THE UNIVERSITY OF IOWA
IOWA INITIATIVE
FOR SUSTAINABLE COMMUNITIES

FINAL DELIVERABLE

Title	Volga River Trail Development
Completed By	Jack Crothers, Justin Thiemann, Sarah Ritchie, Taylor Garcia
Date Completed	May 2020
UI Department	Department of Civil & Environmental Engineering
Course Name	CEE:4850:0001 Project Design & Management
Instructor	Rick Fosse
Community Partners	City of Volga

This project was supported by the Iowa Initiative for Sustainable Communities (IISC), a community engagement program at the University of Iowa. IISC partners with rural and urban communities across the state to develop projects that university students and IISC pursues a dual mission of enhancing quality of life in Iowa while transforming teaching and learning at the University of Iowa.

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UNIVERSITY OF IOWA DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING Project Design & Management (CEE:4850:0001)

Rural Trail

Trail Committee, Volga IA

TopTier Design Engineers

Jack Crothers, Justin Thiemann, Sarah Ritchie, Taylor Garcia

Section I: Executive Summary

The objective of this project is to provide an ADA compliant trail that connects the city of Volga, Iowa to the Clayton County Conservation Office. The trail will closely follow the path of the Volga River's banks, providing the users of the trail with views of the scenery. Outlook points with benches and shade will be placed periodically to allow the users to rest if needed. The trail will be able to accommodate multiple modes of transportation such as bicycles, motorbikes, UTVs, and horses. We will propose handrails and signage throughout the trail to keep the safety of the trail user in best interest. There will be culverts designed for the streams on both the north and south side of the Volga River.

We have designed two alternative routes for the trail, one that follows the north banks of the river and another that follows the south banks. The trail can be constructed as paved or gravel. The trailhead locations of both alternatives are at the Volga Campgrounds and Clayton County Conservation Center.

The north and south route are 8.07 miles and 8.34 miles in length, respectively. The trail consists of 6" of crushed limestone with fines that may act as a subbase or gravel path. In the future, the trail may be upgraded by installing 5" of P.C.C. pavement or 4" of asphalt pavement. Handrails are to be installed in areas where there is a steep transverse slope to minimize accidents. The handrails are pressure-treated pine that will resist weathering and decay. Mile markers are placed throughout the trail to indicate to the users how long they have travelled. There is one outlook point designed near the halfway point of each alternative, which will provide shade and seating to the users. Due to the Volga River being prone to flooding, erosion control measures have been incorporated into the design of the trail. Turf reinforcement mats are to be installed in areas that have a high scouring potential, reducing the likelihood of the trail getting washed out. Both alternatives have multiple streams that the trail must cross. Therefore, culverts were designed to allow proper crossing. In areas where culverts were not a viable option, prefabricated bridges by Wheeler Bridge are recommended. The north route requires four culverts and two prefabricated bridges, and the South route requires two culverts and two prefabricated bridges.

The base preliminary cost estimate is $1,256,500 for the north route and $967,500 for the south route. This estimate is for a gravel path with handrails, turf reinforcement mats, culverts, and bridges. Paving the trail with P.C.C. would add an additional cost of $293,500 to the north route and $305,500 to the south route. Alternatively, paving the trail with asphalt would add an additional cost of $150,000 to the north route and $156,000 to the south route.

Our firm would recommend constructing the South Trail with a paved asphalt surface. The South Trail costs significantly less due to it being able to match the existing contours much better than the North Trail. We would also recommend splitting the construction into phases, initially starting with a gravel path and then, later, paving the surface. This will reduce the upfront costs and spread the total cost out.

Section II: Organization Qualifications

1. Name of Organization

TopTier Design Engineers

2. Organization Location and Contact Info

Jack Crothers (Project Manager)
Email: jack-crothers@uiowa.edu

3. Organization and Design Team Description

Jack Crothers is a 4th year civil engineering student at the University of Iowa with a Civil Practice focus area. He is the project manager and the main point of contact with the client. He also did the culvert designs for the streams on the north and south side of the Volga River.

Taylor Garcia is a 4th year civil engineering student at the University of Iowa with a focus area in Civil Practice. She designed the bridge abutments and helped with the trail design in Civil 3D.

Justin Thiemann is a 4th year civil engineering student at The University of Iowa with a focus area in management. He worked on the trail design, created the detailed drawings as well as the outlook points.

Sarah Ritchie is a 5th year civil engineering student at the University of Iowa with a focus in Civil Practice. She created the cost estimations for the north and south routes for the trail.

Section III: Design Services

1. Project Scope

The objective of this project is to provide an ADA compliant trail that connects the city of Volga, Iowa to the Clayton County Conservation Office. The trail will closely follow the path of the Volga River's banks, providing the users of the trail with views of the scenery. An outlook point with benches and shade will be placed near the halfway point to allow the users to rest if needed. The trail will be able to accommodate multiple modes of transportation such as bicycles, motorbikes, UTVs, and horses. We will propose handrails and signage throughout the trail to keep the safety of the trail user in best interest. There will be culverts designed for the streams on both the north and south sides of the Volga River.

2. Work Plan

Volga Trail

TopTier Design Engineers:
Jack Crothers, Justin Thiemann,
Taylor Garcia & Sarah Ritchie

Project Start: Mon, 2/10/2020
Display Week: 1

TASK	LED BY	PROGRESS	START	END
Trail Design	Justin & Taylor			
Gather GIS Data		100%	2/10/20	2/20/20
Locate Trailhead Locations		100%	2/20/20	3/1/20
Complete Three Alternative Routes		100%	3/1/20	3/11/20
Complete Decision Matrix		100%	3/11/20	3/21/20
Create Corridor and Surfaces		100%	3/21/20	4/5/20
Design Handrails, Mile Markers, and Erosion Control		100%	4/5/20	4/17/20
Design Outlook Points		25%	4/17/20	4/24/20
Culvert Design and Flood Analysis	Jack			
Gather Stream Data		100%	3/11/20	3/21/20
Determine Culvert Length		100%	3/21/20	3/28/20
Calculate Flows		100%	3/28/20	4/10/20
Determine Culvert Sizes		100%	4/10/20	4/17/20
Contact Bridge Manufacturer		100%	3/21/20	4/5/20
Cost Estimation	Sarah			
Find Detail Prices		100%	3/11/20	3/21/20
Separate Prices into Categories		100%	3/21/20	3/31/20
Gather Material Volumes		100%	3/31/20	4/12/20
Tabulate Costs		100%	4/12/20	4/17/20
Deliverables Preparation and Revisions				
Drawing Sets	Justin	50%	4/10/20	5/8/20
Report	Jack	50%	4/10/20	5/8/20
Presentation Slides	Taylor	50%	4/15/20	5/8/20
Poster	Sarah	50%	4/15/20	5/8/20
Revisions	All	0%	4/20/20	5/8/20

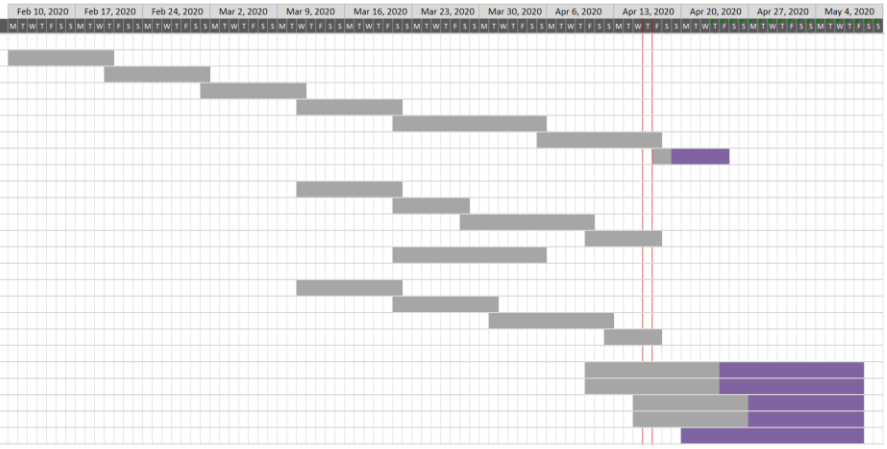


Figure 1: Work plan

Section IV: Constraints, Challenges, and Impacts

1. Constraints

The project location requires the number of possible routes to be limited due to the meandering of the Volga River on the north end of the trail and the private property on the south end. The grading of the trail must comply with ADA standards, which limits the routes near steep inclines.

2. Challenges

Since the location of the trail is near a river, flooding must be taken into consideration during the design process. Additionally, some areas around the river are wetlands, which require special design specifications. Steep changes in elevations will have to be overcome through proper route design while also attempting to minimize the cut and fill for the projects and abide ADA standards. There are numerous streams leading out of the Volga River on the north and south sides. There are some streams too wide that a culvert would not be sufficient, and a bridge would be necessary. The possible trailhead locations may rely on the reconstruction of a pedestrian bridge. On the South side of the Volga River, there is a property owner who may cause problems with the eventual construction of the trail.

3. Societal Impacts within the community and/or state of Iowa

With the addition of the trail, the Volga River would be much easier to reach for the community. It would promote travel between Volga and Osborne and encourage healthy leisure and transport opportunities. It will provide people of all ages with an attractive, secure, and non-expensive place to go walking, jogging, biking, or canoeing. In addition, the future for this trail includes connecting it to larger state trails across Iowa.

The construction of the trail would require easements on private property. This may be unwelcomed by some property owners who want control over the entirety of their land. At certain locations of the trail, easements are located at the edge of agricultural fields, reducing crop yield for the affected farmers.

Since much of the land used for the route is within forested areas, the removal of trees and other vegetation is necessary to construct the trail. This may cause slight negative impacts on the environment.

Section V: Proffer of Alternative Solutions

We designed the trail with the three following materials: PCC, asphalt, and gravel. The hard surfaces – PCC and asphalt pavement – is more expensive but preferable if the traffic on the trail is mainly those walking and riding bicycles, whereas the soft surfaces such as gravel will be less expensive and preferable for those riding on horseback or off-road vehicles.

There are two completely designed trails on the north and the south side of the Volga River with different start/end locations. It will be up to the client to choose which trail they will desire once the full cost and overall attractiveness of the trail is considered.

There are seven stream crossings on the north side of the Volga River and 5 stream crossings on the south side. At certain points along the trail, a field verification is necessary because the location in question may just be a drainage ditch. Where the stream crossing was too wide or the flow of the stream was too strong, a prefabricated bridge was recommended. A culvert was recommended with specific culvert dimensions for the other streams.

Section VI: Final Design Details

The design of the trail follows the standards of the Iowa DOT Design Manual, Iowa Statewide Urban Design and Specifications (SUDAS), the US Department of Transportation, and the ADA Accessibility Guidelines to ensure the safety, durability, and accessibility of the trail. The site plan, corridor, cross section, handrails, and mile markers were designed with Civil3D. The volume calculations were designed using Civil 3D. The hydrology of the streams was measured using Hydraflow within Civil 3D.

North Trail Site Plan

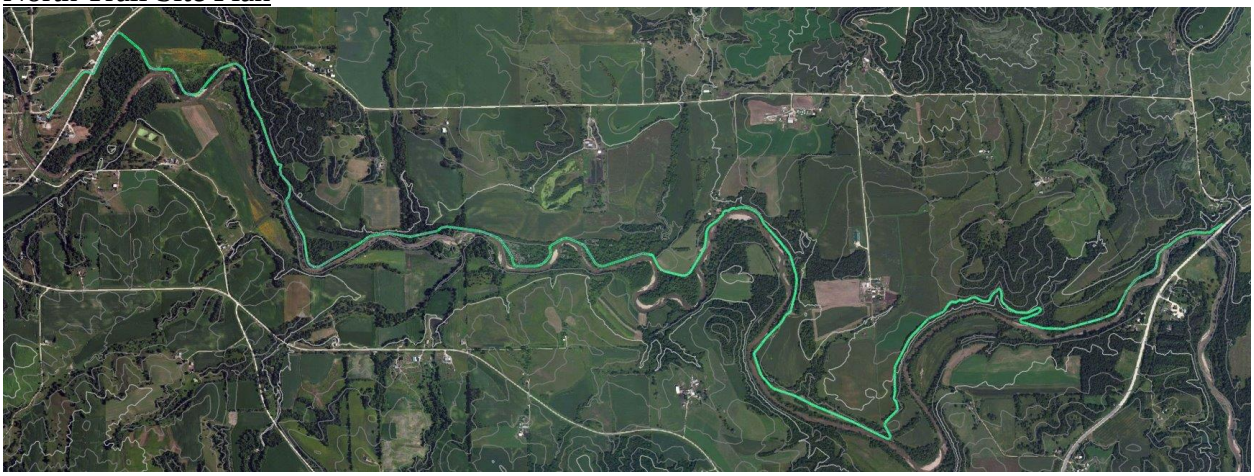


Figure 2: North Trail site plan

South Trail Site Plan

Figure 3: South Trail site plan

Length, Elevation, and Design Data:

Table 1: Tabulation of length, elevation, and design data

Trail	**North**		**South**	
Length	**Feet**	**Miles**	**Feet**	**Miles**
Length	42,585	8.07	44,020	8.34
Elevation	**Feet**		**Feet**	
Start Elevation	790.0		794.1	
End Elevation	759.9		782.0	
Maximum Elevation	837.0		845.5	
Minimum Elevation	746.3		746.4	
Design Data	**North & South**			
Minimum Radius of Curvature	30 ft			
Maximum Grade	5.00%			
Minimum K-Value (Sag Curve)	10			
Minimum K-Value (Crest Curve)	3			
Maximum Design Speed	15 mph			
Right of Way Width	30 ft			

Cross Section:

The paved cross section consists of pavement, subgrade, buffers, and cut and fill. The pavement and subgrade are ten feet wide and have a 1.5% cross-slope sloping down towards the Volga river. The pavement consists of either P.C.C. or asphalt. The thickness for the P.C.C. pavement is five inches and the thickness for the asphalt pavement is four inches. The subgrade consists of crushed limestone with fines and is six inches thick. There is a two-foot buffer past both sides of the edge of pavement with a –2.0% cross slope from the centerline. The cut and fill slopes have a max slope of 3:1. A detail of the cross-section is provided in Figure 4.

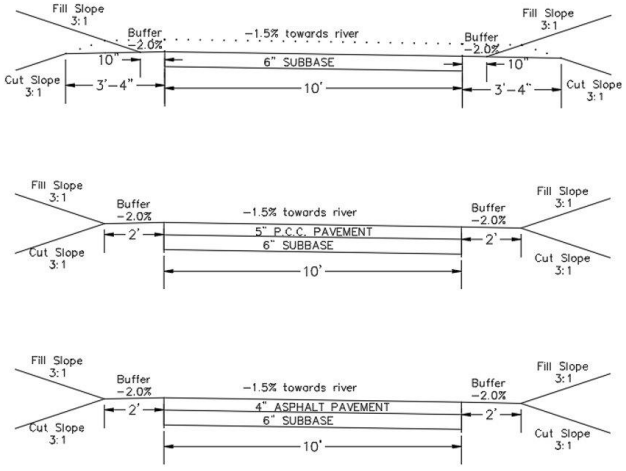


Figure 4: Gravel and paved cross section details

Handrails:

Handrails are provided along steep transverse slopes on the trail to provide safety to its users. The material used for the handrails is pressure-treated pine to prevent weathering and decay and provide an economic solution to prevent accidents on the trail. The handrails are three feet in height and located six inches off the edge of pavement. A detail of the handrails is provided in Figure 5, and the handrail placement locations are provided in Table 2.

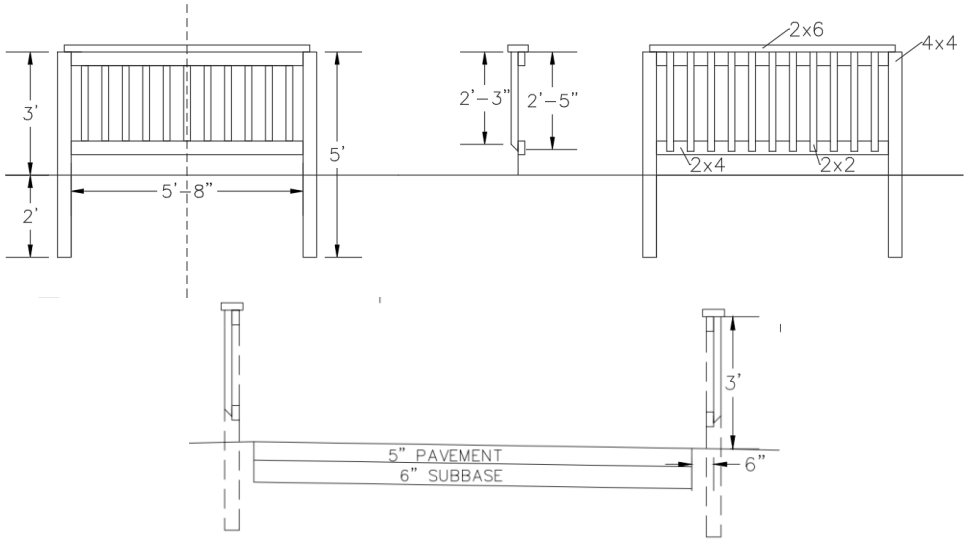


Figure 5: Handrail detail

Table 2: Handrail placement locations

Section	North			South		
	Start Station	End Station	Side of Pavement	Start Station	End Station	Side of Pavement
1	64+50	92+60	Right	114+50	127+00	Left
2	124+50	127+50	Right	174+75	202+25	Left
3	219+00	240+00	Right	230+00	249+00	Left
4	298+00	305+00	Right	265+25	249+00	Left
5	312+50	372+00	Right	265+25	298+00	Left
6	410+00	422+00	Right	407+50	424+00	Left

Mile Markers:

Mile markers are placed along the trail at various points to indicate the distance travel by its users. The posts are six-foot long galvanized 1.12 lbs/ft U-channel signposts buried two feet in the ground. The signs are 6” x 6” custom aluminum sheet metal signs attach to the signpost using two 3/8” diameter stainless steel hex head cap screws. A detail of the mile markers is provided in Figure 6, and the mile marker placement locations are provided in Table 3.

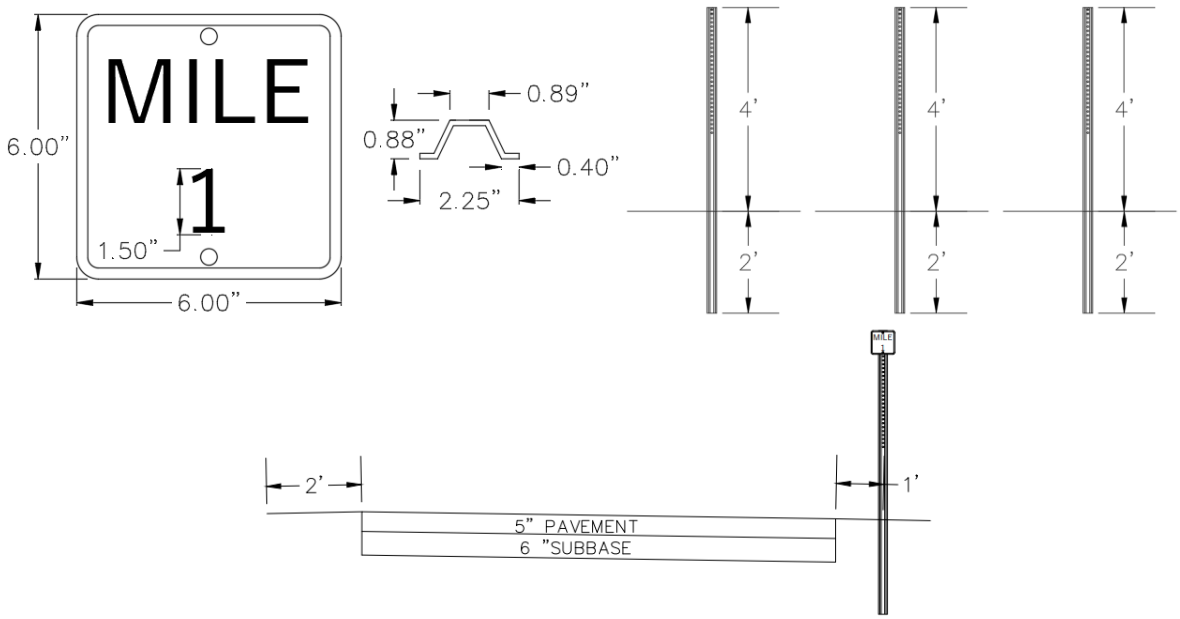


Figure 6: Mile marker detail

Table 3: Mile marker placement locations

Mile Marker	North		South	
	Station	Side of Pavement	Station	Side of Pavement
8 (West)	3+10	Left	17+60	Left
1 (East)	52+80	Right	52+80	Right
7 (West)	55+90	Left	70+40	Left
2 (East)	105+60	Right	105+60	Right
6 (West)	108+70	Left	123+20	Left
3 (East)	158+40	Right	158+40	Right
5 (West)	161+50	Left	176+00	Left
4 (East)	211+20	Right	211+20	Right
4 (West)	214+30	Left	228+80	Left
5 (East)	264+00	Right	264+00	Right
3 (West)	267+10	Left	281+60	Left
6 (East)	316+80	Right	316+80	Right
2 (West)	319+90	Left	334+40	Left
7 (East)	369+60	Right	369+60	Right
1 (West)	372+70	Left	387+20	Left
8 (East)	422+40	Right	422+40	Right

Outlook Points:

One outlook point was designed for each alternative route. Each outlook point is placed near the halfway point of its respective route and will provide shade and seating to the trail's users. The design includes and 15' x 15' paved patio located directly off the trail's edge of pavement towards the river. The patio is designed to fit Yardistry's 11' x 13' Carolina Pavilion. The pavilion covers enough area to fit two benches and one picnic table under its roof. The detail of the outlook point is provided in Figure 7.

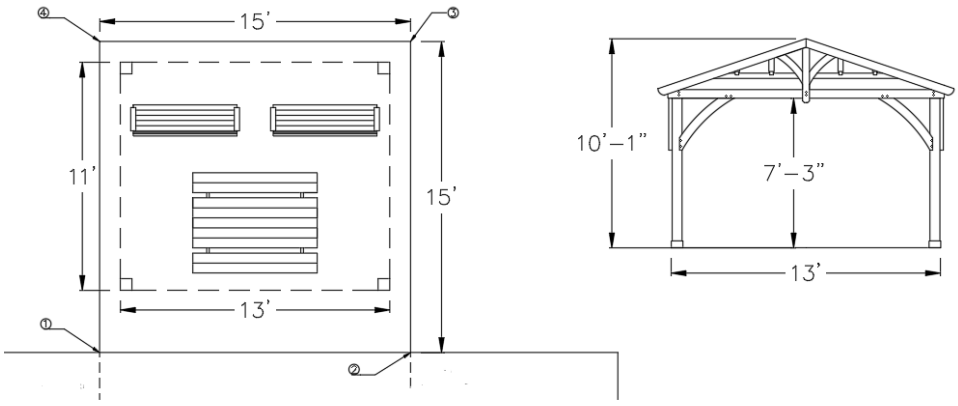


Figure 7: Outlook point detail

Total Material Volumes:

The trail was designed to closely match the existing elevations of the land to minimize the total cut and fill volumes as well as the net cut/fill. Table 4 provides the volumes of the total cut and fill volumes and the total pavement and subgrade volumes required to construct each alternative.

Table 4: Total material volumes

Material	North Trail	South Trail
Cut (cy)	15,525	19,735
Fill (cy)	15,533	19,226
Pavement (cy)	6,520	6,781
Subgrade(cy)	6,114	8,137

Erosion Control:

Due to the Volga River's high potential of flooding, mitigation measures are included in the design to protect the trail from scouring. Turf reinforcement mats are to be placed in areas along the trail where there is high scouring potential. The mats shall meet or exceed the specifications of the Low & Bonar EnkaMat 7010. The mats are designed to four feet wide and placed past both edges of pavement, covering the two-foot buffer and into the daylighting. The turf reinforcement mat placement locations are provided in Table 5.

Table 5: Turf reinforcement mat placement locations

Section	North		South	
	Start Station	End Station	Start Station	End Station
1	35+00	58+00	0+00	14+00
2	94+00	193+00	34+00	47+00
3	295+00	305+00	90+00	110+00
4	371+00	396+00	150+00	157+00
5	422+00	425+00	303+00	327+00

North Trail Culvert Data:

For each stream, we used the USGS Stream Stats to find the minimum and peak flow for each stream crossing. Once the flows were found, Hydraflow Express on Civil 3D was used to design each respective culvert. Each stream was either provided with a recommended standard culvert size from the "Single precast reinforced concrete box culvert standards" from the Iowa DOT Design Manual. Each stream is labeled with the following: station of the start/end of the culvert, the flood basin analyzed through USGS Stream Stats, the values used in launch express to design the culvert for a 2 year minimum flow and 100 year maximum flow, the plot and values of the culvert during a 2-year flow (minimum flow), and the number of culverts/recommended sizing. All the stream calculations and supporting material is displayed in Appendix A for the North Trail stream crossings. Table 6 below summarizes the culvert calculations for the north stream crossings. The streams that were too large or had too strong of flow were assigned with recommended prefabricated bridges from Wheeler Bridge, a bridge manufacturer located in Saint Paul, Minnesota. The cost provided includes the shipping of the bridges, but an outside contractor will need to be used for installation. The 130' bridge would ship as two pieces requiring one field splice. The 200' bridge would ship as four pieces requiring three field splices. A field splice is used to connect two or more truss sections into one. We would recommend the crane and installation equipment to enter the trail on the Clayton County Conservation Center end due to more room and less traffic in the area. The North Trail stream crossings had one 50-foot prefabricated bridge and one 130-foot prefabricated bridge. At certain points along the trail, a field verification is necessary because the location in question may just be a drainage ditch.

Table 6: Stream crossing data for North Trail

Stream #	Station	Min Flow Rate (cfs)	Max Flow Rate (cfs)	Proposed
Stream #1 (Pine Creek)	STA 58+73 to STA 59+90	579 cfs	4480 cfs	Pre Fab Bridge #1
Stream #2	STA 134+66.50 to STA 135+14.50	193 cfs	1690 cfs	4 - 12 foot by 4 foot RCB culverts
Stream #3*	STA 153+00 (Rough)	13.4 cfs	68 cfs	—
Stream #4	STA 195+74 to STA 196+24	185 cfs	1640 cfs	Pre Fab Bridge #2 (50 foot)
Stream #5	STA 244+05 to STA 244+45	119 cfs	1150 cfs	4 - 10 foot by 4 foot RCB culverts
Stream #6	STA 281+62 to STA 282+10	108 cfs	719 cfs	4 - 12 foot by 4 foot RCB culverts
Stream #7	STA 378+25 to STA 378+73	171 cfs	1260 cfs	4 - 12 foot by 4 foot RCB culverts

*Field Verification is necessary because this may just be a drainage ditch.

South Trail Culvert Data:

For each stream, we used the USGS Stream Stats to find the minimum and peak flow for each stream crossing. Once the flows were found, Hydraflow Express on Civil 3D was used to design each respective culvert. Each stream was either provided with a recommended standard culvert size from the Single precast reinforced concrete box culvert standards from the Iowa DOT Design Manual. Each stream is labeled with the following: station of the start/end of the culvert, the flood basin analyzed through USGS Stream Stats, the values used in launch express to design the culvert for a 2 year minimum flow and 100 year maximum flow, the plot and values of the culvert during a 2-year flow (minimum flow), and the number of culverts/recommended sizing. All the stream calculations and supporting material is displayed in Appendix A for the South Trail stream crossings. Table 7 below summarizes the culvert calculations for the South stream crossings. The streams that were too large or had too strong of flow were assigned with recommended prefabricated bridges from Wheeler. The South Trail stream crossings had two recommended prefabricated bridges of 50 feet. At certain points along the trail, a field verification is necessary because the location in question may just be a drainage ditch.

Table 7: Stream crossing data for South Trail

Stream #	Station	Min Flow Rate (cfs)	Max Flow Rate (cfs)	Proposed
Stream #1	STA 30+95.00 to 31+45.00	541 cfs	4040 cfs	Pre Fab Bridge #2
Stream #2	STA 101+55.00 to STA 101+85.00	121cfs	835 cfs	3 – 10 foot by 4 RCB Culverts
Stream #3 (Hewitt Creek)	STA 153+70 to STA 154+20	893 cfs	6620 cfs	Pre Fab Bridge #2 (50 feet)
Stream #4*	STA 168+50 to STA 170+00 (Rough)	24.2 cfs	123 cfs	—
Stream #5	STA 225+21.00 to STA 225+53.00	145 cfs	1080 cfs	4 - 8 foot by 4 foot RCB culverts

*Field Verification is necessary because this may just be a drainage ditch.

130 ft Bridge Abutment

Using ACI 318-02 calculations, the dimensions of the abutment was designed. A spreadsheet was provided to us that contains the calculations for a retaining wall per linear foot, as seen in Figure 11 in Appendix C. However, we had to add the weight of the bridge and an AASHTO – H5 type vehicle, which is 10,000 lbs. The spreadsheet did not allow for adding additional vertical forces, so we had to hand calculate the extra forces effects on the abutment. We took that weight, converted to kip, and then divided by 10ft, which is the width of our bridge. This was done in a separate spreadsheet as seen in Table 13 of Appendix C. After these calculations were completed, the final dimensions of the abutment are shown below in Figure 9.

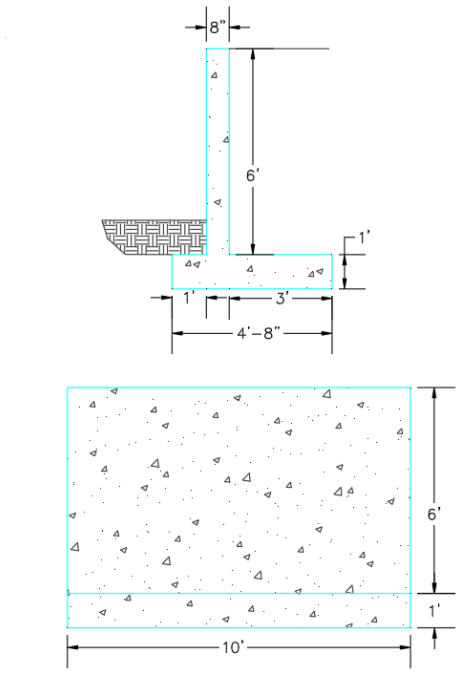


Figure 9: 130 ft bridge abutment

50 ft Bridge Abutment

A similar approach was used for the 50 ft bridge abutments. We took the weight of the bridge plus the AASHTO – H5 vehicle and added it to the existing calculations. The new dimension size can be seen in Table 14 in Appendix C. Below is the dimensions of the abutment.

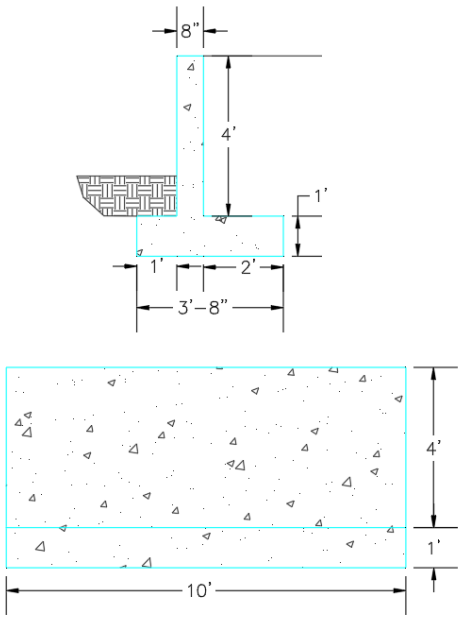


Figure 10: 50 ft bridge abutment

Section VII: Engineer's Cost Estimate

The cost estimations are split up into two parts: The trail base, and any additional items. The base of the trail only includes the 6-inch crushed limestone subbase and any required materials. The North Trail base cost estimation summary is shown in Table 8**.** There is an additional 10% contingency cost to account for anything that was missed. Furthermore, there is a 3% administrative cost for any additional engineering that might be needed. The total for the base of the North Trail comes out to be about $1,256,500.00. Similarly, the cost estimation summary of South Trail base is shown in Table 9 with a total of $967,500.00. The detailed preliminary cost estimation for the North Trail base and South Trail base are shown in Table 15 and Table 16 in Appendix D respectfully.

Table 8: Summary of the preliminary cost estimation for the North Trail base

ITEM	PRICE
EARTHWORK	$315,600
TRAFFIC CONTROL	$3,745
SITE WORK AND LANDSCAPING	$145,153
CULVERTS AND BRIDGES	$454,600
MISCELLANEOUS	$193,000
CONSTRUCTION SUBTOTAL:	$1,112,098
10% CONTINGENCY:	$111,210
ADMINISTRATIVE COST:	$33,363
TOTAL PROJECT COST:	$1,256,500

Table 9: Summary of preliminary cost estimation for the South Trail base

ITEM	PRICE
EARTHWORK	$390,600
TRAFFIC CONTROL	$3,745
SITE WORK AND LANDSCAPING	$90,822
CULVERTS AND BRIDGES	$171,500
MISCELLANEOUS	$199,500
CONSTRUCTION SUBTOTAL:	$856,167
10% CONTINGENCY:	$85,617
ADMINISTRATIVE COST:	$25,686
TOTAL PROJECT COST:	$967,500

The summary cost estimations for additional items are shown in Table 10 for the North Trail and in Table 11 for the South Trail. The additional items include the alternative types of pavement considered, mileage signs, benches, picnic tables and pavilions. The detailed cost estimations for the additional items for the North and South Trail are shown in tables 17 and 18 in Appendix D respectively. The majority of the cost estimations were determined using the Iowa DOT bid tabs and RSMeans data. All the prices have taken inflation into account.

Table 10: Summary cost estimation for additional North Trail items

ITEM	PRICE
5" PCC PAVEMENT	$293,500
4" ASPHALT PAVEMENT	$150,000
TRAFFIC CONTROL	$660
MISCELLANEOUS	$2,825

Table 11: Summary cost estimation for additional South Trail items

ITEM	PRICE
5" PCC PAVEMENT	$305,500
4" ASPHALT PAVEMENT	$156,000
TRAFFIC CONTROL	$660
MISCELLANEOUS	$2,825

Section VIII: Proposal Attachments

1. **Appendix A – North Stream Crossings**
2. **Appendix B – South Stream Crossings**
3. **Appendix C – Bridge Abutment Design**
4. **Appendix D – Detailed Cost Estimations**
5. **Appendix E – Bibliography**

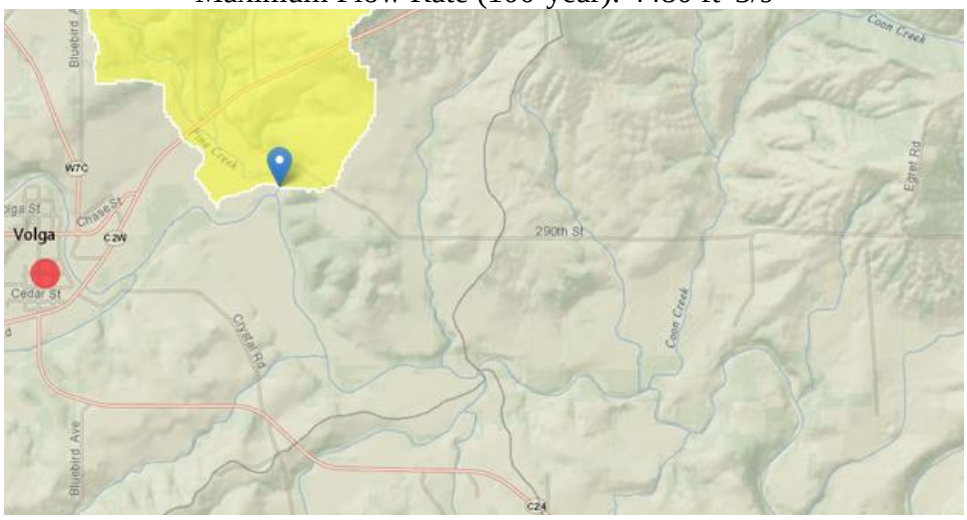
Appendix A – North Stream Crossings

Table 11: Stream crossing data for North Trail

Stream #	Station	Min Flow Rate (cfs)	Max Flow Rate (cfs)	Proposed
Stream #1 (Pine Creek)	STA 58+73 to STA 59+90	579 cfs	4480 cfs	Pre Fab Bridge #1
Stream #2	STA 134+66.50 to STA 135+14.50	193 cfs	1690 cfs	4 - 12 foot by 4 foot RCB culverts
Stream #3*	STA 153+00 (Rough)	13.4 cfs	68 cfs	—
Stream #4	STA 195+74 to STA 196+24	185 cfs	1640 cfs	Pre Fab Bridge #2 (50 foot)
Stream #5	STA 244+05 to STA 244+45	119 cfs	1150 cfs	4 - 10 foot by 4 foot RCB culverts
Stream #6	STA 281+62 to STA 282+10	108 cfs	719 cfs	4 - 12 foot by 4 foot RCB culverts
Stream #7	STA 378+25 to STA 378+73	171 cfs	1260 cfs	4 - 12 foot by 4 foot RCB culverts

*Field Verification is necessary because this may just be a drainage ditch.

Stream #1:
STA 58+73 to STA 59+90
Pre Fab Bridge #1 (130 feet)
Minimum Flow Rate (2-year): 579 ft^3/s
Maximum Flow Rate (100-year): 4480 ft^3/s



STEEL RECREATION BRIDGE ESTIMATE

4/14/2020

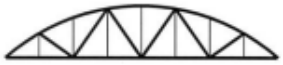
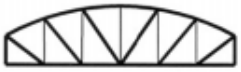
T21672A

Customer:
University of Iowa
Jack Crothers
ph#847-337-5046 / jack-crothers@uiowa.edu

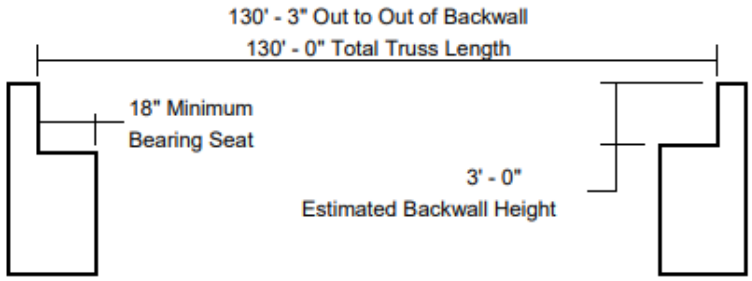
Project:
Pedestrian Bridge
Volga Trail
Volga, IA

Wheeler

Wheeler Lumber LLC | PH 952-929-7854
9531 West 78th Street | Eden Prairie, MN 55344
#N/A
#N/A

[X]  **Parallel**	[ ]  **Bowstring**	[ ]  **Modified**

Bridge Geometry:



Bridge Geometry is for estimating purposes only and may not represent final bridge configuration.

Bridge Span:	130' - 0"	**Live Load:**	90#	**Field Splices:**	1
Bridge Width:	10' - 0"	**Vehicle Load:**	AASHTO - H5	**Number of Pieces:**	2
Truss Type:	Parallel	**Finish:**	Weathering	**Lifting Weight:**	64,350 lbs
Diagonal:	Pratt	**Railing Config:**	Horizontal - 54" w/ Ipe Rubrail	**Opening:**	4" Max
Decking Type	Treated Timber				

Total Bridge Price: **$125,000.00**

Notes:

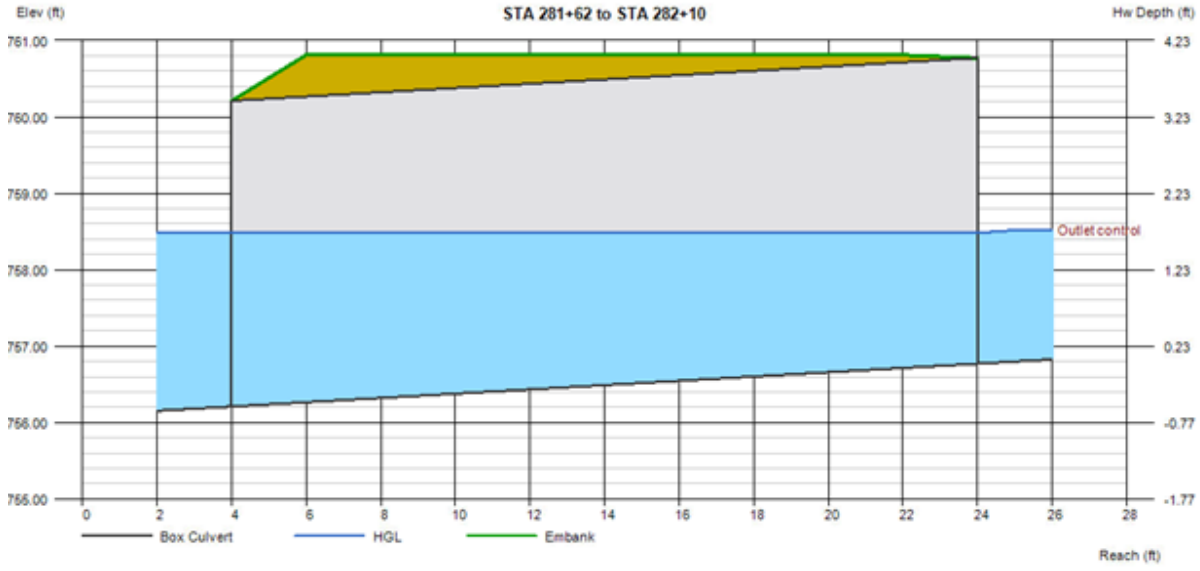
Delivery: Prices are estimated as F.O.B. trucks delivered to jobsite. Trucks only deliver on a good haul road suitable for normal over the road trucks. A formal quote and more detailed estimate of shipping must be completed before ordering. Unloading is not included. Delivery of materials can typically be offered in 10-12 weeks after approval of plan/shop drawings.

Terms: Subject to credit approval, terms are 25% payment upon approval of shop drawings, net 30 days on balance, 1 ½% per month service charge on past due invoices. Above items are subject to sales tax.

Stream #2:
4 - 12 foot by 4 foot RCB culverts
STA 134+66.50 to STA 135+14.50
Minimum Flow Rate (2-year): 193 ft^3/s
Maximum Flow Rate (100-year): 1690 ft^3/s

StreamStats Report

Region ID:	IA
Workspace ID:	IA20200414080959305000
Clicked Point (Latitude, Longitude):	42.79693, -91.50644
Time:	2020-04-14 03:10:14 -0500

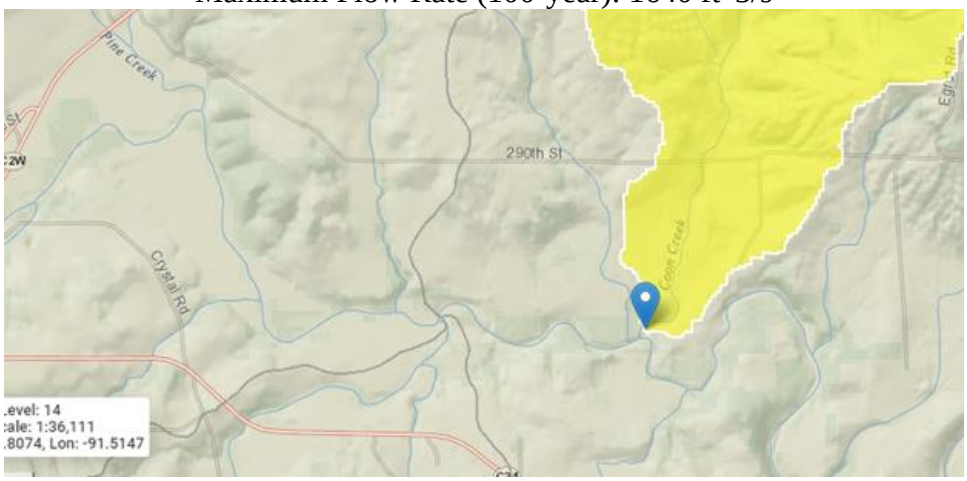


Q			Veloc		Depth		HGL			
Total	Pipe	Over	Dn	Up	Dn	Up	Dn	Up	Hw	Hw/D
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)	
193.00	193.00	0.00	1.68	2.11	28.77	22.90	775.34	775.34	775.44	0.50

Section	Item	Input
Pipe	Inv Elev Dn =	772.94
	Length (ft) =	20.00
	Slope (%) =	2.45
	Inv Elev Up =	773.43
	Rise (in) =	48.0
	Shape =	Box
	Span (in) =	144.0
	No. Barrels =	4
	n-value =	0.012
	Culvert Type =	Flared Wingwalls
	Culvert Entrance =	30D to 75D wingwall flares
Embank	Top Elev =	777.44
	Top Width (ft) =	16.00
	Crest Len (ft) =	10.00
Calcs	Q Min (cfs) =	193.00
	Q Max (cfs) =	1690.00
	Q Incr (cfs) =	150.00
	Tailwater (ft) =	(dc+D)/2

Stream #3: Field Verification Necessary
STA 134+66.50 to STA 135+14.50
Minimum Flow Rate (2-year): 13.4 ft^3/s
Maximum Flow Rate (100-year): 68 ft^3/s

Stream#4: STA 195+74 to STA 196+24
Prefab Bridge #1
50 feet long
Minimum Flow Rate (2-year): 185 ft^3/s
Maximum Flow Rate (100-year): 1640 ft^3/s



STEEL RECREATION BRIDGE ESTIMATE

3/10/2020

T21672

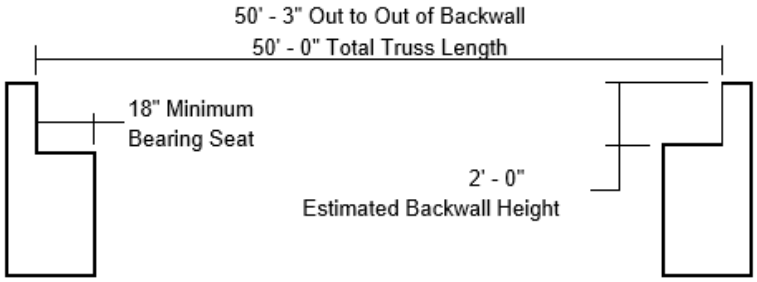
Customer:
University of Iowa
Jack Crothers
ph# 847-337-5046 / jack-crothers@uiowa.edu

Project:
Pedestrian Bridge
Volga Trail
Volga, IA

Wheeler Lumber LLC | PH 952-929-7854
9531 West 78th Street | Eden Prairie, MN 55344
Tim Lincoln | Sales Representative
tlincoln@wheeler1892.com | Cell - 612-270-3446

[X] Parallel	[ ] Bowstring	[ ] Modified

Bridge Geometry:



Bridge Geometry is for estimating purposes only and may not represent final bridge configuration.

Bridge Span:	50' - 0"	**Live Load:**	90#	**Field Splices:**	0
Bridge Width:	10' - 0"	**Vehicle Load:**	AASHTO - H5	**Number of Pieces:**	1
Truss Type:	Parallel	**Finish:**	Weathering	**Lifting Weight:**	17,200 lbs
Diagonal:	Pratt	**Railing Config:**	Horizontal - 54" w/ Ipe Rubrail	**Opening:**	4" Max
Decking Type	Treated Timber				

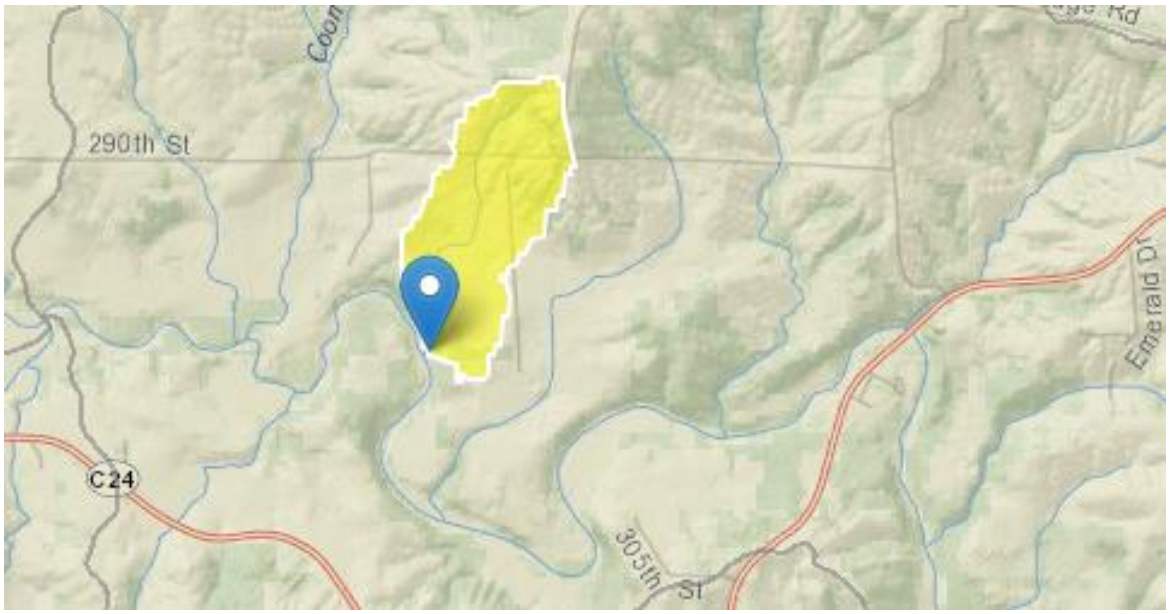
Total Bridge Price: **$36,800.00**

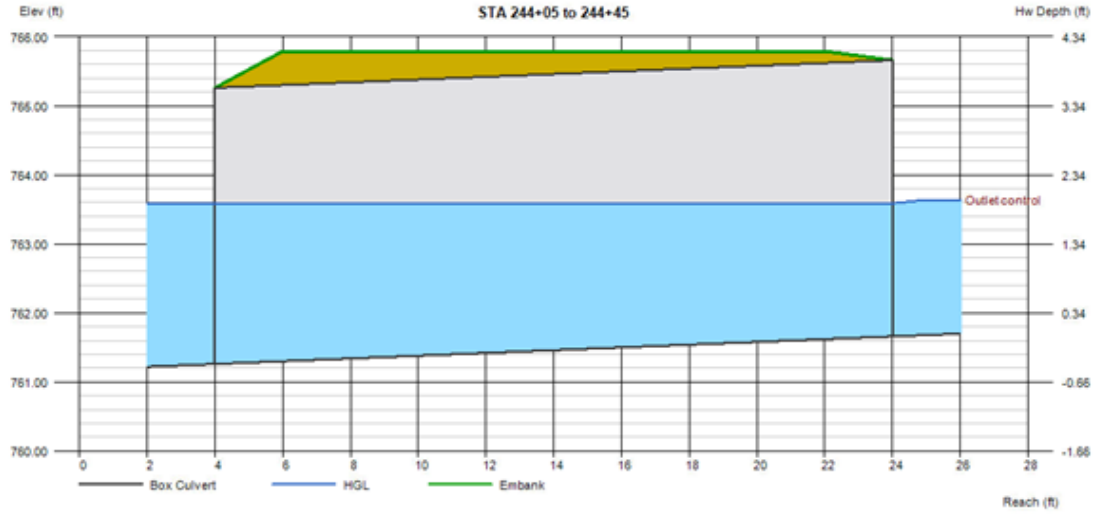
Notes:

Delivery: Prices are estimated as F.O.B. trucks delivered to jobsite. Trucks only deliver on a good haul road suitable for normal over the road trucks. A formal quote and more detailed estimate of shipping must be completed before ordering. Unloading is not included. Delivery of materials can typically be offered in 10-12 weeks after approval of plan/shop drawings.

Terms: Subject to credit approval, terms are 25% payment upon approval of shop drawings, net 30 days on balance, 1 ½% per month service charge on past due invoices. Above items are subject to sales tax.

Stream #5:
4 - 10 foot by 4 foot RCB culverts
STA 244+05 to STA 244+45
Minimum Flow Rate (2-year): 119 ft^3/s
Maximum Flow Rate (100-year): 1150 ft^3/s

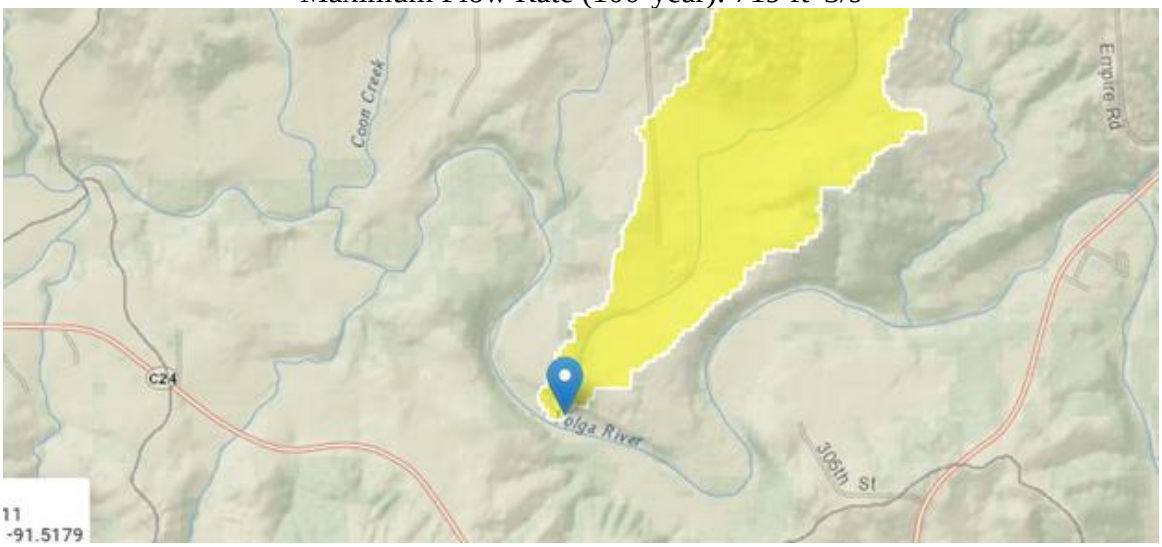




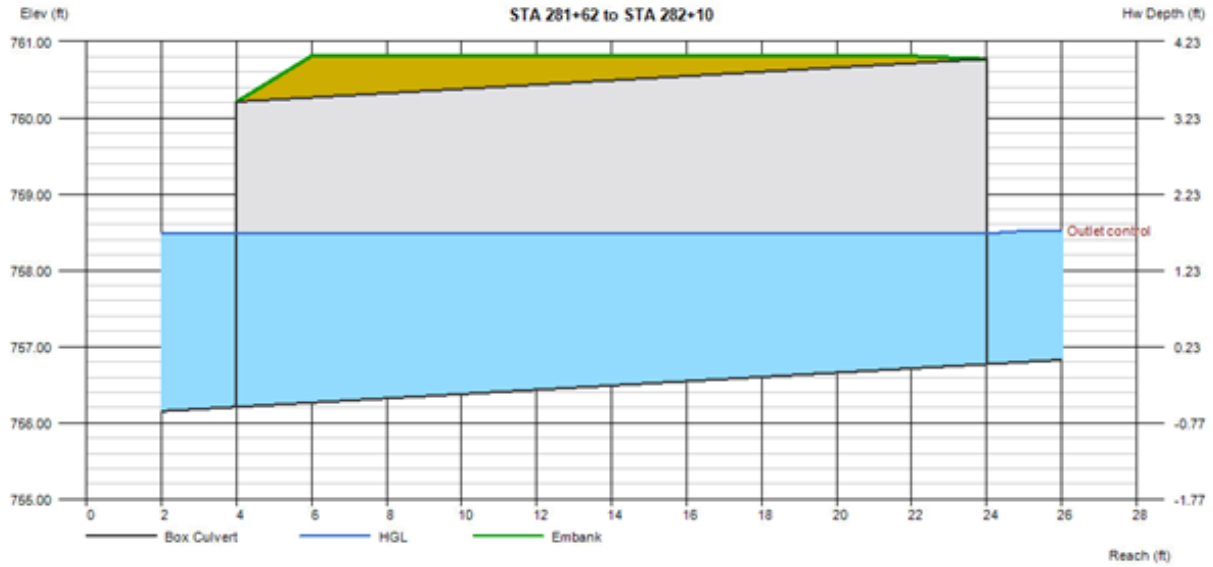
Q			Veloc		Depth		HGL			
Total	Pipe	Over	Dn	Up	Dn	Up	Dn	Up	Hw	Hw/D
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)	
119.00	119.00	0.00	1.28	1.54	27.90	23.12	763.59	763.59	763.64	0.49

Section	Item	Input
Pipe	Inv Elev Dn =	761.26
	Length (ft) =	20.00
	Slope (%) =	2.00
	Inv Elev Up =	761.66
	Rise (in) =	48.0
	Shape =	Box
	Span (in) =	120.0
	No. Barrels =	4
	n-value =	0.012
	Culvert Type =	Flared Wingwalls
	Culvert Entrance =	30D to 75D wingwall fla
Embank	Top Elev =	765.79
	Top Width (ft) =	16.00
	Crest Len (ft) =	10.00
Calcs	Q Min (cfs) =	119.00
	Q Max (cfs) =	1150.00
	Q Incr (cfs) =	150.00
	Tailwater (ft) =	(dc+D)/2

Stream#6:
4 - 12 foot by 4 foot RCB culverts
STA 281+62 to STA 282+10
Minimum Flow Rate (2-year): 108 ft^3/s
Maximum Flow Rate (100-year): 719 ft^3/s



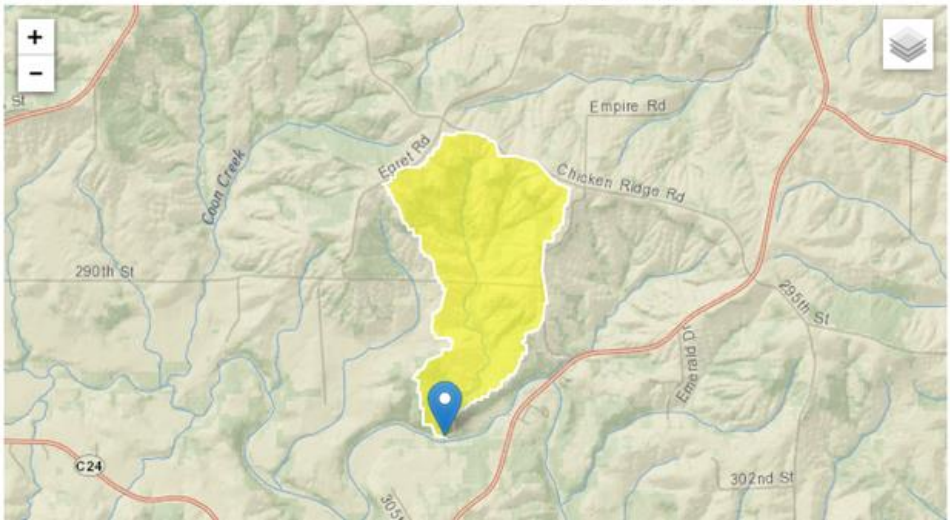
Section	Item	Input
Pipe	Inv Elev Dn =	756.21
	Length (ft) =	20.00
	Slope (%) =	2.80
	Inv Elev Up =	756.77
	Rise (in) =	48.0
	Shape =	Box
	Span (in) =	144.0
	No. Barrels =	4
	n-value =	0.012
	Culvert Type =	Flared Wingwalls
	Culvert Entrance =	30D to 75D wingwall flares
Embank	Top Elev =	760.81
	Top Width (ft) =	16.00
	Crest Len (ft) =	10.00
Calcs	Q Min (cfs) =	108.00
	Q Max (cfs) =	719.00
	Q Incr (cfs) =	150.00
	Tailwater (ft) =	(dc+D)/2



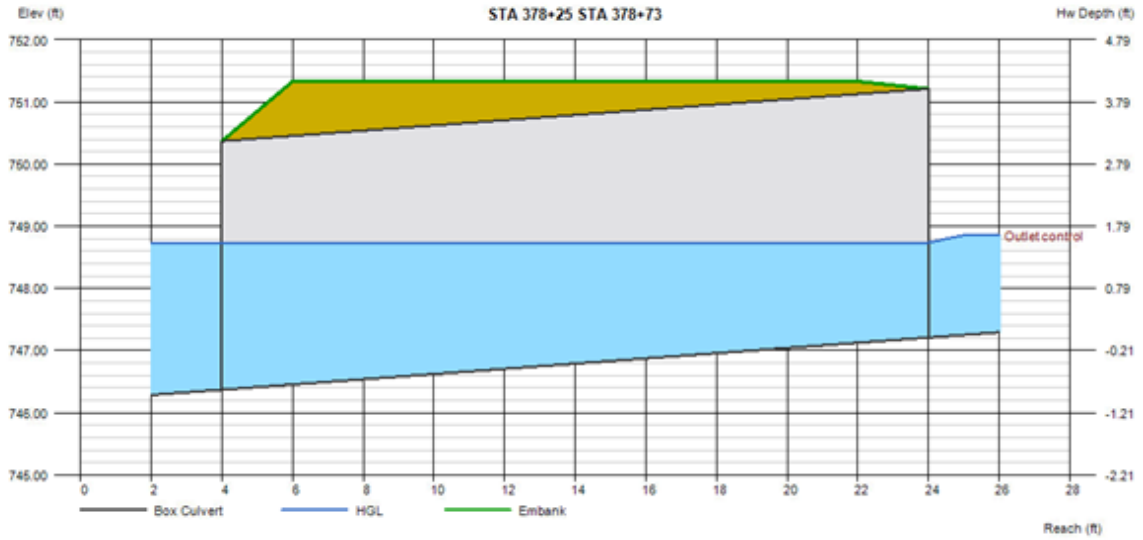
Q			Veloc		Depth		HGL			
Total	Pipe	Over	Dn	Up	Dn	Up	Dn	Up	Hw	Hw/D
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)	
108.00	108.00	0.00	0.99	1.31	27.24	20.53	758.48	758.48	758.52	0.44

Stream #7:
4 - 12 foot by 4 foot RCB culverts
STA 378+25 STA 378+73
Minimum Flow Rate (2-year): 171 ft^3/s
Maximum Flow Rate (100-year): 1260 ft^3/s

Region ID:	IA
Workspace ID:	IA20200414101925468000
Clicked Point (Latitude, Longitude):	42.79035, -91.45487
Time:	2020-04-14 05:19:40 -0500



Section	Item	Input
Pipe	Inv Elev Dn =	746.37
	Length (ft) =	20.00
	Slope (%) =	4.20
	Inv Elev Up =	747.21
	Rise (in) =	48.0
	Shape =	Box
	Span (in) =	144.0
	No. Barrels =	4
	n-value =	0.012
	Culvert Type =	Flared Wingwalls
	Culvert Entrance =	30D to 75D wingwall flares
Embank	Top Elev =	751.33
	Top Width (ft) =	16.00
	Crest Len (ft) =	10.00
Calcs	Q Min (cfs) =	171.00
	Q Max (cfs) =	1260.00
	Q Incr (cfs) =	150.00
	Tailwater (ft) =	(dc+D)/2



Q			Veloc		Depth		HGL			
Total	Pipe	Over	Dn	Up	Dn	Up	Dn	Up	Hw	Hw/D
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)	
171.00	171.00	0.00	1.51	2.33	28.40	18.33	748.74	748.74	748.86	0.41

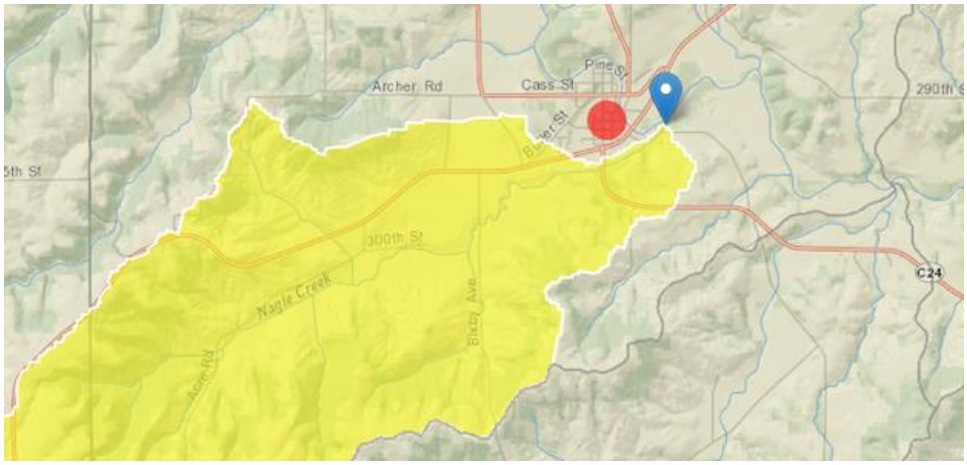
Appendix B - South Stream Crossings

Table 12: Stream crossing data for South Trail

Stream #	Station	Min Flow Rate (cfs)	Max Flow Rate (cfs)	Proposed
Stream #1	STA 30+95.00 to 31+45.00	541 cfs	4040 cfs	Pre Fab Bridge #2
Stream #2	STA 101+55.00 to STA 101+85.00	121cfs	835 cfs	3 – 10 foot by 4 RCB Culverts
Stream #3 (Hewitt Creek)	STA 153+70 to STA 154+20	893 cfs	6620 cfs	Pre Fab Bridge #2 (50 feet)
Stream #4*	STA 168+50 to STA 170+00 (Rough)	24.2 cfs	123 cfs	—
Stream #5	STA 225+21.00 to STA 225+53.00	145 cfs	1080 cfs	4 - 8 foot by 4 foot RCB culverts

*Field Verification is necessary because this may just be a drainage ditch.

Stream #1:
STA 30+95.00 to STA 31+45.00
Pre Fab Bridge #1
Minimum Flow Rate (2-year): 541 ft^3/s
Maximum Flow Rate (100-year): 4040 ft^3/s



STEEL RECREATION BRIDGE ESTIMATE

3/10/2020

T21672

Customer:
University of Iowa
Jack Crothers
ph# 847-337-5046 / jack-crothers@uiowa.edu

Project:
Pedestrian Bridge
Volga Trail
Volga, IA

Wheeler Lumber LLC | PH 952-929-7854
9531 West 78th Street | Eden Prairie, MN 55344
Tim Lincoln | Sales Representative
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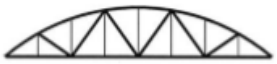
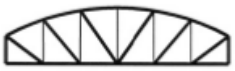
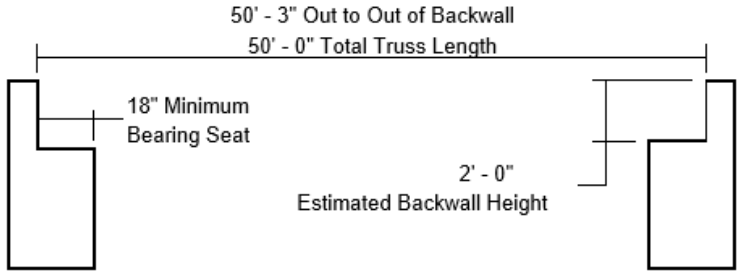
[X]  **Parallel**	[ ]  **Bowstring**	[ ]  **Modified**

Bridge Geometry:



Bridge Geometry is for estimating purposes only and may not represent final bridge configuration.

Bridge Span:	50' - 0"	**Live Load:**	90#	**Field Splices:**	0
Bridge Width:	10' - 0"	**Vehicle Load:**	AASHTO - H5	**Number of Pieces:**	1
Truss Type:	Parallel	**Finish:**	Weathering	**Lifting Weight:**	17,200 lbs
Diagonal:	Pratt	**Railing Config:**	Horizontal - 54" w/ Ipe Rubrail	**Opening:**	4" Max
Decking Type	Treated Timber				

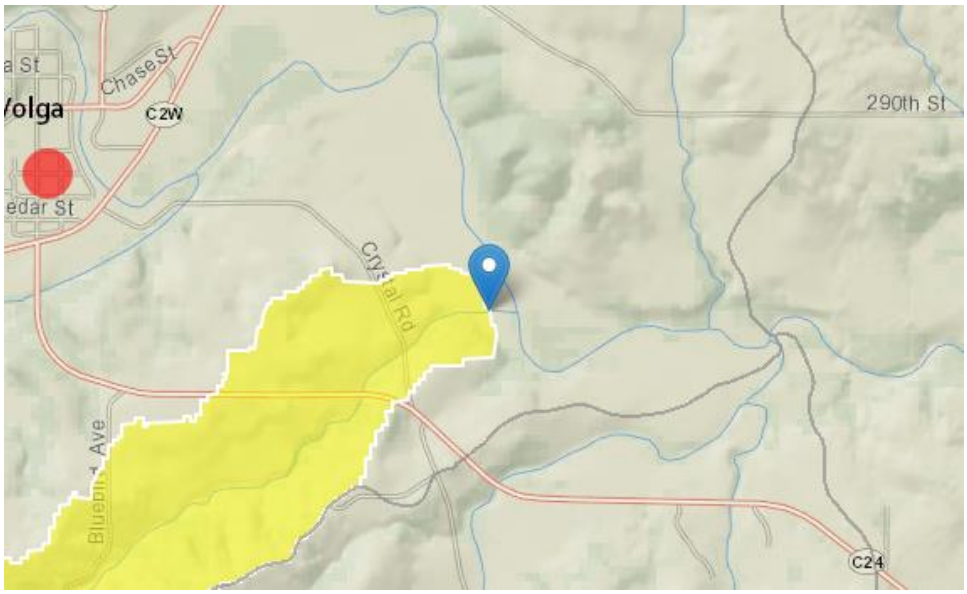
Total Bridge Price: **$36,800.00**

Notes:

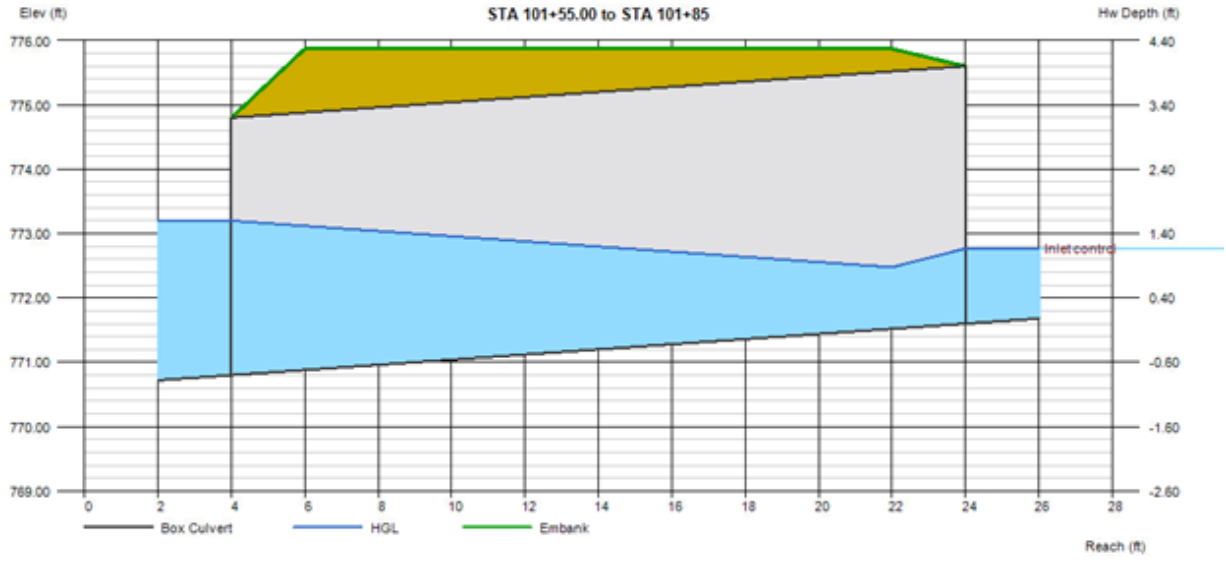
Delivery: Prices are estimated as F.O.B. trucks delivered to jobsite. Trucks only deliver on a good haul road suitable for normal over the road trucks. A formal quote and more detailed estimate of shipping must be completed before ordering. Unloading is not included. Delivery of materials can typically be offered in 10-12 weeks after approval of plan/shop drawings.

Terms: Subject to credit approval, terms are 25% payment upon approval of shop drawings, net 30 days on balance, 1 ½% per month service charge on past due invoices. Above items are subject to sales tax.

Stream #2:
3 – 10 foot by 4 RCB Culverts
STA 101+55.00 to STA 101+85.00
Minimum Flow Rate (2-year): 121 ft^3/s
Maximum Flow Rate (100-year): 835 ft^3/s

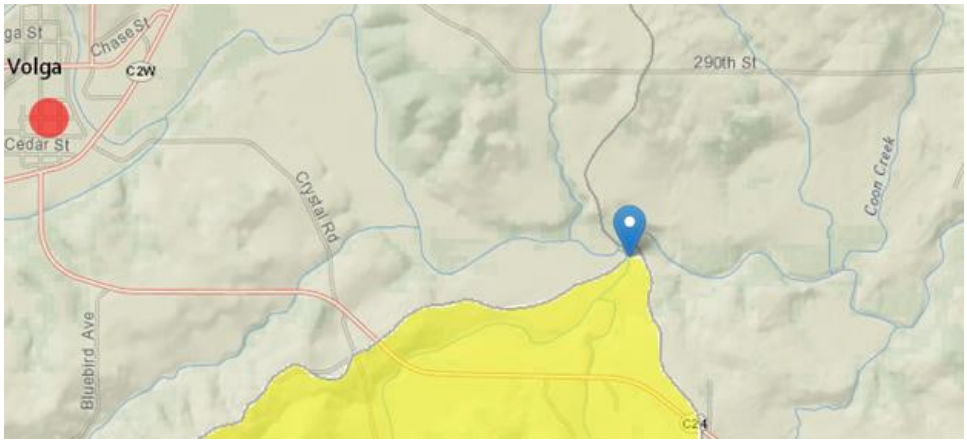


Section	Item	Input
Pipe	Inv Elev Dn =	770.80
	Length (ft) =	20.00
	Slope (%) =	4.00
	Inv Elev Up =	771.60
	Rise (in) =	48.0
	Shape =	Box
	Span (in) =	120.0
	No. Barrels =	3
	n-value =	0.012
	Culvert Type =	Flared Wingwalls
	Culvert Entrance =	30D to 75D wingwall flares
Embank	Top Elev =	775.87
	Top Width (ft) =	16.00
	Crest Len (ft) =	10.00
Calcs	Q Min (cfs) =	121.00
	Q Max (cfs) =	835.00
	Q Incr (cfs) =	150.00
	Tailwater (ft) =	(dc+D)/2



Q			Veloc		Depth		HGL			
Total	Pipe	Over	Dn	Up	Dn	Up	Dn	Up	Hw	Hw/D
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)	
121.00	121.00	0.00	1.68	5.06	28.78	9.56	773.20	772.40	772.77	0.29

Stream #3: Hewitt Creek
STA 153+70 to STA 154+20
50 ft Pre Fab Bridge #1
Minimum Flow Rate (2-year): 893 ft^3/s
Maximum Flow Rate (100-year): 6620 ft^3/s



STEEL RECREATION BRIDGE ESTIMATE

3/10/2020

T21672

Customer:
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ph# 847-337-5046 / jack-crothers@uiowa.edu

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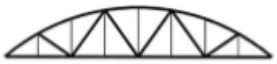
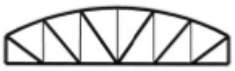
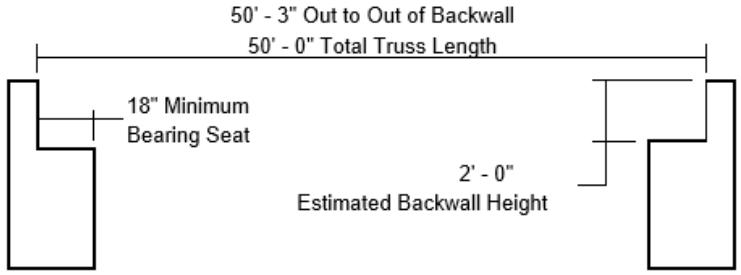
[X]  **Parallel**	[ ]  **Bowstring**	[ ]  **Modified**

Bridge Geometry:



Bridge Geometry is for estimating purposes only and may not represent final bridge configuration.

Bridge Span:	50' - 0"	**Live Load:**	90#	**Field Splices:**	0
Bridge Width:	10' - 0"	**Vehicle Load:**	AASHTO - H5	**Number of Pieces:**	1
Truss Type:	Parallel	**Finish:**	Weathering	**Lifting Weight:**	17,200 lbs
Diagonal:	Pratt	**Railing Config:**	Horizontal - 54" w/ Ipe Rubrail	**Opening:**	4" Max
Decking Type	Treated Timber				

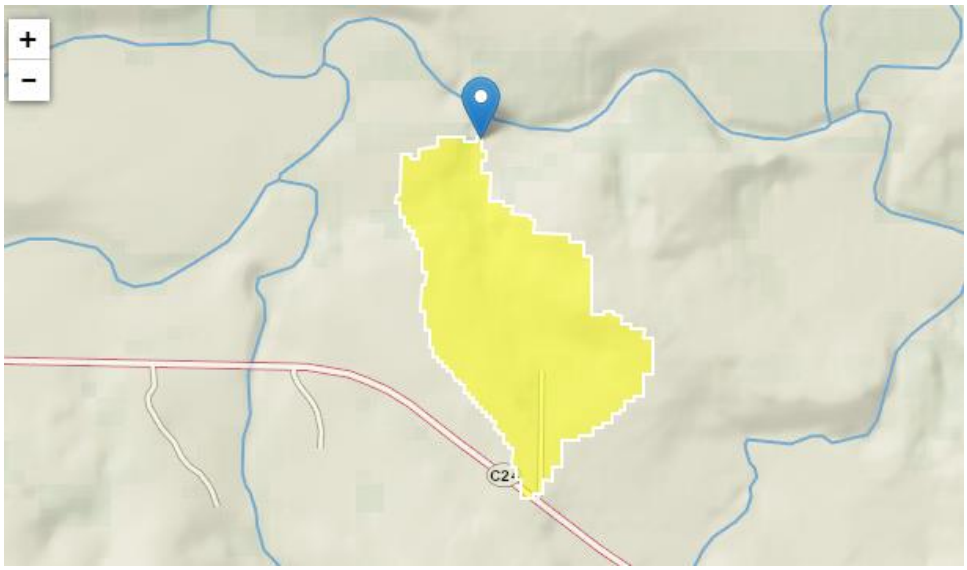
Total Bridge Price: **$36,800.00**

Notes:

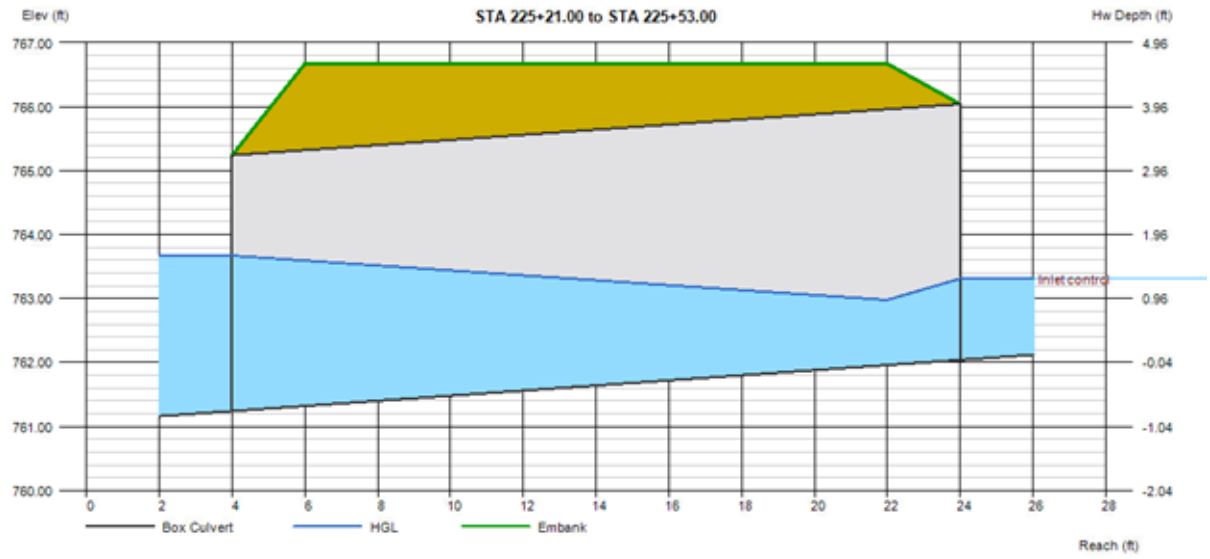
Delivery: Prices are estimated as F.O.B. trucks delivered to jobsite. Trucks only deliver on a good haul road suitable for normal over the road trucks. A formal quote and more detailed estimate of shipping must be completed before ordering. Unloading is not included. Delivery of materials can typically be offered in 10-12 weeks after approval of plan/shop drawings.

Terms: Subject to credit approval, terms are 25% payment upon approval of shop drawings, net 30 days on balance, 1 ½% per month service charge on past due invoices. Above items are subject to sales tax.

Stream #4:
STA 168+50 to STA 170+00 (Rough)
Field Verification Necessary
Minimum Flow Rate (2-year): 24.2 ft^3/s
Maximum Flow Rate (100-year): 123 ft^3/s



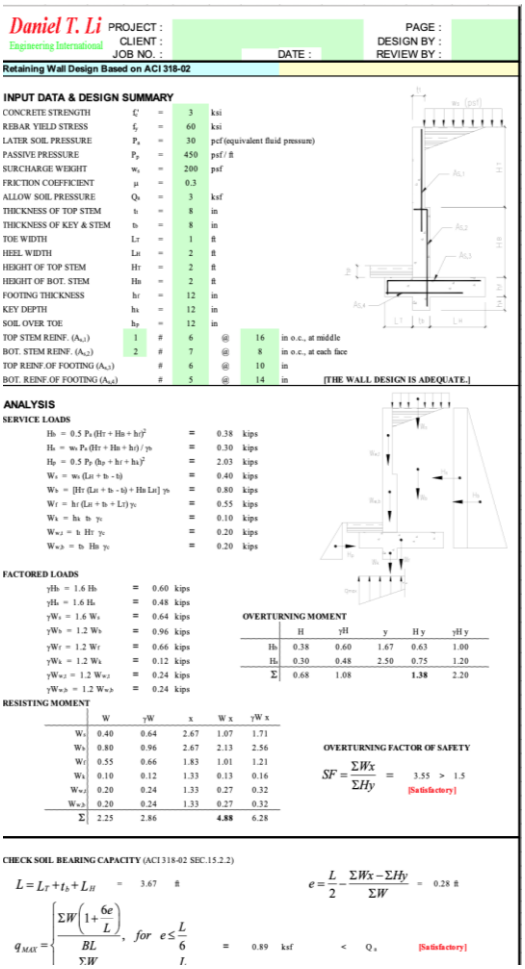
Stream #5:
4 - 8 foot by 4 foot RCB culverts
Minimum Flow Rate (2-year): 145 ft^3/s
Maximum Flow Rate (100-year): 1080 ft^3/s
STA 225+21.00 to STA 225+53.00



Q			Veloc		Depth		HGL			
Total	Pipe	Over	Dn	Up	Dn	Up	Dn	Up	Hw	Hw/D
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)	
145.00	145.00	0.00	1.86	5.26	29.17	10.33	763.67	762.90	763.31	0.32

Section	Item	Input
Pipe	Inv Elev Dn =	761.24
	Length (ft) =	20.00
	Slope (%) =	4.00
	Inv Elev Up =	762.04
	Rise (in) =	48.0
	Shape =	Box
	Span (in) =	96.0
	No. Barrels =	4
	n-value =	0.012
	Culvert Type =	Flared Wingwalls
	Culvert Entrance =	30D to 75D wingwall flares
Embank	Top Elev =	766.67
	Top Width (ft) =	16.00
	Crest Len (ft) =	10.00
Calcs	Q Min (cfs) =	145.00
	Q Max (cfs) =	1080.00
	Q Incr (cfs) =	150.00
	Tailwater (ft) =	(dc+D)/2

Appendix C – Bridge Abutment Design



Daniel T. Li — Engineering International

PROJECT : CLIENT : JOB NO. : DATE : PAGE : DESIGN BY : REVIEW BY :

Retaining Wall Design Based on ACI 318-02

INPUT DATA & DESIGN SUMMARY

CONCRETE STRENGTH	f'_c	=	3	ksi	
REBAR YIELD STRESS	f_y	=	60	ksi	
LATER SOIL PRESSURE	P_a	=	30	pcf (equivalent fluid pressure)	
PASSIVE PRESSURE	P_p	=	450	psf / ft	
SURCHARGE WEIGHT	w_s	=	200	psf	
FRICTION COEFFICIENT	μ	=	0.3		
ALLOW SOIL PRESSURE	Q_a	=	3	ksf	
THICKNESS OF TOP STEM	t_t	=	8	in	
THICKNESS OF KEY & STEM	t_b	=	8	in	
TOE WIDTH	L_T	=	1	ft	
HEEL WIDTH	L_H	=	2	ft	
HEIGHT OF TOP STEM	H_T	=	2	ft	
HEIGHT OF BOT. STEM	H_B	=	2	ft	
FOOTING THICKNESS	h_f	=	12	in	
KEY DEPTH	h_k	=	12	in	
SOIL OVER TOE	h_p	=	12	in	
TOP STEM REINF. (A_{s1})	1	#	6	@ 16	in o.c., at middle
BOT. STEM REINF. (A_{s2})	2	#	7	@ 8	in o.c., at each face
TOP REINF.OF FOOTING (A_{s3})		#	6	@ 10	in
BOT. REINF.OF FOOTING (A_{s4})		#	5	@ 14	in [THE WALL DESIGN IS ADEQUATE.]

ANALYSIS

SERVICE LOADS

$H_b = 0.5\ P_a (H_T + H_B + h_f)^2$	=	0.38	kips
$H_s = w_s P_a (H_T + H_B + h_f) / \gamma_s$	=	0.30	kips
$H_p = 0.5\ P_p (h_p + h_f + h_k)^2$	=	2.03	kips
$W_s = w_s (L_H + t_b - t_t)$	=	0.40	kips
$W_b = [H_T (L_H + t_b - t_t) + H_B L_H]\ \gamma_c$	=	0.80	kips
$W_f = h_f (L_H + t_b + L_T)\ \gamma_c$	=	0.55	kips
$W_k = h_k\ t_b\ \gamma_c$	=	0.10	kips
$W_{w1} = t_t\ H_T\ \gamma_c$	=	0.20	kips
$W_{w2} = t_b\ H_B\ \gamma_c$	=	0.20	kips

FACTORED LOADS

$\gamma H_b = 1.6\ H_b$	=	0.60	kips
$\gamma H_s = 1.6\ H_s$	=	0.48	kips
$\gamma W_s = 1.6\ W_s$	=	0.64	kips
$\gamma W_b = 1.2\ W_b$	=	0.96	kips
$\gamma W_f = 1.2\ W_f$	=	0.66	kips
$\gamma W_k = 1.2\ W_k$	=	0.12	kips
$\gamma W_{w1} = 1.2\ W_{w1}$	=	0.24	kips
$\gamma W_{w2} = 1.2\ W_{w2}$	=	0.24	kips

OVERTURNING MOMENT

	H	γH	y	H y	γH y
H_b	0.38	0.60	1.67	0.63	1.00
H_s	0.30	0.48	2.50	0.75	1.20
Σ	0.68	1.08		**1.38**	2.20

RESISTING MOMENT

	W	γW	x	W x	γW x
W_s	0.40	0.64	2.67	1.07	1.71
W_b	0.80	0.96	2.67	2.13	2.56
W_f	0.55	0.66	1.83	1.01	1.21
W_k	0.10	0.12	1.33	0.13	0.16
W_{w1}	0.20	0.24	1.33	0.27	0.32
W_{w2}	0.20	0.24	1.33	0.27	0.32
Σ	2.25	2.86		**4.88**	6.28

OVERTURNING FACTOR OF SAFETY

$$SF = \frac{\Sigma Wx}{\Sigma Hy} = 3.55 > 1.5 \quad \text{[Satisfactory]}$$

CHECK SOIL BEARING CAPACITY (ACI 318-02 SEC.15.2.2)

$$L = L_T + t_b + L_H = 3.67 \text{ ft} \qquad e = \frac{L}{2} - \frac{\Sigma Wx - \Sigma Hy}{\Sigma W} = 0.28 \text{ ft}$$

$$q_{MAX} = \begin{cases} \dfrac{\Sigma W\left(1 + \dfrac{6e}{L}\right)}{BL}, & for\ e \le \dfrac{L}{6} \\ \dfrac{\Sigma W}{I.} & \end{cases} = 0.89 \text{ ksf} < Q_a \quad \text{[Satisfactory]}$$

Figure 11: ACI 318-02 Retaining wall spreadsheet

Table 13: 130 ft bridge abutment calculation

130 ft bridge	
W (kip)	3.8
W_{bridge} (kip)	3.7175
ΔW (kip)	7.5175
W_x (kip)	10.17
$W_{x,bridge}$ (kip)	5.93313
ΔW_x (kip)	16.10313
ΔH_y (kip)	3.19
SF>1.5	5.0480031
B (ft)	1
L (ft)	4.67
e (ft)	0.6172574
L/6 (ft)	0.7783333
q_{max}<L (ksf)	2.8863501
Q_a (ksf)	3
2.88<3	

Table 14: 50 ft bridge abutment calculation

50 ft bridge	
W (kip)	2.25
W_{bridge} (kip)	1.36
ΔW (kip)	3.61
W_x (kip)	4.88
$W_{x,bridge}$ (kip)	2.171
ΔW_x (kip)	7.051
ΔH_y (kip)	1.38
SF>1.5	5.1094203
B (ft)	1
L (ft)	3.67
e (ft)	0.2640859
L/6 (ft)	0.6116667
q_{max}<L (ksf)	1.4083407
Q_a (ksf)	3
1.40<3	

Appendix D – Detailed Cost Estimations

Table 15: Detailed cost estimation for North Trail base

ITEM	UNIT	QUANTITY	UNIT PRICE	EXTENED PRICE
EARTHWORK				
SUBBASE	CY	6117.85	$40.00	$244,500
CLASS 10 EXCAVATION	CY	1201.36	$25.00	$30,000
CLEARING AND GRUBBING	ACREA	13.7	$3,000.00	$41,100
TRAFFIC CONTROL				
W11-2 PEDESTRIAN SIGN	EA	4	$100.00	$400
CLW6 PAINTED PAVEMENT MARKINGS WATERBORNE OR SOLVENT-BASED	STA	2.4	$60.00	$145
2' X 5' DETECTABLE WARNING	SF	80	$40.00	$3,200
SITE WORK AND LANDSCAPING				
4" x 4" x 5' PRESSURE-TREATED PINE HANDRAIL	EA	2175	$6.49	$14,100
2" x 6" x 6' PRESSURE-TREATED PINE HANDRAIL	EA	2175	$4.69	$10,200
2" x 2" x 29' PRESSURE-TREATED PINE HANDRAIL	EA	23925	$0.72	$17,200
2" x 4" x 5'8" PRESSURE-TREATED PINE HANDRAIL	EA	4350	$2.98	$13,000
#8 2-1/2" INTERNAL SQUARE FLAT-HEAD WOOD SCREWS, 1800 PER PACK	PACK	39	$123.00	$4,800
8' WIDE NYLON FILAMENT TURF REINFORCEMENT MAT	FT	16000	$5.21	$83,500
SOD STAPLES 11 GAUGE, 1000 PER BOX	BOX	16	$19.60	$315
SODE STAPLES 8 GAUGE, 500 PER BOX	BOX	80	$24.75	$1,975
8 INCH ZIP TIES, 1000 PER BAG	BAG	4	$15.65	$63
CULVERTS AND BRIDGES				
12' x 4' RCB CULVERT	LF	240	$850.00	$204,000
10' X 4' RCB CULVERT	LF	120	$700.00	$84,000
130' PREFABRICATED BRIDGE	EA	1	$125,000.00	$125,000
50' PREFABRICATED BRIDGE	EA	1	$36,800.00	$36,800
REINFORCED CONCRETE FOR BRIDGE ABUTMENTS	CY	10.1	$475.00	$4,800
MISCELLANEOUS				
30' EASMENTS	ACRE	29.3	$6,584.00	$193,000
			CONSTRUCTION SUBTOTAL:	$1,112,098
			10% CONTINGENCY:	$111,210
			ADMINISTRATIVE COST:	$33,363
			TOTAL PROJECT COST:	$1,256,500

Table 16: Detailed cost estimation for South Trail base

ITEM	UNIT	QUANTITY	UNIT PRICE	EXTENED PRICE
EARTHWORK				
SUBBASE	CY	8141.2	$40.00	$325,500
CLASS 10 EXCAVATION	CY	877.5	$25.00	$21,900
CLEARING AND GRUBBING	ACRE	14.4	$3,000.00	$43,200
TRAFFIC CONTROL				
W11-2 PEDESTRIAN SIGN	EA	4	$100.00	$400
CLW6 PAINTED PAVEMENT MARKINGS WATERBORNE OR SOLVENT-BASED	STA	2.4	$60.00	$145
2' X 5' DETECTABLE WARNING	SF	80	$40.00	$3,200
SITE WORK AND LANDSCAPING				
4" x 4" x 5' PRESSURE-TREATED PINE HANDRAIL	EA	1804	$6.49	$11,700
2" x 6" x 6' PRESSURE-TREADED PINE HANDRAIL	EA	1804	$4.69	$8,450
2" x 2" x 29' PRESSURE-TREATED PINE HANDRAIL	EA	19844	$0.72	$14,300
2" x 4" x 5'8" PRESSURE-TREATED PINE HANDRAIL	EA	3608	$2.98	$10,800
#8 2-1/2" INTERNAL SQUARE FLAT-HEAD WOOD SCREWS, 1800 PER PACK	PACK	32	$123.00	$3,925
8' WIDE NYLON FILAMENT TURF REINFORCEMENT MAT	FT	7800	$5.21	$40,600
SOD STAPLES 11 GAUGE, 1000 PER BOX	BOX	7	$19.60	$135
SOD STAPLES 8 GAUGE, 500 PER BOX	BOX	35	$24.75	$865
8 INCH ZIP TIES, 1000 PER BAG	BAG	3	$15.65	$47
CULVERTS AND BRIDGES				
10' X 4' RCB CULVERT	LF	60	$700.00	$42,000
8' X 4' RCB CULVERT	LF	80	$650.00	$52,000
50' PREFABRICATED BRIDGE	EA	2	$36,800.00	$73,500
REINFORCED CONCRETE FOR BRIDGE ABUTMENTS	CY	8.4	$475.00	$4,000
MISCELLANEUOS				
30' EASMENTS	ACRE	30.3	$6,584.00	$199,500
			CONSTRUCTION SUBTOTAL:	$856,167
			10% CONTINGENCY:	$85,617
			ADMINISTRATIVE COST:	$25,686
			TOTAL PROJECT COST:	$967,500

Table 17: Detailed cost estimation for North Trail additional items

ITEM	UNIT	QUANTITY	UNIT PRICE	EXTENED PRICE
STREETS AND RELATED WORK				
5" PCC PAVEMENT	SY	6524.54	$45.00	$293,500
4" ASPHALT PAVEMENT	SY	6524.54	$23.00	$150,000
TRAFFIC CONTROL				
6" x 6" CUSTOM SHEET ALUMINUM SIGN	EA	16	$18.93	$305
U-CHANNEL SIGN POST, 6', 1.12 IBS./FT., GALVANIZED POST	EA	16	$14.50	$230
3/8"-16, STAINLESS STEEL HEX HEAD CAP SCREW, 316, 1-1/2"L	EA	32	$3.89	$125
MISCELLANEOUS				
BENCHES	EA	2	$300.00	$600
YARDISTRY CAROLINA PAVILLION	EA	1	$1,920.00	$1,925
WOOD PICNIC TABLE	EA	1	$300.00	$300

Table 18: Detailed cost estimation for South Trail additional items

ITEM	UNIT	QUANTITY	UNIT PRICE	EXTENED PRICE
STREETS AND RELATED WORK				
5" PCC PAVEMENT	SY	6785.03	$45.00	$305,500
4" ASPHALT PAVEMENT	SY	6785.03	$23.00	$156,000
TRAFFIC CONTROL				
6" x 6" CUSTOM SHEET ALUMINUM SIGN	EA	16	$18.93	$305
U-CHANNEL SIGN POST, 6', 1.12 IBS./FT., GALVANIZED POST	EA	16	$14.50	$230
3/8"-16, STAINLESS STEEL HEX HEAD CAP SCREW, 316, 1-1/2"L	EA	32	$3.89	$125
MISCELLANEOUS				
BENCHES	EA	2	$300.00	$600
YARDISTRY CAROLINA PAVILLION	EA	1	$1,920.00	$1,925
WOOD PICNIC TABLE	EA	1	$300.00	$300

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