Lake Fisher Park: Recreational and Environmental Enhancements

Prepared For: The City of Bloomfield

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Section I Executive Summary

The University of Iowa Senior Design student group is pleased to submit this design report to the City of Bloomfield for the enhancement of the Lake Fisher Recreation Area. The purpose of this project is to expand and improve recreational opportunities within the park through targeted infrastructure upgrades, diversified amenities, and enhanced support for tourism and community use.

Located just west of Bloomfield in Davis County, Iowa, the Lake Fisher Recreation Area encompasses approximately 322 acres of green space, including an 82-acre man-made lake. The park currently provides fishing, boating, hiking, camping, and general outdoor recreation opportunities. The City seeks to build upon these existing features by investing in facilities that promote outdoor recreation, eco-tourism, and community engagement while preserving the ecological integrity of the lake and its surrounding environment.

This Senior Design group, based in Iowa City, Iowa, is a student-led team composed of ten members specializing in various civil and environmental engineering disciplines. Our team's collective expertise includes site development, utility coordination, structural design, water quality assessment, stormwater management, watershed analysis, cost estimation, and architectural visualization. This multidisciplinary background equips us to deliver a resilient, accessible, and environmentally responsible transformation of the Lake Fisher Recreation Area.

Figure 1. 1 Aerial image of

Figure 1.1 Aerial image of Lake Fisher

To accommodate growing visitor demand, six new energy efficient cabins have been designed for the northwest portion of the park. These units offer both single-family and multi-family lodging options, with several featuring shared patio spaces to support group gatherings. The existing RV Park has been redesigned to improve circulation, capacity, and safety through the addition of pull-through parking spaces. A new RV dump station is included in the redesign. The two existing pavilions were retained, as they were in good condition and could continue to provide visitors with locations to gather. In addition, a new venue suitable for gatherings such as weddings has been proposed for the south end of the lake.

Recreational amenities have been significantly expanded throughout the site, including a new ADA-compliant trail that encircles the lake. This trail begins at a trailhead located on the south side of the site and directly connects to all major points of interest throughout the park. Fitness workout areas have been incorporated along the trail to provide diverse exercise options, and new gravel biking trails were designed to support both recreation and organized events. Two new beaches—one on the west side and one on the south side—provide swimming and relaxation opportunities, with recommended beach volleyball courts.

Figure 1. 2 Enhanced recreation area with tennis, pickleball and basketball courts

Additional recreational improvements include a full basketball court, two tennis courts adaptable for pickleball, and a redesigned softball complex with a new playing surface and expanded spectator seating. A green playground and three outdoor workout areas have been designed along the trail to support youth recreation and physical activity. A two-section dog park, separating large and small dogs, has been incorporated near the tennis and basketball courts and will serve as Bloomfield's only designated dog park. Enhancements to the existing frisbee golf course include added trees and upgraded tee boxes.

Improvements to lake access for boating, fishing, and kayaking were also incorporated. At the existing boat ramp, an expanded parking area improves traffic flow for vehicles and trailers, and the adjacent dock has been updated with multiple mooring stalls for temporary boat tie-off. This will provide easy access for boaters until a larger, more permanent boat ramp can be constructed. Three kayak launches have been strategically located on shores to support non-motorized watercraft. A future boat ramp is proposed near the existing water treatment plant, complete with an additional kayak launch to meet anticipated demand. Enhancements to the existing fishing jetties—including the addition of a fish-cleaning station on the southwest shore—improve shoreline access and convenience for anglers.

To improve visitor comfort and eliminate reliance on portable restrooms, three permanent restroom facilities have been incorporated into the design. One facility is integrated into the pavilion near the existing softball field, another with shower and laundry facilities is located adjacent to the redesigned RV park, and a third is positioned near the south end of the lake to support trail, venue, and beach users. Outdoor shower stations were included at each beach. All restroom facilities, along with wastewater from the cabins and RV dump station, will be served by onsite septic systems.

Figure 1.3 Rendering of the Venue on the south side of the lake

Environmental considerations played a central role in the design. Erosion control measures have been developed to stabilize the shoreline and reduce wave-induced erosion. A comprehensive stormwater analysis identified high-water levels and flow paths to guide resilient design decisions. Water quality sampling was conducted to identify contaminants of concern within the lake. The planting of wetlands is proposed in the southwest and southeast lake inlets to provide wildlife habitat, support contaminant removal, prevent erosion, and enhance visual appeal. The team also evaluated strategies for managing overpopulated fish species.

To provide the city with current and accurate topographic data of the park, a high-resolution drone-based topographic survey was performed in collaboration with Seiler Geospatial. This survey provided current elevation data to support accurate site design for all trails, structures, and parking lots.

Project implementation is organized into four construction phases.

Phase One includes installation of utilities, the restroom and septic system for the existing pavilion, temporary parking improvements at the existing boat ramp, construction of the lake-encircling trail, installation of the west-side dock, softball spectator seating, frisbee golf upgrades, tree planting, erosion control, and fish population management. The estimated cost for the construction of Phase One is $ 2,114,721.00.

Phase Two includes the construction of two cabins, the recreation area and associated parking, the RV park including the dump station, restrooms, and septic systems, establishment of wetlands and native grasses, one beach, the dog park, and gravel biking trails. The estimated cost for the construction of Phase Two is $ 2,754,731.00.

Phase Three comprises construction of all structures on the south side of the lake, two more cabins, the second beach, improvements to the southwest fishing jetties and addition of the fish-cleaning station, and upgrades to the parking area near the existing west pavilion. The estimated cost for the construction of Phase Three is $ 1,989,246.00.

Phase Four includes the remaining softball field improvements, construction of the permanent east boat ramp, the remaining two cabins, and the workout areas along the trail. The estimated cost for the construction of Phase Four is $ 1,305,962.00

The estimated total cost of construction for the Lake Fisher Recreation Area improvements is $8,164,660.00. This total cost includes a 40 percent contingency for each phase because the design provided in this report is a 60 percent design and due to expected unknown complications during construction. A detailed breakdown of this estimate is provided in Section VII of this report.

In addition to this engineering design report, the project deliverables include detailed plan sets, a cost estimate for construction and design services, and a final presentation to stakeholders.

Section II Organization Qualifications and Experience

1. Organization Location and Contact Information

Department of Civil & Environmental Engineering
University of Iowa
103 South Capitol Street
Iowa City, IA 52242

2. Organization and Design Team Description

This Senior Design group is a student-led team within the Senior Design Capstone Course. The team consists of ten members specializing in diverse areas of civil and environmental engineering. Areas of expertise include site development, structural design, environmental analysis, utility mapping, cost estimation, and architectural visualization.

Our team is proficient in industry-standard software, including Civil 3D, Revit, HEC-RAS, and RISA3D, to ensure the development of high-quality deliverables. Each member has been assigned a defined role tailored to their area of expertise:

- Carson Merten – Project Manager, Civil/Structural design

Oversees project delivery, including scheduling, design coordination, and client communication. Provides technical oversight in civil and structural engineering design, including site development, utility mapping, structural analysis, and Revit modeling.

- Luke Althaus – Structural Designer

Specializes in structural analysis, modeling, and design of structures. Contributes to overall site layout and integration with civil works.

- David Verastegui – Structural Designer

Provides advanced structural analysis and modeling using RISA3D and Revit to ensure code compliance and structural integrity.

- John Crane – Multi-Disciplinary Designer

Brings a cross-disciplinary background in civil, structural, and environmental engineering. Supports integration across design elements and addresses project needs as required.

- Fernando Carrillo – Civil Designer

Focuses on ADA-compliant trail design, utility mapping, and sited development. Ensures accessibility and compliance with standards.

- Thomas Holzapfel – Civil Designer

Responsible for site development and utility coordination. Provides design expertise for ADA-compliant trails, roads, and parking systems.

- Elise McKee – Environmental Engineer

Contributes to water distribution modeling, stormwater evaluation, environmental impact analysis, and utility coordination.

- Kristin Stein – Environmental Engineer

Specializes in water quality assessment, erosion control strategies, and preparation of environmental documentation.

- Dylan Seiffert – Environmental Engineer

Assists with environmental sampling, design of water distribution systems, and the integration of sustainable engineering practices.

- Idris Kecira – Architect, Structural Designer

Produces architectural renderings and visualizations aligned with engineering designs. Provides support for structural analysis and design documentation.

Section III Design Services

1. Project Scope

The City of Bloomfield has partnered with the team to enhance the Lake Fisher Recreation Area, located just west of Bloomfield, Iowa. In response to this request, the team designed new cabins, boat ramps, recreational areas—including playgrounds and sports courts—trails, restrooms, a dog park, and an expanded RV park. These improvements also created a need for a comprehensive stormwater runoff model, water quality control initiatives, erosion management strategies, and septic system design. The team has taken on each of these tasks and provided the following summary of work.

Figure 3.1 Site layout showing all major elements included in the scope

A total of six cabins were designed, each containing two bedrooms. The cabins were developed for multi-use purposes such as family gatherings, hunting lodging, or weekend getaways. Design considerations included foundational design, structural analysis, and aesthetics. In addition, year-round use was considered as requested by the City.

The park's two existing pavilions were maintained in the final design. To improve accessibility, an expanded parking area was added near the northernmost pavilion adjacent to the proposed recreation area. Additionally, an attached restroom has been designed for the existing pavilion near the softball field, along with another expanded parking area at that location. Per the City's request, a dedicated venue space was added at the southern end of the lake to accommodate large family events, gatherings, and weddings. This venue was not included in the original scope of services but will act as a nice addition to further enhance the use of the park.

The City has requested improvements to the existing boat ramp. The team first recommends increasing parking at the existing ramp to accommodate the expected increase in visitors to the lake. This existing boat ramp will continue to be used until the adjacent abandoned water plant is demolished. Following demolition of the water plant, that area will be utilized for the construction of a larger and more accessible permanent boat ramp and dock. Docks with kayak launches have been proposed at three locations around the lake to accommodate non-motorized vessels.

To attract families and younger visitors, new recreational amenities were designed for the northwest side of the lake. These include two multi-use sport courts striped for tennis and pickleball, as well as a full basketball court. Additionally, green playgrounds—play areas that incorporate natural materials and elements—were designed at the City's request to encourage outdoor physical activity and learning for young children.

To further improve recreational opportunities, a new accessible trail system around the lake was developed, with a trailhead located on the south side of the lake. The trail meets all Americans with Disabilities Act requirements and adheres to SUDAS standards. It was intentionally routed to create connectivity between all major site features and can be used for walking, running, and biking. Following discussions with the client, three outdoor workout areas were added along the trail to promote additional physical activity. Although not part of the original project scope, these features strengthen the recreational value of the site. In addition to the Class A compacted stone pathways, gravel biking trails were also included to provide an alternative option for visitors.

Improvements were also made to the existing RV park. The design expands the area to accommodate ten RVs, adds gravel pads for stability, and provides adequate space for vehicles to safely and comfortably turn around.

Northwest of the lake, a new dog park has been designated. The space includes separate areas for small and large dogs, each equipped with prefabricated dog playground equipment. Recommendations for equipment providers were specified.

As a result of the planned development, stormwater runoff must be modeled and compared to the pre-development conditions. The team carried out models for the one year to 500-year storm to understand the flood risks and potential impacts of different storm events. Additionally, the NRCS method was utilized to estimate peak flows and develop hydrographs at the outlet point of the lake. This information was taken into consideration when implementing erosion control features.

Due to the expected larger volume of runoff entering the lake after development, preventative erosion control features were implemented into the design. Additionally, measures were taken to improve the significant existing erosion issues on the southern shoreline of the lake. Such features include the planting of native species in the area and implementation of rip rap to stabilize the soil.

Ensuring safe swimming, fishing, and water sports is a primary goal of the Lake Fisher Recreation Area improvements. To protect recreation and ecological health, the team evaluated the lake's existing water quality, testing contaminants such as industrial chemicals, pesticides, and nutrients including nitrogen and phosphorus. In response to identified concerns, watershed management practices—such as native plantings and constructed wetlands—were recommended to improve long-term water quality.

To accommodate the expected increase in visitors, three restroom facilities were included in the design. Two will be located on the northwest side of the lake to serve park users, while the third, located on the south side, will support guests using the venue. Showers and a small laundry facility with two washers and two dryers were also added to the RV Park Restrooms for multi-day visitors.

Waste generated from restrooms, RVs, laundry machines, showers, and cabins will drain to septic tanks. The design for Lake Fisher includes five separate septic tanks and associated leach fields. All sizing criteria, material specifications, and leach field size calculations for the septic tank were done according to Iowa Administrative Code 567 Chapter 69.

In the final stages of design, all necessary potable water and septic piping were incorporated into the engineering drawings. Iowa codes and standards guided decisions on pipe diameter, material, and slope. Existing underground utility maps provided by the City were also utilized to avoid conflicts with existing infrastructure.

2. Work Plan

<table>
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Figure 3.2 Summary of work completed by the team

Section IV Constraints, Challenges and Impacts

Constraints

Several notable constraints were present in this project. One constraint encountered during the trail design and site layout process was the presence of the City's designated burn yard located within the project area. This area is used periodically for controlled burning of vegetation and debris, producing smoke that can be a nuisance to individuals in the area. Due to the unpredictable timing, duration, and intensity of these burns, the trail alignment and beach location had to be intentionally routed away from this zone to ensure public safety and reduce the likelihood of negative impacts on visitors and the environment.

Another important constraint was the property line along the northwest corner of the project site. This portion of the site was intended to be developed more heavily; however, the property boundary directly abuts an active gun club. Due to this limitation, the design team had to condense several planned features—including the recreation areas with basketball and pickleball courts—into a much smaller footprint than originally envisioned. This required careful spatial planning to ensure safety, maintain adequate separation between activities, and still provide functional, high-quality amenities within the restricted space.

A further constraint was the need to maintain ADA compliance across all components of the park. Ensuring accessible routes, appropriate slopes, compliant surfaces, and inclusive access to amenities required careful coordination throughout the design process. These requirements influenced trail grading, ramp locations, recreation area layouts, and beach access features, ensuring that all visitors—regardless of mobility—could safely and comfortably use the park.

The final constraint was the preservation of the existing pavilion. Constructed by the local Amish community, the pavilion was valued for its craftsmanship and cultural significance. Rather than removing it, the project was constrained to make additions and modifications while maintaining the original structure. This requirement influenced the surrounding layout and design decisions, ensuring that new features integrated seamlessly with the existing pavilion without compromising its integrity or character.

Challenges

Grading throughout the site presented another notable challenge. The lake lies moderately below much of the existing grade, making it difficult to provide safe and functional connections to the waterfront. Ensuring that all trails, ramps, and access points complied with ADA requirements while accommodating the significant changes in elevation required careful planning and design. The grading strategy needed to balance accessibility, safety, and site stability, while also integrating seamlessly with surrounding trails, recreation areas, and beach access points.

In the northwest portion of the site, the presence of the Isaac Walton Shooting Range introduced an additional challenge for the placement of several planned recreation amenities, including the proposed dog park. Regular firearm activity at the range has the potential to create elevated noise levels and intermittent disturbances, which could negatively impact the experience of park users in this area. To mitigate these concerns, the design incorporates strategic tree plantings intended to function as a natural sound buffer, reducing both noise transmission and visual exposure to the range. While these plantings do not eliminate the issue entirely, they provide a practical and sustainable measure to improve user comfort and enhance the overall suitability of the northwest corner for recreational use.

Designing the waterfront structures posed an additional challenge due to fluctuating water levels. The bank-full elevation was 820 ft, while the design low water elevation was 818 ft, requiring careful consideration to ensure usability across this range. All docks, boat ramps, and beach areas were designed to accommodate both high and low water conditions while maintaining ADA-compliant access. This required precise elevation planning, structural adjustments, and material selection to ensure that all visitors—regardless of mobility—could safely and comfortably access the waterfront under variable water level conditions.

The addition of several new structures with restroom facilities introduced a challenge related to the placement of septic systems. Each structure required a septic tank and associated leach field, which could not interfere with existing structures or site features. Furthermore, the size of the leach fields imposed additional constraints, as no buildings, trails, or other improvements could be placed on top of them. Careful coordination of structure locations, utility layouts, and surrounding site elements was necessary to ensure proper system function, maintain regulatory compliance, and avoid conflicts with existing amenities and infrastructure.

Societal Impact

An important societal consideration for this project was the unique demographic composition of the community, which includes a significant Amish population. To ensure the recreational facilities serve all residents equitably, the design intentionally incorporates features that support their customary modes of transportation and park use. This includes providing adequate hitching posts as well as shaded areas and accessible water sources for horses near key gathering points. Because the Amish community frequently utilizes the softball complex and often attends games in large numbers, additional spectator seating was also incorporated into the design to accommodate these gatherings comfortably. These enhancements not only improve accessibility and usability for Amish residents but also foster inclusivity and strengthen the park's role as a shared community space.

Due to the project being located within a smaller community with limited financial resources, careful consideration was given to the long-term affordability of the proposed improvements. To ensure the City can implement the design without exceeding its available budget, the project was intentionally organized into clearly defined phases. This approach allows the community to prioritize essential elements first, while deferring more discretionary features until additional funding becomes available. By structuring the work in manageable stages, the design supports responsible fiscal planning, maximizes the impact of local investment, and provides the flexibility needed for the City to continue enhancing the park as resources permit.

During the evaluation of existing site amenities, it was determined that the current shelter structures remain in good condition and continue to serve the needs of park users effectively. Although the City expressed openness to potential renovations, the design team elected to retain the shelters in their present form—aside from the planned addition of a restroom facility at the softball shelter—in order to minimize unnecessary costs and maintain the functional integrity of the existing buildings. In doing so, the project also subtly honors the craftsmanship of the Amish community members who originally contributed to the construction of the pavilion near the softball field. Preserving these structures acknowledges their role in shaping the park's history and reflects an appreciation for the traditional building methods that have long supported recreation in the area.

Section V Alternative Solutions That Were Considered

1. Site Layouts

To ensure a clear understanding of all team and client perspectives, the team was divided into three groups, each tasked with developing an alternative site layout. This approach allowed the team to explore multiple configurations that addressed the client's requirements while considering existing site constraints. Within each group, the placement, dimensions, and quantities of the requested features were discussed. Following this, the team held an internal design review and a subsequent meeting with the client to evaluate the advantages and limitations of each alternative. Figures 5.1, 5.2, and 5.3 present the layouts submitted by each group for internal and client feedback.

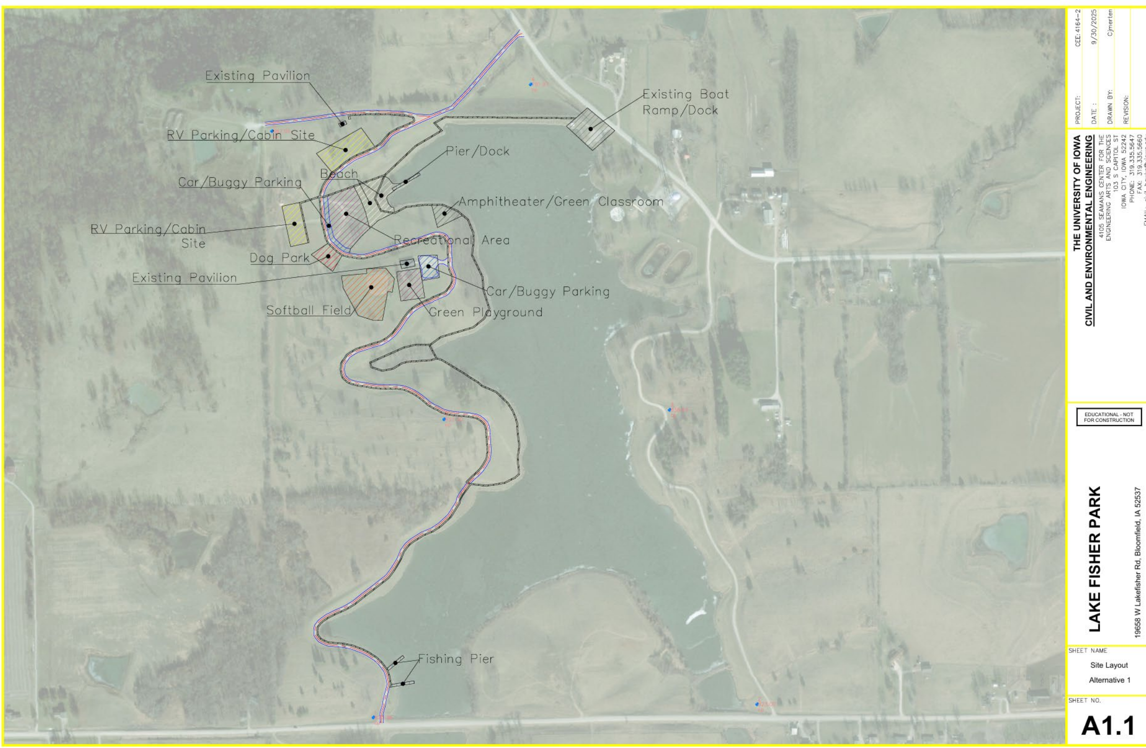


Figure 5.1 Layout alternative 1

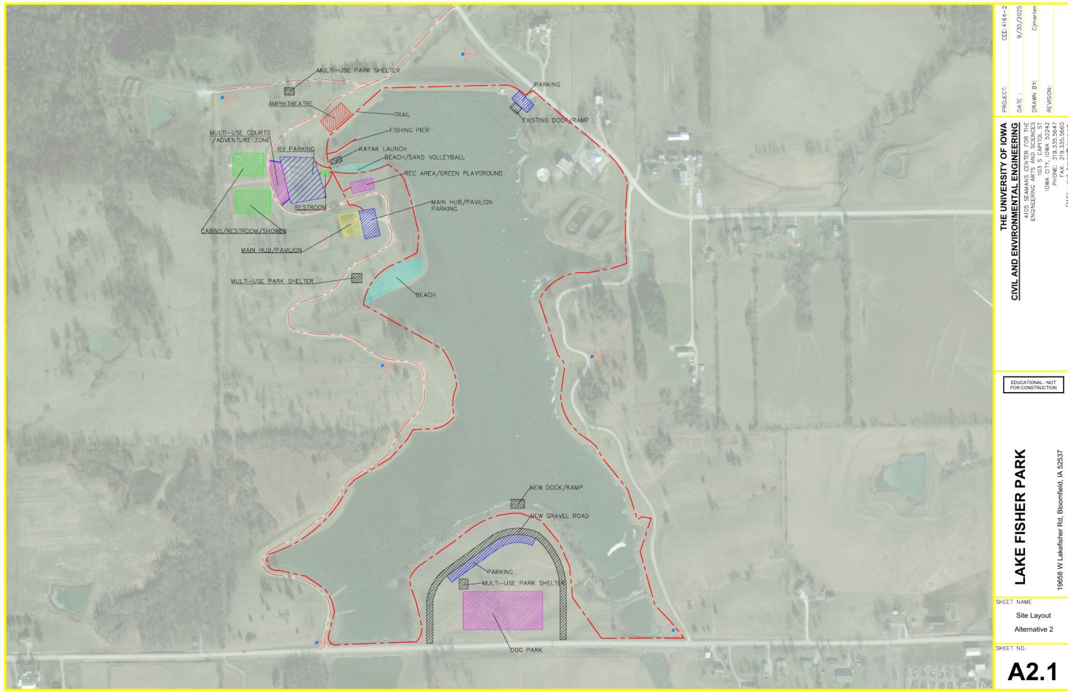


Figure 5.2 Layout alternative 2

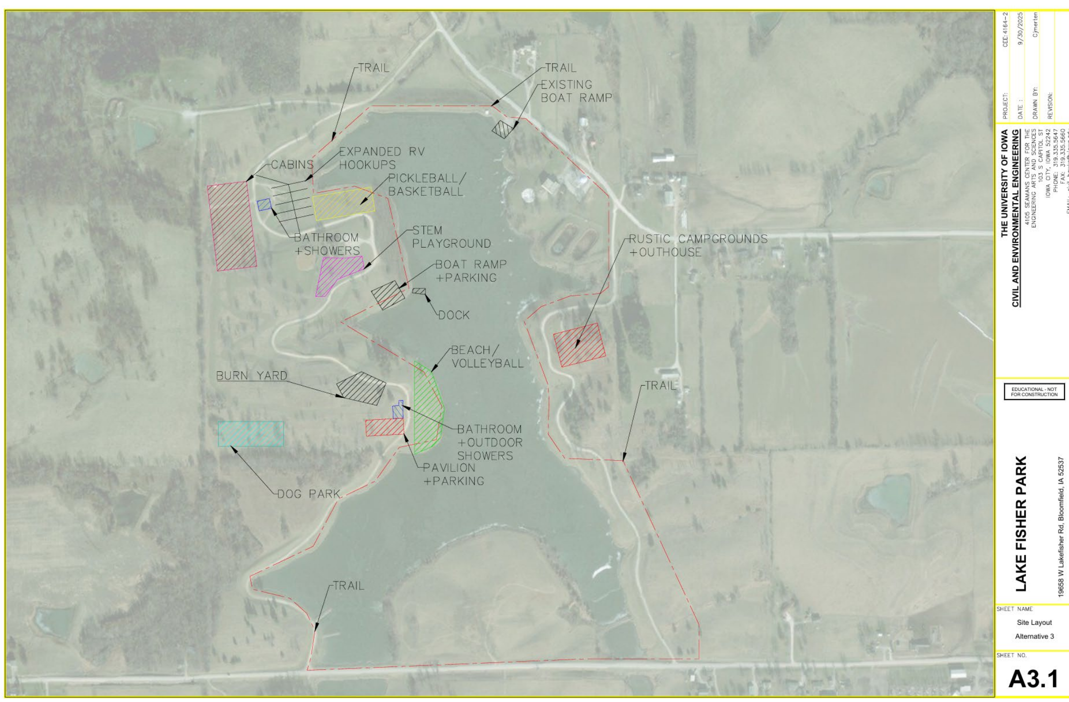


Figure 5.3 Layout alternative 3

Following both internal and client feedback, the team was able to refine the design in a more targeted manner to meet the City's requests while remaining within the site's constraints.

The team and the City agreed that the majority of the design should focus on the northwest portion of the park. This area proved to be the most versatile, accessible, and spacious portion of the park. Alternative 2 was the only concept that incorporated the southernmost end of the site; this area was initially considered for a dog park but was later revised to a venue in response to the City's input. Alternatives 2 and 3 also proposed extending the trail to the east side of the park, a feature that was further refined in the final design despite fewer amenities being placed on the east side.

An additional consideration for all groups was the existing burn yard on the west side of the site. Because the burn yard may be active two to three times per month during peak periods, park features in that area were intentionally limited to avoid conflict with operations.

Once a general layout was agreed upon internally and with the client, the design team advanced the level of detail for each site feature. Tasks were assigned to team members based on technical expertise and workload, with some features requiring collaboration from multiple designers. Team members responsible for interdependent features coordinated regularly to ensure consistent design assumptions across the site. The specific considerations for each feature and the corresponding engineering analyses are detailed in Section VI.

2. Cabins

Figure 5.4 A Frame Trio 100 A-Frame Cabin

In considering designs for the cabins, initial ideas included "A-Frame" or log cabin structures, but their designs were ultimately less versatile than a typical stud wall construction which contractors are more familiar with. This reduces cost, construction waste, and build times. A more standard design also allows us as designers to focus on optimizing other facets of the cabin design, notably the energy efficiency of each residence which would allow them to operate into the cold winter months efficiently and at minimal cost to the operator.

Figure 5.5 Southland Log Cabin

A two-bedroom design with a joined kitchenette and living room was selected for its appeal to both families as well as hunters who would be renting out these cabins. This design balances a need for privacy without significantly reducing square footage and giving renters access to the basic amenities that one might expect when staying multiple days away from home.

Lastly, for a platform framing system of trusses supported by stud walls over a wood frame floor with a crawl space was selected for its resistance to wear incurred by the freezing and thawing ground as well as for its capacity to serve as storage space for the park should that be necessary.

3. Venue

During the design phase, multiple location and structural concepts were evaluated for the proposed venue. The initial concept envisioned an amphitheater with a semi-circular configuration and a scenic backdrop. This design was considered well-suited for presentations, performances, and concerts. However, following client input, the focus shifted from an amphitheater to a more traditional venue structure. The amphitheater had originally been planned near the recreation area, positioned along the lakefront to take advantage of the natural setting. While this location offered aesthetic appeal, it was later identified as a potential site for a septic system or leech field required for the recreation area restrooms. This constraint necessitated reconsideration of the location. Subsequently, the design transitioned to a open-air style venue, relocated to the south peninsula. This placement provided a distinct feature within the park while maintaining separation from the recreation area, thereby establishing the venue as a stand-alone facility dedicated to hosting events. The amphitheater concept had incorporated a concrete half-bowl structure to enhance acoustics, but its lack of a roof presented significant limitations. Events would have been vulnerable to weather disruptions, and the proximity to the lake introduced potential flooding risks. In contrast, the revised venue design features a flat, roofed structure constructed on elevated ground, effectively mitigating these concerns and ensuring greater reliability for year-round use. All proposed concepts were carefully measured and reviewed to confirm spatial feasibility, optimize land use, and align with the client's requirements.

4. Restrooms

A restroom design for the RV Park restroom first included a shower area connected directly to the main restrooms. This design was changed to separate shower and restroom areas. Changes were made due to the desire to lock the shower area separate from the restrooms, allowing only the users of the RV park to have access to the showers. Along with that, the first design did not include an area for laundry. To further incentivize visitors to the RV park, a laundry area has been included in the design to increase convenience. Lastly, the utility room was made larger and more centralized. A centralized utility room gives the largest buffer between mechanical equipment and the elements. Preventing utility failure as well as reducing maintenance costs. To increase the amount of green and sustainable infrastructure on site, solar panels were added to the restrooms. This necessitated a larger mechanical room to house the equipment.

5. RV Park

The main goal was to expand the RV park while keeping it easily accessible. The first iteration included a central through-lane and added additional lanes on each side. These new lanes were set at a 45-degree angle relative to the main through-lane. Initially, all angled lanes faced the same direction; however, this would have required one-way traffic through the park.

To resolve this, the lots were reoriented, to opposite directions on either side of the through-lane. The central through-lane was extended and new through-lanes were added along both sides, ensuring full accessibility throughout the expanded layout.

6. Trails

Initially, the trail was located only on the west side of the site, as no development was planned on the east side. One of the first major revisions made was to have the west-side trail branch off to connect directly to the existing shelter and then run along the road to serve the recreation areas. The trail was also rerouted to pass through the land bridge on the southeast side of the site, and it was shifted closer to the lake on the east side.

Once development on the east side was confirmed, we redesigned the trail network to allow users to walk, run, and bike around the entire lake, creating a continuous loop. A branch on the west side was added to provide direct access to all major site features, reducing the need for users to drive and park. The idea to route the trail through the land bridge originated from the client, and a subsequent site visit confirmed that this was feasible. Initially, the trail had been aligned to cross the existing road on the southeast side based on an aerial image that showed what appeared to be a mowed path, which was assumed to be a trail. A site visit revealed that this was a corridor for electrical poles and that the adjacent slopes were quite steep, making ADA compliance difficult. As a result, the alignment was shifted closer to the road and lake, where grades were more manageable.

7. Boat Ramps and Docks

The boat ramp and dock facilities underwent numerous design iterations throughout the project. The initial concept focused on replacing the existing dock with an upgraded structure while leaving the current boat ramp unchanged, as it had recently undergone maintenance. However, after meeting with the client, reviewing alternative concepts, and conducting the team's own site assessment, it became clear that providing multiple access points would better serve the lake. Early alternatives included adding a single dock on the west side of the lake near the existing parking area. As the project evolved and the southern portion of the lake was identified as a suitable location for a venue and trailhead, the associated utility requirements ultimately guided the development of the current dock layout. Additionally, a dock was incorporated into the north fishing jetty to provide convenient access for the nearby cabins and RV sites.

Several dock design alternatives were evaluated over the course of the project. Initially, pile-supported docks were considered, but the team ultimately shifted toward a floating dock system. This option offered greater flexibility and aligned with the client's preference for a low-maintenance solution. Temporary pole-anchored floating docks were also explored as an alternative; however, this option was dismissed due to the need for recurring winter removal and maintenance.

For much of the project timeline, the existing boat ramp was deemed adequate and was not scheduled for modification. This changed when the client informed the team that a significant portion of infrastructure on the east side of the lake would be removed. This includes a decommissioned water treatment plant with two unused lime pits. This created an opportunity to design a larger, more functional boat ramp with increased parking capacity and improved turning radii to better accommodate vehicles towing large boats.

8. Beaches and Sand Volleyball

The beaches underwent numerous revisions over the course of the project. The initial plan featured a single beach on the lower west side of the lake; however, the client noted that smoke from the nearby burn pit frequently affected this area. To address this concern, the team explored relocating the beaches further north to avoid smoke and provide closer access to the parking area. A second beach on the south side of the lake was also considered to promote increased activity in that area. These iterative alternatives ultimately informed the development of the final beach design.

The design process also considered the lake's low water level, which required significant grading. Early concepts included a retaining wall to manage the elevation difference, but by adjusting the trail alignment down to the beach, the need for stairs or a retaining wall was eliminated. Various amenities were debated, including full showers and restrooms, but the final plan incorporated only a small beach shower. Similarly, sand volleyball was initially considered for removal due to space constraints from grading, but the design was modified to accommodate the volleyball area. These successive iterations reflect the project's exploration of alternatives before arriving at the final, functional beach layout.

9. Recreational Area

In the initial concept, the team planned for three full-size basketball courts and six pickleball courts, all located on the west side of the site. After confirming the projected number of users, the number of courts were reduced to better match demand and create a more efficient use of space. The design was revised to one full-size basketball court and two courts designed to function as both pickleball and tennis courts. To keep the cabins more secluded and preserve a quieter setting for overnight users, the positions of the rec area and the cabins were swapped, moving the recreation facilities away from the cabins and closer to other active-use areas on the site.

10. Dog Park

The dog park was originally planned as a single large area on the south side of the site, on the peninsula where the trailhead parking is now located. After further consideration, the dog park was relocated to the northwest portion of the site, closer to the main cluster of development, so users can access more amenities within a concentrated area. The dog park was also divided into a larger area and a smaller field to give owners options based on their dog's size and comfort level.

11. Workout Areas

The workout areas were originally conceived as a single pad with four pieces of equipment manufactured by Kompan, located next to the shelter on the west side to complement the other recreational amenities and the green playground.

After receiving client feedback, this concept was expanded from one workout area to three, and the locations were adjusted to better align with the trail network. This allows visitors to use exercise equipment conveniently while walking or running through the site and creates a more versatile and accessible fitness experience. The design team also focused on incorporating more calisthenics equipment, which supports more social interaction and efficient usage of the space. These changes were made to better support the City's goal of increasing activity options and social gathering areas for young people.

12. Green Playground

Time was spent researching, initially, as there was a need to find a dependable playground equipment manufacturer and designer that fit the criteria of the City. The main criteria were that it implemented natural elements into the aesthetics and material of the equipment, and that it promoted learning opportunities for children. We had considered a common design incorporating a mostly metal swing set and tower following the already existing layout, but more specialized manufacturers were researched to fully realize the client's vision.

Natural Playgrounds Company, a playground design company that does work across the United States providing wood playground features, was contacted. This manufacturer was selected based on the level of safety their products provide by meeting all ASTM, CPSC, and licensing requirements. Their designs also possess the educational element that the client was looking for.

A preliminary playground design was then developed to receive a quote on their services. The design involves 2 pads to incorporate features for both physical activity and learning separately. Considerations and alterations made to the playground design were based on the placement of features in relation to each other to avoid intersecting fall zones. A minimum of 6 feet of space in all directions was provided for features that could potentially cause injury.

13. Stormwater Analysis

To decide how to evaluate the lake and watershed area affecting the lake, USGS StreamStats was used. In this application, there were many locations that could be selected as the watershed outlet. Figure 5.4 below is an example of the different watersheds that could be used to break up one larger watershed for the area draining into the lake.

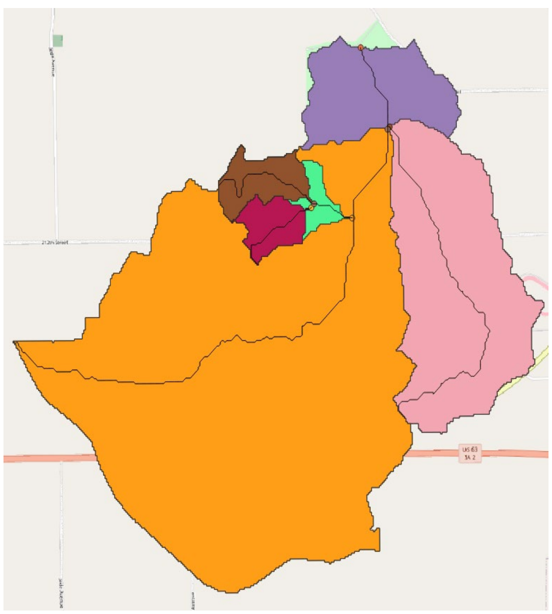


Figure 5.4 6 Site subwatersheds

To get an accurate representation, the lake must not be considered as a part of the watershed, because the flow through the lake is generally much slower than on land as well as there is a specific outlet device in the lake that limits the outflow. It was decided that one single watershed should be used for this evaluation, and the lake area will be eliminated from it for all area, slope, and longest flow path calculations resulting in the watershed shown in the Final Design Section VI.

The two main options—the NRCS Storm Data and NOAA Atlas 14—were considered as resources for gathering storm data. The NRCS Storm Data can be specified by selecting a county, and the NOAA Atlas 14 data is specified by selecting a rain gauge. It was found that there is a rain gauge on the Fisher Lake Recreation Area site shown below in Figure 5.5.

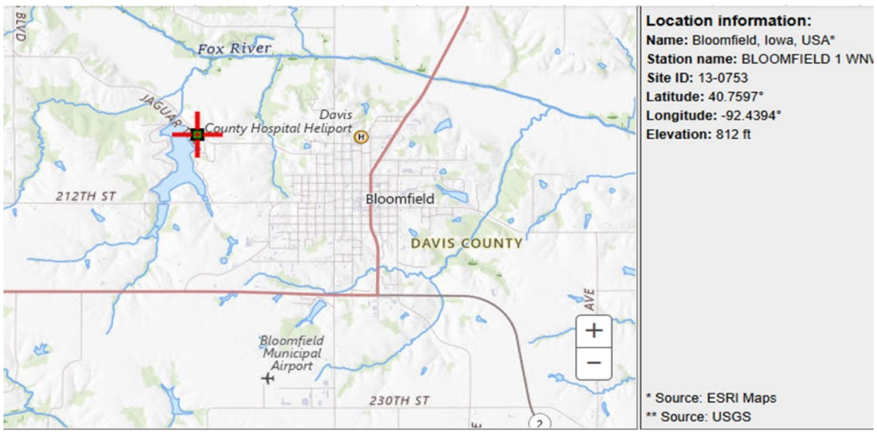


Figure 5.5 7 NOAA Atlas 14 rain gauge location.

Due to the proximity of the gauge to the site, it was determined that this resource would be the most accurate for use in modeling.

The final major determination to be made for the stormwater model was the dimensions of the outlet structure shown in Figure 5.6.

Figure 5.6 8 Existing outlet structure.

It was assumed that the top of the outlet structure is at an elevation of 820ft, the same elevation as bank full. It was estimated that the height of the outlet from the top to the top of the inlet weir is 2ft, meaning that the permanent pool of the Lake is located at 818 feet of elevation. It was also estimated that the two sides of the inlet start as a two-sided weir 3ft long on each side, with 2ft between the sides. Then, once the water rises to 820ft, the left and right sides are engaged and are 6ft long each. The discharge pipe is 3ft in diameter. These assumptions were used to calculate the discharge of the structure for each elevation from 818ft to 840ft.

14. Erosion Control

When determining potential alternatives for erosion control, chapter seven of the Iowa SUDAS Design Manual was consulted. Alternatives such as compost blankets and filter berms were considered. However, due to the temporary nature of such solutions, it was determined that native wildflowers and rip rap erosion control measures were most suitable for the site.

15. Water Quality Analysis

During the early phase of design for this project, it was discussed that taking several samples on different days at sampling locations throughout the lake would be helpful to develop average constituent concentrations within the lake. With the knowledge that the Iowa Department of Natural Resources was performing a complete, multi-year study on the watershed and the lake itself it was determined that sufficient data would soon be available to draw conclusions on the water quality within the lake. Thus, the six samples were collected at various locations surrounding the lake for the purposes of comparison to IDNR data.

16. Wetlands

A complete constructed wetland was initially considered to assist in pollutant removal. The original design was to include microtopography to increase biological uptake of pollutants by plants, increase the time of concentration, and decrease flow velocity. Following the evaluation of the current sediment forebays, the outlet structures on the south road, and the variability in lake depth south of 212th Street on the SW side of the lake it was determined that a complete constructed wetland design was not feasible. A similar situation was encountered on the SE side of the lake. Thus, it was determined that a smaller area of wetland plants could be planted on the SW and SE inflow areas to protect against erosion, provide habitat, assist in pollutant reduction, and enhance the area visually. This option was determined to require a lower cost, less maintenance, and decreased access requirements while still providing the same benefits, however to a lesser degree.

17. Septic Tank Design

The original design included three septic tanks. However, it was realized that the resulting leach fields were too large to fit into the allotted space, it was concluded that five septic tanks would be necessary. Each of the five septic tanks has an associated leach field. As nothing can be constructed on a septic tank or its leach field, the team determined that these areas can be used to plant native grasses and wildflowers, which help to improve ecosystem health, soil health, and beautification of the area.

18. Fish Population

After communicating with the City to determine their goals in terms of the lake's ecological health it was determined that several fish species were negatively impacting the health of both the lake and the more desirable fish species. The initial solution to this issue was to recommend physical removal of the species negatively impacting the lake and stocking a greater number of predator species which are more desirable to anglers. Following communications with the IDNR, it was determined that a complete removal of all fish species within the lake by chemical means would be optimal. This would be followed by a restocking of desirable fish species and allowing several years for the populations to rebound.

Section VI Final Design Details

1. Watershed and Stormwater Evaluation

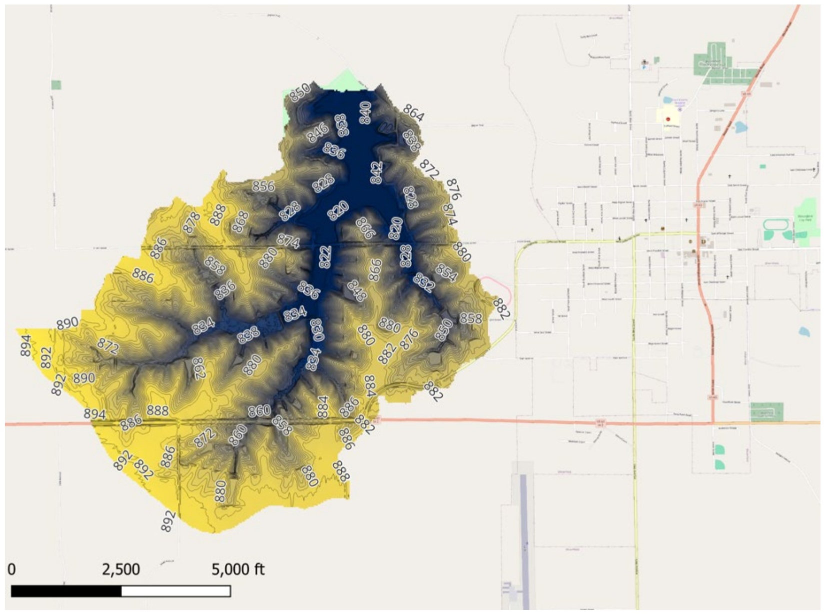


Figure 6. 1 Watershed flow paths.

The Fisher Lake Recreation Area sits inside a 1,422-acre (2.2-square-mile) watershed. Any rain that falls in this area eventually drains into Lake Fisher and then out through the main spillway. Figure 6.1 shows how water flows downhill from the highest points (yellow) to the lowest point at the lake (blue).

Not all rain makes it to the lake as some soaks into the ground. This process, called infiltration, helps protect the Recreation Area and the dam by reducing how much water reaches the lake during storms. How much water infiltrates depends on the type of soil and how the land is being used.

The watershed contains three soil groups—B, C, and D—which differ in how well they absorb water. Group B soils absorb water the best, while Group D absorbs the least. Their locations are shown in Figure 6.2 using data from the USDAs Web Soil Survey. Water surfaces (red) have no infiltration.

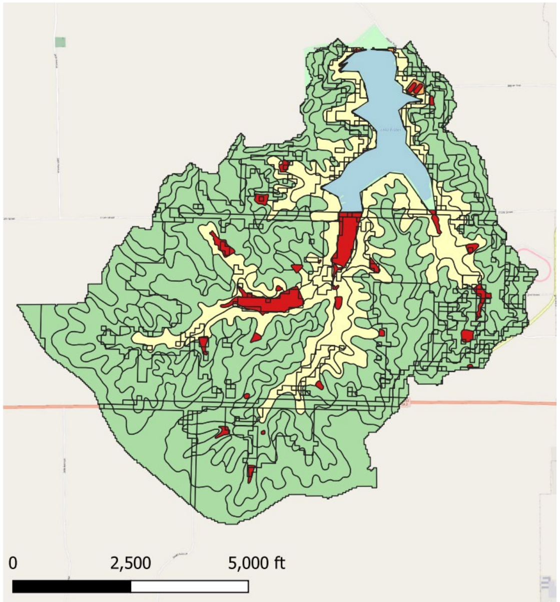
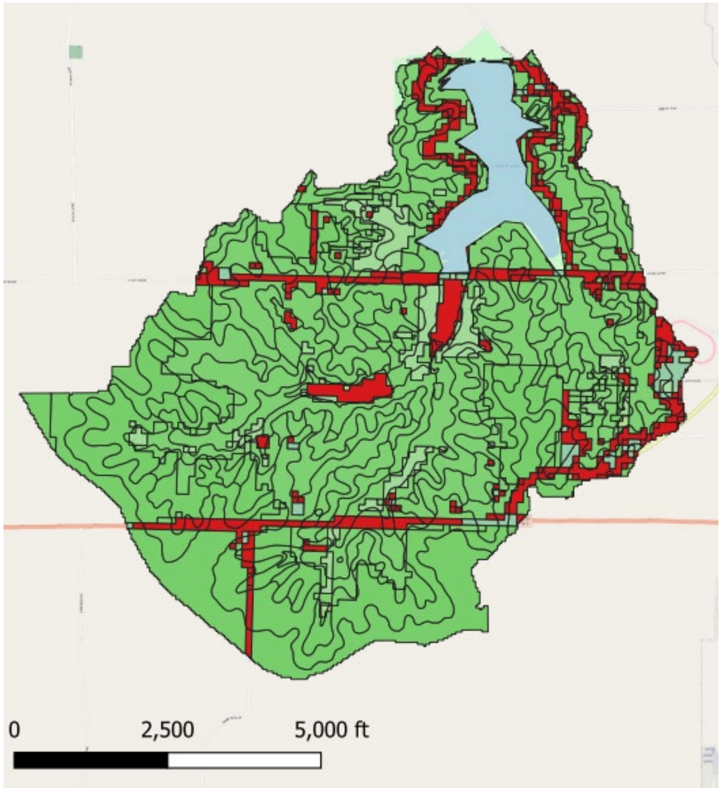


Figure 6. 2 Watershed Hydrologic Soil Groups

Land use also affects how much water runs off. The watershed includes farmland, pastures, roads, small reservoirs, homes, grasslands, and wooded areas. This information was provided by the Multi-Resolution Land Characteristics Consortium. Hard surfaces like roads, houses, and concrete don’t allow much infiltration, while fields and grasslands absorb water well. These areas are shown in Figure 6.3 (red = poor infiltration, green = good).



Soil type and land use are combined to calculate a curve number (CN) for each small section of land. A weighted average of all these values gives one CN for the whole watershed: 83.68. This number was used in stormwater models to estimate how much rainfall becomes runoff and how much soaks into the soil.

Another important value is the time of concentration, which is how long it takes water from the farthest point in the watershed to reach the Lake. Using USGS StreamStats, the longest flow path was found to be 9,660 feet and shown in Figure 6.4. Using the Kirpich method and the slope from StreamStats, the time of concentration is 61.6 minutes. This converts to a lag time of 36.97 minutes, which is needed for HEC-HMS modeling.

Figure 6. 3 Watershed land use

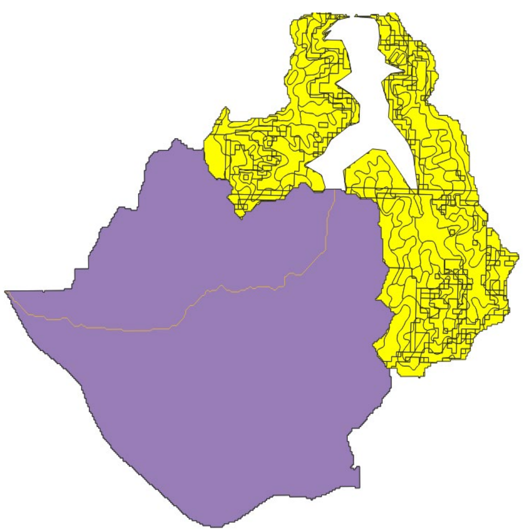


Figure 6. 4 Watershed longest flow path

HEC-HMS is software used to estimate how much water flows into and out of the lake during storms. It uses information such as watershed area, curve number, lag time, lake storage curves, spillway flow curves, the base lake level, and rainfall for the design storms. More details are in Section V and Appendix J.

Storms ranging from the 1-year, which has a 100 percent chance of happening per year, to the 500-year, which has a 0.2% chance of happening per year, were modeled. NOAA Atlas 14 was used to obtain the precipitation depths for a typical 24-hour storms for each design year. The 1- and 2-year storms stay within the Lake's banks. The 100-year storm must safely pass through the spillway, and the 500-year storm is used to test the limits of the system.

The most important outputs from HEC-HMS are the peak inflow, peak outflow, and the highest water level the lake reaches during each storm. These values are compared to existing ground elevations and to planned site features to understand potential impacts.

The team also compared pre-development and post-development conditions. The planned project adds 8.0 acres of gravel and 0.88 acres of concrete, slightly raising the curve number from 83.68 to 83.73. This small increase is within typical model uncertainty but does mean slightly more runoff will occur. Both conditions were modeled for completeness.

To combat the increase in curve number, and therefore runoff, there are multiple elements that can be added. The one considered in this proposal is planting native grasses and plants as well as adding trees. This increases the infiltration of the soil on and around where these plants are planted by restoring the landscape, and because the plants also use the water through their roots. The areas the team decided to add these plants are the leach fields for the septic tanks, as regulations state that no structures can be built on it, and the disk golf area, since adding trees was requested by the City and it adds more difficulty and interest to the course. By planting native plants, the area planted will reduce in curve number by 5, and by planting trees, each 100 ft^2 surrounding each tree will reduce in curve number by 10. The proposed added plants result in a new curve number of 83.72. This is a 0.01 reduction from the post-development curve number and could easily be reduced more by planting more native plants and trees. However, this reduction is again well within the model uncertainty.

It was found that the post-development watershed conditions are almost identical to pre-development conditions. A comparison of the model results is shown in Table 6.1. Overall, the added development does not increase the peak flow into the lake or the peak water level, which are key factors for preventing downstream flooding and protecting the dam.

Table 6. 1 Pre- and post-development Inflows, outflows, and Peak Elevation

	Design Storm	Peak Inflow (cfs)	Peak Discharge (cfs)	Peak Lake Elevation (ft)
Pre-Development	1-yr	981.2	43.3	819.5
	2-yr	1286.6	49.6	820.0
	10-yr	2369.5	66.9	821.6
	100-yr	4470	89.9	824.5
	500-yr	6187.6	103.9	826.7
Post-Development	1-yr	983.7	43.3	819.5
	2-yr	1289.3	49.6	820.0
	10-yr	2372.7	66.9	821.6
	100-yr	4477.4	89.9	824.5
	500-yr	6200.9	104	826.7

For reference, the lake banks sit at an approximate elevation of 820 ft, and normal water level is approximately 818 ft. Based on the contour mapping in Figure 6.5, the southwest road is at elevation 824 ft, and the southeast road and dam embankment are at 828 ft.

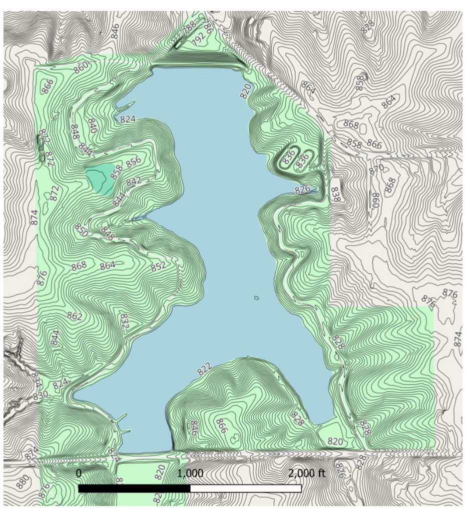


Figure 6. 5 Site contour map

As shown in Table 6.1, the 1- and 2-year storms keep water within the lake's banks before and after development. During the 100-year storm, the water level rises high enough to cover the southwest road, but it is still safely passed through the existing outlet with no risk of overtopping the dam. Even with the 500-year storm event, the lake and outlet structure perform well, with a peak water level of 826.7 ft, which is still 1.3 ft below the top of the dam and the southeast road.

With the proposed improvements implemented, the peak inflow of water into the lake does increase slightly. This makes sense, as the increased impervious area is preventing the current amount of rainfall from absorbing into the soil, and this rainfall is instead entering the lake. The exact increase in percentage and cfs is show in Figure 6.6 below.

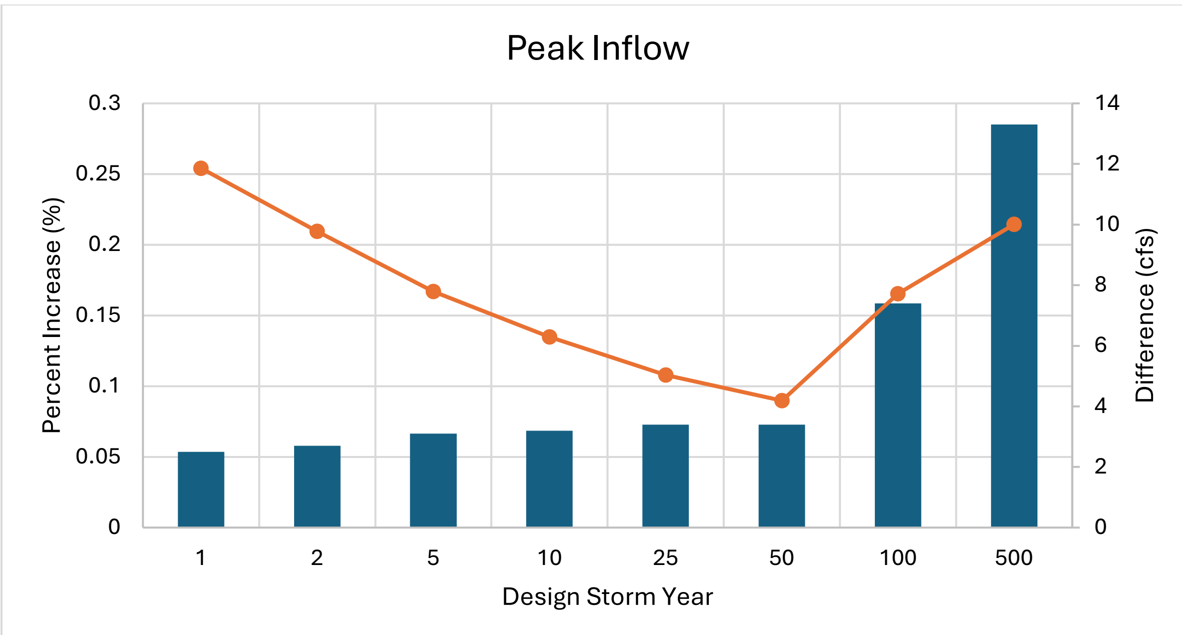


Figure 6. 6 Peak inflow change from pre-development to post-development in percent increase and cfs.

Additionally, the peak discharge from the lake does not change from pre-development to post-development, which was the most important criteria to target for. This means that the flow out of the lake and into the receiving stream is not increasing. The speed of the water is a main contributor to erosion potential. With our proposed design, we are not increasing the erosion potential and concern downstream through the water speed. Since the peak inflow increases slightly, and the peak discharge does not, the peak storage of the lake increases as well. However, this increase is not significant enough to impact the peak elevation of the lake as discussed above.

However, our design does increase the total discharge volume. The volume is given from the model in inches, which is the total depth in inches over the entire Lake area that is being discharged. These results are shown in Figure 6.7 and compared to pre-development discharge volume.

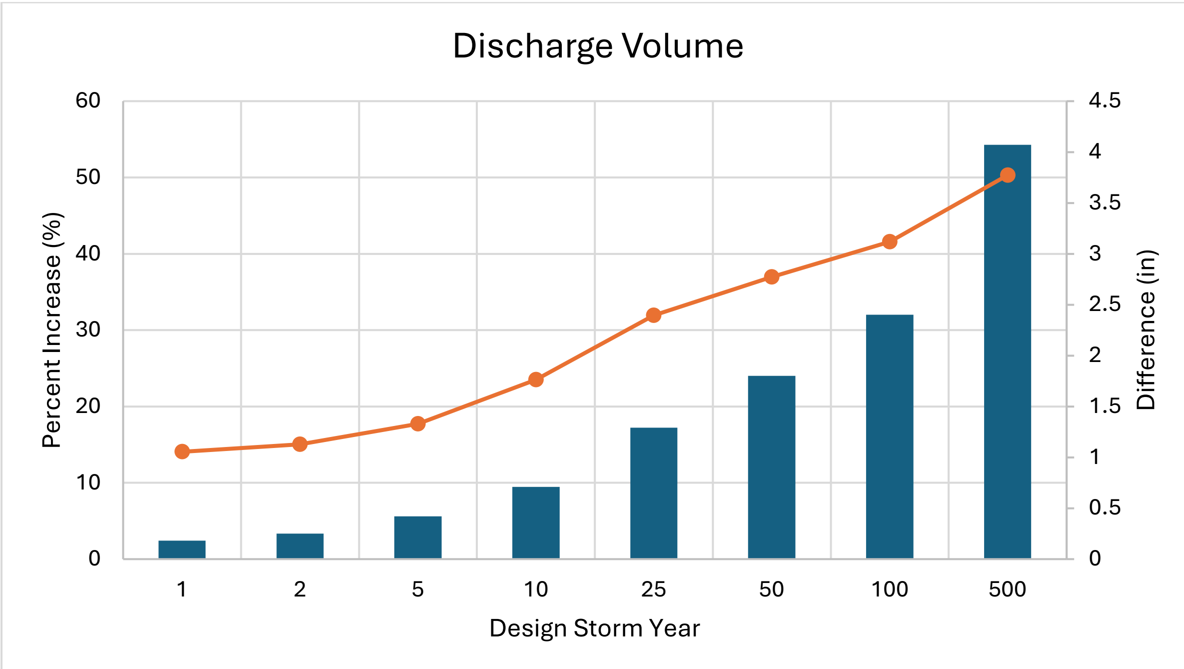


Figure 6. 7 Lake discharge volume

To make sense of this graph, for example, the 1-year storm, the discharge volume was increased by 0.18 inches, which would be 0.18 inches over the entire 82-acre lake or 1.23 ac-ft of increased water volume discharging from the pre-development conditions. This is a 14.1 percent increase in discharge volume. This increase in volume without an increase in discharge flowrate means that the water is being discharged from the lake over a longer period of time in our proposed design than in the current, pre-development conditions. This could potentially have impacts on the erosion potential in the streams downstream of the lake as they would be conveying the peak flow, or a higher-than-normal flow, for a longer period of time. However, because the discharge volume for the pre-development conditions is already very low, the increased discharge volume is also a relatively small amount.

2. Septic Tanks

A total of five septic tanks and associated leach fields were required to accommodate wastewater generated by the newly developed cabins, restrooms, and RV dumping stations.

The first of the five septic tanks was designated for RV waste and was located near the existing RV park. This tank was designed to handle flows of approximately 2,500 gallons per day, calculated by multiplying the ten RV units by 250 gallons per day per RV in accordance with IAC 567 Chapter 69. The tank measured 13.9 feet in length and eight feet in width, with a baffle height of six feet. The inlet pipe elevation was set at six feet, with the tee extending upward to 6.5 feet and downward to 5.333 feet. The outlet pipe elevation was 5.75 feet, with the tee extending up to 6.5 feet and down to 4.75 feet. The associated leach field comprised approximately 14,700 square feet, utilizing 24 distribution pipes at 70 feet per pipe.

The second septic tank was designated to receive wastewater from the cabins. This system was sized to handle approximately 900 gallons per day, representing the estimated flow rate from six-bedroom residences. The tank measured 12.03 feet long and five feet wide, with a baffle height of four feet. The inlet pipe height was set at four feet, with the tee extending up to 4.5 feet and down to 3.33 feet. The outlet pipe height was 3.75 feet, with the tee extending up to 4.5 feet and down to 2.75 feet. The leach field for this system totaled approximately 4,800 square feet, consisting of six pipes at 100 feet per pipe.

The third septic tank received waste from the restrooms located at the south end of the lake. The estimated wastewater flow to this tank was 4,340 gallons per day, calculated based on the number of parking spaces, with each parking space assigned a design flow of 20 gallons per day. The tank dimensions were 20.18 feet in length and twelve feet in width, with a baffle height of four feet. The inlet pipe height was four feet, with the tee extending to 4.5 feet and down to 3.33 feet. The outlet pipe height was 3.75 feet, with the tee rising to 4.5 feet and extending downward to 2.75 feet. The leach field area totaled 25,500 square feet, using 29 pipes at 100 feet per pipe.

The fourth septic system was designed to treat waste generated at the existing shelter which was retrofit with a restroom. The design flow for this tank was approximately 700 gallons per day, calculated based on the available parking spaces. The tank measured 10.70 feet long and five feet wide, with a baffle height of 3.5 feet. The inlet pipe was set at a height of 3.5 feet, with the tee extending upward to four feet and downward to 2.83 feet. The outlet pipe height was 3.25 feet, with the tee extending up to four feet and down to 2.25 feet. The corresponding leach field area was approximately 3,900 square feet, consisting of five pipes at 100 feet per pipe.

The final septic tank was designated for the new restrooms containing showers and laundry facilities. The estimated daily flow to this tank was 2,620 gallons per day, calculated based on the number of laundry machines and total parking spaces in accordance with IAC 567 Chapter 69 and guidance from Maricopa County. The tank measured 14.59 feet long and eight feet wide, with a baffle height of six feet. The inlet pipe elevation was six feet, with the tee extending to 6.5 feet and down to 5.333 feet. The outlet pipe height was 5.75 feet, with the tee rising to 6.5 feet and extending to 4.75 feet. The leach field area totaled 15,600 square feet, incorporating 18 pipes at 100 feet per pipe. An engineering drawing detailing the dimensions of each septic tank has been provided in Figure 6.10.

The EPA provided a reference figure for a traditional septic tank, and an additional diagram of a conventional septic system was included for context. The total volume of each tank was designed at twice the expected daily sewage flow to ensure a minimum solids-settling time of two days. The primary settling compartment length, where influent first entered, was set to 0.65 times the total tank length, and each tank length was designed to be at least 1.5 times the tank width in accordance with IAC 567 Chapter 69. 18-inch manholes were designed to allow access to the tanks for maintenance purposes. The total length of distribution piping required for each leach field was determined using percolation rates for a silty loam soil with moderate structure. According to the Web Soil Survey, this soil type was the predominant classification at Lake Fisher. All leach field pipes were installed within three-foot-deep trenches spaced six feet apart. Each distribution pipe was specified as 4-inch diameter PVC installed at a slope of 1 percent.

IAC 567 Chapter 69 guidance was followed to ensure the septic tank construction materials were suitable to prevent environmental contamination. The tanks installed at the Lake Fisher Recreation Area are to be constructed of a vibrated and reinforced special concrete mix with a wall thickness of 2.5 inches, a water-to-cement ratio of 0.45, a density of 650 pounds per cubic yard, and a minimum 28-day compressive strength of 4,000 psi. The tank bottom is to be constructed at a thickness of three inches, and the tank top is to be four inches thick and reinforced with 3/8-inch steel rods arranged on a six-inch grid. Reinforcing bars will be provided with a minimum concrete cover of one inch. All inlet and outlet ports were designed using heavy-duty Schedule 40 PVC. These can be purchased from vendors including PVC Pipe Supplies or Core & Main.

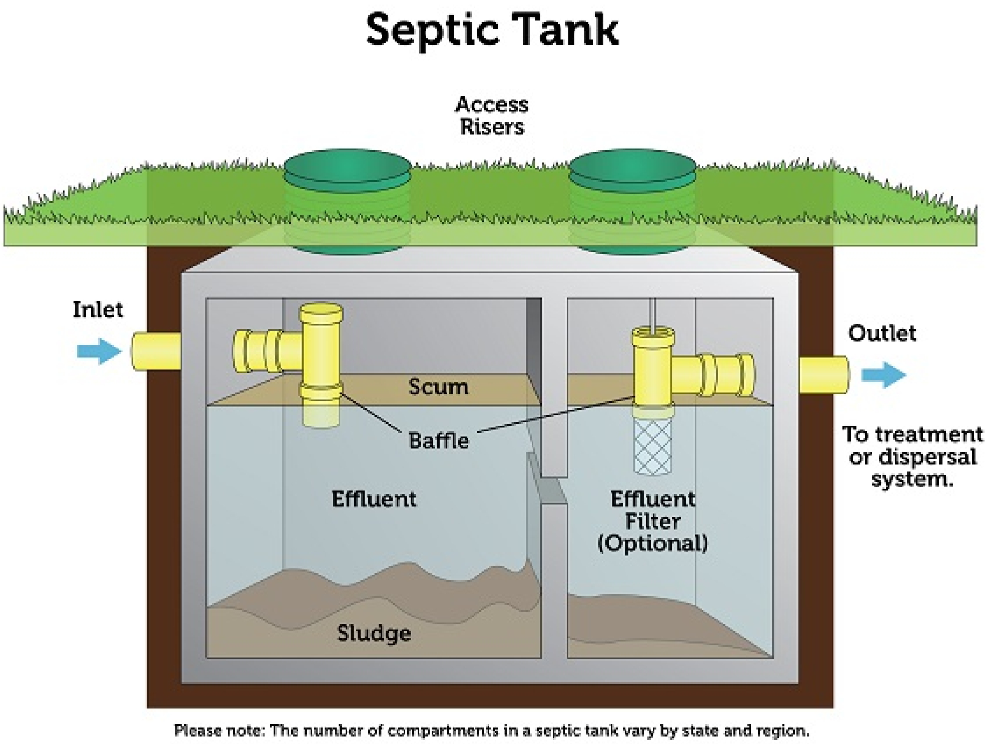


Figure 6. 8 Septic tank example.

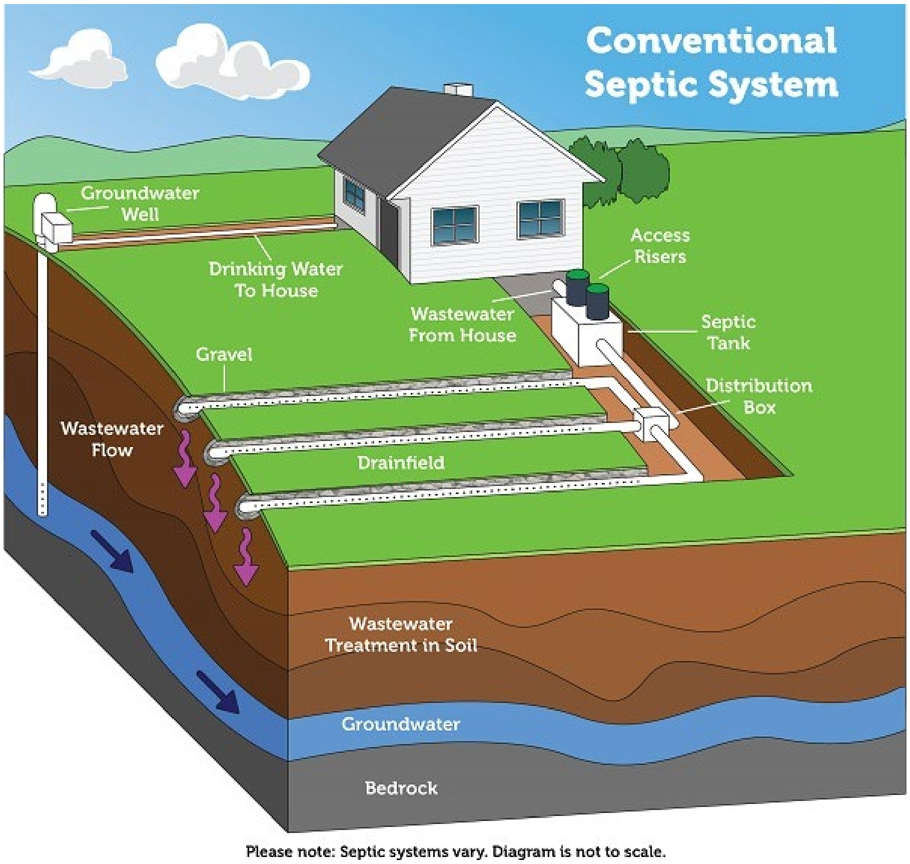


Figure 6. 9 Septic system example.

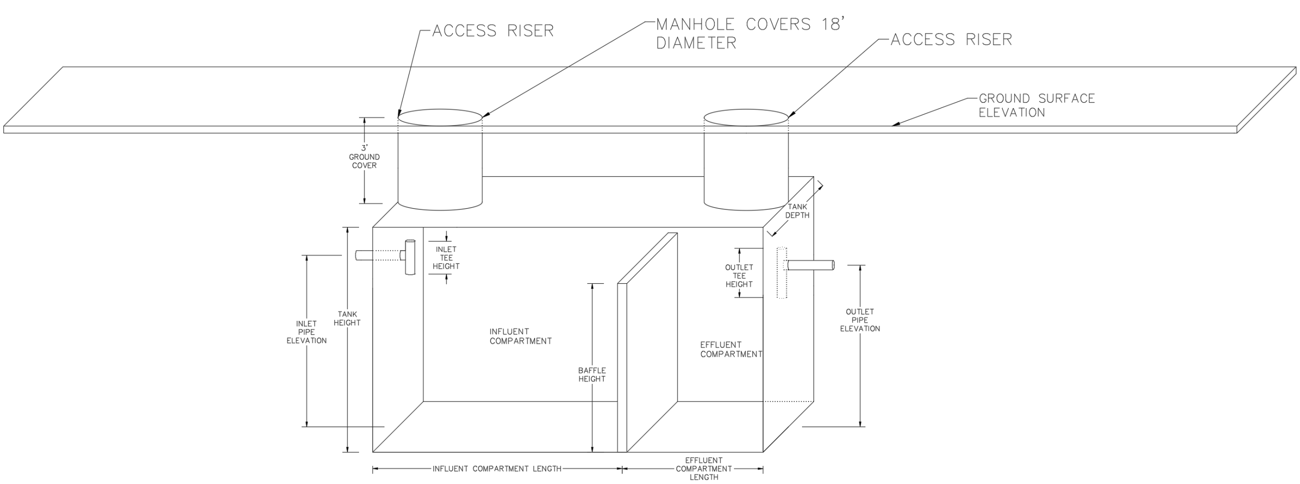


Figure 6. 10 Septic system dimensions detail.

3. Erosion Control

According to the Iowa DNR, erosion control has been identified as a significant concern at Lake Fisher. The erosion control practices implemented in this design were intended to address existing erosion issues while also preventing additional erosion expected to result from increased runoff following site development. At the time of assessment, the majority of erosion concerns were located along the south shoreline of the lake, detailed in Figure 6.11. To stabilize soils in these areas, the team recommended establishing a three-foot buffer of native wildflowers. This measure represented an improvement over the existing grass cover, as native wildflowers possess deeper root systems and greater capacity for long-term soil stabilization. The recommended seed mix was the Standard Forb Mix, which could be obtained from the Allendan Seed Company in Winterset, Iowa or an equivalent provider. Seeding practices were recommended to follow the procedures outlined in Section 9010 of the Iowa SUDAS Manual.

To mitigate anticipated erosion associated with increased stormwater runoff into the lake, the design also recommended the installation of riprap along the banks of the outlet stream located on the north side of the lake, detailed in Figure 6.12. Although flow increases were expected throughout the lake system, the outlet conveyed the most concentrated discharge, making it the location most susceptible to erosion and therefore the priority for protection measures.

Figure 6. 11 South Shoreline

Figure 6. 12 Outlet Stream

4. ADA-Compliant Trail System

An interconnected trail system complying with the Americans with Disabilities Act (ADA) and SUDAS design standards in conjunction with AASHTO, was designed in AutoCAD Civil3D to allow for accessible travel methods to all areas of Lake Fisher Park. Specifically, a shared use path was designed to go around Lake Fisher, intended for recreational and fitness purposes. The beginning of this path is marked by a trailhead along with parking on the south side of the site. More details of the trailhead site and its design can be found below. This accessible shared use path branches off into sidewalks to increase connectivity and allow proper access to all proposed site features. Using specifications in the SUDAS Design Manual Chapter 12 – Pedestrian and Bicycle Facilities, the shared path was designated as a Type 3, as the path will primarily serve as a recreation and fitness benefit. Given the lower volume of expected users, the width of this path was set at its minimum allowable value of 10 feet to accommodate two-way traffic. While a recommended surface thickness of 5” is given by SUDAS, the design proceeded with a 6” thick pavement to serve occasional emergency vehicles in the case that a user requires assistance. For cross slopes, a 1.5%

slope is recommended, but per Section 12B-2 – Shared Use Path Design, SUDAS recommends increasing this value if the path will be unpaved, as ours is anticipated to be, to allow for draining water off the path, thus the value was increased to 2%. Following the previously mentioned SUDAS section/chapter, the shared use path was ensured to be separated by at least 6 feet at any section that runs along the existing park road. Given that the path is expected to be an unpaved surface, the design speed was set at 12 mph, giving a respective horizontal curve minimum radius of 27 feet, per Table 12B-2.01 and Table 12B-2.02 in SUDAS Chapter 12 Section 12B-2. Vertical alignments were ensured to comply with the proper stopping sight distance and minimum length requirements for each respective curve per equations 12B-2.02 and 12B-2.01. These alignments were set to follow the existing ground as much as possible to minimize cut and fill, while complying with the grade requirements in Table 12B-2.04. Finally, there are areas in which the trail is forced to cross the existing gravel road to adhere to the previously mentioned restrictions, and in these sections the path is paved 20 feet wider, per figure 12B-2.06. Design of all connecting sidewalks adhered to the same design requirements, aside from the width which was adjusted to lower values depending on the location. While design was done in a manner to allow for evaluation of all material types such as concrete, asphalt, and a compacted granular fill, the recommended material for all proposed trails is Class A compacted stone. The cost for this material is significantly lower than concrete and asphalt and is typical for nature trails. Material quantity estimations were calculated via volume tables in Civil3D. All figures related to the trail design can be found in Appendix A of this report.

5. Workout Areas

Three designated workout areas were placed alongside the multi-use trail to increase opportunities for visitors to exercise and socialize. Each piece of equipment and bench is to be sourced from Kompan, a reliable exercise equipment designer and manufacturer (or an equivalent manufacturer). The areas were designed at various sizes with varying pieces of workout equipment, accommodating multiple groups of people looking to exercise and socialize at the park. These are designed to support teens, adults, seniors, and wheelchair users looking to improve their health in an outdoor space. The dimensions of the areas allow for a safe and comfortable workout space, and each area is spaced out from the others to provide a variety of stopping points for users along the trail. The pieces of equipment within each workout area are spaced adequately based on Kompan's recommendations to ensure safety for the users. Wood chips are to be used as the flooring material to enhance comfortability and aesthetics. A depth of 12 inches is to be used for the wood chips to meet playground safety requirements for shock absorption. Material quantities and costs for the equipment were provided by Kompan and their partner, Crouch Recreation. The overall dimensions of these sites are noted in Figure 6.13.

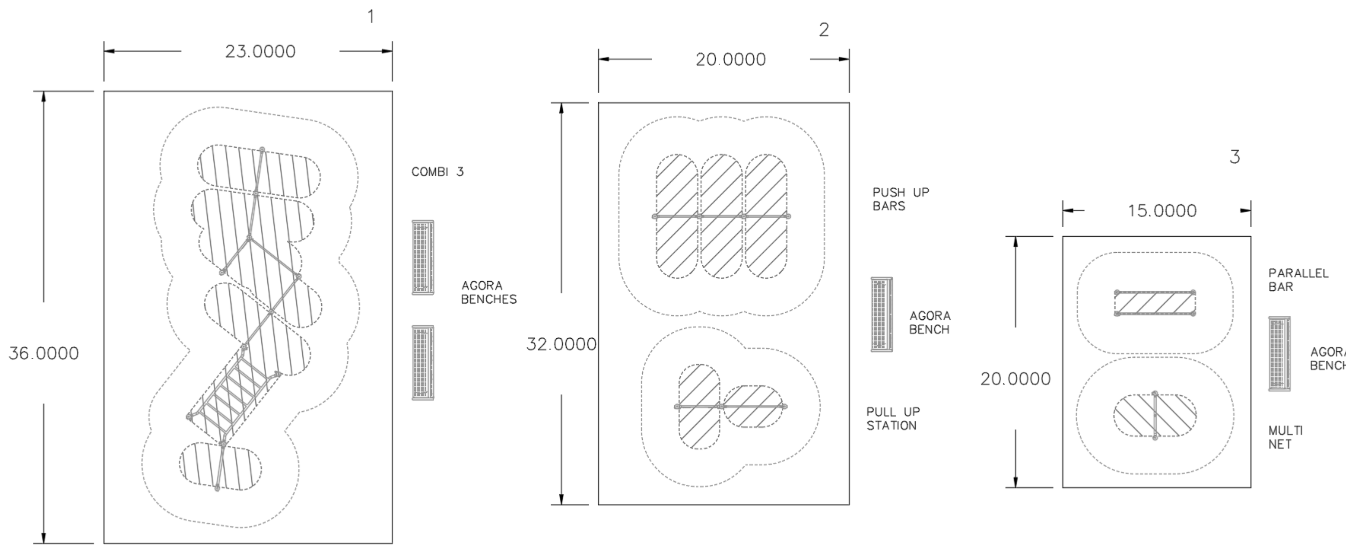


Figure 6. 13 Workout Areas Dimensions

Overall dimensions for Areas 1, 2, and 3 are designed to be 23' X 36', 20' X 32', and 15' X 20' respectively. The dimensions and materials specifications for each of the workout features and benches are provided by Kompan and can be found in Appendix H of this report. This information is also available on their website. Kompan is based in Odense, Denmark, and provide equipment for parks in 20 countries across Europe, North America, Asia/Pacific and the Middle East. Their equipment is highly customizable in terms of color and aesthetics. Crouch Recreation is a park designer and developer based in Omaha, Nebraska, and represents Kompan. Crouch Recreation is able to distribute the equipment to Bloomfield and assist the park development with help from The Henley Group as the installers. The Henley Group are based in Davenport, Iowa.

6. Green Playground

The plan for the green playground was developed shortly after getting in contact with Natural Playgrounds Company, a playground manufacturer and designer. Its general placement was designed to be near the shelter on the west side of the park, which allows for adequate visibility and supervision for families. The playground is separated into two areas, with Area 1 being dedicated to learning, and Area 2 being designed for physical activity. The design services provided by Natural Playgrounds Company are highly customizable in addition to their prefabricated features. The team was able to interpret the details and dimensions of each feature listed on their website to create a preliminary drawing of an adequately spaced playground. The guiding principle of this design was to pay attention to the fall zones of each feature, which are displayed in Figure 6.14. This approach applied more to Area 2 due to it being dedicated to physical activity. A depth of 12 inches is to be used for the wood chips to meet playground safety requirements for shock absorption.

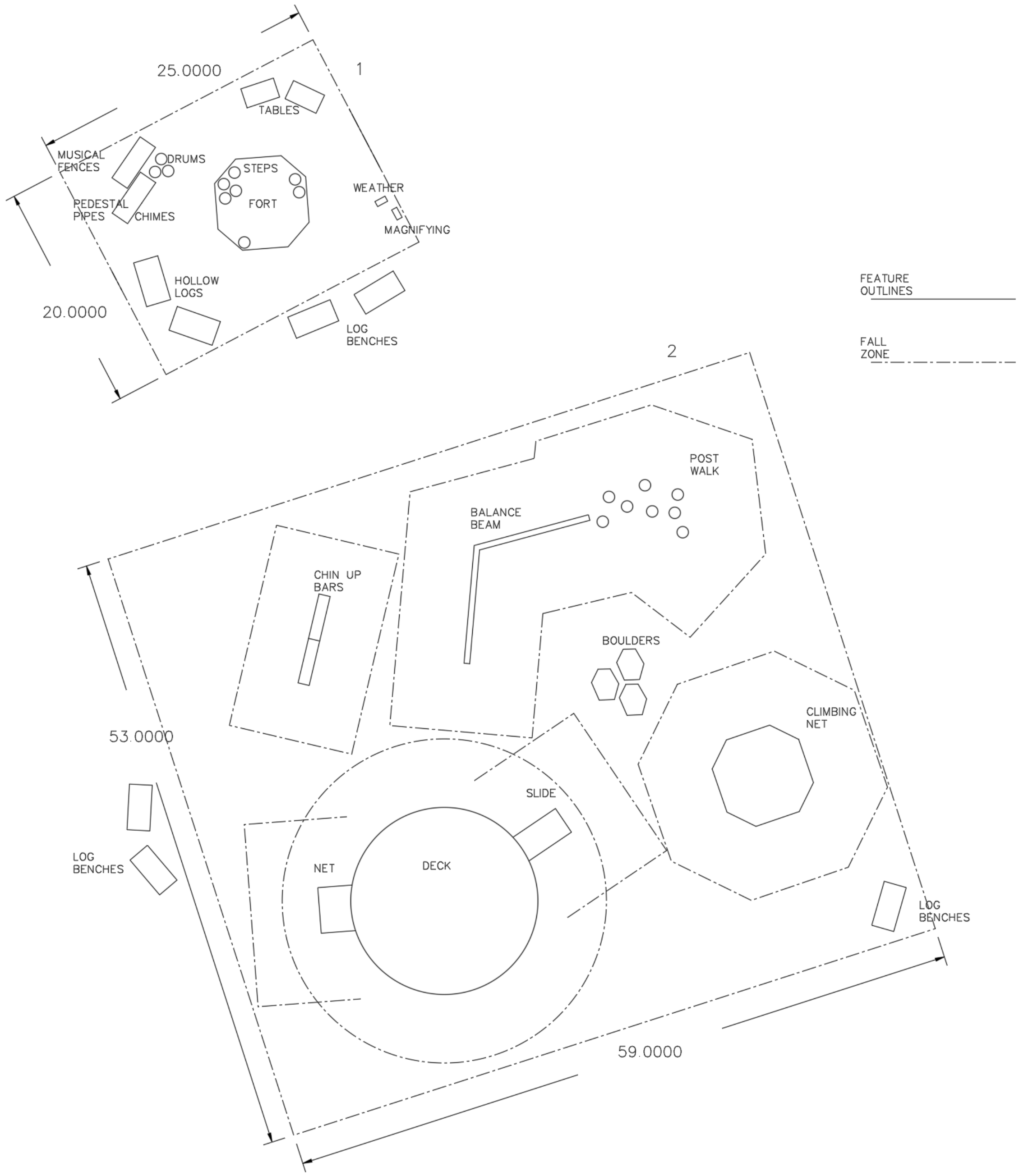


Figure 6. 14 Green Playground Dimensions

The overall dimensions of Areas 1 and 2 are 25’ X 20’ and 59’ X 53’ respectively. The dashed lines within Area 2 refer to fall zones to take note of on certain features such as the deck or the balance beam. Features that have a risk of injury due to falls must have 6 feet of space for clearance, which greatly reduces the risk of additional collisions from falls.

The details regarding the materials and dimensions of each feature in the playground can be found in Appendix G. This information is provided by Natural Playgrounds Company and can be found on their website. There is a large amount of variability for each feature based on design requests, such as making features smaller or larger based on the age of users. The documents on their website are also highly beneficial for understanding the maintenance of their products. Most of their products are made of wood which means they require specific treatment and maintenance procedures year-round with the changing temperatures and weather conditions. These maintenance procedures are also detailed in Appendix G.

7. Rec Area

The recreational court area consists of one full-size high school basketball court and two adjacent courts designed for dual use as both tennis and pickleball courts, responding to client input that existing courts in town are frequently in use and that additional, flexible court space would better serve the community. The basketball court is sized to NFHS high school standards with an 84-foot by 50-foot playing area and a surrounding safety buffer for a total paved footprint of approximately 104 feet by 70 feet, while each dual-use court is dimensioned to standard tennis court guidelines with a 36-foot by 78-foot playing area; pickleball lines are then overlaid using a 20-foot by 44-foot playing area and recommended clearances to allow efficient shared use of the same paved surface. The overall layout, sizing, and striping can be see in Figure 6.15 below. Additionally, the existing frisbee golf course was improved through the addition to trees as obstacles and tee boxes to better mark the location of each starting location.

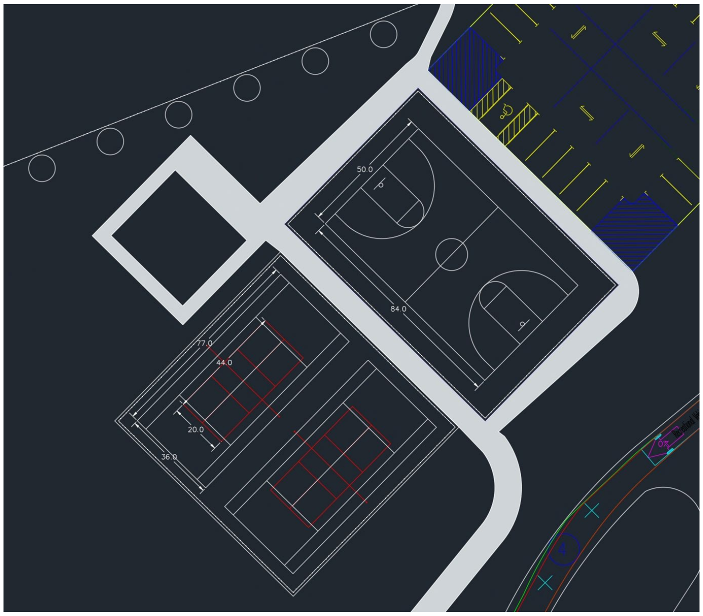


Figure 6. 15 Recreational Courts Dimensions

8. Beaches and Sand Volleyball

New beach areas were proposed on the south and west sides of Lake Fisher to provide designated swimming and shoreline recreation spaces. Each beach will include an adjacent sand volleyball court, and both sites are designed to tie directly into the existing trail system while accommodating high-use recreational activity. Small beach showers will be installed at each location to allow users to rinse off before returning to the parking areas.

Figure 6. 16 Beach locations

Both beaches will consist of a 1-ft-deep layer of washed recreational sand placed directly on the prepared beach surface. The beach grades will be constructed to maintain a 10% slope from the upland edge toward the water, except within the sand volleyball areas. To support consistent recreational use during fluctuating lake levels, sand will extend approximately 10–15 ft into the water at each beach, creating a fully sanded near-shore zone and a smooth transition into the lakebed.

Trails connecting to the beaches will be graded to transition from higher surrounding terrain down to the lake's lower shoreline elevation while maintaining ADA-compliant slopes. Due to steep existing contours, these connections require precise, constrained alignment, resulting in a tight grading corridor that achieves compliance without the need for stairs or retaining structures.

Each beach will include a sand volleyball court positioned outside of the 10% sloped zone to ensure proper playability. Courts will measure 60 ft by 30 ft and will utilize the same washed recreational sand as the main beach areas.

9. Boat Ramp

A dual-lane boat launch facility was designed on the east side of the lake to accommodate increased boating activity anticipated after park improvements, including higher-volume fishing tournaments and general recreational use. The ramp layout follows the Iowa DNR's recommended launch geometry and construction standards, modified to reflect the site's existing grades, shoreline conditions, and water-level variability. All ramp and dock components were drafted and graded in AutoCAD Civil3D to ensure accurate slab placement, elevation control, and ADA-compliant access to the floating dock system.

The launch facility will consist of two parallel concrete ramps separated by an ADA-accessible pedestrian sidewalk that provides continuous access from the parking lot to the gangway and floating dock. Ramp slabs were designed with progressively increasing grades to improve trailer submergence and launching efficiency at both design low water and bank-full conditions. The slabs start from 4% meeting at the parking lot and end at 16% finishing in the water. Reinforcement, slab thicknesses, connection types, and crushed-stone bedding depths follow standard DNR and SUDAS recommendations and are summarized in the Appendix K. All slab connections were detailed to ensure structural continuity and accommodate differential settlement along the shoreline.

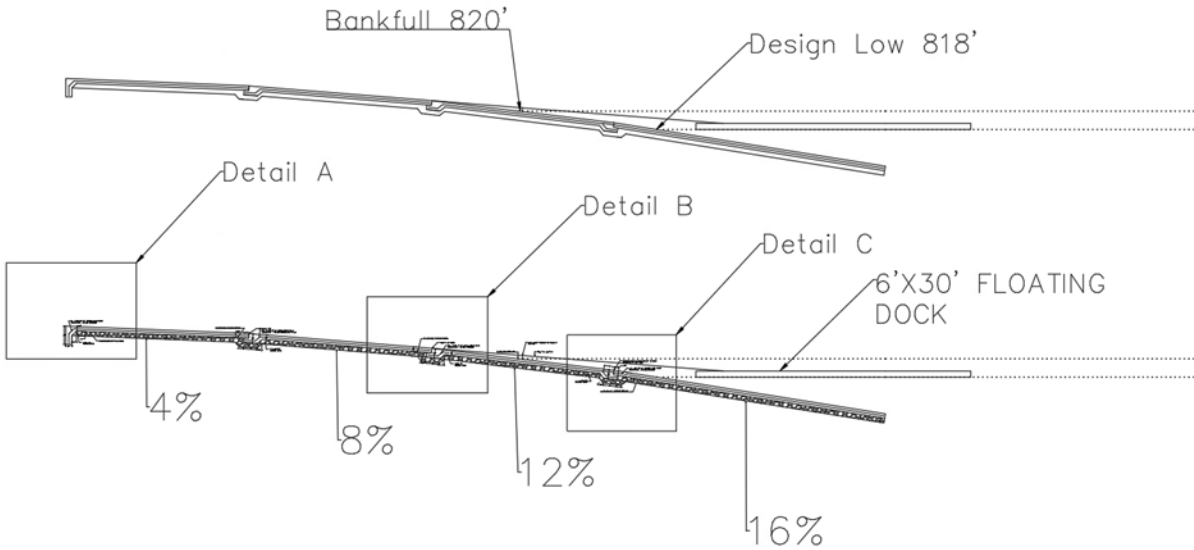


Figure 6. 17 Boat ramp section slopes and side profile with detail locations

The central sidewalk follows the ramp profile until transitioning to a cast-in-place concrete abutment, which provides the support and elevation control necessary for the gangway hinge connection. Both the sidewalk and gangway were designed to maintain slopes less than 1:12 between low-water elevation and bank-full elevation, ensuring year-round ADA compliance regardless of fluctuating lake levels. The selected gangway and floating dock modules are pre-manufactured aluminum units designed to withstand variable loading and water level changes while maintaining accessible widths in accordance with ADA and SUDAS pedestrian standards.

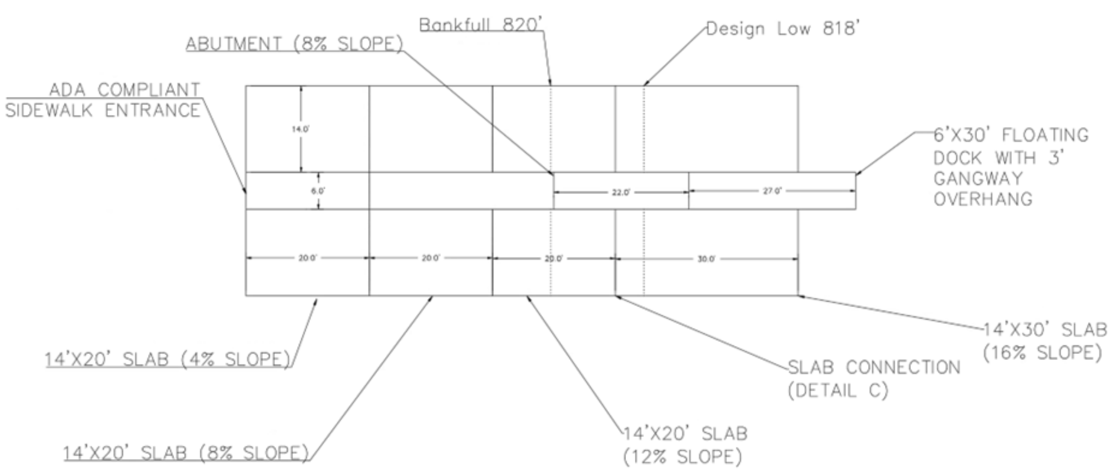


Figure 6. 18 Boat ramp plan view

To protect the shoreline and maintain long-term stability of the launch surface, Class E riprap was placed along both exterior ramp edges and in the zone between the ramps and dock abutment. The final configuration will allow two boats to launch simultaneously while maintaining safe pedestrian circulation, durable access, and compliance with all relevant DNR and SUDAS design guidance.

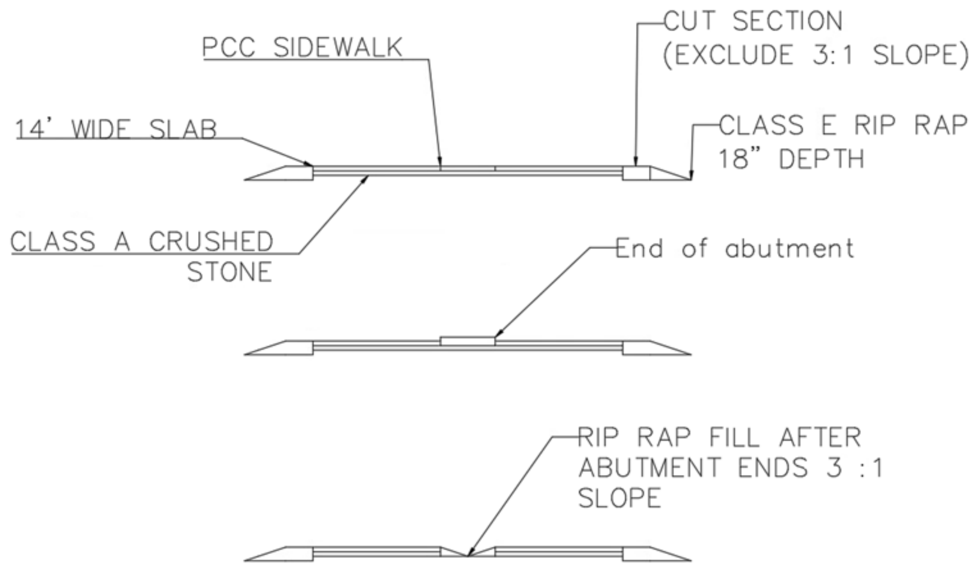


Figure 6. 19 Cross Sectional View of Boat Ramp

10. Docks

Dock System

All proposed docks for Lake Fisher Park are based on designs provided by AccuDock, a manufacturer specializing in ADA-compliant recreational docking systems. AccuDock was selected for its extensive experience with accessible kayak launches, durable floating platforms, and systems engineered to remain stable throughout winter conditions. Their prefabricated ADA-compliant kayak launch, featuring integrated handrails and step-down assistance, addresses a key user need for improved accessibility and ease of entry.

The docks utilize high-density polyethylene (HDPE) floating components to provide the necessary buoyancy, freeze-thaw resistance, and flexibility to accommodate seasonal ice movement. All proprietary hardware and connection details will be installed according to manufacturer specifications. Given the custom requirements of the waterfront access discussed with the client, it is recommended to use either AccuDock custom docks or an alternative manufacturer offering equivalent performance and similar customization capabilities.

Existing Dock Retrofit

The existing dock is currently located on the east side of the lake adjacent to the existing boat ramp. It currently features a straight dock with 3 fingers each 12' from the base of the dock. It is a floating dock design with poles being used to anchor the dock in place which need to be removed each winter. The connection to land is a 4' wide gangway with a roller on top of a concrete abutment. The retrofits will include adding a 25'x16' ADA accessible kayak launch with a 6' wide ADA compliant transition plate. This will allow kayak launching abilities without needing to construct a whole new dock. The next retrofit will include removing the poles and switching to concrete anchor attachments and utilizing 4 concrete anchors to secure the dock in place. This will allow the dock to stay in over the winter by allowing small amount of movement so the ice will not damage the dock. The only required winter maintenance will be detaching the gangway from the dock and moving it landside.

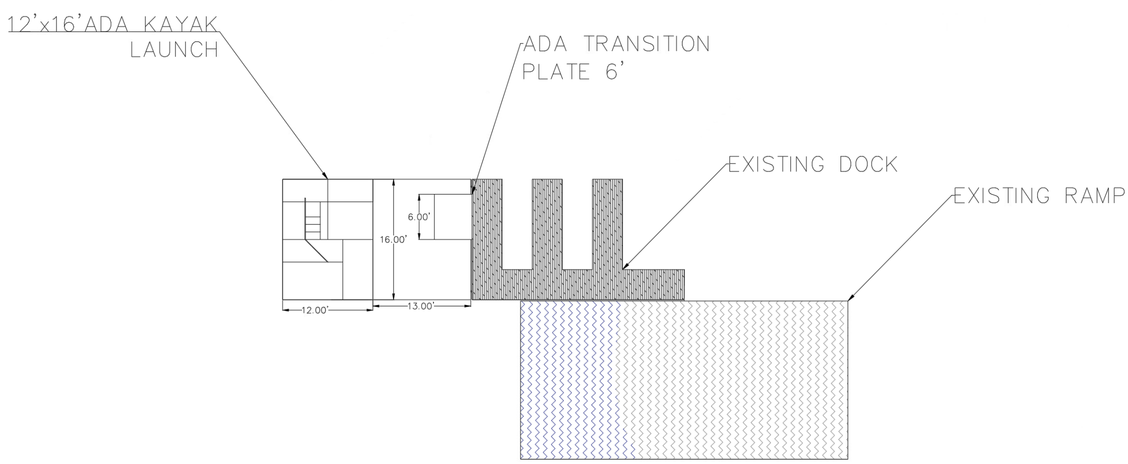


Figure 6. 20 Existing dock retrofits

Dock 1 – Cabin/RV Area Access Dock

Dock 1 is located on the northwest fishing jetty and connects directly to the shared-use trail system, providing boating and kayak access for cabin and RV users. The dock includes a 12 ft × 18 ft ADA-compliant kayak launch, two boat slips sized for standard recreational vessels, and a 6 ft × 25 ft gangway designed to maintain ADA accessibility under both high- and low-water conditions.

The gangway connects to a 4 ft × 6 ft × 1 ft concrete abutment using a hinged joint as illustrated in Appendix K. Dock 1 utilizes Accudock's HDPE floating modules combined with concrete anchoring to allow movement under ice pressure, enabling the structure to remain in place year-round. All required dock-to-gangway and gangway-to-abutment hardware will follow the manufacturer's engineered connection system.

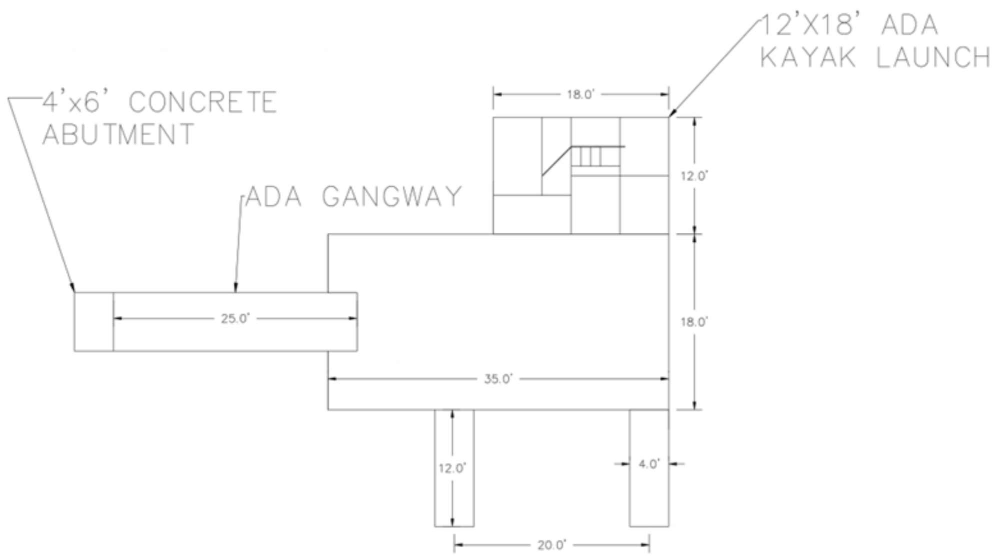


Figure 6. 21 Dock 1 Drawing

Dock 2 – West Dock

Dock 2 is located on the west side of the lake near the primary parking area and serves as a small kayak launch and recreational swimming dock adjacent to the beach. It connects to the trail system via a 4 ft × 6 ft concrete abutment with a hinged connection. An 18 ft ADA-compliant gangway accommodates seasonal water-level changes while maintaining accessible slopes.

This dock is a floating HDPE system designed to remain in the water during winter months. It features an Accudock kayak launch integrated into a "strong-arm" structural layout, enabling secure support without the use of traditional anchors.

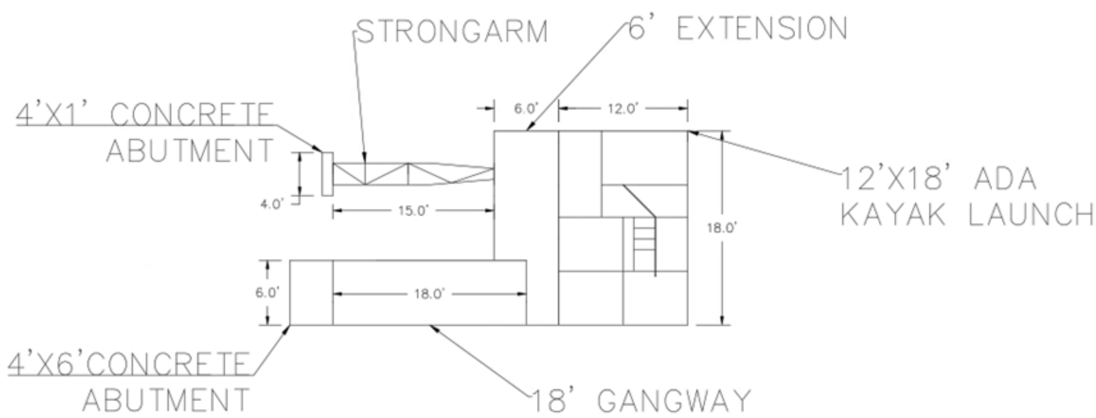


Figure 6. 22 West dock drawing

Dock 3 – Venue Dock

Dock 3 was designed as the largest of the three dock systems and was intended to provide functional access and gathering space for the venue area. It contains two 16-ft-wide boat slips to accommodate multiple guest vessels, along with a standard Accudock ADA-compliant kayak launch. The right wing of the dock was designed as a trail-connected overlook area to support photography, seating, and small gatherings related to events.

This dock will utilize HDPE floating modules and will be secured with concrete anchoring to allow flexibility under ice loading. It will be connected to the upland trail system using two 32-ft gangways, each tied to separate 4 ft × 6 ft concrete abutments. All components, including railings and potential benches on the right wing, maintain ADA compliance throughout expected water-level fluctuations.

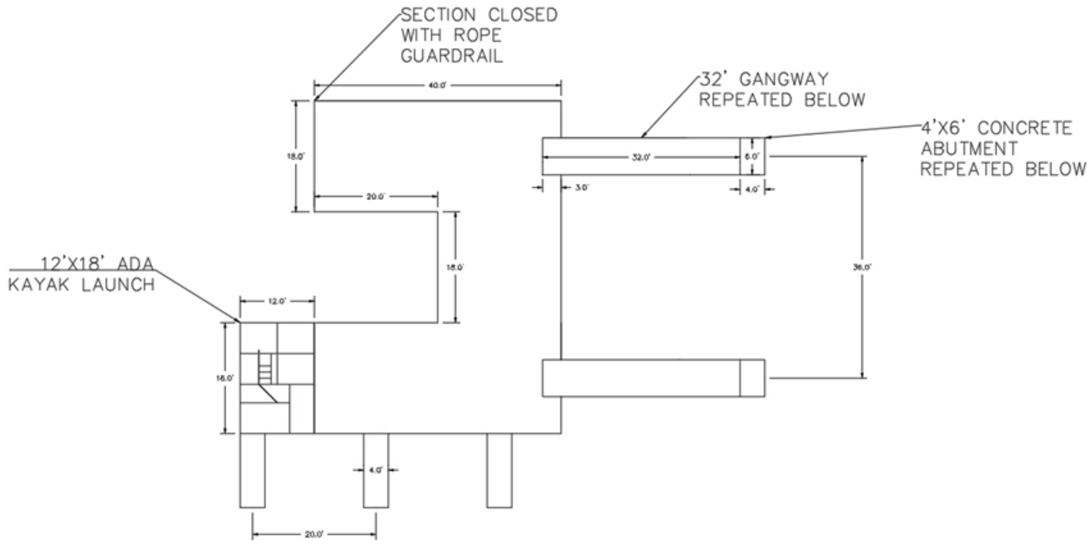


Figure 6. 23 Venue dock drawing

11. Dog Park

The dog park on the northwest corner of the park area was split into a large dog area, and a small dog area. This was done for both safety purposes and to increase draw and availability to the people of Bloomfield and beyond. The design for the dog park is shown below in Figure 6.24.

Figure 6. 24 Dog park location and sectioning

The large dog section was designed to have an area of 1 acre as suggested by AARP Livable Communities. This was done to prevent overcrowding while also allowing visitors to safely control their dogs. Several dog agility obstacles were included such as a jump over, jump hoop, weave poles, and paws table. Benches and a water fountain were provided to allow access to water and comfort to both the owners and the dogs in both the large and small dog enclosure. The small dog zone was designed to have an area of 0.2 acres. To enter the dog park, there will be a double fence entrance to prevent the dogs inside of the park from being let out while a new dog is entering. Trees are proposed to be planted surrounding the dog park on the north and south side in order to provide shade and separate the park from the road. A new parking lot was also designed by the dog park to provide quick access. Finally, a waste removal supply stand was provided and includes a container for waste disposal bags, and a small trash can.

12. Parking Lots

Trailhead Parking

The trailhead parking lot on the south peninsula of Lake Fisher was designed to serve the venue, the beach, and visitors using the trail system. The number of parking spaces was selected based on the anticipated demand for these combined uses. The venue's estimated seating capacity is 200 people. According to Iowa SUDAS Section 8C-1.01, the closest applicable classification for determining minimum parking requirements is a church or theater, which requires 0.4 parking spaces per seat. This results in a minimum of 80 required spaces.

However, because the lot must also accommodate beachgoers and trail users, the team determined that providing parking closer to the venue's full seating capacity would be more appropriate. Using the Civil 3D built-in parking tool and applying the required stall size of 9' × 17.5' per the ITE Guidelines for Parking Facility Location and Design, the lot layout was developed. Parking lots are typically designed with a width at least twice the stall length; the resulting overall lot dimensions are approximately 183 ft × 375 ft.

With these dimensions, the projected parking count ranged between 201 and 300 spaces. Based on Iowa SUDAS Section 8C-1.02, this range required 7 ADA-accessible parking stalls. The final design provides 217 total spaces, including 7 ADA-accessible stalls. Spaces are arranged along the perimeter and in two double-sided interior rows. A swept-path analysis confirmed that a garbage truck can safely maneuver through the lot without encroaching on any parking stalls.

For every parking lot the surface will by 6" granular surfacing, class A compacted gravel. To indicate each individual stall there will be concrete stoppers and for ADA accessible stalls there will be ADA signs.

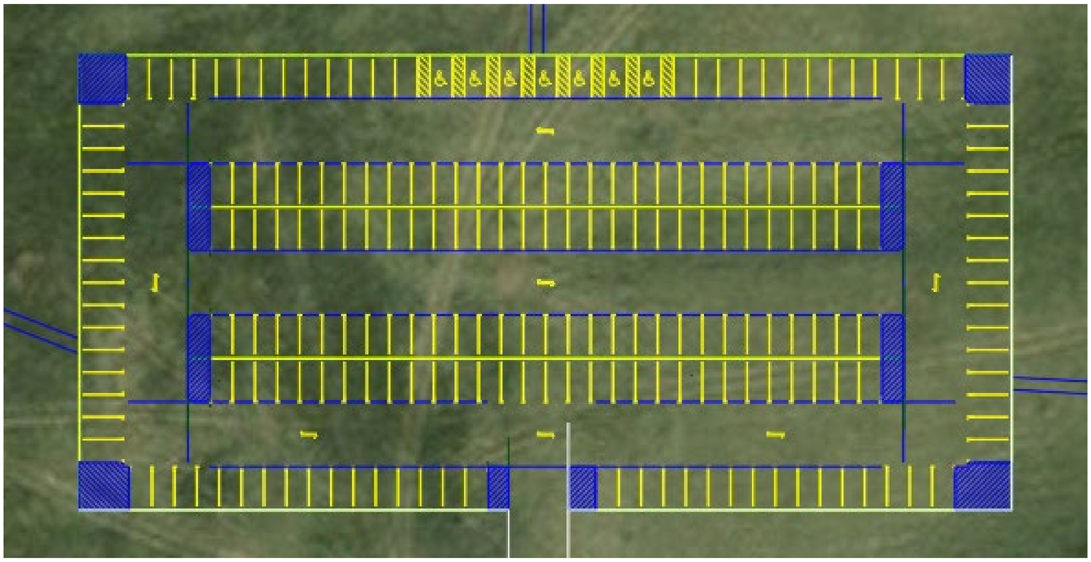


Figure 6. 25 South peninsula parking lot

Similar to the trailhead parking lot, the design of the remaining parking areas follows the same overall logic. All standard parking stalls measure 9 ft × 17.5 ft and meet the ITE *Guidelines for Parking Facility Location and Design*. These additional parking areas serve the recreational zone, the existing pavilion, and the new East Boat Ramp.

Recreation Area Parking

The recreational area parking lot was designed to support the basketball court, two tennis/pickleball courts, and the restroom facility. No minimum number of required stalls exists for this type of amenity grouping, as such an estimated 21 stalls— including one ADA-accessible stall per Iowa SUDAS 8C-1.02—were provided. This estimate was based on anticipated usage: approximately 10 users for the basketball court, 4 users for the tennis/pickleball courts, and an additional 7 users for restroom and trail access.

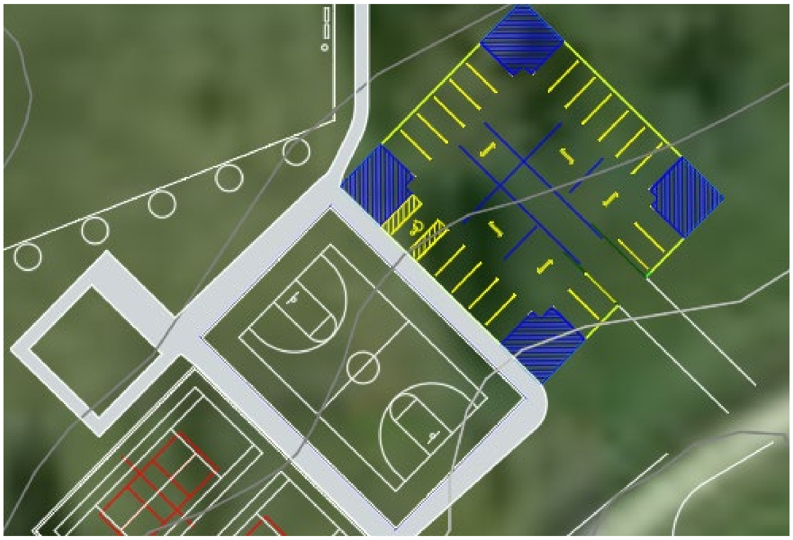


Figure 6. 26 Recreation area parking

Existing Pavillion Parking

The parking lot serving the existing pavilion and softball field was designed similarly to the current lot but expanded to accommodate increased attendance. Although the original layout only included stalls on the west side, the new configuration adds parking on the north and south sides. The final layout includes 25 stalls, with one ADA-accessible stall provided per Iowa SUDAS 8C-1.02. An additional area including hitching post was designed to serve the Amish community.

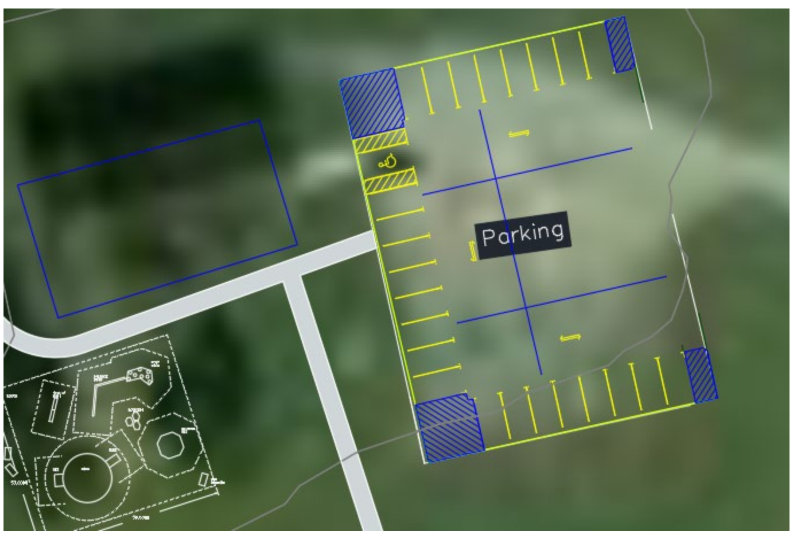


Figure 6. 27 Existing pavilion parking

East Boat Ramp Parking

The East Boat Ramp parking lot required a different design approach to account for the larger vehicles and trailers typically used by boaters. On the north side, six standard 9 ft × 18 ft stalls are provided, while the south side includes 9 ft × 40 ft stalls suitable for vehicles pulling trailers. The layout also incorporates a 40-ft maneuvering aisle to allow large trailers adequate space to turn and back into place.

Figure 6. 28 East Boat Ramp Parking

13. RV Lot

The primary objective for the RV lot was to expand the available capacity while improving site accessibility and circulation. To achieve this, a 30-ft two-way through lane was introduced along the north–south axis of the existing site. Five RV stalls were positioned on each side of this central lane. The east-side stalls were set at a 45° angle oriented to the northeast, while the west-side stalls were set at a 45° angle oriented to the southwest. This angled configuration maximizes the number of stalls within the constrained site area and provides improved maneuverability for large RVs.

Each stall measures 80 ft in length and 18 ft in width, providing ample space for modern recreational vehicles and trailers. All stalls include electrical and water hookups, benches, as well as dedicated campfire areas for evening use. To save on costs, instead of a sewer system a RV dump station will be placed to the northwest of the campground providing easy access from every stall. There will also be a restroom near the site with showers for the campers. Stalls are spaced approximately 50 ft apart to ensure adequate separation and user privacy.

The east-side stalls were designed to connect directly to an exit lane to facilitate efficient outbound movement. On the west side, the existing access road was realigned to allow each stall to connect through to the roadway, improving circulation and reducing the need for backing maneuvers.

The material of the surface was selected as 6” granular surfacing, class A compacted gravel. See below for the layout and swept-path analysis.

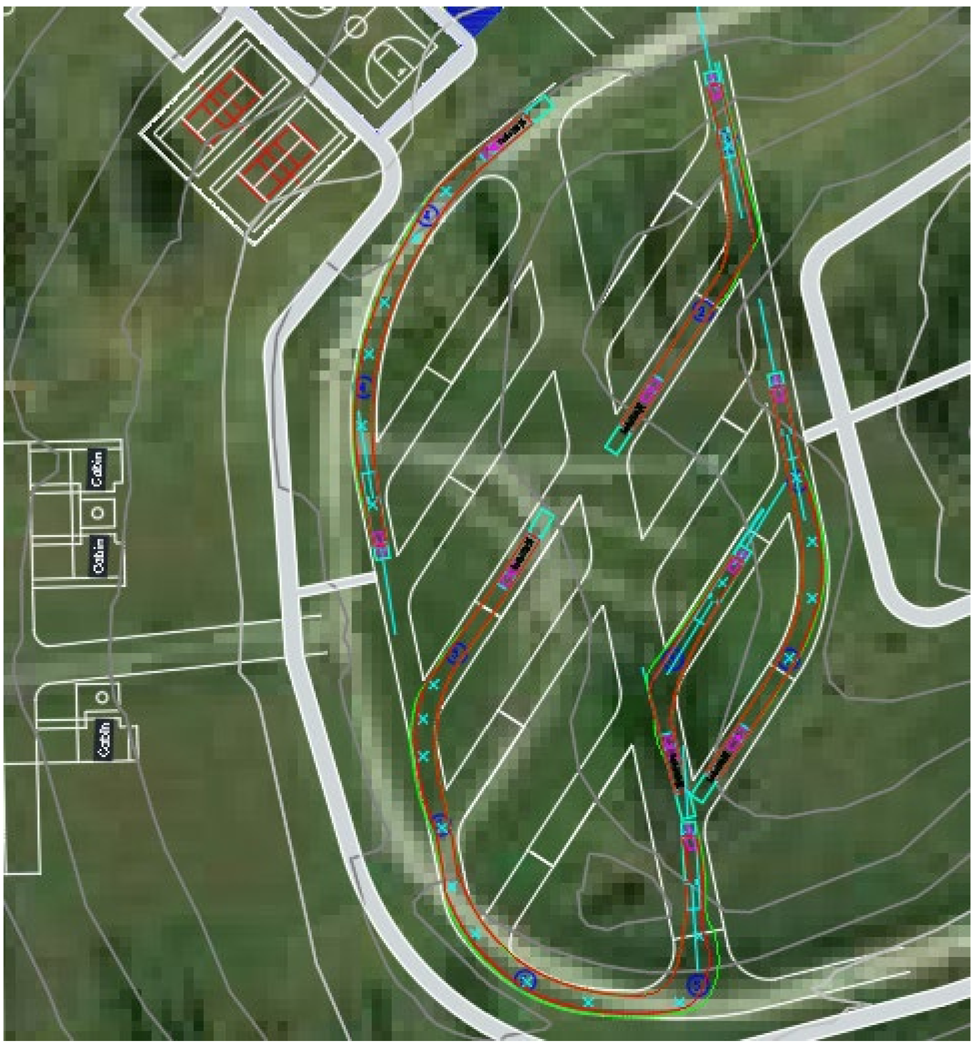


Figure 6. 29 Swept Path Analysis of Layout

14. Cabins

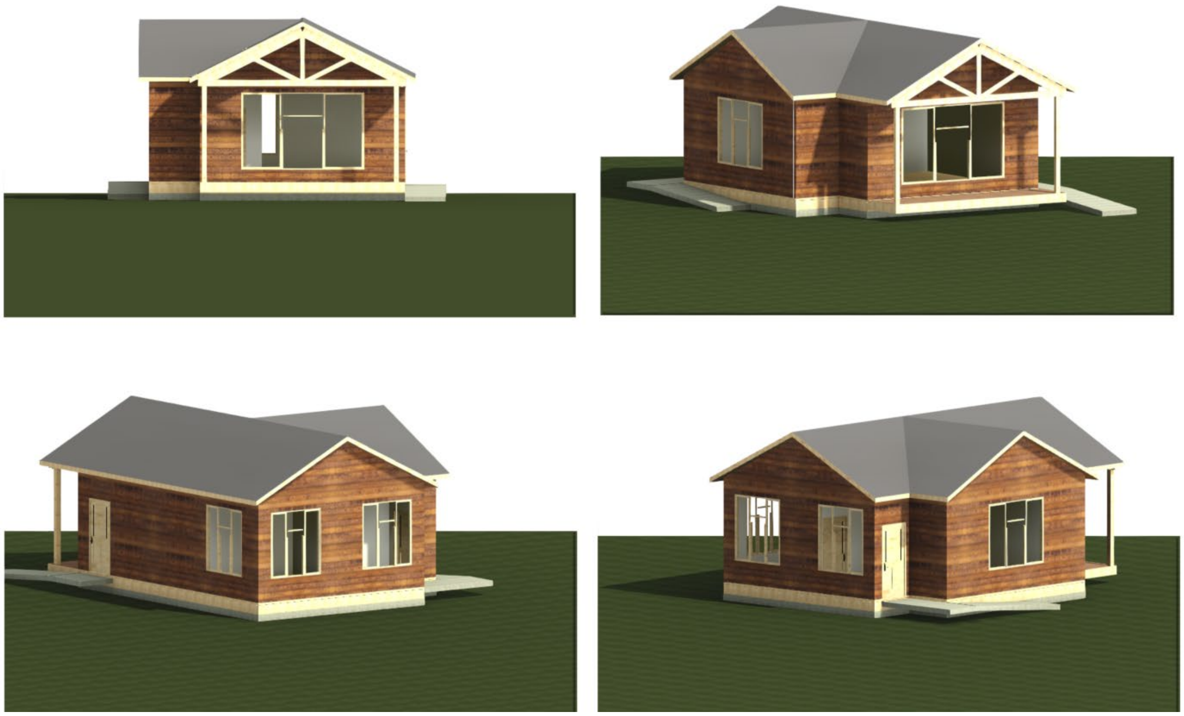


Figure 6. 30 Cabin Renders

When designing the cabin structures, the client indicated a preference for a natural wood appearance that blended seamlessly with the surrounding landscape. This aesthetic preference guided the overall design concept and informed the selection of materials, finishes, and structural components. The cabins will be intended for year-round use, with one of their primary functions being to provide comfortable and durable accommodation for hunters and traveling families during the winter season. To meet this goal, the design focused on creating energy-efficient spaces capable of withstanding cold temperatures while preserving an inviting interior atmosphere.

The project consisted of a total of six identical cabins organized on a site that would allow for incremental additions to the site depending on observed demand. Structural design considerations followed the National Design Specification (NDS) for Wood Construction published by the American Wood Council, ensuring compliance with industry standards and best practices. All major framing components were analyzed for bending, shear, and compression under typical environmental and occupancy loading

- **Roof System:** The roof framing utilized Southern Pine No. 1 roof trusses composed of 2x12 top chords, 2x8 bottom chords, and 2x6 webs, selected after confirming their capacity to support dead, live, snow, and wind loads. Of note for this design is the use of both rigid and fiberglass batt insulation to achieve higher than standard insulation values which can not only decrease heating costs in the winter but possibly be designed to meet standards to receive additional grant money.
- **Floor System:** Because the cabins were designed with a crawl space to protect the structure from moisture and insulate the interior, the floor joists were designed using Southern Yellow Pine No.2, 2x10 lumber. These joists provide both the strength and stiffness necessary for long-term residential use.
- **Wall Framing:** Exterior walls were framed with Southern Pine No. 2, 2x6 studs. This stud size is standard for residential construction also allows for sufficient insulation thickness to support winter occupancy.

These selections ensure that each cabin meets the structural requirements for year-round living while delivering the natural wood aesthetic desired by the client. Comprehensive calculations for these components are documented in Appendix N.

In addition to the primary framing, the cabins feature exposed timber beams at the porch and entry areas to emphasize the outdoor, rustic character. These are both functional structural elements and provide an eye-catching decorative element to the 6 structures. Structural analysis confirmed that 8x8 Southern Pine No. 2 posts and appropriately sized beams provide more than sufficient support for roof overhangs and porch loads. Full calculations for these elements are included in Appendix N.

Each cabin rests on a reinforced concrete foundation designed to ensure long-term durability. The USDA Soil Survey identified the site soil as sandy loam with an allowable bearing pressure of 2,500 psf. Based on structural analysis (Appendix I), the footings for each cabin were designed as square spread footings measuring 3 feet by 3 feet, resulting in a bearing pressure of 1,120 psf and a factor of safety of 2.2.

Overall, the cabin design successfully integrates structural integrity with the natural wood aesthetic envisioned by the client. By combining exposed timber elements, insulated framing, and a durable foundation system, the final design provides comfortable, reliable lodging suitable for hunters and other guests throughout the year.

15. Venue

When designing the venue, the client requested that it resemble the pavilion at Honey Creek Park. This served as the primary inspiration for the overall concept. The goal was to create a large, open space that could accommodate a variety of events while maintaining a natural and inviting aesthetic. To achieve this, the design incorporated wide-span timber trusses paired with substantial timber columns and girders, ensuring both structural integrity and visual appeal. The trusses were designed to span 45 feet, supported by robust timber elements that complement the open layout.

Structural design considerations were guided by the National Design Specification (NDS) for Wood Construction published by the American Wood Council, ensuring compliance with industry standards and best practices. Each truss component was carefully analyzed for strength and performance under expected loads:

- Top Chords: After completing tensile and bending checks, Southern Pine Grade 1, 2x6 dimensional lumber was selected for its strength and durability. Each truss requires approximately 48 feet of this material.
- Bottom Chords: Compression checks indicated that Southern Pine Select Structural, 2x8 lumber was the most suitable choice. Each truss uses 45 feet of this grade.
- Web Members: Evaluated for both tensile and compressive strength, the webs utilize Southern Pine Grade 2, 2x4 lumber, totaling 60 feet per truss.

These selections ensure that the trusses meet all structural requirements while maintaining the desired aesthetic. Detailed calculations for all truss members are provided in Appendix C.

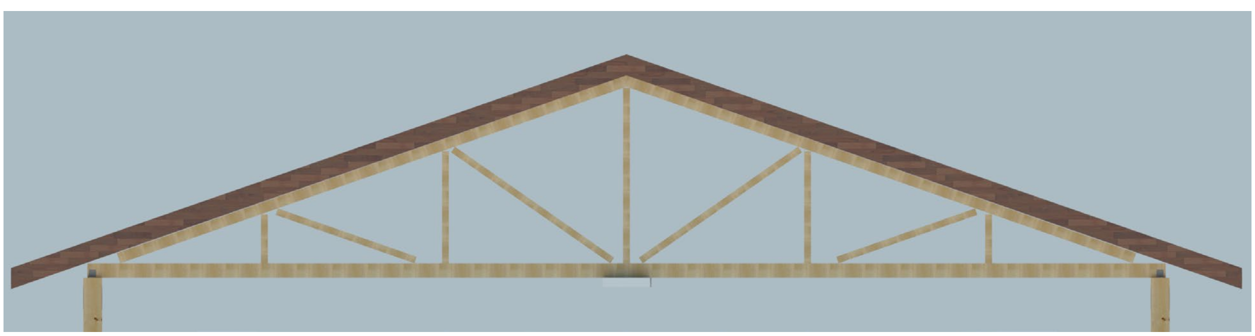


Figure 6. 31 Venue trusses

In addition to the trusses, the girders and columns were designed using timber to preserve the natural aesthetic throughout the park. Oversized timbers were chosen intentionally to create a visual effect reminiscent of a forest canopy, reinforcing the connection between the venue and its surroundings. Structural analysis confirmed that 10x10 Southern Pine Grade 2 columns provide more than sufficient support for the anticipated loads. Girders were incorporated to reduce spacing between trusses while allowing columns to remain separated, preserving the open design without compromising stability. Full column and girder calculations are included in Appendix C along with the venue calculations.

Figure 6. 32 The Venue located on the south peninsula

The flooring consists of a 6-inch concrete slab, reinforced with #5 rebar spaced at 24 inches in both directions, meeting industry standards for durability and load-bearing capacity suitable for concerts, weddings, and other large gatherings. For the foundation, each column required a square footing to distribute loads effectively and prevent settlement. Using the USDA Soil Survey, the allowable bearing pressure of the loam soil was determined to be 43.5 psi. Based on structural calculations (see Appendix C), the square footings were sized at 6 feet by 6 feet, resulting in a bearing pressure of 11.7 psi and providing a factor of safety of 3.7. This ensures that the foundation system is robust and capable of supporting the venue under all anticipated conditions. Thorough calculations for the foundation design are provided in Appendix I.

Overall, the design successfully integrates structural performance with aesthetic considerations, creating a venue that is both functional and visually appealing. The use of natural timber elements and open spans reflects the client's vision while adhering to engineering standards for safety and reliability.

16. Restrooms

Recreational Area Restroom

The primary considerations for the restroom facility near the recreational area were year-round usability and energy efficiency, while also enhancing the overall appeal of the campsite. To make the restrooms a key attraction, the design includes not only standard restrooms but also laundry facilities and spacious showers. This provides RV users with access to larger, more comfortable showers than those typically found in their vehicles, as well as the convenience of on-site laundry services, eliminating the need for trips to off-site laundromats.

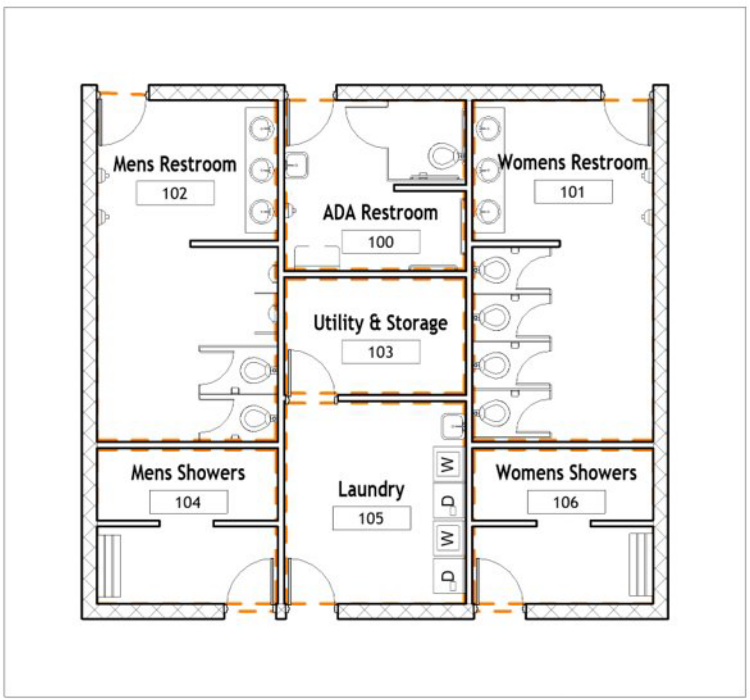


Figure 6. 33 Recreation area restroom layout

A major design priority was ensuring the restroom building operates efficiently and sustainably. The exterior walls will be constructed using 12-inch CMU (Concrete Masonry Unit) block, which offers excellent insulation properties for year-round thermal performance while also providing structural support for the roof system. To further enhance sustainability, the roof will feature a 5-kW solar power system, ideally suited for the building's east-west orientation and 3/12 slope. Based on irradiance data for Bloomfield, the system will utilize 330-watt panels, requiring a total of sixteen panels to achieve the desired capacity. Additional battery storage can be incorporated, with options such as 300 Ah batteries available for approximately $500 each. All lighting within the restroom will utilize LED fixtures, significantly reducing energy consumption. Other energy-efficient features include an electric heating system, electric water heater, and air hand dryers, all of which can be powered primarily by the solar system and supplemented by the municipal grid during periods of low solar irradiance.

Figure 6. 34 Recreation area restroom rendering

The restroom layout was designed to accommodate a high volume of users while meeting accessibility standards. It includes two urinals and six stalls, along with one ADA-compliant stall in the family restroom. The family restroom also features an ADA-compliant shower and a baby changing station. Plumbing will be centralized within interior partition walls to prevent freezing during cold weather and to simplify maintenance. A dedicated utility room will house the HVAC system, plumbing components, solar storage batteries, and the power transformer, ensuring efficient organization and accessibility.

Structural integrity will be achieved through reinforced CMU walls and a concrete slab foundation. The 12-inch CMU block walls will be reinforced with #5 rebar every 16 inches vertically and every 24 inches horizontally. The floor slab will consist of a standard 6-inch concrete slab reinforced with #5 rebar spaced at 24 inches in both directions. A spread footing system was selected for its simplicity and effectiveness in distributing loads. The total footing area will be 560 square feet, resulting in a bearing pressure of 7.517 psi, which was well below the allowable limit and provides a factor of safety of 5.8.

Figure 6. 35 Alternative view of rendered recreation area restroom

This design ensures the restroom facility is not only functional and accessible but also energy-efficient and structurally sound, aligning with modern sustainability goals while enhancing the overall user experience at the RV park.

Trailhead Restroom

The primary considerations for the restroom facility near the venue were guest comfort, accessibility, and aesthetics, while also ensuring energy efficiency and structural integrity. To enhance the overall experience for guests, the restrooms will feature large mirrors and upscale finishes, creating a functional space suitable for formal and informal events. The layout includes two urinals, four stalls, and an ADA-compliant family restroom, ensuring accessibility for all guests and compliance with modern building codes. These accommodations were designed to handle high occupancy during large events while maintaining a clean and inviting atmosphere.

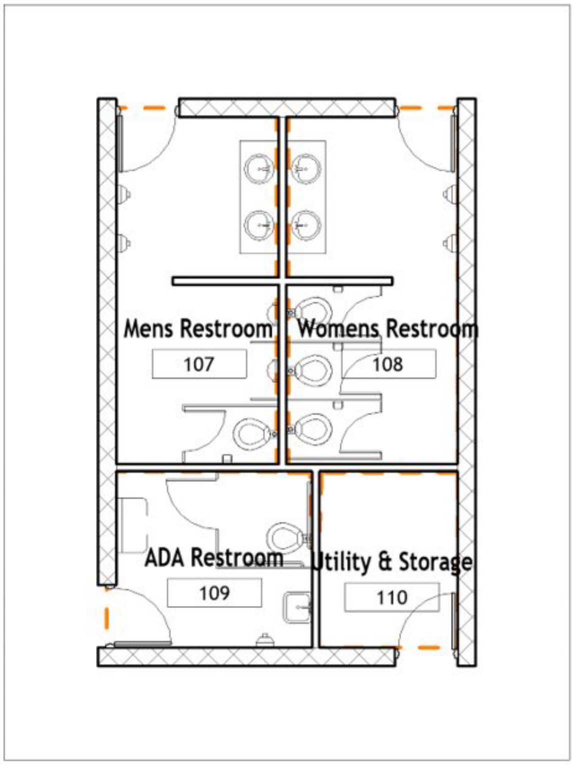


Figure 6. 36 Trailhead restroom layout

The utility room, while no longer centralized, remains fully enclosed and insulated to protect equipment from environmental exposure. It will be constructed using 12-inch CMU (Concrete Masonry Unit) block walls with insulation, providing durability and thermal efficiency for the venue's operational needs. This space houses essential systems such as HVAC components, plumbing connections, and electrical infrastructure, ensuring efficient organization and ease of maintenance.

Structural integrity will be achieved through reinforced CMU walls and a concrete slab foundation. The restroom and utility areas utilize 12-inch CMU block walls, which offer excellent insulation properties for year-round thermal performance while providing robust structural support. The floor slab will consist of a standard 6-inch concrete slab reinforced with #5 rebar spaced at 24 inches in both directions, meeting industry standards for durability and load-bearing capacity.

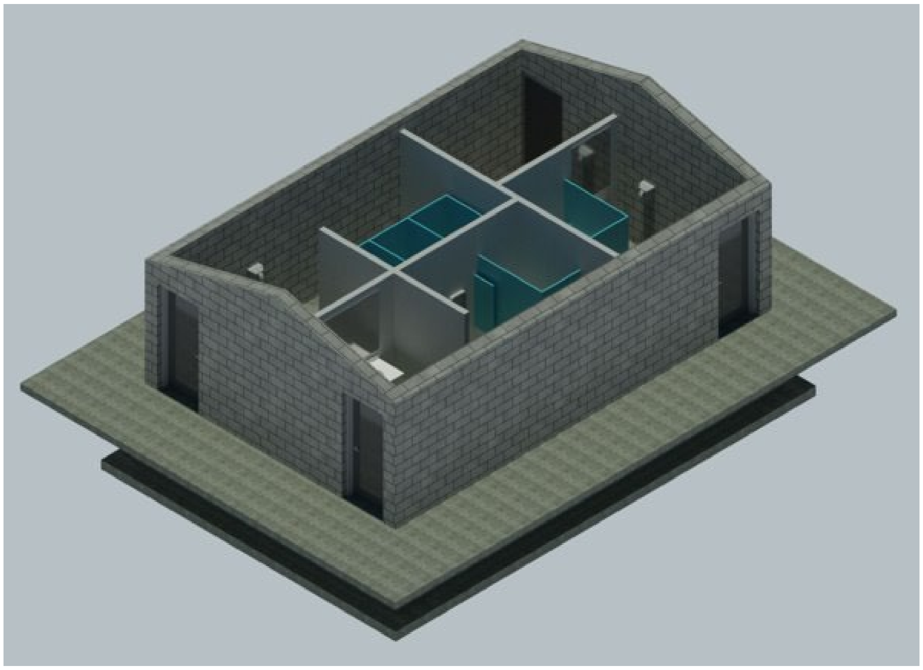


Figure 6. 37 Rendering of trailhead restroom showing layout

For the foundation, a spread footing system was selected to effectively distribute loads. Based on structural calculations, the total footing area is 395 square feet, resulting in a bearing pressure of 6.55 psi, which is well below the allowable soil bearing capacity and provides a factor of safety of 6.6.

Figure 6. 38 Alternative view of rendered trailhead restroom

Existing Pavilion Restroom

The restroom facilities for the existing pavilion near the softball field were designed with simplicity, accessibility, and durability as the primary considerations. As this is an existing structure intended for seasonal use only, no foundation modifications were required, and the design focused on providing essential amenities for visitors during events.

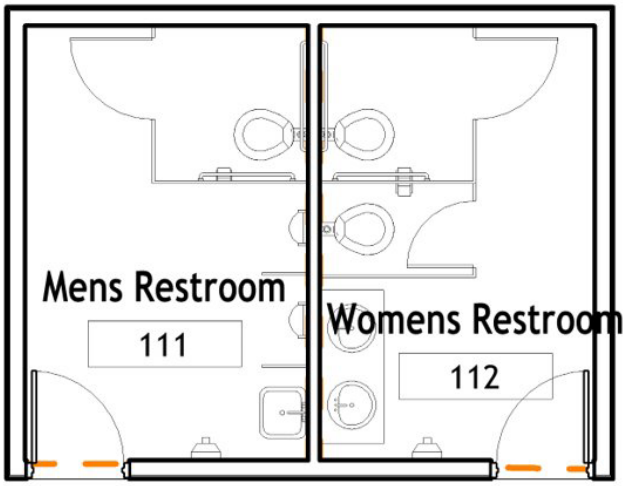


Figure 6. 39 Existing Pavilion restroom layout

The restroom layout includes two urinals, one standard stall, and two ADA-compliant stalls—one in each restroom—ensuring compliance with accessibility standards and convenience for all users. The design prioritizes functionality and ease of maintenance, with finishes selected for durability rather than decorative features.

Unlike previous designs, this restroom does not include a utility room or complex mechanical systems. The structure uses insulated stud walls with wood siding, offering a cost-effective and aesthetically pleasing solution that complements the surrounding park environment. This approach provides adequate thermal performance for seasonal use while maintaining durability against outdoor conditions.

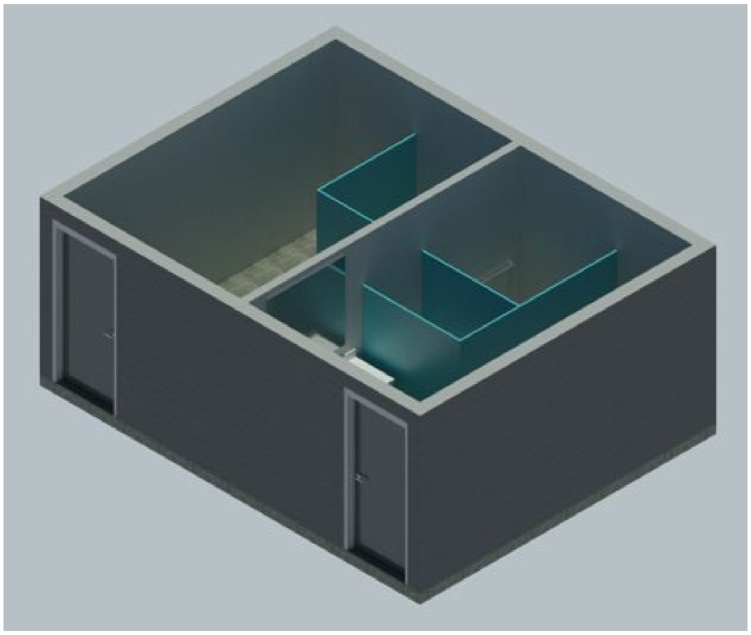


Figure 6. 40 Rendering of Existing Pavilion restroom

Lighting and ventilation systems are designed to meet standard requirements for comfort and safety during events. Plumbing is simplified to reduce maintenance needs and accommodate the limited operational period.

This restroom design provides a practical and accessible solution for the pavilion, meeting ADA requirements and offering essential amenities for visitors. By using insulated stud walls with wood siding and eliminating unnecessary complexity, the facility ensures functionality and ease of maintenance while aligning with the seasonal nature of the venue.

17. Fish Population Management

Historically, the overpopulation of three fish species—Common Carp, Yellow Bass, and Gizzard Shad—has contributed to persistent water quality and ecological challenges within Lake Fisher. These species, identified by both the City of Bloomfield and the Iowa Department of Natural Resources (IDNR), negatively influence lake clarity, nutrient balance, and the stability of desirable fish populations.

Common Carp are benthic feeders that disturb lakebed sediments while foraging. This activity resuspends solids and nutrients, leading to increased turbidity and elevated phosphorus levels. The resulting nutrient enrichment promotes algal blooms, which can restrict sunlight penetration, inhibit aquatic plant growth, and reduce dissolved oxygen concentrations.

Yellow Bass, a small predatory species known for rapid reproduction, prey on the young of more desirable fish species and compete directly with larger sport fish for forage. Their proliferation disrupts balanced predator–prey dynamics and hinders the establishment of a healthy, diverse fishery.

Gizzard Shad further compound water quality issues by consuming zooplankton—the primary food source for juvenile game fish—and by feeding on bottom detritus. This behavior resuspends phosphorus-rich organic material, exacerbating the potential for algal blooms. Collectively, these impacts can reduce water quality to levels that increase the likelihood of periodic fish kills.

Following consultation with the IDNR, the agency indicated that the only effective method for fully removing these overpopulated species is the application of rotenone. Rotenone is a plant-derived piscicide that interrupts the oxygen uptake mechanism in fish gills. The IDNR advised that, to allow Lake Fisher to achieve long-term ecological restoration, a whole-lake treatment using a sufficiently high concentration of rotenone would be necessary to eliminate the existing fish community.

Such an intervention would be conducted under the IDNR's ongoing Lake Restoration Program. During discussions with the IDNR, several considerations and constraints were identified. First, rotenone requires time to naturally break down within the water column, during which recreational use may be limited. Second, strict measures must be implemented to prevent rotenone discharge through the primary outlet structure to avoid impacts on downstream waterways. Third, a detailed fish restocking plan must be established to ensure the timely reintroduction of desirable sport and forage species following treatment.

18. Water Quality

A comprehensive water quality investigation was conducted to identify any constituents of concern within Lake Fisher. Five samples were collected from key hydrologic locations, including the southwest inlet, southeast inlet, the area north of the berm on the southeast shoreline, the west side of the lake, and the outlet at the north end. A map showing the sampling locations is provided in Appendix E.

These samples were analyzed in collaboration with the Center for Health Effects of Environmental Contamination at the University of Iowa and evaluated for general water quality parameters, major ions, PFAS compounds, metals, pesticides, herbicides, insecticides, and fungicides. The results indicated no major water quality concerns for the lake as a whole. However, the southeast inlet exhibited the poorest water quality among the sampling locations, which was expected given that its sub watershed drains both agricultural land and a large urban area compared to other sub watersheds draining to the lake. This inlet demonstrated the highest concentrations of E. coli, nitrate, ammonia, turbidity, PFAS, several metals, and the insecticide imidacloprid. All water quality data collected can be found in Appendix E.

To improve overall water quality within Lake Fisher, a multi-faceted strategy is recommended. The first component involves the removal of overpopulated fish species that negatively affect lake clarity and nutrient dynamics, consistent with IDNR restoration guidance. The second focuses on enhancing natural treatment processes through the construction of wetlands at both major inlets, which will help remove contaminants, reduce sediment loading, and improve ecological function. The third recommendation emphasizes community engagement within the upstream watershed to communicate water quality goals and promote practices that reduce pollutant runoff into the lake.

19. Wetlands

The planting of wetland areas is recommended at both the southeast and southwest inlets of Lake Fisher. The primary design objectives include enhancing wildlife habitat, improving opportunities for hunting and fishing, and increasing the visual quality of the inlet areas. In addition to these ecological and recreational benefits, the selected vegetation will support pollutant removal through biological uptake and by providing surface area for microbial communities that facilitate biodegradation.

Sediment capture ponds were originally constructed at these inlet locations in the 1990s. For the current design, the procedures outlined in Section 9.08 and Chapter 3 Section 6 of the Iowa Stormwater Management Manual (ISWMM) were applied to confirm that the existing sediment forebays and ponds provide adequate storage for the required Water Quality Volume (WQv) and Channel Protection Volume (CPv). Supporting calculations are provided in Appendix F.

To improve water quality treatment prior to discharge into Lake Fisher, it is recommended that the sediment capture ponds be vegetated with plant species known for effective nutrient, metal, and pollutant removal. A table including common Iowa wetland species utilized for the removal of nutrients, sediment, and metals is included in Appendix F.

Due to the nature of this wetland system, and the fact that pollutant removal is a secondary objective the anticipated removal of pollutants is significantly lower than had a complete constructed wetland been designed. Table 6.1 below shows a conservative estimate of pollutant removal based on the constructed wetland removal percentages provided in ISWMM chapter 4. Tables 6.2 and 6.3 below indicate the anticipated concentrations of contaminants before and after wetlands are implemented.

Table 6. 2: Conservative removal Percentages Based on ISWMM Ch. 4

Design removal percentages				
SS (%)	N(%)	P(%)	Pathogens (%)	metals (%)
20	10	10	10	20

Table 6. 3: Common Pollutant Concentrations Prior to Wetland Addition

	MPNs	ug/L	mg/L N	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Total E. Coli	**Phosphorus, total**	**TN**	**TSS (averaged from DNR data**	**Magnesium**	**Potassium**	**Calcium**	**Chromium**	**Manganese**	**Iron**	**Nickel**	**Zinc**	**Arsenic**	**Strontium**	**Barium**	**Lead**
SW Inlet	8.6	11.32	0.501	11.86	7581	5813	20885	<0.60	21.86	37.78	0.49	12.42	2.06	92.78	43.05	0.25
SE Inlet	33.1	9.33	0.585	11.86	9598	5513	31653	1.32	33.09	131.37	1.43	8.07	2.11	130.2	98.89	0.29

Table 6. 4: Estimated Common Pollutant Concentrations Following Wetland Addition

	MPNs	ug/L	mg/L N	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Total E. Coli	**Phosphorus, total**	**TN**	**TSS (averaged from DNR data**	**Magnesium**	**Potassium**	**Calcium**	**Chromium**	**Manganese**	**Iron**	**Nickel**	**Zinc**	**Arsenic**	**Strontium**	**Barium**	**Lead**
SW Inlet	7.74	10.188	0.451	9.488	6064.8	4650.4	16708	0.48	17.488	30.2	0.392	9.936	1.648	74.224	34.44	0.2
SE Inlet	29.79	8.397	0.527	9.488	7678.4	4410.4	25322.4	1.056	26.472	105	1.144	6.456	1.688	104.16	79.11	0.232

Section VII Engineer's Cost Estimate

The cost estimate for the Lake Fisher project was developed primarily using data from the Iowa Public Works Service Bureau, Iowa DOT bid tabs, and quotes obtained directly from manufacturers. Given the overall scale and complexity of the project, as well as the fact that the design is currently at the 60% stage, a contingency of 40% was applied to account for potential unknowns and items not yet fully defined. The estimated cost for each project phase is summarized below, with detailed itemized cost tables for each design feature within each phase provided in Appendix O.

Table 7. 1: Estimated cost for each phase and total project cost

Phase	Cost
1	$ 2,114,721.00
2	$ 2,754,731.00
3	$ 1,989,246.00
4	$ 1,305,962.00
Total	$ 8,164,660.00

Appendices

Appendix A-Trails

Trail Design Specifications

Table 12B-2.01: Shared Use Path Design Speed by Context

Design Speed	Shared Use Path Context	Description
12 mph	Unpaved path surfaces	On unpaved path surfaces, bicyclists tend to travel slower to compensate for reduced braking ability, so a lower design speed (12 mph) may be used.
15 mph	Paved, high volumes with diverse users	For most shared use paths with higher volumes of users in relatively flat areas, a design speed of 15 mph is generally appropriate due to the mixed-use operation with pedestrians on the facility.
18 to 30 mph	Paved, low volume of users, especially pedestrians	For shared use paths with lower volumes of users, where pedestrian volumes are low (less than 30%), where the primary purpose of the shared use path is to provide a higher speed bicycling opportunity between destinations, or on wider paths where bicycles are provided separate spaces from pedestrians, a design speed of 18 to 30 mph may be appropriate.
18 to 30 mph	Paved, rolling terrain	On shared use paths with rolling terrain and sustained steeper grades (greater than 5%), the appropriate design speed should be selected based on the anticipated travel speeds of bicyclists going downhill; however, design speed should generally not exceed 30 mph.

Source: ODOT *Multimodal Design Guide*

Figure A. 1 Shared use path design speeds

Table 12B-2.02: Minimum Radii for Horizontal Curves at Lean Angle

Design Speed (mph)	Minimum Radius (feet)
12	27
14	36
16	47
18	60
20	74
25	115
30	166

Source: *AASHTO Bicycle Guide* Exhibit 5.6

Figure A. 2 Minimum radii for horizontal curves at lean angle

Equation 12B-2.01

$$S > L \quad L = 2S - \frac{200(\sqrt{h_1}+\sqrt{h_2})^2}{A}$$

$$S > L \quad L = 2S - \frac{200(\sqrt{h_1}+\sqrt{h_2})^2}{A}$$

$$L > S \quad L = \frac{AS^2}{100(\sqrt{2h_1}+\sqrt{2h_2})^2}$$

where:

L= Minimum length of vertical curve (ft)
A = Algebraic grade difference (percent)
S = Stopping sight distance (ft)
h_1 = Eye height (4.5 feet for a typical bicyclist)
h_2 = Object height (0 ft)

Equation 1A

Equation 12B-2.02

$$S = \frac{V^2}{30(f \pm G)} + 3.67V$$

Equation 2A

Table 12B-2.04: Vertical Alignment

Grade Range	**Maximum Segment Length (feet)**		
	Preferred	***Acceptable[1]***	***Allowed[2]***
< 5%	Any length	Any Length	Any Length
≥ 5% and < 8.33%	--	50	200
≥ 8.33% and < 10%	--	30	30
≥ 10% and < 12.50%	--	--	10

[1] Derived from AGODA Section 1016 (Outdoor Recreation Access Routes)

[2] Derived from AGODA Section 1017 (Trails)

Figure A. 3 Allowable vertical alignments based on grade

Figure 12B-2.06: Crossing at Unpaved Surface

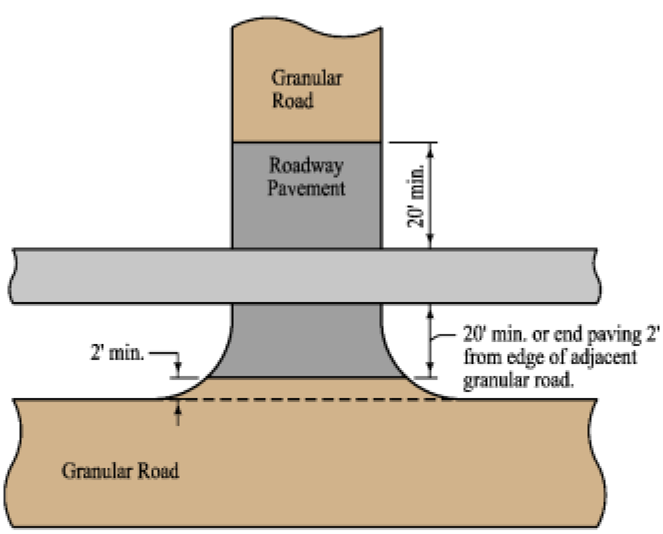


Figure A. 4 Schematic for crossings at unpaved surfaces

Appendix B-Septic Tanks

Septic Tank Specifications

Table IIb
Maximum Soil Loading Rates Based Upon Soil Evaluations
in gal/ft^2/day for Septic Tank Effluent

Soil Texture	Single Grain	Massive	Structure - Granular, Blocky, or Prismatic			Platy	
			Weak	Moderate	Strong	Weak	Moderate to Strong
Coarse sand and gravel	1.2 (1.6)	X	1.2 (1.6)	X	X	1.2 (1.6)	X
Medium sands	0.7 (1.4)	X	0.7 (1.4)	X	X	0.7 (1.4)	X
Fine sands	0.5 (0.9)	X	0.5 (0.9)	X	X	0.5 (0.9)	X
Very fine sands[1]	0.3 (0.5)	X	0.3 (0.5)	X	X	0.3 (0.5)	X
Sandy loam	X	0.3 (0.5)	0.45 (0.7)	0.6 (1.1)	0.65 (1.2)	0.4 (0.6)	0.3 (0.5)
Loam	X	0.4 (0.6)	0.45 (0.7)	0.5 (0.8)	0.55 (0.8)	0.4 (0.6)	0.3 (0.5)
Silty loam	X	NS	0.4 (0.6)	0.5 (0.8)	0.5 (0.8)	0.3 (0.5)	0.2 (0.3)
Clay loam	X	NS	0.2 (0.3)	0.45 (0.7)	0.45 (0.7)	0.1 (0.2)	0.1 (0.2)
Silty clay loam	X	NS	0.2 (0.3)	0.45 (0.7)	0.45 (0.7)	NS	NS

Figure B. 1 Maximum Soil Loading Rates

Table IIc

Minimum Length of Absorption Trenches in Lineal Feet by Width of Trench and Soil Loading Rate

Soil loading rate gal/ft^2	Two bedroom, 300 gpd[1]		Three bedroom, 450 gpd[1]		Four bedroom, 600 gpd[1]		Five bedroom, 750 gpd[1]		Six bedroom, 900 gpd[1]	
	Width of trench in feet									
	2′	3′	2′	3′	2′	3′	2′	3′	2′	3′
0.1	Not suitable for soil absorption trenches									
0.2	750	500	1125[2]	750	1500[2]	1000[2]	1875[2]	1250[2]	2250[2]	1500[2]
0.3	500	333	750	500	1000[2]	666	1250[2]	833[2]	1500[2]	1000[2]
0.4	375	250	562	375	750	500	938[2]	625	1125[2]	750
0.5	300	200	450	300	600	400	750	500	900[2]	600
0.6	250	167	375	250	500	333	625	417	750	500
0.7	214	143	321	214	428	286	536	357	643	429
0.8	188	125	281	188	375	250	469	312	562	375
0.9	167	111	250	167	333	222	417	278	500	333
1.0	150	100	225	150	300	200	375	250	450	300
1.1	136	91	205	136	273	182	341	227	409	273
1.2	125	84	188	125	250	167	313	208	375	250

Figure B. 2 Total Linear Feet of Leach Field Pipes

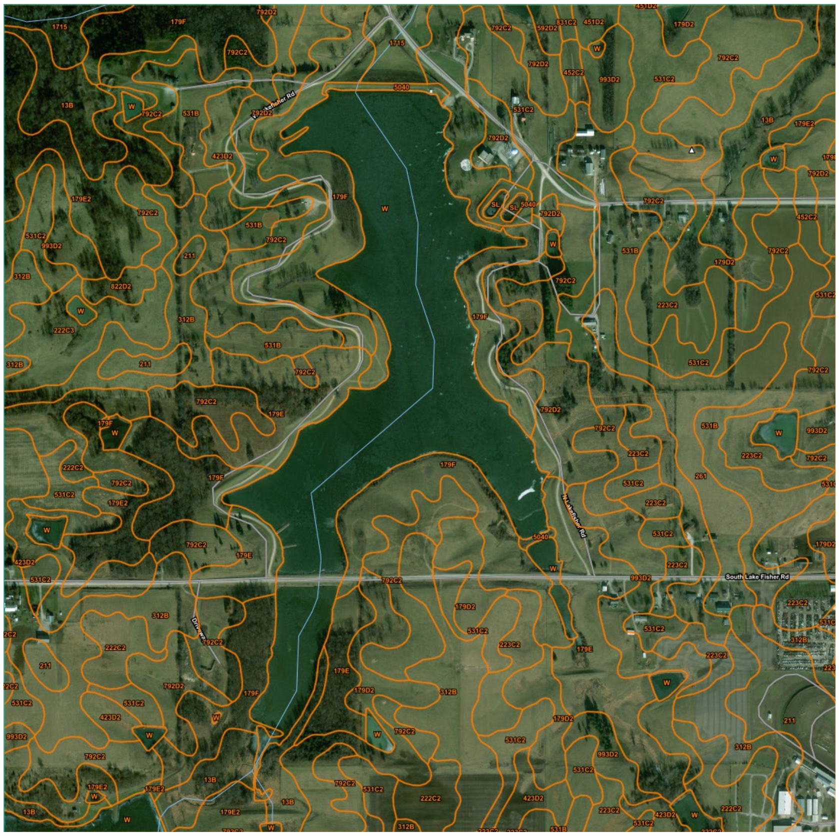


Figure B. 3 Soil Map

	estimated daily sewage flow:		900	gpd	150	gpd per bedroom			SEPTIC TANK LEACH FIELDS MUST BE 5O FEET FROM LAKE AND 10 FT FROM BUILDINGS PER 410_IAC_6-8_3p12					
					6	total bedrooms		*IAC 567 Ch 69						
septic tank must be at least 1250 gallons, or two times the daily sewage flow, whichever is greater														
	Total V (gal)	1800		*Table I IAC Ch 69					**Leach Field Calcs:**					
	Total V (ft^3)	240.641711							max soil loading rate	0.5	gpd/ft^2	*value obtained using a silty loam soil type, moderate structure		
									effluent loading rate	900	gpd	*gpd/bedroom * bedrooms		
	L (ft)	12.0320856		*min L = 1.5W	check: 1.5 W=	7.5								
	W (ft)	5		*min = 5 ft					minimum leach field area	1800	ft^2			
	D (ft)	4		*min= 40 in, max = 6.5 ft										
									septic tank area	60.1604278	ft^2			
	Influent tank:													
	L (ft)	7.82085561							total area	1860.16043	ft^2			
	W (ft)	5												
	Effluent tank:													
	L (ft)	4.21122995												
	W (ft)	5			**Pipe Criteria:**									
					*inlet pipe must be 2-4 inches higher than outlet pipe									
					*pipe height measured from centerline									
					inlet pipe height (ft)	4		8 in =	0.666666667	ft				
					inlet tee			15 in =	1.25	ft				
						top	4.5	*shall extend above liquid level at least 6 inches						
						bottom	3.33333333	*bottom tee shall extend 8 inches below the liquid level, but for no more than 30% of the liquid depth					check:	1.2
					outlet pipe height (ft)	3.75								
					outlet tee									
						top	4.5	*shall extend above liquid level at least 6 inches						
						bottom	2.75	*shall extend below the liquid level of at least 15 in, but no more than 40% of the liquid depth					check:	1.6
					Leach Field Pipes									
					Linear feet:									
					*based on criteria from table 11c of IAC Ch 69									
					*used six bedroom criteria									
					Width of trench	3	ft		*trench bottom depth 18-24 in, shall not exceed 36 in					
					soil loading rate	0.5	gpd/ft^2		*minimum seperation between trench bottom and any confining layer shall be 36 in					
									*no trench shall be greater than 100 ft					
					total linear feet	600	ft		*all soil absorption trenches shall be of equal length					
					diameter	4 in	or	6 in						
					grade	12in/100ft		8in/100ft						
					*groundwater table must not be within 3 feet of trench bottom									

Figure B. 4 Septic Tank Design Calculations

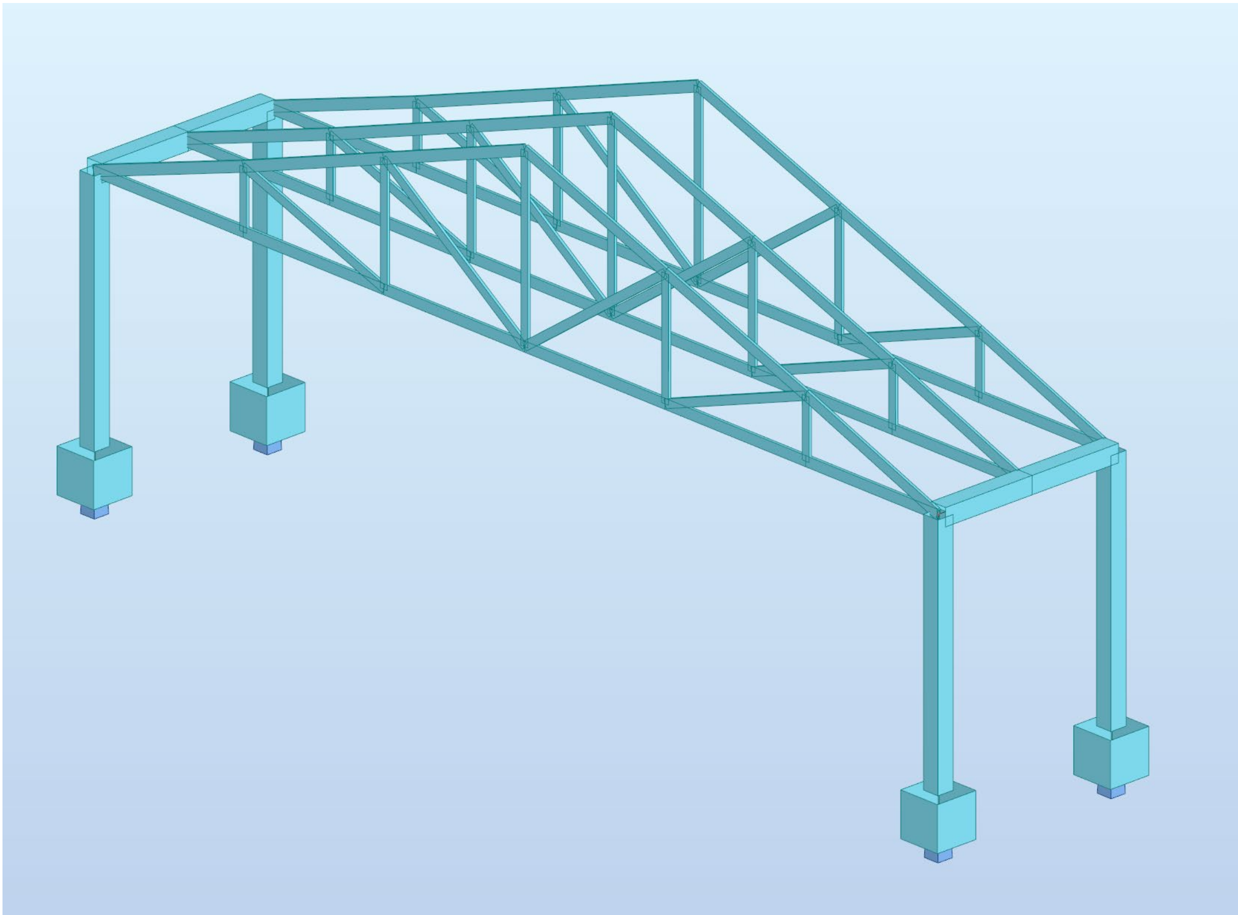
Appendix C-Venue

Robot Calculations

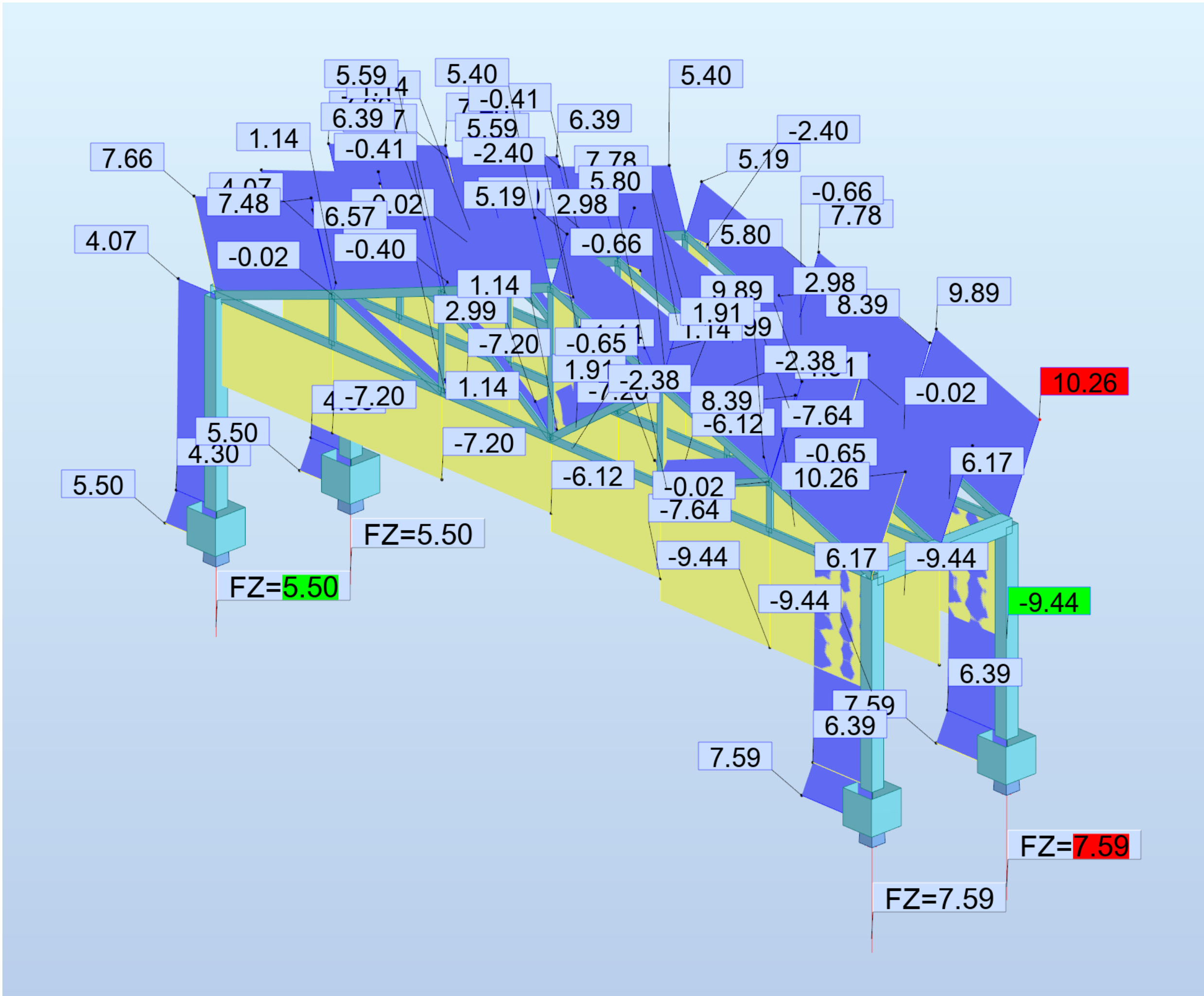
Below are all structural calculations completed during the design of the venue.

#	Case	Load type	List				
1	1:DL1	self-weight	3to77	Whole structu	-Z	Factor=1.00	Normal
2	1:DL1	uniform load	9to14	PX=0.0	PY=0.0	PZ=-0.04	global
3	2:SN1	uniform load	9to14	PX=0.0	PY=0.0	PZ=-0.14	global
4	4:SN2	uniform load	12to14	PX=0.0	PY=0.0	PZ=-0.04	global
5	5:SN3	uniform load	10 11	PX=0.0	PY=0.0	PZ=-0.27	global
6	6:SN4	uniform load	9	PX=0.0	PY=0.0	PZ=-0.14	global
7	1:DL1	uniform load	28 29 36to39	PX=0.0	PY=0.0	PZ=-0.04	global
8	2:SN1	uniform load	28 29 36to39	PX=0.0	PY=0.0	PZ=-0.14	global
9	4:SN2	uniform load	37to39	PX=0.0	PY=0.0	PZ=-0.04	global
10	5:SN3	uniform load	29 36	PX=0.0	PY=0.0	PZ=-0.27	global
11	6:SN4	uniform load	28	PX=0.0	PY=0.0	PZ=-0.14	global
12	1:DL1	uniform load	53 54 61to64	PX=0.0	PY=0.0	PZ=-0.04	global
13	2:SN1	uniform load	53 54 61to64	PX=0.0	PY=0.0	PZ=-0.14	global
14	4:SN2	uniform load	62to64	PX=0.0	PY=0.0	PZ=-0.04	global
15	5:SN3	uniform load	54 61	PX=0.0	PY=0.0	PZ=-0.27	global
16	6:SN4	uniform load	53	PX=0.0	PY=0.0	PZ=-0.14	global
*							

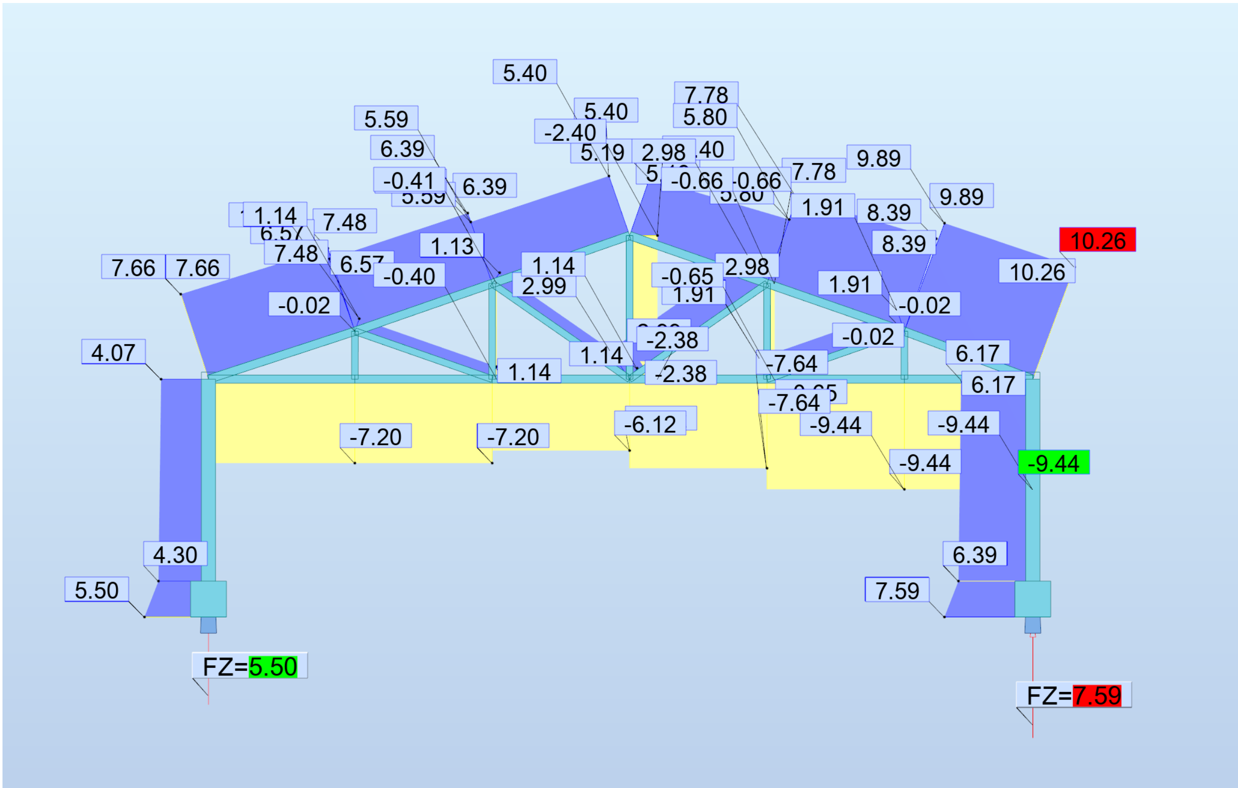
Robot Load Inputs



System Designed for Analysis



Analysis Results



Analysis Results

Dead Loads

Roof Loads

$TW := 4.5\ ft$

Dead Loads

Sheet Metal	$SM := 2.5\ psf$	Boise 20 Gauge
Roofing	$RF := 7\ psf$	Boise Joists 2x8 16" o.c., R-49 insulation, 1/2" gypsum board (Decorative planks)
Solar	$SP := 2.3\ psf$	

$w_d := ((SM + RF) \cdot TW) = 0.043\ klf$

Live Loads

Snow Loads

$p_g := 38\ \boldsymbol{psf}$ $\quad W_2 := 0.55$

$C_e := 1$ Table 7.3-1 Partially Exposed and Surface Roughness C

$C_t := 1.2$ Table 7.3-2 & 7.3-3

$p_f := 0.7 \cdot C_e \cdot C_t \cdot p_g = 31.92\ \boldsymbol{psf}$ $\quad R := 49$

$w_{s1} := p_f \cdot TW = 0.144\ \boldsymbol{klf}$

Sloped Roof

$C_s := 1$ Table 7.4-1c 4"/12" Roof Slope

$p_s := C_s \cdot p_f = 31.92\ \boldsymbol{psf}$ $\quad p_g := 38$ $\quad l_u$ Length of roof upwind

$0.3 \cdot p_s = 9.576\ \boldsymbol{psf}$ $\quad \gamma := 0.13 \cdot p_g + 14 = 18.94$ $\quad S := 3$

$w_{s2} := 9.576\ \boldsymbol{psf} \cdot TW = 0.043\ \boldsymbol{klf}$

Balanced Snow Load

East to West

$l_{u1} := 26$

$h_{d1} := 1.5 \cdot \sqrt{\dfrac{p_g^{\,0.74} \cdot l_{u1}^{\,0.7} \cdot W_2^{\,1.7}}{\gamma}} = 2.492$

West to East

$l_{u2} := 26$

$h_{d2} := 1.5 \cdot \sqrt{\dfrac{p_g^{\,0.74} \cdot l_{u2}^{\,0.7} \cdot W_2^{\,1.7}}{\gamma}} = 2.492$

$W_1 := \dfrac{8}{3} \cdot h_{d1} \cdot \sqrt{S} = 11.508$

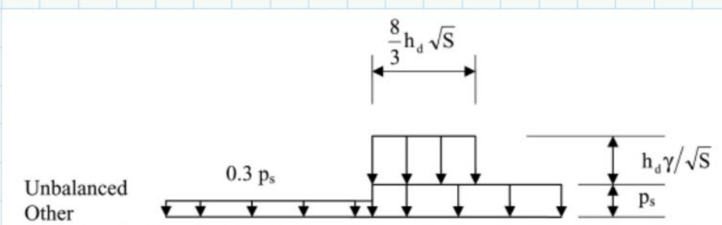
$\boxed{W_2} := \dfrac{8}{3} \cdot h_{d2} \cdot \sqrt{S} = 11.508$

$p_{d1} := \dfrac{h_{d1} \cdot \gamma}{\sqrt{S}} = 27.245$

$p_{d2} := \dfrac{h_{d2} \cdot \gamma}{\sqrt{S}} = 27.245$

$w_{s3} := \left(p_s + \left(p_{d1} \cdot \boldsymbol{psf}\right)\right) \cdot TW = 0.266\ \boldsymbol{klf}$

$w_{s4} := p_s \cdot TW = 0.144\ \boldsymbol{klf}$



Unbalanced Snow Load

Truss Calculations

Web Member Design

Southern Pine Grade 2

$A_{net} := 1.5\ in \cdot 3.5\ in$

Tension

$F_t := 3000\ lbf$

$f_t := \dfrac{F_t}{A_{net}} = 571.429\ psi$ $\qquad C_D := 1.15 \qquad F'_t := 675\ psi \cdot (C_D) = 776.25\ psi$

$DCR := \dfrac{f_t}{F'_t} = 0.736$

2x4 is good

Compression

$P := 2400\ lbf \qquad E_{min} := 510\ ksi \qquad L := 8\ ft \qquad d := 3.5\ in \qquad F_c := 1450\ psi$

$f_c := \dfrac{P}{A_{net}} = 457.143\ psi \qquad C_D := 1.15 \qquad E'_{min} := E_{min}$

$F_{ce} := \dfrac{0.822 \cdot E'_{min}}{\left(\dfrac{L}{d}\right)^2} = 557.231\ psi \qquad F'_{cs} := F_c = (1.45 \cdot 10^3)\ psi$

$\dfrac{F_{ce}}{F'_{cs}} = 0.384 \qquad c := 0.8 \qquad C_p := \dfrac{1 + \dfrac{F_{ce}}{F'_{cs}}}{2 \cdot c} - \sqrt{\left(\left(\dfrac{1 + \dfrac{F_{ce}}{F'_{cs}}}{2 \cdot c}\right)^2 - \dfrac{\dfrac{F_{ce}}{F'_{cs}}}{c}\right)} = 0.347$

$F'_c := F_c \cdot C_D \cdot C_p = 579.173\ psi$

$DCR := \dfrac{f_c}{F'_c} = 0.789$

2x4 is good

Top Chord Design

Dense Southern Pine Grade 1

$A_{net} := 1.5\ in \cdot 5.5\ in$

Tension

$F_t := 10260\ lbf$

$f_t := \frac{F_t}{A_{net}} = \left(1.244 \cdot 10^3\right)\ psi$ $\quad C_D := 1.15$ $\quad F'_t := 1100\ psi \cdot \left(C_D\right) = \left(1.265 \cdot 10^3\right)\ psi$

$DCR := \frac{f_t}{F'_t} = 0.983$

2x6 is good

Bottom Chord Design

Southern Pine Select Structural

Compression

$P := 9440\ lbf$ $\quad E_{min} := 660\ ksi$ $\quad L := 15\ ft$ $\quad d := 7.5\ in$ $\quad F_c := 1900\ psi$

$A_{net} := 1.5\ in \cdot 7.5\ in$ $\quad C_D := 1.15$ $\quad E'_{min} := E_{min}$ $\quad f_c := \frac{P}{A_{net}} = 839.111\ psi$

$F_{ce} := \frac{0.822 \cdot E'_{min}}{\left(\frac{L}{d}\right)^2} = 941.875\ psi$ $\quad F'_{cs} := F_c = \left(1.9 \cdot 10^3\right)\ psi$

$\frac{F_{ce}}{F'_{cs}} = 0.496$ $\quad c := 0.8$

$$C_p := \frac{1 + \frac{F_{ce}}{F'_{cs}}}{2 \cdot c} - \sqrt{\left(\left(\frac{1 + \frac{F_{ce}}{F'_{cs}}}{2 \cdot c}\right)^2 - \frac{\frac{F_{ce}}{F'_{cs}}}{c}\right)} = 0.431$$

$F'_c := F_c \cdot C_D \cdot C_p = 940.856\ psi$

$DCR := \frac{f_c}{F'_c} = 0.892$

2x8 is good

Top Chord Bending

Dense Southern Pine Grade 1

2x6 is good

$S_{xx} := 142.9\ in^3$ $\quad b := 1.5\ in$ $\quad d := 5.5\ in$ $\quad E_{min} := 660\ ksi$

$M_{pos1} := 1.8\ kip \cdot ft$ $\quad f_{bpos1} := \frac{M_{pos1}}{S_{xx}} = 151.155\ psi$

$F_b := 1650$ $\quad C_D := 0.9$ $\quad C_M := 1$ $\quad C_t := 1$ $\quad C_F := 1.2$

$l_u := 8\ ft$ $\quad \frac{l_u}{d} = 17.455$ $\quad l_e := 1.63 \cdot l_u + 3 \cdot d = 172.98\ in$

$R_B := \sqrt{\frac{l_e \cdot d}{b^2}} = 20.563$ $\quad F_{bE} := \frac{1.2 \cdot E_{min}}{{R_B}^2} = 1.873\ ksi$

$$C_{Lpos1} := \frac{1 + \left(\frac{F_{bE}}{f_{bpos1}}\right)}{1.9} - \sqrt{\left(\frac{1 + \left(\frac{F_{bE}}{f_{bpos1}}\right)}{1.9}\right)^2 - \frac{\left(\frac{F_{bE}}{f_{bpos1}}\right)}{0.95}} = 0.996$$

$$F'_{bpos1} := \left(F_b \cdot C_D \cdot C_F \cdot C_t \cdot C_{Lpos1} \cdot C_M\right) \cdot psi = \left(1.774 \cdot 10^3\right)\ psi$$

$CheckBpos1 :=$ if $f_{bpos1} \le F'_{bpos1}$
  "GOOD"
else
  "BAD"

$DCR := \frac{f_{bpos1}}{F'_{bpos1}} = 0.085$

$CheckBpos1 = \text{"GOOD"}$

Girder Calculations

10x10 Southern Pine, Grade 2

$S_{xx} := 142.9\ in^3$ $\quad b := 9.5\ in$ $\quad d := 9.5\ in$ $\quad E_{min} := 510\ ksi$

$M_{pos1} := 4.83\ kip \cdot ft$ $\quad f_{bpos1} := \dfrac{M_{pos1}}{S_{xx}} = 405.598\ psi$

$M_{neg1} := 4.91\ kip \cdot ft$ $\quad f_{bneg1} := \dfrac{M_{neg1}}{S_{xx}} = 412.316\ psi$

$F_b := 1100$ $\quad C_D := 0.9$ $\quad C_M := 1$ $\quad C_t := 1$ $\quad C_F := 1.2$

$l_u := 9\ ft$ $\quad \dfrac{l_u}{d} = 11.368$ $\quad l_e := 1.37 \cdot l_u + 3 \cdot d = 176.46\ in$

$R_B := \sqrt{\dfrac{l_e \cdot d}{b^2}} = 4.31$ $\quad F_{bE} := \dfrac{1.2 \cdot E_{min}}{{R_B}^2} = 32.948\ ksi$

$$C_{Lpos1} := \frac{1 + \left(\dfrac{F_{bE}}{f_{bpos1}}\right)}{1.9} - \sqrt{\left(\frac{1 + \left(\dfrac{F_{bE}}{f_{bpos1}}\right)}{1.9}\right)^2 - \frac{\left(\dfrac{F_{bE}}{f_{bpos1}}\right)}{0.95}} = 0.999$$

$$F'_{bpos1} := \left(F_b \cdot C_D \cdot C_F \cdot C_t \cdot C_{Lpos1} \cdot C_M\right) \cdot psi = \left(1.187 \cdot 10^3\right)\ psi$$

$CheckBpos1 :=$ if $f_{bpos1} \le F'_{bpos1}$
  "GOOD"
else
  "BAD"

$DCR := \dfrac{f_{bpos1}}{F'_{bpos1}} = 0.342$

$CheckBpos1 =$ "GOOD"

$C_D := 1$

$l_u := 9\ ft = 9\ ft$ $\frac{l_u}{d} = 11.368$ $l_e := 1.37 \cdot l_u + 3 \cdot d = 176.46\ in$

$R_B := \sqrt{\frac{l_e \cdot d}{b^2}} = 4.31$ $F_{bE} := \frac{1.2 \cdot E_{min}}{{R_B}^2} = 32.948\ ksi$

$$C_{Lneg1} := \frac{1 + \left(\frac{F_{bE}}{f_{bneg1}}\right)}{1.9} - \sqrt{\left(\frac{1 + \left(\frac{F_{bE}}{f_{bneg1}}\right)}{1.9}\right)^2 - \frac{\left(\frac{F_{bE}}{f_{bneg1}}\right)}{0.95}} = 0.999$$

$$F'_{bneg1} := \left(F_b \cdot C_D \cdot C_F \cdot C_t \cdot C_{Lneg1} \cdot C_M\right) \cdot psi = \left(1.319 \cdot 10^3\right)\ psi$$

CheckBneg1 := if $f_{bneg1} \le F'_{bneg1}$
  "GOOD"
else
  "BAD"

$DCR := \frac{f_{bneg1}}{F'_{bneg1}} = 0.313$

CheckBneg1 = "GOOD"

Column Design

Column Calculations

Southern-Pine, Grade 2

$P := (7.59\ kip) \cdot 2 = 15.18\ kip$

Check a 10x10, GOOD

$l := 10\ ft = 10\ ft$ $\quad K_{ex} := 1 \quad K_{ey} := 1$

$l_{ex} := l \cdot K_{ex} = 10\ ft \quad l_{ey} := l \cdot K_{ey} = 10\ ft$

$b := 9.5\ in \quad d := 9.5\ in \quad A_g := b \cdot d = 0.627\ ft^2 \quad f_{cg} := \dfrac{P}{A_g} = 168.199\ psi$

$F_b := 1100\ psi \quad E := 1400\ ksi \quad E_{min} := 510\ ksi \quad G_s := 0.55$

$F_t := 675\ psi \quad F_v := 175\ psi \quad F_{cp} := 565\ psi \quad F_c := 1450\ psi$

$A := A_g - \left(0.75 + \dfrac{1}{16}\right) in \cdot 9.5\ in = 0.573\ ft^2$

$\dfrac{l}{d} = 12.632 \quad f_c := \dfrac{P}{A} = 183.93\ psi$

$C_F := 1 \quad C_M := 1 \quad C_i := 1 \quad C_t := 1 \quad C_D := 1$

$\lambda_x := \dfrac{l_{ex}}{d} = 12.632 \quad \lambda_y := \dfrac{l_{ey}}{d} = 12.632 \quad E'_{min} := E_{min}$

$F_{ce} := \dfrac{0.822 \cdot E'_{min}}{{\lambda_x}^2} = \left(2.627 \cdot 10^3\right)\ psi \quad F'_{cs} := F_c = \left(1.45 \cdot 10^3\right)\ psi$

$\dfrac{F_{ce}}{F'_{cs}} = 1.812 \quad c := 0.8$

$$C_p := \frac{1 + \dfrac{F_{ce}}{F'_{cs}}}{2 \cdot c} - \sqrt{\left(\left(\frac{1 + \dfrac{F_{ce}}{F'_{cs}}}{2 \cdot c}\right)^2 - \frac{\dfrac{F_{ce}}{F'_{cs}}}{c}\right)} = 0.85$$

$F'_c := F_c \cdot C_p = \left(1.232 \cdot 10^3\right)\ psi$

$$CheckC := \begin{array}{l} \text{if } f_c \le F'_c \\ \quad \text{“GOOD”} \\ \text{else} \\ \quad \text{“BAD”} \end{array}$$

$CheckC = \text{“GOOD”}$

$$CheckCG := \begin{array}{l} \text{if } f_{cg} \le F'_{cs} \\ \quad \text{“GOOD”} \\ \text{else} \\ \quad \text{“BAD”} \end{array}$$

$DCR := \dfrac{f_c}{F'_c} = 0.149$

$CheckCG = \text{“GOOD”}$

Using 2024 National Construction Estimator, Need to factor area so -9% for Ottumwa, then factor inflation

Concrete

Slab

Floor Slab Assembly, 6" thick

$6.1 per SF 8750 SF

$Price := 6.1 \cdot 8750 = 53375$

Columns/Foundation

Foundation Assembly Columns/Foundation

$722 per CY $24 \cdot 1.04 = 24.96$ 25 cubic yards Columns

$24 \cdot 0.89 = 21.36$ 21.36 cubic yards Footing

4.94 cubic yards Drop Panels

$Price := (25 + 21.36 + 4.94) \cdot 722 = 37038.6$

Roof Assembly

2" x 8" ceiling joist at 16" on center with insulation and 1/2" gypsum drywall.

$4.58 per SF $(27.5 \cdot 105) \cdot 2 = 5775$

Decorative Wood Paneling Pine

$4.62 per SF

$Price := 5775 \cdot (4.58 + 4.62) = 53130$

Trusses

Bottom Chord, Southern Pine SS, 16', 2'x8' $16.3 per

Top Chord, Southern Pine #1, 16', 2'x6' $16.9 per

Web, Southern Pine #2, 16', 2'x4' $8.23 per

Bottom Chord 45', need 3 boards

Top Chord 48', need 3 boards

Web 60', need 4 boards

Square foot of a single truss

Labor is 0.82 per square foot

$3.5 \cdot 60 = 210$ $5.5 \cdot 48 = 264$ $7.5 \cdot 45 = 337.5$

$210 + 264 + 337.5 = 811.5$ $Labor := 811.5 \cdot 0.82 = 665.43$

$Material := (16.3 \cdot 3) + (16.9 \cdot 3) + (8.23 \cdot 4) = 132.52$

$Price := 23 \cdot (Labor + Material) = 18352.85$

Lumber Columns/Girders

Girders 6" x 6" compared to 8" x 8" and extrapolated

6" x 6" 9.3 per LF

8" x 8" 16.47 per LF

10" x 10" $(16.47 - 9.3) + 16.47 = 23.64$ 23.64 per LF

$(99.83 \cdot 2) + (10 \cdot 24) = 439.66$

$Price := 23.64 \cdot 439.66 = 10393.562$

Lighting

Recessed LED, 6 watt, waterproof

$141.5 each 21 fixtures

$Price := 141.5 \cdot 21 = 2971.5$

Electrical

Typical in-place cost, recreation facilities

$15.7 per SF 4455 SF

$Price := 15.7 \cdot 4455 = 69943.5$

Total Cost

$Total := 245205.1$

Inflation of 2%

$Total := Total \cdot 1.02 = 250109.202$

Area Reduction -9%

$Total := Total \cdot 0.91 = 227599.374$

Appendix D-Restrooms

Below are all structural and cost estimate calculations for the restrooms.

RV Park Restroom

Dead Loads

Senior Design Bathroom 1 Calcs

Roof Loads

$TW := 18\ ft + 4.5\ in = 18.375\ ft$

Dead Loads

Sheet Metal	$SM := 2.5\ psf$	Boise 20 Gauge
Roofing	$RF := 7\ psf$	Boise Joists 2x8 16" o.c., R-49 insulation, 1/2" gypsum board (Decorative planks)
Solar	$SP := 2.3\ psf$	

$w_d := ((SM + RF + SP) \cdot TW) = 0.217\ klf$

Live Loads

Snow Loads

$p_g := 38\ psf$ $W_2 := 0.55$

$C_e := 1$ Table 7.3-1 Partially Exposed and Surface Roughness C

$C_t := 1.2$ Table 7.3-2 & 7.3-3

$p_f := 0.7 \cdot C_e \cdot C_t \cdot p_g = 31.92\ psf$ $R := 49$

$w_{s1} := p_f \cdot TW = 0.587\ klf$

Sloped Roof

$C_s := 1$ Table 7.4-1c 4"/12" Roof Slope

$p_s := C_s \cdot p_f = 31.92\ psf$ $p_g := 38$ l_u Length of roof upwind

$0.3 \cdot p_s = 9.576\ psf$ $\gamma := 0.13 \cdot p_g + 14 = 18.94$ $S := 3$

$w_{s2} := 9.576\ psf \cdot TW = 0.176\ klf$

Balanced Snow Load

East to West

$l_{u1} := 21$

$h_{d1} := 1.5 \cdot \sqrt{\dfrac{p_g^{\ 0.74} \cdot l_{u1}^{\ 0.7} \cdot W_2^{\ 1.7}}{\gamma}} = 2.312$

West to East

$l_{u2} := 21$

$h_{d2} := 1.5 \cdot \sqrt{\dfrac{p_g^{\ 0.74} \cdot l_{u2}^{\ 0.7} \cdot W_2^{\ 1.7}}{\gamma}} = 2.312$

$W_1 := \dfrac{8}{3} \cdot h_{d1} \cdot \sqrt{S} = 10.679$

$W_2 := \dfrac{8}{3} \cdot h_{d2} \cdot \sqrt{S} = 10.679$

$p_{d1} := \dfrac{h_{d1} \cdot \gamma}{\sqrt{S}} = 25.283$

$p_{d2} := \dfrac{h_{d2} \cdot \gamma}{\sqrt{S}} = 25.283$

$w_{s3} := \left(p_s + \left(p_{d1} \cdot \mathbf{psf}\right)\right) \cdot TW = 1.051\ \mathbf{klf}$

$w_{s4} := p_s \cdot TW = 0.587\ \mathbf{klf}$

Unbalanced Snow Load

Using 2024 National Construction Estimator, Need to factor area so -9% for Ottumwa, then factor inflation

Concrete

Slab

Floor Slab Assembly, 6" thick

$6.1 per SF 2112.6 SF

$Price := 6.1 \cdot 2112.6 = 12886.86$

Foundation

Foundation Assembly Columns/Foundation

$722 per CY 43.7 cubic yards Columns

$Price := 43.7 \cdot 722 = 31551.4$

CMU Block Walls

Concrete block wall assembly for 12" thick wall.

$16.27 per SF 1237.7 square foot

$Price := 16.27 \cdot 1237.7 = 20137.379$

Partition Walls

Wall assemblies, interior wall, 2" x 4" stud wall with 5/8" gypsum on both sides.

$4.34 per SF 1087.1 square foot

$Price := 4.34 \cdot 1087.1 = 4718.014$

Roof Assembly

2" x 8" ceiling joist at 16" on center with insulation and 1/2" gypsum drywall.

$4.58 per SF $(21.5 \cdot 38.3) \cdot 2 = 1646.9$

$Price := 1646.9 \cdot 4.58 = 7542.802$

Urinals

Water-conserving, wall mounted

$456.9 each 2 urinals

$Price := 456.9 \cdot 2 = 913.8$

Bathroom Stalls

Floor-mounted flush valve type

$566 each 6 stalls

$642 each ADA stall

$Price := (566 \cdot 6) + 642 = 4038$

Sink

$279.3 each 7 bathroom sinks

$730.3 each 1 laundry sink

$Price := (279.3 \cdot 7) + 730.3 = 2685.4$

Door

$819.10 each 7 doors

$Price := (819.1 \cdot 7) = 5733.7$

Baby Changing Station

$Price := 376.2$

Hand Dryer

$244 each plus $60.60 for wiring 5 hand dryers

$Price := (244 + 60.60) \cdot 5 = 1523$

Soap Dispenser

$49.70 each plus $14.90 for labor 7 soap dispensers

$Price := (49.7 + 14.9) \cdot 7 = 452.2$

Toilet Paper Multi-Roll Dispenser

$66.50 each plus $10.70 for labor 6 dispenser

$Price := (66.5 + 10.7) \cdot 6 = 463.2$

Mirrors

$472.9 for 96" x 48" 2 of large

$91.7 for 36" x 48" 1 of small

$Price := (472.9 \cdot 2) + 91.7 = 1037.5$

Robe Hooks

$9.37 plus $10.7 labor each 4 hooks

$Price := (9.37 + 10.7) \cdot 4 = 80.28$

Shower Rod and Curtain

$65 plus $16.70 for labor 4 shower rods

$Price := (65 + 16.7) \cdot 4 = 326.8$

Bathroom Bench

$283.6 each 2 benches

$Price := 283.6 \cdot 2 = 567.2$

Plumbing

Single story, total plumbing rough-in cost

$Price := 4813$

Electric Heating

12.5 kW system

$Price := 2119$

Electric Water Heater

50 gallon, 63 GPH, 12 year

$Price := 880.5$

Solar Costs

5 kW system

$Price := 15500$

Lighting

Vapor tight LED light fixtures, 50 watt, 4' long

$206.8 each	17 fixtures

$Price := 206.8 \cdot 17 = 3515.6$

Electrical

Typical in-place cost, recreation facilities

$15.7 per SF	1293.22 SF

$Price := 15.7 \cdot 1293.22 = 20303.554$

Outdoor Lighting

Cylinder globe fixture

$125.4 each	8 fixtures

$Price := 125.4 \cdot 8 = 1003.2$

Total Cost

$Total := 141260.8$

Inflation of 2%

$Total := Total \cdot 1.02 = 144086.016$

Area Reduction -9%

$Total := Total \cdot 0.91 = 131118.275$

Venue Restroom

Dead Loads

Senior Design Bathroom 2 Calcs

Roof Loads

$TW := 9\ ft + 4\ in = 9.333\ ft$

Dead Loads

Sheet Metal	$SM := 2.5\ psf$	Boise 20 Gauge
Roofing	$RF := 7\ psf$	Boise Joists 2x8 16" o.c., R-49 insulation, 1/2" gypsum board (Decorative planks)
Solar	$SP := 2.3\ psf$	

$w_d := ((SM + RF + SP) \cdot TW) = 0.11\ klf$

Live Loads

Snow Loads

$p_g := 38\ psf$ $W_2 := 0.55$

$C_e := 1$ Table 7.3-1 Partially Exposed and Surface Roughness C

$C_t := 1.2$ Table 7.3-2 & 7.3-3

$p_f := 0.7 \cdot C_e \cdot C_t \cdot p_g = 31.92\ psf$ $R := 49$

$w_{s1} := p_f \cdot TW = 0.298\ klf$

Sloped Roof

$C_s := 1$ Table 7.4-1c 4"/12" Roof Slope

$p_s := C_s \cdot p_f = 31.92\ psf$ $\boxed{p_g} := 38$ l_u Length of roof upwind

$0.3 \cdot p_s = 9.576\ psf$ $\gamma := 0.13 \cdot p_g + 14 = 18.94$ $S := 3$

$w_{s2} := 9.576\ psf \cdot TW = 0.089\ klf$

Balanced Snow Load

East to West

$l_{u1} := 12.26$

$h_{d1} := 1.5 \cdot \sqrt{\frac{p_g^{\ 0.74} \cdot l_{u1}^{\ 0.7} \cdot W_2^{\ 1.7}}{\gamma}} = 1.915$

West to East

$l_{u2} := 12.26$

$h_{d2} := 1.5 \cdot \sqrt{\frac{p_g^{\ 0.74} \cdot l_{u2}^{\ 0.7} \cdot W_2^{\ 1.7}}{\gamma}} = 1.915$

$W_1 := \frac{8}{3} \cdot h_{d1} \cdot \sqrt{S} = 8.846$

$\boxed{W_2} := \frac{8}{3} \cdot h_{d2} \cdot \sqrt{S} = 8.846$

$p_{d1} := \frac{h_{d1} \cdot \gamma}{\sqrt{S}} = 20.942$

$p_{d2} := \frac{h_{d2} \cdot \gamma}{\sqrt{S}} = 20.942$

$w_{s3} := \left(p_s + \left(p_{d1} \cdot \boldsymbol{psf}\right)\right) \cdot TW = 0.493\ \boldsymbol{klf}$

$w_{s4} := p_s \cdot TW = 0.298\ \boldsymbol{klf}$

Unbalanced Snow Load

Using 2024 National Construction Estimator, Need to factor area so -9% for Ottumwa, then factor inflation

Concrete

Slab

Floor Slab Assembly, 6" thick

$6.1 per SF 1208.1 SF

$Price := 6.1 \cdot 1208.1 = 7369.41$

Foundation

Foundation Assembly Columns/Foundation

$722 per CY 30.74 cubic yards Columns

$\boxed{Price} := 30.74 \cdot 722 = 22194.28$

CMU Block Walls

Concrete block wall assembly for 12" thick wall.

$16.27 per SF 783.5 square foot

$\boxed{Price} := 16.27 \cdot 783.5 = 12747.545$

Partition Walls

Wall assemblies, interior wall, 2" x 4" stud wall with 5/8" gypsum on both sides.

$4.34 per SF 457.8 square foot

$\boxed{Price} := 4.34 \cdot 457.8 = 1986.852$

Roof Assembly

2" x 8" ceiling joist at 16" on center with insulation and 1/2" gypsum drywall.

$4.58 per SF $(12.67 \cdot 34.67) \cdot 2 = 878.538$

$Price := 878.538 \cdot 4.58 = 4023.704$

Urinals

Water-conserving, wall mounted

$456.9 each 2 urinals

$Price := 456.9 \cdot 2 = 913.8$

Bathroom Stalls

Floor-mounted flush valve type

$566 each 4 stalls

$642 each ADA stall

$Price := (566 \cdot 4) + 642 = 2906$

Sink

$279.3 each 5 bathroom sinks

$Price := 279.3 \cdot 5 = 1396.5$

Door

$819.10 each 4 doors

$Price := (819.1 \cdot 4) = 3276.4$

Hand Dryer

$244 each plus $60.60 for wiring 5 hand dryers

$Price := (244 + 60.60) \cdot 5 = 1523$

Soap Dispenser

$49.70 each plus $14.90 for labor 5 soap dispensers

$Price := (49.7 + 14.9) \cdot 5 = 323$

Toilet Paper Multi-Roll Dispenser

$66.50 each plus $10.70 for labor 5 dispenser

$Price := (66.5 + 10.7) \cdot 5 = 386$

Mirrors

$268.9 for 72" x 48" 2 of medium

$91.7 for 36" x 48" 1 of small

$Price := (472.9 \cdot 2) + 91.7 = 1037.5$

Plumbing

Single story, total plumbing rough-in cost

$Price := 4813$

Electric Heating

12.5 kW system

$Price := 2119$

Electric Water Heater

50 gallon, 63 GPH, 12 year

$\boxed{Price} := 880.5$

Solar Costs

5 kW system

$\boxed{Price} := 15500$

Lighting

Vapor tight LED light fixtures, 50 watt, 4' long

$206.8 each	10 fixtures

$\boxed{Price} := 206.8 \cdot 10 = 2068$

Electrical

Typical in-place cost, recreation facilities

$15.7 per SF	605 SF

$\boxed{Price} := 15.7 \cdot 605 = 9498.5$

Outdoor Lighting

Cylinder globe fixture

$125.4 each	6 fixtures

$\boxed{Price} := 125.4 \cdot 6 = 752.4$

Total Cost

$Total := 95715.4$

Inflation of 2%

$Total := Total \cdot 1.02 = 97629.708$

Area Reduction -9%

$Total := Total \cdot 0.91 = 88843.034$

Softball Field Restroom

Cost Estimation

Using 2024 National Construction Estimator, Need to factor area so -9% for Ottumwa, then factor inflation

Partition Walls

Wall assemblies, interior wall, 2" x 4" stud wall with 5/8" gypsum on both sides.

$4.34 per SF 113.33 square foot

$Price := 4.34 \cdot 113.33 = 491.852$

Exterior Walls

Exterior Wall assemblies, 2" x 6" stud wall with drywall interior, and wood siding.

$7 per SF 493.8 square foot

$Price := 7 \cdot 493.8 = 3456.6$

Roof Assembly

2" x 8" ceiling joist at 16" on center with insulation and 1/2" gypsum drywall.

$4.58 per SF 303.66 square foot

$Price := 303.66 \cdot 4.58 = 1390.763$

Urinals

Water-conserving, wall mounted

$456.9 each 2 urinals

$Price := 456.9 \cdot 2 = 913.8$

Bathroom Stalls

Floor-mounted flush valve type

$566 each 1 stall

$642 each 2 ADA stall

$Price := 566 + (642 \cdot 2) = 1850$

Sink

$279.3 each 3 bathroom sinks

$Price := 279.3 \cdot 3 = 837.9$

Door

$819.10 each 2 doors

$Price := (819.1 \cdot 2) = 1638.2$

Hand Dryer

$244 each plus $60.60 for wiring 2 hand dryers

$Price := (244 + 60.60) \cdot 2 = 609.2$

Soap Dispenser

$49.70 each plus $14.90 for labor 3 soap dispensers

$Price := (49.7 + 14.9) \cdot 3 = 193.8$

Toilet Paper Multi-Roll Dispenser

$66.50 each plus $10.70 for labor 3 dispenser

$Price := (66.5 + 10.7) \cdot 3 = 231.6$

Mirrors

$268.9 for 72" x 48" 1 of medium

$91.7 for 36" x 48" 1 of small

$Price := 472.9 + 91.7 = 564.6$

Plumbing

Single story, total plumbing rough-in cost

$Price := 4813$

Lighting

Vapor tight LED light fixtures, 50 watt, 4' long

$206.8 each 4 fixtures

$Price := 206.8 \cdot 4 = 827.2$

Electrical

Typical in-place cost, recreation facilities

$15.7 per SF 303.2 SF

$Price := 15.7 \cdot 303.2 = 4760.24$

Outdoor Lighting

Cylinder globe fixture

$125.4 each

4 fixtures

$Price := 125.4 \cdot 4 = 501.6$

Total Cost

$Total := 23080.5$

Inflation of 2%

$Total := Total \cdot 1.02 = 23542.11$

Area Reduction -9%

$Total := Total \cdot 0.91 = 21423.32$

Appendix E-Water Quality

Figure E. 1 Water quality analysis sampling locations

Table 1E: General water quality parameters

Table 2E: Ion Concentrations Within Lake Fisher

Table 3E: PFAS Concentrations

Table 4E.1: Concentrations of Metals

Table 5E.2: Concentrations of Metals

Table 5E: Concentrations of Detected Insecticides, Herbicides, Pesticides, and Fungicides

Table 6E. 1: Non-detected Insecticides, Herbicides, Pesticides, and Fungicides

Table 6E. 2: Non-detected Insecticides, Herbicides, Pesticides, and Fungicides

Table 6E. 3: Non-detected Insecticides, Herbicides, Pesticides, and Fungicides

Appendix F-Wetlands

Table 1F: Removal Percentages for Common Pollutants from ISWMM Ch. 4

	SS (%)	N(%)	P(%)	Pathogens (%)	metals (%)
Extended detention and wet detention basins	50-80	30-65	30-65	<30	50-80
constructed wetlands	50-80	<30	15-45	<30	50-80

Table 2F: Common Iowa Wetland Plant Species

Plant type	Plant recommendations	Contaminant removal
Emergent	Broadleaf Cattails	Nutrient
	Softstem Bulrush	Nutrient
	Hardstem Bulrush	Nutrient
	Broadleaf Arrowhead	Metals
	Soft Rush	Metals
	Bottlebrush Sedge	Nutrient
	Wool Grass	Nutrient
Shallow Marsh	Pickerelweed	Nutrient
	Blue Flag Iris	Nutrient
Submerged	Coontail	Nutrient/Metal
	Duck Weed	Nutrient/Metal
Buffer	swamp milkweed	Sediment
	Switch Grass	Sediment
	Virginia Wild Rye	Sediment

Figure F.1: calculations for ensuring existing SW inlet pond and sediment forebay are sufficiently sized

Figure F.2: calculations for ensuring existing SE inlet pond and sediment forebay are sufficiently sized

Appendix G-Green Playground

Drawing

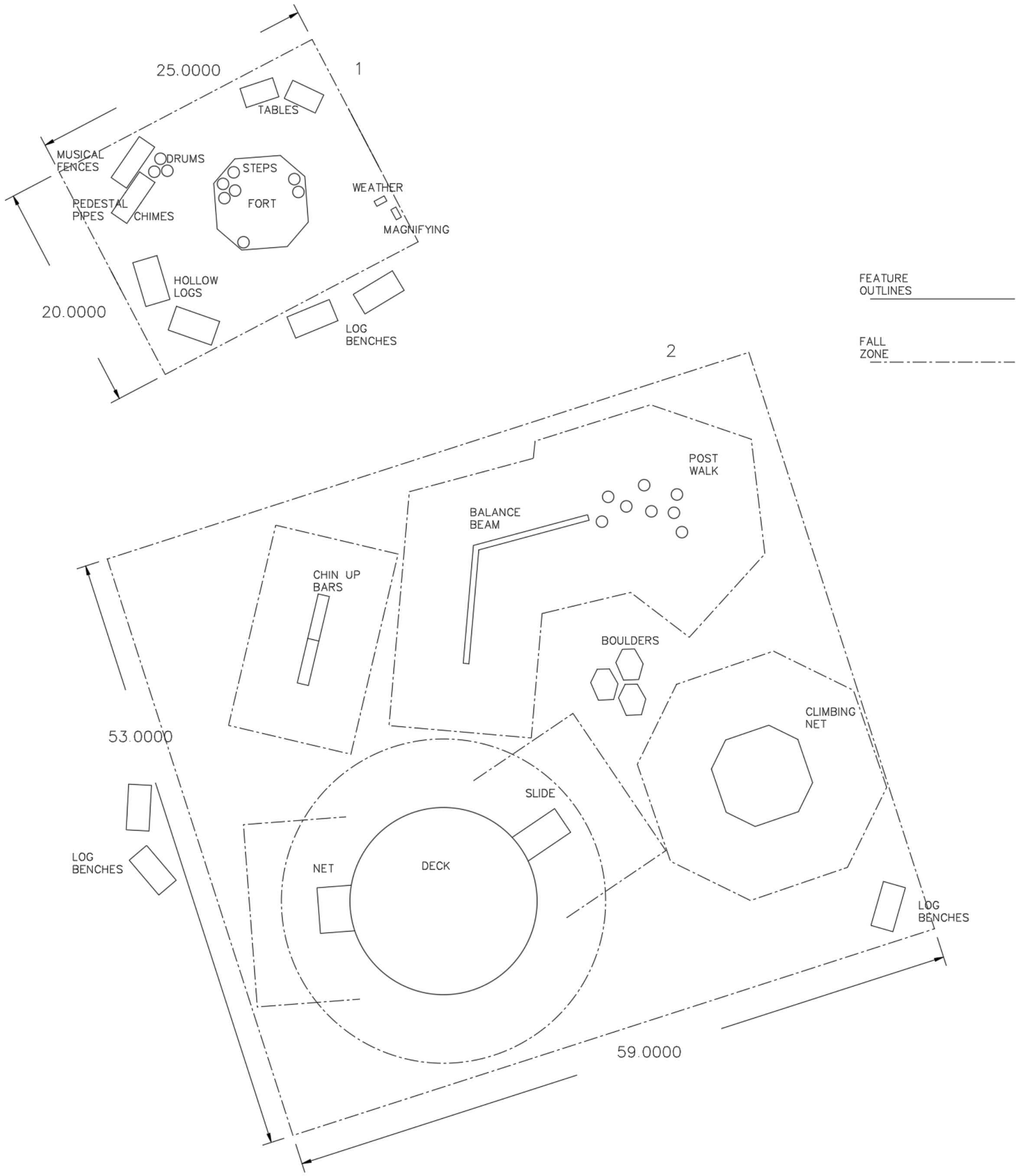


Figure G. 1 Green Playground drawing

Cost Estimate

Table G 1: Cost estimation for Green Playground

Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
Hank Drum	with feet (portable)	EACH	$ 537.95	3	$ 1,613.85	$ 1,610.00
Wind Chimes		EACH	$ 319.95	1	$ 319.95	$ 320.00
Pedestal Pipes	mounted in Ground	EACH	$ 528.95	1	$ 528.95	$ 530.00
Musical Fences	6'	EACH	$ 1,499.95	1	$ 1,499.95	$ 1,500.00
Hollow Log	4' Long 23in Interior	EACH	$ 2,899.95	2	$ 5,799.90	$ 5,800.00
Fort	~11' octagonal	EACH	$ 2,799.95	1	$ 2,799.95	$ 2,800.00
Sitting Stumps (set of 4) "steps"		EACH	$ 269.95	2	$ 539.90	$ 540.00
Picnic Table (child)		EACH	$ 324.95	2	$ 649.90	$ 650.00
Weather Station	below 3000 ft	EACH	$ 1,394.95	1	$ 1,394.95	$ 1,390.00
Magnifying Station	w/Post	EACH	$ 302.95	1	$ 302.95	$ 300.00
Log Benches	Whole Log Bench, on log supports	EACH	$ 309.95	5	$ 1,549.75	$ 1,550.00
Chin Up Bars	(2 bars)	EACH	$ 389.95	1	$ 389.95	$ 390.00
Balance Beams	8'	EACH	$ 249.95	1	$ 249.95	$ 250.00
Post Walk	5-12 yrs	EACH	$ 999.95	1	$ 999.95	$ 1,000.00
Boulders and Rocks	Boulder ~ 24-30in	EACH	$ 379.95	3	$ 1,139.85	$ 1,140.00
Spiderweb Climbing Net	Spiderweb Horizontal Net 12' x 12' w posts	EACH	$ 2,699.95	1	$ 2,699.95	$ 2,700.00
Tree Decks	12' Octagon 6' H	EACH	$ 7,166.95	1	$ 7,166.95	$ 7,170.00
Net Climb for Decks	6' deck	EACH	$ 999.95	1	$ 999.95	$ 1,000.00
Embankment Slides (3 foot drop to 35 foot drop)	6'	EACH	$ 3,049.95	1	$ 3,049.95	$ 3,050.00
Wood Protector and Preservative (1 gallon)	Log Oil	EACH	$ 82.95	1	$ 82.95	$ 80.00
Wood Protector and Preservative (1 gallon)	Lumber Protector and Preservative (1 gallon)	EACH	$ 65.95	1	$ 65.95	$ 70.00
Equipment Total					$ 33,845.40	$ 33,840.00
Shipping Total					$ 2,798.68	$ 2,800.00
Wood Chip Surfacing		CY	$ 40.00	135.00	$ 5,400.00	$ 5,400.00
Design Services	For full set of drawings on a 100k budget, plan on 17k				$ 8,500.00	$ 8,500.00
Contingency	10% of budget				$ 10,000.00	$ 10,000.00
Labor	45% of budget excluding contingency (crew 4-5, 350 hrs)				$ 44,000.00	$ 44,000.00
CPSI	Inspection				$ 1,000.00	$ 1,000.00
Total					$ 105,544.08	$ 105,540.00

Costs estimated based on quote provided by Natural Playgrounds Company (11/13/2025).

Hank Drum (Tongue Drum)

NMS-STD

Shipping Weight: 18 lbs
Shipping Dimensions: 16"L X 13"W X 13"H
Brand: Natural Playgrounds Company
Toxicity: Krylon Clear Coat
Age Appropriateness: all ages

Children absolutely love these steel "Tongue Drums" (also called Hank Drums, Tank Drums, or Cylinder Drums). They produce resonant, bongy sounds that vibrate up and through a child's body.

The 12" round drum is 14" high and produces different tones from the 6 tongues cut into the top of the drum.

Each drum is uniquely finished with a deep green base with lighter overtones that give it depth, all of which are exterior colors chosen to blend in with natural settings. We then clear coat the surface for long-lasting exterior exposure and use.

Each drum is mounted on a threaded metal pipe so that it looks like a large bud on top of a stalk.

These drums are ready to play "out of the box."

Installation instructions included, but we also make these with wooden legs so they are self-supporting and can be taken and used inside, as well (see the other listing in the store).

A note about why drums are so very important on your playground:

Research indicates that drumming induces relaxation by enhancing theta-wave production and brain-wave synchronization.

Drumming produces pleasurable experiences, enhanced awareness of preconscious dynamics, release of emotional trauma, and reintegration of self.

Drumming alleviates self-centeredness, isolation, and alienation, creating a sense of connectedness with self and others.

Drumming provides a secular approach to accessing a higher power...

Hank Drums are to be played with hands, fingers, and other soft objects(in other words, not sticks, pebbles, stones, rocks, boards, heavy mallets). Otherwise, the clearcoat cover and underlying paint may chip, which will then cause the metal drum to rust! Also, heavy beating on the drum tongues with a fist or other large/heavy objects may cause the tongues to bend or break. Neither of these is covered by the warranty!

Wind Chimes

NMS-WC

Shipping Weight: 14 lbs
Shipping Dimensions: 24"L X 16"W X 4"H
Brand: Natural Playgrounds Company
Toxicity: child friendly wood preservative
Age Appropriateness: all ages

Wind Chimes have their origins in Indian wind bells which were suspended on the corners of pagodas to scare away evil spirits.

Our chimes are long and made with 1-1/2” pipes, so the sound is unbelievable, full of long-lasting, multi-toned resonance that’s just beautiful!

When played by the wind or children, a single chime produces a fundamental sound with a variety of additional overtones, so when our chimes start moving, many, many different tones and overtones are produced, making this instrument sound truly magical.

Depending on where they're hung, when they start ringing, Wind Chimes can indicate a change in wind direction or velocities, so children will always know when air is in motion. This, of course, can lead to imaginative stories about wind elves and fairies ringing the chimes, or to discussions about wind and why the air moves, or about clouds moving, birds in flight, kites flying, and so on.

These silver-colored Wind Chimes are a beautiful, outdoor musical instrument that can be hung anywhere. They can be played both by the wind and by children gently brushing the pipes.

Because each is hand made, and none is ever made exactly the same, placing several of these in different places on your Natural Playground will provide endless, beautiful entertainment for children and adults alike.

Made to hang from anything such as a tree branch or any other support off the ground, installation is very easy. Endlessly delightful!

Pedestal Pipes

NMS-PP

Shipping Weight: 37 lbs
Shipping Dimensions: 72"L X 10"W X 10"H
Brand: Natural Playgrounds Company
Toxicity: child friendly wood preservative
Age Appropriateness: all ages

The "Pedestal Pipe" is a beautiful, outdoor musical instrument that has different melodious sounds depending on the size of each pipe.

We like to scatter several of them in wildflower meadows or in sound gardens.

Each set produces distinctly different sounds depending on the the length of the pipe and whatever the child uses to strike the pipe, so the sound is always changing, and always delightful!

Children love to explore the sounds, become intrigued with the tonal variations, and then search for a series of "notes" that play familiar songs.

Pedestal Pipes come with a single post that can be mounted at any height in any location.

If Pedestal Pipes are purchased for indoor use, the post is shortened and sturdy feet are included.

Comes with easy assembly and installation instructions and a mallet.

<embed height=”10” width=”100” src="/sounds/PedPipe.mp3" />

Musical Fences

NMS-MF4

Shipping Weight: 70 lbs
Shipping Dimensions: 49"L X 29"W X 6"H
Brand: Natural Playgrounds Company
Toxicity: child friendly wood preservative
Age Appropriateness: preschool

This description is for our 4' Musical Fence which is designed for younger children (You'll find the same description under our 6' fence for older children).

Our unique Musical Fence is sized to fit within a Natural Playground setting as part of the music/sound garden. The fence frame is cedar, and it holds vertical, galvanized, metal tubes spaced closely together so that children walking or running along the fence while dragging their hand or a stick along the pipes make percussive musical sounds (like in the old days of running a stick along fence balusters).

But the neat thing, is that when kids swipe their hands across all the tubes, the tubes swing into each other, thus setting off a series of resounding, random notes that sound just like wind chimes (but with much deeper sounds). Further, a child can also strike the individual tubes with a stick or a stone to create individual notes!

This is sort of like a giant chime, but it’s operated by kid and not the wind (well, unless it’s a hurricane! :)

This wonderfully inventive, unique musical instrument teaches many lessons about rhythm, movement, and sound. The pipes are not "tuned" for a very simple reason: Children need to "find" sounds on the playground, just as they find and hear different sounds in nature. if they’re given perfectly tuned pipes in consecutive order, then they will always think that musical sounds are always perfectly pitched and "come" that way.

Our pipes teach them about the randomness of sounds and notes, and that making traditional "music" is up to them.

In-ground installation instructions are included. Built/installed dimensions for the 4' Fence: L=48", W=12", H=43" without the roof.

Note: If you want the four foot Musical Fence for use inside (or even outside when you don’t have the option of mounting it in the ground), just choose the “with feet” option from the pull down menu (see photo below). There is an extra charge for the feet.

<embed height=”10”width=”100” src="/sounds/New4.m4a" />
<embed autostart="false” height=”10” width=”100” src="/sounds/WithBands.m4a" />

Hollow Log

FTTP-HL

Shipping Weight: 300 lbs
Shipping Dimensions: 36"L X 28"W X 28"H
Brand: Natural Playgrounds Company
Toxicity: non-toxic
Age Appropriateness: all ages

There is nothing like a hollow log! It smells fabulous, looks phenomenal, it's fun to be inside it, and it is certainly a VERY natural play element.

Kids get to see wood grain and growth rings up close, see how branches connect to the tree trunk, and even see what a tree looks like on the inside!

Keep in mind, that just as each tree is different, each of the 3' long or 4' long hollow logs which have a ~23" diameter core (through which even fit adults can crawl) is different, because each one is uniquely-shaped on the outside -- which is why it's such a fabulous addition to your playground!!

The Hollow Log usually comes with bark on it, which looks very nice, but when the log dries and shrinks, it MAY start falling off. If you want us to peel and then treat the log on the outside, we offer that option.

Keep in mind that these heavy logs are usually round or close to it, so with some effort they could be rolled. If you perceive this to be an issue, we suggest ordering the stabilizers running the length of the log on 2 sides.

Maintenance: You may notice occasional mold growing on the surfaces of the log. This is completely normal. A mixture of 1 : 1 bleach and water applied with a stiff brush will wipe it away!

Lastly, these are heavy items, so we ship them by freight. If you don't have a loading dock, ask the shipper for a lift gate which will lower the pallet to the ground. If that's not possible, get lots of strong people to help unload. The bigger ones might weigh up to 500+ pounds.

But they are well worth the weight :))

A NOTE about sap:

All trees have sap. It's the liquid that circulates inside the tree to distribute water and nutrients. It's how they feed themselves. It's the "blood" of a tree.

We make our hollow logs from large pines that are being removed from construction sites, so you're going to see and maybe feel some sap/pitch.

We heat the sap with our commercial heat gun until it crystallizes. If you have issues, you can do the same, possibly using a regular heat gun or a small propane torch.

To remove sap from hands? Try a hand sanitizer.

Fort

TDG-FORT

Shipping Weight: lbs
Shipping Dimensions: "L X "W X "H
Brand: Natural Playgrounds Company
Toxicity:
Age Appropriateness:

There is nothing more exciting to kids than a playground Fort, and ours is meant to be installed on flat ground or embedded into a hill (or mountain :)

This playground Fort is about 22" deep from the top of the posts and walls down to the ground, but it is very, very easy to make this Fort less deep! (see instructions).

Big kids can crawl out of it as is, but small kids can, too. However, if you want to help the smaller kids get out even more easily, follow the simple instructions to make the walls shorter, or to keep it challenging and add more learning/discovery opportunities, buy two or more of our stepping stumps, like 8", 10", and 12" high ones to make steps inside the fort (or do both!)

Once the Fort's in place, you can add a tall post with a flag on it to make the experience more imaginary.

Our octagonal Forts are either 8' or ~11' across measured from flat side to opposite flat side.

If embedded into the ground, this playground Fort is essentially in a hole, so it should probably be drained, but that's easy to do, especially if you're building a hill around it (again, see the instructions)!

Sitting Stumps (set of 4)

TSCLP-SS

Shipping Weight: 400 lbs
Shipping Dimensions: 48.00"L X 40.00"W X 22"H
Brand: Natural Playgrounds Company
Toxicity: child friendly wood preservative
Age Appropriateness: all ages

The Sitting Stumps, cut from real logs as part of a forest management, thinning project in northern New England, are a fantastic way to bring pieces of one of nature's most beautiful creations onto the playground.

These can be placed 6' apart for a safe outdoor classroom, and arranged in front of a chalkboard and/or demonstration table (see elsewhere in the store).

The various-sized, easily manipulated sitting stumps can also be used for loose parts, stacking, imaginative play, and amphitheater seating.

Natural log Sitting Stumps will range from 10" (great for toddlers) to 15" high, unless otherwise specified, and are ~12" diameter. Come as a set of 4, but can be sold individually.

Because they are natural, Sitting Stumps will exhibit cracks or splits as they dry out over time, but this will only add to their beauty and teach children about natural processes. It will not reduce the structural integrity of the Sitting Stumps.

They'll last a long, long time (years and years!) without much sign of wear anyway; we want children to know what real wood smells like (and not smell some kind of oil or mineral smell that gives off a weird odor
when the stumps are in the hot sun); and we want the children to see and observe the inevitable changes that will occur over a long period of time!

Because bark clings to the trunk differently depending on the seasons throughout the year, sometime being loose, and sometime being tight, we have never been able to guarantee that any of our tree products will come with bark. Unfortunately, sometimes it looks great leaving our shop, but when it gets to the customer, some of the bark has fallen off, which then doesn't look great, then some people complain....

So you do have the option of having us peel off all the bark, and then treating the Sitting Stumps with child-friendly preservative for a long lasting product.

Four 12"+/- D x 12-15"+/- H natural sitting stumps

NOTE: if you need longer stumps for use as vertical retainers in a sand play area, or on a hill, let us know. We can cut them to any length.

Picnic Table (child)

NF-PT

Shipping Weight: 28 lbs
Shipping Dimensions: 36"L X 21"W X 10"H
Brand: Natural Playgrounds Company
Toxicity: child friendly wood preservative
Age Appropriateness: preschool

Full-sized picnic tables can be obtrusive on playgrounds and are not comfortable for children, so these mini picnic tables are a perfect height and are definitely a must have for any natural playground/outdoor learning environment.

We can make them any size (just ask!), but the one shown here is for children from 3-6 years old, and seats 4-6 comfortably.

The splinter-free, weather-resistant Cedar, Mini Picnic Table comes as a kit, and is sanded smooth with rounded corners and edges for safety. The tables have a perfect kid-sized 22"x 36" top, with a table height of 20", and a seat height of 12".

Cedar will weather and age naturally, but will be best if treated with a kid-friendly treatment (see our child-friendly preservative under Maintenance in the store). Please specify if you want the table treated, and we will be happy to apply a non-toxic preservative that, for the most part, maintains the natural color and texture of the table.

Light weight! Very portable!...yet very durable.

Weather Station

SSC-weather

Shipping Weight: 100 lbs
Shipping Dimensions: 72"L X 30"W X 10"H
Brand: Natural Playgrounds Company
Toxicity: child friendly wood preservative
Age Appropriateness: all ages

Our fabulous, easy-to-read Weather Station has 5 very good sensors that collect data related to the weather and environment.

What better way to get the children involved in the environment around them? If they see the numbers and measurements, and you teach them how to take notes about what's happening hour-to-hour, or day-to-day, they will begin to understand the relationships between the varying measurements!

Once they understand that, they'll be able to make their own weather forecasts!

How cool is that??!!

Types of Sensors

The following measurement devices are included with the Natural Playgrounds Weather Station:

Thermometer, that measures air temperature in degrees, with an Hygrometer that measures the amount of moisture in the air.

Barometer - Measures the weight of the air above you. It changes with the temperature. However, barometers are designed to work at 3000 foot elevations or less. If you're in a higher elevation, we will adjust the instrument to work at your elevation, but you have to let us know!!!

Anemometer - Measures how fast the wind is blowing, or wind speed. This is a very accurate instrument, not a cheesy play toy :)

Weather Vane indicator - Shows which direction the wind is blowing (also Wind Vane). This red vane is also the wind collector which takes the pressure of the wind into the big red tube and directs it through the white tube into the indicator.

Rain Gauge - Measures the amount of rain that falls to the ground.

The instruments are made for outdoor use. We recommend mounting the post high enough off the ground that kids can see BUT CAN'T REACH the instruments. These are delicate instruments and are not able to withstand abuse (or, obviously, vandalism), so please advise your teachers and set some strict guidelines for how kids interact with and respect the Weather Station.

Easy installation instructions included!

Magnifying Station

SSC Magnifying

Shipping Weight: 30 lbs
Shipping Dimensions: 72"L X 15"W X 8"H
Brand: Natural Playgrounds Company
Toxicity: child friendly wood preservative
Age Appropriateness: all ages

This brand new, science learning element is designed to help children understand and better connect with nature.

The indestructible magnifying glass gives kids 5x magnification. That means that whatever they hold about 8" under the glass will be enlarged 5 times its size!! so they see everything in great detail!

They'll be able to see the small veins in a leaf, the hairs on spiders' legs, cobweb strands, particles of sand that'll look like small pebbles, the cells in their own skin, essentially everything with a fresh eye.

The reason we designed a cantilever arm is so kids can put big things under it. Compare this fabulous feature to other magnifiers, all of which offer a very limited viewing area that children can't even get their hands under!

Don't delay! Get this inexpensive, fabulous science tool immediately, and watch your children be amazed as they run all over the playground finding different things to investigate.

You might need more than one :))

The Magnifying Station can be installed into the ground, or if you want, you can purchase just the glass mounted in the arm so you can use it inside or outside whenever the occasion warrants. Both options include the slipover lens cover.

The instrument is made for outdoor use.

Easy installation instructions included!

NOTE: As with any type of magnifying lens (binocular, reading glasses, old bottle bottom, raindrop, etc), this magnifying glass has a focal length (this one is 7-7/8") which concentrates light at that point.

Light is made up of photons, or tiny particles of energy, so if the sun's light is concentrated on a small area, it can get get very hot!

We all tried this when we were kids! I remember having this real cheap magnifying glass, and it was great fun concentrating the sun's energy on one point to see what would happen. It felt like a prick on my skin, or you could burn a hole through a leaf, or ... :)

It's also possible that as the Earth turns, and the sun's position changes, vegetation under the magnifying station may suffer

from too much intense heat, which is another reason to always use the slipover cover which blocks the sun entirely.

Log Benches

NF-LB

Shipping Weight: 250 lbs
Shipping Dimensions: 48.00"L X 14"W X 14"H
Brand: Natural Playgrounds
Toxicity: child friendly wood preservative
Age Appropriateness: all ages

Children want places to sit and look at a bug, to lean against, to talk with friends, or to just watch what's going on in the playground.

Teachers also love comfortable places to sit and watch what's going on, or to sit with their "buddies," or to console a child.

Log Benches made from real, whole logs, are particularly attractive features as they blend in with the natural theme yet are practical and low cost.

The very beautiful-looking, 48” long Milled Log Benches are milled top and bottom so they rest flat on the ground and there is a flat top for sitting. They are then sanded and treated with child-friendly preservative that should be reapplied 2-3 times/year (you can use a garden sprayer). They are typically about 15” high.

For the whole log benches, bark will likely still be on the log, so children can see and study bark up close, try to identify the type of tree, and play with its texture. The bench also gives off the wonderful, natural smell of wood, and as it ages, the bark will slough off and expose the smooth surface of the tree wood beneath.

Logs used in the benches are treated when they leave our shop, and should be treated with a good child-friendly preservative 2-3 times/year to keep them from drying out. Logs are typically about 8" diameter, 48" long, and when mounted on the bases, are 10-16" tall (depending on requested height). Bench for toddlers is 10" height. Ages 2+ would be 14-16" height.

Whole Log Bench comes as a three-piece kit. No installation is required; sit on it as soon as you get it!

Two, separate Whole Log Benches are shown in the photo. The price is for a single Log Bench.

These Whole Log Benches may be fixed to the ground, so order accordingly.

During the season when the bark is “tight,” we will probably make the decision to keep it on. However, should it arrive on your premises without bark, it’s because It was cut during the “loose bark” season, and therefore subject to shipping damage.

For those of you who want a long-lasting, glossy, clear marine finish, we offer that option for any bench that is debarked, so if you want this, you also have to order the debarking.

Chin Up Bars

SP-ACUPB

Shipping Weight: 125 lbs
Shipping Dimensions: 48"L X 10"W X 10"H
Brand: Natural Playgrounds
Toxicity: child friendly wood preservative
Age Appropriateness: all ages

One of the greatest upper body challenges, the Chin-Up/Pull-Up Bars are a must-have on any playground, fitness course, or challenge course.

We have found that children as young as toddlers love to hang from bars, so this infinitely versatile play element can be made for any age group, up to and including adults. Also, because the bars can be mounted side by side, and at different heights, they can be used for hanging, pull-ups, chin-ups, push-ups, and simple gymnastic exercises.

By the way, pull ups is undoubtedly the most universal exercise used by climbers who lock their elbows at 90° and 135° for extended periods of time. This exercise is also called “Frenchy.”

The Chin Up Bar comes in 3 different versions. The Adjustable is just that. It will easily adjust for any age, from young children to adults. Just lift it up, and reset it in any of the slots.

The Double consists of 3 posts in a line, and the Triple consists of 4 posts making a straight line or an L (your choice).

If you’re looking for a similar item, we suggest you look at our Horizontal Ladders.

Comes with complete installation instructions.

For schools and public playgrounds, a fall zone would be required.

Appendix H-Workout Areas

Drawing

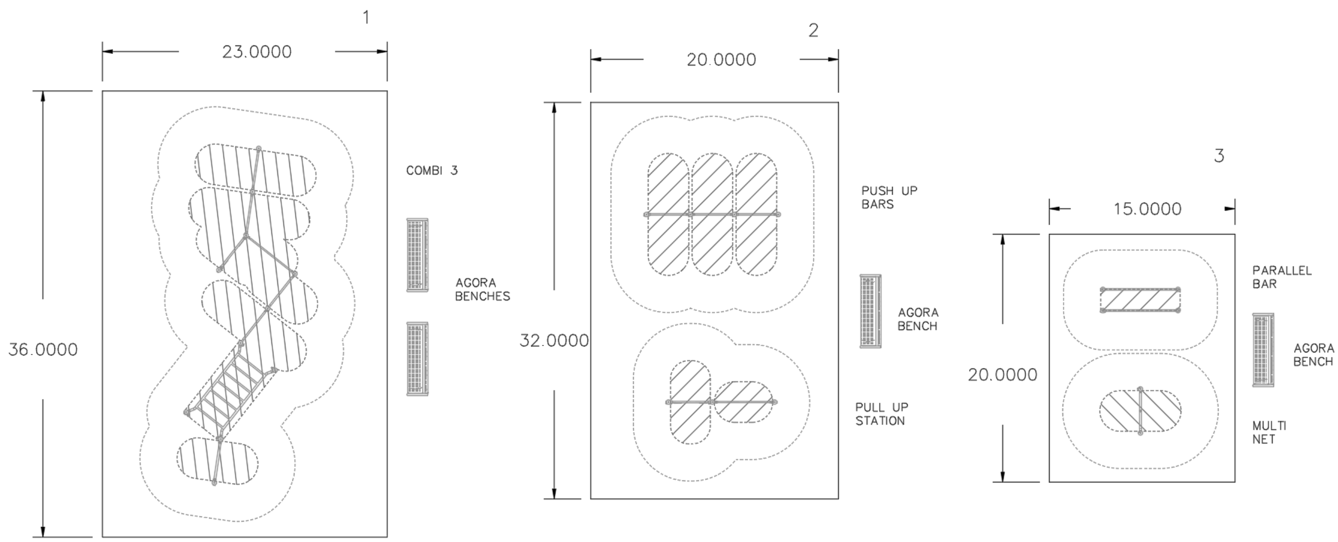


Figure H. 1 Plan view drawings of the three recommended workout areas

Cost Estimate

Table H 1: Cost estimate for workout areas

Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
COMBI 3		EACH	$ 8,460.00	1	$ 8,460.00	$ 8,460.00
PARALLEL BARS		EACH	$ 1,600.00	1	$ 1,600.00	$ 1,600.00
PUSH UP BARS		EACH	$ 1,080.00	1	$ 1,080.00	$ 1,080.00
PULL UP STATION		EACH	$ 2,510.00	1	$ 2,510.00	$ 2,510.00
Multi Net		EACH	$ 1,650.00	1	$ 1,650.00	$ 1,650.00
Agora Steel Bench with Backrest		EACH	$ 2,700.00	4	$ 10,800.00	$ 10,800.00
Equipment Total					$ 26,100.00	$ 26,100.00
Shipping Total					$ 3,732.00	$ 3,730.00
Install Fitness Equipment					$ 29,700.00	$ 29,700.00
Alternate Bid – Mulch Supply & Instal		CY		66	$ 15,400.00	$ 15,400.00
Total					$ 74,932.00	$ 74,930.00

Costs estimated based on quote provided by Kompan, Crouch Recreation, and The Henley Group (12/11/2025).

Multi Net

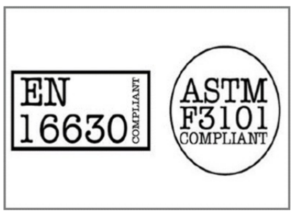
FSW207

Post are made of Ø101.6 x 2mm, pre-galvanized carbon steel and powder coated, a great protection to all conditions.

The connectors are made of die-cast aluminium, specially alloyed for the outdoor environments and heavy usage. The screws attaching the connectors are stainless steel and protected by zinc washers.

The ropes are made of UV-stabilised PES with inner steel cable reinforcement. The rope is induction treated in order to create a strong connection between steel and rope which leads to good wear resistance.

Item no. FSW20700-0000		
Installation Information		
Max. fall height		133 cm
Safety surfacing area		18.5 m²
Total installation time		3.8 hours
Excavation volume		0.00 m³
Concrete volume		0.00 m³
Footing depth (standard)		0 cm
Shipment weight		80 kg
Anchoring options	In-ground	✔
	Surface	✔
Warranty Information		
Hot dip galvanised steel		Lifetime
Post		10 years
Connectors		10 years
Ropes & nets		10 years
Spare parts guaranteed		10 years



All KOMPAN fitness products are compliant with the ASTM F3101 & EN16630 Outdoor Fitness Standards. Load tests are performed as a static test by adding dynamic factors as well as safety factors to the specified load of 78kg per user. A product intended for 1 user is loaded with 420kg.

The information sign is made of a PA6 (Polyamide) and shows the most relevant exercise and a QR code. When scanned the QR code will link to an animated illustration of the exercise and offers the possibility of downloading the KOMPAN sport & fitness App, which will provide a large amount of exercises and workouts.

KOMPAN fitness products are standard available in Orange, Anthracite, Medium Grey, Dark Grey, Dark Blue, Light Blue, Yellow, Red, Black, Dark Green, Lime, Medium Green, Beige and Brown. All other RAL colours are available on request. It will always be possible to match the surroundings or colour theme!

2 / 11/28/2025

Data is subject to change without prior notice.

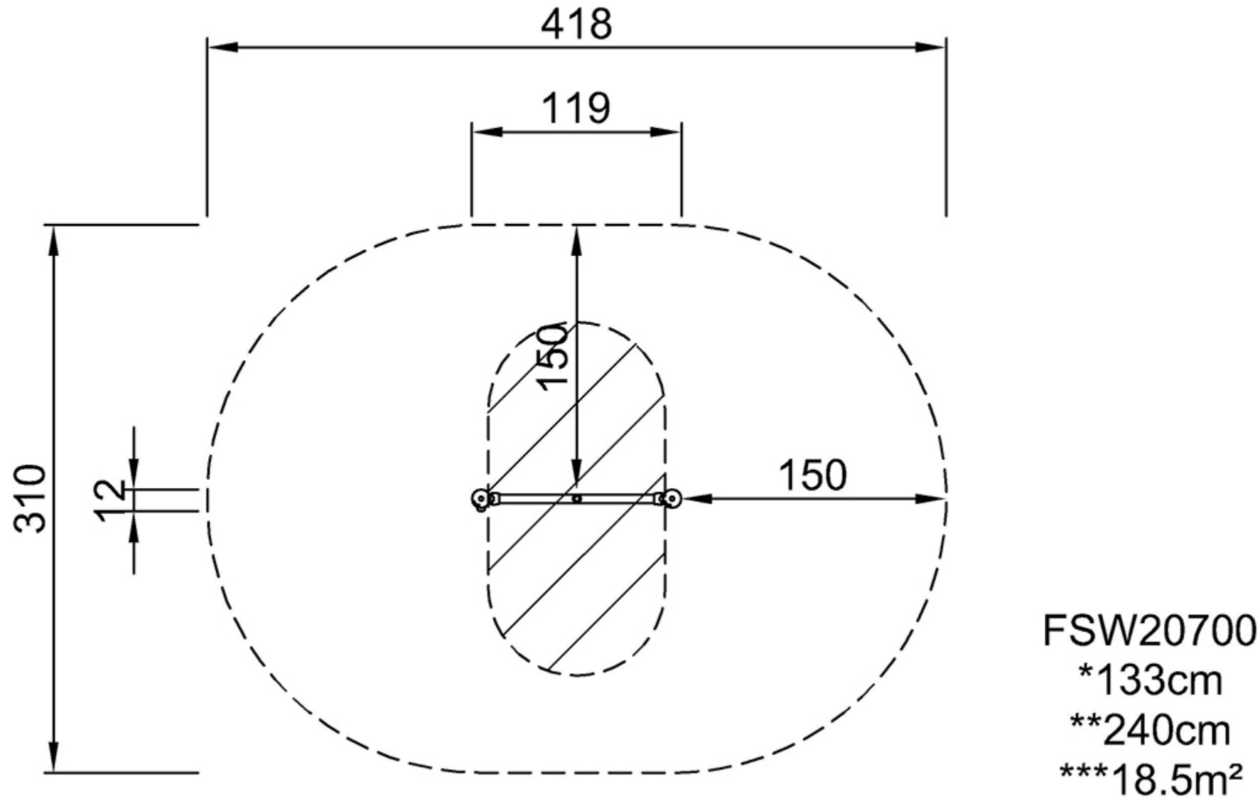


Figure H. 2 Multi net plan view

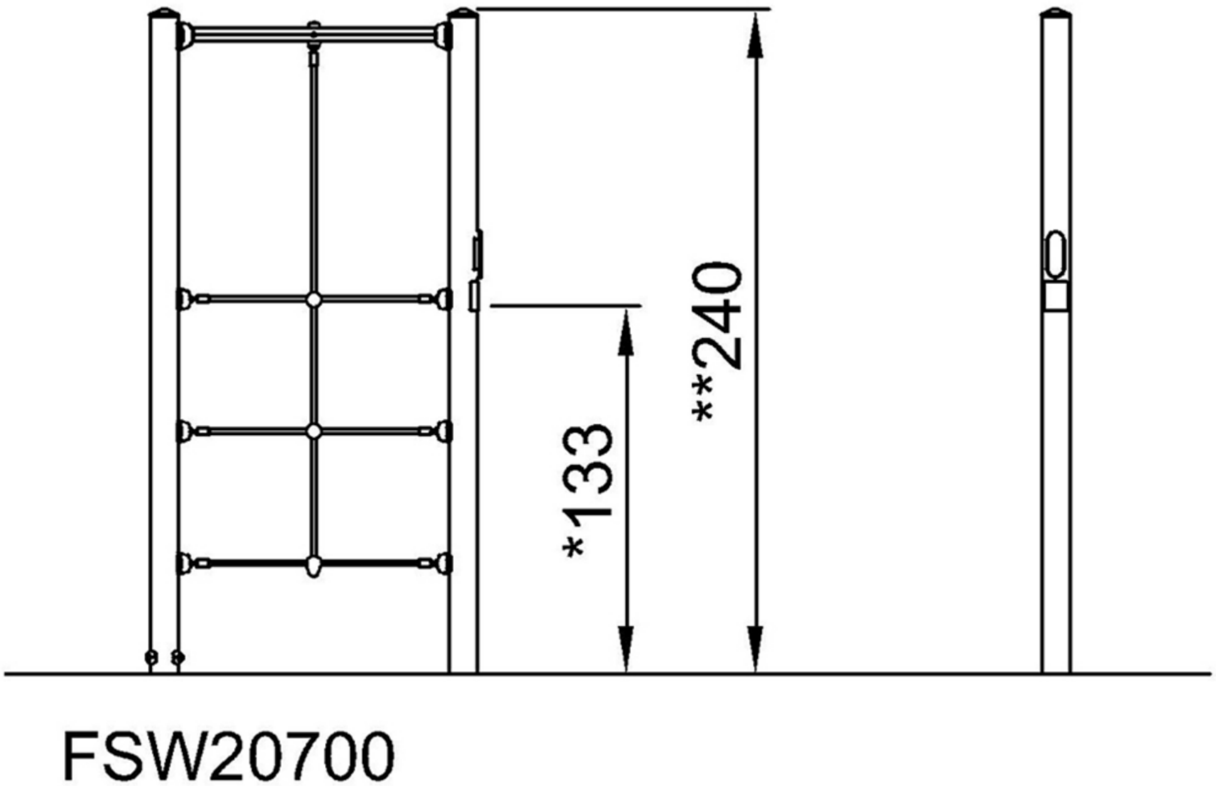


Figure H. 3 multi net dimensions

Parallel Bars

FSW201

KOMPAN Let's play

Post are made of Ø101.6 x 2mm, pre-galvanized carbon steel and powder coated, a great protection to all conditions.

The connectors are made of die-cast aluminium, specially alloyed for the outdoor environments and heavy usage. The screws attaching the connectors are stainless steel and protected by zinc washers.

Bars intended as grips during exercises are made of hot-dip galvanised steel ø38mm. A great diameter to support the wrist when doing dips or handstands.

Item no. FSW20102-0901		
Installation Information		
Max. fall height		99 cm
Safety surfacing area		15.9 m²
Total installation time		2.6 hours
Excavation volume		0.11 m³
Concrete volume		0.06 m³
Footing depth (standard)		90 cm
Shipment weight		75 kg
Anchoring options	In-ground	✔
	Surface	✔
Warranty Information		
Hot dip galvanised steel		Lifetime
Post		10 years
Connectors		10 years
Spare parts guaranteed		10 years

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TÜV SÜD

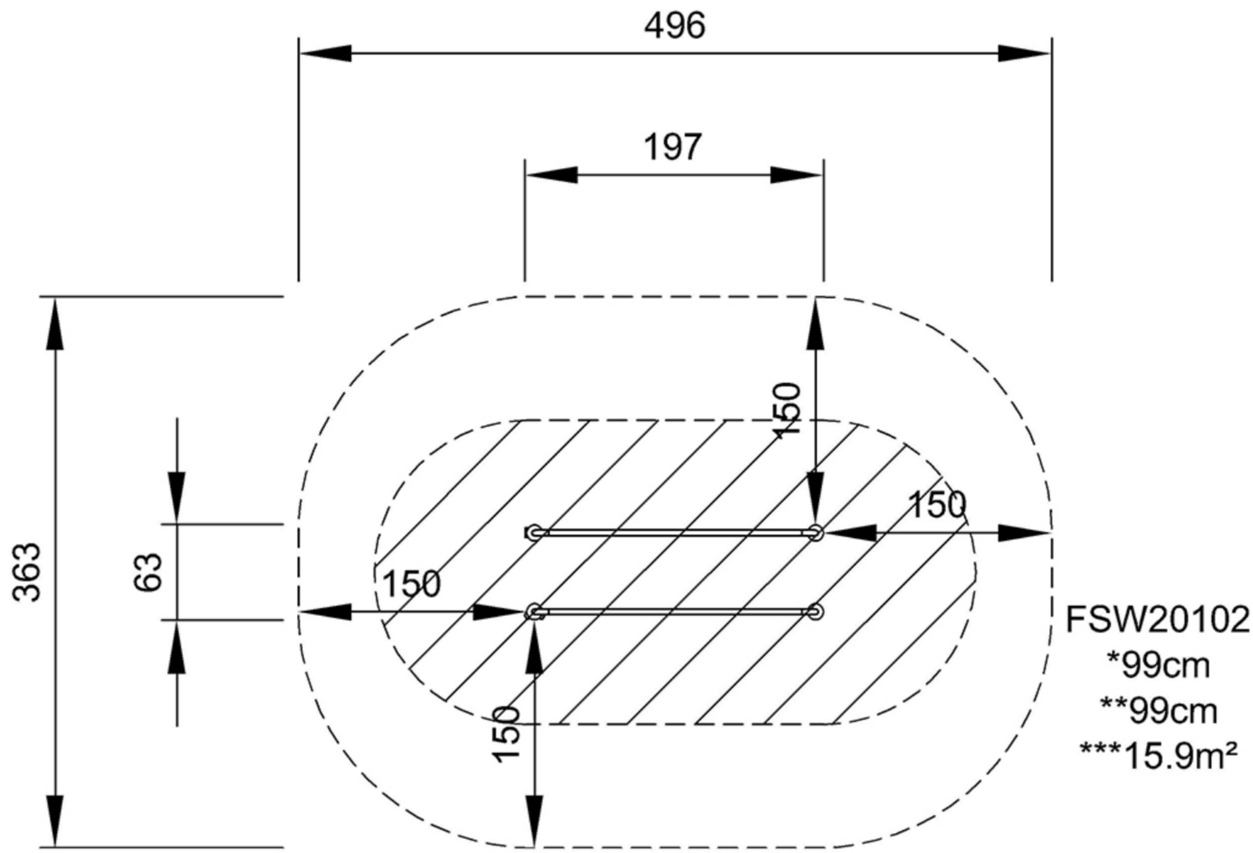


Figure H. 4 Parallel Bars plan view

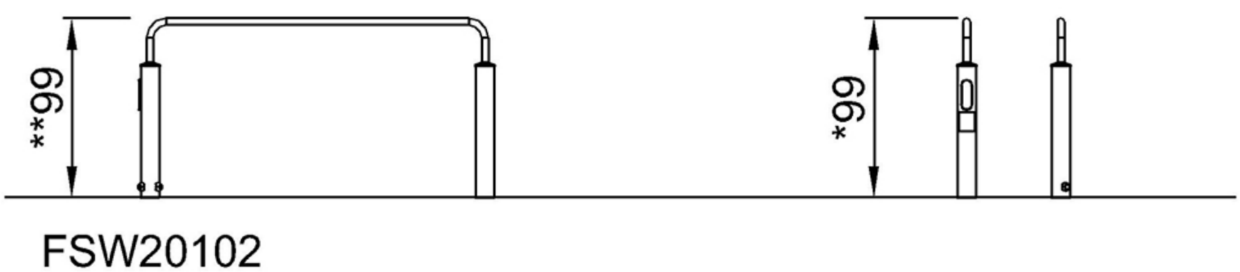


Figure H. 5 Parallel Bars dimensions

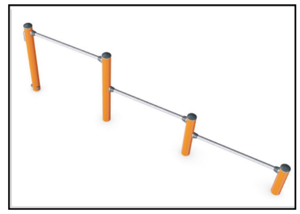
Push Up Bars

FSW209

KOMPAN Let's play

Post are made of Ø101.6 x 2mm, pre-galvanized carbon steel and powder coated, a great protection to all conditions.

The connectors are made of die-cast aluminium, specially alloyed for the outdoor environments and heavy usage. The screws attaching the connectors are stainless steel and protected by zinc washers.



The push up bars features three 38 x 2mm push up bars at three heights of respectively 38cm, 58cm and 99cm.

Item no. FSW20902-0901

Installation Information	
Max. fall height	99 cm
Safety surfacing area	17.7 m²
Total installation time	2.3 hours
Excavation volume	0.18 m³
Concrete volume	0.08 m³
Footing depth (standard)	90 cm
Shipment weight	64 kg
Anchoring options	In-ground ✓
	Surface ✓

Warranty Information	
Hot dip galvanised steel	Lifetime
Post	10 years
Connectors	10 years
Spare parts guaranteed	10 years

All KOMPAN fitness products are compliant with the ASTM F3101 & EN16630 Outdoor Fitness Standards. Load tests are performed as a static test by adding dynamic factors as well as safety factors to the specified load of 78kg per user. A product intended for 1 user is loaded with 420kg.

The information sign is made of a PA6 (Polyamide) and shows the most relevant exercise and a QR code. When scanned the QR code will link to an animated illustration of the exercise and offers the possibility of downloading the KOMPAN sport & fitness App, which will provide a large amount of exercises and workouts.

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2 / 11/28/2025

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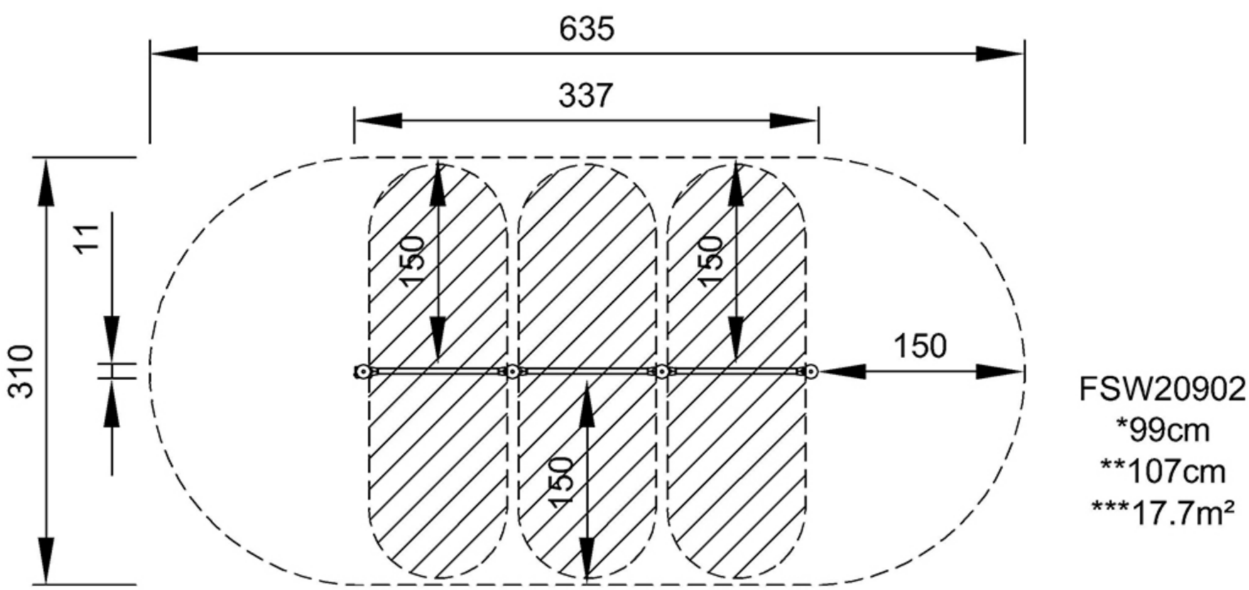
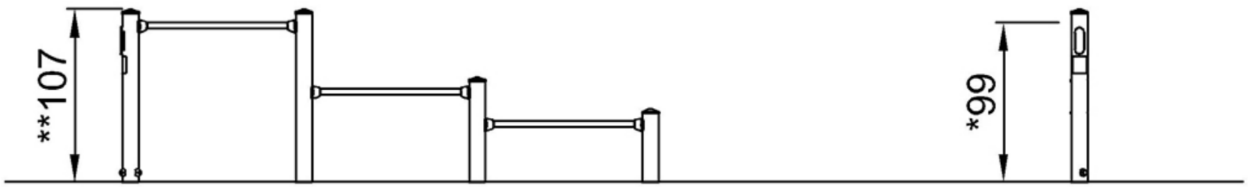


Figure H. 6 Push up bars plan view



FSW20902

Figure H. 7 Push up bars dimensions

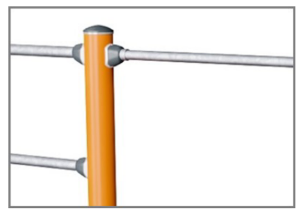
Pull Up Station

FSW208

KOMPAN Let's play

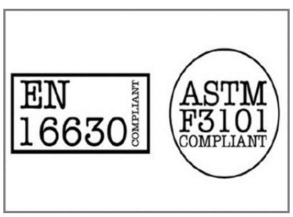
Post are made of Ø101.6 x 2mm, pre-galvanized carbon steel and powder coated, a great protection to all conditions.

The connectors are made of die-cast aluminium, specially alloyed for the outdoor environments and heavy usage. The screws attaching the connectors are stainless steel and protected by zinc washers.



All bars intended for pull ups are made of solid, ø32mm x 138 m, hot dip galvanised, S235JR steel bars. This diameter gives the right grip for everyone.

Item no. FSW20802-0901	
Installation Information	
Max. fall height	133 cm
Safety surfacing area	15.6 m²
Total installation time	2.9 hours
Excavation volume	0.53 m³
Concrete volume	0.30 m³
Footing depth (standard)	90 cm
Shipment weight	106 kg
Anchoring options	In-ground ✓
	Surface ✓
Warranty Information	
Hot dip galvanised steel	Lifetime
Post	10 years
Connectors	10 years
Spare parts guaranteed	10 years



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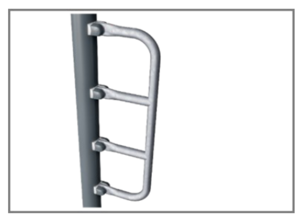
The information sign is made of a PA6 (Polyamide) and shows the most relevant exercise and a QR code. When scanned the QR code will link to an animated illustration of the exercise and offers the possibility of downloading the KOMPAN sport & fitness App, which will provide a large amount of exercises and workouts.



The handles offer 4 different heights to place the hands or feet

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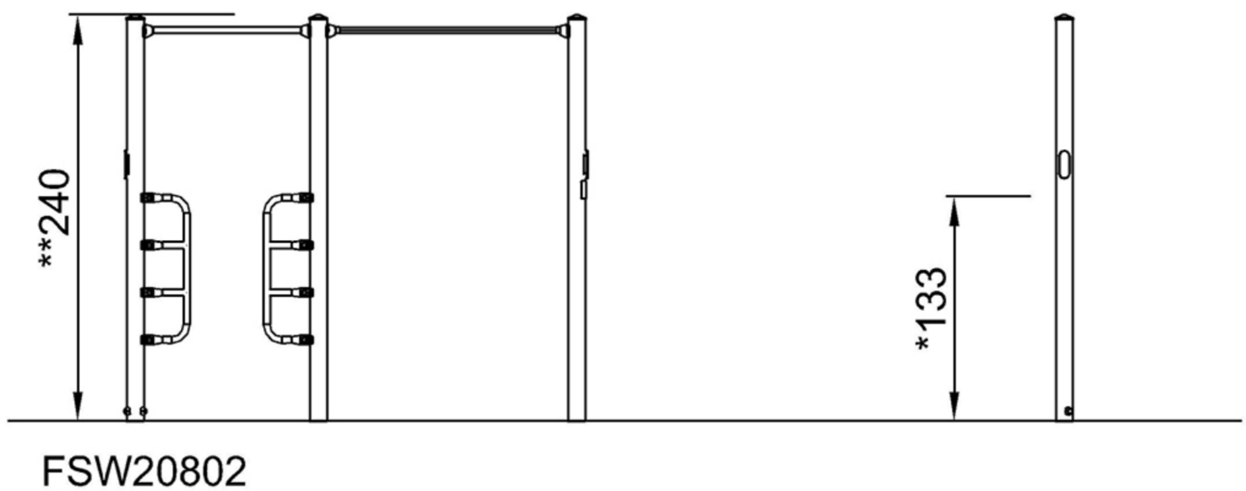


Figure H. 8 pull up bars profile view

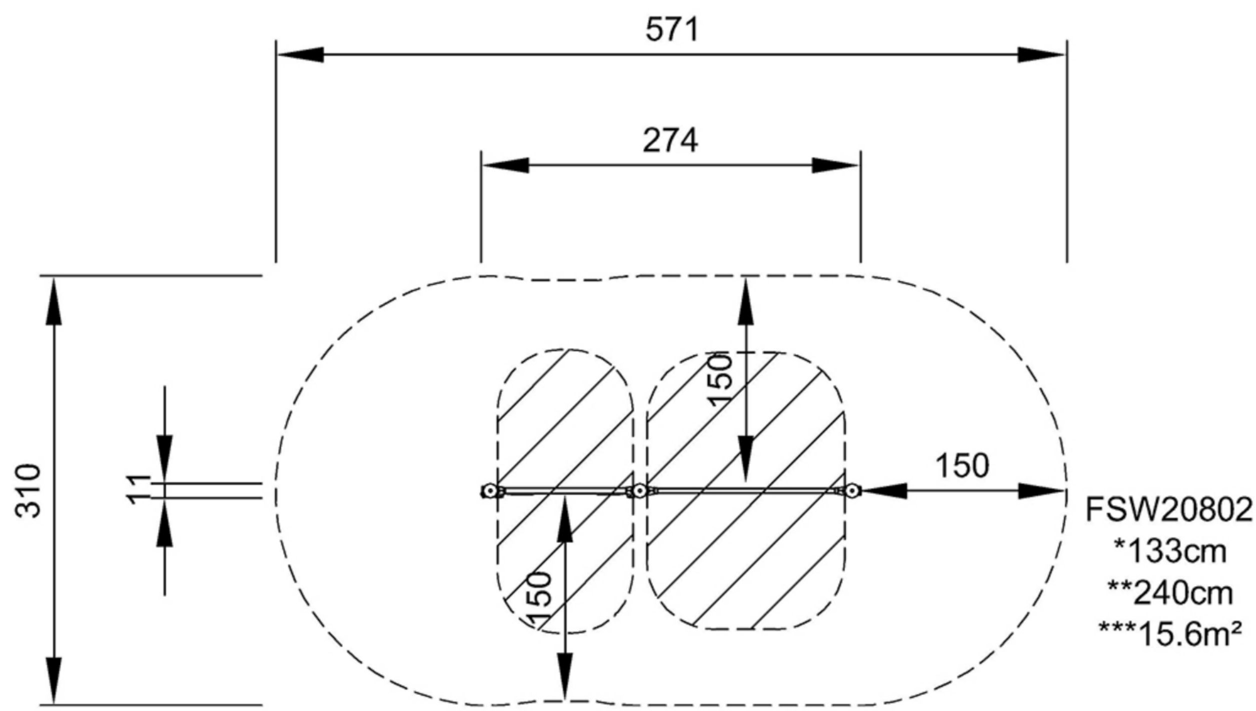


Figure H. 9 Pull up bar area plan view

Agora Steel Bench with Backrest

PAR4054

The steel surfaces are hot dip galvanized inside and outside with lead free zinc. The galvanization has excellent corrosion resistance in outdoor environments and require low maintenance. Painted steel parts are hot dip galvanized before powder coating.

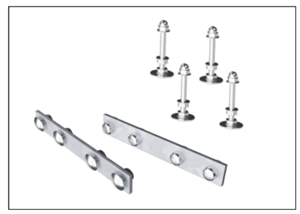
Powder coated top finish on top of galvanisation is processed in two steps: Light grinding and clean sweeping, powder coating - thickness 70-120 µm.

The Agora full steel assortment is available as standard in 9 different colors to match the selected color scheme on the play, sport or fitness site.

Item no. PAR4054-0609		
Installation Information		
Total installation time		1.5 hours
Excavation volume		0.19 m³
Concrete volume		0.13 m³
Footing depth (standard)		60 cm
Shipment weight		73 kg
Anchoring options	Surface	✔
	In-ground	✔
Warranty Information		
Hot dip galvanised steel		Lifetime
Painted toplayer		10 years
Stainless steel components		Lifetime
Spare parts guaranteed		10 years

KOMPAN outdoor furniture is available for surface and in-ground installation. Surface installation by anchoring to base layer or in-ground installation as either direct in ground or additional hot dip galvanized steel brackets.

The benches and tables can be combined in multiple settings by choosing individual products or assembled into larger solutions. See catalogue pages for more inspiration.



The hardware is made of stainless steel or galvanised steel to ensure durable connections with a high corrosion resistance.

2 / 11/06/2025

Data is subject to change without prior notice.

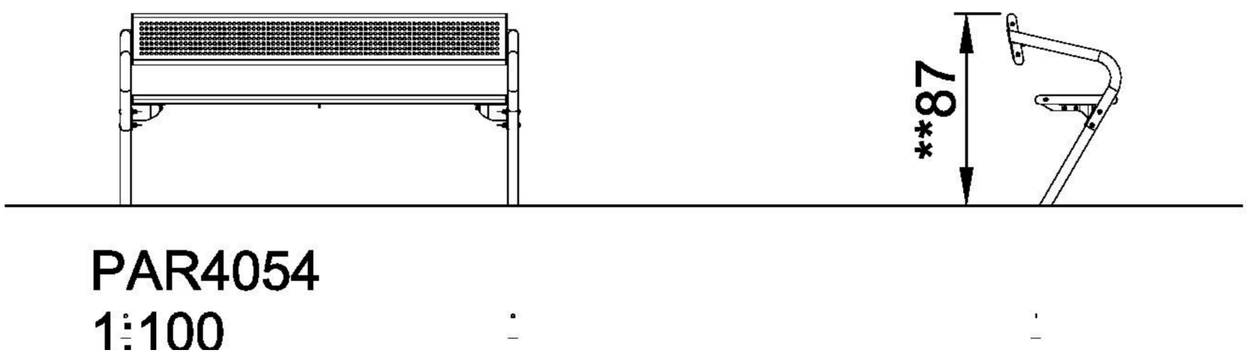


Figure H. 10 Bench profile view

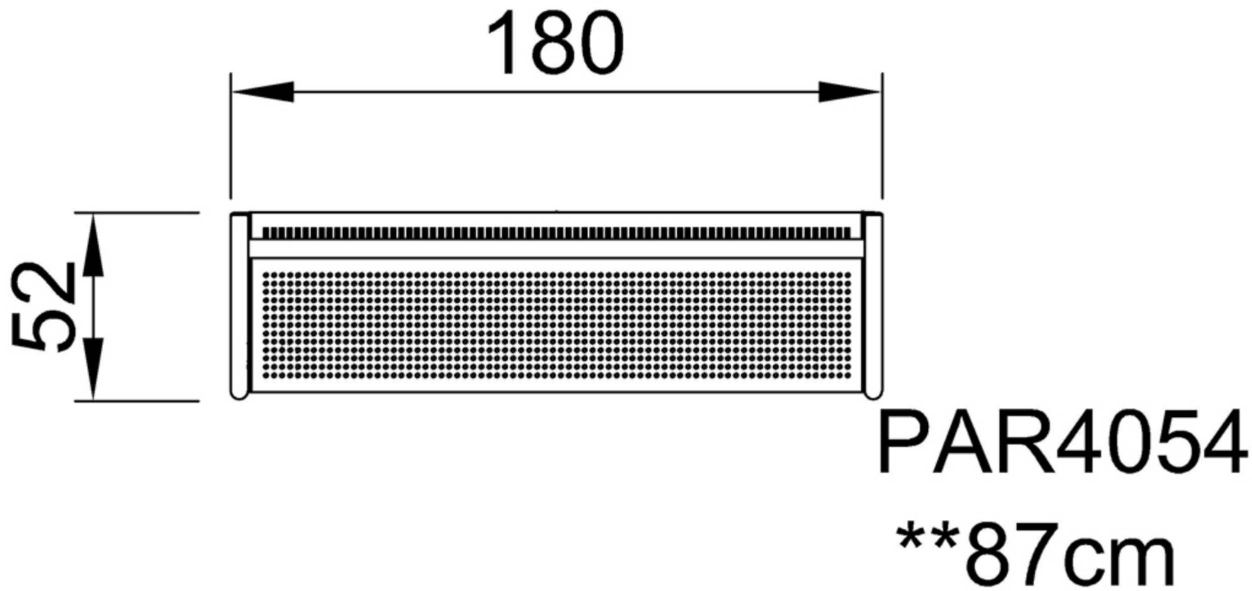


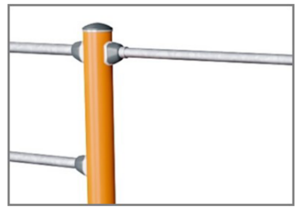
Figure H. 11 Bench plan view

Combi 3

FPW103

Post are made of Ø101.6 x 2mm, pre-galvanized carbon steel and powder coated, a great protection to all conditions.

The connectors are made of die-cast aluminium, specially alloyed for the outdoor environments and heavy usage. The screws attaching the connectors are stainless steel and protected by zinc washers.



All bars intended for pull ups are made of solid, ø32mm x 138 m, hot dip galvanised, S235JR steel bars. This diameter gives the right grip for everyone.

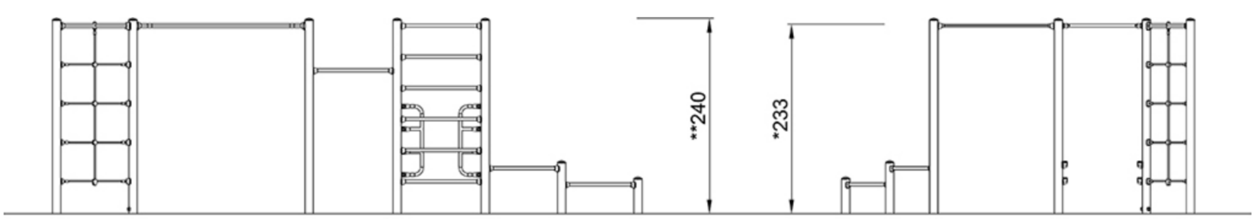
Item no. FPW10300-0900		
Installation Information		
Max. fall height		233 cm
Safety surfacing area		54.3 m²
Total installation time		6.9 hours
Excavation volume		1.31 m³
Concrete volume		0.70 m³
Footing depth (standard)		90 cm
Shipment weight		409 kg
Anchoring options	In-ground	✔
	Surface	✔
Warranty Information		
Hot dip galvanised steel		Lifetime
Post		10 years
Connectors		10 years
Ropes & nets		10 years
Spare parts guaranteed		10 years

The push up bars features three 38 x 2mm push up bars at three heights of respectively 38cm, 58cm and 99cm.

Corocord 16mm ropes of UV-stabilized PES rope strands with inner steel cable reinforcement. The polyester yarn is made from +95% post-consumer materials and is inductively melted onto each strand. The ropes are highly wear-and vandalism-resistant and can be replaced at site if needed.

2 / 11/29/2025

Data is subject to change without prior notice.



FPW10300

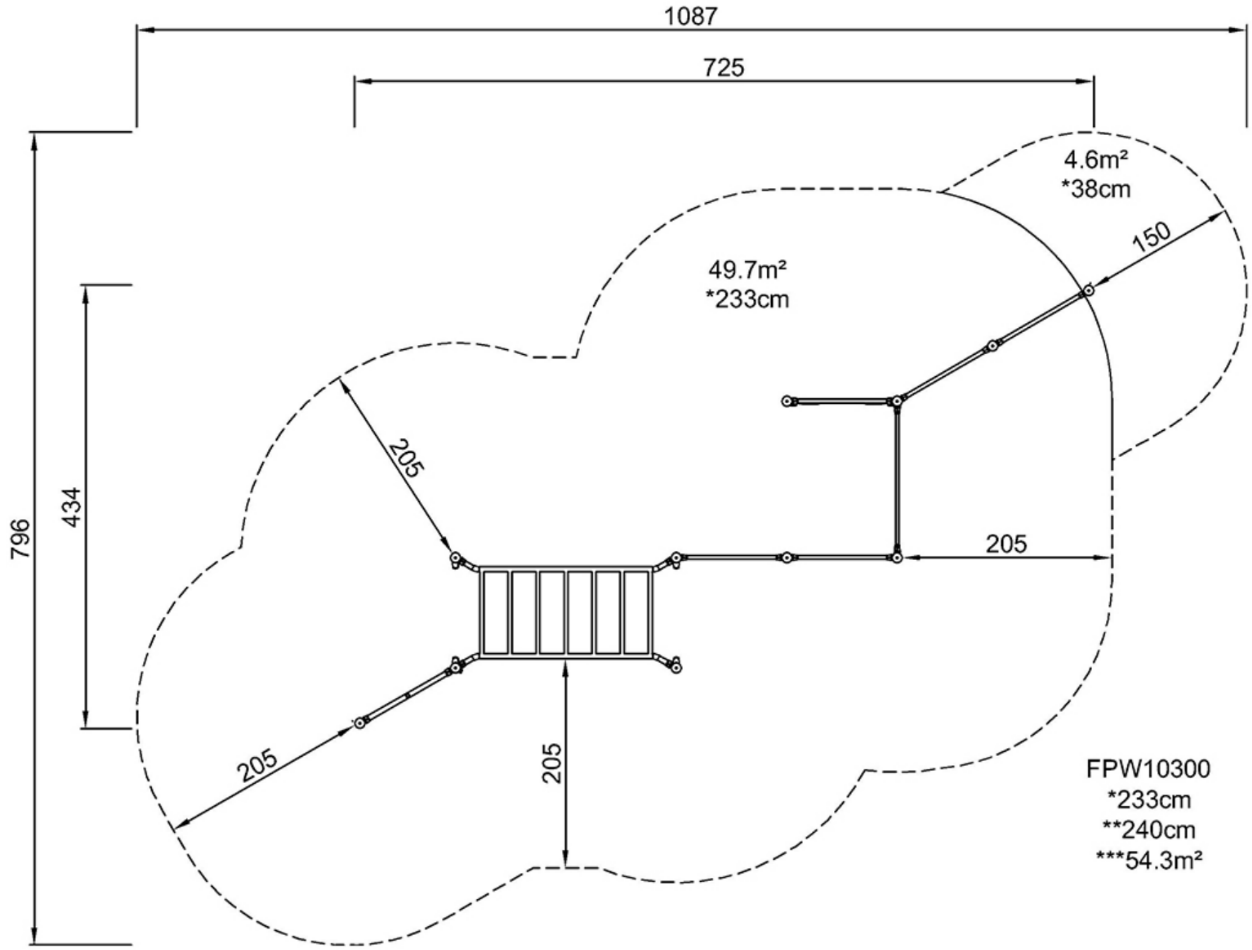


Figure H. 12 Combi 3 plan view

Appendix I-Foundation

All foundation calculations are shown below.

Foundation Calculations

Allowable Bearing Pressure

$q_{all} := 43.5\ \boldsymbol{psi}$

$q_{all} = 6.264\ \boldsymbol{ksf}$

Armstrong Loam

USDA web soil survey

Venue Column Foundations

$P_{col} := 7.57\ \boldsymbol{kip}$

Weight from slab

$w_c := 150\ \boldsymbol{pcf}$ 6" thick

$q_c := w_c \cdot 6\ \boldsymbol{in} = 0.075\ \boldsymbol{ksf}$

$A_c := 18.5\ \boldsymbol{ft} \cdot 35\ \boldsymbol{ft} = 647.5\ \boldsymbol{ft}^2$

$P_c := q_c \cdot A_c = 48.563\ \boldsymbol{kip}$

Weight from foundation

$V_f := 28\ \boldsymbol{ft}^3$

$P_f := w_c \cdot V_f = 4.2\ \boldsymbol{kip}$

$A_{foot} := 6\ \boldsymbol{ft} \cdot 6\ \boldsymbol{ft} = 36\ \boldsymbol{ft}^2$

Bearing Pressure

$$q_u := \frac{P_{col} + P_c + P_f}{A_{foot}} = 11.638\ \boldsymbol{psi}$$

$$FS := \frac{q_{all}}{q_u} = 3.738$$

RV Park Restroom

Bathroom 1 Foundation

Weight from CMU walls

$w_c := 150\ pcf$

$V_w := 325.49\ ft^3 + 278.26\ ft^3 + 317.4\ ft^3 + 270.17\ ft^3 = \left(1.191 \cdot 10^3\right)\ ft^3$

$P_{cmu} := w_c \cdot V_w = 178.698\ kip$

Weight from partition walls

$w_c := 20\ psf$

$A_w := 2 \cdot \left(258.79\ ft^2 + 32.13\ ft^2 + 33.08\ ft^2 + 93.08\ ft^2 + 45.04\ ft^2\right)$

$A_w := A_w + 93.63\ ft^2 + 69.18\ ft^2 + 36.96\ ft^2 = \left(1.124 \cdot 10^3\right)\ ft^2$

$P_w := w_c \cdot A_w = 22.48\ kip$

Weight from slab

$w_c := 150\ pcf$ 6" thick

$q_c := w_c \cdot 6\ in = 0.075\ ksf$

$A_{c1} := 47.67\ ft \cdot 12\ ft = 572.04\ ft^2$

$P_{c1} := q_c \cdot A_{c1} = 42.903\ kip$

$A_{c2} := 18\ ft \cdot 44.33\ ft = 797.94\ ft^2$

$P_{c2} := q_c \cdot A_{c2} = 59.846\ kip$

Weight from foundation

$V_f := 258.1\ ft^3 + 214.77\ ft^3 + 247.96\ ft^3 + 224.89\ ft^3$

$P_f := w_c \cdot V_f = 141.858\ kip$

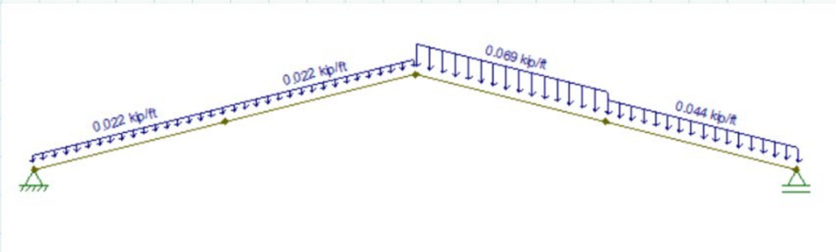
$A_{foot} := \left(40.75\ ft \cdot 37.33\ ft\right) - \left(32.75\ ft \cdot 29.33\ ft\right) = 560.64\ ft^2$

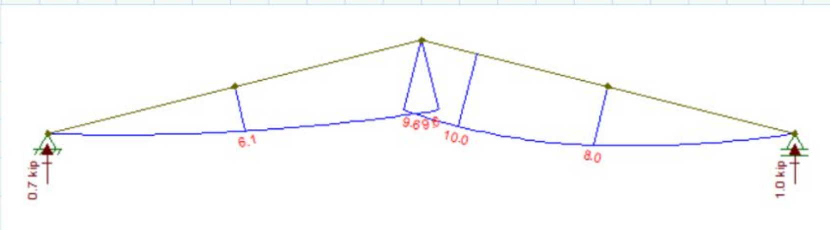
Roof Load

$w_1 := 0.7\ \dfrac{kip}{ft}$ $\qquad\qquad$ $w_2 := 1\ \dfrac{kip}{ft}$

$L := 34.33\ ft$

$P_{r1} := w_1 \cdot L = 24.031\ kip$ $\qquad\qquad$ $P_{r2} := w_2 \cdot L = 34.33\ kip$





Bearing Pressure

$$q_u := \frac{\left(2 \cdot P_{c1}\right) + \left(2 \cdot P_{c2}\right) + P_f + P_w + P_{cmu} + P_{r1} + P_{r2}}{A_{foot}} = 1.083\ ksf$$

$$FS := \frac{q_{all}}{q_u} = 5.787$$

Venue Restroom

Bathroom 2 Foundation

Weight from CMU walls

$w_c := 150\ pcf$

$V_w := 232.11\ ft^3 + 105.92\ ft^3 + 45.02\ ft^3 + 251.97\ ft^3 + 127.15\ ft^3 = 762.17\ ft^3$

$P_{cmu} := w_c \cdot V_w = 114.326\ kip$

Weight from partition walls

$w_c := 20\ psf$

$A_w := 45.04\ ft^2 + 44.96\ ft^2 + 147.67\ ft^2 + 145.02\ ft^2 + 75.13\ ft^2 = 457.82\ ft^2$

$P_w := w_c \cdot A_w = 9.156\ kip$

Weight from slab

$w_c := 150\ pcf$ 6" thick

$q_c := w_c \cdot 6\ in = 0.075\ ksf$

$A_c := 30\ ft \cdot 40.25\ ft = \left(1.208 \cdot 10^3\right)\ ft^2$

$P_c := q_c \cdot A_c = 90.563\ kip$

Weight from foundation

$V_f := 142.45\ ft^3 + 190.34\ ft^3 + 132.33\ ft^3 + 200.46\ ft^3$

$P_f := w_c \cdot V_f = 99.837\ kip$

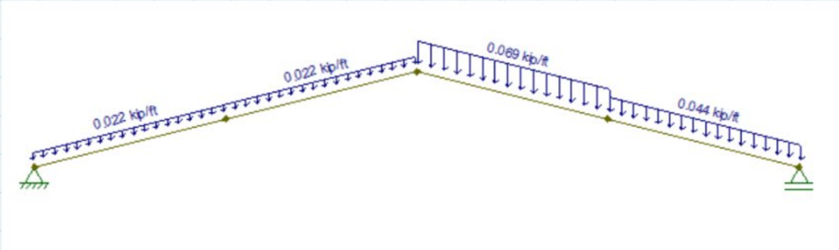
$A_{foot} := (23.58\ ft \cdot 33.75\ ft) - (15.58\ ft \cdot 25.75\ ft) = 394.64\ ft^2$

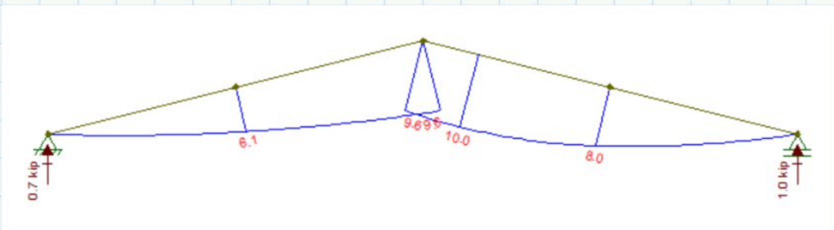
Roof Load

$w_1 := 0.7\ \dfrac{kip}{ft}$ $\qquad$ $w_2 := 1\ \dfrac{kip}{ft}$

$L := 34.33\ ft$

$P_{r1} := w_1 \cdot L = 24.031\ kip$ $\qquad$ $P_{r2} := w_2 \cdot L = 34.33\ kip$





Bearing Pressure

$$q_u := \frac{P_c + P_f + P_w + P_{cmu} + P_{r1} + P_{r2}}{A_{foot}} = 0.943\ ksf$$

$$FS := \frac{q_{all}}{q_u} = 6.641$$

Appendix J – Watershed and Stormwater Evaluation

Watershed Analysis

Table 1J Watershed Area

5756002	m2
1422.289	ac
2.222326	mi2

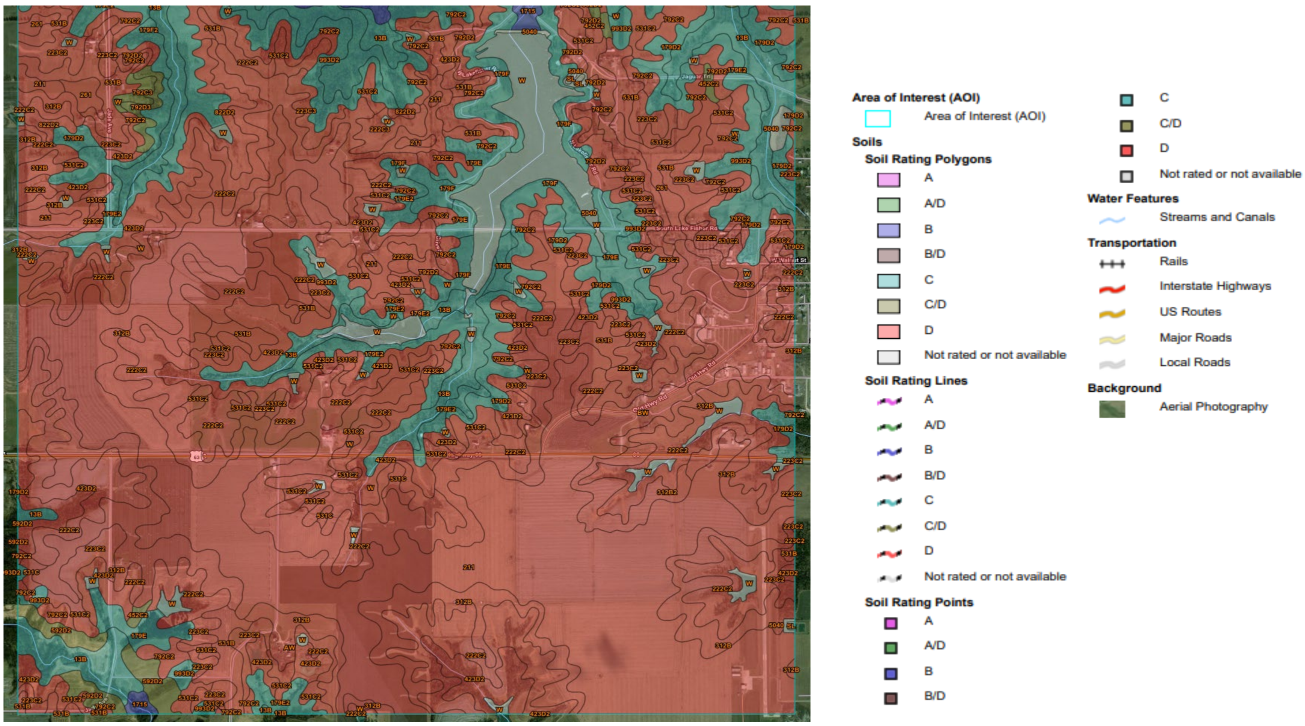


Figure J. 1 Watershed soil types

Table 2J: Land use curve numbers

		HSG		
	Land Cover	B	C	D
open Water	11	100	100	100
Perennial Ice/Snow	12	100	100	100
Developed, Open Space	21	61	74	80
Developed, Low Intensity	22	75	83	87
develop, Medium Intensity	23	85	88	92
Developed, High Intensity	24	92	94	98
Barren Land	31	86	90	94
Decidious Forest	41	55	70	77
Evergreen Forest	42	55	70	77
Mixed Forest	43	55	70	77
Shrub/Scrub	52	65	77	83
Grassland/Herbaceous	71	61	74	89
Pasture/Hay	81	61	74	80
Cultivated Crops	82	78	85	89
Woody Wetlands	90	86	91	94
Emergent Herbaceous Wetlands	95	85	90	93

Table 3J: Watershed curve number calculation

Land Cover	Hydrologic Soil Group	CN	AREA_1	area fraction	CN fraction
52	D	83	21812.08	0.003789	0.31452433
11	C	100	72.27	1.26E-05	0.00125556
11	0	100	827.73	0.000144	0.01438029
11	0	100	900	0.000156	0.01563585
11	B	100	35.905	6.24E-06	0.00062378
11	C	100	3467.674	0.000602	0.06024449
11	D	100	491.076	8.53E-05	0.00853155
11	C	100	2002.804	0.000348	0.03479505
11	C	100	203.133	3.53E-05	0.00352906
11	0	100	268219.9	0.046598	4.6598303
11	C	100	11.699	2.03E-06	0.00020325
11	C	100	133.952	2.33E-05	0.00232717
11	0	100	1911.779	0.000332	0.03321366
11	C	100	3361.813	0.000584	0.05840535
11	C	100	0.144	2.5E-08	2.5017E-06
11	0	100	899.856	0.000156	0.01563335
11	D	100	1.545	2.68E-07	2.6842E-05
11	C	100	23.821	4.14E-06	0.00041385
11	0	100	3574.634	0.000621	0.06210272
11	0	100	2088.239	0.000363	0.03627933

11	C	100	475.923	8.27E-05	0.00826829
11	C	100	135.837	2.36E-05	0.00235992
11	C	100	685.286	0.000119	0.01190559
11	0	100	32085.18	0.005574	0.55742128
11	C	100	1075.33	0.000187	0.01868189
11	C	100	2504.951	0.000435	0.04351894
11	C	100	549.253	9.54E-05	0.00954227
11	D	100	173.214	3.01E-05	0.00300928
11	D	100	0.027	4.69E-09	4.6908E-07
11	0	100	2526.76	0.000439	0.04389783
11	C	100	847.01	0.000147	0.01471525
11	C	100	325.853	5.66E-05	0.0056611
11	C	100	22.53	3.91E-06	0.00039142
11	C	100	0.851	1.48E-07	1.4785E-05
11	0	100	33903.76	0.00589	0.58901571
11	C	100	0.591	1.03E-07	1.0268E-05
11	D	100	998.367	0.000173	0.0173448
11	0	100	2601.043	0.000452	0.04518836
21	D	80	281.59	4.89E-05	0.00391369
21	C	74	833.712	0.000145	0.01071832
21	D	80	55.702	9.68E-06	0.00077418
21	D	80	16.544	2.87E-06	0.00022994
21	D	80	576.171	0.0001	0.00800793
21	D	80	649.878	0.000113	0.00903235

21	D	80	653.349	0.000114	0.00908059
21	C	74	246.651	4.29E-05	0.00317098
21	D	80	413.548	7.18E-05	0.00574771
21	D	80	486.452	8.45E-05	0.00676097
21	D	80	550.68	9.57E-05	0.00765365
21	D	80	349.32	6.07E-05	0.00485504
21	D	80	1611.164	0.00028	0.02239282
21	D	80	11736.47	0.002039	0.16311975
21	C	74	858.778	0.000149	0.01104057
21	D	80	4738.407	0.000823	0.06585692
21	D	80	2685.026	0.000466	0.03731793
21	D	80	26.254	4.56E-06	0.00036489
21	D	80	1962.364	0.000341	0.02727399
21	D	80	786.476	0.000137	0.01093086
21	D	80	1325.61	0.00023	0.01842404
21	C	74	425.55	7.39E-05	0.00547093
21	D	80	892.047	0.000155	0.01239815
21	D	80	7.953	1.38E-06	0.00011054
21	C	74	900	0.000156	0.01157053
21	D	80	12.105	2.1E-06	0.00016824
21	D	80	887.895	0.000154	0.01234044
21	D	80	697.251	0.000121	0.00969077
21	D	80	619.061	0.000108	0.00860404
21	D	80	3175.756	0.000552	0.04413836

21	C	74	10491.67	0.001823	0.13488237
21	D	80	4808.334	0.000835	0.0668288
21	C	74	900	0.000156	0.01157053
21	D	80	184.151	3.2E-05	0.00255943
21	D	80	715.849	0.000124	0.00994925
21	C	74	624.086	0.000108	0.00802334
21	D	80	1025.86	0.000178	0.01425795
21	D	80	150.053	2.61E-05	0.00208552
21	C	74	0.399	6.93E-08	5.1296E-06
21	D	80	899.601	0.000156	0.01250314
21	D	80	5317.315	0.000924	0.07390289
21	0	100	3.203	5.56E-07	5.5646E-05
21	D	80	55.843	9.7E-06	0.00077614
21	C	74	7223.641	0.001255	0.09286818
21	D	80	248.129	4.31E-05	0.00344863
21	D	80	1551.871	0.00027	0.02156873
21	C	74	199.606	3.47E-05	0.00256616
21	D	80	546.071	9.49E-05	0.00758959
21	0	100	28.829	5.01E-06	0.00050085
21	C	74	4495.502	0.000781	0.05779483
21	D	80	129.992	2.26E-05	0.0018067
21	D	80	1008.827	0.000175	0.01402122
21	D	80	195.818	3.4E-05	0.00272158
21	C	74	900	0.000156	0.01157053

21	D	80	3758.615	0.000653	0.05223924
21	D	80	17.74	3.08E-06	0.00024656
21	C	74	5223.645	0.000908	0.06715594
21	C	74	900	0.000156	0.01157053
21	D	80	2.751	4.78E-07	3.8235E-05
21	C	74	3597.249	0.000625	0.04624676
21	C	74	649.85	0.000113	0.00835457
21	C	74	250.15	4.35E-05	0.00321596
21	D	80	346.846	6.03E-05	0.00482065
21	D	80	553.154	9.61E-05	0.00768803
21	D	80	11.045	1.92E-06	0.00015351
21	D	80	6.261	1.09E-06	8.7019E-05
21	D	80	882.694	0.000153	0.01226815
21	C	74	1124.786	0.000195	0.01446041
21	D	80	4024.31	0.000699	0.05593202
21	C	74	5650.619	0.000982	0.07264518
21	D	80	2812.167	0.000489	0.039085
21	D	80	105.221	1.83E-05	0.00146242
21	D	80	5182.613	0.0009	0.07203073
21	C	74	900	0.000156	0.01157053
21	D	80	63.176	1.1E-05	0.00087805
21	D	80	836.824	0.000145	0.01163063
21	D	80	2225.465	0.000387	0.0309307
21	D	80	0.757	1.32E-07	1.0521E-05

21	D	80	2273.778	0.000395	0.03160218
21	C	74	618.967	0.000108	0.00795753
21	C	74	1463.571	0.000254	0.01881588
21	D	80	1517.462	0.000264	0.0210905
21	C	74	394.868	6.86E-05	0.00507648
21	D	80	505.132	8.78E-05	0.0070206
21	D	80	493.856	8.58E-05	0.00686388
21	D	80	12.338	2.14E-06	0.00017148
21	D	80	889.005	0.000154	0.01235587
21	D	80	10.995	1.91E-06	0.00015281
21	D	80	527.729	9.17E-05	0.00733466
21	D	80	1789.586	0.000311	0.02487262
21	D	80	1282.685	0.000223	0.01782744
21	C	74	3350.674	0.000582	0.04307675
21	D	80	239.505	4.16E-05	0.00332877
21	C	74	9.821	1.71E-06	0.00012626
21	D	80	37.15	6.45E-06	0.00051633
21	D	80	77.914	1.35E-05	0.00108289
21	D	80	1514.611	0.000263	0.02105087
21	D	80	2085.389	0.000362	0.02898385
21	C	74	291.933	5.07E-05	0.00375313
21	D	80	608.067	0.000106	0.00845124
21	D	80	438.574	7.62E-05	0.00609554
21	D	80	345.748	6.01E-05	0.00480539

21	D	80	1578.848	0.000274	0.02194368
21	D	80	344.919	5.99E-05	0.00479387
21	D	80	394.623	6.86E-05	0.00548468
21	D	80	1060.457	0.000184	0.0147388
21	D	80	3003.962	0.000522	0.04175067
21	D	80	100.956	1.75E-05	0.00140314
21	D	80	545.746	9.48E-05	0.00758507
21	D	80	1153.299	0.0002	0.01602917
21	D	80	1594.857	0.000277	0.02216618
21	D	80	205.143	3.56E-05	0.00285119
21	D	80	682.685	0.000119	0.00948832
21	D	80	217.315	3.78E-05	0.00302036
21	D	80	3919.796	0.000681	0.05447942
21	D	80	1643.254	0.000285	0.02283882
21	D	80	4453.464	0.000774	0.06189663
21	D	80	835.422	0.000145	0.01161114
21	D	80	64.578	1.12E-05	0.00089754
21	D	80	551.579	9.58E-05	0.00766614
21	0	100	348.42	6.05E-05	0.00605316
21	D	80	2470.114	0.000429	0.03433097
21	D	80	240.492	4.18E-05	0.00334249
21	0	100	30.489	5.3E-06	0.00052969
21	D	80	6258.903	0.001087	0.08698959
21	D	80	900	0.000156	0.01250868

21	D	80	390.993	6.79E-05	0.00543423
21	D	80	509.007	8.84E-05	0.00707445
21	D	80	299.175	5.2E-05	0.00415809
21	D	80	600.825	0.000104	0.00835059
21	D	80	900	0.000156	0.01250868
21	D	80	960.945	0.000167	0.01335573
21	0	100	104.23	1.81E-05	0.00181081
21	D	80	764.873	0.000133	0.01063061
21	D	80	135.127	2.35E-05	0.00187807
21	D	80	33.709	5.86E-06	0.00046851
21	C	74	866.291	0.000151	0.01113716
21	D	80	18.6	3.23E-06	0.00025851
21	D	80	207.078	3.6E-05	0.00287808
21	D	80	674.322	0.000117	0.00937209
21	D	80	51.663	8.98E-06	0.00071804
21	D	80	848.337	0.000147	0.01179064
21	D	80	400.108	6.95E-05	0.00556092
21	D	80	499.892	8.68E-05	0.00694777
21	D	80	900	0.000156	0.01250868
21	D	80	433.938	7.54E-05	0.0060311
21	D	80	198.473	3.45E-05	0.00275848
21	D	80	267.588	4.65E-05	0.00371908
21	D	80	52.6	9.14E-06	0.00073106
21	D	80	535.36	9.3E-05	0.00744072

21	D	80	3720.357	0.000646	0.05170751
21	D	80	4691.682	0.000815	0.06520751
21	D	80	1297.544	0.000225	0.01803396
21	D	80	502.456	8.73E-05	0.0069834
22	B	75	355.735	6.18E-05	0.00463518
22	C	83	269.454	4.68E-05	0.00388545
22	0	100	186.765	3.24E-05	0.0032447
22	D	87	650.773	0.000113	0.00983621
22	C	83	249.227	4.33E-05	0.00359379
22	B	75	322.991	5.61E-05	0.00420853
22	D	87	2085.322	0.000362	0.03151893
22	D	87	5804.705	0.001008	0.08773613
22	C	83	2771.088	0.000481	0.03995834
22	D	87	866.793	0.000151	0.01310128
22	D	87	33.207	5.77E-06	0.00050191
22	D	87	1628.972	0.000283	0.02462135
22	C	83	171.028	2.97E-05	0.00246618
22	D	87	900	0.000156	0.01360319
22	C	83	900	0.000156	0.01297776
22	D	87	86.842	1.51E-05	0.00131259
22	D	87	3892.49	0.000676	0.05883365
22	D	87	990.64	0.000172	0.01497318
22	D	87	502.196	8.72E-05	0.00759052
22	C	83	2508.788	0.000436	0.03617605

22	D	87	1188.438	0.000206	0.01796283
22	D	87	4800.579	0.000834	0.07255911
22	D	87	1224.004	0.000213	0.0185004
22	D	87	2658.215	0.000462	0.04017801
22	D	87	4666.187	0.000811	0.07052782
22	D	87	29.109	5.06E-06	0.00043997
22	0	100	227.329	3.95E-05	0.00394943
22	D	87	0.408	7.09E-08	6.1668E-06
22	C	83	1543.155	0.000268	0.02225188
22	C	83	179.716	3.12E-05	0.00259146
22	D	87	720.284	0.000125	0.01088685
22	D	87	831.78	0.000145	0.01257207
22	D	87	236.253	4.1E-05	0.00357088
22	C	83	281.599	4.89E-05	0.00406058
22	D	87	3962.815	0.000688	0.05989659
22	D	87	255.586	4.44E-05	0.00386309
22	D	87	518.552	9.01E-05	0.00783774
22	C	83	1281.448	0.000223	0.01847813
22	C	83	867.976	0.000151	0.01251598
22	D	87	900	0.000156	0.01360319
22	0	100	1007.263	0.000175	0.01749935
22	C	83	792.737	0.000138	0.01143105
22	D	87	900	0.000156	0.01360319
22	C	83	692.416	0.00012	0.00998445

22	C	83	304.415	5.29E-05	0.00438958
22	C	83	407.502	7.08E-05	0.00587607
22	D	87	900	0.000156	0.01360319
22	C	83	5733.662	0.000996	0.08267786
22	0	100	321.084	5.58E-05	0.00557825
22	C	83	1072.043	0.000186	0.01545857
22	D	87	4427.414	0.000769	0.06691885
22	D	87	2174.501	0.000378	0.03286684
22	C	83	2027.127	0.000352	0.02923063
22	C	83	50.289	8.74E-06	0.00072515
22	D	87	3093.881	0.000538	0.04676295
22	C	83	1715.384	0.000298	0.02473538
22	D	87	2625.137	0.000456	0.03967805
22	D	87	3856.184	0.00067	0.0582849
22	C	83	6394.439	0.001111	0.09220609
22	D	87	3218.269	0.000559	0.04864303
22	C	83	87.008	1.51E-05	0.00125463
22	D	87	812.992	0.000141	0.0122881
22	D	87	793.177	0.000138	0.0119886
22	D	87	336.215	5.84E-05	0.00508177
22	D	87	670.608	0.000117	0.01013601
22	D	87	10495.94	0.001823	0.15864251
22	C	83	1311.551	0.000228	0.01891221
22	C	83	10251.75	0.001781	0.1478275

22	D	87	4875.913	0.000847	0.07369775
22	D	87	108.532	1.89E-05	0.00164042
22	D	87	1827.722	0.000318	0.02762539
22	D	87	13185.63	0.002291	0.19929625
22	C	83	192.117	3.34E-05	0.00277028
22	D	87	50.845	8.83E-06	0.0007685
22	D	87	4985.027	0.000866	0.07534698
22	D	87	5362.608	0.000932	0.08105398
22	D	87	204.32	3.55E-05	0.00308823
22	D	87	14.577	2.53E-06	0.00022033
22	D	87	288.308	5.01E-05	0.00435768
22	D	87	611.692	0.000106	0.00924552
22	D	87	900	0.000156	0.01360319
22	D	87	9266.618	0.00161	0.14006176
22	D	87	813.16	0.000141	0.01229063
22	D	87	2489.568	0.000433	0.03762897
22	D	87	834.623	0.000145	0.01261504
22	D	87	65.377	1.14E-05	0.00098815
22	D	87	74.543	1.3E-05	0.00112669
22	D	87	825.457	0.000143	0.0124765
22	D	87	194.004	3.37E-05	0.0029323
22	D	87	474.114	8.24E-05	0.00716607
22	D	87	860.088	0.000149	0.01299994
22	D	87	39.912	6.93E-06	0.00060326

22	D	87	111.434	1.94E-05	0.00168429
22	D	87	511.618	8.89E-05	0.00773293
22	D	87	175.091	3.04E-05	0.00264644
22	D	87	798.763	0.000139	0.01207303
22	D	87	900	0.000156	0.01360319
22	D	87	6561.004	0.00114	0.09916733
22	D	87	1578.128	0.000274	0.02385286
22	D	87	900	0.000156	0.01360319
22	D	87	5610.222	0.000975	0.08479658
22	D	87	3094.486	0.000538	0.0467721
22	D	87	6947.463	0.001207	0.10500852
22	D	87	4147.828	0.000721	0.062693
22	D	87	193.098	3.35E-05	0.00291861
22	D	87	706.902	0.000123	0.01068458
22	D	87	489.032	8.5E-05	0.00739155
22	D	87	735.167	0.000128	0.0111118
22	D	87	164.833	2.86E-05	0.00249139
22	D	87	2.901	5.04E-07	4.3848E-05
22	D	87	734.604	0.000128	0.01110329
22	D	87	162.495	2.82E-05	0.00245606
22	D	87	170.932	2.97E-05	0.00258358
22	D	87	729.068	0.000127	0.01101961
22	D	87	900	0.000156	0.01360319
22	D	87	0.2	3.47E-08	3.0229E-06

22	D	87	899.8	0.000156	0.01360017
22	C	83	530.59	9.22E-05	0.00765096
22	C	83	369.41	6.42E-05	0.00532679
22	D	87	900	0.000156	0.01360319
22	D	87	26873.65	0.004669	0.40618597
22	0	100	506.629	8.8E-05	0.00880175
22	D	87	6800.265	0.001181	0.10278368
22	D	87	2155.316	0.000374	0.03257686
22	D	87	0.52	9.03E-08	7.8596E-06
22	C	83	414.66	7.2E-05	0.00597929
22	D	87	484.82	8.42E-05	0.00732789
22	D	87	208.748	3.63E-05	0.00315515
22	D	87	691.252	0.00012	0.01044804
22	D	87	1431.161	0.000249	0.02163151
22	D	87	1268.839	0.00022	0.01917807
22	D	87	1375.523	0.000239	0.02079056
22	D	87	32.033	5.57E-06	0.00048417
22	D	87	1521.264	0.000264	0.02299338
22	C	83	3384.63	0.000588	0.04880545
22	D	87	18079.71	0.003141	0.27326859
22	D	87	5097.81	0.000886	0.07705165
22	D	87	2180.857	0.000379	0.03296291
22	D	87	20594.39	0.003578	0.31127709
22	D	87	11236.86	0.001952	0.16984129

22	D	87	1580.535	0.000275	0.02388924
22	D	87	5948.724	0.001033	0.08991293
22	C	83	4175.225	0.000725	0.06020562
22	D	87	14.007	2.43E-06	0.00021171
22	D	87	885.993	0.000154	0.01339148
22	D	87	3472.63	0.000603	0.05248761
22	D	87	8.971	1.56E-06	0.00013559
22	D	87	118.401	2.06E-05	0.00178959
22	D	87	900	0.000156	0.01360319
22	D	87	4084.416	0.00071	0.06173455
22	D	87	650.014	0.000113	0.00982474
22	D	87	5884	0.001022	0.08893464
23	D	92	195.688	3.4E-05	0.00312774
23	D	92	1604.312	0.000279	0.02564223
23	D	92	611.76	0.000106	0.00977795
23	C	88	1188.24	0.000206	0.01816628
23	C	88	656.624	0.000114	0.01003872
23	C	88	205.419	3.57E-05	0.00314053
23	0	100	937.957	0.000163	0.01629529
23	C	88	230.272	4E-05	0.00352049
23	0	100	1569.728	0.000273	0.02727115
23	C	88	48.759	8.47E-06	0.00074545
23	0	100	1751.241	0.000304	0.03042461
23	D	92	166.475	2.89E-05	0.00266082

23	D	92	3433.525	0.000597	0.05487911
23	D	92	900	0.000156	0.01438498
23	D	92	12536.46	0.002178	0.20037426
23	D	92	1262.212	0.000219	0.02017433
23	D	92	7221.303	0.001255	0.11542037
23	D	92	744.923	0.000129	0.01190634
23	D	92	21.208	3.68E-06	0.00033897
23	D	92	1033.869	0.00018	0.01652465
23	D	92	167.538	2.91E-05	0.00267781
23	D	92	140.633	2.44E-05	0.00224778
23	D	92	92.651	1.61E-05	0.00148087
23	D	92	807.349	0.00014	0.01290411
23	D	92	1298.355	0.000226	0.02075202
23	D	92	1385.417	0.000241	0.02214356
23	D	92	484.158	8.41E-05	0.00773845
23	D	92	217.049	3.77E-05	0.00346916
23	D	92	198.793	3.45E-05	0.00317737
23	D	92	39.779	6.91E-06	0.0006358
23	D	92	860.221	0.000149	0.01374918
23	D	92	71.158	1.24E-05	0.00113734
23	D	92	1728.842	0.0003	0.02763263
23	D	92	900	0.000156	0.01438498
23	D	92	210.362	3.65E-05	0.00336228
23	D	92	4882.226	0.000848	0.07803416

23	D	92	3907.412	0.000679	0.0624534
23	D	92	74.167	1.29E-05	0.00118543
23	D	92	2866.266	0.000498	0.04581243
23	D	92	659.567	0.000115	0.01054207
23	D	92	6.201	1.08E-06	9.9113E-05
23	D	92	893.799	0.000155	0.01428587
23	D	92	509.216	8.85E-05	0.00813896
23	C	88	363.163	6.31E-05	0.00555218
23	D	92	27.621	4.8E-06	0.00044148
23	D	92	3600	0.000625	0.05753994
23	D	92	3257.939	0.000566	0.05207267
23	D	92	2435.933	0.000423	0.03893429
23	D	92	4206.128	0.000731	0.06722787
23	D	92	868.506	0.000151	0.01388161
23	D	92	751.288	0.000131	0.01200807
23	D	92	1048.712	0.000182	0.0167619
24	0	100	900	0.000156	0.01563585
24	D	98	1800	0.000313	0.03064627
24	D	98	2413.667	0.000419	0.04109438
24	D	98	1186.333	0.000206	0.02019816
24	D	98	840.152	0.000146	0.01430418
24	D	98	59.848	1.04E-05	0.00101895
41	C	70	3987.185	0.000693	0.04848903
41	0	100	1412.815	0.000245	0.02454507

41	C	70	1800	0.000313	0.02189019
41	D	77	737.72	0.000128	0.00986873
41	C	70	162.28	2.82E-05	0.00197352
41	D	77	485.088	8.43E-05	0.00648919
41	D	77	4481.408	0.000779	0.05994932
41	C	70	22134.15	0.003845	0.26917818
41	D	77	2904.955	0.000505	0.03886057
41	D	77	6012.67	0.001045	0.08043353
41	C	70	437.355	7.6E-05	0.00531877
41	C	70	27580.77	0.004792	0.33541575
41	C	70	3651.679	0.000634	0.04440887
41	0	100	2387.429	0.000415	0.04147721
41	D	77	4585.997	0.000797	0.06134844
41	D	77	1838.504	0.000319	0.02459429
41	D	77	450.351	7.82E-05	0.0060245
41	C	70	2249.65	0.000391	0.02735849
41	C	70	2700	0.000469	0.03283529
41	0	100	312.184	5.42E-05	0.00542363
41	0	100	843.938	0.000147	0.01466188
41	D	77	2640.549	0.000459	0.03532352
41	D	77	1038.365	0.00018	0.01389056
41	C	70	11683.59	0.00203	0.14208667
41	C	70	4914.753	0.000854	0.05976939
41	C	70	18742.5	0.003256	0.22793166

41	D	77	324.12	5.63E-05	0.00433586
41	C	70	221.404	3.85E-05	0.00269254
41	C	70	690.235	0.00012	0.0083941
41	D	77	378.247	6.57E-05	0.00505994
41	D	77	441.172	7.66E-05	0.00590171
41	C	70	6378.901	0.001108	0.07757521
41	0	100	890.042	0.000155	0.01546285
41	C	70	797.434	0.000139	0.00969777
41	0	100	102.566	1.78E-05	0.0017819
41	D	77	602.381	0.000105	0.00805826
41	0	100	297.618	5.17E-05	0.00517057
41	C	70	4850.104	0.000843	0.05898317
41	C	70	235.749	4.1E-05	0.002867
41	C	70	8308.885	0.001444	0.10104617
41	0	100	3135.497	0.000545	0.05447352
41	D	77	641.665	0.000111	0.00858377
41	C	70	22370.72	0.003887	0.27205519
41	D	77	4557.381	0.000792	0.06096564
41	D	77	900	0.000156	0.01203961
41	C	70	471.21	8.19E-05	0.00573049
41	0	100	428.79	7.45E-05	0.00744944
41	C	70	1113.085	0.000193	0.01353647
41	C	70	351.609	6.11E-05	0.00427599
41	0	100	2135.307	0.000371	0.03709705

41	D	77	534.541	9.29E-05	0.00715074
41	D	77	2632.547	0.000457	0.03521648
41	0	100	432.912	7.52E-05	0.00752105
41	D	77	7.912	1.37E-06	0.00010584
41	D	77	892.088	0.000155	0.01193376
41	C	70	2586.056	0.000449	0.03144959
41	D	77	381.132	6.62E-05	0.00509853
41	C	70	3143.278	0.000546	0.03822609
41	0	100	189.534	3.29E-05	0.00329281
41	C	70	1193.175	0.000207	0.01451046
41	D	77	429.069	7.45E-05	0.0057398
41	C	70	1977.756	0.000344	0.02405192
41	D	77	6056.462	0.001052	0.08101935
41	D	77	243.537	4.23E-05	0.00325788
41	C	70	900	0.000156	0.0109451
41	C	70	362.502	6.3E-05	0.00440847
41	C	70	537.498	9.34E-05	0.00653663
41	D	77	770.631	0.000134	0.01030899
41	C	70	1029.369	0.000179	0.01251838
41	D	77	1429.961	0.000248	0.01912908
41	0	100	370.039	6.43E-05	0.00642875
41	C	70	936.233	0.000163	0.01138573
41	C	70	5857.912	0.001018	0.07123935
41	C	70	15705.86	0.002729	0.19100235

41	D	77	869.65	0.000151	0.0116336
41	C	70	4530.35	0.000787	0.05509458
41	D	77	679.264	0.000118	0.00908675
41	D	77	2062.609	0.000358	0.02759222
41	C	70	1758.127	0.000305	0.02138097
41	D	77	3136.2	0.000545	0.04195402
41	D	77	106.895	1.86E-05	0.00142997
41	D	77	4856.904	0.000844	0.06497246
42	D	77	892.105	0.000155	0.01193399
42	D	77	7.895	1.37E-06	0.00010561
43	D	77	531.904	9.24E-05	0.00711546
43	D	77	368.096	6.39E-05	0.00492415
52	D	83	1201.45	0.000209	0.01732459
52	C	77	15.018	2.61E-06	0.0002009
52	0	100	30.241	5.25E-06	0.00052538
52	D	83	3239.477	0.000563	0.04671239
52	D	83	13.813	2.4E-06	0.00019918
52	C	77	899.782	0.000156	0.01203669
52	C	77	0.218	3.79E-08	2.9163E-06
52	D	83	900	0.000156	0.01297776
52	D	83	443.864	7.71E-05	0.0064004
52	C	77	1815.277	0.000315	0.02428358
52	D	83	1340.859	0.000233	0.01933483
52	D	83	806.848	0.00014	0.01163453

52	D	83	93.152	1.62E-05	0.00134323
52	D	83	26.484	4.6E-06	0.00038189
52	D	83	873.516	0.000152	0.01259587
52	D	83	50.046	8.69E-06	0.00072165
52	D	83	849.954	0.000148	0.01225611
52	D	83	142.693	2.48E-05	0.00205759
52	D	83	1655.199	0.000288	0.02386752
52	D	83	2.109	3.66E-07	3.0411E-05
52	D	83	4982.524	0.000866	0.07184665
52	D	83	417.476	7.25E-05	0.00601989
52	C	77	41.475	7.21E-06	0.00055483
52	D	83	151.596	2.63E-05	0.00218597
52	D	83	1606.929	0.000279	0.02317148
52	C	77	900	0.000156	0.01203961
71	C	74	900	0.000156	0.01157053
71	D	89	876.219	0.000152	0.0135482
71	C	74	23.781	4.13E-06	0.00030573
71	C	74	646.599	0.000112	0.00831277
71	D	89	181.724	3.16E-05	0.00280984
71	C	74	71.678	1.25E-05	0.0009215
71	D	89	68.844	1.2E-05	0.00106447
71	D	89	1731.156	0.000301	0.02676734
71	D	89	900	0.000156	0.01391591
71	D	89	1125.676	0.000196	0.01740534

71	D	89	5189.391	0.000902	0.08023899
71	D	89	432.499	7.51E-05	0.00668735
71	D	89	3152.434	0.000548	0.04874332
71	D	89	1779.898	0.000309	0.027521
71	D	89	6223.963	0.001081	0.09623567
71	D	89	96.138	1.67E-05	0.0014865
81	D	80	503.278	8.74E-05	0.00699483
81	C	74	108.047	1.88E-05	0.00138907
81	D	80	1734.922	0.000301	0.02411288
81	B	61	2089.292	0.000363	0.02214155
81	0	100	3372.921	0.000586	0.05859833
81	C	74	0.813	1.41E-07	1.0452E-05
81	B	61	0.151	2.62E-08	1.6002E-06
81	0	100	819.151	0.000142	0.01423125
81	D	80	1305.138	0.000227	0.01813951
81	C	74	6875.561	0.001195	0.08839321
81	D	80	860.784	0.00015	0.01196364
81	D	80	5244.571	0.000911	0.07289186
81	C	74	17785.14	0.00309	0.2286484
81	D	80	60.835	1.06E-05	0.00084552
81	0	100	3909.45	0.000679	0.06791954
81	D	80	2860.311	0.000497	0.03975413
81	D	80	700.542	0.000122	0.00973651
81	D	80	1092.696	0.00019	0.01518687

81	B	61	5368.586	0.000933	0.05689431
81	0	100	1861.041	0.000323	0.03233218
81	D	80	154.736	2.69E-05	0.0021506
81	0	100	846.492	0.000147	0.01470625
81	D	80	840.283	0.000146	0.0116787
81	0	100	1789.076	0.000311	0.03108192
81	D	80	1542.119	0.000268	0.0214332
81	C	74	9197.668	0.001598	0.11824656
81	D	80	15.298	2.66E-06	0.00021262
81	0	100	2.199	3.82E-07	3.8204E-05
81	C	74	882.503	0.000153	0.01134559
81	0	100	540.706	9.39E-05	0.00939378
81	C	74	3059.294	0.000531	0.03933073
81	C	74	17758.68	0.003085	0.22830815
81	D	80	2.557	4.44E-07	3.5539E-05
81	0	100	2038.765	0.000354	0.03541981
81	C	74	1604.414	0.000279	0.02062658
81	D	80	137.516	2.39E-05	0.00191127
81	0	100	58.07	1.01E-05	0.00100886
81	C	74	4839.419	0.000841	0.06221627
81	D	80	1630.626	0.000283	0.02266331
81	0	100	1070.868	0.000186	0.01860437
81	C	74	559.088	9.71E-05	0.00718772
81	0	100	645.719	0.000112	0.01121819

81	C	74	3854.281	0.00067	0.0495512
81	C	74	63.109	1.1E-05	0.00081134
81	0	100	601.73	0.000105	0.01045396
81	C	74	235.16	4.09E-05	0.00302325
81	0	100	457.204	7.94E-05	0.00794308
81	C	74	442.796	7.69E-05	0.00569265
81	0	100	1253.68	0.000218	0.0217804
81	C	74	3246.321	0.000564	0.04173517
81	C	74	429.515	7.46E-05	0.00552191
81	C	74	505.652	8.78E-05	0.00650074
81	0	100	187.722	3.26E-05	0.00326133
81	D	80	206.626	3.59E-05	0.0028718
81	D	80	545.301	9.47E-05	0.00757889
81	0	100	225.733	3.92E-05	0.0039217
81	C	74	128.966	2.24E-05	0.00165801
81	D	80	930.325	0.000162	0.01293016
81	0	100	1146.09	0.000199	0.01991122
81	C	74	1523.585	0.000265	0.01958743
81	C	74	660.557	0.000115	0.00849222
81	D	80	14601.9	0.002537	0.20294503
81	D	80	7523.558	0.001307	0.10456644
81	C	74	15272.29	0.002653	0.19634272
81	D	80	5459.466	0.000948	0.07587858
81	D	80	7192.308	0.00125	0.09996255

81	D	80	35632.06	0.00619	0.49523342
81	D	80	4777.849	0.00083	0.0664051
81	0	100	1420.509	0.000247	0.02467874
81	D	80	1219.946	0.000212	0.01695546
81	D	80	26834.27	0.004662	0.37295711
81	D	80	21301.78	0.003701	0.29606353
81	D	80	0.084	1.46E-08	1.1675E-06
81	C	74	5800.034	0.001008	0.07456608
81	D	80	5576.026	0.000969	0.0774986
81	D	80	37600.39	0.006532	0.52259037
81	C	74	2856.927	0.000496	0.03672907
81	D	80	2656.145	0.000461	0.03691653
81	B	61	526.535	9.15E-05	0.00558002
81	C	74	42647.24	0.007409	0.54827913
81	0	100	1631.017	0.000283	0.02833593
81	C	74	9484.928	0.001648	0.12193961
81	D	80	4367.493	0.000759	0.06070176
81	D	80	187.015	3.25E-05	0.00259923
81	0	100	717.345	0.000125	0.01246256
81	D	80	16038.43	0.002786	0.22291062
81	C	74	900	0.000156	0.01157053
81	0	100	900	0.000156	0.01563585
81	C	74	827.958	0.000144	0.01064435
81	C	74	72.042	1.25E-05	0.00092618

81	D	80	5510.23	0.000957	0.07658413
81	D	80	3459.371	0.000601	0.04808019
81	D	80	3096.369	0.000538	0.04303499
81	D	80	8787.431	0.001527	0.12213242
81	D	80	25449.25	0.004421	0.35370724
81	D	80	1173.121	0.000204	0.01630466
81	D	80	16261.6	0.002825	0.22601237
81	D	80	16155.2	0.002807	0.22453361
81	D	80	4056.637	0.000705	0.05638131
81	D	80	174.748	3.04E-05	0.00242874
81	D	80	350.604	6.09E-05	0.00487288
81	C	74	2104.019	0.000366	0.02704957
81	C	74	10642.96	0.001849	0.13682738
81	D	80	14631.42	0.002542	0.20335537
81	C	74	12540.18	0.002179	0.16121838
81	D	80	12840.08	0.002231	0.17845824
81	D	80	9160.336	0.001591	0.12731526
81	D	80	5316.295	0.000924	0.07388871
81	D	80	3013.368	0.000524	0.0418814
81	D	80	8239.658	0.001431	0.11451918
81	D	80	20319.6	0.00353	0.28241268
81	0	100	3557.28	0.000618	0.06180123
81	C	74	7878.887	0.001369	0.10129212
81	C	74	33771.18	0.005867	0.43416719

81	D	80	14496.58	0.002519	0.2014812
81	D	80	2407.581	0.000418	0.03346185
81	D	80	17132.87	0.002977	0.23812182
81	0	100	3940.562	0.000685	0.06846005
81	D	80	99169.05	0.017229	1.37830451
81	D	80	1437.309	0.00025	0.01997649
81	C	74	142.064	2.47E-05	0.0018264
81	0	100	672.186	0.000117	0.011678
81	C	74	85.75	1.49E-05	0.00110241
81	D	80	96.285	1.67E-05	0.00133822
81	C	74	591.708	0.000103	0.00760708
81	0	100	212.008	3.68E-05	0.00368325
81	D	80	24.882	4.32E-06	0.00034582
81	D	80	875.118	0.000152	0.01216286
81	D	80	1800	0.000313	0.02501736
81	D	80	24.051	4.18E-06	0.00033427
81	D	80	850.363	0.000148	0.0118188
81	D	80	25.586	4.45E-06	0.00035561
81	D	80	559.935	9.73E-05	0.00778228
81	D	80	1240.065	0.000215	0.01723509
81	C	74	790.114	0.000137	0.01015782
81	D	80	109.886	1.91E-05	0.00152725
81	D	80	307.239	5.34E-05	0.00427017
81	D	80	50.572	8.79E-06	0.00070288

81	D	80	1442.189	0.000251	0.02004432
81	D	80	1015.651	0.000176	0.01411606
81	D	80	4384.349	0.000762	0.06093603
81	D	80	14780.59	0.002568	0.2054286
81	D	80	617.371	0.000107	0.00858055
81	D	80	511.544	8.89E-05	0.00710971
81	0	100	4930.512	0.000857	0.08565862
81	D	80	6347.72	0.001103	0.08822401
81	D	80	105.951	1.84E-05	0.00147256
81	D	80	6001.523	0.001043	0.08341238
81	0	100	4.787	8.32E-07	8.3165E-05
81	D	80	718.726	0.000125	0.00998924
81	D	80	181.274	3.15E-05	0.00251944
81	D	80	2636.699	0.000458	0.03664625
81	0	100	145.8	2.53E-05	0.00253301
81	D	80	900	0.000156	0.01250868
81	D	80	10534.07	0.00183	0.14640808
81	C	74	76303.9	0.013256	0.98097399
81	D	80	13656.84	0.002373	0.18981003
81	C	74	17982.15	0.003124	0.2311811
81	C	74	13733.67	0.002386	0.17656208
81	0	100	901.728	0.000157	0.01566587
81	D	80	5164.325	0.000897	0.07177655
81	0	100	3174.411	0.000551	0.05514958

81	D	80	61092.73	0.010614	0.84909944
81	D	80	26085.93	0.004532	0.36255628
81	C	74	24731.68	0.004297	0.31795407
81	D	80	29972.5	0.005207	0.41657386
81	D	80	6149.112	0.001068	0.08546365
81	D	80	2711.081	0.000471	0.03768006
81	D	80	7367.708	0.00128	0.10240035
81	D	80	67867.02	0.011791	0.94325213
81	D	80	32212.51	0.005596	0.44770664
81	D	80	8646.468	0.001502	0.12017324
81	0	100	2533.836	0.00044	0.04402076
81	C	74	9153.89	0.00159	0.11768374
81	D	80	7446.789	0.001294	0.10349946
81	0	100	1714.45	0.000298	0.02978543
81	C	74	233.661	4.06E-05	0.00300398
81	C	74	112.248	1.95E-05	0.00144308
81	D	80	5482.551	0.000952	0.07619943
81	D	80	801.813	0.000139	0.01114403
81	D	80	41207.21	0.007159	0.57271984
81	D	80	825.355	0.000143	0.01147123
81	D	80	8254.973	0.001434	0.11473204
81	D	80	11616.89	0.002018	0.16145774
81	C	74	35526.22	0.006172	0.45673021
81	0	100	963.29	0.000167	0.0167354

81	D	80	121132	0.021044	1.68355761
81	D	80	9114.638	0.001584	0.12668012
81	C	74	20608.81	0.00358	0.26494991
81	D	80	7727.162	0.001342	0.10739624
81	0	100	2701.515	0.000469	0.04693388
81	D	80	8130.907	0.001413	0.1130077
81	D	80	1049.617	0.000182	0.01458814
81	D	80	5142.648	0.000893	0.07147528
81	D	80	6476.652	0.001125	0.09001598
81	D	80	14724.57	0.002558	0.20464996
81	C	74	57443.46	0.00998	0.73850147
81	D	80	109.644	1.9E-05	0.00152389
81	D	80	4746.586	0.000825	0.06597059
81	C	74	12832.06	0.002229	0.16497079
81	C	74	17843.23	0.0031	0.22939517
81	D	80	8631.743	0.0015	0.11996859
81	0	100	2492.706	0.000433	0.0433062
81	0	100	1673.365	0.000291	0.02907165
81	D	80	12270.46	0.002132	0.17054138
81	D	80	18.942	3.29E-06	0.00026327
81	C	74	6149.855	0.001068	0.07906343
81	D	80	9282.672	0.001613	0.12901555
81	0	100	1397.505	0.000243	0.02427909
81	0	100	911.925	0.000158	0.01584303

81	D	80	12616.44	0.002192	0.17534998
81	D	80	21127.31	0.00367	0.29363863
81	D	80	23997.58	0.004169	0.33353123
81	D	80	807.324	0.00014	0.01122062
81	D	80	20955.67	0.003641	0.29125312
81	D	80	5653.277	0.000982	0.07857227
81	D	80	9421.633	0.001637	0.1309469
81	C	74	1081.66	0.000188	0.01390598
81	0	100	5658.364	0.000983	0.09830372
81	D	80	1988.536	0.000345	0.02763774
81	D	80	7894.039	0.001371	0.10971558
81	D	80	43379.62	0.007536	0.60291312
81	D	80	25687.96	0.004463	0.357025
81	0	100	961.466	0.000167	0.01670371
81	D	80	18228.24	0.003167	0.25334579
81	C	74	44228.55	0.007684	0.5686086
81	D	80	85.014	1.48E-05	0.00118157
81	D	80	15894.74	0.002761	0.22091366
81	D	80	271945.4	0.047246	3.77964259
81	D	80	20817.52	0.003617	0.28933304
81	D	80	12148.32	0.002111	0.16884388
81	0	100	1068.599	0.000186	0.01856495
81	D	80	7789.206	0.001353	0.10825856
81	0	100	3304.485	0.000574	0.05740938

81	D	80	34804.46	0.006047	0.48373098
81	D	80	9510.533	0.001652	0.13218248
81	C	74	94084.13	0.016345	1.20955925
81	D	80	6862.967	0.001192	0.09538519
81	D	80	3012.793	0.000523	0.04187341
81	D	80	8437.068	0.001466	0.11726289
81	D	80	7163.222	0.001244	0.0995583
81	D	80	799.317	0.000139	0.01110934
81	0	100	272.53	4.73E-05	0.00473471
81	D	80	21215.5	0.003686	0.29486435
81	C	74	11522.39	0.002002	0.14813356
81	D	80	8255.363	0.001434	0.11473746
81	C	74	58733.07	0.010204	0.7550809
81	C	74	4477.971	0.000778	0.05756945
81	D	80	20534.83	0.003568	0.28540409
81	D	80	10841.29	0.001883	0.15067811
81	D	80	5851.346	0.001017	0.08132514
81	D	80	394.614	6.86E-05	0.00548456
81	D	80	3267.521	0.000568	0.04541376
81	D	80	16479.09	0.002863	0.22903518
81	0	100	8707.887	0.001513	0.1512836
81	D	80	12969.2	0.002253	0.18025285
81	D	80	609.953	0.000106	0.00847745
81	D	80	2090.047	0.000363	0.02904859

81	D	80	54.666	9.5E-06	0.00075978
81	D	80	3590.104	0.000624	0.04989719
81	D	80	1755.225	0.000305	0.02439506
81	D	80	1216.258	0.000211	0.01690421
81	D	80	355.876	6.18E-05	0.00494616
81	D	80	3827.868	0.000665	0.05320176
81	D	80	646.283	0.000112	0.00898239
81	D	80	253.717	4.41E-05	0.00352629
81	D	80	779.373	0.000135	0.01083214
81	D	80	1020.627	0.000177	0.01418522
81	D	80	2390.331	0.000415	0.0332221
81	D	80	6246.608	0.001085	0.0868187
81	0	100	443.445	7.7E-05	0.00770405
81	D	80	158.6	2.76E-05	0.00220431
81	D	80	4930.838	0.000857	0.06853143
81	D	80	10579.96	0.001838	0.14704599
81	D	80	5850.215	0.001016	0.08130942
81	C	74	1640.051	0.000285	0.02108473
81	D	80	250.295	4.35E-05	0.00347873
81	D	80	41172.33	0.007153	0.57223512
81	D	80	11634.95	0.002021	0.16170872
81	D	80	10877.3	0.00189	0.15117847
81	D	80	32448.68	0.005637	0.45098916
81	0	100	458.77	7.97E-05	0.00797029

81	D	80	1857.949	0.000323	0.02582277
81	C	74	3486.707	0.000606	0.04482561
81	0	100	572.975	9.95E-05	0.00995439
82	D	89	44.485	7.73E-06	0.00068783
82	D	89	2344.391	0.000407	0.03624926
82	D	89	38.72	6.73E-06	0.00059869
82	D	89	3138.504	0.000545	0.04852793
82	D	89	261.289	4.54E-05	0.00404008
82	D	89	5779.244	0.001004	0.08935937
82	D	89	1669.256	0.00029	0.02581024
82	D	89	990.823	0.000172	0.01532022
82	D	89	10199.39	0.001772	0.15770417
82	D	89	31054.42	0.005395	0.48016716
82	D	89	4255.543	0.000739	0.06579972
82	D	89	420.751	7.31E-05	0.0065057
82	D	89	23171.1	0.004026	0.35827435
82	D	89	594.111	0.000103	0.00918622
82	D	89	2105.889	0.000366	0.03256151
82	D	89	97.893	1.7E-05	0.00151363
82	D	89	802.107	0.000139	0.01240228
82	D	89	33507.7	0.005821	0.51810017
82	D	89	1998.24	0.000347	0.03089703
82	D	89	10198.26	0.001772	0.15768667
82	D	89	6227.041	0.001082	0.09628326

82	D	89	11799.33	0.00205	0.18244265
82	D	89	2637.121	0.000458	0.04077548
82	C	85	35.708	6.2E-06	0.00052731
82	D	89	922.556	0.00016	0.01426467
82	D	89	863.441	0.00015	0.01335063
82	D	89	9438.591	0.00164	0.14594063
82	D	89	70291.16	0.012212	1.08685042
82	D	89	14404.91	0.002503	0.22273041
82	C	85	256.644	4.46E-05	0.00378991
82	D	89	3607.569	0.000627	0.05578067
82	D	89	13811.73	0.0024	0.2135587
82	D	89	18122.49	0.003148	0.28021208
82	D	89	5473.343	0.000951	0.08462949
82	D	89	18.337	3.19E-06	0.00028353
82	D	89	788.694	0.000137	0.01219488
82	D	89	111.306	1.93E-05	0.00172103
82	D	89	22758.84	0.003954	0.35189986
82	D	89	24143.51	0.004194	0.37330991
82	D	89	131135.1	0.022782	2.02762686
82	D	89	7608.949	0.001322	0.11765049
82	D	89	23729.5	0.004123	0.36690836
82	D	89	77928.29	0.013539	1.20493658
82	D	89	45224.49	0.007857	0.6992665
82	D	89	9852.57	0.001712	0.15234163

82	D	89	9318.718	0.001619	0.14408714
82	D	89	19300.62	0.003353	0.29842852
82	D	89	27927.03	0.004852	0.43181113
82	D	89	191725.3	0.033309	2.96447928
82	D	89	6028.257	0.001047	0.09320964
82	D	89	9985.669	0.001735	0.15439962
82	D	89	137911.2	0.02396	2.13240005
82	D	89	3033.374	0.000527	0.0469024
82	D	89	932.193	0.000162	0.01441368
82	D	89	63214.61	0.010982	0.97743186
82	D	89	5581.432	0.00097	0.08630078
82	D	89	6983.217	0.001213	0.10797534
82	D	89	218283.1	0.037923	3.37512006
82	D	89	87957.02	0.015281	1.36000199
82	0	100	2717.796	0.000472	0.04721673
82	D	89	5676.272	0.000986	0.0877672
82	D	89	2889.923	0.000502	0.04468434
82	D	89	227506.5	0.039525	3.51773306
82	D	89	689.124	0.00012	0.01065532
82	D	89	4794.072	0.000833	0.07412652
82	D	89	14.156	2.46E-06	0.00021888
82	0	100	738.462	0.000128	0.01282943
90	D	94	605.803	0.000105	0.00989324
90	D	94	1909.512	0.000332	0.03118382

90	0	100	1984.685	0.000345	0.03448027
90	D	94	309.004	5.37E-05	0.00504628
90	D	94	1490.996	0.000259	0.02434913
95	B	85	68.411	1.19E-05	0.00101024
95	0	100	174.648	3.03E-05	0.00303419
95	C	90	656.941	0.000114	0.01027183
95	B	85	20.145	3.5E-06	0.00029749
95	0	100	1301.751	0.000226	0.02261554
95	C	90	478.104	8.31E-05	0.00747556
95	0	100	518.799	9.01E-05	0.00901318
95	C	90	381.201	6.62E-05	0.0059604
95	C	90	783.461	0.000136	0.01225008
95	0	100	1016.539	0.000177	0.0176605
95	D	93	740.135	0.000129	0.0119584
95	0	100	159.865	2.78E-05	0.00277736
95	D	93	456.229	7.93E-05	0.00737131
95	0	100	443.771	7.71E-05	0.00770971
95	C	90	210.745	3.66E-05	0.00329518
95	0	100	689.255	0.00012	0.01197454
95	D	93	211.168	3.67E-05	0.00341185
95	0	100	688.832	0.00012	0.0119672
95	C	90	154.153	2.68E-05	0.00241031
95	0	100	745.847	0.00013	0.01295773
95	D	93	50.362	8.75E-06	0.0008137

95	D	93	2266.358	0.000394	0.03661765
95	D	93	266.876	4.64E-05	0.00431193
95	D	93	116.404	2.02E-05	0.00188074
95	D	93	1069.284	0.000186	0.01727647
95	D	93	40.228	6.99E-06	0.00064997
95	0	100	1590.489	0.000276	0.02763183

Table 4J: SW longest flow path time of concentration calculation

L	2946.234	m
	9659.783607	ft
slope	0.00702	
tc	61.61404348	min
	1.026900725	hr
tl	36.96842609	min

Table 5J: SE longest flow path time of concentration calculation

L	1715	m
	5622.951	ft
slope	0.0136	
tc	31.48869	min

tl	18.89322	min

Fisher Lake Bathymetry Data

Figure J. 2 Topographic map

Table 6J: Fisher Lake bathymetry storage calculation

elevation	contour (ft)	stage (ft)	area (ac)	incremental storage (ac-ft)	cumulative storage (ac-ft)
797.5	22.5	0	0	0	0
798	22	0.5	1.7	0.425	0.425
800	20	2.5	6.69	8.39	8.815
802	18	4.5	13.6	20.29	29.105
804	16	6.5	21.21	34.81	63.915
806	14	8.5	29.41	50.62	114.535
808	12	10.5	37.87	67.28	181.815
810	10	12.5	48.34	86.21	268.025
812	8	14.5	55.13	103.47	371.495
814	6	16.5	60.71	115.84	487.335
816	4	18.5	65.85	126.56	613.895
818	2	20.5	70.09	135.94	749.835
820	0	22.5	82.2	152.29	902.125

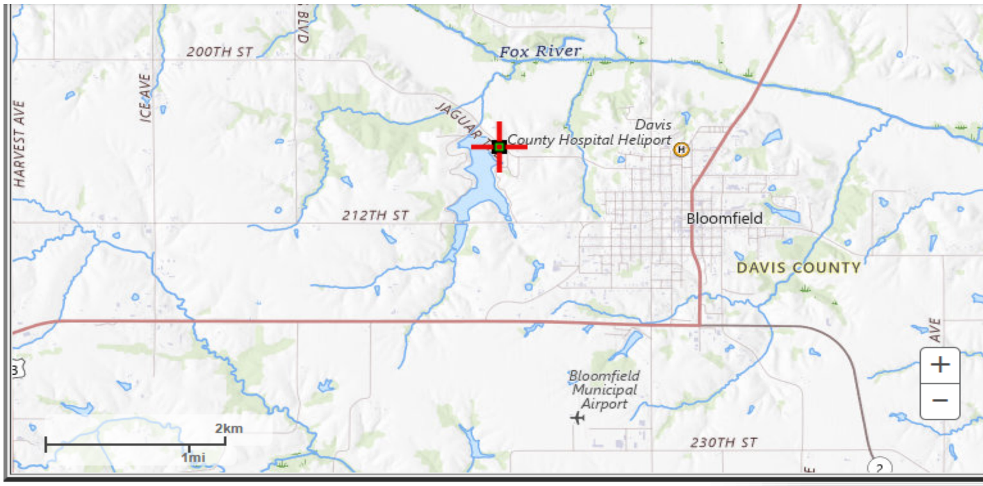
Recreation Area Contours

Table 7J: Fisher lake recreation area elevation-area

Elevation	Area (ac)
822	98.165
824	108.8

826	120.154
828	132.246
830	144.121
832	155.562
834	178.651
836	194.28
838	210.577
840	226.654

Precipitation Data



Location information:
Name: Bloomfield, Iowa, USA*
Station name: BLOOMFIELD 1 WNW
Site ID: 13-0753
Latitude: 40.7597°
Longitude: -92.4394°
Elevation: 812 ft

* Source: ESRI Maps
** Source: USGS

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 8, Version 2

PF tabular | PF graphical | Supplementary information | Print page

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	**0.386** (0.299-0.496)	**0.450** (0.349-0.579)	**0.559** (0.432-0.720)	**0.652** (0.501-0.843)	**0.787** (0.587-1.04)	**0.894** (0.651-1.20)	**1.01** (0.708-1.37)	**1.12** (0.759-1.55)	**1.28** (0.835-1.80)	**1.41** (0.892-2.00)
10-min	**0.564** (0.438-0.726)	**0.659** (0.510-0.848)	**0.818** (0.632-1.06)	**0.955** (0.734-1.24)	**1.15** (0.859-1.53)	**1.31** (0.954-1.75)	**1.47** (1.04-2.00)	**1.64** (1.11-2.27)	**1.88** (1.22-2.64)	**2.06** (1.31-2.92)
15-min	**0.688** (0.534-0.886)	**0.803** (0.623-1.03)	**0.997** (0.771-1.29)	**1.16** (0.895-1.51)	**1.40** (1.05-1.86)	**1.60** (1.16-2.14)	**1.80** (1.26-2.44)	**2.00** (1.36-2.77)	**2.29** (1.49-3.22)	**2.51** (1.59-3.56)
30-min	**0.970** (0.753-1.25)	**1.14** (0.881-1.46)	**1.42** (1.10-1.83)	**1.66** (1.28-2.15)	**2.00** (1.49-2.66)	**2.28** (1.66-3.05)	**2.56** (1.80-3.48)	**2.86** (1.93-3.95)	**3.27** (2.12-4.59)	**3.58** (2.27-5.08)
60-min	**1.27** (0.984-1.63)	**1.48** (1.15-1.91)	**1.85** (1.43-2.39)	**2.17** (1.67-2.81)	**2.64** (1.97-3.50)	**3.01** (2.20-4.03)	**3.40** (2.40-4.63)	**3.82** (2.58-5.28)	**4.39** (2.86-6.18)	**4.84** (3.06-6.85)
2-hr	**1.57** (1.23-1.99)	**1.83** (1.44-2.32)	**2.28** (1.79-2.90)	**2.68** (2.09-3.42)	**3.27** (2.47-4.30)	**3.74** (2.76-4.96)	**4.24** (3.03-5.71)	**4.77** (3.27-6.54)	**5.51** (3.63-7.69)	**6.09** (3.90-8.55)
3-hr	**1.75** (1.39-2.21)	**2.05** (1.62-2.58)	**2.56** (2.01-3.22)	**3.01** (2.36-3.80)	**3.68** (2.81-4.81)	**4.23** (3.14-5.56)	**4.81** (3.46-6.44)	**5.43** (3.74-7.40)	**6.30** (4.18-8.75)	**7.00** (4.50-9.77)
6-hr	**2.07** (1.66-2.57)	**2.42** (1.94-3.00)	**3.04** (2.42-3.78)	**3.59** (2.85-4.48)	**4.41** (3.41-5.70)	**5.10** (3.84-6.63)	**5.82** (4.24-7.71)	**6.60** (4.61-8.92)	**7.70** (5.16-10.6)	**8.58** (5.59-11.9)
12-hr	**2.39** (1.94-2.92)	**2.81** (2.28-3.43)	**3.54** (2.86-4.34)	**4.20** (3.38-5.16)	**5.18** (4.06-6.61)	**5.99** (4.57-7.70)	**6.86** (5.05-8.98)	**7.78** (5.49-10.4)	**9.08** (6.16-12.4)	**10.1** (6.66-13.9)
24-hr	**2.75** (2.27-3.31)	**3.22** (2.65-3.89)	**4.06** (3.32-4.90)	**4.80** (3.91-5.81)	**5.90** (4.68-7.42)	**6.80** (5.26-8.63)	**7.77** (5.79-10.0)	**8.80** (6.28-11.6)	**10.2** (7.03-13.8)	**11.4** (7.59-15.5)
2-day	**3.20** (2.67-3.80)	**3.71** (3.10-4.41)	**4.60** (3.83-5.48)	**5.40** (4.46-6.44)	**6.56** (5.27-8.14)	**7.53** (5.88-9.41)	**8.54** (6.44-10.9)	**9.63** (6.95-12.6)	**11.1** (7.72-14.9)	**12.4** (8.31-16.6)
3-day	**3.49** (2.94-4.11)	**4.05** (3.41-4.77)	**5.02** (4.20-5.92)	**5.86** (4.88-6.93)	**7.08** (5.71-8.67)	**8.07** (6.35-9.99)	**9.10** (6.90-11.5)	**10.2** (7.40-13.2)	**11.7** (8.16-15.5)	**12.9** (8.73-17.3)
4-day	**3.75** (3.17-4.38)	**4.34** (3.67-5.08)	**5.35** (4.51-6.27)	**6.22** (5.21-7.32)	**7.48** (6.06-9.09)	**8.48** (6.70-10.4)	**9.52** (7.26-12.0)	**10.6** (7.74-13.7)	**12.1** (8.48-16.0)	**13.3** (9.04-17.7)
7-day	**4.48** (3.83-5.16)	**5.10** (4.36-5.89)	**6.16** (5.24-7.13)	**7.06** (5.98-8.20)	**8.35** (6.84-10.0)	**9.37** (7.48-11.4)	**10.4** (8.02-13.0)	**11.5** (8.48-14.7)	**13.0** (9.20-17.0)	**14.2** (9.74-18.8)
10-day	**5.14** (4.43-5.88)	**5.81** (5.00-6.65)	**6.92** (5.94-7.94)	**7.87** (6.71-9.07)	**9.20** (7.58-10.9)	**10.3** (8.25-12.4)	**11.3** (8.79-14.0)	**12.5** (9.23-15.8)	**14.0** (9.94-18.2)	**15.2** (10.5-20.0)
20-day	**7.01** (6.13-7.90)	**7.90** (6.90-8.90)	**9.34** (8.13-10.6)	**10.5** (9.11-12.0)	**12.1** (10.1-14.2)	**13.4** (10.9-15.8)	**14.6** (11.4-17.7)	**15.8** (11.9-19.8)	**17.5** (12.5-22.4)	**18.7** (13.0-24.4)
30-day	**8.55** (7.54-9.54)	**9.66** (8.51-10.8)	**11.4** (10.0-12.8)	**12.9** (11.2-14.5)	**14.8** (12.4-17.0)	**16.2** (13.2-19.0)	**17.6** (13.8-21.1)	**18.9** (14.2-23.4)	**20.6** (14.9-26.2)	**21.9** (15.4-28.4)
45-day	**10.5** (9.33-11.6)	**11.9** (10.6-13.2)	**14.1** (12.5-15.7)	**15.9** (13.9-17.7)	**18.1** (15.3-20.7)	**19.8** (16.3-23.0)	**21.4** (16.9-25.4)	**22.9** (17.3-28.0)	**24.8** (18.0-31.2)	**26.1** (18.4-33.6)

Figure J. 3 NOAA Atlas 14 Depth-Duration-Frequency data

Table 8J: Comparison of precipitation depths in inches for NRCS and NOAA Atlas 14

	Design Storm Year						
	1	2	5	10	25	50	100
NRCS Storm Data	-	3.3	4.2	4.8	5.6	6.2	6.8
NOAA Atlas 14	2.75	3.22	4.06	4.8	5.9	6.8	7.77

Outlet Computations

Figure J. 4 Measured outlet structure dimensions

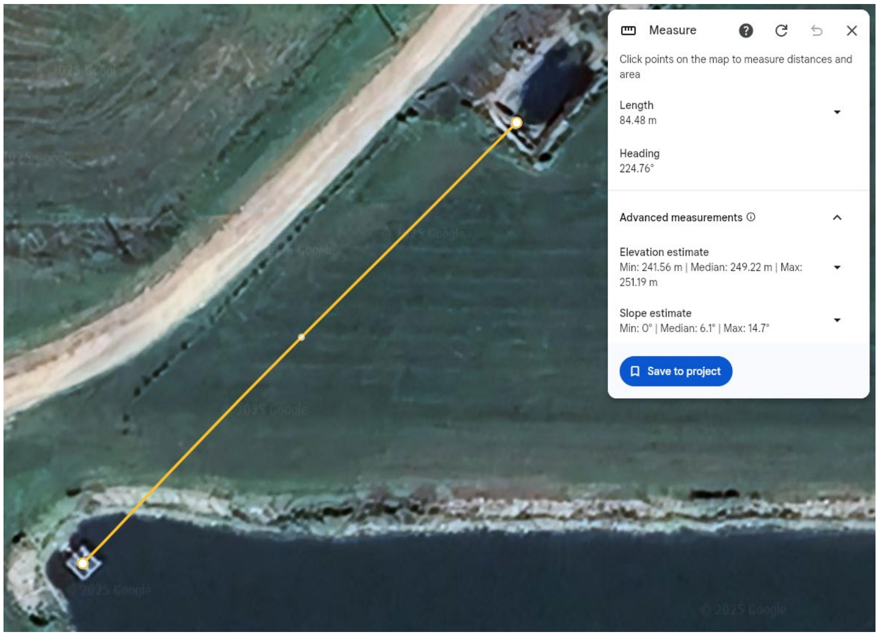


Figure J. 5 Distance from outlet structure to discharge location

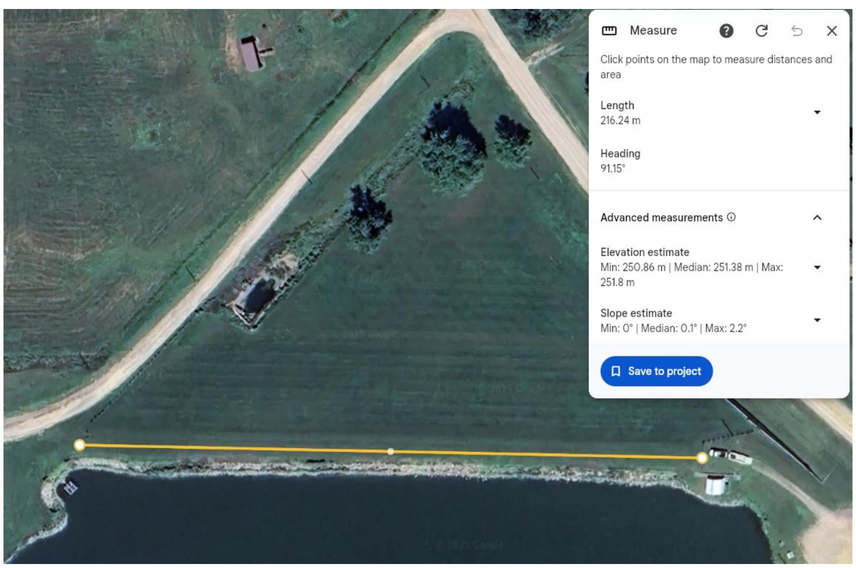


Figure J. 6 Dam length

Stage-Discharge Curve															
		*there are 2 of these					*there are 2 of these				D (ft)	3			
	Lower Drop Inlet					Upper Drop Inlet							Auxillary Spillway		
	Weir		Orifice			drop inlet weir		drop inlet orifice			Outlet Pipe		(Essentially Dam Failure)		
	elev (ft)	818	elev (ft)	818		elev (ft)	820	elev (ft)	820		elev (ft)	818	elev (ft)	828	
	C_w	3	C_d	0.48		C_w	3	C_d	0.62		n	0.62	C_w	3	
	L (ft)	6	A (ft2)	9	drop inlet control	b (ft)	6	A (ft2)	9	drop inlet control	A (ft2)	7.068583471	b (ft)	708.696	overall structure curve
water surface elevation (ft)	head (ft)	discharge (	head (ft)	discharge (cfs)	discahrge (cfs)	head (ft)	discharge (cfs)	head (ft)	discharge (cfs)	discahrge (cfs)	head (ft)	discharge (cfs)	head (ft)	discharge (cfs	discharge (cfs)
815	0	0	0	0	0	0	0	0	0	0	0	0	0		0
815.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
816	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
816.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
817	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
817.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
818	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
818.5	0.5	6.363961	0.5	24.51385894	6.363961031	0	0	0	0	0	0.5	24.86863889	0	0	12.72792206
819	1	18	1	34.66783178	18	0	0	0	0	0	1	35.1695664	0	0	35.1695664
819.5	1.5	33.06811	1.5	42.45924917	33.06811153	0	0	0	0	0	1.5	43.07374608	0	0	43.07374608
820	2	50.91169	2	49.02771787	49.02771787	0	0	0	0	0	2	49.73727778	0	0	49.73727778
820.5	2.5	71.15125	2.5	54.81465497	54.81465497	0.5	6.363961031	0.5	31.66373446	6.363961031	2.5	55.60796707	0	0	55.60796707
821	3	93.53074	3	60.04644602	60.04644602	1	18	1	44.77928271	18	3	60.91547588	0	0	60.91547588
821.5	3.5	117.8622	3.5	64.85757442	64.85757442	1.5	33.06811153	1.5	54.84319684	33.06811153	3.5	65.79623395	0	0	65.79623395
822	4	144	4	69.33566355	69.33566355	2	50.91168825	2	63.32746892	50.91168825	4	70.3391328	0	0	70.3391328
822.5	4.5	171.8269	4.5	73.54157681	73.54157681	2.5	71.15124735	2.5	70.80226268	70.80226268	4.5	74.60591668	0	0	74.60591668
823	5	201.2461	5	77.51962848	77.51962848	3	93.53074361	3	77.55999278	77.55999278	5	78.64154121	0	0	78.64154121
823.5	5.5	232.1756	5.5	81.30327226	81.30327226	3.5	117.8622077	3.5	83.77436696	83.77436696	5.5	82.47994425	0	0	82.47994425
824	6	264.5449	6	84.91849834	84.91849834	4	144	4	89.55856542	89.55856542	6	86.14749215	0	0	86.14749215
824.5	6.5	298.2926	6.5	88.38597536	88.38597536	4.5	171.8269478	4.5	94.99120338	94.99120338	6.5	89.66515268	0	0	89.66515268
825	7	333.3647	7	91.72246137	91.72246137	5	201.246118	5	100.1295201	100.1295201	7	93.04992641	0	0	93.04992641
825.5	7.5	369.7127	7.5	94.94176742	94.94176742	5.5	232.1755801	5.5	105.0167267	105.0167267	7.5	96.31582427	0	0	96.31582427
826	8	407.2935	8	98.05543575	98.05543575	6	264.5448922	6	109.6863937	109.6863937	8	99.47455557	0	0	99.47455557
826.5	8.5	446.0678	8.5	101.0732297	101.0732297	6.5	298.2926415	6.5	114.1652182	114.1652182	8.5	102.5360249	0	0	102.5360249
827	9	486	9	104.0034953	104.0034953	7	333.3646652	7	118.4748459	118.4748459	9	105.5086992	0	0	105.5086992
827.5	9.5	527.0574	9.5	106.8534338	106.8534338	7.5	369.7127263	7.5	122.6331162	122.6331162	9.5	108.3998838	0	0	108.3998838
828	10	569.21	10	109.6293099	109.6293099	8	407.293506	8	126.6549378	126.6549378	10	111.2159341	0	0	111.2159341
828.5	10.5	612.43	10.5	112.3366142	112.3366142	8.5	446.06782	8.5	130.5529217	130.5529217	10.5	113.9624202	0.5	751.6856211	865.6480413
829	11	656.6917	11	114.9801903	114.9801903	9	486	9	134.3378481	134.3378481	11	116.6442558	1	2126.088	2242.732256
829.5	11.5	701.9712	11.5	117.5643374	117.5643374	9.5	527.0573973	9.5	138.0190187	138.0190187	11.5	119.2658023	1.5	3905.873061	4025.138864
830	12	748.2459	12	120.092892	120.092892	10	569.2099788	10	141.6045254	141.6045254	12	121.8309518	2	6013.484969	6135.315921
830.5	12.5	795.4951	12.5	122.5692947	122.5692947	10.5	612.429996	10.5	145.10146	145.10146	12.5	124.3431945	2.5	8404.100732	8528.443927
831	13	843.699	13	124.9966451	124.9966451	11	656.6917085	11	148.5160791	148.5160791	13	126.805675	3	11047.47731	11174.28299
831.5	13.5	892.839	13.5	127.3777475	127.3777475	11.5	701.9711533	11.5	151.8539359	151.8539359	13.5	129.2212382	3.5	13921.41252	14050.63376
832	14	942.8977	14	129.7151488	129.7151488	12	748.2459489	12	155.1199856	155.1199856	14	131.5924679	4	17008.704	17140.29647
832.5	14.5	993.8584	14.5	132.0111704	132.0111704	12.5	795.4951288	12.5	158.3186723	158.3186723	14.5	133.921719	4.5	20295.51177	20429.43349
833	15	1045.706	15	134.2679351	134.2679351	13	843.6989985	13	161.4539999	161.4539999	15	136.211145	5	23770.38647	23906.59762
833.5	15.5	1098.424	15.5	136.4873902	136.4873902	13.5	892.8390112	13.5	164.5295905	164.5295905	15.5	138.4627214	5.5	27423.65082	27562.11354
834	16	1152	16	138.6713271	138.6713271	14	942.8976615	14	167.5487339	167.5487339	16	140.6782656	6	31246.98449	31387.66276
834.5	16.5	1206.42	16.5	140.8213984	140.8213984	14.5	993.8583903	14.5	170.5144285	170.5144285	16.5	142.859454	6.5	35233.13365	35375.9931
835	17	1261.67	17	142.9391322	142.9391322	15	1045.705503	15	173.4294162	173.4294162	17	145.0078371	7	39375.70079	39520.70863
835.5	17.5	1317.74	17.5	145.0259453	145.0259453	15.5	1098.424098	15.5	176.2962123	176.2962123	17.5	147.1248518	7.5	43668.98838	43816.11323
836	18	1374.616	18	147.0831536	147.0831536	16	1152	16	179.1171308	179.1171308	18	149.2118334	8	48107.87975	48257.09158
836.5	18.5	1432.287	18.5	149.1119826	149.1119826	16.5	1206.419703	16.5	181.8943062	181.8943062	18.5	151.2700248	8.5	52687.74662	52839.01665
837	19	1490.743	19	151.1135753	151.1135753	17	1261.670321	17	184.6297125	184.6297125	19	153.3005858	9	57404.376	57557.67659
837.5	19.5	1549.974	19.5	153.089	153.089	17.5	1317.739542	17.5	187.3251793	187.3251793	19.5	155.3046001	9.5	62253.91153	62409.21613
838	20	1609.969	20	155.039257	155.039257	18	1374.615583	18	189.9824068	189.9824068	20	157.2830824	10	67232.80586	67390.08894
838.5	20.5	1670.719	20.5	156.9652843	156.9652843	18.5	1432.287157	18.5	192.6029775	192.6029775	20.5	159.2369844	10.5	72337.78141	72497.01839
839	21	1732.214	21	158.8679633	158.8679633	19	1490.743439	19	195.1883681	195.1883681	21	161.1672002	11	77565.79784	77726.96504
839.5	21.5	1794.445	21.5	160.748123	160.748123	19.5	1549.974032	19.5	197.7399583	197.7399583	21.5	163.0745707	11.5	82914.02474	83077.09931
840	22	1857.405	22	162.6065445	162.6065445	20	1609.968944	20	200.2590402	200.2590402	22	164.9598885	12	88379.8185	88544.77839

Figure J. 7 Outlet structure discharge calculations

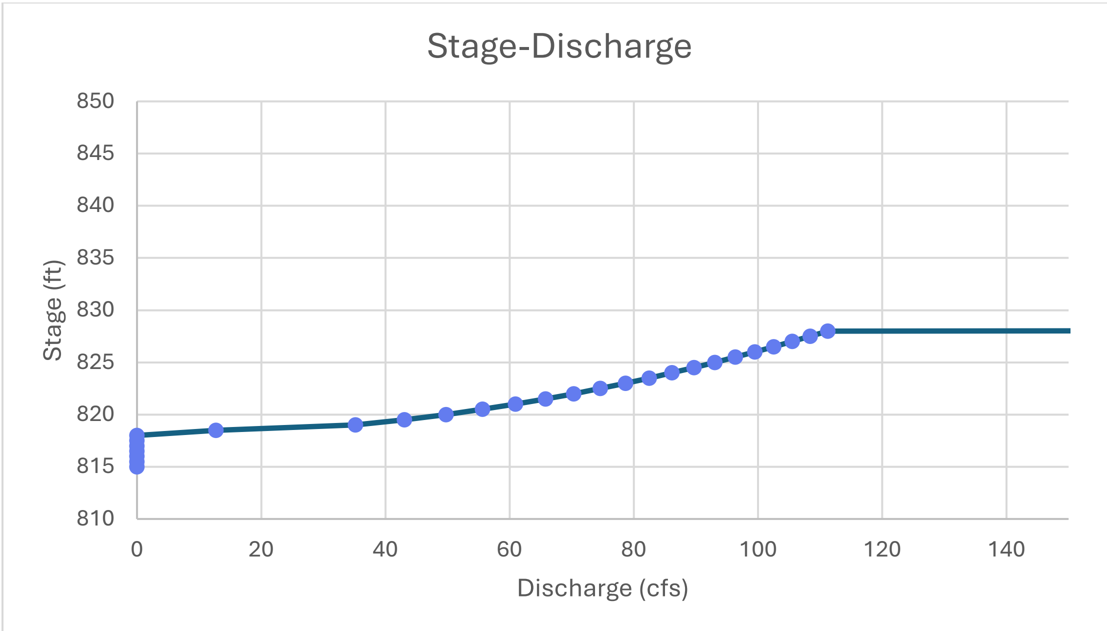


Figure J. 8 Stage discharge relationship

Pre-development HEC-HMS

1-year

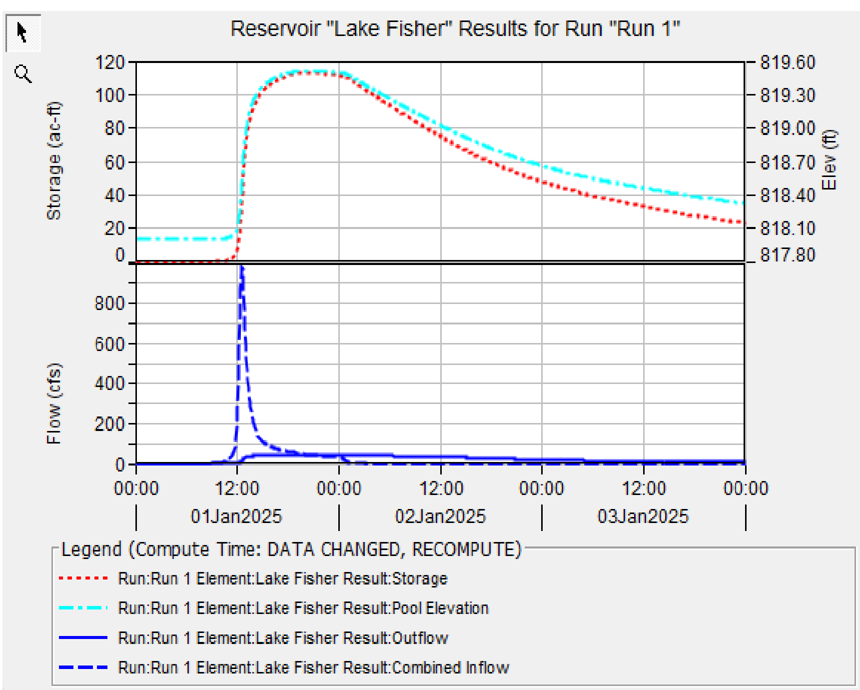


Figure J. 9 Plotted 1-yr storm discharge and storage

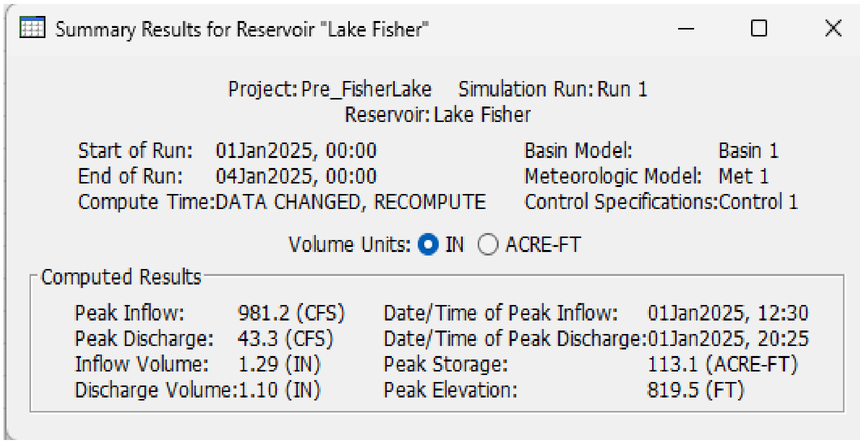


Figure J. 10 Tabulated information for 1-yr storm

2-year

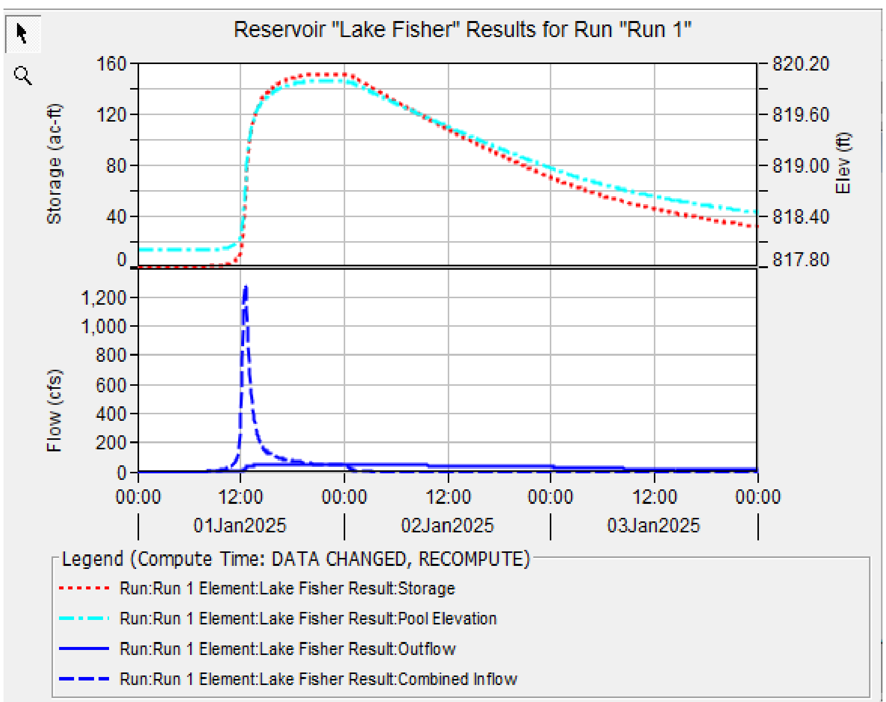
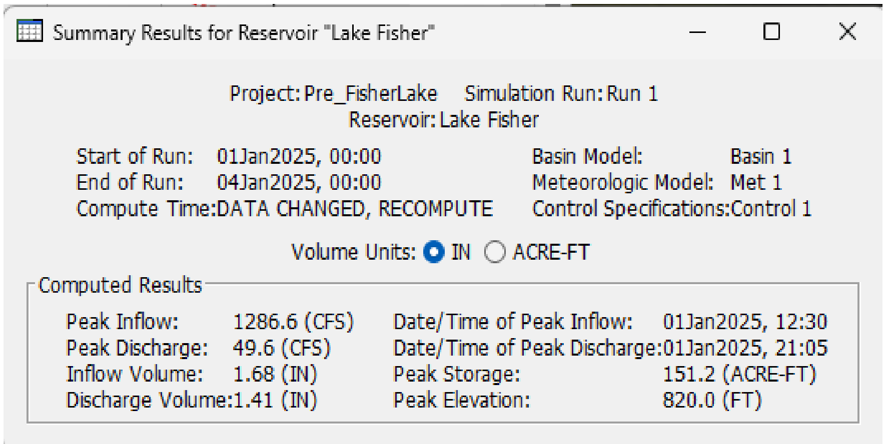


Figure J. 11 Plotted 2-yr storm discharge and storage



Summary Results for Reservoir "Lake Fisher"

Project: Pre_FisherLake Simulation Run: Run 1
Reservoir: Lake Fisher

Start of Run:	01Jan2025, 00:00	Basin Model:	Basin 1
End of Run:	04Jan2025, 00:00	Meteorologic Model:	Met 1
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	Control 1

Volume Units: IN ACRE-FT

Computed Results

Peak Inflow:	1286.6 (CFS)	Date/Time of Peak Inflow:	01Jan2025, 12:30
Peak Discharge:	49.6 (CFS)	Date/Time of Peak Discharge:	01Jan2025, 21:05
Inflow Volume:	1.68 (IN)	Peak Storage:	151.2 (ACRE-FT)
Discharge Volume:	1.41 (IN)	Peak Elevation:	820.0 (FT)

Figure J. 12 Tabulated information for 2-yr storm

5-year

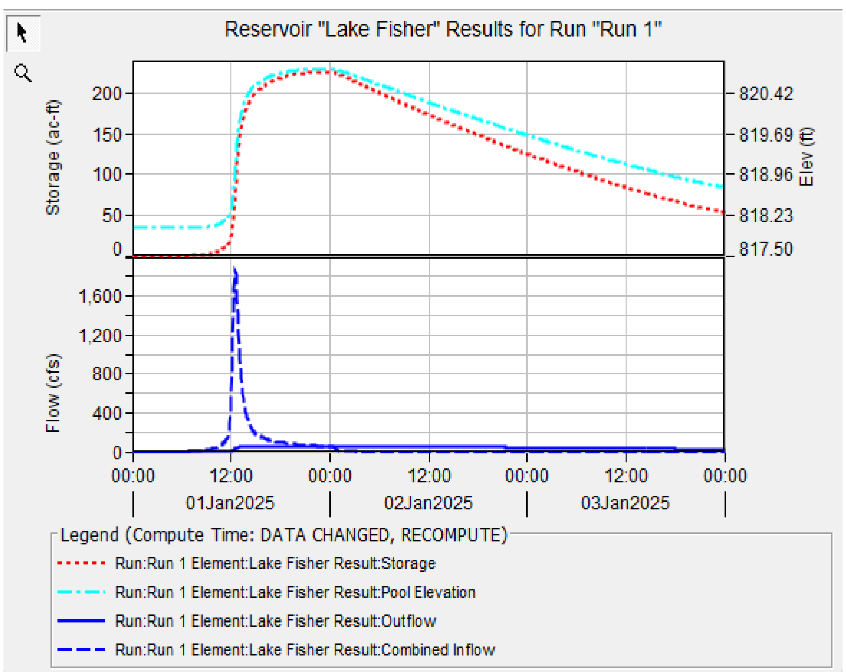


Figure J. 13 Plotted 5-yr storm discharge and storage

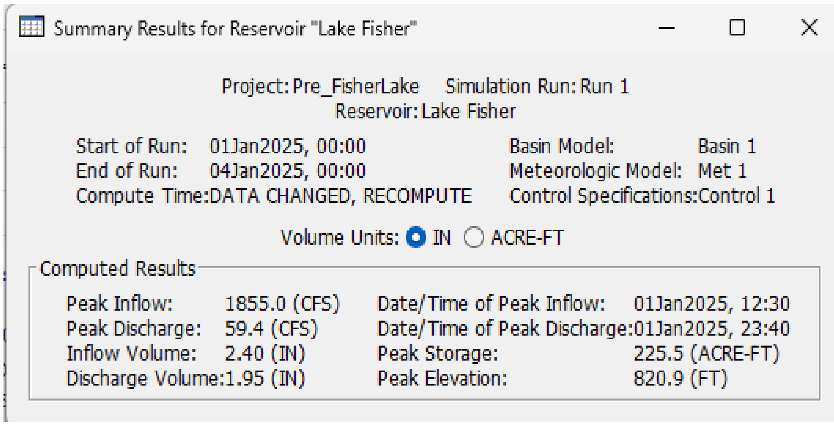


Figure J. 14 Tabulated information for 5-yr storm

10-year

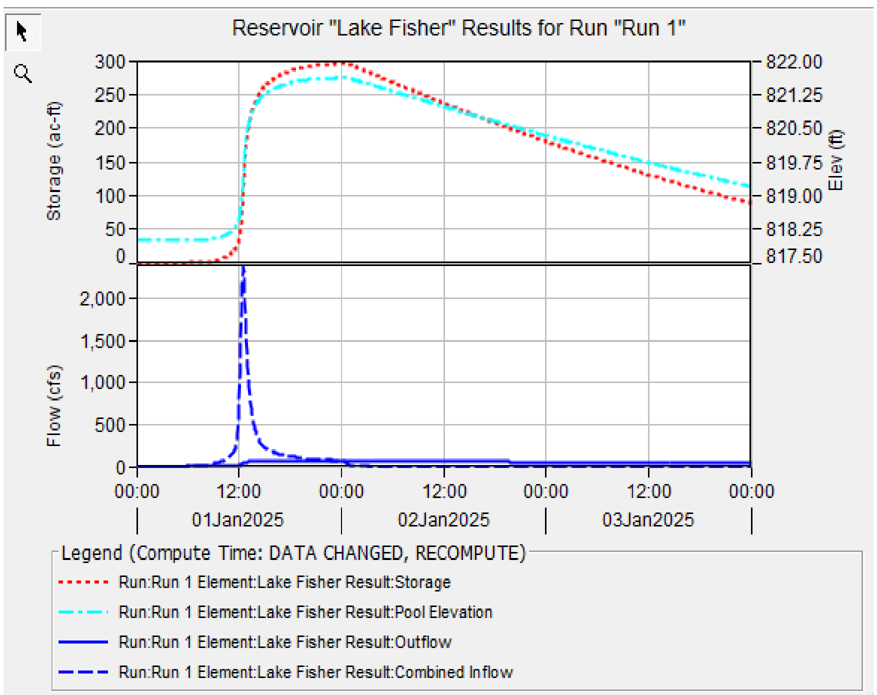
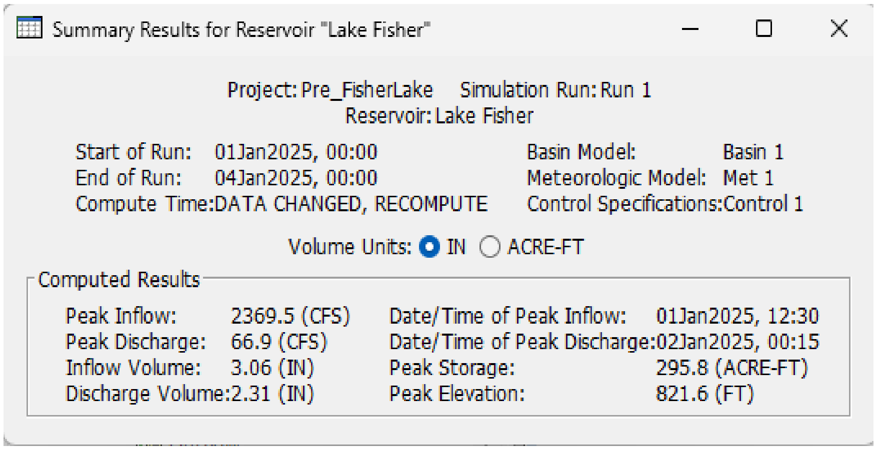


Figure J. 15 Plotted 10-yr storm discharge and storage



Summary Results for Reservoir "Lake Fisher"

Project: Pre_FisherLake Simulation Run: Run 1
Reservoir: Lake Fisher

Start of Run:	01Jan2025, 00:00	Basin Model:	Basin 1
End of Run:	04Jan2025, 00:00	Meteorologic Model:	Met 1
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	Control 1

Volume Units: IN ACRE-FT

Computed Results

Peak Inflow:	2369.5 (CFS)	Date/Time of Peak Inflow:	01Jan2025, 12:30
Peak Discharge:	66.9 (CFS)	Date/Time of Peak Discharge:	02Jan2025, 00:15
Inflow Volume:	3.06 (IN)	Peak Storage:	295.8 (ACRE-FT)
Discharge Volume:	2.31 (IN)	Peak Elevation:	821.6 (FT)

Figure J. 16 Tabulated information for 10-yr storm

25-year

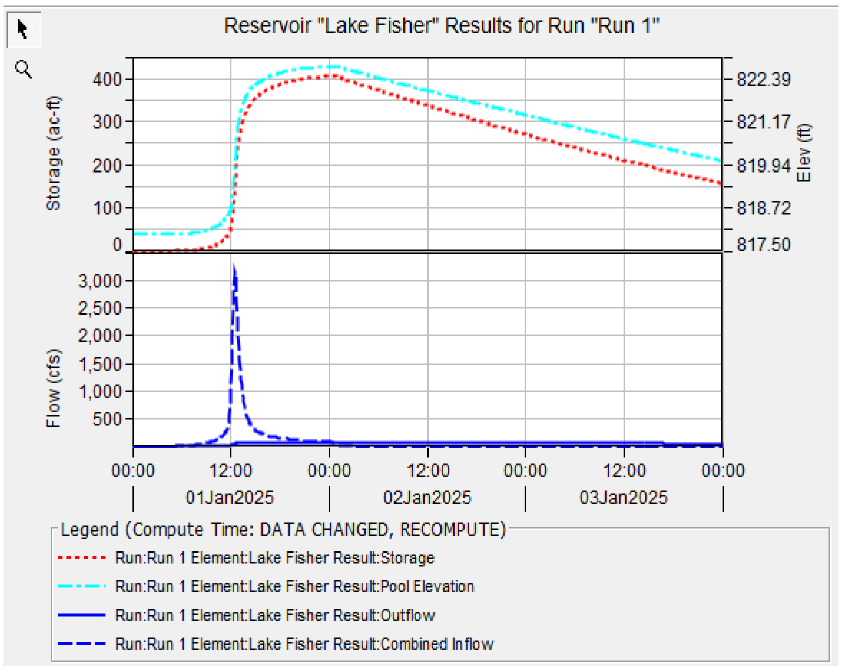


Figure J. 17 Plotted 25-yr storm discharge and storage

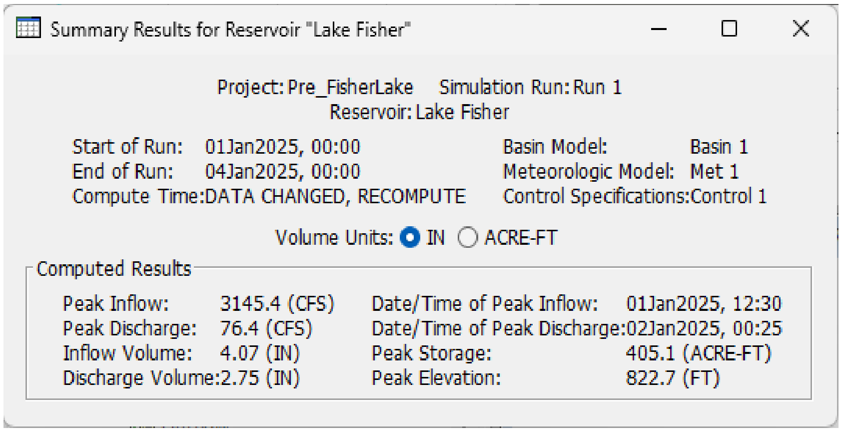


Figure J. 18 Tabulated information for 25-yr storm

50-year

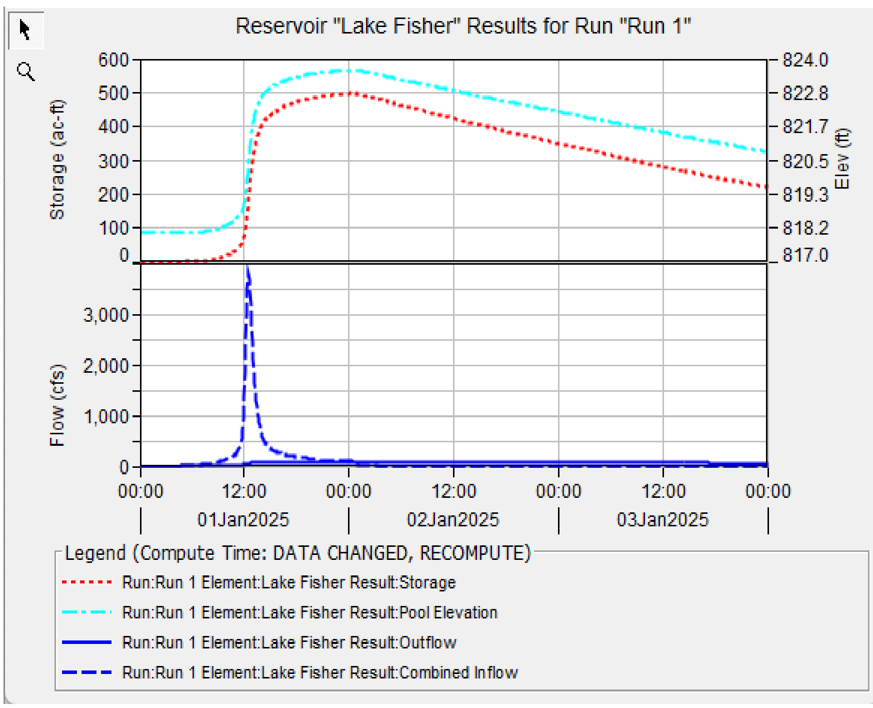


Figure J. 19 Plotted 50-yr storm discharge and storage

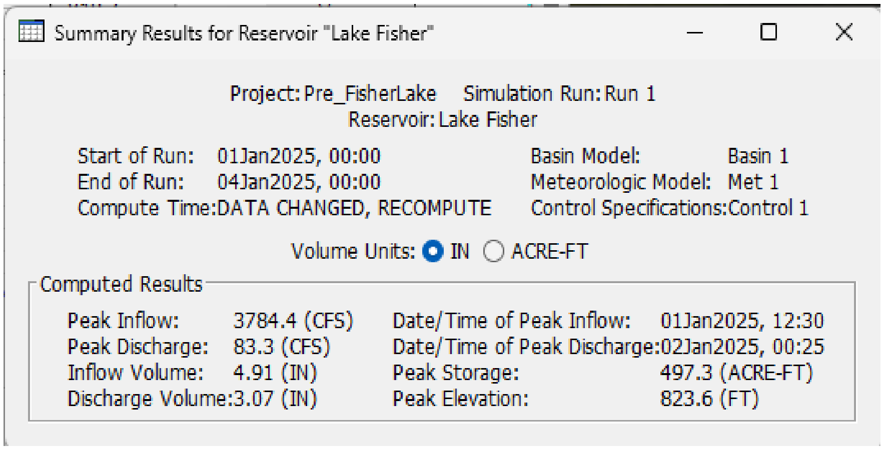


Figure J. 20 Tabulated information for 50-yr storm

100-year

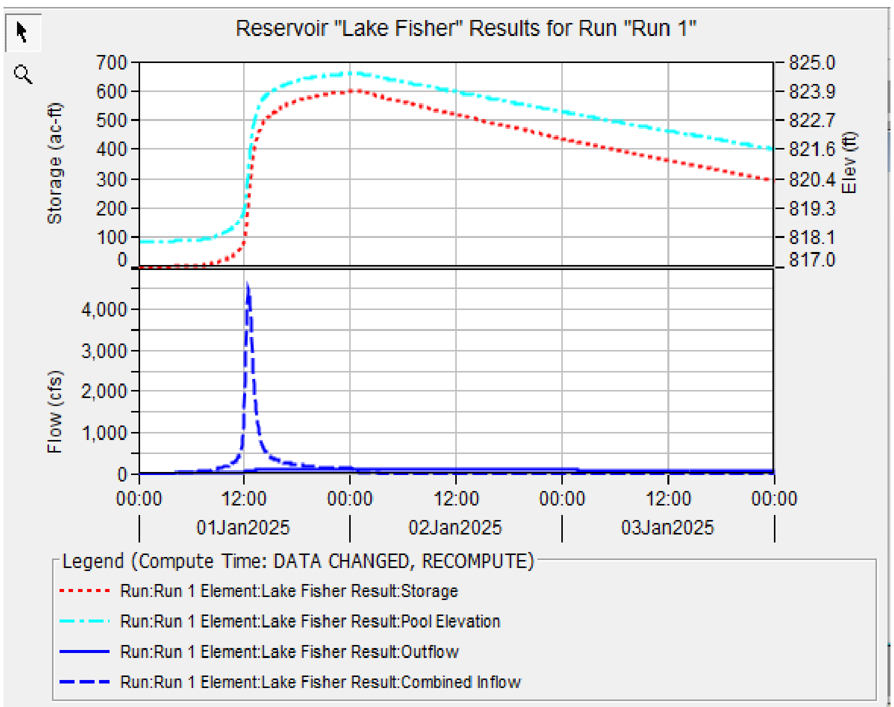


Figure J. 21 Plotted 100-yr storm discharge and storage

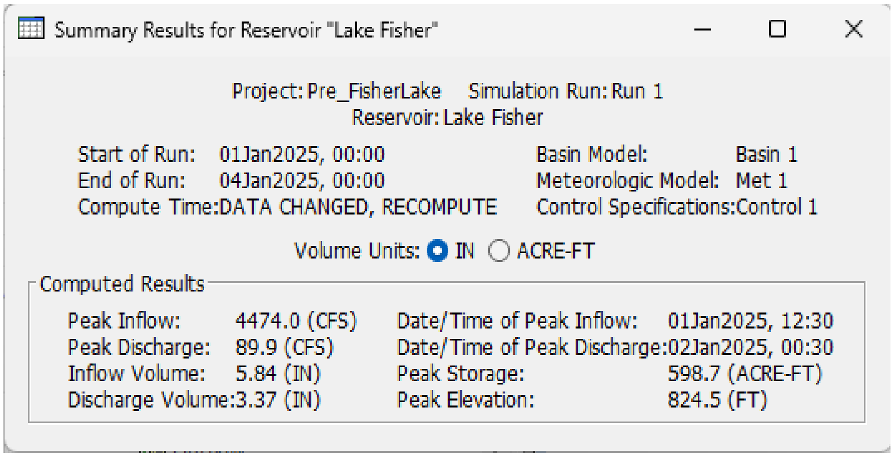


Figure J. 22 Tabulated information for 100-yr storm

500-year

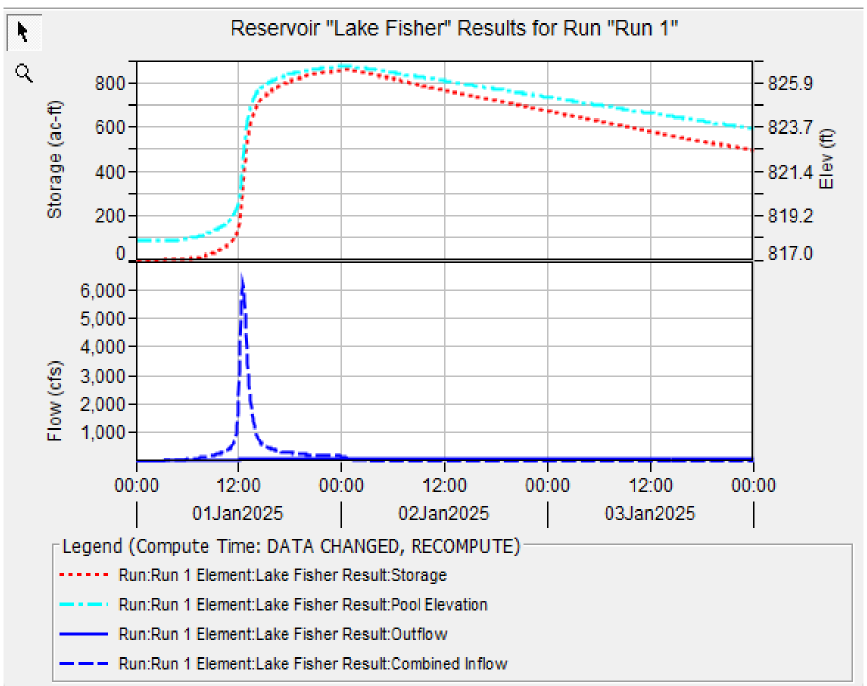
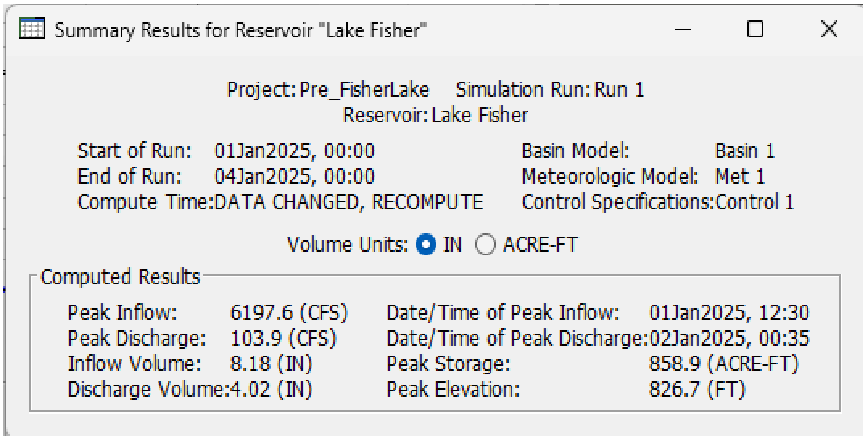


Figure J. 23 Plotted 500-yr storm discharge and storage



Summary Results for Reservoir "Lake Fisher"

Project: Pre_FisherLake Simulation Run: Run 1
Reservoir: Lake Fisher

Start of Run: 01Jan2025, 00:00 Basin Model: Basin 1
End of Run: 04Jan2025, 00:00 Meteorologic Model: Met 1
Compute Time:DATA CHANGED, RECOMPUTE Control Specifications:Control 1

Volume Units: IN ACRE-FT

Computed Results

Peak Inflow: 6197.6 (CFS) Date/Time of Peak Inflow: 01Jan2025, 12:30
Peak Discharge: 103.9 (CFS) Date/Time of Peak Discharge:02Jan2025, 00:35
Inflow Volume: 8.18 (IN) Peak Storage: 858.9 (ACRE-FT)
Discharge Volume:4.02 (IN) Peak Elevation: 826.7 (FT)

Figure J. 24 Tabulated information for 500-yr storm

Post-development HEC-HMS

Table 9J: increased impervious surfaces and curve number

						CN			
	trails (ft3)	everything else (ft3)		total (ft3)	total (ac)	A	B	C	D
Gravel	110000	238300		348300	7.995868	76	85	89	91
Concrete		38200		38200	0.876951	98	98	98	98

Table 10J: Post-development curve number calculation

	CN	Area
Pre-dev	83.68312	1422.289
Post-dev	83.72746	

1-year

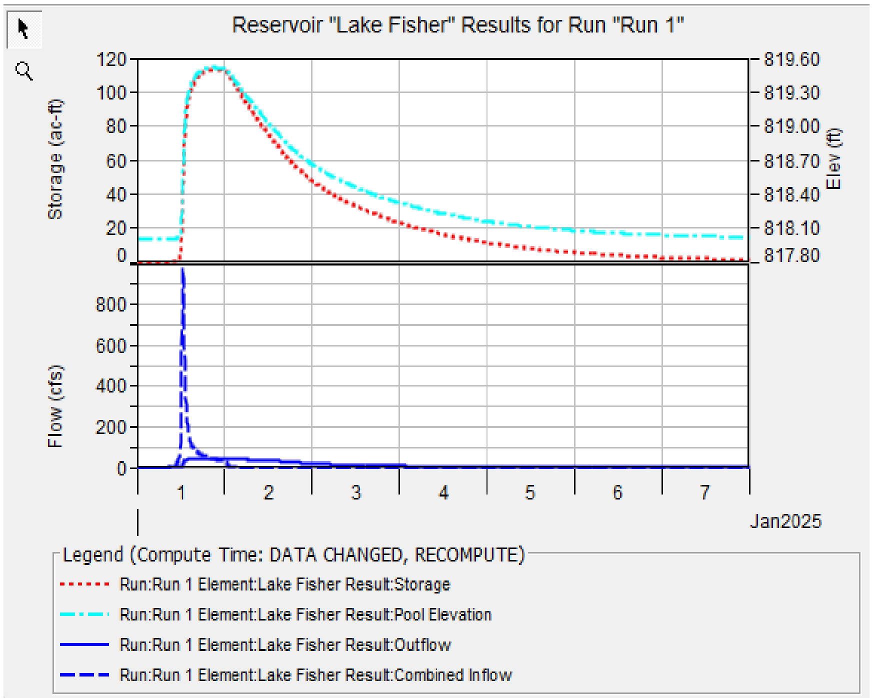


Figure J. 25 Plotted 1-yr storm discharge and storage

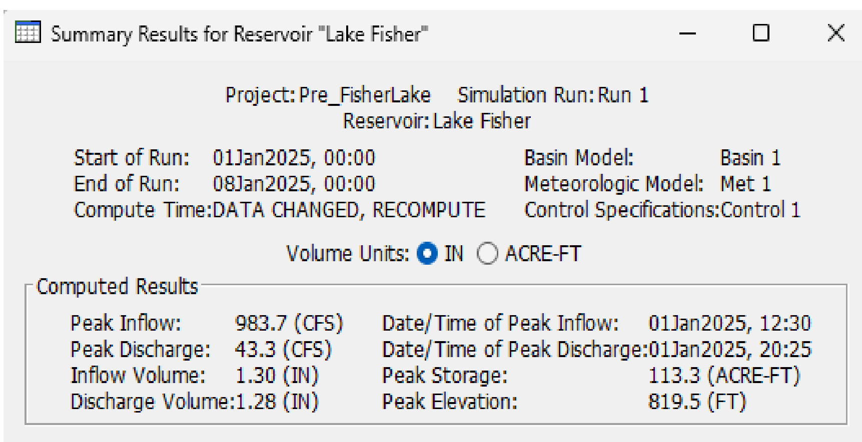


Figure J. 26 Tabulated information for 1-yr storm

2-year

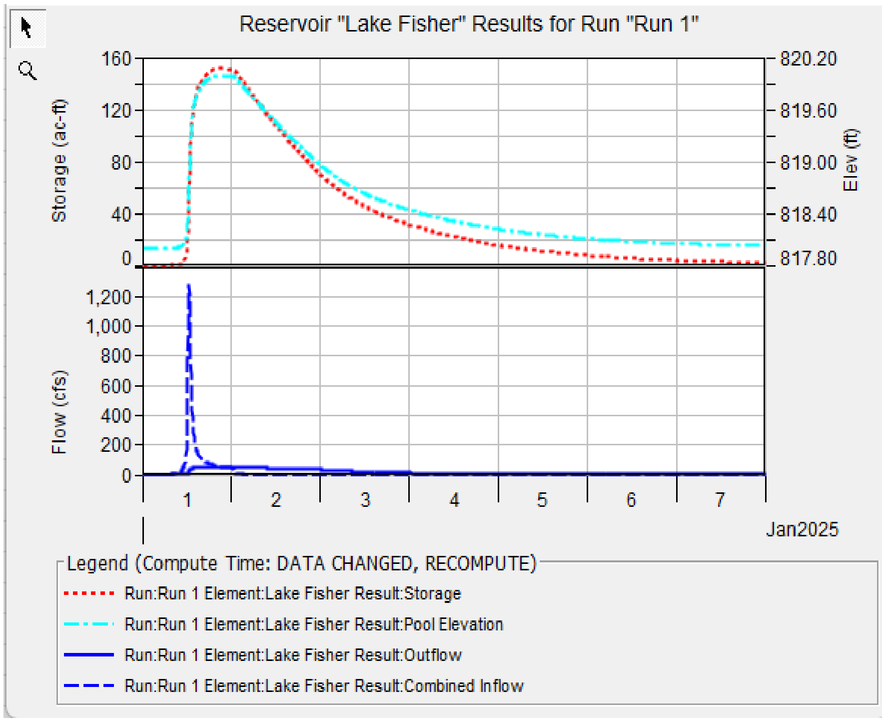


Figure J. 27 Plotted 2-yr storm discharge and storage

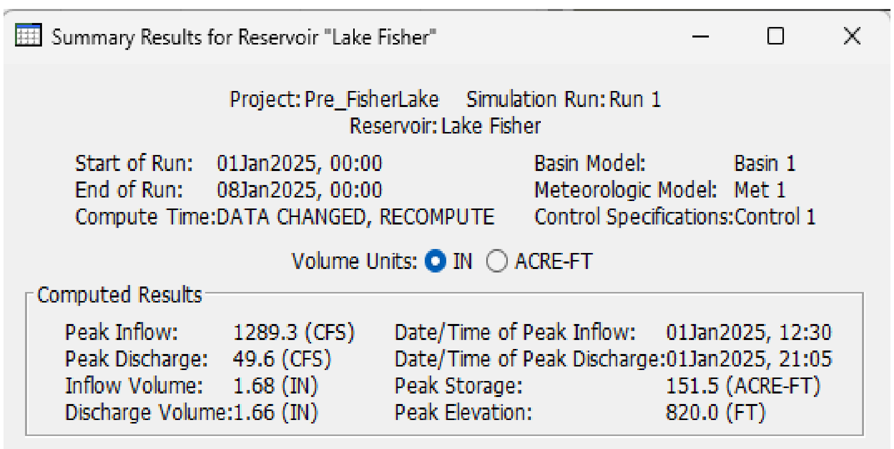


Figure J. 28 Tabulated information for 2-yr storm

5-year

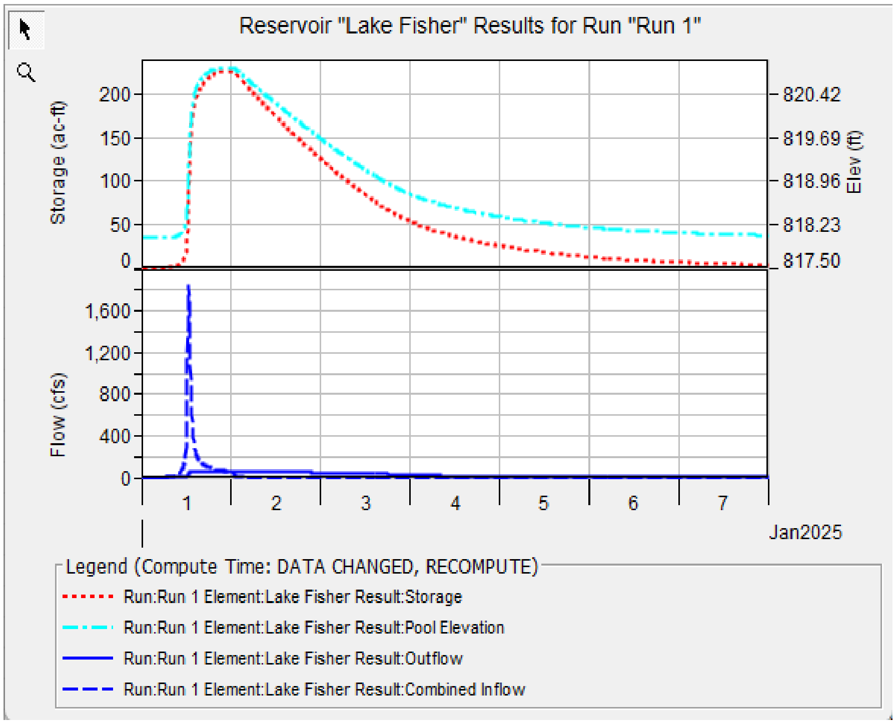
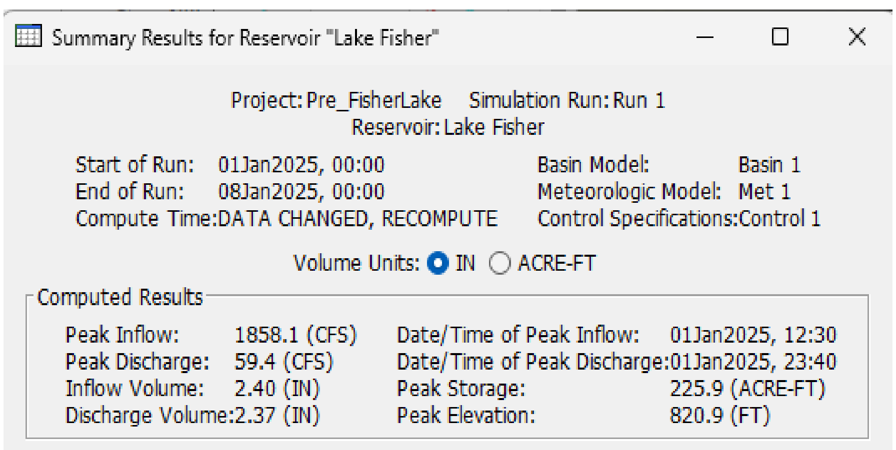


Figure J. 29 Plotted 5-yr storm discharge and storage



Summary Results for Reservoir "Lake Fisher"

Project: Pre_FisherLake Simulation Run: Run 1
Reservoir: Lake Fisher

Start of Run:	01Jan2025, 00:00	Basin Model:	Basin 1
End of Run:	08Jan2025, 00:00	Meteorologic Model:	Met 1
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	Control 1

Volume Units: IN ACRE-FT

Computed Results

Peak Inflow:	1858.1 (CFS)	Date/Time of Peak Inflow:	01Jan2025, 12:30
Peak Discharge:	59.4 (CFS)	Date/Time of Peak Discharge:	01Jan2025, 23:40
Inflow Volume:	2.40 (IN)	Peak Storage:	225.9 (ACRE-FT)
Discharge Volume:	2.37 (IN)	Peak Elevation:	820.9 (FT)

Figure J. 30 Tabulated information for 5-yr storm

10-year

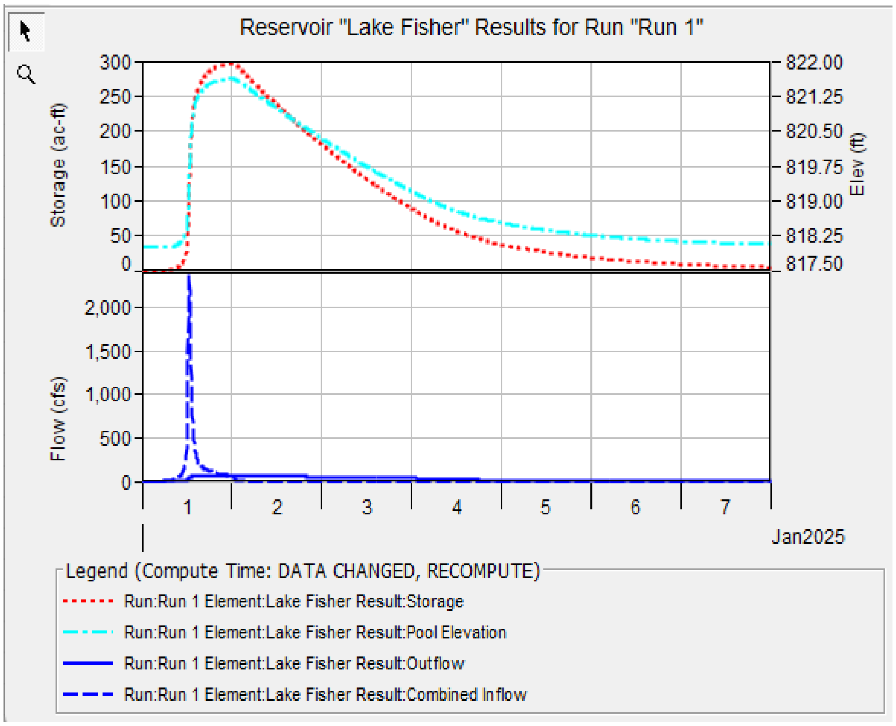


Figure J. 31 Plotted 10-yr storm discharge and storage

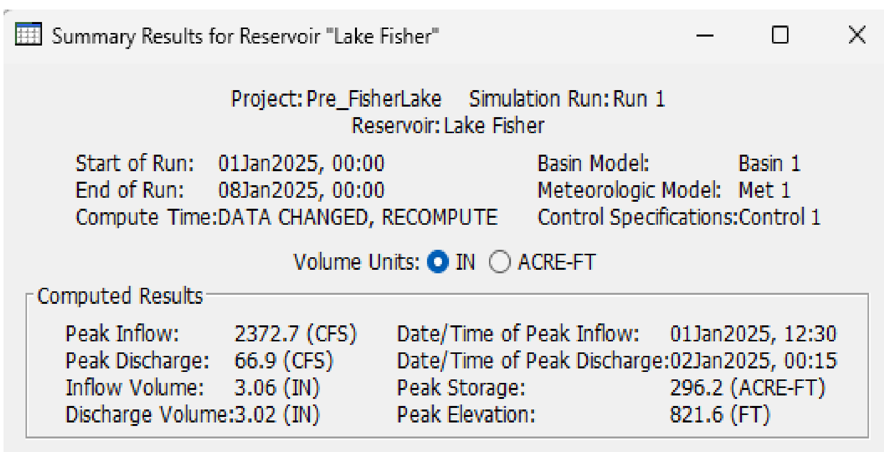


Figure J. 32 Tabulated information for 10-yr storm

25-year

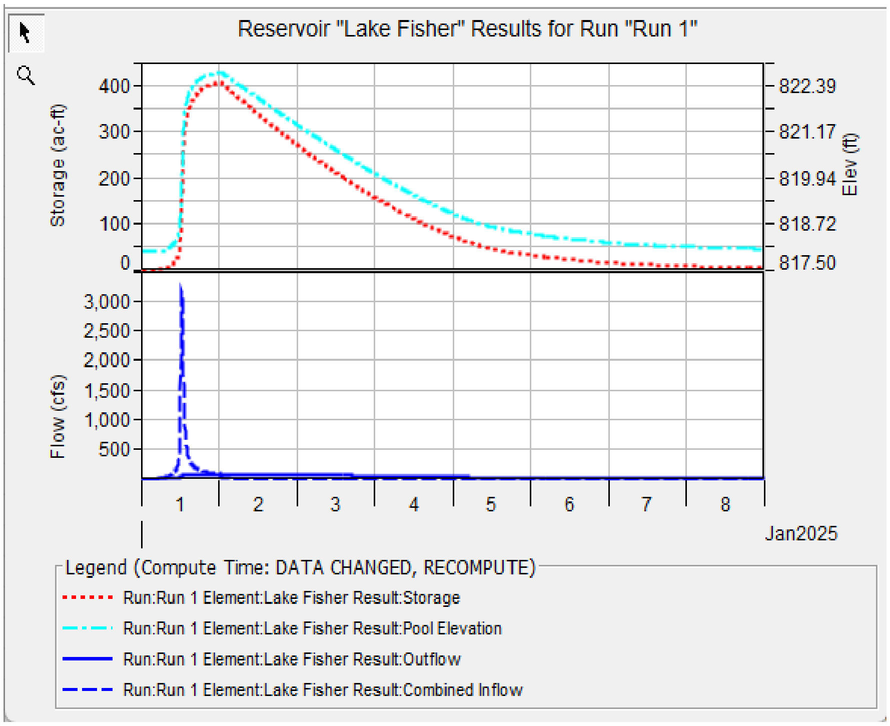
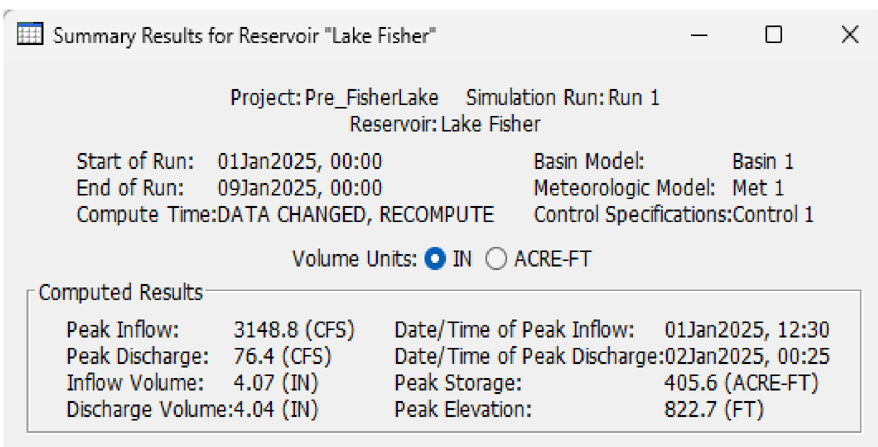


Figure J. 33 Plotted 25-yr storm discharge and storage



Summary Results for Reservoir "Lake Fisher"

Project: Pre_FisherLake   Simulation Run: Run 1
Reservoir: Lake Fisher

Start of Run:	01Jan2025, 00:00	Basin Model:	Basin 1
End of Run:	09Jan2025, 00:00	Meteorologic Model:	Met 1
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	Control 1

Volume Units: IN   ACRE-FT

Computed Results

Peak Inflow:	3148.8 (CFS)	Date/Time of Peak Inflow:	01Jan2025, 12:30
Peak Discharge:	76.4 (CFS)	Date/Time of Peak Discharge:	02Jan2025, 00:25
Inflow Volume:	4.07 (IN)	Peak Storage:	405.6 (ACRE-FT)
Discharge Volume:	4.04 (IN)	Peak Elevation:	822.7 (FT)

Figure J. 34 Tabulated information for 25-yr storm

50-year

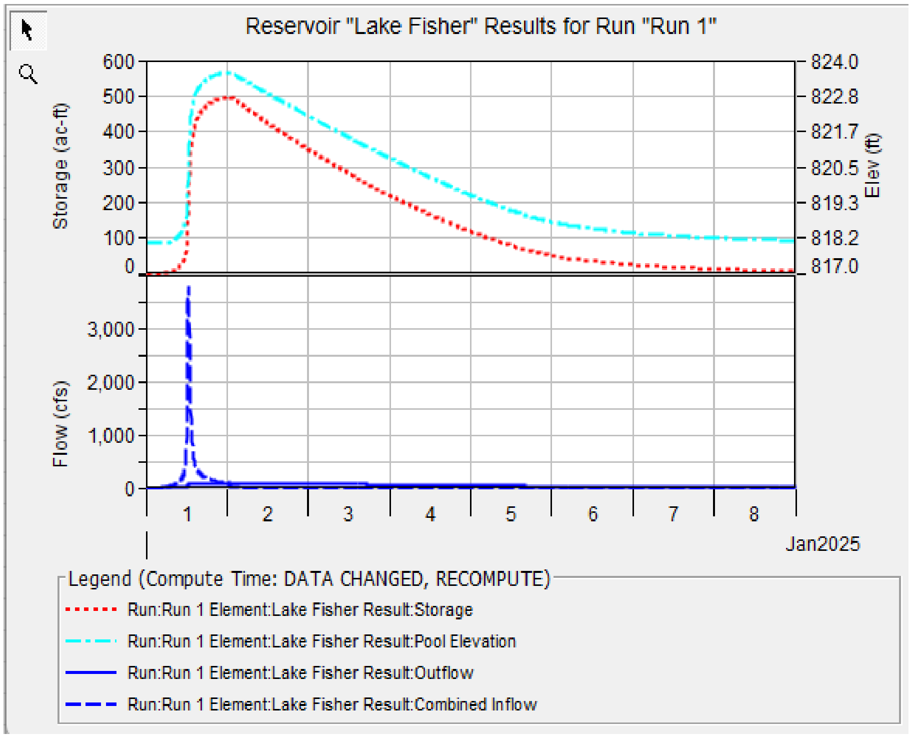


Figure J. 35 Plotted 50-yr storm discharge and storage

Summary Results for Reservoir "Lake Fisher"

Project: Pre_FisherLake   Simulation Run: Run 1
Reservoir: Lake Fisher

Start of Run:	01Jan2025, 00:00	Basin Model:	Basin 1
End of Run:	09Jan2025, 00:00	Meteorologic Model:	Met 1
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	Control 1

Volume Units: IN ACRE-FT

Computed Results

Peak Inflow:	3787.8 (CFS)	Date/Time of Peak Inflow:	01Jan2025, 12:30
Peak Discharge:	83.3 (CFS)	Date/Time of Peak Discharge:	02Jan2025, 00:25
Inflow Volume:	4.92 (IN)	Peak Storage:	497.8 (ACRE-FT)
Discharge Volume:	4.87 (IN)	Peak Elevation:	823.6 (FT)

Figure J. 36 Tabulated information for 50-yr storm

100-year

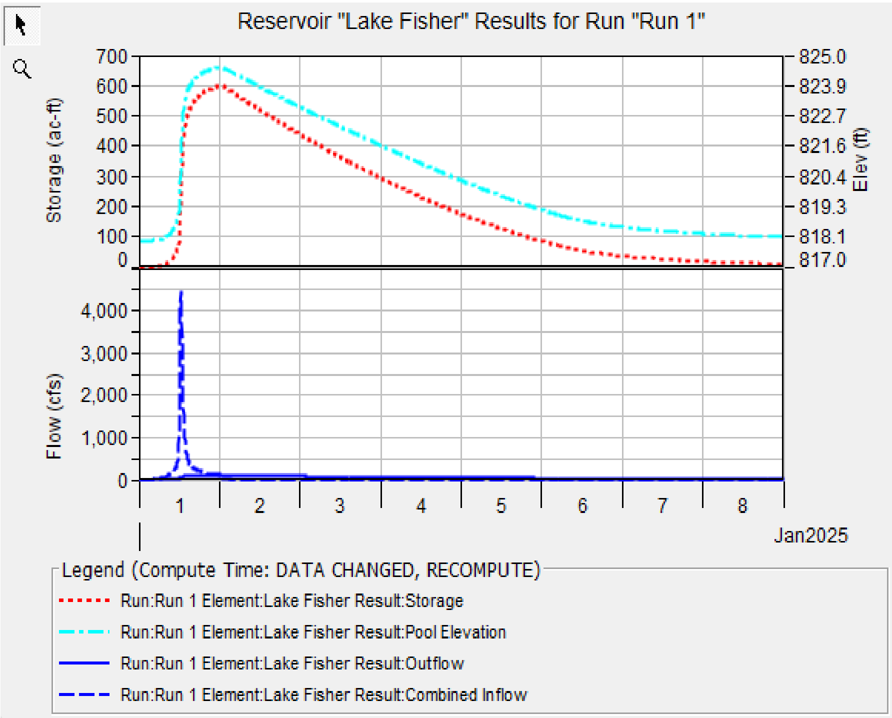
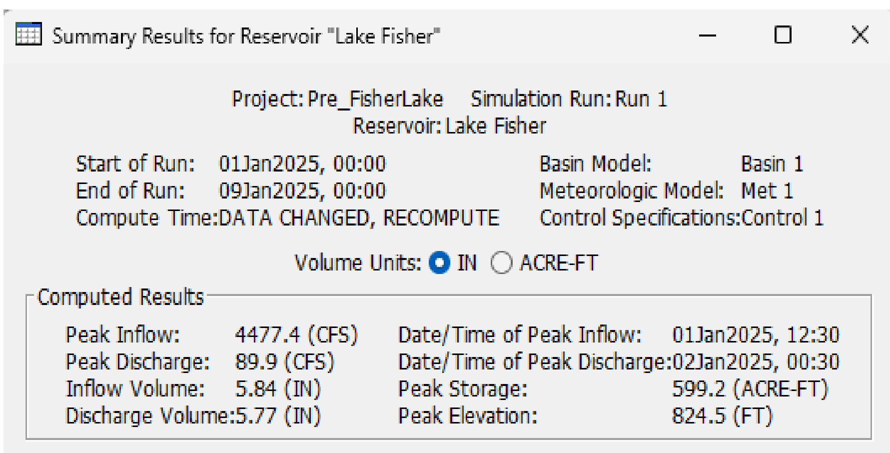


Figure J. 37 Plotted 100-yr storm discharge and storage



Summary Results for Reservoir "Lake Fisher"

Project: Pre_FisherLake Simulation Run: Run 1
Reservoir: Lake Fisher

Start of Run:	01Jan2025, 00:00	Basin Model:	Basin 1
End of Run:	09Jan2025, 00:00	Meteorologic Model:	Met 1
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	Control 1

Volume Units: IN ACRE-FT

Computed Results

Peak Inflow:	4477.4 (CFS)	Date/Time of Peak Inflow:	01Jan2025, 12:30
Peak Discharge:	89.9 (CFS)	Date/Time of Peak Discharge:	02Jan2025, 00:30
Inflow Volume:	5.84 (IN)	Peak Storage:	599.2 (ACRE-FT)
Discharge Volume:	5.77 (IN)	Peak Elevation:	824.5 (FT)

Figure J. 38 Tabulated information for 100-yr storm

500-year

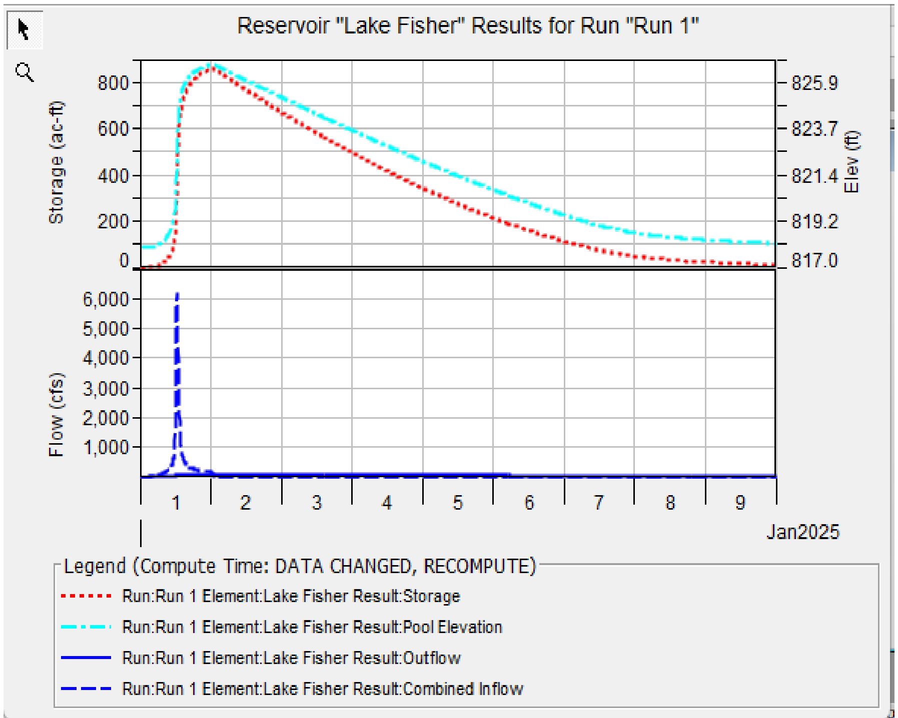


Figure J. 39 Plotted 500-yr storm discharge and storage

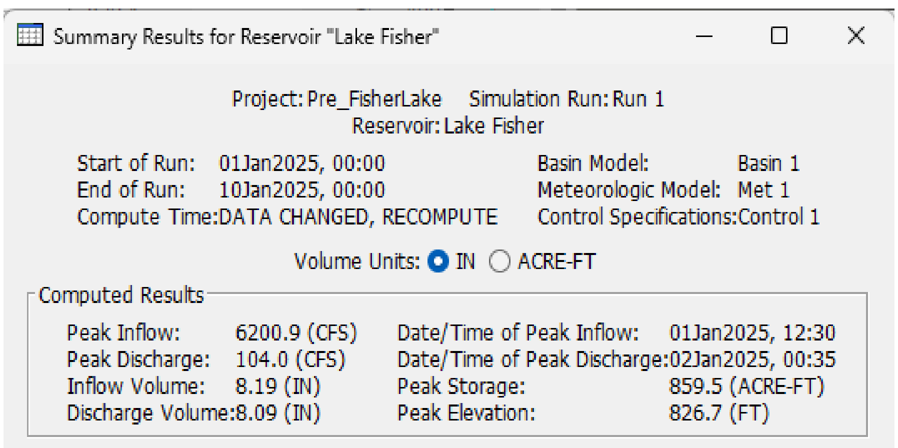


Figure J. 40 Tabulated information for 500-yr storm

Table 11J: Post-development peak inflow, peak storage, and discharge volume increase from pre-development

design year	peak inflow	% increase	peak storage	% increase	discharge volume	% increase
1	2.5	0.254143	0.2	0.176523	0.18	14.0625
2	2.7	0.209416	0.3	0.19802	0.25	15.06024
5	3.1	0.166837	0.4	0.177069	0.42	17.72152
10	3.2	0.134867	0.4	0.135044	0.71	23.50993
25	3.4	0.107978	0.5	0.123274	1.29	31.93069
50	3.4	0.089762	0.5	0.100442	1.8	36.96099
100	7.4	0.165274	0.5	0.083445	2.4	41.59445
500	13.3	0.214485	0.6	0.069808	4.07	50.30902

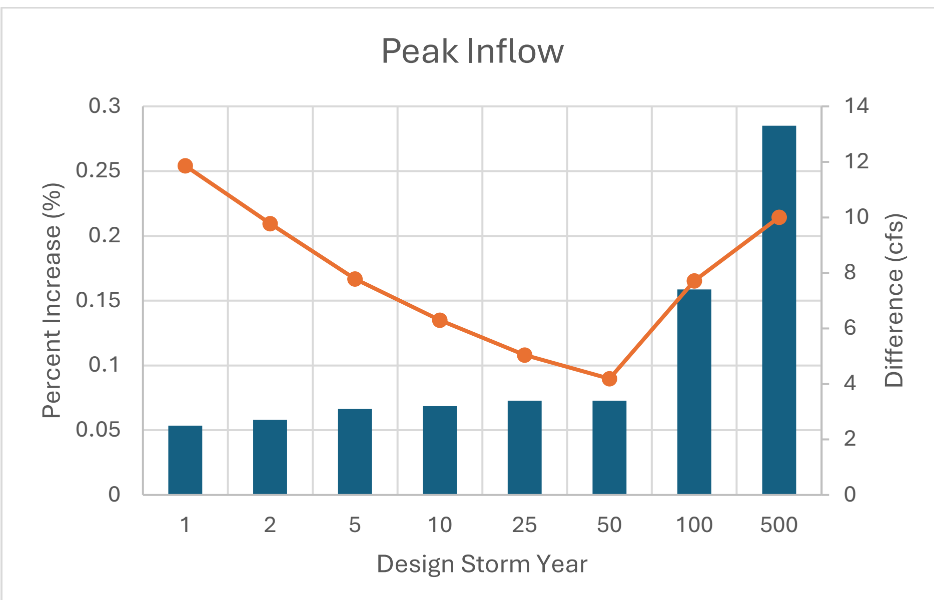


Figure J. 41 Increase in peak inflow for pre- vs. post-development

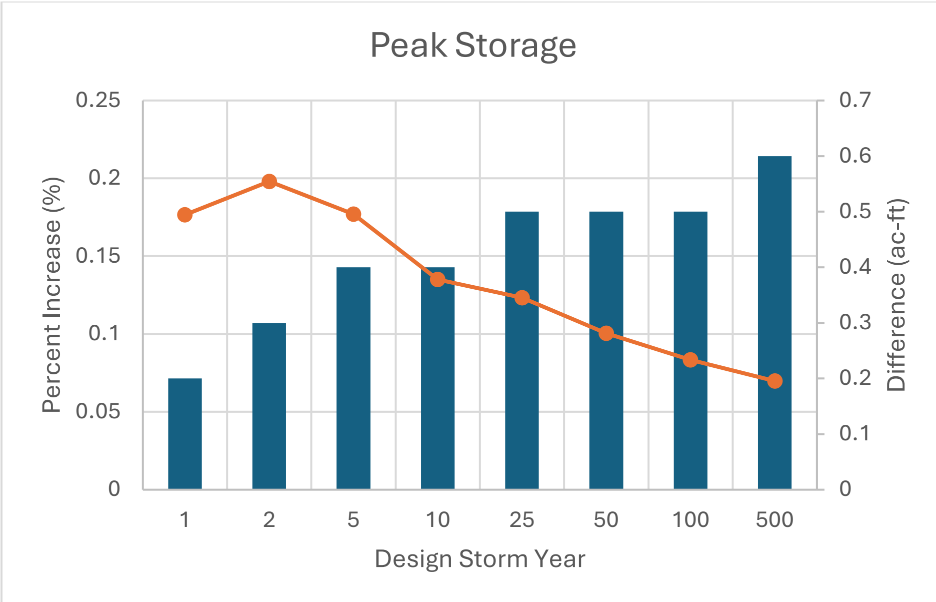


Figure J. 42 Increase in peak storage for pre- vs. post-development

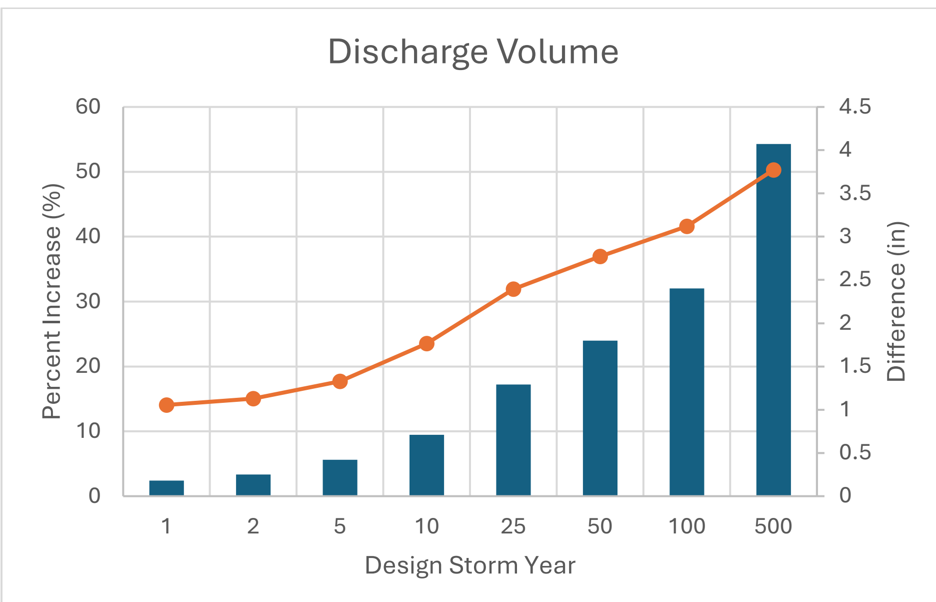


Figure J. 43 Increase in discharge volume for pre- vs. post-development

Table 12J: Total area and curve numbers for native planting and trees

	area (ft3)	area (ac)	delta CN	CN
Leach field	68700	1.57713499	-5	79
Trees	3000	0.06887052	-10	74

Table 13J: Effect of planting natives and trees on curve number

Postdev	83.7274618
With Natives	83.7217486

Appendix K-Ramps and Docks

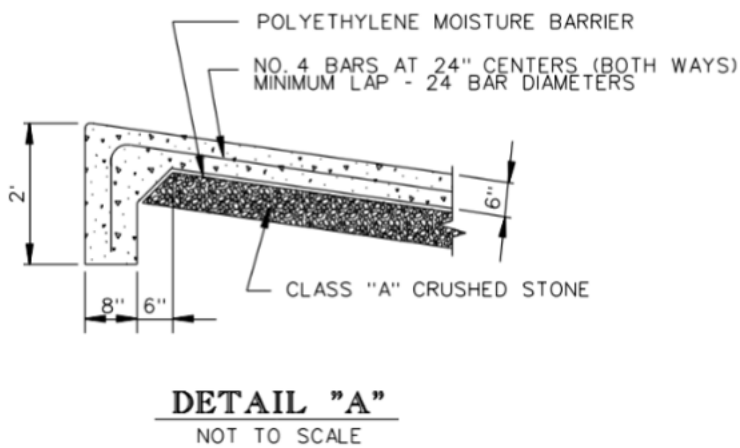


Figure K. 1 Detail A

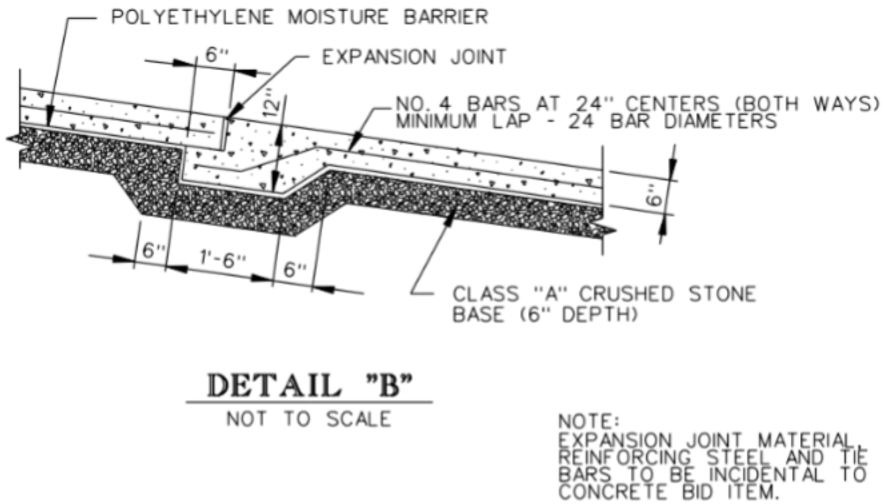


Figure K. 2 Detail B

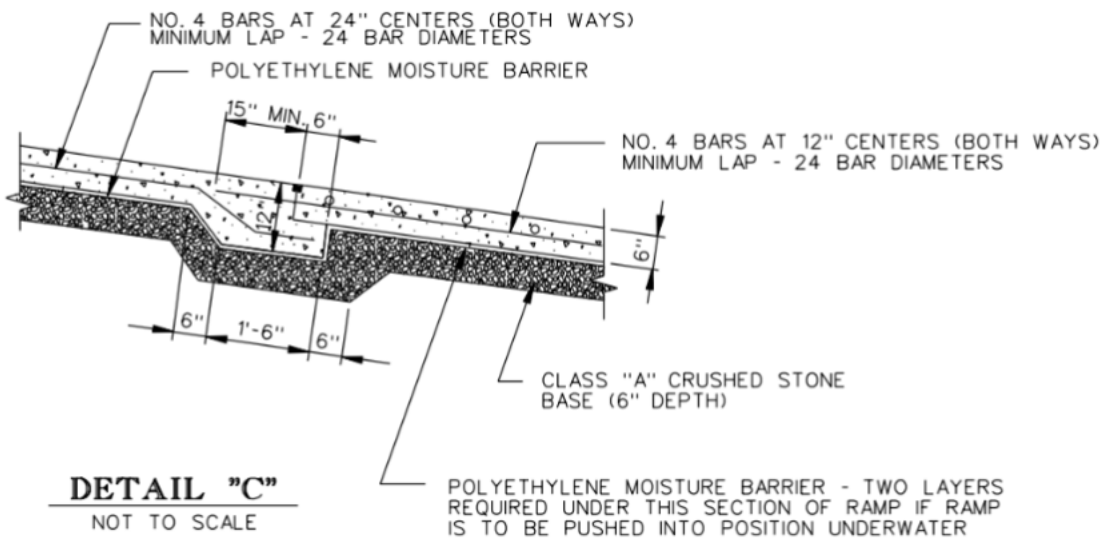


Figure K. 3 Detail C

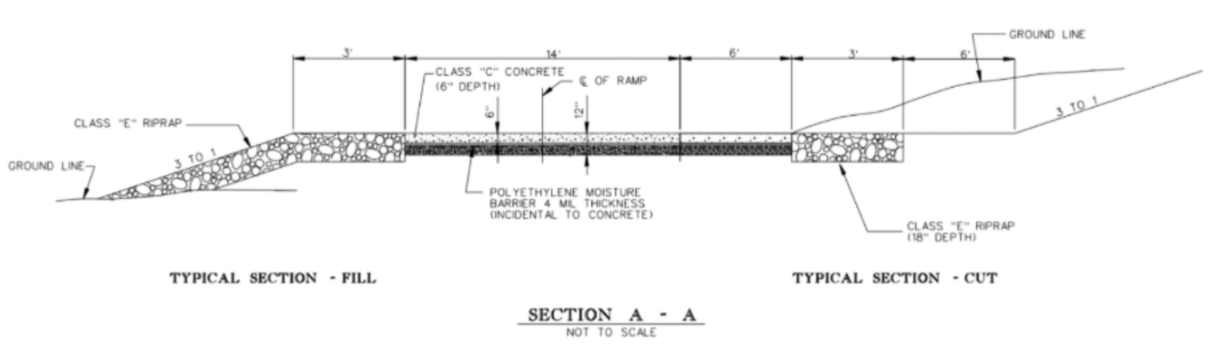


Figure K. 4 DNR side profile example

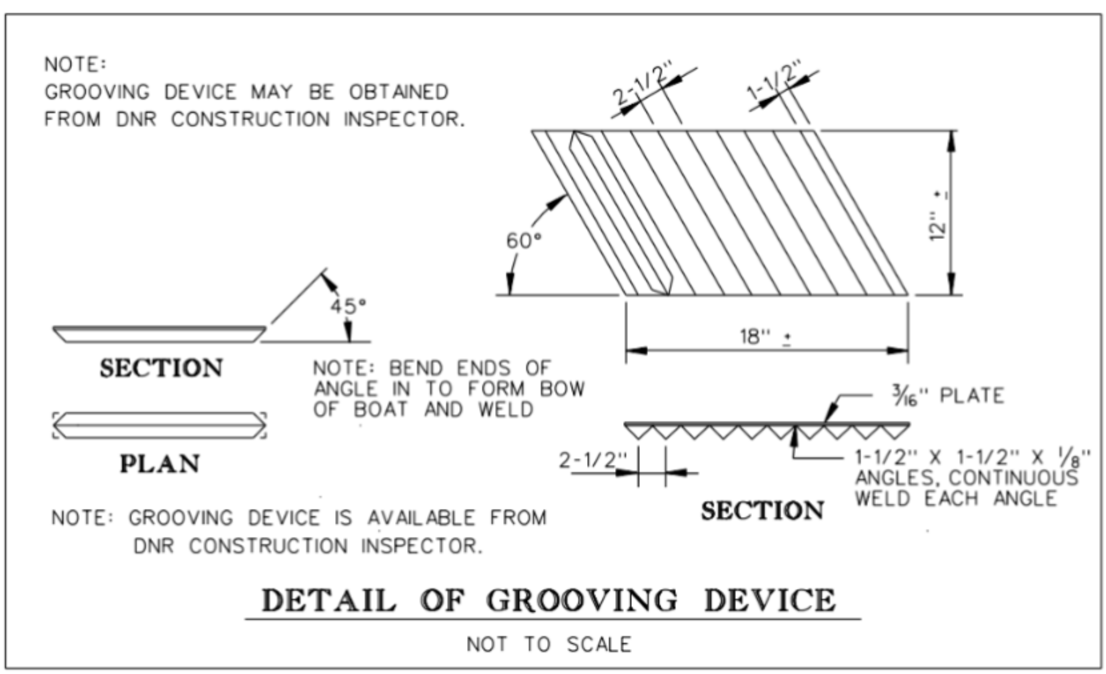


Figure K. 5 Groving detail from DNR

GENERAL NOTES

ALL CONCRETE SHALL CONFORM TO CLASS "C" MIX 4 I. D. O. T. SPECIFICATION SERIES 2015

ALL EXPOSED EDGES OF CONCRETE TO BE BEVELED WITH ¾" CHAMFER STRIPS

THE TOP 1" OF ALL EXPANSION JOINTS TO RECEIVE A SILICONE BASE POURING TYPE SEALER

EXPANSION JOINTS - ¾" PREFORMED RESILIENT FILLER MATERIAL

REINFORCING STEEL - GRADE 40 - DEFORMED

THAT PORTION OF THE RAMP TO BE PLACED BELOW THE WATERLINE MAY BE FORMED ABOVE THE WATERLINE AND CAREFULLY PUSHED INTO POSITION UNDERWATER TO THE LOCATION AND ELEVATION AS SHOWN ON THE PLAN AND AS APPROVED BY THE ENGINEEER. THE REMAINING SECTIONS OF THE RAMP SHALL BE FORMED AND POURED IN PLACE.

Figure K. 6 Notes from DNR

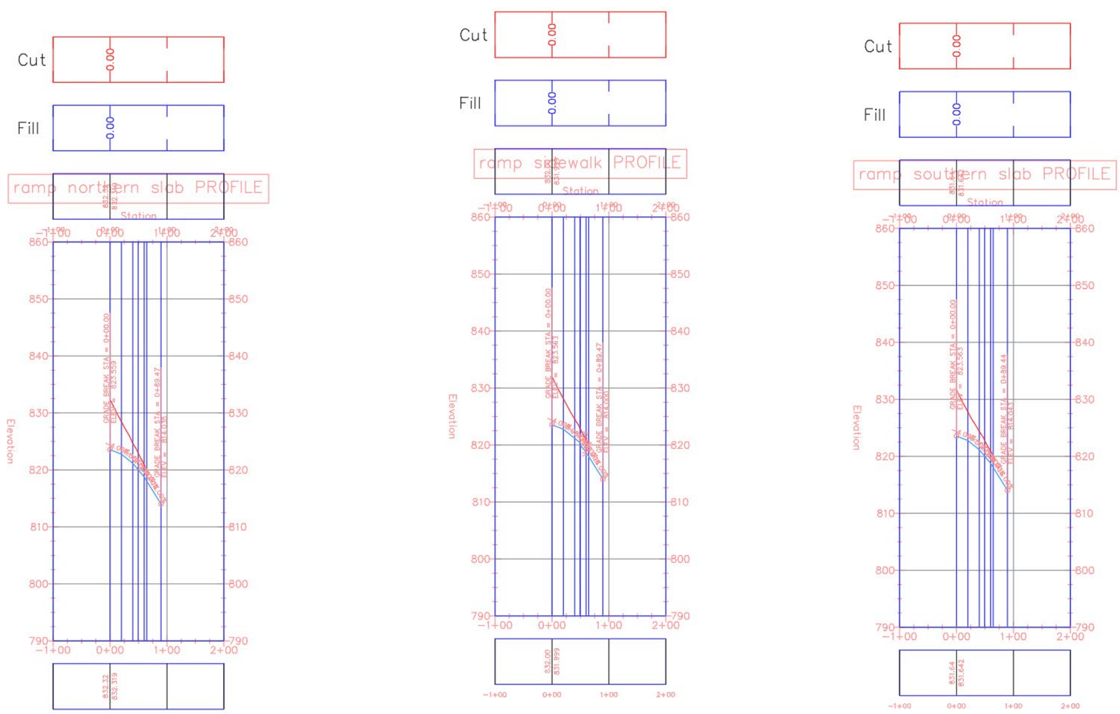


Figure K. 7 Boat ramp alignments to design low of 818' with at least 4' of underwater depth at end

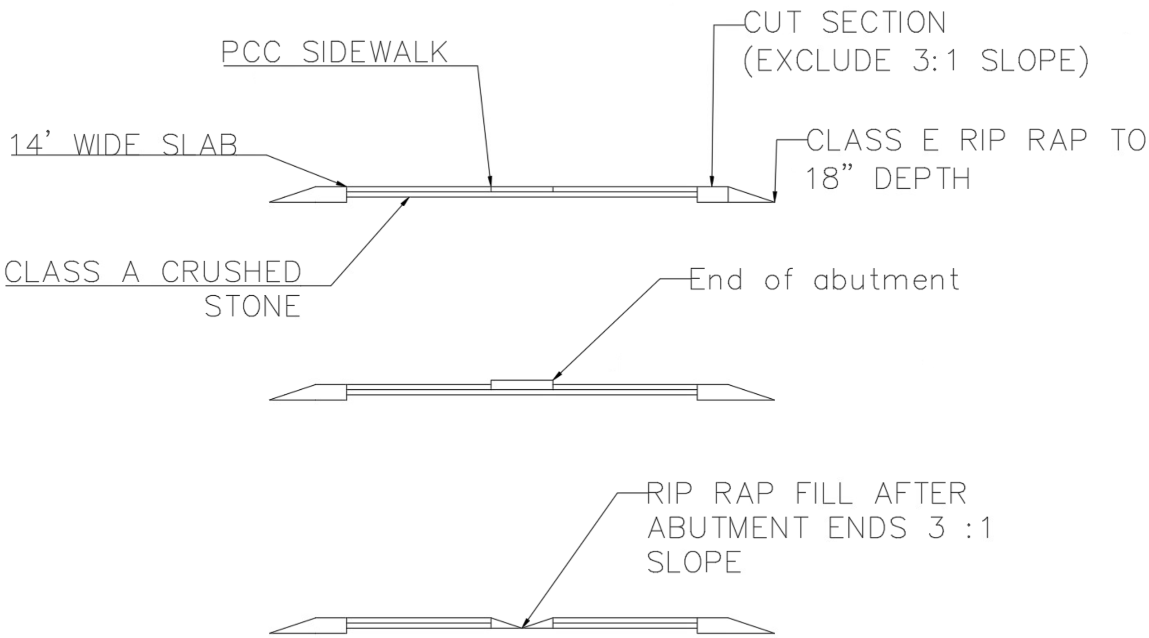


Figure K. 8 Boat ramp cross sections

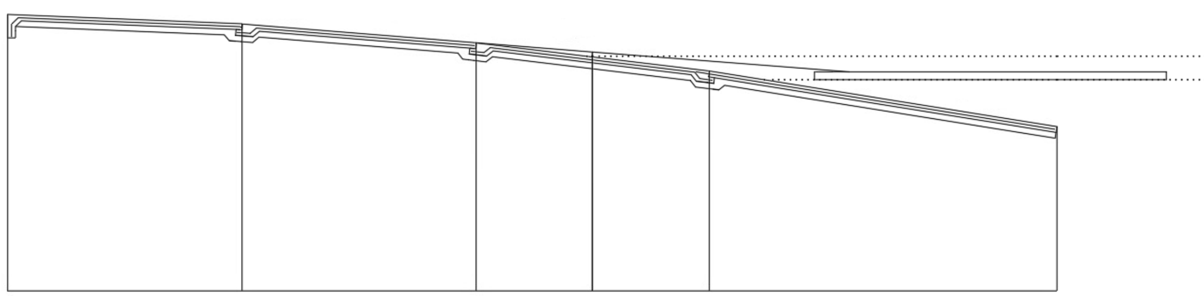


Figure K. 9 Boat ramp side profile

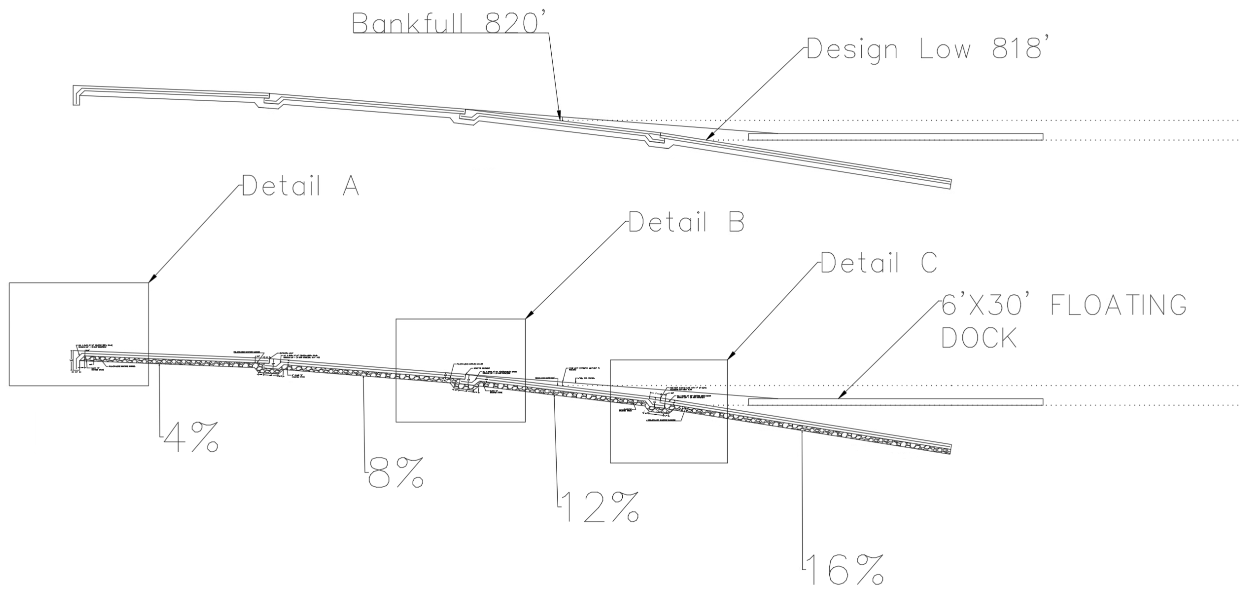


Figure K. 10 Boat ramp side profile and detail locations

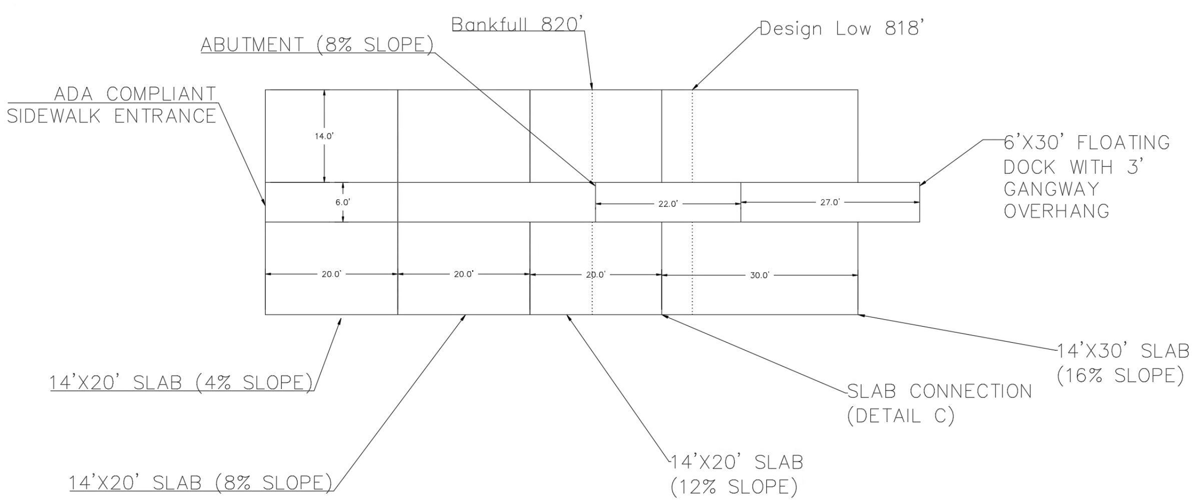


Figure K. 11 Boat ramp plan view

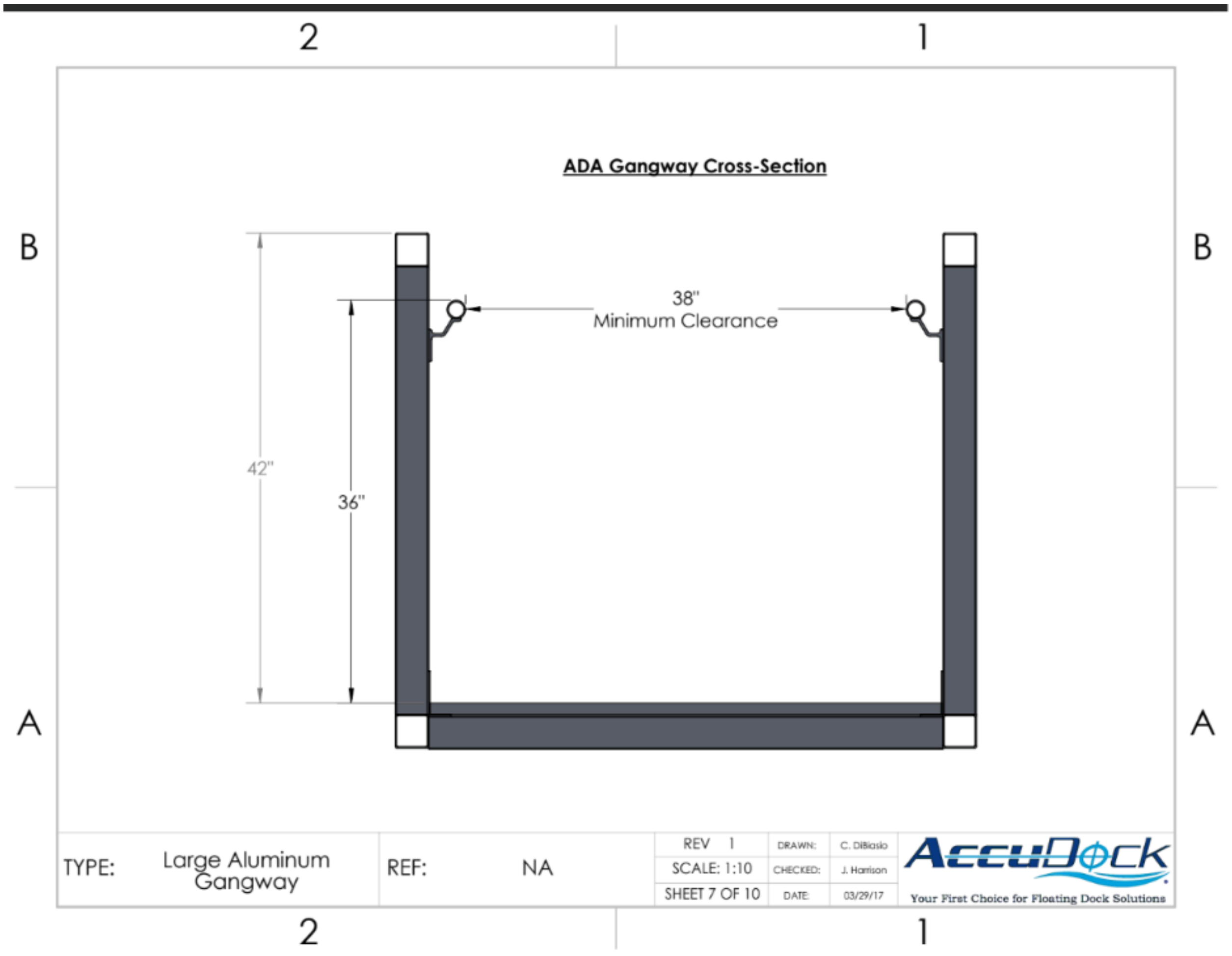


Figure K. 12 *Gangway custom width view*

Figure K. 13 Hinge connection to be featured on concrete abutments

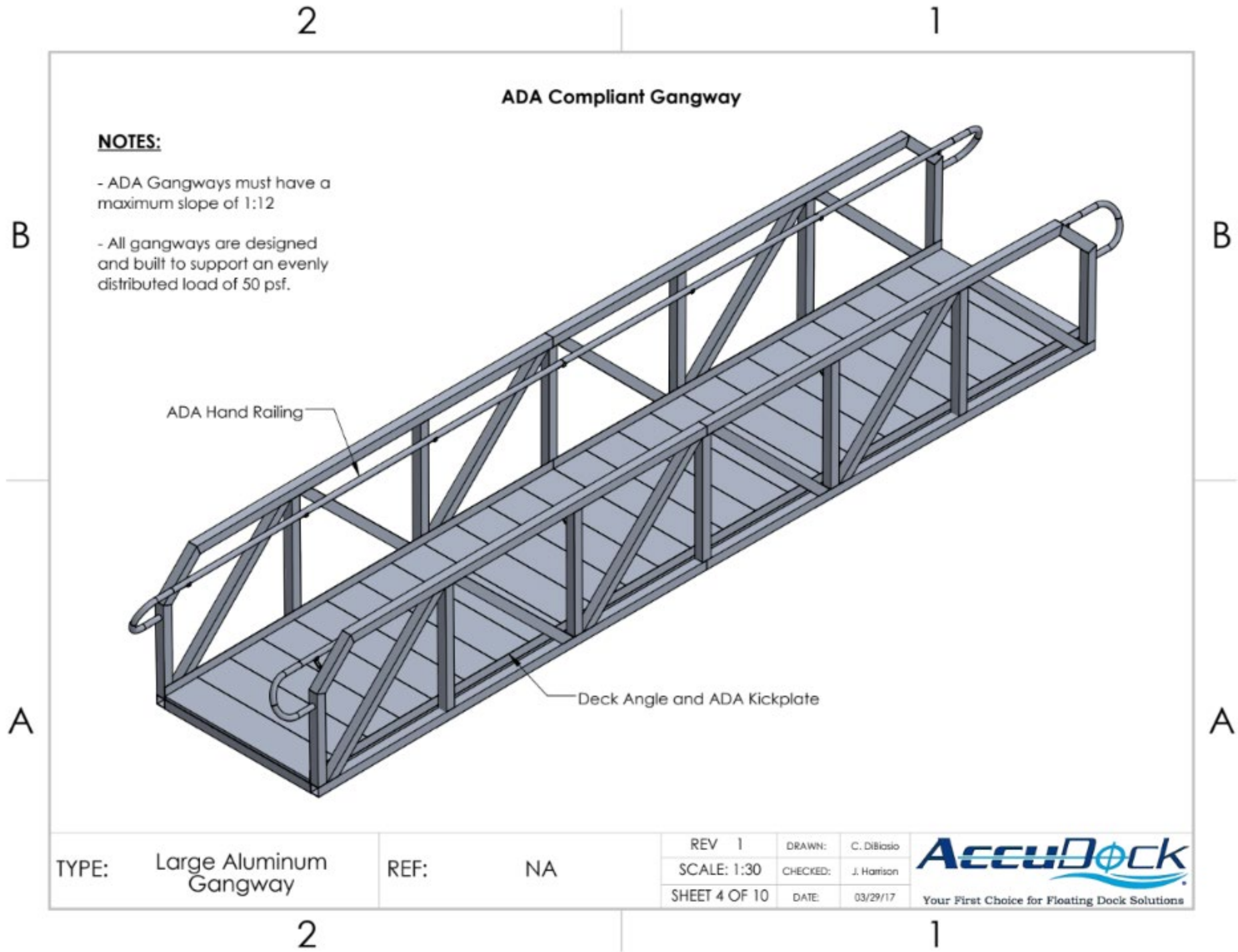


Figure K. 14 Custom gangway specifications 1

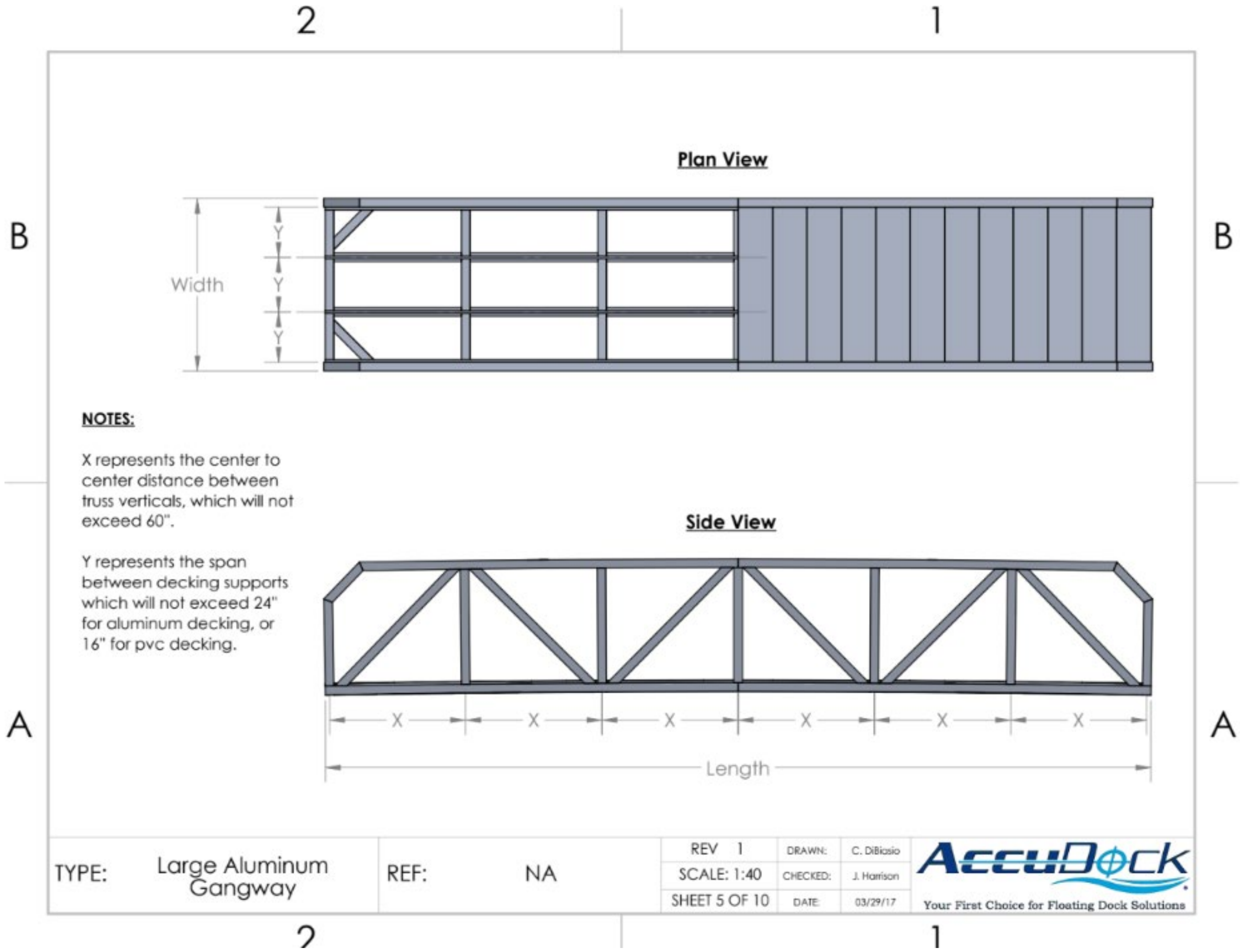


Figure K. 15 Custom gangway specifications 2

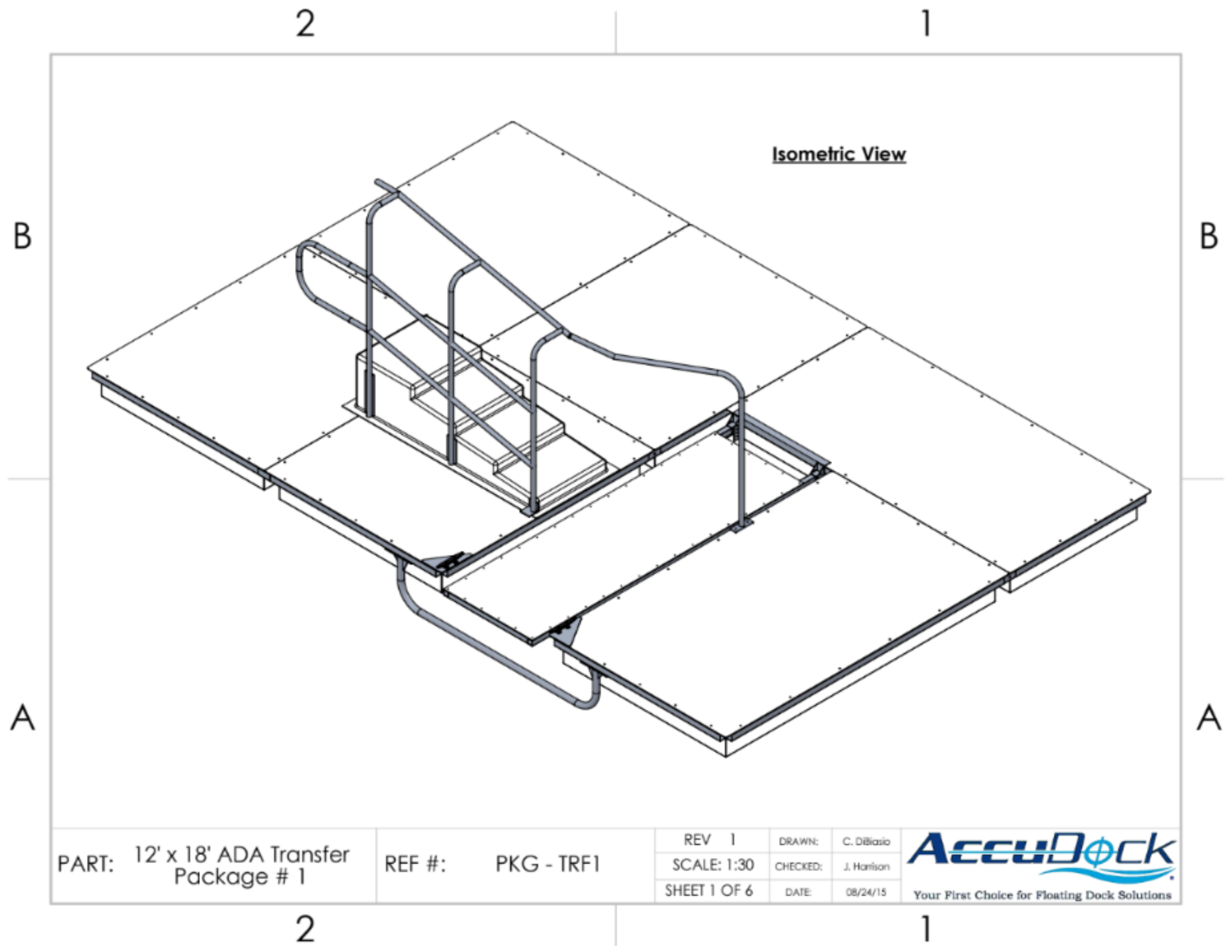


Figure K. 16 Standard ADA compliant prefabricated Accudock kayak launch side view

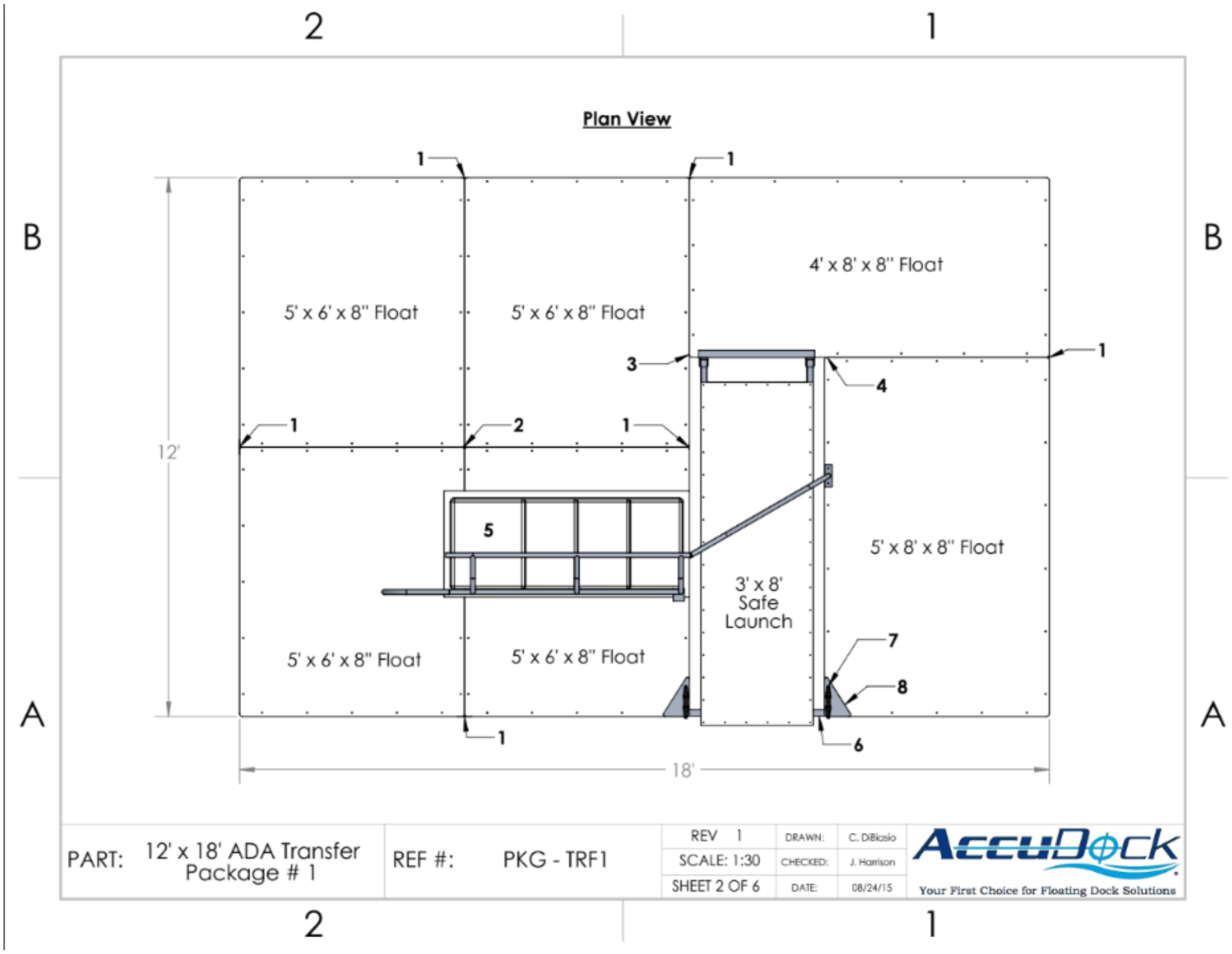


Figure K. 17 Standard ADA compliant prefabricated Accudock kayak launch plan view

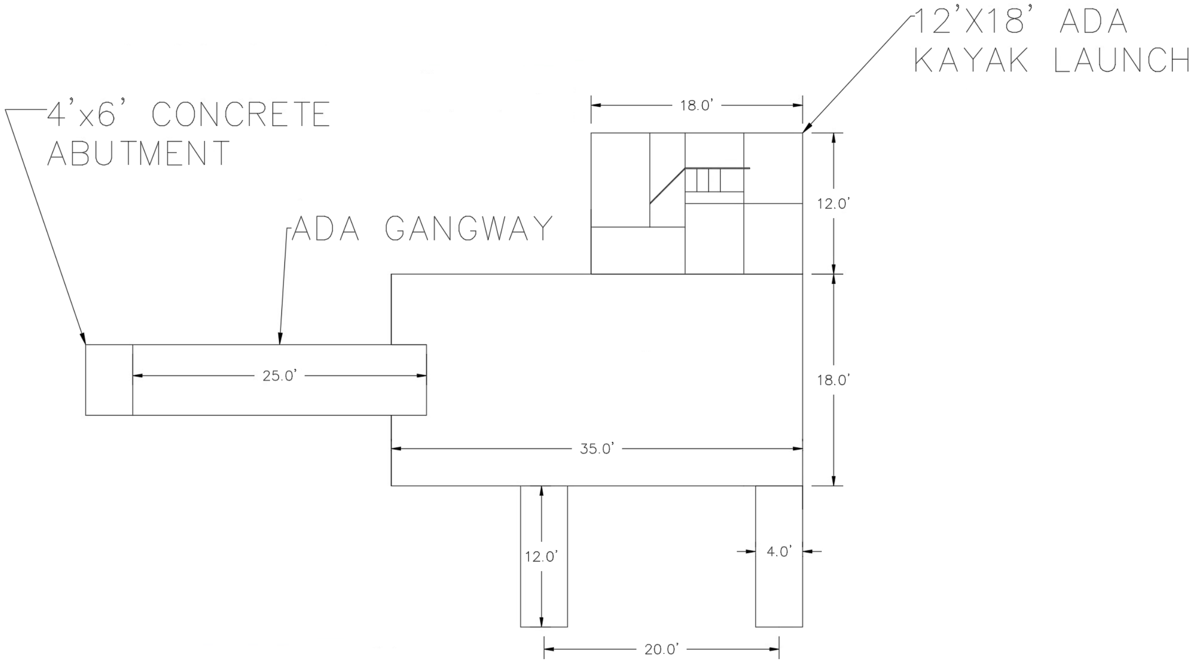


Figure K. 18 Dock 1/Northwest dock

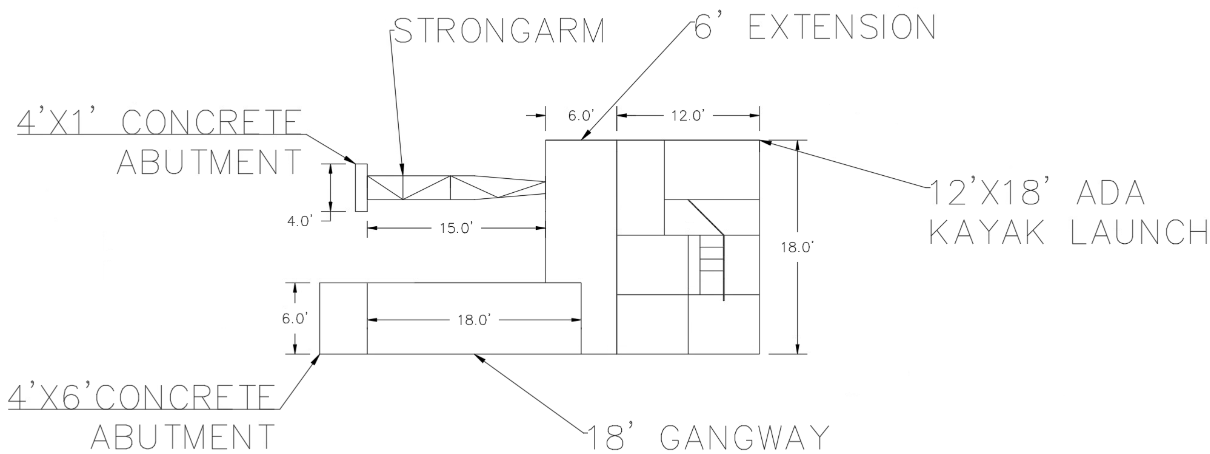


Figure K. 19 Westside dock

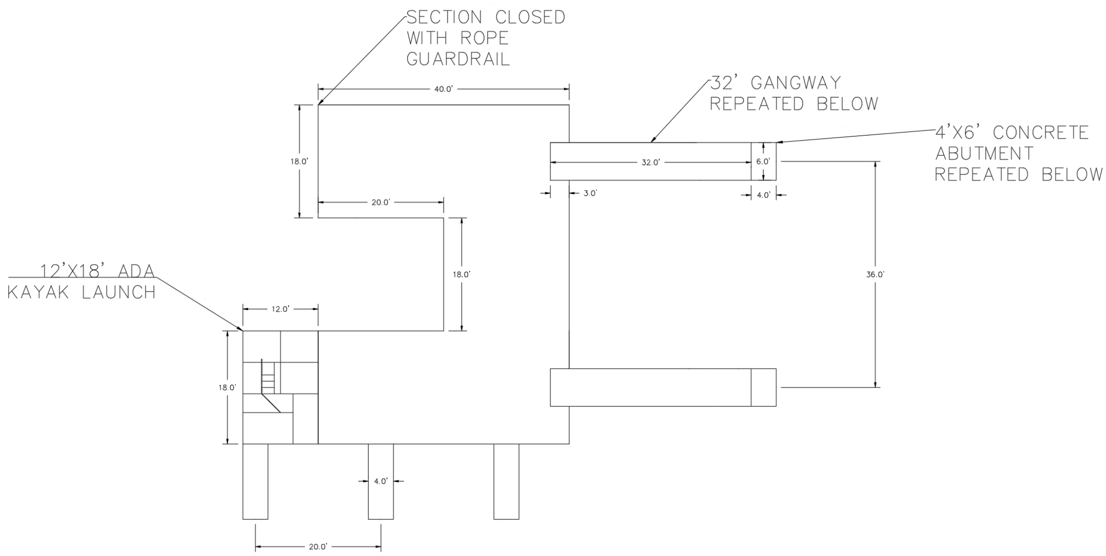


Figure K. 20 Dock 3/Venue Dock

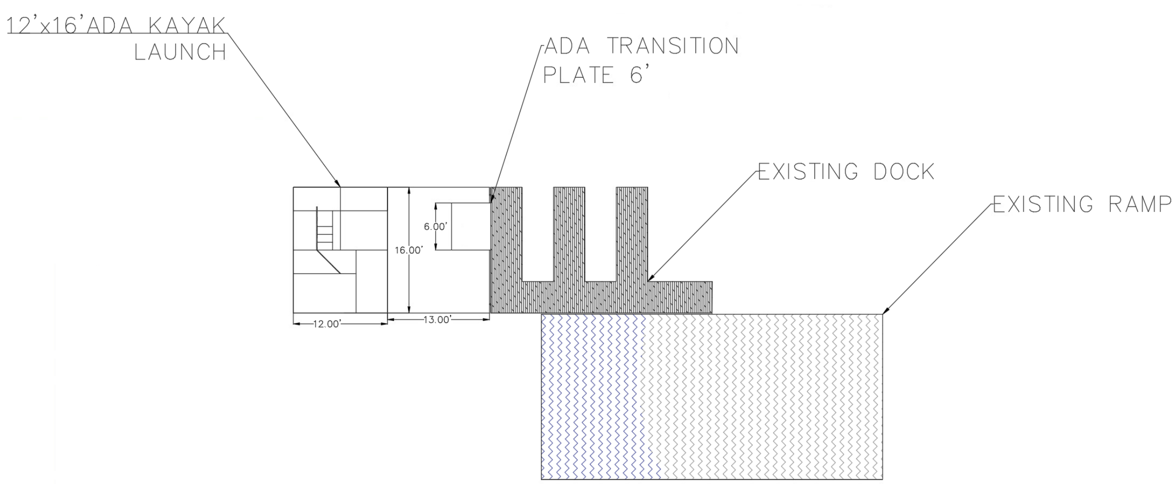


Figure K. 21 Existing dock retrofits

Appendix L-Parking Lots

Table 8C-1.01: Parking Ratios

Land Use	Spaces per Unit
Residential and Lodging	
Single and two family dwellings	2.0 / unit (tandem parking allowed)
Row dwellings	2.0 / unit + 1 visitor space per 4 units
Multiple family (apartment and condo)	1 to 2 bedroom units: 2.0 spaces / unit 3+ bedroom units: 2.5 spaces per unit plus 3.0 / 1,000 sf of GFA for lease management
Mobile home park	2.0 / unit (tandem parking allowed) plus 1 visitor space per 10 units plus 3.0 / 1,000 sf of GFA for lease management
Housing for seniors	1.0 / unit plus 10 / 1,000 sf of GFA for multipurpose buildings
Hotel/motel	1.25 / room + 10 / 1,000 sf of GFA of lounge or restaurant + 20 / 1,000 sf of GFA of conference or banquet facilities
Retail Sales and Services	
General and convenience retail	2.75 / 1,000 sf of GFA
Grocery stores	6.75 / 1,000 sf of GFA
Heavy/hard goods	2.5 / 1,000 sf of GFA, including outdoor sales area
Discount superstores	5.5 / 1,000 sf of GFA, including outdoor sales area
Specialty superstores	4.5 / 1,000 sf of GFA, including outdoor sales area
Shopping center	Special parking study required
Food and Beverage Services	
Restaurant, sit down	10 / 1,000 sf of GFA
Restaurant, fast food	1.5 / 1,000 sf of GFA
Restaurant, take out only	2 / 1,000 sf of GFA
Bar/nightclub	10 / 1,000 sf of GFA
Office and Business Services	
< 25,000 sf of GFA	3.8 / 1,000 sf of GFA
25,000 to 100,000 sf of GFA	Scale between 3.8 and 3.4 / 1,000 sf of GFA
100,000 sf of GFA	3.4 / 1,000 sf of GFA
Consumer services	4.6 / 1,000 sf of GFA
Data processing and telemarketing	6.0 / 1,000 sf of GFA
Medical office (not part of hospital)	4.5 / 1,000 sf of GFA
Industrial, Storage, and Wholesale	
Manufacturing or industrial	1.85 / 1,000 sf of GFA, plus parking for office, sales, or similar use where those uses exceed 10% of sf of GFA
Storage or wholesale	0.67 / 1,000 sf of GFA
Mini-warehouse	1.75 / 1,000
Educational or Institutional Uses	
Elementary or middle schools	1.0 / employee + 10 spaces for visitors
High school	1.0 / employee + 0.3 / student
Church or theatre	0.4 / seat

GFA: Gross Floor Area means the area in square feet within the exterior walls of a building, exclusive of any area used for off-street parking, courtyards, or mechanical equipment.

Source: Adapted from ULI/NPA

Figure L. 1 Number of parking spaces based on land use

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

Figure L. 2 Required number of ADA compliant parking spaces

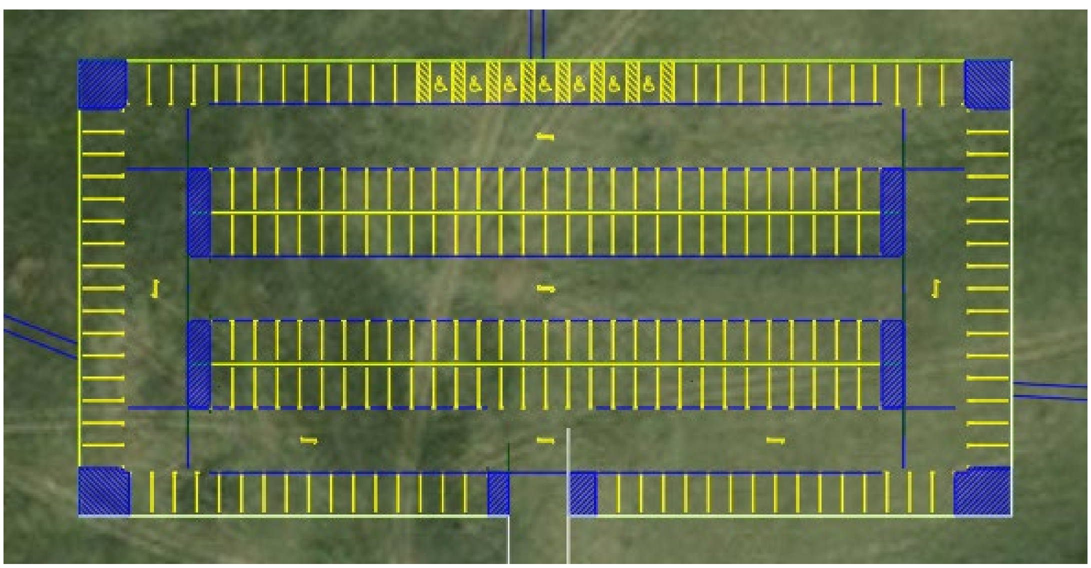


Figure L. 3 Southern peninsula parking area

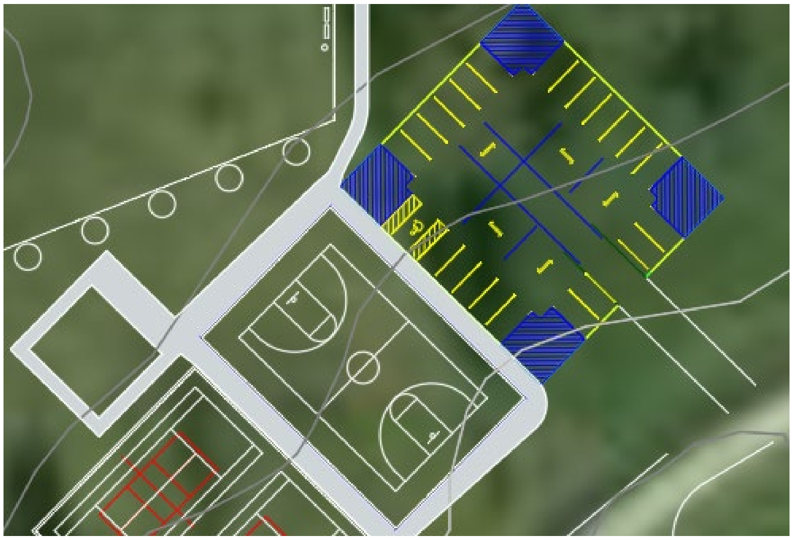


Figure L. 4 Recreation Area parking lot

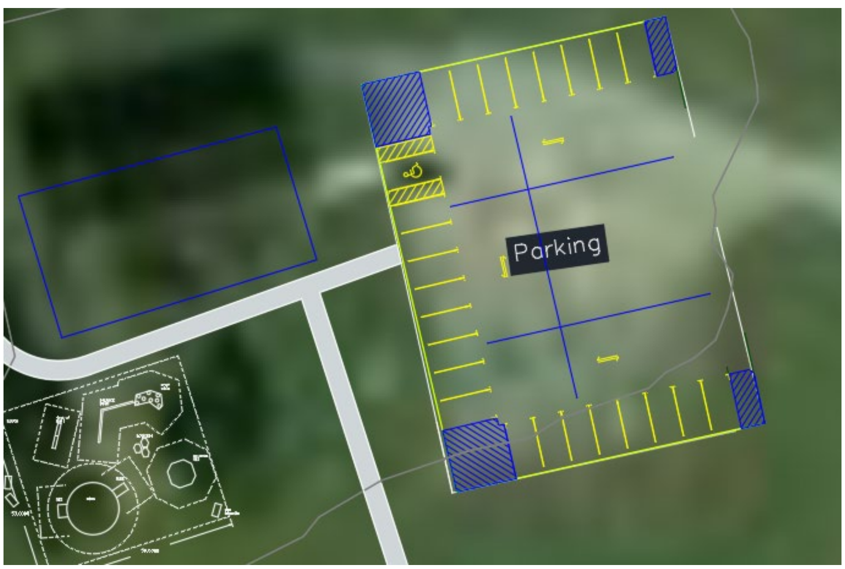


Figure L. 5 Existing pavilion parking lot

Figure L. 6 East boat ramp parking lot

Appendix M-RV Campground

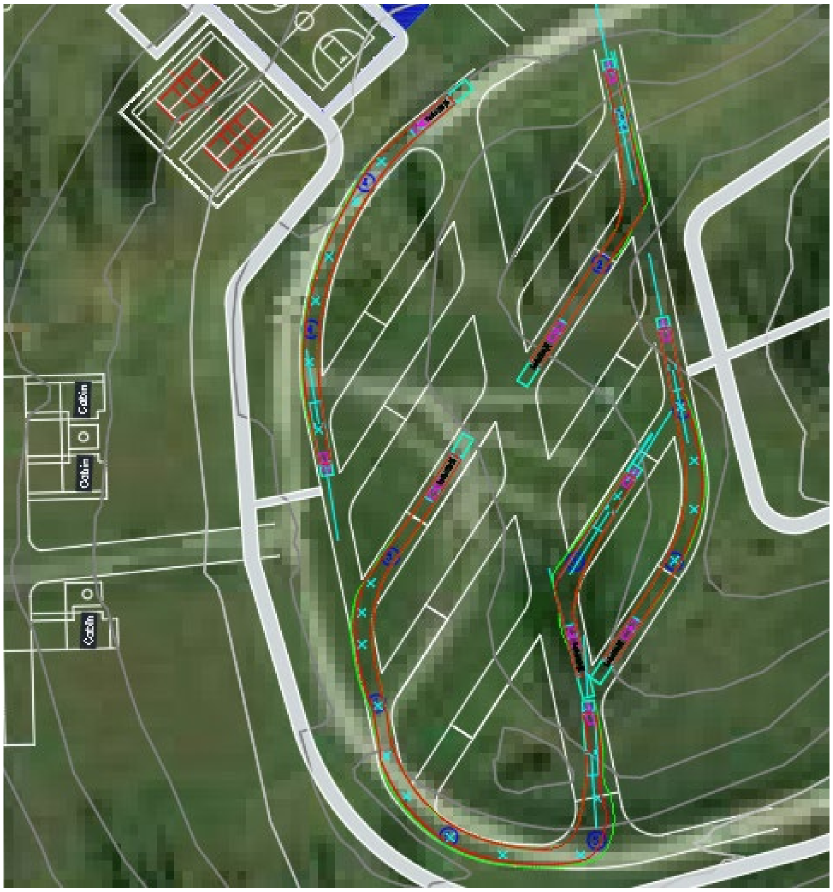


Figure M. 1 RV parking area

Appendix N – Cabin Structural Calculations

All structural calculations for the cabins are shown below.

Loading

Slope	6	on	12	20 degree

Top Chord

Dead Load	16.75	PSF	
Solar Panels	4	PSF	
Roof Tile	3	PSF	
Waterproof Mem.	1	PSF	
1/2" OSB	2	PSF	
4" Rigid Foam	0.5	PSF	
1/2" OSB	2	PSF	
Framing	3	PSF	
13" Fglass Batt.	1.25	PSF	
Snow Load	38	PSF	
Pg	38	PSF	
W2	0.55		
Ce	0.8		Roughness D + Fully Exposed
Ct	1.18		
Pf	25.1104	PSF	
Cs	1		
Ps	38	PSF	
Ps,u1	11.4	PSF	
	6.725324	ft	
Ps,u2	61.88331		
hd*	1.783321	ft	
W	10	ft	
Gamma,s	18.94	PCF	
S	2		
Rroof	58	R	
Rigid Foam	20	R	Extruded Polystyrene
Thickness	4	inches	
Fiberglass Batt.	38	R	
Thickness	12	inches	
Wind	-35	PSF	*C&C
V	109	mph	
Kd	0.85		
Exposure Cat	D		
Kzt	1		
Kz	1.03		
Ke	1		
qz	31.32782	mi/h	
G	0.85		
Enclosure Class	Enclosed		
GCpi	0.18		
GCp+	0.3		
GCP-	-2		
p+	12.78175	PSF	
p-	-58.0505	PSF	
0.6p+	7.669051	PSF	
0.6p-	-34.8303	PSF	

Bottom Chord

Dead Load	12	PSF
Mech	4	PSF
20" Blown In Cell.	3	PSF
Framing	3	PSF
5/8 Gyp	2	PSF
Live Load	20	PSF

Floor

Dead Load	15	PSF
Carpet w/ Pad	6	PSF
3/4" OSB	3	PSF
Framing	6	PSF
Live Load	40	PSF

Wall

Wind	26	PSF
V	109	mph
Kd	0.85	
Exposure Cat	D	
Kzt	1	
Kz	1.03	
Ke	1	
qz	31.32782	mi/h
G	0.85	
Enclosure Class	Enclosed	
GCpi	0.18	
GCp+	1	
GCP-	-1.4	
p+	31.4218	PSF
p-	-42.0733	PSF
0.6p+	18.85308	PSF
0.6p-	-25.244	PSF

Insulation R-Value Chart - What R-Value Do I Need - TLS Energy Savers
LEED scorecard | U.S. Green Building Council
Which Wood Species is Best for Trusses? - Ranger Truss Of Texas
Ceiling Insulation Weight Tables (All Types and R Values Covered) - The Tibble

Queen Post (Fan) -- Spans 10' to 22'

2' Truss Analysis

		ASD1		ASD2		ASD3		ASD3-UB		ASD4		ASD4-UB
	Member	Fx	My	Fx	My	Fx	My	Fx	My	Fx	My	Fx
BOT	1	-742.44	3600	-1142.44	9600	-1882.5	3600	-1529.5	3600	-1897.49	8100	-1632.73
	2	-742.44	3600	-1142.44	9600	-1882.5	3600	-1914.91	3600	-1897.49	8100	-1921.8
TOP	3	867.53	1256.11	1314.74	1256.11	2227.13	4106.26	1772.97	2110.99	2222.64	3393.72	1882.02
	4	680.28	1256.11	1127.49	1256.11	1615	4106.26	1458.28	2110.99	1716.73	3393.72	1599.19
	5	680.28	1256.11	1127.49	1256.11	1615	4106.26	1571.16	5896.93	1716.73	3393.72	1683.85
	6	867.53	1256.11	1314.74	1256.11	2227.13	4106.26	2263.36	4106.26	2222.64	3393.72	2249.81
WEB	7	187.25	0	187.25	0	612.13	0	314.29	0	505.91	0	282.83
	8	-407.48	0	-807.48	0	-787.5	0	-714.17	0	-992.5	0	-937.5
	9	187.25	0	187.25	0	612.13	0	745.59	0	505.91	0	606.01

Sign Conventions

F-	Tension
F+	Compression
M-	Neg
M+	Pos

	ASD5		ASD5-		ASD6		ASD6-		ASD6-UB		ASD6-UB-	
My	Fx	My	Fx	My	Fx	My	Fx	My	Fx	My	Fx	My
8100	-982.43	3600	307.72	3600	-2077.48	8100	-1109.86	8100	-1812.72	8100	-845.11	8100
8100	-982.43	3600	307.72	3600	-2077.48	8100	-1109.86	8100	-2101.79	8100	-1134.17	8100
1897.27	1153.73	1856.08	-384.87	-1369.31	2437.29	3843.7	1283.34	1424.65	2096.67	2347.24	947	-71.8
1897.27	877.04	1856.08	-180.75	-1369.31	1864.3	3843.7	1070.96	1424.65	1746.76	2347.24	957.7	-71.8
4736.73	877.04	1856.08	-180.75	-1369.31	1864.3	3843.7	1070.96	1424.65	1831.42	5186.7	1038.08	2767.66
3393.72	1153.73	1856.08	-384.87	-1369.31	2437.29	3843.7	1283.34	1424.65	2464.46	3843.7	1310.51	1424.65
0	276.69	0	-204.12	0	572.98	0	212.38	0	349.91	0	-10.7	0
0	-487.48	0	-57.43	0	-1052.49	0	-729.95	0	-997.5	0	-674.96	0
0	276.69	0	-204.12	0	572.98	0	212.38	0	673.08	0	312.48	0

ASD7		ASD7-	
Fx	My	Fx	My
-685.45	2160	604.7	2160
-685.45	2160	604.7	2160
806.72	1353.63	-731.88	-1871.76
604.93	1353.63	-452.86	-1871.76
604.93	1353.63	-452.86	-1871.76
806.72	1353.63	-731.88	-1871.76
201.79	0	-279.02	0
-324.48	0	105.57	0
201.79	0	-279.02	0

Fmin (lb)	LC	Fmax (lb)	LC	Mmin (lb-in)	LC	Mmax (lb-in)
-2077.48	ASD6	604.7	ASD7-	2160	ASD7-	9600
-2101.79	ASD6-UB	604.7	ASD7-	2160	ASD7-	9600
-731.88	ASD7-	2437.29	ASD6	-1871.76	ASD7-	4106.26
-452.86	ASD7-	1864.3	ASD6	-1871.76	ASD7-	4106.26
-452.86	ASD7-	1864.3	ASD6	-1871.76	ASD7-	5896.93
-731.88	ASD7-	2464.46	ASD6-UB	-1871.76	ASD7-	4106.26
-279.02	ASD7-	612.13	ASD3	0		0
-1052.49	ASD6	105.57	ASD7-	0		0
-279.02	ASD7-	745.59	ASD3-UB	0		0

ASD2
ASD2
ASD3
ASD3
ASD3-UB
ASD3-UB

3' Truss Analysis

		ASD1		ASD2		ASD3		ASD3-UB		ASD4		ASD4-UB
	Member	Fx	My	Fx	My	Fx	My	Fx	My	Fx	My	Fx
BOT	1	-1113.66	5400	-1713.66	14400	-2823.75	5400	-2294.25	5400	-2846.24	12150	-2449.1
	2	-1113.66	5400	-1713.66	14400	-2823.75	5400	-2872.37	5400	-2846.24	12150	-2882.7
TOP	3	1301.295	1884.165	1972.11	1884.165	3340.695	6159.39	2659.455	3166.485	3333.96	5090.58	2823.03
	4	1020.42	1884.165	1691.235	1884.165	2422.5	6159.39	2187.42	3166.485	2575.095	5090.58	2398.785
	5	1020.42	1884.165	1691.235	1884.165	2422.5	6159.39	2356.74	8845.395	2575.095	5090.58	2525.775
	6	1301.295	1884.165	1972.11	1884.165	3340.695	6159.39	3395.04	6159.39	3333.96	5090.58	3374.715
WEB	7	280.875	0	280.875	0	918.195	0	471.435	0	758.865	0	424.245
	8	-611.22	0	-1211.22	0	-1181.25	0	-1071.26	0	-1488.75	0	-1406.25
	9	280.875	0	280.875	0	918.195	0	1118.385	0	758.865	0	909.015

Sign Conventions

F-	Tension
F+	Compression
M-	Neg
M+	Pos

	ASD5		ASD5-		ASD6		ASD6-		ASD6-UB		ASD6-UB-	
My	Fx	My	Fx	My	Fx	My	Fx	My	Fx	My	Fx	My
12150	-1473.65	5400	461.58	5400	-3116.22	12150	-1664.79	12150	-2719.08	12150	-1267.67	12150
12150	-1473.65	5400	461.58	5400	-3116.22	12150	-1664.79	12150	-3152.69	12150	-1701.26	12150
2845.905	1730.595	2784.12	-577.305	-2053.97	3655.935	5765.55	1925.01	2136.975	3145.005	3520.86	1420.5	-107.7
2845.905	1315.56	2784.12	-271.125	-2053.97	2796.45	5765.55	1606.44	2136.975	2620.14	3520.86	1436.55	-107.7
7105.095	1315.56	2784.12	-271.125	-2053.97	2796.45	5765.55	1606.44	2136.975	2747.13	7780.05	1557.12	4151.49
5090.58	1730.595	2784.12	-577.305	-2053.97	3655.935	5765.55	1925.01	2136.975	3696.69	5765.55	1965.765	2136.975
0	415.035	0	-306.18	0	859.47	0	318.57	0	524.865	0	-16.05	0
0	-731.22	0	-86.145	0	-1578.74	0	-1094.93	0	-1496.25	0	-1012.44	0
0	415.035	0	-306.18	0	859.47	0	318.57	0	1009.62	0	468.72	0

ASD7		ASD7-	
Fx	My	Fx	My
-1028.18	3240	907.05	3240
-1028.18	3240	907.05	3240
1210.08	2030.445	-1097.82	-2807.64
907.395	2030.445	-679.29	-2807.64
907.395	2030.445	-679.29	-2807.64
1210.08	2030.445	-1097.82	-2807.64
302.685	0	-418.53	0
-486.72	0	158.355	0
302.685	0	-418.53	0

Fmin (lb)	LC	Fmax (lb)	LC	Mmin (lb-in)	LC	Mmax (lb-in)
-3116.22	ASD6	907.05	ASD7-	3240	ASD7-	14400
-3152.69	ASD6-UB	907.05	ASD7-	3240	ASD7-	14400
-1097.82	ASD7-	3655.935	ASD6	-2807.64	ASD7-	6159.39
-679.29	ASD7-	2796.45	ASD6	-2807.64	ASD7-	6159.39
-679.29	ASD7-	2796.45	ASD6	-2807.64	ASD7-	8845.395
-1097.82	ASD7-	3696.69	ASD6-UB	-2807.64	ASD7-	6159.39
-418.53	ASD7-	918.195	ASD3	0		0
-1578.74	ASD6	158.355	ASD7-	0		0
-418.53	ASD7-	1118.385	ASD3-UB	0		0

ASD2
ASD2
ASD3
ASD3
ASD3-UB
ASD3-UB

Bottom Chord

Material Props			Section Properties		
No.1	SP		2x8		
Fb	1,500	psi	d1	7.25	in
Fv	175	psi	d2	1.5	in
Ft	1,000	psi	A	10.875	in^2
Fc	1,650	psi			
			S1	13.14	in^3
E	1,600,000	psi	S2	2.719	in^3
Emin	580,000	psi			
			I1	47.63	in^4
l	5	ft	I2	2.039	in^4

Bending + Tension ASD6

ft/F't +fb/Fb* <= 1.0

	0.632356601	<=	1	OK

(fb-ft)/Fb** <= 1.0

	0.442092896	<=	1	OK

P	3116.22	lb
ft	286.5489655	psi
F't	1600	
M	12150	lb-ft
fb1	924.6575342	psi
fb2	4468.554616	psi
Fb*	2040	psi
Fb1**	1443.381186	psi
Fb2**	2039.016076	psi
Cd Wind	1.6	
Cd Wind	1.6	
CM(Fb)	0.85	
CM (Ft)	1	
CM(Fc)	0.8	
CME	0.9	
Ct	1	
CL1 (W)	0.707539797	
CL2 (W)	0.999517684	
CL1 (S)	0.707539797	

CL2 (S)	0.999517684			
CF	1			
Cfu	1			
Ci	1			
Cr	1			
Cp	0.12349785			
CT	1			
lu/d1	8.275862069	>	7	
lu/d2	40	>	7	
le1	120.15	in		
le2	102.9	in		
Rb1	19.67612767			
Rb2	1.71362311			
Fbe1	1617.977528	psi		
Fbe2	213314.8688	psi		
Fbe1/Fb*	0.793126239			
Fbe2/Fb*	104.5661122			

Bending + Compression ASD7-

[fc/Fc']^2 + [1/(1-fc/Fce1)]*[fb1/Fb1'] + [1/(1-(fc/Fce2)-(fb1/Fbe)^2)]*[fb2/Fb2'] <=1

0.283785442	<	1	OK

(fc/Fce2) + (fb1/Fbe)^2 < 1

0.3342387	<	1	OK

fc < Fce1

83.40689655	<	6264.924	OK

fc < Fce2

83.40689655	<	268.1775	OK

fb1 <Fbe

246.5753425	<	1617.978	OK

P	907.05	lb
fc	83.40689655	psi
F'c	260.8274597	

M	3240	lb-in	
fb1	246.5753425	psi	
fb2	1191.614564	psi	
Fb*	2040	psi	
Fb1'	1443.381186		
Fb2'	2039.016076		
lu/d1	8.275862069	>	7
lu/d2	40	>	7
le1	120.15	in	
le2	102.9	in	
Rb1	19.67612767		
Rb2	1.71362311		
Fbe1	1617.977528	psi	
Fbe2	213314.8688	psi	
Fbe1/Fb*	0.793126239		
Fbe2/Fb*	104.5661122		
le/d1	8.275862069	<	50
le/d2	40	<	50
Fce1	6264.924375	psi	
Fce2	268.1775	psi	
Fc*	2112	psi	
Fce/Fc*	0.126977983		

Web

Material Props			Section Properties		
No.1	SP		2x6		
Fb	1,500	psi	d1	5.5	in
Fv	175	psi	d2	1.5	in
Ft	1,000	psi	A	8.25	in^2
Fc	1,650	psi			
			S1	7.56	in^3
E	1,600,000	psi	S2	2.063	in^3
Emin	580,000	psi			
			I1	20.8	in^4
l	5.590169944	ft	I2	2.039	in^4

Tension ASD4

ft	<	F't	
180.4545			1160

DSR 0.155564263

P	1488.75	lb
ft	180.4545455	psi
F't	1160	
Cd Snow	1.16	
Cd Snow	1.16	
CM(Fb)	0.85	
CM (Ft)	1	
CM(Fc)	0.8	
CME	0.9	
Ct	1	
CF	1	
Cfu	1	
Ci	1	
Cr	1	
Cp	0.135842822	
CT	1	

Compression ASD3-UB

fc	<	F'c

135.5618		208.0025	
DSR	0.651731584		
P	1118.385	lb	
fc	135.5618182	psi	
F'c	208.0025298		
le/d1	12.19673442	<	50
le/d2	44.72135955	<	50
Fce1	2884.398	psi	
Fce2	214.542	psi	
Fc*	1531.2	psi	
Fce/Fc*	0.140113636		

Top Chord

Material Props				Section Properties		
No.1	SP			2x12		
Fb	1,500	psi		d1	11.25	in
Fv	175	psi		d2	1.5	in
Ft	1,000	psi		A	16.875	in^2
Fc	1,650	psi				
				S1	31.64	in^3
E	1,600,000	psi		S2	4.219	in^3
Emin	580,000	psi				
				I1	178	in^4
l	5.590169944	ft		I2	4.164	in^4

Bending + Tension ASD7-

ft/F't +fb/Fb* <= 1.0

0.08415855	<=	1	OK

(fb-ft)/Fb** <= 1.0

0.028129775	<=	1	OK

P	1097.82	lb
ft	65.056	psi
F't	1600	
M	2807.64	lb-ft
fb1	88.73704172	psi
fb2	665.4752311	psi
Fb*	2040	psi
Fb1**	841.8496673	psi
Fb2**	2039.547357	psi
Cd Wind	1.6	
Cd Snow	1.16	
CM(Fb)	0.85	
CM (Ft)	1	
CM(Fc)	0.8	
CME	0.9	
Ct	1	
CL1 (W)	0.412671406	
CL2 (W)	0.999778116	
CL1 (S)	0.554658277	

CL2 (S)	0.999839311		
CF	1		
Cfu	1		
Ci	1		
Cr	1		
Cp	0.135842822		
CT	1		
lu/d1	5.96284794	>	7
lu/d2	44.72135955	>	7
le1	143.7645445	in	
le2	114.5145445	in	
Rb1	26.81086948		
Rb2	1.164993312		
Fbe1	871.4248735	psi	
Fbe2	461535.2594	psi	
Fbe1/Fb*	0.427169056		
Fbe2/Fb*	226.2427742		

Bending + Compression ASD3-UB

[fc/Fc']^2 + [1/(1-fc/Fce1)]*[fb1/Fb1'] + [1/(1-(fc/Fce2)-(fb1/Fbe)^2)]*[fb2/Fb2'] <=1

0.814052365 < 1 OK

(fc/Fce2) + (fb1/Fbe)^2 < 1

0.753882328 < 1 OK

fc < Fce1

139.6586667 < 12067.99 OK

fc < Fce2

139.6586667 < 214.542 OK

fb1 <Fbe

279.5636852 < 871.4249 OK

P	2356.74	lb
fc	139.6586667	psi
F'c	208.0025298	

M	8845.395	lb-in	
fb1	279.5636852	psi	
fb2	2096.561982	psi	
Fb*	1479	psi	
Fb1'	820.3395921		
Fb2'	1478.76234		
lu/d1	5.96284794	>	7
lu/d2	44.72135955	>	7
le1	143.7645445	in	
le2	114.5145445	in	
Rb1	26.81086948		
Rb2	1.164993312		
Fbe1	871.4248735	psi	
Fbe2	461535.2594	psi	
Fbe1/Fb*	0.589198697		
Fbe2/Fb*	312.0589989		
le/d1	5.96284794	<	50
le/d2	44.72135955	<	50
Fce1	12067.9875	psi	
Fce2	214.542	psi	
Fc*	1531.2	psi	
Fce/Fc*	0.140113636		

Exterior Column

	LC	Member Forces		Material Props			Section Pro
	ASD 1	862.44	862.44	No.1	SP		5x5
	ASD 2	1462.44	1462.44				d1
	ASD 3	2002.5	2002.5	Ft	875	psi	d2
	ASD 3 UB	1538.22	2026.815	Fc	1,550	psi	
	ASD 4	2167.485	2167.485				A
	ASD 4 UB	1819.275	2185.725	E	1,600,000	psi	
	ASD 5	1102.425	1102.425	Emin	580,000	psi	I1
	ASD 5-	-187.725	-187.725				I2
	ASD 6	2347.485	2347.485	l	10	ft	
	ASD 6-	1379.865	1379.865				
	ASD 6 UB	1999.275	2365.71				
	ASD 6 UB-	1031.655	1398.09				
	ASD 7	757.455	757.455				
	ASD 7-	-532.71	-532.71				

Case 1	Pc	2365.71	lb	ASD 6	Wind
Case 2	Pc	2185.725	lb	ASD 4 UB	Snow
Case 3	Pc	1462.44	lb	ASD2	Live
Case 1	Pt	-532.71	lb	ASD 7	Wind

Compresssion

	fc	<	F'c	DCR
Case 1	116.8252		559.4566	0.208819
Case 2	107.937		538.159	0.200567
Case 3	72.21926		525.9281	0.137318

Case 1	fc	116.8252	psi
Case 2	fc	107.937	psi
Case 3	fc	72.21926	psi

Case 1+4	CD	1.6
Case 2	CD	1.15
Case 3	CD	1
	CM (Fc)	0.8
	CM (Emin)	0.9
	Ct	1
	CF	1
	Ci	1

26.66667 < 50

Case 1	F*c	1984			
Case 2	F*c	1426			
Case 3	F*c	1240			
	Fce	603.3994			
Case 1	Fce/F*c	0.304133			
Case 2	Fce/F*c	0.423141			
Case 3	Fce/F*c	0.486612			
Case 1	Cp	0.281984			
Case 2	Cp	0.377391			
Case 3	Cp	0.424136			
Case 1	F'c	559.4566			
Case 2	F'c	538.159			
Case 3	F'c	525.9281			
	Tension				
	ft	<	F't		DCR
Case 1	26.30667			1400	0.01879
Net					

perties

4.5	in
4.5	in
20.25	in^2
76.26	in^4
76.26	in^4

Floor Joists

Material Props

No.2	SP	
Fb	1,100	psi
Fv	175	psi
E	1,400,000	psi
Emin	470,000	psi
l	14.5	ft
Dead	15	psf
Live	40	psf
D + L	55	psf
wd	20	plf
wl	53.33333	plf
wd+l	73.33333	plf
M	1927.292	lb-ft
	23127.5	lb-in
fb	1081.23	psi
	<	
F'b	1265	psi
DCR	0.854727	OK
CD	1	
CM	1	
Ct	1	
CL	1	
CF	1	
Cfu	1	
Ci	1	
Cr	1.15	
Fb*	1265	

Section Properties

2x10	@	16	in
d1	9.25	in	
d2	1.5	in	
A	13.875	in^2	
S1	21.39	in^3	
S2	3.469	in^3	
I1	98.93	in^4	
I2	2.602	in^4	

Floor Girder

Material Props			Section Properties			
24F-1.8E	Glulam		2-1/2x12-3/8	Wt		180 in
Fb	2,400	psi	d1	12.375	in	
Fv	265	psi	d2	2.5	in	
			A	30.9375	in^2	
			S1	63.81	in^3	
E	1,800,000	psi				
Emin	950,000	psi				
			I1	394.8	in^4	
l	12	ft				
Dead	15	psf				
Live	40	psf				
D + L	55	psf				
wd	225	plf				
wl	600	plf				
wd+l	825	plf				
M	14850	lb-ft				
	178200	lb-in				
fb	2792.666	psi				
	<					
F'b	2928.917	psi				
DCR	0.953481	OK				
CD	1					
CM	1					
Ct	1					
CL	1.220382					
CV	1					
Cfu	1					
Cc	1					
CI	1					
Fb*	2400					
l/d	11.63636	>	7			
le	271.845	in				

Rb	23.20028	
Fbe	2117.963	psi
Fb*	2,400	psi
Fbe/Fb*	0.882484	

Appendix O-Cost Estimate

Phase 1

Table 1O: Cost estimate for addition of water utilities

Water Utilities							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2554-0112006	WATER MAIN, TRENCHED, DIP, 6"	WATER MAIN, TRENCHED, DUCTILE IRON PIPE (DIP), 6 IN.	LF	$6.00	10135	$60,810.00	$61,000.00
2554-0207006	VALVE, GATE, DIP, 6"	VALVE, GATE, DIP, 6 IN.	EACH	$1,350.00	31	$41,850.00	$41,900.00
2554-0202200	FITTINGS BY COUNT, DI, 6"	FITTINGS BY COUNT, DUCTILE IRON,	EACH	$860.00	41	$35,260.00	$35,300.00
						Subtotal	$138,200.00

Table 2O: Cost estimate for Existing Pavilion Restroom

Existing Pavilion Restroom							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Roof Assembly	-	SF	$4.25	304	$1,290.91	$1,300.00

--	Exterior Walls	-	SF	$6.50	494	$3,208.42	$3,200.00
--	Partition Walls	-	SF	$4.03	113	$456.54	$455.00
--	Urinals	-	EACH	$424.09	2	$848.19	$850.00
--	Stalls	-	EACH	$525.36	1	$525.36	$525.00
--	ADA Stalls	-	EACH	$595.90	2	$1,191.81	$1,200.00
--	Restroom Sink	-	EACH	$259.25	3	$777.74	$780.00
--	Door	-	EACH	$760.29	2	$1,520.58	$1,525.00
--	Air Hand Dryer + Wiring	-	EACH	$282.73	2	$565.46	$565.00
--	Soap Dispenser	-	EACH	$59.96	3	$179.89	$180.00
--	Multi-Roll Toilet Paper Dispenser	-	EACH	$71.66	3	$214.97	$215.00
--	Medium Mirror	-	EACH	$249.59	1	$249.59	$250.00
--	Small Mirror	-	EACH	$85.12	1	$85.12	$85.00
--	Plumbing	-	EACH	$4,467.43	1	$4,467.43	$4,475.00

--	Lighting	-	EACH	$191.95	4	$767.81	$770.00
--	Electrical	-	SF	$14.57	303	$4,418.45	$4,425.00
--	Outdoor Lighting	-	EACH	$116.40	4	$465.59	$465.00
						Subtotal	$21,265.00

Table 3O: Cost estimate for Existing Pavilion septic system

Existing Pavilion Septic							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2102-2710070	Excavation	EXCAVATION, CLASS 10, ROADWAY AND BORROW	CY	$8.56	234	$2,003.04	$2,000.00
--	Tanks	Septic Tank, 1500 Gallons or Less	EACH	$3,040.00	1	$3,040.00	$3,050.00
4010-A-1004	Pipes and Trenching	8" PVC Pipe	LF	$85.00	648	$55,080.00	$55,000.00
						Subtotal	$60,050.00

Table 4O: Cost estimate for walking trails

Walking Trails							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2102-2710070	Cut/Fill	EXCAVATION, CLASS 10,	CY	$8.56	27500	$235,400.00	$235,500.00

		ROADWAY AND BORROW					
2312-8260050	6" Granular Surface	GRANULAR SURFACING ON ROAD, CLASS A CRUSHED STONE	CY	$77.00	3650	$281,050.00	$281,000.00
2107-0875000	Compaction of Surfacing	COMPACTION WITH MOISTURE AND DENSITY CONTROL	CY	$2.00	3650	$7,300.00	$7,300.00
--	Park Benches	ParkCatalog 6' Recycled Plastic Traditional Bench	EACH	$1,070.00	5	$5,350.00	$5,350.00
--	Bike Rack	ParkCatalog 7 Bike Wave Rack	EACH	$800.00	1	$800.00	$800.00
						Subtotal	$529,950.00

Table 5O: Cost estimate for West Dock

West Dock							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
HD-DOCK	Floating Dock Segment	18'x18' w/ Kayak Launch	EACH	$18,000.00	1	$18,000.00	$18,000.00
ACC-EDGE	Edge Guard	2-1/2" Roll Off Guard	EACH	$22.00	70	$1,540.00	$1,550.00
ACC-308SF	Safe Launch Platform	-	EACH	$929.00	1	$929.00	$930.00

ACC-TRF	ADA Transfer Platform	-	EACH	$4,000.00	1	$4,000.00	$4,000.00
ACC-SR2	Side Railing	Kayak Accessory	EACH	$179.00	2	$358.00	$360.00
CON-UWI	Connector	Underwater Beam Connector	EACH	$299.00	1	$299.00	$300.00
ATT-AC1	Anchor Chain Brachet	-	EACH	$130.00	10	$1,300.00	$1,300.00
Misc	Ganway	6'x18'	EACH	$5,400.00	1	$5,400.00	$5,400.00
GAN-HP6	Hinge Plate	6' Landside	EACH	$659.00	1	$659.00	$660.00
GAN-CP6	Hinge Plate	6' Dockside	EACH	$659.00	1	$659.00	$660.00
GAN-CTA	Control Arm	15' Heavy Duty	EACH	$1,800.00	1	$1,800.00	$1,800.00
GAN-HP3	Hinge Plate	3' Landside	EACH	$369.00	1	$369.00	$370.00
GAN-CP3	Hinge Plate	3' Dockside	EACH	$369.00	1	$369.00	$370.00
GAN-COH	Compensation Float	-	EACH	$999.00	2	$1,998.00	$2,000.00
--	Shipping Items to Site	Shipping	EACH	$4,496.00	1	$4,496.00	$4,500.00
						Subtotal	$42,200.00

Table 6O: Cost estimate for softball seating

Softball Seating							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Softball Bleachers	4 Row Low-Rise Aluminum Bleachers	EACH	$4,579.00	4	$18,316.00	$18,300.00
						Subtotal	$18,300.00

Table 7O: Cost estimate for frisbee golf upgrades

Frisbee Golf Upgrades							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Tee Marker	StandardGolf Disc Golf Tee and Distance Marker	EACH	$129.00	18	$2,322.00	$2,325.00
						Subtotal	$2,325.00

Table 8O: Cost estimate for additional trees

Tree Planting							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2610-0000120	TREES	American Pillar Arbovitae	EACH	$35.00	130	$4,550.00	$4,550.00
						Subtotal	$4,550.00

Table 9O: Cost estimate for erosion control

Erosion Control

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2507-6800042	Rip-Rap	REVETMENT, CLASS D	TON	$65.00	3853	$250,412.50	$250,500.00
2507-6800061	Rip-Rap	REVETMENT, CLASS E	TON	$65.00	3853	$250,412.50	$250,500.00
						Subtotal	$501,000.00

Table 10O: Cost estimate for Existing boat ramp improvements

Existing Ramp Enhancements							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
HD-DOCK	25'x16' ADA kayak launch	25'x16'	EACH	$25,560.00	1	$25,560.00	$25,600.00
ACC-EDGE	Edge Gaurd	2-1/2" roll off guard	EACH	$22.00	83	$1,826.00	$1,825.00
ACC-308SF	Safe Launch Platform	-	EACH	$929.00	1	$929.00	$930.00
ACC-TRF	ADA Transfer Platform	-	EACH	$4,000.00	1	$4,000.00	$4,000.00
ACC-SR2	Side Railing	Kayak Accessory	EACH	$179.00	2	$358.00	$360.00
CON-UWI	Connector	Underwater Beam Connector	EACH	$299.00	1	$299.00	$300.00

ATT-AC1	Anchor Chain Brachet	-	EACH	$130.00	16	$2,080.00	$2,075.00
ATT-SSS	Flat Surface Assembly	-	EACH	$375.00	2	$750.00	$750.00
Misc.	Mini Gangway	6'x4'	EACH	$12,150.00	1	$12,150.00	$12,200.00
GAN-HP6	Hinge Plate	6'	EACH	$659.00	1	$659.00	$660.00
GAN-RA	Gangway Roller Assembly	-	EACH	$299.00	2	$598.00	$600.00
GAN-RP	Roller Pad w/ Hardware	-	EACH	$299.00	1	$299.00	$300.00
GAN-TP6	Transition Plate	6'	EACH	$799.00	1	$799.00	$800.00
--	Concrete Anchors and Chain	Concrete Anchors (Heavy Duty)	EACH	$180.00	5	$900.00	$900.00
--	Shipping		EACH	$3,872.00	1	$3,872.00	$3,875.00
						Subtotal	$55,175.00

Table 11O: Total estimated cost for Phase 1

Lake Fisher Phase 1 Cost							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost

2533-4980005	Mobilization	MOBILIZATION	LS	$137,301.50	1	$137,301.50	$137,500.00
						Design Features	$1,373,015.00
						Contingency	40%
						Phase 1 Total	$2,114,721.00

Phase 2

Table 12O: Cost estimate for two cabins and associated septic system

2 Cabins and Septic							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Cabinets, Kitchen	35-1/2" Wide, 24" Deep	LF	$212.40	10	$2,124.00	$2,125.00
--	Countertops	Square Edge, Separate Backsplash	LF	$25.33	10	$253.30	$255.00
--	Sills, Pier Blocks, Floor Beams	-	SF	$0.80	700	$560.00	$560.00
--	Floor Joists 16" OC, R38 Insulation, 3/4" OSB Subflooring	2x8 Joists	SF	$5.74	700	$4,018.00	$4,025.00
--	Girders	2 1/2x12 3/8 Glu.	LF	$16.50	26	$429.00	$430.00

--	Layout, Backing, Blocking,Framing For Openings	Studs, Sole Plates, Header/End Joists, Bracing	SF	$5.52	700	$3,864.00	$3,875.00
--	Roof Truss Assembly	Truss with 2x6,8,12 Web, Bottom, Top	SF	$2,394.57	1	$2,394.57	$2,400.00
--	Roof Sheathing	Small Job + 6 on 12	SF	$0.40	700	$280.00	$280.00
--	Doors, Prehung Exterior	36x84, Rustic	EACH	$838.10	2	$1,676.20	$1,675.00
--	Windows	12'x6'	EACH	$403.00	1	$403.00	$405.00
--	Windows	8'x6'	EACH	$3,667.00	1	$3,667.00	$3,675.00
--	Windows	5'x6'	EACH	$4,317.00	3	$12,951.00	$13,000.00
--	Concrete Slab	-	SF	$5.66	854	$4,833.64	$4,825.00
--	Foundation	-	CY	$670.00	14	$9,380.00	$9,375.00
--	Painting, Interior	3 Coats, Paint	SF	$4.10	700	$2,870.00	$2,875.00
--	Shower Stalls	Acrylic, 48x35x72	EACH	$2,119.00	1	$2,119.00	$2,125.00
--	WC	Floor Mounted, Residential	EACH	$615.40	1	$615.40	$615.00

--	Lavatories	-	EACH	$381.00	1	$381.00	$380.00
--	Kitchen Sinks	1 Bowl	EACH	$651.20	1	$651.20	$650.00
--	Whole House Plumbing	Single Story, Total	EACH	$4,813.00	1	$4,813.00	$4,825.00
--	Electrical	-	SF	$14.57	700	$10,199.00	$10,200.00
2102-2710070	Excavation	EXCAVATION, CLASS 10, ROADWAY AND BORROW	CY	$8.56	318	$2,723.27	$2,725.00
--	Tanks	Septic Tank, Greater than 1500 Gallons	EACH	$3,220.00	1	$3,220.00	$3,225.00
4010-A-1004	Pipes and Trenching	8" PVC Pipe	LF	$85.00	881	$74,885.00	$75,000.00
						Subtotal	$149,525.00
						Amount of Cabins	2
						Total Cost	$299,050.00

Table 13O: Cost estimate for recreation area

Recreational Area (Courts, Restroom, Parking)							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Basketball Court	Earthwork, Surfacing, Drainage, Lighting, and Fencing of Basketball Court	LS	$63,480.00	1	$63,480.00	$63,500.00

--	Dual Tennis/Pickleball Court	Earthwork, Surfacing, Drainage, Lighting, and Fencing of Tennis Court	LS	$163,296.00	2	$326,592.00	$326,500.00
2312-8260050	6" Granular Surface	GRANULAR SURFACING ON ROAD, CLASS A CRUSHED STONE	CY	$77.00	441	$33,987.03	$34,000.00
2107-0875000	Compaction of Surfacing	COMPACTION WITH MOISTURE AND DENSITY CONTROL	CY	$2.00	441	$882.78	$885.00
--	Concrete stops	Precast Concrete Parking Wheel Stops	EACH	$200.00	21	$4,200.00	$4,200.00
2524-9325001	ADA Parking Sign R7-8	TYPE A SIGNS, SHEET ALUMINUM	SF	$27.00	2	$40.50	$41.00
--	Concrete Slab	-	SF	$5.66	2113	$11,961.58	$12,000.00
--	Columns/Foundation	-	CY	$670.00	44	$29,286.01	$29,300.00

--	Roof Assembly	-	SF	$4.25	1647	$7,001.23	$7,000.00
--	CMU Block Walls	-	SF	$15.10	1238	$18,691.52	$18,700.00
--	Partition Walls	-	SF	$4.03	1087	$4,379.26	$4,375.00
--	Urinals	-	EACH	$424.09	2	$848.19	$850.00
--	Stalls	-	EACH	$525.36	6	$3,152.17	$3,150.00
--	ADA Stalls	-	EACH	$595.90	1	$595.90	$595.00
--	Restroom Sink	-	EACH	$259.25	7	$1,814.72	$1,825.00
--	Laundry Sink	-	EACH	$677.86	1	$677.86	$680.00
--	Door	-	EACH	$760.29	7	$5,322.02	$5,325.00
--	Changing Station	-	EACH	$349.19	1	$349.19	$350.00
--	Air Hand Dryer + Wiring	-	EACH	$282.73	5	$1,413.65	$1,425.00
--	Soap Dispenser	-	EACH	$59.96	7	$419.73	$420.00
--	Multi-Roll Toilet Paper Dispenser	-	EACH	$71.66	6	$429.94	$430.00
--	Large Mirror	-	EACH	$438.95	2	$877.89	$880.00
--	Small Mirror	-	EACH	$85.12	1	$85.12	$85.00

--	Robe Hook	-	EACH	$18.63	4	$74.52	$75.00
--	Shower Rod and Curtain	-	EACH	$75.83	4	$303.34	$305.00
--	Restroom Bench	-	EACH	$263.24	2	$526.48	$525.00
--	Plumbing	-	EACH	$4,467.00	1	$4,467.43	$4,475.00
--	Electric Heating 12.5kW	-	EACH	$1,967.00	1	$1,966.86	$1,975.00
--	Electric Water Heater 50 gal	-	EACH	$817.28	1	$817.28	$815.00
--	Solar Cost 5kW	-	EACH	$14,387.00	1	$14,387.10	$14,400.00
--	Lighting	-	EACH	$191.95	17	$3,263.18	$3,275.00
--	Electrical	-	SF	$14.57	1293	$18,845.76	$18,800.00
--	Outdoor Lighting	-	EACH	$116.40	8	$931.17	$930.00
						Subtotal	$562,091.00

Table 14O: Cost estimate for Rec Area septic

Recreational Restroom Septic							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2102-2710070	Excavation	EXCAVATION, CLASS 10, ROADWAY	CY	$8.56	760.5	$6,509.88	$760.00

		AND BORROW					
--	Tanks	Septic Tank, Greater than 1500 Gallons	EACH	$3,220.00	1	$3,220.00	$3,225.00
4010-A-1004	Pipes and Trenching	8" PVC Pipe	LF	$85.00	2106	$179,010.00	$179,000.00
						Subtotal	$182,985.00

Table 15O: Cost estimate for wetlands

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2601-2636018	WETLAND GRASS SEEDING	WETLAND GRASS SEEDING	ACRE	$7,000.00	4	$28,000.00	$28,000.00
						Subtotal	$28,000.00

Table 16O: Cost estimate for planting of native grasses

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
9010-H-1000	Natives	Standard Forbs Mix	ACRE	$6,000.00	2.9	$17,400.00	$17,400.00
						Subtotal	$17,400.00

Table 17O: Cost estimate for the dog park

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Park Benches	ParkCatalog 6' Recycled Plastic Traditional Bench	EACH	$1,070.00	2	$2,140.00	$2,150.00
9060-A	Chainlink Fence		LF	$36.50	1250	$45,625.00	$45,600.00
--	Trash Can	Tidy Up Trash Receptacle w/ Lid and Liner	EACH	$1,166.00	1	$1,166.00	$1,175.00
--	Doggie Bad Dispenser Station	DOGIPOT Header Pak Pet Station	EACH	$464.00	2	$928.00	$930.00
--	Fence Entrance	-	EACH	$2,160.00	4	$8,640.00	$8,650.00
--	Gates	-	EACH	$5,600.00	2	$11,200.00	$11,200.00
--	Water Fountain	ADA Fido & Me Water Fountain	EACH	$5,980.00	2	$11,960.00	$12,000.00
--	Obstacle Course	Park Warehouse Novide Dog Park Agility Course	EACH	$4,959.00	1	$4,959.00	$4,950.00
						Subtotal	$86,655.00

Table 18O: Cost estimate for west beach

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Sand	Washed Recreational Sand	CY	$44.80	1780	$79,754.17	$80,000.00
						Subtotal	$80,000.00

Table 19O: Biking Trails							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2312-8260050	6" Granular Surface	GRANULAR SURFACING ON ROAD, CLASS A CRUSHED STONE	CY	$77.00	1606	$123,662.00	$123,500.00
2107-0875000	Compaction of Surfacing	COMPACTION WITH MOISTURE AND DENSITY CONTROL	CY	$2.00	1606	$3,212.00	$3,200.00
						Subtotal	$126,700.00

Table 20O: RV Park							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost

2312-8260050	6" Granular Surface	GRANULAR SURFACING ON ROAD, CLASS A CRUSHED STONE	CY	$77.00	1429	$110,002.20	$110,000.00
2107-0875000	Compaction of Surfacing	COMPACTION WITH MOISTURE AND DENSITY CONTROL	CY	$2.00	1429	$2,857.20	$2,850.00
--	Water Hookup	RV Water Hookup	EACH	$700.00	10	$7,000.00	$7,000.00
--	Electric Hookup	RV Electric hookup	EACH	$1,200.00	10	$12,000.00	$12,000.00
--	Picnic Bench	ProWood 71-in Brown Southern yellow pine Rectangle Picnic Table 59" X 71"	EACH	$400.00	10	$4,000.00	$4,000.00
--	Campfire	30 in. Outdoor Wood Burning Fire Pit with Cooking Grill	EACH	$100.00	10	$1,000.00	$1,000.00

						Subtotal	$136,850.00

Table 21O: RV Park Dumping Station/Septic							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2102-2710070	Excavation	EXCAVATION, CLASS 10, ROADWAY AND BORROW	CY	$8.56	657	$5,619.64	$5,625.00
--	Tanks	Septic Tank, Greater than 1500 Gallons	EACH	$3,220.00	1	$3,220.00	$3,225.00
4010-A-1004	Pipes and Trenching	8" PVC Pipe	LF	$85.00	1818	$154,530.00	$154,500.00
						Subtotal	$163,350.00

Table 22O: Green Playground							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Hank Drum	With Feet (Portable)	EACH	$537.95	3	$1,613.85	$1,625.00
--	Wind Chimes	-	EACH	$319.95	1	$319.95	$320.00
--	Pedestal Pipes	Mounted in Ground	EACH	$528.95	1	$528.95	$530.00

--	Musical Fences	6'	EACH	$1,499.95	1	$1,499.95	$1,500.00
--	Hollow Log	4' Long 23" Interior	EACH	$2,899.95	2	$5,799.90	$5,800.00
--	Fort	11' octagonal	EACH	$2,799.95	1	$2,799.95	$2,800.00
--	Sitting Stumps (set of 4) "steps"	-	EACH	$269.95	2	$539.90	$540.00
--	Picnic Table (child)	-	EACH	$324.95	2	$649.90	$650.00
--	Weather Station	Below 3000 ft	EACH	$1,394.95	1	$1,394.95	$1,400.00
--	Magnifying Station with Post	-	EACH	$302.95	1	$302.95	$305.00
--	Log Benches	Whole Log Bench, on Log Supports	EACH	$309.95	5	$1,549.75	$1,550.00
--	Chin Up Bars	(2 bars)	EACH	$389.95	1	$389.95	$390.00
--	Balance Beams	8'	EACH	$249.95	1	$249.95	$250.00
--	Post Walk	5-12 yrs	EACH	$999.95	1	$999.95	$1,000.00
--	Boulders and Rocks	Boulder ~ 24-30"	EACH	$379.95	3	$1,139.85	$1,150.00
--	Spiderweb Climbing Net	Spiderweb Horizontal Net 12' x	EACH	$2,699.95	1	$2,699.95	$2,700.00

		12' with Posts					
--	Tree Decks	12' Octagon 6' H	EACH	$7,166.95	1	$7,166.95	$7,175.00
--	Net Climb for Decks	6' Deck	EACH	$999.95	1	$999.95	$1,000.00
--	Embankment Slides (3 foot drop to 35 foot drop)	6'	EACH	$3,049.95	1	$3,049.95	$3,050.00
--	Wood Protector and Preservative (1 gallon)	Log Oil	EACH	$82.95	1	$82.95	$83.00
--	Wood Protector and Preservative (1 gallon)	Lumber Protector and Preservative (1 gallon)	EACH	$65.95	1	$65.95	$66.00
--	Shipping Total	-	LS	$2,798.68	1	$2,798.68	$2,800.00
--	Wood Chip Surfacing	-	CY	$40.00	135.00	$5,400.00	$5,400.00
--	Design Services	-	LS	$8,500.00	1	$8,500.00	$8,500.00
--	Contingency	10% of Budget	LS	$10,000.00	1	$10,000.00	$10,000.00
--	Labor	45% of Budget excluding Contingenc	LS	$44,000.00	1	$44,000.00	$44,000.00

		y (Crew 4-5, 350 hrs)					
--	CPSI	Inspection	LS	$1,000.00	1	$1,000.00	$1,000.00
						Subtotal	$105,584.00

Table 23O: Lake Fisher Phase 2 Cost							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2533-4980005	Mobilization	MOBILIZATION	LS	$178,866.50	1	$178,866.50	$179,000.00
2102-2710070	Cut/Fill	EXCAVATION, CLASS 10, ROADWAY AND BORROW	CY	$8.56	142237	$1,217,548.72	$1,217,500.00
						Design Features	$1,788,665.00
						Contingency	40%
						Phase 2 Total	$2,754,731.00

Phase 3

Table 24O: Venue							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost

--	Concrete Slab	-	SF	$5.66	8750	$49,542.68	$49,500.00
--	Columns/Foundation	-	CY	$670.00	51	$34,379.23	$34,400.00
--	Roof Assembly	-	SF	$4.25	5775	$24,550.43	$24,600.00
--	Decorative Wood Paneling	-	SF	$4.29	5775	$24,764.84	$24,800.00
--	Trusses	-	EACH	$740.66	23	$17,035.12	$17,000.00
--	Lumber Column/Girder	-	LF	$21.94	440	$9,647.30	$9,650.00
--	Lighting	-	EACH	$131.34	21	$2,758.15	$2,750.00
--	Electrical	-	SF	$14.57	4455	$64,921.56	$65,000.00
						Subtotal	$227,700.00

Table 25O: Venue Parking

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2312-8260050	6" Granular Surface	GRANULAR SURFACING ON ROAD, CLASS A CRUSHED STONE	CY	$ 77.00	1278	$ 98,389.06	$ 98,500.00

2107-0875000	Compaction of Surfacing	COMPACTION WITH MOISTURE AND DENSITY CONTROL	CY	$ 2.00	1278	$ 2,555.56	$ 2,550.00
--	Concrete stops	Precast Concrete Parking Wheel Stops	EACH	$200.00	217	$43,400.00	$43,400.00
2524-9325001	ADA Parking Sign R7-8	TYPE A SIGNS, SHEET ALUMINUM	SF	$ 27.00	11	$ 283.50	$ 285.00
						Subtotal	$ 144,735.00

Table 26O: Venue Restroom

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Concrete Slab	-	SF	$5.66	1208	$6,840.29	$6,850.00
--	Columns/Foundation	-	CY	$670.00	31	$20,600.73	$20,600.00
--	Roof Assembly	-	SF	$4.25	879	$3,734.80	$3,725.00
--	CMU Block Walls	-	SF	$15.10	784	$11,832.27	$11,800.00
--	Partition Walls	-	SF	$4.03	458	$1,844.20	$1,850.00
--	Urinals	-	EACH	$424.09	2	$848.19	$850.00

--	Stalls	-	EACH	$525.36	4	$2,101.44	$2,100.00
--	ADA Stalls	-	EACH	$595.90	1	$595.90	$595.00
--	Restroom Sink	-	EACH	$259.25	5	$1,296.23	$1,300.00
--	Door	-	EACH	$760.29	4	$3,041.15	$3,050.00
--	Changing Station	-	EACH	$349.19	1	$349.19	$350.00
--	Air Hand Dryer + Wiring	-	EACH	$282.73	5	$1,413.65	$1,425.00
--	Soap Dispenser	-	EACH	$59.96	5	$299.81	$300.00
--	Multi-Roll Toilet Paper Dispenser	-	EACH	$71.66	5	$358.29	$360.00
--	Medium Mirror	-	EACH	$249.59	2	$499.19	$500.00
--	Small Mirror	-	EACH	$85.12	1	$85.12	$85.00
--	Plumbing	-	EACH	$4,467.00	1	$4,467.43	$4,475.00
--	Electric Heating 12.5kW	-	EACH	$1,967.00	1	$1,966.86	$1,975.00
--	Electric Water Heater 50 gal	-	EACH	$817.28	1	$817.28	$815.00
--	Solar Cost 5kW	-	EACH	$14,387.00	1	$14,387.10	$14,400.00

--	Lighting	-	EACH	$191.95	10	$1,919.52	$1,925.00
--	Electrical	-	SF	$14.57	605	$8,816.51	$8,825.00
--	Outdoor Lighting	-	EACH	$116.40	6	$698.38	$700.00
						Subtotal	$88,855.00

Table 27O: Venue Septic							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2102-2710070	Excavation	EXCAVATION, CLASS 10, ROADWAY AND BORROW	CY	$8.56	1261	$10,794.16	$10,800.00
--	Tanks	Septic Tank, Greater than 1500 Gallons	EACH	$3,220.00	1	$3,220.00	$3,225.00
4010-A-1004	Pipes and Trenching	8" PVC Pipe	LF	$85.00	3492	$296,820.00	$297,000.00
						Subtotal	$311,025.00

Table 28O: Trailhead							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost

--	Trailhead Signage	Nu-Fram Signage	EACH	$5,000.00	1	$5,000.00	$5,000.00
						Subtotal	$5,000.00

Table 29O: South Dock							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
HD-DOCK	Floating dock segment	20'x54'	EACH	$64,800.00	1	$64,800.00	$65,000.00
HD-DOCK	Floating dock segment	20'x18'	EACH	$21,600.00	2	$43,200.00	$43,200.00
HD-DOCK	Floating dock segment	4'x12'	EACH	$2,880.00	3	$8,640.00	$8,650.00
PKG-TRF2	ADA Kayak Launch 12'x18'	-	EACH	$11,520.00	1	$11,520.00	$11,500.00
ACC-BSHD	Bump Strip	4"	EACH	$19.00	320	$6,080.00	$6,075.00
ACC-CHD10	10" Cleat	S-Style Aluminum	EACH	$40.00	6	$240.00	$240.00
ACC-RL3	Railing	Heavy Duty Triple Aluminum	EACH	$75.00	100	$7,500.00	$7,500.00
ACC-308SF	Safe Launch Platform	-	EACH	$929.00	1	$929.00	$930.00
ACC-TRF	ADA Transfer Platform	-	EACH	$4,000.00	1	$4,000.00	$4,000.00
ACC-SR2	Side Railing	Kayak Accessory	EACH	$179.00	2	$358.00	$360.00

--	Concrete anchors and chain	-	EACH	$180.00	8	$1,440.00	$1,450.00
CON-UWI	Connector	Underwater Beam Connector	EACH	$299.00	1	$299.00	$300.00
ATT-AC1	Anchor Chain Brachet	-	EACH	$130.00	30	$3,900.00	$3,900.00
Misc	Gangway	6'x32'	EACH	$12,150.00	2	$24,300.00	$24,300.00
GAN-HP6	Hinge Plate	6' Landside	EACH	$659.00	2	$1,318.00	$1,325.00
GAN-RA	Gangway Roller Assembly	-	EACH	$299.00	4	$1,196.00	$1,200.00
GAN-RP	Roller Pad w/ Hardware	-	EACH	$299.00	2	$598.00	$600.00
GAN-TP6	Transition Plate	6' Width	EACH	$799.00	2	$1,598.00	$1,600.00
--	Shipping	-	EACH	$20,233.00	1	$20,233.00	$20,200.00
						Subtotal	$202,330.00

Table 30O: South Beach							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Sand	Washed Recreational Sand	CY	$ 44.80	1780	$ 79,754.17	$ 80,000.00

Subtotal	$ 80,000.00

Table 31O: Existing Pavilion Parking Improvements							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Water Trough	Tarter Oval Versa 40 with Spigot	EACH	$ 180.00	1	$ 180.00	$ 180.00
--	Hitching Post	6' Wide x 6' Tall Hitching Post	EACH	$ 199.95	4	$ 799.80	$ 800.00
--	Horse Shelter	ShelterLogic 12x24x9 3-in-1 Run In Shelter Round	EACH	$ 700.00	1	$ 700.00	$ 700.00
						Subtotal	$ 1,680.00

Table 32O: Northwest Dock							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
HD-DOCK	Floating dock segment	18'x35'	EACH	$37,800.00	1	$37,800.00	$37,800.00
HD-DOCK	Floating dock segment	4'x12'	EACH	$2,880.00	2	$5,760.00	$5,750.00
PKG-TRF2	ADA Kayak Launch 12x18	-	EACH	$11,520.00	1	$11,520.00	$11,500.00

ACC-BSHD	Bump Strip	4"	EACH	$19.00	160	$3,040.00	$3,050.00
ACC-CHD10	10" Cleat	S-Style Aluminum	EACH	$40.00	4	$160.00	$160.00
ACC-EDGE	Edge Gaurd	2-1/2" Roll Off Guard	EACH	$22.00	39	$858.00	$860.00
ACC-308SF	Safe Launch Platform	-	EACH	$929.00	1	$929.00	$930.00
ACC-TRF	ADA Transfer Platform	-	EACH	$4,000.00	1	$4,000.00	$4,000.00
ACC-SR2	Side Railing	Kayak Accessory	EACH	$179.00	2	$358.00	$360.00
--	Concrete anchors and chain	-	EACH	$180.00	4	$720.00	$720.00
CON-UWI	Connector	Underwater Beam Connector	EACH	$299.00	1	$299.00	$300.00
ATT-AC1	Anchor Chain Brachet	-	EACH	$130.00	24	$3,120.00	$3,125.00
Misc	Ganway	6'x25'	EACH	$9,000.00	1	$9,000.00	$9,000.00
GAN-HP6	Hinge Plate	6' Landside	EACH	$659.00	1	$659.00	$660.00
GAN-RA	Gangway Roller Assembly	-	EACH	$299.00	2	$598.00	$600.00
GAN-RP	Roller Pad w/ Hardware	-	EACH	$299.00	1	$299.00	$300.00

GAN-TP6	Transition Plate	6' Width	EACH	$799.00	1	$799.00	$800.00
--	Shipping	-	EACH	$13,489.00	1	$13,489.00	$13,500.00
						Subtotal	$93,415.00

Table 33O: 2 Cabins							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Cabinets, Kitchen	35-1/2" Wide, 24" Deep	LF	$212.40	10	$2,124.00	$2,125.00
--	Countertops	Square Edge, Separate Backsplash	LF	$25.33	10	$253.30	$255.00
--	Sills, Pier Blocks, Floor Beams	-	SF	$0.80	700	$560.00	$560.00
--	Floor Joists 16" OC, R38 Insulation and 3/4" OSB Subflooring	2x8 Joists	SF	$5.74	700	$4,018.00	$4,025.00
--	Girders	2 1/2x12 3/8 Glu.	LF	$16.50	26	$429.00	$430.00
--	Layout, Backing, Blocking,Framing For Openings	Studs, Sole Plates, Header/End Joists, Bracing	SF	$5.52	700	$3,864.00	$3,875.00

--	Roof Truss Assembly	Truss with 2x6,8,12 Web, Bottom, Top	SF	$2,394.57	1	$2,394.57	$2,400.00
--	Roof Sheathing	Small Job + 6 on 12	SF	$0.40	700	$280.00	$280.00
--	Doors, Prehung Exterior	36x84, Rustic	EA	$838.10	2	$1,676.20	$1,675.00
--	Windows	12'x6'	EA	$403.00	1	$403.00	$405.00
--	Windows	8'x6'	EA	$3,667.00	1	$3,667.00	$3,675.00
--	Windows	5'x6'	EA	$4,317.00	3	$12,951.00	$13,000.00
--	Concrete Slab	-	SF	$5.66	854	$4,833.64	$4,825.00
--	Foundation	-	CY	$670.00	14	$9,380.00	$9,375.00
--	Painting, Interior	3 Coats, Paint	SF	$4.10	700	$2,870.00	$2,875.00
--	Shower Stalls	Acrylic, 48x35x72	EACH	$2,119.00	1	$2,119.00	$2,125.00
--	WC	Floor Mounted, Residential	EACH	$615.40	1	$615.40	$615.00
--	Lavatories	-	EACH	$381.00	1	$381.00	$380.00
--	Kitchen Sinks	1 Bowl	EACH	$651.20	1	$651.20	$650.00
--	Whole House Plumbing	Single Story, Total	EACH	$4,813.00	1	$4,813.00	$4,825.00

--	Electrical	-	SF	$14.57	700	$10,199.00	$10,200.00
						Subtotal	$68,575.00
						Amount of Cabins	2
						Total Cost	$137,150.00

Table 34O: Lake Fisher Phase 3 Cost

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2533-4980005	Mobilization	MOBILIZATION	LS	$129,189.00	1	$129,189.00	$129,000.00
2102-2710070	Cut/Fill	EXCAVATION, CLASS 10, ROADWAY AND BORROW	CY	$8.56	70761	$605,714.16	$605,500.00
						Design Features	$ 1,291,890.00
						Contingency	40%
						Phase 3 Total	$1,989,246.00

Phase 4

Table 35O: Softball Field Improvements							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Softball Field Improvements	Resurfacing, Striping, Batters/Catchers Box Replacements	LS	$ 390,270.00	1	$ 390,270.00	$ 390,500.00
						Subtotal	$ 390,500.00

Table 36O: Permanent East Boat Ramp and Parking							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2312-8260050	6" Granular Surface	GRANULAR SURFACING ON ROAD, CLASS A CRUSHED STONE	CY	$77.00	42.26	$3,254.02	$3,250.00
2507-6800061	Rip-Rap	REVETMENT, CLASS E	TON	$90.00	5.12	$460.80	$460.00
--	Class C Concrete	ADA Parking Sign R7-8	SY	$140.00	260.2557	$36,435.80	$36,400.00
fp000009	Polyethylene Moisture Barrier	-	SF	$0.12	2604	$312.48	$310.00

2404-7775000	Number 4 Rebar	REINFORCING STEEL	LB	$1.50	1651.3	$2,476.95	$2,475.00
2107-0875000	Compaction of Surfacing	COMPACTION WITH MOISTURE AND DENSITY CONTROL	CY	$2.00	42.26	$84.52	$85.00
2101-0850002	Clearing/Grubbing	CLEARING AND GRUBBING	ACRE	$7,111.11	0.125	$888.89	$890.00
HD-DOCK	Floating Dock Segment	6'x30'	EACH	$12,960.00	1	$12,960.00	$13,000.00
ACC-BSHD	Bump Strip	4"	EACH	$19.00	78	$1,482.00	$1,475.00
ACC-CHD10	10" Cleat	S-Style Aluminum	EACH	$40.00	6	$240.00	$240.00
ATT-AC1	Anchor Chain Brachet	-	EACH	$130.00	4	$520.00	$520.00
Misc	Gangway	6'x22'	EACH	$9,000.00	1	$9,000.00	$9,000.00
GAN-HP6	Hinge Plate	6'	EACH	$659.00	1	$659.00	$660.00
GAN-CP6	Hinge Plate	6' Dockside	EACH	$659.00	1	$659.00	$660.00
GAN-COH	Compensation Float	-	EACH	$999.00	1	$999.00	$1,000.00
--	Concrete Anchors and Chain	-	EACH	$180.00	2	$360.00	$360.00

--	Shipping	-	EACH	$3,872.00	1	$3,872.00	$3,875.00
						Subtotal	$74,660.00

Table 37O: 2 Cabins

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	Cabinets, Kitchen	35-1/2" Wide, 24" Deep	LF	$212.40	10	$2,124.00	$2,125.00
--	Countertops	Square Edge, Separate Backsplash	LF	$25.33	10	$253.30	$255.00
--	Sills, Pier Blocks, Floor Beams	-	SF	$0.80	700	$560.00	$560.00
--	Floor Joists 16" OC, R38 Insulation and 3/4" OSB Subflooring	2x8 Joists	SF	$5.74	700	$4,018.00	$4,025.00
--	Girders	2 1/2x12 3/8 Glu.	LF	$16.50	26	$429.00	$430.00
--	Layout, Studs, Sole Plates, Header And End Joists, Backing, Blocking, Bracing, Framing For Openings		SF	$5.52	700	$3,864.00	$3,875.00

--	Roof Truss Assembly	Truss with 2x6,8,12 Web, Bottom, Top	SF	$2,394.57	1	$2,394.57	$2,400.00
--	Roof Sheathing	Small Job + 6 on 12	SF	$0.40	700	$280.00	$280.00
--	Doors, Prehung Exterior	36x84, Rustic	EACH	$838.10	2	$1,676.20	$1,675.00
--	Windows	12'x6'	EACH	$403.00	1	$403.00	$405.00
--	Windows	8'x6'	EACH	$3,667.00	1	$3,667.00	$3,675.00
--	Windows	5'x6'	EACH	$4,317.00	3	$12,951.00	$13,000.00
--	Concrete Slab	-	SF	$5.66	854	$4,833.64	$4,825.00
--	Foundation	-	CY	$670.00	14	$9,380.00	$9,375.00
--	Painting, Interior	3 Coats, Paint	SF	$4.10	700	$2,870.00	$2,875.00
--	Shower Stalls	Acrylic, 48x35x72	EACH	$2,119.00	1	$2,119.00	$2,125.00
--	WC	Floor Mounted, Residential	EACH	$615.40	1	$615.40	$615.00
--	Lavatories	-	EACH	$381.00	1	$381.00	$380.00
--	Kitchen Sinks	1 Bowl	EACH	$651.20	1	$651.20	$650.00

--	Whole House Plumbing	Single Story, Total	EACH	$4,813.00	1	$4,813.00	$4,825.00
--	Electrical	-	SF	$14.57	700	$10,199.00	$10,200.00
						Subtotal	$68,575.00
						Amount of Cabins	2
						Total Cost	$137,150.00

Table 38O: Workout Areas

Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
--	COMBI 3	-	EACH	$8,460.00	1	$8,460.00	$8,460.00
--	PARALLEL BARS	-	EACH	$1,600.00	1	$1,600.00	$1,600.00
--	PUSH UP BARS	-	EACH	$1,080.00	1	$1,080.00	$1,080.00
--	PULL UP STATION	-	EACH	$2,510.00	1	$2,510.00	$2,510.00
--	Multi Net	-	EACH	$1,650.00	1	$1,650.00	$1,650.00
--	Agora Steel Bench with Backrest	-	EACH	$2,700.00	4	$10,800.00	$10,800.00
--	Equipment Total	-	LS	$26,100.00	1	$26,100.00	$26,100.00

--	Shipping Total	-	LS	$3,732.00	1	$3,732.00	$2,000.00
--	Wood Chip Surfacing	-	CY	$40.00	66	$2,640.00	$2,640.00
--	Labor	45% of budget excluding contingency	LS	$45,100.00	1	$45,100.00	$25,000.00
						Subtotal	$81,840.00
						Amount	3
						Total Cost	$245,520.00

Table 39O: Lake Fisher Phase 4 Cost							
Item Code	Item	Item Description	Unit	Unit Cost	Quantity	Total Cost	Rounded Cost
2533-4980005	Mobilization	MOBILIZATION	LS	$84,783.00	1	$84,783.00	$85,000.00
						Design Features	$847,830.00
						Contingency	40%

Phase 4 Total	$1,305,962 .00

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