Conceptual Engineering Design Report

for

Two Rivers Greenway

Phase I

Town of Basalt, CO

Loris and Associates, Inc.

2585 Trailridge Drive East
Lafayette, CO 80026
(303) 444-2073

L O R I S

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Mastering the Art of Engineering Structures and Infrastructures

April 27, 2009

Mr. Larry Thompson, P.E.
Town Engineer
Town of Basalt, Colorado
101 Midland Avenue
Basalt, CO 81621

Re: **Two Rivers Greenway, Phase I**
Conceptual Engineering Design Report
LORIS Project No. 213-08142

Dear Mr. Thompson:

Loris and Associates has completed the conceptual design package for Phase I of the Two Rivers Greenway project. Attached you will find the Conceptual Design Plans and a Conceptual Engineering Design Report that summarizes the design process for this stage of the project. The report also provides general details regarding the requirements that will need to be considered as the project moves into the final design phases. Included in this package are a geotechnical report, conceptual landscaping and hardscape design, hydraulic analysis, environmental findings letter, and a conceptual cost estimate.

Thank you for the opportunity to submit this report and these plans. We understand that this project requires a considerable amount of attention to the needs of the Town and its citizens, and we look forward to continuing into the next stages of the project. Please do not hesitate to call should you have any questions or require any additional information.

Sincerely,

The Office of
Loris and Associates, Inc.

Kevin F. Dooley, E.I.
Project Engineer

Reviewed by,

Peter J. Loris, P.E.
President

Conceptual Engineering Design Report

for

Two Rivers Greenway: Phase I

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Lafayette, CO 80026
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April 27, 2009

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PROJECT DESCRIPTION & DESIGN CRITERIA

PROJECT LOCATION

Two Rivers Greenway, Phase I, is located within the town limits of Basalt in Eagle County, Colorado. The project consists of approximately 2,200 linear feet of roadway and pedestrian improvements along Two Rivers Road (previously State Highway 82), beginning just west of the Homestead Drive and continuing to Midland Avenue.

EXISTING CONDITIONS

The Two Rivers Road corridor runs, generally, east to west, and is currently classified as a Non-Rural Arterial (NR-C) roadway with varying right-of-way widths. The Average Daily Traffic (ADT) counts along Two Rivers Road from Midland Avenue to the Highway 82 Bypass at Emma Road, as measured in August 2008 just west of Homestead Drive, are recorded to be 5,869 Vehicles per Day (VPD).

Through the Phase I portion of the project, as described above, Two Rivers Road is made up of a 24-foot, crowned pavement section, and is striped with no-passing lanes and paved shoulders. Existing roadway conditions consist of generally mild grades of ± 1.0 %, sloping down from east to west. The road is superelevated at grades of ± 4.0 % through the existing bus parking area just west of Midland Avenue and drains to the south, and existing traffic humps are located just east and west of Homestead Drive.

Roadside conditions cover a wide variety of surroundings. Areas to the north of Two Rivers Road, near Homestead Drive, consist of steep shale bedrock terrain with moderate vegetation and 1:1 fore slopes. This slope is cut off by Two Rivers Road, but then continues on to the southern portion of the roadway and eventually terminates at the Roaring Fork River. For the portion of the Roaring Fork River that is immediately adjacent to Two Rivers Road, the side slopes contain heavy vegetation and some evidence of wildlife. Much of the roadside where the river is adjacent to the roadway is considered to be wetland habitat. An existing pedestrian bridge that crosses the river is located south of Two Rivers Road, opposite of Homestead Drive.

Continuing easterly along the project, approximately 0.22 acres of wetlands lie to north of the roadway at the base of 1:1 densely vegetated steep slopes. An existing 5-foot gravel path has also been constructed above this wetland that connects Homestead Drive to Two Rivers Road. A riverfront park is located within this area to the south, which contains a 0.79-acre pond and soft-surface pedestrian paths. This area is known as "Old Pond Park" and is owned by the Town of Basalt. An open space area is adjacent to the park to the east, and is currently planned to be developed by the Roaring Fork Conservancy as an 8,500-square foot River Learning Center.

Moving further east of the River Learning Center and wetlands, an existing Pitkin County regional recycling center is located north of the road with an exit onto Two Rivers Road just west of Midland Spur. This area contains sanitary sewer and storm drainage structures that originate from downtown Basalt and Midland Avenue, as well as a drainage swale that conveys runoff from the hill above the recycling center. To the south of the road is an unpaved commercial parcel, owned by the Town of Basalt, which contains a small building with a gravel parking area. A soft surface trail is also located on this parcel which leads to an existing trail system that runs along the Roaring Fork River and connects to Old Pond

Park and the existing pedestrian bridge across from Homestead Drive. This land may be developed in the future and an access easement is in place along the west side of the property that is shared with the River Learning Center. Existing drainage storage areas are situated along the Two Rivers Road frontage of this property, and wetlands are located along the eastern property line.

An existing residential development is located to the east of the undeveloped property. This property contains approximately 32 mobile home units. The residential property frontage along Two Rivers Road consists of dense vegetation and trees considered to be wetland area. A small waterway is located along the frontage property line that appears to be fed by stormwater runoff and a natural spring. This waterway flows from east to west and feeds the wetlands that are located adjacent to the commercial parcel to the west. The eventual outfall for these wetlands is the Roaring Fork River to the south.

The existing roadway in front of the mobile home park contains 28 angled parking spaces, two of which are deemed handicapped parking. There are bus pullout areas for both eastbound and westbound buses, and bus stop shelters on both the north and south side of the roadway. The parking area is superelevated with curb and gutter and concrete sidewalk on the north side of the road, and an asphalt path with no curb on the south side of the road. The road drains to the south over the parking area and asphalt path, and outfalls via overland flow to the densely vegetated waterway that runs east to west along the residential frontage property line. This bus parking area is utilized by the Roaring Fork Transportation Authority, as is the entire Two Rivers Road corridor.

The property to the north of the bus parking area is owned by the Town of Basalt and contains the Town Hall and other municipal offices. This property is situated much lower that the existing roadway and drainage is conveyed through a shallow swale system and small drainage culverts that eventually connect to the recycling center drainage system. Several landscape and hardscape features are located in this area as well, including grouted cobble islands and paved pedestrian crosswalks. Street lighting with an underground electric service and an underground potable water main are also located on the south side of the bus parking area.

The project ends at the existing intersection of Midland Avenue, which contains several of the same landscape and hardscape characteristics found within the bus parking area. The intersection is a four-way stop and is drained via curb inlets.

CONCEPTUAL DESIGN CRITERIA

Conceptual design criteria for Phase I of the Two Rivers Greenway project center around four key proposed improvements:

- Multi-Use Pedestrian & Bicycle Facilities
- Extension of Urbanized Downtown Basalt along Two Rivers Road
- On-Street Parking & Traffic Calming along Two Rivers Road
- Low-Impacts to Existing Wildlife and Riparian Habitat

All of these improvements are a part of the Two Rivers Greenway Master Plan, which was approved by the Town of Basalt in 2007.

Pedestrian and bicycle facilities are a key factor when considering design criteria for this project. The proposed paths must be safe, provide adequate connectivity to downtown Basalt, and provide a unique and satisfying experience for a wide range of users. To achieve these goals, the path must be wide enough to accommodate recreational bikers and walkers, and the roadway must contain bicycle facilities. The recreational path must also be located in areas that will be pleasing to the user, as well as practical for connectivity to future developments along Two Rivers Road from Midland Avenue and Homestead Drive. All proposed paths and modifications of existing paths must be ADA compliant.

Extending the general experience of the existing streetscape east of Midland Avenue is vital to the overall vision of this phase of Two Rivers Greenway. Existing landscaping and hardscape must be incorporated into the proposed design. Cobble rock hardscape islands and decorative concrete pavers at pedestrian crosswalks, such as those found at the intersection of Midland Avenue and Two Rivers Road, will be utilized in the proposed design, as well as the use of angled parking.

On-street parking facilities must provide enough parking for future development needs and provide safe access to the multi-use path and parks in the surrounding areas. Parking must also provide access for handicap permitted vehicles and path users, as well as public transit and River Learning Center visitors. The proposed River Learning Center is expected to have large groups in attendance, and bus pullout facilities would be required along Two Rivers Road near the proposed River Learning Center site.

Calming of traffic along Two Rivers Road is imperative to the safety of pedestrian users in the project area. The use of raised medians, curb and gutter, decorative paver crosswalks, speed tables, as well as signage and striping will all contribute to the transition of vehicles entering into the more urbanized area of Two Rivers Road and downtown Basalt.

It is important that existing wildlife and riparian corridors along Two Rivers Road remain intact throughout the length of the project. Currently, the conceptual design does propose some minor fringe wetland impacts that are unavoidable due to the limited space available for what is proposed; however, these impacts should be able to be permitted and mitigated without major obstacles. Ninety-nine percent of the existing wetlands will remain after the project is complete.

PROJECT DESIGN INFORMATION

PEDESTRIAN SIDEWALK

A key feature of Phase I of Two Rivers Greenway will be the incorporation of unique pedestrian facilities throughout the project. These facilities will be used by members of the community, as well as those visiting the area. In order to accommodate the different types of users that are attracted by such a distinctive multi-use path, several design considerations must be taken into account.

- Minimum Width
    - 10 feet typical (Multi-Use)
    - 12 feet through River Learning Center area (Multi-Use)
    - 11 feet along "River Walk" from Old Pond to Homestead Dr. (Multi-Use)

  - 5 feet along parallel parking (Pedestrian only)
  - 10 foot pedestrian crosswalks (Decorative Concrete Pavers)
- 6" Concrete Class D w/ 6" Class 6 Aggregate Base Course (ABC)
- Steel Cable Pedestrian Railing (where required)
- 3:1 Maximum Side-Slopes
- 2% Maximum Cross-Slope
- 5% Maximum Grade
- Colored Concrete through congested areas (at parking & bus shelters near Midland Avenue)
- ADA compliant curb ramps at crosswalk locations

URBAN ROADWAY

Two Rivers Road will be widened to accommodate vehicular and bicycle traffic. The existing roadway centerline will generally remain the same, as well as the existing roadway cross slopes. The proposed design calls for milling and resurfacing of the existing roadway at a 2.5 inch average depth. New roadway widening for shoulders, parking and chicanes will utilize full depth roadway construction consisting of hot-mix bituminous asphalt and aggregate base and subbase courses. Curb and gutter will convey roadway drainage and driveway connections will be made for existing driveways and future developments connections.

The following outlines general conceptual design information for the roadway design:

Geometry & Roadway Characteristics

- 10' Travel Lanes (Minimum)
- 4' Striped Bicycle Lanes (Minimum; only where no parking is present)
- 14' Shared Vehicle/Bicycle Lane (Minimum; includes curb pan; only where parking is present)
- Driveway Connections
  - 20' minimum width
  - 25' typical turning radii (15' minimum)
- Parking Facilities
  - 9'x19', 60º angled parking (48 spaces)
  - 7'x20' parallel parking (23 spaces)
  - 12'x19' 60º handicapped angled parking with 5' access isle and curb ramp (per ADA) (4 spaces)
  - Total "build-out" parking: 75 spaces (includes handicapped & existing parking to remain)

- 40' bus pullout area with 30' tapers (100' total length) (RFTA & school bus accessible)
- 2.5' Curb and Gutter
- 4' Valley Gutter/ Drainage Pan Gutter
- Cross-slopes to Match Existing
- 9' Landscape Planting Islands (from back-of-curb)

Pavement Design

- Milling & Resurfacing of Existing Roadway (2.5" average depth)
- Full Depth New Pavement Section (see Geotechnical Report)
    - 4" Hot Mix Asphalt
    - 6" Aggregate Base Course - Class 6
    - 7" Aggregate Subbase - Class 3

Traffic Calming

- Speed Tables with Advanced Warning Striping (per MUTCD)
- Raised Medians/Chicanes with Directional Striping & Signage
    - 8' minimum width from face-of-curb
    - 32' striped directional taper (8:1 per AASHTO)
    - Directional warning signage (per MUTCD)
    - 1.5' curb and gutter w/ spillout condition
    - ADA compliant curb ramps at crosswalks

HYDRAULICS & DRAINAGE

The proposed improvements along Two Rivers Road are located within Hydraulic Reach 2 of the Roaring Fork River. The Town of Basalt requirements do not allow for an increase in the regulatory floodplain due to these types of improvements, nor can the improvement significantly weaken the Town's continuing master planning efforts. Per a Hydraulic Analysis provided by McLaughlin Water Engineers, the proposed improvements do not cause a rise in the regulatory 100-year floodplain (see attached). This analysis was based on the Town's adopted HEC-RAS model and the appropriate FEMA hydraulic cross-sections.

Drainage design for the project will be based on recommendations made to the Town of Basalt in the "Stormwater Evaluations and Recommendations Report of the Watershed Improvement and Education Project," by The Matrix Design Group, dated September 30, 2001. Existing drainage patterns will remain in place, with enhancements to the "first flush" treatment of stormwater runoff to the eventual drainage outfall, the Roaring Fork River. Treatment of runoff will consist of a combination of on-site infiltration via shallow swales, wetlands and riparian areas, bio-retention areas, and sediment separation via catch basin sediment filters. Stormwater runoff conveyance will consist of overland flow, buried

pipe, and shallow swales. All proposed pipes and swales will be designed for the 10-year design storm, and retention basins will be designed for the 25-year design storm.

Much of the existing drainage infrastructure will be required to be removed, replaced, or modified in order to provide a drainage treatment system that will be in accordance with the recommendations made in the aforementioned report. Other resources that will be utilized in developing an adequate drainage treatment system include USGS Quadrangle Maps, USCS Soils Maps, the TR-55/Rational Method design guide, Urban Drainage and Flood District design criteria, as well as Eagle County and Town of Basalt design standards.

LANDSCAPING & HARDSCAPE

Dunnett Design Group, Inc. working closely with Loris and Associates has provided a conceptual illustrative plan highlighting the proposed improvements for Phase I of the Two Rivers Greenway project. Primary objectives for the project include:

- Enhancement and emphasis on the scenic and natural qualities of the corridor
- Improved pedestrian and bicycle safety by the redesign of the roadway
- Creation of a multi-use recreational sidewalk
- Improved river access for fishermen and boaters
- Creation of new recreation and educational opportunities along the length of the corridor

Dunnett Design has developed a landscape plan which includes new street tree and shrub plantings which will create more of a parkway setting along the road and also aid in slowing traffic. The proposed chicanes located along the roadway will be planted with low maintenance native grasses and wildflowers. A taller grass species will also be planted which will add some winter texture and interest. The borders of the chicanes will have an apron of river cobble similar to the existing cobble accents at the Midland Avenue intersection.

The design team is also proposing several bio-retention basins along the corridor which are pockets of native wetland plants and accompanying microorganisms which naturally clean stormwater runoff from the roadway before entering the river. These bio-retention basins are great opportunities to educate the public on the critical functions of wetlands which are prevalent throughout the corridor. The project team has discussed emphasizing the natural assets of the project corridor through interpretive opportunities with Roaring Fork Conservancy representatives. Several areas have been identified that would be excellent for interpretive signage, two of which are interpretive overlooks along the 11 foot trail just west of the River Learning Center site. The two overlooks are cantilevered decks which hover above the Roaring Fork River tributary creek and offer great views of the water channel and the riparian areas beyond. Other interpretive areas are located at the Old Pond Park trailhead, the recycle center and at the bio-retention basins.

The stretch of 11 foot trail from Old Pond to the Homestead Drive intersection calls for a retaining wall ranging in height from 2 feet to 8 feet high. We have included several finish

options in the packet including a rough board-form finish, exposed aggregate, and a distressed and aged concrete which has a rough finish reminiscent of conglomerate river boulders.

An elliptical entry way with accent pavements, benches, bike racks, and interpretive gardens are shown at the proposed Roaring Fork River Learning Center site. The design elements and accent pavements are proposed to help slow bike traffic at the building's main entry. This scheme is conceptual and is shown for graphic intent only. A final site plan will most likely be developed by the Roaring Fork Conservancy's design team.

Other features of the corridor include adding additional tree planting islands in the angled parking areas, adding a sidewalk on north side of the roadway and enhancing the existing bus stop at the Midland Avenue intersection with new bike parking and plantings.

CONCEPTUAL COST OPINION

The proposed improvements along Two Rivers Road require several challenging features to construct. LORIS has provided a Conceptual Opinion of Probable Construction Cost to best represent the bid price that the Town of Basalt may expect to receive for this project based solely on this Conceptual Design. Several items are not able to be quantified at this time based on lack of information and the need for more comprehensive construction details and therefore have been provided as a "Lump Sum" estimated cost. These Lump Sum items are based on the proposed size and location of this project compared to other similar projects that LORIS has had experience with in the area. Items such as existing utility relocations, construction-level engineering, legal fees, and other miscellaneous fees are considered to be a "contingency cost" at this time and may vary greatly as the project moves forward towards construction.

Although LORIS strives to be as thorough as possible when providing an Engineer's Opinion of Probable Construction Cost, we can make no warranty as to the accuracy of this opinion as compared to bids or actual costs, and we have no control over a contractor's price of labor, materials, equipment, or methods of pricing. This Conceptual Opinion of Probable Construction Cost is based solely on our qualifications and experience as design engineers in estimating other similar projects.

Two Rivers Greenway: Phase I

Conceptual Engineering Design Plans

CONCEPTUAL DESIGN
NOT FOR CONSTRUCTION
03-18-2009

CONCEPTUAL DESIGN PLANS OF PROPOSED

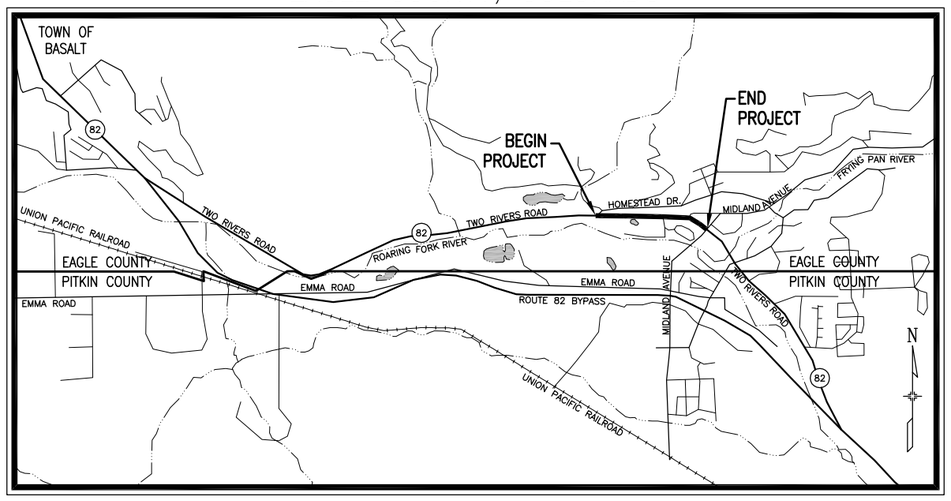
TWO RIVERS GREENWAY

PHASE 1

PROJECT NO. 213-08142

TOWN OF BASALT

EAGLE COUNTY, COLORADO



VICINITY MAP
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INDEX OF SHEETS

PROJECT DESCRIPTION

MILLING, RESURFACING, AND WIDENING OF EXISITNG TWO RIVERS ROAD (SH 82) FROM HOMESTEAD DRIVE TO MIDLAND AVENUE, AS WELL AS CONSTRUCTION OF NEW PARKING ALONG TWO RIVERS ROAD AND A 10 FT.-12 FT. PEDESTRIAN PATH ALONG THE ROARING FORK RIVER.

LOCATION: S.H. 82 ALONG THE ROARING FORK RIVER, FROM HOMESTEAD DRIVE TO MIDLAND AVENUE. TOWN OF BASALT, COLORADO

Print Date: Mar 18, 2009
File Name: 08142-(01)-Cover Sheet.dwg
Horiz. Scale: Vert. Scale: As Noted
Unit Information Unit Leader Initials

Sheet Revisions

Date:	Comments	Init.

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www.LorisandAssociates.com

TOWN OF BASALT 1901
101 MIDLAND AVENUE
BASALT, CO 81621

As Constructed
No Revisions:
Revised:
Void:

TWO RIVERS GREENWAY - PHASE 1
COVER SHEET

Designer: PJL
Detailer: KFD
Sheet Subset:
Structure Numbers:
Subset Sheets:

Project No./Code
213-08142
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Sheet Number 1

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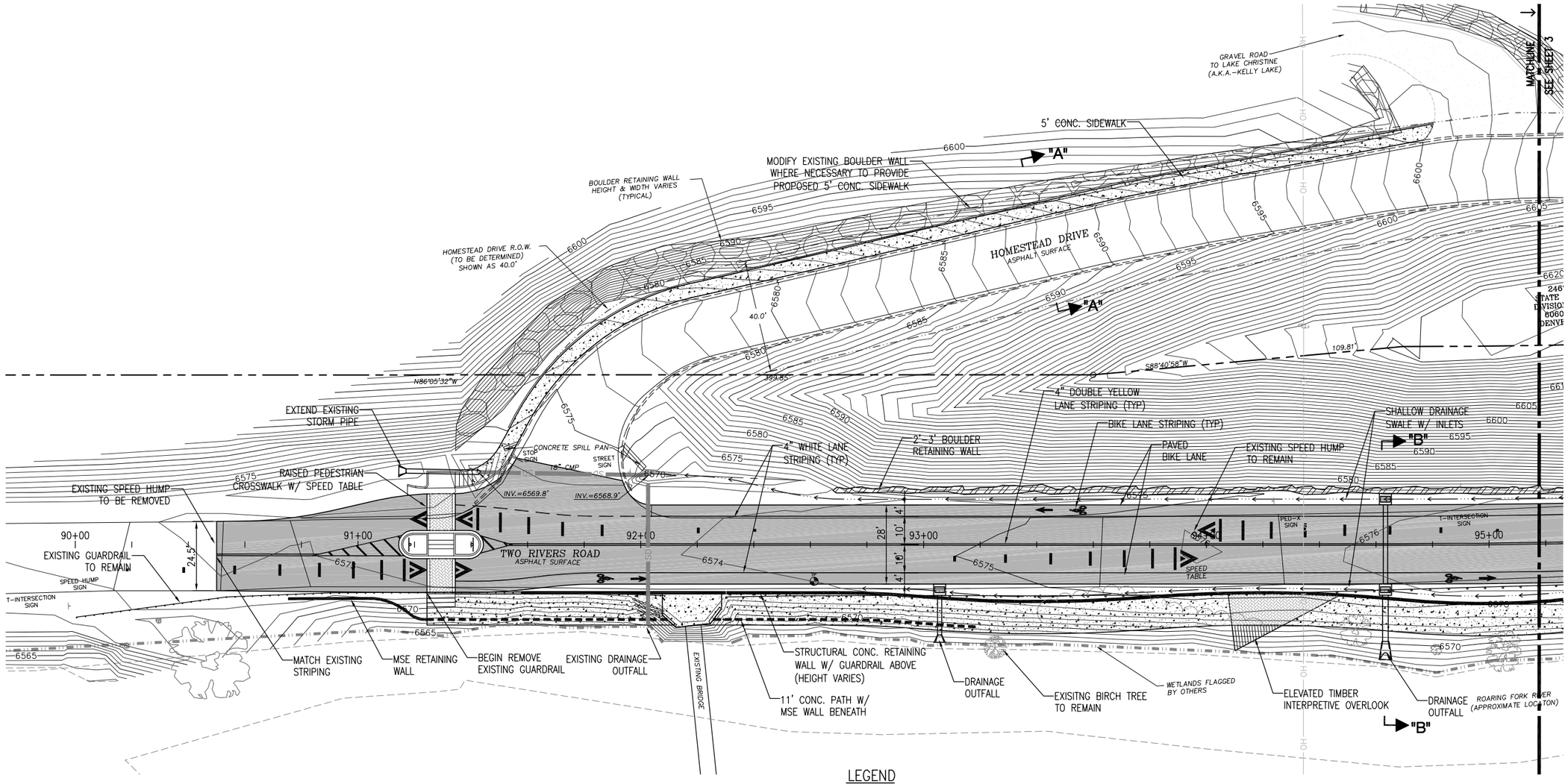

LEGEND

- 6595 — EXISTING CONTOUR W/ ELEVATION
- EXISTING WETLAND BOUNDARY
- EXISTING TREE
- EXISTING RIGHT OF WAY
- PROPOSED SWALE CENTERLINE
- PROPOSED MSE RETAINING WALL
- BOULDER RETAINING WALL
- PROPOSED ASPHALT PAVEMENT
- PROPOSED CONCRETE PEDESTRIAN PATH
- DECORATIVE CONCRETE PAVERS
- DECORATIVE ROCK HARDSCAPE

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SCALE: 1" = 40'

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	Sheet Subset:	Subset Sheets:	

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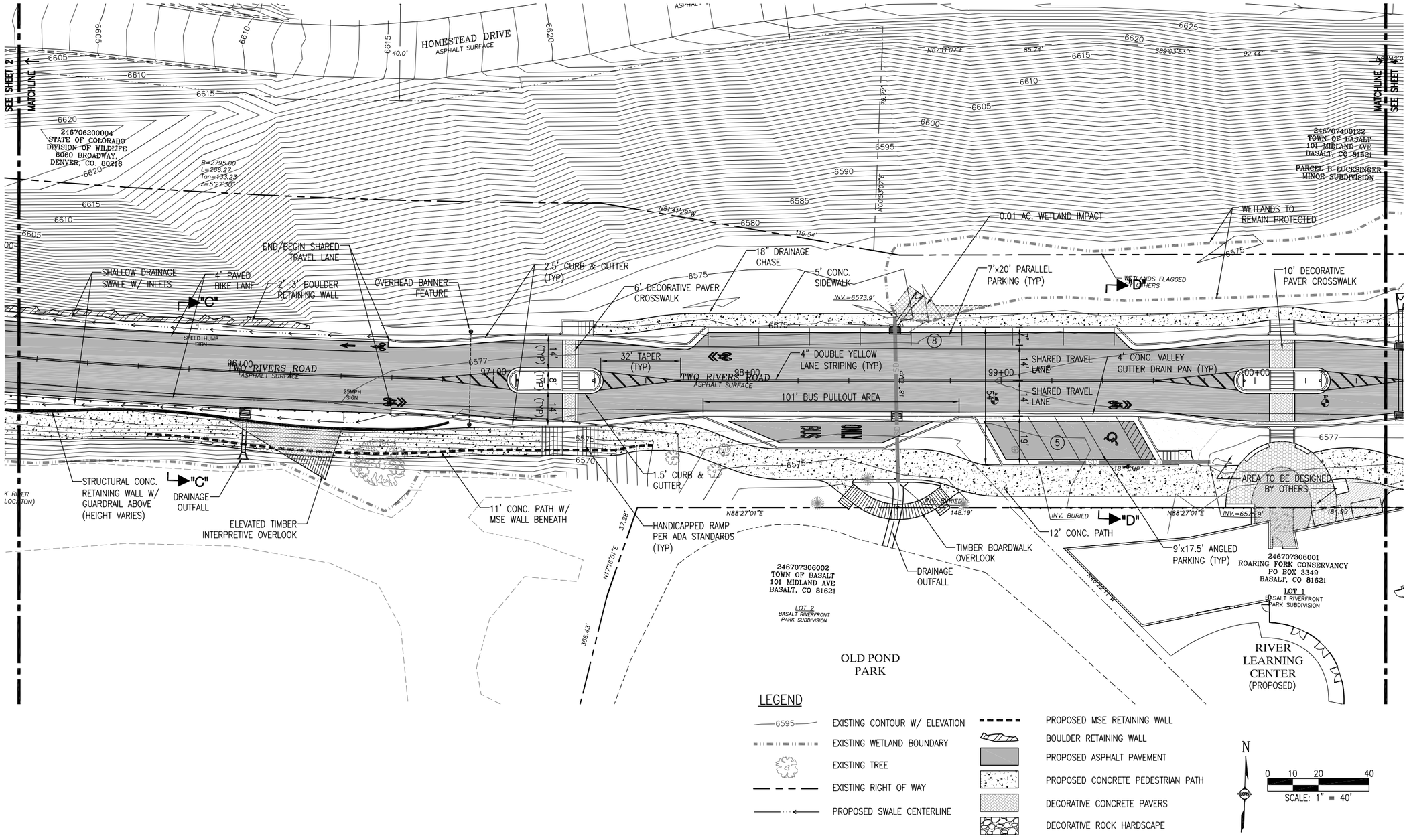

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Unit Information Unit Leader Initials			Void:

TWO RIVERS GREENWAY - PHASE 1
CONCEPTUAL SITE LAYOUT PLAN

Designer:	PJL	Structure Numbers	
Detailer:	KFD		
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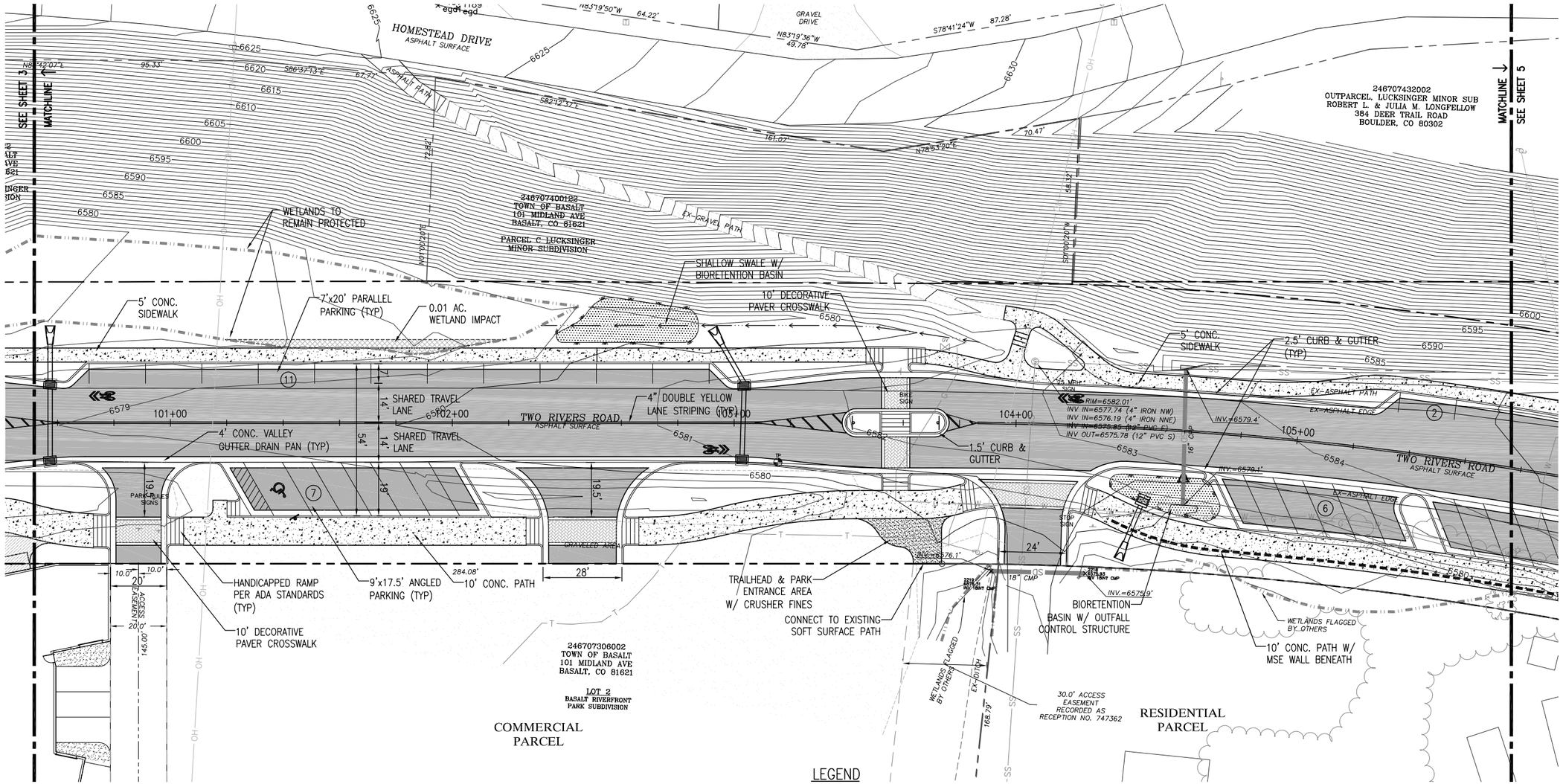

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Detailer:	KFD		
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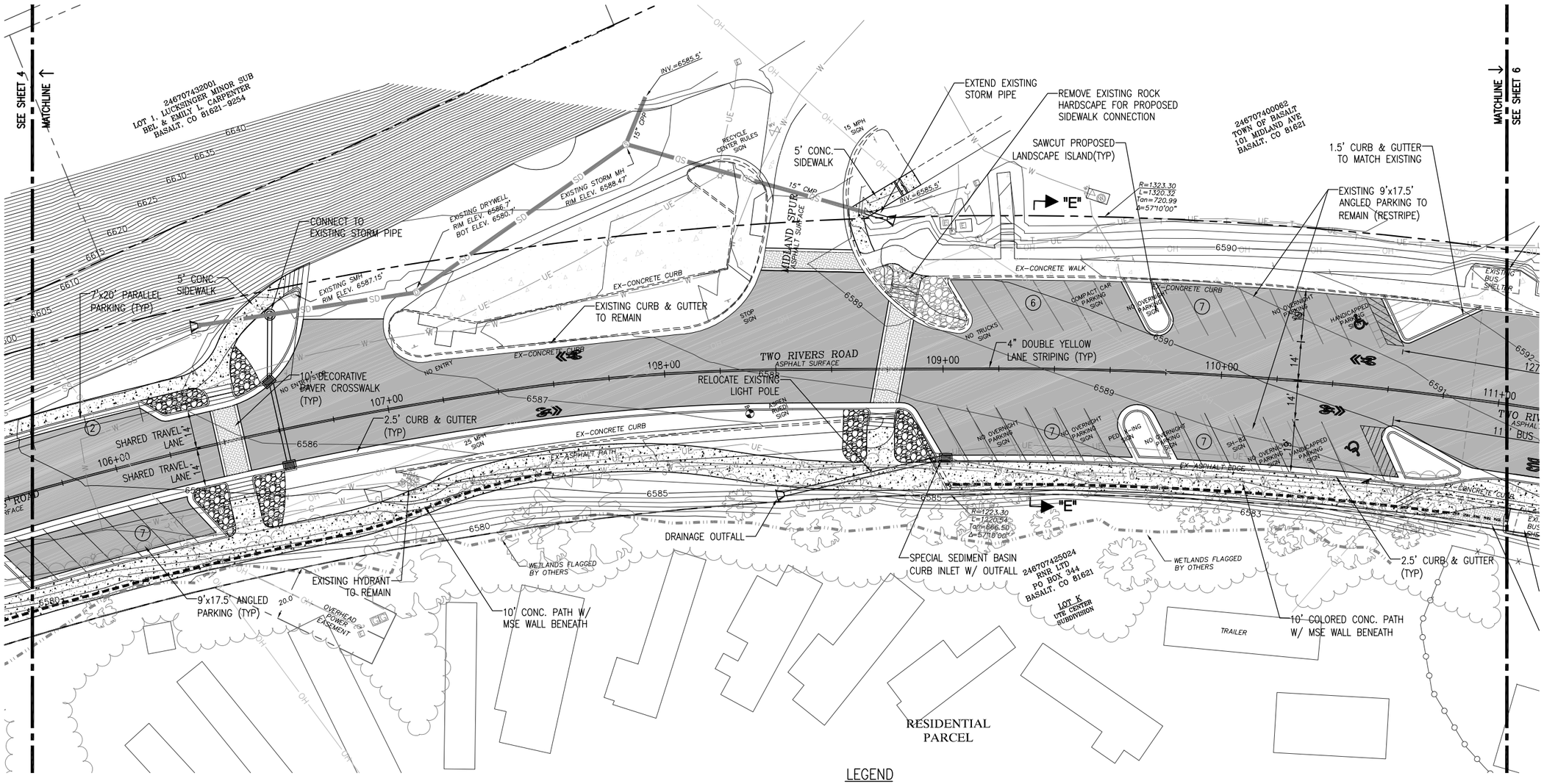

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Sheet Number 5

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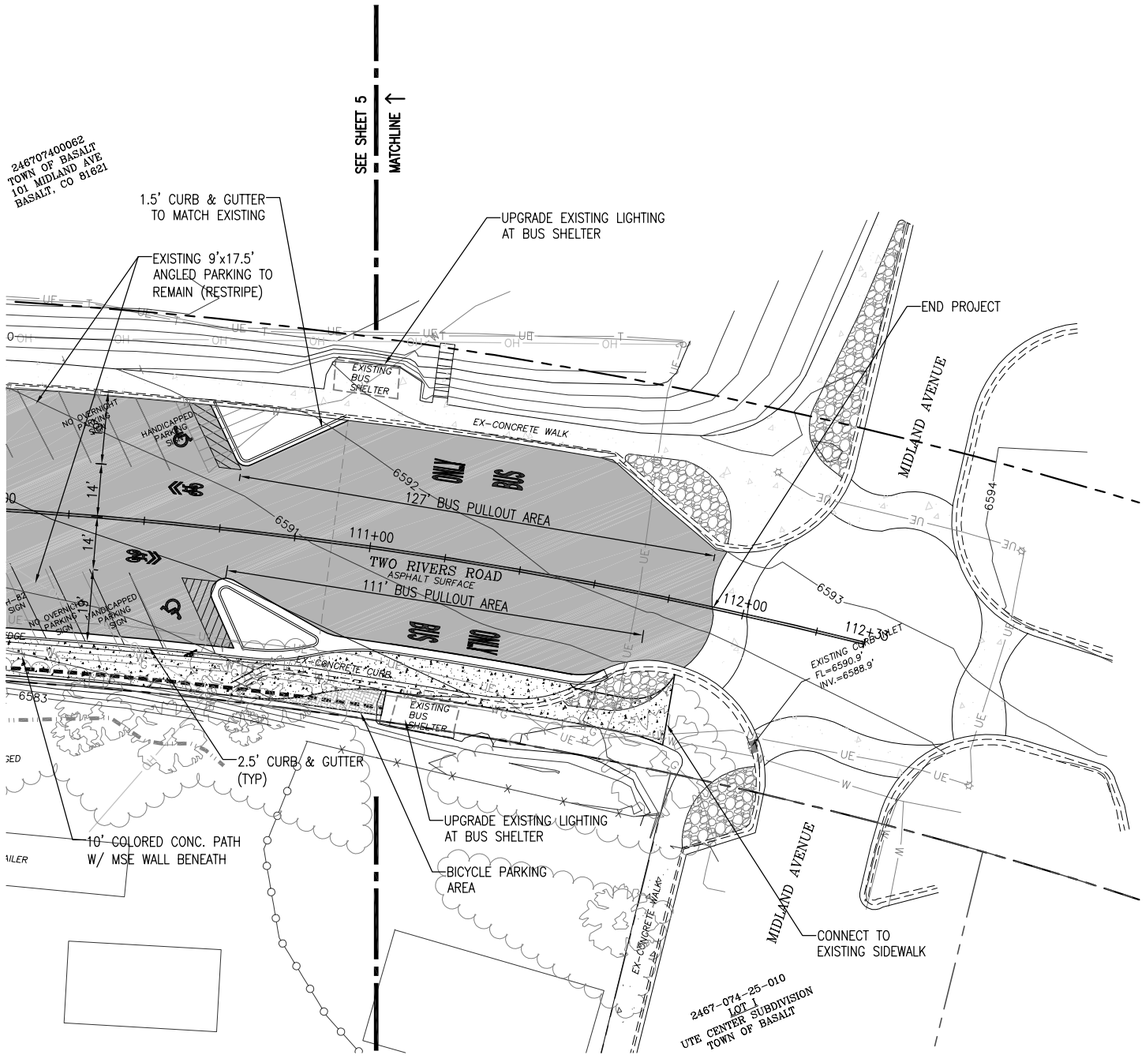

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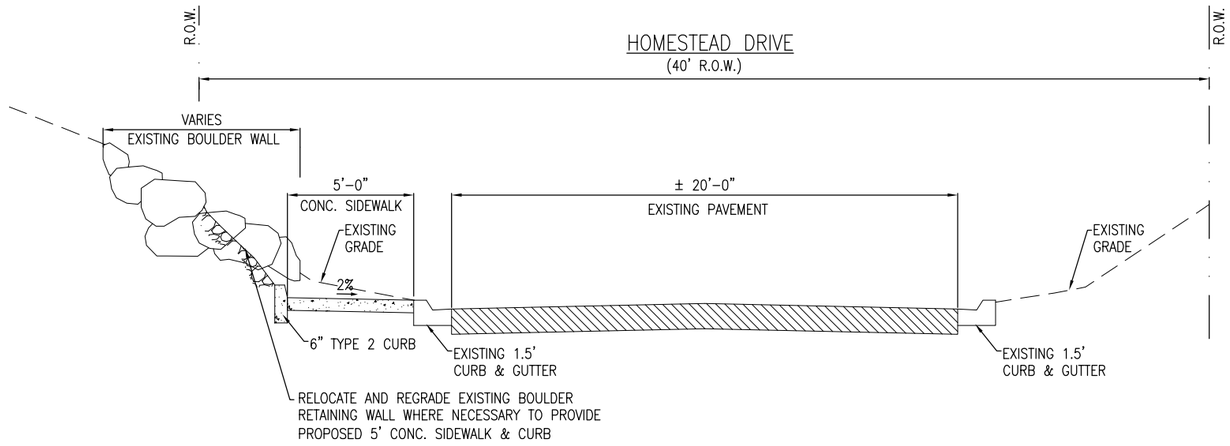

SECTION "A-A"
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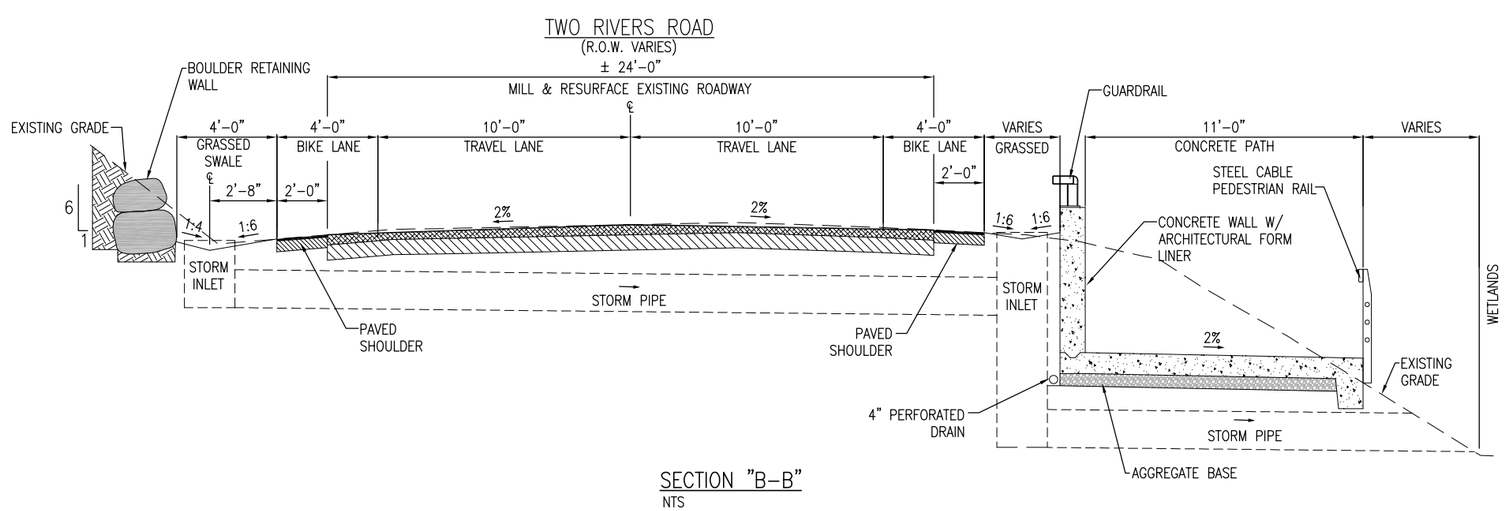

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TOWN OF BASALT 1901
101 MIDLAND AVENUE
BASALT, CO 81621

As Constructed
No Revisions:
Revised:
Void:

TWO RIVERS GREENWAY - PHASE 1
CONCEPTUAL
TYPICAL SECTION

Designer: PJL
Detailer: KFD
Sheet Subset:
Structure Numbers
Subset Sheets:

Project No./Code
213-08142
-
Sheet Number 7

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CONCEPTUAL DESIGN
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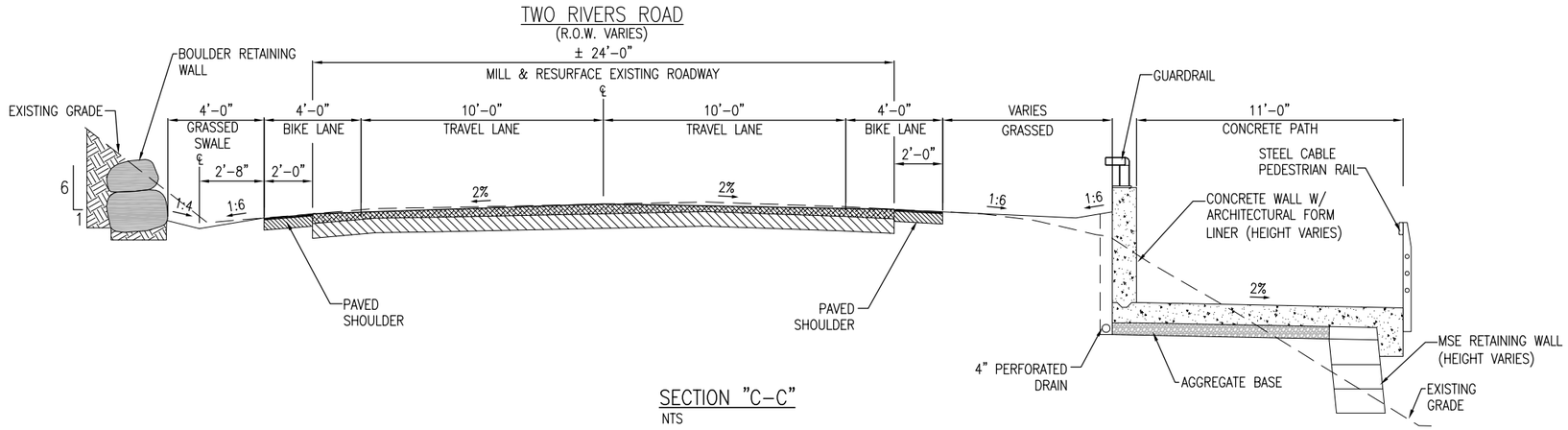
03-18-2009



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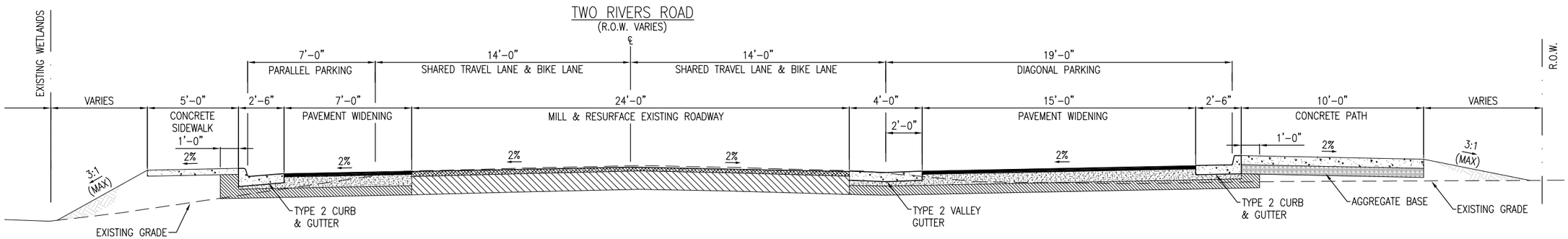

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Horiz. Scale: AS SHOWN Vert. Scale: As Noted					TOWN OF BASALT 1901, 101 MIDLAND AVENUE BASALT, CO 81621	Revised:	Designer: PJL / Structure Numbers	–
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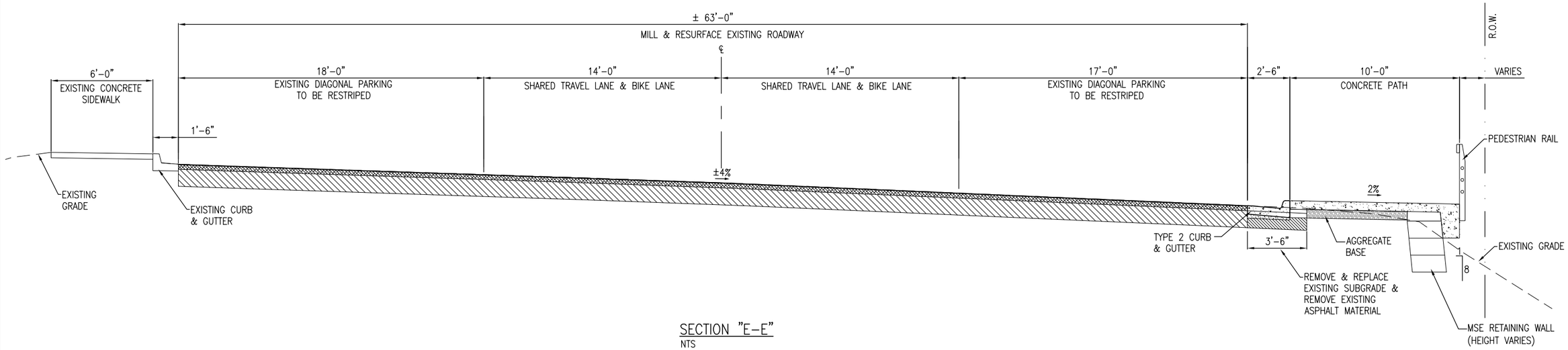
CONCEPTUAL DESIGN
NOT FOR CONSTRUCTION
03-18-2009

TWO RIVERS ROAD
(100' R.O.W.)



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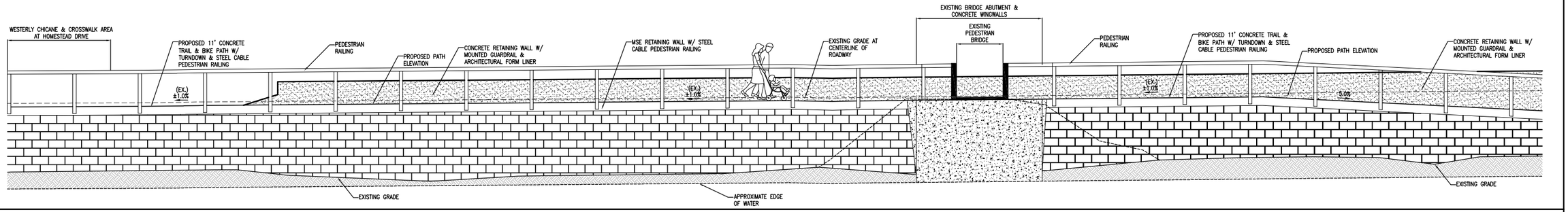

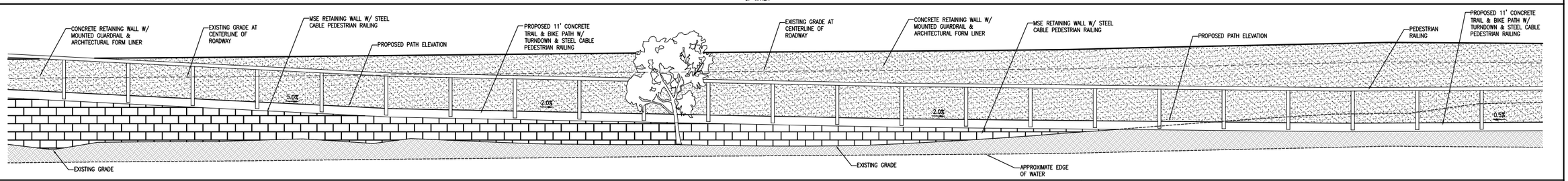

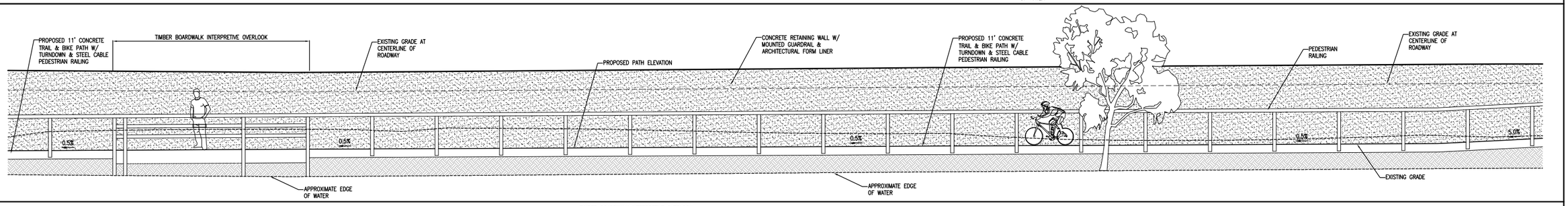

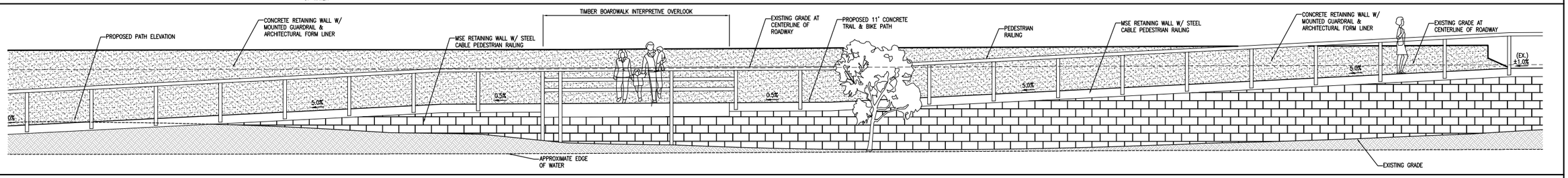

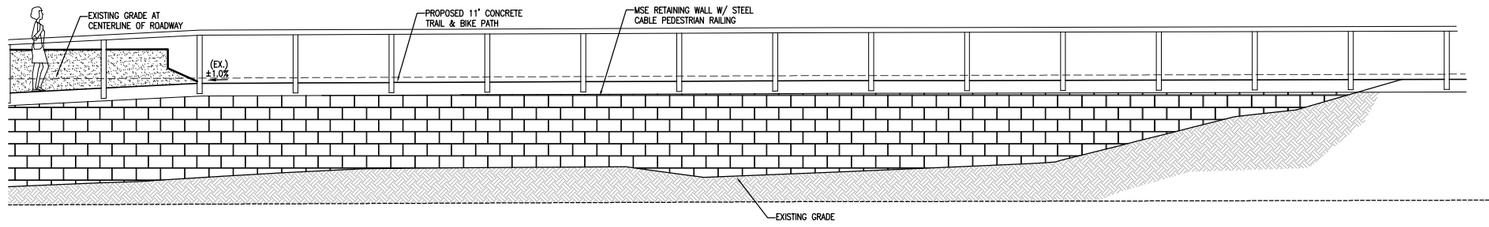

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CONCEPTUAL DESIGN NOT FOR CONSTRUCTION 03-18-2009

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File Name: 08142-(08)-Riverwalk Elevation.dwg	
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Unit Information Unit Leader Initials	

Sheet Revisions

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No Revisions:	CONCEPTUAL RIVERWALK PATH ELEVATION		213-08142
Revised:	Designer: PJL	Structure Numbers	–
Void:	Detailer: KFD		Sheet Number 10
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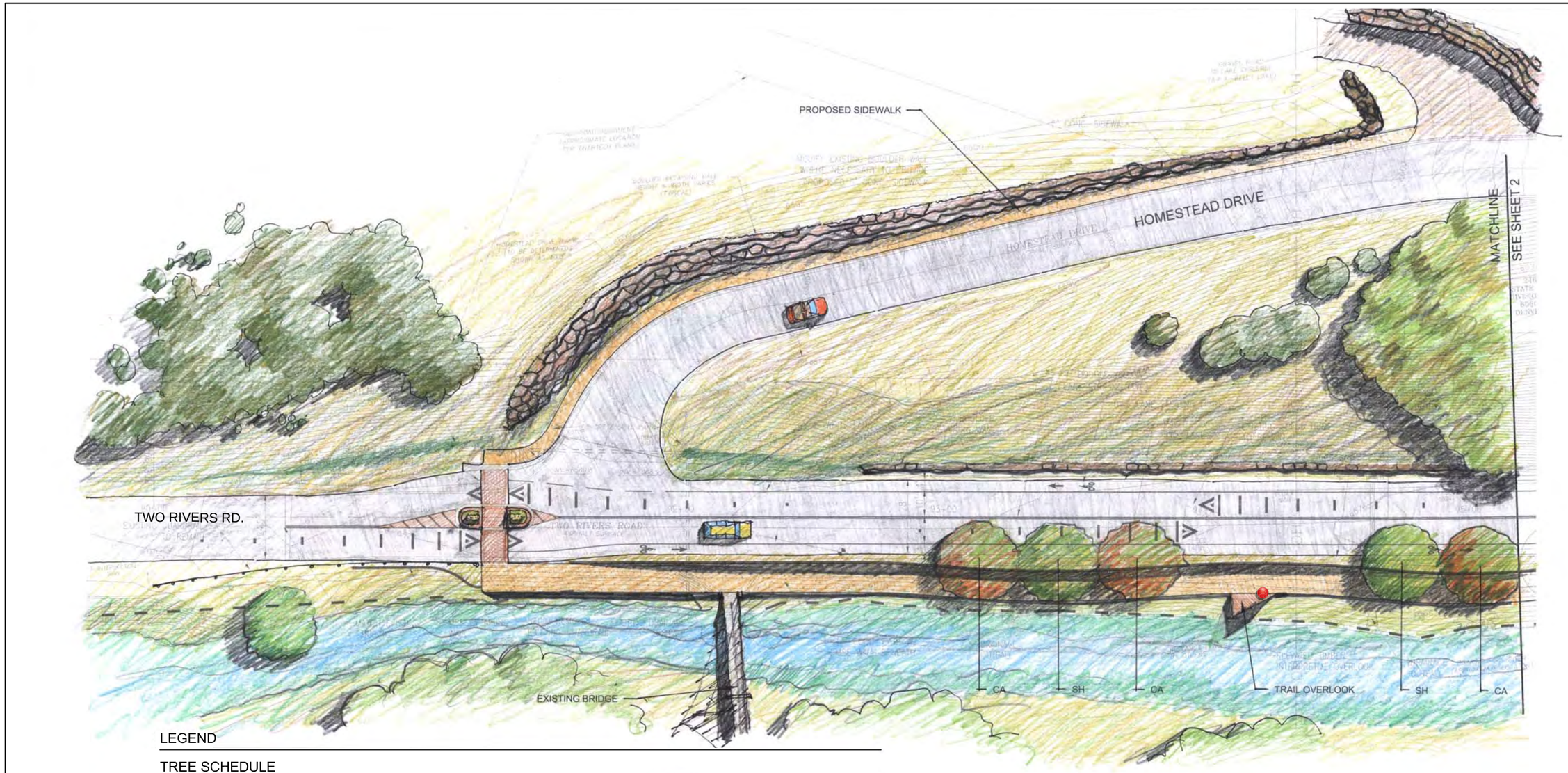
Two Rivers Greenway: Phase I

Conceptual Landscape Design Package



LEGEND

TREE SCHEDULE

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE/NOTES
TREES				
0	NM	Acer platanoides ' Royal Red'	Norway Maple	2-1/2" Cal B&B
3	CA	Fraxinus pennsylvanica 'Cimarron'	Cimarron Ash	2-1/2" Cal B&B
2	SH	Gleditsia triacanthos inermis 'Skyline'	Skyline Honeylocust	2-1/2" Cal B&B
0	AL	Tilia americana	American Linden	2-1/2" Cal B&B

Interpretive Opportunity

SHRUB PLANTING

PERENNIAL PLANTING

NATIVE SEED/ WILDFLOWER MIX

BIO RETENTION BASIN

NORTH

SCALE: 1"=40'-0"

0 20' 40' 80'

conceptual design
not for construction
02-20-2009

dunnett design group, inc.
site planning - landscape architecture
412 NORTH MILL STREET
ASPEN, CO 81611
TEL/FAX 970.544.5240
MOBILE 970.379.4367
email:dunnettdesign@comcast.net

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TWO RIVERS GREENWAY – PHASE 1

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Subset Sheets:

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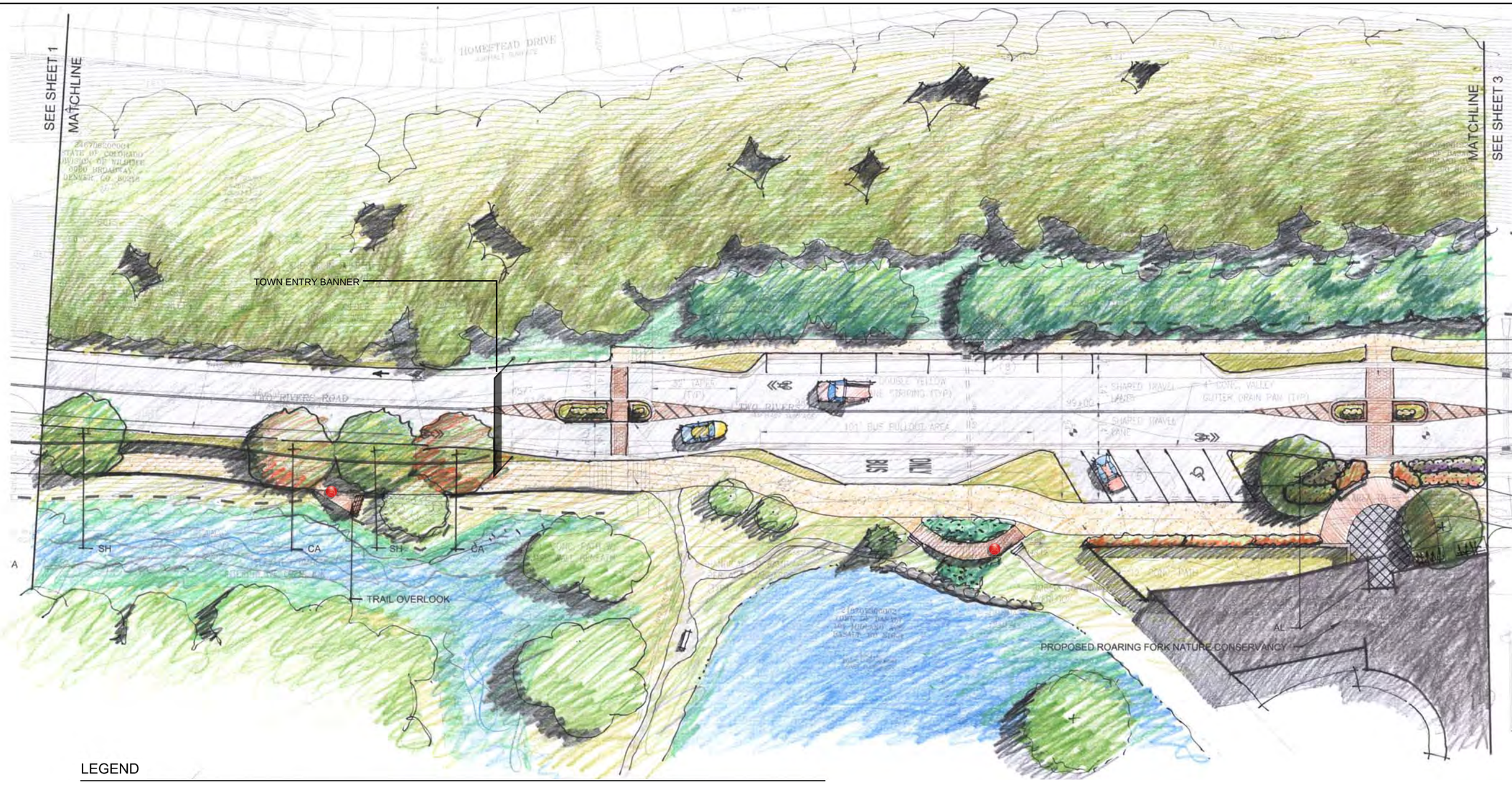

LEGEND

TREE SCHEDULE

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE/NOTES
TREES				
0	NM	Acer platanoides ' Royal Red'	Norway Maple	2-1/2" Cal B&B
2	CA	Fraxinus pennsylvanica 'Cimarron'	Cimarron Ash	2-1/2" Cal B&B
2	SH	Gleditsia triacanthos inermis 'Skyline'	Skyline Honeylocust	2-1/2" Cal B&B
2	AL	Tilia americana	American Linden	2-1/2" Cal B&B

Interpretive Opportunity

SHRUB PLANTING

PERENNIAL PLANTING

NATIVE SEED/ WILDFLOWER MIX

BIO RETENTION BASIN

NORTH

SCALE: 1"=40'-0"

0 20' 40' 80'

conceptual design
not for construction
02-20-2009

dunnett design group, inc.
site planning - landscape architecture
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TWO RIVERS GREENWAY - PHASE 1

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Detailer:
Sheet Subset:
Structure Numbers
Subset Sheets:

Project No./Code
213-08142
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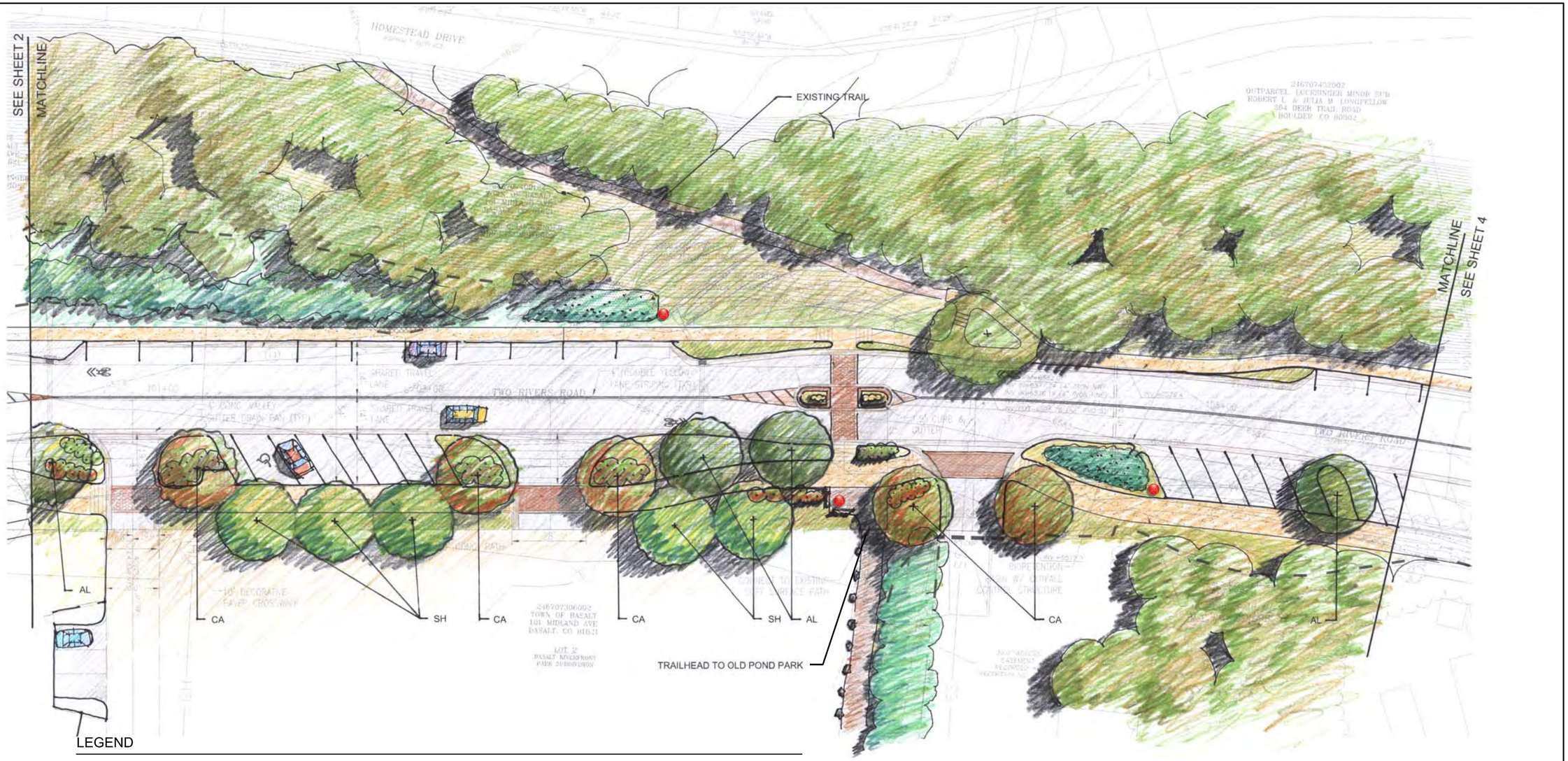
Sheet Number L-2



LEGEND

TREE SCHEDULE

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE/NOTES
TREES				
0	NM	Acer platanoides ' Royal Red'	Norway Maple	2-1/2" Cal B&B
5	CA	Fraxinus pennsylvanica 'Cimarron'	Cimarron Ash	2-1/2" Cal B&B
5	SH	Gleditsia triacanthos inermis 'Skyline'	Skyline Honeylocust	2-1/2" Cal B&B
4	AL	Tilia americana	American Linden	2-1/2" Cal B&B

Interpretive Opportunity

SHRUB PLANTING

PERENNIAL PLANTING

NATIVE SEED/ WILDFLOWER MIX

BIO RETENTION BASIN

NORTH

SCALE: 1"=40'-0"

0 20' 40' 80'

conceptual design
not for construction
02-20-2009

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Void:

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Detailer:
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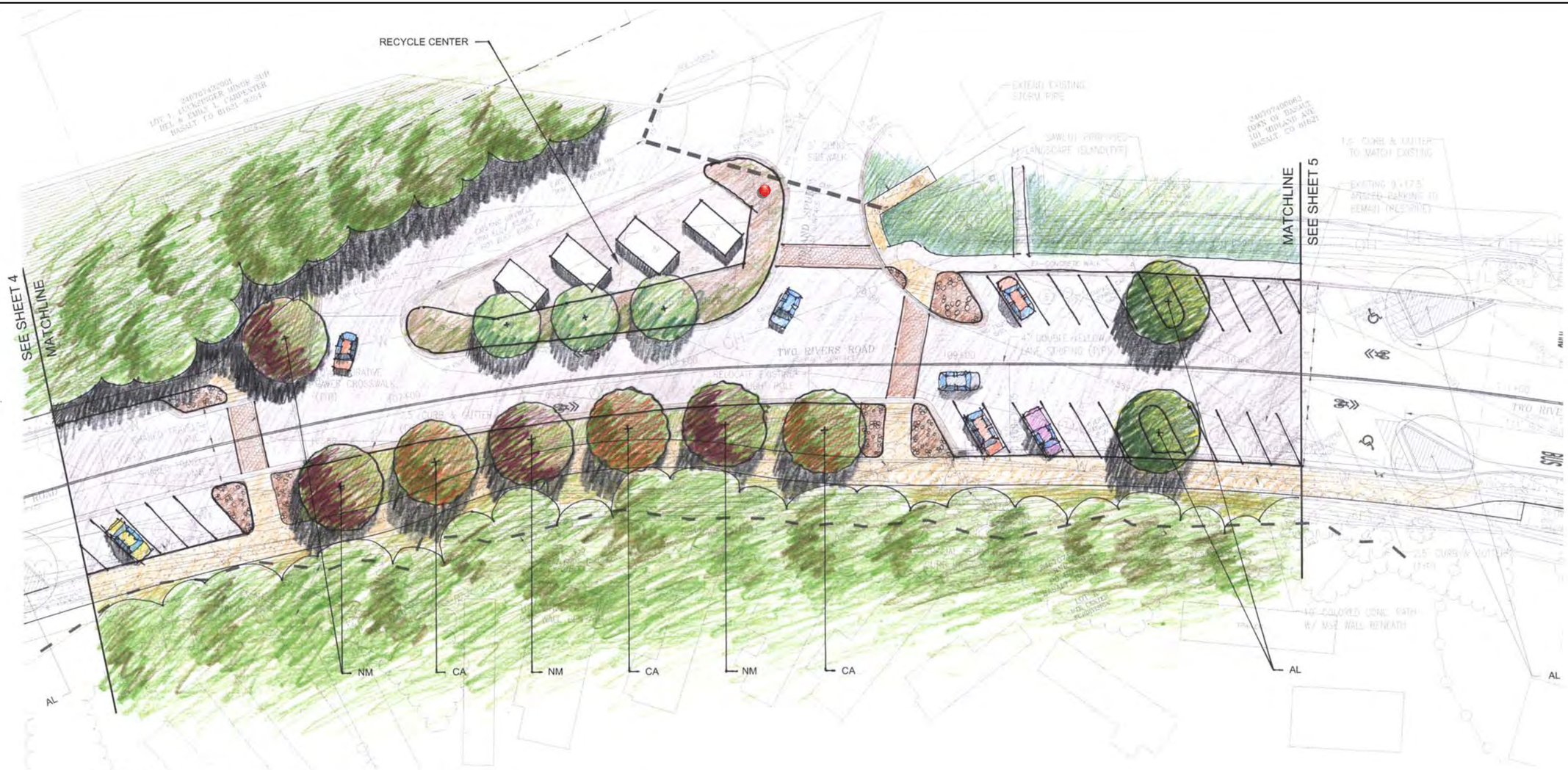

LEGEND

TREE SCHEDULE

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE/NOTES
TREES				
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3	CA	Fraxinus pennsylvanica 'Cimarron'	Cimarron Ash	2-1/2" Cal B&B
0	SH	Gleditsia triacanthos inermis 'Skyline'	Skyline Honeylocust	2-1/2" Cal B&B
2	AL	Tilia americana	American Linden	2-1/2" Cal B&B

Interpretive Opportunity

SHRUB PLANTING

PERENNIAL PLANTING

NATIVE SEED/ WILDFLOWER MIX

BIO RETENTION BASIN

NORTH

0 20' 40' 80'

SCALE: 1"=40'-0"

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not for construction
02-20-2009

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site planning – landscape architecture
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101 MIDLAND AVENUE
BASALT, CO 81621

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No Revisions:
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Void:

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Detailer:
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Structure Numbers
Subset Sheets:

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213-08142
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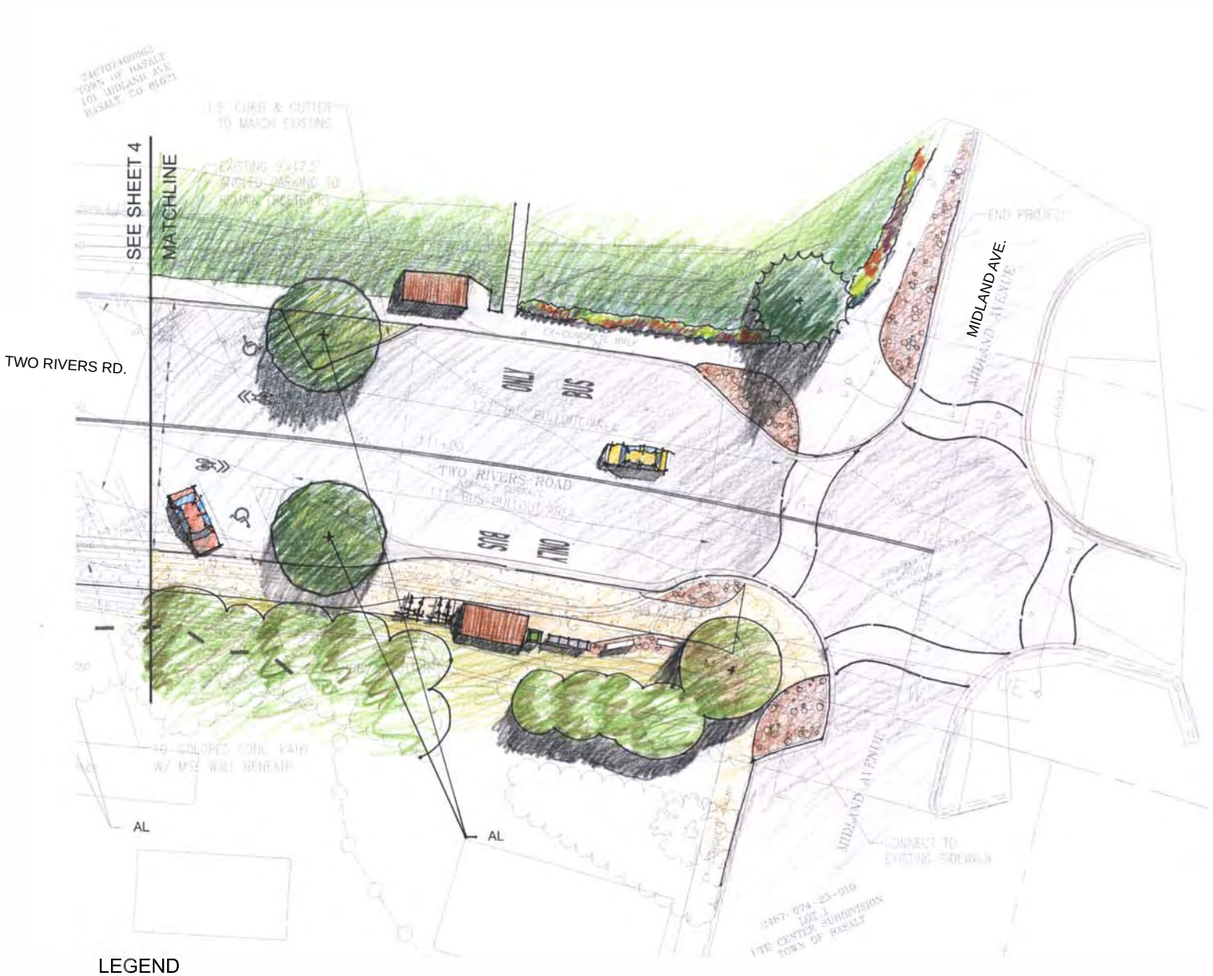
Sheet Number L-4



LEGEND

TREE SCHEDULE

QUANTITY	KEY	SCIENTIFIC NAME	COMMON NAME	SIZE/NOTES
TREES				
0	NM	Acer platanoides ' Royal Red'	Norway Maple	2-1/2" Cal B&B
0	CA	Fraxinus pennsylvanica 'Cimarron'	Cimarron Ash	2-1/2" Cal B&B
0	SH	Gleditsia triacanthos inermis 'Skyline'	Skyline Honeylocust	2-1/2" Cal B&B
2	AL	Tilia americana	American Linden	2-1/2" Cal B&B

SHRUB PLANTING

PERENNIAL PLANTING

NATIVE SEED/ WILDFLOWER MIX

BIO RETENTION BASIN

NORTH

0 20' 40' 80'

SCALE: 1"=40'-0"

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not for construction
02-20-2009

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101 MIDLAND AVENUE
BASALT, CO 81621

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TWO RIVERS GREENWAY - PHASE 1

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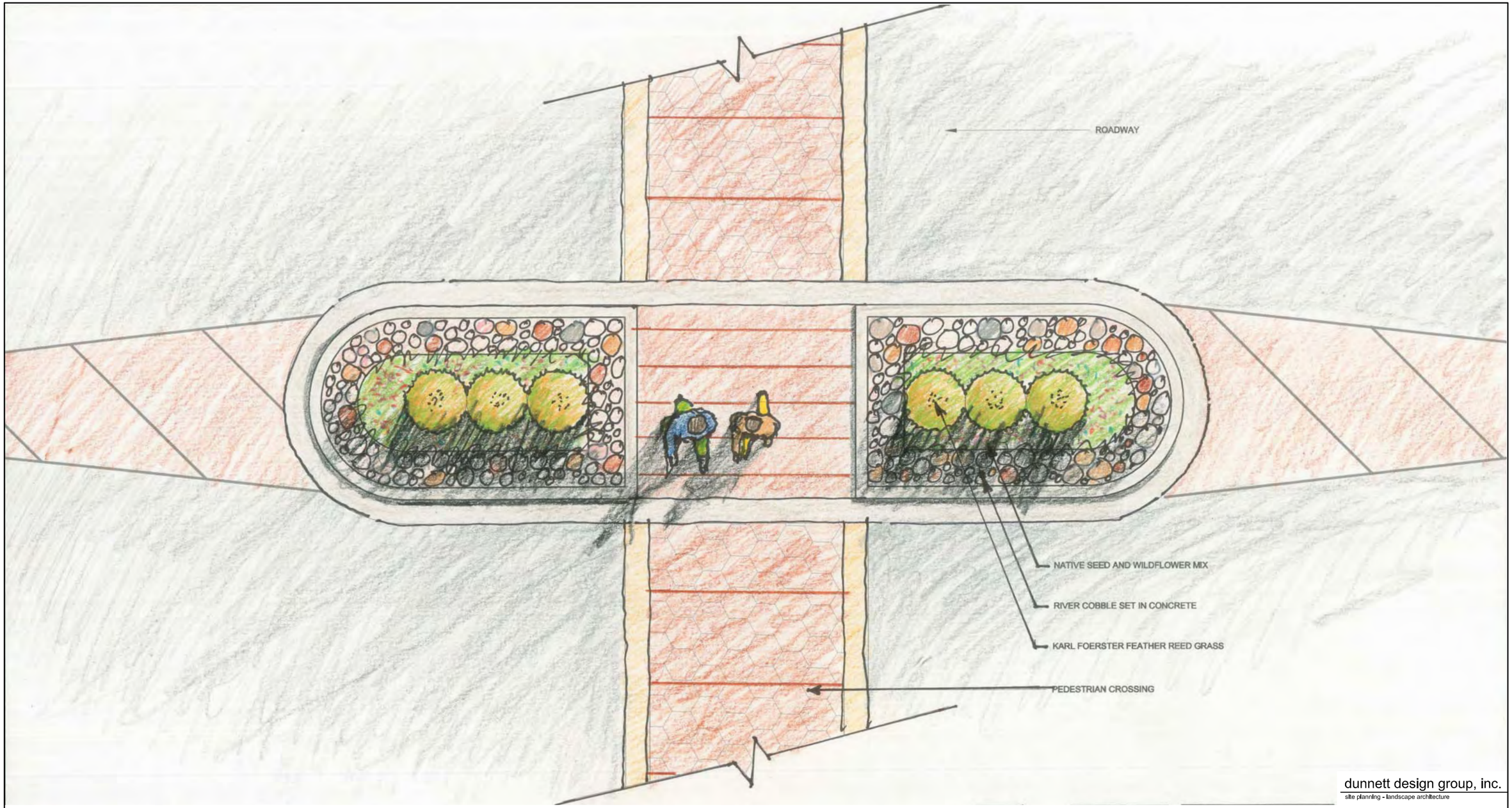

CHICANE TYPICAL PLANTING PLAN

0 1' 2' 4'

SCALE: 1"=2'-0"

conceptual design
not for construction
02-20-2009

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site planning - landscape architecture
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Horiz. Scale: Vert. Scale: As Noted			
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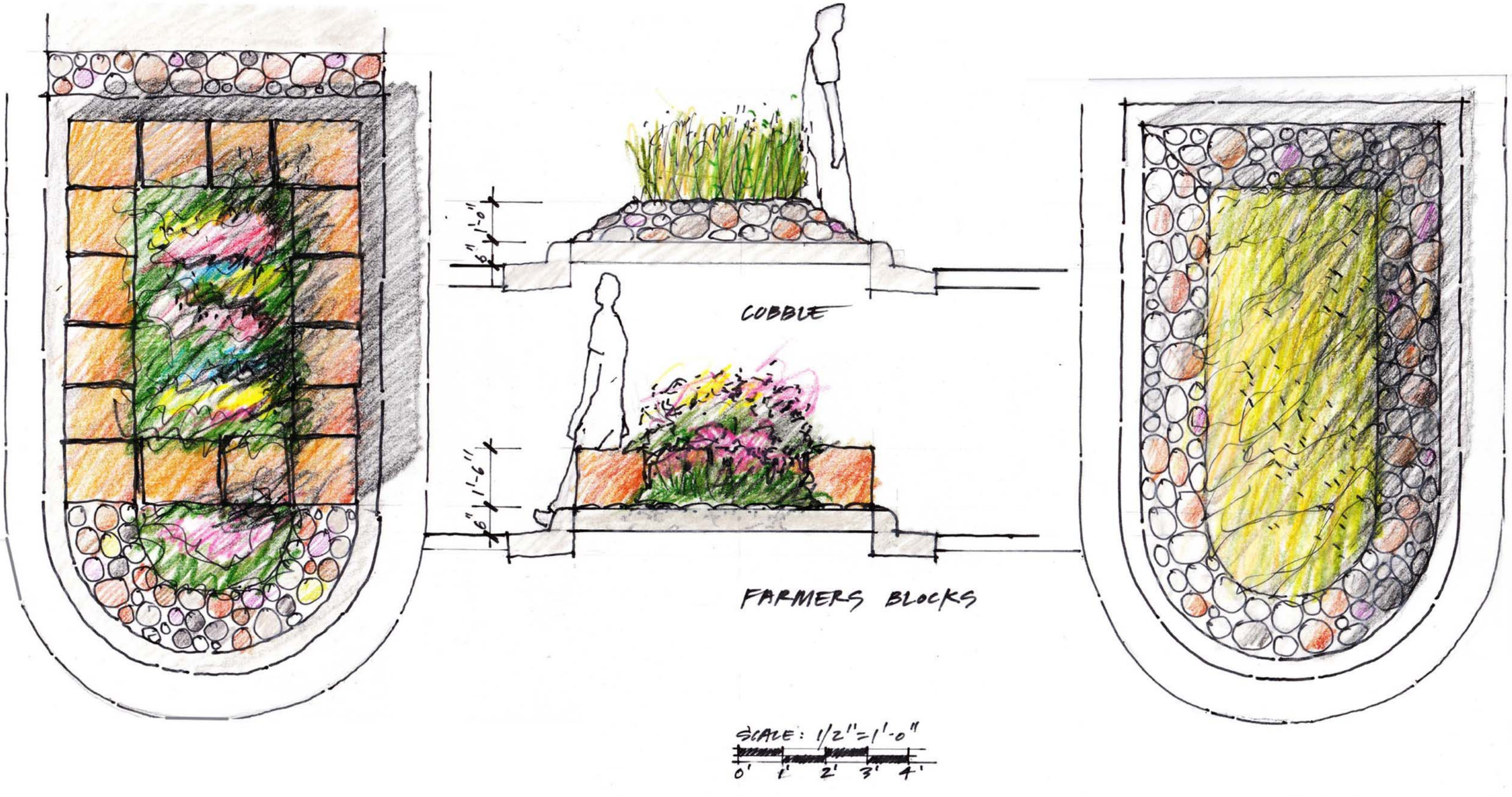
Sheet Number L-6



TWO RIVERS GREENWAY MEDIAN OPTIONS 1

March 17, 2009

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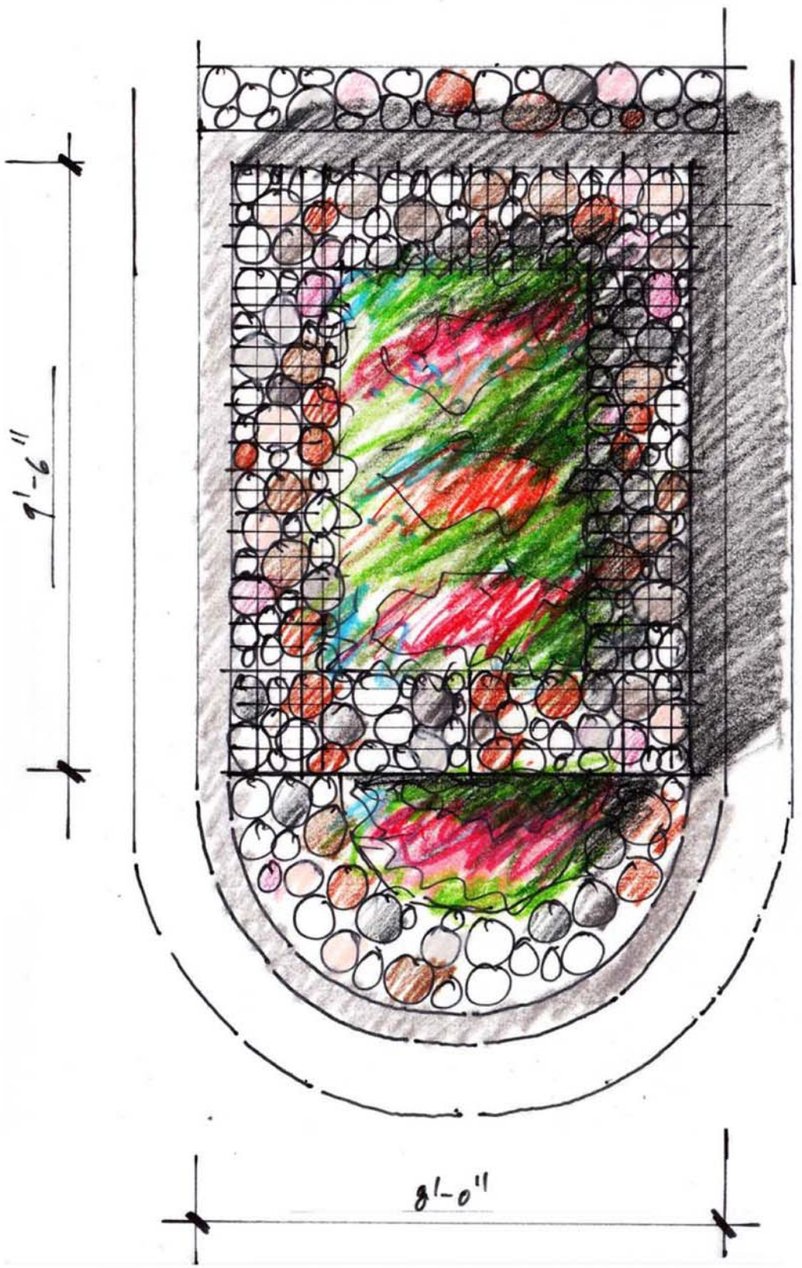
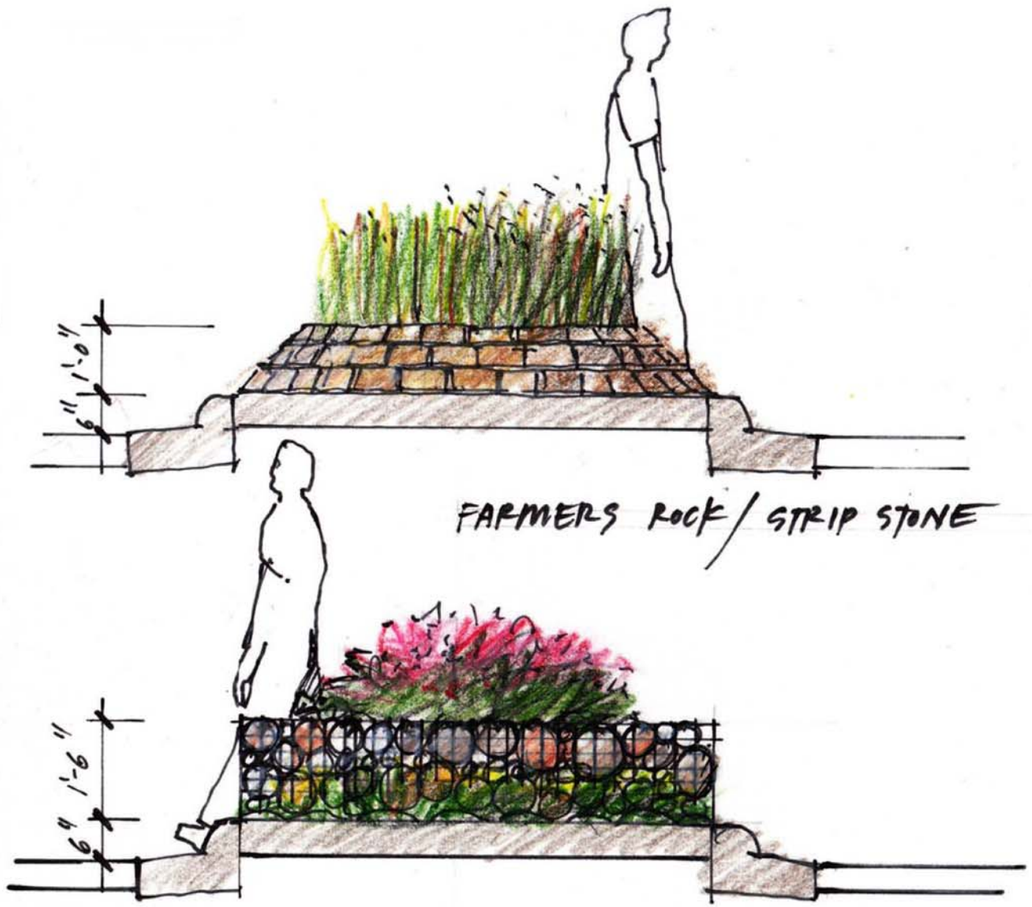
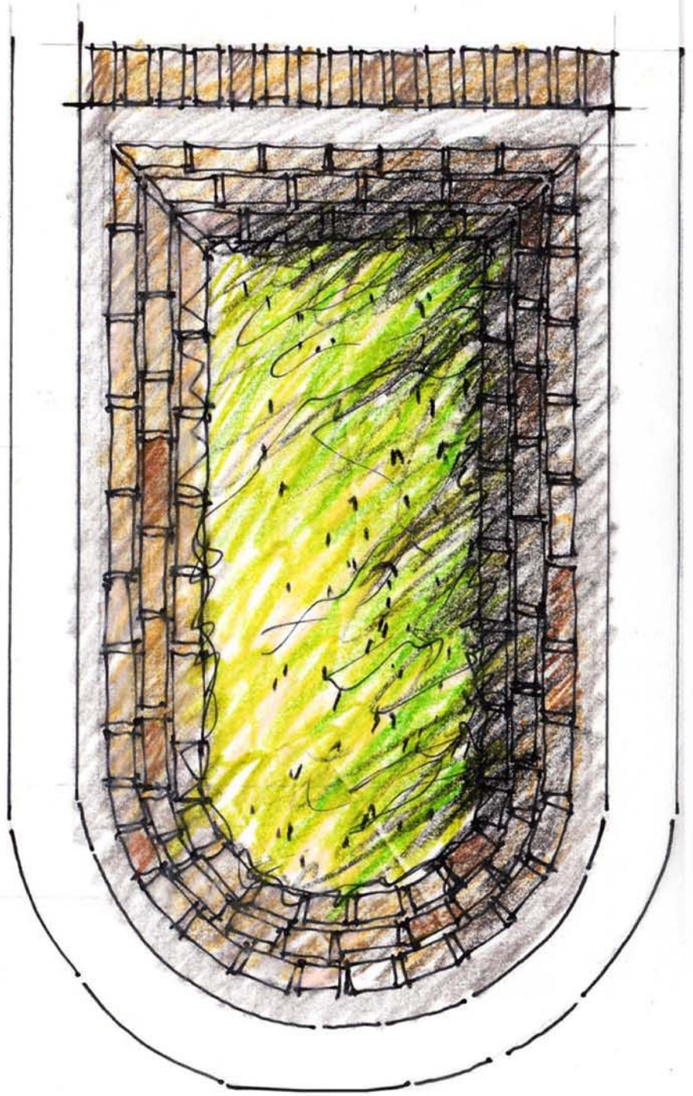
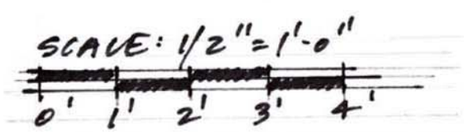
Aspen, CO. 81611
970.544.5240





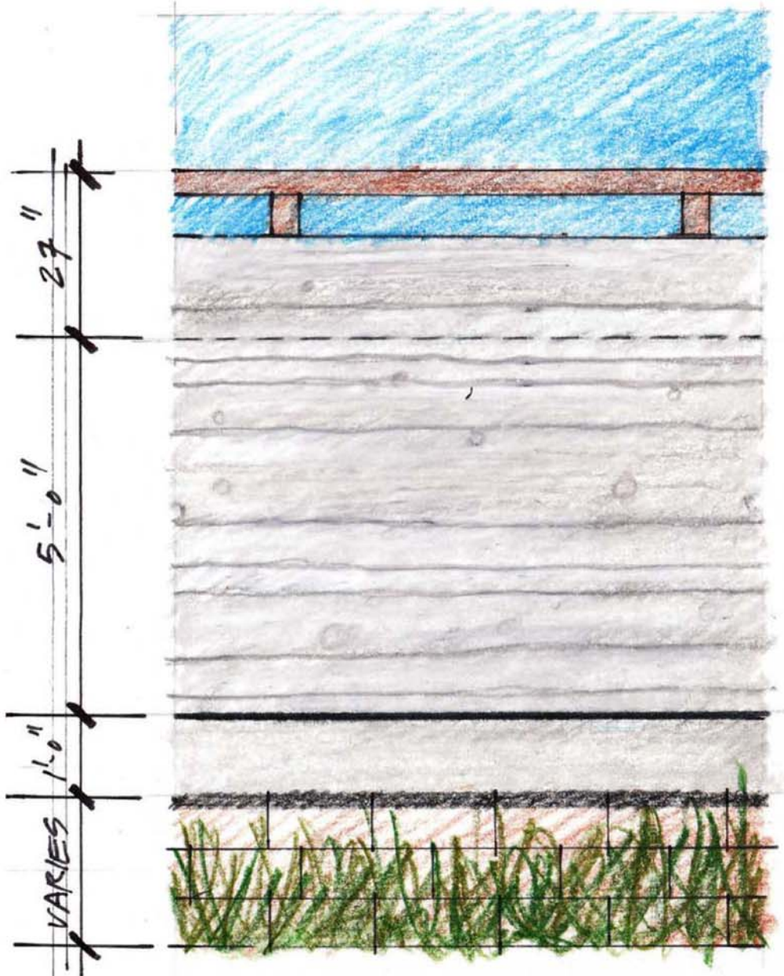




TWO RIVERS GREENWAY MEDIAN OPTIONS 2

March 17, 2009

dunnett design group, inc.
412 N. Mill St. Unit B-3
Aspen, CO. 81611
970.544.5240



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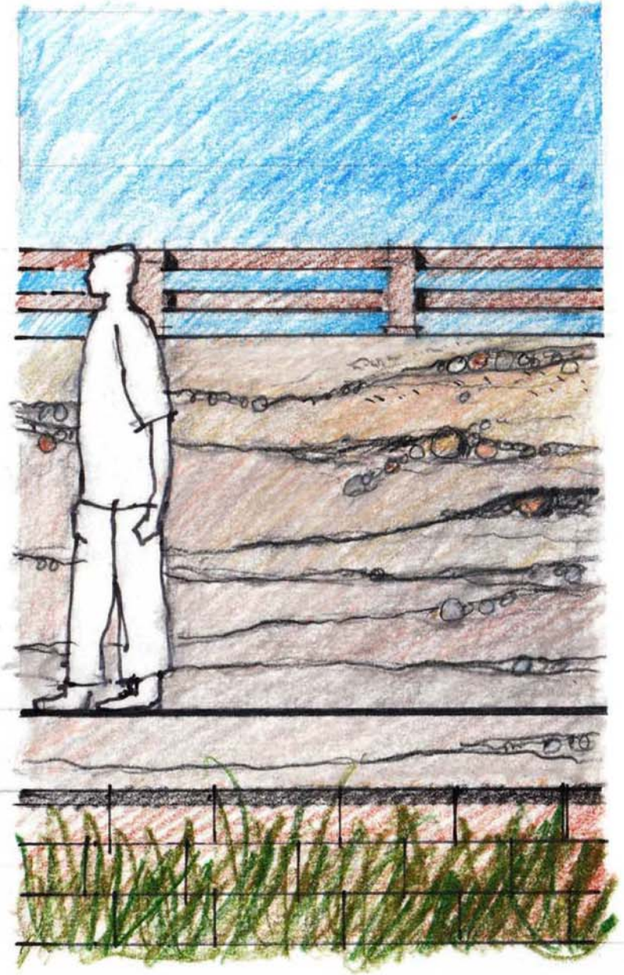

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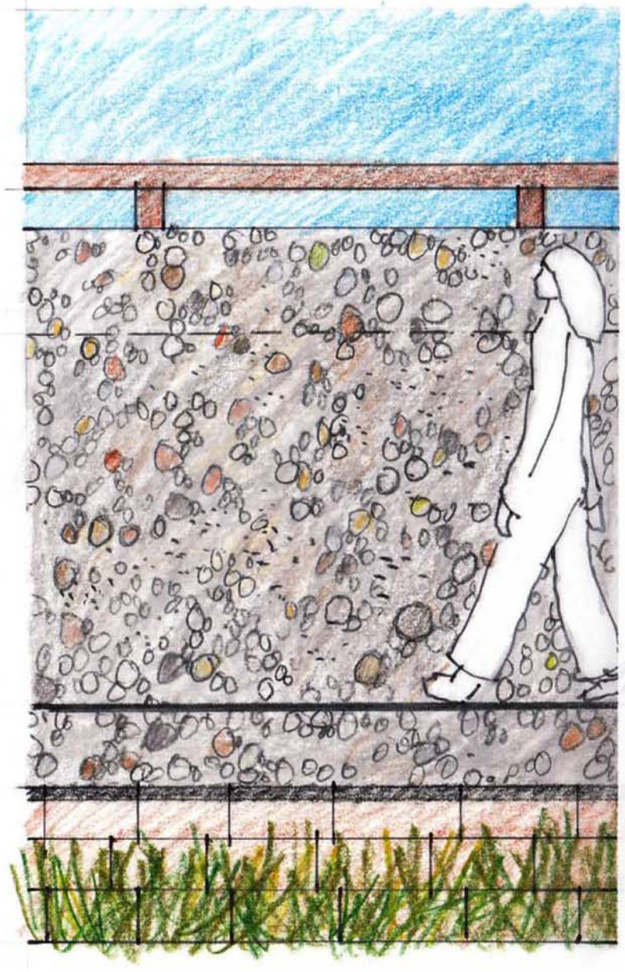


ROUGH EXPOSED AGG.

SCALE: 1/2"=1'-0"

0' 1' 2' 3' 4'

TWO RIVERS GREENWAY RETAINING WALL OPTIONS

March 17, 2009

dunnett design group, inc.

412 N. Mill St. Unit B-3
Aspen, CO. 81611
970.544.5240

Two Rivers Greenway: Phase I

Geotechnical Investigation & Pavement Design

Geotechnical Investigation and Pavement Design

Two Rivers Greenway
Phase 1
Two Rivers Road
between Homestead Drive and Midland Avenue
Basalt, Colorado

Project No. 28-212
October 16, 2008

Prepared for:

Mr. Peter Loris, P.E.
Loris and Associates, Inc..
2585 Trailridge Drive East
Lafayette, Colorado 80026

Prepared by:

Yeh and Associates, Inc.
170 Mel Ray Road
Glenwood Springs, Colorado 81601
Phone: 970-384-1500
Fax: 970-384-1501

TABLE OF CONTENTS

PURPOSE AND SCOPE

This report presents the results of our geotechnical investigation for the design and construction of a pedestrian trail along Two Rivers Road for the Two Rivers Greenway, Phase 1 project located in Basalt, Colorado (Figure 1). The project also includes repaving of Two Rivers Road. The purpose of this study was to evaluate geotechnical characteristics of the on-site soils and pavement subgrade to provide geotechnical recommendations for pavements, retaining walls and other geotechnical related issues at the subject site.

The site investigation consisted of geologic reconnaissance and exploratory test hole drilling to investigate subsurface conditions. Test hole drilling was observed by a representative of Yeh and Associates. Samples obtained during the field exploration were examined by the project personnel and representative samples were subjected to laboratory testing to determine the engineering characteristics of materials encountered. This report summarizes our field investigation, the results of our analysis, and our conclusions and recommendations based on the proposed construction, site reconnaissance, subsurface investigation, and results of the laboratory testing.

PROPOSED CONSTRUCTION

We understand that this project involves the reconstruction of approximately 2,000 lineal feet of roadway (Two Rivers Road). The reconstruction will include (but not limited to) new paving, new parking, chicanes and construction of retaining walls to accommodate a pedestrian trail on the riverside of the road. We believe that Two Rivers Road will remain a two-lane with shoulder areas and occasional bus (lane) pullouts at bus stops. From plans (Scope of Work Sketch) provided, the intersection by the Recycle Center will be realigned. At the time of the investigation, wall locations, wall heights, footing elevations, subgrade elevations, etc. were not available.

SITE CONDITIONS

The site was located in Basalt, Colorado and more specifically, between Homestead Drive and Midland Avenue. Two Rivers Road was an existing two-lane paved road connecting Highway 82 with Midland Avenue. The existing road is relatively flat, sloping down to the east at grades of less than 1 percent. The Roaring Fork River was located to the south. A steeply sloped hill was located to the north, just off the

right-of-way. Cattails and/or ponds were observed between the toe of slopes to the north and edge of pavement. Near the intersection with Homestead Drive, shale bedrock was observed. Residential housing (trailers), a restaurant and open space known as the Roaring Fork Conservancy were located between Two Rivers Road and the Roaring Fork River. An irrigation ditch was located adjacent to the east end of the project near a residential area. The origin of the ditch was unknown and it meandered around and through the residential area. The existing "Old Pond" was located within the Conservancy. The wetland area between Two Rivers Road and "Old Pond" was located immediately adjacent to the steep slopes below the roadway. This area was heavily vegetated.

SUBSURFACE INVESTIGATION

Subsurface conditions were investigated by drilling eleven exploratory test holes. The locations of the test holes are presented on Figure 1. Test holes THD-1 through THD-6 were drilled for the proposed pedestrian trail and anticipated retaining walls. Test holes THS-1 through THS-6 were drilled to investigate subgrade conditions below the roadway. Due to drill rig and traffic control mobilization and accessibility, all holes were drilled in the eastbound lane or shoulder area on the pavement with the exception of test holes THD-5 and THD-6. These two borings were drilled off the roadway in dirt areas adjacent to the existing parking area and bus stop. All test holes were advanced using a CME 55 drill rig with 4-inch continuous flight auger to pre-determined depths or practical drill rig refusal. Modified California or standard split spoon samplers were used to record blow counts and obtain samples.

To perform the modified California penetration resistance tests, a 2.0-inch inside diameter sampler was seated at the bottom of the test hole, then driven up to 12 inches with blows of an standard hammer weighing 140 pounds and falling a distance of 30 inches utilizing a "cat head" (ASTM D1586). The number of blows (Blow Count) required to drive the sampler 12 inches or a fraction thereof, constitutes the N-value. The N-value, when properly evaluated, is an index of the consistency or relative density of the material tested. Split-spoon samples were obtained in the same manner but with a 1.5-inch inside diameter sampler. The results are shown on the test hole logs in Figure 2.

SUBSURFACE CONDITIONS

Subsoils encountered in the test holes consisted of varying amounts of existing fill underlain by sand, silt and gravel. The gravel contained occasional silt, cobbles and small boulders. Practical drill rig refusal was encountered in test holes THD-2, THD-3, THD-4/THH-3, THD-5 and THD-6 at depths of 10 to 15 feet. Fill was encountered in all the test holes with the exception of test holes THD-5 and THD-6. The fill consisted of a gravelly road base (base course) and silty, clayey sand. The silty sand fill consisted railroad ballast. Bedrock was encountered in test holes THD-1 and THD-2 at depths of 14 and 12 feet, respectively. Eleven sand fill samples tested had 20 to 48 percent fines (material passing the No. 200 sieve). Atterberg limit testing on these sand fill samples indicated liquid limits of non-liquid to 34 percent and plasticity indices of non-plastic to 11 percent. One natural sand sample tested had 31 percent fines. One natural gravel sample tested had 17 percent fines. Four natural silt samples tested had 52 to 86 percent fines, liquid limits of non-liquid to 34 percent and plasticity indices of non-plastic to 7 percent. One weathered bedrock sample tested had 66 percent fines, a liquid limit of 36 percent and a plastic index of 13 percent. The sand fill classified as an SM and SC, the sand as SM, the gravel as GM, and the silt as an ML according to the Unified Soil Classification System (USCS). The sand fill classified as an A-2-4, A-4, and A-6, the sand as an A-2-4, the gravel as an A-1-b and the silt as an A-4 based on the American Association of State Highway Transportation Officials (AASHTO) classification system. Results of the laboratory testing are presented in are summarized in the Summary of Laboratory Test Results.

Groundwater was encountered in a majority of the test holes with the exception of test hole THD-2, which was dry to a depth of 10 feet. Groundwater depths varied between 4 and 12 feet below existing grades. All test holes were backfilled and patched or plugged immediately after drilling for safety reasons and delayed water levels were not measured. Based on the groundwater depths and presumed retaining wall footing elevations, dewatering and/or diversion may be required or necessary for new construction. Variations in groundwater conditions may occur seasonally. The magnitude of the variation will be largely dependent upon the amount of spring snowmelt, duration and intensity of precipitation, local landscape irrigation practices, site grading changes, and the surface and subsurface drainage characteristics of the surrounding area.

SITE DEVELOPMENT

Wall heights, wall locations, footing elevations (retaining wall) and sub-grade elevations were unavailable at the time of this investigation. We believe retaining wall footings would be placed on sand and/or gravel materials. Foundations should not be placed on silt or clay soils or existing fill. If these materials are encountered in foundation excavations, we recommend these materials be removed and replaced with a granular material prior to foundation construction. We should be contacted to provide additional recommendations, if necessary. Granular fill placement specifications are described below and should be approved by the geotechnical engineer prior to placement. Foundation excavations may be planned near or below measured groundwater levels. Dewatering and/or diversion may be required.

We believe a majority of the materials encountered at this site may be excavated with conventional heavy equipment although with depth, the gravel, cobble and boulders become denser and may require additional effort and means. On-site soils can be used in site grading fills provided the material is substantially free of organic material, debris and particles larger than 3 inches.

Areas to receive fill should be stripped of vegetation, organic soils and debris. Topsoil is not recommended for fill material. Fill should be placed in thin, loose lifts of 8 inches thick or less. For silt and clay soils, we recommend these materials be moisture conditioned to 0 to 3 percent above optimum moisture content and compacted to at least 95 percent of maximum standard Proctor dry density (ASTM D 698). For granular soils, we recommend the materials be moisture conditioned to within 2 percent of optimum moisture content and compacted to the specification above. For fill below a depth of 15 feet, we recommend the materials be moisture conditioned within 2 percent of optimum moisture content and compacted to at least 100 percent of maximum standard Proctor dry density (ASTM D 698). Placement and compaction of fill should be observed and tested by a representative of the geotechnical engineer.

We recommend that permanent soil cut slopes under 10 feet be constructed at a minimum slope of 2H:1V. For permanent cut slopes over 10 feet, we recommend a minimum slope of 2.5H:1V. Fill slopes should be constructed no steeper than 3H:1V. If fill slopes are planned steeper than 3H:1V, the slopes could be redesigned using retaining wall systems or reinforced soil slopes (RSS). Surface water should be directed away from the crest of slopes. The slopes should be protected from erosion by revegetation or other means. The risk of slope

instability increases if seepage is encountered in cut slopes. Flatter slopes may be required if significant seepage is encountered in cut slopes.

FOUNDATION RECOMMENDATIONS (RETAINING WALLS)

Based on the results of our subsurface investigation, we believe the retaining wall footings would be placed on sand and/or gravel material and/or properly placed granular fill. Foundations should not be placed on silt, clay or fill soils. If existing fill, silt and/or clay material are encountered at footing levels, then these materials should be removed and replaced with a granular fill material. We should be contacted for additional recommendations if these materials are encountered in foundation excavations. Groundwater will likely be encountered at depths of between 4 and 12 feet from existing road grades. Temporary dewatering and/or diversion may be required. Foundation excavations should be observed by a representative of the geotechnical engineer prior to foundation construction. The following design and construction details should be observed for footing foundations placed on the on-site soils or properly compacted fill.

1. Foundations should be constructed on undisturbed natural sand and/or gravel soils or properly compacted granular fill. Loose, disturbed soils encountered at foundation level should be removed and replaced with compacted fill or the foundation should be extended to undisturbed soils.

2. Footing foundations can be designed for a maximum allowable soil pressure of 3,000 psf.

3. Resistance to sliding at the bottom of the footing can be calculated based on a coefficient of friction of 0.35. Passive pressure against the side of the footing can also be considered for the sliding resistance if it is properly compacted. Passive pressure can be estimated based on an equivalent fluid density of 350 pcf for a level backfill.

4. Footing foundations should be protected from freezing. We recommend the bottom of footings be constructed at least 3.5 feet below finished grade or as required by local municipal code.

5. All foundation excavations should be observed by a representative of the geotechnical engineer prior to placement of concrete.

RETAINING WALLS

If retaining walls are able to rotate to mobilize shear strength of the retained soils, the walls can be designed for active earth pressure conditions. Wall rotation is typically on the

order of 0.5 to 1 percent of the wall height. For active conditions, retaining walls can be designed using an equivalent fluid density of 50 pcf. If walls are backfilled with approved granular soils (i.e. Class 1 structural backfill), retaining walls could be designed using an "active" equivalent fluid pressure of 40 pcf. This equivalent fluid density assumes a horizontal, on-site material backfill. If wall rotation cannot be tolerated, a higher equivalent fluid density should be used such as an "at rest" condition. For "at rest" conditions, we recommend using an equivalent fluid density of 60 pcf for on-site material backfill. Passive pressure against the footing can be calculated using an equivalent fluid density of 350 pcf for on-site material backfill. These values assume the backfill materials are not saturated. Wall designs should consider the influence of surcharge loading such as traffic, construction equipment and/or sloping backfill.

Walls can be backfilled with on-site materials provided the material meets the requirements in the SITE DEVELOPMENT section. Retaining walls should be constructed with a drainage system to drain away any excess water immediately behind the wall. The drainage system may consist of free-draining gravel and/or weep holes commonly used for the wall drainage.

EXISTING PAVEMENT

All test holes (except test holes THD-5 and THD-6) were drilled within existing asphalt surface. The pavement on Two Rivers Road appeared to be recently repaved, but exhibited signs of rutting. In general, the pavement appeared in relatively good condition. The table below summarizes the average measured roadway thicknesses on Two Rivers Road.

Layer	Average Depth (Inches)
Asphalt	3.9
Base Course	13.6
Combined Asphalt and Base Course	17.6

PAVEMENT DESIGN

Traffic Loading

A 20-year, 18-kip design Equivalent Single Axle Load (ESAL) was estimated based on the 20-year growth factor from CDOT's traffic information for Highway 82, south of Two Rivers road. Based on CDOT's information, we calculated a 20-year growth factor of 1.54. Using a current (2008) traffic loading of 5869 vehicles per day (provided by the Town of Basalt), we multiply this number by the 20-year growth factor to obtain the projected ADT of 9038 vehicles per day at year 2028. Traffic loading numbers and calculations are presented in Appendix A. The 20-year, 18-kip design Equivalent Single Axle Load (ESAL) is presented in Table 1 below.

Table 1 - Design Equivalent 18-kip Single Axle Load (ESAL)

Roadway Section	20-Year Flexible ESAL
Two Rivers Road between Homestead Drive and Midland Avenue	679,429

Determination of Resilient Modulus (M_R) of Subgrade for Design

Based on laboratory test results, we estimated an average R-value of 33 for the sub-grade soils in the project area. The average was based on A-6 to A-2-4 soils. From this R-value, the resilient modulus was calculated using Equations 2.1 and 2.2 from the CDOT 2006 Pavement Design Manual. The resulting resilient modulus was 7,555 psi. The pavement design program DARWin version 3.1 was employed to determine the AASHTO pavement thickness designs.

Asphalt Pavement Thickness Recommendations

A full-depth asphalt, a composite and a composite with a sub-base pavement designs using a combination of hot mix asphalt (HMA), Class 6 Aggregate Base Course (ABC) and a Class 3 subbase with a minimum R-value of 77 and Subbase Class 3 is presented. Pavement section thickness was determined in accordance with the 2006 CDOT Pavement Design Manual. The parameters for the pavement design are shown below:

Table 2 – Pavement Design Parameters

Hot Mix Asphalt (HMA) Composite Designs			
Initial Serviceability	4.5	Reliability Level, %	90
Terminal Serviceability	2.5	Overall Standard Deviation	0.44
Construction Stage	1	Str. Layer Coeff. – Asphalt Mix	0.44
Str. Layer Coeff. – ABC	0.12	Str. Layer Coeff. – Subbase	0.10

The results of the equivalent pavement thickness designs are summarized below.

Table 3 – Recommended Pavement Sections

Section	Pavement Type	Thickness (inches)
Two Rivers Road (between Homestead Drive and Midland Avenue)	Full Depth HMA	7.5" HMA
	HMA + ABC	5" HMA + 8" ABC
	HMA + ABC + Class 3	4" HMA + 6" ABC + 7" Class 3
Pedestrian Trail	Full Depth HMA	3.0" HMA

Concrete Pavement

We recommend concrete pavement for areas where heavy trucks with tight turning areas are planned. These areas typically include trash pickup, bus pullouts and delivery locations. Table 4 shows the recommended pavement thickness for these areas.

Table 4 –Recommended Concrete Thicknesses

Roadway Section	Recommended Thickness (inches)
Bus Pullouts and Truck Areas	6.0"
Pedestrian Trail	4.0"

The design for concrete pavement was determined based on placement directly on the existing subgrade materials, but in order to provide drainage and also an adequate working platform for construction, we recommend that at least 4 inches of Class 6 ABC be placed on the subgrade prior to construction of the concrete pavement.

Hot Mix Asphalt Type

For the asphalt mix, we recommend that the asphalt mix meet Grading SX (75) criteria in accordance with the current CDOT Specifications. The SuperPave Gyratory Revolutions (N_{des}) for the asphalt mix should be 75. A performance graded binder meeting the requirements of PG 64-22 is recommended for the SX(75) mix. The PG 64-22 is not a polymer modified asphalt. PG 64-22 provides 98 percent reliability against rutting. Regardless of the pavement chosen, the asphalt mix for asphalt pavement should be placed in 2 to 3 inch lifts.

Aggregates for hot plant mix bituminous pavement should be of uniform quality, composed of clean, hard, durable particles of crushed stone, gravel, or slag. Excess of fine material should be wasted before crushing. The specified gradation for a Grading SX is shown below:

Table 5 – Specifications of Gradation for the Grading SX

Sieve Size	Percent Passing
1 ½"	
1"	
3/4"	100
1/2"	90-100
3/8"	
#4	
#8	28-58
#30	
#200	2-10

Pavement Subgrade Preparation

Prior to placing subbase or aggregate base course and asphalt pavement, the entire subgrade area should be scarified to a depth of 12 inches and recompacted to the specified relative compaction with a moisture content in accordance with the CDOT Standard Specifications for Road and Bridge Construction. In locations where the in-place subgrade contains more than 40 percent minus No. 200 sieve material, a separator fabric conforming to CDOT Separator Geotextile Class B should be installed prior to placing the subbase. Based on our investigation, we believe that the subgrade soils would consist of silty, clayey sand fill that occasionally contains more than 40 percent fines. Due to the erratic nature of this fill, we anticipate fabric may be required for portions of the roadway. We should be contacted to evaluate the materials when the subgrade soils are exposed. Imported fill material should be

compacted in thin lifts to within 2 percent of optimum moisture content in accordance AASHTO T 99 or T 180. As noted above, the ABC should have a minimum R-value of 77. For all layers, drainage needs to be addressed during construction to prevent ponding of water and provide for ease of construction. The pavement subgrade and aggregate base course should be proof rolled with a heavily loaded pneumatic-tire vehicle. Areas which deform more than 0.5 inch under heavy wheel loads should be removed, replaced if necessary and reworked to achieve a stable subgrade prior to paving. We recommend that proof rolling and compaction tests be performed under the direct supervision of a representative of the geotechnical engineer.

Drainage Considerations

The collection and diversion of surface drainage away from paved areas is critical to the satisfactory performance of the pavement. Proper drainage design should include prevention of ponding of water on or immediately adjacent to pavement areas. All landscape sprinkler heads and lines adjacent to pavement areas should be frequently checked for leaks and maintained in good working order. Over-spray from sprinklers should be minimized. Concentrated runoff should be avoided in areas susceptible to erosion.

A pavement section is a layered structure designed to disperse dynamic traffic loads to the subgrade. The performance of the pavement structure depends on the traffic loadings and physical properties of the subgrade materials. As described below, soils are represented for flexible pavement design purposes by means of a soil support value that is empirically related to strength.

Groundwater

Groundwater was encountered within 4 feet of existing asphalt grade, or within 2 to 3 feet of proposed new asphalt sections at or near THS-4. In this area, additional subgrade improvement may be necessary. If the subgrade materials are too saturated for placement of the asphalt sections, then we recommend the removal and replacement of these materials. These materials can be replaced with an imported or on-site granular fill material. See the SITE DEVELOPMENT section for specifications and placement recommendations.

WATER SOLUBLE SULFATE

Based on the results of water-soluble sulfate concentrations measured by our tests, we anticipate a Class 0 exposure for concrete due to the presence of water-soluble sulfate. We measured water soluble sulfate concentrations of 0.010 to 0.014 percent in three select samples. Based on ACI 201.2R-01, "Guide to Durable Concrete," concentrations between 0.0 and 0.1 percent represent Class 0 exposure (negligible). For cast-in-place structures and pavements, ACI indicates any type cement may used.

LIMITATIONS

The analyses and recommendations presented in this report are based upon our data obtained from the borings at the indicated locations, field observations, laboratory testing, our understanding of the proposed construction and other information discussed in this report. It is possible that subsurface conditions may vary between or beyond the points explored. The nature and extent of such variations may not become evident until construction. If variations appear, we should be contacted immediately so we can review our report in light of the variations and provide supplemental recommendations as necessary. We should also review the report if the scope of the proposed construction, including the proposed loads, finished elevations or structure locations, change from those described in this report. The conclusions and recommendations contained in this report shall not be considered valid unless Yeh and Associates reviews the changes and either verifies or modifies the conclusions of this report in writing.

The scope of services for this project did not include, specifically or by implication, any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions or biological conditions. If the owner is concerned about the potential for such contamination, conditions or pollution, other studies should be undertaken.

The report was prepared in substantial accordance with the generally accepted standards of practice for geotechnical engineering as exist in the site area at the time of our investigation. No warranties, express or implied, are intended or made. The recommendations in this report are based on the assumption that Yeh and Associates will conduct an adequate program of construction testing and observation to evaluate compliance with our recommendations.

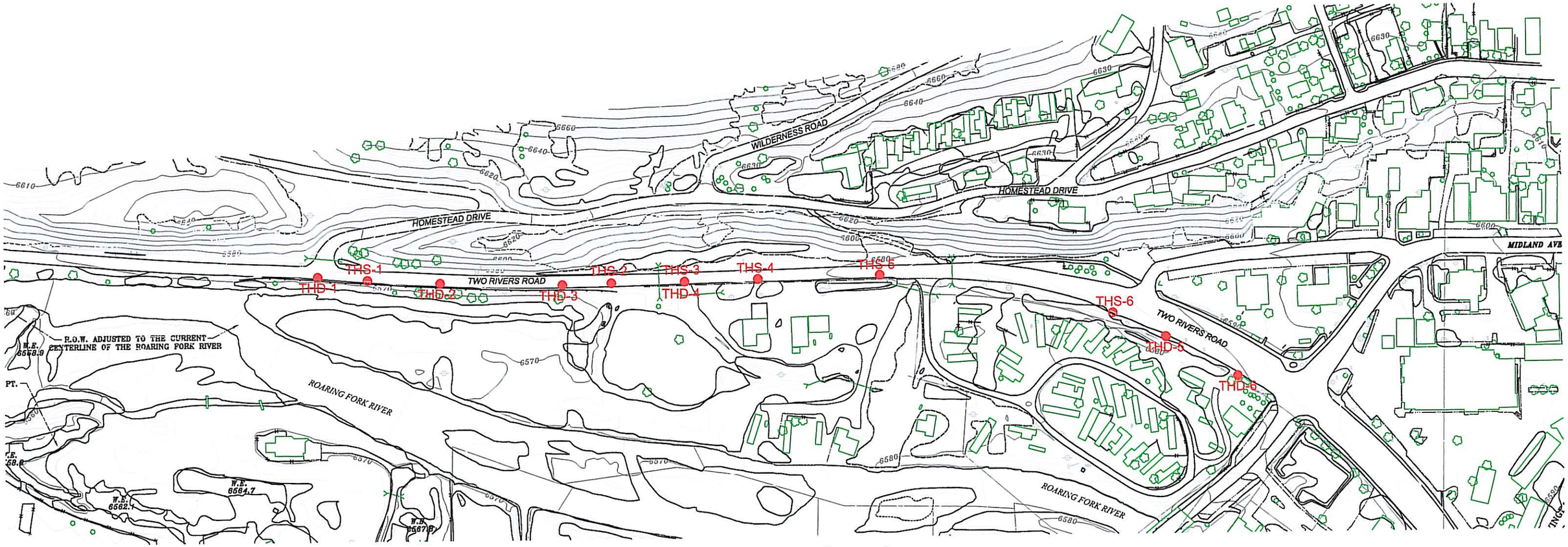
YEH AND ASSOCIATES, INC.

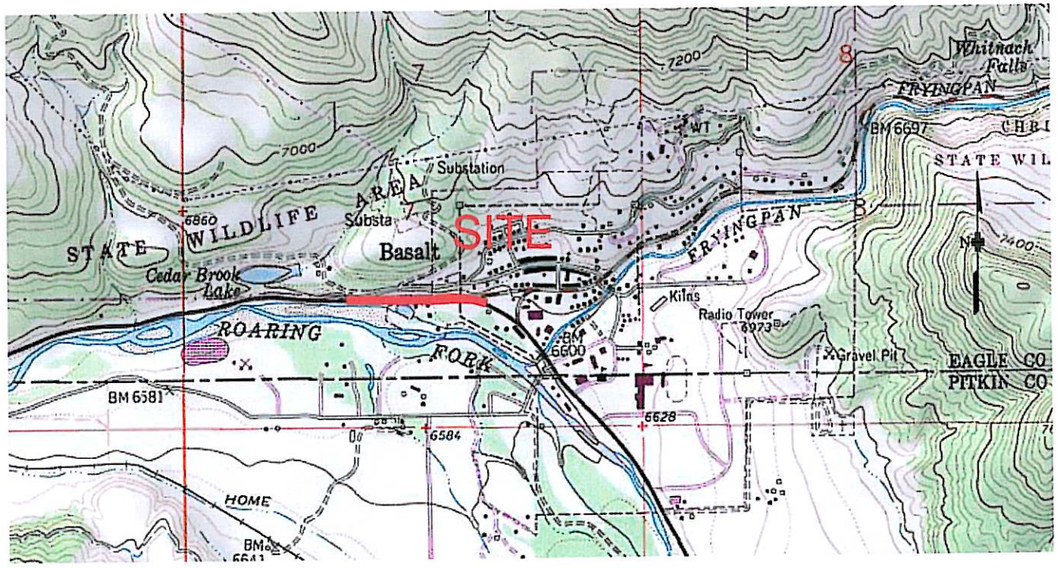
Keith E. Asay
Staff Engineer

Reviewed by:

Richard D. Johnson, P.E.
Senior Geotechnical Engineer

COLORADO REGISTERED
RICHARD D. JOHNSON
35832
10/17/08
PROFESSIONAL ENGINEER





Topographic map created with TOPO!®©National Geographic

Vicinity Map
Basalt, Colorado

Not to scale

Legend:

THS-1 or THD-1
Indicates approximate test hole location

NOTE:
Based on plan map provided by Loris and Associates, September 2008

N

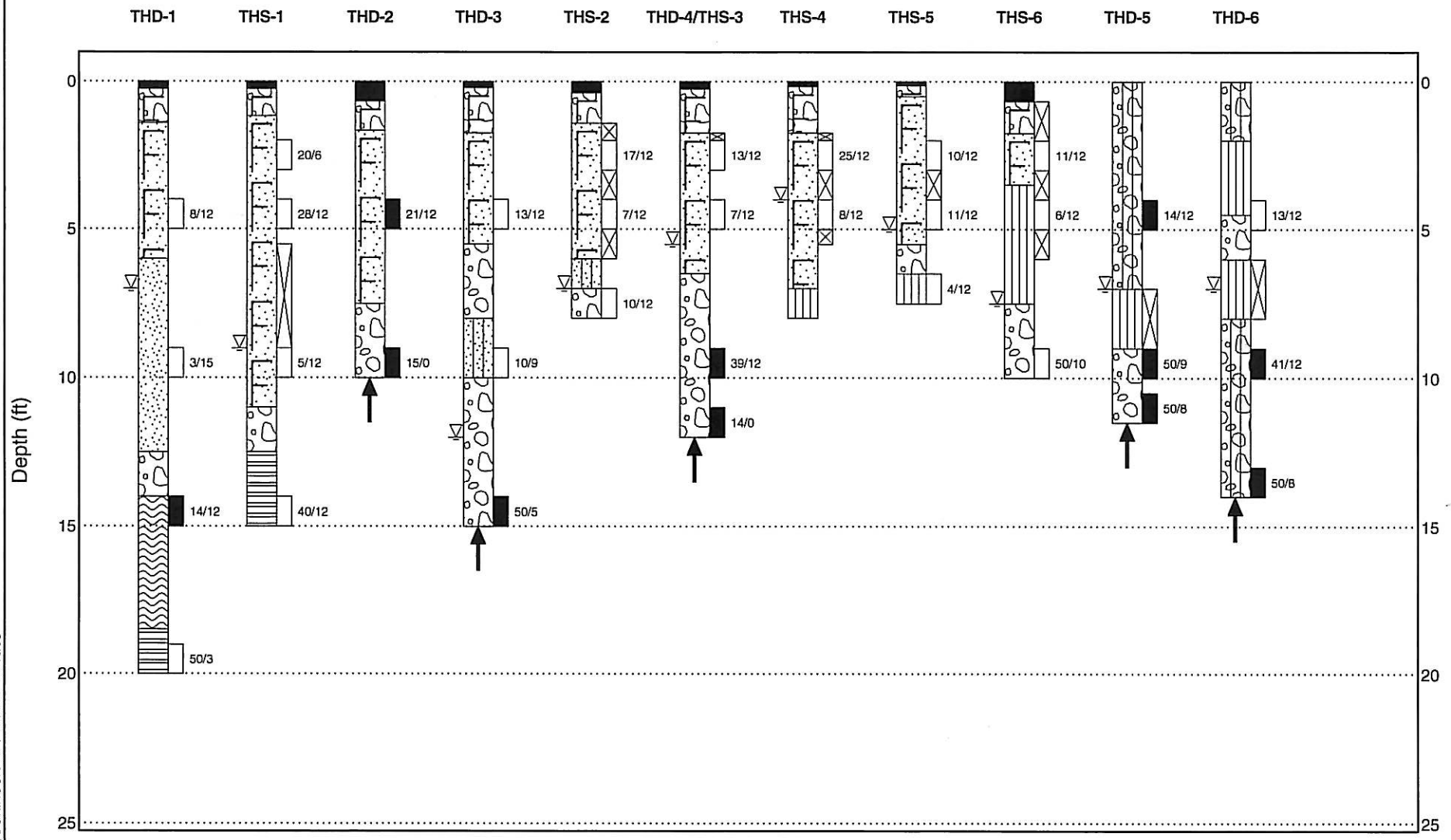
200 0 100 200

SCALE: 1" = 200'

Approximate Test Hole Locations

Figure 1

Project #28-212



YEH AND ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING CONSULTANTS

Two Rivers Greenway, Phase 1

Project Number: 28-212

Figure No. 2

FENCES BY DEPTH - A SIZE 28-212, BORINGS.GPJ RDJ.GDT 10/16/08

YEH AND ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING CONSULTANTS

Project: Two Rivers Greenway, Phase 1
Project Number: 28-212

Legend for Symbols Used on Test Hole Logs

Sample Types

Modified California Sampler. The symbol 8/12 indicates that 8 blows from a 140 pound hammer falling 30 inches was used to drive 2-inch I.D. sampler 12 inches.

Split Spoon Sampler. The symbol 14/12 indicates that 14 blows from a 140 pound hammer falling 30 inches was used to drive 1.5-inch I.D. sampler 12 inches.

Bulk sample was obtained from auger cuttings at the depths indicated.

Other Symbols

Indicates practical drill rig refusal.

Indicates depth to groundwater at time of drilling.

Soil Lithology

Asphalt

Fill: Base Course

Fill: Sand, silty, clayey, occasional gravel and cobble, likely railroad ballist, loose to dense, slightly moist to wet, red, brown, black (SM, SC).

Sand, fairly clean, loose, wet, red, brown (SP).

Silt, sandy, soft to medium stiff, moist to wet, red, brown (ML).

Sand, silty, loose to medium dense, slightly moist to moist, red, brown (SM).

Gravel, silty, occasional cobble and small cobble, medium dense, red, brown (GM).

Gravel, sandy, occasional cobble and small boulders, medium dense to very dense, moist to wet, brown, gray (GP).

Bedrock Lithology

Weathered Bedrock Shale, stiff, moist to wet, gray, brown.

Bedrock Shale, silty, very hard, moist to wet, gray, blue, black.

Notes: 1. Test holes were drilled on August 28, 2008 with 4-inch continuous flight auger.
2. Test hole descriptions are subject to explanations contained in this report.

Figure 3

YEH & ASSOCIATES, INC

Summary of Laboratory Test Results

Project No: 28-212 Project Name: Two Rivers Greenway, Phase 1

Sample Location			Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg			Water Soluble Sulfate (%)	CLASSIFICATION	
Test Hole	Depth (ft)	Sample Type			Gravel > #4 (%)	Sand (%)	Fines < #200 (%)	LL	PL	PI		AASHTO	USCS
THD-1	14	SS	19.5				66	36	23	13	0.010	A-6 (7)	Weathered Bedrock
THD-2	4	SS	17.4				36	34	26	8	0.014	A-4 (0)	SM
THD-3	9	CA	17.7				31					A-2-4 (0)	SM
THD-4 THS-3	2	CA	6.6	103			20					A-2-4 (0)	SM
THD-5	7-9	Bulk	30.9				52	NL	NP	NP	0.010	A-4 (0)	ML
THD-6	6-8	Bulk	28.4				57	NL	NP	NP		A-4 (0)	ML
	9	SS	13.1				17					A-1-b (0)	GM
THS-1	4	CA	9.8				21	30	20	10		A-2-4 (0)	SC
THS-2	2	CA	16.0				23	34	27	7		A-2-4 (0)	SM
	2-6	Bulk	16.7				47	32	21	11		A-6 (2)	SC
THS-3	21"-30"	Bulk	17.1				39	30	22	8		A-4 (0)	SC
THS-4	2	CA	15.3				48	32	22	10		A-4 (2)	SC
	21"-4.5'	Bulk	12.9				43	30	19	11		A-4 (1)	SC
	4.5-5.5	Bulk	23.6				41	33	22	11		A-6 (1)	SC
THS-5	2	CA	22.4				30	NL	NP	NP		A-2-4 (0)	SM
THS-6	2	CA	24.7				31	NL	NP	NP		A-2-4 (0)	SM
	4	CA	28.7	91			86	34	27	7		A-4 (7)	ML
	4-6	Bulk	24.1				60	28	24	4		A-4 (1)	ML

CA - Indicates modified California sampler
SS - Standard split spoon sampler
NL - Indicates nonliquid
NP - Indicates nonplastic

APPENDIX A

PAVEMENT THICKNESS DESIGN

TRAFFIC LOADING using Volume

Two Rivers Greenway, Phase 1

Project No. 28-212

Current ADT	5869	vehicles per day	Design Life = 20 years
Projected ADT	9038	vehicles per day	
Average ADT	7453.5	vehicles per day	

☒ Flexible Pavement

☐ Rigid Pavement

Anticipated Traffic		Separate ADT	Equivalency Factor	Equivalent ADT
Combination Trucks	1%	75	1.087	82
Single Unit Trucks	3%	208	0.249	52
Cars & Light Trucks	96%	7170	0.003	22
	100%	7453.5		155

Total ESAL	1,132,381	
Lanes per direction	1	lanes
Lane Factor	0.6	
Design ESAL	679,429	

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

Two Rivers Greenway, Phase 1, Full Depth

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	679,429
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	90 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	7,555 psi
Stage Construction	1
Calculated Design Structural Number	3.16 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt	0.44	1	7.5	12	3.30
Total	-	-	-	7.50	-	3.30

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

Two Rivers Greenway, Phase 1, Composite

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	679,429
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	90 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	7,555 psi
Stage Construction	1
Calculated Design Structural Number	3.16 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Asphalt Mix	0.44	1	5	12	2.20
2	Aggregate Base	0.12	1	8	12	0.96
Total	-	-	-	13.00	-	3.16

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

Two Rivers Greenway, Phase 1, Composite with Sub-base

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	679,429
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	90 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	7,555 psi
Stage Construction	1
Calculated Design Structural Number	3.16 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	Subbase Class 3	0.1	1	7	12	0.70
2	ABC Class 6 R>77	0.12	1	6	12	0.72
3	HMA	0.44	1	4	12	1.76
Total	-	-	-	17.00	-	3.18

Two Rivers Greenway: Phase I

Floodplain Hydraulic Analysis

McLaughlin Water
ENGINEERS, LTD.

MEMORANDUM

TO: Mr. Peter J. Loris, P.E., Loris and Associates

FROM: Aaron Asquith, P.E.

RE: Two Rivers Road Hydraulic Analysis

The Two Rivers Road improvements are proposed to extend from just downstream of Midland Avenue Bridge (FEMA Cross Section 76.2) downstream to the intersection of Two Rivers Road and West Homestead Drive (FEMA Cross Section 71). The relationship of the proposed improvements to the FEMA Cross Sections is provided on the attached Drawing No. 1.

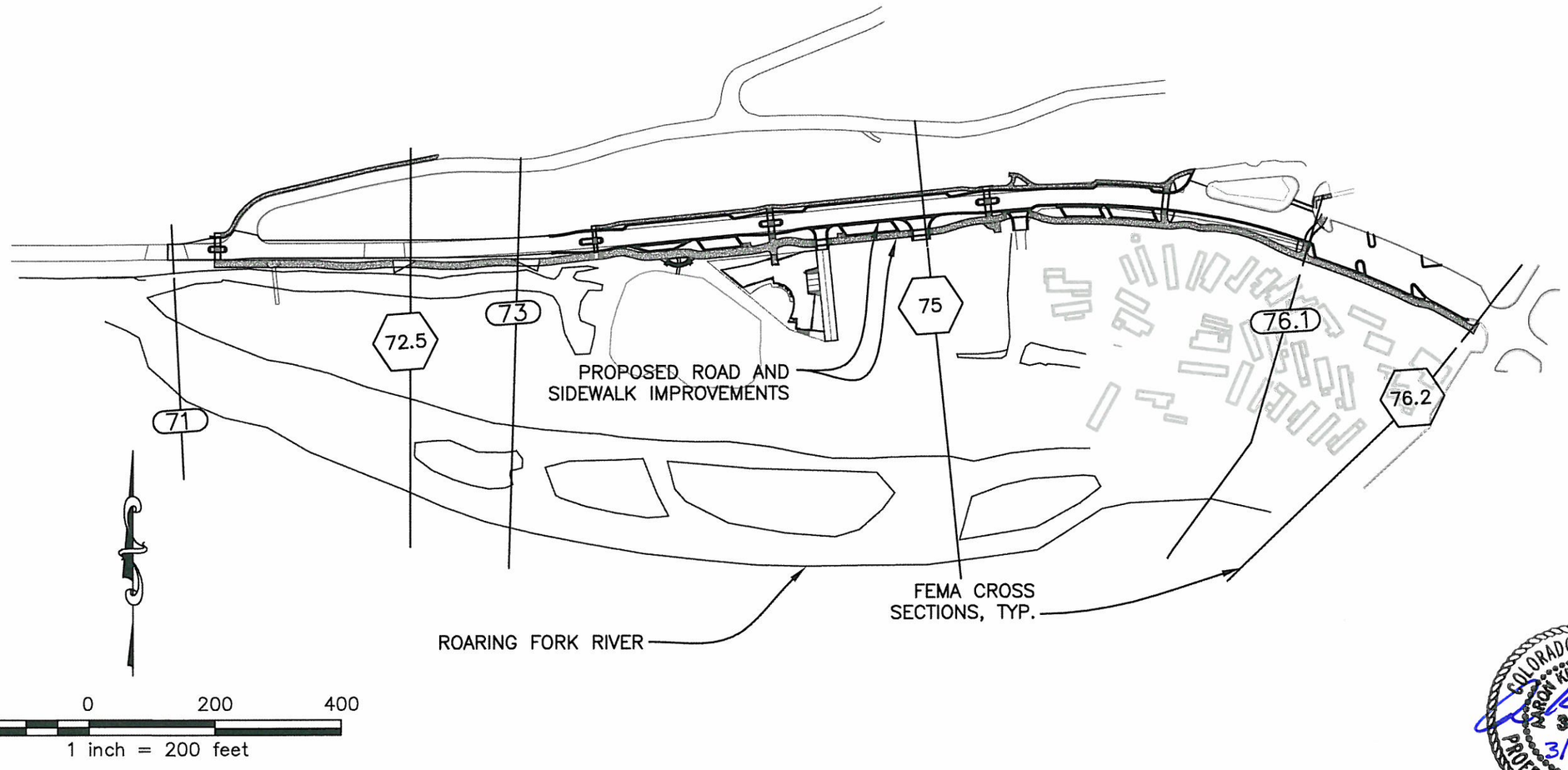
The improvements are located within Reach 2 of the Roaring Fork (as identified in the river masterplan) and are subject to Ordinance Number 25 Series of 2000, which amends Sections: 16-356, 16-461, 16-463, 16-464, and 16-465 of the Municipal Code of the Town of Basalt, Colorado. As such, the improvements must not increase the regulatory floodplain (Section 16-465(b)), nor substantially impair the Town's on-going master planning effort (Section 16-465(d)).

McLaughlin Water Engineers was tasked with evaluating impacts of these improvements to the regulatory floodplain. The Town's adopted HEC-RAS model was utilized to evaluate impacts to 100-yr water surface elevations as a result of the proposed road and sidewalk improvements. Cross section data within the regulatory floodplain model was modified based upon the proposed cross sections provided by Loris and Associates. The following table represents the modeled changes in the 100-yr Water Surface Elevation (WSEL).

Cross Section	Existing 100-yr WSEL (feet)	Proposed 100-yr WSEL (feet)	Net Change (feet)
76.2	6585.84	6585.84	0.00
76.1	6584.37	6584.38	0.01
75	6579.83	6579.83	0.00
73	6573.09	6573.09	0.00
72.5	6572.45	6572.47	0.02
71	6569.76	6569.76	0.00

As can be seen from the table, the proposed design does not create increases in the regulatory 100-yr water surface elevations as measured in tenths of a foot. As a result, the proposed improvements do not increase the regulatory floodplain. Based upon the improvements proposed in the Reach 2 Preliminary Design, the improvements do not substantially impair the Town's on-going master planning effort (Section 16-465(d)).

Enclosures: Drawing No. 1;
Proposed Cross Sections – Provided by Loris and Associates

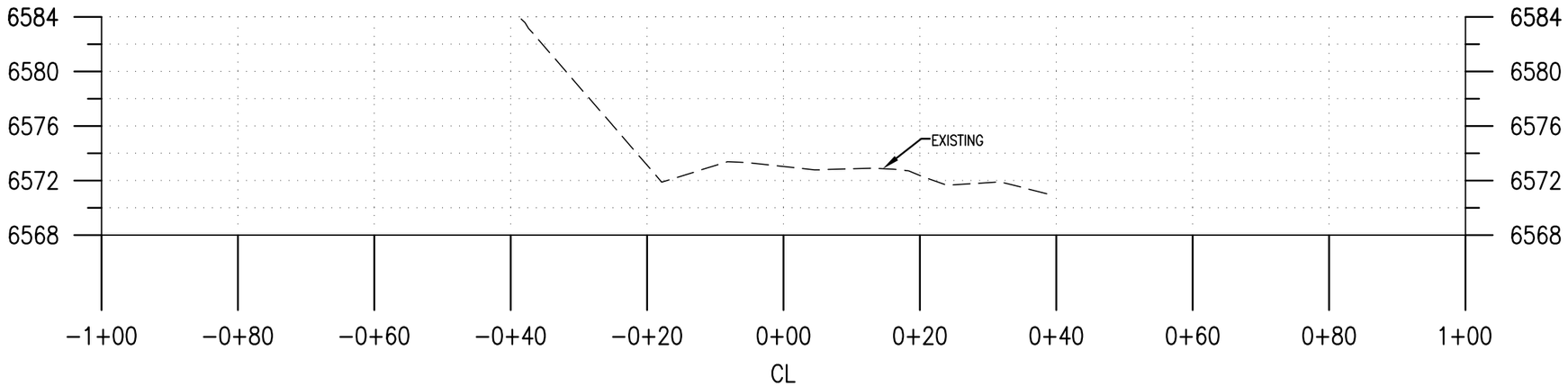


COLORADO REGISTERED
AARON KEITH ARNOLD
36602
3/4/09
PROFESSIONAL ENGINEER

TOWN OF BASALT LORIS AND ASSOCIATES	HYDRAULIC MODELING OF TWO RIVERS ROAD IMPS.	McLaughlin Water Engineers, Ltd. 2300 15th Street, Suite 220 Denver, Colorado 80202 T 303.964.3333 F 303.964.3355	1

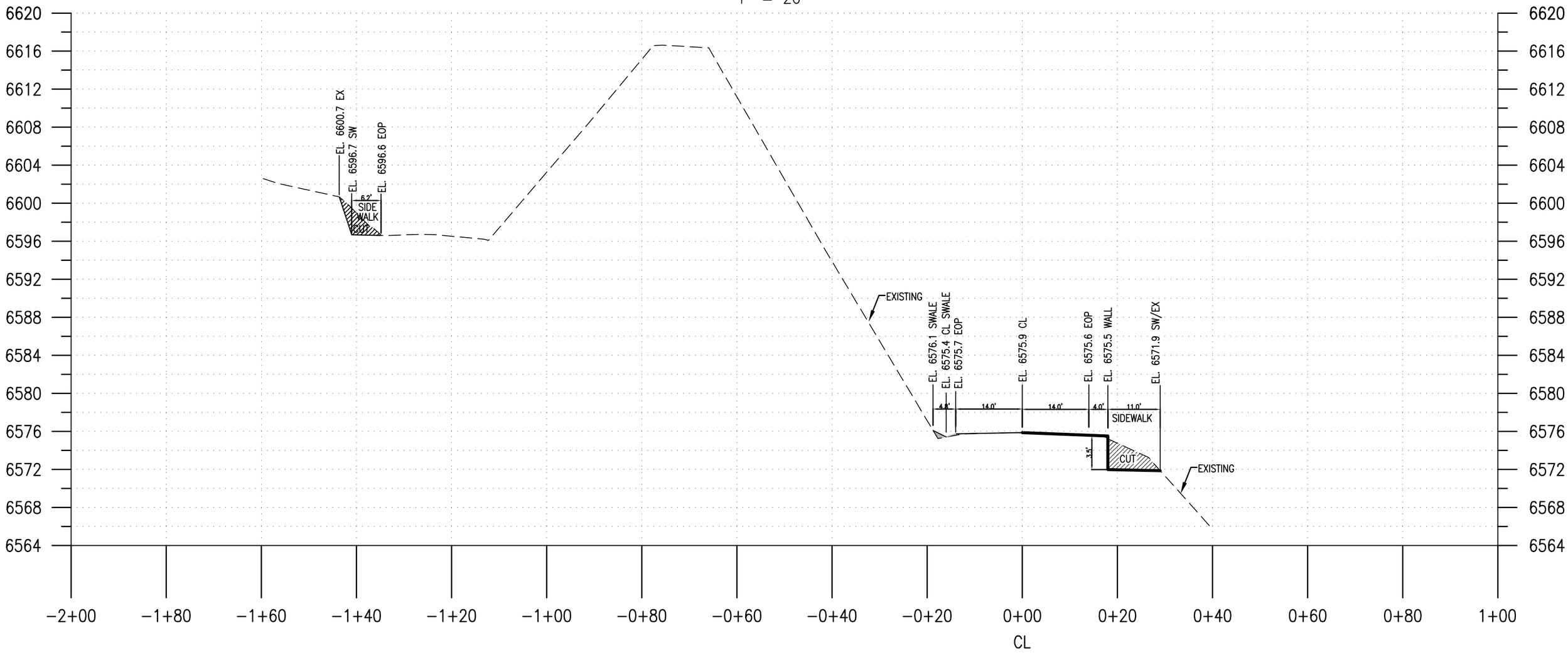
Hyd–71

STA. 90+58
SCALE: 1:1 HORIZ. 1:2 VERT.
1" = 20'



Hyd–72.5

STA. 94+36
SCALE: 1:1 HORIZ. 1:2 VERT.
1" = 20'

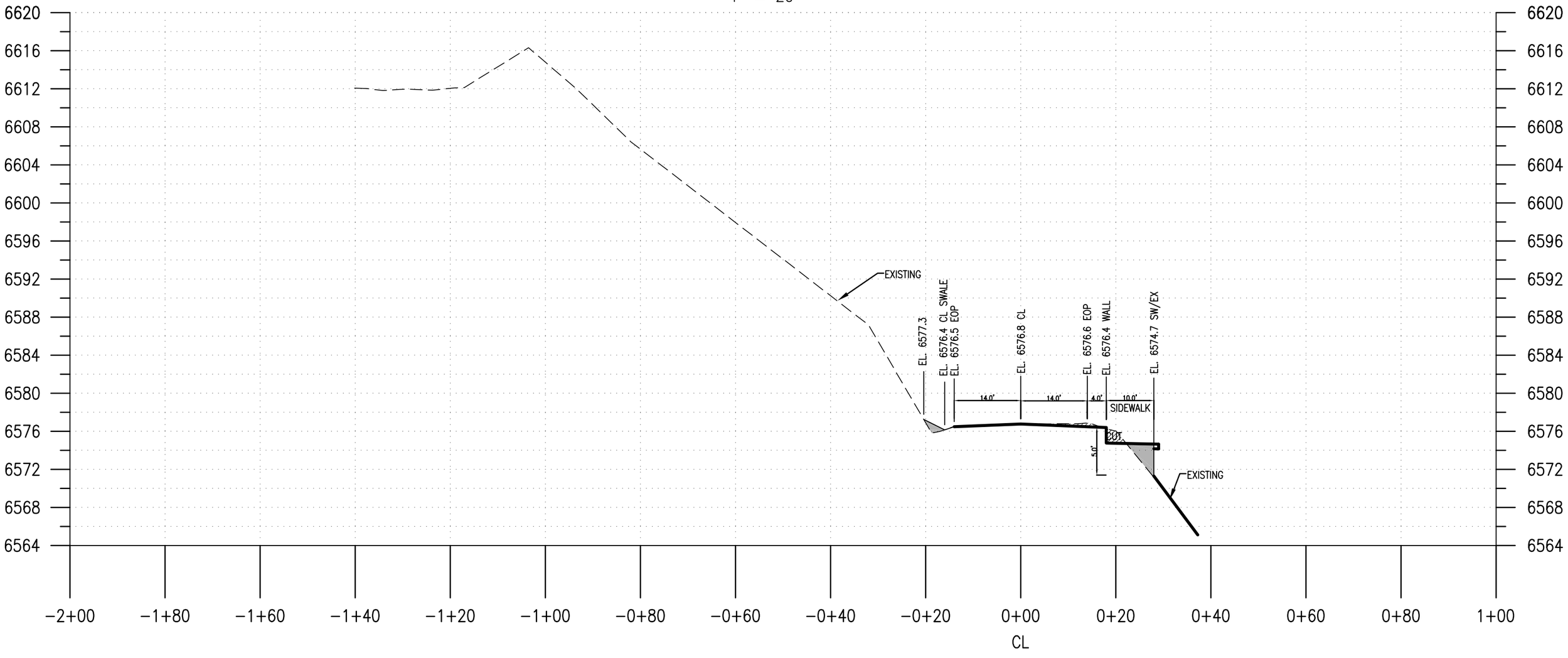


Hyd–73

STA. 96+07

SCALE: 1:1 HORIZ. 1:2 VERT.

1" = 20'

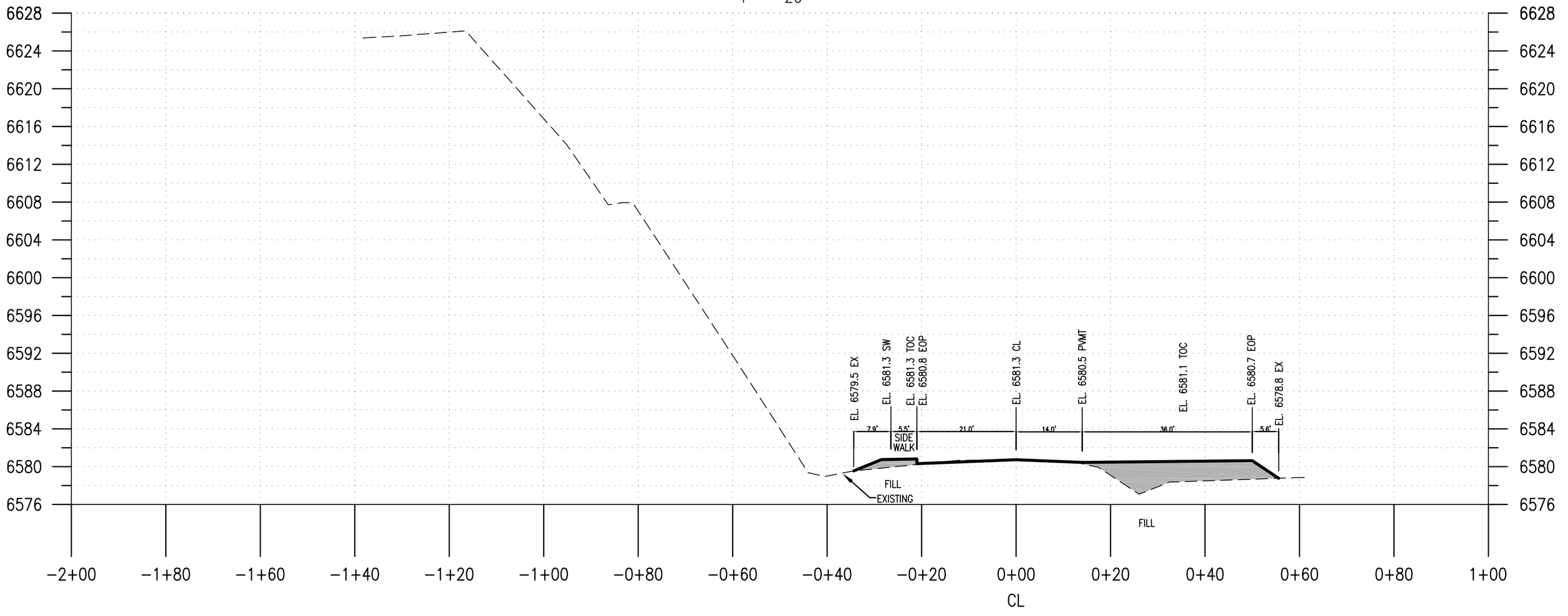


Hyd–75

STA. 102+55

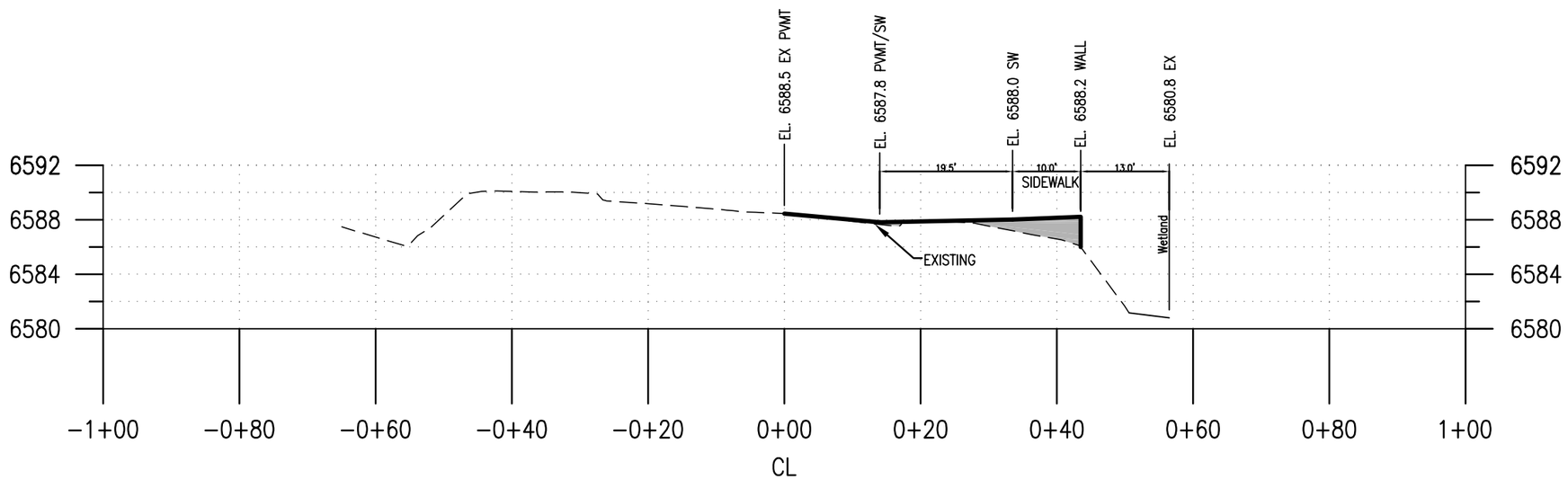
SCALE: 1:1 HORIZ. 1:2 VERT.

1" = 20'



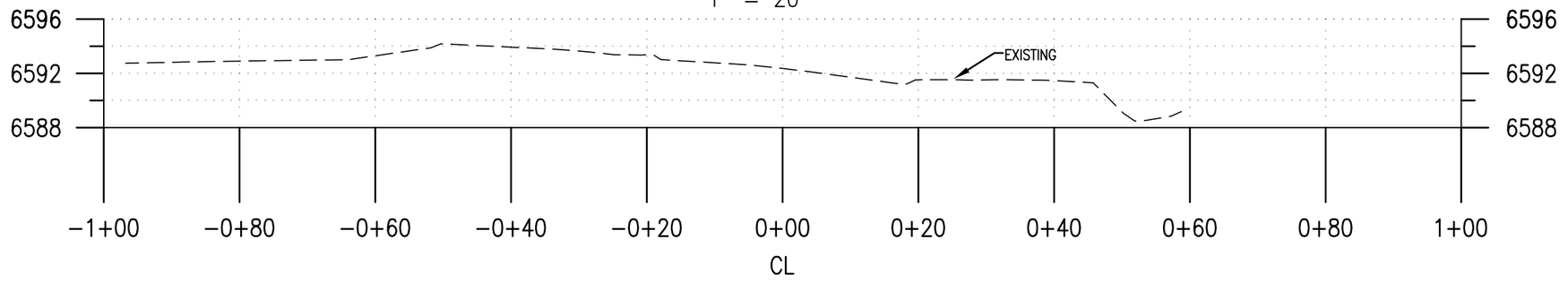
Hyd–76.1

STA. 108+82
SCALE: 1:1 HORIZ. 1:2 VERT.
1" = 20'



Hyd–76.2

STA. 111+85
SCALE: 1:1 HORIZ. 1:2 VERT.
1" = 20'



Two Rivers Greenway: Phase I

Environmental Findings

Ellsperman Ecological Services, LLC.

295 Escalante Road
Carbondale, Colorado 81623
(970)274-2171

March 16, 2009

Loris and Associates, Inc.
Attention: Kevin Dooley
2585 Trailridge Drive East
Lafayette, CO 80026

RE: Two Rivers Road Phase I

In order to provide the best recommendations for the Two Rivers Road Phase I Project, it was important to provide an accurate environmental analysis or "environmental picture" of the proposed activities within the project boundaries. This environmental analysis was completed by Ellsperman Ecological Services LLC as an integral part of a multi-faceted approach to ensure that environmental impacts to the proposed project would be considered in all aspects of design and planning. Several key arenas of environmental analysis and environmental design were completed as a portion of this project that included rapid wetland delineation, arboricultural conditions, storm water considerations, erosion control, wildlife concerns, environmental interpretation opportunities and restoration potential. As a portion of the planning and design for the Phase I portion of this project, each of these individual arenas were analyzed and incorporated into the design.

The project site, located on Two Rivers Road between Midland Avenue and the Old Pond Park Pedestrian Bridge, was analyzed during multiple field site visits during July, August, and September 2008. Additional environmental design analysis and associated recommendations occurred during the entire design and planning process for the project. Although ecological conditions throughout the entirety of Two Rivers Road vary widely, the Phase I envelope is heavily degraded and found directly adjacent to a highly modified transportation corridor. In fact, the Phase I Two Rivers Road Project provides an opportunity to significantly increase the health of the ecological conditions within this corridor including multiple opportunities for riparian restoration, storm water management, and other arenas.

This letter serves to provide an overview of activities completed within the context of environmental analysis for the project. Specific areas of environmental analysis are provided below, including an overview of activities specific to each area.

Rapid Wetland Delineation

A majority of the Two Rivers Road Phase I Project is located directly adjacent to waters that are both jurisdictionally and non-jurisdictionally regulated by the US Army Corp of Engineers. During the design process, it was critical that wetland zones that were potentially protected within the project boundaries were identified to ensure the best possible design alternatives. A rapid delineation of the entire project boundary was completed in order to provide the team with the best information about where wetland conflicts existed and how best to proceed with design. The entire corridor within Phase I was delineated and surveyed as an important tool to the design process. By utilizing these tools, the design team was able to better understand the conflicts and provide protection to these areas in every possible strategy. This delineation and associated design concepts are provided with the final design recommendations.

Arboricultural Resources

A complete survey of the arboricultural resources found within the project boundaries was provided to ensure that important community forestry resources within the project were identified and protected. In addition, specific arboricultural red flags such as hazard trees or future tree conflicts were surveyed in order to provide the design team with pertinent information about the proposed improvements. Although surveys of the corridor showed that there were not many arboricultural issues within the Phase I envelope, there were a number of trees which were identified as important for protection. These trees were identified in the field and via survey documentation and design alternatives were employed for their protection. In other cases, specific trees were identified as potentially hazardous and must be more fully explored for their hazard rating in following design phases for the project.

Stormwater Management

As a portion of the design, much attention was placed on proper stormwater management for the project. These protection measures were fundamental to the design process and as they relate to the environmental analysis of the site, opportunities and constraints of the stormwater plan were visited extensively by the team. Within the design, proper stormwater management was paramount to the planning process and multiple stormwater best management principles were applied. Specific stormwater improvements were identified as a portion of the process and were field verified for their applicability within the design. The protection of the ecology of the site was an important design consideration during this process and specific improvements in this important area are outlined on plan documentation.

Erosion Control

Similar to stormwater management, the entire project boundaries were surveyed for existing and potential new erosion control challenges. In order to provide a sustainable design, areas that exhibited erosion control problems or areas that were identified as future erosion control problems were addressed as a part of the project. Multiple best management strategies for dealing with erosion issues are documented as a portion of the design documentation.

Wildlife Concerns

In July, 2006, Wildlife Specialties, LLC, provided a report on potential wildlife concerns for the entire Two Rivers Road Corridor. In order to provide the design team with information critical to understanding these concerns, a review of this report and subsequent field investigation for the Phase I portion of the project was undertaken. Most of the information provided by Wildlife Concerns focused on less degraded portions of the Two Rivers Road Corridor, but where appropriate, a survey of the concerns was looked at carefully by the team including identifying Great Blue Heron nest sites, raptor surveys, and neotropical migrant bird species surveys. This field investigation included a review of all documentation contained within the reports and field visits to identify any potential conflicts. The proposed design for the Phase I portion of the project incorporated all findings into the documentation. More specific recommendations for future design and implementation of the project will be important and is outlined specifically in the Wildlife Specialties report.

Restoration

A key portion of the design concept for the project was to include future opportunities for riparian restoration of this important ecological corridor. Opportunities for significant restoration of many areas were identified and certainly will be an important portion of any project within the Two Rivers Road Corridor, based upon the proximity to critical resources and the current degraded conditions. Field investigations determined that the Phase I project boundaries are significantly degraded. This degradation is evidenced by the high level of noxious vegetation identified and the significant current erosion control and stormwater management issues within the Phase I portion of the project. Restoration concepts include significant eradication of noxious vegetation and restoration of appropriate riparian grasses, forbs, and woody vegetation.

Environmental Interpretation

A key concept in the design includes the ability to utilize the Two Rivers Corridor Phase I Project for significant interpretation of the local ecology and natural resources. Specific opportunities were discussed and sited in the design documentation. These opportunities were designed to be central in the planning process and were located and conceptualized to be in concert with the environmental mission of the community and to maximize the potential ability to interpret these important resources.

Please contact me if there are any questions related to this documentation or any of the ecological conditions which exist within the project boundaries.

Sincerely,

Stephen Ellsperman, Ellsperman Ecological Services LLC

Two Rivers Greenway: Phase I

Engineer's Opinion of Probable Construction Cost

L O R I S

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Mastering the Art of *Engineering Structures and Infrastructures*

Two Rivers Greenway - Phase 1

Conceptual Design

OPINION OF PROBABLE CONSTRUCTION COST

3/3/2009 KFD

In providing opinions of probable construction cost, the Client understands that Loris and Associates has no control over costs of the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinions of probable construction costs provided herein are to be made on the basis of our qualifications and experience. Loris and Associates make no warranty, expressed or implied, as to the accuracy of such opinions as compared to bid or actual costs.

ITEM	CONTRACT ITEM	UNIT	UNIT COST	Quantity	Total
201	CLEARING AND GRUBBING	LS	$50,000.00	1	$ 50,000
202	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	$50,000.00	1	$ 50,000
202	REMOVAL OF ASPHALT MATERIAL	SY	$20.00	1393	$ 27,860
202	REMOVAL OF CURB & GUTTER	LF	$15.00	340	$ 5,100
202	REMOVAL OF GAURDRAIL	LF	$10.00	630	$ 6,300
203	REMOVE & RESET BOULDER WALL	LS	$30,000.00	1	$ 30,000
203	UNCLASSIFIED EXCAVATION (CIP)	CY	$40.00	550	$ 22,000
203	EMBANKMENT MATERIAL (CIP)	CY	$40.00	2100	$ 84,000
206	STRUCTURE EXCAVATION	CY	$40.00	1812	$ 72,480
206	STRUCTURE BACKFILL (CLASS 1)	CY	$50.00	2037	$ 101,850
206	MECHANICAL REINFORCEMENT OF SOIL	CY	$60.00	650	$ 39,000
207	TOPSOIL	CY	$75.00	100	$ 7,500
208	EROSION LOG	LF	$7.50	300	$ 2,250
208	SILT FENCE	LF	$5.00	4500	$ 22,500
208	SEDIMENT REMOVAL AND DISPOSAL	LS	$7,500.00	1	$ 7,500
208	CONCRETE WASHOUT STRUCTURE	EA	$2,500.00	2	$ 5,000
208	STORM DRAIN INLET PROTECTION	EA	$150.00	25	$ 3,750
210	RESET SIGN	EA	$500.00	10	$ 5,000
212	SEEDING (NATIVE)	AC	$7,000.00	0.50	$ 3,500
214	LANDSCAPING (TREES)	EA	$750.00	36	$ 27,000
214	LANDSCAPING (SHRUBS)	EA	$65.00	577	$ 37,505
214	LANDSCAPING (IRRIGATION)	LS	$35,000.00	1	$ 35,000
214	LANDSCAPING (OTHER)	LS	$25,000.00	1	$ 25,000
216	BIORETENTION AREA	LS	$25,000.00	1	$ 25,000
304	AGGREGATE SUBBASE (CLASS 3) (7") (ROADWAY)	CY	$45.00	560	$ 25,200
304	AGGREGATE BASE COURSE (CLASS 6) (6") (ROADWAY)	CY	$35.00	475	$ 16,625
304	AGGREGATE BASE COURSE (CLASS 6) (6") (SIDEWALK)	CY	$35.00	510	$ 17,850
403	BITUMONOUS ASPHALT ROADWAY	TN	$100.00	1430	$ 143,000
406	MILL EXISITING ASPHALT (2" AVG. DEPTH)	SY	$15.00	7000	$ 105,000
504	BOULDER RETAINING WALL	SF	$40.00	775	$ 31,000
504	ROCK RETAINING WALL (DRAINAGE OUTFALL)	SF	$45.00	105	$ 4,725
504	MSE BLOCK FACING	SF	$50.00	3454	$ 172,700
504	TIEBACK ANCHORS	LF	$40.00	2640	$ 105,600
506	RIPRAP	CY	$200.00	110	$ 22,000
508	TREATED TIMBER BOARDWALK OVERLOOK	EA	$20,000.00	3	$ 60,000
514	PEDESTRIAN RAILING (STEEL)	LF	$200.00	1440	$ 288,000
601	CONCRETE CLASS B (MISC)	CY	$450.00	12	$ 5,400
601	CONCRETE CLASS D (WALL)	CY	$600.00	333	$ 199,800
602	REINFORCING STEEL (EPOXY COATED)	LB	$2.00	39916	$ 79,832
603	15" CMP	LF	$90.00	8	$ 720
603	18" RCP	LF	$125.00	302	$ 37,750
603	24" RCP	LF	$150.00	20	$ 3,000
603	15" STEEL END SECTION	EA	$600.00	1	$ 600
603	18" CONC. END SECTION	EA	$700.00	5	$ 3,500
603	18" STEEL END SECTION	EA	$400.00	4	$ 1,600
603	24" CONC. END SECTION	EA	$900.00	1	$ 900
604	CURB INLET (TYPE C)	EA	$3,600.00	7	$ 25,200
604	CURB INLET (SPECIAL SEDIMENT BASIN)	EA	$9,000.00	1	$ 9,000
604	DROP INLET (TYPE C)	EA	$3,200.00	5	$ 16,000
604	DROP INLET (SPECIAL DRAINAGE CONTROL STRUCTURE)	EA	$7,500.00	2	$ 15,000
606	GUARDRAIL (TYPE 3) (WALL MOUNTED)	LF	$35.00	527	$ 18,445
608	CONCRETE SIDEWALK (6")	SY	$60.00	2687	$ 161,220

L O R I S

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Two Rivers Greenway - Phase 1

Conceptual Design

OPINION OF PROBABLE CONSTRUCTION COST

3/3/2009 KFD

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608	CONCRETE SIDEWALK (6") (COLORED)	SY	$75.00	363	$ 27,225
608	ADA HANDICAPPED RAMP	EA	$500.00	25	$ 12,500
609	6" CURB (TYPE 2)	LF	$20.00	590	$ 11,800
609	1.5' CURB & GUTTER (TYPE 2)	LF	$25.00	402	$ 10,050
609	2.5' CURB & GUTTER (TYPE 2)	LF	$35.00	2948	$ 103,180
609	4' VALLEY GUTTER / DRAIN PAN	LF	$45.00	540	$ 24,300
610	DECORATIVE CONCRETE PAVERS	SF	$45.00	2300	$ 103,500
610	DECORATIVE ROCK HARDSCAPE ISLAND	SF	$50.00	900	$ 45,000
614	SIGN PANEL (CLASS I)	EA	$300.00	35	$ 10,500
625	CONSTRUCTION SURVEYING	LS	$40,000.00	1	$ 40,000
626	MOBILIZATION	LS	$100,000.00	1	$ 100,000
627	PAVEMENT STRIPING (THERMOPLASTIC)	LS	$38,000.00	1	$ 38,000
630	CONSTRUCTION TRAFFIC CONTROL	LS	$120,000.00	1	$ 120,000
	Subtotal of Bid Items				**$2,910,817**
	CONTINGENCY (MISC. ITEMS, UTILITY RELOCATIONS, CONSTRUCTION ENGINEERING, EASEMENT, LEGAL, ETC)	20%			$ 582,163
	TOTAL BID				**$3,492,980**

	ITEMS PROVIDED BY OWNER				
					$ -
	Subtotal of Items Provided by Owner				**$0**

	OTHER PROJECT COSTS				
	CONSULTANT DESIGN	7%			$ 244,509
	CONSTRUCTION MANAGEMENT	3%			$ 104,789
	CONSTRUCTION TESTING	0.5%			$ 17,465
	STAFF TIME				
	Subtotal of Other Project Costs				**$366,763**

	TOTAL PROJECT (2009)				**$3,859,743**

	TOTAL PROJECT (2010)	10%			**$4,245,717**

	TOTAL PROJECT (2011)	10%			**$4,670,289**