Law Park Revitalization

A Cross Disciplinary Engineering Design Project with Multiple Constraints

Project Background and Objectives

Law Park is located in a downtown area of a city in Wisconsin, USA, and shares its borders with a U.S. highway and the city's second largest lake.

Law Park is currently home to a variety of different activities. The park offers easy access to the lake for kayaks, canoes, and swimmers. The space is also used as a staging and viewing area for a number of more structured events, such as annual triathlons, a popular July 4th celebration, and area ski team shows. However, Law Park is not without its limitations. Given its location, the park has limited space and a significant portion of that space is consumed by a parking lot. The park also has outdated facilities that includes a boat launch in need of repair.

The project drew the engineering student team together with professional engineers and community members to design a new Law Park that will revitalize the park as a community resource and visitor destination, expand downtown connections and universal accessibility to the park for pedestrians and bicyclists, improve water quality, and strengthen the city's "green city" reputation.

The Triple Bottom Line

Existing Conditions of Law Park

Design Evaluation: The Triple Bottom Line of Sustainability							
		Factor Ranking Design			Weighted Individual Factor		
Evaluation Category	Factor Weight	S&E	R2P	TSP	S&E	R2P	TSP
Environmental Sustainability							
Green City Essence	0.4	5	6	9	2	2.4	3.6
Stormwater Treatment	0.3	3	5	8	0.9	1.5	2.4
Natural Design	0.3	8	5	6	2.4	1.5	1.8
Economic Sustainability							
Tourism Attraction	0.4	4	6	9	1.6	2.4	3.6
Project Cost	0.5	9	7	5	4.5	3.5	2.5
Life Cycle Costs	0.1	9	6	5	0.9	0.6	0.5
Social Sustainability							
Accessibility	0.333	5	5	5	1.665	1.665	1.665
Community Resource	0.333	6	7	8	1.998	2.331	2.664
Public Preference	0.333	4	7	7	1.332	2.331	2.331
Total					**17.295**	**18.227**	**21.06**

Decision Matrix

Design Options and Methodology

The student team developed three holistic designs that varied in size and cost. The first design was the smallest and most cost effective, utilizing simple and effective concepts to address the Triple Bottom Line. The second design proposed filling a portion of the lake and creating a larger park, yet still maintaining the original shoreline as best as possible and only providing enough space for room to play. Finally, the third design proposed the most amount of fill and is the most ambitious and expensive design, resulting in a space that architecturally dominates the local area as a signature park. In analyzing each design, the team utilized a decision matrix to evaluate how well the design satisfied the Triple Bottom Line.

Law Park (Existing)

1st Design: Simple and Effective

2nd Design: Room to Play

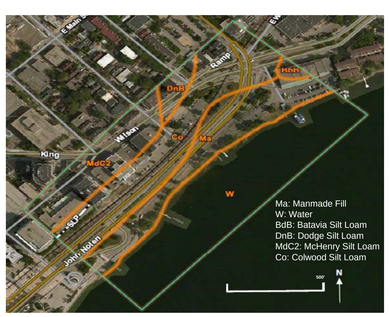
3rd Design: The Signature Park

The Signature Park

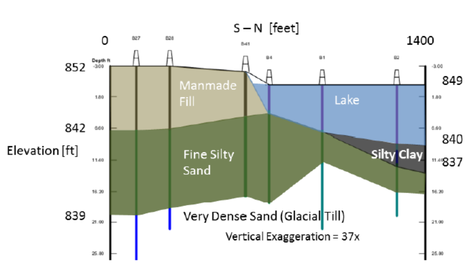
While the Signature Park design is the most ambitious and expensive of the three designs, the increased space allows the park to include a man-made wetland, boater's beach, and larger seating and open space area. This design provides enough space for a dynamic park that satisfies the Triple Bottom Line by promoting social good, encouraging economic consideration, and fostering environmental stewardship.

Design Constraints

During the soils investigation of Law Park, a substantial amount of man-made fill below the surface was discovered. Thus, the geotechnical considerations of the proposed park was a significant design constraint, and further analysis concluded that man-made fill would not have sufficient bearing strength for shallow foundations. As such, cast-in-place steel pipe piles were required for the foundation of the FLW Boathouse and bridge abutments. Other design constraints included significant traffic congestion in an extremely compact park as well as major environmental regulations and permitting associated with the park's close proximity to the lake.



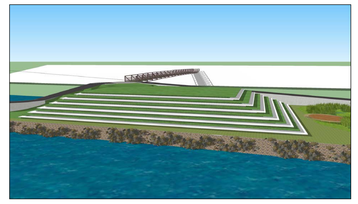
Law Park Subsurface Soils



Cross Section of Law Park and the Lake.

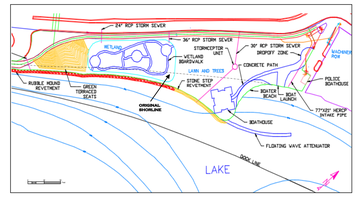
Outcomes

After using several different engineering disciplines to analyze each of the designs, the design team finalized and modeled The Signature Park. The model shows distinct features that sets this park apart from any other, and defines the city the same way Millennium Park defines the city of Chicago.

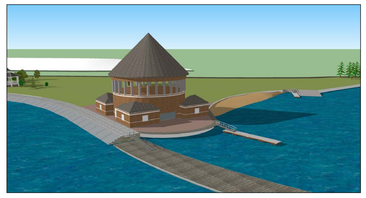


Rendering of Tiered Concrete Seating

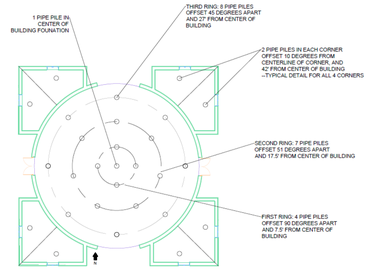
Rendering of Wetland

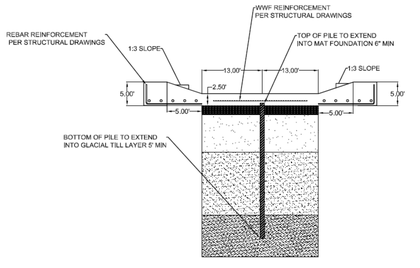


Site Layout of Proposed Design



Rendering of Boathouse/Shoreline





FLW Boathouse Foundation – Plan View (left) and Section Cut (right)

Knowledge and Skills Gained

The students applied their engineering curriculum to a real-world problem. They used their knowledge of civil engineering to evaluate alternatives, considered risks and benefits, and created a viable final design, while meeting the time and budget constraints of their client and internal organization. Their interaction with mentors and other members of the engineering profession taught them valuable communication skills, and gave them insights into questions about ethics, professional responsibilities, and the logistics of taking a design project to completion.

Cross Discipline Collaboration

Fields: Structural, Geotechnical, Environmental, Transportation, and Construction Engineering; estimating, scheduling, client and community interaction. Design Team: Four civil and environmental engineering students; two volunteer registered engineers as mentors from the local engineering community; faculty and adjunct faculty members, community representatives, project review by a multidisciplinary panel of experts.

Law Park Revitalization Project Description

Project Description

Law Park, located in a downtown area of a city in Wisconsin, USA, occupies a small strip of land (approximately three acres) situated between the city's second largest lake and a U.S. highway. The park offers easy lake access for kayaks, canoes, swimmers, and other activities, and is also used as a staging and viewing area for several structured events, such as annual triathlons, a popular July 4th celebration, and area ski team shows, amounting to over 100,000 visitors per year. The park also serves as a home for the county sheriff's Marine and Trail enforcement watercraft. However, Law Park is not without its limitations. Given its location, the park has limited space and a significant portion of that space is consumed by a parking lot. The park also has outdated facilities that includes a boat launch in need of repair.

The local community, working through a community "Clean Lakes" organization, has requested engineering services to revitalize Law Park to enhance the connection between workers, residents, and visitors to the lake and to serve as a catalyst for redevelopment of underutilized properties in the Law Park vicinity. Specific goals for the Law Park Revitalization Project are:

1. Revitalize Law Park as a community recreational resource and visitor destination.
2. Improve universal accessibility to the recreational activities the lake must offer.
3. Improve pedestrian and bicycle connections between the downtown and lake area.
4. Improve water quality in the lake.
5. Strengthen the city's growing reputation as a green city with this revitalized signature park.

Figure 1. Image of Law Park's limited space and parking lot

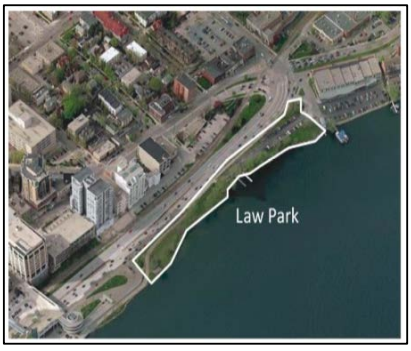


Figure 2. Aerial photo of Law Park today

The Clean Lakes community organization challenged a team of civil and environmental engineering undergraduate students (the student team) to design and propose a solution to the revitalization effort, based on a Request for Proposals (RFP) that had been developed for professional engineering services. With the project goals established, the student team began collaborating with faculty members, professional engineers, mentors, public, and the community Clean Lakes organization. The design included application of engineering principles in geotechnical, structural, environmental, transportation, and construction engineering. The student team prepared and submitted: a proposal (as though they were competing for the project); a formal preliminary design report describing the three concept designs; a listing of pertinent regulatory

standards and professional codes; a geotechnical report; contract documents (construction contract, technical specification, construction plans); regular project management reports; regular peer evaluation reports; opinions of cost; and project schedules. Their work included three formal presentations along with a public meeting.

The student team developed three concept designs for the Law Park Revitalization: Simple and Effective (S&E); Room to Play (R2P); and The Signature Park (TSP).

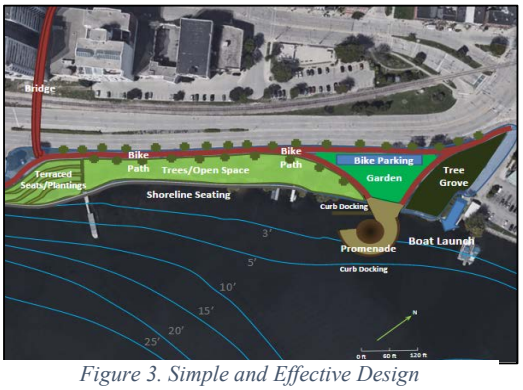


Figure 3. Simple and Effective Design

Understanding that any changes brought to the physical location of the shoreline has been under contentious debate for years, the student team wanted to provide a design that was simple and used the limited space as efficiently as possible. Ways of efficiently using the park includes tiered stone seating along the immediate shoreline and pedestrian bridge abutment, as well as, maintaining a large open space that can be flexible for a variety of different recreational activities and events.

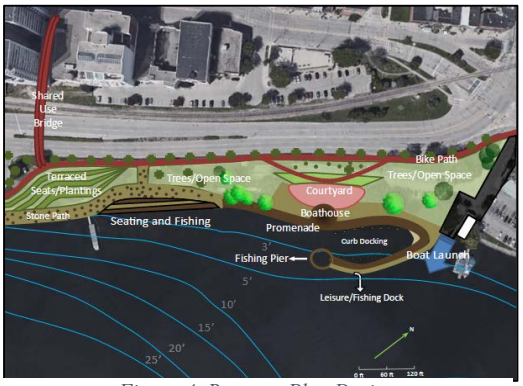


Figure 4. Room to Play Design

The goal behind Room to Play is to form a compromise between the two extremes, Simple & Effective and The Signature Park. This design features the same tiered stone seats along the shoreline to maximize space efficiency and also includes a fishing dock and pier with a protected area for docking boats and winter skating. Pushing the boathouse and adjacent promenade out slightly farther, the design includes a separate courtyard for sitting down and enjoying a lunch or snack.

Figure 5. The Signature Park Design

The student team developed the Signature Park design to truly bring to the City what Millennium Park brought to Chicago. By filling up to 200 feet out into the lake, the design could incorporate a large wetland area as a natural way to treat runoff along with more greenspace and a second grade. With the increased space and grade change, the park can be changed to a dynamic area that brings character to Law Park, yet seamlessly integrates with the shoreline like it was always there.

The three alternative designs were evaluated based on their environmental, economic, and social sustainability, the Triple Bottom Line (Figure 6). Water treatment, ecological restoration, tourism, community strengthening, and financial costs and benefits were considered in determining the recommended alternative, with respect for the input of the Clean Lakes organization, city officials, experts, and the public. The student team ultimately recommended the Signature Park design for the Law Park Revitalization Project. While the Signature Park design is the most ambitious and expensive of the three designs, the increased space allows the park to include a man-made wetland, boater's beach, and larger seating and open space area. This design provides enough space for a dynamic park that satisfies the "Triple Bottom Line" by promoting social good, encouraging economic consideration, and fostering environmental stewardship.

Figure 6. The Triple Bottom Line

Collaboration of Faculty, Students and Licensed Professional Engineers

Were licensed professional engineers (P.E.s) involved?

Two P.E.s from the local community served as mentors throughout the semester, meeting weekly with the student team. The mentors provided design supervision, lessons-learned experiences, critique and oversight for presentations and reports, and advice for client relationships and public meetings. In addition, overall instruction for the course was provided weekly by a P.E. Two student team presentations (at the preliminary and final design stages) were made to a panel of judges from the local P.E. community, thereby widening the students' exposure to other professionals and affording opportunities for additional critique of their work.

How did the students, faculty, and P.E.s interact?

The weekly contact between mentors and students allowed the students to benefit from the P.E.'s many years of experience. At the same time, the mentors and faculty expected the student team to retain responsibility for its own performance to the pre-established goals for time management, presentations, design components, deliverables, and schedules. Both mentors and faculty made themselves available for phone or email discussions as necessary and provided review of the student deliverables.

What did the students learn through the collaboration that would not have been learned in the classroom?

Communication and Collaboration as Components of Design: Collaboration between engineers, stakeholders, regulatory agencies, and the public is difficult if not impossible to teach in the classroom. In this project, the student team spoke directly to the community Clear Lakes organization and the public, learning to listen and balance the needs and requirements of various entities. The project constraints and needs then became critical elements of three concept designs.

Multiple Right Answers: Most classroom activities and problems are designed to promote an understanding of the theory by having a single "correct" answer. In this project, having achieved an understanding of the engineering, environmental, and public constraints, the students prepared an evaluation matrix in which weighted decision criteria were applied to three concept designs, all of which can be considered "right answers." The team made a recommendation to proceed with The Signature Park design, the largest and most expensive option that incorporates a wetland area as a natural way to treat runoff along with more greenspace.

Design Evaluation: The Triple Bottom Line of Sustainability							
Evaluation Category	Factor Weight	Factor Ranking Design			Weighted Individual Factor		
		S&E	R2P	TSP	S&E	R2P	TSP
Environmental Sustainability							
Green City Essence	0.4	5	6	9	2	2.4	3.6
Stormwater Treatment	0.3	3	5	8	0.9	1.5	2.4
Natural Design	0.3	6	6	8	1.8	1.8	2.4
Economic Sustainability							
Tourism Attraction	0.4	4	6	9	1.6	2.4	3.6
Project Cost	0.5	9	7	5	4.5	3.5	2.5
Life Cycle Costs	0.1	9	6	5	0.9	0.6	0.5
Social Sustainability							
Accessibility	0.333	5	5	5	1.665	1.665	1.665
Community Resource	0.333	6	7	8	1.998	2.331	2.664
Public Preference	0.333	4	7	7	1.332	2.331	2.331
Total					**16.695**	**18.527**	**21.66**

Figure 7: Evaluation Matrix – a higher score indicates a more desirable outcome.

Application/Integration of Multiple Disciplines: In this project, it was necessary for the student team to combine their individual skills for successful performance of the work, yet complete tasks in several disciplines of civil and environmental engineering. To do this, they identified the skill sets of each team member, assigned themselves tasks accordingly, and sought outside advice from mentors, faculty and other students in areas where needs remained.

Learn to Identify the Uncertainties: Engineering projects have uncertainties, and awareness of the uncertainties informs the designers and user of related risks. Many classroom activities present the student with data and/or a set of assumptions upon which analyses are to be based. In this

project, students were challenged to themselves identify areas where they did not have or find pertinent information, or where certain information was not knowable prior to performing analyses. They correctly identified several items (geotechnical conditions, current-day quality of existing materials, site plans prepared by others, etc.) as items that should be noted and considered.

Protection of Public Health, Safety, and/or Welfare of the Public

The student team was challenged to evaluate the three design alternatives based on the Triple Bottom Line of environmental, economic, and social sustainability (Figure 6). Water treatment, ecological restoration, tourism, community strengthening, and financial costs and benefits were considered in determining the recommended alternative, with respect for the input of the community Clean Lakes organization, city officials, experts and the public.

Based on the Triple Bottom Line criteria, as quantified in the project decision matrix (Figure 7), the student team recommended The Signature Park design for the Law Park Revitalization Project. As noted in their final design summary, the design stewards the environment at a higher level than the other alternatives considered. This design exudes "green city" essence and functions as one – wetlands and repurposed parking restore water quality and encourage wildlife ecology while generating an increased social magnetism. Social equity is further enhanced with larger land space facilitating events and bringing communities together. Accessible to all and more attractive than ever, the Signature Park draws visitors to the water – increasing tourism to the park and the city. The Signature Park asks a higher price – larger project and life cycle costs – than the other designs; this cost is met with benefits to people, place and the planet that cascade off one another more effectively than either other design. The selected design serves as an accessible community resource, connecting visitors to each other through the park and the lake. It balances costs and benefits – long and short term, direct and indirect – most effectively and proposes the strongest environmental ethic.

An important change from the preliminary to final design was the rearrangement of the shoreline, which was configured to better facilitate lake flow from the prevailing current at the site, or littoral drift, and what it carries (like algae) while still providing fishing and boating amenities.

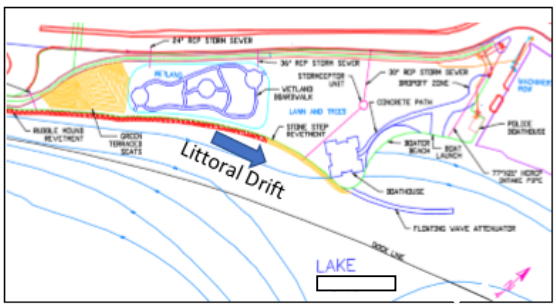


Figure 8. Final Design of The Signature Park

Figure 9. Rendering of the Wetland

Multidiscipline and/or Allied Profession Participation

During this project, the work by the student team included structural, geotechnical, environmental, transportation, and construction engineering, drafting, estimating, scheduling, client and community interaction, review of regulatory requirements and professional standards, and preparation of written reports and construction documents. The four civil and environmental engineering students logged approximately 1,000 hours of design work, including team meetings and meetings with mentors and faculty.

Knowledge and Skills Gained

The students applied their engineering curriculum to a real-world problem. They used their knowledge of civil engineering to evaluate alternatives, considered risks and benefits, and created a viable final design, while managing themselves to meet the time and budget constraints of their client and internal organization.

Their interaction with mentors and other members of the engineering profession taught them valuable communication skills, and gave them insights into questions about ethics, professional responsibilities, and the logistics of taking a design project to completion.

During the soils investigation of Law Park, a substantial amount of man-made fill below the surface was discovered. Thus, the geotechnical considerations of the proposed park were a significant design constraint, and further analysis concluded that man-made fill would not have sufficient bearing strength for shallow foundations. As such, the student team proposed cast-in-place steel pipe piles for the foundation of the boathouse and bridge abutments.

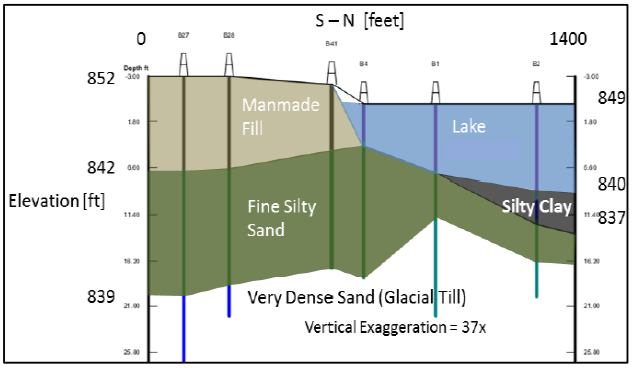


Figure 10. Cross Section of Law Park and the Lake

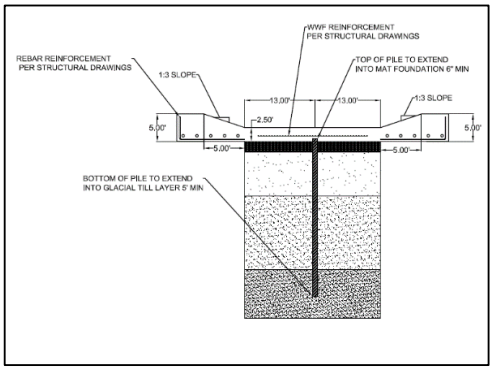


Figure 11. Boathouse Foundation - Section Cut

Other design constraints included significant traffic congestion in an extremely compact park as well as major environmental regulations and permitting associated with the park's proximity to the lake.

Law Park Revitalization Abstract

Law Park, located in a downtown area of a city in Wisconsin, USA, occupies a small strip of land situated between the city's second largest lake and a U.S. highway. The park offers easy lake access for kayaks, canoes, swimmers, and other activities, and is also used as a staging and viewing area for several annual triathlons, a popular July 4th celebration, and area ski team shows, amounting to over 100,000 visitors per year. The park also serves as a home for the county sheriff's Marine and Trail enforcement watercraft. However, Law Park is not without its limitations. Given its location, the park has limited space and a significant portion of that space is consumed by a parking lot. The park also has outdated facilities that includes a boat launch in need of repair.

In collaboration with three P.E.'s, city officials, and the community "Clean Lakes" organization, a team of four undergraduate civil and environmental engineering students worked to develop a design for a new Law Park that will revitalize the park as a community resource and visitor destination, expand downtown connections and universal accessibility to the park for pedestrians and bicyclists, improve water quality and continue to strengthen the city's growing "green city" reputation.

The students developed three design alternatives, preparing a concept design for each. Then, having achieved an understanding of the engineering, environmental, and public constraints, they prepared an evaluation matrix in which weighted decision criteria were applied to each concept design. Based on input from their collaborators and an expert panel, the team made a recommendation to proceed with the "Signature Park" design, the most ambitious and expensive option that incorporates a man-made wetland area as a natural way to treat runoff along with more greenspace and a second grade.

Figure 1: Proposed Signature Park Design

During the soils investigation of Law Park, a substantial amount of manmade fill below the surface was discovered. Thus, the geotechnical considerations of the proposed park was a significant design constraint, and further analysis concluded that man-made fill would not be sufficient for shallow foundations. As such, cast-in-place steel pipe piles were proposed for the foundation of the boathouse and bridge abutments. Other design constraints included significant traffic congestion in an extremely compact park as well as major environmental regulations and permitting associated with the park's close proximity to the lake. An important change from the preliminary to final design was the rearrangement of the shoreline, which is now configured to better facilitate lake flow from the prevailing current at the site, or littoral drift, and what it carries (algae for example) while still providing fishing and boating amenities.