# Recreational River Access for Webster City, Iowa

**Submitted to:** Kent Harfst, Recreation & Public Grounds Director/Assistant City Manager

**Submitted on:** May 3rd, 2019

**Prepared by:** ZDA Consultants Inc.


Zach Heisterkamp, Project Manager

David Braun, Technical Services

Aaron Gehrke, Report Editor

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## Section I: Executive Summary

ZDA Consultants are proposing their services to the City of Webster City for the engineering and design of recreational river access points, as well as the modification of a low-head dam along the Boone River. Our highly skilled team has the experience and expertise to deliver innovative, functional, aesthetically pleasing, and well-engineered designs. To go along with our technical skills, we assure professional management and leadership throughout the entirety of the project.

Launch sites were designed using the Iowa Department of Natural Resources (IDNR) guidelines for water trail development. Challenges such as preventing stream bank erosion, limiting adverse effects to natural Boone River habitats, and reducing the amount of waste generated by recreational river users were addressed to limit the environmental impact of the project. The site locations suggested to ZDA were Nokomis Park, Waterworks Park, and 7B Ranch. The City also asked for the modification of the current low-head dam, located near the Waterworks Park site, to a structure that will allow for better user navigability.

The final design at the Nokomis Park access includes five parking stalls with an additional ADA accessible stall. A 14 foot concrete ramp is also included on site. This launch will be utilized by both recreational river-goers and the search and rescue boat. A 40 foot parallel parking space was added to provide parking for the search and rescue truck and trailer. An infiltration trench was provided to collect and filter stormwater from the post-constructed site.

Components of the final design at Waterworks Park include five parking stalls that can hold 10 standard vehicles or 5 trailer pulled vehicles. Two additional ADA accessible parking stalls were also provided. Two stair-step launches were included to provide portage around the low-head dam. To provide safer passage for users who choose to go over the low-head dam, ZDA recommends placing a steel cap over the sheet pile. Rock arch rapids were also designed downstream of the dam to mitigate circulating currents and drowning risks. This will also provide the City with a unique and exciting whitewater feature. An infiltration trench is located on site to meet stormwater management requirements.

Final design at 7B Ranch includes a stair-step ramp, six total parking stalls, and an infiltration trench. The stair-step ramp will be constructed in a similar fashion to the stair-step ramps at Waterworks Park. Taking into account that the 7B Ranch site is in a fairly wooded area, parking area was placed to minimize the amount of tree clearing needed.

The estimated total combined cost of all four phased projects comes to $409,300. The completion of new launch sites will connect current water trail systems that were once unused or not easily navigable. ZDA believes the completion of the project will bring an increase in popularity in the outdoors and improved river accessibility to the Webster City community.

## Section II: Organization Qualifications and Experience

Name of Organization

The name of the student engineering firm that will be working on this project and responsible for all final deliverables, including a report, presentation, and design drawings is ZDA Consultants Inc.

Organization Location and Contact Information

Project Manager: Zach Heisterkamp
Phone: 712-253-8348
Email: zachary-heisterkamp@uiowa.edu

Location: Department of Civil and Environmental Engineering
4105 Seamans Center for the Engineering Arts & Sciences
Iowa City, Iowa, 52242

Organization and Design Team Description

The design team will consist of the following personnel. For further detail regarding the work experience of each member, please reference the individual resumes found in *Appendix E*.

**Zach Heisterkamp** will serve as project manager and take the lead on site design. Zach is studying civil engineering with an environmental focus, and has relevant experience in environmental hydraulics through past work experience.

**David Braun**, will serve as technical services and take the lead on hydraulic analysis and dam modifications design. David is focused on water resources, and has relevant work experience with conducting floodplain and drainage analyses, as well as preparing project cost estimates through his previous internship.

**Aaron Gehrke** will serve as report editor and will take the lead on river launch design. Aaron is studying civil engineering with an environmental focus. He has relevant work experience in surveying and construction site inspection through previous internships.

## Section III: Design Services

Project Scope

Three new river access locations, as well as the modification of a low-head dam along the Boone River, are to be designed. These designs will have the goal of increasing the popularity of river recreation, creating more accessible water trails, and improving the sense of local community. With only one access point being currently advertised as a state designated water trail, additional river accessibility is needed to promote more diverse river usage and to accommodate search and rescue boats. The modification of the low-head dam and the new river access points will be designed for the use of canoes, kayaks, inner tubes, and other similarly sized watercraft. The increased number of access points will give river goers more flexibility when planning excursions and allow travelers more opportunities to deposit trash along the water trail. Access roads and on-site parking will be designed in a way that is both attractive and functional. A complete list of tasks and objectives is compiled below:

- Utilizing notes from the field walk-through, and work sessions, develop an approximate assessment of the conditions to confirm, or determine, the extents of the problems and potential solutions to them.
- Develop conceptual drawings/sketches/illustrations to illustrate the alternative design options to the Client.
- Develop a summary of the advantages/disadvantages of the design alternatives that may include items such as constructability, utility conflicts/coordination, easement and right-of-way needs, personal property impacts, environmental impacts, sustainability, costs and other meaningful attributes.
- Conduct a meeting with the Client to review and select the preferred design concepts.
- Complete the project design to meet the Client's objectives.
- Prepare a design report.
- Prepare design sheets that include appropriate design plans, cross-section drawings, details and notes.
- Prepare and print out a project poster.
- Prepare a presentation to present the final design report to the Client, Instructor, and Department.
- Prepare a List of Materials and identify potential vendors when applicable.
- Prepare a cost estimate for the project.
- Prepare a listing of entities or agencies permits that control design and/or construction of the project.
- Submit draft work products to the Instructor and Client.

- Revise draft design report, drawings, cost estimate, and poster based on Client and Instructor comments and directives.
- After the final presentation to the Client, seek last comments from the Instructor.
- Amend the work products based on comments/requests from the Client heard during the presentation and the Instructor's final comments.
- Submit final electronic copies of the design report, drawings, cost estimate, poster and final presentation on a flash drive or other similar device for the Instructor to pass along to the Client.

<u>Work Plan</u>

*Table 1: Timeline of Project.*

| NUM | TASK | LEAD | START | END | DAYS |
|---|---|---|---|---|---|
| **1** | **Preliminary** | | | - | |
| 1.1 | Proposal Write-Up | Team | Tue 1/22/19 | Fri 2/01/19 | 11 |
| 1.2 | Proposal Presentation | Team | Tue 1/22/19 | Fri 2/01/19 | 11 |
| 1.3 | Site Visit | Team | Thu 1/31/19 | Thu 1/31/19 | 1 |
| 1.4 | Research Standards and Codes | Team | Mon 1/28/19 | Sun 2/10/19 | 14 |
| **2** | **Design** | | | - | |
| 2.1 | Hydraulic Analysis | David & Zach | Mon 2/11/19 | Thu 4/11/19 | 60 |
| 2.2 | Low Head Dam Modification | Team | Wed 2/13/19 | Sat 3/30/19 | 46 |
| 2.3 | River Access Point Design | Aaron | Mon 2/18/19 | Mon 4/01/19 | 43 |
| 2.4 | Parking Lot Design | Zach | Mon 3/25/19 | Wed 4/03/19 | 10 |
| 2.5 | Stormwater Management | Zach | Sat 3/30/19 | Wed 4/03/19 | 5 |
| **3** | **Finalization** | | | - | |
| 3.1 | Cost Estimate | Aaron & David | Mon 4/01/19 | Thu 4/11/19 | 11 |
| 3.2 | Project Poster | Team | Thu 4/11/19 | Fri 4/12/19 | 2 |
| 3.3 | Project Presentation | Team | Thu 4/11/19 | Fri 4/12/19 | 2 |
| 3.4 | Revision | Aaron | Fri 4/12/19 | Thu 5/02/19 | 21 |
| 3.5 | Submittal | Team | Fri 5/03/19 | Fri 5/03/19 | 1 |

A gantt chart organizing all project objectives can be found in *Figure F-1* located in *Appendix F*.

Methods and Design Guides

Site design will adhere to the Iowa Department of Natural Resources guidance for state designated water trails. Development projects that disturb streambanks, riparian areas, channel bottoms, or near-river areas require a review of resources that will be impacted. Joint permits will be needed from the DNR flood plain development program, the DNR sovereign lands program, and the US Army Corps of Engineers. In addition, municipal and county floodplain permitting will be required.

Parking and access road design will follow the Iowa Statewide Urban Design and Specifications (SUDAS) manual. Parking areas will be designed to meet specifications included in the Americans with Disabilities Act (ADA). In addition, parking area recommendations by the Iowa DNR for state designated water trails will be integrated into the design. On site stormwater management will be designed using the Iowa Urban Stormwater Manual engineering standards.

Boat launches will comply with the IDNR's guidance for state designated water trail development. Launches providing universal access are based on ADA specifications. Although ADA standards for boat launch design do not currently exist, universal design practices implement the construction of facilities in ways that integrate users of varying abilities.

Signage will be completed using the IDNR's guidance for state designated water trail development.

The IDNR Stream Restoration Toolbox will be consulted for low-head dam modifications.

## Section IV: Constraints, Challenges, and Impacts

Constraints

Webster City currently has allotted $20,000, provided from the City's Hotel/Motel Tax Grant, to design and improve river access sites for recreation along the Boone River. The sites will be selected around locations that have preferable launch site characteristics according to the Iowa DNR Water Trails Development Tools Guide. Favorable characteristics include gradual and stable streambank slopes and locations along calmer, mid-depth straight segment of river. Other river characteristics that can influence the site location are the strength of river currents as well as the amount of lateral river movement, both of which should be minimized. In addition to the river access, adequate roads and parking facilities, and stormwater retention at the access sites will need to be incorporated into the design. Existing river access points or locations that are connected by either access roads or the City's 5.5 miles of recreation trails will be highly considered for design.

The environmental impact of the design will need to be assessed including a hydrologic analysis of the river and low-head dam, a stormwater calculations of the sites to plan for water runoff, and soil survey to determine the possibility of erosion or settlement at the sites. Specific environmental constraints to the design of this project include maintaining the existing water surface elevations upstream of the low-head dam, allowing for continued mitigation of coal-tar around the dam site, preventing erosion of the river bank, preventing other possible contaminants from the site design to drain into the river, and reducing the impact on natural habitats and species such as threatened river otters, hawks, eagles, and mussels in and along the Boone River.

The City has also requested that our team try to keep the river recreation route, particularly in the case of tubers, within city limits. This not only will promote the local business and economy of the City, but will also help contain trash from recreational river use along the banks of the Boone River; making it accessible to clean up by the City or volunteers. To further reduce trash, additional placement of trash receptacles and public signage at the various site locations will be evaluated. The final project design is to be completed by Friday, May 3rd 2018 at 5:00 PM and will be presented to the Client.

## Challenges

Our biggest challenge with the river access sites will be ensuring public safety, particularly with all the recreational activity around the low-head dam. The low-head dam is currently a popular fishing spot within the community. If our team were to extend the water trail upstream of the dam, we will also need to evaluate how river-goers will navigate either over or around the dam in a safe and efficient manner. With the current dam design there are sharp edges of metal sheet piling that are exposed as riprap and other filler has been washed away. These sharp edges can easily tear up a river goer's watercraft or cause personal injury. Aside from the challenges with passing over the dam; just downstream there are potential dangers present with the naturally-occuring recirculating currents. When the tailwater develops close to the dam it can cause air entrainment which will then can trap passengers or their watercrafts and makes it extremely difficult to escape the recirculating currents. This entrapment zone that forms just downstream of the dam is a common cause of death by drowning that occurs at low-head dams across the state of Iowa. When planning for recreational use along the Boone River, considerations for the presence of natural obstacles and debris in the river that need to be cleared before opening the water trail need to be made.

Another challenge our team will face is limiting the amount of erosion around the river access ramps, during and after construction. At the three locations chosen for the river access points, there are some challenges with accessibility to the river due to existing vegetation that will need to be cleared for site development. With less vegetation the soil along the river banks can become less stable which can limit the durability of some of the designed access ramps. Erosion can be mitigated with the implementation of riprap along the banks.

Societal Impact within the Community and State of Iowa

The proposed design will most likely have both positive and negative effects to the local community of Webster City, as well as other neighboring communities near the Boone River. The primary impact, and one of the key goals of this project, will be an increase of recreational activity and tourism to Webster City. This can be achieved by creating a fully connected and enhanced recreational water trail along the Boone River within Webster City limits. This will in turn increase revenue for local businesses. Currently, this project is being funded with Webster City's Hotel/Motel Tax Grant funds, but as tourism in Webster City increases, there may be a future demand for the development of lodging and other accommodations. This will require the City to accumulate additional funds for these future projects.

As discussed above, an increased amount of activity along the Boone River could also have some potentially negative impacts to natural habitats. An increase of recreational river use could result in more trash along the river banks, however our team hopes to mitigate the issue of trash by incorporating more trash bins and signage into the project design as well as keeping the primary river route for tubers within the City limits.

Overall, this design project of recreation river access promotes a healthy and active lifestyle for members of the community and connects with the hundreds of miles of existing water trails in Iowa.

## Section V: Considered Alternative Solutions

Parking Lot

Concrete, asphalt, and gravel were all considered when deciding the type of pavement surface that would be used. Concrete would be the most expensive option, but would offer more resiliency to areas that are prone to flooding. Concrete parking lots would also be expected to last longer and require less maintenance.

Asphalt would be the middle option of the three. Asphalt would be cheaper than concrete, but may not hold up to frequent flooding conditions. Additionally, asphalt would absorb the most heat of the three pavement options. The river launch areas will be occupied with many barefoot individuals, so asphalt pavement could cause a hazard.

Lastly, a gravel parking lot would be the cheapest of all three options. Gravel parking lots can be practical in low trafficked areas, but would still require the most maintenance. Washout of gravel parking lots could easily take place during flood events due to all of the proposed sites' proximities to the Boone River.

Launch Alternatives

There are five launch designs outlined in the IDNR water trail development program: Cast-in-place concrete ramp, precast concrete ramp, universal ramp, natural surface ramp, and a stair-step launch design. The selection of which design to implement is based on site specific conditions such as streambank composition, existing slope, bankfull/low flow elevations, and desired usage. The launch is then designed based on the following factors: Armoring selection, channel restoration practices, slope of launch, push-in section, transition zone, horizontal alignment, and launch elevation.

Low-Head Dam Modifications

Utilizing Chapter 4 of the IDNR "Dam Mitigation Manual", our team was able to identify four primary alternatives for navigation around or modifications made to the existing low-head dam along the Boone River located at Waterworks Park. These alternatives considered safe passage along the river, environmental impacts, ease of implementation/feasibility, and construction cost. A brief description of each alternative can be found below.

*Portage Around Dam*

The most cost effective alternative is to leave the existing dam configuration as is and create portage paths around the dam to exit and reenter the river downstream of the dam. This option will have no adverse environmental impacts and will allow for the City to continue mitigating the coal-tar contamination as water surface elevations remain unchanged. However this option did not achieve the City's goal of having a fully-connected water trail so our group wanted to explore more options.

*Capping Dam and Downstream Rock Arch Rapids*

This design keeps the original structure of the existing low-head dam and will add a 15" wide steel C-shaped beam over the exposed metal sheet pile and replace the rip rap upstream of the dam for a smooth transition and passage over. This design will also include rock arch rapids downstream of the crest of the dam to serve as energy dissipation, eliminate circulating currents, allow for greater fish passage, and add some fun, unique navigable rapids features for recreational users. This alternative will maintain existing water surface elevations and not disturb any coal-tar mitigation efforts.

*Height Reduction of Dam and Upstream Rock Ramp*

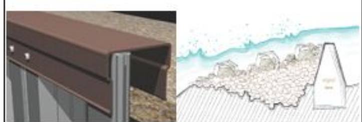
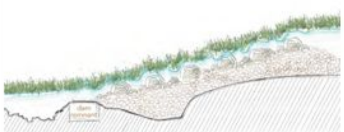
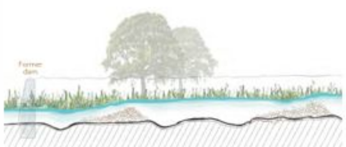
The initial thought with this design was to allow for easier access over the main channel of the dam by reducing the height of it. To maintain the water surface elevation upstream of the dam a rock ramp of river stone and rip rap would be installed. Ultimately this design was decided against for not being as cost effective as some other designs. There was also still a safety concern with river goers crossing over the exposed sheet piling, which is sharp and could cut watercrafts or cause personal injury. Additionally, by reducing the height of the dam at the center channel the velocity of the water began to increase. This could cause an increase in sediment transport and have adverse environmental impacts to the Protected Water Areas downstream.

*Complete Dam Removal and River Restoration*

This last alternative would have the most significant environmental impact as it would release the sediment that has built up behind the dam downstream and increase river velocities. While the Boone River would eventually see an improvement in its natural species and ecosystems along the river, implementing this design is not quite feasible. This is because of existing coal-tar mitigation systems which were designed for the existing dam and water surface conditions.

Ultimately, our group decided upon a combination of the first two alternatives explored which includes: capping the dam, installing rock ramps downstream of the dam, and providing portage options just upstream and downstream of the low head dam. Our reasoning for this alternative selection can be found in *Table 3* below.

*Table 3: Decision matrix for the dam modification alternatives.*

| Modification | Environmental Impact | Cost | Recreational Use | Safety | Total |
|---|---|---|---|---|---|
| Portage Around Dam   | 4<br>The existing dam conditions remain unchanged therefore there is no additional environmental impact | 4<br>This is the most cost-effective design alternative | 1<br>By forcing users to exit and reenter the river this design option is not the most conducive to recreation | 4<br>Public safety is enhanced by eliminating the risk of crossing over the low head dam | 13 |
| Capping and Rock Arch Rapids  | 4<br>All sediment buildup remains behind the dam and the large rocks downstream provide energy dissipation | 3<br>Not making any modifications to the low head dam and just adding rock ramps downstream is the least expensive. | 3<br>Maintaining the original height of the dam may make passage over the low head dam difficult for users. | 3<br>The sheet metal may still be exposed and offers less clearance over the dam. | 13 |
| Height Reduction and Rock Ramps  | 2<br>The height of the dam is maintained by the rock arch rapids but there may be some sediment that is transported downstream during construction. | 2<br>A significant reduction to the low head dam in addition to rock arch rapids can be costly. | 3<br>Fairly easy passage, however rock rapids may pose challenge for recreational tubers. | 3<br>Some public safety concerns regarding passage through river rapids. | 10 |
| Complete Dam Removal and Restoration  | 1<br>By completely removing the dam it is likely that all the sediment built up behind it will be transported downstream. Higher river velocities may also be experienced. | 1<br>Completely removing the dam is the most costly. | 4<br>With a more natural river profile it is easy to achieve smooth passage. | 4<br>Without having to cross over any low head dam or rock rapids ensures the greatest public safety. | 10 |

**Scoring Key: 1 is the worst; 4 is the best.**

## Water Quality & Stormwater Management

The IDNR Water Trail Design Guide recommends two options for water quality and stormwater management. One option is to capture the water and infiltrate it into the ground by using an infiltration trench. The other option is to filter it before it reaches adjacent water bodies by using a vegetated filter strip. A list of criteria for deciding which management practice to use is summarized below.

Infiltration Trench

1. Seasonal water table is > 4' deep
2. Does not flood frequently
3. Surface and underlying soils are NRCS Hydrologic Group A, B, or C
4. Slope is < 15%

Vegetated Filter

1. Seasonal water table < 4' deep
2. Floods frequently
3. Surface and underlying soils are NRCS Hydrologic Group D
4. Slope is > 15%

The USGS web soil survey was used to define the listed criteria. A summary table of the information is listed below:

*Table 2: Stormwater management criteria for the USGS web soil survey.*

| Site | Water Table Depth | Flood Frequency | Hydrologic Group | Slope |
|---|---|---|---|---|
| Nokomis Park | 4 | Occasional | A | Mild (0-2%) |
| Water Works Park | 4-7 | Occasional | A | Mild (0-2%) |
| 7B Ranch | 4-7 | Frequent | A | Mild (0-2%) |

## Section VI: Final Design Details

### Parking Lot Design

Concrete is recommended for all parking surfaces. Although it is the most expensive option, it is also the most durable and aesthetically pleasing one. All parking areas and access roads will be constructed on top of 12” of prepared subgrade, followed by 4” of granular subbase, followed by 6” of class C Concrete. Parking areas for water trails were designed to minimize landscape disruption, and stream impact, while also accommodating river-goers. All parking areas were set back at least 50 feet from the top of the streambank to minimize the impact to the surrounding habitat. Parking lot layouts and designs were accomplished using Section 8B-1 of the Iowa SUDAS Design Manual. Recommendations from the Iowa Department of Natural Resources were also taken into consideration. Generous sized parking stalls measuring 20’ x 10’ were used at the Nokomis Park access and the 7B Ranch access to better accommodate gear and people. The Nokomis Park and 7B Ranch locations both include 5 parking stalls with an additional van-accessible ADA parking space. The ADA parking spaces measure 20’ x 16’. A 40’ parallel parking bump out was designed for Nokomis Park to accommodate the city’s search and rescue boat. Civil 3D Vehicle tracking was used to verify all parking lot navigation. The maneuvering for the search and rescue truck and trailer is shown below in *Figure 1*.

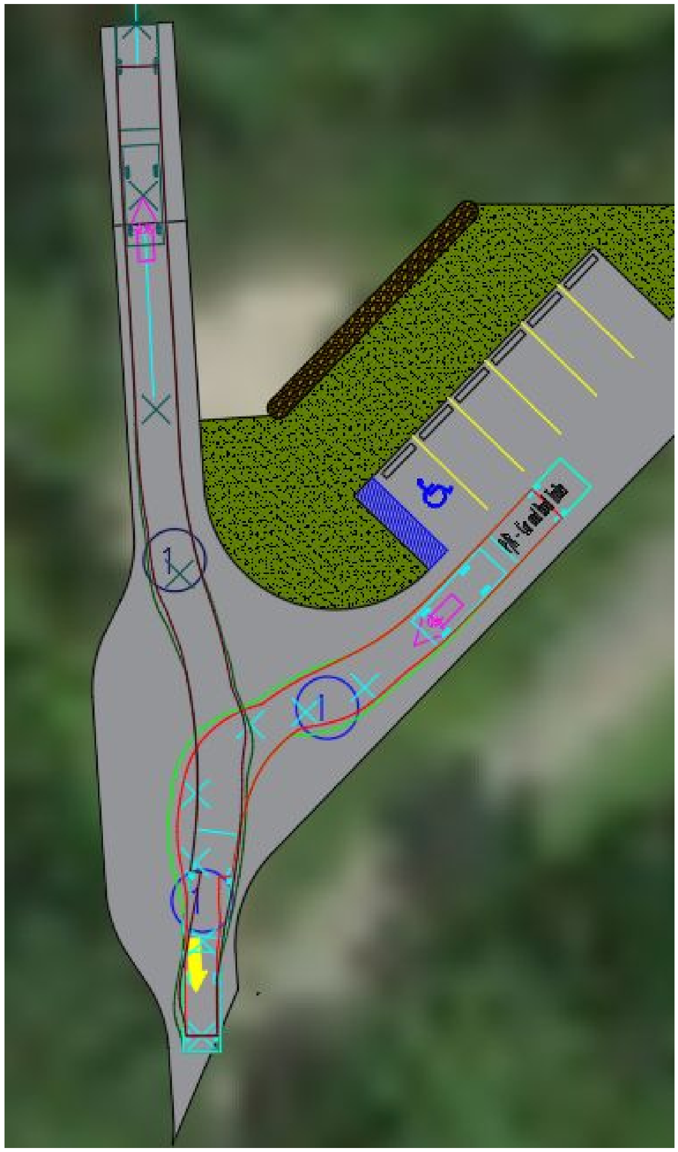


*Figure 1: Truck and trailer vehicle tracking at Nokomis Park.*

Waterworks Park access includes 5 parking stalls measuring 45’ x 10’ with an additional ADA parking space measuring 45’ x 16’. These parking stalls can hold two full size vehicles, or a vehicle towing a boat trailer or other equipment. Parking areas were designed to drain into infiltration trenches located on their respective site. Site plans for Nokomis Park, Water Works Park, and 7B Ranch Access can be seen in *Drawings 1,3,* and *5* respectively, located in the drawing sets. Detailed grading sheets for each of the sites can be seen in *Drawings 2,4,* and *6* located in the drawing sets. Pavement slopes were kept between 0.6% and 2% when possible, but never exceeded 5%.

River Launch Design

Launch designs were accomplished using guidelines from the IDNR water trail development program. Timber is sized according to the National Institute of Standards: American Softwood Lumber Standard. Launch designs can be seen in *Drawings 7,8 and 11,* located in the drawing sets. All geotextiles used will be US 270, a woven polypropylene filter fabric to allow for both geotextile separation and geotextile stabilization.

Nokomis Park will have one launch constructed, replacing the existing gravel ramp. The detail of the ramp design can be seen in *Drawing 7* and then in reference to the overall site plan of Nokomis Park in *Drawing 1* both located in the drawing sets. The launch is a 14 foot wide, 50 foot long, cast-in-place concrete ramp meant to accommodate the city's search and rescue boat, as well as recreational river-goers. The ramp will be angled 45 degrees into the river. It will be constructed of 6 inches of Class C concrete overlaying a 6 inch subbase of Class A compacted stone. The surface will be grooved to provide additional friction. The push-in section will be 30 feet long, at a slope of 16%, and will accommodate both low-flow and bankfull elevation launches. The launch section will be 20 feet long, at a slope of 8% to meet a top elevation of 1024.86 feet. Half inch expansion joints will be located every 10 feet along the concrete. The 6 foot wide shoulders of the push-in section will be lined with Class E riprap to protect the ramp from scour and erosion. Prairie grasses will also be seeded above the bankfull elevation to provide further erosion control.

Waterworks Park will have two launches constructed to provide portage for river-goers who wish to avoid going over the low-head dam; as well as provide a new launch point downstream of the dam for river-goers who want to avoid the dam all together. The detail of the two launches can be seen in *Drawing 8* and then in reference to the overall site plan of Waterworks Park in *Drawing 3* both located in the drawing sets. The first launch is a stair-step design which will be located upstream of the low-head dam. The launch will be 5 feet wide, constructed 45 degrees to the river. The launch will be constructed of 5 Class C cast-in-place concrete steps, each 7.25 inches high, sloped 3% towards the river. These steps will accommodate both low flow and bankfull elevation launches; reaching a top elevation of 1017.5 feet. There will be a 6 inch deep subbase of Class A compacted stone underneath the steps. Filter fabric will be placed between the subbase course and the steps. The steps will overlap each other by 12 inches and will be anchored together using ½” rebar, 5 inches long, 3 per step. The 3 foot wide shoulders of the concrete steps will be lined with Class D riprap to protect the launch from scour and erosion. Prairie grass will also be seeded above this bankfull elevation to provide further erosion control.

The second launch is a stair-step design, and will be located downstream of the low-head dam. This launch will provide both a portage trail for those wishing to exit and re-enter after the dam, as well as provide a starting launch for river-goers wishing to experience a shorter trip. The launch will be 5 feet wide, constructed 45 degrees to the river. The launch will be constructed of 3 Class C cast-in-place concrete steps and 2 Western Red Cedar steps. The concrete steps will accommodate the low flow and bankfull elevations. There will be a 6 inch deep subbase of Class A compacted stone underneath the concrete steps. Filter fabric will be placed between the subbase course and these steps. The steps will overlap each other by 12 inches and will be anchored together using ½" rebar, 3 per step. The 3 foot wide shoulders of the concrete steps will be lined with Class D riprap to protect the launch from scour and erosion. Prairie grass will also be seeded above this bankfull elevation to provide further erosion control. The timber steps will extend beyond the bankfull elevation, reaching a top elevation of 1017.3 feet. The steps will be bound together using 10" timber screws, as well as being anchored to the ground using ½" rebar, 32 inches in length. The first timber step will overlay the top concrete step by 2.5 inches, and the second timber step will overlay the first timber step by 7.25 inches. This value will also be the height of each step, both concrete and timber. The voids in the timber steps will be filled with ⅜" compacted aggregate to provide effective drainage.  All steps will be sloped 3% towards the river to alleviate ponding.

7B Ranch will have one launch constructed that will serve as the last Webster City exit point for river-goers. It will also serve as a launch point for river-goers who want to begin their journey in the protected water area. The details of this launch design can be seen in *Drawing 11* and then in reference to the overall site plan of 7B Ranch Access in *Drawing 5* both located in the drawing sets. The launch will be 5 feet wide, constructed 45 degrees to the river. The launch will be constructed of 9 Class C cast-in-place concrete steps and 2 Western Red Cedar steps. The concrete steps will accommodate both low flow and bankfull elevation launches. There will be a 6 inch deep subbase of Class A compacted stone underneath the concrete steps. Filter fabric will be placed between the subbase course and these steps. The steps will overlap each other by 12 inches and will be anchored together using ½" rebar, 3 per step. The 3 foot wide shoulders of the concrete steps will be lined with Class D riprap to protect the launch from scour and erosion. Prairie grass will also be seeded above this bankfull elevation to provide further erosion control. The timber steps will extend beyond the bankfull elevation, reaching a top elevation of 1013.2 feet. The steps will be bound together using 10" timber screws, as well as being anchored to the ground using ½" rebar, 32 inches in length. The first timber step will overlay the concrete step by 2.5 inches, and the second timber step will overlay the first timber step by 7.25 inches. This value will also be the height of each step, both concrete and timber. The voids in the timber steps will be filled with ⅜" compacted aggregate to provide effective drainage.  All steps will be sloped 3% towards the river to alleviate ponding.

Signage

Signage selection was completed using the Iowa DNR Water Trails Guide. While there are a plethora of different signs available, our selection only includes signs required by the Iowa DNR. We did however include a “Water Trail Rules” sign at every new launch. This was done to ensure the safe use of the water trail by all river-goers; as well as reduce littering on the trail. Examples of all signs are located below in *Figures 2-5*.

At Nokomis Park, there will be six signs placed. The first two signs will be “On-Land Navigational” signs. These will go on the roadway by the entrances to the parking lot to alert river-goers of where to enter the site. The next three signs will go by the launch. These signs are the “State-Designated Water Trail Logo and Trail Identification”, “Next Downstream Launch Identification and Distance”, and “Water Trail Rules” signs. These signs indicate which water trail you’re on, which access point you’re at on the water trail, the distance to the next access point, and alert river-goers of the rules of the water trail. The next sign will also go by the launch. This sign is the “Sign Face for Site with Portage Trail Ahead” sign. This sign will accomplish three things. Firstly, it will warn river-goers of the presence of the dam downstream. It will then inform them that this ramp is the last launch before the dam. Finally, it will alert them that there is a portage trail around the dam if they wish to go on the river.

At Waterworks Park, there will be seven signs placed. The first sign will be the “On-Land Navigational” sign. This will go on the roadway by the entrance to the parking lot to alert river-goers of where to enter the site. The next three signs will go by the launch. These signs are “State-Designated Water Trail Logo and Trail Identification”, “Next Downstream Launch Identification and Distance”, and “Water Trail Rules” signs. These signs indicate which water trail you’re on, which access point you’re at on the water trail, the distance to the next access point, and alert river-goers of the rules of the water trail. Due to the dam being at this site, there will be several dam warning signs implemented. The first sign is the “Sign Face to Identify Bank for Portage Trail” sign. This will go a minimum distance of three times the river width upstream of the next sign. This sign placement gives river-goers plenty of time to move right for the portage trail if they do not wish to go over the dam. The next sign is the “Last Safe Exit” sign. This sign directs river-goers to immediately move right for portage in case they missed the first sign. This sign is placed right before the portage trail sign; which is the final sign at this site. The “Portage Trail Wayfinding” sign is then placed to direct river-goers to the location of the portage trail on the right bank.

At 7B Ranch, there will be four signs placed. The first sign will be the “On-Land Navigational” sign. This will go on the roadway by the entrance to the parking lot to alert river-goers of where to enter the site. The next three signs will go by the launch. These signs are “State-Designated Water Trail Logo and Trail Identification”, “Next Downstream Launch

Identification and Distance", and "Water Trail Rules" signs. These signs indicate which water trail you're on, which access point you're at on the water trail, the distance to the next access point, and alert river-goers of the rules of the water trail.


*Figure 2: Sample On Land Navigational Sign.*

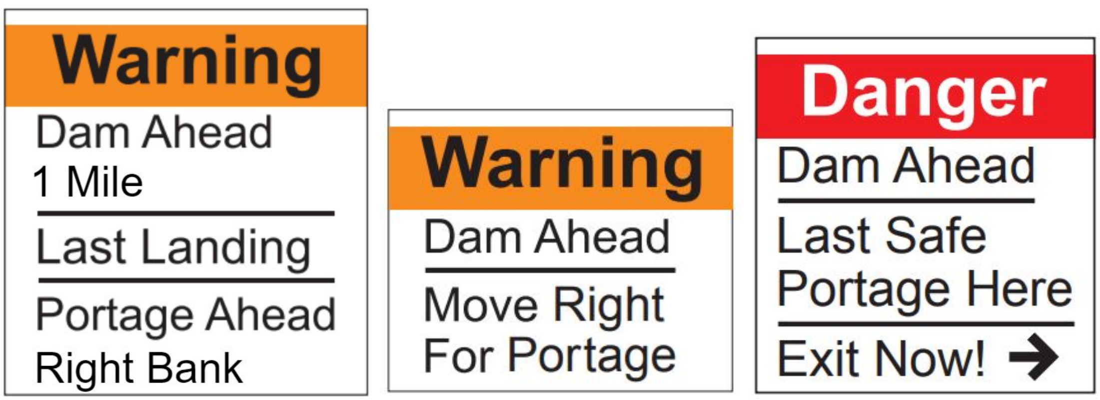



*Figure 3: Sample Dam Warning and Danger Signs.*


*Figure 4: Sample State-Regulated Water Trail Logo, Trail Identification, and Water Trail Rules Signs.*


*Figure 5: Sample Portage Trail Wayfinding Sign.*

Steel Capping of the Low Head Dam

Honoring the City's request, our team has selected a dam modification design that would allow for smooth and safe passage over the low-head dam, and allow for a connected water trail along the Boone River. The dam modification design can be seen in *Drawing 9* located in the drawing sets. A 103.5' long section of C15 x 33.9 galvanized steel will be anchored to the top of the dam. Steel was a relatively inexpensive and durable material. When compared to other capping materials, such as wood or concrete, it had a greater resistance to the freeze-thaw cycles which is critical in Iowa's winter climate. The steel beam will provide cover over the sheet pile allowing for river goers to pass over the dam smoothly, avoiding the sheet pile's rough edges. The bolts used to anchor the steel to the dam will be 316 stainless steel hex cap screws; ¾" diameter, each 6 inches in length. The cap screws will be placed every 18 inches, on each side of the dam, connecting to the outermost side of the sheet pile.

Downstream Rock Arch Rapids

To help prevent recirculating currents and eliminate the "drowning effect" commonly associated with low head dams, riprap and boulders will be placed downstream of the dam crest as indicated in *Drawing 10*. Our team utilized the requirements specified in the Iowa DNR River Restoration Toolbox Practice Guide 1. The full detail of requirements can be found in *Appendix I*. An average bed slope of 5% can be achieved by grading with random broken stone or waste concrete (approximately ¼-⅜ cubic yard in size) followed by a 2.5' thick layer of Class A granular subbase. ⅜" aggregate will be used to fill in voids every 2' of base placement as well as covering 0.75-1.0' of the boulders in the rock arches. The reach of the rapids span about 70' downstream of the dam crest. The arch rapids or weir structures are spaced 14' apart to ensure a head loss over each arch of no greater than 0.8'. Fieldstone boulders that are used in the rock arches should be sized approximately 3.5' wide, 3.0' long, and 1.5' thick. It is critical that the boulders are wider than they are long or thick to avoid rotating or shifting out of place due to shear forces in the river. A 0.4-1.0' gap in every rock arch shall be included to allow for fish passage. Some randomness can be introduced by alternating the cross sectional position of the gap in each weir. Additional boulders should be placed 1' downstream of the gaps.

Our team hopes that this rock arch rapids feature will provide a unique and exciting element to the City of Webster City and patrons of the Boone River Recreational Water Trail. The rock arch rapids design caters to recreational users of all levels of experience as faster, more turbulent water is directed to the center of the arches while more calm waters can be experienced on the edges of the rock arches.

It should be noted that this is a conservative and preliminary design put together by our design team based on the recommendations and requirements in the Iowa DNR River Restoration Toolbox Practice Guide 1. A stream restoration professional should be consulted for final designs.

Water Quality & Stormwater Management

Infiltration trenches containing observation wells will be used at all sites to meet stormwater management requirements. This stormwater management design was chosen because it best agrees with the design criteria considered in *Table 2* above. The goal of on-site stormwater management is to minimize impact to water resources from construction of amenities serving water trail recreation, as well as capture any contaminants from the parking lot to prevent them from being discharged into the Boone River. Infiltration trenches are long, narrow, rock-filled trenches that receive stormwater runoff. Runoff is stored in the void space between the aggregate before eventually being infiltrated into the ground. Infiltration trenches perform well in removing fine sediment and pollutants, making them great stormwater management solutions for parking lots.

A more in depth field survey should be conducted to validate the information gathered from the web soil survey before construction begins. It was determined that infiltration trenches were best suited for all three sites. Additionally, infiltration trenches have a smaller footprint than bioretention basins and are generally more cost effective. The Water Quality Volume method outlined in the IDNR Stormwater Manual was used to design the infiltration trenches. This method assumes that the runoff from 90% of the storms that occur in an average year will be treated. For Iowa, this equates to providing water quality treatment for the runoff resulting from a rainfall depth of 1.25 inches. The results of these calculations are shown in *Appendix H*.

A 20' long vegetated filter strip will be placed between each parking area it's respective infiltration trench. This allows the runoff to be kept as sheet flow, which is critical for the operation of the infiltration trench. Native Iowa prairie grasses and plants are recommended for use in the filter strips. Chapter 3 of the IDNR Water Trail Design Guide has an extensive list of native plants that can be used for filter strips. A combination of blue lobelia, goldenrod cultivars, and butterfly milkweed are recommended. Native prairie plants in combination with infiltration trenches not only manage the quantity of water, but also manage the quality of water by removing nitrogen, phosphorus, metals, and hydrocarbons. Additionally, the prairie plants will also provide a habitat for pollinators and be aesthetically pleasing to visitors. Cross sections of the infiltration trenches can be seen in *Drawing 12* located in the drawing sets .

<u>Additional Amenities</u>

Additional amenities will also be included to better accommodate river-goers. These amenities include bike racks, kayak racks, benches, and solar compacting trash cans. A bike rack will be placed at the 7B Ranch access location to provide users the opportunity to self shuttle. For example, a kayaker could park their bike at 7B Ranch and then drive to Nokomis Park or Waterworks Park to begin their journey. Afterwards, the kayaker could utilize the city's existing bike trail to travel back to their vehicle. Kayak racks will also be provided at each site to help with staging and managing equipment. Similarly, benches could be used to put on equipment or for staging purposes. To help manage the amount of trash that can be generated from river users, solar compacting trash cans will be placed at each site. Solar compacting trash bins can hold up to eight times as much garbage and recyclable material. The ability to store more garbage will ease the burden placed on the city's waste management team. Additionally, many models of solar compacting trash bins can be monitored on a phone and can alert waste management when they need to emptied, thus saving time and money.

Although the dual compacting units, which include both trash and recycling bins, have an initial cost of $7,000 each, there is a relative short payback period for their usage. Our team assumed that without these bins they would need to hire an additional waste management staff member during the summer months when the recreation trails are in high usage (3 months), who would be working full time (40 hours/week) making an hourly salary of $11.00/hour. The hiring of this additional employee would cost the City roughly $5,280/year. Knowing this, and instead implementing three dual unit solar compacting bins - one at each location - would have an total initial cost of $21,000 that could be reach a full payback period in approximately 4 years.

## Section VII: Engineer's Cost Estimate

Below is a cost estimate for the complete construction of the proposed final design at all three site locations. Unit prices for each material were compiled using 2018 RS Means Construction Cost Data. The unit prices include the cost of material, labor, and equipment for each item. A 15% contingency factor was included to provide for any discrepancy or unexpected additional costs. The final construction cost estimate was $409,300. The summary of project costs can be found below in *Table 4*. A complete breakdown of each phased project and its respective elements can be found in *Appendix G*.

*Table 4: Summary of Project Cost Estimates.*

| | |
|---|---|
| **NOKOMIS PARK** | |
| SUBTOTAL | $ 83,900 |
| + 15% Contingency | $ 96,000 |
| | |
| **WATER WORKS PARK** | |
| SUBTOTAL | $ 162,000 |
| + 15% Contingency | $ 186,300 |
| | |
| **DAM & ROCK RAPIDS** | |
| SUBTOTAL | $ 49,000 |
| + 15% Contingency | $ 56,000 |
| | |
| **7B RANCH** | |
| SUBTOTAL | $ 62,000 |
| + 15% Contingency | $ 71,000 |
| | |
| **TOTAL PROJECT COST** | $ 409,300 |

## Appendices

Appendix A: Bid Page

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

## RFP # 06-spring2019

## Recreational River Access

| |
|---|
| Bidder's Organization Name: ZDA Consultants Inc. |
| Lead Point of Contact for Proposal - Name/Title: Zachary Heisterkamp / Project Manager |

| | |
|---|---|
| Proposed Cost: | $24,543.00 |
| *The proposed cost listed above is for reference purposes only, not evaluation purposes. In the event that the cost noted above does not match the Bidder's detailed cost proposal documents, then the information on the cost proposal documents will take precedence.* | |

- This proposal and the pricing structure contained herein will remain firm for a period of 180 days from the date and time of the bid opening.
- No personnel currently employed by the Department participated, either directly or indirectly, in any activities relating to the preparation of the Bidder's proposal.
- No attempt has been made or will be made by the Bidder to induce any other person or firm to submit or not to submit a proposal.
- The undersigned is authorized to enter into obligations on behalf of the above-named organization.

*To the best of my knowledge all information provided in the enclosed proposal, both programmatic and financial, is complete and accurate at the time of submission.*

Zachary Heisterkamp 2/8/2019 — Zachary Heisterkamp, Project Manager

Authorized Signature — Date — Name and Title (Typed)

Appendix B: Tasks Form

# UNIVERSITY OF IOWA
# DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING
**Project Design & Management**

(CEE:4850:0001)

## RFP # 06-spring2019

## Recreational River Access
## Tasks Form

Bidder's Organization Name: ZDA Consultants Inc.

| Task Description | Task Hours |
|---|---|
| Task 1: Research & Development for Design | 75 |
| Task 2: Hydraulic Analysis and River Assessment | 90 |
| Task 3: Low-Head Dam Modification | 90 |
| Task 4: Drafting for River Access Design | 60 |
| Task 5: Drafting for Site Development and Accessibility | 60 |
| Task 6: Report and Presentation | 45 |
| TOTAL BILLABLE HOURS | 420 |

Appendix C: Cost of Engineering Services Form

# UNIVERSITY OF IOWA
# DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

**Project Design & Management**

(CEE:4850:0001)

## RFP # 06-spring2019

## Recreational River Access
## Cost Form

Bidder's Organization Name: ZDA Consultants Inc.

| Budget Summary | | | | | |
|---|---|---|---|---|---|
| **Task** | **Hours** | **Hourly Rate**[1] | **Multiplier for Overhead, Profit, and Benefits**[2] | **Total** | |
| Research & Development for Design | 75 | $29.00 | 2.00 | $4,350.00 | |
| Hydraulic Analysis and River Assessment | 90 | $29.00 | 2.00 | $5,220.00 | |
| Low-Head Dam Modification | 90 | $29.00 | 2.00 | $5,220.00 | |
| Drafting for River Access Design | 60 | $29.00 | 2.00 | $3,480.00 | |
| Drafting for Site Development and Accessibility | 60 | $29.00 | 2.00 | $3,480.00 | |
| Report and Presentation | 45 | $29.00 | 2.00 | $2,610.00 | |
| | 420 | | | **$24,360.00** | **SUBTOTAL** |
| Travel Expenses | N/A | $0.29/mi X 317 miles | 2 trips | $184.00 | |
| | | | | **$24,544.00** | **TOTAL COST** |

[1] Direct Costs is broadly defined as any cost that can be assigned to a specific task in an accurate way, such as wages, materials, and supplies.
[2] Indirect Costs include overhead costs of maintaining a design firm and employee fringe benefits that cannot be accurately attributed to given tasks and profit margin.

Appendix D: Client Information and Work Products

**Contact**

Kent Harfst
Recreation & Public Grounds Director/Assistant City Manager
515-832-9193
kent_harfst@webstercity.com

Lindsay Henderson
Community Vitality Director
515-832-9151
lhenderson@webstercity.com

**Location**

Webster City, IA

**Work products:**

Site design is to be completed in Civil 3D. The design is to be generated and shown in plan and cross section views and rendered in 3D. The final plan drawings are to be used to generate a plan set that is printable both electronically and on paper*.

The site drawings shall include as a minimum the following elements:

- Site Location
- Construction boundaries
- Existing and future facilities/improvement locations
- Existing and final grading (cut and fill requirements)
- Retaining walls (if applicable)
- Stormwater drainage
- Access road
- Sidewalks
- Other applicable improvement

River access points are to adhere to the Iowa DNR guidance for water trail development. The design is to be complete in Civil 3D, shown in plan and cross section views, and rendered in 3D. The final plan drawings are to be used to generate a plan set that is printable both electronically and on paper*.

Parking lot design is to be completed using Civil 3D. The design is to be generates and shown in plan and cross section views, rendered in 3D, evaluated using swept path analysis and a visual drive through generated. The final plan drawings are to be used to generate a plan set that is printable both electronically and on paper*.

The design shall include as a minimum the following elements:

- Location and size
- Parking stall number, size and location using Civil 3D Vehicle Tracking
- Swept-path Analysis using Civil 3D Vehicle Tracking
- Cross-section

Pavement type and thickness
Drainage

Access road design is to be completed in Civil 3D. The designs are to be generated and shown in plan and cross sections views, rendered in 3D and a visual drive through generated. The final plan drawings are to be used to generate a plan set that is printable both electronically and on paper*.
The design shall include as a minimum the following elements:

Horizontal alignment
Vertical alignment
Cross-section
Swept path analysis using Civil 3D Vehicle Tracking
Pavement type and thickness
Drainage

Shelter structure designs are to follow applicable building standards and codes and to be completed in AutoCAD using Robot Structural Analysis extension (or comparable software). The design is to be shown in plan and cross section views and rendered in 3D. The rendering shall be created using AutoCAD Revit (3D Max or comparable software). The final plan drawings are to be used to generate a plan set that is printable both electronically and on paper*.
The design may include as a minimum the following elements:

Foundations
Foundation wall
Floor Slab
Walls
Roof beams/trusses
Doors and windows located and sized
Lintels and/or beams above openings in walls
Utility entrance (Water supply, Wastewater, Electrical supply)

*Drawings

Drawing Size. All drawings of a single project must be a uniform standard size, as designated by the American National Standards Institute (ANSI). The following is the required sheet size:

(D) 22” x 34”     560 mm x 860 mm

Drawing Lettering. Lettering on drawings must be legible when drawings are reduced to half size and when they are printed as PDF. This applies to concept and design development drawings.

Drawing Scale. All drawings will be produced with metric drawing scales which are always expressed in nodimensional ratios. Scales should also be illustrated graphically on the drawings. Scale of drawings should be appropriate for high resolution and legibility to include half-size reduced copies.
There are nine preferred base scales: 1:1 (full size), 1:5, 1:10, 1:20, 1:50, 1:100, 1:200, 1:500, 1:1,000. Three others have limited usage: 1:2 (half size), 1:25, 1:250. Floor plans should be drawn at 1:100 (close to ⅛-inch scale).

CAD Standards. The National CAD/CIFM Standards should be obtained via the internet. These guidelines should be followed for all CAD drawing formatting.

Dimensioning. US Customary Units are the unit of measurement to appear on documents for building plans and details for all disciplines.

# Appendix E: Design Team Resumes

## David Braun


University Address:
514 S Dodge St
Iowa City, IA 52240

(847) 922-3567
david.alexander.braun@gmail.com

Permanent Address:
263 Arlington Ln.
Grayslake, IL 60030


**EDUCATION**

The University of Iowa, Iowa City, IA — Anticipated Graduation Date: May 2019

- **B.S.E Civil Engineering**, focus on Water Resources & International Development — GPA: 3.29/4.00

**WORK EXPERIENCE**

**Water Intern**, HDR, Inc. Des Moines, IA — May 2018 – January 2019

- Analyzed deficiencies in inlet and pipe capacities using **InfoWorks ICM** 1D and 2D hydrological modeling software and local survey data
- Calculated high-level cost estimates and project benefits to determine recommended project alternatives
- Evaluated opportunities for integration of green infrastructure into flood mitigation projects
- Prepared project figures using **ArcGIS** and **Bluebeam Revu** illustrating our proposed alternatives and model results
- Conducted traffic counts of intersection during peak hours and drafted highway drainage culverts in **MicroStation**

**ENGINEERING PROJECT EXPERIENCE**

*Design of Transportation Systems* — August 2018 – December 2018

**Rural Expressway Bypass**

- Designed four alternative routes using **ArcGIS**, and Iowa DOT/SUDAS Design Manuals
- Assessed alternatives based on environmental impact according to NEPA, existing land cover, project cost, and forecasted population/traffic growth
- Created alignments, assemblies, corridors, and cut/fill reports for the recommended route using **Civil 3D**

*Engineers Without Borders Iowa Professional Chapter* — November 2016 – Present

**El Salvador - New Community Pump System**

- Identified new accessible fresh water sources to accommodate for current failing filter system and wells, by studying local area from satellite pictures and community's description
- Collected soil boring samples, recorded depth to water table, salinity, elevations, tidal influences
- Led technical report/demonstration for community leaders at end of project week, for their continued data collection
- Designed a single pump/pipe system to carry water 2 miles back to community

*University of Iowa Study Abroad* — December 2017 – January 2018

**Mewat District, India – Freshwater Crisis Case Study**

- Sampled soils and tube wells, measured water levels, quality, and salinity to observe effect of check dams and rainwater harvesting systems after monsoon seasons

**PROFESSIONAL INVOLVEMENT AND LEADERSHIP**

**President/Concrete Canoe/Corn Monument, ASCE** — August 2015 – Present

- Lead general and executive board meetings, organize regional conferences, and volunteer/social events
- Coordinate fundraising campaigns with local businesses to aid design teams' budgets
- Created/tested various mixes of concrete to get ideal density without sacrificing tensile strength

**Vice President of Events, Student Advancement Network /UI Foundation** — January 2016 – Present

- Interact with students, donors, and alumni to promote the importance of philanthropy and alumni engagement
- Organize and host campus events like President's Block Party, Phil's Week, guest lectures, Alumni events, building tours, volunteering with Dance Marathon, and networking with university donors

**Secretary, Chi Epsilon Honors Fraternity** — October 2017 – Present

- Civil Engineering Honors Society focused on community service/involvement by promoting STEM related fields

**Section Leader, Hawkeye Marching Band** — July 2011 – Present

- Lead 260 peers by teaching, constructively critiquing, and directing to excel visually and musically

**TECHNICAL SKILLS:** ArcGIS, Civil 3D InfoWorks ICM, AutoCAD, Bluebeam Revu, MicroStation, Lab Work with Chemicals, Recording Elevations with Survey Equipment, Microsoft Office Suite

*Figure E-1: Resume of David Braun.*

# AARON GEHRKE

510 South Van Buren Street Apt 9, Iowa City, IA 52240 • Cell: 563-349-2927 • Aaron-Gehrke@uiowa.edu

## Objective

To apply my engineering skills, and my passion for sustainability, to the real world through an internship, or co-op, in the field of Civil/Environmental Engineering.

## Skills

- AutoCAD experience
- JAVA experience
- Construction tools handling
- Firearm and explosives handling

## Education

**Bachelor of Science**: Environmental Engineering, Current
**University of Iowa, College of Engineering** - 3100 Seamans Center, Iowa City, IA 52240
- Currently completing coursework to obtain a Certificate in Sustainability.
- Expected graduation date: 2018

## Work History

**12B, Combat Engineer**, 03/2016 to Current
**Iowa Army National Guard, B CO 228th BEB** – 3615 Brady St, Davenport, IA 52806
- Trained and proficient in: bridge assembly, land navigation, weapons and equipment maintenance, first aid, explosives construction, radio communications, and mine detection.

**Construction Laborer**, 11/2016 to Current
**Hall Masonry Inc** – 4774 Orval Yoder Turnpike SW, Kalona, IA 52247
- Used hammers, saws, cement mixers, scaffolding, and other tools to prepare construction sites and assist the brick layers in construction.
- Loaded and unloaded building materials used for construction.

**Line Cook**, 08/2015 to Current
**BoJames Burger and Brew** – 118 East Washington St, Iowa City, IA 52240
- Prepared food items consistently and in compliance with recipes, portioning, cooking and waste control guidelines.

**Food Service**, 04/2013 to 07/2014
**Genesis Medical Center** – 1227 East Rusholme St, Davenport, IA 52803
- Positively engaged with patients, offering menu information, and delivering food trays to their rooms.
- Washed dishes, glassware, flatware, pots, and/or pans using dishwashers or by hand.

*Figure E-2: Resume of Aaron Gehrke.*

**Zach Heisterkamp**

614 S. Clinton St. #1 | (712)-253-8348
Iowa City, IA 52242 | zachary-heisterkamp@uiowa.edu

**Education**

The University of Iowa, Iowa City, IA | August 2015 - Present
Major: **Civil Engineering** | Current GPA: **3.81**/4.00
Focus Area: **Environmental**

**Engineering Experience**

**Engineering Intern** | Summer & Winter 2016-2017
City of Cedar Falls Engineering Division

- Assisted with underground and pavement inspection for the 2016 & 2017 Reconstruction Project
- Assisted with general surveying duties for 2016 & 2017 Reconstruction Project
- Collaborated with CAD technicians and engineers to produce effective plans

**Undergraduate Researcher** | Fall 2017-Present
IIHR Hydroscience & Engineering

- Managed and deployed field instrumentation, such as pressure transducers, turbidity sensors, and web cameras at various creek monitoring sites around the Iowa City area.
- Organized and presented data obtained from creek monitoring sites on a weekly basis.

**NSF-Research Experience for Undergraduates (REU)** | Summer 2018
Interdisciplinary Geospatial Approaches to Watershed Science (I-GAWS)

- Designed and implemented research techniques for parameterizing riparian vegetation using LiDAR
- Visited with stakeholders involved with Iowa Nutrient Reduction Strategy, such as Des Moines Water Works and the Iowa Soybean Association.
- Presented at the University of Iowa I-GAWS REU 2018 Summer Symposium

**Leadership and Volunteer Experience**

**Women's Resource Action Center** | Fall 2017-Present

- Co-facilitated workshops to promote and empower University of Iowa students to become allies in shifting unhealthy social norms and eliminating violence in the community
- Collaborated with university staff to present violence prevention and bystander intervention workshops
- Received national certification as a NASPA peer educator

**American Society of Civil Engineers** | Fall 2017- Present

- Fundraising chair (2017)
- Raised money for the corn monument, concrete canoe competition, and the steel bridge competition
- Participated in the annual student-faculty golf outing at Brown Deere Golf Course

**Theta Tau** | Spring 2017-Present
Professional Engineering Fraternity

- Participate with Habitat for Humanity to construct affordable housing in the Iowa City area.
- Host carnival games at the Party After the Parade during Homecoming week.

**Technology Experience**

AutoCAD Civil3D, Excel, Agisoft Photoscan, LiDAR, Cyclone, ArcMap

*Figure E-3: Resume of Zach Heisterkamp.*

## Appendix F: Gantt Chart


*Figure F-1: Project Gantt Chart.*

## Appendix G: Project Construction Cost Estimate

*Table 3: Summary of Project Cost Estimates.*

| | |
|---|---|
| **NOKOMIS PARK** | |
| SUBTOTAL | $ 83,900 |
| + 15% Contingency | $ 96,000 |
| | |
| **WATER WORKS PARK** | |
| SUBTOTAL | $ 162,000 |
| + 15% Contingency | $ 186,300 |
| | |
| **DAM & ROCK RAPIDS** | |
| SUBTOTAL | $ 49,000 |
| + 15% Contingency | $ 56,000 |
| | |
| **7B RANCH** | |
| SUBTOTAL | $ 62,000 |
| + 15% Contingency | $ 71,000 |
| | |
| **TOTAL PROJECT COST** | $ 409,300 |

*Table G-1: Cost Estimate for Nokomis Park.*

| MATERIAL | TYPE | UNIT | QUANTITY | UNIT PRICE | COST |
|---|---|---|---|---|---|
| Cut | Earthwork | CY | 842.97 | $1.44 | $1,211.77 |
| Fill | Earthwork | CY | 187.47 | $38.40 | $7,198.85 |
| Concrete | Paving | SY | 309.52 | $200.00 | $61,903.70 |
| Concrete Parking Bumpers | Paving | Ea. | 6.00 | $75.90 | $455.40 |
| Pavement Markings | Paving | LF | 200.00 | $0.23 | $46.00 |
| 4" PVC Pipe | Pipe | LF | 3 | $50.00 | $150.00 |
| 3/8" Aggregate | Aggregate | Ton | 8.76 | $28.50 | $249.74 |
| 1-3" Aggregate | Aggregate | Ton | 24.44 | $35.00 | $855.56 |
| Medium Aggregate Sand | Aggregate | CY | 11.93 | $29.50 | $351.81 |
| Class A Granular Subbase | Aggregate | Ton | 19.11 | $21.00 | $401.31 |
| Class E Rip Rap | Aggregate | Ton | 18.9 | $38.22 | $722.36 |
| Stabilization Fabric | Landscape | SY | 51.11 | $0.86 | $43.96 |
| Landscape Filter Fabric (18" x 180' ro | Landscape | SF | 1.56 | $58.50 | $91.00 |
| Tree Removal | Landscape | Ea. | 4 | $450.00 | $1,800.00 |
| Shrub Removal | Landscape | ac | 0.03 | $1,386.00 | $45.74 |
| Seeding and Fertilizer | Landscape | ac. | 0.05 | $759.50 | $37.06 |
| Vegetative Seeds | Landscape | ac. | 0.06 | $150.00 | $9.45 |
| Accessible Parking Sign and Post | Signage | Ea. | 1 | $276.00 | $276.00 |
| Water Trail Signs | Signage | Ea. | 3 | $200.00 | $600.00 |
| Solar Compacting Bins (Dual Unit) | Misc. | Ea. | 1 | $7,000.00 | $7,000.00 |
| Wooden Park Bench | Misc. | Ea. | 1 | $500.00 | $500.00 |
| | | | | **SUBTOTAL** | **$83,950** |
| | | | | 15% Contingency | $12,592 |
| | | | | **TOTAL PROJECT COST** | **$96,542** |

*Table G-2: Cost Estimate for Waterworks Park.*

| MATERIAL | TYPE | UNIT | QUANTITY | UNIT PRICE | COST |
|---|---|---|---|---|---|
| Cut | Earthwork | CY | 670.95 | $1.44 | $964.49 |
| Fill | Earthwork | CY | 52.69 | $38.40 | $2,023.30 |
| Concrete | Paving | SY | 697.94 | $200.00 | $139,587.63 |
| Pavement Markings | Paving | LF | 300.00 | $0.23 | $69.00 |
| 4" PVC Pipe | Pipe | LF | 3 | $50.00 | $150.00 |
| 3/8" Aggregate | Aggregate | Ton | 23.05 | $28.50 | $656.84 |
| 1-3" Aggregate | Aggregate | Ton | 40.00 | $35.00 | $1,400.00 |
| Medium Aggregate Sand | Aggregate | CY | 6.67 | $29.50 | $196.67 |
| Class A Granular Subbase | Aggregate | Ton | 7.28 | $21.00 | $152.88 |
| Class D Rip Rap | Aggregate | Ton | 10.56 | $34.19 | $361.05 |
| Timber | Steps | MBF | 0.03 | $2,650.00 | $79.50 |
| 10" Timber Screws | Support | Ea. | 12 | $4.50 | $54.00 |
| 1/2" Rebar (32" long) | Support | Ea. | 15 | $1.10 | $16.50 |
| Stabilization Fabric | Landscape | SY | 80.00 | $0.86 | $68.80 |
| Landscape Filter Fabric (18" x 180' ro | Landscape | Ea. | 2.11 | $58.50 | $123.72 |
| Tree Removal | Landscape | Ea. | 15 | $450.00 | $6,750.00 |
| Shrub Removal | Landscape | ac | 0.16 | $1,386.00 | $221.76 |
| Vegetative Seeds | Landscape | ac. | 0.07 | $150.00 | $10.35 |
| Accessible Parking Sign and Post | Signage | Ea. | 2 | $276.00 | $552.00 |
| Water Trail Signs | Signage | Ea. | 6 | $200.00 | $1,200.00 |
| Solar Compacting Bins (Dual Unit) | Misc. | Ea. | 1 | $7,000.00 | $7,000.00 |
| Wooden Park Bench | Misc. | Ea. | 1 | $500.00 | $500.00 |
| | | | | **SUBTOTAL** | **$162,138** |
| | | | | 15% Contingency | $24,321 |
| | | | | **TOTAL PROJECT COST** | **$186,459** |

*Table G-3: Cost Estimate for Dam Capping and Downstream Rock Arch Rapids*

| MATERIAL | TYPE | UNIT | QUANTITY | UNIT PRICE | COST |
|---|---|---|---|---|---|
| C15" x 33.9" Beam | Capping | LF | 122 | $55.00 | $6,710.00 |
| 1/2" Steel Bolts (6" long) | Support | Ea. | 19 | $5.02 | $95.38 |
| 3/8" Aggregate | Aggregate | Ton | 709.80 | $28.50 | $20,229.30 |
| Random Broken Stone | Aggregate | SY | 40.00 | $100.90 | $4,036.00 |
| Class A Granular Subbase | Aggregate | Ton | 1.00 | $21.00 | $20.90 |
| Field Stone Bolders | Aggregate | Ton | 55 | $300.00 | $16,500.00 |
| Landscape Filter Fabric (18" x 180' ro | Landscape | Ea. | 28 | $58.50 | $1,638.00 |
| | | | | **SUBTOTAL** | **$49,230** |
| | | | | 15% Contingency | $7,384 |
| | | | | **TOTAL PROJECT COST** | **$56,614** |

*Table G-4: Cost Estimate for 7B Ranch Access.*

| MATERIAL | TYPE | UNIT | QUANTITY | UNIT PRICE | COST |
|---|---|---|---|---|---|
| Cut | Earthwork | CY | 507.73 | $1.44 | $729.86 |
| Fill | Earthwork | CY | 28.54 | $38.40 | $1,095.94 |
| Concrete | Paving | SY | 226.35 | $200.00 | $45,270.37 |
| Concrete Parking Bumpers | Paving | Ea. | 6 | $75.90 | $455.40 |
| Pavement Markings | Paving | LF | 200.00 | $0.23 | $46.00 |
| 4" PVC Pipe | Pipe | LF | 3 | $50.00 | $150.00 |
| 3/8" Aggregate | Aggregate | Ton | 10.53 | $28.50 | $300.06 |
| 1-3" Aggregate | Aggregate | Ton | 17.78 | $35.00 | $622.22 |
| Medium Aggregate Sand | Aggregate | CY | 2.96 | $29.50 | $87.41 |
| Class A Granular Subbase | Aggregate | Ton | 8.19 | $21.00 | $171.99 |
| Class D Rip Rap | Aggregate | Ton | 11.88 | $34.19 | $406.18 |
| Timber | Steps | MBF | 0.03 | $2,650.00 | $79.50 |
| 10" Timber Screws | Support | Ea. | 12 | $4.50 | $54.00 |
| 1/2" Rebar (32" long) | Support | Ea. | 17 | $1.10 | $18.70 |
| Stabilization Fabric | Landscape | SY | 51.11 | $0.86 | $43.96 |
| Landscape Filter Fabric (18" x 180' ro | Landscape | SF | 0.83 | $58.50 | $48.75 |
| Tree Removal | Landscape | Ea. | 10 | $450.00 | $4,500.00 |
| Shrub Removal | Landscape | ac | 0.05 | $1,386.00 | $66.53 |
| Vegetative Seeds | Landscape | ac. | 0.03 | $150.00 | $5.10 |
| Accessible Parking Sign and Post | Signage | Ea. | 1 | $276.00 | $276.00 |
| Water Trail Signs | Signage | Ea. | 2 | $200.00 | $400.00 |
| Solar Compacting Bins (Dual Unit) | Misc. | Ea. | 1 | $7,000.00 | $7,000.00 |
| Wooden Park Bench | Misc. | Ea. | 1 | $500.00 | $500.00 |
| | | | | **SUBTOTAL** | **$62,328** |
| | | | | 15% Contingency | $9,349 |
| | | | | **TOTAL PROJECT COST** | **$71,677** |

## Appendix H: Infiltration Trench Calculations

Water Quality Volume Method

$$WQv = \frac{(P)(Rv)(A)}{12}$$

Where:

WQv = Water quality volume

P = rainfall depth in inches for selected area of state (i.e. 1.25 inches)

A = Area in feet

Rv = Site runoff volume coefficient (0.95 for pavement)

I = % Impervious

Computing Trench Surface Area

$$A_t = \frac{WQv}{nd_t + \frac{fT}{12}}$$

Where:

$A_t$ = Trench surface area, $ft^2$

f = infiltration rate, in/hr

T = drain time (maximum time to dewater the entire WQv), hours

$d_t$ = trench design depth

n = porosity of the stone reservoir in the trench

Assumptions

f = 0.50 in/hr (conservative estimate)

n = 0.35 (typical)

T = 48 hr (Iowa Storm Water Manual)

$d_t$ = 3 ft (design choice)

Nokomis Infiltration Trench

$$WQv = \frac{(1.25\ in)(0.95)(7216\ ft^2)}{12} = 714\ ft^3$$

$$A_t = \frac{WQv}{nd_t + \frac{fT}{12}} = \frac{714\ ft^3}{(0.35)(3\ ft) + \frac{(0.5\frac{in}{hr})(48\ hr)}{12}} = 234\ ft^2$$

Water Works Infiltration Trench

$$WQv = \frac{(1.25\ in)(0.95)(11285\ ft^2)}{12} = 1117\ ft^3$$

$$A_t = \frac{WQv}{nd_t + \frac{fT}{12}} = \frac{1117\ ft^3}{(0.35)(3\ ft) + \frac{(0.5\frac{in}{hr})(48\ hr)}{12}} = 366\ ft^2$$

7B Ranch Infiltration Trench

$$WQv = \frac{(1.25\ in)(0.95)(4902\ ft^2)}{12} = 485\ ft^3$$

$$A_t = \frac{WQv}{nd_t + \frac{fT}{12}} = \frac{485\ ft^3}{(0.35)(3\ ft) + \frac{(0.5\frac{in}{hr})(48\ hr)}{12}} = 159\ ft^2$$

## Appendix I: IDNR Rock Arch Rapids Requirements and Details

*Table I-1: Required Design Data for Freestanding Rock Arch Rapids.*

| Dimension[2] | Name | Typical Unit | Guidelines[3] | Description |
|---|---|---|---|---|
| A | Bankfull width | Feet | ≥15 feet; mid-sized to large streams | The channel width at bankfull stage, often where discharge has filled the channel to the top of its banks and water begins to overflow onto a floodplain |
| B1 | Low-flow trough width | Feet | Width based on analysis of median discharge for month of August, a low flow trough depth=±1', and roughness that considers weir stone protrusion (±0.5') | Width of a small, pilot channel to concentrate low flows. Also, "fish trench." |
| B2 | Low-flow trough depth | Feet | Approx. 1'-- Maintain trough depth by adjusting trough channel width for base stone and weir stones. Target spilling out into channel base on outsides of trough. | Depth of a small, pilot channel to concentrate low flows. Also, fish trench. |
| C | Channel base width | Feet | -- | Width of the existing channel bottom from toe of bank to toe of bank as defined by a break in slope between the steeper channel bank and the flatter channel bottom. This can also be defined by the width typically submerged by tailwater on smaller dams. |
| D | Boulder weir spacing | Feet | Spacing calculated based on overall head loss and not exceeding 0.8-ft. drop per weir | Spacing between arched boulder weirs measured from water surface to water surface at thalweg |
| E | Rock arch rapids length | Feet | Length between up- and- downstream tie-in points such that slope is ≤5% | Length between upstream end of elevation drop (e.g. -at dam, culvert outlet, headcut, other instability) and downstream limits of the installation |
| F | Weir angle | Degrees | 20-30°; a more acute angle can be used to resolve steeper side slopes | Angle between the bank and upstream from the tangent line where the arched boulder weir intercepts the bank |
| G | Cut-off sill (keyway) length | Feet | ½ Bankfull Width | Boulder weirs that extend beyond the point where they intercept the stream bank; this helps prevent out-of-bank flows from washing around the weirs |

| Dimension[2] | Name | Typical Unit | Guidelines[3] | Description |
|---|---|---|---|---|
| H | Weir drop | Feet | ≤0.8 ft; measured from water surface to water surface at thalweg for Iowa fish passage | Height difference between the successive arched boulder weirs that does not exceed the physical mobility limitations of subject fish species |
| I | Base stone layer thickness | Feet | ≥2 x D100 of select base stone; 2.5 feet minimum and must be thicker than D50 calculation. | Thickness of select base material |
| J | Volume of rock and/or waste concrete | Cubic yards | Convert to tons for contractor bidding. | The volume to fill in the sub-pavement (wedge) between the upstream and downstream ends of the rapids up to the subgrade on which the base stone (pavement) is placed. |
| K | Centerline slope | Percent | ≤5% | Slope along the center (thalweg) of the rock arch rapids, from the upstream grade control to end of the rock arch rapids' tie-in to the downstream channel bottom. |
| L | Side slope | Ratio | 1:1 maximum | Slope of the stream bank down to a point 1/3 across the channel bankfull width |

| Dimension[2] | Name | Typical Unit | Guidelines[3] | Description |
|---|---|---|---|---|
| M | Weir boulder length | Feet | 3.5 ft. average; ideally weir boulders should be longer than they are wide and thick ("flat-shaped"), to resist rotation, tumbling, and be of a durable composition. They should be large enough to resist movement due to shear stress generated by concentrated flow (including ice and debris) thru the rapids. | One of three measurements to describe size of weir boulder building materials, the length is typically the largest dimension |
| N | Weir boulder width | Feet | 3.0 ft average; ideally weir boulders should be longer than they are wide and thick ("flat-shaped"), to resist rotation, tumbling, and be of a durable composition. They should be large enough to resist movement due to shear stress generated by concentrated flow (including ice and debris) thru the rapids. | One of three measurements to describe size of weir boulder building materials, the width is typically the median dimension |

| Dimension[2] | Name | Typical Unit | Guidelines[3] | Description |
|---|---|---|---|---|
| O | Weir boulder thickness | Feet | 1.5 ft minimum; ideally weir boulders should be longer than they are wide and thick ("flat-shaped"), to resist rotation, tumbling, and be of a durable composition. They should be large enough to resist movement due to shear stress generated by concentrated flow (including ice and debris) thru the rapids. | One of three measurements to describe size of weir boulder building materials, the thickness is typically the smallest dimension |
| P | Base Stone | Feet | A D50 based on hydraulic and shear stress relationships at various discharges can conservatively be used as a minimum stone size. Voids can be filled with chokestone to help base stone resist movement (become dislodged), due to shear stress generated by flow over the rapids. Rock base material should also have particles large enough to wedge in between the gaps of the weir boulders. | This layer forms the main pavement of the structure. |
| Q | Weir boulder protrusion | Feet | 0.5 ft. – to maximum ½ weir boulder thickness. Generally, less protrusion toward the center of channel and more protrusion as the weirs reach the banks is advisable. | Distance that weir boulders protrude out of the base stone layer. |

| Dimension[2] | Name | Typical Unit | Guidelines[3] | Description |
|---|---|---|---|---|
| R | Weir boulder fish gap | Feet | 0.4 to 1 ft.; 0.3 to 0.6 ft. in low flow trough of every weir that extends 0.5' lower than the tailwater surface. Some weir boulders should be placed with gaps. Often, using irregularly-shaped, narrower parts of the stone for the top, with the broader, flatter part of the boulder at the bottom, yields the gap at the water surface even though the bottoms are snugged together. Base stone material has particles large enough to become wedged in the gaps. Special care should be given to ensure there are gaps in the low-flow trough corresponding (fish trench). 0.3' to 0.6' wide gaps should be created at least one place in the low flow trough. Some randomness can be introduced by putting the gap in different cross sectional positions. Place an additional weir stone 1' downstream of the gap, with its top elevation at or slightly below the low-flow water surface. Then, create a minimum 2' to 3' deep trench through the base stone about an excavator bucket width wide connecting each fish passage gap. | Distance between selected surface boulders intended to provide specific flow path through rapids structure. |

| Dimension[2] | Name | Typical Unit | Guidelines[3] | Description |
|---|---|---|---|---|
| S | Choke stone size | Inches | 3/8" to 6" | Stone to fill-in voids in subpavement and base stone layer for each 2 feet of thickness. |

Notes:

1. Data are for rock arch rapids constructed of boulders.
2. Some dimension labels are referenced in the detail drawings.
3. Common guidance, values, or ranges are given unless they require computation using site-specific input.

*Figure I-1: Plan View of Rock Arch Rapids.*

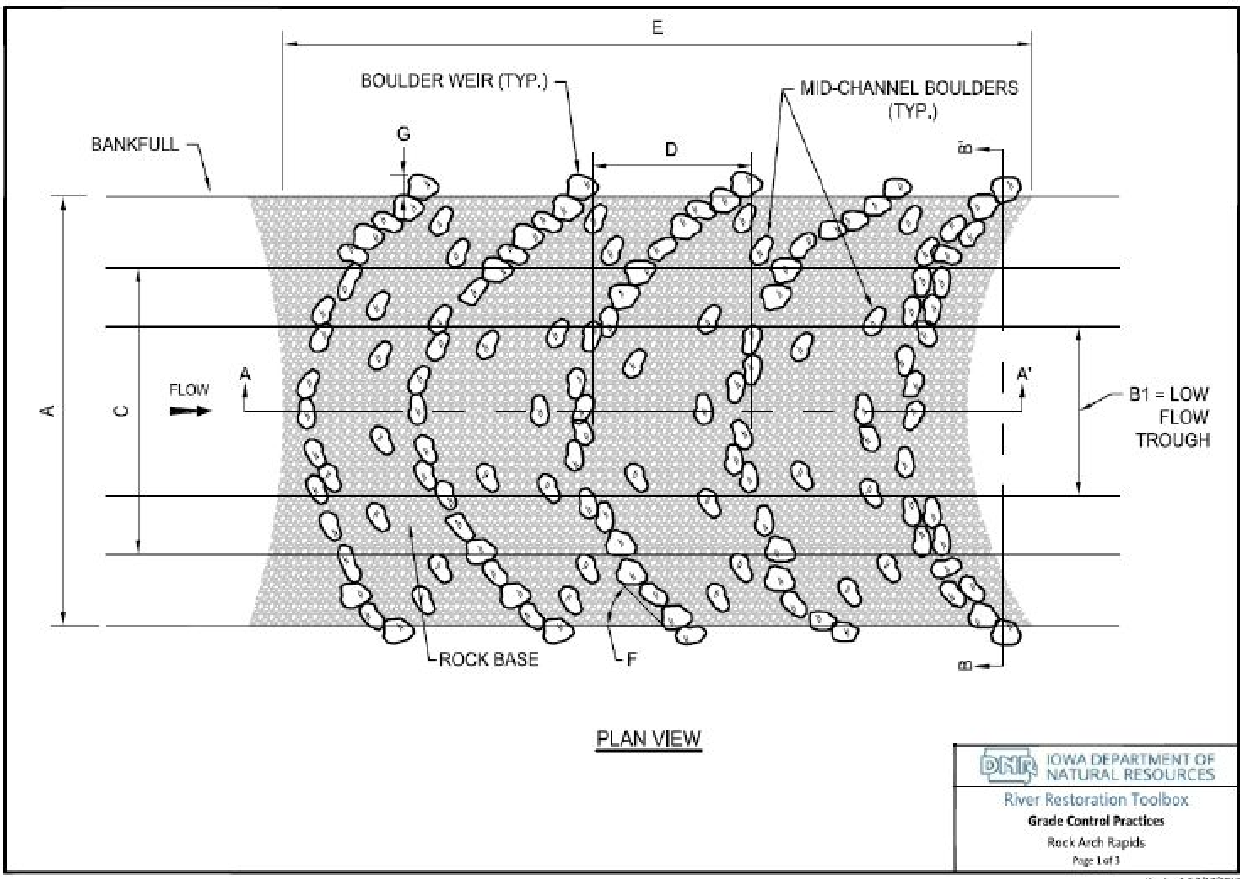


*Figure I-2: Profile View of Rock Arch Rapids.*

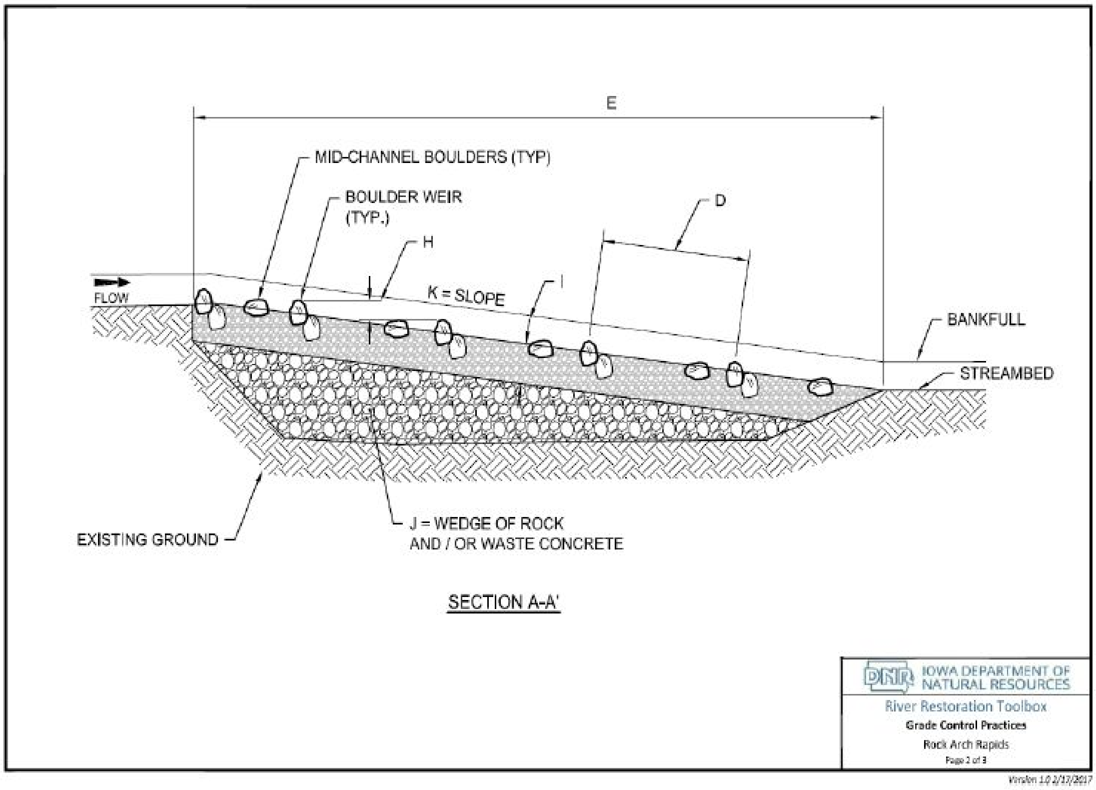
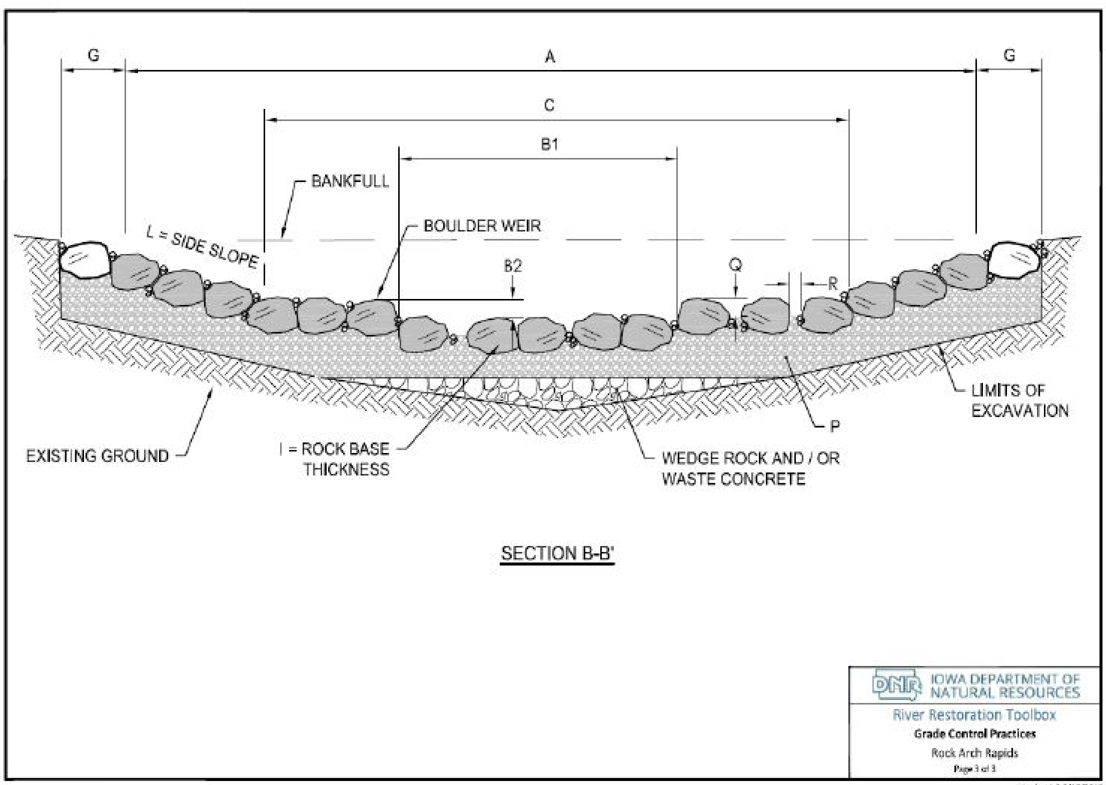



*Figure I-3: Cross Section View of Rock Arch Rapids.*



<u>Appendix J: Design Renderings and Models</u>

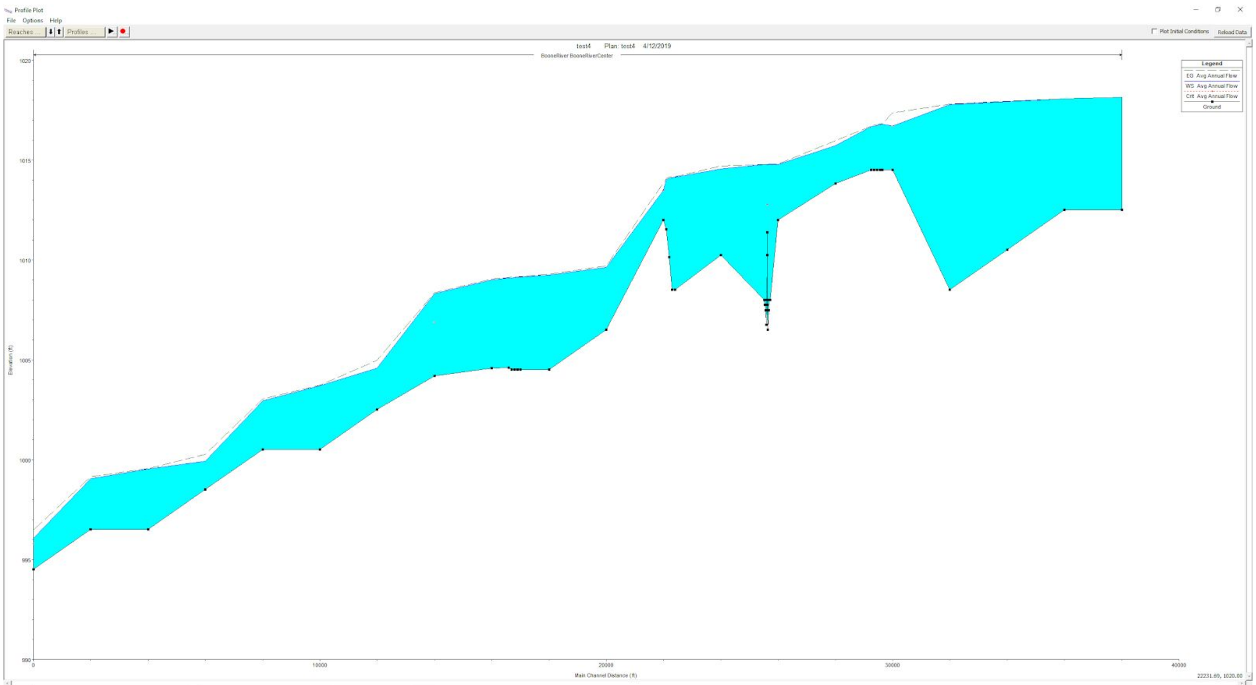
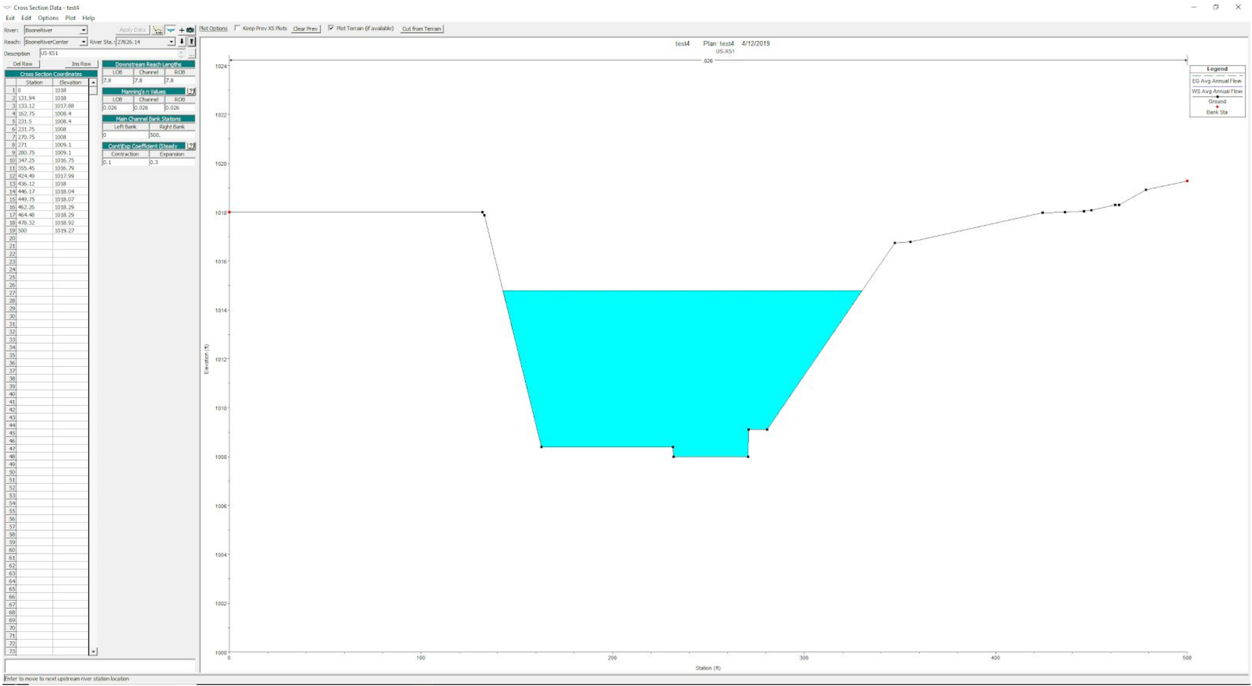



*Figure J-1: The 2D profile plot of the Boone River centerline. Shown is the assumed river bed elevation and the existing water surface elevation using the average annual flow data from USGS Stream Gage 05481000 near Webster City, IA.*


*Figure J-2: The 3D plot of the entire HEC-RAS modeled Boone River reach with cross section and water surface profile data.*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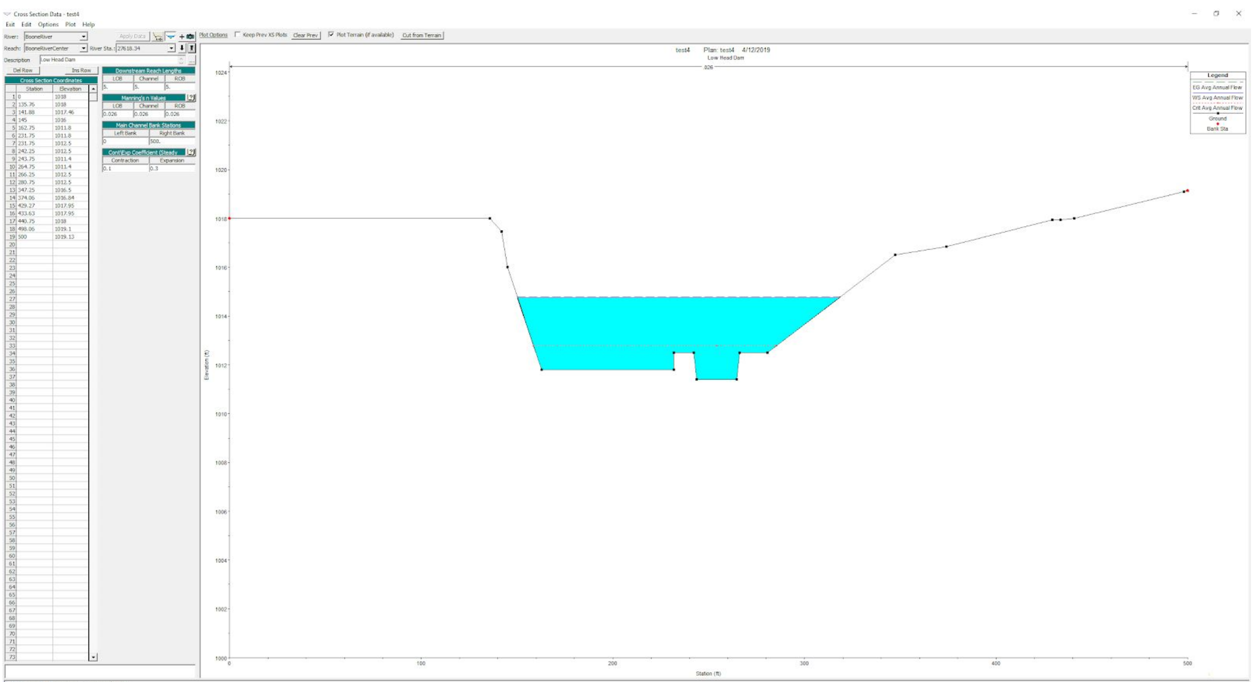
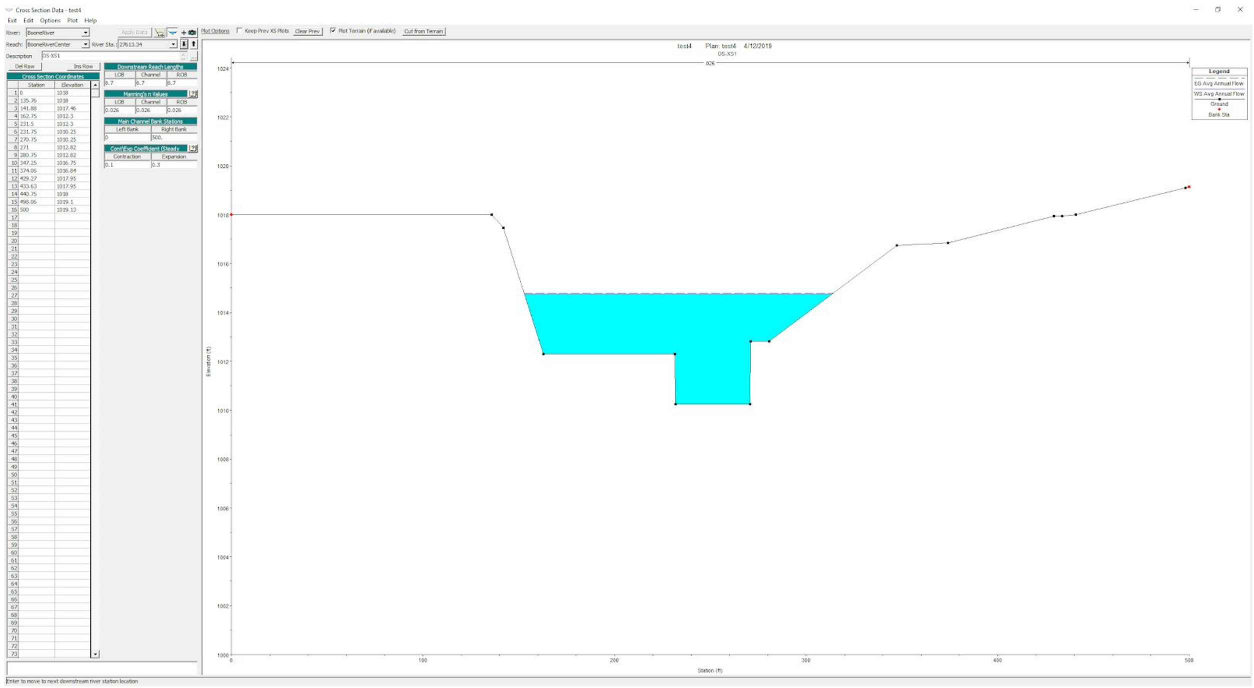
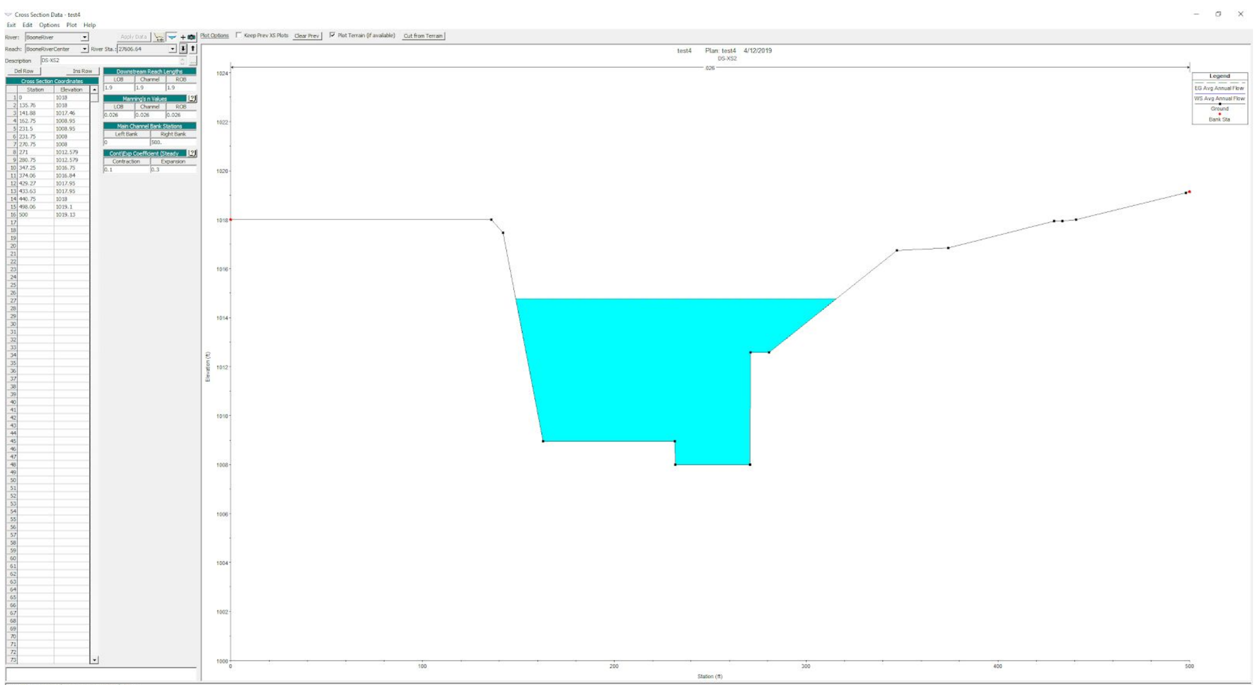
test4 Plan: test4 4/12/2019
US-XS1


Cross Section Data - test4
test4 Plan: test4 4/12/2019
Low Head Dam





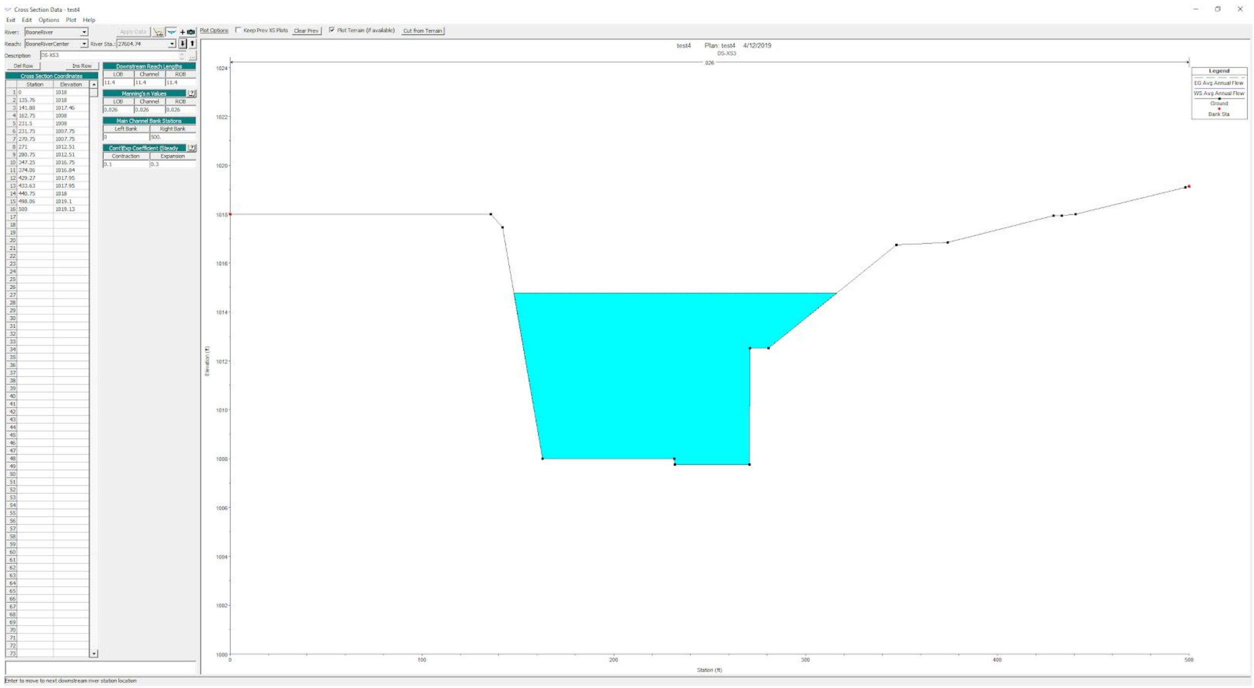



*Figure J-3: Five example cross sections from the HEC-RAS model representing the existing dam and rip rap configuration that was reconstructed in 1990. (Top to bottom) Located 7.8' US of the dam, at the low head dam, 5' DS of the dam, 11.7' DS of the dam, and 13.6' DS of the dam.*

References


IDNR, *Design Development 3-04 3A Water Trail Launch Design*. (n.d.)

IDNR, *Signage, Water Trail Launch Design.* (n.d).

IDNR, *River Restoration Toolbox Practice Guide 1 Grade Control*. (2018)

IDNR, *Iowa Stormwater Management Manual Design Standards Chapter 5 - Infiltration Practices.* (n.d)

IDNR, *Iowa Stormwater Management Manual Design Standards Chapter 2 - Unified Sizing Criteria.* (n.d)

Iowa SUDAS, *8B-1 Design Manual Chapter 8-Parking Lots 8B-Layout and Design.* (n.d.)

Gordian, *Building Construction Costs with RSMeans Data, (2018)*
Eric Meier, *The Wood Database (2015)*

National Institute of Standards*: American Softwood Lumber Standard.* (n.d.)

## **Design Drawings**

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# WEBSTER CITY, IA

| INDEX OF SHEETS | |
|---|---|
| 00 | TITLE SHEET |
| 01 | NOKOMIS SITE PLAN |
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| 03 | WATER WORKS SITE PLAN |
| 04 | WATER WORKS GRADING |
| 05 | 7B RANCH SITE PLAN |
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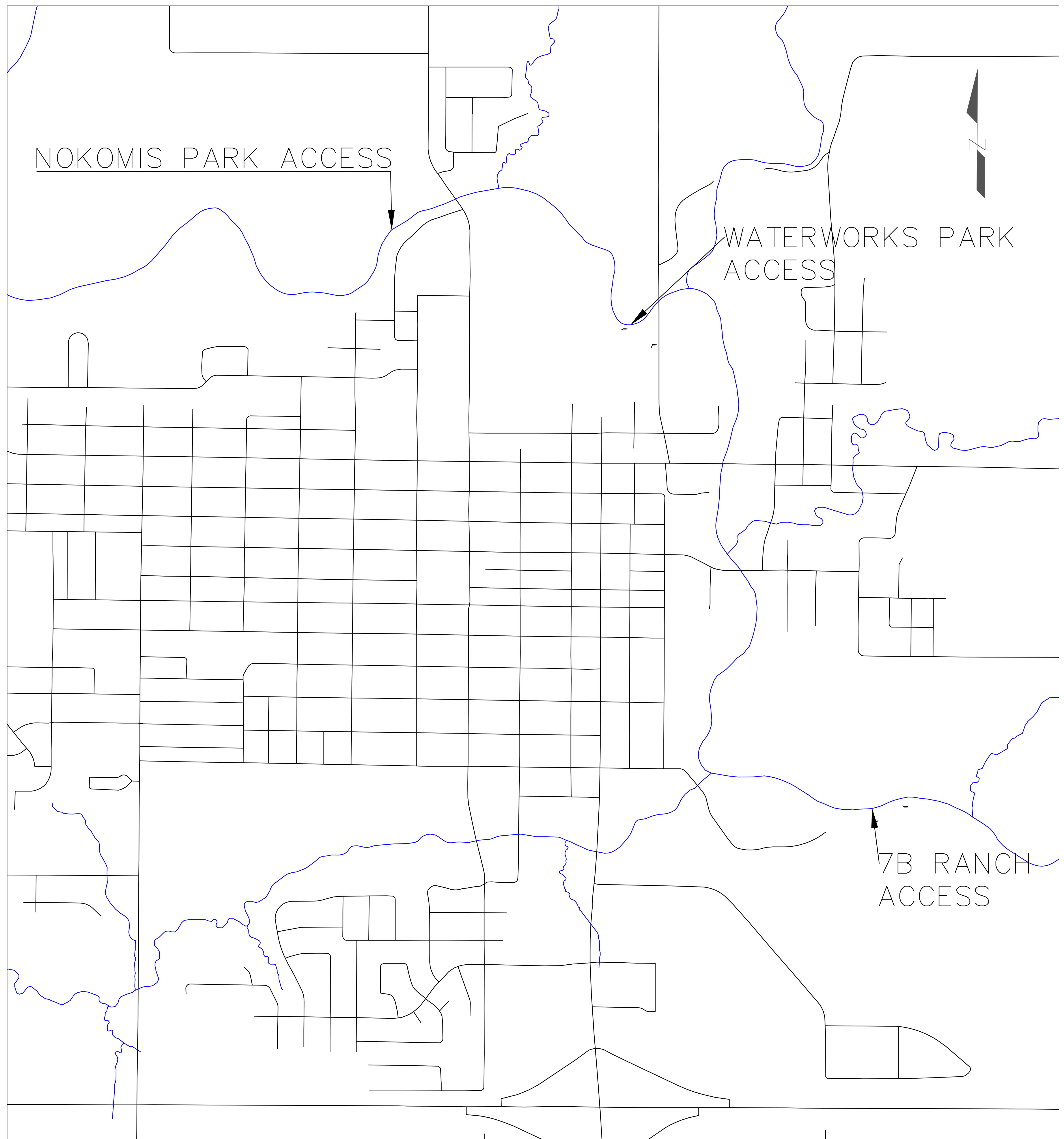
| 09 | LOW-HEAD DAM CAP |
| 10 | ROCK ARCH RAPIDS DESIGN |
| 11 | 7B RANCH LAUNCH DESIGN |
| 12 | INFILTRATION TRENCH DESIGN |

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SHEET NO.

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SHEET NAME

7B RANCH
SITE PLAN

SHEET NO.

05


PROJECT: CEE:4850

DATE: 5/3/19

DRAWN BY: ZAH

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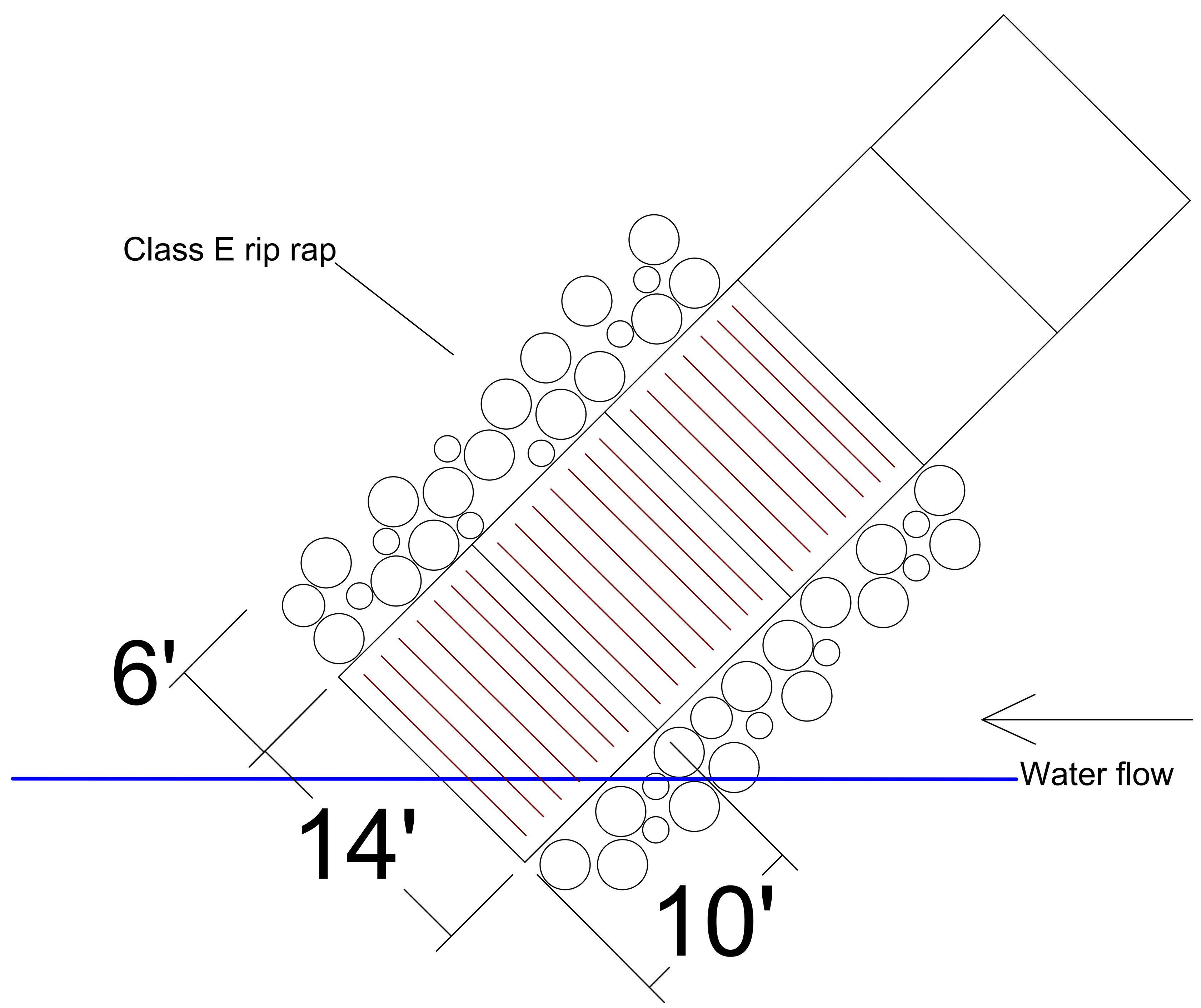
7B RANCH GRADING

SHEET NO.

**06**

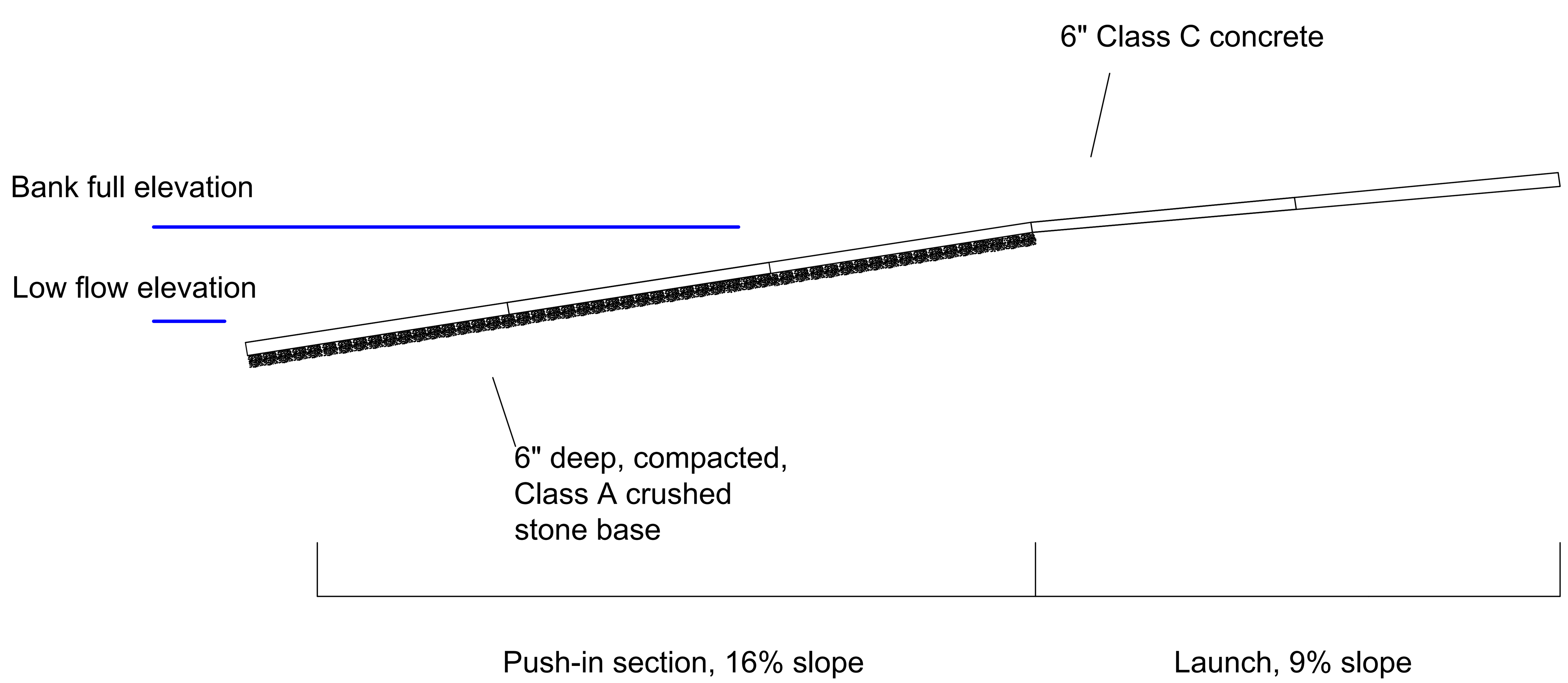
# (1) Nokomis Park, Concrete Ramp Launch Design

## Plan View




Notes
-Launch is angled 45 degrees to water
-Class C concrete
-Armor both shoulders with Class E rip rap
-1/2" expansion joints every 10 ft
-Bank full elevation:1020 ft
-Low flow elevation: 1015.5 ft

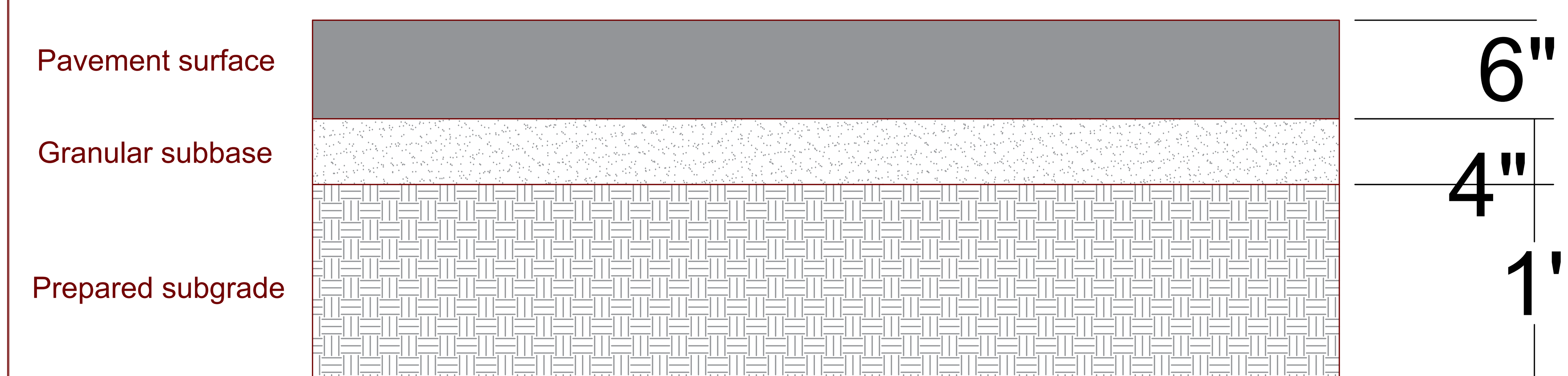
## Cross Section




# (2) Pavement Details

## Cross Section

Notes
-Pavement surface consists of Class C Concrete
-Granular subbase consists of sand or gravel
-prepared subgrade consists of appropriate soil

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DATE : 5/3/19
DRAWN BY: AMG
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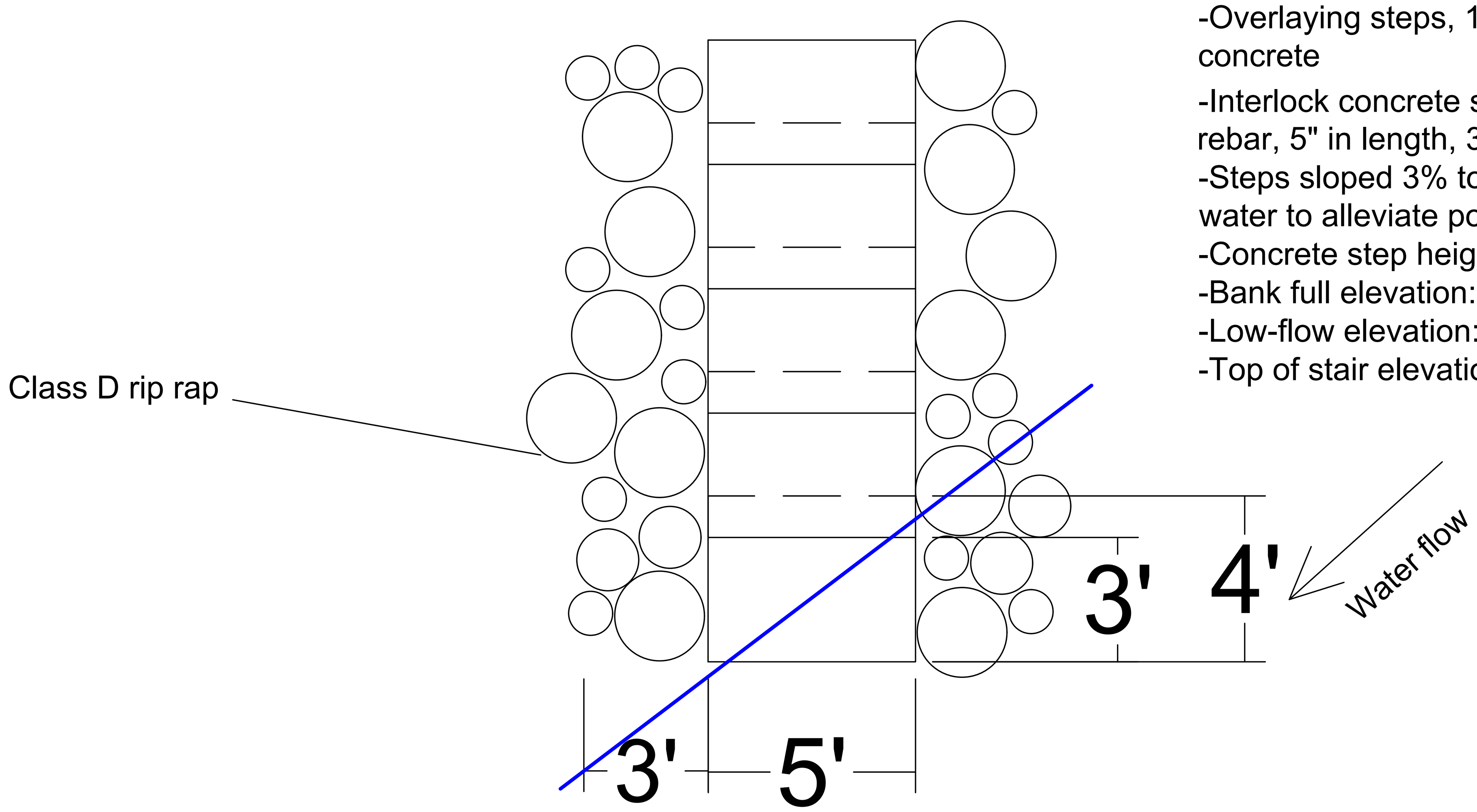
WEBSTER CITY, IA 50595

SHEET NAME
NOKOMIS LAUNCH DESIGN

SHEET NO.
07

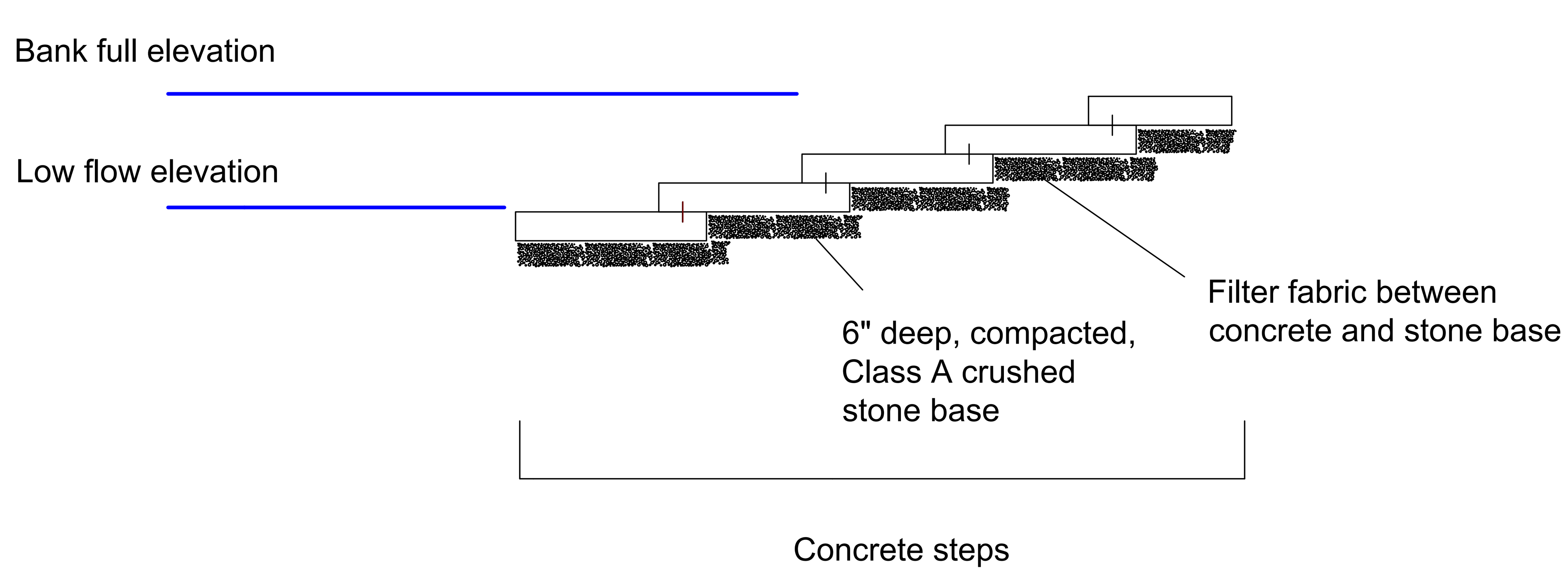
## (3) Waterworks Park, Upstream Launch Design

### Plan View



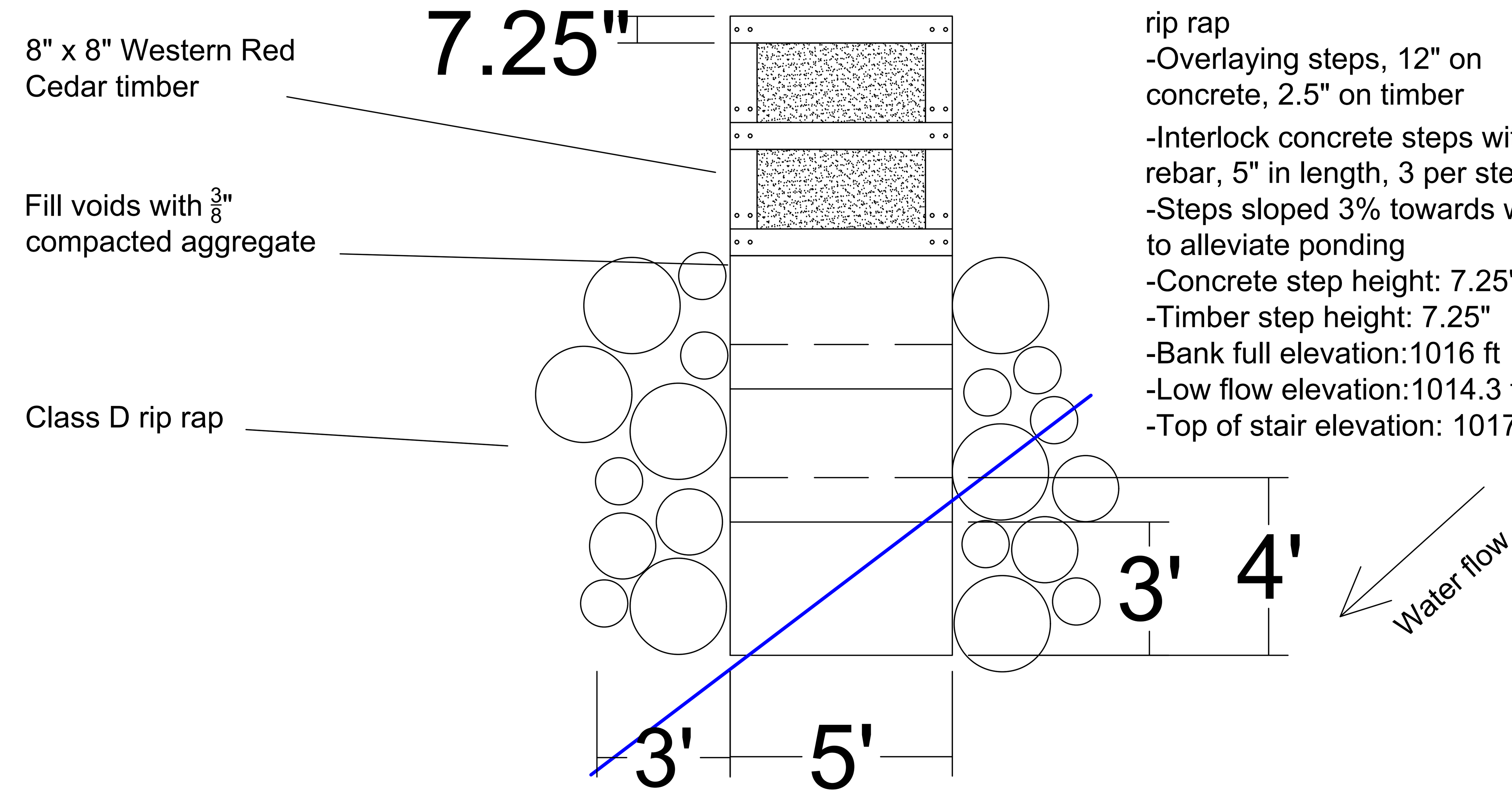

Notes:
- Launch is angled 45 degrees to water
- Class C concrete
- Armor both sides with Class D rip rap
- Overlaying steps, 12" on concrete
- Interlock concrete steps with $\frac{1}{2}$" rebar, 5" in length, 3 per step
- Steps sloped 3% towards water to alleviate ponding
- Concrete step height: 7.25"
- Bank full elevation:1017.2 ft
- Low-flow elevation:1014.5 ft
- Top of stair elevation: 1017.5 ft

### Cross Section



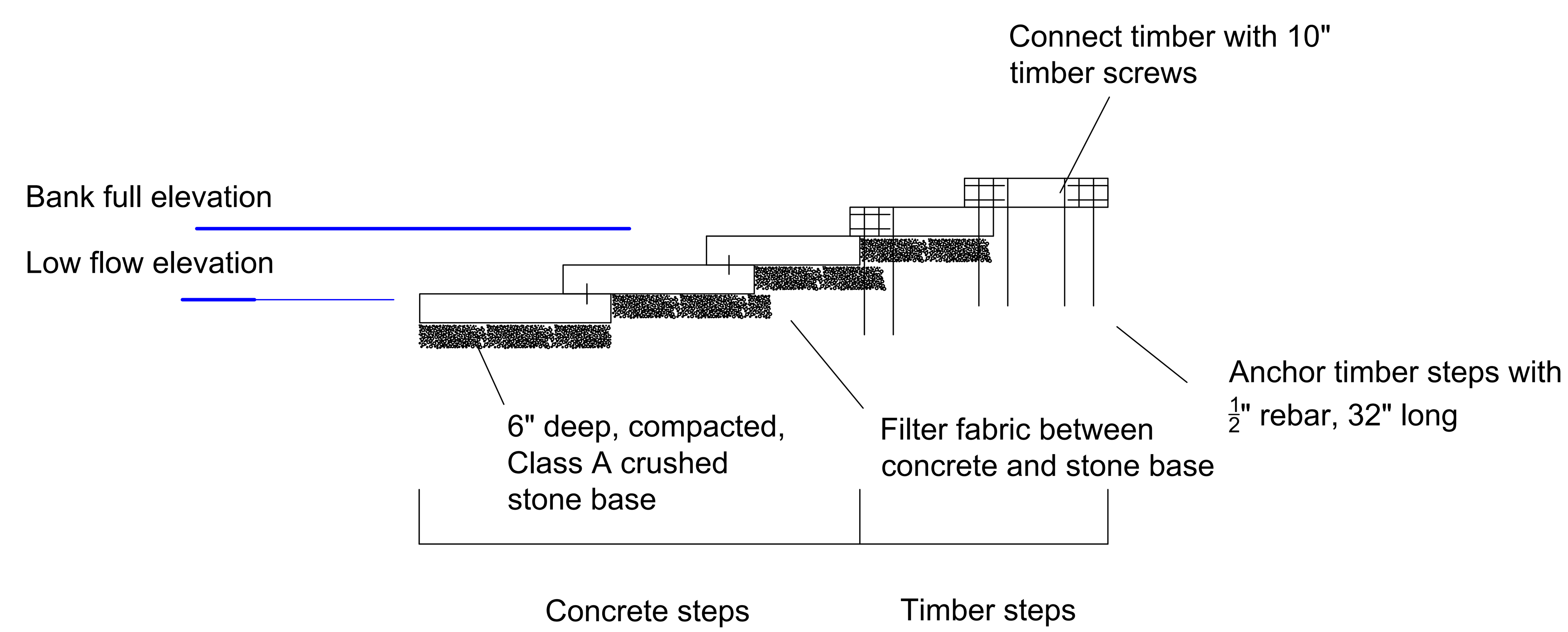

## (4) Waterworks Park, Downstream Launch Design

### Plan View




Notes:
- Launch is angled 45 degrees to water
- Class C concrete
- Armor both sides with Class D rip rap
- Overlaying steps, 12" on concrete, 2.5" on timber
- Interlock concrete steps with $\frac{1}{2}$" rebar, 5" in length, 3 per step
- Steps sloped 3% towards water to alleviate ponding
- Concrete step height: 7.25"
- Timber step height: 7.25"
- Bank full elevation:1016 ft
- Low flow elevation:1014.3 ft
- Top of stair elevation: 1017.3 ft

### Cross Section




PROJECT: CEE:4850
DATE : 5/3/19
DRAWN BY: AMG
REVISION: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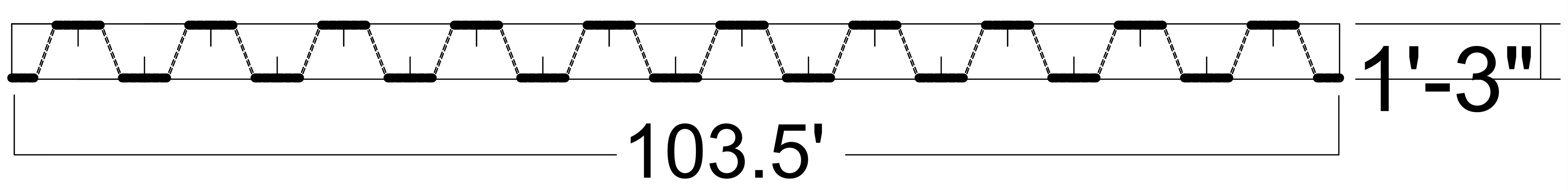
SHEET NAME
WATER WORKS LAUNCH DESIGN

SHEET NO.
08

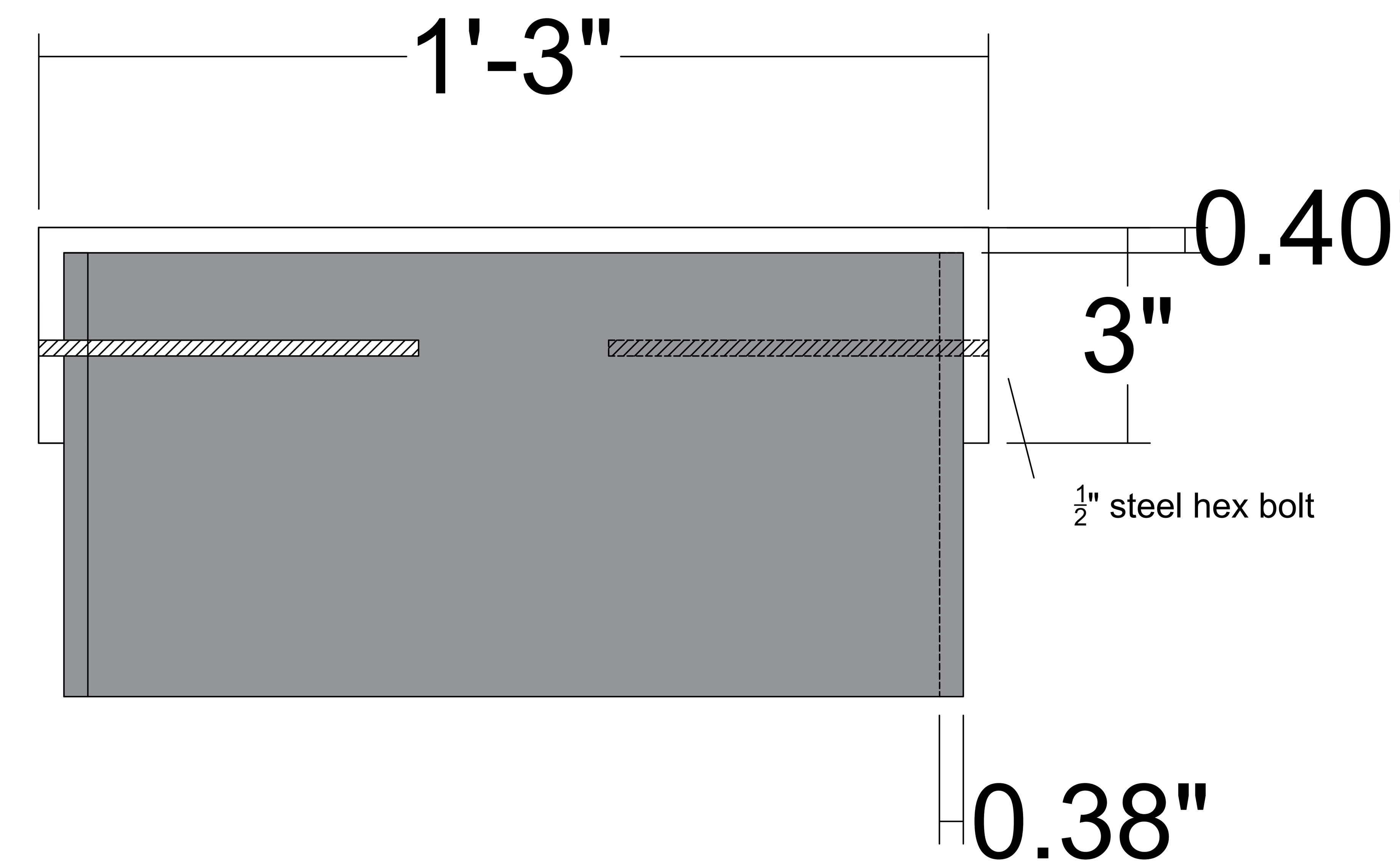
## (5) Waterworks Park, Dam Cap Design

### Plan View

Notes:
-C-shaped galvanized steel beam overlaying sheet pile
-Beam: C 15x33.9
-Total length: 103.5'
-Bolted every 18" to secure beam to sheet pile
-Bolts: $\frac{3}{4}$" 316 stainless steel hex cap screw, 6" in length

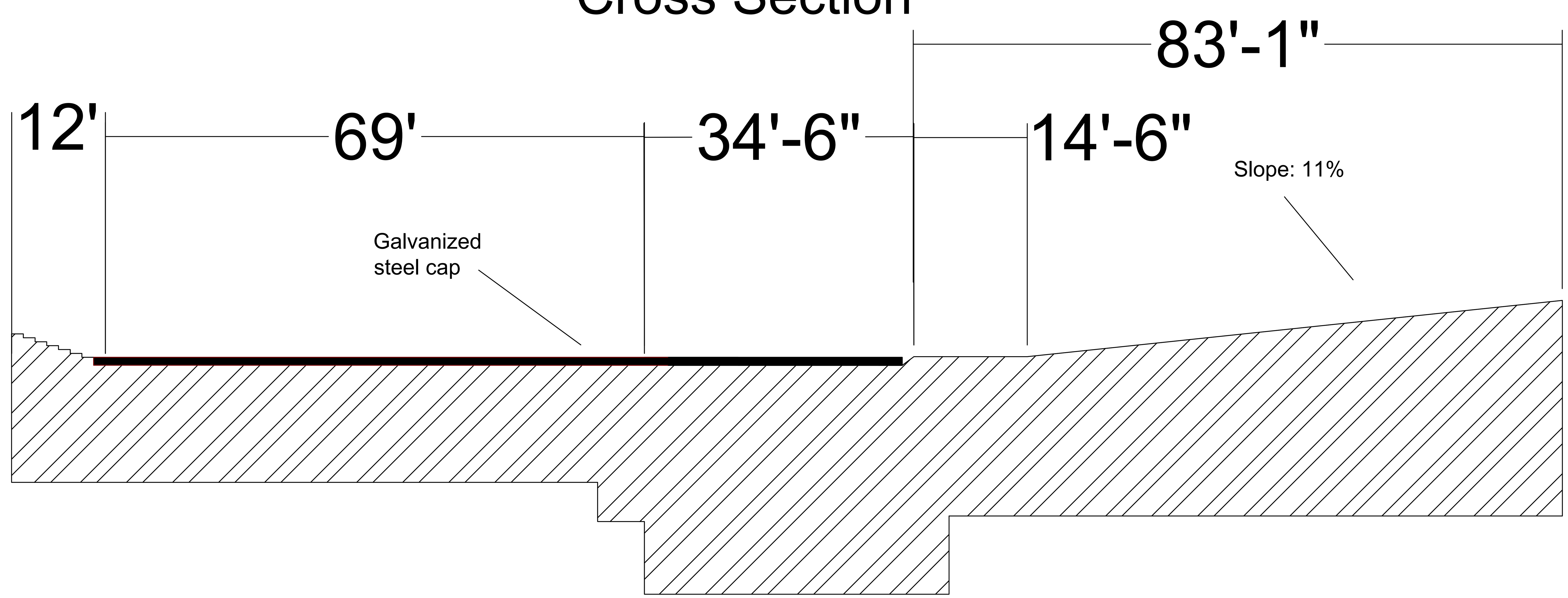



### Cross Section




## (6) Waterworks Park, Low-Head Dam Design

### Cross Section

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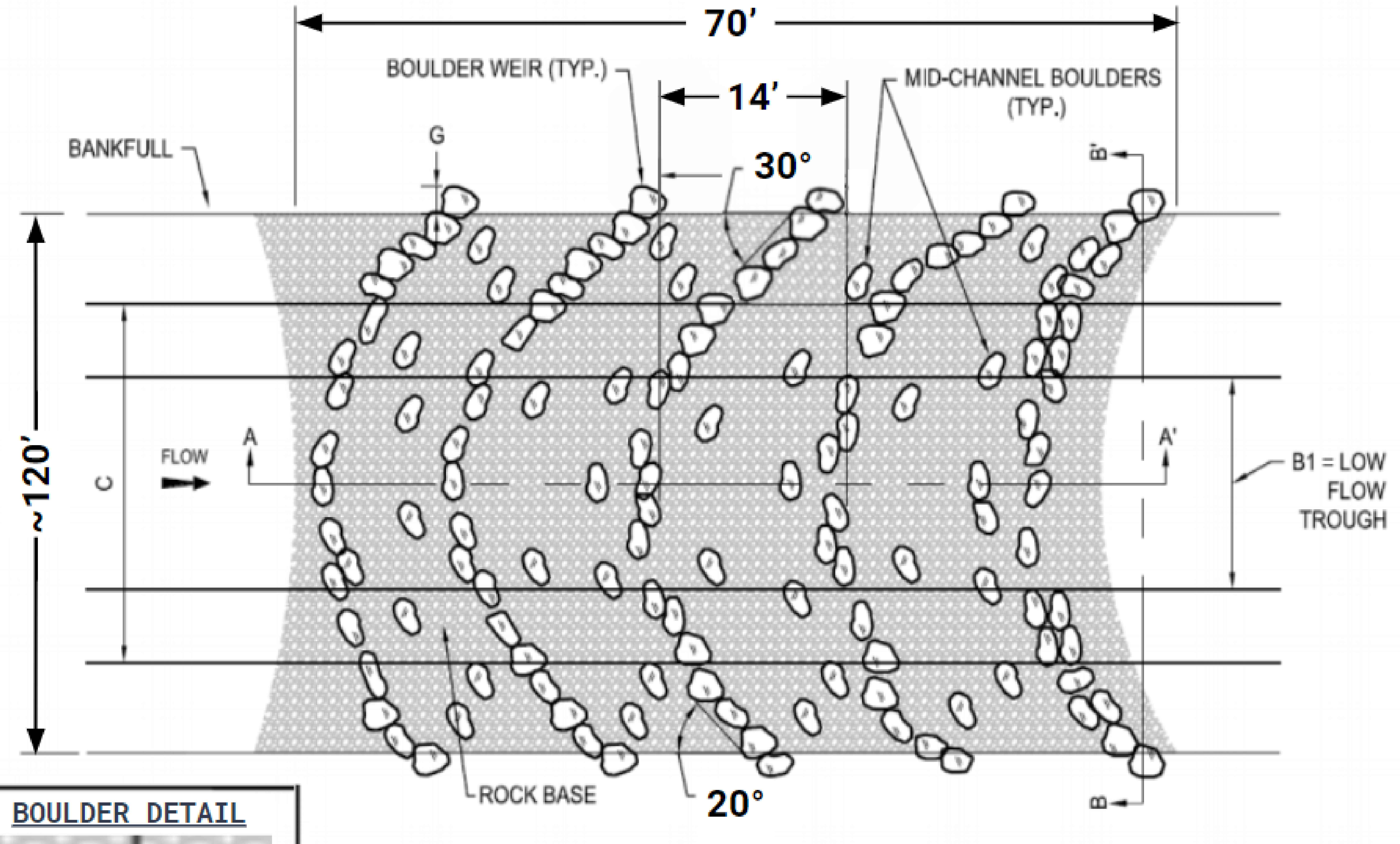
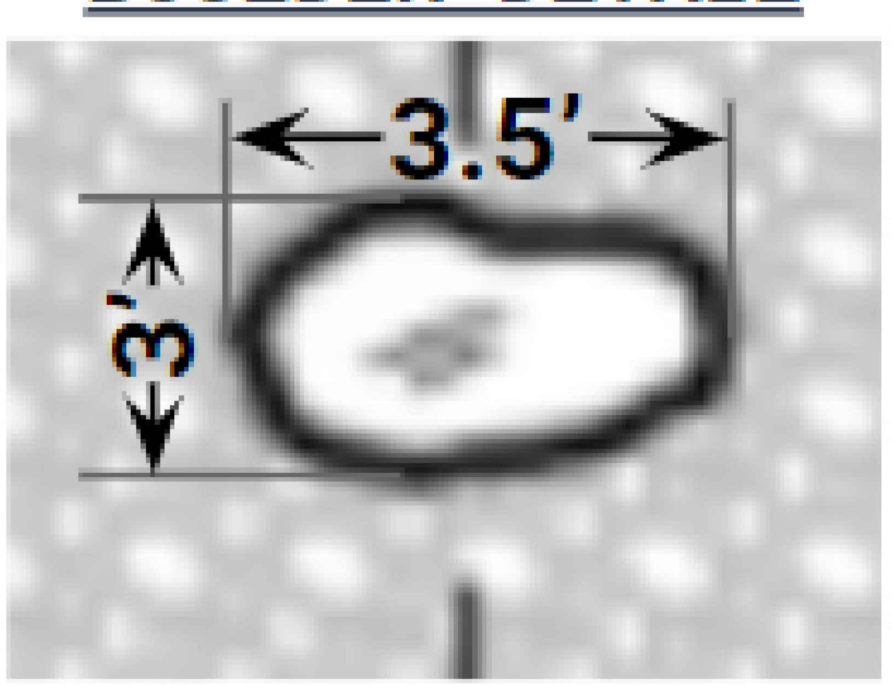
SHEET NAME
LOW-HEAD DAM CAP

SHEET NO.
09




PLAN VIEW

## BOULDER DETAIL




IOWA DEPARTMENT OF NATURAL RESOURCES

River Restoration Toolbox

**Grade Control Practices**

Rock Arch Rapids

Page 1 of 3

*Version 1.0 2/17/2017*

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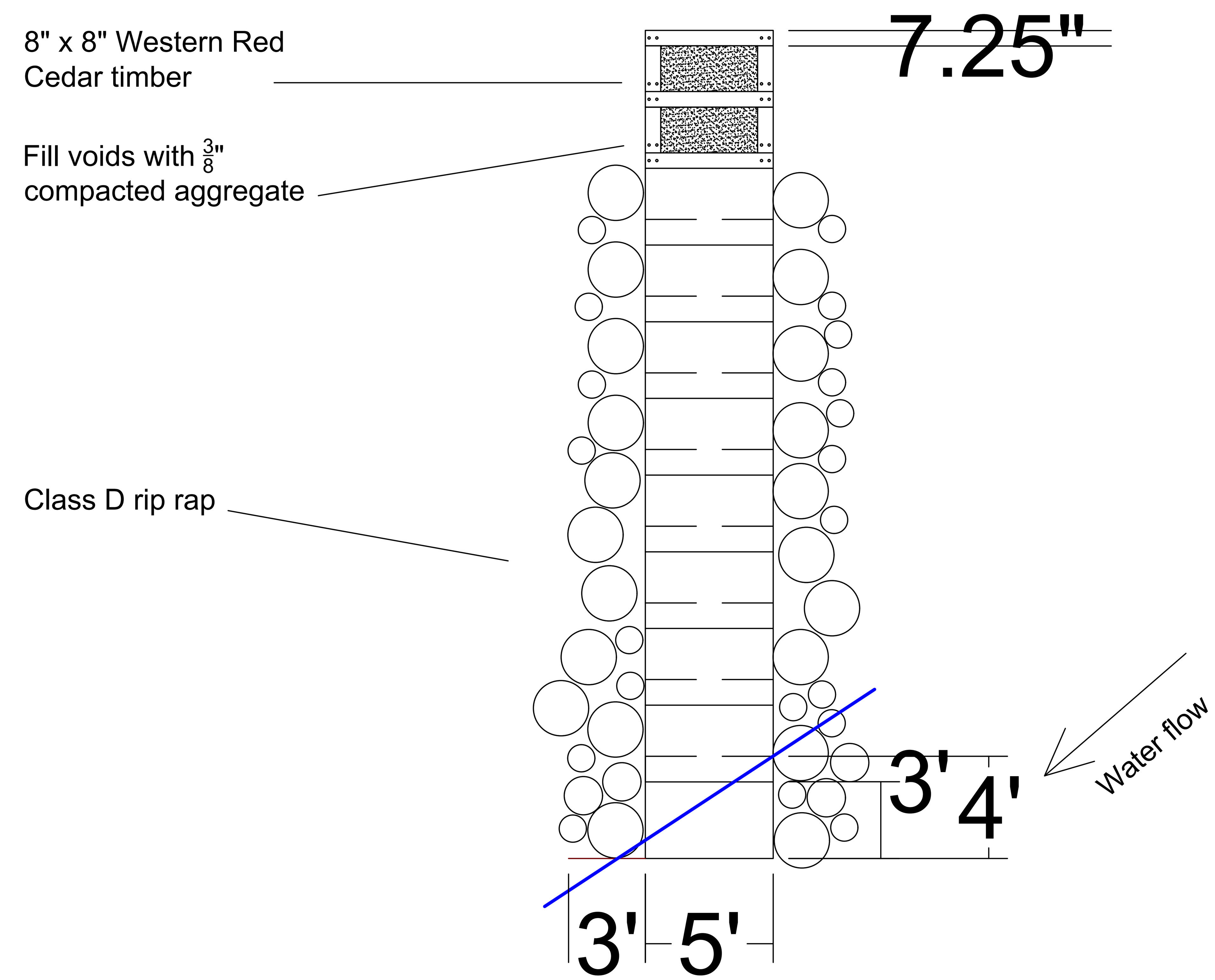
SHEET NAME

ROCK ARCH RAPIDS DESIGN

SHEET NO.

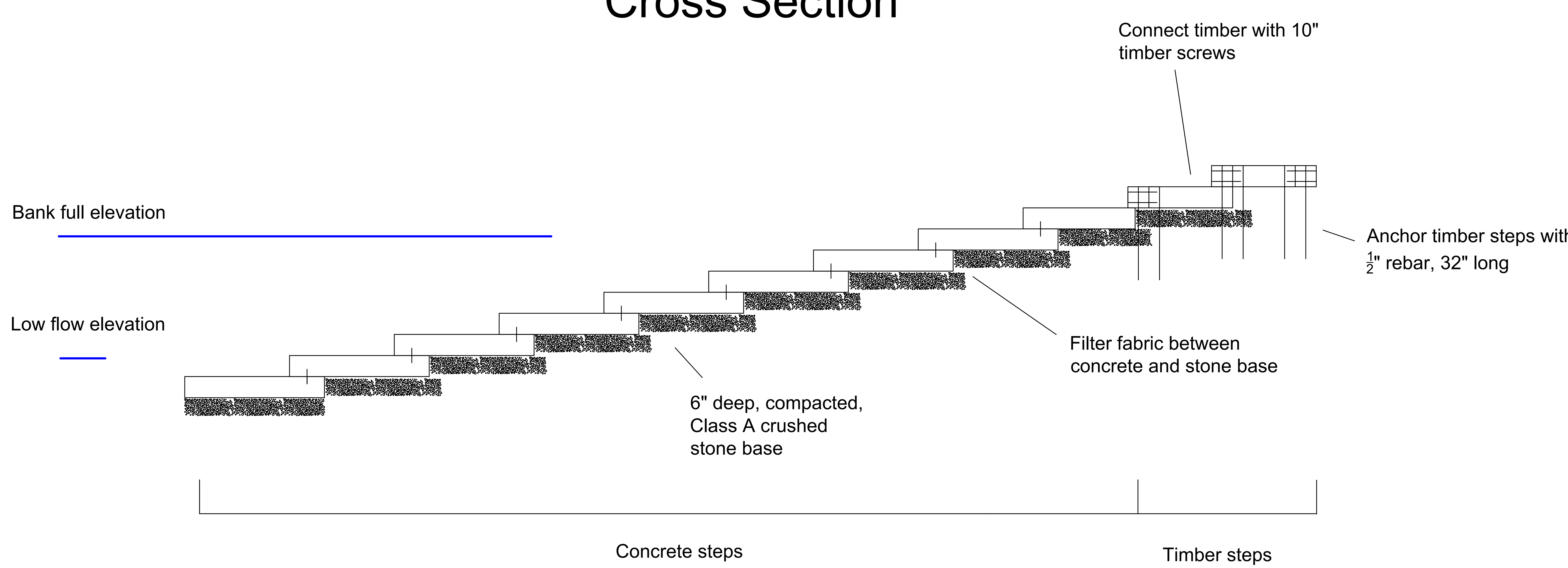
10

# Plan View




Notes:
-Launch is angled 45 degrees to water
-Class C concrete
-Armor both sides with Class D rip rap
-Overlaying steps, 12" on concrete, 2.5" on timber
-Interlock concrete steps with $\frac{1}{2}$" rebar, 5" in length, 3 per step
-Steps sloped 3% towards water to alleviate ponding
-Concrete step height: 7.25"
-Timber step height: 7.25"
-Bank full elevation:1012 ft
-Low flow elevation:1006.6 ft
-Top of stair elevation: 1013.2 ft

# Cross Section




(7) Ranch 7-B, Stair-Step Launch Design

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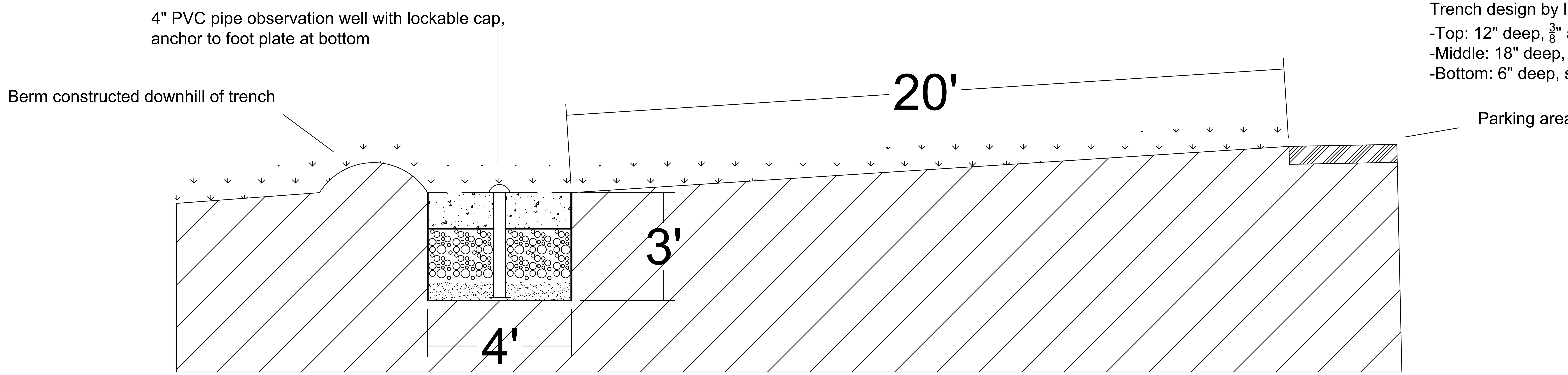
SHEET NAME
7B RANCH LAUNCH DESIGN

SHEET NO.
11

# Cross Section

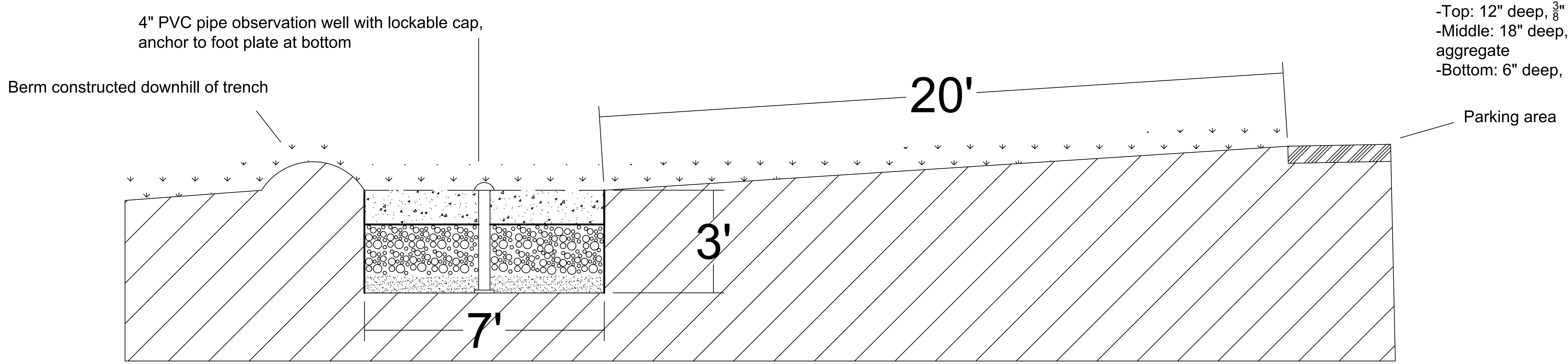
Notes:
-Line the sides of trench with filter fabric
-Filter fabric between top and middle layer of aggregate
Trench design by layer:
-Top: 12" deep, $\frac{3}{8}$" aggregate
-Middle: 18" deep, 1-3" aggregate
-Bottom: 6" deep, sand




## (8) Nokomis Park, Ranch 7-B Infiltration Trench Design

# Cross Section

Notes:
-Line sides of trench with filter fabric
-Filter fabric between top and middle layer of aggregate
Trench design by layer:
-Top: 12" deep, $\frac{3}{8}$" aggregate
-Middle: 18" deep, 1-3" aggregate
-Bottom: 6" deep, sand




## (9) Waterworks Park Infiltration Trench Design

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SHEET NAME
INFILTRATION TRENCH DESIGN

SHEET NO.
12