The University of Iowa
IOWA INITIATIVE
FOR SUSTAINABLE COMMUNITIES

# Mason City Waterways Access and Development

Completed by: Hunter Miller, Marri VanDyke, Paige Salz
May 2018

Class led by: Richard Fosse
Course Name: Project Design & Management
Department of Civil & Environmental Engineering

***In partnership with***
**The City of Mason City**

City of Mason City Iowa

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**UNIVERSITY OF IOWA**
**DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING**


**Project Design & Management**

(CEE:4850:0001)

# Waterway Access and Development

**Report Prepared For**

Steven Van Steenhuyse

Director of Development Services

Mason City, IA


**MVS Consultants**

Hunter Miller, Project Manager

Marri VanDyke, Technical Services

Paige Salz, Editor


| Authorized Signature | Date | Name and Title (Typed) |
|---|---|---|
| Hunter Miller | 04/20/18 | Hunter Miller - Project Manager |

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## Section I: Executive Summary

MVS Consultants is a team of students enrolled in the capstone design course at the University of Iowa.  They were requested to provide the City of Mason City, Iowa with a design plan for the Waterways Access and Development project. The goal of the project was to develop sites that would encourage access to the Winnebago River. The sites should also serve as an attraction to bring visitors to the town. Currently, the City of Mason City is working with WHKS & Co. of Mason City to reconstruct the dams throughout the Winnebago River. The final design presented is under the assumption that WHKS has completed construction, and that all dams are passable.

The site locations suggested to MVS Consultants were 12$^{th}$ Street, East Park, and Asbury Park. Designs were completed for all three locations, forming a cohesive plan for the river. Each site also has the ability to function independently from the others, so construction could be phased if desired.

Components in the final design of 12$^{th}$ Street include an access road, a parking lot with six stalls, stair entry to the river, a kayak rental store, and a bioretention basin to collect and filter storm water runoff. It is recommended that the access road and parking lot be constructed with concrete because of its longevity. Stone stairs will allow river access to kayakers and tubers. Larger boats should be prevented from accessing the river at this point, as the retrofitted dam will make the water too dangerous for them. The kayak rental store will provide the main draw to outside visitors. It should be constructed with concrete masonry units (CMUs) to avoid flood damage. The basin should be 1,930 square feet to properly manage stormwater runoff. MVS Consultants estimates the total cost of this site to be $288,100.

Final design of East Park includes an access road, a parking lot with eleven stalls, stair entry to the river, a boat ramp, and a basin. Again, concrete is recommended for the access road and parking lot. Stone stairs will still allow river access to kayakers and tubers, but the boat ramp will allow additional access to trolling boats. The basin should be 1,650 square feet. MVS Consultants estimates the total cost of this site to be $141,140.

Asbury Park is composed of an access road, a parking lot with eleven stalls, stair entry to the river, a boat ramp, and a basin. As with the other sites, concrete is the recommended material for the access road and parking lot. The stairway and boat ramp were designed similarly to the design in East Park. The basin should be 1,760 square feet. MVS Consultants estimates the total cost of this site to be $181,760.

The estimated total combined cost of development at all three sites is $611,000. MVS Consultants believes that having multiple river access points is the best option for Mason City. This gives the kayakers the ability to choose the trip intensity that works best for them, drawing both families and enthusiasts to the river and the city.

## Section II: Organization Qualifications and Experience

1. **Name of Organization**

   MVS Consultants

2. **Organization Location and Contact Information**

   Proposed Site

   East Park

   717 3rd St. NE

   Mason City, IA 50401

   Bidding Firm Headquarters

   MVS Consultants

   103 South Capitol St.

   Iowa City, IA 52240

   Project Manager

   Hunter Miller

   Email: hunter-miller@uiowa.edu

   Phone: (319) 404-1420

3. **Organization and Design Team Description**

   MVS Consultants is a team of students enrolled in the capstone design course at the University of Iowa. The design team has the combined experience of twelve years with varying interests applicable to the Waterways Access and Development project. These interests include structures, water resources, and site design. Each team member specializes in a specific aspect of the civil engineering practice. Hunter Miller is our Project Manager focusing in hydraulics and water resources. Marri VanDyke offers Technological Support while specializing in structures. Paige Salz is the team's Editor and she has experience in site design work. Together they form a well-rounded team capable of finding the most effective project design.

## 4. Description of Experience with Similar Projects

The team at MVS Consultants is prepared to tackle any challenges associated with the Waterway Access and Development project because of our educational knowledge and past experiences.

Hunter’s past experiences include three internships and a Water Resources Design project. At his first internship, Hunter assisted in job site supervision on grading, structural, and underground utility projects as well as cost estimation. His second internship experience involved the detailed inspection on bridge, culvert, and paving projects. As a part of this inspection, Hunter was also in charge of the daily inspection reports, collecting concrete and rock tickets, pile driving logs, and storm drainage reports. He carefully analyzed plans and specifications to check the contractor’s work. Hunter’s final internship position gave him experience in MicroStation where he designed a new trunk sewer system and HMA resurfacing project. He also observed bridge, sanitary sewer, HMA, and sidewalk replacements. While at the University of Iowa, Hunter performed a site development and design report as a part of the Water Resources Design course. This report consisted of a storm water management system for a new shopping center, park, and parking lot. Hunter’s experiences display a diverse background in site development, HMA implementation, and construction observation that will be beneficial for the Waterway Access and Development project.

Marri has interned with the City of Muscatine’s Public Works Department. While there, she observed municipal airport and roadway paving operations. Marri also assisted on a new sidewalk surrounding an elementary school and park by designing the layout, calculating material quantities, and estimating associated costs. In her Design of Wood Structures class project, Marri designed an apartment building. She selected the layout and sizes of joists, beams, and trusses and calculated the deflection, shear, bending, and bearing stress in each of these elements. These analyses were compared to NDS requirements and accurate drawings were made in AutoCAD. Marri’s experience in municipal paving projects and wood structures will prove essential in the completion of this project.

Paige’s previous experience comes from an internship in site development. While there, she specialized in site layout, grading, and utility placement. Paige has experience on a wide variety of lot uses as well as site constraints. These site constraints range from connecting to existing utilities and avoiding the disruption of wetlands. The internship has given her an understanding of working in floodplains and wetland mitigation, which will be crucial in this project. All of these drawings were done using AutoCAD Civil 3D software in which she is now highly proficient.

## Section III: Design Services

1. **Project Scope**

The goal of the Waterway Access and Development project was to help the city create safe and useful access points, so tubers and kayakers can float through the entire city without disruption. Our task was to design access points that consisted of access roads, river landings, parking lots, and a shelter structure. MVS Consultants provided a site design of each location and provided storm water management at each location. A total of four tasks has been completed during the design of this project.

The first task was to visit the potential sites and determine the best locations for access points and a possible shelter. As the team travelled between the different points, it was decided to provide access at all three potential locations, $12^{th}$ Street, East Park, and Asbury Park. Having safe access at all these locations allows for versatility among float trips and will entice a wider variety of users.

Secondly, the team created preliminary design concepts for each site. Alternatives that were considered include type of pavement and shelter. These alternatives are further analyzed in Section V of this report.

The final design of each site contains an access road, parking lot, stone stairway, and storm water drainage plan. Additionally, boat ramps were implemented at East and Asbury Park as well as a kayak rental store at the $12^{th}$ Street site. The rental store was placed at $12^{th}$ Street because it is the northern-most site the team designed and it is the only one above the dam reconstruction that WHKS is performing.

Finally, MVS Consultants took care of project management and coordination items including weekly updates, documentation of work done and to be done, and cost estimates.

2. **Work Plan**

The work plan for this project has been displayed with the use of a Gantt chart. The Gantt chart graphically displays the timeline of the tasks shown above in the project scope section and can be seen in Appendix A.

# Section IV: Constraints, Challenges and Impacts

1. **Constraints**

Some constraints faced in the design of the Waterway Access and Development project included space, time, budget, honoring the applicable safety codes, and the three dams. Space constraints on site were set by the city park property lines, the Winnebago River, and Willow Creek. The existing park infrastructure was also a constraint because disturbing existing playgrounds, trails, gardens, and roads running through the park was undesirable. The time frame for design provided a third constraint. Ninety percent completed plans were due on April 20th and final plans will be due on May 4th of this year. A budget was not specified, but construction materials and phasing were optimized throughout the design to avoid overspending. As professional engineering students, we were required to follow the appropriate codes as specified by the American Concrete Institute (ACI), American Society of Civil Engineers (ASCE), Americans with Disabilities Act (ADA), Statewide Urban Design and Specifications (SUDAS), Iowa Department of Natural Resources (IDNR), and the National Design Specification (NDS) to protect the safety and well-being of the community. All design work done complied with these design standards and any others the team deemed applicable. Finally, the two low-head dams and one elevated dam provided a constraint on our design criteria. The team verified they are being removed by another firm called WHKS & Co. also of Mason City. Once dam renovations are in place, our team will verify safe access to the Winnebago River.

2. **Challenges**

Design challenges included working in a floodplain, other environmental considerations, and public acceptance of the design. The Winnebago River's floodplain impedes on all three properties, as shown by the flood plain maps in Appendix B. Because of the floodplain impedance, all infrastructure was designed to be resilient to flooding events and highly variable water levels. The variability of the water levels greatly impacted our access in all considered locations. Other environmental concerns arose when working next to the river including public safety and habitat for wildlife. Precautions were taken to limit the negative effects of constructing in a natural area. A final challenge involved public acceptance of the design. As discussed, this has been left for the City to manage after preliminary design plans have been submitted. After city review, it was agreed that public comments would be taken at that time.

3. **Societal Impact within the Community and/or State of Iowa**

As mentioned in the project challenges section, public acceptance and societal impact was an important consideration during the design. The design team believes that better access to the Winnebago River and further infrastructure in East Park will benefit society. However, some societal impacts considered include population characteristics, property rights, and sustainable practices. Impacts to population characteristics considers how all diverse populations will use the spaces. The sites will provide an updated gathering space for the community and a seamless connection to nature. The project may also entice visitors and businesses to come to the city and promote use of the waterway. These access locations will bring about all types of people, including fisherman and families, looking to spend some time on the water. Property rights for adjacent property owners was also considered. Locations of these access points were chosen to limit impedance on or near private property. Each site is owned by the city and is not adjacent to private establishments. Therefore, negative impact on private property will be avoided. Finally, sustainable practices were established to avoid negative societal and environmental impacts. Sustainable practices were incorporated into the sites' stormwater management practices. Sheet flow from the parking lots will carry all pollutants into bioretention basins where they will be filtered out through natural mediums. Also, sustainable practices were enacted by avoiding the development of greenfields. Each city site is currently a gravel park site which reduces the amount of disturbance to untouched ground. By considering public acceptance and societal impacts through population characteristics, property rights, and sustainable practices, MVS can provide a well-rounded and thoughtfully designed product to the client.

## Section V: Alternative Solutions that were Considered

The final design of each site contains an access road, parking lot, stone stairway, and storm water drainage plan. Additionally, boat ramps were implemented at East and Asbury Park as well as a kayak rental store at the 12$^{th}$ Street site. The rental store was placed at 12$^{th}$ Street because it is the northern-most site the team designed and it is the only one above the dam reconstruction that WHKS is performing. Aside from the structure, each park component had multiple design alternatives.

Both concrete and asphalt were considered for the parking lot and access roads. Asphalt is less expensive, but it also requires more frequent maintenance than concrete. Also, the sites will primarily be used in the summer when an asphalt parking lot would generate the most heat. Excess heat generation is not only bad for the environment, but it is not ideal for barefooted patrons of the parks either. Because of these factors, we recommend using concrete in the final design.

A boat ramp or fishing dock were options originally proposed for the boat launch. Having only a dock would provide a place to fish while preventing larger boat traffic. We instead suggest having boat ramps at East and Asbury Park to give trolling boats access to the river. There should not be a boat ramp at the 12$^{th}$ Street site as the dam reconstruction is dangerous for boats larger than a canoe or kayak. To separate tube and kayak access from boat access, stone stairways are present at all three sites.

Possible alternatives to the kayak rental store were a gazebo or picnic shelter. Gazebos can add charm to a park, and they are less expensive than picnic shelters. A picnic area would provide a place to eat, which the community would appreciate. Both of these options are already present in East Park and unsheltered picnic tables are currently at all three locations. The rental store was chosen because it will give more people an opportunity to use the river and bring new business into town. This business and the dam reconstruction will likely be a source of revenue through increased tourism through the city. All of these factors contributed to the team's decision to choose the rental structure over a gazebo or picnic shelter at 12$^{th}$ Street.

When designing the kayak rental store, wood, steel, and concrete masonry units (CMUs) were considered as building materials. Wooden structures blend in best with natural surroundings and are also the cheapest to build. Steel can provide extra strength with a modern appearance, but it costs more than wood. Our recommendation is to utilize masonry units in a way that fits in with the Frank Lloyd Wright architecture seen throughout the city. The structure will be in the flood zone, so choosing masonry units over wood will reduce risk of flood damage.

In depth details of the final design elements can be found in the following section.

## Section VI: Final Design Details

Access Roads

Access roads were designed to a standard 24 ft. width for two-way traffic. Since Asbury Park was designed for one-way traffic, 16 ft. lanes were used. The added width allows more flexibility for trailer movements without encouraging two-way traffic. These design concepts comply with Ch. 5 of SUDAS and the Iowa DNR Water Trails Manual.

The driveways to the parks connect to current road infrastructure at existing grades to minimize grading. The proposed driveways were placed at existing road connections or at locations that are easily visible to encourage park use. Where possible, access roads have a positive grade inward to prevent storm water from the street draining down the driveways and into the parks. For paved drives, running slopes shall not exceed 5% and cross slopes shall not exceed 2% for user comfort. These ideas comply with Ch. 5 of SUDAS and the IDNR Water Trails Manual. The grading sheets are attached as a part of the complete drawing set in Drawings 2, 4, and 6.

Access roads are designed and priced to be either concrete or asphalt. MVS Consultants included both prices in the cost estimate as a part of Appendix C. For more pavement selection details, consult Drawings 12 and 13.

Parking Lots

The parking lots for all three parks were designed to be accessible to people with disabilities. According to the Iowa DNR Water Trails Manual, one accessible stall is required for every five 10 ft. stalls. The accessible stall shall be 16 ft. wide to accommodate van lifts and wheelchair access. All car stalls are 20 ft. long. East Park and Asbury Park both have 40 ft. trailer parking stalls because of the boat ramp access provided. Vehicle mobility has been verified using AutoDesk's AutoTurn software at all three locations with both passenger vehicles and vehicles pulling boat trailers. Since MVS consultants recommended concrete finishes on the driveways and parking lots, finish grades were adjusted to allow for proper drainage. As with the access roads, running slopes shall not exceed 5% and cross slopes shall not exceed 2%. The grading sheets in Drawings 2, 4, and 6, prove that the design slopes comply with industry standards. The parking lots are designed to drain to the bioretention basins shown at each property. Each parking lot was designed with PCC and asphalt. For the pavements to comply with SUDAS 8B-1, they must each be 6 in. thick on 12 in. of prepared subgrade.

Boat Ramps

Boat ramps at East and Asbury Parks were designed in accordance with the Iowa DNR Water Trails Manual. This document specified that boat ramps have 14 ft. widths and that they be installed in two distinct sections. The first section, the one that connects to the rest of the parking lot, is called the launch slope. The launch slope is to be kept as close to 8% grade as possible. An eight percent launch slope was achieved at both ramp sites. The launch slope has one 20 ft. section followed by one 10 ft. section that can be cast in place. The final portion of the ramp is the transition section because it completes the transition from land to water. The transition slope is 14% as recommended by the DNR and shall be precast concrete. The entirety of the ramp shall be grooved, non-skid concrete to prevent dangerous launch skids. The ramps shall be between 30 and 45 degree angles to the river bank to minimize maintenance and provide a reasonable launch angle. Water from the parking ramp shall not drain down the boat ramp and into the river. This is achieved by a slight positive grade at the head of the launch slope. This grade prevents water from running down the boat ramp and is instead directed into the basins. Cross-section and plan view drawings of the boat ramps are shown in Drawings 9 and 10.

Stairways

Stairways were also designed according to Iowa DNR standards. The Iowa DNR Water Trails Manual specifies a simple construction of timber beams, concrete, and slab stone as detailed in Drawings 8, 9, and 10. The stairs are meant for pedestrian access instead of sharing a boat ramp with vehicles for safety reasons. The bottom stair elevations at all three sites were determined by average water elevations. Then stairs were carried on in 1 ft. lifts until a top elevation was achieved that could provide satisfactory sidewalk slopes. East Park's stairs are 3 ft. wide while Asbury and 12th Street have 2 ft. wide stairs because of the extremely flat nature of East Park's existing grades. Great care was taken to keep grades as close to existing as possible to minimize costs and environmental impacts. The stairways will provide safe pedestrian access to the river at all three park locations within Mason City.

Stormwater Management

Stormwater management for each access location was handled in similar fashion. The goal of stormwater management at each location was to limit the 5-year post-development runoff to no more than the 5-year pre-development runoff by on-site treatment. Pre and post-development runoff calculations were completed using the modified rational method which incorporates the time of concentration. Stormwater runoff for all impervious improvements at each site was classified as sheet flow for the first 100 ft. of drainage and then classified as shallow concentrated flow for drainage distances exceeding 100 ft. Iowa SUDAS sections 2B-3 and 2B-4 were consulted to complete these calculations. Three site locations produced many values, so results for pre and post-development runoff calculations and site specific details can be found in Appendix D.

As required by the Iowa DNR Water Trails Manual, the main concern for runoff at river access locations is to minimize pollutant discharge into nearby bodies of water by treating the water quality volume. Water quality volume for each access location was calculated using the short cut method as specified by Chapter 2, Section 1 of the Iowa Stormwater Management Manual. Results from these calculations are provided in Appendix D. The Iowa DNR Water Trails Manual recommends use of bioretention cells to treat runoff at waterway access locations and the manual was consulted for all aspects of the cells. Stormwater runoff is directed into these cells via sheet flow and runoff is infiltrated into selected engineering soils. The bioretention cells incorporate an engineering soil mix that is composed of 40% compost, 40% sand, and 10 to 20% loamy soil. This layer of soil is covered with shredded hardwood mulch and selected cover plants. Each bioretention cell will have a 2 ft. ponding area and will maintain 1 ft. of freeboard as required by SUDAS. The cover plants were selected based off height and color and are native to the region but not invasive. Little Bluestem, Butterfly Milkweed, and Turtlehead Seed were selected from tables of Iowa DNR recommended plants for bioretention cells. A typical cross-section of the bioretention cells can be found in Drawing 8.

Although the main use of each basin is to limit pollutants, SUDAS recommends that infiltration basins are sized for a 100-year storm event. Each bioretention basin was sized to hold the difference between the 100-year flood and 5-year predevelopment runoff. The storage capacity of each basin was higher for the 100-year flood than the water quality volume, so the 100-year flood controlled the sizing. Results from these calculations are provided in Appendix D.

The Asbury Park (Drawings 5, 6, and 10) and East Park (Drawings 3, 4, and 9) accesses are located at low elevations that are very close to the river. Outflow channels were provided at these locations, but erosion control measures were not included. This is because if the 100-year flood is exceeded, these locations will be completely flooded, and erosion control measures would have no effect. This will save in cost and prevent further clean-up after flood events. The 12$^{th}$ Street access (Drawings 1, 2, and 8) is much higher in elevation than the other two accesses. Rip-rap outlet protection was utilized at this location for any flows exceeding the 100-year flood. Quantities for materials used for stormwater treatment were estimated using AutoCAD Civil 3D.

Structure Foundation Footing

To determine the required footing dimensions, the applied loading was calculated first. The applied dead load was found to be 29 kip and live load was taken as 10 kip. ASCE Chapter 7 was referenced when calculating a snow load equal to 18.5 kip. The envelope procedure was utilized when calculating a wind load of 0.35 kip, as is laid out in ASCE Chapter 28. After the necessary loading was found, the footing was designed based on ACI 318-99 and a soil bearing capacity of 3,000 psf. The footing requires a thickness of 5.5 in., a width of 2.5 ft., and extensions of 1 ft. Three #3 bars are required at the top and bottom of the footing. See Appendix E for the supporting design calculations and Drawing 11 for a detailed cross section of the footing.

Structure Trusses

The trusses were designed with equations from Chapter 3 of the NDS Wood Construction manual. Reference design values were found in Chapter 4 of the NDS Supplement. The selected truss shape is a 4/3 Fink Truss, with all members constructed using 2x4s. Lumber used for construction should be Select Structural Douglas Fir. See Appendix F for the supporting design calculations via Medeek Truss Designer. Details on the truss are shown in Drawing 11. Structural renderings can also be found as a part of Appendix G.

## Section VII: Engineer's Cost Estimate

Cost estimates for this project were completed individually for each access location. RSMeans Cost Handbooks were consulted for pricing of materials needed to complete construction. Typical contingency fees (10%) and engineering fees (20%) were assumed and included in the cost estimate. Alternative estimates were also completed for asphalt pavement alternatives as well as estimates for construction with and without a shelter structure at the 12th Street access. A complete cost estimate can be found as a part of Appendix C, but a summary of values can be found in Tables 1 through 3 below.

Table 1: Cost Summary of 12th Street Location

| 12th Street | |
|---|---|
| **Alternatives** | **Total Cost** |
| PCC & Shelter | $288,000 |
| PCC & No Shelter | $206,000 |
| HMA & Shelter | $232,500 |
| HMA & No Shelter | $150,000 |

Table 2: Cost Summary of East Park Location

| East Park | |
|---|---|
| **Alternatives** | **Total Cost** |
| PCC | $182,000 |
| HMA | $117,500 |

Table 3: Cost Summary of Asbury Park Location

| Asbury Park | |
|---|---|
| **Alternatives** | **Total Cost** |
| PCC | $141,000 |
| HMA | $78,000 |

# Appendix A

Gantt Chart

# Gantt Chart

## Waterways Access and Development

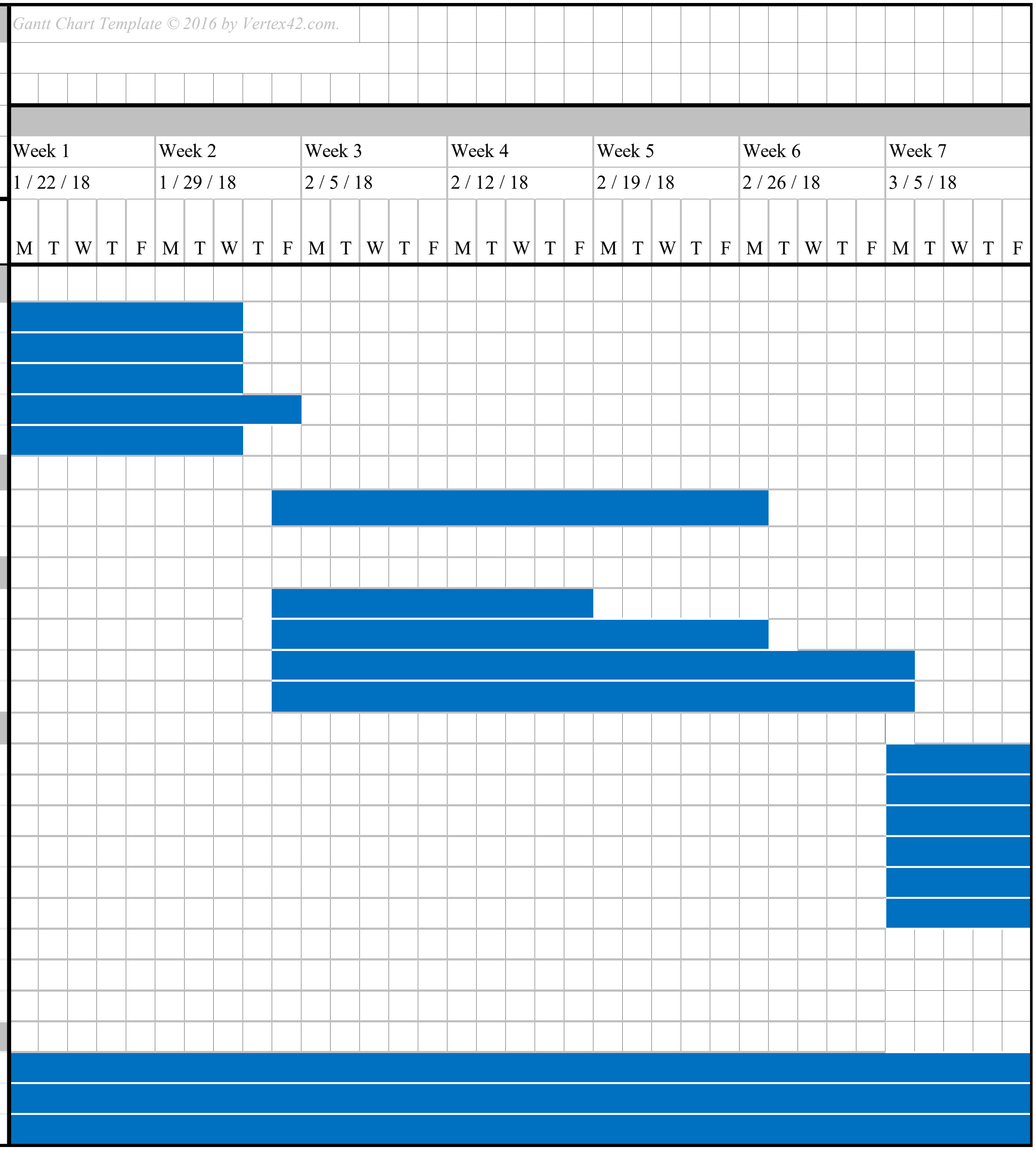
MVS Consultants

Project Lead: Hunter Miller

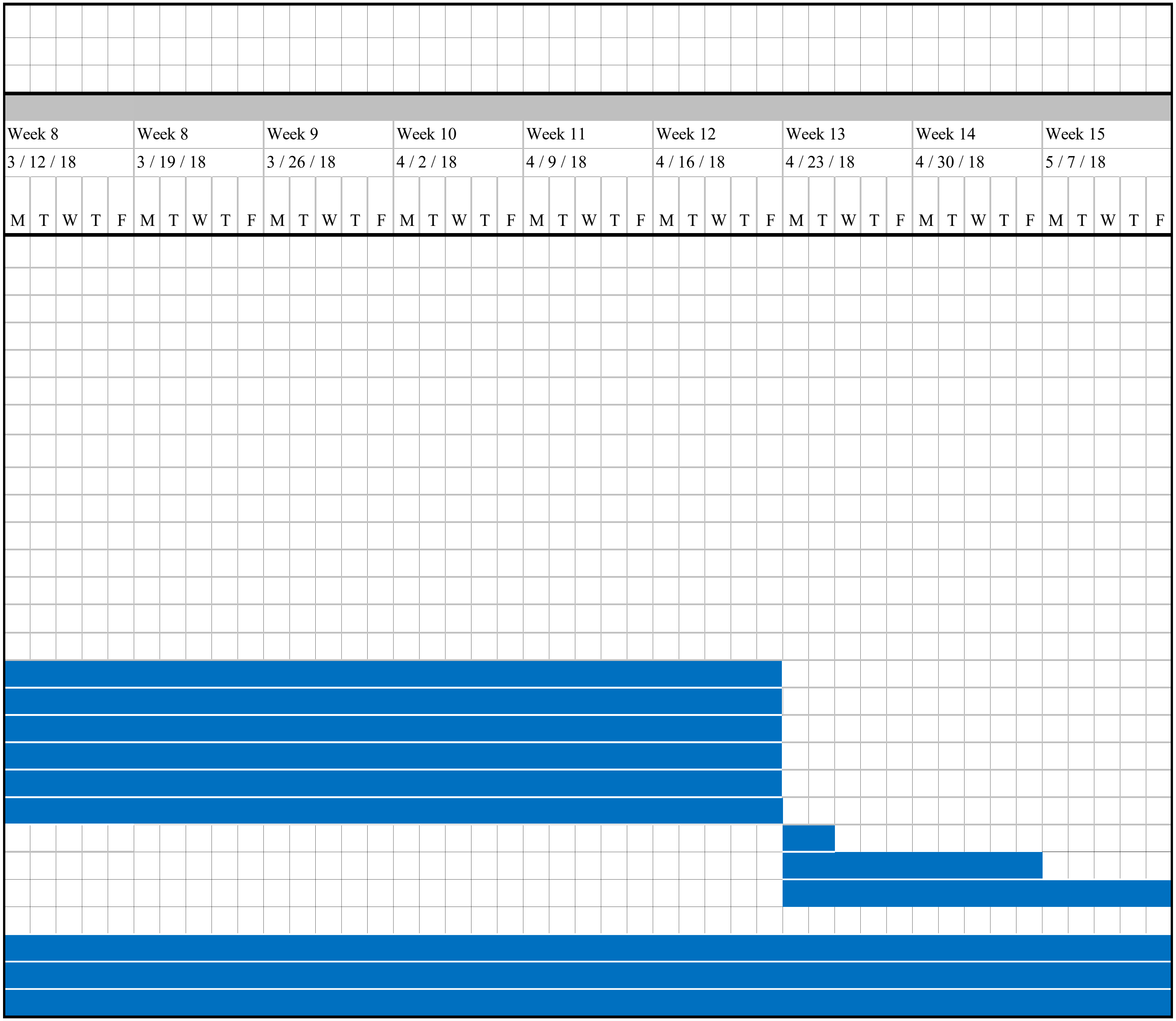
Project Start Date: 01/22/18

Display Week: 1

| WBS | Task | Lead | Work Days |
|---|---|---|---|
| **1** | **Project Kickoff and Data Collection** | | |
| 1.1 | Project Scope Summary | Hunter Miller | 8 |
| 1.2 | Similar Work Summary | Paige Salz | 8 |
| 1.3 | Team Meetings for Data Collection | Hunter Miller | 8 |
| 1.4 | Proposal | Hunter Miller | 10 |
| 1.5 | Site Visit Meeting Agenda | Hunter Miller | 8 |
| **2** | **Field Assessment and Concept Development** | | |
| 2.1 | Team Meetings for Conceptual Designs | Hunter Miller | 17 |
| 2.2 | Site Visit | Hunter Miller | 1 |
| **3** | **Design Concept Development** | | |
| 3.1 | Assessment of Existing Conditions | Hunter Miller | 12 |
| 3.2 | Conceptual Design of Alternatives | Hunter Miller | 18 |
| 3.3 | Summary of Alternatives | Paige Salz | 22 |
| 3.4 | Review Meeting to Discuss Alternatives | Hunter Miller | 22 |
| **4** | **Design** | | |
| 4.1 | Complete Design | Hunter Miller | 35 |
| 4.2 | Design Report | Paige Salz | 35 |
| 4.3 | Design Drawings | Marri VanDyke | 35 |
| 4.4 | Project Poster | Paige Salz | 35 |
| 4.5 | List of Materials and Quantities | Marri VanDyke | 35 |
| 4.6 | Cost Estimate | Hunter Miller | 35 |
| 4.7 | Revisions or Design Aspects | Paige Salz | 2 |
| 4.8 | Final Report, Drawings and Poster | Hunter Miller | 10 |
| 4.9 | Final Design Presentations | Hunter Miller | 15 |
| **5** | **Project Management and Coordination** | | |
| 5.1 | Administration and Coordination | Hunter Miller | 80 |
| 5.2 | General Communication | Marri VanDyke | 80 |
| 5.3 | Documentation of Work-to-date | Paige Salz | 80 |



Gantt Chart, cont.



# Appendix B

Floodplain Maps

## NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

**Coastal Base Flood Elevations** shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Iowa State Plane North zone 3876 (FIPSZONE 1401). The **horizontal datum** was NAD83. Differences in datum, spheroid, projection or state plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov/.

**Base Map** information shown on this FIRM was derived from the U.S.D.A. Farm Service Agency National Agriculture Imagery Program (NAIP) produced at a scale of 1:12,000 from photography dated 2008.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

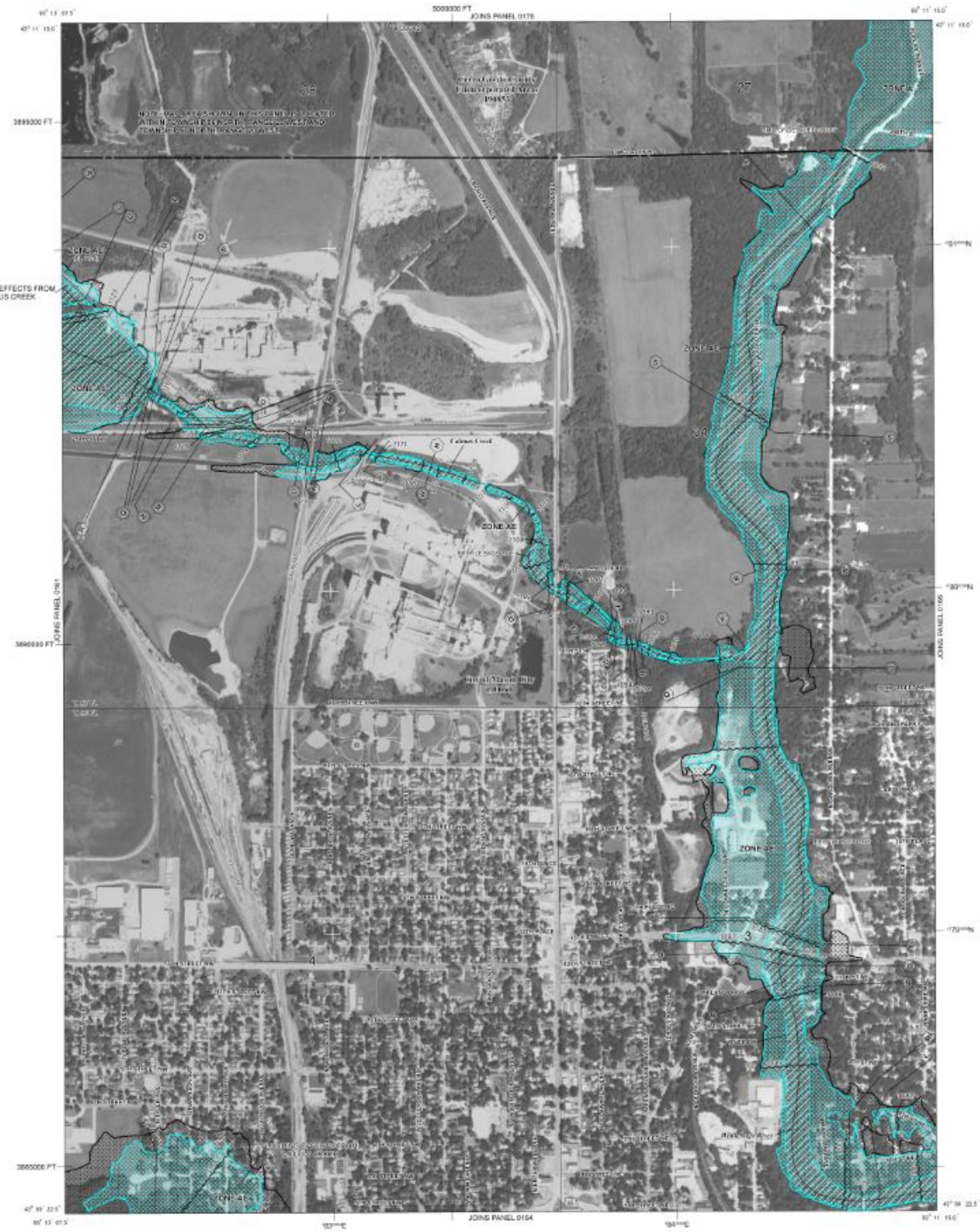
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX) at 1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip

The **profile base lines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile base line**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

## PANEL INDEX




## LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard may include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

| | |
|---|---|
| ZONE A | No Base Flood Elevations determined. |
| ZONE AE | Base Flood Elevations determined. |
| ZONE AH | Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined. |
| ZONE AO | Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined. |
| ZONE AR | Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood. |
| ZONE A99 | Area to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined. |
| ZONE V | Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined. |
| ZONE VE | Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined. |

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

| | |
|---|---|
| ZONE X | Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. |

OTHER AREAS

| | |
|---|---|
| ZONE X | Areas determined to be outside of the 0.2% annual chance floodplain. |
| ZONE D | Areas in which flood hazards are undetermined, but possible. |

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

| | |
|---|---|
| | 1% annual chance floodplain boundary |
| | 0.2% annual chance floodplain boundary |
| | Floodway boundary |
| | Zone D boundary |
| | CBRS and OPA boundary |
| | Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities. |
| 513 | Base Flood Elevation line and value; elevation in feet* |
| (EL 16) | Base Flood Elevation value where uniform within zone; elevation in feet* |

*Referenced to the North American Vertical Datum of 1988

| | |
|---|---|
| A — A | Cross section line |
| — — — — | Transect line |
| | Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere |
| | 1000-meter Universal Transverse Mercator grid values, zone 15 |
| 2250000 FT | 5000-foot grid ticks: Iowa State Plane North Coordinate System, 3876 zone (FIPSZONE 1401), Lambert Conformal Conic |
| KA3015 × | Bench mark (see explanation in Notes to Users section of this FIRM panel) |
| • M1.5 | River Mile |

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MAY 16, 2012

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0162C

# FIRM

FLOOD INSURANCE RATE MAP

CERRO GORDO COUNTY, IOWA

AND INCORPORATED AREAS

PANEL 162 OF 400

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

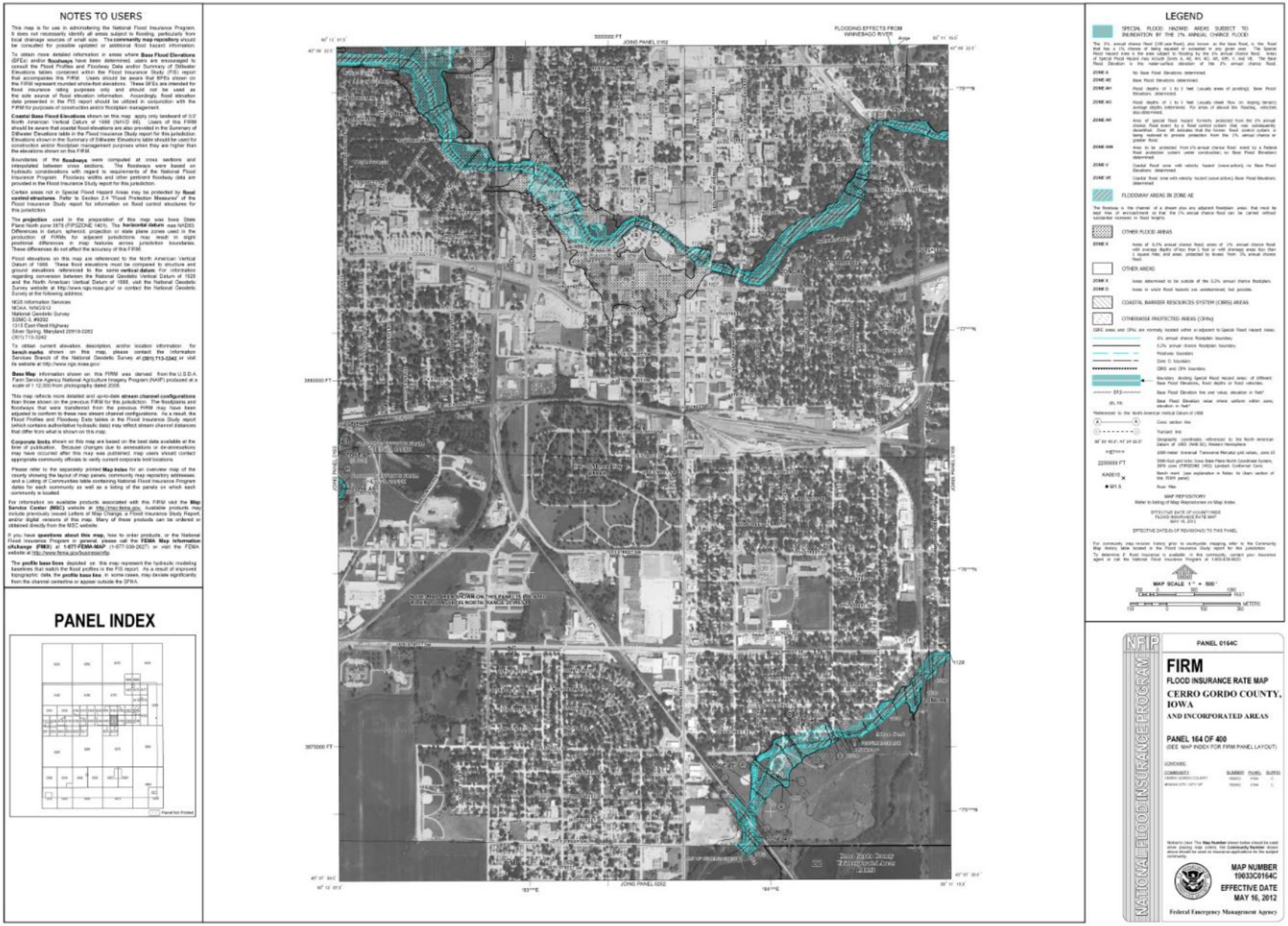
| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| CERRO GORDO COUNTY | [illegible] | 0162 | C |
| MASON CITY, CITY OF | [illegible] | 0162 | C |

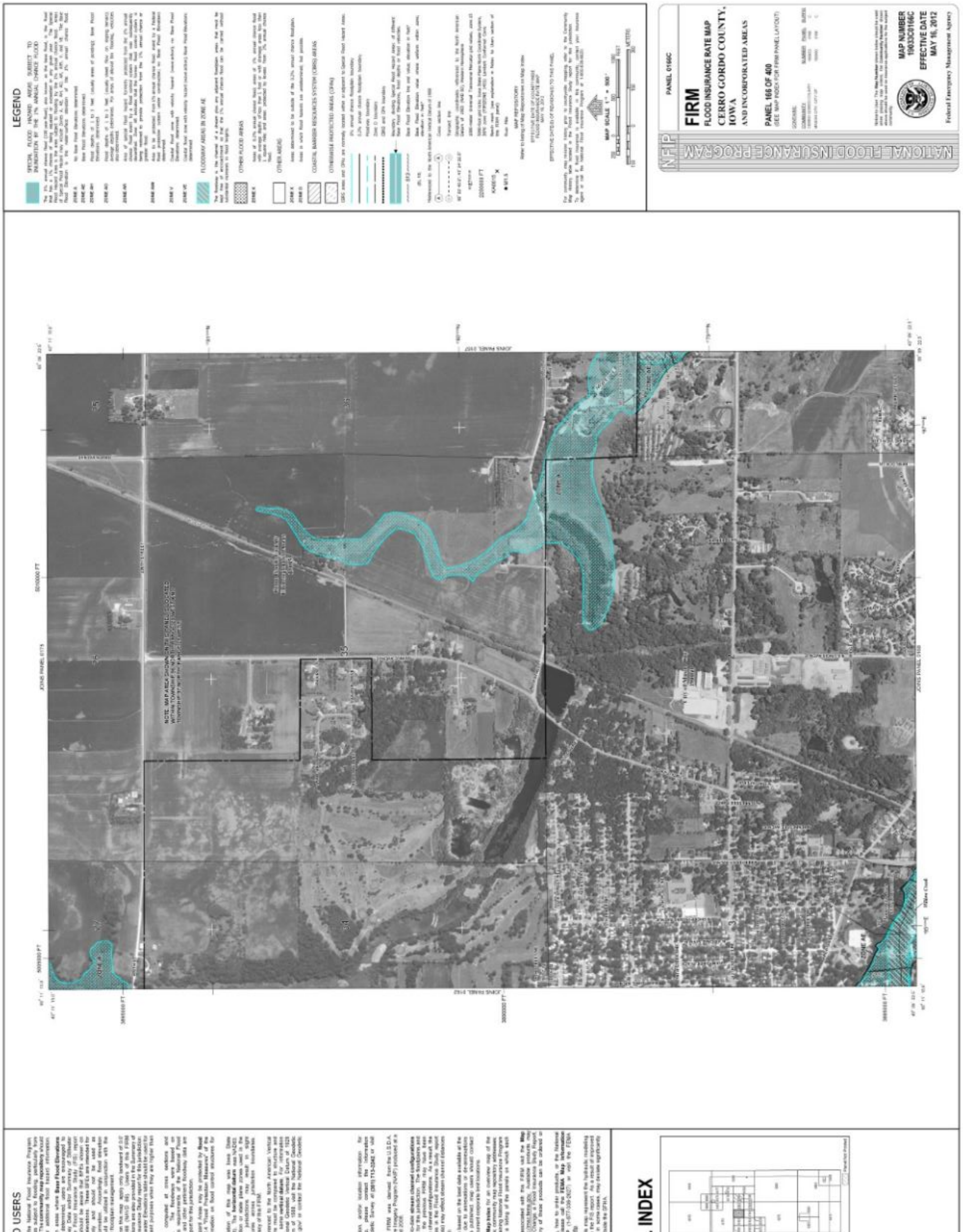
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

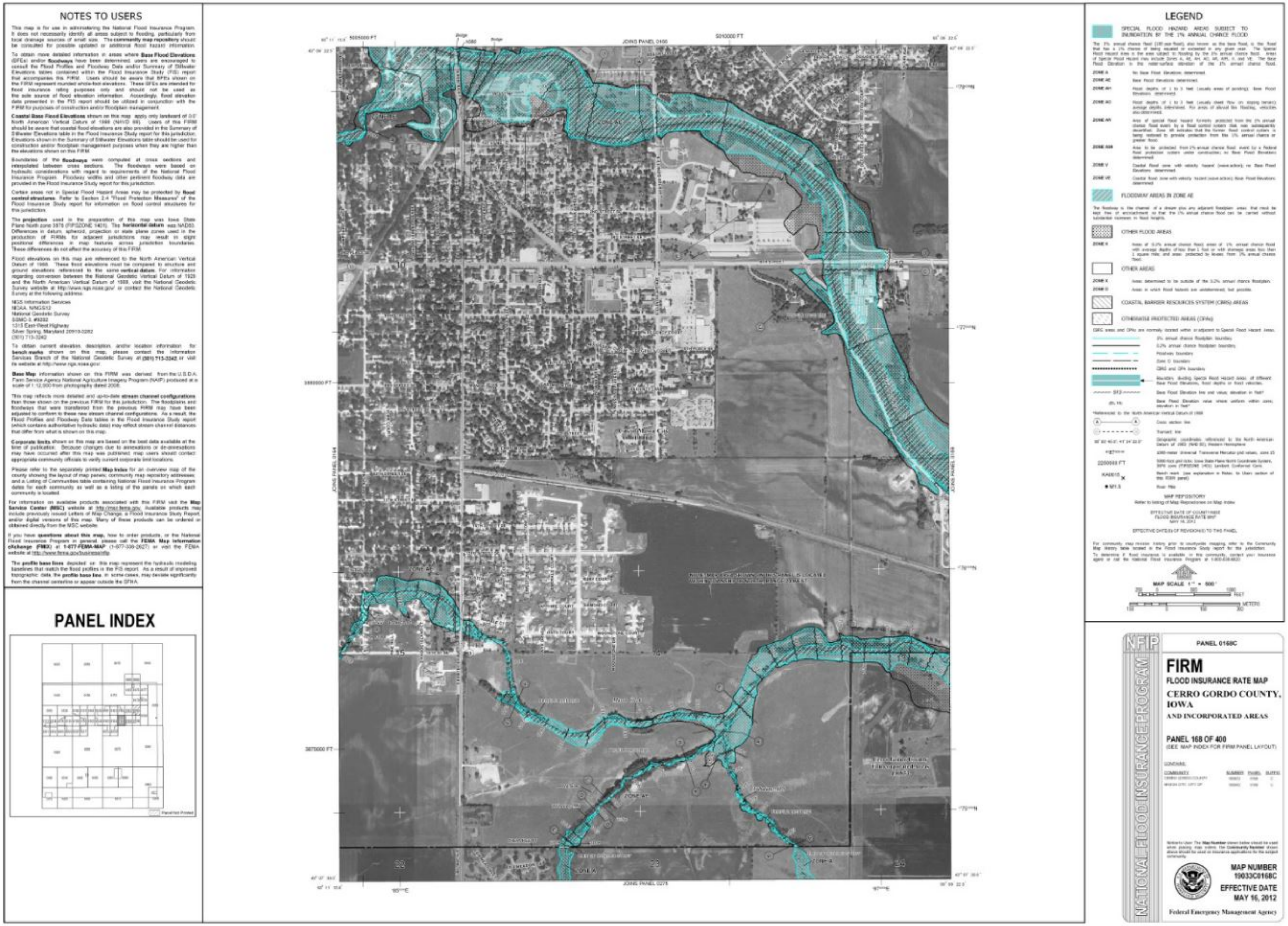
MAP NUMBER
19033C0162C

EFFECTIVE DATE
MAY 16, 2012

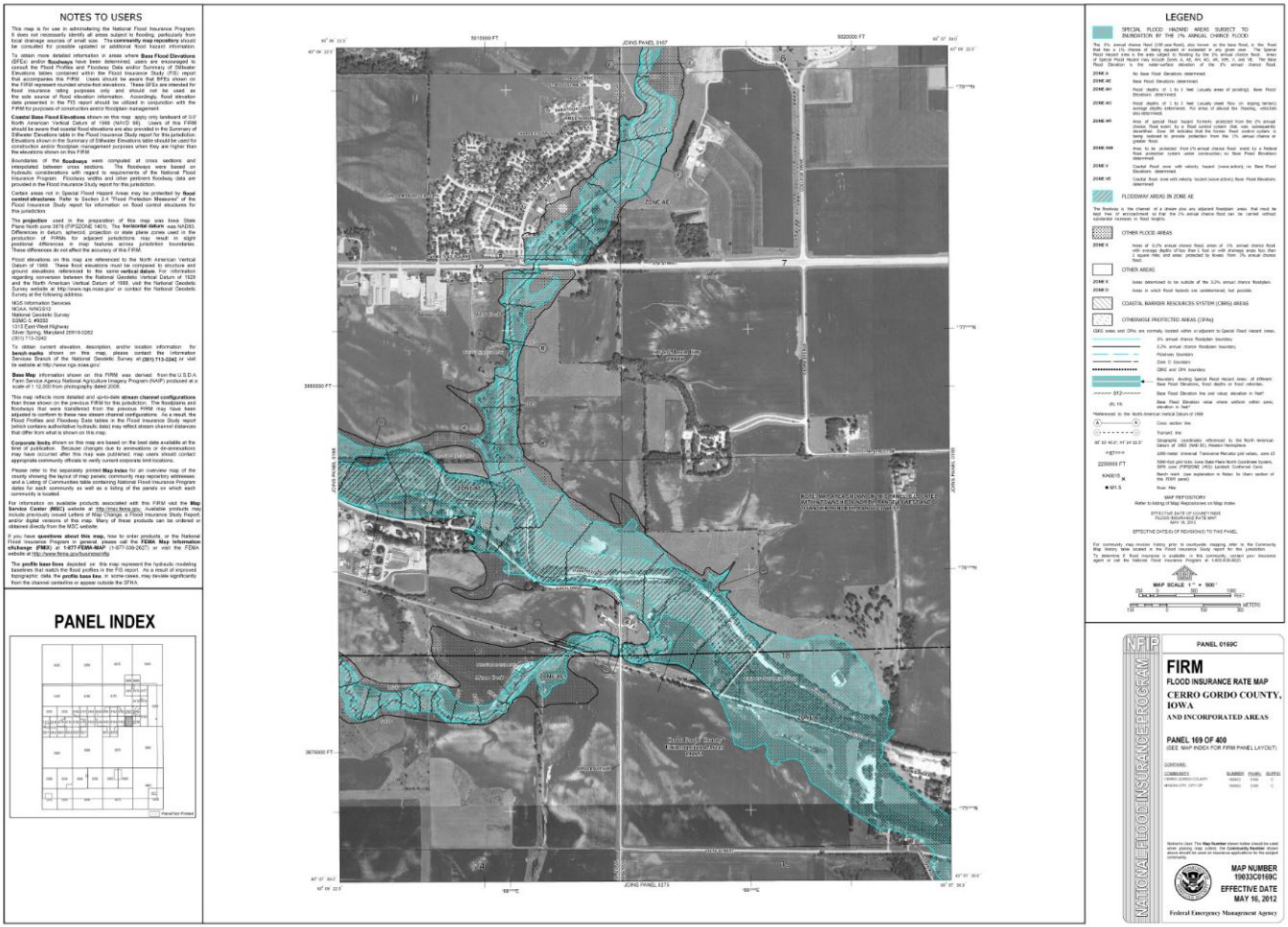
Federal Emergency Management Agency


NOTES TO USERS
PANEL INDEX
LEGEND
FLOODING EFFECTS FROM WINNEBAGO RIVER
JOINS PANEL 0162
JOINS PANEL 0252
MAP SCALE 1" = 500'
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0164C
FIRM
FLOOD INSURANCE RATE MAP
CERRO GORDO COUNTY, IOWA
AND INCORPORATED AREAS
PANEL 164 OF 400
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
MAP NUMBER 19033C0164C
EFFECTIVE DATE MAY 16, 2012
Federal Emergency Management Agency


NOTES TO USERS
PANEL INDEX
LEGEND
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 96 NORTH, RANGE 20 WEST
ZONE A
ZONE AE
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0166C
FIRM
FLOOD INSURANCE RATE MAP
CERRO GORDO COUNTY, IOWA
AND INCORPORATED AREAS
PANEL 166 OF 400
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
MAP NUMBER
19033C0166C
EFFECTIVE DATE
MAY 16, 2012
Federal Emergency Management Agency



NOTES TO USERS
PANEL INDEX
LEGEND
MAP SCALE 1" = 500'
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0168C
FIRM
FLOOD INSURANCE RATE MAP
CERRO GORDO COUNTY, IOWA
AND INCORPORATED AREAS
PANEL 168 OF 400
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
MAP NUMBER
19033C0168C
EFFECTIVE DATE
MAY 16, 2012
Federal Emergency Management Agency


NOTES TO USERS
PANEL INDEX
LEGEND
ZONE AE
JOINS PANEL 0167
JOINS PANEL 0275
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0169C
FIRM
FLOOD INSURANCE RATE MAP
CERRO GORDO COUNTY, IOWA
AND INCORPORATED AREAS
PANEL 169 OF 400
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
MAP NUMBER 19033C0169C
EFFECTIVE DATE MAY 16, 2012
Federal Emergency Management Agency

## Appendix C

Cost Estimate

| 12th Street | | | | |
|---|---|---|---|---|
| **Item** | **Unit** | **Quantity** | **Unit Price** | **Total** |
| 6" PCC Class C | cy | 279.00 | $200.00 | $55,800.00 |
| 4" PCC Class C | cy | 21.00 | $242.00 | $5,082.00 |
| Class A Granular Subbase | ton | 781.00 | $21.00 | $16,401.00 |
| Turtlehead Seed | acre | 0.03 | $12,121.21 | $400.00 |
| Little Bluestem seed | acre | 0.01 | $130.00 | $1.69 |
| Butterfly Milkweed seed | acre | 0.04 | $12,500.00 | $500.00 |
| Engineered Soil Mix | cy | 130.00 | $35.00 | $4,550.00 |
| Medium aggregate concrete sand | cy | 78.00 | $29.50 | $2,301.00 |
| Shredded hardwood mulch | sy | 160.00 | $3.86 | $617.60 |
| Painted Pavement Markings, 4" | lf | 100.00 | $0.34 | $34.00 |
| 6"x6" Recycled Timbers | lf | 160.00 | $10.95 | $1,752.00 |
| Slab Stone Ramp Stairs | ea | 2.00 | $150.00 | $300.00 |
| 3/8" Gravel Mix | ton | 2.10 | $28.50 | $59.85 |
| Armoring (Rip-rap) | ton | 33.00 | $32.50 | $1,072.50 |
| 1/2" Rebar Stakes (30" length) | lf | 50.00 | $1.00 | $50.00 |
| 16" Timber Screws | ea | 14.00 | $5.00 | $70.00 |
| Landscape Filter Fabric (18"x100' roll) | ea | 1.00 | $58.50 | $58.50 |
| Geoweb | sf | 10.00 | $3.40 | $34.00 |
| Crushed Limestone | ton | 0.40 | $45.00 | $18.00 |
| Fill | cy | 4145.00 | $2.80 | $11,606.00 |
| Borrow | cy | 4145.00 | $10.00 | $41,450.00 |
| Silt Fence | lf | 403.00 | $2.11 | $850.33 |
| Waddles | lf | 100.00 | $2.00 | $200.00 |
| Accessible Stall Symbol | ea | 1.00 | $58.50 | $58.50 |
| Clearing and Grubbing | acre | 0.25 | $6,850.00 | $1,712.50 |
| Mobilization | ea | 1.00 | $12,937.61 | $12,937.61 |
| HMA Pavement, 6" | ton | 565.00 | $23.00 | $12,995.00 |
| Grass Seeding | acre | 4.00 | $6.50 | $26.00 |
| Accessible Parking Sign and Post | ea | 1.00 | $276.00 | $276.00 |
| Basic CMU Units | blocks | 394.00 | $3.50 | $1,379.00 |
| Split-Face CMU Units | blocks | 965.00 | $1.25 | $1,206.25 |
| Normal Weight Concrete | cy | 28.50 | $108.00 | $3,078.00 |
| Rebar | ft | 888.00 | $0.75 | $666.00 |
| Trusses | ea | 20.00 | $230.00 | $4,600.00 |
| Roof underlayment | ea | 2.00 | $80.00 | $160.00 |
| Asphalt Shingles | ea | 130 | $90.00 | $11,700.00 |
| Foam Insulation | fbm | 13525.00 | $1.50 | $20,287.50 |
| 5/8 Plywood OSB (4'x8') | ea | 40 | $30.00 | $1,200.00 |
| 5/8 Drywall (4'x8') | ea | 38.00 | $15.00 | $570.00 |
| Windows (48"x12") | ea | 10 | $150.00 | $1,500.00 |
| Windows (24"x12") | ea | 1.00 | $100.00 | $100.00 |
| Doors (32") | ea | 3 | $400.00 | $1,200.00 |
| Garage Door (8'x10') | ea | 1.00 | $750.00 | $750.00 |
| Lighting | ls | 1 | $5,000.00 | $5,000.00 |
| Ductwork | ls | 1.00 | $5,000.00 | $5,000.00 |
| Plumbing | ls | 1 | $5,000.00 | $5,000.00 |
| **Total** | | | | $221,615.83 |
| | | | | |
| **10% Contingencies** | | | | $22,161.58 |
| **20% Engineering and Administration** | | | | $44,323.17 |
| **Total Project Cost (PCC & Shelter)** | | | | $288,100.58 |
| | | | | |
| **Total Project Cost (PCC & No Shelter)** | | | | $205,684.81 |
| **Total Project Cost (HMA & Shelter)** | | | | $232,454.08 |
| **Total Project Cost (HMA & No Shelter)** | | | | $150,038.31 |

| East Park | | | | |
|---|---|---|---|---|
| **Item** | **Unit** | **Quantity** | **Unit Price** | **Total** |
| 6" PCC Class C | cy | 320.00 | $200.00 | $64,000.00 |
| 4" PCC Class C | cy | 4.70 | $242.00 | $1,137.40 |
| Class A Granular Subbase | ton | 872.00 | $21.00 | $18,312.00 |
| Turtlehead Seed | acre | 0.04 | $12,121.21 | $424.24 |
| Little Bluestem seed | acre | 0.01 | $130.00 | $1.82 |
| Butterfly Milkweed | acre | 0.02 | $12,500.00 | $287.50 |
| Engineered Soil Mix | cy | 139.00 | $35.00 | $4,865.00 |
| Medium aggregate concrete sand | cy | 84.00 | $29.50 | $2,478.00 |
| Shredded hardwood mulch | acre | 0.04 | $3.86 | $0.14 |
| Painted Pavement Markings | lf | 280.00 | $0.34 | $95.20 |
| 10'x6"x6" Recycled Timbers | ea | 8.00 | $10.95 | $87.60 |
| Slab Stone Ramp Stairs | ea | 2.00 | $150.00 | $300.00 |
| 3/8" Gravel Mix | ton | 1.00 | $28.50 | $28.50 |
| Armoring (Rip-rap) | ton | 32.00 | $32.50 | $1,040.00 |
| 1/2" Rebar Stakes (30" length) | ea | 10.00 | $1.00 | $10.00 |
| Clearing and Grubbing | acre | 0.10 | $6,850.00 | $685.00 |
| HMA Pavement, 6" | ton | 630.00 | $23.00 | $14,490.00 |
| 16" Timber Screws | ea | 6.00 | $5.00 | $30.00 |
| Landscape Filter Fabric | sf | 50.00 | $58.50 | $2,925.00 |
| Geoweb | sf | 12.00 | $3.40 | $40.80 |
| Crushed Limestone | ton | 0.60 | $45.00 | $27.00 |
| Fill | cy | 2623.00 | $2.80 | $7,344.40 |
| Borrow | cy | 2623.00 | $10.00 | $26,230.00 |
| Silt Fence | lf | 355.00 | $2.11 | $749.05 |
| Waddles | lf | 100.00 | $2.00 | $200.00 |
| Accessible Space | ea | 1.00 | $58.50 | $58.50 |
| Mobilization | ea | 1.00 | $8,156.76 | $8,156.76 |
| Grass Seeding | acre | 4.00 | $6.50 | $26.00 |
| Accessible Parking Sign and Post | ea | 1.00 | $276.00 | $276.00 |
| **Total** | | | | $139,815.90 |
| | | | | |
| **10% Contingencies** | | | | $13,981.59 |
| **20% Engineering and Administration** | | | | $27,963.18 |
| **Total Project Cost (PCC)** | | | | $181,760.68 |
| | | | | |
| **Total Project Cost (HMA)** | | | | $117,397.68 |

| Asbury Park | | | | |
|---|---|---|---|---|
| **Item** | **Unit** | **Quantity** | **Unit Price** | **Total** |
| 6" PCC Class C | cy | 317.00 | $200.00 | $63,400.00 |
| 4" PCC Class C | cy | 8.50 | $242.00 | $2,057.00 |
| Class A Granular Subbase | ton | 867.00 | $21.00 | $18,207.00 |
| Turtlehead Seed | acre | 0.03 | $12,121.21 | $303.03 |
| Little Bluestem seed | acre | 0.02 | $130.00 | $2.08 |
| Butterfly Milkweed | acre | 0.05 | $12,500.00 | $675.00 |
| Engineered Soil Mix | cy | 101.00 | $35.00 | $3,535.00 |
| Medium aggregate concrete sand | cy | 61.00 | $29.50 | $1,799.50 |
| Shredded hardwood mulch | acre | 0.03 | $3.86 | $0.10 |
| Painted Pavement Markings | lf | 260.00 | $0.34 | $88.40 |
| 10'x6"x6" Recycled Timbers | ea | 5.00 | $10.95 | $54.75 |
| Slab Stone Ramp Stairs | ea | 2.00 | $150.00 | $300.00 |
| 3/8" Gravel Mix | ton | 0.40 | $28.50 | $11.40 |
| Armoring (Rip-rap) | ton | 28.30 | $32.50 | $919.75 |
| 1/2" Rebar Stakes (30" length) | ea | 8.00 | $1.00 | $8.00 |
| 16" Timber Screws | ea | 4.00 | $5.00 | $20.00 |
| Landscape Filter Fabric | sf | 20.00 | $58.50 | $1,170.00 |
| Geoweb | sf | 10.00 | $3.40 | $34.00 |
| Crushed Limestone | ton | 0.40 | $45.00 | $18.00 |
| Excavation | cy | 677.00 | $3.10 | $2,098.70 |
| Cut from site | cy | 677.00 | $10.00 | $6,770.00 |
| Silt Fence | lf | 465.00 | $2.11 | $981.15 |
| Waddles | lf | 100.00 | $2.00 | $200.00 |
| Accessible Space | ea | 1.00 | $58.50 | $58.50 |
| HMA Pavement, 6" | ton | 640.00 | $23.00 | $14,720.00 |
| Mobilization | ea | 1.00 | $5,556.87 | $5,556.87 |
| Grass Seeding | acre | 4.00 | $6.50 | $26.00 |
| Accessible Parking Sign and Post | ea | 1.00 | $276.00 | $276.00 |
| **Total** | | | | $108,570.22 |
| | | | | |
| **10% Contingencies** | | | | $10,857.02 |
| **20% Engineering and Administration** | | | | $21,714.04 |
| **Total Project Cost (PCC)** | | | | $141,141.29 |
| | | | | |
| **Total Project Cost (HMA)** | | | | $77,857.29 |

# Appendix D

Stormwater Calculations

## Table D1: Design Calculation Results for 12th Street Access

| 12th Street | |
|---|---|
| **Site Area (acres)** | 2.05 |
| **Pre-Development Time of Concentration (minutes)** | 11.73 (10) |
| **Post-development Time of Concentration (minutes)** | 4.22 (5) |
| **5-year Pre-Development Runoff (cfs)** | 5.92 |
| **5-year Post Development Runoff (cfs)** | 8.95 |
| **Water Quality Volume ($ft^3$)** | 2140 |
| **100-year Required Bioretention Storage ($ft^3$)** | 3769 |

## Table D2: Design Calculation Results for East Park Access

| East Park | |
|---|---|
| **Site Area (acres)** | 1.56 |
| **Pre-Development Time of Concentration (minutes)** | 16.42 (15) |
| **Post-development Time of Concentration (minutes)** | 3.86 (5) |
| **5-year Pre-Development Runoff (cfs)** | 3.98 |
| **5-year Post Development Runoff (cfs)** | 6.86 |
| **Water Quality Volume ($ft^3$)** | 1702 |
| **100-year Required Bioretention Storage ($ft^3$)** | 3261 |

## Table D3: Design Calculation Results for Asbury Park Access

| Asbury Park | |
|---|---|
| **Site Area (acres)** | 1.65 |
| **Pre-Development Time of Concentration (minutes)** | 14.01 (15) |
| **Post-development Time of Concentration (minutes)** | 2.47 (5) |
| **5-year Pre-Development Runoff (cfs)** | 4.28 |
| **5-year Post Development Runoff (cfs)** | 7.34 |
| **Water Quality Volume ($ft^3$)** | 1927 |
| **100-year Required Bioretention Storage ($ft^3$)** | 3468 |

# Appendix E

Structural Footing Design Calculations

## Assumptions

- Building satisfies wind born debris provisions, is simple diaphragm, enclosed, regular shaped, not flexible, aerodynamically stable, symmetrical, gable roof, and exempt from torsional load cases.
- Risk category II
- $Kzt := 1.0$
- Exposure type C
- $f_c' := 3\ ksi$
- $f_y := 60\ ksi$

## Calculations

Dead Load

Upper Roof:

Shingles: 2 psf

5" thick foam insulation: 0.21 psf

Waterproof underlayment: 0.7 psf

5/8" plywood sheathing: 2 psf

Roof framing:

$SG := 0.49$ specific gravity of Douglis Fir

$0.49 \cdot 62.43 \cdot \frac{1.5 \cdot 5.5}{144} \cdot \frac{12}{24} = 0.876$ psf

Total: $2\ psf + 0.21\ psf + 0.7\ psf + 2\ psf + 0.876\ psf = 5.786\ psf$

Convert to Horizontal Plane

4:12 roof pitch $\theta := 18.43\ °$

$$\frac{5.786\ psf}{\cos(\theta)} = 6.099\ psf$$

Convert to Pounds

$$UR := \frac{6.099\ psf \cdot 40\ ft \cdot 30\ ft}{2} = \left(3.659 \cdot 10^3\right)\ lbf$$

Lower Roof

6" thick foam insulation: 0.252 psf

5/8" gypsum wall board: 2.75 psf

Lighting: 1.5 psf

Duct allowance: 4 psf

Piping alowance: 1.5 psf

Weight of garage door: $\frac{112\ lbf}{40\ ft \cdot 30\ ft} = 0.093\ psf$

Total: $0.252\ psf + 2.75\ psf + 1.5\ psf + 4\ psf + 1.5\ psf + 0.093\ psf = 10.095\ psf$

Convert to Pounds

$$LR := \frac{10.095\ psf \cdot 30\ ft \cdot 40\ ft}{2} = \left(6.057 \cdot 10^{3}\right)\ lbf$$

Walls

Masonry Units (Unfilled)

$\frac{10 \cdot 12}{8} = 15$ blocks tall

$\frac{30 \cdot 12}{16} = 22.5$ blocks wide

$$\frac{35\ lbf \cdot 15 \cdot 22.5}{30} = 393.75\ lbf$$

Mortar

$\frac{135\ lbf}{ft^{3}} \cdot 13\ in \cdot 6\ in \cdot 8\ in = 48.75\ lbf$ per block

$$\frac{48.75\ lbf \cdot 15 \cdot 22.5}{30} = 548.438\ lbf$$

Total: $W := 393.75\ lbf + 548.438\ lbfs = 942.188\ lbf$

Balanced Snow Load (ASCE Chapter 7)

Risk Category and Importance Factor

3 to 300 people: Risk category II
Therefore,

$$I_s := 1.00$$

Select ground snow load

Mason City, Iowa: $p_g := 40\ psf$

Determine roof snow load factors

Terrain category C, partially exposed: $C_e := 1.0$

Structure kept just above freezing: $C_t := 1.1$

Cold roof with 4:12 slope: $C_s := 1.0$

Calculate balanced snow load

$$p_s := 0.7 \cdot C_s \cdot C_e \cdot C_t \cdot I_s \cdot p_g = 30.8\ psf$$

Convert to Pounds

$$p_s := \frac{p_s \cdot 40\ ft \cdot 30\ ft}{2} = 18.48\ kip$$

Total Dead Load

$$D := UR + LR + W + p_s = 29\ kip$$

Wind Load (ASCE Chapter 28)

Define Variables

$LHD := 30\ ft$ Least horizontal dimension

$h_e := 10\ ft$ Height to the eave

$h_p := 14.33\ ft$ Height to peak

$V := 115\ \frac{mile}{hr}$ Risk category II wind speed for Mason City

Design Calculations

Case A is more conservative than Case B

$h := \frac{1}{2} \cdot (h_e + h_p) = 12.165\ ft$

$h < 60\ ft$

$h < LHD$ Building is low rise.

$\theta := \operatorname{atan}\left(\frac{5}{15}\right) = 18.435\ ^\circ$ < 45 OK

**All conditions are met, use the envelope procedure**

Use mean roof height of 15 ft to find $\lambda$ for exposure C from ASCE Figure 28.6-1 (Lowest height in table)

$\lambda := 1.21$

Determine Pressure Coefficients

$V = 115\ \frac{mile}{hr}$ $\theta = 18.435\ ^\circ$

Use $\theta = 20^\circ$ to avoid interpolation (more conservative)

$A' := 29\ \frac{lbf}{ft^2}$ $E' := -25.2\ \frac{lbf}{ft^2}$

$B' := -7.7\ \frac{lbf}{ft^2}$ $F' := -17.5\ \frac{lbf}{ft^2}$

$C' := 19.4\ \frac{lbf}{ft^2}$ $G' := -17.5\ \frac{lbf}{ft^2}$

$D' := -4.2\ \frac{lbf}{ft^2}$ $H' := -13.3\ \frac{lbf}{ft^2}$

Adjust for height, exposure, and topography

$A := A' \cdot \lambda \cdot Kzt = 35.09\ \frac{lbf}{ft^2}$ $E := E' \cdot \lambda \cdot Kzt = -30.492\ \frac{lbf}{ft^2}$

$B := B' \cdot \lambda \cdot Kzt = -9.317\ \frac{lbf}{ft^2}$ $F := F' \cdot \lambda \cdot Kzt = -21.175\ \frac{lbf}{ft^2}$

$C := C' \cdot \lambda \cdot Kzt = 23.474\ \frac{lbf}{ft^2}$ $G := G' \cdot \lambda \cdot Kzt = -21.175\ \frac{lbf}{ft^2}$

$D := D' \cdot \lambda \cdot Kzt = -5.082\ \frac{lbf}{ft^2}$ $H := H' \cdot \lambda \cdot Kzt = -16.093\ \frac{lbf}{ft^2}$

Use $A \cdot 10\ ft \cdot 1\ ft = 0.351\ kip$

Calculate width of end zone

$a_1 := 0.1 \cdot LHD = 0.914\ m$ $a_2 := 0.4 \cdot h = 1.483\ m$

$a := min(a_1, a_2) = 0.914\ m$ $0.04 \cdot LHD = 0.366\ m$

$a \geq 1.2\ ft$ $a \leq 3\ ft$ OK

Width of End Zone

$w := 2 \cdot a = 1.829\ m$

| | | | |
|---|---|---|---|
| **Daniel T. Li** Engineering International | PROJECT : | | PAGE : |
| | CLIENT : | | DESIGN BY : |
| | JOB NO. : | DATE : | REVIEW BY : |

## Wall Footing Design Based on ACI 318-99

### INPUT DATA

| | | | | |
|---|---|---|---|---|
| CONCRETE STRENGTH | fc' | = | 3.5 | ksi |
| REBAR YIELD STRESS | fy | = | 60 | ksi |
| AXIAL DEAD LOAD | $P_{DL}$ | = | 29 | k |
| DEAD LOAD MOMENT | $M_{DL}$ | = | 30 | ft-k |
| AXIAL LIVE LOAD | $P_{LL}$ | = | 10 | k |
| LIVE LOAD MOMENT | $M_{LL}$ | = | 0 | ft-k |
| LATERAL LOAD (0=WIND, 1=SEISMIC) | | | 0 | Wind |
| WIND AXIAL LOAD | $P_{LAT}$ | = | 0.35 | k |
| WIND MOMENT | $M_{LAT}$ | = | 0 | ft-k |
| WALL THICKNESS | t | = | 8 | in |
| WALL LENGTH | Lw | = | 30 | ft |
| WALL FOOTING EXTENSION | Le | = | 1 | ft |
| FOOTING WIDTH | B | = | 2.5 | ft |
| FOOTING THICKNESS | T | = | 5.5 | in |
| FOOTING EMBEDMENT DEPTH | Df | = | 5 | ft |
| SURCHARGE | qs | = | 0 | ksf |
| SOIL WEIGHT | ws | = | 0.11 | kcf |
| ALLOWABLE SOIL PRESSURE | Qa | = | 3 | ksf |
| LONGITUDINAL REINF. BAR SIZE : | | # | 3 | |
| TRANSVERSE REINF. BAR SIZE : | | # | 3 | |

### DESIGN SUMMARY

| | | | | |
|---|---|---|---|---|
| FOOTING WIDTH | B | = | 2.50 | ft |
| FOOTING LENGTH | L | = | 32.00 | ft |
| FOOTING THICKNESS | T | = | 5.50 | in |
| LONG. BARS AT ENDS (BOTTOM) | 3 | # | 3 | HOOKED |
| LONG. BARS AT WALL (BOTTOM) | 3 | # | 3 | CONT. BARS |

**THE FOOTING DESIGN IS ADEQUATE.**

### ANALYSIS

**DESIGN LOADS** (IBC 2000 SEC.1605.3.2 & ACI 318-99 SEC.9.2.1)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CASE 1: DL + LL | P | = | 44 | k | 1.4 DL + 1.7 LL | Pu | = | 58 | k |
| | M | = | 30 | ft-k | | Mu | = | 42 | ft-k |
| | e | = | 0.68 | ft, < (L / 6) | | eu | = | 0.73 | ft, < (L / 6) |
| CASE 2: DL + LL +1.0 W | P | = | 44 | k | 1.2 DL + LL + 1.3 W | Pu | = | 45 | k |
| | M | = | 30 | ft-k | | Mu | = | 36 | ft-k |
| | e | = | 0.67 | ft, < (L / 6) | | eu | = | 0.80 | ft, < (L / 6) |
| CASE 3: DL + LL + 0.5 W | P | = | 44 | k | 0.9 * DL+ 1.3 W | Pu | = | 27 | k |
| | M | = | 30 | ft-k | | Mu | = | 27 | ft-k |
| | e | = | 0.68 | ft, < (L / 6) | | eu | = | 1.02 | ft, < (L / 6) |

$e_{max}$ < 0.5 L , [Satisfactory]

**CHECK SOIL BEARING CAPACITY** (ACI 318-99 SEC.15.2.2)

$$q_{MAX} = \begin{cases} \dfrac{P\left(1+\dfrac{6e}{L}\right)}{BL} + q_s + (0.15 - w_s)T, & for \quad e \le \dfrac{L}{6} \\ \dfrac{2P}{3B(0.5L - e)} + q_s + (0.15 - w_s)T, & for \quad e > \dfrac{L}{6} \end{cases}$$

| | CASE 1 | | CASE 2 | | CASE 3 | |
|---|---|---|---|---|---|---|
| = | 0.64 | ksf, | 0.64 | ksf, | 0.64 | ksf |

$q_{MAX}$ < $k\,Q_a$ , [Satisfactory]

where k = 1 for gravity loads, 4/3 for lateral loads.

**DESIGN FOR FLEXURE** (ACI 318-99 SEC.15.4.2, 10.2, 10.5.3, 10.5.4, 7.12.2, 12.2, & 12.5)

$$\rho = \frac{0.85 f'_c \left(1 - \sqrt{1 - \dfrac{M_u}{0.383 b d^2 f'_c}}\right)}{f_y}$$

$$\rho_{MIN} = \begin{cases} 0.0018 \dfrac{T}{d}, & for \quad top + bottom \\ MIN\left(\dfrac{4}{3}\rho\right), & for \quad top \quad or \quad bottom \quad only \end{cases}$$

$$\rho_{MAX} = 0.75\left(\frac{0.85 \beta_1 f'_c}{f_y} \frac{87}{87 + f_y}\right)$$

REINFORCING IN LONGITUDINAL DIRECTION

| | | | | | |
|---|---|---|---|---|---|
| $A_{s,\,L,\,bott}$ | = | 0.30 $in^2$ | $A_{s,\,L,\,top}$ | = | $in^2$ |

REINFORCING IN TRANSVERSE DIRECTION

| | | | | | |
|---|---|---|---|---|---|
| $A_{s,\,T,\,bott}$ | = | 0.00 $in^2$ / ft | $A_{s,\,T,\,top}$ | = | 0.00 $in^2$ / ft |

$$L_d = MAX\left(\frac{\rho_{required}}{\rho_{provided}}\frac{0.075\alpha\beta\gamma\lambda d_b f_y}{\sqrt{f'_c}\left(c+\frac{K_{tr}}{d_b}\right)}\ ,\ 12\ \ in\right)$$

= LONGITUDINAL 10.80 in , TRANSVERSE ###### in

$$L_{dh} = MAX\left(\frac{\rho_{required}}{\rho_{provided}}\frac{0.02\beta\lambda d_b f_y}{\sqrt{f'_c}}\ ,\ 8d_b\ ,\ 6\ \ in\right)$$

= LONGITUDINAL 6.00 in , TRANSVERSE 6.00 in

**CHECK FLEXURE SHEAR** (ACI 318-99 SEC.15.5.2, 11.1.3.1, & 11.3)

LONGITUDINAL DIRECTION

$(V_{u,L})_{MAX}$ = 2.54 kips < $2\phi Bd\sqrt{f'_c}$ = 49.41 kips

[Satisfactory]

TRANSVERSE DIRECTION

$(V_{u,T})_{MAX}$ = 0.59 kips / ft < $2\phi Ld\sqrt{f'_c}$ = 2.91 kips / ft

[Satisfactory]

where $\phi$ = 0.85 (ACI 318-99, Section 9.3.2.3 )

# Appendix F

Structural Truss Design Calculations

## Truss Data

| | |
|---|---|
| Truss Type: | Fink (4/3) |
| Out-to-out Span: | 30 ft. |
| Top Chord Pitch: | 4 /12 |
| Spacing: | 24 in. o/c |
| Bearing Width: | 7.25 in. |
| Overhang: | 12 in. |

## Design Loads

| | |
|---|---|
| Top Chord Live Load: | 20 psf |
| Top Chord Dead Load: | 6 psf |
| Bottom Chord Live Load: | 0 psf |
| Bottom Chord Dead Load: | 10 psf |

## Design Assumptions

| | |
|---|---|
| Number of Plies: | 1 PLY |
| Butt Cut: | 0.25 in. |
| Bottom Chord Pitch: | 0 /12 |
| TC Bracing: | OSB 7/16 in. |
| BC Bracing: | 10 ft. o/c |
| Code: | IBC2012 / TPI2007 |

## Design Options

| | |
|---|---|
| Truss Plate Mfr.: | Mitek |
| Peak Joint Fixity: | Rigid |
| DOL Lumber: | 1.15 |
| DOL Plates: | 1.15 |
| Rep Stress Incr: | YES |
| CSI/JSI Limit: | 1.00/1.00 |

## Geometry

| | |
|---|---|
| Total Scarf: | 9.750 in. |
| Adj. Scarf: | 2.500 in. |
| Number of Top Chord Panels: | 4 |
| Top Chord Panel Lengths: | 85.125 in. |
| Number of Bottom Chord Panels: | 3 |
| Bottom Chord Panel Lengths: | 113.500 in. |
| Heel Height: | 3.939 in. |
| Φ: | 18.43 deg. |
| $\theta_2$: | 45.00 deg. |
| $\theta_1$: | 45.00 deg. |

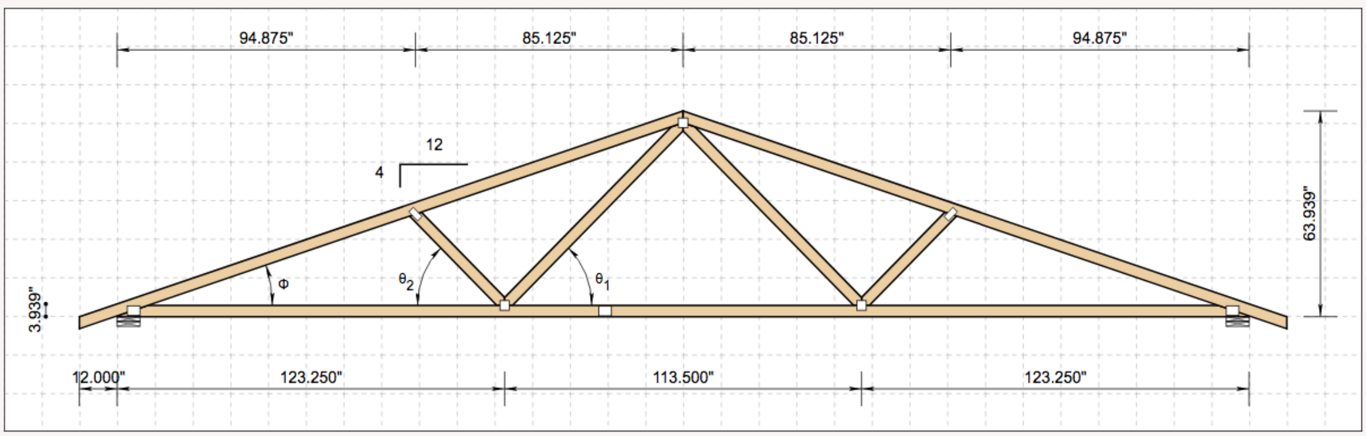
| **LUMBER** (Engineered) | | CSI |
|---|---|---|
| Top Chord: | 2 X 4 DF SS | 0.87 |
| Bot. Chord: | 2 X 4 DF No.1 & Btr | 0.92 |
| Webs (tension): | 2 X 4 SPF Stud | 0.33 |
| Webs (compression): | 2 X 4 SPF Stud | 0.14 |
| Bearing (@ Heel): | 2 X 4 DF No.1 & Btr | 0.17 |

**DEFLECTIONS** (@ Joint 7)

| | |
|---|---|
| $\Delta_{LL}$ = 0.124 in. | $(L/d)_{LL}$ = 2891.8 |
| $\Delta_{TL}$ = 0.223 in. | $(L/d)_{TL}$ = 1616.0 |
| $\Delta_{CR}$ = 0.223 in. | $(L/d)_{CR}$ = 1616.0 |
| $\Delta_{LongTerm}$ = 0.321 in. | $(L/d)_{LongTerm}$ = 1121.3 |

Creep Factor ($K_{cr}$) = 2.0

Weight: 102 lbs



## Loads and Forces

**ASD DESIGN METHOD: SF(D) + (L)**

SF (Slope Factor) = 1/Cosine(Φ) = 1.05

Top Chord: DL(SF) + LL = 6(1.05) + 20 = 26.32 psf = 52.65 plf
Bottom Chord: DL(SF) + LL = 10(1.00) + 0 = 10.00 psf = 20.00 plf

| | | |
|---|---|---|
| $R_1$: 1142.39 lbs. | $P_1$: 363.49 lbs. | $F_{12}$: 2463.10 lbs. |
| $R_5$: 1142.39 lbs. | $P_5$: 363.49 lbs. | $F_{45}$: 2463.10 lbs. |
| | $P_2$: 394.87 lbs. | $F_{23}$: 2175.62 lbs. |
| Φ: 18.43 deg. | $P_4$: 394.87 lbs. | $F_{34}$: 2175.62 lbs. |
| α: 48.10 deg. | $P_3$: 373.48 lbs. | $F_{17}$: 2336.70 lbs. |
| β: 46.59 deg. | $P_6$: 197.29 lbs. | $F_{56}$: 2336.70 lbs. |
| | $P_7$: 197.29 lbs. | $F_{67}$: 1589.87 lbs. |
| | | $F_{27}$: 408.37 lbs. |
| | | $F_{46}$: 408.37 lbs. |
| | | $F_{37}$: 689.95 lbs. |
| | | $F_{36}$: 689.95 lbs. |

**PLATES** (Engineered)

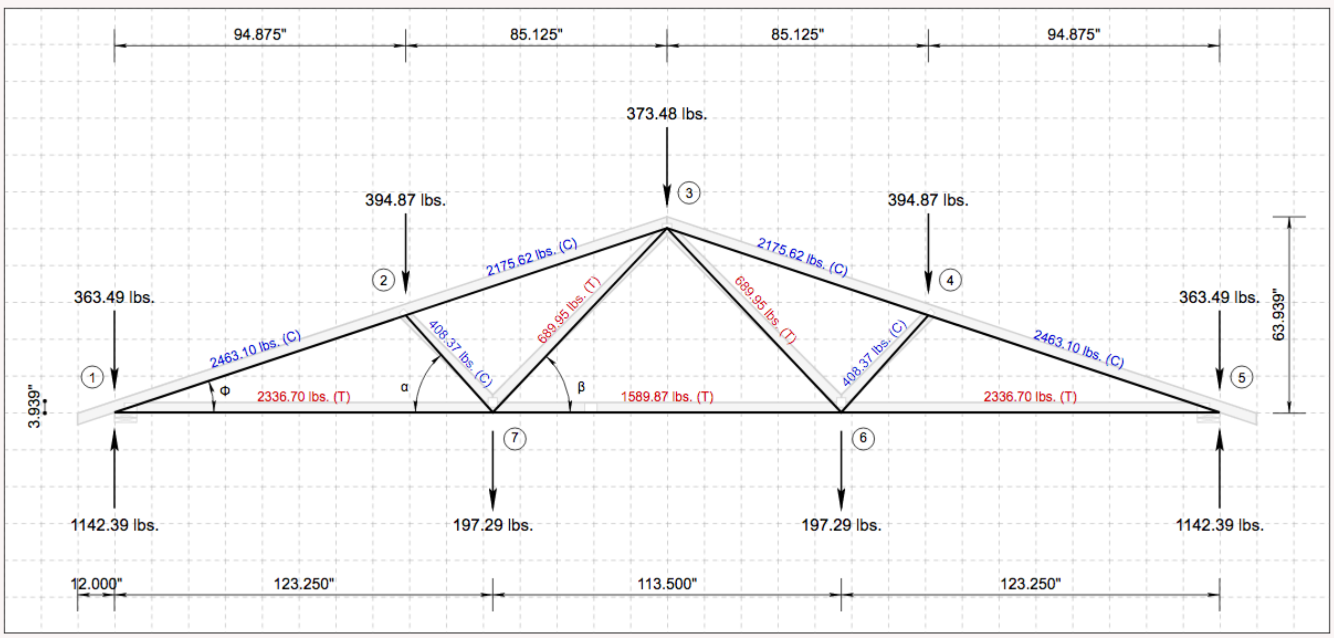
| Joint | Type | Plate Size | X | Y | JSI |
|---|---|---|---|---|---|
| 1 | MT20 | 3.0 x 4.0 | CTR | CTR | 1.00 |
| 2 | MT20 | 2.0 x 4.0 | CTR | CTR | 0.32 |
| 3 | MT20 | 3.0 x 3.0 | CTR | CTR | 0.91 |
| 4 | MT20 | 2.0 x 4.0 | CTR | CTR | 0.32 |
| 5 | MT20 | 3.0 x 4.0 | CTR | CTR | 1.00 |
| 6 | MT20 | 3.0 x 3.0 | CTR | CTR | 0.72 |
| 7 | MT20 | 3.0 x 3.0 | CTR | CTR | 0.72 |
| 8 | MT20 | 3.0 x 4.0 | CTR | CTR | 0.62 |

*Plates have not been designed to provide for placement tolerances ($C_q$=1). It is the responsibility of the fabricator to increase plate sizes to account for this factor.

Max. Horz. ① = 87 lbs

Max. Uplift ① = 275 lbs

ICC-ES Report: ESR-1988



# Appendix G

Structural Renderings

Figure G1: Isometric View of Structure

Figure G2: Elevation View of Structure

Figure G3: Side Elevation View of Structure

## Appendix H

References

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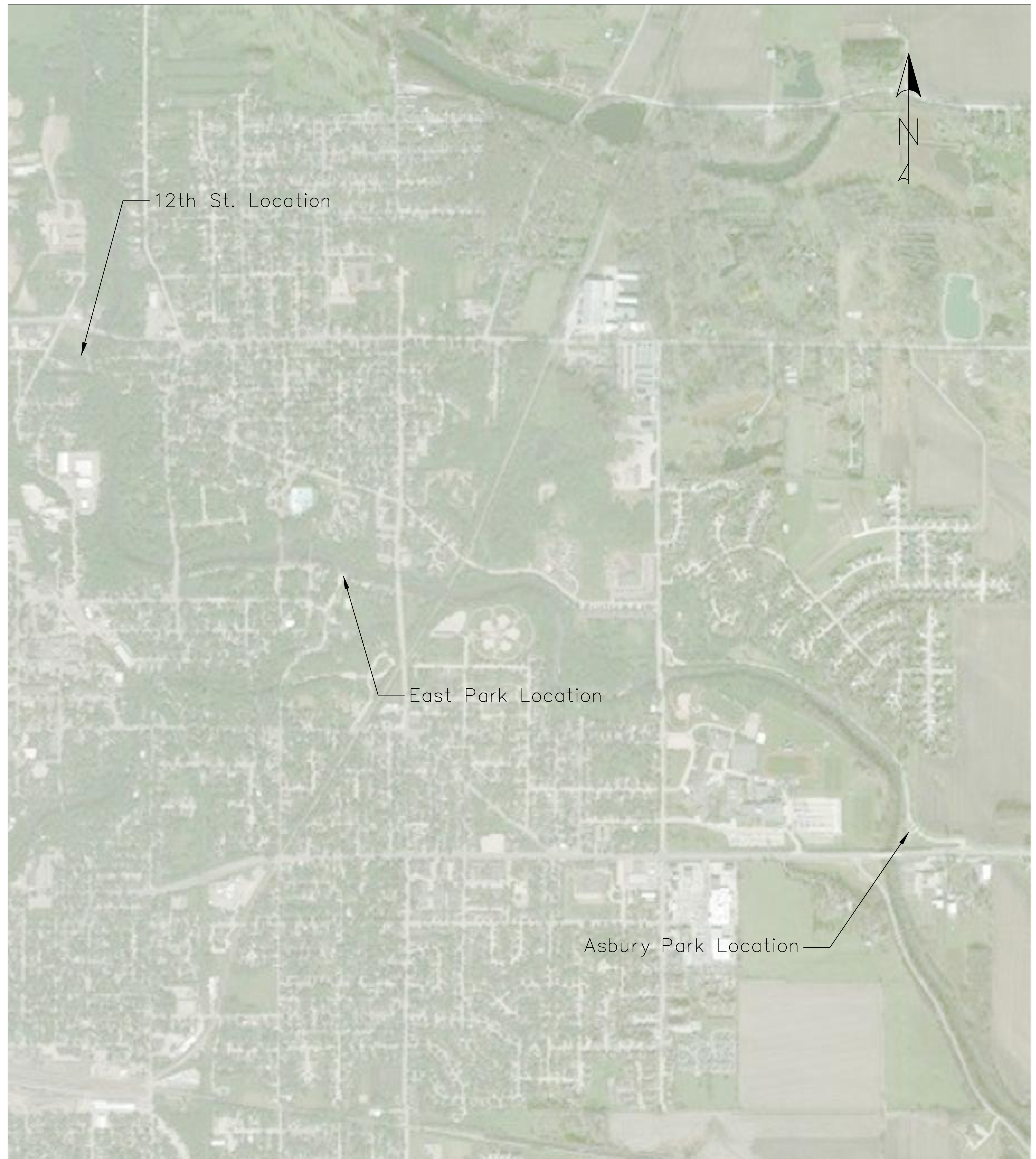
State of Iowa

MVS Consultants

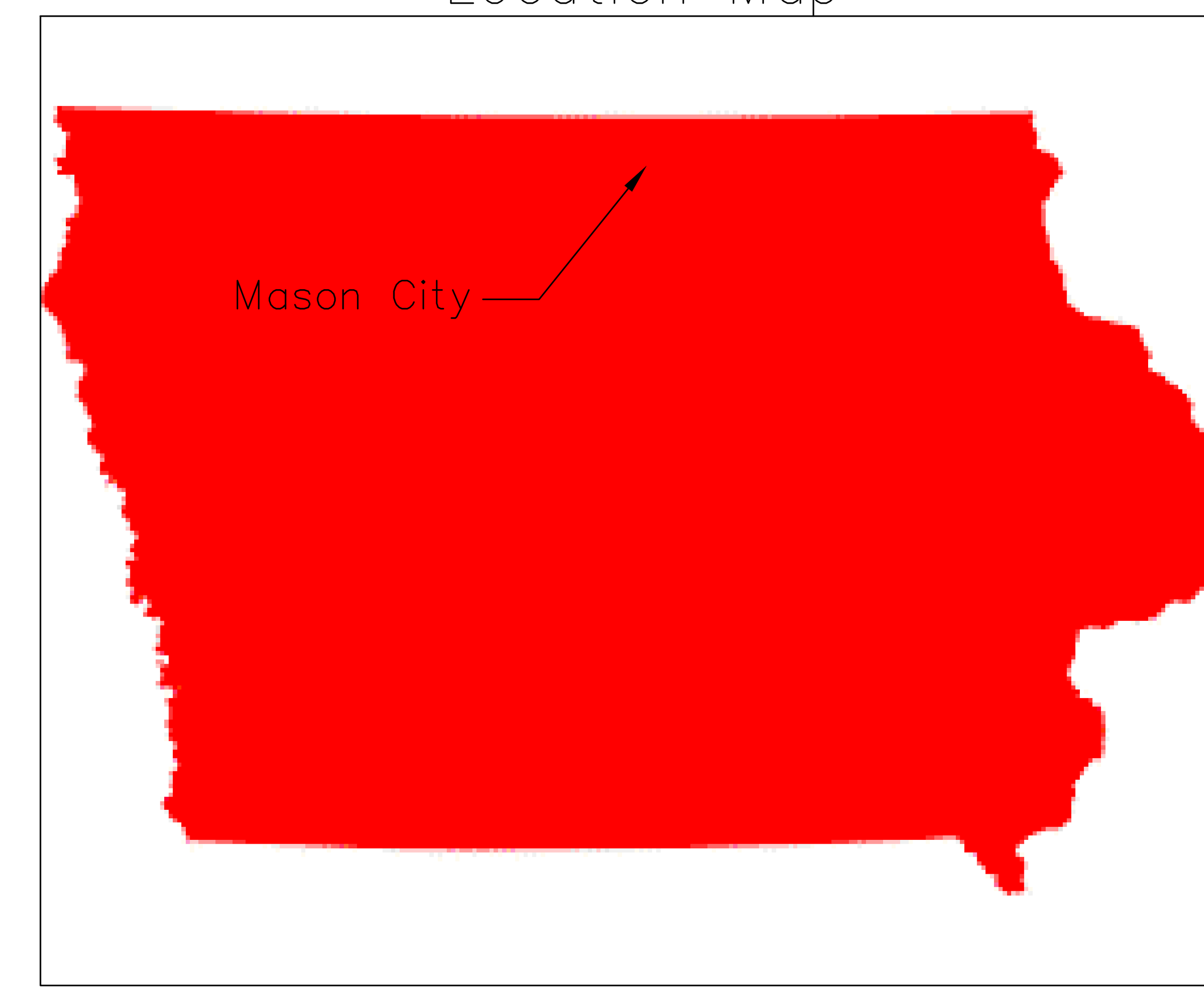
# Waterway Access & Development

## Mason City, IA

| Sheet List Table | |
|---|---|
| Sheet Number | Sheet Title |
| 00 | Title Sheet |
| 01 | 12th Street Site Plan |
| 02 | 12th Street Grading |
| 03 | East Park Site Plan |
| 04 | East Park Grading |
| 05 | Asbury Park Site Plan |
| 06 | Asbury Park Grading |
| 07 | Structure Floor Plan |
| 08 | Bioretention Basin and 12th St. Details |
| 09 | East Park Details |
| 10 | Asbury Park Details |
| 11 | Structure Details |
| 12 | PCC Details |
| 13 | HMA Details |
| 14 | Sidewalk Details |




Location Map

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Professional Engineer
Registered Civil Engineer

Date

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DATE : 04/20/2018
DRAWN BY: PES
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Waterway Access

MASON CITY, IA 50401

SHEET NAME

TITLE SHEET

SHEET NO.

00


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SHEET NAME
12TH STREET SITE PLAN

SHEET NO.
01


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SHEET NAME
12TH STREET GRADING

SHEET NO.
02


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EAST PARK
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EAST PARK SITE PLAN

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**03**


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ASBURY PARK
MASON CITY, IA 50401

SHEET NAME

ASBURY PARK SITE PLAN

SHEET NO.

**05**


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# Waterway Access

ASBURY PARK
MASON CITY, IA 50401

SHEET NAME

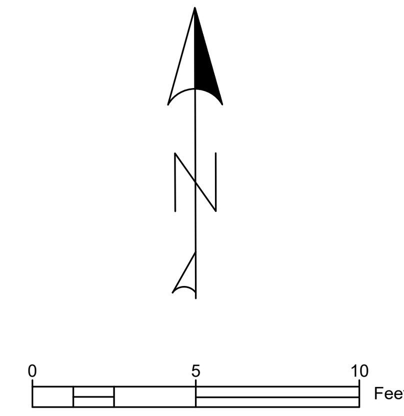
ASBURY PARK GRADING

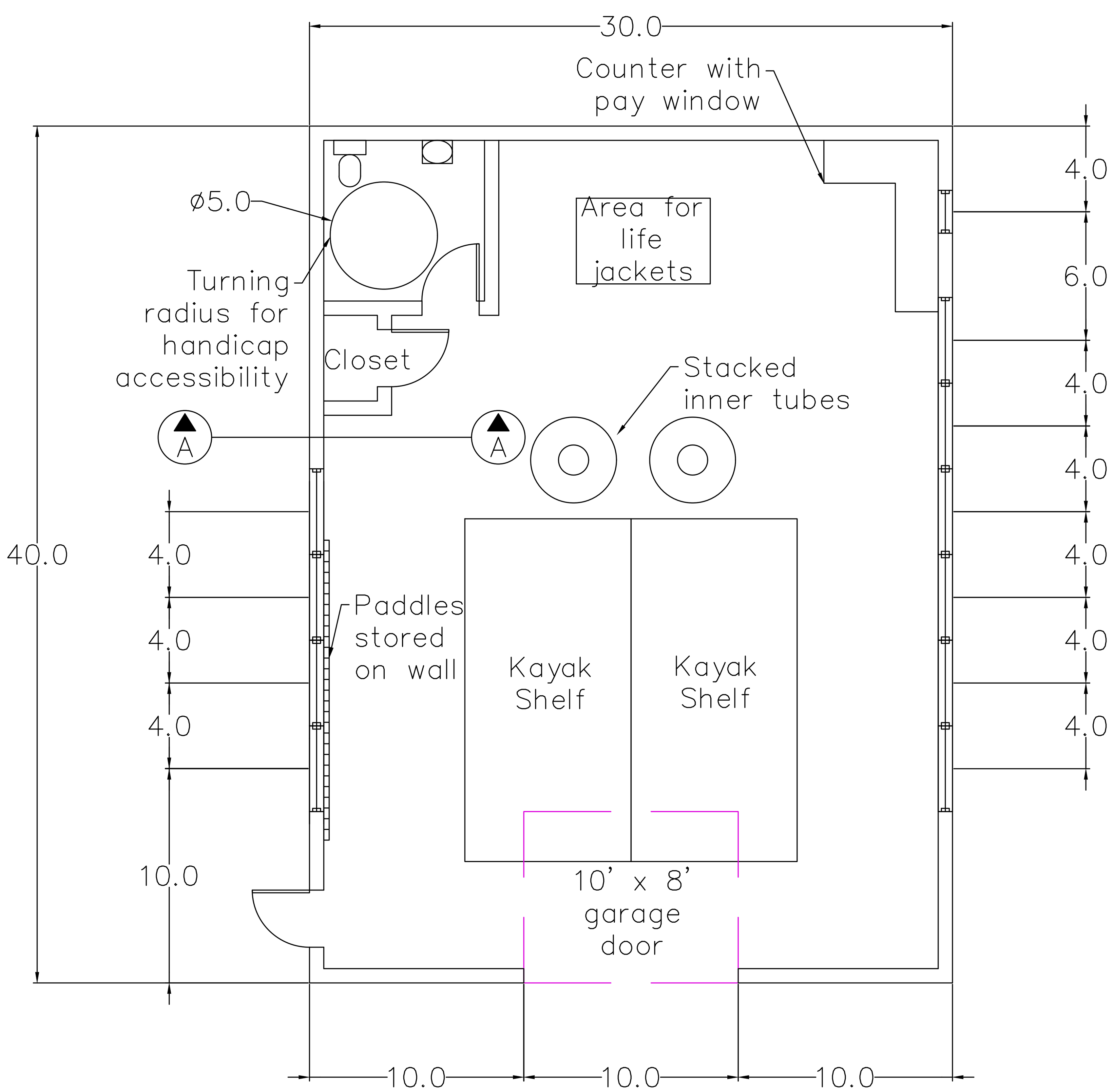
SHEET NO.

06

NOTES

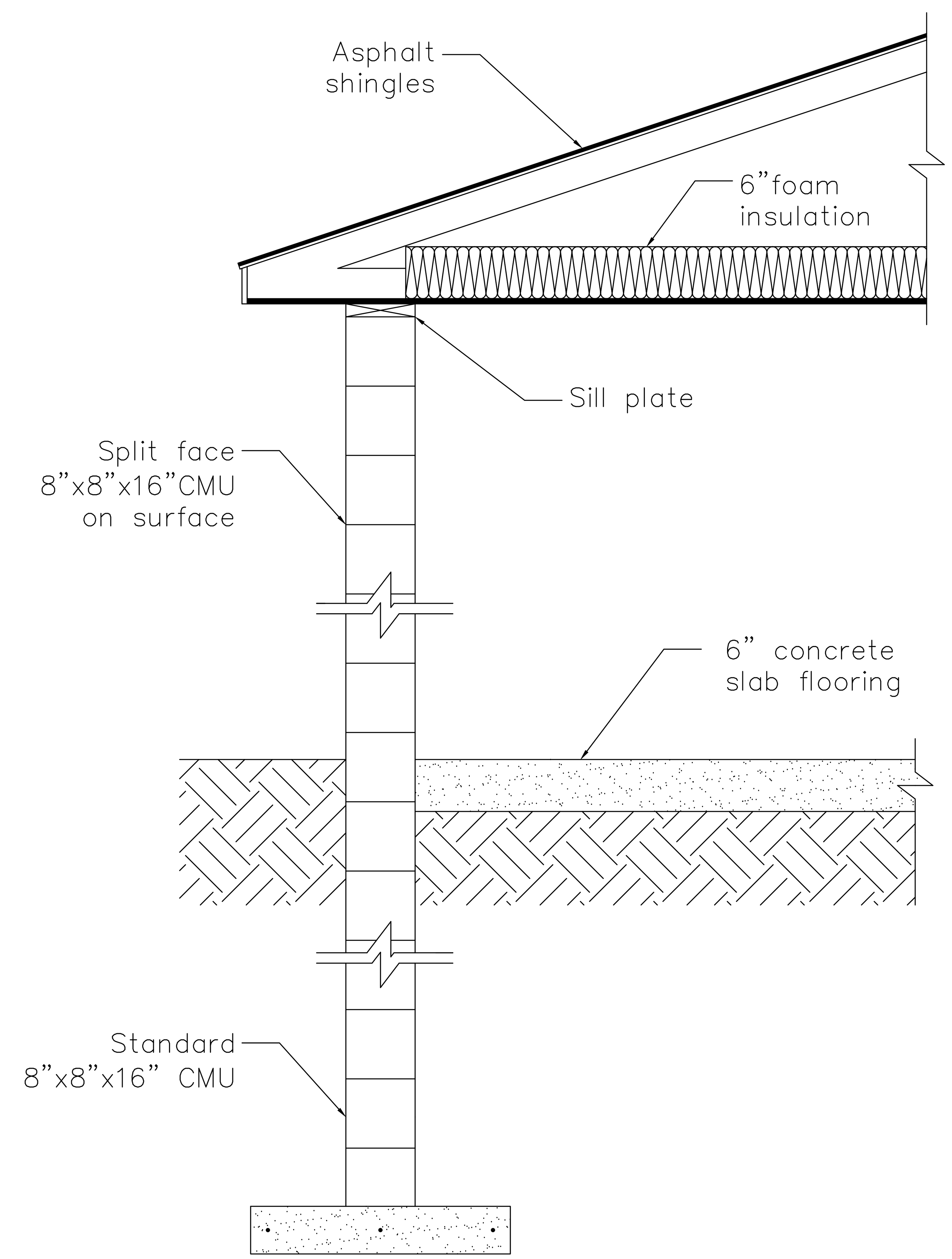
- Wall height is 10'
- Wall thickness is 8"
- One 24" x 36" window on eastern wall
- Six 48" x 12" windows on eastern wall
- Four 48" x 12" windows on western wall
- All doors are 32" wide
- Bathroom is 7'-6" x 7'-6"




NOTES

- Wall height: 10'
- Frost line: 60"
- Foundation wall meets footing at the frost line




A **Structure Cross Section**
SCALE: 1"=1'

| | |
|---|---|
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| DATE : | 04/20/2018 |
| DRAWN BY: | MVS |
| REVISION: | |


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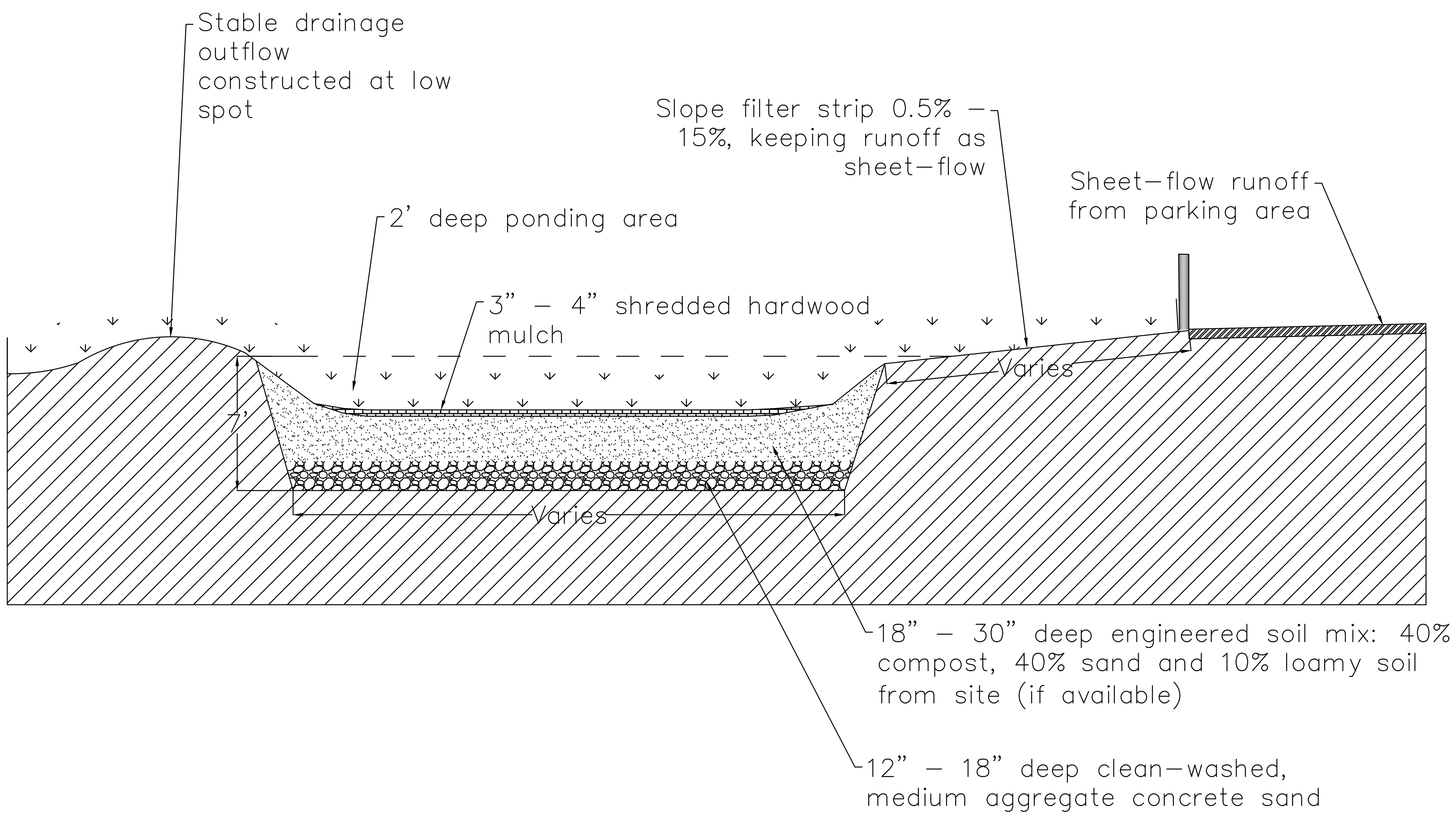
**Waterway Access**
12TH STREET
MASON CITY, IA 50401

SHEET NAME
STRUCTURE FLOOR PLAN

SHEET NO.
**07**

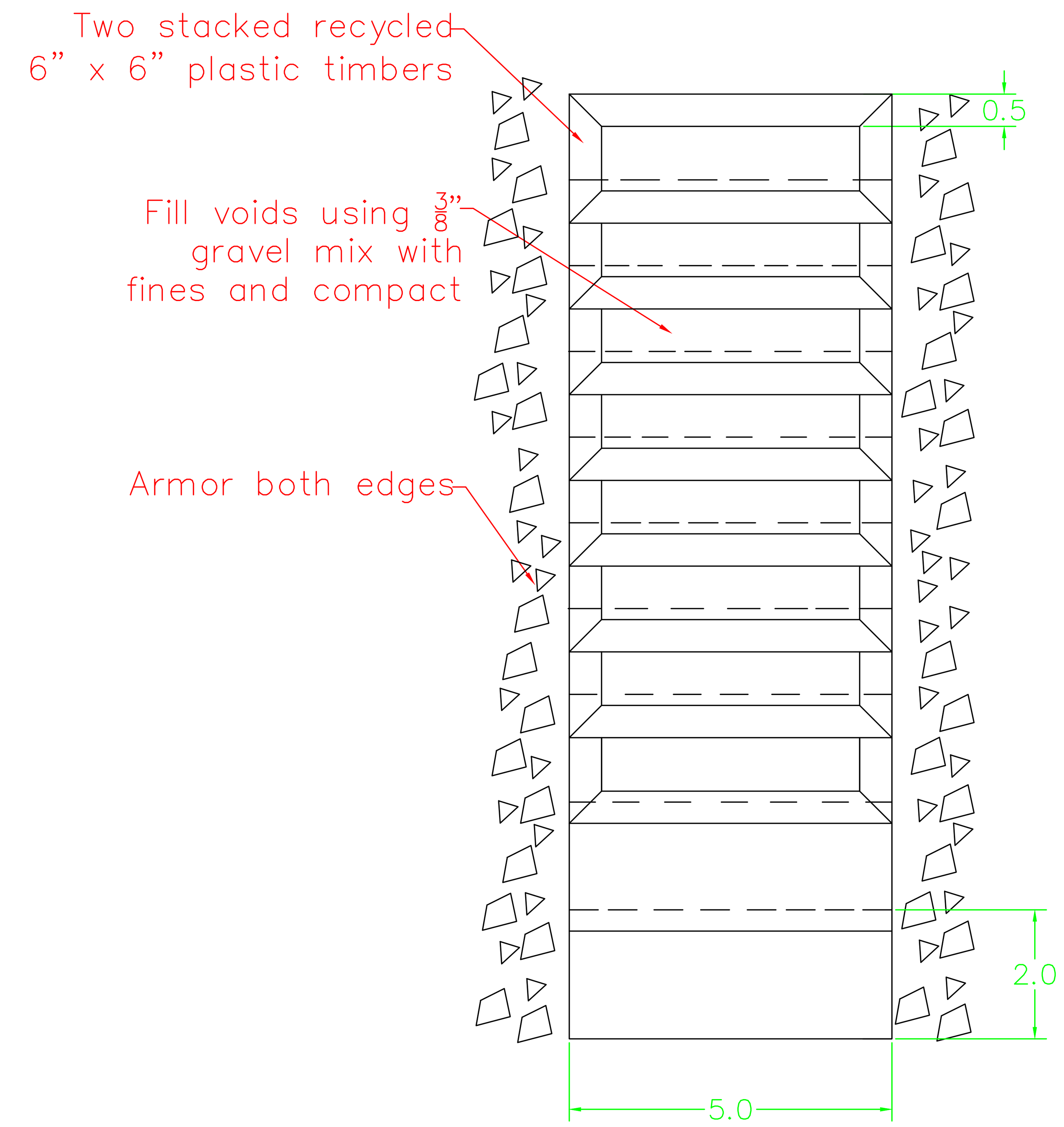
NOTES
- 12th Street
  - Bottom Width: 25'
  - Filter Strip Width: 8.5'
- East Park
  - Bottom Width: 25'
  - Filter Strip Width: 5'
- Asbury Park
  - Bottom Width: 11'
  - Filter Strip Width: 10'

Cross–Section



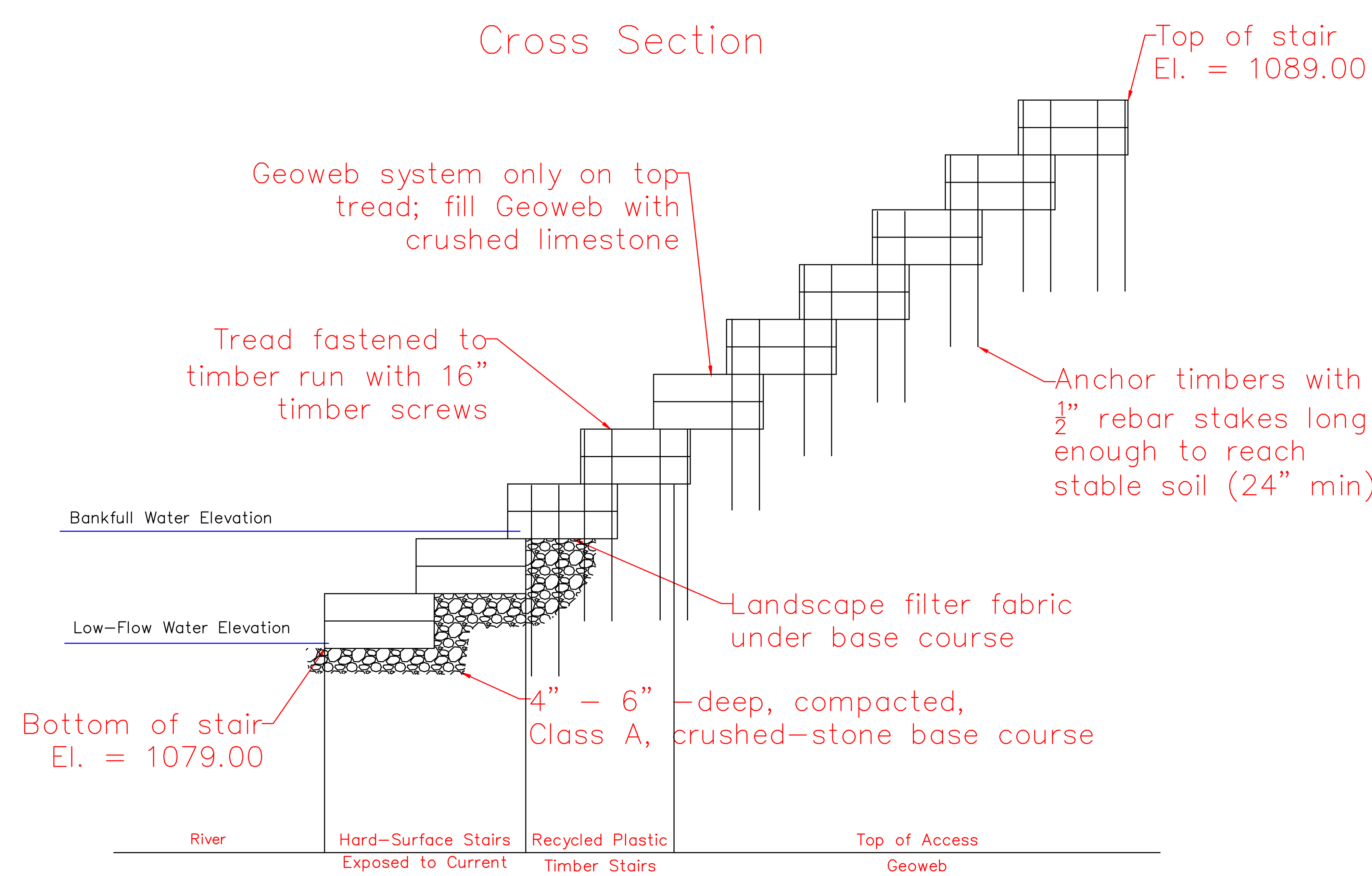

1 **Bioretention Basin**
Not to Scale

Plan View




NOTES
- Construct step treads with a 2–3% slope toward the stream to alleviate water ponding on the surface
- Treads should not be steepened to accommodate high streambanks
- Bottom 2–3 steps to be slab stone or concrete surfacing
- All stair treads should be the same width and length
- Canoe slides can be built with two telephone poles or aluminum guardrails along steep slopes

Cross Section




2 **12th Street Stairs**
Not to Scale

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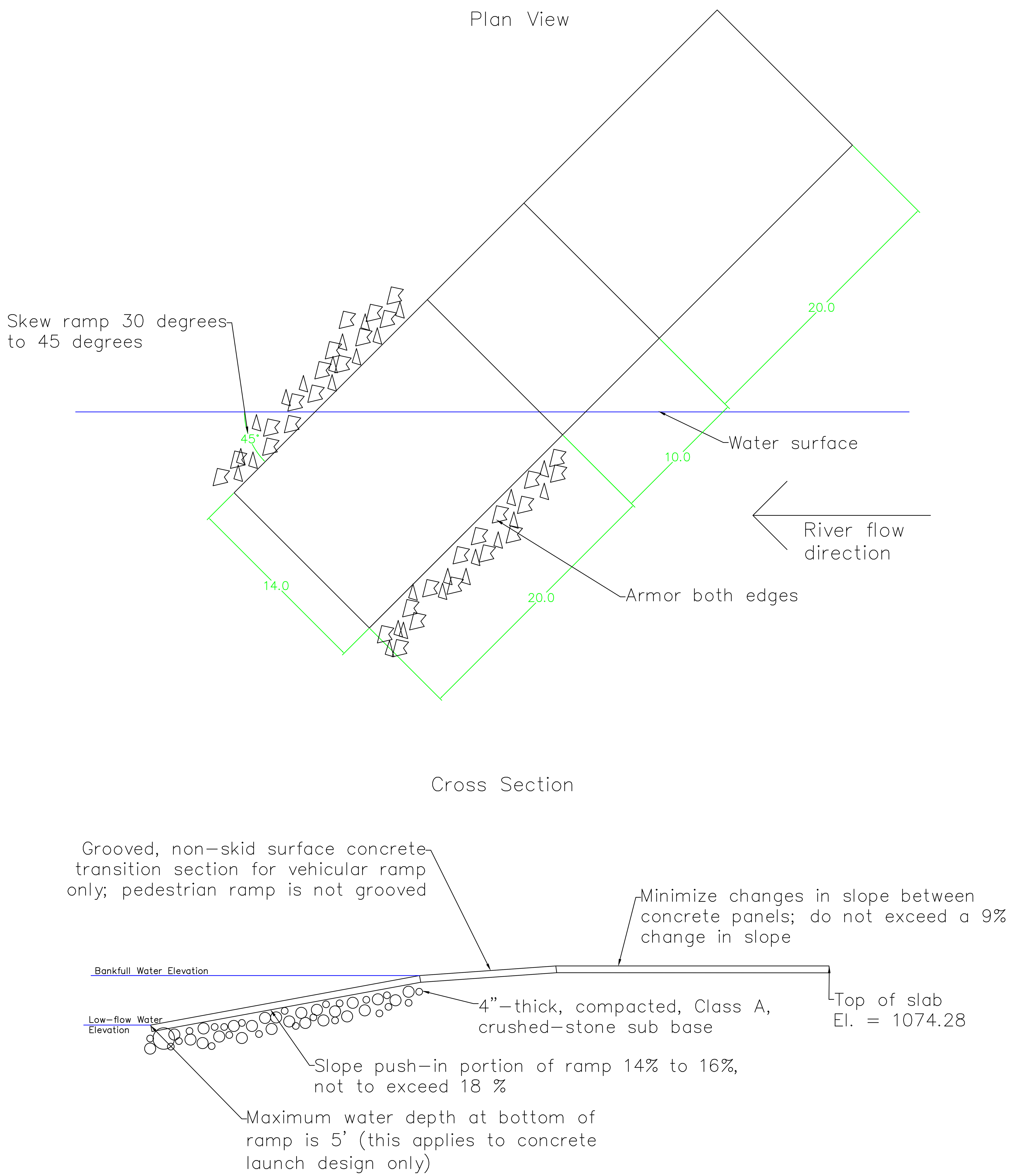
**Waterway Access**
12TH STREET
MASON CITY, IA 50401

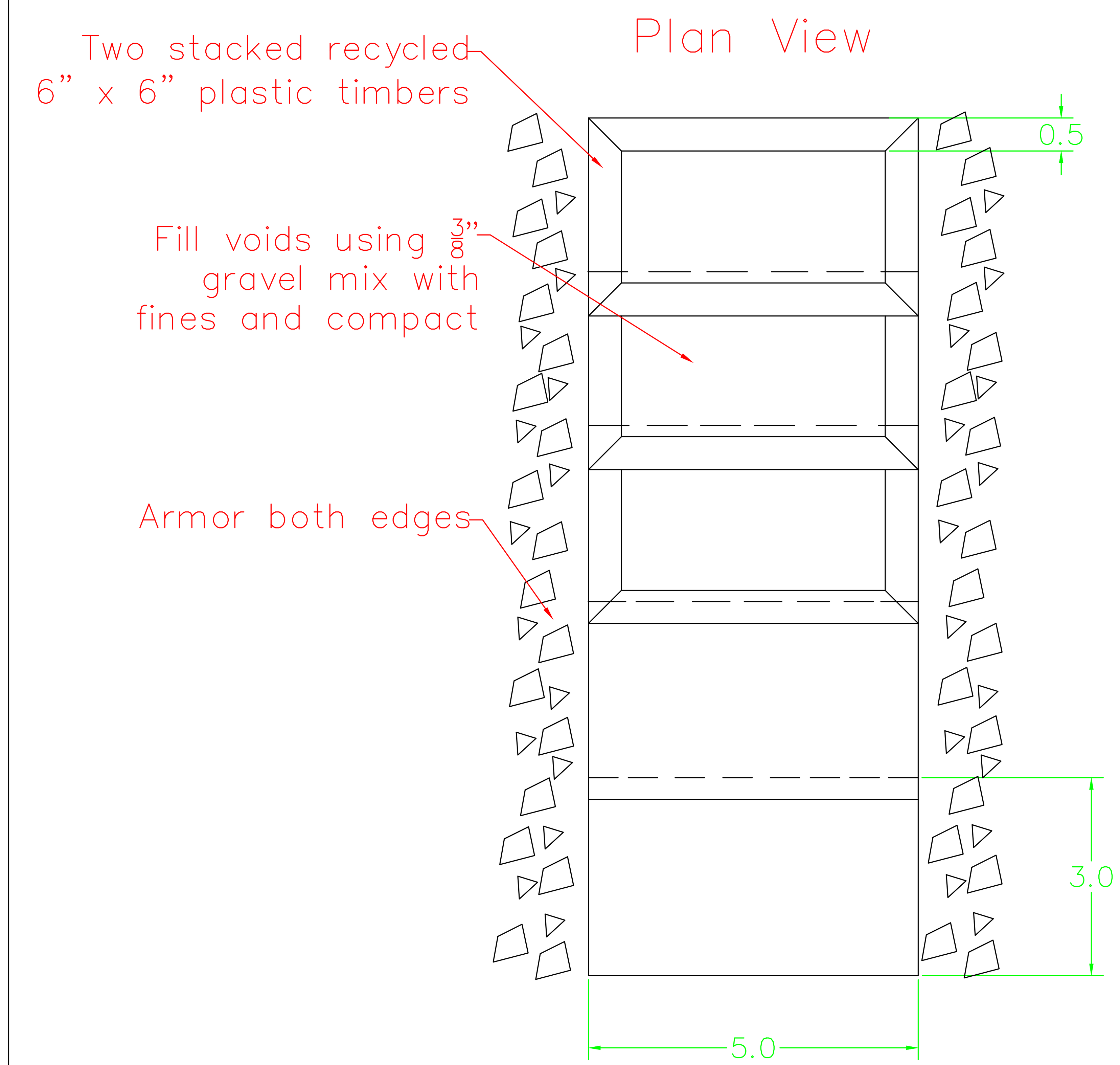
SHEET NAME
BASIN & 12TH ST. DETAILS

SHEET NO.
**08**



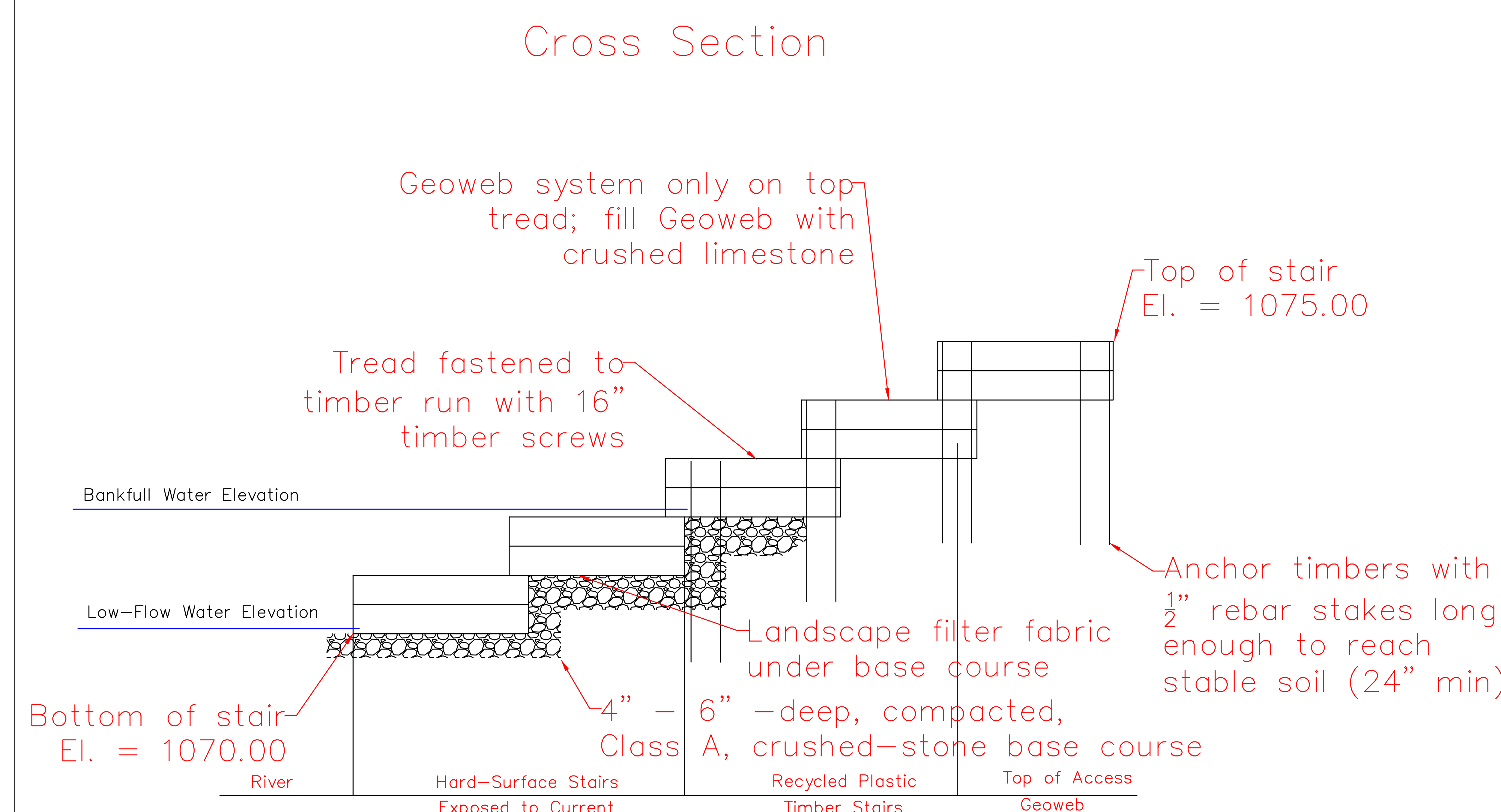

## 3 East Park Boat Ramp

Not to Scale




NOTES

- Construct step treads with a 2-3% slope toward the stream to alleviate water ponding on the surface
- Treads should not be steepened to accommodate high streambanks
- Bottom 2-3 steps to be slab stone or concrete surfacing
- All stair treads should be the same width and length
- Canoe slides can be built with two telephone poles or aluminum guardrails along steep slopes




## 4 East Park Stairs

Not to Scale

PROJECT: CEE: 4850
DATE : 04/20/2018
DRAWN BY: HJM
REVISION:


THE UNIVERSITY OF IOWA
CIVIL AND ENVIRONMENTAL ENGINEERING
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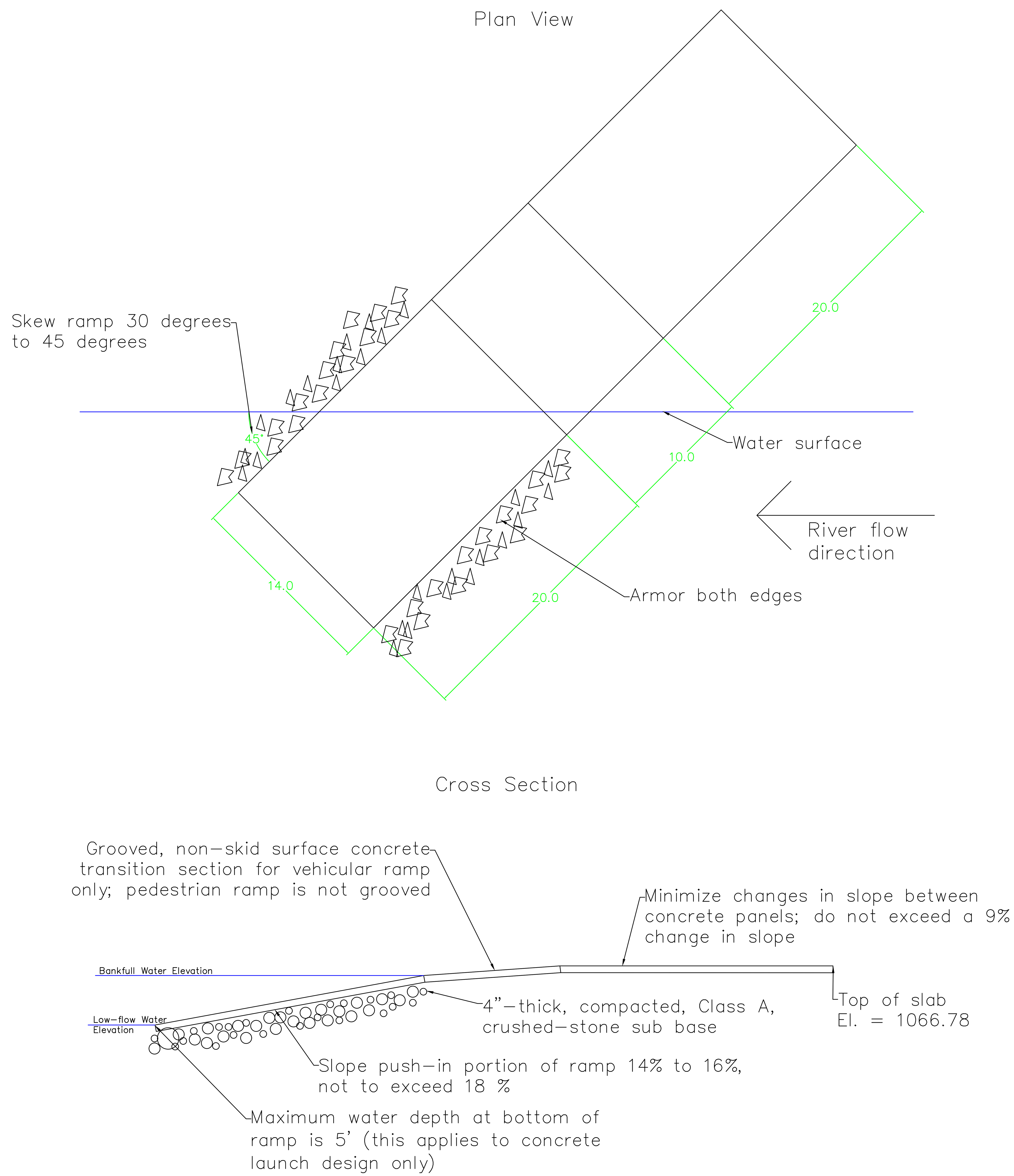
**Waterway Access**

EAST PARK
MASON CITY, IA 50401

SHEET NAME
EAST PARK DETAILS

SHEET NO.
**09**

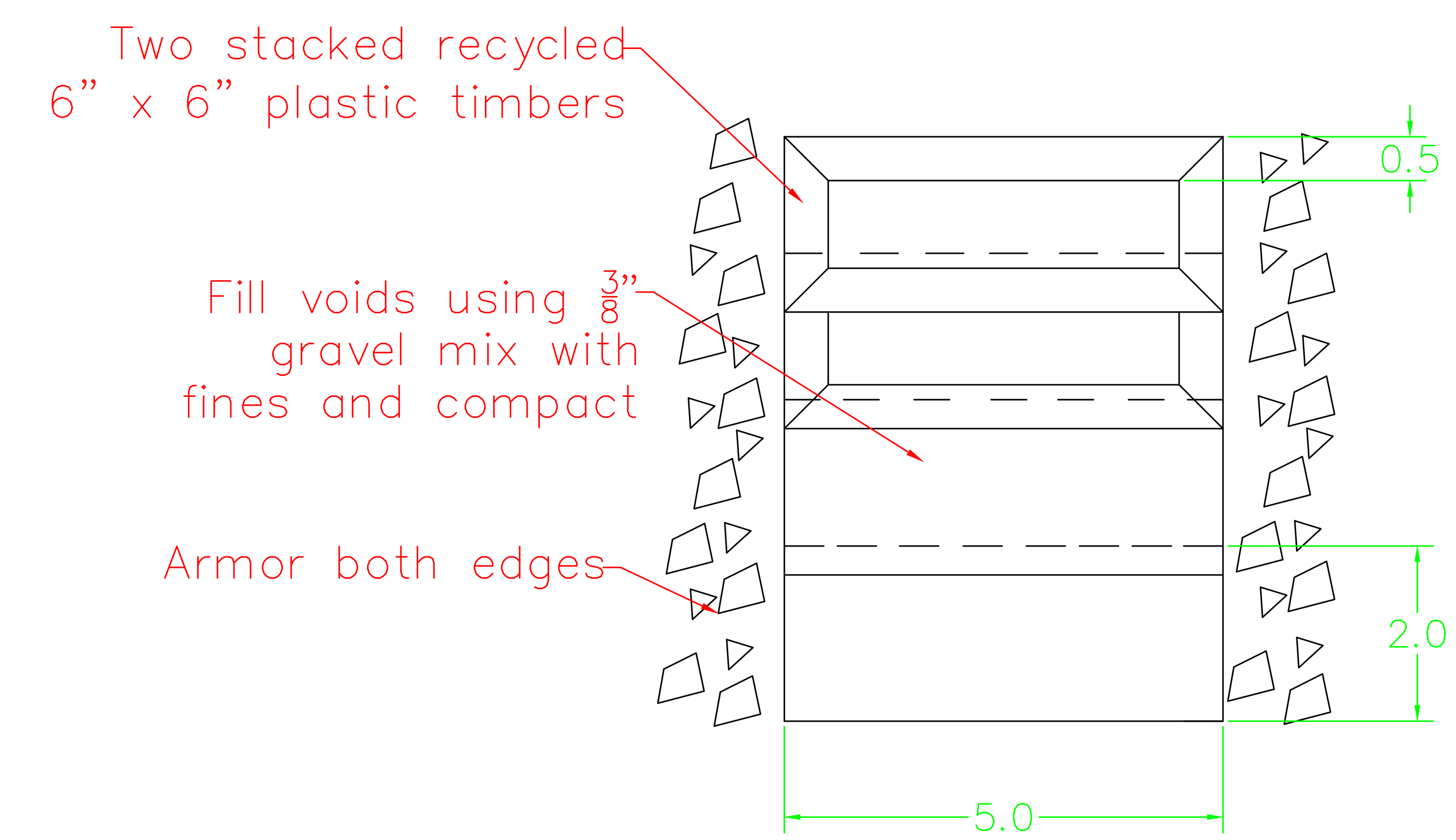


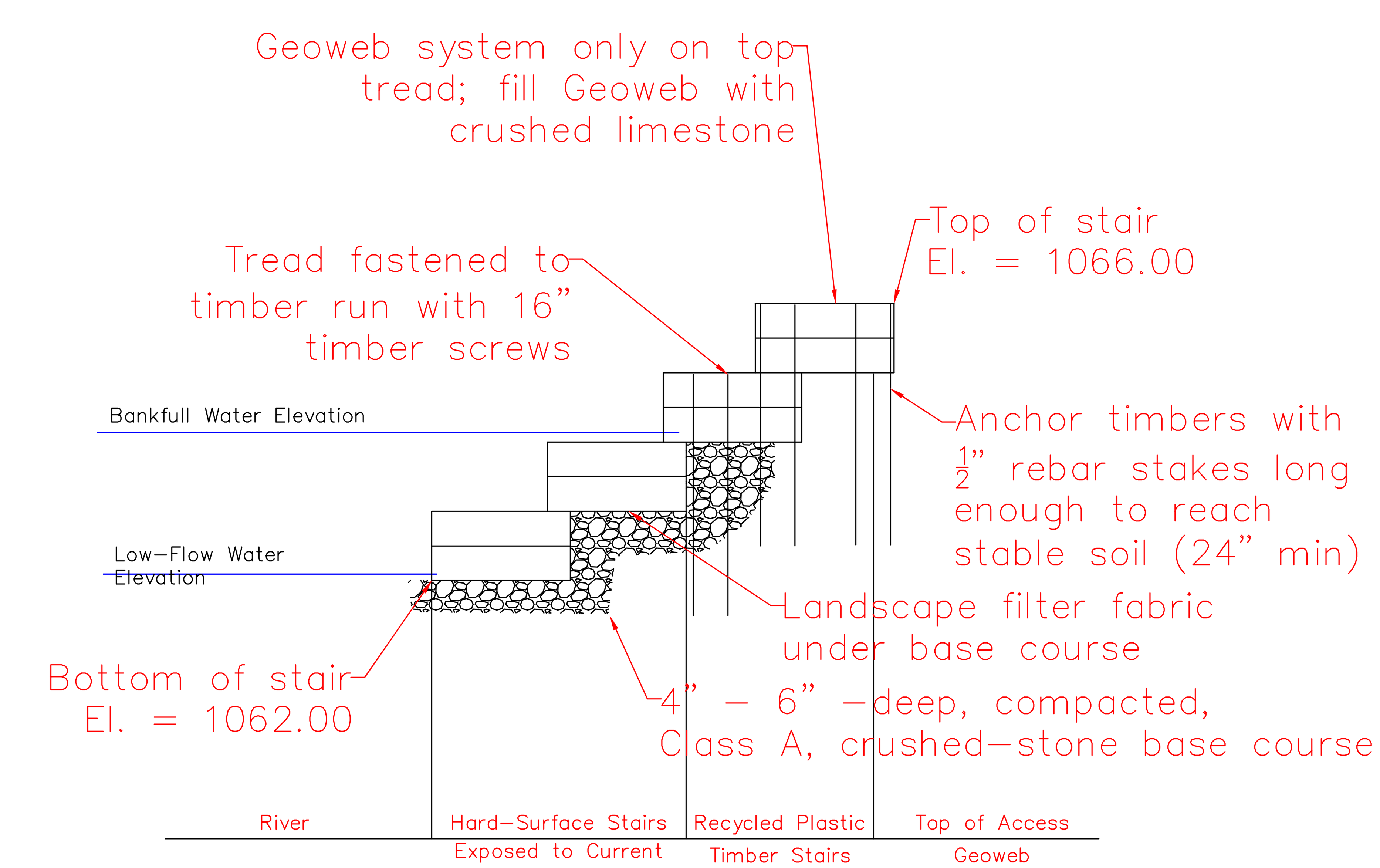

## 5 Asbury Park Boat Ramp

Not to Scale

NOTES

- Construct step treads with a 2-3% slope toward the stream to alleviate water ponding on the surface
- Treads should not be steepened to accommodate high streambanks
- Bottom 2-3 steps to be slab stone or concrete surfacing
- All stair treads should be the same width and length
- Canoe slides can be built with two telephone poles or aluminum guardrails along steep slopes




## 6 Asbury Park Stairs

Not to Scale

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DATE : 04/20/2018
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**Waterway Access**

ASBURY PARK
MASON CITY, IA 50401

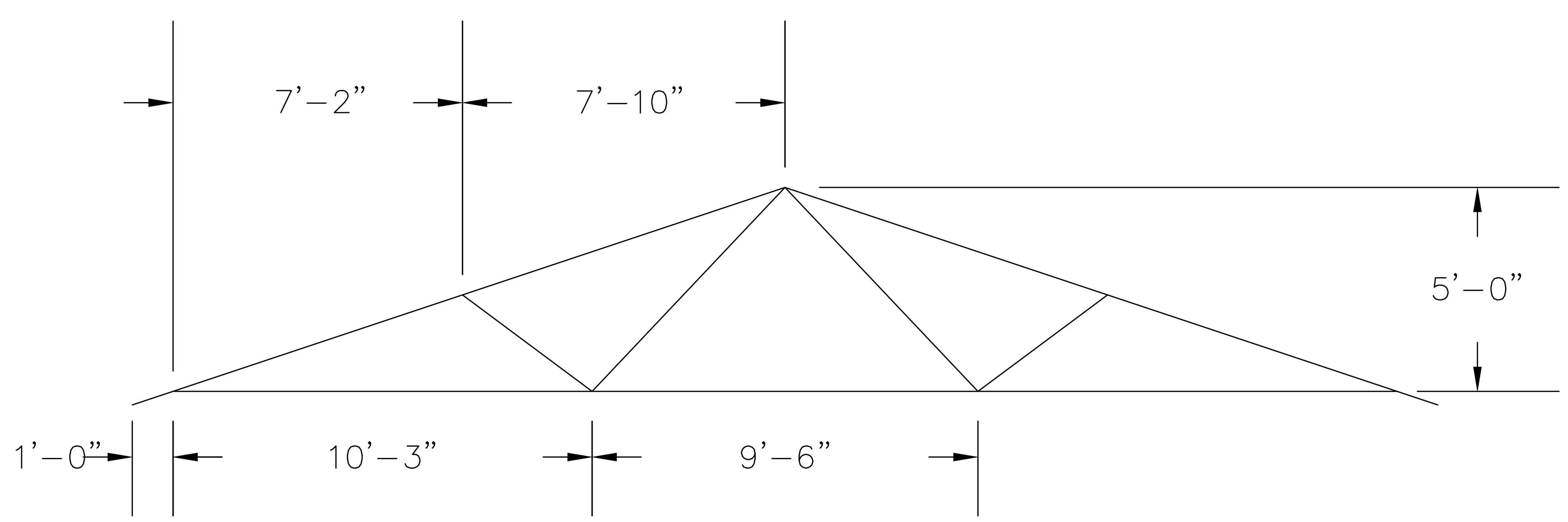
SHEET NAME

ASBURY PARK DETAILS

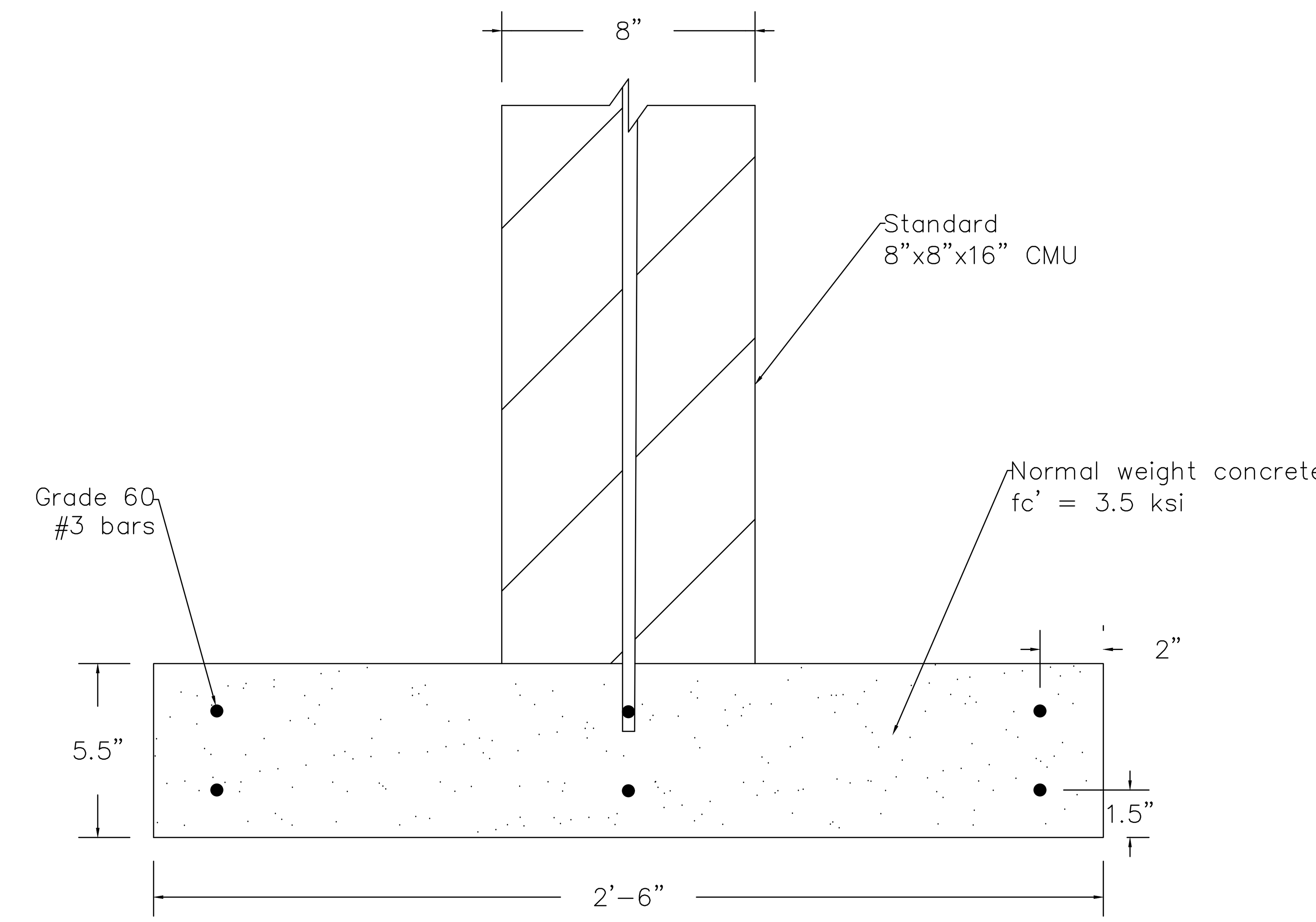
SHEET NO.

**10**

NOTES
- All members are No. 1 Douglas Fir Larch
- Top chord: 2"x4"
- Web members: 2"x4"
- Truss Spacing: 24" O.C.
- Roof Pitch: 4:12
- Medeek Truss Designer used to calculate truss




7 **Truss Detail**
Not to Scale




8 **Footing Detail**
Not to Scale

PROJECT: CEE: 4850
DATE : 04/20/2018
DRAWN BY: MVS
REVISION: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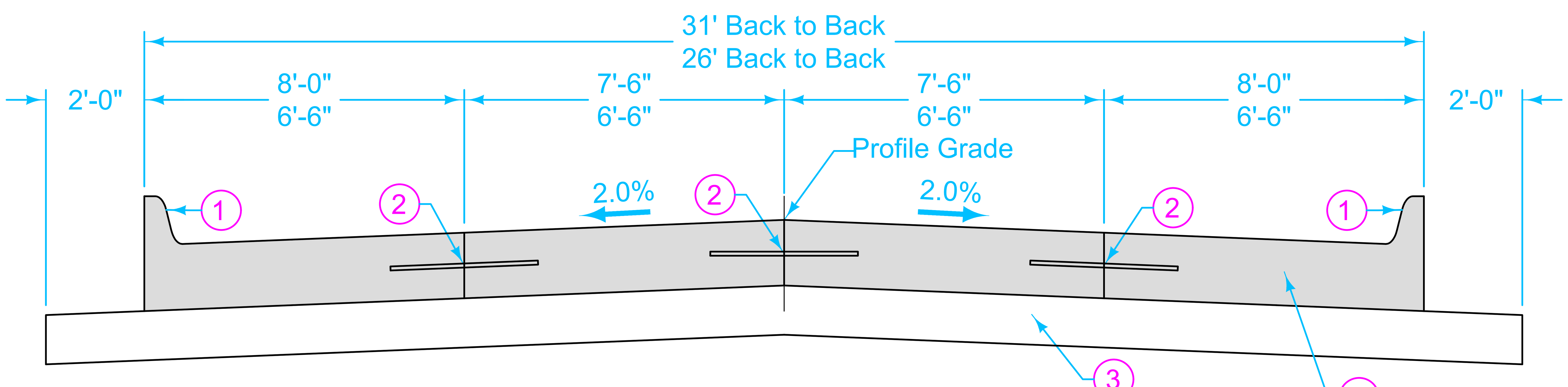
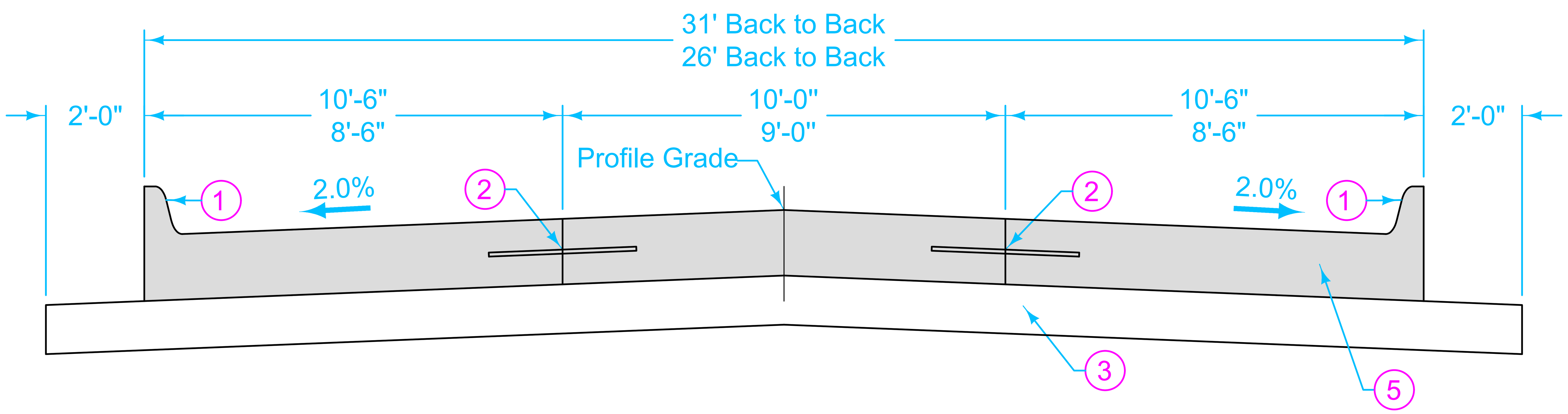
**Waterway Access**
12TH STREET
MASON CITY, IA 50401

SHEET NAME
STRUCTURE DETAILS

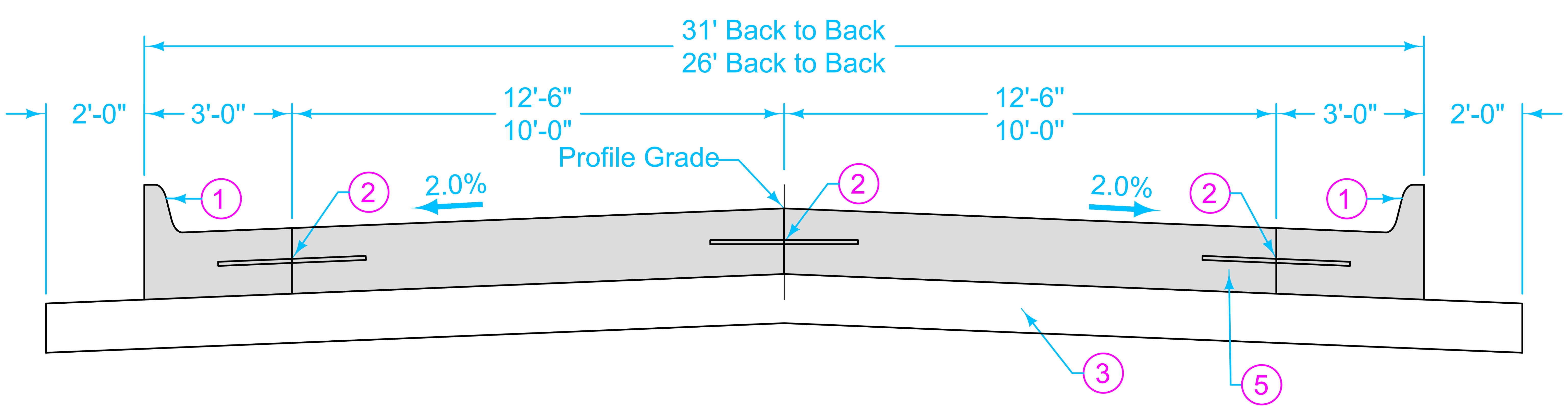
SHEET NO.
11




QUARTER POINT JOINTING




THIRD POINT JOINTING




GUTTERLINE JOINTING

9 PCC Detail
Not to Scale

1. 6 inch standard curb.
2. BT, KT, or L joint depending on pavement thickness and construction staging.
3. Subbase or subgrade as specified.
4. Unless otherwise specified in the contract documents.
5. No dowels within 24" of the back of curb. With gutterline joint, place first dowel 6 inches from the joint. See Figure 7010.101, Sheet 8.

**TRANSVERSE JOINT REQUIREMENTS (4)**

| Pavement Thickness | Transverse Joint Type | Transverse Joint Spacing |
|---|---|---|
| 6" | C | 12' |
| 7" | C | 15' |
| 8" | CD (5) | 15' |
| 9" | CD (5) | 15' |
| ≥10" | CD (5) | 20' |

| REVISION | |
|---|---|
| 1 | 10-16-12 |

7010.901

SHEET _1 of _1

PCC PAVEMENT JOINTING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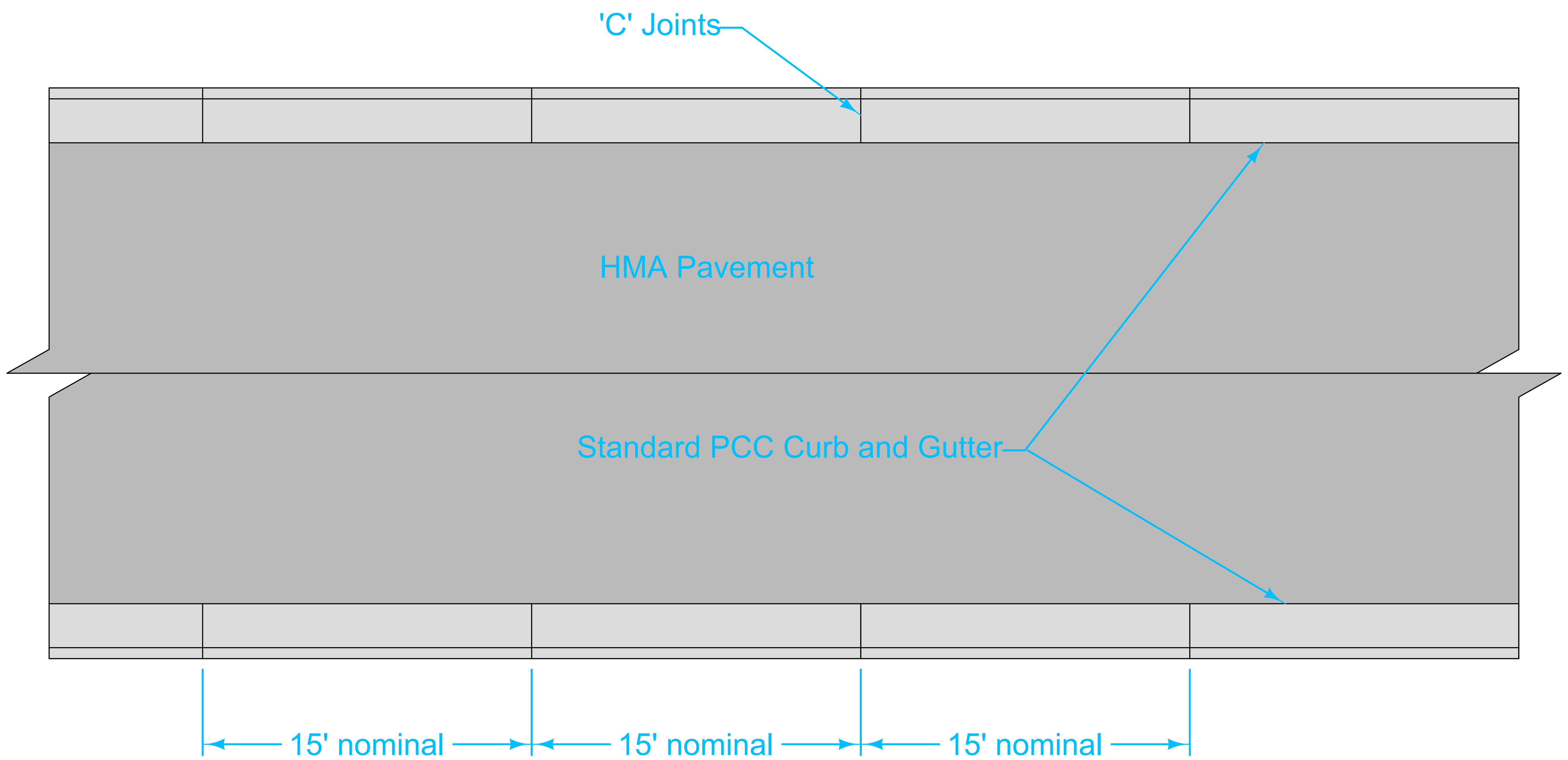
**Waterway Access**

MASON CITY, IA 50401

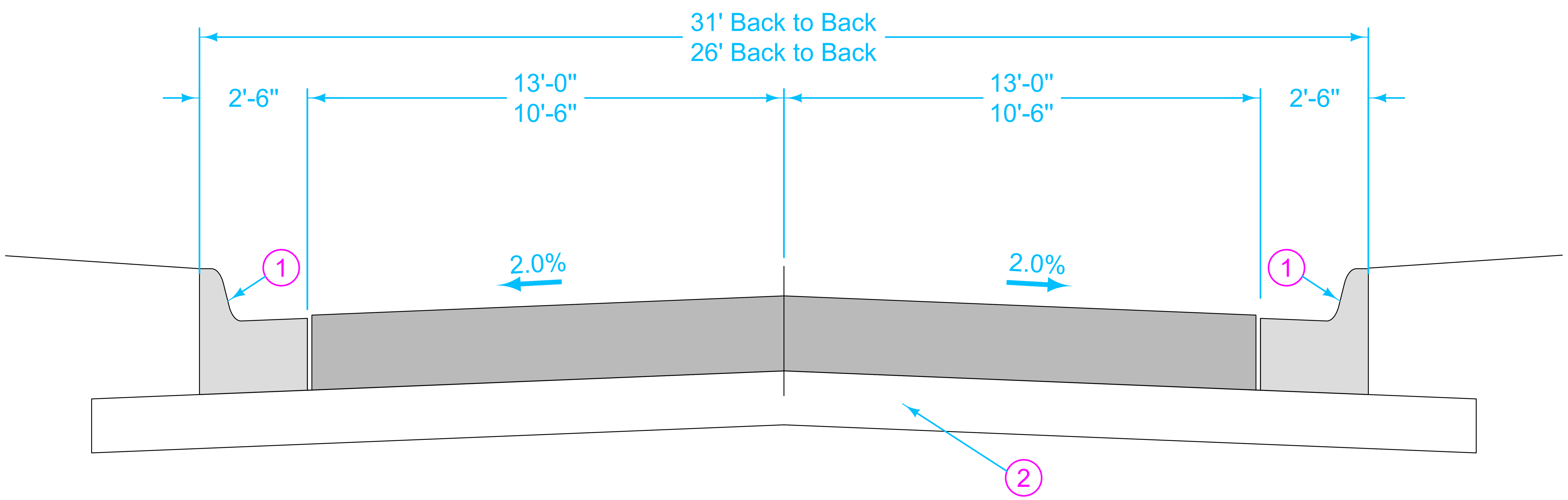
SHEET NAME
CONCRETE DETAILS

SHEET NO.
**12**




1 6 inch standard curb and gutter.

2 Subbase or subgrade as specified.




**TYPICAL CROSS-SECTION**

10 HMA Detail
Not to Scale

| REVISION | |
|---|---|
| New | 10-19-10 |
| 7020.901 | |
| SHEET 2 of 2 | |

HMA PAVEMENT

PROJECT: CEE: 4850
DATE : 04/20/2018
DRAWN BY: HJM
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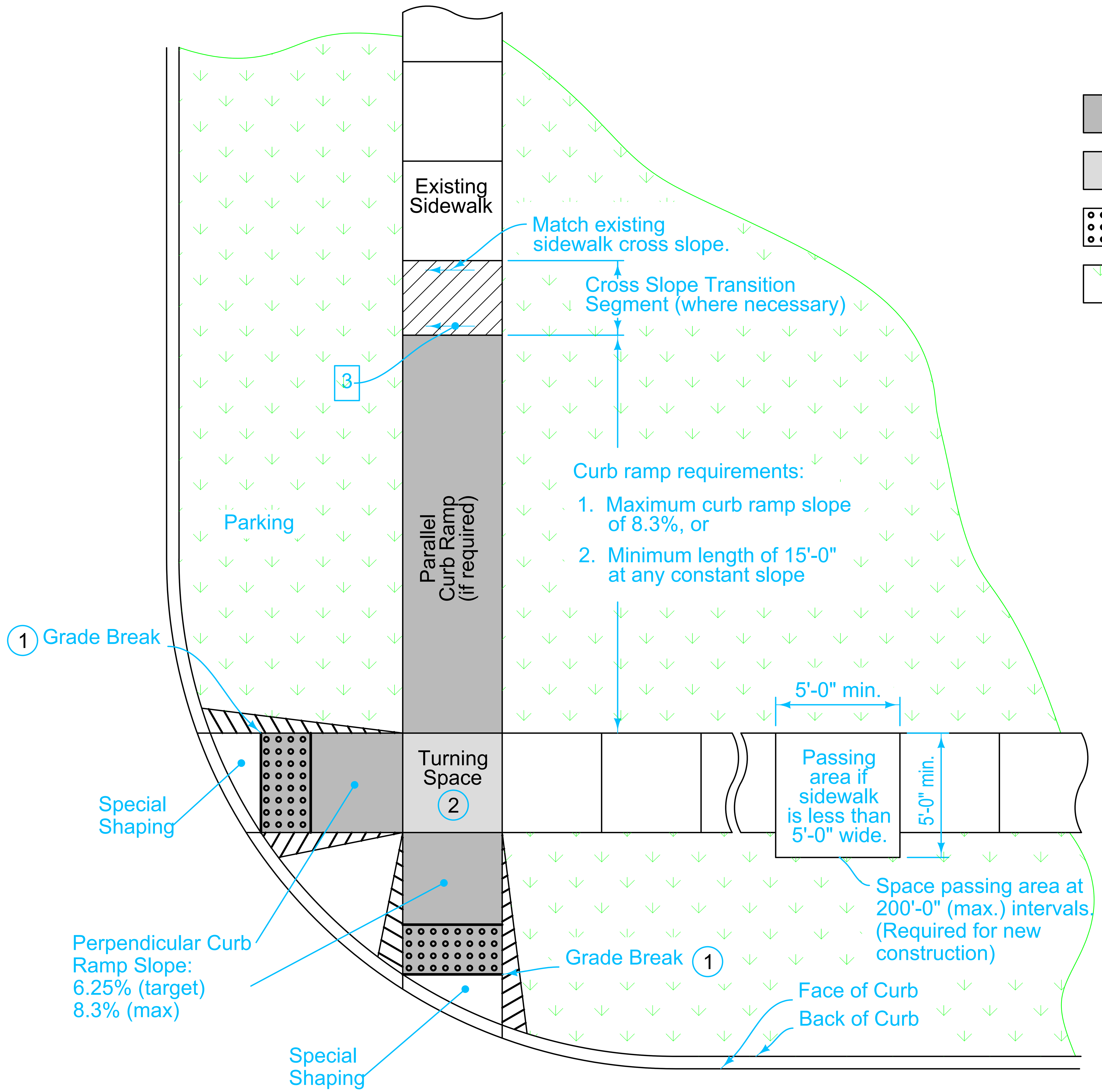
**Waterway Access**
MASON CITY, IA 50401

SHEET NAME
ASPHALT DETAILS

SHEET NO.
**13**




Key

| | |
|---|---|
| [gray box] | Curb Ramp |
| [light gray box] | Turning Space |
| [dotted box] | Detectable Warning |
| [grass box] | Grass |

1. Match pedestrian street crossing slope, or flatter.
2. Minimum 4 feet by 4 feet. Target cross slope of 1.5% with a maximum cross slope of 2.0%.
3. Target cross slope of 1.5% with a maximum cross slope of 2.0%.

## 11 Sidewalk Detail

Not to Scale

REVISION

| 3 | 10-20-15 |
|---|---|

7030.204

SHEET _1 of _1

GENERAL FEATURES
OF AN ACCESSIBLE SIDEWALK

PROJECT: CEE: 4850
DATE : 04/20/2018
DRAWN BY: HJM
REVISION:

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SHEET NAME
SIDEWALK DETAILS

SHEET NO.
**14**