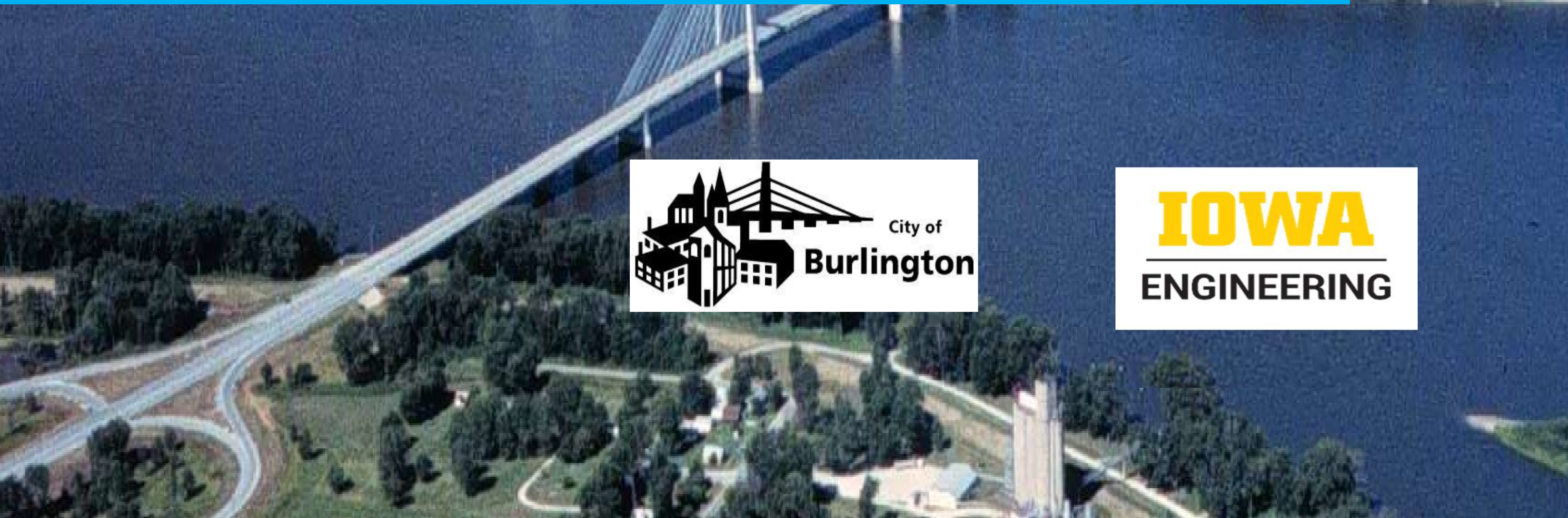
BURLINGTON SOUTH RIVERFRONT PARK EXTENSION

Design Report

May 9th, 2025

103 South Capitol Street
Iowa City, IA 52240



City of Burlington

IOWA ENGINEERING

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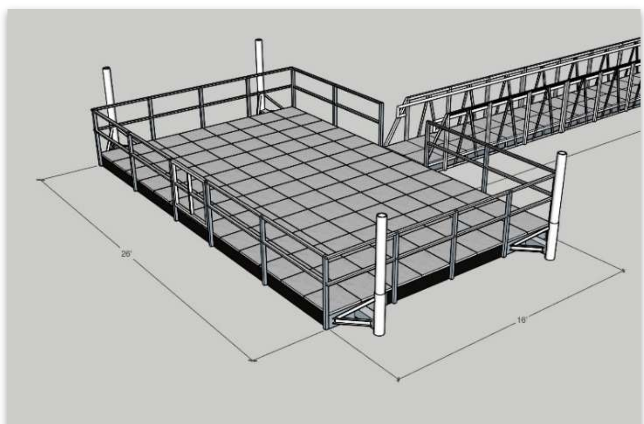
Section I: EXECUTIVE SUMMARY

We are pleased to submit this design report for the South Riverfront Park Expansion Project in Burlington, Iowa. This design satisfies the client's objectives by enhancing public access to the riverfront, highlighting the natural features of the location, and integrating elements of Burlington's rail history into the site. This initiative includes various recreational and leisure amenities that are accessible for all members of the community. These objectives were met while working with the constraints and challenges presented by this project. These include space limitations, concerns of flooding by the adjacent Mississippi River, and environmental concerns associated with the former uses of the site. The following elements are part of the final design and are discussed in further detail in this report. *All design elements align with SUDAS, Iowa DOT, USACE standards and ASTM Standards.*

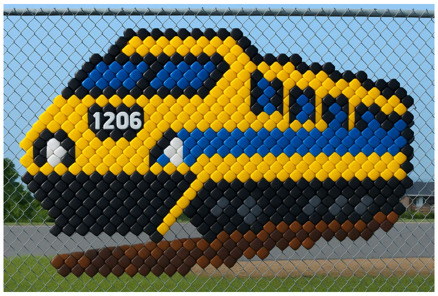
A significant portion of the project involves site clean-up and preparation due to the current deficient soil and miscellaneous debris on site. The project team recommends the removal of existing structures – including the Public Works building and scale house. The existing PCC pavement will be crushed and repurposed as base material for the parking lot and trail. Vegetation and surface debris will be cleared, and the top 12 inches of soil scarified to remove remaining debris and improve infiltration. 6 inches of high-quality topsoil will be imported to support green space development. For riverbank stabilization, similar riprap consistent with upstream treatment is recommended.

A second boat ramp was designed to expand public river access and reduce congestion at the existing launch. The ramp will mirror the design of the current facility, featuring two 15-foot-wide by 100-foot-long lanes with a 12% slope, V-grooved PCC pavement and protective riprap at the toe. A floating dock with gangplank access will improve user convenience. The adjacent parking lot will be reconfigured and expanded to include 30 boat trailer spaces and 79 single vehicle spaces, with ADA-compliant access. A one-way, double-wide rigging lane, curb less layout, and strategic drainage features – including curb cuts and riprap-side curbing – will support traffic flow and site sustainability. Lighting and signage upgrades follow SUDAS and MUTCD guidance to enhance safety and usability.



The park design includes a 10-foot-wide shared-use trail looping through the southern portion of the site with a mid-point crossover. A key addition includes a fishing dock with a 30-foot gangway adaptable to river level changes, anchored via either pile or ballast systems. A weather-resistant fish cleaning station is included adjacent to the dock. A prefabricated performance-suitable pavilion at the north end of the site will provide a sheltered space for community events and social gatherings featuring a flood resistant design. All trails and park amenities are designed to be ADA compliant.

To reflect the site's proximity to the historic BNSF railyard, the design team recommends incorporating a vintage rail car as a central interpretive feature. The preferred concept includes a rail car with accessible side doors, an ADA-compliant ramped porch, and an interior exhibit displaying a historical timeline of the BNSF railway, complete with seating. Additionally, a vinyl-coated chain link fence is recommended as a barrier between the site and the adjacent railyard. This fence provides visibility into the railyard while offering opportunities for educational or artistic displays.



The landscaping plan prioritizes resilient, low-maintenance vegetation due to the site's floodplain conditions. Buffalo grass is recommended for open lawn areas due to its low maintenance and soil stabilization qualities. To enhance natural aesthetics and provide shade without obstructing views, 4-inch caliper park-grade native trees – such as silver maple, bur oak and bald cypress – will be strategically planted throughout the park.

The total construction cost is estimated to be approximately $2,057,000. A breakdown of the cost estimate can be found in Section VII of this report.

Section II: Organization Qualifications and Experience

Organization and Design Team Description

The design team comprises three University of Iowa students enrolled in the capstone design class, along with faculty advisor Rick Fosse. While each member had a defined role, the team functioned as a cohesive unit, contributing collectively to the overall design process.

Jerin Ugrin – Project Manager Jerin specializes in civil engineering practice and leads the team by overseeing the project schedule, maintaining client relations, and ensuring that all design milestones are met efficiently. His experience in CAD design, construction inspection, and surveying provided a strong foundation for managing project execution and coordination. His main design focus throughout the project was the parking lot extension, additional boat ramp, fishing dock and cleaning station, site drainage, and earthwork.

Claire Recker – specializes in transportation engineering and her experience in site layout design and trail restoration enhanced the team's ability to create functional and accessible public spaces. Her main design focus was the overall site landscaping as well as pavilion structures and fencing for a barrier between the railyard and the site.

Jenna Dinges – specializes in civil engineering practice, and her expertise in geotechnical work, municipal inspections, and civil engineering software enhanced the precision and efficiency of the design process. Her main design focuses throughout the project were the recreational aspects such as the trail loop and the rail car display.

Section III: Design Services

Project Scope

The project aimed to transform a former industrial site into a vibrant community park, enhancing access to the Mississippi River. The development includes a variety of different amenities for recreational activities, parking, landscaped pathways, and a shelter for gatherings and performances. Additionally, the project incorporates an artistic display of a rail car, more boating access, fishing and other popular recreational activities in Burlington. The scope of services provided includes:

- Assessed existing site conditions
- Identified regulatory permits required that influenced design
- Created and presented design alternatives to the client
- Put together site drawings and plans of the clients' preferred alternative including:
    - Debris removal and site preparation plan
    - Site grading and drainage
    - Riverbank protection and erosion control
    - ADA compliant pedestrian access and trail design
    - Park amenities such as picnic tables, benches and pavilions
    - Additional boat ramp and parking lot extension
    - ADA compliant fishing dock and fish cleaning station
    - Pedestrian barrier along adjacent railyard
    - Landscaping

- Created a detailed cost estimate covering all aspects of the project.
- Compiled all design aspects into a final report, poster, presentation and design sheets.

Work Plan

A work plan we followed for the development of the design and engineering services is provided below.

- ❖ Data Collection: Gathered relevant site information and researched similar projects.
- ❖ Initial Meeting: Conducted project kickoff with the client.
- ❖ Site Visit: Assessed current site conditions.
- ❖ Design Options: Develop multiple design concepts.

  - Each team member developed an alternative to propose to the client which were ultimately combined into one preferred design
- CAD Development: Created 2D CAD designs and selected optimal layout using Civil 3D.
- Advanced Modeling: Developed Civil 3D grading models and 3D renderings.
- Documentation: Produced cross-sections, plan sets, material lists and cost estimates.
  - Jerin: parking lot, boat ramp, fishing dock, fish cleaning station
  - Claire: landscaping, pavilion structure/pad, barrier fencing
  - Jenna: trail, rail cart display, drainage system
- Reporting: Compiled a comprehensive design report, design sheets, poster, and presentation.

(A Gantt Chart for the project schedule is provided in the Appendix I)

Section IV: Constraints, Challenges, and Impacts

This project proposed many aspects that presented constraints and challenges to the design and construction of the development. The variables that provided the constraints and challenges to this project included:

Constraints

- Space: Limited area between the Mississippi River and BNSF railyard required innovative design.
- Environmental Concerns: Potential soil contamination, groundwater issues, and potential industrial pollution due to the former uses of the site.
- Aesthetics: Designed to reflect the historic character of the railyard and downtown Burlington.
- Permits: Identified and designed for the relevant permits from the U.S Army Corps of Engineers and Iowa DNR.

Challenges

- **Flooding**: Designed resilient site amenities within a 100-year floodplain.
- **Historical Usage**: Addressed safety concerns related to former industrial activities.
- **Lack of precise topography data for the site**

Social Impact

This development presents many opportunities to the community of Burlington, including:

- Enhancing the downtown district and community access to the Mississippi River.
- Converting underutilized space into a public amenity.
- Promoting urban naturalization and site beautification.
- Providing public interaction with Burlington's industrial history and BNSF Railway.
- Expanding recreational and leisure opportunities for all age groups within the community.

The development could also present community challenges, including:

- Increasing traffic and congestion in the park area as well as surrounding roadways.
- Increasing maintenance and city duties to keep the park area clean and upkept.
- Potential infringement on industrial activities in the area.

Burlington has a rich history and culture within its place in eastern Iowa, especially its history with the Mississippi River and the BNSF Railroad. Key demographics, community structures and resources are factored into the design methodology and impact studies include:

- Burlington metro area population: 23,980
- 22.2% of the population is over 65 years old, while 21.2% is under 18.
- Median household income: $55,274
- The most common industries in Burlington include Manufacturing, Healthcare and Social Assistance, and Retail Trade.

Section V: Alternative Solutions That Were Considered

Many different design concepts were considered in the initial stages of the design process. The design team presented the client with options that were recreational focused and entertainment focused. Ultimately, the client wanted a low maintenance park for the public to enjoy that beautified the land on the riverfront. A few ideas that were considered but not implemented into the final design include:

Family movie night screen

- Pros: Would foster social interactions for all community members. The screen could be used for sport event viewings, public presentations, and concerts as well.
- Cons: The cost of installing the screen, projector and sound system could be significant. All equipment would require weather and floodproof enclosures. Outdoor events would require good weather and staffing time.

Space for temporary staging

- Pros: Would provide a versatile way for the city to host a variety of public events. The space could be used for recreational activities when the stage was disassembled.
- Cons: The city already has an indoor entertainment venue and surrounding outdoor event spaces immediately north of the site.

Sand volleyball / Tennis courts / Pickleball courts / Basketball courts

- Pros: Would encourage physical activity and provide spaces for social interaction within many age groups. Courts attract more visitors and promote regular use of the park.
- Cons: The client was not interested in putting any sports courts on site. Regular maintenance is required to ensure the courts remain safe and functional. Weather conditions can accelerate wear and tear, especially since the site is within the Mississippi River floodplain.

Campsite / RV hookups

- Pros: Would provide visitors the opportunity to camp in a centralized and beautiful location within the city. Could work to attract out-of-town visitors to explore the city and shop at local businesses.
- Cons: There is insufficient space on site to include an economically viable RV park. The city currently does not have camping within its limits and therefore would have to implement a regulatory body to monitor and maintain the campsite.

Splash pad

- Pros: Provide a safe and accessible water feature with minimal staffing and maintenance. A splash pad would draw visitors to the park and foster community engagement.
- Cons: Typically, they are expensive to install. They only offer seasonal activities.

Dog park

- Pros: Would serve as a social hub for dog owners, creating an engaging space for residents and visitors. Provides a safe area for dogs to exercise and play.
- Cons: Burlington already has an outdoor dog park. Regular maintenance would be required to ensure the area remains clean and safe.

Outdoor Workout Stations

- Pros: Provides a space for the community to get active along their walk on the trail.
- Cons: Recreational amenities could experience extra wear and tear due to being in the floodplain.

Section VI: Final Design Details

The site was previously an industrial area, thus the design process places significant emphasis on thorough site cleanup and preparation. To ensure the land is suitable for development, further examination of the soil is recommended. Our design team recommends conducting a Phase 2 Environmental Assessment to evaluate potential soil contamination and feasibility of site for use as a community park. Once the site has been fully demolished and regraded with fresh topsoil, the design team has proposed a range of amenities aimed at enhancing the park's value and providing enjoyable spaces for the community.

Site Removals, Preparation, and Earthwork

Before continuing with further development of the riverfront site, it is essential to clean up and prepare the area. The first step involves the removal of existing structures, including the Public Works maintenance building (below) near the current parking lot, the former railway scale house, control features for deteriorating riverbank erosion, and industrial elements such as the existing sheet pile walls. Demolition permits will be required for the removal of these structures, and all work must comply with local regulations and safety standards.

Following structure removal, existing pavements associated with previous site uses will also need to be taken out. This includes the pavement from the former grain elevator site, as well as the deteriorating pavement in the existing parking lot extension. Portland Cement Concrete (PCC) pavement removed during this phase can be crushed and reused as base material for the parking lot and trail.

Next, thorough clearing and grubbing will be conducted to remove the remaining debris and vegetation. The engineering team recommends scarifying the top 12 inches of soil to eliminate residual debris and enhance stormwater infiltration. Class 13 excavation, as defined by SUDAS, will be used to remove all encountered materials and allow for proper grading and earthwork. The site will need to be regraded to allow for proper stormwater drainage, and preparation for continued site development. Additionally, it is recommended to import and place six inches of high-quality topsoil across the site to support vegetation growth, as the existing on-site soil lacks sufficient nutrient content and is not suitable for this application.

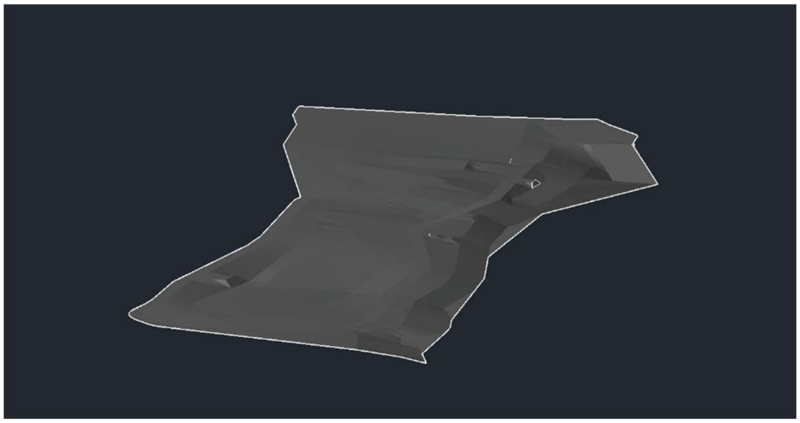
Site Grading

The riverbank has significant risks of erosion; to support future development on the site, erosion mitigation strategies must be employed. The project team recommends consistency with the bank upstream with the placement of riprap along the site's bank to prevent further loss from erosion and to fortify the bank for future developments. SUDAS and Iowa DOT standards on riprap erosion control are followed, and riprap sizing methods and selection are detailed in the appendix. Iowa DOT Class D revetment stone is recommended for this site, as a 12-inch layer on top of a geotextile blanket over the underlying existing soil. USACE permitting will be required for riverbank construction, storm sewer outlet, and improvements.

Existing Riprap

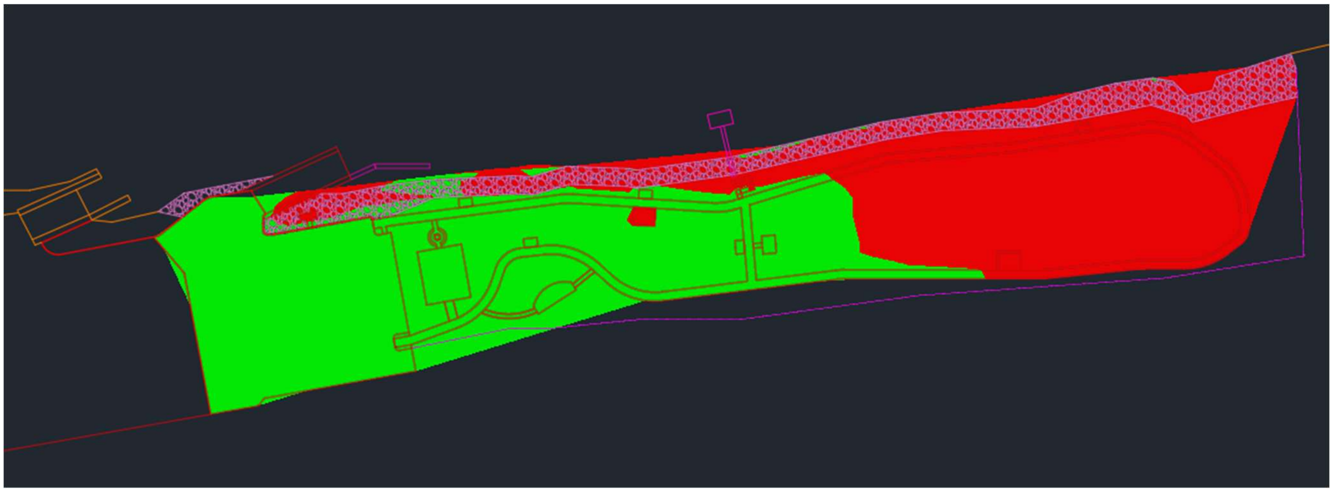
Re-grading and earthwork calculations and plans have been developed using Autodesk Civil 3D. A grading model was developed for the site ensuring adequate and efficient drainage to the site. This project is a net fill project in terms of the difference between the existing ground surface and the proposed future ground. For green space, topsoil import and unsuitable soil waste will have significant quantities that are explored in detail in the cost estimate and calculation appendix.

See Appendix B: Design Calculations for supporting calculations on rip-rap sizing and Appendix H: Earthwork.



Civil3D Grading Model

Shown below is a depiction of the areas that will be cut and filled. The areas in green require more materials to bring the surface up to grade whereas the areas in red require more materials to be removed.



Elevations Table				
Number	Minimum Elevation	Maximum Elevation	Area	Color
1	−8.03	0.00	111208.57	
2	0.00	7.30	125525.59	

Civil3D Cut/Fill Analysis

Boat Ramp

One of the key features of the site redevelopment is the addition of a second river access point. The new boat ramp will improve public access to the Mississippi River and help alleviate congestion at the existing ramp. To maintain continuity and consistency, the new ramp will follow similar design standards and attributes as the existing facility.

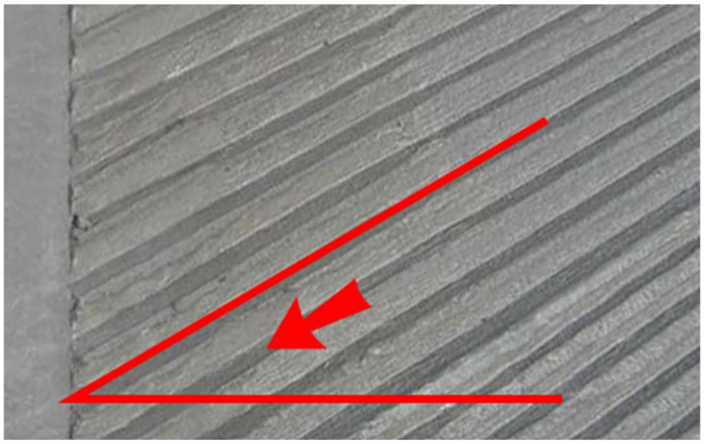
Existing Boat Ramp

The proposed boat ramp will require cut and fill along the existing shoreline to create an appropriate slope for launching. Like the current ramp, it is oriented at an angle away from the river's main current, making it easier for users to launch and retrieve boats. Shoreline modifications and in-water construction will require a permit from the U.S. Army Corps of Engineers (USACE). The ramp design was informed by existing site conditions, including elevation data, river stage statistics, and feedback from key stakeholders.

To ensure maximum usability under varying river conditions, design guidance was primarily sourced from the California Department of Parks and Recreation, specifically the Division of Boating and Waterways guidelines for boat launching facilities. The ramp is designed to accommodate two 15-foot-wide by 100-foot-long launching lanes, each with a 12% downward slope. These dimensions and gradients were determined based on historical river data maintained by the National Weather Service (NWS), National Oceanic and Atmospheric Administration (NOAA), and USACE. Further technical analysis and supporting data can be found in the appendix.

The ramp structure consists of 9-inch-thick reinforced Portland Cement Concrete (PCC) pavement with "V-Groove" texturing for traction, placed over an 18-inch aggregate base atop compacted fill. At the toe of the ramp, large riprap anchor rock and geotextile fabric will be installed to protect the ramp from scouring caused by river currents. Additionally, the ramp will feature floating docks connected to river piles and accessed via a gangplank, providing convenient pick-up and drop-off points for boat passengers.

See design sheets BR1-BR3 for layout of the boat ramp.



V-Groove Textured Pavement

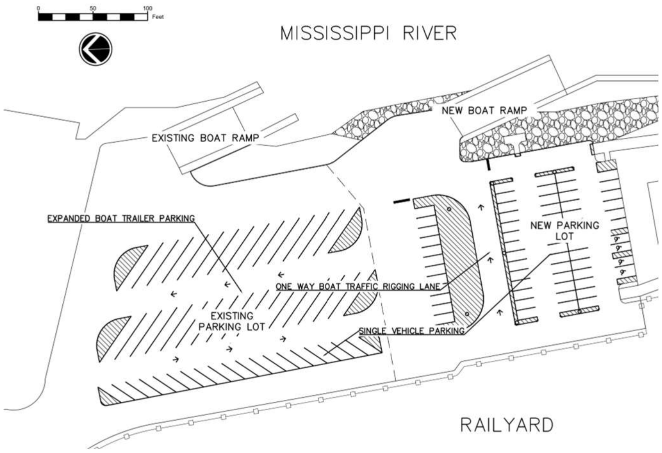
Parking Lot Extension

In conjunction with the new boat ramp access facility and the ongoing development of the riverfront site, enhancements to the existing parking facilities and an extension of the parking lot are essential to accommodate the entire site effectively. Beginning with the existing facilities, a comprehensive painting plan will be implemented to reconfigure parking arrangements, ensuring optimal capacity and operational efficiency.

To alleviate existing congestion and facilitate the addition of a second ramp access, the number of pull-through boat trailer parking spaces will increase from 11 to 30. Single vehicle parking spaces will be reduced from 87 to 79, including ADA accessible parking, strategically positioned for convenient access to park areas.

In addition to expanded parking, a boat launching efficiency plan has been devised to maximize the use of boat ramps, incorporating a double-wide, one-way boat traffic rigging lane. This design, inspired by successful models at Brinker Lake Boat Launch in Waterloo, Iowa, and Pleasant Creek State Park near Palo, Iowa, aims to streamline operations and enhance user experience.

Pleasant Creek State Park Boat Ramp Facilities Example



Boat Ramp and Parking Lot Facilities Plan

The parking lot design opts for a curbless layout without medians, utilizing painted markings for clear delineation. This approach promotes efficient drainage across the site while maintaining consistency with the existing lot and seamlessly integrating with the new extension. Curbs will only be installed on the east side of the lot, adjacent to the riprap and riverbank, ensuring both safety and effective water drainage.

To further support drainage, a curb cut will be incorporated to provide an additional outlet for water runoff from the parking lot. This feature enhances vehicle safety and aligns with existing site characteristics, complemented by a curb buffer to prevent accidental vehicle rollovers.

Drainage Curb Cut Example

The pavement design adheres to rigorous standards, including the AASHTO ‘93/’98 Rigid Pavement Design Method and SUDAS Chapter 5F Pavement Thickness Design. The pavement section will consist of 7 inches of PCC atop a 6-inch aggregate base layer, overlying a recompacted subgrade of the existing site soil. Pavement jointing will follow SUDAS and ACPA guidelines, featuring unreinforced construction with standard contraction joints.

The lighting design will be in accordance with SUDAS recommendations, ensuring consistency with existing structures in the parking lot and connecting seamlessly to the current utility network.

Existing Parking Lot Area Lighting

A signage plan was implemented following guidance from the Manual on Uniform Traffic Control Devices (MUTCD). Stop signs and bars were added to provide increased safety and efficiency between single user vehicle and boat trailer traffic. See design sheets PL1-PL10 for layout of the boat ramp and parking lot. See Appendix D: Design Calculations for parking lot calculations along with Appendix E: Jointing Layout and Appendix F: ADA Parking.

Park Trail and Sidewalks

The proposed trail will be designed as a shared-use path, spanning approximately 0.40 miles, looping from the south end of the parking lot to the southern boundary of the site. It will also include a cut-through point about halfway down for those who don’t want to go the full distance. In accordance with the SUDAS Design Manual, referencing both "Chapter 12: Pedestrian and Bicycle Facilities" and "Chapter 5: Roadway Design," the trail will have a width of 10 feet and a thickness of 7 inch path clearance and site maintenance. The paving structure will include a 6-inch base layer of gravel aggregate over a 1-foot scarified sub-base. The cross slope of the trail will be designed at 1.5% toward the river to promote effective drainage across the site. Due to the flat site conditions there is minimal grade change throughout the trail. At the trail's entrance, detectable warnings will be included to ensure ADA accessibility, as required for access to the park. Additionally, the design will adhere to ADA compliance standards outlined in SUDAS, "Section 12A-2: Accessible Sidewalk Requirements," ensuring that the slope does not exceed 5%.

The sidewalks are designed to seamlessly connect to the park amenities along the trail, with a narrower width and reduced thickness compared to the trail itself. Specifically, the sidewalk will have a width of 5 feet and a thickness of 5 inches, in accordance with the SUDAS Design Manual, "Chapter 12: Pedestrian and Bicycle Facilities." The pavement structure will consist of 5 inches of PCC pavement atop 6 inches of aggregate base, followed by a 12-inch scarified subbase. To ensure proper drainage, the sidewalk will feature a cross slope of 1.5% towards the river. Additionally, the design will adhere to ADA compliance guidelines, maintaining a slope of less than 5%, consistent with the trail's slope.

See design sheets TR1-TR6 for layout, cross section, and dimension drawings.

Fishing Dock and Fish Cleaning Station

Key recreational enhancements proposed for the site include the addition of an ADA-accessible fishing dock and a fish cleaning station. These features are designed to support and enhance public use of the riverfront, particularly for anglers and boaters.

Fishing Dock

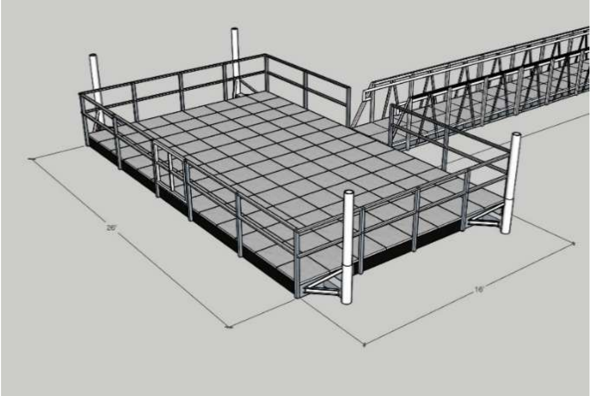
The proposed fishing dock will be fully ADA-compliant and adaptable to fluctuating river conditions. Its design follows the U.S. Access Board’s guidelines for fishing piers and platforms, ensuring accessibility and regulatory compliance. While final dimensions may vary based on the selected manufacturer, the gangway will be a minimum of 30 feet in length to meet slope requirements under variable river conditions.

Due to the dynamic nature of river levels, the dock's gangway will feature either a quick-disconnect hinge system or a roller mechanism, allowing it to adjust freely with changes in water elevation. The dock itself will be a floating structure, anchored using either driven piles or an anchor and winch system with concrete block anchors, depending on site conditions and preferred manufacturer specifications.

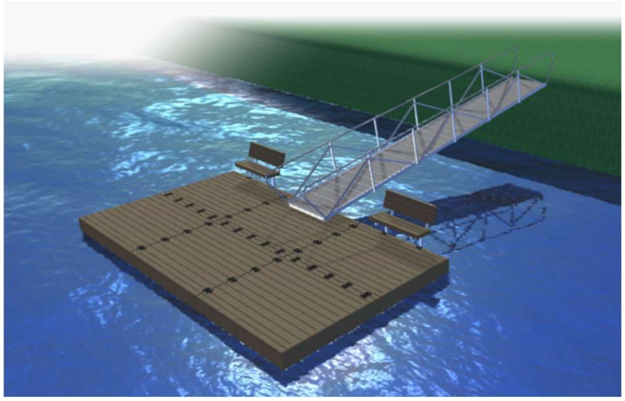
Two potential manufacturers have been identified. Mac’s Docks, a provider of existing dock systems in the city, offers durable, customizable, and permanent dock solutions suitable for long-term public use. Alternatively, EZDock offers a modular plastic dock system that is more cost-effective but generally less robust. Based on considerations of durability, longevity, and public safety, the design team recommends selecting a system similar to those provided by Mac’s Docks.

Dock installation on the river will require a USACE permit, applications can be submitted online showing construction plans, dock design details, and descriptions.

See design sheets D1-D2 for layout of the fishing dock.



Mac’s Docks - Dock Rendering



EZDock - Dock Rendering

Fish Cleaning Station

A fish cleaning station is also proposed to serve anglers that are using the new fishing dock and launching facilities. This station would provide a dedicated, sanitary location for cleaning fish, improving overall user convenience and environmental management.

The design team recommends a weather-resistant, outdoor-rated cleaning station equipped with integrated waste disposal solutions. One preferred model is a prefabricated KillerDock cleaning station, known for its robust construction, stainless steel work surfaces, and optional features such as cutting boards, wash-down systems, and overhead canopies. These stations are available in a range of sizes and configurations to meet site-specific needs and user demand.

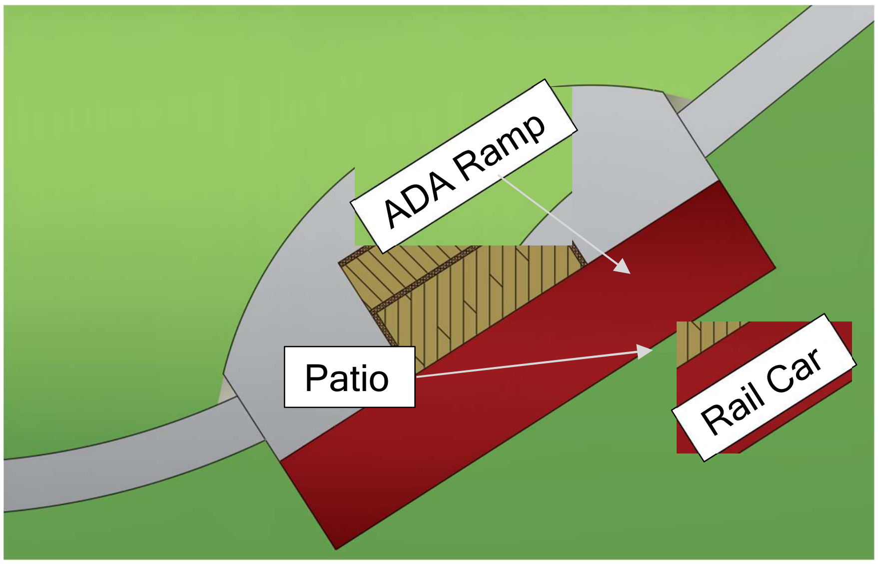
An outdoor resilient station is recommended because of the risk of flooding on the site. Opting for a resilient outdoor station would provide a risk-free option, opposed to a larger fishing cleaning building. Two different locations are recommended, the first being just north of the existing parking lot near the bathroom facilities, where a larger more customizable station could be installed with access to existing water and sanitary services. Another option would be one of KillerDocks' reduced options that can be mounted on the new fishing dock.

KillerDock Outdoor Fish Cleaning Station

Rail Car Display

The city has requested that the design incorporates and reflects the history of the neighboring BNSF railyard. To honor this history and create a cohesive connection between the two areas, the design team proposes a platform along the trail to incorporate this feature. It is located near the entertainment pavilion, and the other is further south.

The first option the team proposed was displaying an old rail car as a central feature. We recommend selecting a rail car model with large side doors that can be opened to allow access to the interior. To ensure accessibility for all, the design will include a porch with a ramp, making the rail car ADA-compliant. The slope of the ramp will be carefully designed based on the elevation difference between the bottom of the rail car and the surrounding ground surface. Inside the rail car, the design features a historical timeline, showcasing photographs and key moments from the BNSF railway's history. Benches will be provided inside for community members to pause, reflect, and appreciate the historical significance of the site. Below is a proposed layout for the porch and ramp design, along with a reference for the historical timeline wall.



First Proposed Rail Car Display Layout

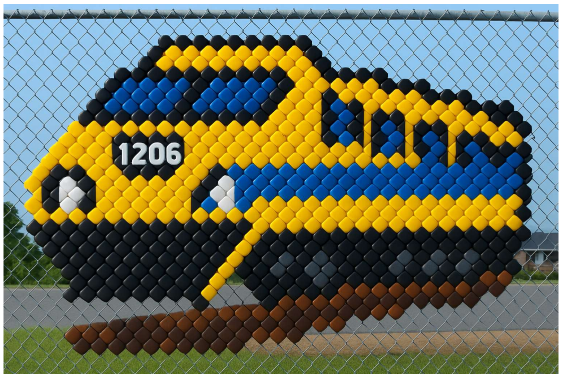
Another option would be to display only an engine from BNSF. This approach would mitigate concerns about people potentially using the rail car as a place to camp overnight, thereby reducing the city's liability and maintenance responsibilities. This option also simplifies the overall design while still offering a nod to the area's rich railway history. The design team recommends that the City works with BNSF railroad to donate and help install the display.

Second Proposed Rail Car Display

The last option would be to place a flat car on the site to use as an elevated observation platform. Benches and picnic tables could be placed on the platform for visitors to have a spot to hang out and admire the sights of the railyard and the river. A railing would be required for safety measures.

Third Proposed Rail Car Display

Pedestrian Fence - A pedestrian fence will be placed along the east side S Front Street to protect parkgoers from the adjacent rail yard. A six-foot vinyl-coated chain link fence is recommended as a low maintenance, cost effective option that will allow parkgoers a clear view of the railyard trains and activities. The simple concept of the chain link creates opportunities to put educational plaques or artistic elements on display, as seen in example pictures below.



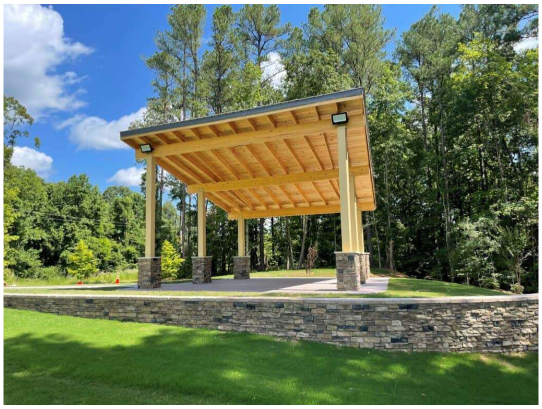
Proposed Fence Elements

Pavilion Structure / Performance Venue

A new pavilion structure will be placed on the north end of the site. The pavilion will offer a welcoming, sheltered space where park visitors can relax and enjoy extensive views of the river and the adjacent railyard. Additionally, the pavilion will double as a north facing, performance venue for a variety of community events. This new amenity enhances the overall park experience by providing a versatile location for gatherings and activities.

The pavilion will be accessible for all users by access of an ADA compliant sidewalk. It will also be located closer to the parking lot to make usage convenient for people of all abilities, and to allow for reliable lawn chair space during performance events.

We recommend a prefabricated pavilion structure, such as the ones below, by the manufacturer Romtec. These customizable, performance-suitable design options match the park's aesthetics and location.



Due to the location of the site within the 100-year floodplain of the Mississippi River, we recommend the pavilion be made with galvanized steel or treated wood.

The pavilion will sit on a 6-inch concrete pad that will be reinforced with #4 rebar in the lateral and longitudinal directions. 4-inch gravel aggregate will be placed under the slab followed by a 12-inch scarified subbase. The concrete pad size and proper footings will be selected according to the specific pavilion chosen.

See design sheets ST1-ST2 for the concrete pad plan and cross section details.

Multipurpose Pad

In addition to the large pavilion structure, the park features two smaller 20’x25’ pads designed for versatility. These pads can accommodate various park amenities like picnic tables and barbecues, either with a small shelter structure or in an open-air configuration. They can be constructed to match the quality of the pavilion pad or to a simpler standard, depending on preference. Offering both options enhances the park's adaptability to public needs while giving the city greater control over its design.

See design sheet ST3 for more details and information.

Proposed Prefabricated Pavilion Structure Options

Landscaping

The site landscaping plan includes planting hardy lawn grass to create a versatile, open space for recreational activities and public gatherings. The engineering team recommends buffalo grass (*Bouteloua dactyloides*) due to its high adaptability to floodplain environments and its low maintenance requirements. Additionally, buffalo grass is native to the region and contributes to soil stabilization, making it ideal for protecting the riverbank. A park mix made from a blend of tall fescues, ryegrass and bluegrass would also be a low maintenance option due to its quick establishment, drought resistance and wear tolerance. The deep-rooted nature of tall fescues enhances soil stability, which is crucial for a riverfront location prone to erosion.

To enhance the natural feel of the riverfront park, flowering prairie plantings could replace the lawn turf in the southern region of the site as a placeholder for future park additions.

A diverse selection of native tree species will be strategically planted throughout the park to provide shade and enhance the site's natural aesthetics without blocking panoramic views of the river and adjacent rail yard. We recommend planting bur oak (*Quercus macrocarpa),* silver maple (*Acer saccharinum*), and bald cypress (*Taxodium distichum*) due to their proven resilience in floodplain environments. These species are well-suited for soil salt tolerance, ensuring longevity and low maintenance. We recommend plalnting 4-5-inch caliper park-grade trees to stabilize the landscape and offer immediate aesthetic benefits. Use proper planting and installation practices outlined in SUDAS section 9030. We recommend guying and planting pits for the trees listed above. Apply a 10-10-10 starter fertilizer to provide balanced nutrients essential for plant establishment and recovery in floodplain soils.

See design sheets LS1-LS6 for the proposed planting layout of the site. We have provided our best recommendations for turf and trees, but the species that have consistently performed well for the Burlington Parks Department are the most reliable choice for success.

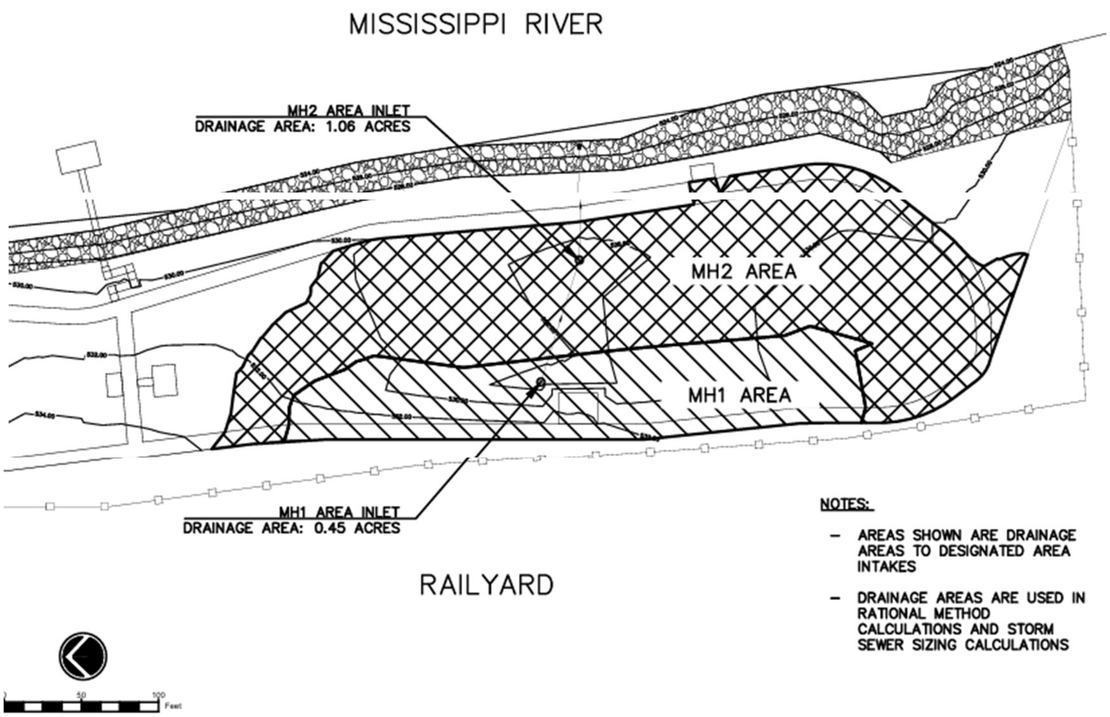


Proposed Tree Species

Drainage

Because the park site is situated within a floodplain, proper drainage is a critical consideration in the design. The site has been carefully planned with a slope towards beehive intake structures, strategically placed along the trail loop. These intake structures will be interconnected underground, directing surface water to the river via storm sewer pipe and connects. The drainage system is designed to function through gravity flow. Since it will be draining into the Mississippi River, it will require approval from the U.S. Army Corps of Engineers.

To determine the appropriate pipe sizing and slope, several formulas were employed. Utilizing the Iowa DOT Design Bureau Chapter 4A-5 and SUDAS Chapter 2 stormwater guidelines, the peak flow was calculated as 0.233 cfs to manhole 1 and 0.461 cfs to manhole 2, based on a 10-year return period. A detailed breakdown of these calculations can be found in Appendix G with the calculated flow rate; the pipe diameter was determined to be 15 inch to manhole 1 and 21 inch to manhole 2. Given the design specifications from SUDAS Division 6 – Structures for Sanitary and Storm Sewers, the design team recommends using a type 3B and a type 5 grate for the manhole structure tops.

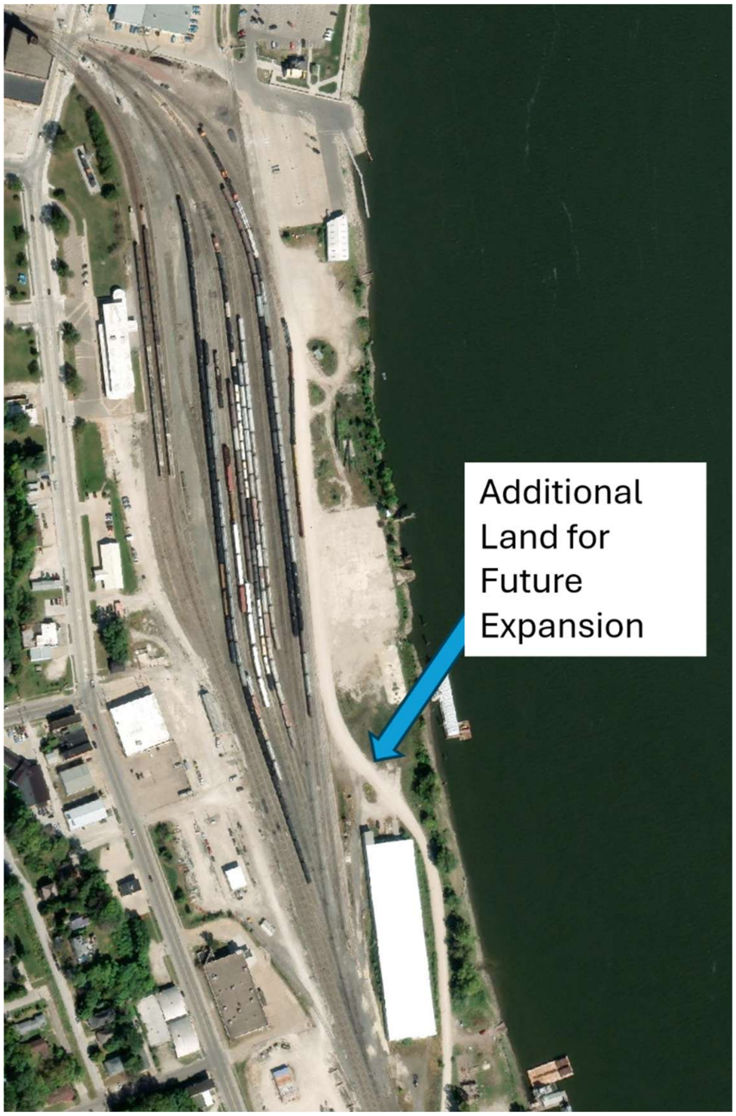


Additionally, in accordance with SUDAS Division 4 – Sewers and Drains, a pipe apron guard will be included at the outlet to prevent debris from entering the system.

See Appendix G: Design Calculations for Culvert and Manhole Design for supporting design calculations. See design sheets SS1-SS6 for layout and details.

Future Expansion

Based on analysis of the existing site, the engineering team believes there is insufficient space to include an economically viable RV park at the south end of the site. The necessary amenities and utility extensions would make construction prohibitively expensive for a limited number of RV spots. However, the flexible and resilient design layout for this project allows for easy expansion if the city chooses to do so in the future. If land is acquired to the south of the site, the addition of an RV park would be more economically justifiable. An expansion would also provide space for a second rail display. It could be placed near the south end of the trail and will enhance interaction with Burlington's rich rail history.



Potential Land for Future Amenities

Section VII: Cost Estimate

Construction Cost Estimate

The cost estimate was prepared primarily using the Iowa Public Works Service Bureau's bid tabulation tables, as well as the Iowa DOT bid tabs, quotes from manufacturers, and online research. The estimated construction cost is $1,714,000 prior to the inclusion of a contingency. A contingency of 20% has been added, bringing the total estimated cost to $2,057,000. This is a higher than average contingency, but given the past industrial use of this site, there is the potential to encounter contaminates that may require remediation. It is important to note that this cost estimate does not include the potential expenses associated with acquiring property ownership of the land from the BNSF Railway or additional surveying and design costs.

Further breakdown is included in Appendix J: Cost Estimate.

Appendix

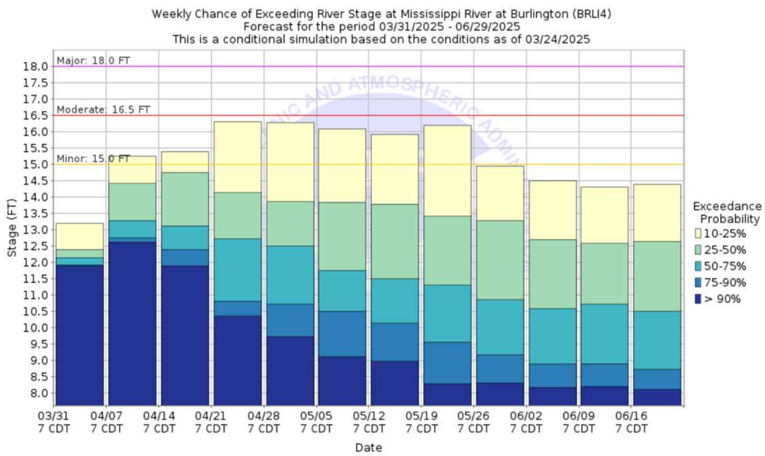
Appendix A: Mississippi River Statistical Data Collection

For multiple design criteria, knowing the history of the river conditions concerning flooding and flows in the Mississippi River at Burlington, was a must for making informed and calculated design decisions. Data is kept on river conditions by the National Weather Service (NWS), National Oceanic and Atmospheric Administration (NOAA), and the U.S. Army Corps of Engineers (USACE). Conveniently the nearest river gage operated and maintained by USACE is located directly adjacent to the site at the BNSF Railroad Drawbridge. Data was collected from the stream gage and summarized to move forward with design calculations and decisions for floodplain analysis, rip rap sizing, boat ramp elevations, and fishing dock anchoring.

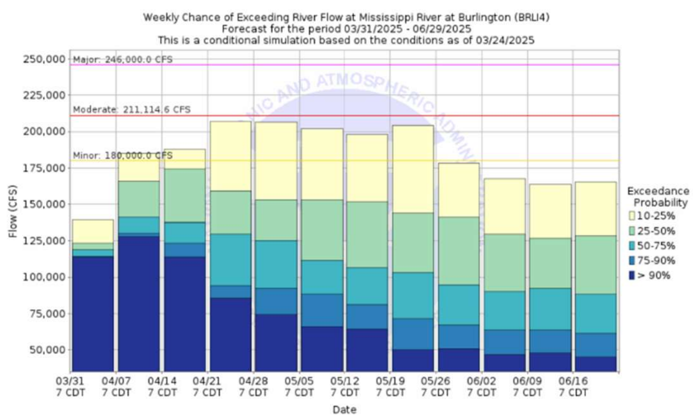
River Gage Data (NWS, NOAA): Mississippi River at Burlington

Mississippi River at Burlington, IA (USACE Stream Gage)		
Longitude	-91.09167	
Latitude	40.79806	
Flat Pool (Stage)	6.8	ft
Drainage Area	114000	sq mi
Datum (zero, elevation)	511.45	ft
Stage		
Record Stage	25.73	ft
Action Stage	14	ft
Flood Stage	15	ft
Moderate Flood Stage	16.5	ft
Major Flood Stage	18	ft
Elevation		
Record elevation	537.18	ft
Action elevation	525.45	ft
Flood elevation	526.45	ft
Moderate Flood elevation	527.95	ft
Major Flood elevation	529.45	ft
Flow		
Minor Flood	180000	cfs
Moderate Flood	211114.6	cfs
Major Flood	246000	cfs

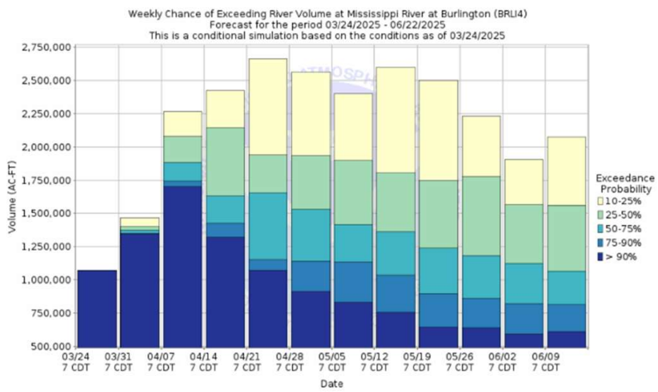
Mississippi River at Burlington, Key Design Data



Mississippi River at Burlington, Stage (ft) Exceedance Probabilities



Mississippi River at Burlington, Flow (cfs) Exceedance Probabilities



Mississippi River at Burlington, Volume (ac-ft) Exceedance Probabilities

USACE keeps ongoing data history on stage data. For design purposes the stage data was collected from every year this century and statistical data (Mean, Median, Maximum, Minimum) was calculated and recorded per decade for each month of the year.

2000s Stage				
Month	Mean	Median	Max	Min
January	8.68	8.59	13.00	7.34
February	9.06	8.52	12.89	7.66
March	10.57	10.36	17.14	7.50
April	12.73	12.70	21.27	7.93
May	13.19	12.61	21.81	8.38
June	13.06	12.24	25.27	8.63
July	10.33	10.44	17.09	7.33
August	8.62	8.51	16.26	7.12
September	8.41	8.38	14.74	7.05
October	8.86	8.45	14.08	7.02
November	8.91	8.52	15.11	7.33
December	8.69	8.54	13.29	7.25

2010s Stage				
Month	Mean	Median	Max	Min
January	10.40	10.22	18.29	7.38
February	10.30	10.54	14.88	7.70
March	12.44	13.05	20.50	7.58
April	14.07	13.96	22.21	8.50
May	14.84	16.01	23.87	9.41
June	14.62	14.23	24.46	10.16
July	13.47	13.66	23.62	7.89
August	10.28	9.84	16.68	7.23
Septembe	10.55	10.08	18.64	6.84
October	11.68	10.46	21.19	7.01
November	10.52	10.42	16.63	7.44
December	10.20	9.75	17.00	7.21

2020s Stage				
Month	Mean	Median	Max	Min
January	9.49	8.80	14.07	7.45
February	9.49	9.12	14.31	8.09
March	10.48	10.70	13.56	7.94
April	13.98	13.36	19.52	9.18
May	13.82	13.88	19.98	9.72
June	12.44	12.87	17.08	7.90
July	11.46	9.83	20.48	7.36
August	9.05	8.57	13.50	7.30
Septembe	8.51	8.55	11.22	7.15
October	8.08	7.96	10.52	7.26
November	8.84	8.74	10.86	7.55
December	8.37	8.23	10.29	7.30

Statistical Stage Data Monthly Per Decade (2000-2024)

The collected and calculated data was then further calculated into statistics from the stage and using the gage datum, transferred to elevation statistical data. Data was then sorted by seasons for design purposes.

Stage			
Month	Avg	Avg Max	Avg Min
January	9.53	15.12	7.39
February	9.62	14.03	7.82
March	11.16	17.07	7.67
April	13.59	21.00	8.54
May	13.95	21.89	9.17
June	13.37	22.27	8.90
July	11.75	20.40	7.53
August	9.32	15.48	7.22
September	9.16	14.87	7.01
October	9.54	15.26	7.10
November	9.42	14.20	7.44
December	9.09	13.53	7.25

Elevation			
Month	Avg	Avg Max	Avg Min
January	520.98	526.57	518.84
February	521.07	525.48	519.27
March	522.61	528.52	519.12
April	525.04	532.45	519.99
May	525.40	533.34	520.62
June	524.82	533.72	520.35
July	523.20	531.85	518.98
August	520.77	526.93	518.67
September	520.61	526.32	518.46
October	520.99	526.71	518.55
November	520.87	525.65	518.89
December	520.54	524.98	518.70

Stage and Elevation Data Monthly (2000-2024)

Seasonal Elevations			
Season	Avg	Avg Max	Avg Min
Winter	520.86	525.67	518.94
Spring	524.35	531.43	519.91
Summer	522.93	530.83	519.33
Fall	520.82	526.23	518.63

Seasonal Statistics (2000-2024)

Appendix B: Rip Rap Sizing

Riprap selection was based on an analysis of river velocity and following Iowa DOT riprap specifications. Average rock diameter was calculated from the Ibash formula for riprap sizing and using this calculated average diameter along with existing riprap sizing, it was determined that the project would specify Class D riprap from Iowa DOT standards.

Rip Rap Sizing (Iowa DOT)

Section 4130 | Revised 4/15/2025
Rip Rap Calculator

River Characteristics	
Design Flow (cfs)	246000
Design Stage (ft)	18
Design Width (ft)	2640
Design Cross Sectional Area (sf)	47520
Design Velocity (fps)	5.176768

Ibash Formula		
Specific Gravity	2.5	(of rip rap stone)
Ibash Constant	0.86	(turbulent)
Gravity (ft/s^2)	32.2	
Avg Rock Diameter (in)	4.506	

$$D_{50} = \frac{V^2}{2 \times g \times C^2 \times (S-1)}$$

where:

- D_{50} is the average diameter of 50% of the spherical rocks for the rip rap in meters;
- V is the average channel velocity in meters per second;
- g is the acceleration due to gravity, either $9.806\ \frac{m}{s^2}$ or $32.17\ \frac{ft}{s^2}$;
- C is the Isbash constant with values equal to 0.86 **for highly turbulent flow of water** or 1.20 **for low turbulence water flow**; and
- S is the specific gravity of the rock with values ranging from around 2.50 to 3.00.

Rip rap specifications

Water velocity (V): 5.177 ft/s

Isbash constant (C): (•) Highly turbulent (0.86) ( ) Low turbulence (1.2)

Gravitational acceleration (g): 32.17 ft/s²

Specific gravity (S): 2.5

Average rock diameter (D_{50}): 4.506 in

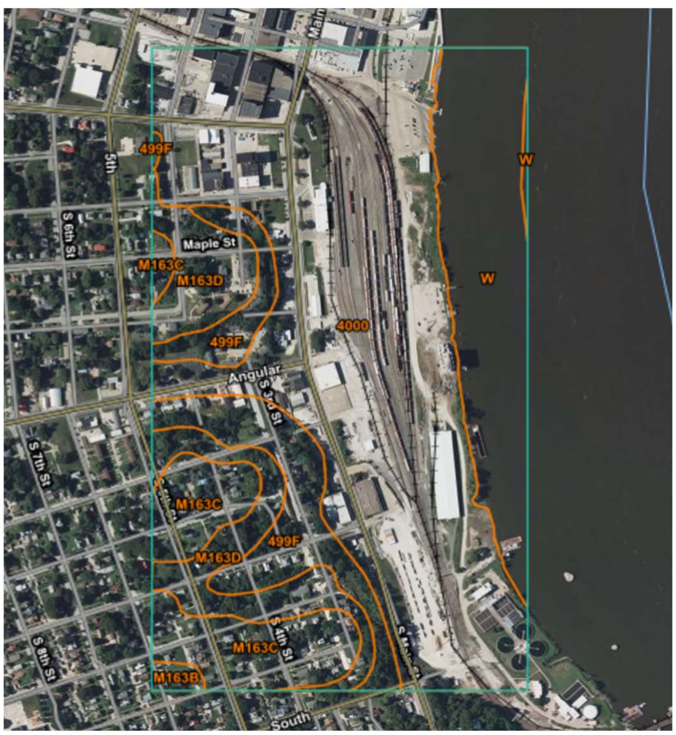
From Iowa DOT, choose Rip Rap Class for Application (Analyze Similar Mississippi River Projects, existing site Rip Rap)

1. **Class A Revetment.**
   - Nominal top size of 400 pounds.
   - At least 75% of the stones are to weigh more than 75 pounds.
   - At least 95% of the stones are to weigh more than 50 pounds.
   - Stones weighing more than 50 pounds are to have at least one relatively flat face with one dimension at least 15 inches.
2. **Class B Revetment.**
   - Nominal top size of 650 pounds.
   - At least 20% of the stones are to weigh more than 500 pounds.
   - At least 50% of the stones are to weigh more than 275 pounds.
   - At least 90% of the stones are to weigh more than 25 pounds.
3. **Class C Revetment.**
   - Nominal top size of 450 pounds.
   - At least 50% of the stones weighing more than 275 pounds.
   - At least 90% of the stones weighing more than 75 pounds.
4. **Class D and Class E Revetment.**
   - Nominal top size of 250 pounds.
   - At least 50% of the stones are to weigh more than 90 pounds.
   - At least 90% of the stones are to weigh more than 5 pounds.
   - The Engineer may approve using revetment containing material larger than 250 pounds.

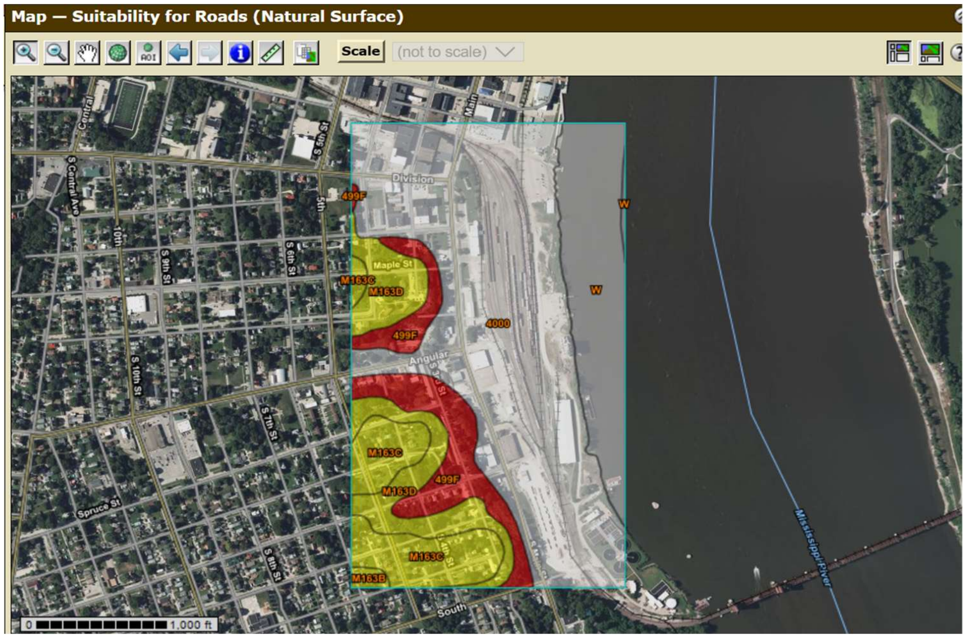
From Rip Rap Calculations and Analysis, Class D Revetment would work best in this application

Appendix C: Existing Soil Conditions Analysis

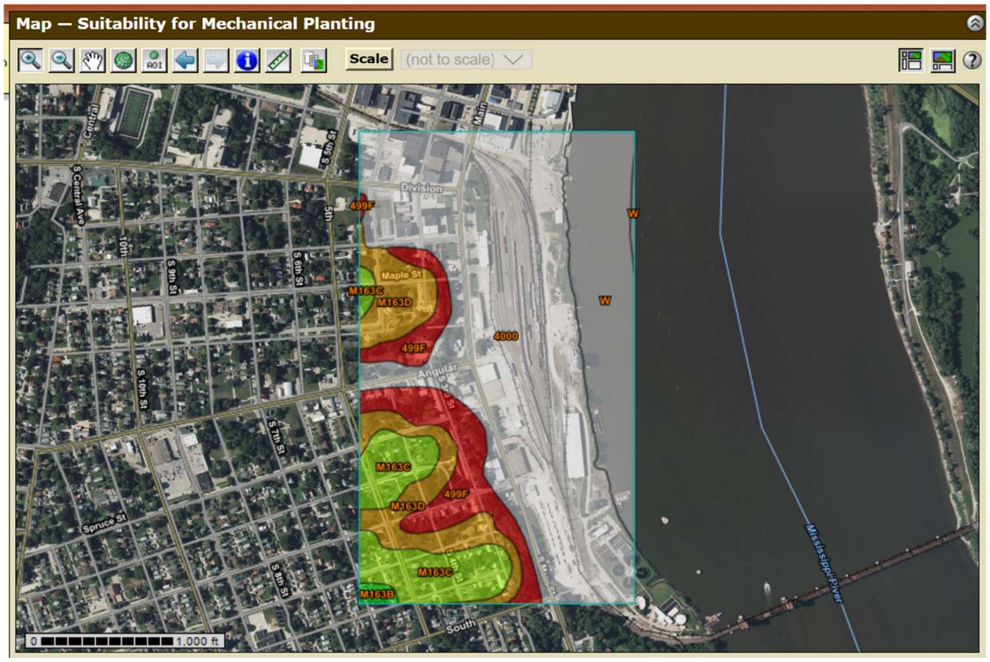
Existing site soil conditions were analyzed using the USDA web soil survey and the site was analyzed for types of soil, as well as suitability for the applications that the repurposing of the area would undergo. The results from the soil survey, as well as boots on the ground field assessment, gave the project team vital insights into the existing conditions of the site. It concluded that the site can be estimated to be made up of silt loam soil for its area and is unsuitable for the site work applications that were planned. For pavement areas, scoured and recompacting will be required for existing soil, as well as addition of an aggregate base course beneath pavement structure. For planned green space areas, imported topsoil and soil amendments will be required.



Site Soil Types	
499F	Nordness Silt Loam (14 to 25 % Slopes)
M163	Fayette Silt Loam



Suitability For Roads	
499F	Poorly Suited
M163	Moderately Suited

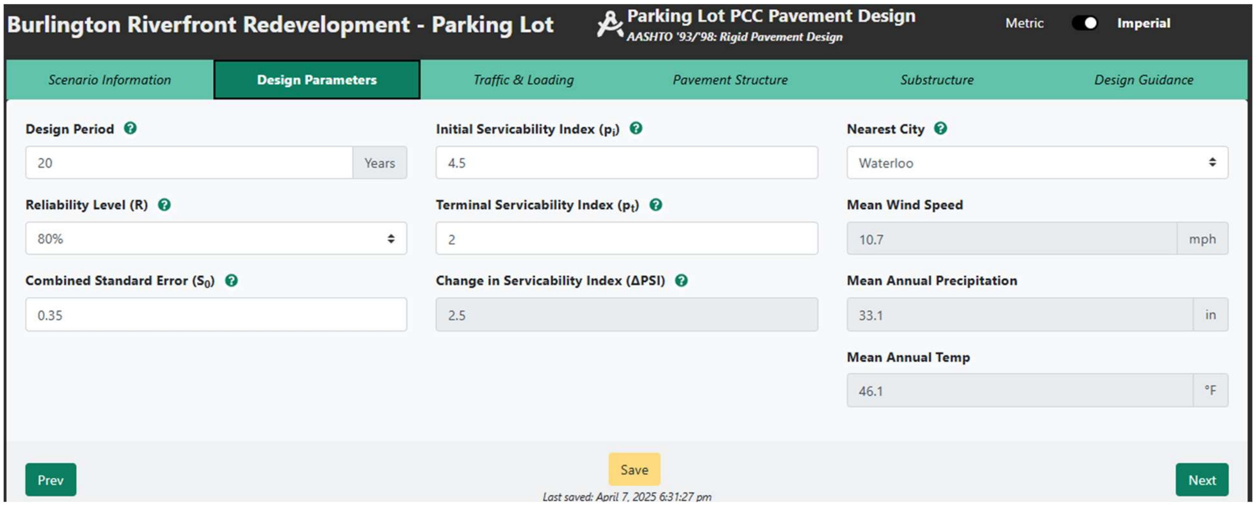


Suitability for Mechanical Planting	
499F	Unsuited
M163	Well/Moderately Suited

Appendix D: Parking Lot Pavement Calculations

Parking lot pavement was calculated using the AASHTO '93/'98 Rigid Pavement Design Method and SUDAS Chapter 5F Pavement Thickness Design. For organization and accuracy, PaveXpress, a pavement calculation tool, was used in the calculation procedure. Key design variables and calculations are summarized below:

AASHTO '93/'98 Rigid Pavement Design		
Variable	**Value**	**Notes/Calculations (SUDAS 5F)**
Design Period (Years)	20	Design Life
Soil CBR	3	Estimated CBR from existing site soil
Soil Resilient Modulus (MR)	4500	MR = 1500*CBR
Reliability (%)	80%	Reliability for Local Street (Parking Lot)
S0 (Std Error)	0.35	Standard Value
ESALS (W18) (lbs)	18000	Standard ESAL Value for Parking Lot
Compressive Strength PCC (fc) (psi)	4000	Value for Parking Lot PCC Mix Design
PCC Modulus of Rupture (Sc')	581.17	Sc' = 2.3fc^0.667
PCC Elastic Modulus (Ec) (psi)	3922885.917	6750*Sc'
Joint Spacing (in)	120	Joint Spacing of Panels
µ Poisson's Ratio	0.3	Standard Value
Load Transfer Coefficient (J)	3	Standard Value
Edge Support E	1	Free Edge
Base Layer Type	Aggregate	Use Crushed Rock Agg. or Recycled PCC
Base Modulus (psi)	15000	Value from AASHTO 98 Table 14
Base Thickness (in)	6	Specified Base Value
Drainage Factor (CD)	1.2	Standard Value
Slab/Base Friction Coefficient	1.4	Value from AASHTO 98 Table 14
Eff. Modulus of Subgrade Reaction (psi/in)	100	Estimated Lower Value from Existing Conditions
Reccommended Thickness of PCC (in)	6	Calculated Value from Method
(round up)	7 in	Final Value


Burlington Riverfront Redevelopment - Parking Lot
Parking Lot PCC Pavement Design
AASHTO '93/'98: Rigid Pavement Design
Metric
Imperial
Scenario Information
Design Parameters
Traffic & Loading
Pavement Structure
Substructure
Design Guidance
Design Period
20
Years
Initial Servicability Index (p_i)
4.5
Nearest City
Waterloo
Reliability Level (R)
80%
Terminal Servicability Index (p_t)
2
Mean Wind Speed
10.7
mph
Combined Standard Error (S_0)
0.35
Change in Servicability Index (ΔPSI)
2.5
Mean Annual Precipitation
33.1
in
Mean Annual Temp
46.1
°F
Prev
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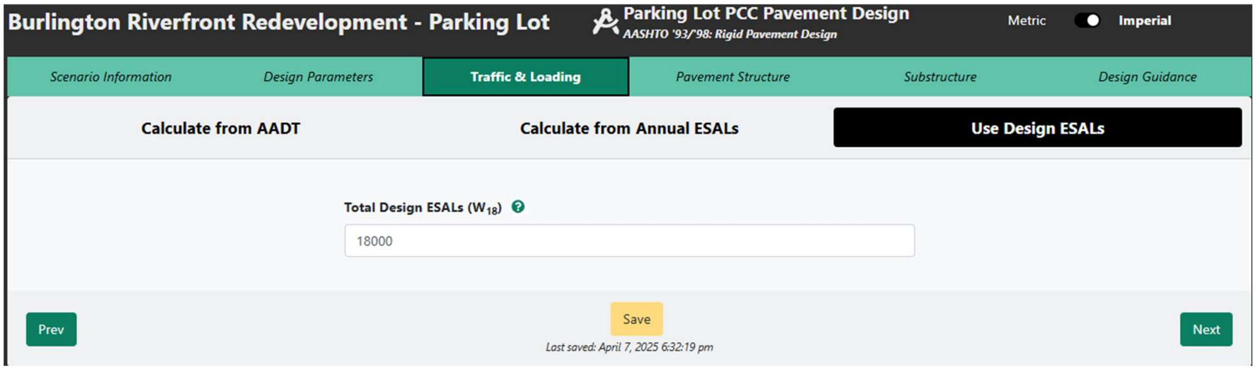
Burlington Riverfront Redevelopment - Parking Lot
Parking Lot PCC Pavement Design
AASHTO '93/'98: Rigid Pavement Design
Metric
Imperial
Scenario Information
Design Parameters
Traffic & Loading
Pavement Structure
Substructure
Design Guidance
Calculate from AADT
Calculate from Annual ESALs
Use Design ESALs
Total Design ESALs (W_{18})
18000
Prev
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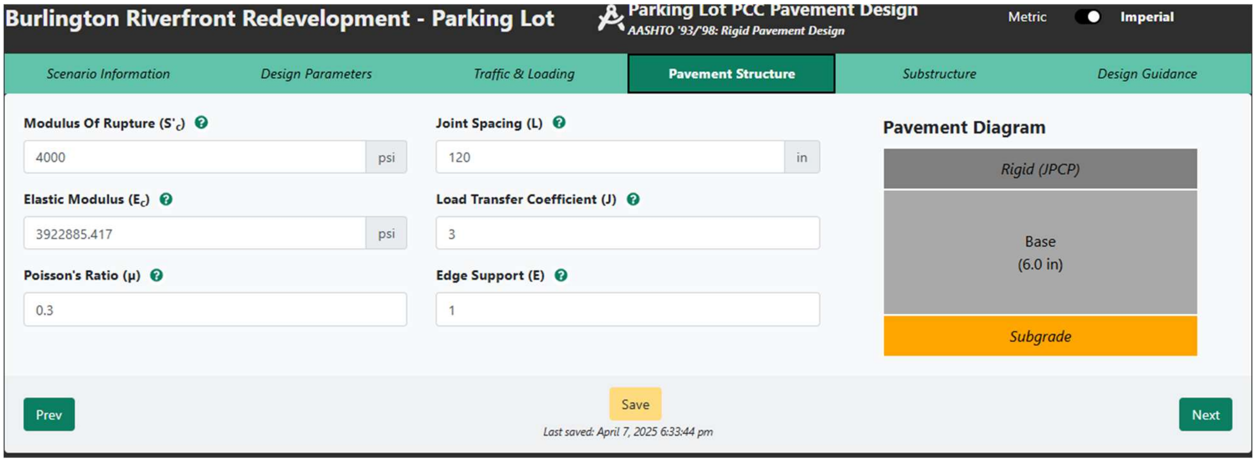
Burlington Riverfront Redevelopment - Parking Lot
Parking Lot PCC Pavement Design
AASHTO '93/'98: Rigid Pavement Design
Metric
Imperial
Scenario Information
Design Parameters
Traffic & Loading
Pavement Structure
Substructure
Design Guidance
Modulus Of Rupture (S'_c)
4000
psi
Joint Spacing (L)
120
in
Pavement Diagram
Rigid (JPCP)
Elastic Modulus (E_c)
3922885.417
psi
Load Transfer Coefficient (J)
3
Base
(6.0 in)
Poisson's Ratio (μ)
0.3
Edge Support (E)
1
Subgrade
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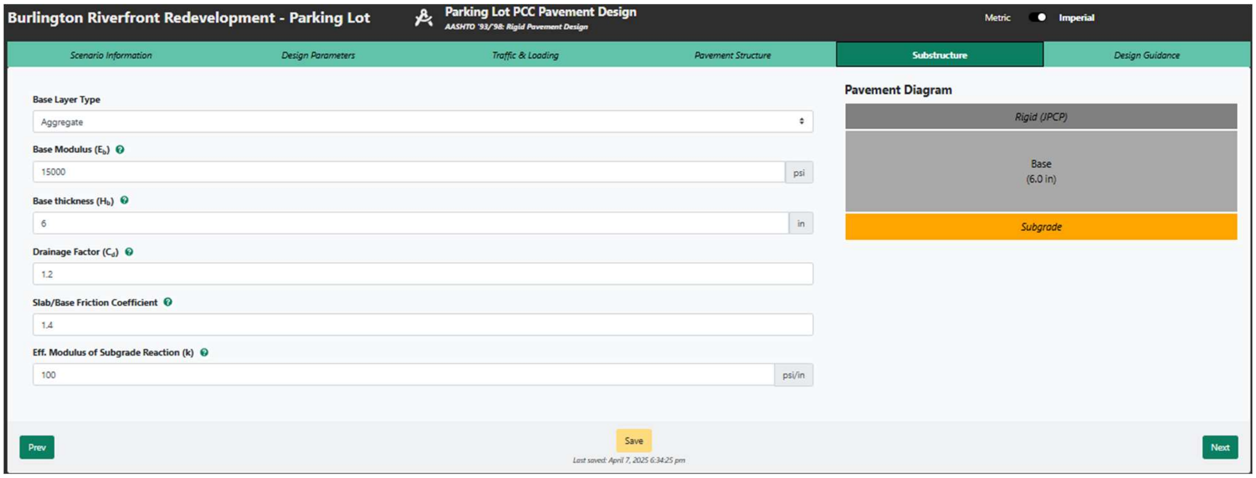


Details

Scenario: Parking Lot PCC Pavement Design

Created By: Jerin Ugrin, jerinugrin@hotmail.com

Last Modified: April 7, 2025 6:35:06 pm

Design Parameters

Design Period: 20 years

Reliability Level (R): 80%

Combined Standard Error (S_0): 0.35

Initial Servicability Index (p_i): 4.5

Terminal Servicability Index (p_t): 2

Delta Servicability Index (ΔPSI): 2.5

Total Design ESALs (W_{18}): 18000

Layers

Rigid (JPCP) - Concrete

Thickness: 6.000000000000032 in

Aggregate base - Base

Thickness: 6 in

Subgrade - Subgrade

Thickness: 0 in

[PaveExpress - Pavement Design Tool]

[SUDAS Chapter 5F Pavement Thickness Design]

Appendix E: Jointing Layout

The jointing layout and pattern of the PCC parking lot pavement was determined using guidance from SUDAS Chapter 5G PCC Pavement Joints, with additional guidance from American Concrete Pavement Association PCC jointing guidance. Typical pavement panels were determined to be 10' by 12' unreinforced with standard contraction joints.

ACPA Jointing Guidance

SUDAS Chapter 5G: PCC Pavement Joints

Appendix F: ADA Parking

ADA accessible parking is determined by this site according to SUDAS parking lot standards and is determined from the number of conventional single user vehicle parking stalls. Summarized results are shown below:

Total Number of Parking Spots	79
Total Number of ADA Accessible	3 Regular, 1 Van

Table 8C-1.02: Minimum Accessible Parking Ratios

Total Number of Spaces Provided	Minimum Number of Accessible Spaces
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1,000	2% of total
1,001 and over	20, plus 1 for each 100, or fraction thereof, over 1,000

Van-accessible Spaces: For every six accessible parking spaces, or fraction thereof, one van accessible parking space must be provided. If only one accessible parking space is required, it must be van-accessible. This requirement applies to all facility types.

SUDAS Chapter 8: Parking Lots

Appendix G: Storm Sewer Design Calculations

For storm sewer design calculations, the project team needed to calculate the design flows going into each area inlet, and that was used to determine pipe, structure, and inlet sizing of the storm sewer network. Design calculations are shown following the Iowa DOT's guidance, following the Rational Method to determine design flows and Manning's equation to determine adequate sizing.

Storm Sewer Pipeline Design Details		
Pipeline	MH1-MH2	MH2-OUT
Length (ft)	82.78	67.58
Pipe Slope	0.74%	0.73%
Invert El. (Upstream)	524.77	524.08
Invert El. (Downstream)	524.16	523.59
Pipe Size/Material	15" RCP	21" RCP

Summarized Storm Pipe Design Details

$$C = \frac{C_1A_1 + C_2A_2 + C_3A_3 ... + ...C_nA_n}{A_1 + A_2 + A_3 ... + ...A_n} \quad \text{(Equation 4A-5\_2)}$$

where:

$A_1, A_2, A_3, \ldots A_n$ = areas of the distinct parts.

C_1 = C value for A_1, C_2 = C value for A_2, etc.

Table 1: Runoff coefficients for the Rational Method.

description of area	runoff coefficient (C)***			
	5 year	10 year	50 year	100 year
Paved Surfaces/Buildings	0.94	0.95	0.98	0.98
Gravel Surfaces, Compacted	0.45	0.50	0.55	0.60
Gravel Surfaces, Loose Graded or Not Compacted	0.35	0.40	0.45	0.50
Industrial Light, 60% Impervious	0.64	0.69	0.79	0.83
Industrial Heavy, 75% Impervious	0.76	0.79	0.86	0.89
Commercial/Business Areas, 85% Impervious	0.81	0.85	0.91	0.92
Residential Row houses/town houses, 65% Impervious	0.66	0.67	0.74	0.76
Residential 1/4 Acre lots, 40% Impervious*	0.48	0.49	0.58	0.62
Residential 1/2 Acre lots, 25% Impervious*	0.36	0.39	0.49	0.54
Residential 1 Acre lots, 20% Impervious*	0.32	0.34	0.46	0.51
Lawn, 0 to 2% slope (flat) **	0.22	0.22	0.30	0.36
Lawn, 2 to 7% slope (average) **	0.24	0.25	0.35	0.40
Lawn, 7% or greater (steep) **	0.26	0.30	0.38	0.45
Parks/Golf Courses/Cemeteries, 8% Impervious	0.21	0.21	0.28	0.34

* Based on Type B soils. Some regions in Iowa have predominant C and D type soils which require larger 'C' values. Appropriate experience is required in selecting appropriate 'C' values. Contact Office of Design Soils Section for further guidance.

** Based on heavy soils and lawn in fair condition. For situations involving sandy soils, contact the Methods Section

*** For higher percent of imperviousness than in the "description of area", developing land with no cover to poor cover, compacted soils, locations of high water table, and/or soils having a slow infiltration rate when thoroughly wetted, these values may be too low. Consult HEC-22, AASHTO Drainage Design Guidelines, or the Methods Section.

Storm Sewer Design Calculations Iowa DOT Methods MH1

Rational Method			
Drainage Area (acres)	0.45405232	(Determined using CAD)	
Pervious (70%)	0.31783662		
Impervious (30%)	0.1362157		
Runoff Coefficient C (10 year)			
C1 (Pervious)	0.36	A1	0.31784
C2 (Impervious)	0.98	A2	0.13622
Runoff Coefficient =	0.546		

$$V = K_u k \sqrt{S} \quad \text{(Equation 4A-5\_5)}$$

where:

V = Velocity of flow, ft/s.

S = Slope, ft/ft.*

k = Intercept coefficient (see Table 6).

K_u = Units conversion factor*, 33.

Table 6: Intercept coefficients for shallow concentrated flow.

land cover/flow regime	k
Forest with heavy ground litter; hay meadow (overland flow)	0.076
Trash fallow or minimum tillage cultivation; contour or strip cropped; woodland (overland flow)	0.152
Short grass pasture (overland flow)	0.213
Cultivated straight row (overland flow)	0.274
Nearly bare and untilled (overland flow)	0.305
Grassed waterway (shallow concentrated flow)	0.457
Unpaved (shallow concentrated flow)	0.491
Paved area (shallow concentrated flow); small upland gullies	0.619

$$T_{c\ shallow} = \frac{L}{60V} \quad \text{(Equation 4A-5\_6)}$$

where:

$T_{c\ shallow}$ = Shallow concentrated flow travel time, minutes.

L = Flow length, feet.

V = Velocity of flow, ft/s.

Time of Concentration		
Manhole 1 Drainage Area		
Shallow Concentrated Flow		
Slope (ft/ft)	0.015	(Site Slope)
Ku	33	
k	0.213	(Overland Flow Short Grass)
V (fps)	0.86087317	
L (ft)	216.1802	(Furthest Point of Drainage)
Tc (min)	4.18528938	Round up
Time of Concentration =	5	min

Rain Gage Data (NOAA)	
Location	Burlington Radio KBUR
Lat, Long	40.8167, -91.1667

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.379** (0.332-0.444)	**0.446** (0.390-0.522)	**0.554** (0.482-0.649)	**0.642** (0.556-0.754)	**0.761** (0.637-0.907)	**0.852** (0.698-1.02)	**0.941** (0.748-1.14)	**1.03** (0.788-1.27)	**1.14** (0.845-1.44)	**1.23** (0.889-1.56)
10-min	**0.555** (0.486-0.650)	**0.653** (0.570-0.764)	**0.811** (0.706-0.950)	**0.940** (0.814-1.10)	**1.11** (0.933-1.33)	**1.25** (1.02-1.50)	**1.38** (1.10-1.68)	**1.51** (1.15-1.86)	**1.68** (1.24-2.10)	**1.80** (1.30-2.29)
15-min	**0.677** (0.592-0.792)	**0.796** (0.696-0.932)	**0.989** (0.861-1.16)	**1.15** (0.993-1.35)	**1.36** (1.14-1.62)	**1.52** (1.25-1.83)	**1.68** (1.34-2.04)	**1.84** (1.41-2.27)	**2.04** (1.51-2.57)	**2.20** (1.59-2.79)
30-min	**0.937** (0.819-1.10)	**1.11** (0.969-1.30)	**1.39** (1.21-1.63)	**1.61** (1.40-1.89)	**1.92** (1.60-2.28)	**2.14** (1.76-2.57)	**2.36** (1.88-2.88)	**2.59** (1.98-3.19)	**2.87** (2.12-3.60)	**3.08** (2.22-3.91)
60-min	**1.21** (1.06-1.42)	**1.42** (1.24-1.66)	**1.75** (1.52-2.05)	**2.04** (1.76-2.39)	**2.44** (2.05-2.92)	**2.76** (2.27-3.32)	**3.08** (2.45-3.76)	**3.41** (2.62-4.23)	**3.87** (2.86-4.87)	**4.22** (3.04-5.35)
2-hr	**1.49** (1.31-1.73)	**1.72** (1.51-2.00)	**2.12** (1.85-2.46)	**2.46** (2.14-2.87)	**2.96** (2.51-3.54)	**3.37** (2.79-4.05)	**3.79** (3.05-4.62)	**4.24** (3.28-5.24)	**4.86** (3.63-6.10)	**5.35** (3.89-6.74)
3-hr	**1.66** (1.46-1.92)	**1.90** (1.67-2.20)	**2.32** (2.04-2.70)	**2.71** (2.37-3.15)	**3.28** (2.81-3.93)	**3.76** (3.14-4.53)	**4.28** (3.46-5.21)	**4.83** (3.76-5.97)	**5.61** (4.21-7.03)	**6.24** (4.55-7.84)
6-hr	**1.96** (1.74-2.26)	**2.24** (1.99-2.58)	**2.76** (2.43-3.18)	**3.23** (2.84-3.73)	**3.95** (3.40-4.72)	**4.56** (3.83-5.46)	**5.22** (4.25-6.34)	**5.94** (4.66-7.31)	**6.97** (5.27-8.69)	**7.80** (5.73-9.74)
12-hr	**2.27** (2.02-2.59)	**2.64** (2.35-3.02)	**3.30** (2.93-3.78)	**3.90** (3.44-4.47)	**4.79** (4.13-5.66)	**5.52** (4.66-6.55)	**6.30** (5.15-7.58)	**7.15** (5.63-8.71)	**8.33** (6.33-10.3)	**9.28** (6.86-11.5)
24-hr	**2.63** (2.35-2.98)	**3.07** (2.75-3.49)	**3.85** (3.43-4.37)	**4.53** (4.02-5.16)	**5.54** (4.80-6.48)	**6.36** (5.39-7.49)	**7.23** (5.94-8.62)	**8.16** (6.46-9.87)	**9.46** (7.23-11.6)	**10.5** (7.81-12.9)
2-day	**3.08** (2.78-3.48)	**3.53** (3.17-3.98)	**4.32** (3.87-4.87)	**5.02** (4.48-5.68)	**6.06** (5.29-7.05)	**6.92** (5.90-8.09)	**7.84** (6.48-9.29)	**8.82** (7.03-10.6)	**10.2** (7.85-12.4)	**11.3** (8.47-13.8)
3-day	**3.37** (3.04-3.78)	**3.84** (3.46-4.31)	**4.65** (4.18-5.23)	**5.38** (4.81-6.06)	**6.44** (5.63-7.45)	**7.32** (6.26-8.51)	**8.24** (6.83-9.71)	**9.22** (7.37-11.0)	**10.6** (8.18-12.9)	**11.7** (8.79-14.2)
4-day	**3.60** (3.26-4.03)	**4.10** (3.70-4.58)	**4.95** (4.46-5.55)	**5.70** (5.11-6.40)	**6.78** (5.94-7.81)	**7.67** (6.56-8.88)	**8.59** (7.14-10.1)	**9.57** (7.66-11.4)	**10.9** (8.46-13.2)	**12.0** (9.05-14.6)
7-day	**4.24** (3.85-4.71)	**4.79** (4.35-5.33)	**5.72** (5.18-6.38)	**6.53** (5.88-7.29)	**7.67** (6.73-8.76)	**8.59** (7.38-9.87)	**9.54** (7.96-11.1)	**10.5** (8.47-12.4)	**11.9** (9.24-14.3)	**12.9** (9.82-15.6)
10-day	**4.83** (4.40-5.36)	**5.44** (4.95-6.03)	**6.45** (5.85-7.16)	**7.31** (6.60-8.13)	**8.52** (7.49-9.67)	**9.49** (8.17-10.8)	**10.5** (8.76-12.1)	**11.5** (9.27-13.5)	**12.9** (10.0-15.4)	**14.0** (10.6-16.8)
20-day	**6.60** (6.04-7.26)	**7.38** (6.75-8.12)	**8.66** (7.90-9.55)	**9.73** (8.83-10.8)	**11.2** (9.88-12.6)	**12.3** (10.7-14.0)	**13.5** (11.3-15.5)	**14.7** (11.9-17.1)	**16.2** (12.7-19.2)	**17.4** (13.3-20.8)
30-day	**8.09** (7.43-8.86)	**9.06** (8.31-9.93)	**10.6** (9.72-11.7)	**11.9** (10.8-13.1)	**13.6** (12.1-15.2)	**15.0** (13.0-16.8)	**16.3** (13.7-18.6)	**17.6** (14.3-20.3)	**19.2** (15.1-22.7)	**20.5** (15.8-24.4)
45-day	**9.97** (9.19-10.9)	**11.2** (10.3-12.3)	**13.2** (12.1-14.5)	**14.8** (13.5-16.2)	**16.9** (15.0-18.8)	**18.5** (16.1-20.7)	**20.0** (16.9-22.7)	**21.5** (17.5-24.7)	**23.3** (18.4-27.3)	**24.7** (19.1-29.2)
60-day	**11.6** (10.7-12.6)	**13.1** (12.1-14.3)	**15.5** (14.3-16.9)	**17.4** (15.9-19.0)	**19.9** (17.6-21.9)	**21.6** (18.8-24.1)	**23.3** (19.7-26.3)	**25.0** (20.4-28.6)	**26.9** (21.3-31.4)	**28.3** (22.0-33.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

$$Q = CIA \quad \text{(Equation 4A-5\_1)}$$

where:

- Q = Peak flow, ft^3/s.
- C = Runoff coefficient (dimensionless).
- I = Rainfall intensity, in/hr.
- A = Drainage area, acres.

Rain Gage: https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=ia

Rainfall Intensity		
Rain Gage :		
IDF Tables (Tc =5min, Tr = 10yrs)		
Rainfall Intensity (in/hr) =	0.941	
Design Flow Calculation Rational Method		
C	0.546	
I	0.941	in/hr
A	0.4541	acres
Q =	0.2333	cfs

Pipe Segment from Manhole 1 to Manhole 2 Calculations									
Inlet Elevation MH1	527.02	ft							
Inlet Elevation MH2	527.08	ft							
Length of Segment	82.779	ft							
Ground Slope	0.00072482								
Mannings n	0.013	Reinforced Concrete Pipe							
Pipe Diameter (Chosen)	0.38	m	15in						
Pipe Slope	0.00736523		0.74%		Using SI Units Mannings Formula				
					Then Converting to U.S. Customary				
Velocity of Design Flow	2.05698484	m/s							
	6.74863795	fps	good						
Minimum Speed	3	fps	From SUDAS Standards						
maximum speed	10	fps							
Use 15 in Reinforced Concrete Pipe									
Invert Elevation MH1	524.77								
Invert Elevation MH2	524.160314								
Time of Travel	12.2660307	sec							
	0.20443384	min							

Manhole 2 followed the same process as Manhole 1

Storm Sewer Design Calculations Iowa DOT Methods MH2

Rational Method			
Drainage Area (acres)	1.06088424	(Determined using CAD)	
Pervious (90%)	0.95479582		
Impervious (10%)	0.10608842		
Runoff Coefficient C (10 year)			
C1 (Pervious)	0.36	A1	0.9548
C2 (Impervious)	0.98	A2	0.10609
Runoff Coefficient =	0.422		
Time of Concentration			
Manhole 1 and 2 Drainage Area			
Shallow Concentrated Flow			
Slope (ft/ft)	0.015	(Site Slope)	
Ku	33		
k	0.213	(Overland Flow Short Grass)	
V (fps)	0.86087317		
L (ft)	267.9863	(Furthest Point of Drainage)	
Tc (min)	5.18826523	Round up	
Time of Concentration =	6	min	
Compare with Tc of MH1 with Pipe Travel Time, and take Max Tc			
Tc(MH1) + travel time	4.38972322		
Use MH2 Drainage Area Tc			
Time of Concentration =	6	min	

Rain Gage: https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html?bkmrk=ia

Rainfall Intensity		
Rain Gage :		
IDF Tables (Tc =5min, Tr = 10yrs)		
Rainfall Intensity (in/hr) =	1.0288	
(Interpolated)		
Xs	5	
	10	
Ys	0.941	
	1.38	
Design Flow Calculation Rational Method		
C	0.422	
I	1.0288	in/hr
A	1.0609	acres
Q =	0.4606	cfs

Pipe Segment from Manhole 2 to Outlet Calculations					
Inlet Elevation MH2	527.08	ft			
Length of Segment	67.5792	ft			
Mannings n	0.013	Reinforced Concrete Pipe			
Pipe Diameter (Chosen)	0.535	m	21in		
Pipe Slope	0.00730721		0.73%		Using SI Units Mannings Formula
					Then Converting to U.S. Customary
Velocity of Design Flow	2.04886791	m/s			
	6.72200758	fps	good		
Min Speed	3	fps	From SUDAS Standards		
max speed	10	fps			
Use 21 in Reinforced Concrete Pipe					
Invert Elevation MH2	524.08				
Invert Elevation OUT	523.59				
Time of Travel	10.0534251	sec			
	0.16755709	min			

Appendix H: Earthwork

Earthwork Calculations were done with the assistance of Autodesk Civil3D grading model calculation features. Total cut and fill were calculated from subtracting the proposed FG surface and the existing ground surface. Further calculations for topsoil fill and Class 13 waste were calculated using the Iowa DOT's guidance on earthwork calculations, with estimated shrink/swell factors for the existing soil and imported topsoil.

Cut/Fill Report

Generated:	2025-04-03 15:40:25
By user:	jerin
Drawing:	C:\Users\jerin\OneDrive - University of Iowa\Riverfront Redevelopment\DESIGN\Civil3D\Project Files\Drainage\C:\Users\jerin\OneDrive - University of Iowa\Riverfront Redevelopment\DESIGN\Civil3D\Project Files\Drainage\BurlingtonRiverRedev_cutfillcalcs.dwg

Volume Summary

Name	Type	Cut Factor	Fill Factor	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
CutFillCalcs	full	1.000	1.000	236734.17	10468.51	14985.17	4516.66<Fill>

Totals

	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Total	236734.17	10468.51	14985.17	4516.66<Fill>

* Value adjusted by cut or fill factor other than 1.0

Earthwork Calculations

Iowa DOT 5A-2 Earthwork Essentials
https://www.projectengineer.net/swell-factors-for-various-soils/

Quantities Taken from FG Surface

Unsuitable Material Cut		
Soil Type	Silt Loam	
Area (SY)	15762.16	Calculated from CAD QTO
Depth (Yd)	0.166667	6 inches
Volume (In-Situ) (CY)	2627.026	
Swell Factor	25%	Of Silt Loam
Total Volume (Cut) (CY)	3283.783	

Waste Volume from top 6" can be used for fill in total cut/fill volumes

Topsoil Fill		
Soil Type	Topsoil	
Area (SY)	15762.16	
Depth (Yd)	0.166667	Calculated from CAD QTO
Volume (In-Situ) (CY)	2627.026	6 inches
Shrink Factor	0%	
Total Volume (Fill) (CY)	2627.026	Of Topsoil

Appendix I:

UNIVERSITY OF IOWA

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING Project Design & Management

(CEE: 4850:0001)

RFP # 07-Spring2025

Riverfront Redevelopment

Gantt Chart – Plan of Work

ACTIVITY	Team Member	PLAN START	PLAN DURATION (WEEKS)	ACTUAL START	ACTUAL DURATION (WEEKS)	PERCENT COMPLETE
Data Collection	ALL	1	3	1	3	100%
Kickoff Meeting with the Client	ALL	2	1	2	1	100%
Site Visit	ALL	3	1	3	1	100%
Develop Design Alternatives	ALL	3	2	3	2	100%
Proposal Report	ALL	2	2	2	2	100%
Proposal Presentation	ALL	2	2	2	2	100%
CAD Drawings	ALL	4	9	4	9	100%
3D Rendering	ALL	4	9	4	9	100%
List of Materials and Quantities	ALL	7	6	7	6	100%
Cost estimate	ALL	7	6	7	6	100%
Design Report	ALL	7	6	7	6	100%
Design Sheets	ALL	7	6	7	6	100%
Project Poster	ALL	10	3	10	3	100%
Presentation	ALL	10	3	10	3	100%

Appendix J:

UNIVERSITY OF IOWA

DEPARTMENT OF CIVIL & ENVIRONMENTAL

ENGINEERING Project Design & Management

(CEE: 4850:0001)

RFP # 07-Spring2025

Riverfront Redevelopment

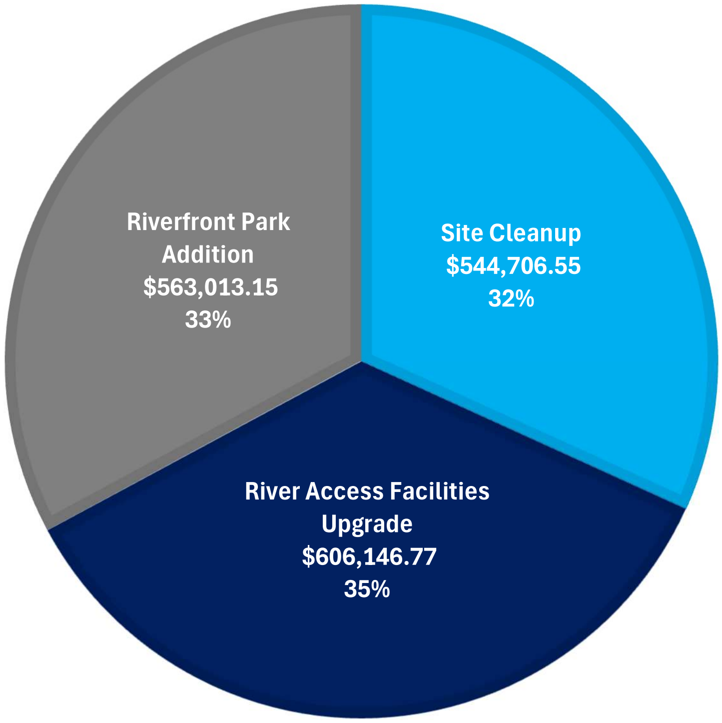
Cost Estimate

Burlington Riverfront Park Extension Construction Cost Estimate					
Trail Loop					
Item Code	Item Description	Unit	Unit Price	Amount	Total Price
7030-C	Shared Use Path, 7in	SY	$ 77.00	2347	$ 180,693.33
7030-E	Sidewalk, PCC, 5in	SY	$ 59.17	120	$ 7,100.40
7030-G	Detectable Warnings	SF	$ 70.00	30	$ 2,100.00
2010-J	Subbase, (Granular)	SY	$ 37.01	3028	$ 91,291.33
2010-G	Subgrade Preparation	SY	$ 3.15	3028	$ 7,770.00
7010-A	Pavement, PCC, 6in, (mix type)	SY	$ 72.69	334	$ 24,278.46
		Category Total			$ 313,233.53
Drainage					
Item Code	Item Description	Unit	Unit Price	Amount	Total Price
4020-A-1	Storm Sewer, Trenched, RCP 15"	LF	$ 75.37	83	$ 6,239.13
4020-A-1	Storm Sewer, Trenched, RCP 21"	LF	$ 170.00	68	$ 11,488.60
6010-B	Manhole, Casting Type 3B, (24")	EA	$ 3,000.00	1	$ 3,000.00
6010-B	Manhole, Casting Type 5, (30")	EA	$ 4,500.00	1	$ 4,500.00
4030-B	SUDAS 4030 Type B Circular Concrete Apron with Guard and Footing	EA	$ 2,000.00	1	$ 2,000.00
		Category Total			$ 27,227.73
Removal/Cleanup					
Item Code	Item Description	Unit	Unit Price	Amount	Total Price
2010-B	Clearing and Grubbing	ACRE	$ 7,111.00	5	$ 35,555.00
2010-D-3	Topsoil, Off-site	CY	$ 29.01	2627	$ 76,210.02
10,010-A	Demolition Work	LS	$ 150,000.00	1	$ 150,000.00
2010-E	Excavation, Class 13 (Fill)	CY	$ 8.56	4517	$ 38,665.52
7040-H	Pavement Removal	SY	$ 10.66	9250	$ 98,605.00
		Category Total			$ 399,035.54
Landscaping/Erosion Control					
Item Code	Item Description	Unit	Unit Price	Amount	Total Price
9010-A	Conventional Seeding, Seeding, Fertilizing, Buffalograss	ACRE	$ 6,146.00	3	$ 20,281.80
9030-A	Plants, Silver Maple, 4"	EACH	$ 575.00	4	$ 2,300.00
9030-A	Plants, Bur Oak, 4"	EACH	$ 575.00	3	$ 1,725.00
9030-A	Plants, Bald Cypress, 4"	EACH	$ 575.00	3	$ 1,725.00
9040-J	Class D Revetment	TON	$ 38.00	2386	$ 90,668.00
9040-N-1	Silt Fence	LF	$ 1.59	1000	$ 1,590.00
9040-T-1	Inlet Protection Device, Filter Sock	EACH	$ 76.74	2	$ 153.48
		Category Total			$ 118,443.28

Parking Lot					
Item Code	**Item Description**	**Unit**	**Unit Price**	**Amount**	**Total Price**
7010-A	Pavement, PCC, 7in.	SY	$ 56.00	5206	$ 291,552.40
2010-J	Subbase (Granular)	SY	$ 37.01	5206	$ 192,684.90
2010-G	Subgrade Preparation	SY	$ 3.15	5206	$ 16,399.82
7010-E	Curb and Gutter	LF	$ 35.00	115	$ 4,029.36
	Painted Pavement Markings, Water Based, White (4")	STA	$ 22.68	14	$ 311.66
	Square Breakaway Sign Post Anchor Base	EACH	$ 41.00	6	$ 246.00
	Square Sign Breakaway Post - 8ft	EACH	$ 64.00	6	$ 384.00
	Traffic Signs, ADA Parking, (10"x14")	EACH	$ 26.00	4	$ 104.00
	Traffic Signs, MUTCD Stop Sign, 30"	EACH	$ 89.00	2	$ 178.00
	Quikrete 6' Concrete Car Stop Parking Bumper	EACH	$ 66.99	10	$ 669.90
	Compression Joint Seal	LF	$ 1.00	8292	$ 8,291.58
		Category Total			$ 514,851.63
Boat Ramp					
Item Code	**Item Description**	**Unit**	**Unit Price**	**Amount**	**Total Price**
7010-A	Pavement, PCC, 9", V-Groove Textured, Reinforced	SY	$ 100.00	350	$ 34,989.42
	Sheet Pile Wall	LF	$ 70.99	124	$ 8,800.44
	18" Aggregate Base (Modified)	CY	$ 37.01	175	$ 6,474.79
	Subgrade Preparation	SY	$ 4.80	350	$ 1,679.49
	Class A Riprap, (Anchor Rock)	SY	$ 35.00	200	$ 7,000.00
7080-B	Engineering Fabric	SY	$ 5.27	200	$ 1,054.00
	Floating Dock and Gangplank	LS	$ 31,297.00	1	$ 31,297.00
		Category Total			$ 91,295.14
Miscellaneous Amenities					
Item Code	**Item Description**	**Unit**	**Unit Price**	**Amount**	**Total Price**
9060-A-2	Chain Link Fence, Commercial, 72"	LF	$ 21.75	1180	$ 25,665.00
	Fishing Dock (Mac's Docks ADA Compliant)	LS	$ 47,619.62	1	$ 47,619.62
	Fish Cleaning Station (KillerDock)	LS	$ 6,495.00	1	$ 6,495.00
	Train Car (Railway History Feature)	EA	$ 100,000.00	1	$ 100,000.00
	Pavilion Structure (ROMTEC)	EA	$ 70,000.00	1	$ 70,000.00
		Category Total			$ 249,779.62

Cost Summary	
Category	**Total Cost**
Site Cleanup	$ 544,706.55
River Access Facilities Upgrade	$ 606,146.77
Riverfront Park Addition	$ 563,013.15
Total Construction Cost (Sum)	$ 1,713,866.47
Contingency Cost (20%)	$ 342,773.29
Total Project Cost	**$ 2,056,639.76**

BURLINGTON SOUTH RIVERFRONT PARK EXTENSION CONSTRUCTION COST ESTIMATE



Appendix K:

UNIVERSITY OF IOWA

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

Project Design & Management

(CEE: 4850:0001)

RFP # 07-Spring2025

Riverfront Redevelopment

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