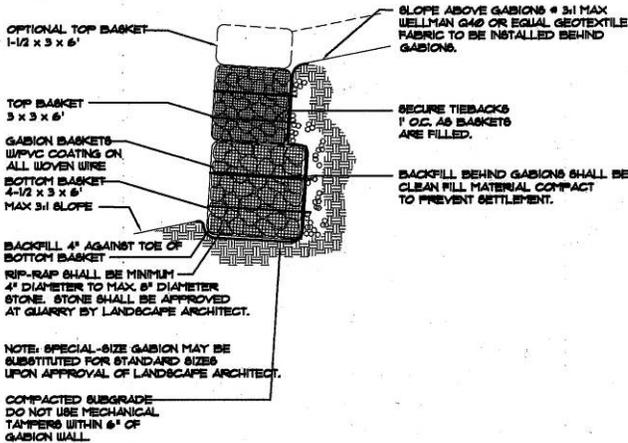


2 TRAPEZOIDAL SWALES

NTS



7 STANDARD SWALES



NOTES ON GABIONS:

CONTRACTOR TO CONSULT MACCAFERRI GABIONS, INC. ON INSTALLATION OF EACH GABION APPLICATION.

IN ALL PHASES OF GABION CONSTRUCTION CONTRACTOR SHALL FOLLOW INSTRUCTION MANUAL ISSUED BY MACCAFERRI GABIONS, INC. MACCAFERRI GABION AND RENO MATTRESS CONSTRUCTION- A FIELD INSPECTOR'S GUIDE.

GABIONS TO BE ANCHORED AND STRETCHED TO FOLLOW CURVATURE OF TRAIL.

ROCK BOXES WILL BE REQUIRED FOR GABION CONSTRUCTION. NO DUMPING OF GABION STONE WILL BE ALLOWED.

FILL CONDITIONS WILL BE USED TO DETERMINE TRANSITION POINT FROM ONE GABION BASKET TO STACK OF TWO GABION BASKETS.

A 3 x 3 x 6' GABION MAY BE USED FOR THE BOTTOM BASKET ONLY WHEN STACKING BASKETS IS NOT REQUIRED.

THE BOTTOM BASKET MUST BE A 4-1/2 x 3 x 6' BASKET WHEN STACKING BASKETS IS REQUIRED.

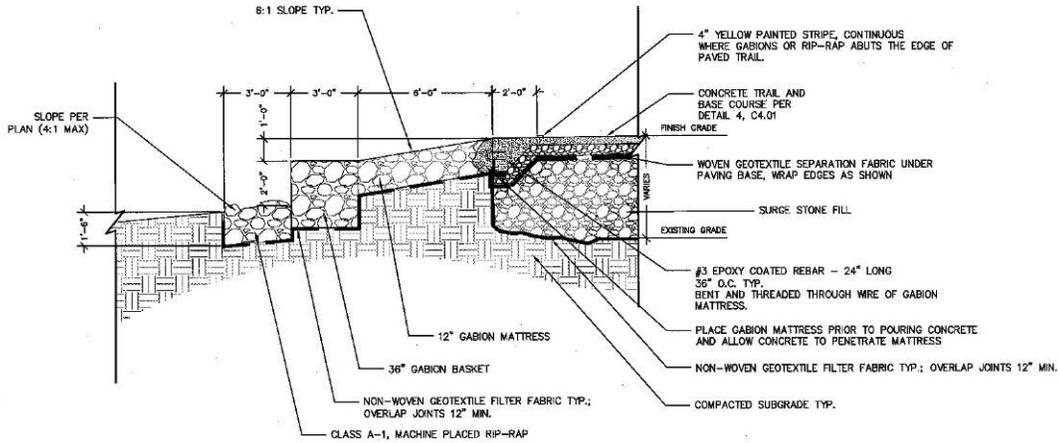
A 1-1/2 x 3 x 6' BASKET MAY BE USED TO INCREASE THE GABION WALL HEIGHT. 1-1/2 x 3 x 6' BASKETS SHALL BE USED AS THE TOP BASKET ONLY.

11 TYPICAL GABION CONSTRUCTION

NTS

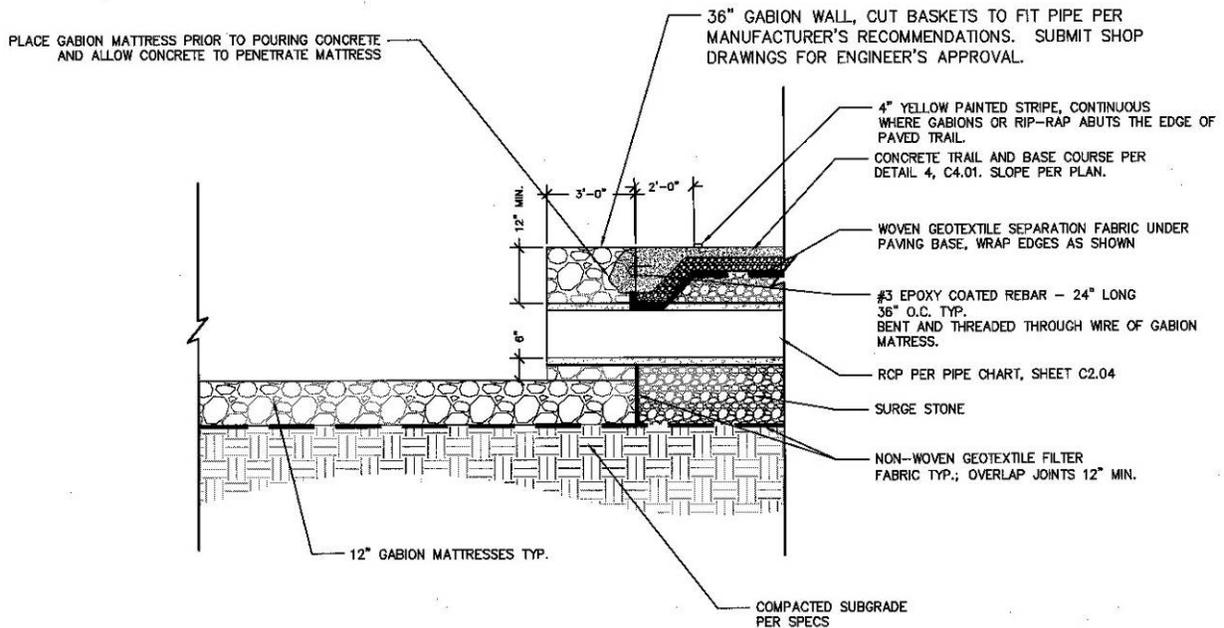
GABION NOTES:

1. FILL GABIONS WITH CLASS A-1 (MIN. ROCK SIZE OF 4"), MACHINE PLACED RIP-RAP. SUBMIT MANUFACTURER'S RECOMMENDED FILL FOR ENGINEER'S APPROVAL IF DIFFERENT FROM ABOVE.
2. ASSEMBLE AND WIRE ALL GABION STRUCTURES TOGETHER PER MANUFACTURER'S RECOMMENDATIONS.
3. SEE MANUFACTURER'S RECOMMENDATIONS FOR FITTING GABIONS TO A RADIUS.



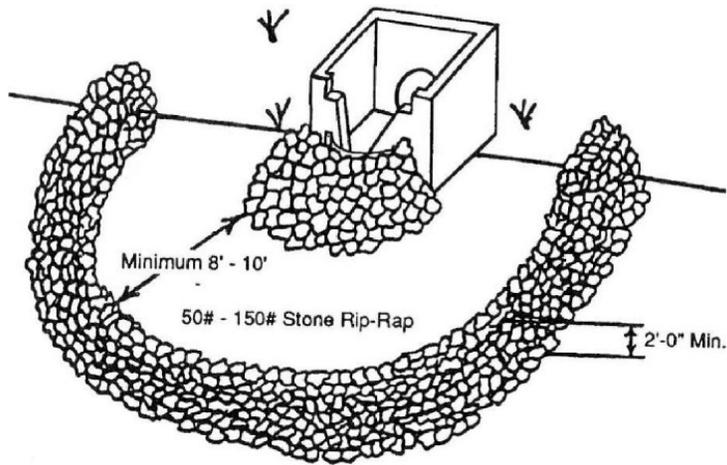
1 GABION RETAINING WALL SECTION

NTS



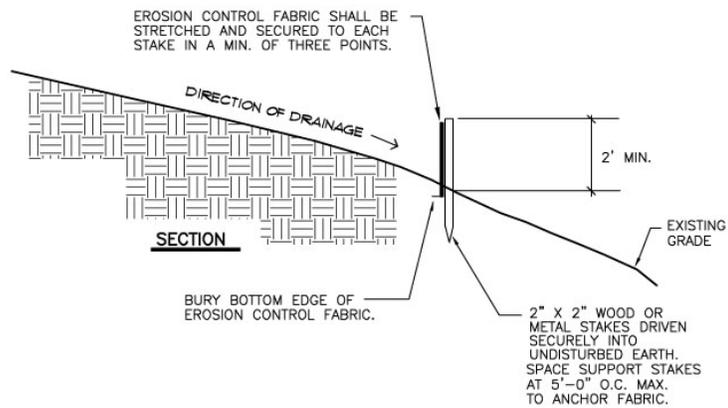
4 GABION HEADWALL

NTS



4 TEMPORARY FILTER RING NTS

- NOTES:
1. FENCE TO BE INSTALLED PRIOR TO EXCAVATION OR BACKFILLING. FENCE TO RUN ENTIRE LENGTH OF TRAIL ALONG THE DOWN HILL SIDE.
 2. CONTRACTOR IS TO MAINTAIN FENCE UNTIL VEGETATION IS ESTABLISHED; THEN REMOVE FENCE AND ANY ACCUMULATED SEDIMENT.
 3. CONTRACTOR MAY SUBSTITUTE APPROVED PRE-ASSEMBLED FENCE.
 4. TO BE INSTALLED AS LIMITS OF CONSTRUCTION PRIOR TO BEGINNING CONSTRUCTION



5 SILT FENCE / LIMITS OF CONSTRUCTION NTS

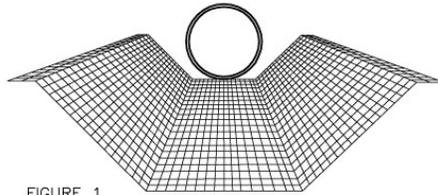


FIGURE 1

IN CHANNELS, ROLL OUT STRIPS OF NETTING PARRALLEL TO THE DIRECTION OF FLOW.

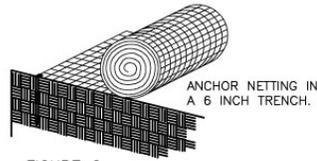


FIGURE 2

ANCHOR NETTING IN A 6 INCH TRENCH.

NOTE:

CONTRACTOR SHALL USE "EXCELSIOR" BLANKET OR SIMILAR WOOD FIBER MATTING OF BIODEGRADABLE TYPE.

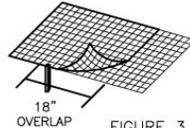


FIGURE 3

JOIN STRIPS BY ANCHORING AND OVERLAPPING.

INSTALLATION INSTRUCTIONS:

1. SEED (PER SPEC) BEFORE PLACEMENT OF MATTING. ROLL STRIPS OUT PARALLEL TO THE DIRECTION OF WATER FLOW (SEE FIGURE 1)
2. START LAYING THE NET FROM THE TOP OF THE CHANNEL OR SLOPE AND UNROLL IT DOWN THE GRADE. ALLOW MATTING TO LAY LOOSELY ON THE SOIL BUT WITHOUT WRINKLES— DO NOT STRETCH.
3. TO SECURE THE NET, BURY THE UPSLOPE END IN A TRENCH NO LESS THAN 6" DEEP, COVER WITH SOIL AND TAMP FIRMLY (SEE FIGURE 2). STAPLE THE MAT EVERY 12" ACROSS THE TOP END AND EVERY 3' AROUND THE EDGES AND BOTTOM. WHERE 2 STRIPS OF NET ARE LAID SIDE BY SIDE, THE ADJACENT EDGES SHOULD BE OVERLAPPED 3 INCHES AND STAPLED TOGETHER. EACH STRIP OF MATTING SHOULD ALSO BE STAPLED DOWN THE CENTER, EVERY 3'. DO NOT STRETCH THE MAT WHEN APPLYING STAPLES.
4. TO JOIN TWO STRIPS, CUT A TRENCH TO ANCHOR THE END OF THE NEW MAT. OVERLAP THE END OF THE PREVIOUS ROLL 18" (SEE FIGURE 2), AND STAPLE EVERY 12" JUST BELOW THE ANCHOR SLOT.
5. ON 3:1 OR SIMILAR BANK INSTALLATIONS, FOLLOW MANUFACTURERS INSTALLATION REQUIREMENTS.

6

EROSION CONTROL MATTING

NTS

NOTE: ALL PERMANENT MATTING TO BE CONTECH TRM 35 OR APPROVED EQUAL. CONTRACTOR TO INSTALL PER MANUFACTURES RECOMMENDATIONS.



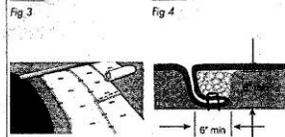
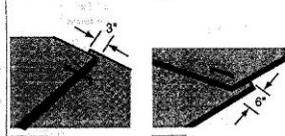
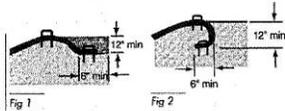
Erosion Control Blanket and TRM Installation Guide

General

Site Preparation (Channel and Slope) – Grade the surface of installation areas so that the ground is smooth and compact. When seeding prior to installation, prepare for seeding by loosening the top 2" to 3" of soil. All gullies, rills, and any other disturbed areas must be fine graded prior to installation. Spread seed before or after mat installation as directed. (Important: Remove all large rocks, dirt clods, stumps, roots, grass clumps, trash, and other obstructions from the soil surface to allow for intimate contact between the soil surface and the mat.)

Slopes

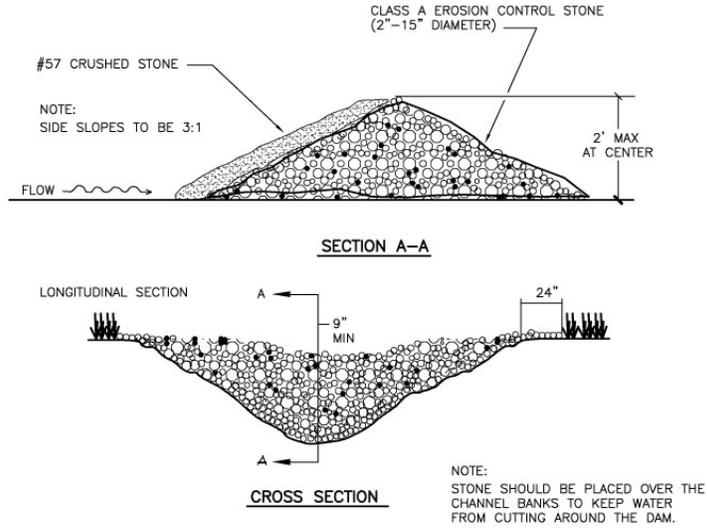
1. Anchor blankets 2" to 3" over the top of slope as in Fig. 1 or Fig. 2. Pin the mat at 1' intervals along the anchor trench bottom.
2. Working backward down the slope, allow the blanket to unroll slowly; ideally the blanket roll will roll against your shin as you work. Place blankets loosely but without slack. The blanket must lie so intimate contact with the soil to perform properly.
3. Staple blanket according to recommended staple pattern for specific product and slope. (See staple pattern guide.)
4. Overlap blanket edges (side-to-side) approximately 3" and staple according to Fig. 3. Note: install blankets so edge overlaps are slanted away from prevailing winds.
5. Overlap blanket ends 6" (15 cm), with upper blanket over lower blanket, and staple at 1' intervals (see Fig. 4 and Fig. 4A) across the width of the blanket.
6. Cut across blanket with scissors and anchor at end of slope.
7. If installation plan specifies "check ditches", see Fig. 5.



3

PERMANENT EROSION CONTROL MATTING

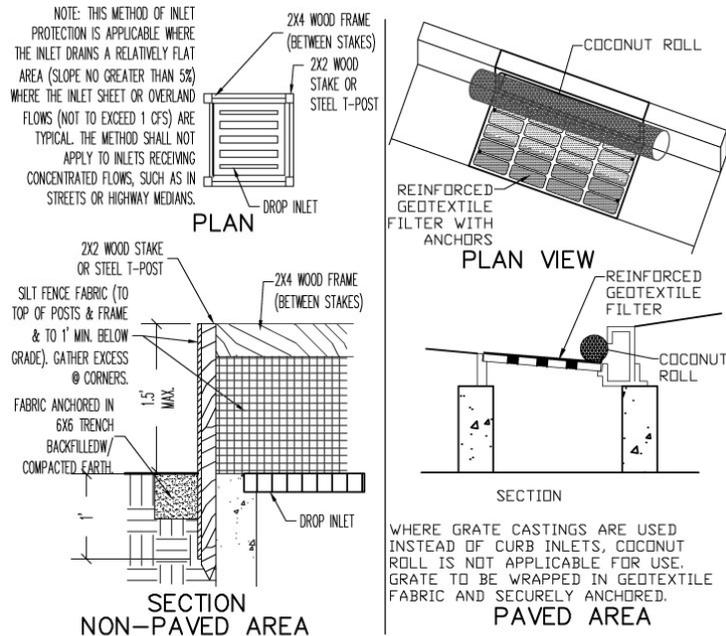
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8

STONE CHECK DAM

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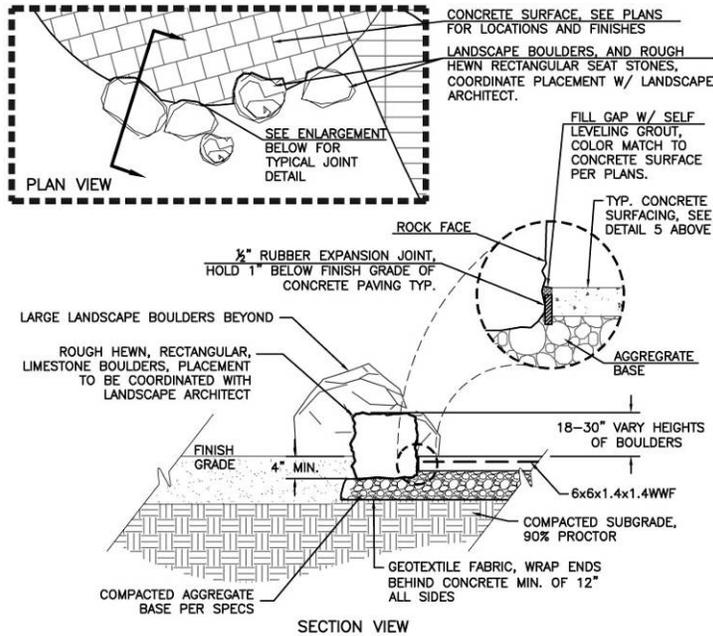
12

INLET PROTECTION

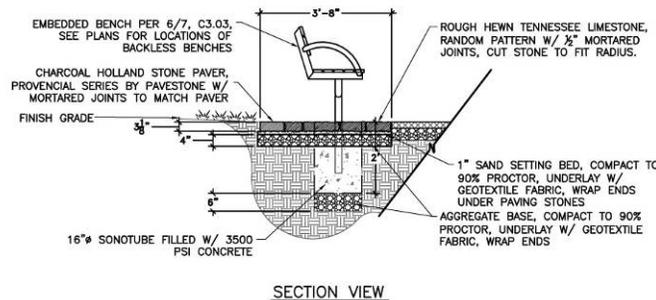
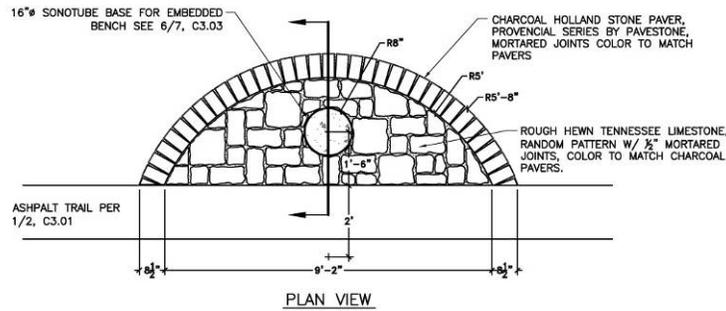
N.T.S.

1.10 GATEWAY TRAIL DETAILS

Paving

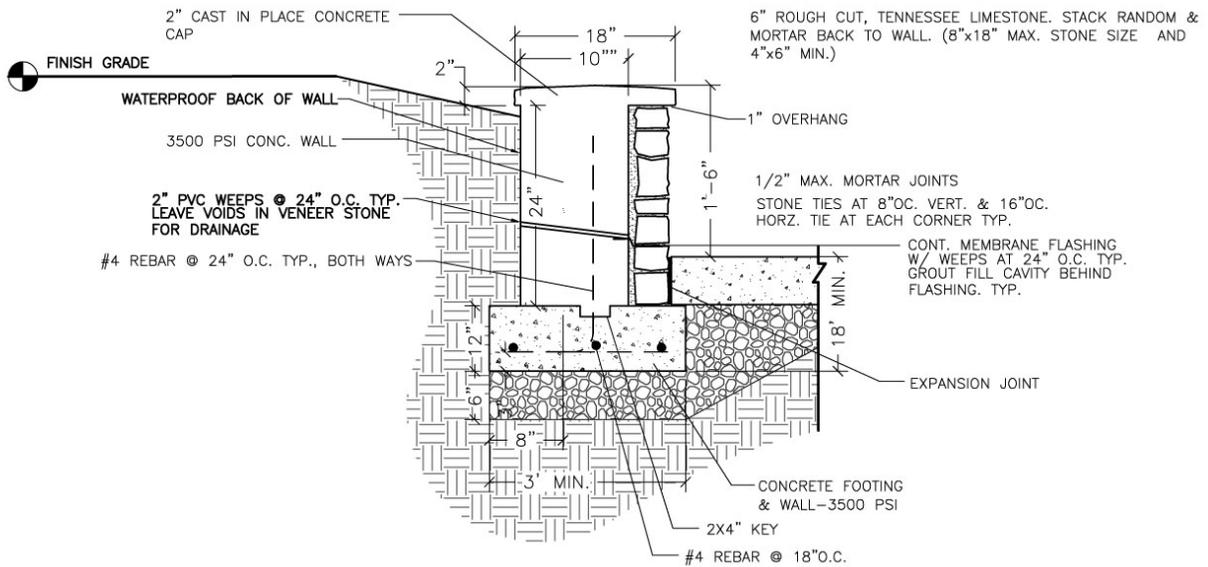


9 CONCRETE PLAZA/STONE INTERFACE
NOT TO SCALE



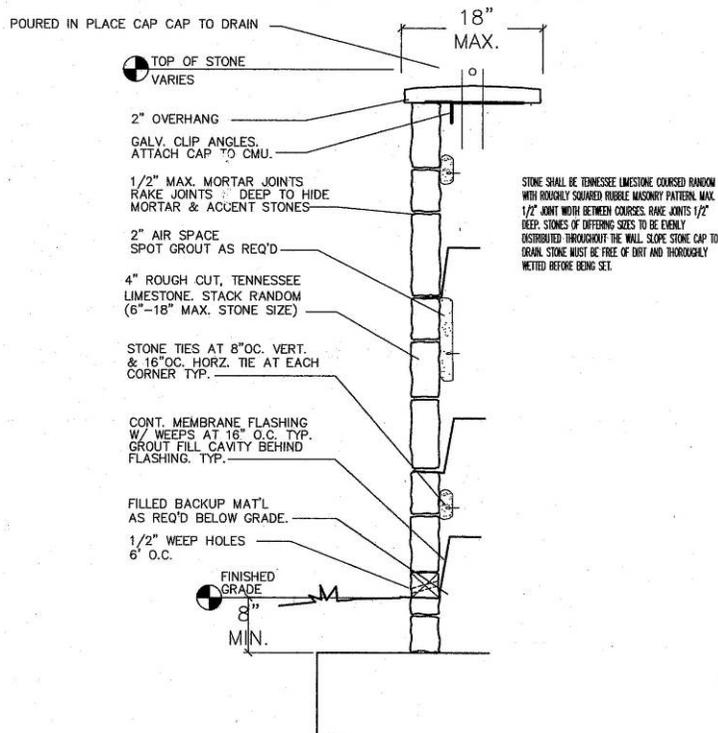
2 BENCH BASE
1/2" = 1'-0"

Walls



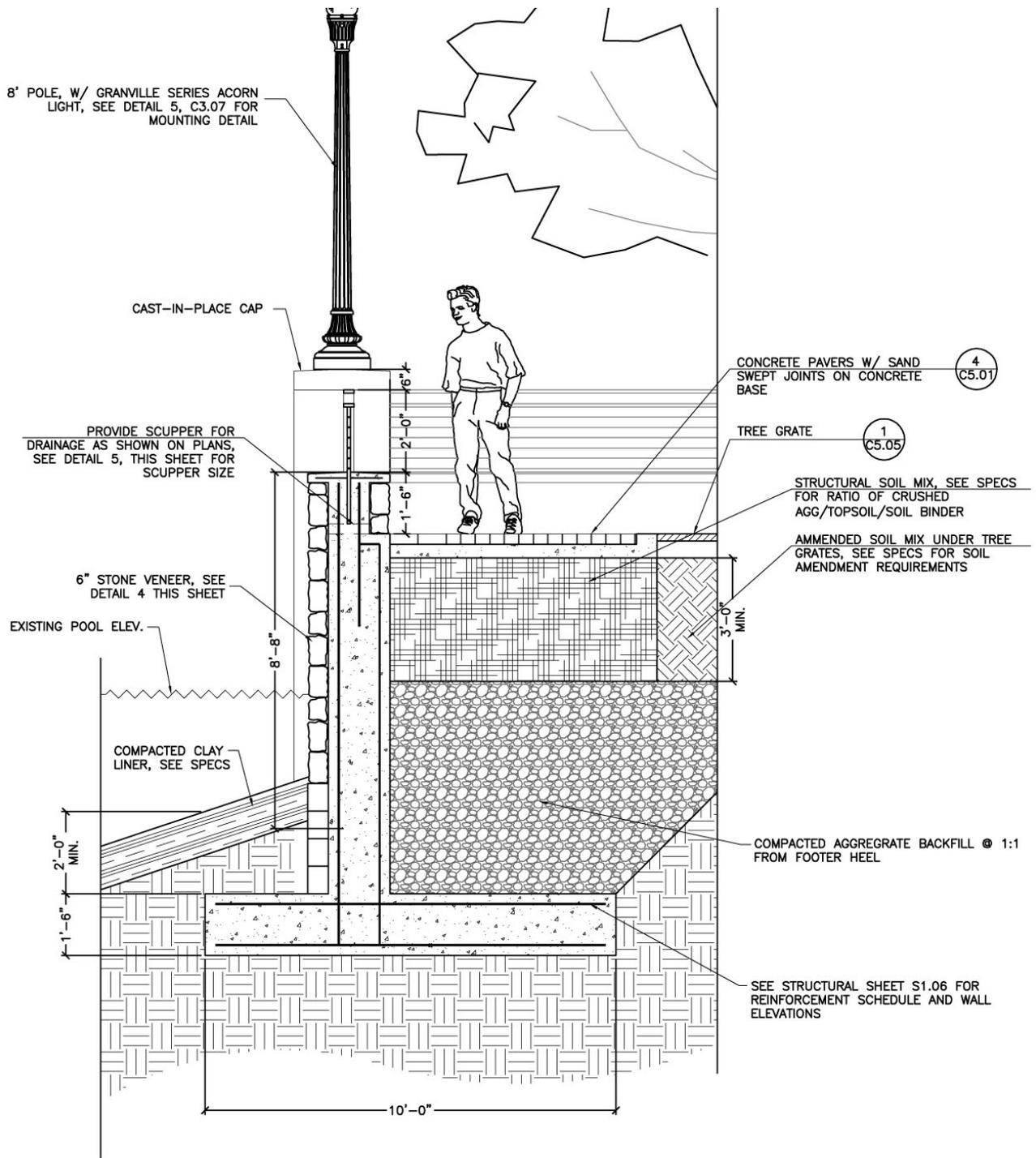
2 SEAT WALL

N.T.S.



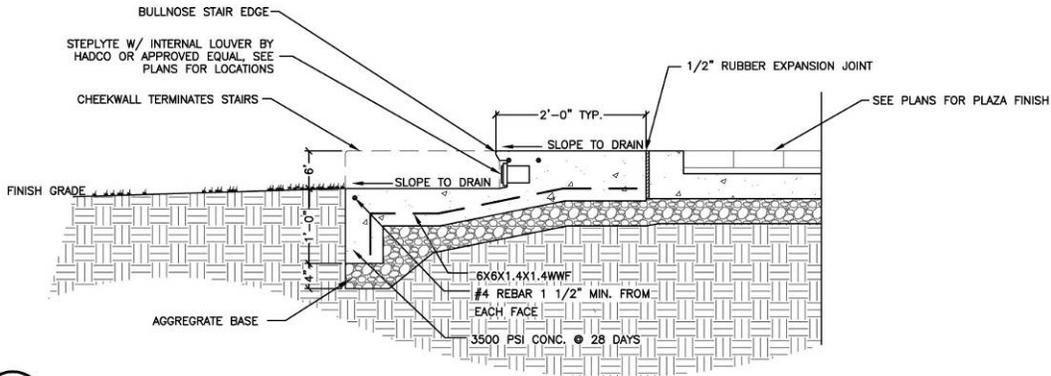
4 STONE VENEER DETAIL

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3 RETAINING WALL SECTION
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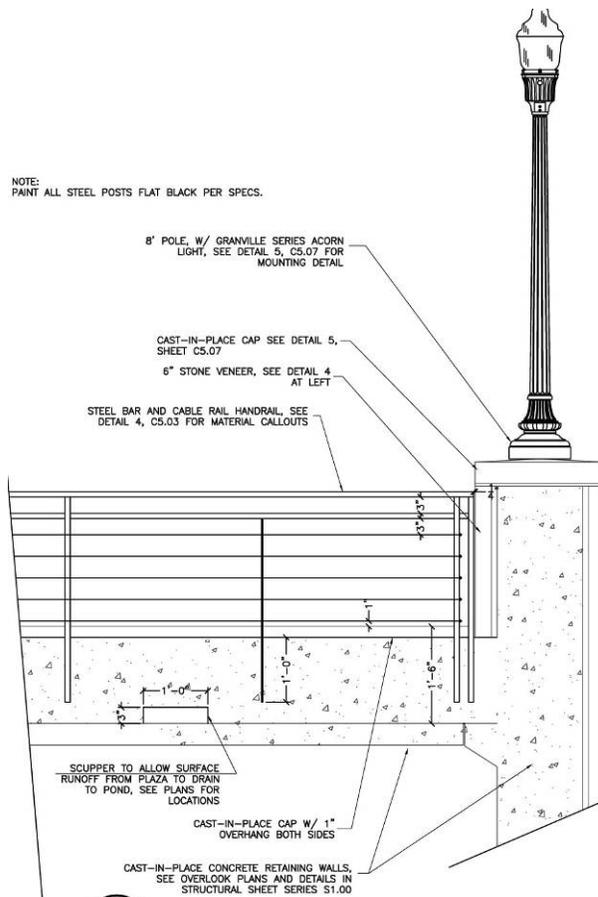
Stairs



1 STAIR DETAIL

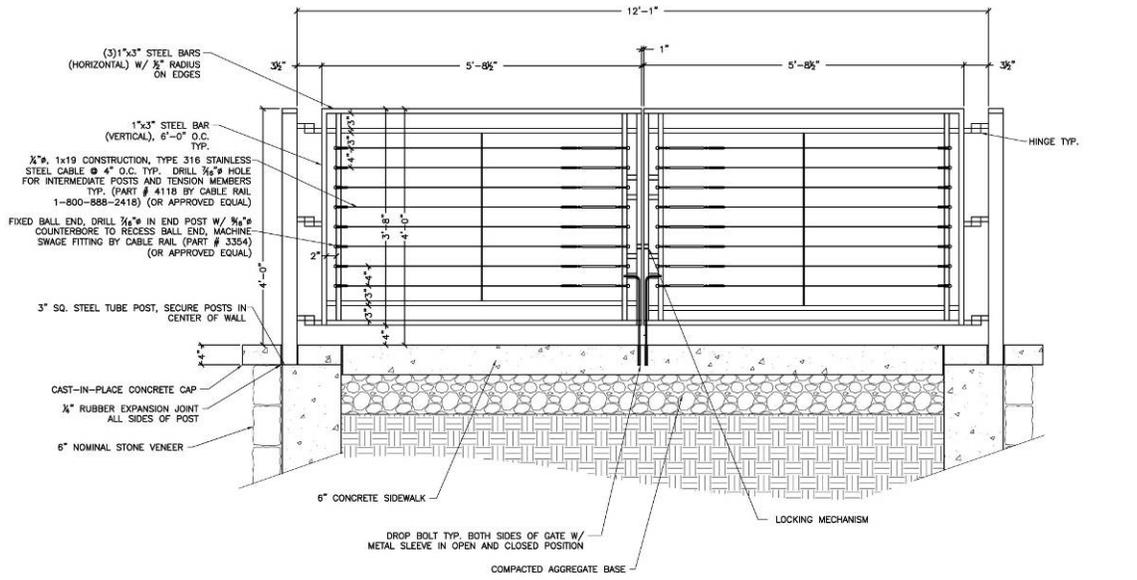
N.T.S.

Fencing



5 RAILING DETAIL

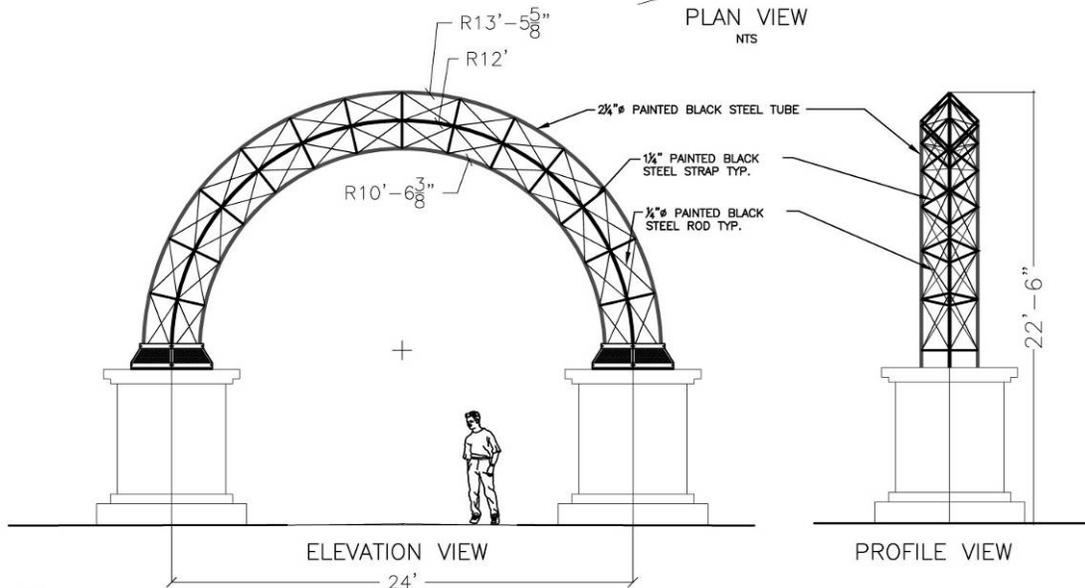
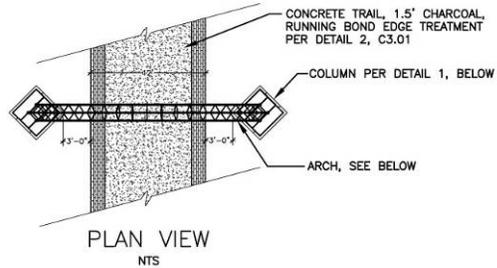
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2 ISLAND GATES

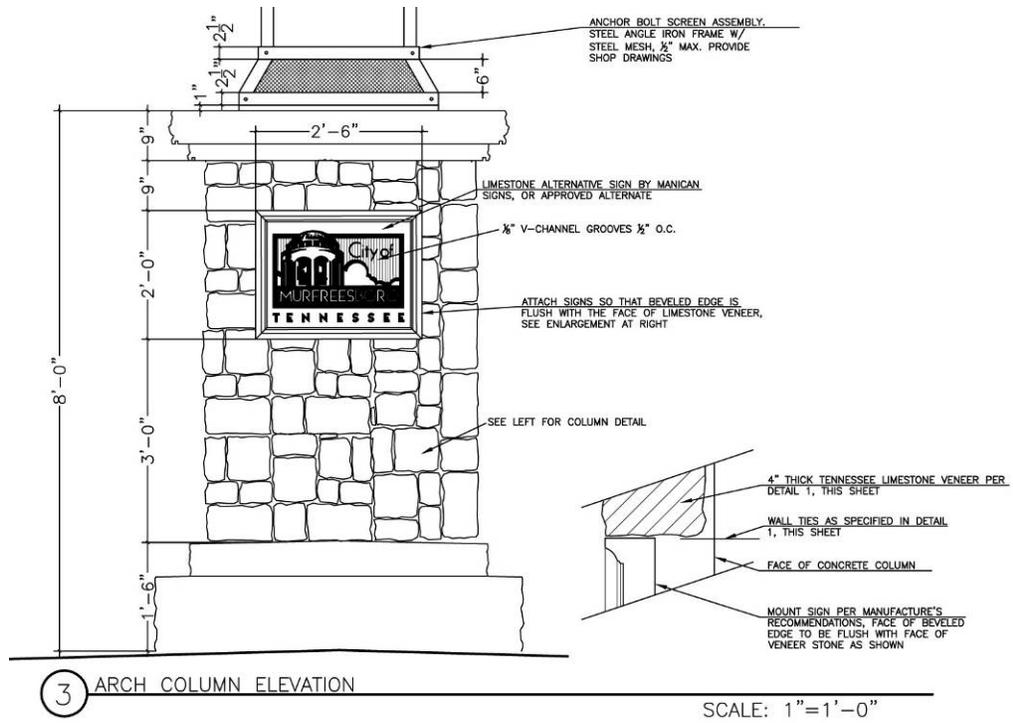
Gateway Arch

- ARCH NOTES:
1. ALL MEMBERS TO BE BLACK ANODIZED ALUMINUM TUBING, SEE BELOW FOR DIMENSIONS.
 2. ALL MATERIALS TO BE CHEMICALLY CLEANED PRIOR TO WELDING FOR OPTIMAL MATERIAL FUSION.
 3. ALL WELDS TO BE MADE WITH A T.I.G WELDER AND OPERATOR SHALL MAINTAIN CLEAN, CONTINUOUS, UNIFORM WELDS.
 4. ALL VISIBLE WELDS ARE TO BE COMPLETELY FREE OF GAPS, SPLATTERS, AND SPURS. GRIND, FILL, OR REMOVE MATERIAL TO CORRECT ANY DISCONTINUITIES.
 5. CONTRACTOR TO SUBMIT SHOP DRAWINGS AND SAMPLES FOR OWNER'S REPRESENTATIVE'S APPROVAL PRIOR TO CONSTRUCTION.

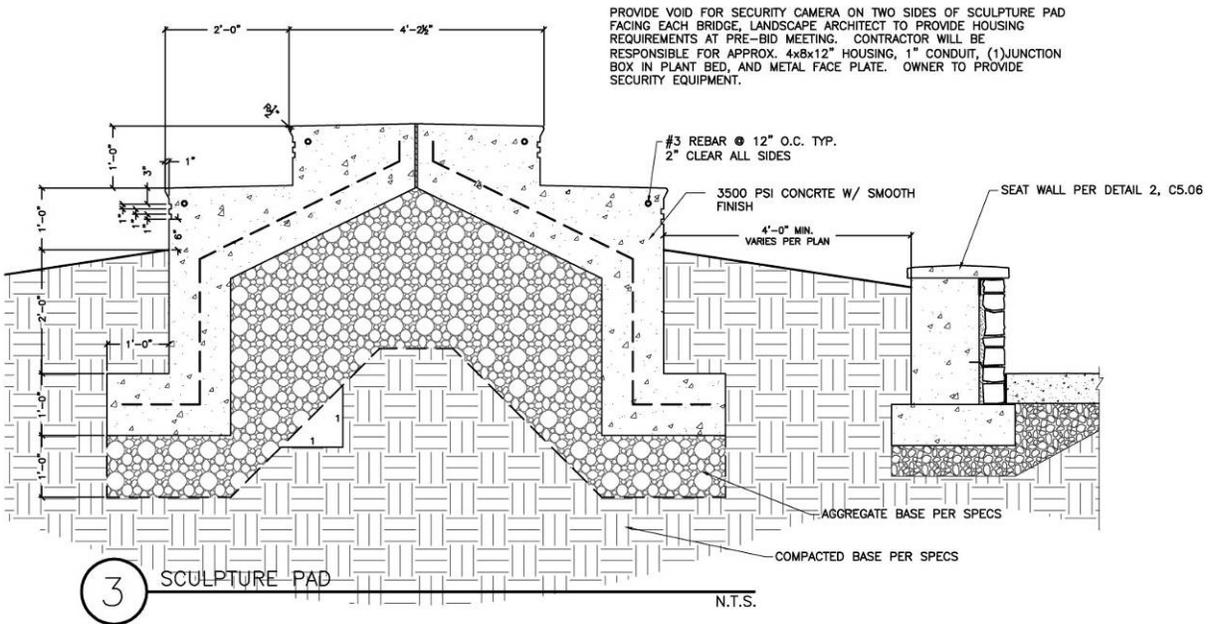


2 GATEWAY ARCH DETAIL

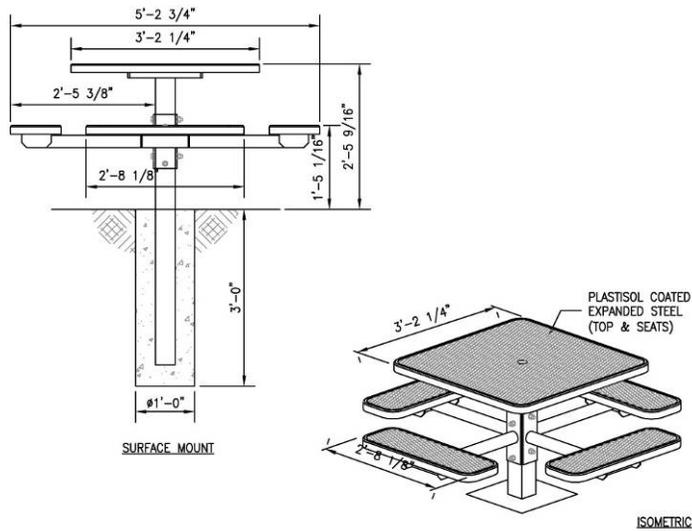
SCALE 1/2" = 1'-0"



Sculpture Pad



Site Furnishings



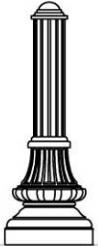
NOTES:

1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. CONTACT LITCHFIELD INDUSTRIES FOR DIMENSIONAL INFORMATION AND SPECIFICATIONS.
4. REFERENCE NUMBER 175-156.

3 SURVIVOR SERIES TABLES
MODEL 4600, 3 FT. SQUARE

WADSWORTH Series

Cast Aluminum Bollard



BOL/W42/14/BT-CA/BK

Specifications

DESCRIPTION: The bollard shall be cast aluminum construction with a 12" dia shaft and a classic tapered and fluted base. The bollard shall be provided with a cast aluminum ball or dome top.

MATERIALS: The bollard and top shall be heavy wall, cast aluminum produced from certified ASTM 356.1 ingot per ASTM B179-95a or ASTM B26-95. The castings shall be formed true to the pattern with complete detail. The fluted shaft shall be an aluminum extrusion, 6061 alloy, heat treated to T6 temper. All exposed hard-ware shall be tamper resistant stainless steel. Anchor bolts to be completely hot dip galvanized.

CONSTRUCTION: The bollard and top shall be one-piece construction with a fluted shaft and cast ball or dome top welded to the top. All exposed welds shall be ground smooth. All welding shall be per ANSI/AWS D12-90. All welders shall be certified per Section 5 of ANSI/AWS D12-90.

DIMENSIONS: The bollard shall be 3'-3" or 3'-0" in height with an 11" diameter base, a 5" diameter shaft, and a 5" diameter ball or 5.5" diameter dome top.

INSTALLATION: The bollard shall be provided with four 3/4" diameter, hot dip galvanized L-type anchor bolts to be installed on a 10.5" ball circle. A door shall be provided in the base for anchorage access.

For finish specifications and color options, see "Finish" section in catalog.

ORDERING GUIDE

catalog number:
BOL/W42/14/14/BT-CA/BK-2

Notes: (check appropriate boxes)
 BOL/W38-14DT (Bollard with Dome Top)
 BOL/W42/14BT (Bollard with Ball Top)

Material/Finish:

Code	Description
CA/BK	Cast Aluminum/Black
CA/DG	Cast Aluminum/Dark Green
CA/DB	Cast Aluminum/Dark Bronze
CA/PP	Cast Aluminum/Pewter Plated
CA/CC	Cast Aluminum/Custom Color

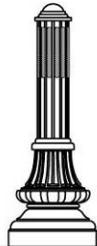
(for complete finish and color options, see "Finish" section in catalog)

Optional Equipment:

Code	Description
SB	Eyebolt mounted on bollard for use with chain by others.
Q	Weatherproof Dome/Receptacle mounted inside base.
DBB	Direct Burial Base for mounting without a concrete footing.
CLD	Custom Logic (see into access door).

WADSWORTH Series

Cast Aluminum Lighted Bollard



BOL/W42/14/BLT-CA/BK

Specifications

DESCRIPTION: The bollard shall be cast aluminum construction with a 12" dia shaft and a classic tapered and fluted base. The bollard shall be provided with an optical assembly mounted inside the shaft providing a I.E.S. Type V distribution with a cast aluminum ball or dome top.

MATERIALS: The bollard and top shall be heavy wall, cast aluminum produced from certified ASTM 356.1 ingot per ASTM B179-95a or ASTM B26-95. The castings shall be formed true to the pattern with complete detail. The fluted shaft shall be an aluminum extrusion, 6061 alloy, heat treated to T6 temper. The lens shall be white acrylic. All exposed hardware shall be tamper resistant stainless steel. Anchor bolts to be completely hot dip galvanized.

CONSTRUCTION: The bollard shall be one-piece construction. The optical assembly shall be secured inside the shaft. All exposed inside shall be ground smooth. All welding shall be per ANSI/AWS D12-90. All welders shall be certified per Section 5 of ANSI/AWS D12-90.

DIMENSIONS: The bollard shall be 3'-3" or 3'-0" in height with an 11" diameter base, a 5" diameter shaft, and a 5" diameter ball or 5.5" diameter dome top.

INSTALLATION: The bollard shall be provided with four 3/4" diameter, hot dip galvanized L-type anchor bolts to be installed on an 10.5" ball circle. A door shall be provided in the base for anchorage and wiring access. The bollard top shall be removable for optical assembly access.

LIGHT SOURCE: The lighted bollards shall be furnished with an H.I.D. ballast and socket assembly. Sockets shall be gasket porcelain, mogul or medium base, with a copper alloy metal plated screw shaft and center contact. The bollard shall have a core and coil, high power factor, regulating type.

For finish specifications and color options, see "Finish" section in catalog.

ORDERING GUIDE

catalog number:
BOL/W42/14/14/DT/14/CA/BK-470-112

Notes: (check appropriate boxes)
 BOL/W38-14DTL (Bollard with Dome Top)
 BOL/W42/14BTL (Bollard with Ball Top)

Material/Finish:

Code	Description
CA/BK	Cast Alun./Black
CA/DG	Cast Alun./Dark Green
CA/DB	Cast Alun./Dark Bronze
CA/PP	Cast Alun./Pewter Plated
CA/CC	Cast Alun./Custom Color

(for complete finish and color options, see "Finish" section in catalog)

Light Source:

Code	Description
470-112	112 watt H.I.D. Socket
480-50	50 watt Mercury Vapor
475-75	75 watt Mercury Vapor
490-100	100 watt Mercury Vapor
485-50	50 watt Metal Halide
470-75	75 watt Metal Halide
485-100	100 watt Metal Halide
430-30	30 watt High Pressure Sodium
440-50	50 watt High Pressure Sodium
470-70	70 watt High Pressure Sodium
430-100	100 watt High Pressure Sodium

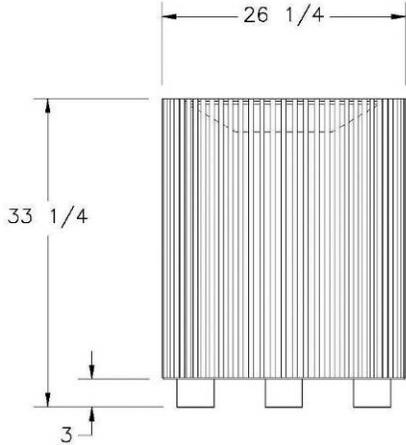
Optional Equipment:

Code	Description
SB	Eyebolt mounted on bollard for use with chain by others.
Q	Weatherproof Dome/Receptacle mounted inside base.
DBB	Direct Burial Base for mounting without a concrete footing.
CLD	Custom Logic (see into access door).

3 BOLLARD

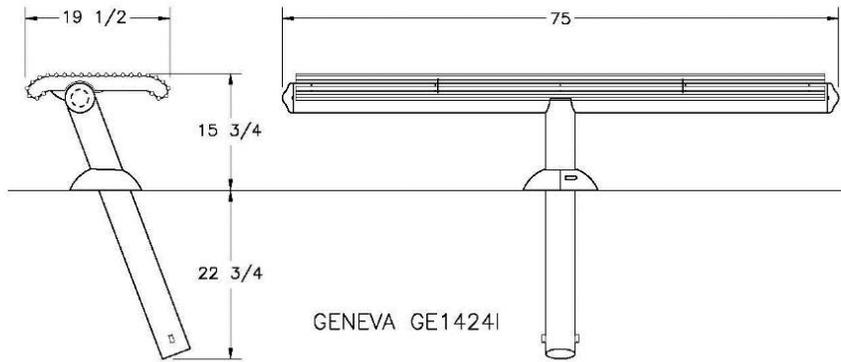
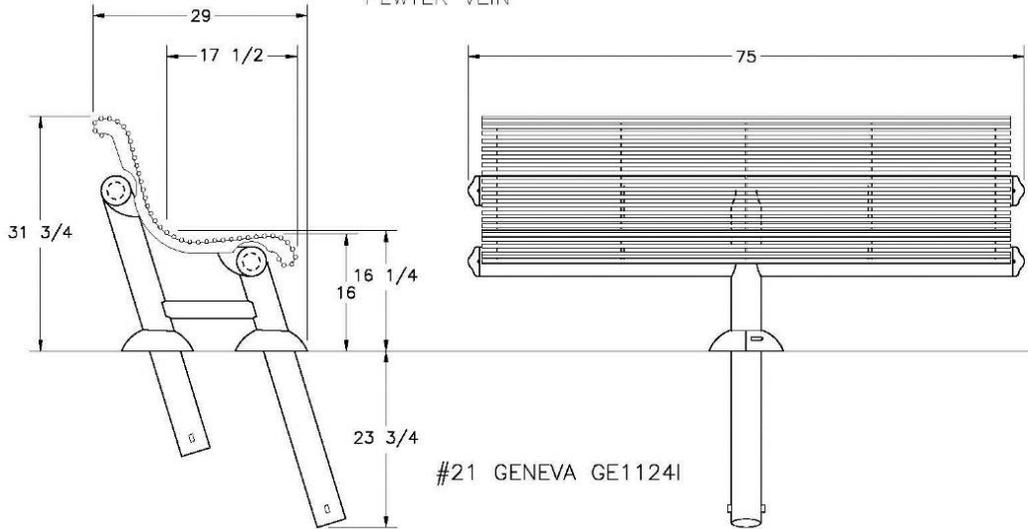
4 ILLUMINATED BOLLARD

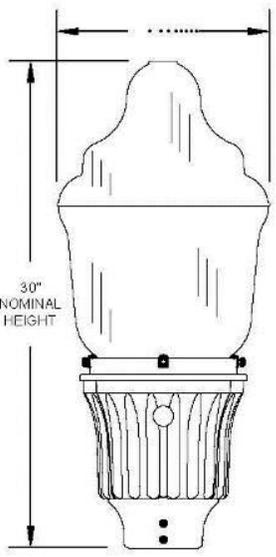
RECEPTACLE: TE3F34S BY URBANSCAPE SITE FURNITURE
 32 GAL; FLAT TOP LID; ROD; SURFACE MOUNTING PER MANUFACTURER'S SPECIFICATIONS; COLOR - PEWTER VEIN



#22 TE3F34P

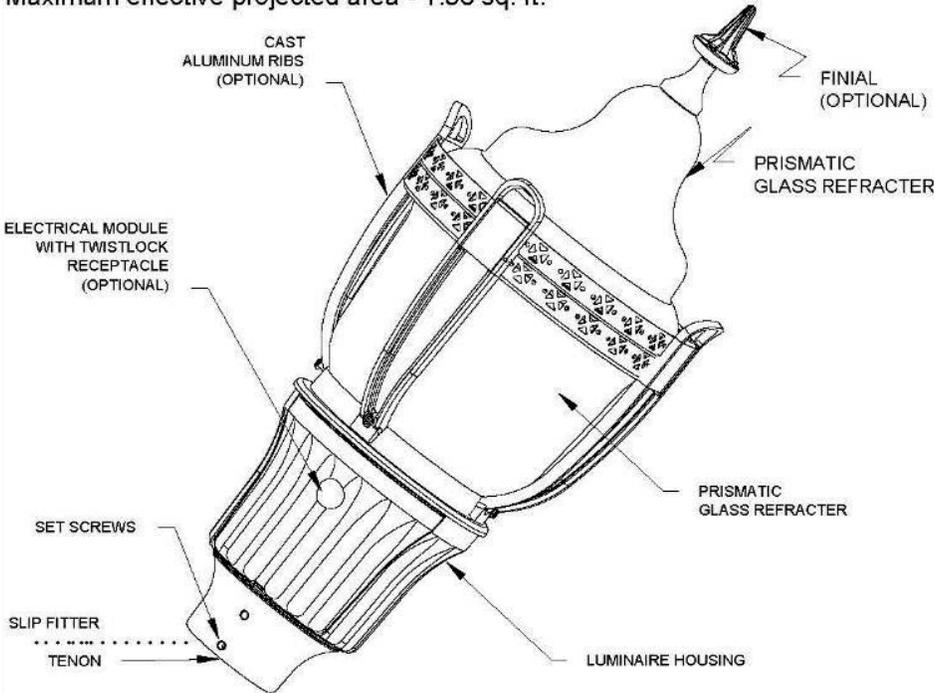
GENEVA BENCH BY URBANSCAPE SITE FURNITURE
6' BENCH W/ OR W/O BACK; IN-GROUND MOUNTING
PER MANUFACTURER'S SPECIFICATIONS; COLOR -
PEWTER VEIN





30" NOMINAL HEIGHT

Maximum weight - 47 lbs
Maximum effective projected area - 1.38 sq. ft.



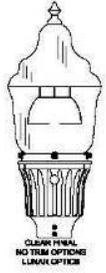
*drawing depicting base model no finial.

ORDERING INFORMATION:

GVU	175MH	MT	B	3	N	S	B
BALLAST TYPE (MOGUL BASE) 175MH = 175W MH	VOLTAGE MT = MULTITAP (factory 240V) (120, 208, 240, 277 VOLT)	HOUSING COLOR B = BLACK	OPTICS 3 = IES TYPE III DISTRIBUTION	FINIAL S = STANDARD	TRIM N = NO TRIM	COLOR B = BLACK	

OPTIONS
H = NEMA TWISTLOCK PHOTOCONTROL RECEPTACLE ONLY

FINIALS

STANDARD
CLOSE FINIAL, NO TRIM OPTIONS, LUMINAIRE OPTION

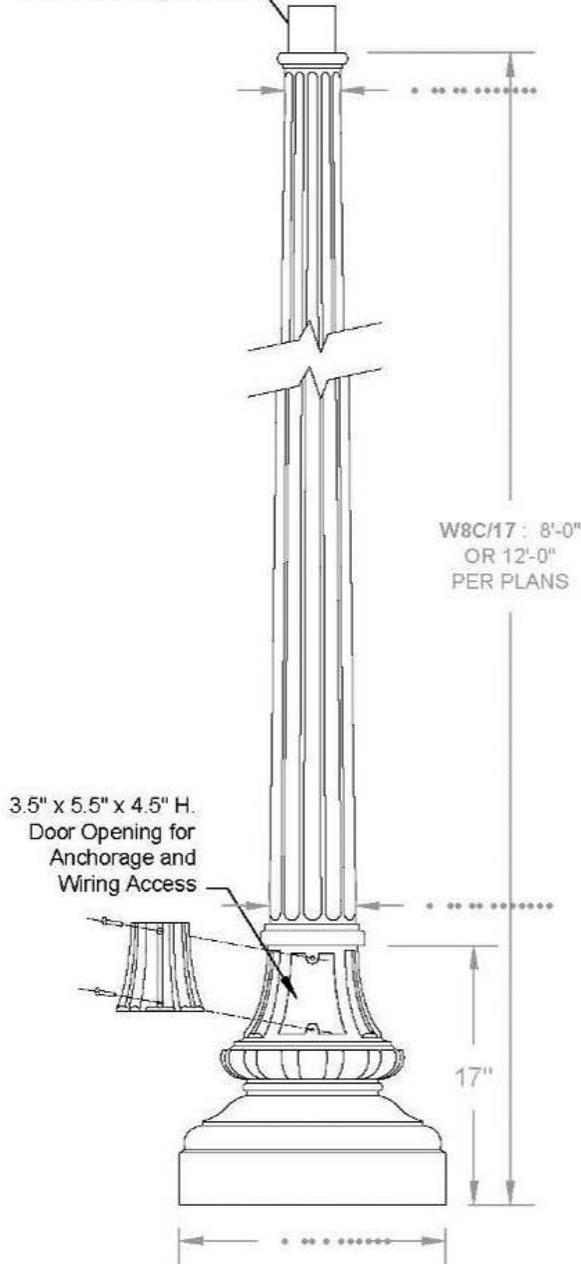


HOLOPHANE[®]
LEADER IN LIGHTING SOLUTIONS
An *culty* Brands Company

Utility Granville[®] Series Postlite

WADSWORTH Series Cast Aluminum Posts

3" O.D. x 3" High Tenon



W8C/17 : 8'-0"
OR 12'-0"
PER PLANS

3.5" x 5.5" x 4.5" H.
Door Opening for
Anchorage and
Wiring Access

17"

HOLOPHANE An Acuity Brands Company
LEADER IN LIGHTING SOLUTIONS 214 OAKWOOD AVENUE - NEWARK, OHIO 43055

ORDERING GUIDE

sample catalog number

W8C/17	-	CA/BK	-	
Post	-	material / finish	-	options
WADSWORTH	-	Cast Aluminum	-	
12' height	-	Black	-	
cast shaft	-		-	
17" dia. base	-		-	

Post	(check appropriate boxes)
Catalog #	Heights
<input checked="" type="checkbox"/> W8C/17	8'-0"

Material/Finish

Catalog Suffix	Description
<input checked="" type="checkbox"/> -CA/BK	Cast Aluminum/Black (std.)

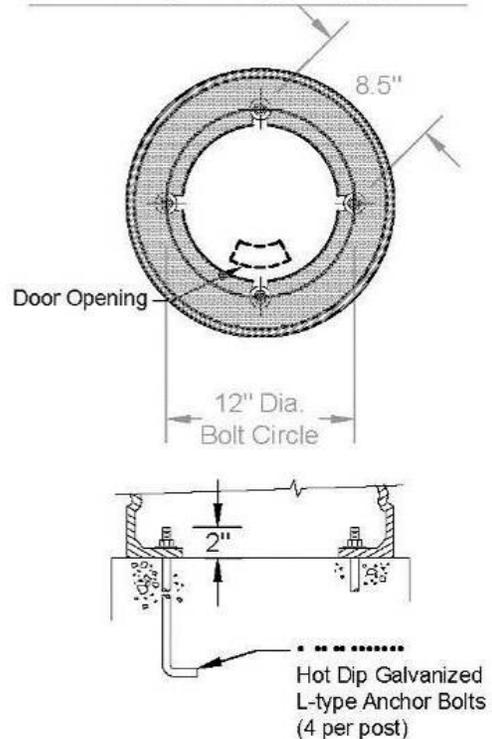
(for complete finish and color options, see 'Finish' section in catalog)

Optional Equipment

Catalog Suffix	Description
<input type="checkbox"/> - _____	Receptacles (see Accessories section)
<input type="checkbox"/> - _____	Banner Arms (see Accessories section)
<input type="checkbox"/> - _____	Flag Pole Holders (see Accessories section)
<input type="checkbox"/> - _____	Custom Logos (see Accessories section)
<input type="checkbox"/> - _____	Signage (see Signage section)

(for optional equipment not found in catalog, consult factory)

ANCHORAGE GUIDE



Hot Dip Galvanized
L-type Anchor Bolts
(4 per post)

2.0 BLUEWAY FACILITY GUIDELINES

The blueway facility guidelines of this master plan provide basic information on creating a successful blueways system. Similar to greenways, it is important to develop quality design standards that are consistent throughout the system when creating blueways. Blueway systems should have access points in key locations and provide safety information for users.

2.1 PURPOSE OF A BLUEWAY

Blueways are water-based trail systems for paddlers. These systems have designed access points and they are important recreation corridors that both promote conservation and can have economic benefits as well.



In the past, rivers were the main transportation routes for the movement of people and goods; now rivers present an opportunity for recreation and education. They provide a unique recreation experience for paddlers, while protecting priceless biological features.

2.2 USERS OF A BLUEWAY

In general, the proposed Stones River blueways are considered mainly flatwater, meaning they typically have little current and obstructions are easily avoided by trained paddlers. Blueway users may be experienced paddlers and inexperienced paddlers who utilize a variety of non-motorized watercraft, which may include canoes, kayaks and stand-up paddling (SUP) boards.

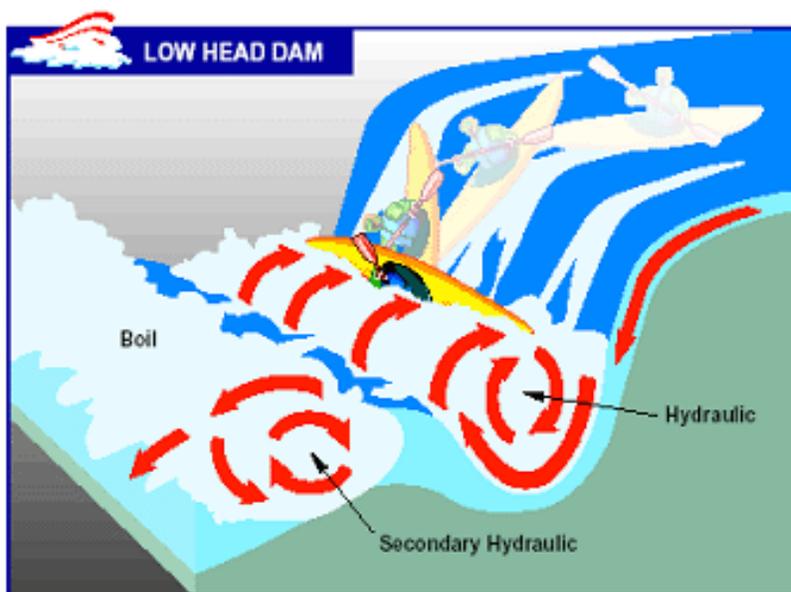
Given the numerous species of fish found in the Stones River and its tributaries, fishing is often a popular activity on blueways. The West Fork of the Stones River near Nices Mill is already known locally for having rainbow trout. By providing access points, signage and other blueway infrastructure, this recreational sport can continue to expand and encourage tourism.

2.3 SAFETY CONCERNS AND MEASURES

While there are many benefits to blueways, they can pose safety concerns for users. These risks are not always apparent, as conditions can change rapidly due to weather conditions, water level or changes in route due to fallen trees or other water hazards.

Low-water levels at certain times of the year also create unfavorable conditions for paddlers. Information on available water data, current water levels and other safety information is a critical component to providing a successful blueway system.

In addition, small low head dams currently exist along some of the streams and pose a serious risk. When water flows over the top of these low head dams, they produce churning currents on the downstream side that may not appear dangerous, but recirculating water can pin someone against the upstream side, making it difficult to escape. If possible, these low head dams should be removed along blueway routes.



Source: American Boat Operators' Course <www.boatcourse.com>

An ongoing study by the University of Tennessee states that there have been 204 deaths at low-head dams in 30 states over the past 50 years. Half of those deaths have occurred since 2000. As more people use rivers for recreation purposes, these unsuspecting “drowning machines” (as they are sometimes called) present a significant health risk to paddlers. Removing low-head dams will not only improve river safety, but also improve aquatic habitats by allowing fish passage.

All paddlers, whether experienced or beginner, need to be prepared for emergencies. Posting rules for paddlers and providing a safe access point are two important elements, but citizens should be advised that rivers pose many dangers.

According to the Centers for Disease Control and Prevention, drowning ranks fifth among the leading causes of unintentional injury death in the United States. Tennessee State Law requires that each person on board a watercraft have an approved Personal Flotation Device (PFD); children 12 years old or younger are required to wear a PFD at all times while on the water. For state regulations regarding Personal Flotation Devices, refer to the *Tennessee Boating Safety Guide*.

The Tennessee Wildlife Resources Agency (TWRA) provides the *Safety Checklist for Canoeing and Paddle Sports* manual. They also have a Boating Safety Education website with important safety information. General guidelines for users include:

- Be prepared and always wear a PFD on and in the river. Paddlers should be prepared for any situation.
- Know your skill level and never paddle alone. Although the blueway may be considered as class I rivers, paddlers of any skill level should check both weather conditions and water level prior to departure. Always tell someone where you are going and when you expect to return.
- Bring plenty of drinking water, regardless of the season. Bring necessary allergy medications and emergency supplies such as a first aid kit, prescription medications, a change of clothes, flashlight, whistle, compass, rain gear, cell phone, sunscreen, insect repellent, snacks, etc., and a waterproof “dry” bag to hold these items. Secure items.
- Check weather conditions and water level before your trip. Do not attempt a trip if the forecast indicates severe weather such as a thunderstorm. Do not attempt a trip during flood conditions.
- Wear clothes and shoes suitable for conditions. Avoid flip-flops or other shoes that can slip off the foot easily.

If sponsoring a float trip, leaders should provide participants with a legal waiver to sign and require participants under the age of 18 be accompanied by an adult who has legal responsibility.

2.4 CORRIDOR PROTECTION

Establishing a Blueways system and becoming a Scenic River can help protect and improve water quality of the Stones River. Currently, parts of the river are listed as 303(d) impaired river according to the Tennessee Department of Environmental and Conservation (TDEC). This is due, in part, to point source land development in the water shed as well as unrestricted cattle access along the river. Opening river access can promote water quality improvements. Improvements might include utilizing low impact development techniques in future construction, adding rain gardens and other stormwater best management practices to existing developments as well as restricting cattle access to the river, when possible.

Engaging nonprofits in assisting with cleanups, education and outreach is an important partnership that benefits the river and its paddlers. The Stones River Watershed Association (SRWA) provides a great way to involve individuals interested in protecting the river as a valuable resource. Other potential sources for assistances include the

statewide organization Tennessee Scenic Rivers Association (TSRA), Boy Scouts of America, Girl Scouts of the U.S.A., Americorps and possibly corporate sponsorships.

Scenic River Program

The Stones River may be eligible to participate in the Tennessee Scenic Rivers Program. Currently, there are thirteen rivers designated as State Scenic Rivers. The program seeks to preserve sections of rivers within the state and they are managed according to the Rules for the Management of Tennessee Natural Resource Areas. (Source: www.tn.gov/environment/na/scenicrivers/#rivers). For example, the Duck River in Maury County is a member of the Scenic Rivers Program. The 37-mile section designated as a state scenic river enhances the ability to protect its “scenic, ecological, cultural and historical values.” It also provides guidelines for the protection for species of rare and endangered plants and animals through protection of water quality and adjacent lands.

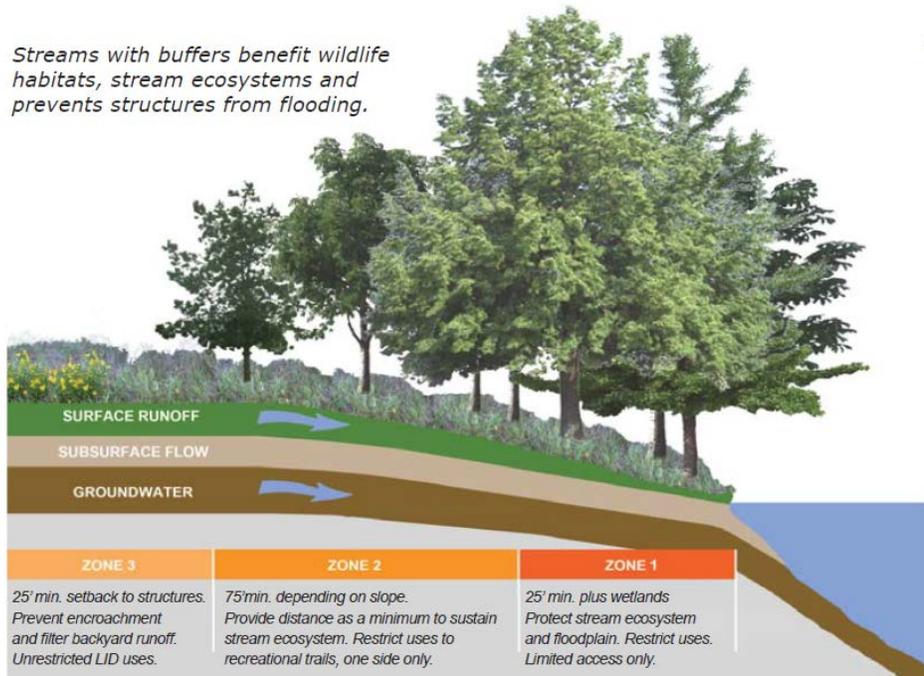
Park and Float Program

The Tennessee Department of Transportation (TDOT) began the Park and Float program in 2010. The program is a partnership between TDOT and the Tennessee Wildlife Resources Agency (TWRA) that helps provide access to Tennessee streams and rivers at bridge crossings on state highways. By recognizing the economic benefits of providing access, the state capitalizes on this existing asset. (Learn more at www.tdot.state.tn.us/environment/ecology/accomplishments.htm).

Aquatic Buffers

Aquatic buffers along the corridor can protect waterways and sensitive aquatic environments.

Buffers protect water quality by filtering pollutants from runoff and provide flood control zones, stream bank stabilization, stream temperature control and room for lateral movement of the stream channel. Linking buffers to create a network of green infrastructure provide benefits for



wildlife corridors. Buffers can protect rivers and streams from future development with conservation easements; thus, conservation easements are a strong marketing tool that helps guarantee the protection of scenic views and our precious natural resources.

Bank Stabilization

Erosion along banks causes land loss, habitat destruction and other adverse effects to water quality and aquatic biodiversity. Designing bank stabilization requires a careful analysis of what is causing the erosion. Applied incorrectly, bank stabilization techniques may cause more erosion downstream.

When determining where to apply bank stabilization, first begin with addressing the most severe sites and working from upstream to downstream. Tributaries should also be evaluated. Verify land use on site and determine if there is a link between the erosion and the land use. For example, cattle access may be a source of soil erosion. Limiting access would be the first step in stabilizing the bank. In general, the first step is to assess the amount of erosion (e.g. minor, moderate, severe) then determine the method for bank stabilization and calculate costs. One of the more difficult steps in bank stabilization is the ability to implement improvements (i.e. garnering public participation and cooperation from the landowner).

It is important to utilize experts who understand river morphology and who can determine the best method to stabilize the bank as well as what time of year is best to implement the proposed measures. Often, low-tech methods can be used that, long-term, can withstand major storm events better than more expensive methods—such as gabion retaining walls. However, without proper expertise, these methods could also fail. For example, planting trees as a bank stabilization method should not be implemented during the rainy seasons when a large storm event could wash away installations before they have an opportunity to take root.

2.5 BLUEWAY ACCESS POINTS

Blueway access points provide facilities for recreational use of waterways. These facilities allow for ease of put-in and take-out for canoes, kayaks and other small recreational watercraft. As shown in the overall blueways master plan, a total of over 50 miles of blueway is proposed along the three forks of the Stones River. Proposed access points along the river vary from a short distance of two miles, and span distances up to six miles (with a median of 2.2 miles between access points). For flat water canoeing, a paddler can average about two miles an hour. Access points shown on the overall blueways master plan with short distances may be eliminated to provide greater distances, but they are included for overall planning purposes. Each site will need to be evaluated for access, distance from the next access point and site-specific attributes.

Below is a list of potential access points and distances:

Map ID	Stones River (West Fork)	Current Status
1	Veterans Pkwy	No Public Access
2	West and Middle Confluence	No Public Access
3	Cason Trail	Future Public Access
4	River Rock Blvd.	No Public Access
5	Bridge Ave. & Molloy	Future Public Access
6	Manson Pike	Public Access
7	General Bragg Trailhead	Future Public Access
8	Thompson Lane	Public Access
9	Nice Mill	Public Access
21	West Fork Recreation Area	Public Access

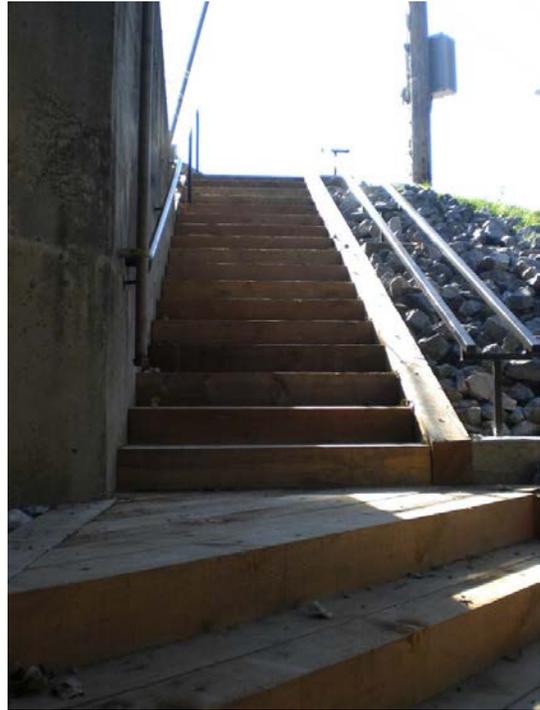
Map ID	Stones River (Middle Fork)	Current Status
10	Elam Mill	No Public Access
11	Joe B. Jackson Trailhead	No Public Access
12	City Schools Office	No Public Access

Map ID	Stones River (East Fork)	Current Status
13	Guy James Road	No Public Access
14	Brown's Mill	No Public Access
15	Lascassas Pike	No Public Access
16	Betty Ford Road	No Public Access
17	VA Hospital	No Public Access
18	Walter Hill	Public Access
19	Mona Recreation Area	Public Access
20	East Fork Recreation Area	Public Access

2.6 BLUEWAY ACCESS AND PARKING AREAS

At a minimum, blueway access and parking areas should include a paved access path to natural staging and launching areas. In some situations, a minimal amount of shotcrete or concrete may be required to improve footing and access within natural rock outcrops. In other situations, a system of large steps or terraces can be constructed of recycled plastic (textured, not slippery when wet) and wood timbers to facilitate put-in and take-out at varying water levels. Ideally, access points should be provided every two to four miles.

These access points should, wherever possible, take advantage of existing park facilities or proposed trailheads for parking, picnicking, restrooms and other amenities. In some situations, access points may be independent of park facilities and will require dedicated parking and signage. In a few cases, roadway pull-offs with adequate room for two or three vehicles may be appropriate. In other cases, more developed parking amenities will be required.



Boat access slide rail next to stairs

Road construction to access points should be carefully planned to minimize impact on the river and surrounding buffer. Access and parking areas should be limited to the minimum necessary and should employ low impact techniques such as porous pavement where possible to reduce stormwater runoff.



In general, parking areas should be located close to launch areas and should have a loading/unloading zone for heavy equipment. When designing parking areas, utilize low impact designs and provide best management practices when constructing to minimize disturbances to the site and soil erosion. In situations where parking cannot be located near access points, pathways to the water should be constructed at a minimum of 5' wide to allow adequate space to carry watercraft to the water's edge.

Riverbanks with a slope greater than 15% will create difficulty transitioning from land to water and will require handrails, steps and/or a boat launch. Bank stabilization should also be provided to protect streams from soil erosion.

The American Disabilities Act (ADA) of 1990 requires that people with disabilities be provided equal access to public programs and services. At a minimum, provide at least one accessible put-in and take-out along the route as the blueway system develops.

Construction of ramps and steps will need to be designed to withstand heavy storm events and may require permits from the U.S. Army Corps of Engineers, Tennessee Department of Environment and Conservation (TDEC) and other regulating authorities.

2.7 MAINTENANCE

Similar to the maintenance of greenways, a blueway system requires both capital and operational funding to implement and maintain the system. Designing the system with proper trash receptacles and clearly stated rules of conduct for blueway users can help reduce litter. As with greenways, these regulations need to be enforced if they are to work. "Adopt a Stream" programs, where an organization volunteers to keep a section of the blueway clean can also help with maintenance.

Regular maintenance tasks include the following:

- Removal of trash
- Signs and traffic markings for paddlers must be inspected regularly and kept in good condition
- Following heavy storm events, blueways should be inspected for water hazards and those hazards should be removed.
- Structures such as ramps, access points, pavilions and restrooms should be inspected annually to ensure they are in good condition. Special attention must be paid to wood foundations and posts to determine if rot or termites are present. At the same time, site furniture and other support facilities should be inspected.
- Mow put-in and take out areas and other selected areas on a scheduled basis depending upon season, species and rate of growth.
- Habitat enhancement and control
- Removal of graffiti
- Repaint/repair flow gauge
- Bank stabilization repair measures

2.8 BLUEWAY FACILITIES AND SIGNAGE

In providing a comprehensive blueway system, the system will require designation of the route, access to put-in/take-outs and several types of signage. The system should also provide sections that are ADA accessible. General guidelines to create ADA compliant facilities for blueways are found below. The elements listed do not create an exhaustive list, but rather provide general guidance.

Route Surface and Slope

The access route to the boat launch site should have a smooth slope surface and be as level as possible. To meet ADA guidelines, the slope should be less than 8.33% and have a cross slope of under 2%. The ADA accessible route should also be clearly marked.

Landing/Loading Area

A leveled boat slip space that is at least 60"x60" should be provided adjacent to the loading area. In a back country canoe launch, this might be constructed using large relatively flat boulders approximately a foot under water. This leveled area should be designed to allow transfer from a wheelchair to a rock then into a floating canoe.

Transfer assistance

Whether on a bank of a lake or on a rocky slope, it is difficult to transfer to a moving boat. When possible at the landing/loading area, provide a grab bar and other grab points to assist in the procedure of getting into a boat seat. If possible, provide a surface that will limit the amount of movement of the boat when entering the craft.

Below are several examples of handicap accessible landing/loading areas to consider.



Source: EZ Launch for Kayaks & Canoes <www.ez-dock.com>



Source: Logical Lasting Launches, by Roger Lewis, Lower Colorado River Authority



Source: Kay-aKcess <www.kay-akcess.com>

Signage

A blueway signage system may consist of wayfinding signs, rules and regulations, hazard signage and travel distance markers along blueway routes. Signage may also include interpretive panels at access areas that educate the visitors about wildlife and habitats found in the streams.

Wayfinding for blueways may be simple signage that guides visitors to the put-in or take-out locations, as shown in this photo. Often, paddlers are experiencing routes for the first time and wayfinding will assist them in locating these areas. This example shown of the brown sign with paddlers in a canoe is a commonly recognized sign standard already in use in Murfreesboro.

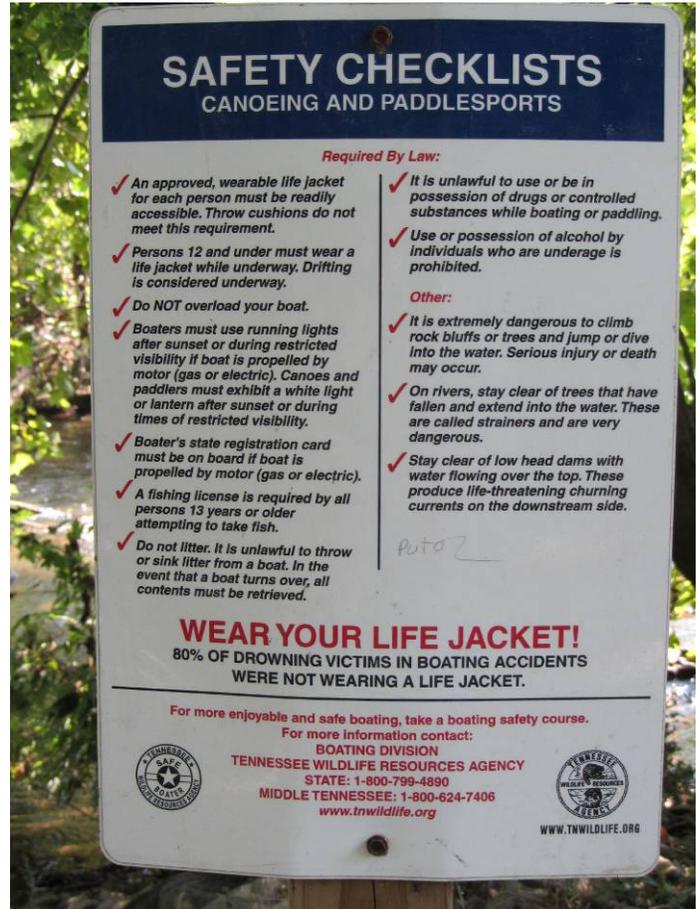


Signage for blueways should be provided to encourage safe use of the river corridor as well as user rules. Signage should identify distances to take-outs downstream as well as any areas where additional caution may be necessary due to adverse conditions such as waterfalls.

Below is a safety checklist for canoeing and paddle sports, as posted on a sign at the Thompson Lane access point.

Required By Law:

- An approved, wearable life jacket for each person must be readily accessible. Throw cushions do not meet this requirement.
- Persons 12 and under must wear a life jacket while underway. Drifting is considered underway.
- Do NOT overload your boat.
- Boaters must use running lights after sunset or during restricted visibility if boat is propelled by motor (gas or electric). Canoes and paddlers must exhibit a white light or lantern after sunset or during times of restricted visibility.
- Boater's state registration card must be on board if boat is propelled by motor (gas or electric).
- A fishing license is required by all persons 13 years or older attempting to take fish.



- It is unlawful to use or be in possession of drugs or controlled substances while boating or paddling.
- Use or possession of alcohol by individuals who are underage is prohibited.

Other:

- It is extremely dangerous to climb rock bluffs or trees and jump or dive into the water. Serious injury or death may occur.
- On rivers, stay clear of trees that have fallen and extend into the water. These are called strainers and are very dangerous.

- Stay clear of low head dams with water flowing over the top. These produce life-threatening churning currents on the downstream side.

Additional items may be added to this checklist. We may also recommend changing the title from Safety Checklists to Rules and Regulations with information regarding restrictions on swimming at these access locations.

Access points should have a clearly visible flow gauge that indicates the degree of safety for canoeing. Given the low water flow of the Stones River during several months of the year, it is important to provide water level information to paddlers. Shown in the picture on the right is a simple flow gauge. Larger signs and information may be needed. Some examples include gauges painted on bridges or rock outcroppings near the access point. Links to the *USGS National Water Information System* with information on current water levels should be provided on blueway websites.



Source: Chris Council, *Aspen Daily News*
<www.aspenjournalism.org/2012/05/01/new-stream-gauge-on-castle-creek-installed>



Source: Iowa Whitewater Coalition
<www.iowawhitewater.org/lhd/images/BooneLowHeadDam.JPG>

Other signs that are important in providing a safe blueway system include signage regarding low head dams. An example of signage provided at low head dams is shown to the left.

3.0 BIKEWAY FACILITY GUIDELINES

Bikeways is the term used in the Murfreesboro GBB Plan to describe bicycle facilities that are always within the right-of-way (ROW) of a roadway, and often within the traveled (curb-to-curb, shoulder-to-shoulder) portion of the roadway. These on-street facilities are critical components of the plan because they serve as connectors that extend the accessible range and therefore the effectiveness of the greenway system. Several types of bikeways exist, each with different design and operating characteristics.

3.1 BICYCLE LANES

A bicycle lane is a portion of the roadway cross-section that has been designated for the preferential or exclusive use of bicyclists by striping, pavement markings, and signage. Bike lanes should be one-way facilities located on both sides of the roadway, in order to carry bicycle traffic in the same direction as adjacent motor vehicle traffic. On one-way streets, bike lanes should be on the right side of the road. Bike lanes are highly regarded by many cyclists because of the safety benefits they provide to cyclists.

Bike lanes are typically considered to be the most desirable facility for higher-volume, urban roadways, including collector roadways. On such roadways, bike lanes benefit both bicyclists and motorists by segregating users, thereby increasing overall capacity. In addition, bike lanes provide a defined area for bicycle travel, decrease sudden lane changing by roadway users, and help to make cyclists feel more confident.

Width

It is recommended that bike lanes be four to six feet in width. However, exact bike lane width should be determined by the type of roadway. Bike lanes on roadways without curb and gutter should have a minimum width of four feet. For roadways with curb and gutter, the bike lane should be at least four feet wide, and should be measured from the gutter pan seam. Bike lanes located next to on-street parking, guardrails or the face of a curb are recommended to have a minimum of five feet in width. Bike lane width is recommended to be increased to six feet when the following roadway conditions are present:

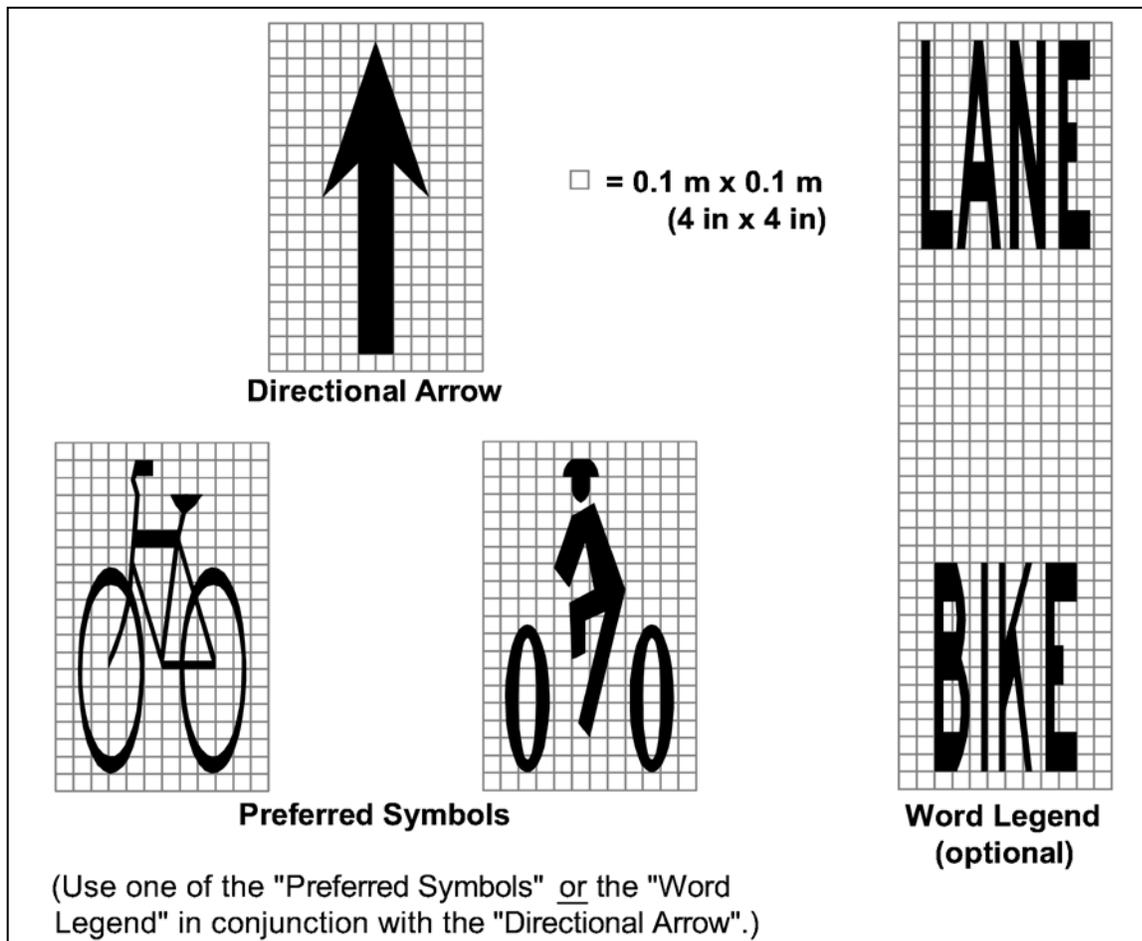
- Streets with high traffic volumes
- Heavy (commercial) vehicle volumes are high
- Steep grades
- Bike lane is adjacent to parking and parking turnover is moderate to heavy

Bike lanes in excess of six feet are generally not recommended, since they can be used for parking or conventional travel lanes.

Pavement Markings

Bicycle lanes should be delineated from conventional travel lanes by a six-inch, single, solid white line. An additional solid white line can be placed between the bike lane and parking lane to encourage motorists to park closer to the curb and to discourage motorists from using the parking lane as a travel lane. This line should be four inches wide.

Standard pavement marking should be placed within bike lanes to indicate the designated space for cyclists. Bicycle lane markings, including symbols and a directional arrow, should be placed after every major intersection, at least 65 feet from the intersection. Symbols and arrows should be located at least every 1,000 feet between intersections.



Typical bike lane symbols, as shown above, are used in bike lanes to indicate designated bicycle use and direction of travel.

Standard pavement markings for bicycle lanes should be white, retro-reflectorized, and created using durable, skid-resistant material. If possible, it is recommended that pavement markings be located out of the path of motor vehicle crossings to maintain the life of the markings. At bus stops, bike lanes should be striped with dashed lines to

indicate where buses are expected to merge into the bike lane in order to reach the curb.

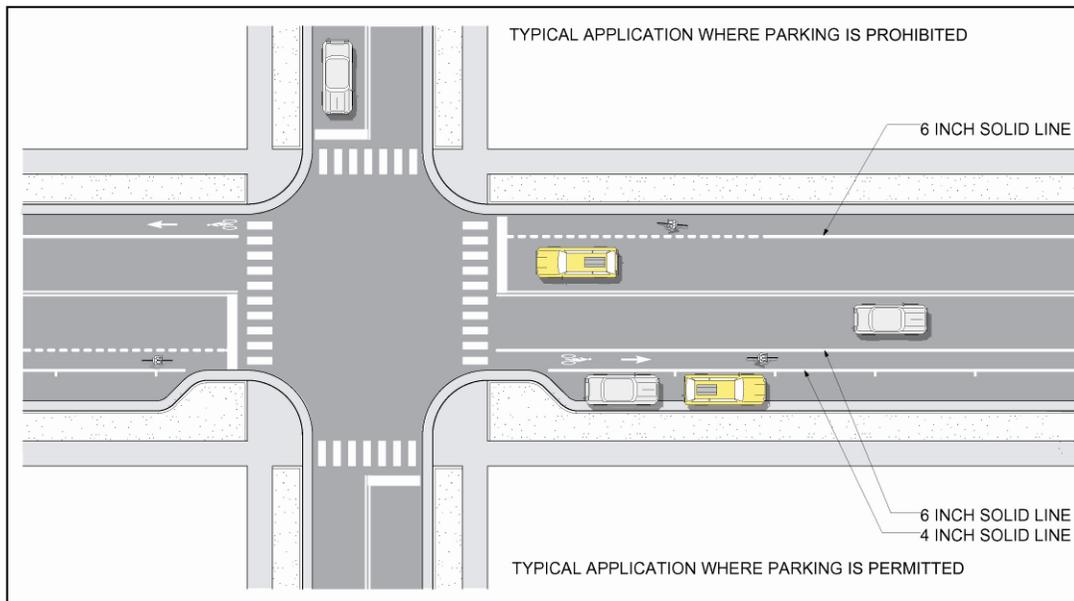
It should be noted that the diamond symbol, which was recommended in the past, is no longer used for bike lanes. This symbol is now associated with High Occupancy Vehicles (HOV) lanes and other motor vehicle facilities. It is recommended that the diamond symbol in existing locations be eliminated as part of regular maintenance.

Bike Lanes Adjacent to Parking Lanes

Bike lanes are often installed adjacent to on-street parking. As mentioned previously, bike lanes on streets with parking should be at least five feet wide to provide additional space to avoid opening car doors, and car mirrors, and to maneuver around vehicles moving into and out of the parking lane. A width of six feet is desirable when parking turnover is significant. AASHTO states that the minimum combined width for the bike lane and the parking lane should be 12 feet. Where on-street parking is present, the bike lane should be placed between the parking lane and the conventional travel lane. Diagonal parking can cause visibility problems for cyclists and is generally not recommended on streets with bike lanes.



Bike Lanes next to Adjacent On-Street Parking



This figure shows bike lanes on a street with and without on-street parking. Note that the curb extensions do not extend into the bike lanes on the side with on-street parking.

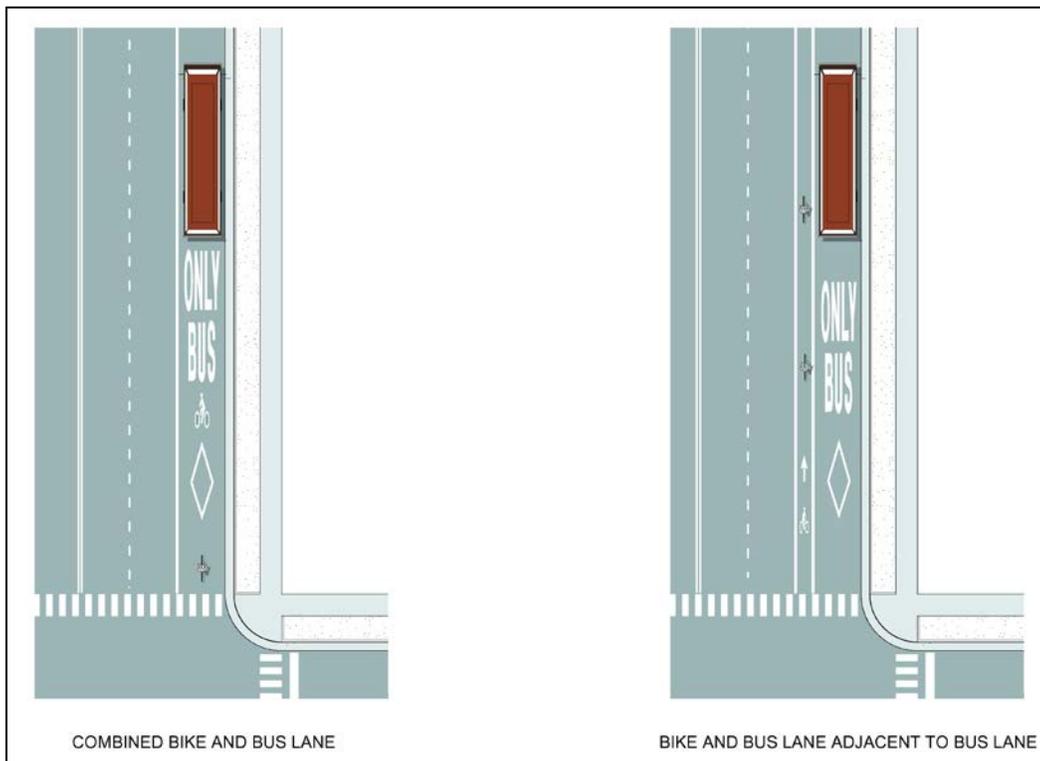
Bus/Bike Lanes



Shared Bus/Bike Lane

Where pavement width allows, a five to six-foot wide bike lane should be provided between the bus lane and conventional travel lanes. A shared lane for buses and bicycles is an option in locations where a bus lane is present, but there is not adequate room for separate bus and bicycle lanes. Shared bus/bike lanes can reduce conflicts with bicyclists, buses, and cars and can increase cyclist safety when used appropriately.

Shared bus/bike lanes are generally used on streets with relatively high automobile traffic, but light, or express, bus traffic. Shared bus/bike lanes with very high bus volumes can create significant conflicts with bikes. It should be noted that right turning vehicles are usually allowed in bus/bike lanes at intersections, and cars remaining in this lane between intersections can cause problems for cyclists. In locations where shared bus/bike lanes are used, the recommended lane width is at least 14 feet.



Bike lanes can share a lane with bus traffic, as shown to the left. If pavement width allows the preferred design is to provide a separate bike lane, as shown on the right.

Innovative Bike Lane Facilities

Left-Side Bike Lane on One-Way Streets

Although bike lanes are typically only recommended for the right side of the roadway, occasionally, bike lanes are installed on the left side of one-way streets for safety benefits. Installation of left side bike lanes can help minimize conflicts due to high bus volumes, a high percentage of right turning traffic, or a high volume of left turning bicycle traffic.

Bicycle traffic turning left from a left side bike lane may create conflicts with motorists who are not expecting bicycle travel on the left side of the street. Also, cyclists may encounter problems moving from the left side bike lane back to the right side of the roadway, if necessary.

Typically, lane width and striping requirements remain the same for left side bike lanes as for bike lanes installed on the right side of the street. Left side bicycle lanes have been used in Minneapolis, Minnesota; Berkeley, California; Eugene, Oregon; and Madison, Wisconsin.

Contra-Flow Bike Lanes

Contra-flow bike lanes allow bicycle traffic to travel in the opposite direction of motor vehicle traffic and are applied on one-way streets where directness and connectivity of bicycle facilities is a high priority. While contra-flow lanes are not generally recommended, they may be appropriate under the following circumstances:

- Fewer conflicts are present on the shorter route, improving safety
- Cyclists can safely re-enter traffic at each end of the lane
- Very few roads, driveways or alleys intersect the roadway on the contra-flow bike lane side
- Out-of-direction travel for cyclists is reduced considerably

Certain design features should be included for contra-flow bike lanes, such as:

- Contra-flow lanes should be placed to the left of motorists
- Proper signage alerting roadway users to two-way bicycle traffic should be provided on streets or driveways intersecting a road with a contra-flow bike lane
- Existing signals should be able to accommodate contra-flow bike traffic
- The contra-flow lane should be the priority on one-way streets where there is not enough width to accommodate both a contra-flow lane and a typical bike lane on the right side of the street

Contra-flow bike lanes should be striped with a double, solid, yellow line to indicate two-way travel. Cities that have used contra-flow bike lanes include Eugene, Oregon; Cambridge, Massachusetts; Minneapolis, Minnesota; Madison, Wisconsin; and San Francisco, California.

Colorized Bike Lanes

Colorized bike lanes can be used in high-conflict locations as a way to alert motorists to the presence of bicyclists and bike lanes, especially in areas where high volumes of motor vehicle traffic cross bike lanes. The use of colorized bike lanes has been shown to increase bicycle safety by improving visibility of bike lanes, encouraging motorists to yield, and warning motorists and cyclists of a potentially dangerous area.



Colorized Bike Lanes

Colorized bike lanes should be used for short segments at conflict points within the bike lane. Potential locations that may benefit from colored bike lanes

include sections of bike lanes where ramps or roadways merge in such a way that typical bicycle lane markings may not be adequately visible.



Sign to Alert Motorists to look for Bicycles

Locations where colorized bike lanes have been used include Portland, Oregon; Cambridge, Massachusetts; Philadelphia, Pennsylvania; Montreal, Canada; and several cities throughout Europe. Although several colors have been used in Europe, green is the most commonly used color in the United States.

“Dooring” in Bike Lanes

Emerging practices for bike lane accommodations with on-street parking focus on efforts to reduce the conflict between parked cars and bicyclists. The “door zone” is the area in the bike lane that is crossed when the driver of a parked car opens

the door. This poses a problem for bike lanes located next to on-street parking. Two emerging strategies for increasing awareness of the “door zone” are:

- Install “Look for Bike” signs to alert drivers to look for bicyclists when opening the driver’s side door.
- Increase the width of the bike lane so that bicyclists can travel outside the “door zone” without entering into the motorists travel lane.



Example of Car Door Opening in Bike Lane

Bicycle Lanes at Intersections

Designing for bicycle travel at intersections is arguably the most crucial, and most challenging, aspect of bicycle facility design. Because a high proportion of incidents between bicycles and automobiles occur at intersections, it is important that bicycle facilities at intersections are designed in a manner that is direct, logical, predictable, and that minimizes unusual circumstances. Both cyclists and motorists must be provided with a well-defined path to follow and a clear indication of who has right of way. As usual, bicycles should be treated as vehicles at intersections and the path designated for bicycles should remain as close to conventional travel lanes as possible. Bike lanes may be striped all the way to the crosswalk. However, they should not extend through pedestrian crossings or through the intersection.

As cyclists approach an intersection, they will need to position themselves in the correct location for the movement they intend to make. For turning movements, this may require cyclists to merge into outside travel lanes in areas without bike lanes. Where bike lanes are present, they are often only intended for through movements. Turning cyclists will still need to position themselves appropriately in other lanes, as needed.

Free-flowing intersections, like those with slip lanes, allow motorists to make turns without being controlled by a traffic signal and enable higher-speed turns. This design decreases safety for cyclists, who must cross paths with motorists at some point. Therefore, slip lanes should be avoided where bicycle facilities are present.

Intersections without Right-Turn Lanes

Bicycle lanes that are provided at signalized or stop-controlled intersections without exclusive right turn lanes should be replaced with a dashed line for a minimum of 50 feet prior to the intersection. The dashed line will alert motorists and cyclists that they may be merging with one another at the intersection. Solid bike lane striping should start again immediately on the far side of the intersection.

Minor intersections that are not stop-controlled should be striped with a solid line all the way to the crosswalk. However, at intersections where a high volume of vehicles are turning right or where there is a near-side bus stop, the bike lane striping should be dashed for at least 50 feet or for the length of the bus stop.

Intersections with Right-Turn Lanes

At intersections where both bicycle lanes and exclusive right turn lanes exist, conflicts are created when right-turning motorists and cyclists traveling through the intersection must cross each other's path of travel. Bike lanes at these intersections should be placed to the left of the exclusive right-turn lane.

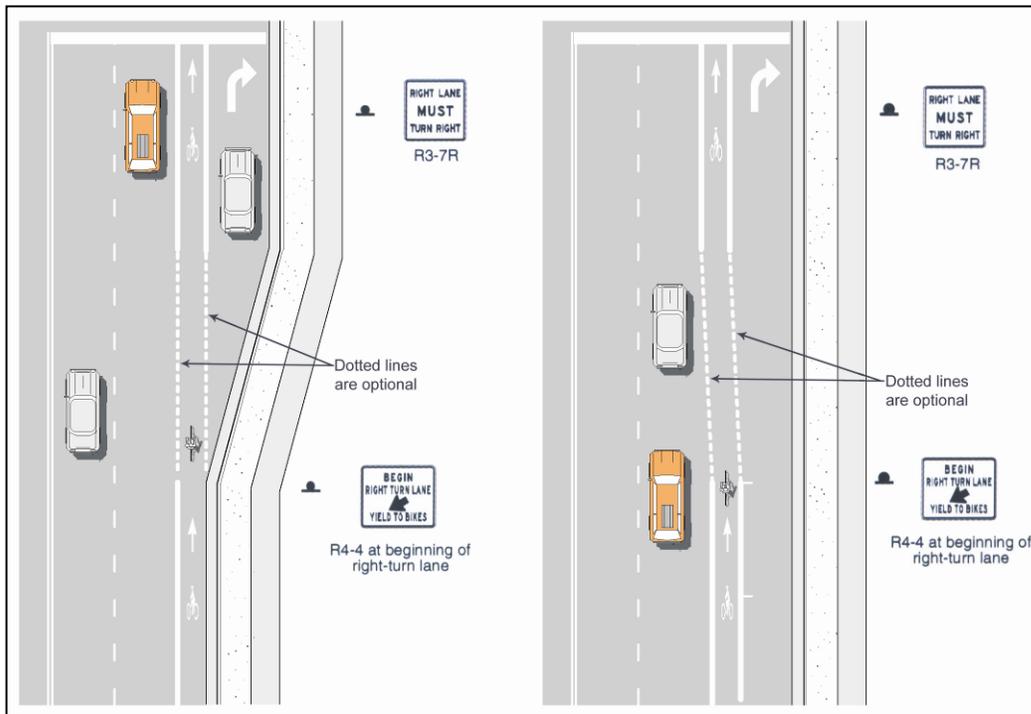
Merging and lane changes between motorists and cyclists should occur before reaching the intersection. To encourage motorists to move into the right turn lane, the bike lane should be striped with dashed lines at least 50 feet in advance of the intersection. The

solid bike lane striping should resume when the full-width of the right-turn lane is achieved and should extend to the crosswalk or stop line.

In locations without adequate space for both a separate bike lane and a right turn lane, the right-turn lane may be marked as a shared-use lane, with bicyclists directed to the left side of the lane. This approach has been used in Memphis, Tennessee as well as Eugene, Oregon. However it is not included in the AASHTO or MUTCD manuals. Another



Bike Lane at Intersection with Right Turn Lane



The illustration on the left shows an exclusive right turn lane without on-street parking, while the illustration on the right shows the right turn lane where on-street parking is present.

option, when space is limited, is to end the bike lane and widen the through lane to at least 14 feet for shared use.

In cases where a parking lane or a through travel lane is dropped at an intersection to create a turn lane, the bike lane should be located between the through lane and the right-turn lane, if possible. In locations where a through lane has been dropped to become a right-turn-only lane, the MUTCD states that bicycle markings should stop at least 100 feet before the beginning of the right-turn lane, and through bicycle markings should resume to the left of the right turn lane. At intersections with a high volume of

right-turning bicycles, it may be appropriate to provide a right turn only bike lane in addition to a through bike lane.

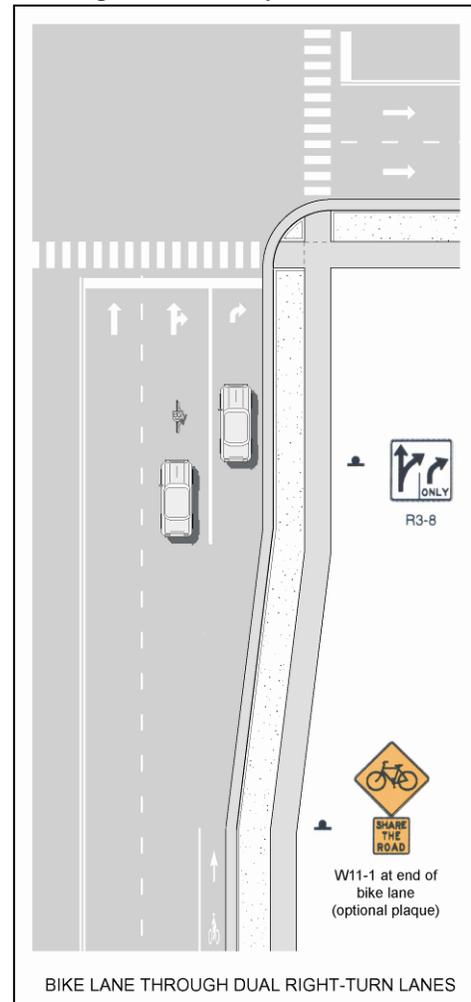
Intersections with Dual Right-Turn Lanes

Approaches with dual right-turn lanes consist of either two exclusive right turn lanes or an exclusive right-turn lane and a shared through/right-turn lane. These configurations complicate the placement of a bike lane. Cyclists traveling straight through the intersection face the difficulty of merging across two right turn lanes to a through lane, or proceeding through the intersection in a lane where drivers may be turning right.

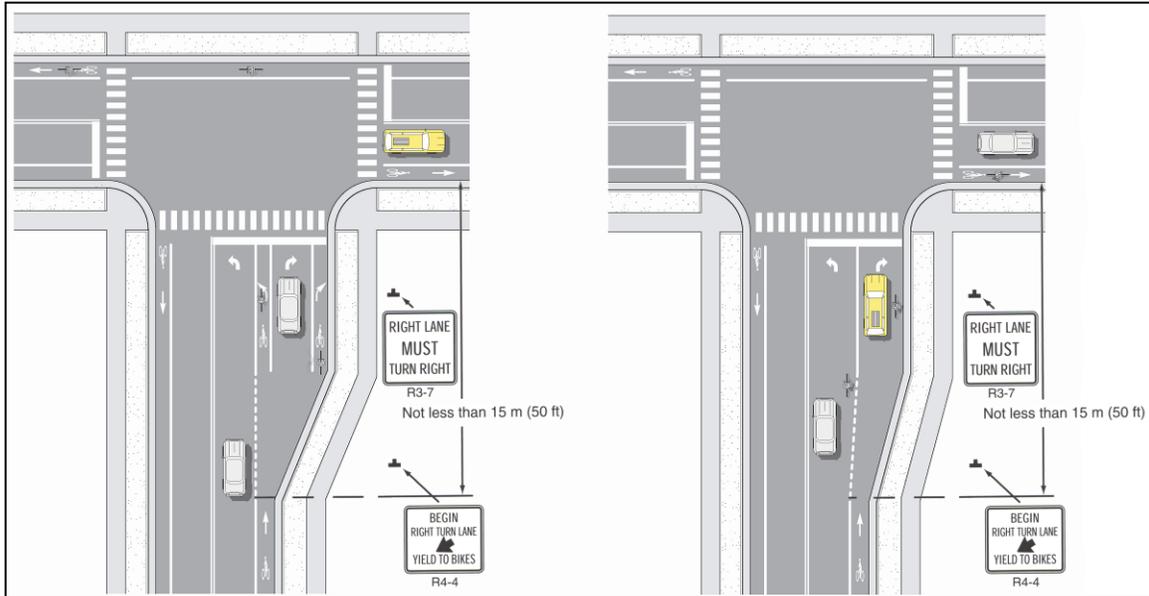
The MUTCD states that, in this situation, the bicycle lane should be discontinued. Possible alternatives at these locations include providing a dashed line from the edge of pavement to guide the cyclist to the shared through/right turn lane, or providing a sidewalk cut to allow the cyclist to approach the intersection as a pedestrian. Proper signage should be provided to warn cyclists of the conditions ahead. Dual right turn lanes should be warranted by an engineering study and avoided, whenever possible, on streets where significant bicycle traffic is anticipated.

T-Intersections

At T-intersections, especially where traffic volumes are high and there is available space, bike lanes should be provided for both left and right-turning movements. If space is limited, the bike lane should be dropped in advance of the intersection so that cyclists may position themselves in the proper conventional lane. If the bike lane is dropped, the left turn lane is recommended to be at least 14 feet wide. The bike lane on the through street of the T-intersection should be striped through the intersection, except at crosswalks.



Proper signage should be installed at dual right turn lanes to warn motorists and cyclists of the lane configuration ahead.



Separate left and right turn bike lanes should be provided at T-intersections, as shown in the illustration to the left. Where pavement width prevents this, a wide left shared left turn lane should be provided, as shown to the right.

Complex Intersections

Intersections that have offset or skewed approaches, or multiple streets entering from different angles, can create confusion for all roadway users. Skewed intersections can reduce bicycle visibility at angles and can increase the distance across the intersection. This often results in a long, confusing path for cyclists. Ideally, approaches to skewed intersections should be realigned to meet at right angles. Where re-alignment is not possible, ample sight distance must be achieved at the intersection. Bike lanes may be dashed through the intersection to guide cyclists and to keep motorists from encroaching into the path of travel of cyclists.

Multiple streets entering an intersection create difficulties for cyclists due to an increased number of conflict points, a larger intersection with a longer distance to cross, reduced visibility of bicycles, and more unpredictable movements by motorists. It may be possible to redesign this type of intersection so that only two roads cross at one point, and the additional approaches intersect the road at another location. Also, redesigning this type of intersection as a roundabout may be appropriate. Where redesigning the intersections is not possible, dashed bike lanes may be continued through the intersection.

Bike Lanes at Roundabouts

Roundabouts can be problematic for cyclists, although low-speed roundabouts tend to accommodate both motor vehicle and bicycle travel fairly well. Higher-speed roundabouts, and roundabouts with multiple lanes or flared entry points, create more points of conflict for cyclists.

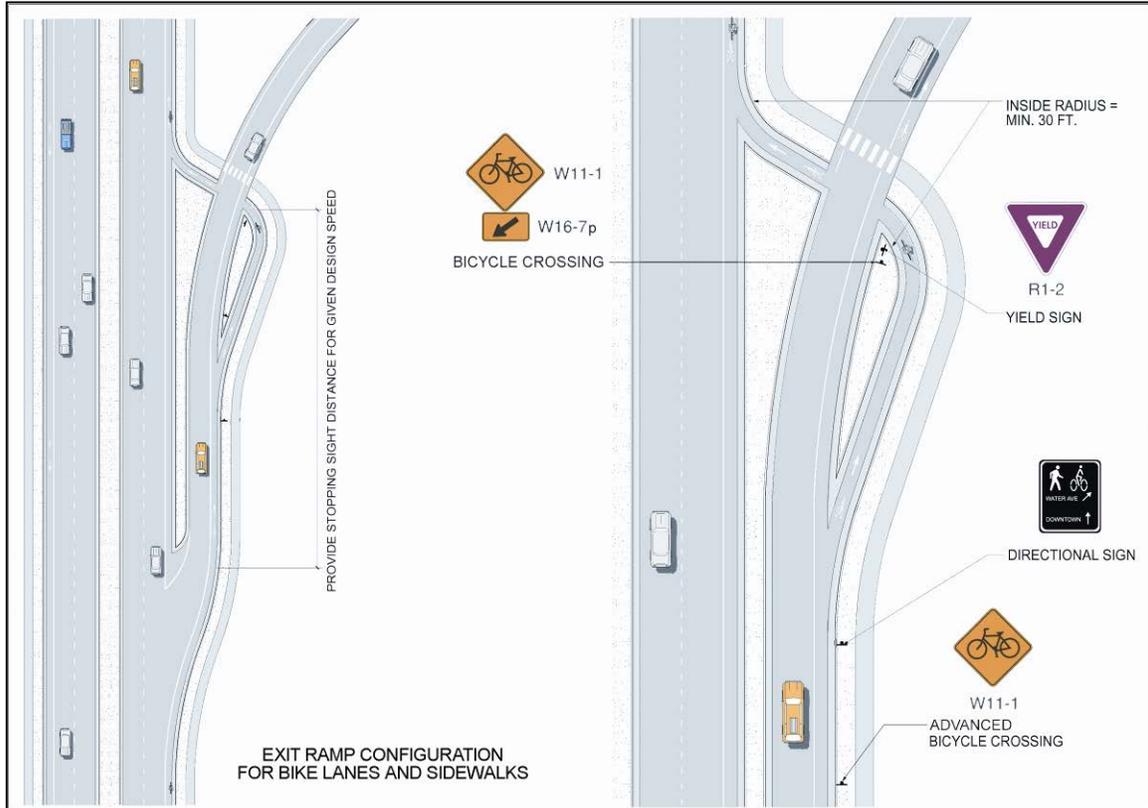
In general, bicycle travel is accommodated at roundabouts by providing separate bicycle paths outside of the roadway or by bicycles sharing conventional travel lanes with motorists. Bicycle lanes through roundabouts are not recommended. At locations where bicycle lanes lead to roundabouts, the bike lane should end between 35 and 65 feet ahead of the roundabout.

Bike Lanes at Interchanges

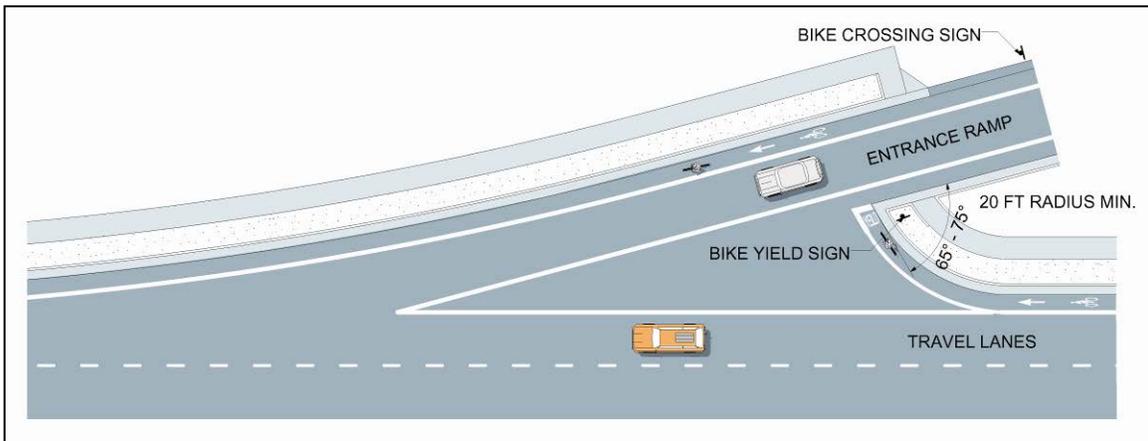
Because of their high-speed, free-flowing motor vehicle traffic, freeway or interstate interchanges can be one of the most difficult areas for cyclists to navigate. Conflicts can occur when cyclists traveling at lower speeds must weave or merge with motorists traveling at much higher speeds. Problems that occur at entrance and exit ramps include:

- Visibility problems caused by the acute angle at which vehicles are approaching
- Accelerating motorists merging into traffic, which increases the speed differential with bicyclists
- Motorists exiting to the right sometimes do not use turn signals, making it difficult for cyclists to predict their movements
- Motorists concentrating on merging may be distracted and not as attentive as normal to the presence of cyclists
- Because they may be exiting bicycle-restricted roadways, motorists may not be anticipating bicycle traffic

While design recommendations for bike lanes at intersections provide suitable solutions for signalized interchange ramps, many interchange designs allow for uncontrolled vehicular movements which require special attention for non-motorized users. The bicycle lane designs shown below help to increase safety and comfort at interchanges which have uncontrolled movements by minimizing the distance that cyclists must cross, by improving sight distance, and by moving the conflict point to a location where motorists are not concentrating on merging with traffic. As shown in the figures, the bike lanes are pulled away from the through lane of the roadway and curve around to intersect the road at near-right angles. Portland, Oregon has also experimented with using colorized bike lanes at entrance and exit ramps to increase visibility.



The bike lane at the entrance ramp shown in the figure intersects the ramp at nearly a right angle before the motorist must merge into traffic.
 Source: *Oregon Bicycle and Pedestrian Plan*



Bike lanes at exit ramps should be pulled away from the roadway to allow nearly right angle crossings at the ramp, as shown above.
 Source: *Oregon Bicycle and Pedestrian Plan*

Interchange-type intersections, such as single point urban interchanges (SPUI) occasionally occur on urban roadways where bicycle travel is permitted. Single point urban interchanges (SPUI) are constructed in areas where there is restricted right-of-way since this type of interchange requires less land. SPUI's are designed to move high volumes of traffic through the interchange at relatively high speeds. With this type

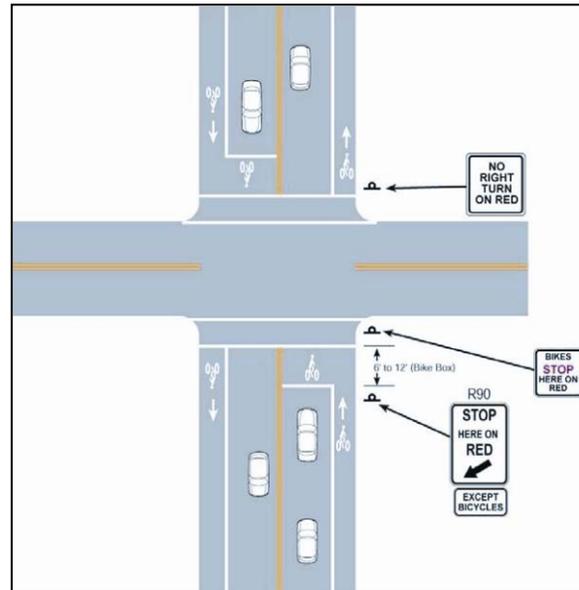
of motor vehicle design it is important for the interchange to include a design that allows for safe bicycle movement. At these intersections, bicycle lanes should be designed to enable cyclists to safely cross the intersection, as well as enter and exit the roadway. The design should include small controlled crossings, a geometry that creates tight, close to right angle crossings, and one that is clearly marked for bicyclists.

Advanced Stop Line/Bicycle Box

At intersections with high volumes and frequent turning conflicts, advanced stop lines, or bike boxes, enable cyclists to move ahead of motorists to position themselves for a turn. As shown in the figure, bike lanes lead into the bike box, which is located between the motor vehicle stop line and the crosswalk. Bicycle markings should be placed in the box and signage should be provided to indicate where cyclists and motorists should stop.

Bike boxes can improve bicycle visibility and decrease turning conflicts with motorists without significant delay to motor vehicle traffic. The downside to bike boxes is that motorists will be restricted from right turns on red, and bike boxes will not help cyclist turning movements during the green signal phase. Also, if the signal turns green before a cyclist has a chance to position themselves, the cyclist may be trapped in an unsafe location. Until they are more common, motorists may be unfamiliar with, and may be confused by, bike boxes. Therefore, bike boxes should be used with caution.

Bike boxes have been used in many cities. Some of these cities include Portland and Eugene, Oregon; Cambridge, Massachusetts; and various cities in the United Kingdom and the Netherlands.



Bike boxes, as shown above, allow cyclists to move ahead of motorists to position themselves for a turn.

3.2 SHOULDER BIKEWAYS

In many cases, the use of paved shoulders in rural areas or on roadways without curb and gutter is a good way to incorporate bicycle facilities. Shoulder bikeways are beneficial to all roadway users in that they provide added space for motorist emergencies and emergency vehicles, improve highway capacity and sight distance, and help to maintain the edge of the roadway. Although shoulder bikeways are typically not striped exclusively for bicycles because of their range of functions, they are still able to provide a cost-effective solution for accommodating bicycle travel on rural roadways.

To most safely accommodate bicycle travel on shoulder bikeways, it is generally recommended that a clear shoulder width of at least four feet be provided. A five or six-foot wide clear shoulder is suggested on roadways with high traffic volumes, average speeds over 50 mph, steep grades, a high volume of large vehicles, or the presence of shoulder rumble strips or obstructions on the side of the road.

3.3 SHARED ROADWAYS

Roadways where cyclists and motorists share the same travel lanes are considered shared roadways. Shared roadways do not provide exclusive space for bicyclist and may require motorists to weave into adjacent lanes to pass a cyclist safely. Types of shared roadways include:

- Wide Outside Lanes,
- Bicycle Boulevards,
- Signed Shared Roadways, and
- Local Roadways.

Wide Outside Lanes (WOL)

Wide outside lanes (WOL) are a preferred alternative for arterial and collector streets that do not have adequate room for bike lanes and do not have paved shoulders. WOLs should be designed to provide adequate room for a standard automobile to pass a cyclist within the travel lane. While some cyclists may feel less comfortable on WOLs than on bike lanes, WOLs are a significant improvement over standard 11 to 12-foot wide travel lanes in accommodating bicycle traffic.

The shared lane pavement marking, also



Example of the Shared Lane Pavement Marking also called a “sharrow”, 2009 Edition of the MUTCD

referred to as “sharrow”, is called out in the 2009 MUTCD to identify WOLs. This marking indicates a presence of cyclists to motorists and also provides a guide to cyclists as to where they should position themselves. It can be especially effective in WOLs that are adjacent to parking lanes.

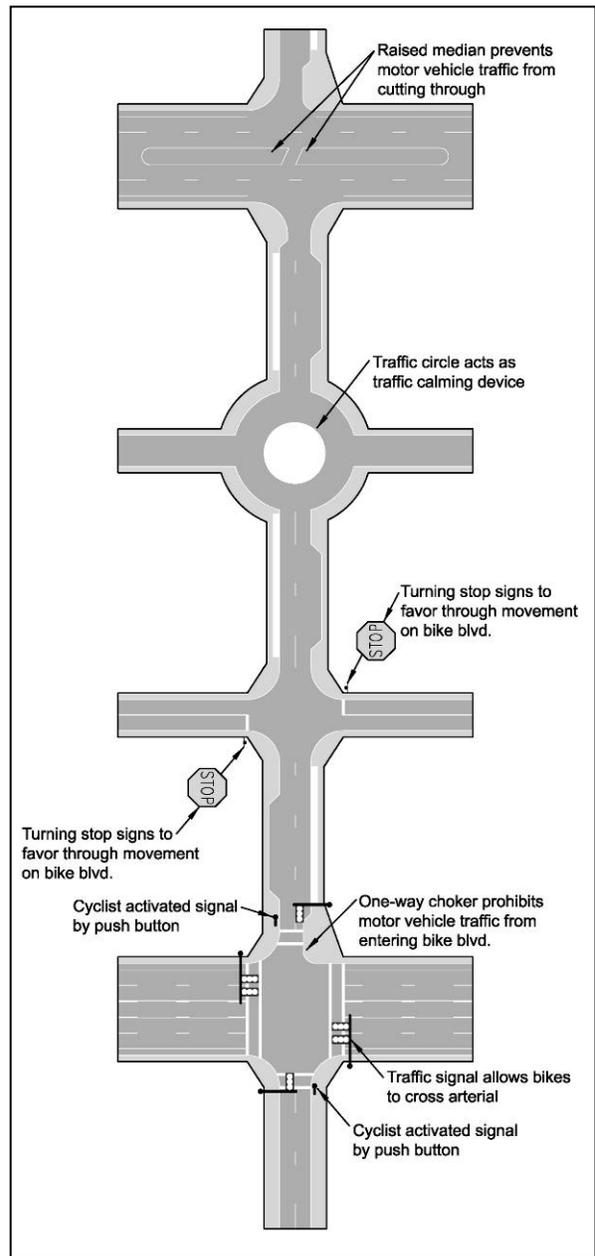
Many times, WOLs can be accomplished on multi-lane roadways by reducing the existing width of other travel lanes and reallocating it to the outside lane. It is recommended that WOLs be a minimum of 14 feet wide, measured from the gutter pan seam. Where on-street parking is provided, an adjacent WOL that is 15 to 16 feet wide is recommended. The parking lane should be striped to encourage motorists to park close to the curb. If WOLs are 15 feet or wider for continuous periods, striped bike lanes should be considered.

Bicycle Boulevard

Typically placed on low volume or residential streets parallel to high volume arterials, bicycle boulevards serve as through streets for cyclists. Motor vehicle traffic is allowed on bicycle boulevards. However, traffic calming devices are used to discourage cut-through traffic and slow motor vehicle traffic. Treatments used on bicycle boulevards, such as medians, traffic circles and chokers, are intended to reduce conflicts between motorists and cyclists, while prioritizing bicycle travel. For example, in order to favor bicycle travel, stop signs are placed on the side street, except at locations where stop control on the bicycle boulevard would benefit cyclists at busy intersections.

Streets on a grid system often are the best candidates for bicycle boulevards, since they are typically direct routes and provide better connectivity than winding streets. While bicycle boulevards offer advantages to cyclists and pedestrians by decreasing motor vehicle speeds and volumes, careful planning is needed to avoid increasing traffic volumes on nearby streets, impeding emergency vehicles, and other negative

Bicycle boulevards, as shown here, are roadways that emphasize bicycle travel.
 Source: *Oregon Bicycle and Pedestrian Plan*



impacts. It is also important to collaborate with residents on streets that a bicycle boulevard may impact.

Signed Shared Roadways (SSR)

Signed shared roadways are roadways that are identified by signage, and where appropriate pavement markings, as preferred bike routes. SSRs are recommended for roadways with limited pavement width and where adding width to support preferred bicycle facilities, such as bike lanes or wide outside lanes, is not possible. Roadways that carry a relatively high volume of bicycle traffic, a low volume of motor vehicle traffic, or that provide critical connectivity between bicycle routes or common destinations may be good candidates to be SSRs. When establishing a roadway as an SSR, the outside lane should be re-striped to provide as much additional pavement width for bicycle travel as possible. In some cases, the roadway should be marked with a “sharrow”. The pavement marking is used to alert motorists of the presence of bicyclists and to indicate to the bicyclist where to ride.



“Sharrow” pavement marking designating a shared lane

It is important to note that SSRs require more than just signage and pavement markings. Care should be taken to ensure that other elements of the roadway are as bicycle-friendly as possible. Regular maintenance to the roadway should be conducted, and common hazards to cyclists should be eliminated. For example, roadway maintenance should include scheduled street sweeping to clear debris. It should also improve other roadway conditions for cyclists, such as storm grates, potholes, railroad crossings, and other facilities. Common hazards facing cyclists are discussed in detail in the *Other Design Considerations* section of the *Bicycle Facilities Design Guidelines*.

In general, “Share the Road” signs are recommended, unless the SSR is a short section between bike lanes or WOLs. It is recommended that the speed limit on SSRs not exceed 35 mph.

Local Roadways

Due to their low traffic volumes and reduced vehicle speeds, special treatments are often not required for motorists and cyclists to share local roadways. At times, local roadways tend to endure more traffic and at higher speeds than is planned. When this is the case, bike lanes are recommended to increase comfort and safety for roadway users if adequate width is available.

3.4 TRAFFIC SIGNALS

Like motorists and pedestrians, cyclists must abide by traffic signals. Therefore, the signal timings should be designed to accommodate cyclists and detection must be designed to detect bicycles.

Traffic Signal Timing

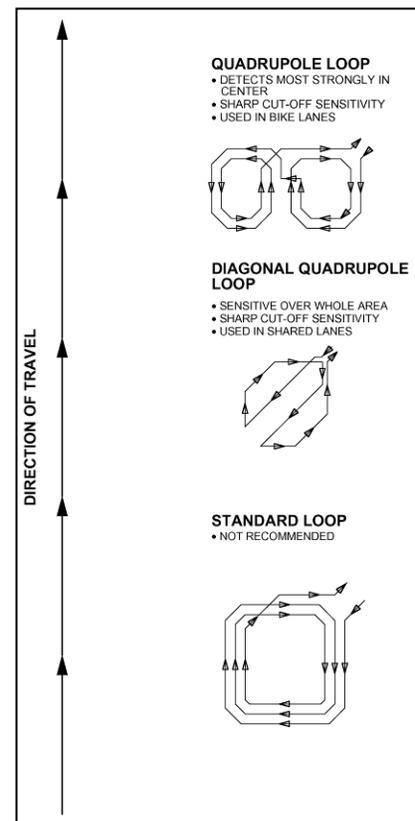
Traffic signal timings that are based solely on motor vehicle traffic may not provide adequate time for cyclists to clear an intersection. Signal clearance intervals should be programmed to allow cyclists enough time to react, accelerate, and proceed through an intersection on the clearance interval. At intersections where bicycle travel is anticipated, the average bicyclist speed of six to eight mph, and perception/reaction/braking time of one second should be considered when programming signal timings. At large intersections, such as multi-lane or skewed intersections, cyclists may also require additional time to cross.

Traffic Signal Detection

At actuated intersections where bicycle travel is expected, detector loops should be designed to detect bicycles in addition to motor vehicles. For this reason, detectors should be located within cyclists' expected path of travel in bike lanes, shoulder bikeways, and conventional travel lanes. Left turn lanes and outside through lanes, or shared through/right turn lanes, may need special consideration since the cyclist may be located on the right side of the lane, outside the typical detection area. At these locations, bicycle detection symbols should be provided to indicate to the cyclist the proper position at which to activate the signal detector.



Pavement Marking indicating Bicycle Detector Loop Location



Detector loops designed to detect bicycles should be used at signalized intersections where bicycles are expected.

The various types of detector loops are shown in the figure. Quadrupole and diagonal quadrupole loops are generally best for bicycle detection, since they are more sensitive throughout the loop. Standard loops are more difficult to adjust for bicycle detection and are not

recommended.

Video detection can also be used for bicycle detection. This type of detector is typically seen at intersections where a designated bike lane is striped and where video detection is used for automobiles. The technology uses detection zones to determine the presence of a bicycle.

Pushbutton-type detectors are generally discouraged for bicycle facilities. However, when a loop or video detector is not an option, a pushbutton may be appropriate if cyclists are able to access the pushbutton without having to dismount or lean and they can remain in the proper position for the direction they wish to travel at the intersection, including left and through movements.

Bicycle Signals

Bicycle signals can be used to help guide cyclists through high-volume, high-conflict intersections by providing a separate signal for cyclists. Bicycle signals protect cyclists at signalized intersections by separating conflicting movements and giving priority to cyclists making certain movements. Also, the overall flow of the intersection may be improved, but may result in additional delays for motorists.

Guidelines for bicycle signals are not provided in MUTCD and are not widely used. However, they have been implemented in cities such as Davis, California; New York, New York; Tucson, Arizona; and in various cities throughout Europe and Australia.

3.5 SIGNAGE

Bicycle facilities will often require signs directed at motorists, cyclists, or both. Additional signage directed at motorists may be required in some instances, such as complex intersections or locations with high bicycle traffic and insufficient bicycle facilities. Signs directed at cyclists are typically smaller versions of standard roadway signs since cyclists travel at lower speeds, and are often traveling closer to the signs. In addition to bike-specific signs, standard roadway signs usually also apply to cyclists.

Signs used for bicycle facilities, like standard roadway signs, should be easy to understand by all roadway users. The use of symbols is preferred over text on signs in general.

The 2009 MUTCD provides guidance on signage, placement and pavement markings for bicycle facilities. The latest edition of the MUTCD should be consulted when installing signs and pavement markings (<http://mutcd.fhwa.dot.gov/>).

Signage Guidelines

Shared-Use Trails (Greenways)

At intersections between shared-use trails and roadways, a “Bicycle Warning” sign (W11-1) should be placed on the roadway in advance of the intersection. Signs directed at cyclists on the shared-use path approach to an intersection, should only be visible to path users, not to motorists.

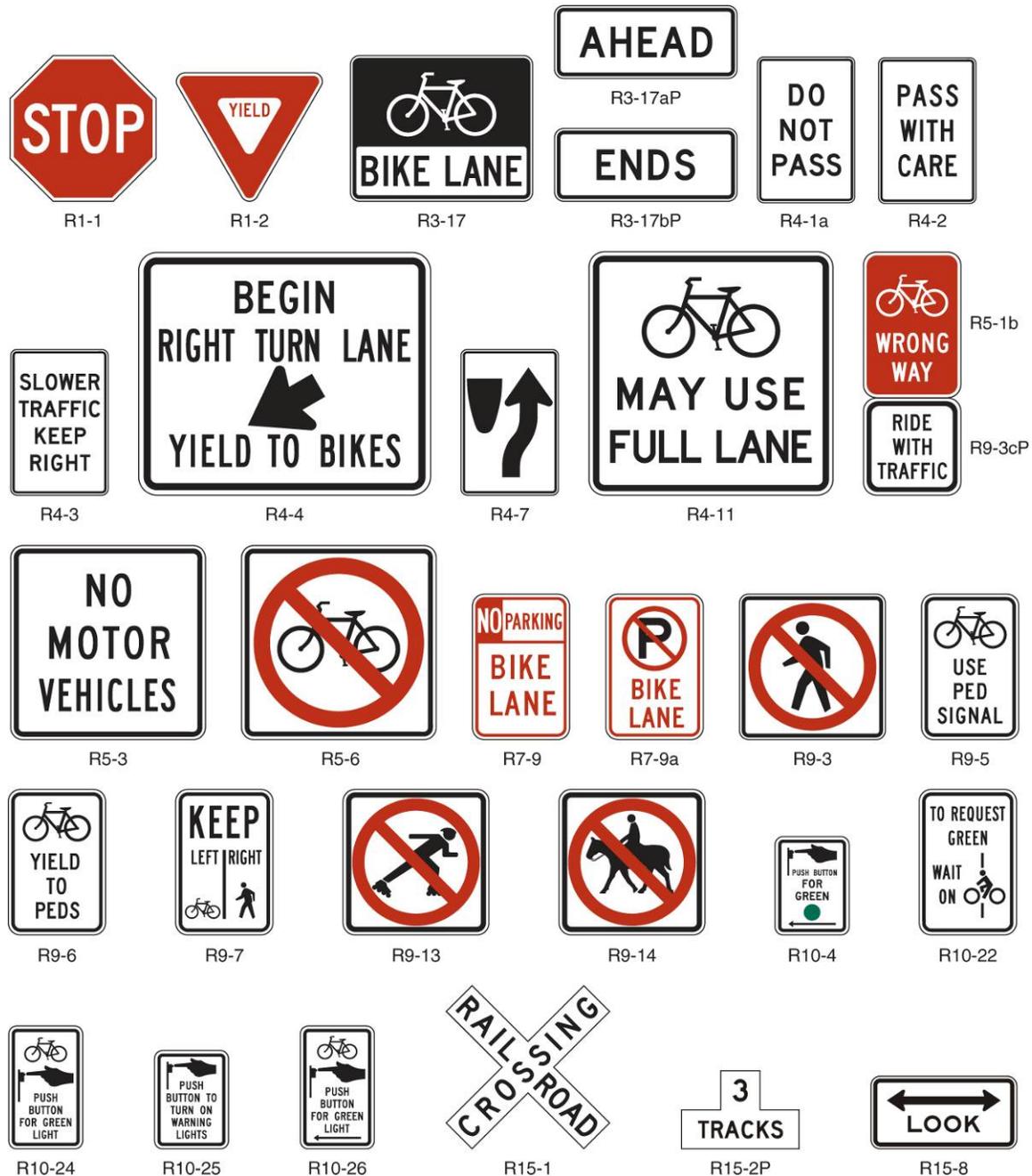
Bicycle Lanes

“Bicycle Lane” signs (R3-17) should only be used on designated bike lanes, which are marked by the “Bicycle Lane Symbol” marking. Supplemental bike lane plaques “Ahead” (R3-17a) and “Ends” (R3-17b) should be used in conjunction with the “Bike Lane” sign (R3-17) before the beginning of a marked bike lane, or before the bike lane ends. The “Bicycle Warning” sign (W11-1) and the “Share the Road” plaque (W16-1) should both be used just after the “Bike Lane Ends” signage. Where bike route signs (D11-1, M1-8, M1-9, and supplemental plaques) are used, they should include directional information, or information identifying the bikeway. On roadways with bike lanes, this type of informational signage is only needed at major intersections or where the route changes streets.

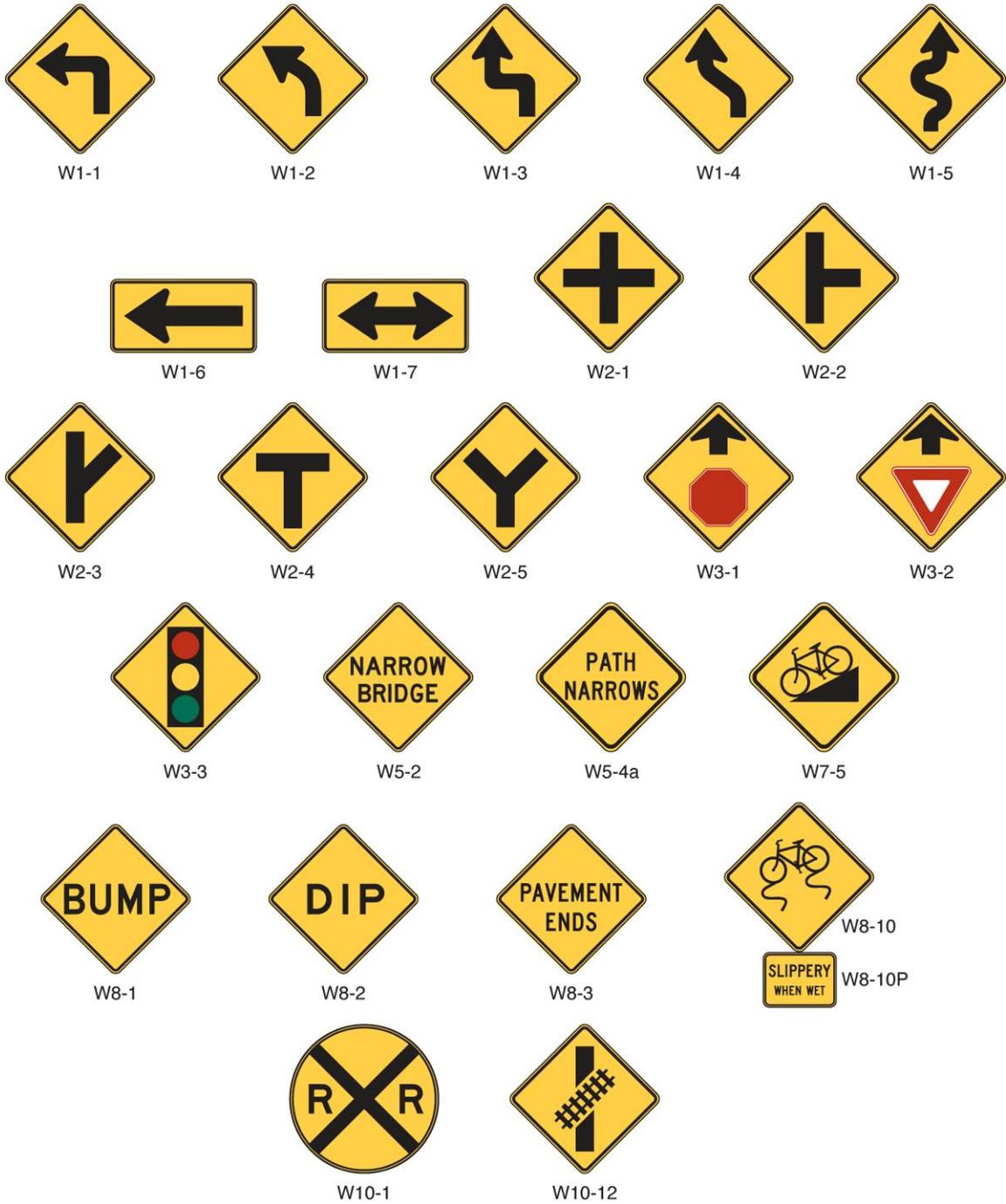
In locations where sections of bike lanes are discontinuous, bike route signs should be provided to guide cyclists from one bike lane to the next. Also, bike route signs are recommended to direct cyclists to destinations. For example, “Bike Route: XX Street Bikeway” or “Bike Route: Zoo.”

“No Parking Bike Lane” signs (R7-9, R7-9a) may be necessary in areas where parking within bike lanes is a recurring problem. However, in most cases, adequate pavement markings in bike lanes reduce the need for these signs.

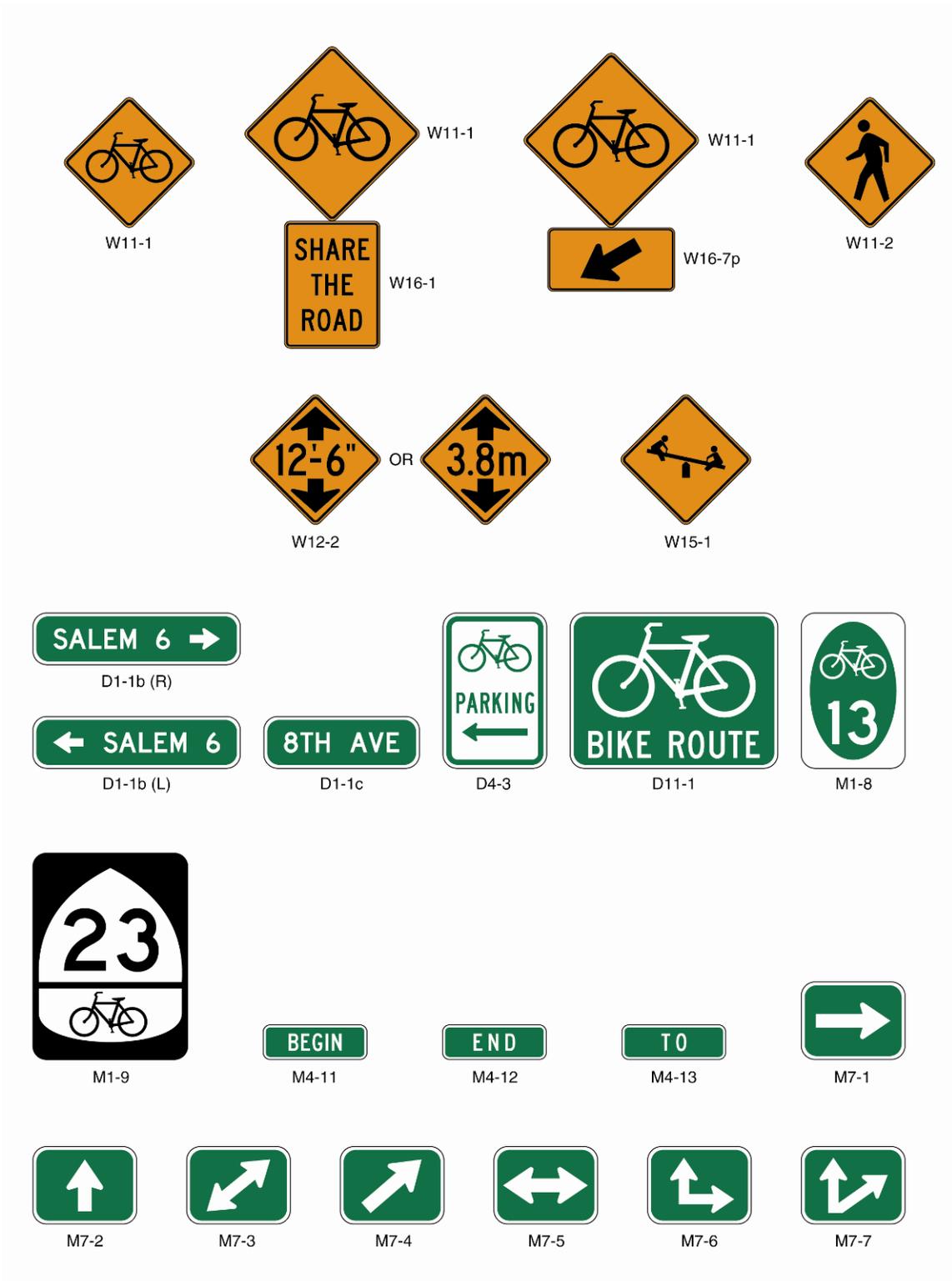
On roadways where motorists must transition across bike lanes into right turn lanes, “Begin Right Turn Lane Yield to Bikes” signs (R4-4) should be installed at the beginning of the taper, or, if none, at the point where merging begins.



Regulatory bicycle facilities signage from the 2009 edition of the *Manual on Uniform Traffic Control Devices*.



Warning bicycle facilities signage from the 2009 edition of the *Manual on Uniform Traffic Control Devices*.



Directional bicycle facilities signage from the 2009 edition of the *Manual on Uniform Traffic Control Devices*.

Shared Roadways

It is recommended that bicycle route signs (D11-1, M1-8, M1-9 and supplemental plaques) be placed at all major intersections where routes change direction and on streets with a minimum spacing of 1,000 feet. As previously mentioned bike route signs should include information, such as destinations, directions or identifying bikeways.

3.6 OTHER DESIGN CONSIDERATIONS

Pavement Surface Quality

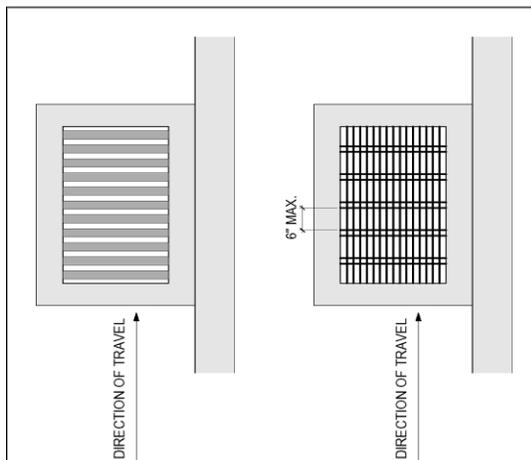
The quality of the pavement surface is an important consideration for cyclists. Potholes, joints, raised pavement or other surface irregularities can trap a bicycle wheel, or even cause cyclists to swerve or lose control, especially when they occur in the path of travel. These types of pavement problems should be repaired quickly and carefully, while making certain that the repairs do not actually leave conditions worse, such as leaving a ridge or loose gravel.

Storm Grates

Storm grates can pose a serious threat to cyclists depending on their design and location. For this reason, storm grates and utility covers should be kept out of the path of bicycle travel as much as possible. When it is not possible to relocate storm grates out of the path of travel, efforts should be made to maximize the safety of the existing storm grates in place.

Storm grates that are not flush with the frame of the grate and grates with long slots parallel to the path of travel can trap bicycle wheels, which can result in serious injury to the cyclist. These types of grates should be replaced with storm grates that are bicycle-compatible as well as hydraulically efficient. If replacing storm grates cannot be

achieved immediately, a temporary solution is to weld steel cross straps or bars to an existing grate, perpendicular to the path of travel, spaced a maximum of six inches apart.



Bicycle-friendly storm grates, such as those illustrated above, are recommended.

Another hazard to cyclists is created by storm grates that have not been raised as the street has been resurfaced and, as a result, are significantly lower than the surrounding pavement. When resurfacing a street, it is recommended that the grate be no more than one-quarter of an inch offset from the new pavement. If this is not possible, the pavement should be tapered into the grate to avoid leaving a severe edge.

In general, bicycle-safe storm grates are recommended for all streets, not just those identified for bicycle travel. Likewise, when

resurfacing streets, storm grates should be nearly level with the pavement on as many streets as possible, not just those designated for bicycle use.

Rumble Strips

Rumble strips are sometimes used on higher-speed roadways to alert motorists that they have veered onto the shoulder or to warn of an approaching intersection. However, for cyclists, they can be unsafe and uncomfortable. For cyclists, the safest option is to prohibit the use of rumble strips on roadways where bicycle travel is expected.

If it is determined that rumble strips will offer safety benefits on a roadway, there are techniques that will minimize their impact on cyclists. There should be at least five feet of space between the rumble strip and the edge of pavement. On roadways with wide outside lanes, rumble strips should be located on the right side of the lane line. Rumble strips should not be used on roads with bike lanes, unless they are placed outside the bike lane, to the right. Another design for rumble strips that is good for bicyclists is to install them with a skip pattern which allows bicyclists to move to the left when necessary.

Construction Zones

Bicycle travel should be maintained through construction zones to the greatest extent possible. Any provisions that are made for motorized traffic should also include provisions for maintaining bicycle travel.

Where bicycle facilities are interrupted for a significant distance, temporary bicycle facilities, such as bike lanes or wide outside lanes, should be provided. In locations where no temporary facilities can be provided, a reasonable detour should be identified and signed. Where bicycle facilities will be interrupted for a shorter distance, cyclists may be routed to conventional travel lanes. Cyclists should not be re-routed onto sidewalks unless no other options exist.

Metal plates that are used on roadways in construction sites may be difficult to see under certain conditions, and can have surfaces that can be slippery for cyclists. If metal plates are used, they should have an edge less than one inch high. If the edge is greater than one inch, an asphalt lip should be provided.

Construction signs should not obstruct the path of travel for cyclists or pedestrians. Also, construction information, especially regarding route changes, is recommended to be provided by local media or websites to the public. It is also recommended that groups affected by the construction such as neighborhood associations, or bike clubs be notified prior to the start of construction.

Bridges

Roadway bridges are as important to cyclists as they are to motorists in providing connectivity across highways or waterways. However, typical bridge elements such as

open grate decking, expansion joints and narrow lanes can present problems for cyclists.

Bridges should be improved to safely accommodate bicycle travel as part of routine bridge maintenance or as major work is scheduled for the bridge. For example, bridges should be retrofitted with bicycle-compatible decking and expansion joints to improve conditions for cyclists.

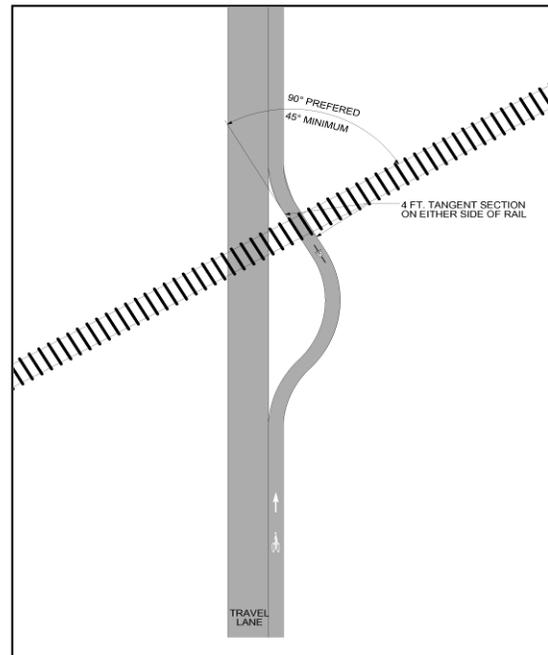
On new bridge construction, six-foot wide bike lanes are desirable to provide cyclists with additional room to maneuver on bridges with high volumes or steep grades. The width of the bridge should be at least as wide as the approaching roadways, including bike lanes, shoulders, curb and gutter, and sidewalks.

Bridges should be as bicycle-friendly as possible, even in locations where designated bicycle facilities are not provided. All new bridges should be designed to accommodate bicycle travel.

Railroad Crossings

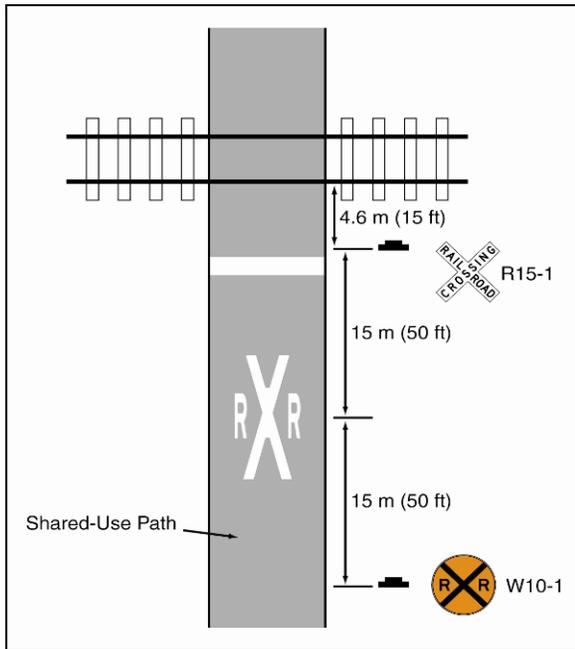
At-grade railroad crossings are most difficult for cyclists where they are forced to cross at an angle, especially if the surface at the crossing is rough. The channel between the flange and pavement can catch a bicycle tire and throw the cyclist.

Bikeways are recommended to cross railroad tracks as close to a right angle as possible. Angled crossings can result in a trapped bicycle wheel and can cause a loss of control for the cyclist. If the projected path of the bikeway will meet the railroad at less than a 45-degree angle, it is generally recommended that the bikeway should be realigned to provide a more perpendicular approach.

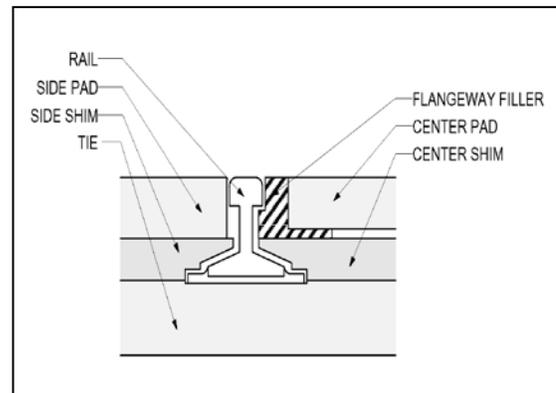


Realigned bike facilities can allow cyclists to cross the railroad at near perpendicular angles.

Advanced warning signs and pavement markings should be installed in advance of a railroad crossing, as stated in the MUTCD. Pavement markings should also be used to indicate the safest crossing angle to cyclists.



Advanced warning signs and pavement markings should be provided prior to a railroad crossing. (MUTCD)



Flangeway fillers can improve a rough railroad crossing surface by minimizing the gap between the rail and the pavement.

The pavement of the bikeway should be level with the rails in order to provide a smooth crossing. Crossings should be constructed of concrete panels with steel reinforcements. Rubberized crossing mats may also be used. However, they are not recommended on roadways with high volumes of heavy vehicles. Neither asphalt nor timber is recommended for crossings since asphalt has a tendency to develop ridges next to the rails, and timber can be slippery and is not as durable.

A rough railroad crossing can also be caused by the gap that can exist between the rail and the adjacent pavement, known as the flangeway. It is recommended that the width of the flangeway be as narrow as possible. Flangeway fillers, which are usually made of rubber, can be used to reduce the flangeway width. Flangeway fillers should not be used on high-speed railroad tracks.

3.7 DESIGN PRACTICES TO BE AVOIDED

Sidewalk Bikeways

Sidewalks for bicycle travel are generally not recommended for several reasons. These include:

- Sidewalks are not designed for higher-speed use by bicycles, which can lead to conflicts with slower-moving pedestrians or with fixed objects, such as poles, benches, and other street furniture.
- At intersections, motorists will expect pedestrians from a sidewalk, but may not be looking for a fast-moving cyclist to emerge from the sidewalk.

- Cyclists face conflicts at intersections where they are unable to follow vehicular traffic rules, but may also not follow pedestrian rules, resulting in confusion for all roadway users.
- Sight distance on sidewalks can be limited by buildings, trees, walls, or other obstructions.

In areas where bicycle travel on sidewalks is expected and allowed, such as locations where children ride on the sidewalk, sidewalks should not be signed as bicycle facilities. In general, cyclists should function as vehicles, and bicycle facilities should be appropriately designed to encourage this practice.

Two-Way Bike Lanes on One Side of the Street

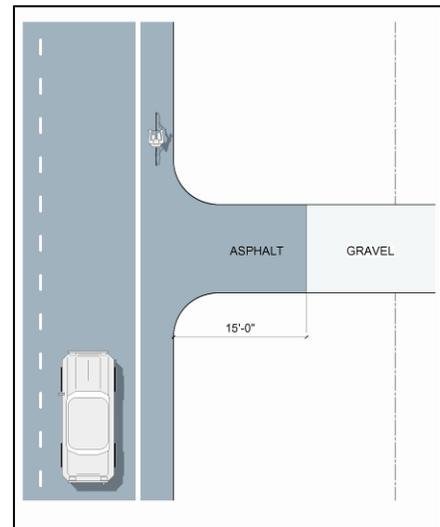
Potential hazards are created for cyclists when two-way bike lanes are installed on one side of the roadway. Cyclists next to the travel lane are traveling between motorists and cyclists who are moving in opposite directions. Cyclists using these lanes may cause confusion by being in unexpected locations at intersections, and they may be forced to make awkward and unsafe movements when moving to and from traditional bicycle lanes.

Gravel Driveways and Alleys

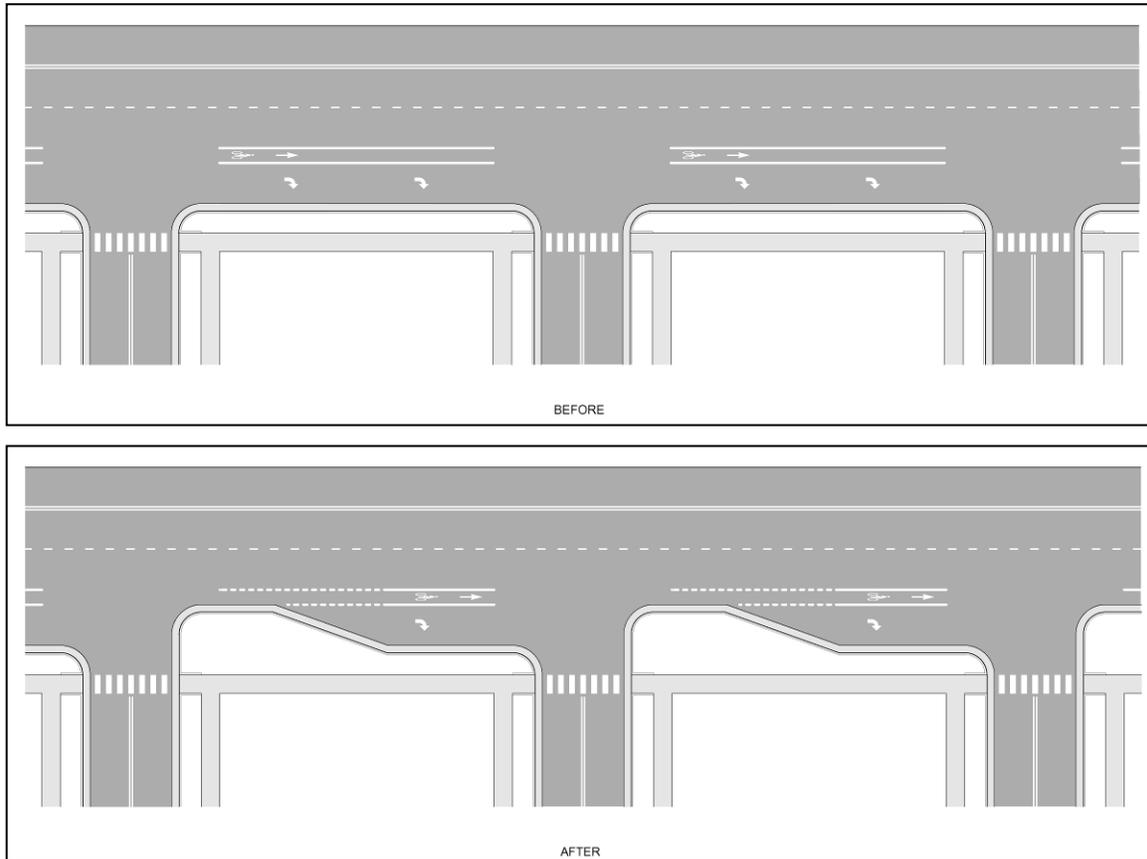
Gravel can be very unstable for cyclists and can result in loss of control. To prevent gravel from drifting onto bicycle facilities, gravel approaches should be paved back at least 15 feet.

Continuous Right-Turn Lanes

Cyclists riding on streets with continuous right turn lanes are forced to ride either to the right of the right-turn lane, where they may be in the path of the right-turning traffic, or to the left of the right-turn lane, where they are in the path of traffic moving into and out of the turn lane.



A paved apron at gravel approaches helps prevent gravel from spilling onto bicycle facilities.



The illustration at top shows a roadway with a continuous right turn lane, which allow constant merging conflicts. The bottom illustration provides separate right turn lanes, which can increase safety for cyclists.

Instead of a continuous right-turn lane, providing multiple right-turn lanes that serve specific intersections may be preferable. Eliminating the continuous right-turn lane will prevent vehicles on the approaching roadway from turning right into the continuous turn lane, resulting in fewer vehicles merging out of the continuous turn lane. Also, multiple turn lanes will create a defined space for motor vehicles to move into the right-turn lane prior to an intersection. Bike lanes should be installed to the left of the right-turn lanes.

Rumble Strips on Urban and Suburban Roadways

Shoulder rumble strips have been implemented by many highway agencies and State Departments of Transportation (DOTs) across the United States as an effective countermeasure to single-vehicle run-off-the-road accidents. In 2001, the FHWA issued a technical advisory on roadway shoulder rumble strips to address the conflict between the use of shoulder rumble strips on non-controlled access roadways and cyclists. FHWA technical advisory recommends rumble strips normally not be used in urban or suburban areas on non-controlled access roadways or along roadways where prevailing speeds are less than 50 mph. Additionally, FHWA recommends rumble strips not be used when their installation would leave a clear shoulder pathway less than 4-foot wide (or less than 5-foot wide if there is an obstruction such as a curb or guardrail) to the right of the rumble strip for bicycle use. The use of shoulder rumble strips on non-

access controlled facilities should be limited to locations that an engineering study or crash analysis suggests that the number of these crashes would likely be reduced by the presence of rumble strips which is consistent with FHWA's policy guidance.

3.8 MAINTENANCE

Cyclists travel on two high-pressure wheels and are even more vulnerable to poor roadway conditions than motor vehicles. Therefore, bicycle facilities should be maintained to the same high standard as roadways for motor vehicle traffic.

Bicycle facilities require routine maintenance just as roadways do. Because of their design, bicycles can be even more susceptible to accidents or damage caused by poor roadway conditions than motor vehicles. Debris on the roadway can deflect bicycle wheels, causing cyclists to lose control, and potholes can bend the rim of a bicycle wheel.

Surface Repairs

Cyclists should be provided with smooth riding surfaces. Therefore, surface imperfections should be maintained. Irregularities, such as potholes, ridges, cracks, and other surface defects, should be identified as part of regular maintenance and repaired promptly, especially when they are located within the bicycle path of travel. Also, an effort should be made to respond quickly to complaints of a specific hazard made by facility users.

Repaving

Repaving projects often present an opportunity to add or improve bicycle facilities on a roadway. Repaving may result in additional room for shoulders or bike lanes, adjustment of conventional travel lanes or the repair of surface irregularities.

Pavement overlays should extend across the entire pavement width (e.g. travel lanes, turn lanes, shoulder area, etc.) to prevent surface problems, like a ridge or edge, within the bicycle travel path.

As part of the repaving project, certain roadway features, such as manhole covers and storm grates, should be raised to offset the pavement surface by no more than one-quarter inch.

As previously mentioned, gravel driveways should be paved at least 15 feet back from the roadway to prevent gravel from spilling into the bicycle travel path. This portion of gravel driveways can be paved during roadway repaving projects.

Debris Removal

Routine inspection and maintenance programs should be organized to guarantee that litter and debris are removed from bicycle facilities on a regular basis. Streets that are equipped with bicycle facilities may require even more attention than roadways without bike facilities. Areas of the roadway between through and turning traffic often collect debris and are often in the path of bicycle travel. In order to keep them functioning properly and to keep water out of the bicycle path of travel, drainage areas should be kept clear of debris.

Maintenance schedules may need to be modified depending on the season. For example, frequent sweeping to remove leaves in the fall may be necessary. Individuals should be discouraged from blowing grass or leaves into the public right-of-way because, in addition to littering the path of bicycle travel, this practice creates increased workload and burden for the government agencies charged with keeping the right-of-way clean.

Utility Cuts

The cut lines of utility cuts on a roadway should be parallel with the flow of traffic and should be located outside the path of bicycle traffic to the greatest extent possible. Cut lines that must be placed within the travel path of cyclists should be filled and made flush with the surface of the pavement.

Vegetation

Vegetation along bicycle facilities should be trimmed periodically to avoid sight distance limitations and to provide a minimum of two feet of roadside clearance, especially at curves or intersections. In addition, care should be taken to ensure that signage is not hidden by vegetation. Preventative maintenance should be performed to keep tree roots from breaking up pavement.

Spot Improvements Program

In many cases, the users of a bicycle facility are the first to be aware of a maintenance problem on a bikeway. Spot improvement programs, where cyclists communicate problems directly to responsible government agencies, provide early detection of problems. This allows needed repairs to be performed quickly. However, spot improvement programs should not be expected to replace routine maintenance and inspection of bicycle facilities.

Providing forms on the government website can be a good way for cyclists to contact the appropriate government agency. The maintenance request can be forwarded to the

proper department, which will then be able to follow-up with the citizen who made the request. Paper forms should also be made available to those without internet access, and should be provided at bike shops or other easily accessible locations to cyclists. The government agencies need to have adequate staff and funding available to address maintenance problems as they arise.

3.9 BIKE FACILITY RETROFITS

Space within the roadway right-of-way should accommodate motor vehicle, bicycle, and pedestrian travel. However, many existing streets were originally constructed without bike lanes. For this reason, creating space for bicycle facilities on roadways can be one of the more challenging aspects of developing a bicycle network.

Bike facilities can be added to existing roadways by paving the shoulder as a bike lane, re-striping the roadway, or widening the roadway. Typically, re-striping or adding bike lanes to the shoulder are the preferred methods of incorporating bike facilities to existing streets since physical constraints often make widening roads not feasible.

Paving the Shoulders

As discussed in the shoulder bikeways section, the shoulder area on roadways without curb and gutter can often be used for bike facilities. However, unpaved or gravel shoulders, or shoulders paved with a rough bituminous surface, should be repaved to provide a stable riding surface for cyclists.

Shoulders should be paved to match the adjacent roadway structure and can function as either bike lanes or wide outside lanes. Minor shoulder grading may be able to provide additional width for paving, improving the comfort and safety of shoulder bike facilities.

Re-stripe the Roadway

Reduce Travel Lane Width

Space can be created for bicycle facilities by narrowing existing travel lanes, turn lanes, or parking lanes. Occasionally, wide lanes can be narrowed and still maintain 11 or 12-foot wide lanes. On lower-speed streets, travel lanes can be reduced to ten feet without compromising safety or operation and can still remain within AASHTO guidelines.

Reduce the Number of Travel Lanes

In some cases, removal of a conventional travel lane may be warranted and can provide roadway space for bike lanes. An engineering study should be conducted to determine levels of service for motor vehicles based on a reduction of travel lanes. Depending on

the roadway, the demand for enhanced bicycle facilities may outweigh a reasonable reduction in motor vehicle capacity.

The practice of reducing the number of conventional travel lanes has actually been effective in improving traffic flow in many locations and is now commonly referred to as a “road diet.” A common example of a road diet is a two-way roadway with a four-lane cross-section that is re-striped as a three-lane cross-section to include a single travel lane in each direction, a center turn lane, and, of course, space for bike lanes. This configuration has been used successfully in cities throughout the United States and Canada and can effectively improve traffic operations by reducing speeding, conflicts and crashes, especially on streets with high turning volumes.

Reduce On-Street Parking

Additional width for bike facilities may be obtained by reducing the amount of pavement width allotted to on-street parking. The width of parking lanes can be reduced to seven feet. However, when seven-foot parking lanes are used, adjacent bike lanes are recommended to have a minimum width of six feet.

Removing a parking lane from one side of the street may be appropriate where there is moderate parking demand. Another alternative would be to allow parking in bike lanes during off-peak periods or during special events, such as at night or during a nearby worship service.

The benefits of on-street parking and its effect on pedestrians and nearby businesses should be considered before reducing or eliminating parking lanes. For example, many businesses rely on on-street parking for their customers, and parking lanes increase pedestrian comfort by providing a buffer between the sidewalk and travel lanes.

Re-stripe for Wide Outside Lanes

Whenever possible, “extra” roadway width should be applied to outside lanes, even in locations where extra width will not result in the standard 14-foot required for WOLs. Cyclists benefit from any additional space in the outside lane, and motorists are provided with more room to pass cyclists without weaving into adjacent lanes. When additional width is provided for wide outside lanes, roadway features, such as storm grates, manhole covers, sign posts, or other obstructions, should be bicycle-compatible or should be relocated, if possible.

3.10 BICYCLE PARKING

Parking is as important to cyclists as it is to motorists and should be well-located, secure, and plentiful. Insufficient bicycle parking can actually discourage a potential cyclist from riding.

Benefits of bicycle parking are not limited to cyclists. Approximately ten bicycles can be parked in the amount of space provided for a single motor vehicle. Therefore, if

installed properly, the use of bicycle parking may lessen overcrowding in parking lots and help satisfy parking demand.

To ensure adequate parking for cyclists, many cities are implementing specific ordinances related to bicycle parking, usually based on the land use and size of the development. These guidelines may be used as a foundation for the development of this type of ordinance.

**CITY OF MURFREESBORO
GREENWAYS, BLUEWAYS, & BIKEWAYS MASTER PLAN**

TECHNICAL MEMORANDUM #5: PLAN IMPLEMENTATION

In 2011, the City of Murfreesboro initiated the development of the Greenways, Blueways, and Bikeways (GBB) Master Plan to help identify and coordinate implementable improvements in recreation and non-motorized transportation over the next 25 years.

This technical memorandum presents a summary and evaluation of Murfreesboro's existing implementation strategies as well as the identification of innovative activities which other communities are using to increase greenway, blueway, and bikeway use. The focus here is on policies and programs which have been used in other communities and which may be applicable in Murfreesboro. Such policies and programs promote bicycling and walking, educate users and potential users, and set standards to provide well designed facilities for non-motorized travel.

Implementation of the GBB Plan should always refer back to the community-held objectives for this plan and for non-motorized transportation and recreation as a whole. Two objectives lead toward the increased usage of these facilities; one by educating users as to the personal and community benefits of usage (Objective #1), and one toward establishing an attitude of at least considering use of these facilities on a regular basis (Objective #2). A third objective is also directly related to the Plan's implementation, by seeking to take advantage of existing programs within the City to increase the effectiveness of the GBB system (Objective #4).

This document should be viewed in the context of a normal planning level document. The intent of the Greenways, Blueways, and Bikeways Master Plan is to provide an overall programmatic vision for the City of Murfreesboro through coordinated planning between recreational and transportation facilities and users and to provide a general basis for facility implementation. Actual implementation of any individual planning recommendation may require additional study and analysis in identifying and quantifying opportunities and constraints including but not limited to project components such as land acquisition, utility relocation, construction cost and etc. Analysis and consideration of identified impacts may ultimately indicate the feasibility of implementation of the actual project recommendation or consideration of more viable alternatives in attempting to achieve and adhere to the overall intent and goals of the plan.

Evaluation of Murfreesboro's Existing Strategies

An evaluation of the existing regulatory processes that promote bike and pedestrian facilities in the City of Murfreesboro was completed so that recommendations could be made that will help promote future development of the greenway system. The City currently has many planning tools that help shape the development of the community. Policies are in place requiring the provision of sidewalks and the best management and treatment of stormwater runoff. Zoning with special overlay districts as well as subdivision regulations help shape how the community grows and what the visual character will be.

A specific look at regulations geared at promoting and improving the pedestrian environment reveals many tools that are currently in place. Sidewalks are required for all new development in the city. Their size, location and time of construction are all regulated by the city's subdivision regulations. Street design specifications call for the provision of bicycle facilities wherever they have been identified in the overall bicycle master plan. Stormwater regulations provide buffers to protect water quality along the water courses within the city, making specific mention for the use of those buffers for greenway development. The special overlay districts provide language for the provision of pedestrian and bike facilities within their boundaries. These facilities are often regulated and promoted by planning staff and the Planning Commission as development occurs within those zones. Review of the various planning and regulatory tools for development in the city reveals that additional processes could be added that are common to other communities that are similar in size and character to Murfreesboro.

Land Acquisition and Greenway Easements

There are many avenues to acquiring greenway rights-of-way with the first and most obvious being fee simple acquisition. Fee simple acquisition results in the direct ownership of real property; it is the most complete form of land ownership. Acquisition is not limited to purchase of land in fee simple, but also includes purchase of development rights and acceptance of donations of land and development rights. These methods may be desirable for larger parcels of land where protection of a natural resource with significant natural qualities is desired. Fee simple acquisition is a very expensive method for acquiring right-of-way but is probably the simplest form for property that is intended for public use. Alternative right-of-way acquisition methods are discussed below.

Multi-Purpose Easements

The City of Murfreesboro should incorporate the right of public access into new sewer easements or coordinate the acquisition of sewer and access easements, where feasible, creating greenway corridors that link new subdivisions and homes with other greenspaces and public facilities such as schools, libraries and commercial centers. The Parks and Recreation Department should work with the Murfreesboro Water and Sewer Department to acquire public access easements on new sewer lines and explore opportunities along existing sewer lines in areas of desired linkages.

Easements through Private Development

There are generally three options for acquiring easements for public access greenways associated with new development along designated corridors. They include:

- Acquire the greenway portion of the property in fee simple

- Where allowable in the City's regulatory processes, acquire an easement for the greenway portion which stipulates public access as a condition
- Provide incentives for developers to include public access greenways in their developments

The development community has become much more aware of the value and benefit to public access greenways and specifically to the desire by citizens to be connected to them. Developers are much more willing to consider granting easements for trails and in some cases are willing to build them as part of their overall project. Requiring easements along planned greenway corridors is consistent with other practices within the City. The current street design specifications require developers of new roads to accommodate for bike lanes and sidewalks wherever previously planned. Greenway easements could be treated in a similar manner. Incentives could be offered that give a developer density bonuses or other compensation for granting easements. If the greenway is not constructed as a part of the overall development, the greenway easement would be maintained by the owner until such time that the city exercises its right to build the trail. At that time, the city would take over maintenance of the trail. Greenway easements should be included in the final property plat and noted as such. It is recommended that the city post signs along the corridor that note the area as a future greenway easement. This will alert property owners of the future intent of the city to build a trail and eliminate any future surprises.

In order to evaluate property found along the greenway corridor, existing routes should be mapped and maintained by the city's GIS department. During the initial planning review stages for new projects, discussions should be made relative to easement dedication. Developer incentives such as density bonuses, variances for parking or other opportunities should be discussed at this time.

Due to the popularity of greenways and the desirability of homeowner's and business owner's to be located along greenway corridors, it is highly feasible that developers will be willing to dedicate right of way for future trail construction. In some cases, developers may be willing to build sections of trail through their development as an amenity feature to help with the sale of lots. In these instances, it is recommended that the trail project be evaluated and a determination be made as to when the city will assume all responsibility for the trail. If the trail does not connect to an existing part of the overall system, the city may want to delay acceptance of the trail until such time that a link can be made to the overall public system. If that is the case, the trail should be maintained as an amenity of the private development. In the case of a trail located within a subdivision, the trail would simply be maintained as an amenity feature for residents in the same manner as a swimming pool, tennis courts or other recreation element.

Riparian Buffers

The City currently accommodates and allows for the development of greenways within water quality protection areas (WQPA). A buffer of 35' to 50' is required along all streams and wetlands. These areas are no-disturb zones with the exception of specific uses such as stream crossings for roads or utilities and greenways. As with the site plan review process, greenway easements could be acquired through the stormwater approval process. Variance requests for special considerations could be approved if mitigated by the granting of a greenway easement. As in other cases, the property owner would maintain the easement until such time that the city exercises the right to develop the trail.

Roadway Buffers

Multi-use paths have been recommended along many of Murfreesboro's existing and future roadway projects. Additional right of way may be required where multi-use paths have been recommended to allow for the desired separation of the trail from the roadway.

Revised Policy Recommendations Include:

- Consideration of a dedicated greenway easement for all property shown along planned corridors
- Consideration to provide density bonuses and other incentives for developers willing to incorporate trail segments as part of their proposed developments
- Consideration to provide a stormwater variance process that incorporates the dedication of greenway easements into the variance approval
- Explore opportunities for multi-purpose easements with the water and sewer department

Non-Infrastructure Strategies for Increasing Use of the GBB System

In addition to policies which facilitate the provision of system infrastructure, other efforts which can be championed or supported by the City can have positive impact on the promotion and use of the system. The numerous potential non-infrastructure policies and programs have different objectives, different levels of effort required to becoming implemented, and, consequently, different levels of effectiveness. To help structure some of the potential policy and program considerations, they have been grouped into three classifications.

Those which:

- 1) **Provide Facilities** – Typically used by City staff to assist in providing a comprehensive, safe, and convenient GBB system,
- 2) **Build Support** – Work towards more use through a collaborative and cooperative environment among local stakeholders and organizations, and
- 3) **Increase Awareness** - Highlight an understanding and awareness of the opportunities, benefits, and need for the GBB system.

Provide Facilities

- Policies should be adopted by City agencies to provide ongoing maintenance of the GBB network. Examples of such maintenance activities include regular street sweeping of roadway bicycle facilities, debris removal, and sign and striping replacement.
- As part of Nashville's Regional Bicycle and Pedestrian Study, a Sidewalk Accommodation Policy was proposed that calls for sidewalk accommodations on all federally classified Arterial roadways within an Urban Growth Boundary of the MPO on which pedestrians are not prohibited. This has largely been accomplished within Murfreesboro's City Limits, but extending arterial sidewalks into the UGB will require additional coordination with County officials. This policy adoption should occur as part of Murfreesboro's comprehensive plan, zoning code, and/or subdivision regulations.
- Some jurisdictions in Tennessee allow "in-lieu-of" payments to the community's sidewalk fund. By collecting equal payments in lieu of actual on-site sidewalk construction, more strategic choices can be made regarding where and when sidewalks are built.
- Develop a maintenance and spot improvement program to be run by the Street or Parks Department. The responsibility could be split where on-road facilities are maintained by the Street Department and greenways are maintained by the Parks Department. Examples of such maintenance activities include regular sweeping, litter and debris removal, vegetation control, and signing and striping.
- Provide spot maintenance forms upon request at bicycle shops and on a website set-up for bicycle and pedestrian information.

- Establish a local sidewalk maintenance program to address sidewalk maintenance and repair needs.
- As a required part of the development review process, evaluate the potential for new developments to provide pedestrian and bicycle connections to nearby destinations and/or facilities. This review should also encourage pedestrian and bicycle facilities which provide logical connections between schools, shopping centers, parks, civic buildings, transit stops, park-and-ride lots, residential developments, and other activity centers.
- Expand the City's current plans, ordinances, regulations, etc. to not only require sidewalk and bikeway facilities but also advocate for development policies that support walking and bicycling through community design, mixed-use development, street connectivity, and transit oriented development.
- Promote and encourage land use decisions that provide a context-appropriate mixture of uses that are supportive of increased walking and bicycling. Specifically, development incentives can be offered which:
 - Encourage a diversity of mixed-income residential neighborhoods, employment, shopping and recreation choices at the activity center, town center, and corridor level;
 - Provide access to a range of travel modes including transit, roadways, walking and biking; and
 - Develop an outreach process that promotes the involvement of all stakeholders.
- Establish developer incentives for inclusion of amenities such as bike racks, lockers, showers, and other facilities in commercial and public building projects.
- Develop bicycle parking requirements for new developments. Alternatively, use car parking reduction incentives to encourage the provision of bike parking.
- Champion the implementation of bike-friendly practices outside of redevelopment scenarios. Providing bike parking in prominent locations at public buildings is a good start.
- Formal bike share programs are another way to promote bike-friendliness, but are expensive and are just beginning in the major urban areas of Tennessee. The effectiveness of these is not yet known. If a bike share program is desired in Murfreesboro, start at likely high-use locations where participants can ride comfortably. Old Fort Park and Wilderness Station might be good places for potential riders to get re-introduced to bicycling by using a Parks-managed bike share program. As more planned on-street facilities are implemented, a formal bike share program with multiple urban stations will become more effective.
- Establish school siting policies that favor sites with good walking and biking access. In addition, the site design of schools should give opportunity for pedestrian and bicycle access.

Build Support

- City staff should engage in national, state, regional, and local advocacy organizations related to greenways, blueways, and bikeways. These are effective ways to learn about new advancements in facility provision, design, and use.
- Providing continuous bicycle and pedestrian facilities across the city will require a new level of inter-agency as well as inter-jurisdictional cooperation. The active role of the Parks Department in greenway implementation will require it to coordinate closely with other agencies like the Planning Department which is charged with coordinating the development of the city, including its greenways. A recognized process by which the Parks Department has an opportunity to review and comment on new development proposals affecting the GBB system could help facilitate this cooperation.
- Consider working with local and regional transit providers (MTA, RTA, and ROVER) to develop strategies and opportunities to increase walking and biking to and from public transportation services. Potential strategies include linking transit stops to sidewalks and bikeways, providing comfortable, well designed transit stops, and providing bike storage at transit stops. One example might be providing covered bike parking at the RTA Relax-and-Ride stop on the MTSU campus. Generally, federal transit funds can be used for bicycle and pedestrian facilities that serve transit activities.
- Provide an annual report on the state of GBB improvements and activities in the city. Information can be used in presentations to elected leaders, community organizations (i.e. YMCA, health depts., churches, bicycle clubs, etc.), and other stakeholders detailing the benefits, projects, and practices for the year related to walking and biking in the city.
- Initiate an annual bicycle and pedestrian count program consistent with the National Bicycle & Pedestrian Documentation Project (NBPD). Data from this program is useful in demonstrating growing usage over time and can be included in the annual report (above). Even more usage data can be obtained by installing continuous counting devices at points along the greenway. Having continuous count data can be used to tailor other activities such as litter maintenance, which may need to be completed more often during certain periods.
- User surveys can be conducted periodically to provide customer feedback on the state of the GBB system. Surveys can also be used as a tool to measure the effectiveness of various policies and programs.
- Develop a “targeted neighborhood” program. The City of Portland has a program that targets an area of town each year to increase bicycling, walking, transit, carpool, and car sharing trips. The projects include programs that are targeted toward the demographics in that neighborhood. Each household in the target area receives an order form for informational materials. The households can order materials about bicycling which include a bike kit, maps, safe routes, ride calendar, and helmet brochure. In some areas there are incentives offered to residents who returned their order forms. The residents receive a newsletter every other month that provides

information on traffic safety and programs in that area, a calendar of events, and other resources.

- Adhere to a locally developed Complete Streets policy to ensure that new roadways and roadway improvements are designed with all users and all skill levels in mind, i.e. it is designed to accommodate bicyclist, pedestrians, transit users, and motorists.

Increase Awareness

- Explore the possibility of providing information regarding the GBB networks, bicyclist/pedestrian safety, etc. to be distributed through the Rutherford County Clerk as part of vehicle registration renewals.
- Promote bicycle safety education locally, including efforts to increase understanding and awareness of the Tennessee 3-foot law for motorists passing bicyclists.
- Establish a formalized cyclist/pedestrian safety enforcement program through the Murfreesboro Police Department. Grants from the National Highway Traffic Safety Administration (NHTSA) can be obtained by local police departments for enforcing pedestrian right-of-way laws and bicycle traffic violations. The grants can be used to conduct targeted enforcement campaigns, pedestrian enforcement at intersections and bicycle enforcement at other intersections. Those behaviors to be targeted should be determined at the outset of a law enforcement campaign. It is recommended that the following behaviors be targeted:

Motorist behaviors

- Failing to pass at a safe distance (not less than three feet),
- Right turners cutting off bicyclists,
- Failing to yield to bicyclists (comply with signals/signs) at intersections,
- Failing to yield to pedestrians at crosswalks, and
- Right turn on red violations.

Bicyclist behaviors

- Riding at night without lights,
- Violating traffic signals/stop signs,
- Sudden changes in direction without scanning or signaling, and
- Failing to yield to motorists at midblock locations.

The effort to enforce the traffic laws as they relate to bicycle and pedestrian safety should be addressed in a publicized, citywide, coordinated bicycle enforcement campaign. Sporadic enforcement is not likely to result in significant improvements to motorist, cyclist, or pedestrian behavior.

- Offer safety training opportunities for adults and children. These can range from “lunch and learn” type presentations to evening/weekend commuter workshops to providing League of American Bicyclists *Traffic Skills 101* courses offered by the Parks Department.
- An informational website should be established that contains information regarding biking and paddling in the region. This website can be used to post facility maps and other information regarding the GBB facilities. The website can also provide opportunities for maintenance requests or other user feedback.
- The website should provide information on a variety of educational resources including information such as elementary instructor training courses on bicycle and pedestrian safety for children through programs like Safe Routes to School.

- It is recommended that a bicycle and pedestrian traffic safety curriculum for elementary and middle school students be developed. The program should establish guidelines to maintain, update, and distribute the materials, as well as train the educators on implementing the materials. This type of curriculum is currently being developed in Knox County for grades K-8 and may be available soon as an example.
- Create, fund, and implement pedestrian and bicycle media campaigns and promotional materials to promote walking and bicycling as a safe, healthy, cost effective, environmentally beneficial transportation choice. Identify partners to provide bicycle and pedestrian education, enforcement, and encouragement programs. One such source may be the Federal Highway Administration's (FHWA) Pedestrian Safety Campaign. FHWA materials include radio, television, and public service announcements; brochures; posters; press releases; and newspaper articles.
- Host special events that feature elements of the GBB System. The following provides information regarding the successful planning of road racing events as well as a map for target areas that can be utilized in the planning of future events.

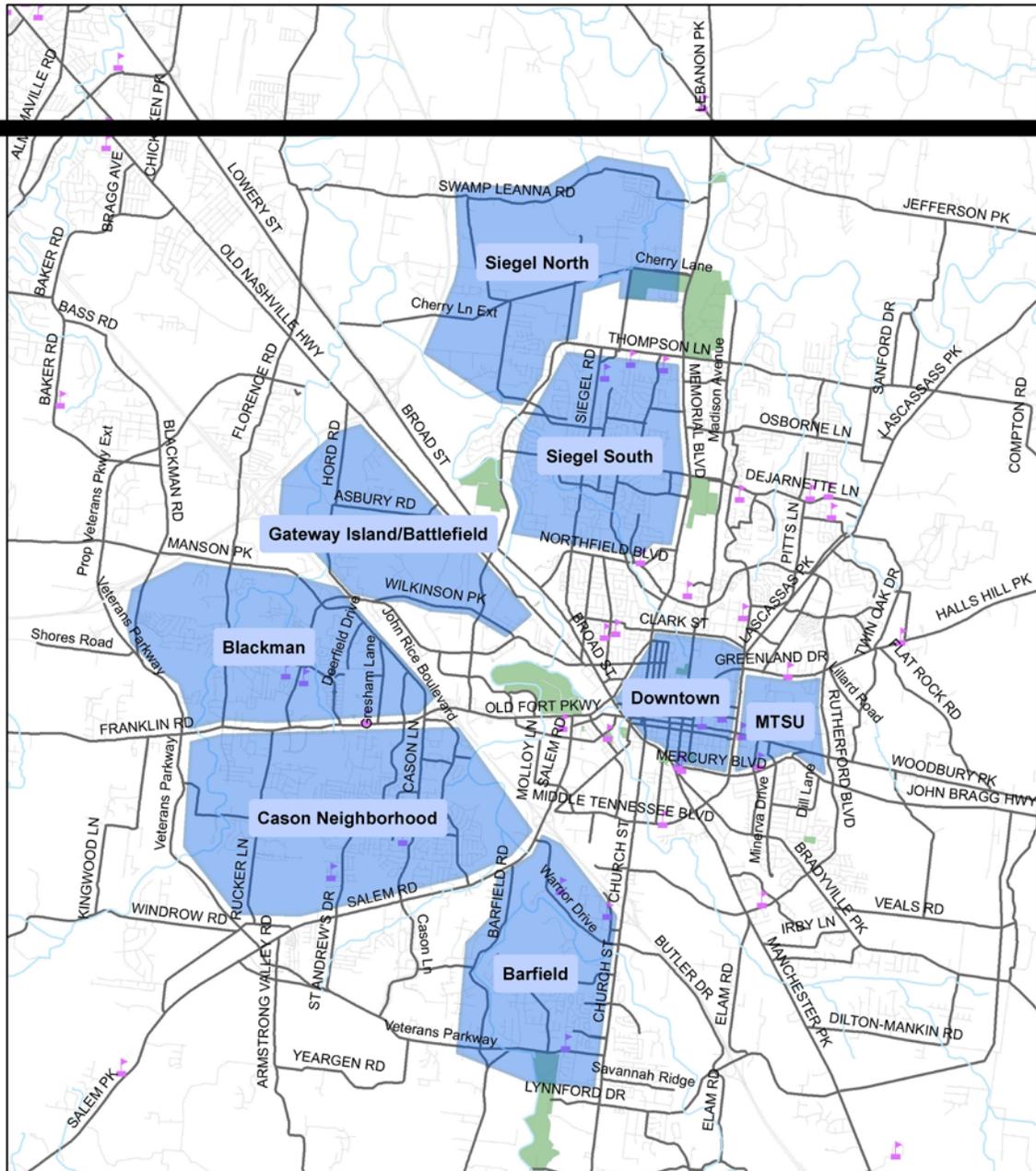
A common way for communities to encourage active recreation is through facilitation and support of local road racing (5 and 10K events, etc). These events are usually organized by local non-profit entities and held as a fundraiser and/or awareness campaign for the hosting organization. While a few experienced race directors are for hire in middle Tennessee, these races are often overseen by a race director with little or no experience in establishing a course for the event. Designing and approving a course using public street infrastructure to hold a road racing event should consider both the advantages and potential complications of a particular route.

The recommended approach for establishing future road racing courses and events in Murfreesboro is to produce a guidance packet which sets forth the City's desired characteristics for an approved road course as well as the expectations for the event host with respect to parking, traffic control, etc. This can be given to race directors as they plan the course and event. Guidelines that should be considered when designing a race course on Murfreesboro's streets include:

- Streets should not be used (or crossed) by the race route if the street has an ADT of 10,000 vehicles per day or more. This would rule out high-volume streets like Broad Street, Middle Tennessee Boulevard, Memorial Boulevard, Thompson Lane, etc.
- Greenways should not be used as part of the route (excepting the Gateway Trail).
- For one-way race routing, a minimum clear street width (accounting for on-street parking, etc.) of 15' is desirable. Where runners are traveling in opposing directions (i.e. on an out-and-back portion of a course), a minimum clear street width of 22' is desired.
- Ample off-street space for before and after race activities (parking, registration, post-race celebration, etc.) must be available. City parks may be encouraged as beginning and/or ending points for these events.
- Race routes should not include at-grade railroad track crossings or streets near hospitals, fire stations, or other locations dependent on clear access.
- Unpaved areas may be used, but including significant lengths of unpaved surface may jeopardize course certification by USATF, RRCA, etc.

- Longer races (marathons, half marathons, etc.) will likely require use of higher-volume streets to obtain the distance and should be planned in close coordination with Murfreesboro's Transportation Department.

A map showing potential races areas has been developed to illustrate some locations where most if not all of these guidelines can be incorporated into future races.



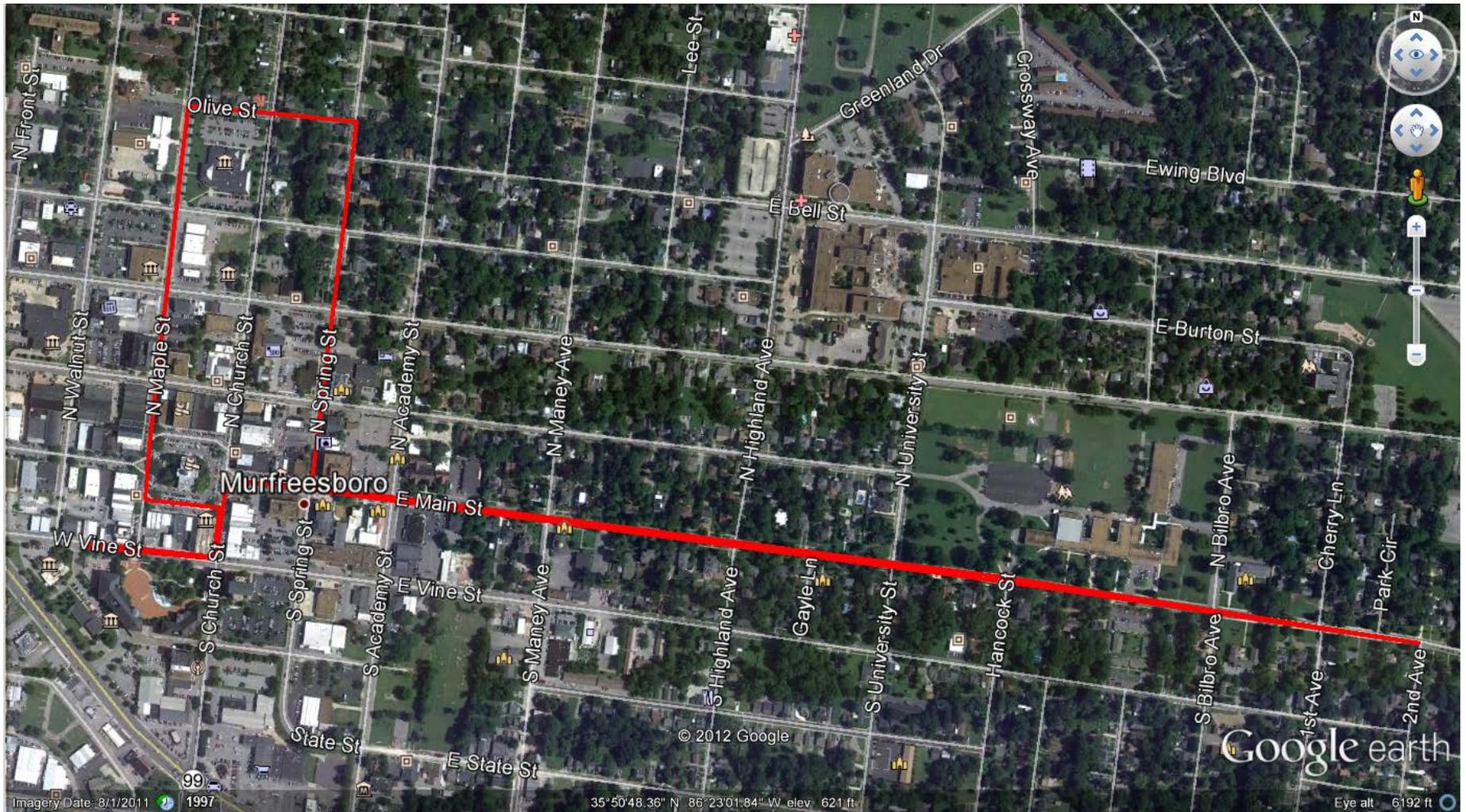
Proposed Race Areas Schools Parks

Proposed race areas have many of the race course characteristics recommended in the street guidelines. These include enough distance to obtain certifiable course distance, avoidance of major streets, and at least one suitable start/finish/parking site. Other courses outside of these areas may be equally suitable.

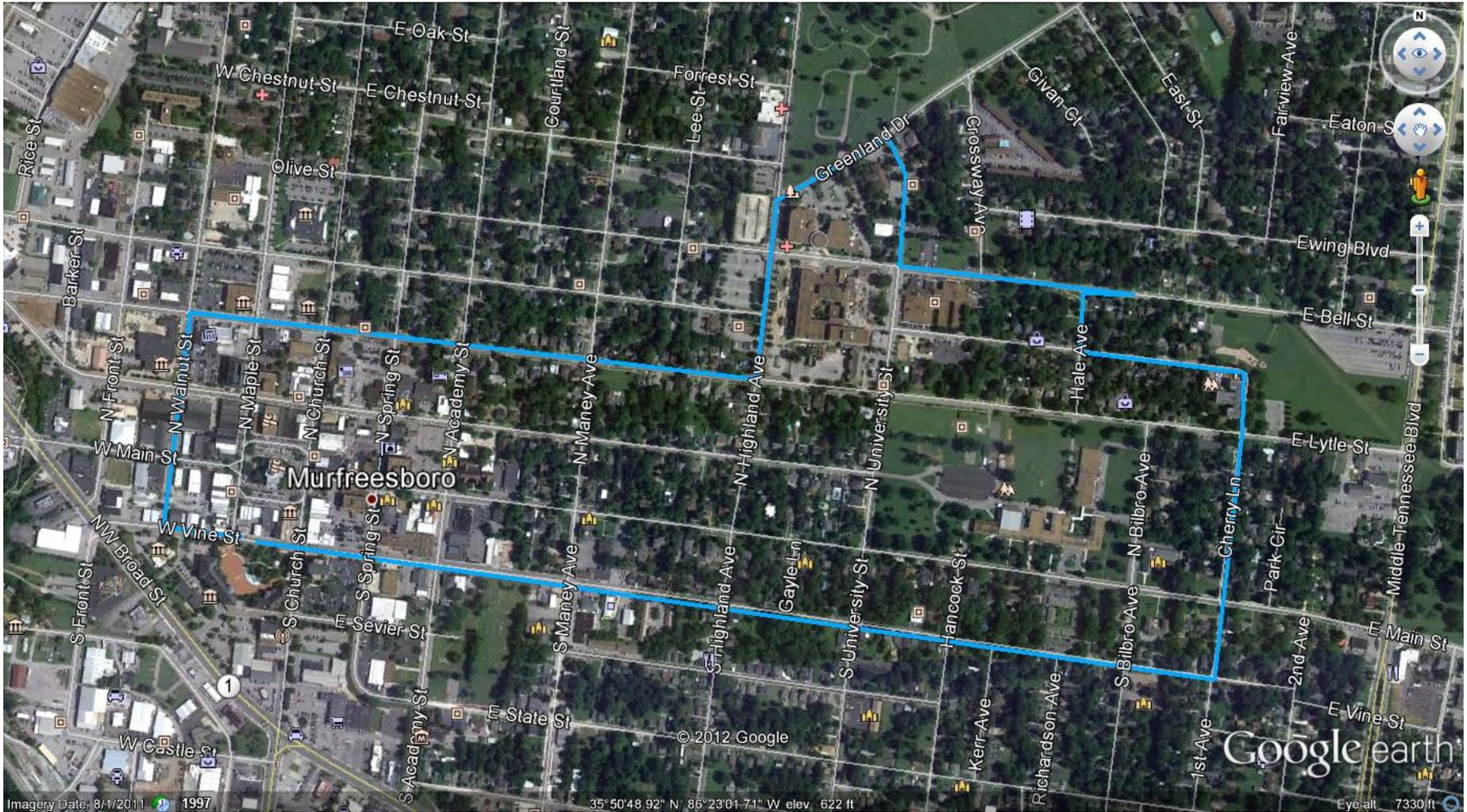
City of Murfreesboro
0 1 2 Miles

**Greenways, Blueways,
and Bikeways Master Plan**
Potential Road Race Areas

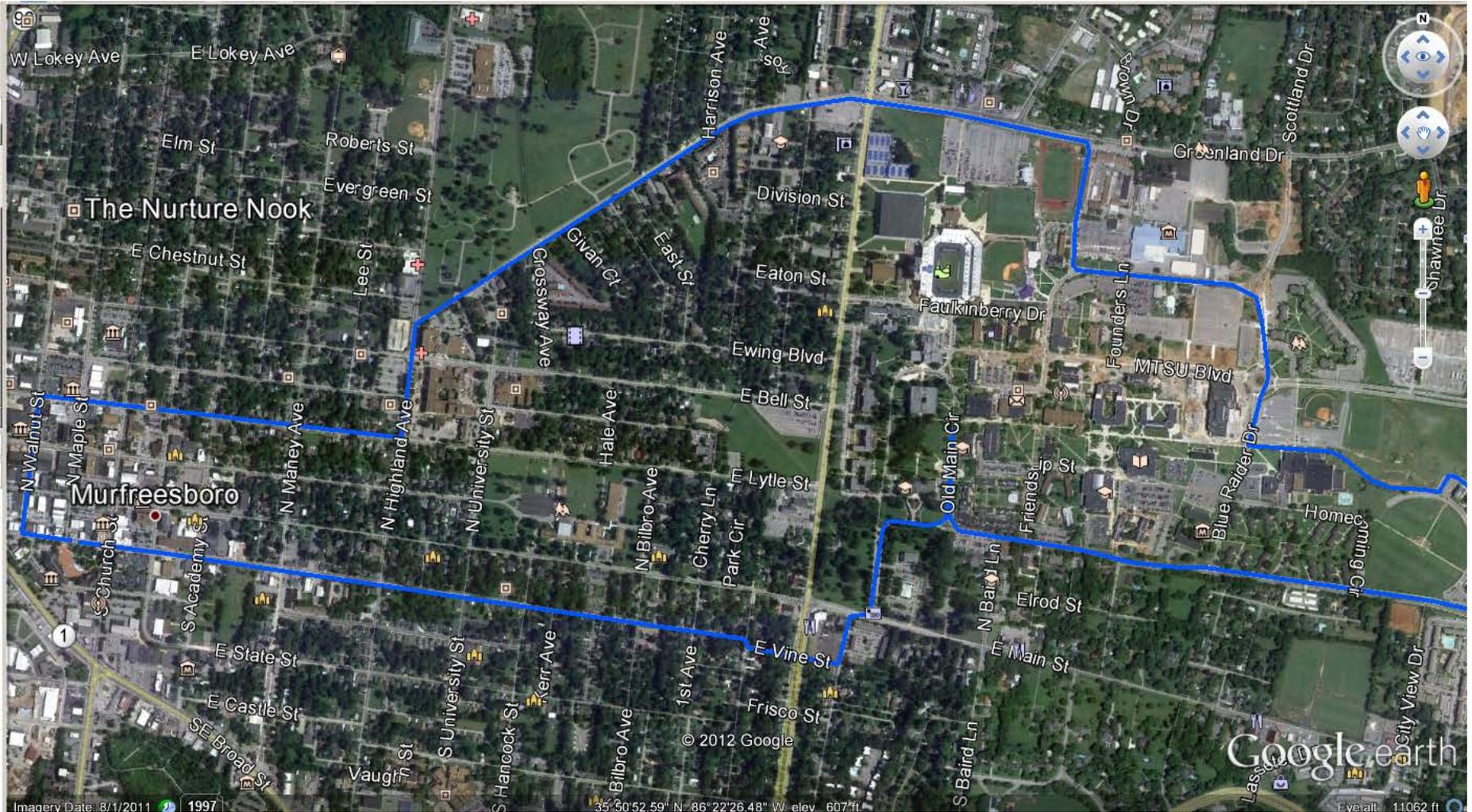
It may further be desirable to establish several “standing” courses which are pre-determined by the city to be adequate for these events. If established, these pre-determined courses would require the use of public property for parking, registration areas, etc. with start/finish locations nearby. Two such locations would be the City Hall Garage/Library Plaza and Patterson Park Community Center. An incentive for a race director to use one of these pre-determined courses is that the event host would save the time and expense of having the course certified by road racing certification agencies.



Option A: Downtown 5K



Option B: Downtown 5K (pairs with Option C 10K)



Option C: Downtown 10K (pairs with Option B 5K)

**CITY OF MURFREESBORO
GREENWAYS, BLUEWAYS, & BIKEWAYS MASTER PLAN**

APPENDIX

**Ordinance
Timeline of Plan Input**

ORDINANCE 13-O-02 to adopt the Greenways, Blueways, and Bikeways Master Plan for the City Of Murfreesboro; Planning Staff, applicant [2012-SI-7].

WHEREAS, the City of Murfreesboro adopted a Comprehensive Land Use Plan on January 12, 1989 and thereafter has adopted other land use plans to complement, implement and modify said Comprehensive Land Use Plan; and,

WHEREAS, a Greenways, Blueways, and Bikeways Master Plan for the City Of Murfreesboro is necessary and prudent to accomplish the goals of the Comprehensive Land Use Plan; and,

WHEREAS, on October 22, 2012 the Planning Commission, City Council, Recreation Commission, and Special Projects Committee met in joint session to hear a presentation from Planning Staff and from consultants regarding preparation of a master plan for Greenways, Blueways, and Bikeways; and,

WHEREAS, the attached Greenways, Blueways, and Bikeways Master Plan was the subject of a public hearing before the Planning Commission at its regular meeting on January 9, 2013, the time and place of which had been published in a newspaper of general circulation in the municipality at least thirty (30) days prior to the meeting; and,

WHEREAS, the Planning Commission adopted the Greenways, Blueways and Bikeways Master Plan, including map, by an affirmative vote of not less than a majority of all members of the Planning Commission; and,

WHEREAS, the Planning Commission has requested consideration and adoption of the Greenways, Blueways and Bikeways Master Plan by the City Council in accordance with T.C.A. §13-4-202; and,

WHEREAS, a Public Hearing on the Greenways, Blueways, and Bikeways Master Plan was held before the City Council of the City of Murfreesboro, Tennessee, on March 7, 2013, pursuant to a Resolution passed and adopted by the City Council on January 31, 2013, and notice thereof published in The Murfreesboro Post, a newspaper of general circulation in said City, on February 3, 2013; and

WHEREAS, the Greenways, Blueways, and Bikeways Master Plan attached hereto is appropriate.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF MURFREESBORO, TENNESSEE, AS FOLLOWS:

SECTION 1. That the Greenways, Blueways, and Bikeways Master Plan for the City Of Murfreesboro attached hereto is hereby adopted.

SECTION 2. That this Ordinance shall take effect fifteen (15) days after its passage upon third and final reading, the public welfare and the welfare of the City requiring it.

Passed:

1st reading March 7, 2013

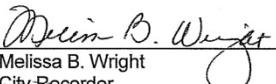
2nd reading March 21, 2013

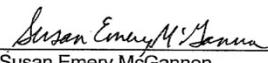
3rd reading April 18, 2013


Tommy Bragg, Mayor

ATTEST:

APPROVED AS TO FORM:


Melissa B. Wright
City Recorder


Susan Emery McGannon
City Attorney



Certification of Adoption.

I hereby certify that the GREENWAY, BLUEWAYS,
AND BIKEWAYS MASTER PLAN including the maps
was adopted in accordance with the requirements of TCA
13-4-202 by the Murfreesboro Planning Commission on
January 9, 2013.

Joseph D. Aydelott
Planning Commission Secretary

2-6-13
Date

This plan was developed in accordance with input and direction provided by the elected leadership, departmental staff, and citizens of the City of Murfreesboro. Additional insight and guidance was provided other agencies and organizations as well. The dates of substantive meetings related to the development of this plan are as follow:

Kick-off meeting: November 16, 2011

Study Advisory Committee Meeting #1: December 16, 2011

Stakeholder interviews: February 2-3, 2012

Study Advisory Committee Meeting #2: March 13, 2012

Public Meeting #1: March 13, 2012

Study Advisory Committee Meeting #3: June 7, 2012

Study Advisory Committee Meeting #4: August 23, 2012

Technical Workshop: August 23, 2012

Public Meeting #2: September 10, 2012

Joint Councils (Parks, Planning, City) Presentation: October 22, 2012

Staff Review Meeting: November 9, 2012

Planning Commission 1st Reading: November 21, 2012

Planning Commission Public Hearing and Adoption: January 9, 2013

City Council Public Hearing and 1st Reading: March 7, 2013

City Council 2nd Reading: March 21, 2013

City Council 3rd Reading: April 18, 2013