Developing a New Baseball Facility for WPI

A Major Qualifying Project

Submitted to the Faculty of

WORCESTER POLYTECHNIC INSTITUTE

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Abstract

The WPI Baseball program has gone without a true home facility for nearly 10 years, commuting to Northborough daily for practices and games. The team has faced growing limits to field accessibility, forcing the team to relocate several practices and home games to different fields each year. In the search for a new facility, research, site visits, and interviews were completed to establish facility criteria. Facility options were identified and evaluated based on the criteria and preliminary cost estimates. The WPI Townhouses property was chosen, and a field design was developed adhering to all local regulations. A 3D rendering of the facility and detailed cost analysis were produced. The final design incorporates all collegiate baseball field needs with an estimated cost of $3,600,000.

Acknowledgements

We would like to thank Professor Leonard Albano and Dr. Mehul Bhatia for their contributions, guidance, and support towards our project. Professor Albano guided our team through the research and design phases with continuous feedback, helping us consider all relevant factors while developing the proposed baseball facility.

We would like to thank WPI Head Baseball Coach Brendan Casey and members of the WPI Baseball team for providing their insight on important considerations for a home baseball facility.

Authorship

The entire team contributed to the research, evaluation, and development of the proposed baseball facility. Background research on existing baseball fields, NCAA requirements, and field specifications were completed by each member of the team. The entire team completed site visits, established design requirements, and evaluated facility options.

DJ Brooks, a Mechanical Engineering major, focused on analyzing and developing the facility's scoreboard design, as well as the writing of the final report. Francis Polito, a Civil Engineering major with a strong background in design software, primarily developed the Revit modeling of the baseball facility. Francis also contributed greatly to the preliminary cost estimates for the final facility options. Jake DelMonte, a Civil Engineering major with a concentration in Project Management and Construction Engineering, contributed primarily to the facility design and writing of the final report. Jake also contributed to the development of the final cost estimate, along with the design of facility elements and diagrams.

Capstone Design Statement

The design problem focused on locating and developing a modern home field for the WPI Baseball program. This facility is intended to meet the functional requirements of a college baseball field while adhering to a set of diverse constraints including economic, environmental, sustainability, constructability, health and safety, ethical, and social considerations.

Economic Constraints

To address economic constraints, the project utilized a thorough cost analysis and method of budget planning by referencing comparable facility and construction costs. When considering the potential construction, materials, and renovations proposed for the facility, all costs were evaluated to propose a high-quality design without costing an excessive amount. For the final facility location, a more detailed analysis was completed where all costs were considered and evaluated. Several facility options were considered to provide relatively inexpensive options by having an existing field with the proper layout and collegiate dimensions. Lastly, all economic considerations were constrained to be within a realistic spending realm for the WPI Athletic Department.

Environmental and Sustainability Considerations

The facility design and evaluation process followed a deliberate approach which prioritized sustainability and environmental responsibility. Wetland protection, storm water discharge and light pollution due to excessive artificial lighting were explored to minimize environmental impacts. Eco-friendly construction techniques and methods were considered while exploring potential construction at the facility location. LED lights and turf material were evaluated to provide sustainable solutions for the facility design.

Constructability

Constructability constraints were addressed during the design planning stages where specific construction activities were proposed. The facility design was developed while keeping

the construction activities realistic for a recreational site and within a reasonable budget and schedule.

Ethical and Social Concerns

Ethical and social considerations were prioritized during the evaluation and development of proposed facilities. While exploring field options, the opinions of relevant University stakeholders were sought to ensure that all social implications and concerns were taken into account. When considering the possibility of shared spaces for facility use, the location and environment of the site were evaluated, acknowledging potential groups who may wish to use the area depending on the time of year. The facility design parameters prioritized safety over cost to protect the well-being of spectators and commuters during gameplay.

Health and Safety

The health and safety considerations were held among the top of project priorities while tending to players, spectators, and potential construction workers at the facility. The backstop fencing was elevated to help protect spectators at the facility, while the raised safety netting along the perimeter of the facility shields any cars or passersby on the adjacent road. When conducting site visits, safety factors were observed and recorded as part of the field records. This design approach aimed to create a safe and healthy environment for the WPI Baseball program and all affiliated parties.

1. Introduction

To address the current absence of a home field for the Worcester Polytechnic Institute (WPI) Baseball program, the goal of this project was to develop a modern NCAA Division III baseball facility. Features of a Division III baseball facility were researched and identified to prioritize the rules of baseball, functionality of the facility, and safety of players and spectators. Opportunities for implementing sustainable development were explored during the design of the baseball field, aiming to improve its service life and sustainability. This report overviews the research, evaluation, and design process of the proposed facility for the WPI Baseball program.

In 2013, WPI constructed an innovative parking garage, allowing for cars to park in the main level garage and three athletic fields to be located on the rooftop. Although this solution provided space for both parking and athletic fields on campus, this development came at the expense of an on-campus baseball field. After losing the necessary space for a collegiate-sized baseball facility, the WPI Baseball Program began practicing and playing their home games at the New England Baseball Complex (NEBC). This absence of a home, on-campus facility has impacted the experience and performance of the program, resulting in several unjust ramifications over recent years.

The 30-minute commute from campus to the baseball field directly impacts the university and fan support, creating an ironically unfavorable environment for the home team. The WPI Baseball team's access to their home facility is significantly less than typical programs that have on-campus fields. This commute to the home field poses obstacles with field access and bus schedules. This field proximity creates time constraints with limited practice windows dependent on buses arriving on time and daily traffic. Players sitting on a bus for over an hour each day is a serious disadvantage to busy student-athletes with strenuous courseloads. Also, an off-campus field is a disadvantage while recruiting, as many interested recruits are unable to see their potential baseball facilities.

Additionally, the lack of a home field creates a significant disparity between WPI and the other baseball teams in the New England Women's and Men's Athletic Conference (NEWMAC). The WPI Baseball program is one of two teams in the conference with an off-campus field, and the only team to have restricted access to their "home" facilities. Consequently, the WPI Baseball team has been forced to play critical, in-conference games at

neutral and unfamiliar locations, sometimes even at the opponent's home field, despite being scheduled as the home team. This situation arose multiple times during the 2021, 2022, and 2023 seasons, posing a significant competitive disadvantage to the WPI Program. A home field should be a guaranteed place where teams can feel more familiar with the field and have an advantage over the opponent. WPI Baseball, however, often faces the obstacles of an away team. In a different light, an on-campus baseball facility can have a positive impact on the greater WPI and Worcester community, providing a source of comradery and location for municipal activities.

While locating the most suitable option for a new WPI Baseball facility, relevant field research and site visits were initially completed. Facility criteria were established through field notes, player surveys, and interviews with WPI Athletic Department Faculty. Facility options were identified and evaluated using a rubric with the established facility criteria along with preliminary cost estimates. A final facility option was chosen, and a field design was developed adhering to all local regulations and NCAA requirements, as appropriate. Supplementary to the facility design, a detailed cost analysis was completed, as overviewed with the objectives in the Methodology chapter.

As described in the Results chapter, the WPI Townhouses property was selected as the final site location and a facility design was developed. Revit was utilized as the primary design software for modeling the field and individual facility elements. Using this modeling software, a 3D rendering of the baseball facility was created at the selected site location. In conjunction with the final design, a detailed cost analysis was completed using time and material estimates from RSMeans (2022) with an applied cost index. The final facility design incorporates all the basic needs of a collegiate baseball field including a scoreboard, dugouts, bleachers, bullpens, batting cages, restrooms, storage space, lighting, foul poles, and fencing with proper dimensions. Considering these elements along with site work and utilities, the cost of the proposed facility is $3,600,000.

2. Background

The goal of this project was to develop a modern NCAA Division III baseball facility for the WPI Baseball program, addressing their current lack of a home field. To achieve this goal, it was necessary to research and identify the required features of a Division III baseball facility that adheres to the rules of baseball, fair play, and the safety of players. Additionally, it was important to research unique features that contribute to improving the overall experience of players and fans. Sustainable baseball field elements were considered to improve the service life and sustainability of the facility. This section provides background information on the required features and technical aspects of a Division III baseball facility.

Lacking a Home Field

Worcester Polytechnic Institute, although known for its academic prowess, experiences significant issues with its baseball program. The team lacks a dedicated home field which impacts the performance and experience of the WPI Baseball program. The absence of a home facility has led to several unjust ramifications that have affected the Program over recent years.

The distant proximity of the home field to campus directly impacts the university and fan support as students must drive nearly 30 minutes to watch games, making them much less likely to attend. In Figure 1, a map of the route from WPI to NEBC can be seen. A facility removed from campus with minimal fan attendance and support, in addition to limited field access, creates an unfavorable environment for a home field, which should create a supportive environment for the home team. This commute to the home field also poses obstacles while recruiting, as many interested recruits visit WPI to tour the campus, however, are unable to see their potential baseball facilities. As a result, many recruits may be hesitant to commit to a situation where they are inconvenienced daily by needing to commute to their home field.

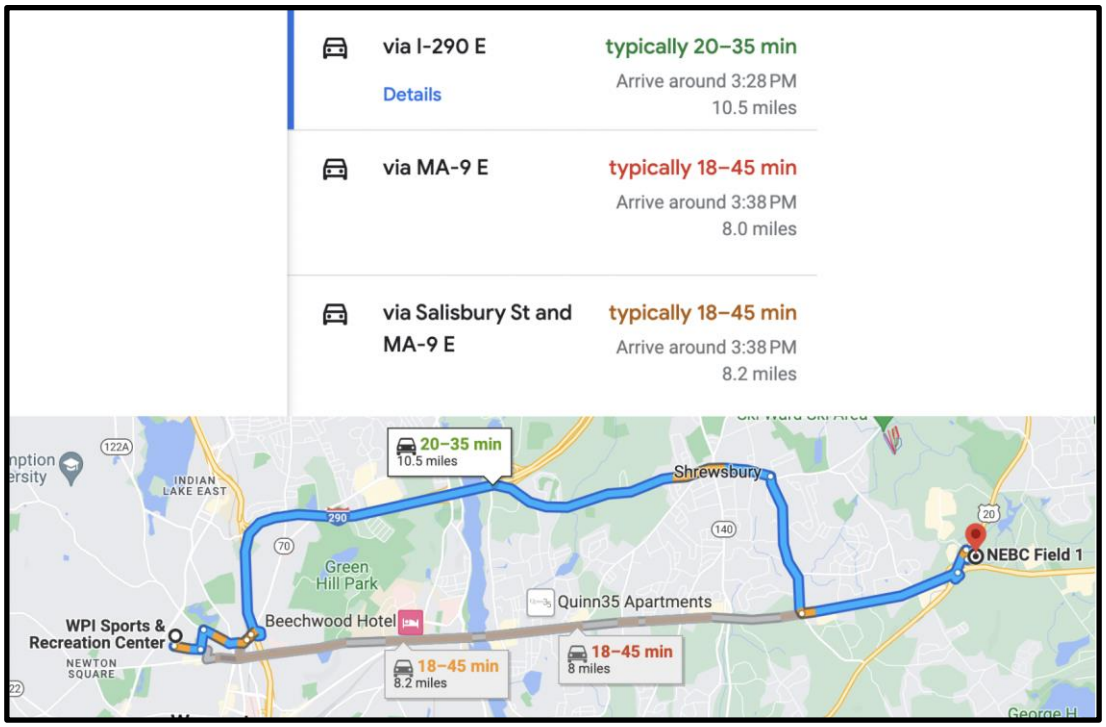

Figure 1: Map of route from WPI to NEBC with estimated departure at 3pm.

Comparison to the Competition

Additionally, the lack of a home field creates a significant disparity between WPI and the other baseball teams in the New England Women's and Men's Athletic Conference (NEWMAC). The WPI Baseball program is one of two teams in the conference with an off-campus field, and the only team to have restricted access to their "home" facilities. Consequently, the WPI Baseball team has been forced to play critical, in-conference games at neutral and unfamiliar locations, sometimes even at the opponent's home field, despite being scheduled as the home team. This situation arose multiple times in the 2021, 2022, and 2023 seasons, posing a significant competitive disadvantage to the Program. A home field should be a guaranteed place where teams can feel more familiar with the field and have an advantage over the opponent. WPI Baseball, however, often faces the obstacles of an away team.

MBTA Zoning Pressures

WPI Baseball's limited access to NEBC already presents a problem, but reports released in 2023 suggest that no one will be able to access the facility in the near future. The town of

Northborough was approached by Trammell Crow Company, a Texas-based real estate developer, to build a 315-unit apartment complex at the site of NEBC. The proposal stems from the new MBTA zoning laws for Massachusetts passed in 2023. With the new regulations, towns that have, or are adjacent to towns that have MBTA service are required to create an additional zoning district with multi-family housing. Northborough is adjacent to Westborough which contains MBTA service, and in its current state, the town needs to add space for 750 units to comply with the new zoning regulations. Trammell Crow Company has already completed or been approved for three similar projects in Billerica, Wrentham, and Chelmsford (Collings 2023). TCC proposed this project in January of 2023, and as recently as June of 2023, Barrett Planning Group has been working with the Town of Northborough's planning director to analyze the project (Lind & Barrett 2023). With the deadline to meet the zoning regulations approaching in 2024, there is a real chance that the apartment complex would gain town approval and the New England Baseball Complex would then cease to exist. In this scenario, the WPI Baseball program would no longer have consistent access to a practice facility, creating yet another obstacle.

Facility Attributes

There are several components to a modern Division III baseball facility that require thought and attention, beginning with the NCAA requirements for a baseball field.

NCAA Requirements

In the 2023-2024 edition of the NCAA Baseball Rules Book (NCAA, 2023), the NCAA outlines the requirements and recommendations for an NCAA baseball field. The book outlines strict requirements for the dimensions of the playing field. For example, the infield must be a 90-foot square, measured from the back point of each base. Dimensions for the area of the infield dirt and baselines, along with the spacing of features such as the coach's boxes and on-deck circles, can be found in Figure 2. Physically, the first, second, and third base bags should be fifteen inches squared with a thickness of three to five inches. Home plate must be seventeen inches wide and have a length of seventeen inches. The plate must be centered six inches on both sides of the batter's box. The dimensions of home plate and the batter's box are displayed in

Figure 3. The pitcher's mound must be ten inches above the top surface of home plate. The pitcher’s plate, commonly referred to as the rubber, must be a rectangular, rubber slab twenty-four inches by six inches in plan. The mound must slope one inch per foot beginning six inches in front of the rubber to a point six feet towards home plate. The full detailed layout and dimensions of the pitcher’s mound can be seen in Figure 4.

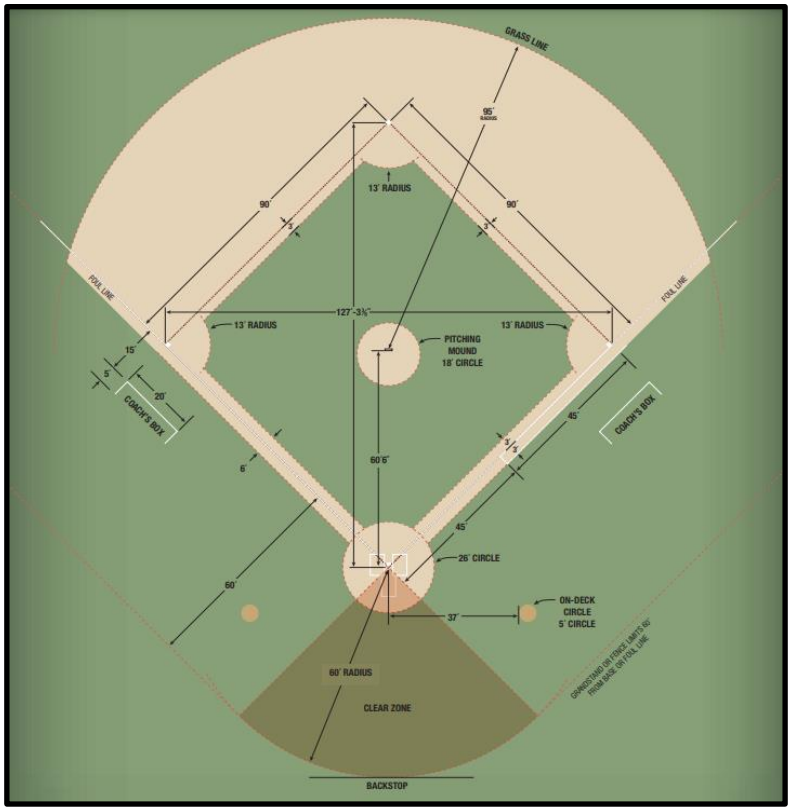

Figure 2: NCAA Baseball Field Rules Book diamond dimensions requirements (NCAA, 2023).

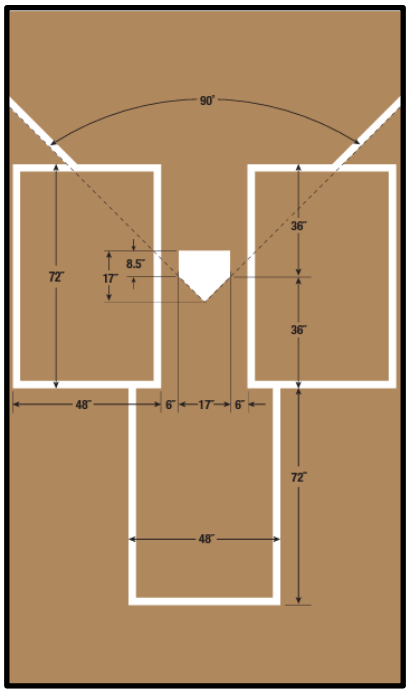

Figure 3: NCAA Baseball Field Rules Book home plate dimension requirements (NCAA, 2023).

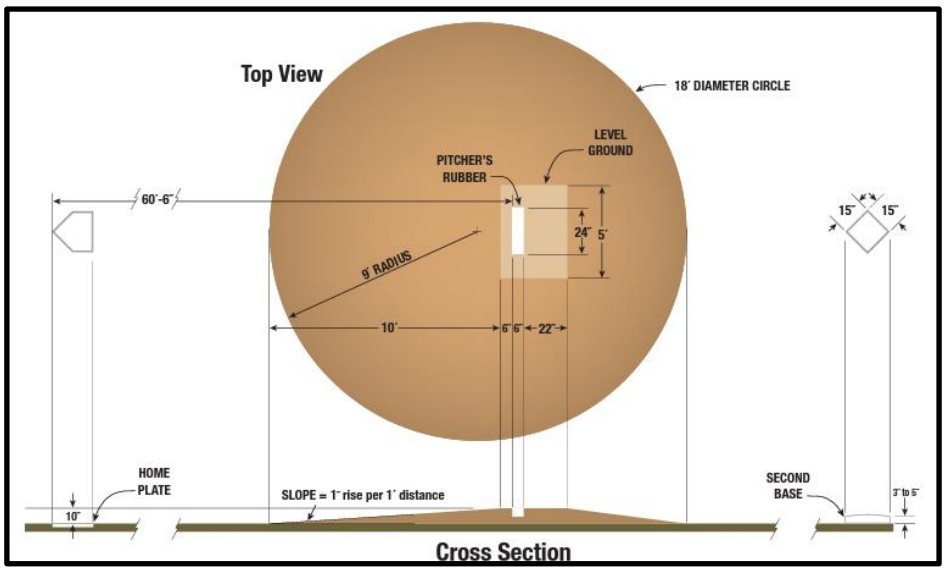

Figure 4: NCAA Baseball Field Rules Book pitcher's mound dimension requirements (NCAA, 2023).

The NCAA recommends that the playing surface be graded two-thirds of one percent beginning at the edge of the pitcher's rubber (not including the mound) to the boundaries of the field. With this grading, the field will play as a flat surface; however, the slight slope will allow

the field to drain. This sloping mechanism will also, in theory, prevent puddling on the playing surface and direct excess water towards foul territory.

The rule book also provides several recommendations for the construction of new baseball fields. The NCAA recommends the outfield fence be located 330 feet from home plate to each foul pole, 375 feet to left and right center field, and 400 feet to straight away center field. If the distance down one line is less than 330 feet, the field should then ensure that the recommended distances for left center, right center, and center field are met. These recommendations become a requirement only for college baseball facilities owned by NCAA member institutions. Field 1 at New England Baseball Complex (NEBC) only spans 310 feet down the lines and 370 feet to center field.

A solid and secure permanent fence is recommended to enclose the outfield. The fence must be a minimum of 6 feet tall, although 8 feet is the recommended height. The rules further detail requirements for facilities that use forms of temporary fencing, both snow and flexible windscreen. Temporary fencing creates an opportunity to use the field for more than just baseball. In addition to the fence, the rule book recommends constructing a warning track in front of the outfield fences, the backstop, and the dugout fence at a minimum of 15 feet in width.

Another aspect to consider along with the field dimensions is the field layout itself. According to the NCAA rules, all new fields should be oriented considering the following factors: protection of players, comfort of spectators, season of use, latitude, east-west geographical location within time zone, prevailing winds, daylight saving time, background and obstacles or barriers. Many of these factors allude directly to the consideration of the sun. The sun plays a major factor in baseball games that is often overlooked, and it can even create a safety hazard if the field layout doesn't consider where the sun will rise and set. The field layout should accommodate the safety of the hitter first, followed by the catcher, then the pitcher, and the rest of the position players. If the sun prevents the hitter and catcher from seeing the pitcher throw the baseball it creates a clear safety hazard. The pitcher is the next most important because the pitcher has the least amount of time to react to a ball off the bat. For safety reasons, it is critical to consider how the sun and weather patterns can affect potential sites and field layouts.

Dugouts, Bullpens, and Batting Cages

Similarly, while looking at the baseball facilities of other teams in the NEWMAC, every facility has at least one batting cage. The batting cage, or batting cages, are strategically located on the home team's side of the field so that the home team receives the competitive advantage of more swings during batting practice. The inclusion of batting cages also provides more flexibility for practice plans. Currently, NEBC does not have outdoor batting cages. This means the only hitting WPI Baseball can do outside is on-field batting practice, which requires several people and many moving parts. Batting cages are a great place for players to get in extra practice on their own or with a teammate.

Each facility in the NEWMAC has its own unique dugouts, all with different features. The NCAA has no specific requirements for dugouts. With that being said, a collegiate baseball facility should have dugouts large enough to comfortably accommodate up to forty-five players. Last year, WPI Baseball carried a roster of over 40 players, and many other Division III teams carry similar numbers. Unlike the major leagues, all pitchers are expected to be in the dugout during the game, not in the bullpen. The bullpen is only utilized for pitchers to warm up. Dugouts should include space to store personal bags as well as team equipment like bats and helmets. Dugouts should also create a comfortable environment to watch the game.

Unlike dugouts, the NCAA has specific requirements when it comes to a facility's bullpens. Both teams are required to have a bullpen that is constructed to the exact measurements of the mound on the playing field. This includes the exact distance to home plate, mound height, and size of home plate. Bullpens should be set up outside the playing area and oriented so that the pitchers are throwing in the same direction as they will be throwing when entering the game. Each bullpen must have two mounds and be large enough to allow two pitchers to warm up at the same time. Bullpens can include additional features that cater to pitchers. An example of this is a plyometric wall somewhere in the bullpen. Today’s pitchers use plyometric balls to perform shoulder care exercises. These balls are weighted and need to be thrown into a hard surface. In addition, it is important to ensure that the pitchers have a space to hook up J-bands, another tool utilized for arm care. While these are not requirements, they are features that collegiate-level pitchers look for in a bullpen.

Light Specifications

The required lighting for a collegiate baseball field is 70 foot-candles in the infield and 50 foot-candles in the outfield. It is recommended to have four light poles in the infield and four in the outfield. The light horizontal uniformity for the infield is 2.0:1 and 2.5:1 for the outfield, see Figure 5 for more information on the placement of the light poles ("Baseball standard intercollegiate play", 2022).

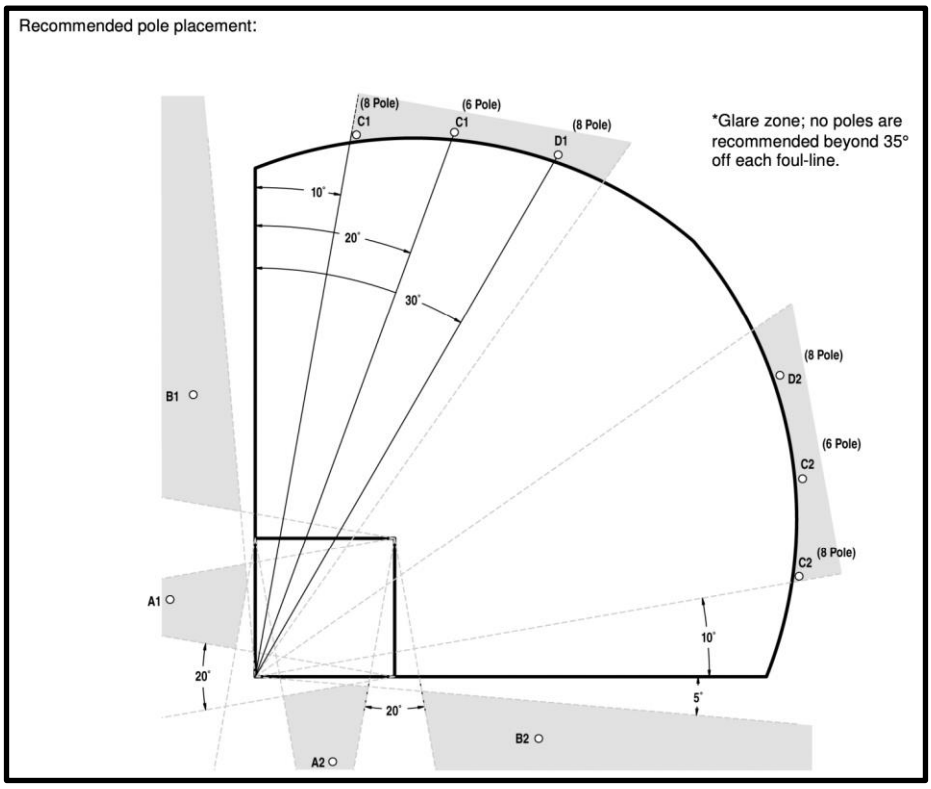

Figure 5: NCAA Baseball Best Lighting Practices ("Baseball standard intercollegiate play", 2022).

Scoreboard and Audio Systems

The first reports of a scoreboard being used at a sporting event came from an 1895 Harvard football game. The scoreboard was made of wood, and to change the score, a small piece of wood with a number was nailed to it ("Nissen Scoremaster"). In 1908, Chicago inventor George A. Baird created an electric baseball scoreboard that tracked balls, strikes, and outs. However, the manual scoreboard remained prevalent in American athletics into the 1920s and

1930s, because baseball executives feared that the electric scoreboard would hurt manual scorecard sales to the fans (Crawford, 2022).

Electric scoreboards weren't popular in stadiums until the late 1930s. As the electric scoreboard's popularity increased, so did the efforts to improve it. The early innovations to the electric scoreboard came in the form of the lights being used. In the 1940s the boards began to utilize incandescent lights creating brighter and more colorful displays. In the 1970s LED lights began to be used, again increasing the visual display. The 1960s and 1970s opened the doors for scoreboards to be used not only to keep score but also as entertainment for fans. This began at the Houston Astrodome in 1965 with its elaborate light display and advanced further in 1980 when the Los Angeles Dodgers implemented the first video board with replay capability (Crawford, 2020). From that point on, professional sports organizations continued to adopt video screens to enhance the fans' entertainment experience. In today's state-of-the-art stadiums, scoreboards are massive 4K LED displays that act as both a television and a scoreboard, much different than the original electric scoreboards.

The "Infinity Screen" at SoFi stadium, created by Samsung, is an excellent example of recent scoreboard innovation. Installed in 2020, the scoreboard is the largest video board in sports. The system is 70,000 square feet and has a 360° dual-sided screen with 4K resolution. N total, the screens include approximately 8 million pixels separated by just 8 millimeters ("SoFi Stadium", 2021). The system weighs over 1,000 metric tons and is longer and wider than the football field itself and its LED panels extend up to four stories. Over 260 speakers are integrated into the design contributing to the stadium's sound system (Digital Trends, 2022). Today LED panels utilize chip-on-board (COB) LED technology. COB involves mounting LED chips directly onto silicon carbide or sapphire substrates, and these panels consume less power while delivering increased brightness and quality ("COB LED Technology"). To ensure durability, LED panels are encased in steel and covered in resin or other transparent and durable plastics that help safeguard them against stadium environments. An image of the "Infinity Screen" can be seen below in Figure 6.

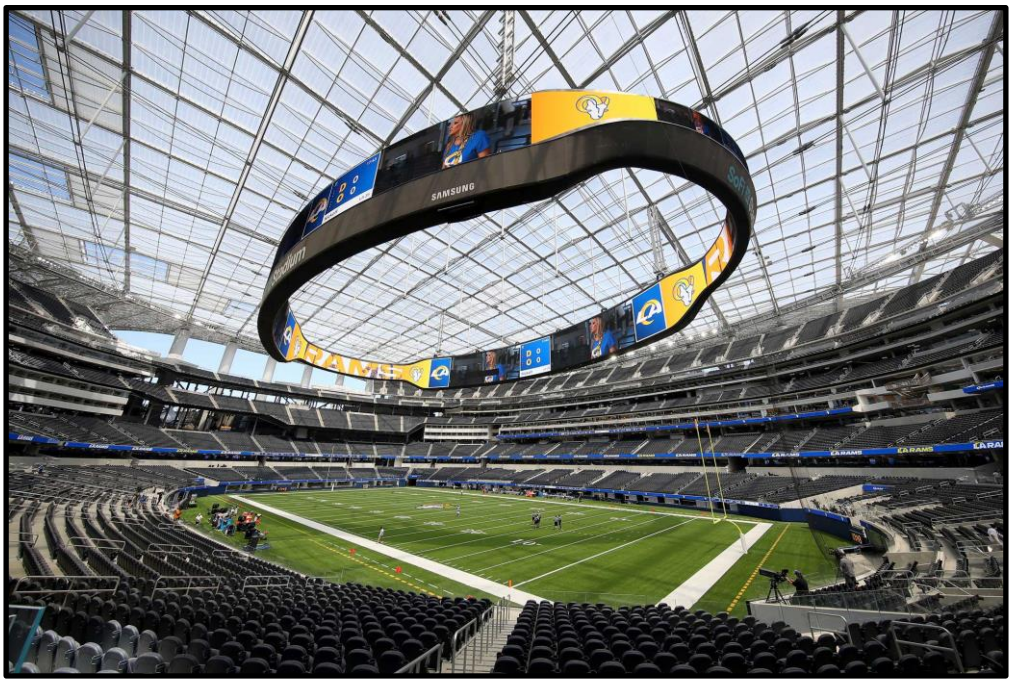

Figure 6: The “Infinity Screen” at SoFi Stadium (Crawford, 2020)

Division I programs, such as Mississippi State, are following in the footsteps of professional organizations as they recently installed a Jumbotron scoreboard with video and replay capabilities (Mississippi State, 2016). Since Division III athletics do not have the same funding capabilities, most NEWMAC facilities have simple electronic scoreboards that can be controlled remotely. At a minimum, a Division III field must have a scoreboard that tallies the score, the number of outs, the pitch count, the number of errors, and the number of hits each team has. This is essential for the fans watching the game as well as players to keep track. Often programs include the school's name, logo, or mascot as well as the field name somewhere on the scoreboard. An example of a typical NEWMAC scoreboard can be seen below in Figure 7.

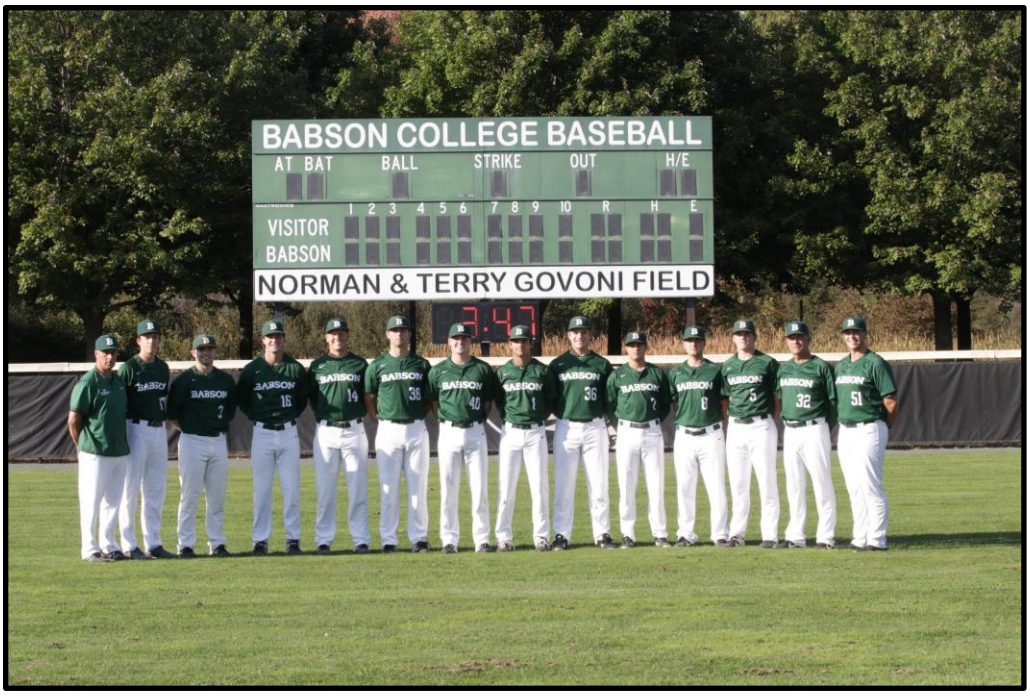

Figure 7: Babson College scoreboard at Norman and Terry Govoni Field (@BabsonBaseball X, 2022).

When installing a scoreboard, it is important to consider the placement and the structural integrity of the scoreboard itself. The scoreboard should be placed somewhere that is easy for both the players and fans to see. Typically, the scoreboard is located behind the outfield fence. Sometimes you can also find it in foul territory down the lines closer to the outfield fence. In terms of structural integrity, the scoreboard must be able to withstand harsh weather and winds in New England. Also, the scoreboard should be made of a material that can withstand impact from batted balls. Chapter 16 of the Massachusetts State Building Code contains provisions for determining wind loads based on the ultimate design wind speed for each city and town in the Commonwealth and the local site characteristics ("780 CMR Ninth Edition", 2018).

Today, LED scoreboards are commonly constructed from aluminum and steel alloys, both known for their excellent corrosion resistance. While aluminum alloys offer lightweight properties compared to steel, steel is recognized for its superior strength and impact resistance. Aluminum alloys boast a higher strength-to-weight ratio than steel, along with greater corrosion resistance (Gabrian, 2023). In addition to metals, LED scoreboards incorporate other materials to cover the LED digits. These materials must be weather-resistant, transparent, and impact-

resistant. Polycarbonate, acrylic, and sometimes fiberglass are commonly used for this purpose. Polycarbonate, a transparent and strong plastic, exhibits good thermal resistance. Acrylic shares similar properties with polycarbonate, although polycarbonate is slightly more durable with a higher yield tensile strength (MatWeb, 2024). The scoreboard itself is typically mounted to two or three steel W-beams, depending on its size, using beam clamps or angle brackets. In some cases, welding may also be utilized (Daktronics, 2024).

Division III baseball facilities use audio systems for music and game announcements. From a player's perspective, good quality music is appreciated for warmups and walk-up songs. Each team prepares for a game by taking batting practice, infield-outfield practice, and other warm-ups, which can last up to two hours. The home team is expected to play music during this time, and entertaining music is always appreciated. Currently, WPI Athletics brings a portable speaker system to NEBC that can barely be heard by players and fans alike. The installation of a permanent system with higher quality audio capabilities would improve the playing environment for the players and improve the production of the game for WPI Athletics.

Sustainability

Turf Fields vs. Grass Fields

Baseball fields can be made of artificial turf or natural, well-maintained grass. The benefit of a turf field is that it can be used in any climate, which is crucial considering the typical New England rain and snow during the winter and spring seasons. Rain causes no damage to a turf playing field if it is used during or after a rainstorm. However, if a grass field is used under the same weather conditions, the surface is prone to damage that would require prompt maintenance, resulting in a delay of a game.

The price of upkeep between turf and grass fields differs because grass fields require daily care to ensure suitable conditions for games. It is also costly to maintain a good grass field as it needs a daily intake of water and multiple man hours per day to keep the field in proper game shape. However, although a turf field typically costs more to install initially, there is much less cost with the upkeep of the field, and it does not require water to be suitable to play on ("Pros and cons of turf fields", 2017). Typically, a turf baseball field costs anywhere between

$420,000 to $1,140,000 to install, depending on the size, quality, infill, and design of the field and turf, as seen in Figure 8.

Baseball field construction costs	Turf baseball field	Natural grass
Construction costs	$420,000 - $1,140,000	$400,000 – $820,000
Maintenance costs	$6,000 - $10,000 x 10 years = $60,000 - $100,000	$18,000 – $44,000
Utilization time/year	2,800 hrs x 10 years = 28,000 hrs.	800 hrs. x 10 years = 8,000 hrs.
Cost per hour of use	$17 - $44	$52 - $108

Figure 8: Turf vs. Natural Grass Price Comparisons ("*Artificial Turf Field - sports venue calculator", (n.d.)).*

Turf Field Drainage

Turf fields drain differently depending on the area of the field. For rectangular areas and field shapes, most fields are graded between 1-2%. These areas slope from the middle section towards the perimeter of the turf. For baseball fields, certain areas require alternative drainage techniques such as hole-punched backing underneath the artificial material. This drainage method utilizes small holes spaced 4" to 6" apart to allow rainwater to seep through the turf and into the sub-base material and soil (Ideal Turf, 2022).

Figure 9: Turf Hole-Punch Backing System ("*Hole Punch Turf Drainage", (2022)).*

Field Lights

LED lighting provides a long-lasting light source for a baseball field compared to metal halide lights. LED lights save about 50% more energy than metal halide lights and require less maintenance. LED lights can be turned on and off easily and require no warm-up time, allowing the lighting to be provided instantaneously, compared to metal halide lighting which takes time to warm up before they reach maximum brightness. LED lights range from 400 to 1500 watts, and the common wattage for a baseball field is 1500 watts. Over time metal halide lights will fade and not be strong enough to light a baseball field because they can only last 6,000 to 15,000 hours of use. Fading is not an issue for LED lights, and they have a lifespan of up to 50,000 to 100,000 hours ("*Metal Halides vs. LEDs",* 2023).

3. Methodology

To locate and design the most suitable option for a new WPI Baseball facility, a structured methodology was developed to complete each objective. The methods included gathering relevant facility considerations, evaluating and choosing a facility location, and establishing a final facility design adhering to all local regulations and NCAA requirements, as appropriate. This section overviews the approach during the research, evaluation, determination, and design of the proposed WPI Baseball facility.

Establish Design Requirements

Initially, extensive field research, surveys, and interviews were conducted to gather insight on relevant facility considerations to identify design requirements.

Review Collegiate Baseball Facilities

While establishing the essential elements for the potential WPI Baseball facility, comparisons were made to relevant programs. Field research was conducted regarding the NEWMAC baseball facilities to establish the components of each home field. Elements that were identified and evaluated for each facility include field conditions, facility proximity to campus, dugouts, batting cages, and light configuration. Similarly, field research examined and compared baseball facilities of the surrounding Worcester-area universities. These colleges include Anna Maria College, Worcester State University, Assumption University, and Holy Cross. Comparisons evaluated the facility conditions among local programs.

A field note sheet was produced to record all observations regarding field layout, field elements, safety factors, and additional notes. The field notes were recorded individually and examined additional elements of baseball facilities that were previously overlooked. These preliminary observation sheets provided a set of standardized field notes to be referenced when completing subsequent site visits.

Survey WPI Baseball Players

A comprehensive survey was developed and electronically delivered to WPI Baseball players where they evaluated different facility criteria. The survey asked players to rank eight different components of a home facility from least important to most important.
The facility criteria used in this survey were later established as evaluation criteria for comparing and evaluating final facility options. The results from the survey dictated the weighting of the criteria within the evaluation rubric, making the more important items worth more points when scoring final facility options. The survey was distributed to the team's roster of 38 players with the goal of receiving 30 responses regarding their preferences.

Interview Faculty and Staff within WPI Athletics Department

Additionally, key personnel within the WPI Athletic Department were identified, including coaches and administrators. Several conversations were held with WPI Baseball Head Coach, Brendan Casey, as his vision for the program is an essential consideration for future options. An extensive set of interview questions was developed and asked to faculty and staff within the WPI Athletics Department through informal interviews. These questions focused on their preferences for the facility and sought their priorities when considering different athletic facility components. Preliminary questions were directed at their thoughts on the current baseball field situation along with any ideas for potential facility solutions. These findings were considered when developing the facility evaluation rubric during the decision-making process.

Select a Facility Location

Establish Decision Criteria

Initially, several factors and field elements were researched and considered before compiling them into eight separate criteria areas. These criteria considered, but were not limited to, field conditions, field layout and dimensions, dugouts, bullpens, storage areas, facility access, and proximity to campus. This baseline facility criteria were established prior to identifying any potential locations to avoid any biases or possibilities of favoring certain field options.
Interviews from faculty and staff within the WPI Athletic Department and the survey rankings

from WPI Baseball players were heavily considered when establishing the final criteria for facilities.

Once the criteria were established, a rubric was created to provide a scoring system for evaluating the facility options. Using the survey results that ranked the importance of field components, a weighting system was applied to the rubric, making some items more significantly scored when evaluated. This rubric was used following the research and designation of the final baseball field options.

Identify Facility Options

Extensive research was completed to search for potential WPI Baseball facility options. This research varied from using Google Earth, Google Maps, and driving around select locations throughout Worcester and nearby areas. This preliminary aspect of research focused on identifying baseball fields that have enough space for adequate baseball facilities and a college-sized field. Also, these potential facilities must not be solely owned by another team or organization during the spring season to be considered 'feasible' as a field option. When visiting the sites, field note sheets were completed individually to capture facility observations. Previous field note sheets from reviewing collegiate facilities were referenced as standardized observation worksheets.

Several different field options were considered and evaluated during the facility research process. These types of options include locating a vacant site with sufficient space, identifying and renovating an existing field, and a 'no-build' option. When finding vacant sites, the aim was to locate an area with sufficient space to build a college-sized field along with all necessary components and facilities. These essential components were identified based on the facility considerations and finalized criteria. The possibility of utilizing an existing field with the potential to meet the necessary requirements was another field option that was explored. Some key elements include undivided facility access during the spring season; space for batting cages, storage, and bullpens; scoreboard; and proper field dimensions. Lastly, a no-build option was evaluated which considered the option of not building any new facilities for the WPI Baseball program and remaining at NEBC in Northborough. While all associated travel costs may be unavailable to access, estimated transportation costs for an off-campus field were considered. At least one field or site was proposed for each option.

Evaluate Facility Options

Utilizing the evaluation rubric, all researched and identified facility options were compared based on the weighted scale. The researched facilities were narrowed down to three to five potential fields which were then evaluated and compared on the rubric as final options. The point system generated an objective point total for each field option, providing a systematic analysis while maintaining emphasis on more significant criteria. Additionally, a cost analysis was completed for all options, providing a breakdown of all associated expenses. The cost evaluation table presented a financial breakdown of site work, amenities, and materials for each facility design. By completing a weighted evaluation and cost analysis, all relevant factors were considered to establish a well-rounded facility location for the WPI Baseball program.

Facility Design and Development

A detailed design for the WPI Baseball facility was developed for the selected location. From this detailed design, a more thorough and complete cost analysis was prepared, estimating the expenses for all identified construction plans and field elements. Sustainable development was explored and implemented into the facility design when feasible.

Site Preparation

Once facility options were narrowed down, local building codes and zoning regulations were investigated to identify any potential obstacles to the proposed construction plans. Likewise, research was conducted on any permits relevant to the facility location and to address any licensing matters.

While focusing on the final facility option, all potential construction activities were researched and identified depending on the existing conditions of the selected location. Site work considerations included clearing, excavation, leveling and grading, procuring materials, and building structures. These activities are all intertwined and directly dependent on the state of the selected facility location. Despite differing site conditions, necessary demolition, excavation, and grading work was estimated for all potential facility structures. All material, utility, and

transportation costs were considered in the cost evaluation table. In addition, field drainage was considered as different turf materials and grading strategies were researched.

Develop Facility Elements

Following site preparation, the facility design was developed establishing several field elements. These components included field layout, dimensions, scoreboard, dugouts, bleachers, bullpens, batting cages, utilities and drainage, storage facilities, foul poles, light poles, and fencing. These field elements were developed based on existing conditions and considerations of the selected site. Each field element was designed and developed using individual Revit drawings. The scoreboard was modeled using SolidWorks. Static SolidWorks simulations were conducted to verify that both the scoreboard design and the chosen materials could withstand local weather conditions.

Develop Facility Design

Overall facility considerations were used to design the orientation of the field along with several elements around the selected site. A Revit drawing of the proposed facility was developed while incorporating all required design elements. Utilizing MassMapper GIS data, the topography of the selected site was imported into Revit where the field design and facility elements were implemented accordingly. An advanced 3D rendering of the facility was generated to display all incorporated elements including facility seating, storage, batting cages, and miscellaneous features.

Cost Estimate

Following the design of the new facility, a more detailed cost analysis was completed. The final cost analysis considered more precise dimensions for material costs based on the final facility design, while systematically considering all the established field elements. The final 3D design was the base for the cost analysis, capturing the full scope of work for the proposed facility. All sources used for cost data are cited and included in the References section.

While progressing through the methodology, the project advanced from gathering relevant field considerations and conducting evaluations to developing a finalized 3D design of

the proposed facility. By considering all relevant factors and completing a detailed analysis of field options, all essential components were evaluated and integrated to produce a viable facility option for the WPI Baseball program.

4. Results

Design Requirements

Research, surveys, and consultation with the WPI Baseball team and athletic department helped establish the facility considerations to identify design criteria.

Collegiate Baseball Facilities Review

Collegiate baseball facilities in surrounding areas were researched including Holy Cross, Assumption University, New England Baseball Complex, and Clark College. Initially, these locations were researched and analyzed via Google Earth, providing aerial views and field dimensions at each site. Once preliminary research was complete, site visits were conducted at each location where all project team members recorded an individual observation worksheet. This worksheet tracked notes and observations regarding facility safety, field layout, field elements, and additional notes, as seen in the sample worksheet below.

Table 1: Sample Field Note Worksheet for facility observations.

Field Note Worksheet

Name: Francis Polito Date: 10/10/23

Weather: 61°F Partly Cloudy Location: Assumption University

Safety	• Dips & holes in outfield grass
Field Layout (Dimensions, Sun Direction, Fencing)	Awkward dimensions in left center, 420' LC, 360' CF, this is due to the football field. 350' LF & RF, had to build around FB Field West to east direction of the field
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	1 Batting cage, Bullpen in LF, Poor condition, Poor seating arrangements, covered dugouts, grass Field, Portapotty for bathroom
Additional Notes	lose Balls into the woods, LF foul line

Additionally, the observation worksheets served as a standardized format for capturing field notes. These preliminary worksheets were later referenced while completing the site visits for the final facility options. All field note worksheets that were prepared while visiting the facilities at Holy Cross, Assumption University, Clark College, and NEBC are included in Appendix B.

WPI Baseball Players Survey Results

After reviewing several collegiate baseball facilities in the local area, we established eight categories as critical to a facility. In addition to reviewing the local fields, the existing problems with WPI Baseball's home facility were taken into consideration. The categories were as follows:

- Proximity to Campus
- Field Layout (Field dimensions, lights, facility space, etc.)
- Parking Area
- Dugouts and Bullpens
- Storage and Facilities (Equipment, locker rooms, bathrooms, etc.)
- Batting Cages
- Facility Access (Any limits to field access, conflicts with shared fields, etc.)
- Systems and Field Orientation (Scoreboard, speaker system, sun direction, batter's eye, fencing, seating, etc.)

A survey was created and sent to the WPI Baseball team, tasking them with rating the importance of each of the eight categories. Twenty-five out of forty-one players on the WPI Baseball team responded to the survey, resulting in a 61% response rate. While collecting data, seven of the responses appeared to assign priorities in the reverse order and after conferring with each respondent, the evaluations were adjusted to accurately reflect the survey results. The ranking of each category was averaged, and the results are displayed in the histogram below.

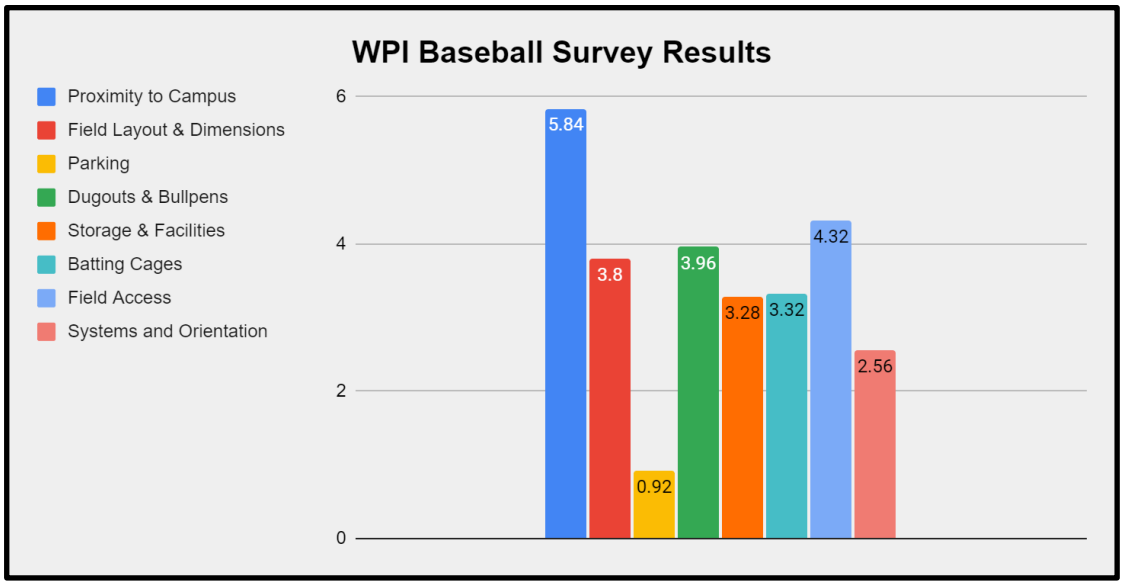

Figure 10: Histogram displaying the WPI Baseball survey results.

Based on the survey results, it is clear that the number one priority of the WPI Baseball team is to ensure the facility is in close proximity to campus. Field access scored as the second most important category. Field parking is the least of the team's priorities, followed by the facility's systems, scoreboard, and field orientation. The remaining four categories all scored an average between three and four.

WPI Athletic Faculty Interviews

The first interview was conducted with Brendan Casey, WPI's Head Baseball Coach. The interview was informal and focused primarily on conversation rather than scripted questions. Coach Casey is new to WPI, entering just his second season as the Head Baseball Coach. Prior to joining WPI, Coach Casey had been an assistant coach at Tufts University since 2016 and helped coach for his alma mater Azusa Pacific University for two years. WPI is the first program Coach Casey has coached that does not have its own baseball facility. Coach Casey admitted that using the New England Baseball Complex as the team's home facility brought some unique challenges in his first year. He recounted multiple occasions in which practice was cut short because of transportation issues and one time when practice was canceled because the bus didn't show up. He also mentioned that scheduling was more difficult with no option to be flexible in the team's practice time. Coach Casey explained that the lack of a baseball facility doesn't necessarily

hinder the ability to recruit prospective student-athletes; however, a new facility would be a huge selling point he could capitalize on. Coach Casey didn't see a home facility as a competitive game-changer, but he thought having one closer to campus would allow players to improve on their own time without limits.

Facility Location

Decision Criteria

After researching Division III baseball facilities and conducting discussions with WPI Baseball Coach Brendan Casey, nine criteria elements were identified to evaluate facility options. Using the results of the WPI Baseball Players Survey, the criteria were evaluated based on the importance of each element. Facility access and proximity to campus were weighted to count twice as much as the standard criteria elements, while the facility parking area was weighted half as much as the standard. The criteria formed a weighted grading system to evaluate all final facility options, as shown below in Table 2.

Table 2: Decision Criteria Rubric

Criteria	1	2	3	4	5
Proximity to Campus (x2)	Over 25 minute drive	15-25 minute drive	10-15 minute drive	5-10 minute drive	On campus; distance considered "walkable"
Existing Field	No existing field but adequate space; Land required to be leveled	Existing field but inadequate dimensions and lights	Existing field and dimensions but inadequate lights	Existing field and lights but inadequate dimensions	Existing field with adequate dimensions and lights
Parking Area (x0.5)	No existing parking lot; minimal street space	Small existing lot; some space for street parking	Existing parking lot (<15 spaces); some space for street parking	Existing parking lot (< 30 spaces); adequate street space and space for buses	Existing parking lot(s) (>30 spaces); adequate street space nearby and allotted bus areas
Dugouts and Bullpens	No dugouts or allotted fencing; No bullpens	Existing dugout fencing with no coverage; bullpens include one mound per side	Covered dugout (> 200 sq. ft); bullpens include two mounds per side with no fencing	Covered dugout (> 250 sq. ft); bullpens include two mounds per side with fencing	Covered dugout (> 300 sq. ft); bullpens include two mounds per side with fencing with bench space
Storage / Facilities	No storage for equipment	Minimum storage for equipment	Adequate storage	Adequate storage with locker rooms or bathrooms	Adequate storage with locker rooms and bathrooms
Batting Cages	No existing cages and no space for future installation	No existing cages but adequate space for future installation	No existing cages but adequate space for future installation of multiple cages	Existing batting cage (1)	Existing batting cages (>1) with turf mattings
Facility Access (x2)	Facility access limited in spring season and fall season	Facility access is limited in spring season but undivided in fall season	Facility access is limited in fall season but undivided in spring season	Facility access is generally undivided but some non-game conflicts exist	Facility access is undivided during spring season and fall season
Scoreboard and Field Orientation	No scoreboard or speaker system; poor field orientation and seating	Facility has a scoreboard but no speaker system; poor field orientation and seating.	Facility has a scoreboard and speaker system; adequate seating and sun direction.	Facility has a scoreboard and speaker system; extensive seating >30 seats; ideal sun direction	Facility has a scoreboard and speaker system; extensive seating >50 seats; ideal sun direction
			Total:	**/ 47.5**	

Facility Options

Several facilities were evaluated including baseball fields owned by other teams, vacant sites with the necessary space to build a baseball field, and a no-build option where the team would remain at their current home field. Six facility sites were identified as viable options with three having existing fields, two being vacant sites, and the last being NEBC as the no-build option. All potential sites were visited, and observation worksheets were completed for each. The commute to each site was researched while considering weekday afternoon traffic, simulating typical bus times for practice.

When considering existing fields in the Worcester area, baseball fields at Worcester Academy, Lake Park, and Cristoforo Colombo Park were examined. The New Balance Field, owned by Worcester Academy, is located in an open grass area along with soccer fields and a softball field. The baseball field is currently used by the junior varsity and middle school teams at the Academy for practices and games. The field has no fence but contains enough space to have adequate collegiate dimensions. The site is located over four miles away and takes anywhere from twelve to thirty-five minutes to get there, as seen in Figure 11 below.

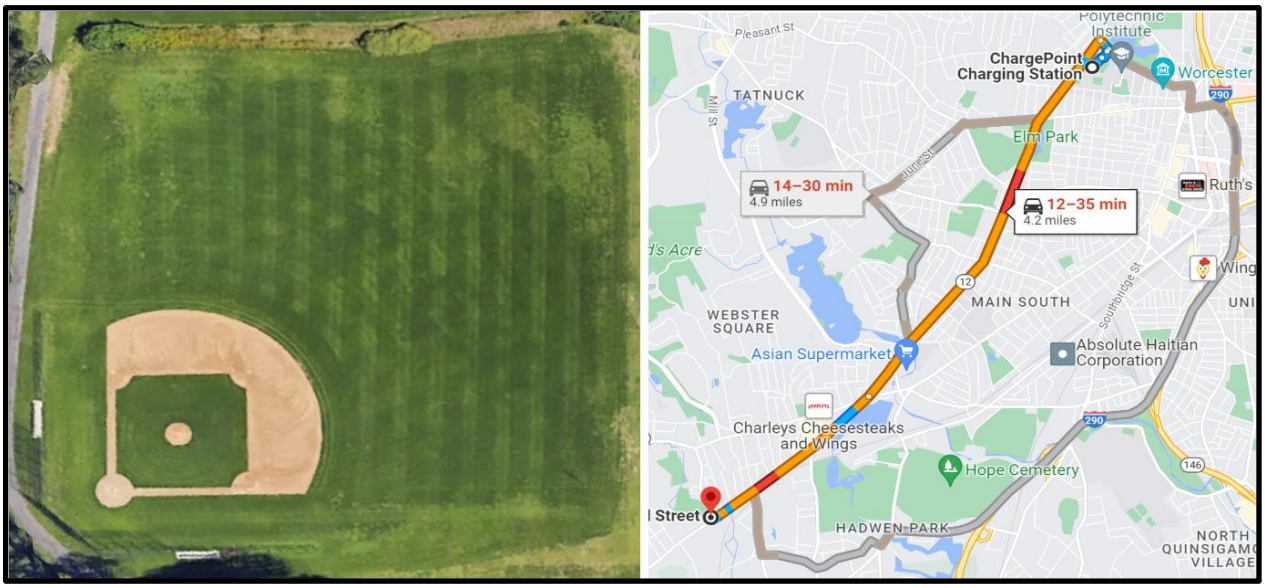

Figure 11: New Balance field and route from WPI campus.

Lake Park's baseball field, Tivnan Field, is located adjacent to Lake Quinsigamond and has adequate collegiate dimensions with a shorter right-center field fence. The field has lights,

dugouts, fencing, and seating, as seen in Figure 12 below. Currently, the facility is owned by the City of Worcester.

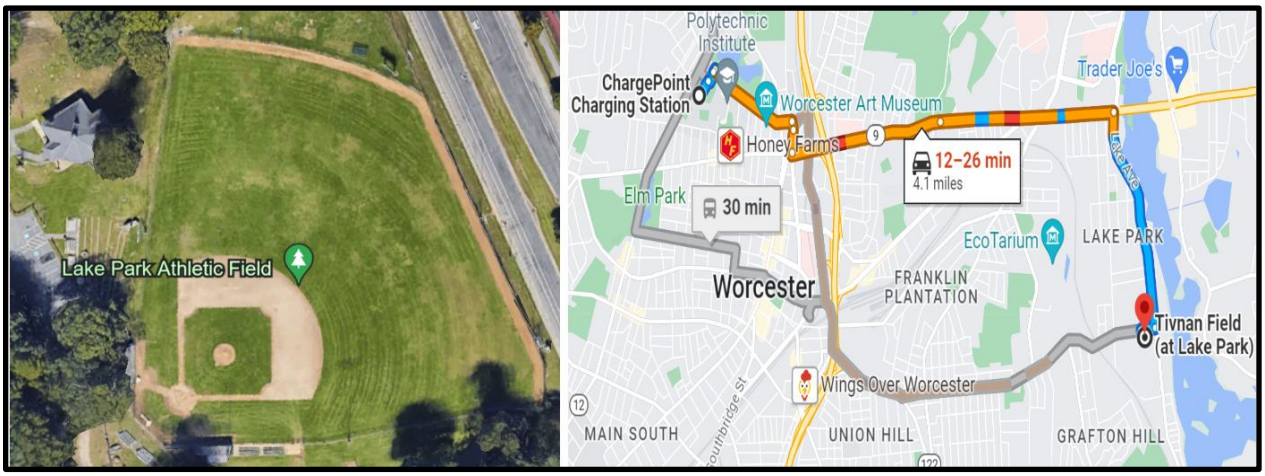

Figure 12: Tivnan Field and route from WPI campus.

Cristoforo Colombo Park's baseball field is located on Shrewsbury Street in a recreational area surrounded by a water park, football field, playground, and tennis courts, as seen in Figure 13. This site was considered but deemed infeasible due to the short distance in right field and the inability to expand with the playground just beyond the fence.

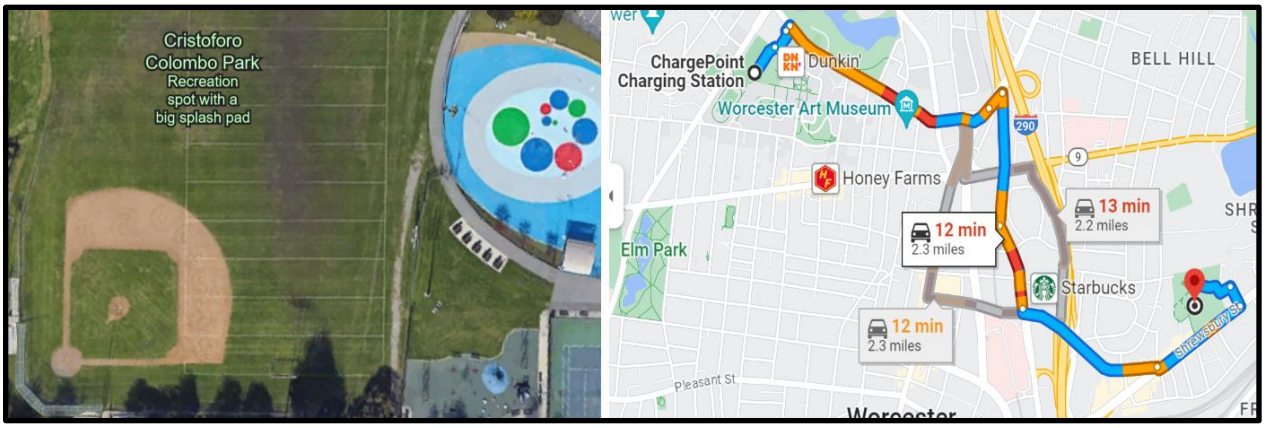

Figure 13: Cristoforo Colombo Park baseball field and route from WPI campus.

Two sites with the potential space for a baseball field were identified and further evaluated based on their feasibility for a future field. First, the WPI Townhouses property is a viable option located on the edge of campus next to Institute Park, as seen in Figure 14 below. The 6.6 acre property has twenty-eight townhouses which have been underutilized in recent

years. The property is currently owned by WPI, and its perimeter is drawn in red below (Worcester MA GIS, 2023).

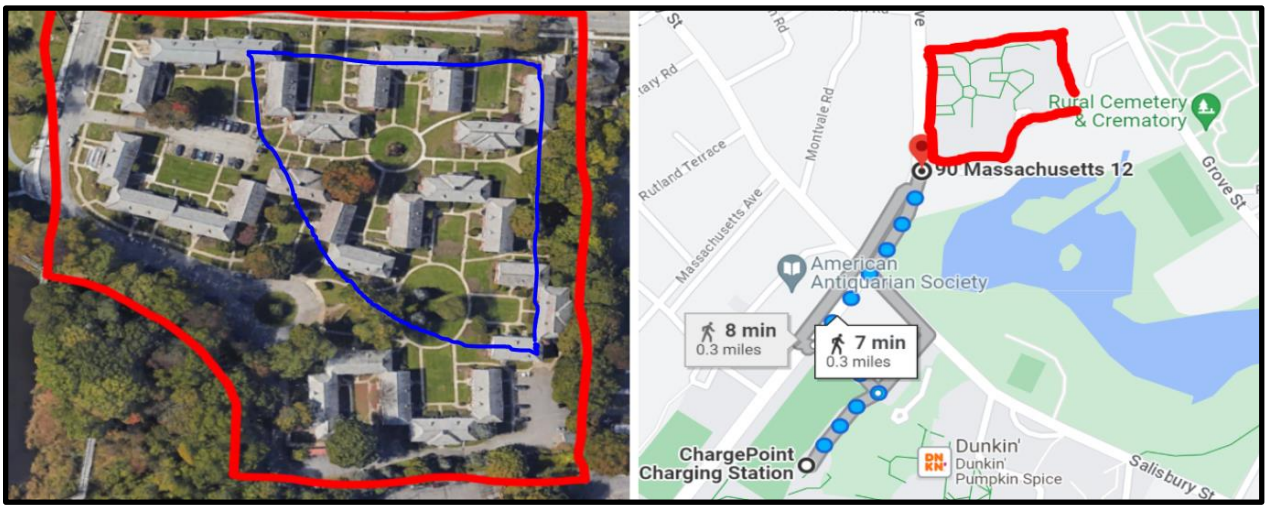

Figure 14: WPI Townhouses property and route from WPI campus.

The second site is located on Park Avenue adjacent to Beaver Brook Park. It is a vacant lot with the potential to house a baseball field, outlined in red in Figure 15 below. However, this site poses issues with land acquisition because the field itself overlaps two different properties requiring multiple purchases, displayed and labeled below. Any facility elements outside of the field may require additional acquisitions, making this site unrealistic for a home baseball field.

Figure 15: Vacant lot near Beaver Brook Park and route from WPI campus.

A "No-Build" option would assume that the WPI Baseball team continues to practice and play games at NEBC, when the team is granted access to the field. This option considers all additional costs incurred from not having a home field including bus costs for practices and

home games, along with fees associated with field access. Figure 16 below displays the baseball facility and the typical commute to NEBC.

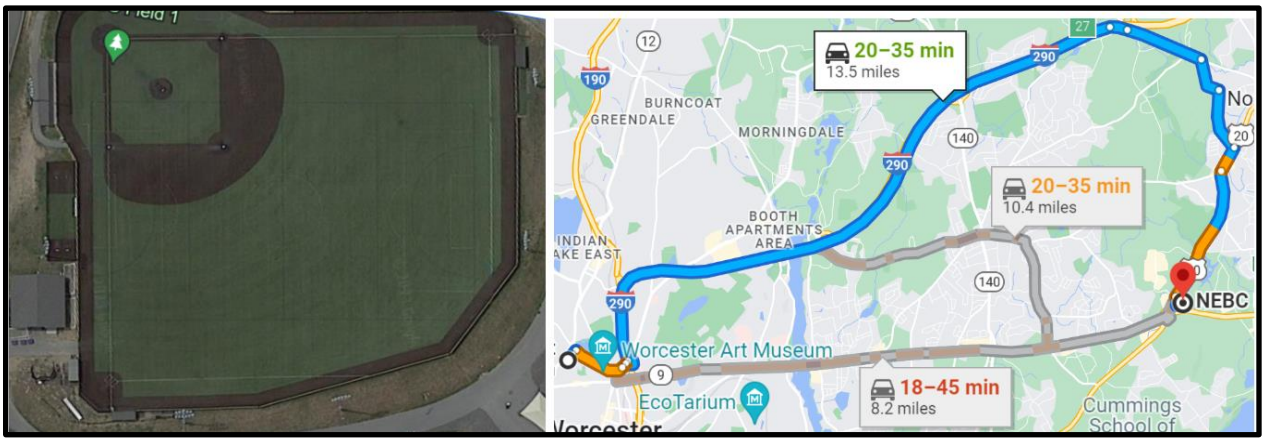

Figure 16: NEBC Field 1 and route from WPI campus.

After the initial evaluation of facility options, Worcester Academy, Tivnan Park, WPI Townhouses, and the No-Build option were identified as the four possible solutions for a home baseball facility. The final three, potential sites were researched in more detail, and all logistics were considered during the evaluation and scoring process. Site visits were conducted at each of the final facility locations, and the field note worksheets are included in Appendix B.

New Balance Field

New Balance Field is utilized by Worcester Academy but is located nearly five miles from their campus. Table 3 below overviews the facility evaluation for the New Balance Field (Worcester Academy, 2023).

Table 3: New Balance Field Evaluation Rubric.

New Balance Field					
Criteria	**1**	**2**	**3**	**4**	**5**
Proximity to Campus (x2)	Over 25 minute drive	15-25 minute drive	10-15 minute drive	5-10 minute drive	On campus; distance considered "walkable"
Existing Field	No existing field but adequate space; Land required to be leveled	Existing field but inadequate dimensions and lights	Existing field and dimensions but inadequate lights	Existing field and lights but inadequate dimensions	Existing field with adequate dimensions and lights
Parking Area (x0.5)	No existing parking lot; minimal street space	Small existing lot; some space for street parking	Existing parking lot (<15 spaces); some space for street parking	Existing parking lot (< 30 spaces); adequate street space and space for buses	Existing parking lot(s) (>30 spaces); adequate street space nearby and allotted bus areas
Dugouts and Bullpens	No dugouts or allotted fencing; No bullpens	Existing dugout fencing with no coverage; bullpens include one mound per side	Covered dugout (> 200 sq. ft); bullpens include two mounds per side with no fencing	Covered dugout (> 250 sq. ft); bullpens include two mounds per side with fencing	Covered dugout (> 300 sq. ft); bullpens include two mounds per side with fencing with bench space
Storage / Facilities	No storage for equipment	Minimum storage for equipment	Adequate storage	Adequate storage with locker rooms or bathrooms	Adequate storage with locker rooms and bathrooms
Batting Cages	No existing cages and no space for future installation	No existing cages but adequate space for future installation	No existing cages but adequate space for future installation of multiple cages	Existing batting cage (1)	Existing batting cages (>1) with turf mattings
Facility Access (x2)	Facility access limited in spring season and fall season	Facility access is limited in spring season but undivided in fall season	Facility access is limited in fall season but undivided in spring season	Facility access is generally undivided but some non-game conflicts exist	Facility access is undivided during spring season and fall season
Scoreboard and Field Orientation	No scoreboard or speaker system; poor field orientation and seating	Facility has a scoreboard but no speaker system; poor field orientation and seating.	Facility has a scoreboard and speaker system; adequate seating and sun direction.	Facility has a scoreboard and speaker system; extensive seating >30 seats; ideal sun direction	Facility has a scoreboard and speaker system; extensive seating >50 seats; ideal sun direction
			Total:	**21.5 / 47.5**	

When considering each evaluation criterion, the commute to New Balance Field runs into traffic on Route 9 and the field does not have any existing lights. The gravel parking lot provides space for at least 30 vehicles and team buses. Adjacent to the lot, there is an existing building with a training room, storage garage, and bathrooms. The existing field setup has 170 sq. ft. dugouts with no overhead coverage and no bullpens on either side of the field. The field has no fence, but the open grass area provides sufficient space for collegiate field dimensions. In foul territory near the right field pole, there is space for batting cages to be installed behind a fence separating the field of play. Currently, there is no scoreboard or speaker system at New Balance Field, but adequate space can be allotted beyond the right-centerfield fence. Since this field is primarily used by Worcester Academy sports, it is assumed that field access would be limited in both the spring and fall seasons.

Table 4: Tivnan Field Evaluation Rubric.

Tivnan Field					
Criteria	**1**	**2**	**3**	**4**	**5**
Proximity to Campus (x2)	Over 25 minute drive	15-25 minute drive	10-15 minute drive	5-10 minute drive	On campus; distance considered "walkable"
Existing Field	No existing field but adequate space; Land required to be leveled	Existing field but inadequate dimensions and lights	Existing field and dimensions but inadequate lights	Existing field and lights but inadequate dimensions	Existing field with adequate dimensions and lights
Parking Area (x0.5)	No existing parking lot; minimal street space	Small existing lot; some space for street parking	Existing parking lot (<15 spaces); some space for street parking	Existing parking lot (< 30 spaces); adequate street space and space for buses	Existing parking lot(s) (>30 spaces); adequate street space nearby and allotted bus areas
Dugouts and Bullpens	No dugouts or allotted fencing; No bullpens	Existing dugout fencing with no coverage; bullpens include one mound per side	Covered dugout (> 200 sq. ft); bullpens include two mounds per side with no fencing	Covered dugout (> 250 sq. ft); bullpens include two mounds per side with fencing	Covered dugout (> 300 sq. ft); bullpens include two mounds per side with fencing with bench space
Storage / Facilities	No storage for equipment	Minimum storage for equipment	Adequate storage	Adequate storage with locker rooms or bathrooms	Adequate storage with locker rooms and bathrooms
Batting Cages	No existing cages and no space for future installation	No existing cages but adequate space for future installation	No existing cages but adequate space for future installation of multiple cages	Existing batting cage (1)	Existing batting cages (>1) with turf mattings
Facility Access (x2)	Facility access limited in spring season and fall season	Facility access is limited in spring season but undivided in fall season	Facility access is limited in fall season but undivided in spring season	Facility access is generally undivided but some non-game conflicts exist	Facility access is undivided during spring season and fall season
Scoreboard and Field Orientation	No scoreboard or speaker system; poor field orientation and seating	Facility has a scoreboard but no speaker system; poor field orientation and seating.	Facility has a scoreboard and speaker system; adequate seating and sun direction.	Facility has a scoreboard and speaker system; extensive seating >30 seats; ideal sun direction	Facility has a scoreboard and speaker system; extensive seating >50 seats; ideal sun direction
			Total:	**23.5 / 47.5**	

The commute to Tivnan Field varies anywhere between twelve and twenty-five minutes depending on the traffic on Route 9. The field is owned by the City of Worcester and is a part of Lake Park. The field has adequate dimensions and existing lighting; however, it is a dirt field. An existing parking lot provides space for about fifteen cars but limited space for team buses. Adjacent to the lot, there is an existing building with bathrooms and another building that overlooks the field. The field has 400 sq. ft. dugouts with low overhead coverage and two bullpens behind the first base dugout. The bullpens do not have fencing but are within the field of play. Behind the left field fence, there is plenty of space for batting cages to be installed. Currently, there is a scoreboard and speaker system installed at the field; however, both look fairly outdated, especially the speaker system. As mentioned, the field is owned by the City of Worcester, so it is assumed that field access would be somewhat limited in both the spring and fall seasons.

Table 5: WPI Townhouses Evaluation Rubric.

WPI Townhouses					
Criteria	**1**	**2**	**3**	**4**	**5**
Proximity to Campus (x2)	Over 25 minute drive	15-25 minute drive	10-15 minute drive	5-10 minute drive	On campus; distance considered "walkable"
Existing Field	No existing field but adequate space; Land required to be leveled	Existing field but inadequate dimensions and lights	Existing field and dimensions but inadequate lights	Existing field and lights but inadequate dimensions	Existing field with adequate dimensions and lights
Parking Area (x0.5)	No existing parking lot; minimal street space	Small existing lot; some space for street parking	Existing parking lot (<15 spaces); some space for street parking	Existing parking lot (< 30 spaces); adequate street space and space for buses	Existing parking lot(s) (>30 spaces); adequate street space nearby and allotted bus areas
Dugouts and Bullpens	No dugouts or allotted fencing; No bullpens	Existing dugout fencing with no coverage; bullpens include one mound per side	Covered dugout (> 200 sq. ft); bullpens include two mounds per side with no fencing	Covered dugout (> 250 sq. ft); bullpens include two mounds per side with fencing	Covered dugout (> 300 sq. ft); bullpens include two mounds per side with fencing with bench space
Storage / Facilities	No storage for equipment	Minimum storage for equipment	Adequate storage	Adequate storage with locker rooms or bathrooms	Adequate storage with locker rooms and bathrooms
Batting Cages	No existing cages and no space for future installation	No existing cages but adequate space for future installation	No existing cages but adequate space for future installation of multiple cages	Existing batting cage (1)	Existing batting cages (>1) with turf mattings
Facility Access (x2)	Facility access limited in spring season and fall season	Facility access is limited in spring season but undivided in fall season	Facility access is limited in fall season but undivided in spring season	Facility access is generally undivided but some non-game conflicts exist	Facility access is undivided during spring season and fall season
Scoreboard and Field Orientation	No scoreboard or speaker system; poor field orientation and seating	Facility has a scoreboard but no speaker system; poor field orientation and seating.	Facility has a scoreboard and speaker system; adequate seating and sun direction.	Facility has a scoreboard and speaker system; extensive seating >30 seats; ideal sun direction	Facility has a scoreboard and speaker system; extensive seating >50 seats; ideal sun direction
			Total:	**29 / 47.5**	

The WPI Townhouses are only a five-minute walk from the Sports and Recreation Center. Currently, the site consists of just under thirty townhouses used as housing for upper-level students. The plot of land is roughly 305,000 SF (Google Earth), which provides sufficient space for a baseball facility if the townhouses were demolished. The plot of land includes a driveway and three separate parking areas, one of which would be demolished. Just under thirty cars could park in the two existing lots, and there is also room for team buses. While there is no existing field, there is plenty of space to include properly sized dugouts, bullpens, batting cages, and storage for equipment. There is insufficient space for locker rooms, but that is not of concern with the close proximity to campus. No existing field provides WPI with the opportunity to design the field exactly how they want it, which includes up-to-date scoreboards, speaker systems, and any additional features the athletic department may see fit. Very importantly, if WPI was to build a field on campus, it would provide the team with undivided facility access during all seasons.

Table 6: New England Baseball Complex Evaluation Rubric.

New England Baseball Complex - Field 1					
Criteria	**1**	**2**	**3**	**4**	**5**
Proximity to Campus (x2)	Over 25 minute drive	15-25 minute drive	10-15 minute drive	5-10 minute drive	On campus; distance considered "walkable"
Existing Field	No existing field but adequate space; Land required to be leveled	Existing field but inadequate dimensions and lights	Existing field and dimensions but inadequate lights	Existing field and lights but inadequate dimensions	Existing field with adequate dimensions and lights
Parking Area (x0.5)	No existing parking lot; minimal street space	Small existing lot; some space for street parking	Existing parking lot (<15 spaces); some space for street parking	Existing parking lot (< 30 spaces); adequate street space and space for buses	Existing parking lot(s) (>30 spaces); adequate street space nearby and allotted bus areas
Dugouts and Bullpens	No dugouts or allotted fencing; No bullpens	Existing dugout fencing with no coverage; bullpens include one mound per side	Covered dugout (> 200 sq. ft); bullpens include two mounds per side with no fencing	Covered dugout (> 250 sq. ft); bullpens include two mounds per side with fencing	Covered dugout (> 300 sq. ft); bullpens include two mounds per side with fencing with bench space
Storage / Facilities	No storage for equipment	Minimum storage for equipment	Adequate storage	Adequate storage with locker rooms or bathrooms	Adequate storage with locker rooms and bathrooms
Batting Cages	No existing cages and no space for future installation	No existing cages but adequate space for future installation	No existing cages but adequate space for future installation of multiple cages	Existing batting cage (1)	Existing batting cages (>1) with turf mattings
Facility Access (x2)	Facility access limited in spring season and fall season	Facility access is limited in spring season but undivided in fall season	Facility access is limited in fall season but undivided in spring season	Facility access is generally undivided but some non-game conflicts exist	Facility access is undivided during spring season and fall season
Scoreboard and Field Orientation	No scoreboard or speaker system; poor field orientation and seating	Facility has a scoreboard but no speaker system; poor field orientation and seating.	Facility has a scoreboard and speaker system; adequate seating and sun direction.	Facility has a scoreboard and speaker system; extensive seating >30 seats; ideal sun direction	Facility has a scoreboard and speaker system; extensive seating >50 seats; ideal sun direction
			Total:	**24.5 / 47.5**	

In the no-build option, WPI Baseball would continue to practice and play at the New England Baseball Complex. As outlined, travel to the NEBC is typically a thirty-minute drive considering the traffic patterns at 3 PM. The facility contains an existing turf field with adequate dimensions for collegiate play. The parking area has plenty of space for cars and team buses. The dugouts are a sufficient size for college baseball and are covered. There is a turf bullpen on each baseline that is fenced off and has two mounds. The first base dugout has a closet with enough room to store team equipment. There are bathrooms relatively close to the playing field, but there is no access to locker rooms. In addition, the facility has no access to batting cages, or any space to include them. The scoreboard is perfectly suitable and the sun direction with the current field layout is acceptable, but there is no built-in speaker system. The problem with the New England Baseball Complex, along with the commute from campus, is the highly restricted field access. Having limited access for extra work and not being able to play home games at your home facility on Fridays and Saturdays are significant problems for a college baseball program.

Cost Evaluation Table

An estimate for each of the four final options was created taking into consideration all costs associated with each location. The full cost estimate for the WPI Townhouses and New Balance Fields can be found in Appendix C. The full cost estimate for Tivnan Field and the No-Build Option can be found in Appendix D. Table 7 below presents the estimated cost for each option, along with a breakdown of the necessary items. The values for the cost estimates were obtained from RSMeans (2022) and additional research, such as material and equipment expenses and a cost index.

Table 7: Site Breakdown and Estimated Cost Table.

Site	Breakdown	Estimated Cost
New Balance Field	Site Prep, Dugouts, Bullpens, Scoreboard, Sound System, Fencing, Batting Cages, Seating, Storage, Artificial Grass Surfacing, Lighting, Transportation	$2,210,000
Tivnan Field	Demolition, Site Prep, Dugouts, Bullpens, Scoreboard, Sound System, Batting Cages, Storage, Artificial Grass Surfacing, Transportation	$2,190,000
WPI Townhouses	Demolition, Site Prep, Dugouts, Bullpens, Scoreboard, Sound System, Fencing, Batting Cages, Seating, Storage, Artificial Grass Surfacing, Lighting, Utilities	$3,410,000
No - Build	Estimated Cost of Facility Access Fees Estimated Cost of Transportation	$64,000.00

Final Evaluation

The final evaluation of all four options includes the evaluation and the estimated costs seen in Table 8. Based on the weighted design criteria evaluations, the WPI Townhouses is the best option for WPI Baseball with the highest score of 29/47.5. The Townhouses have the closest proximity to campus and have the best potential facility access which are key components for the program. However, the cost is the highest considering the demolition of the existing structures and full construction of the baseball facility. The lowest price among the cost estimates proved to be the No-Build Option, and the costs that were taken into consideration were the facility access and transportation costs. However, with the No-Build Option and continuing with the NEBC, there is limited field access and the time to get there is typically a 30-minute commute. Another issue with staying at NEBC is the concern of the complex being closed in the near future to build an apartment complex (Collins, 2023).

The other two facility options include New Balance Field owned by Worcester Academy and Tivnan Field which is owned by the City of Worcester. These options have the two lowest scores compared to all four site locations. The issue around these two facilities is the ability to share the field with Worcester Academy and the City of Worcester. Putting over $2,000,000 into a field that wouldn't be solely WPI's seems unreasonable. Along with that, there would still be transportation costs to get to the fields because the New Balance Field is 4.6 miles away and Tivnan Field is 4 miles away.

Although the site of the WPI Townhouses is the most expensive option, it is an investment that will better WPI Athletics, WPI Baseball, and the Worcester community as a whole. The proximity to campus allows easier access for the WPI community to support its team and improves the appeal of the school for prospective students. Based on the design criteria scores and cost evaluations presented in Table 8 below, the WPI Townhouses emerged as the optimal choice for constructing a facility dedicated to WPI Baseball.

Table 8: Final Evaluation and Cost Estimate Table.

Site	Evaluation	Estimated Cost
New Balance Field	21.5 / 47.5	$2,210,000
Tivnan Field	23.5 / 47.5	$2,190,000
WPI Townhouses	**29 / 47.5**	$3,410,000
No - Build	24.5 / 47.5	**$64,000.00**

Facility Design & Development

The WPI Townhouses site was analyzed, and several different field locations were evaluated within the site. By orienting the field in the northwest corner of the parcel, all facility elements could be incorporated with adequate space while also preserving the existing roads and parking areas.

Site Preparation

The site of the WPI Townhouses was evaluated, and all necessary site preparation activities were considered in order to construct a baseball facility. Currently, the site has twenty-eight townhouses with three main courtyard areas and some concrete walkways between the townhouse groupings. All of the townhouses must be demolished, and the material must be cleared from the site and disposed of following proper guidelines. This demolition process will include the removal of each townhouse foundation as well. The plotted work area and structures designated for demolition are labeled in red in Figure 17.

Figure 17: Baseball Facility Site Preparation Diagram.

When modeling the facility in Revit, the site preparation was simulated using an imported topographical data for the site, as seen below in Figure 18. This parcel data helped identify the required site preparation activities, providing realistic considerations for the facility. The

topographical data was extracted using the MassMapper GIS system, allowing an accurate representation of the site.

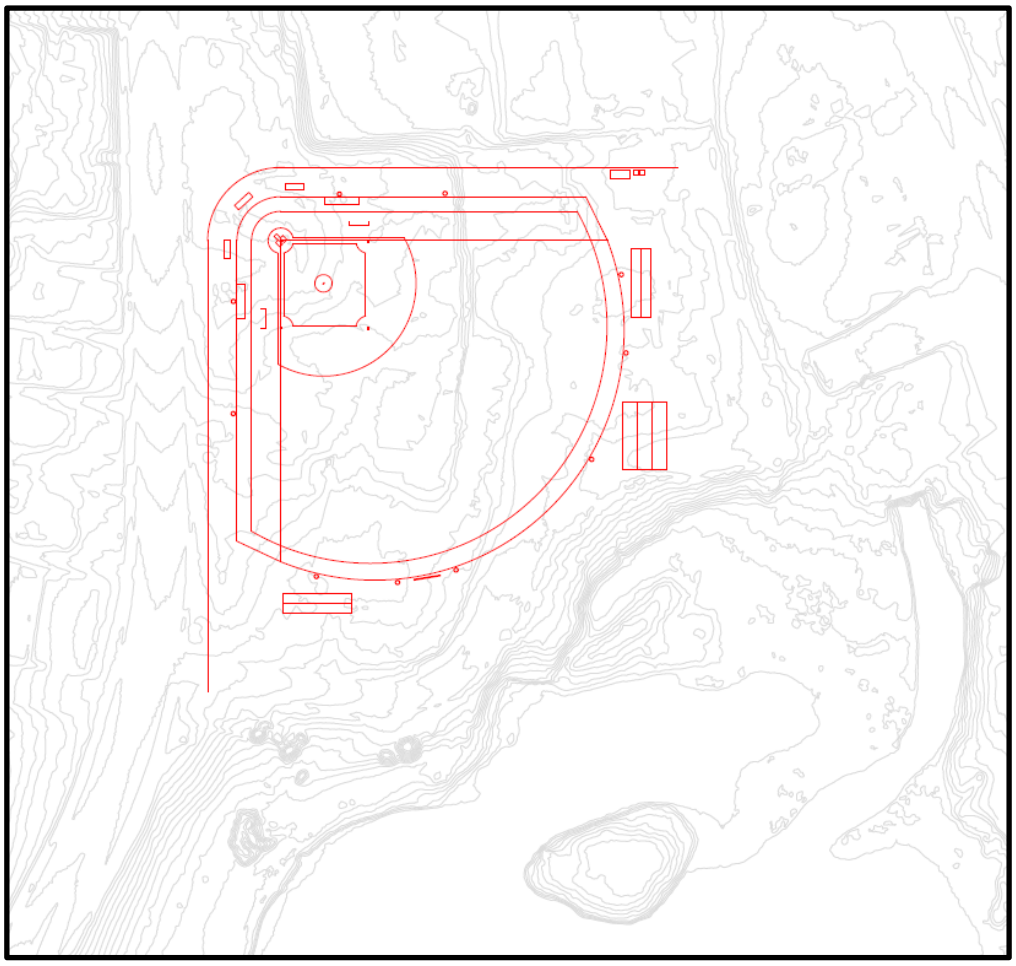

Figure 18: Baseball Facility Topography Diagram.

Drainage

To ensure a level site and playing surface, the land inside of the parking area and roadway will be excavated, leveled, and graded. Most of the work area will be graded completely flat while some areas will be slightly sloped to improve drainage on the field. Although the proposed field material has perforated backing underneath the turf, certain areas will be sloped to prevent standing water on the playing surface. As seen in Figure 19, the outfield is sloped from the center field to the foul lines on both sides. The warning track outlines the perimeter of the field of play and is sloped downwards towards the fence. The backing of the turf in the infield area is hole-punched with 4-6” spacing allowing water to seep through the playing surface.

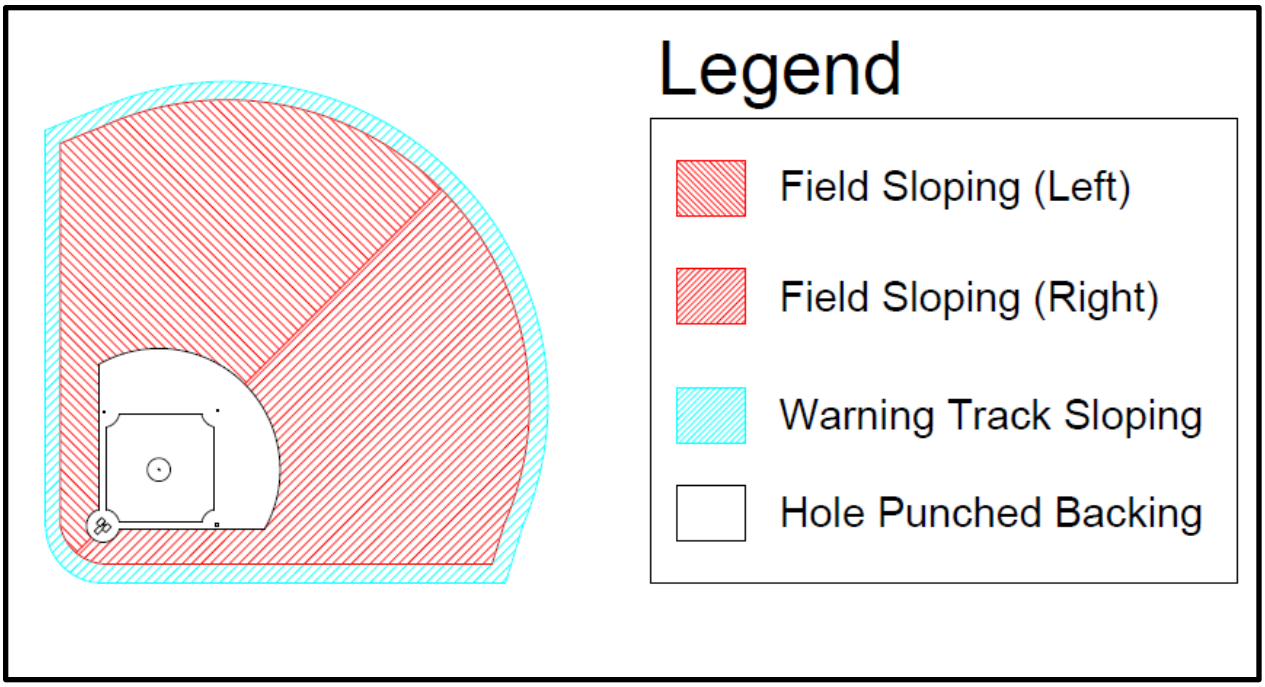

Figure 19: Baseball Facility Drainage Diagram.

Facility Elements

The proposed facility includes the scoreboard, dugouts, bleachers, bullpens, batting cages, utilities, storage, light poles, foul poles, safety netting, fencing, and playing field. These components are essential to the functionality of the field, along with the comfort and safety of the spectating environment. All components were designed in individual Revit files before being incorporated into the main facility drawing. The facility drawing initially included the field, fencing, and safety netting, and all the other facility components were developed and imported into the central Revit file. An aerial 2D diagram of the proposed facility is displayed below in Figure 20.

Home plate of the field is located closest to the northwest corner of the property with the outfield grass being closer to the existing roadway and parking. By keeping the existing roadways, there will be sufficient space for visiting buses and parking spots for fans. Players, fans, and umpires will enter the facility from Park Avenue and approach the field of play from the outfield. Gates entering the playing field will be located at each foul pole and dugout.

Behind the home plate backstop, there is a concrete walkway that extends the length of the field on both fence lines. This allows a safe and accessible area for spectators along with an

adequate surface for bleachers. Additionally, the backstop provides direct protection for fans in the facility, and the safety netting along the property lines helps prevent baseballs from exiting the facility towards the road or surrounding properties. The field orientation creates ample sun in a direction that protects the hitters, catchers, and pitchers throughout the day.

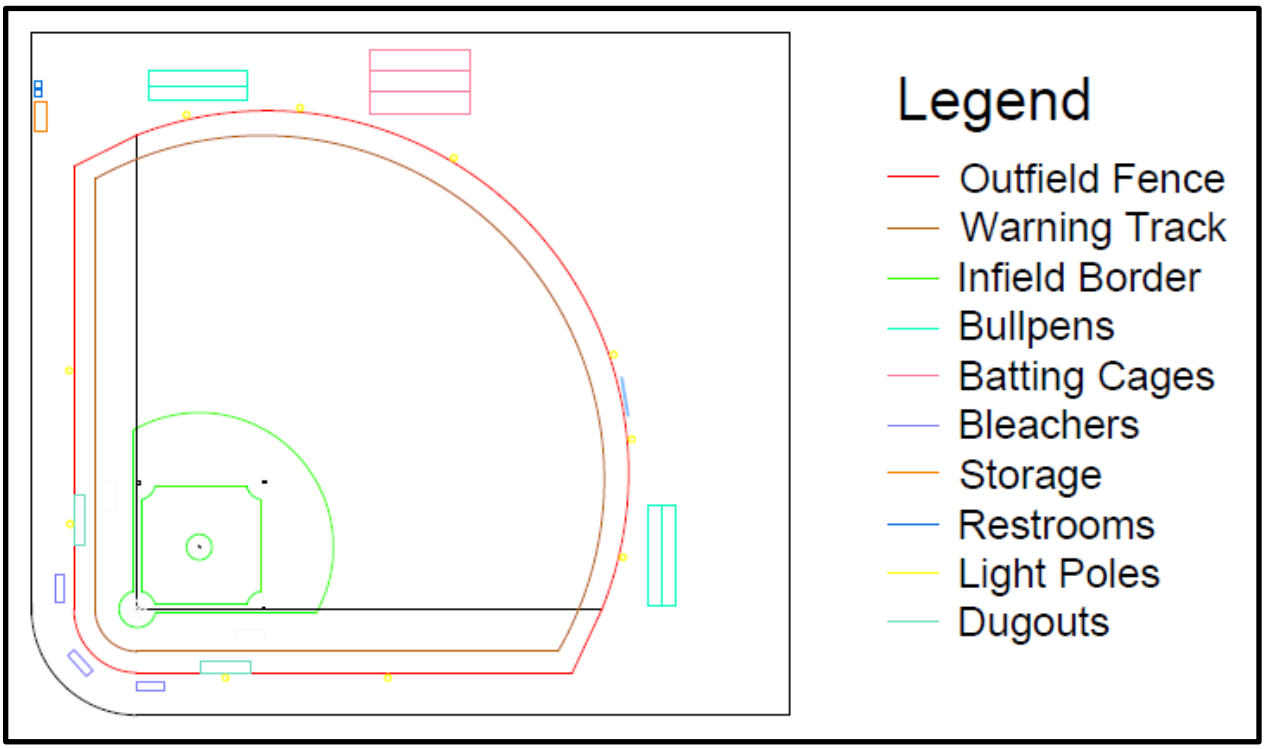

Figure 20: Baseball Facility Component Diagram.

Several facility elements were originally designed while some components were imported from Revit City (2024). An authorship table for all facility elements is included below in Table 9.

Table 9: Facility Element Authorship Table.

Facility Element	Element Designer
Scoreboard	DJ Brooks
Dugouts	Francis Polito
Bleachers	Revit City
Bullpens	Francis Polito
Batting Cages	Revit City
Restrooms	Revit City
Storage	Revit City
Light Poles	Revit City
Foul Poles	Francis Polito
Field	Jake DelMonte, Francis Polito
Fencing	Francis Polito

Scoreboard

The scoreboard is located in right center field with its foundations 3 feet behind the outfield fence. The scoreboard stands 10 feet above ground level and is 8 feet tall, 20 feet wide, and has a depth of 8 inches. The scoreboard exterior is Aluminum Alloy 5052-H32 with polycarbonate digit covers. Aluminum Alloy 5052-H32 was selected to withstand weather conditions because it has very good corrosion resistance, moderate strength, and high fatigue strength (MatWeb, 2023). Polycarbonate is a transparent plastic with high impact strength and high heat resistance, suitable properties to shield the LED scoreboard digits (MatWeb, 2023). The scoreboard is supported by two W8x28 steel posts. The scoreboard is mounted to the supporting structural steel using angle brackets and hardware. The structural steel posts are set in concrete footings to create a stable foundation. The footing dimensions were determined referencing technical information from Daktronics BA-2019 Product Specifications (“BA-2019”, 2024). The footings are detailed in Figure 22.

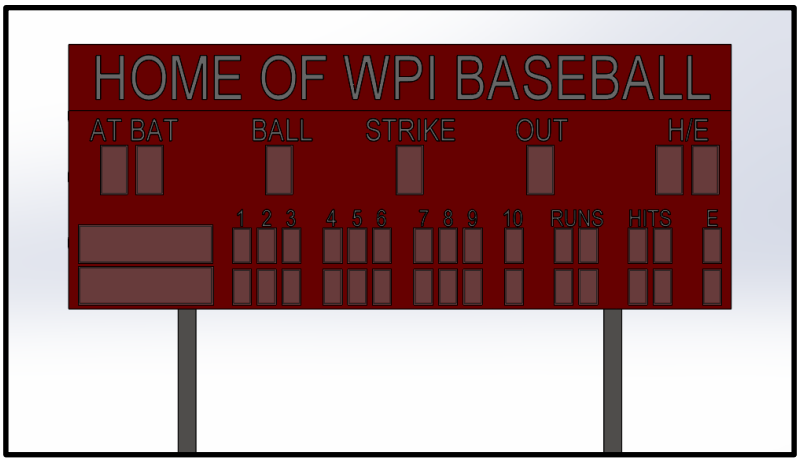

Figure 21: Scoreboard SolidWorks Model.

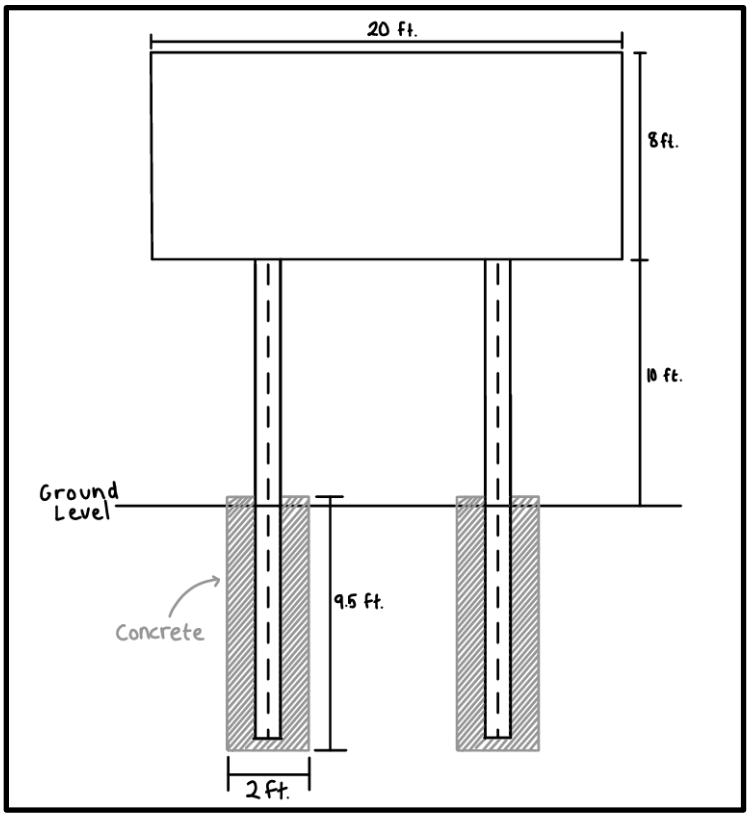

Figure 22: Scoreboard and Footing Dimensions.

Two SolidWorks simulations were run to test whether the scoreboard could withstand local weather conditions. The first simulation was designed to test the structural steel posts with a force load of 25 psf, the typical wind pressure value for the design of low-rise construction in Massachusetts. Fixed geometries were placed at the base of each post to simulate the footings. A 25 psf equivalent force of 13,100 N was placed on the front face of the scoreboard, including

each post. The results show a maximum displacement of .001314 inches and a maximum stress of 14.8 psi at the base of the post. The displacement and stress results are shown in Figure 23.

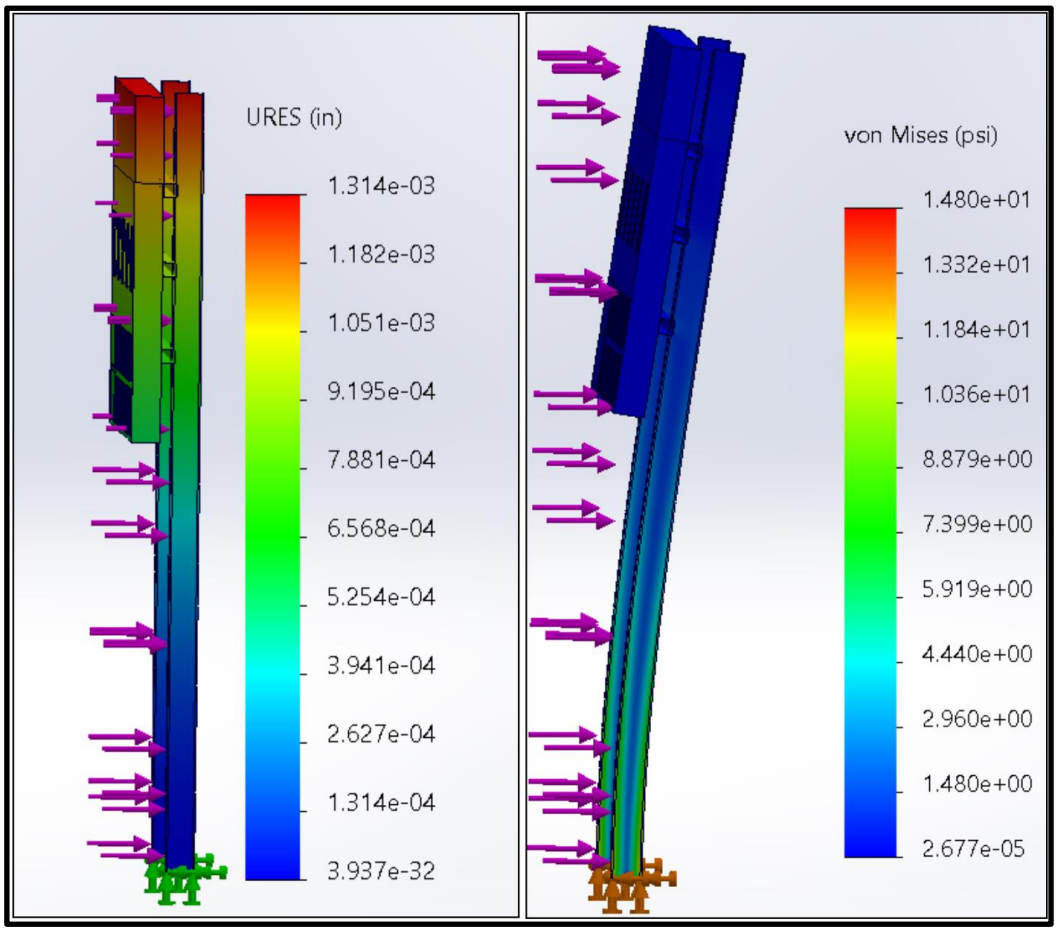

Figure 23: SolidWorks Simulation Displacement and Stress Results.

Chapter 16 of the Massachusetts State Building Code designates Worcester's design wind speed as 124 MPH for Risk Category II ("780 CMR Ninth Edition", 2018). A second SolidWorks simulation was designed to replicate the extreme condition outlined by the building code. A 124 MPH gust, which is the equivalent of a 28,068N force was placed on the posts and face of the scoreboard. Again, fixed geometries were placed at the base of the structural steel to replicate footings. The results show that a 124 MPH wind gust at most can cause a displacement of 8.6 inches. The stress and displacement results are shown in Figure 24. Based on the linear elastic analysis including the material profiles, the point of maximum stress is 80,000 psi and is shown in Figure 25.

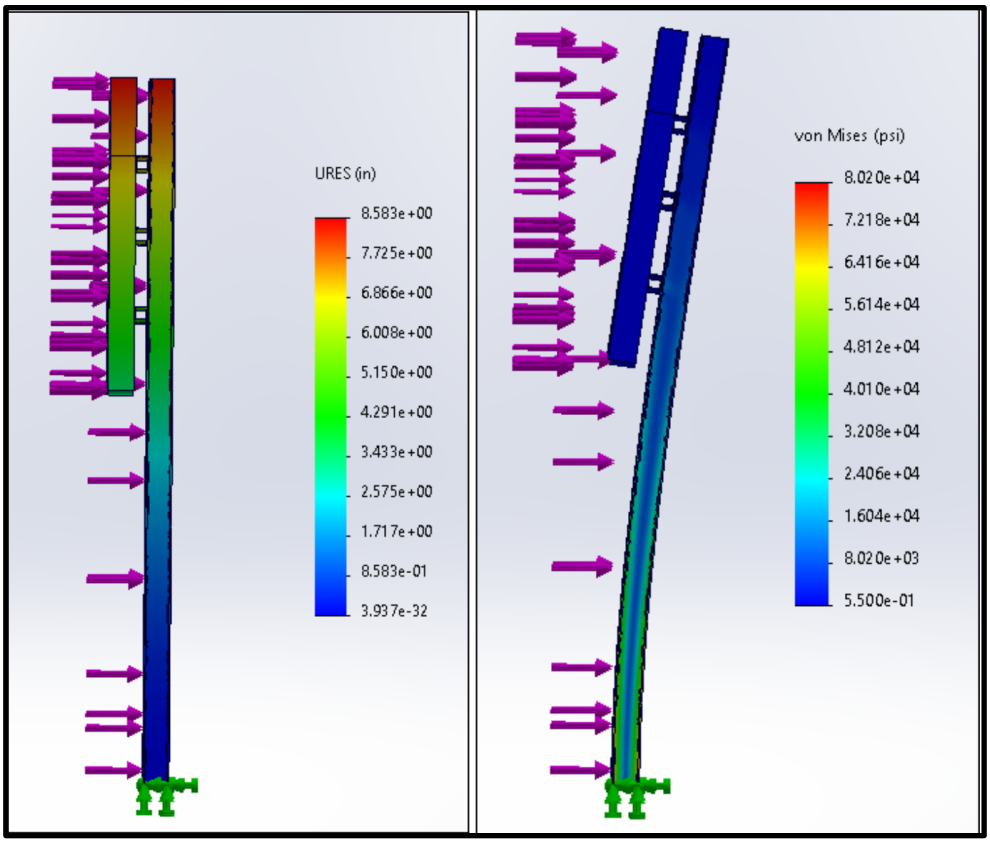

Figure 24: Extreme Condition Simulation Displacement and Stress Results.

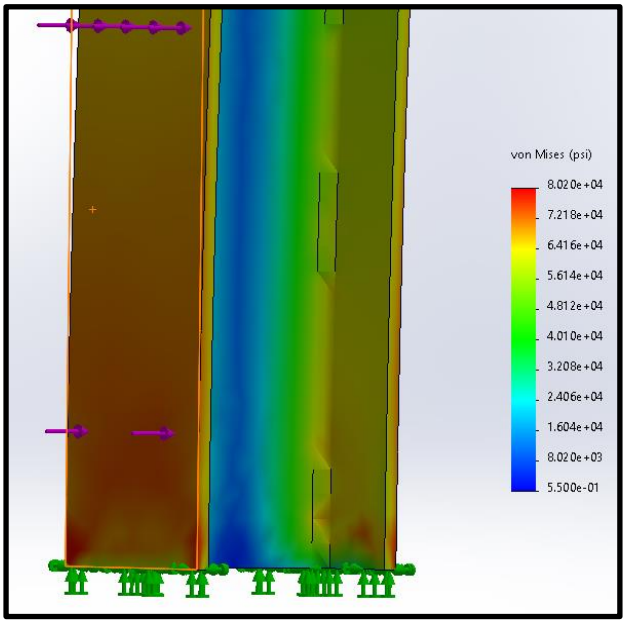

Figure 25: Extreme Condition Simulation Point of Maximum Stress.

According to Risk Factor, Worcester could experience wind gusts up to 92 MPH in an extreme storm event today, with a 1% chance of such an event occurring over the next 30 years ("Worcester, MA Hurricane Map"). While the likelihood of the scoreboard experiencing such extreme conditions is low, the simulation results indicate potential susceptibility to deformation. However, it's important to note that this does not necessarily imply failure of the design. While the scoreboard may require structural reinforcement in the event of a storm of that magnitude, the design will not collapse.

Dugouts

The dugouts provide space for each team to sit and store equipment during the game. The dugouts are 450 square feet with roof coverage, located along each fence line between home plate and first or third base. The front railing of the dugouts are 60 feet away from each foul line. The Revit drawing for an individual dugout is shown below in Figure 26.

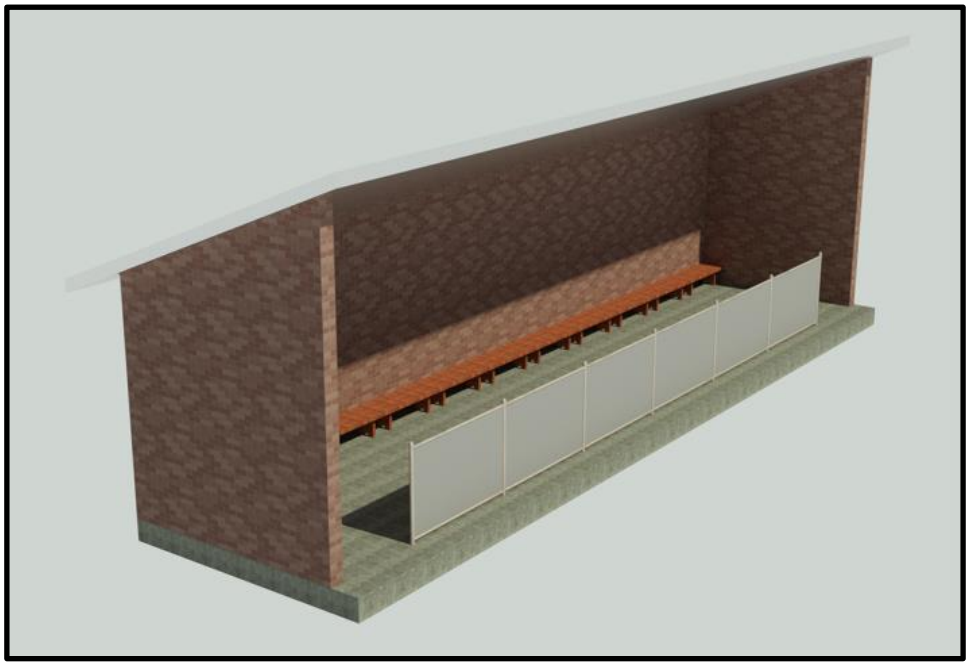

Figure 26: Dugout Revit Drawing.

Bleachers

The bleachers provide seating for fans during games at the baseball facility. Two sets of bleachers are located on the concrete walkway between the dugouts and the center of the home plate backstop. This location provides a clear vantage point for fans while also protecting them

from foul balls with the higher fences behind home plate. The bleachers are aluminum and accommodate up to 30 fans in each seating section. The Revit drawing for a bleacher section is shown in Figure 27.

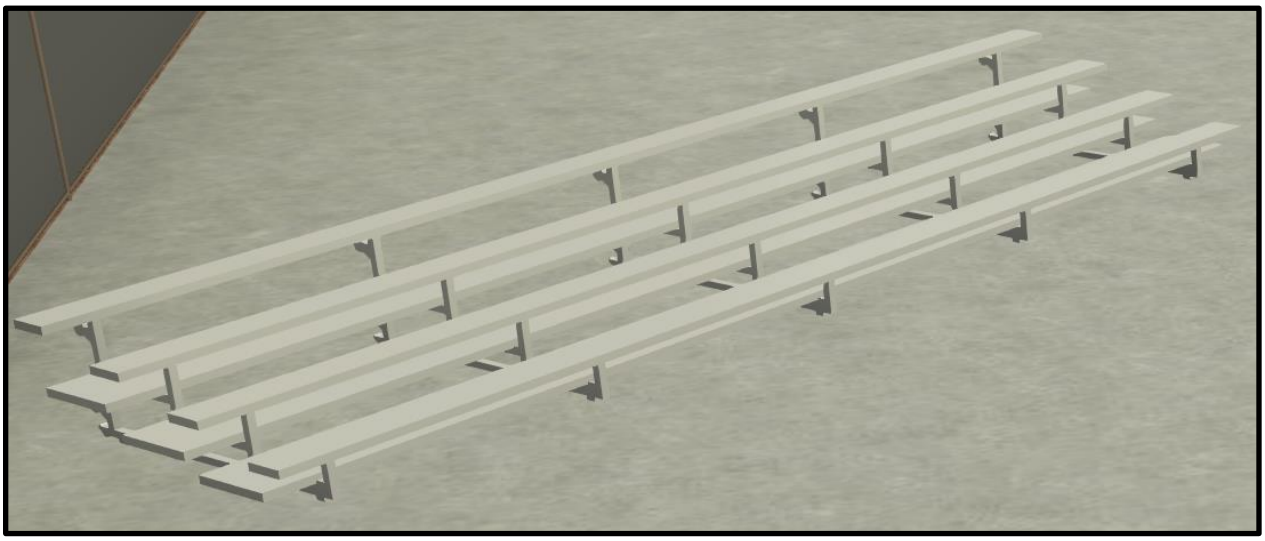

Figure 27: Bleachers Revit Drawing.

Bullpens

The bullpens are fenced-in areas for the pitchers to warm up before and during the game. Two bullpens are located behind the outfield fence near each foul pole to provide each team an area for their respective pitchers. Figure 28 shows a Revit drawing for a typical bullpen. The fencing perimeter of the bullpen is 70 feet long and 20 feet wide, allowing space for two pitchers to warm up simultaneously with two mounds and two plates.

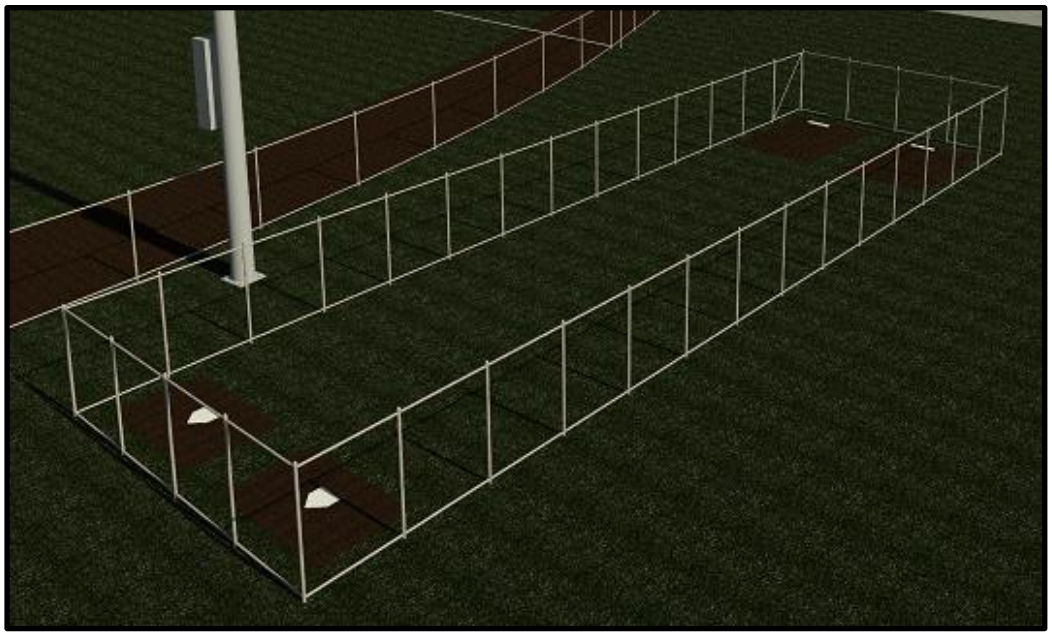

Figure 28: Bullpen Revit Drawing.

Batting Cages

The batting cages provide a contained space for hitters to take batting practice and hit before the game. Three cages are located next to each other with mesh nets held up by steel poles and wires in each corner of the cage, as displayed in Figure 29. The dimensions of an individual cage are 66 feet in length and 9 feet in height and width. The total allotted area for the three cages is 70 feet long by 30 feet wide. The batting cages are located outside of the playing field, roughly 60 feet beyond the left center field fence. Three cages enables the home team the option to use multiple cages during pregame warmups while still allowing the visiting team to use one as well.

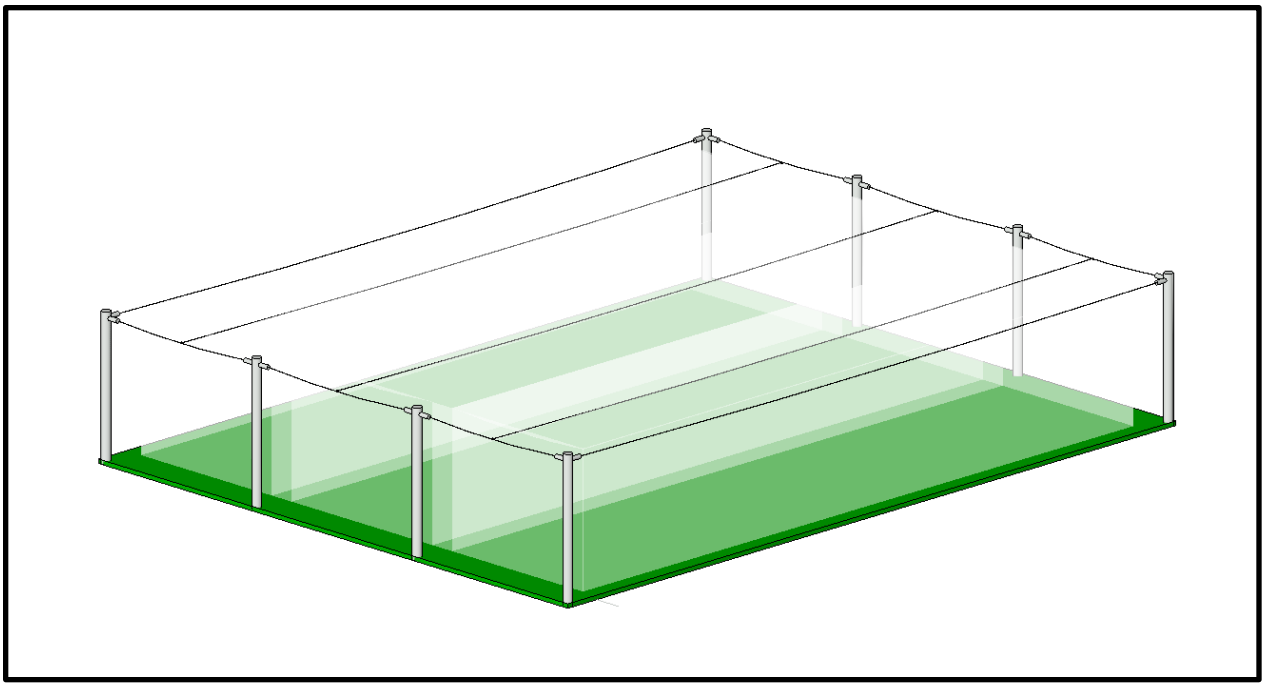

Figure 29: Batting Cages Revit Drawing.

Restrooms

Restrooms are provided at the facility with two accessible porta-potties located beyond the storage container near the left field line. This positions the bathrooms in close proximity to the parking lot, and they are also closer for the home team to use during games, while being accessible to all players and spectators. Each portable restroom is 5 feet by 5 feet with a height of 7.5 ft, as seen in Figure 30, creating a comfortable and accessible environment for all attendees.

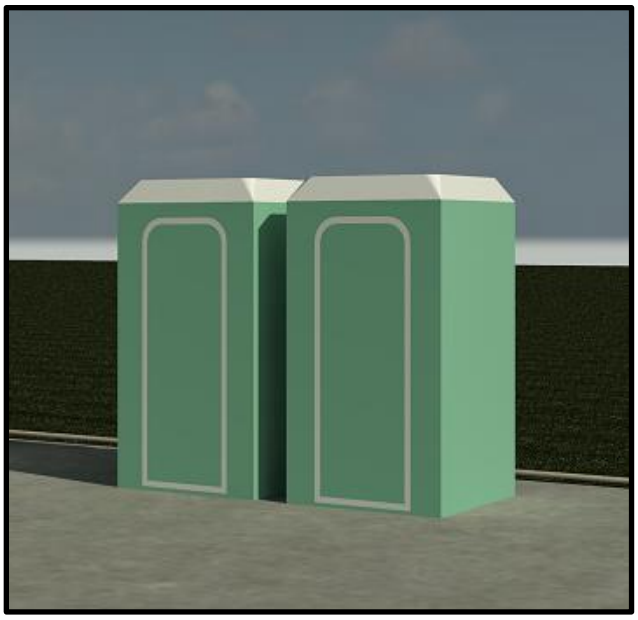

Figure 30: Restrooms Revit Drawing.

Storage

The storage for the facility is provided by a 8.5 feet by 20 feet storage container with a height of 8 feet, as pictured in Figure 31. The facility storage will hold L-screens, tees, helmet bags, baseballs, speakers, and any miscellaneous equipment over the offseason and overnight while the baseball team is in-season. This container will be located outside the field of play down the left field line, just beyond the concrete pathway.

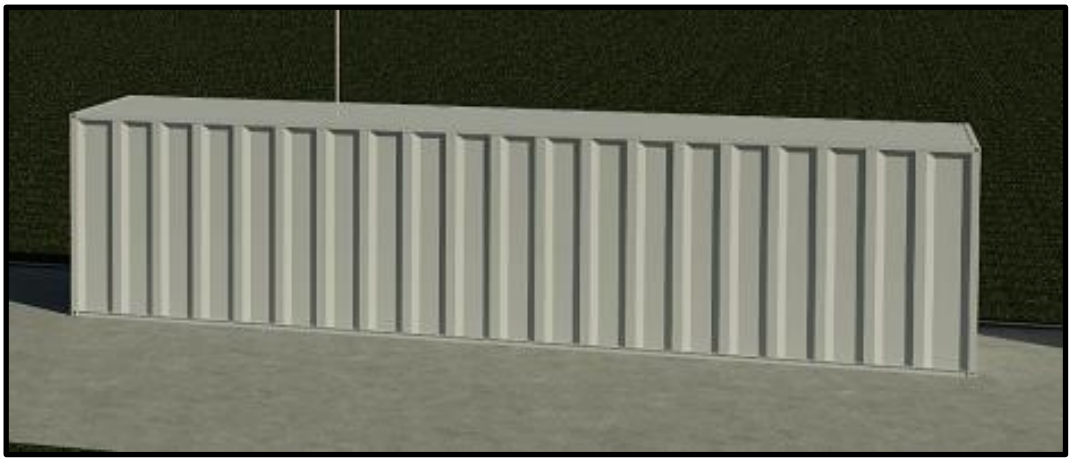

Figure 31: Storage Revit Drawing.

Light Poles

Light poles will provide illumination for night practices and games at the facility. Eight light poles will be positioned around the field: two on each baseline and two on each side of the outfield. The outfield poles will be 50 feet in height while the four infield poles will be 70 feet tall. The outfield light poles will be located 10° and 30° from each foul line in reference to home plate, as seen previously in Figure 5. Each pole will be located three feet behind the fence line. The standard light pole utilized for the facility is shown below in Figure 32.

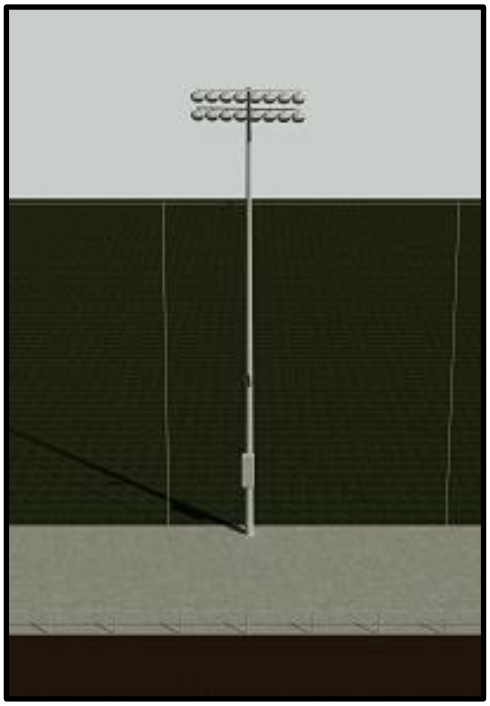

Figure 32: Light Poles Revit Drawing.

Foul Poles

The foul poles will be located where the outfield fence line meets the foul line. The poles will be placed one foot behind the fence line, remaining outside of the field of play. The cylindrical poles will be 20 feet tall and constructed out of galvanized steel with a yellow powder-coated finish, as seen in Figure 33.

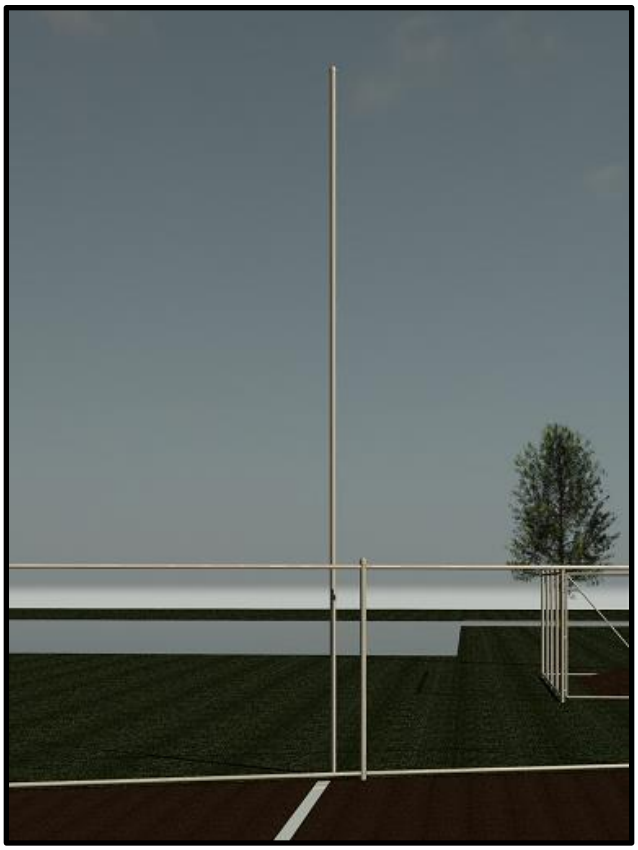

Figure 33: Foul Poles Revit Drawing.

Field and Fencing

The proposed WPI Baseball field has collegiate dimensions with fence distances of 330 feet down both foul lines and 390 feet to center field. The entire playing surface is made from artificial turf, making the field suitable during late winter months and cold or rainy weather. The infield, baselines, pitcher's mound, and warning track will be a brown-colored turf while the infield, outfield, and foul territories will be green. Along the perimeter of the field, a 15-foot wide warning track will be installed between the fence and green turf material.

Behind home plate, the curved fence line is a radius of 60 feet from home plate, running until the fence becomes parallel to the baseline. This fence will be 25 feet tall, known as the backstop, and will extend from the front edge of one dugout to the other. On the far side of each dugout, a new 4-foot-tall fence line will start parallel to the baselines extending to the outfield fence. The outfield fence will be 6 feet in height and arc from 330 feet at each foul line to 390 feet in center field.

Providing additional safety measures at the facility, two lines of safety netting will run along the property to help prevent any baseballs from exiting the parcel. The safety netting will be 60 feet in height, starting at the northwest corner of the site and jutting parallel to each baseline for 500 feet in length.

Facility Design

A full facility Revit drawing was developed using the field and fencing as the baseline Revit drawing and importing each of the individual elements. Figures 34 to 38 provide different views of the facility, highlighting specific areas and the surrounding scenery with trees and Park Avenue. This facility design provides ample space beyond the outfield fence for additional work in the future.

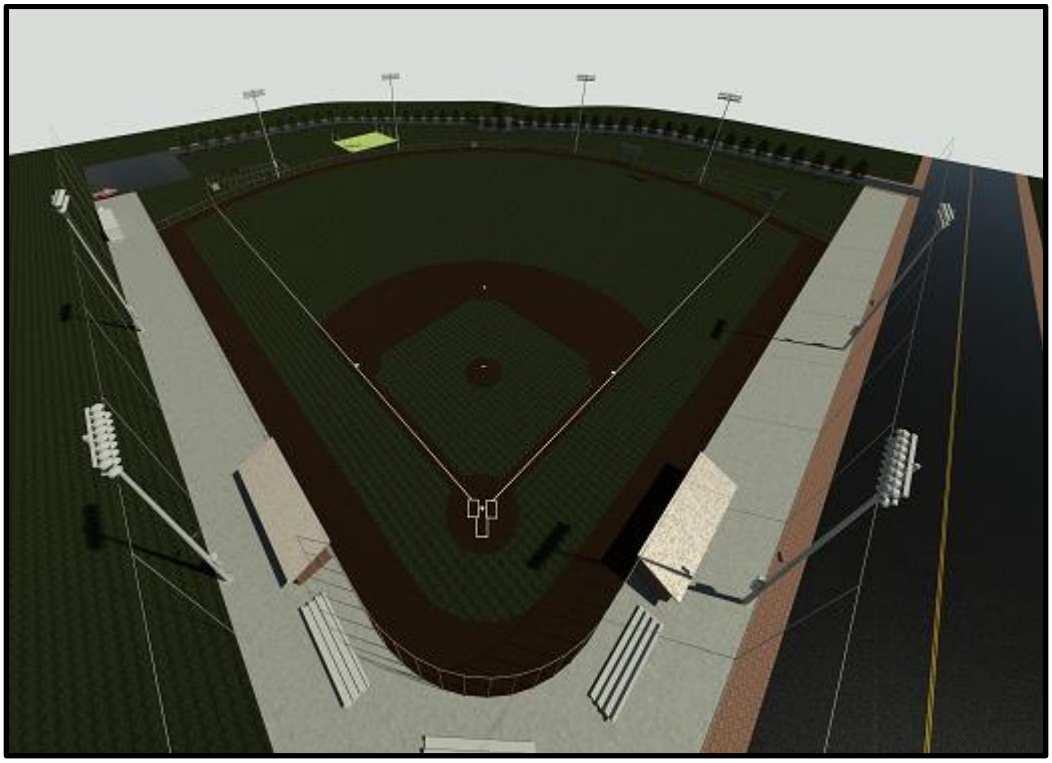

Figure 34: Front, Bird's Eye View of the WPI Baseball Facility.

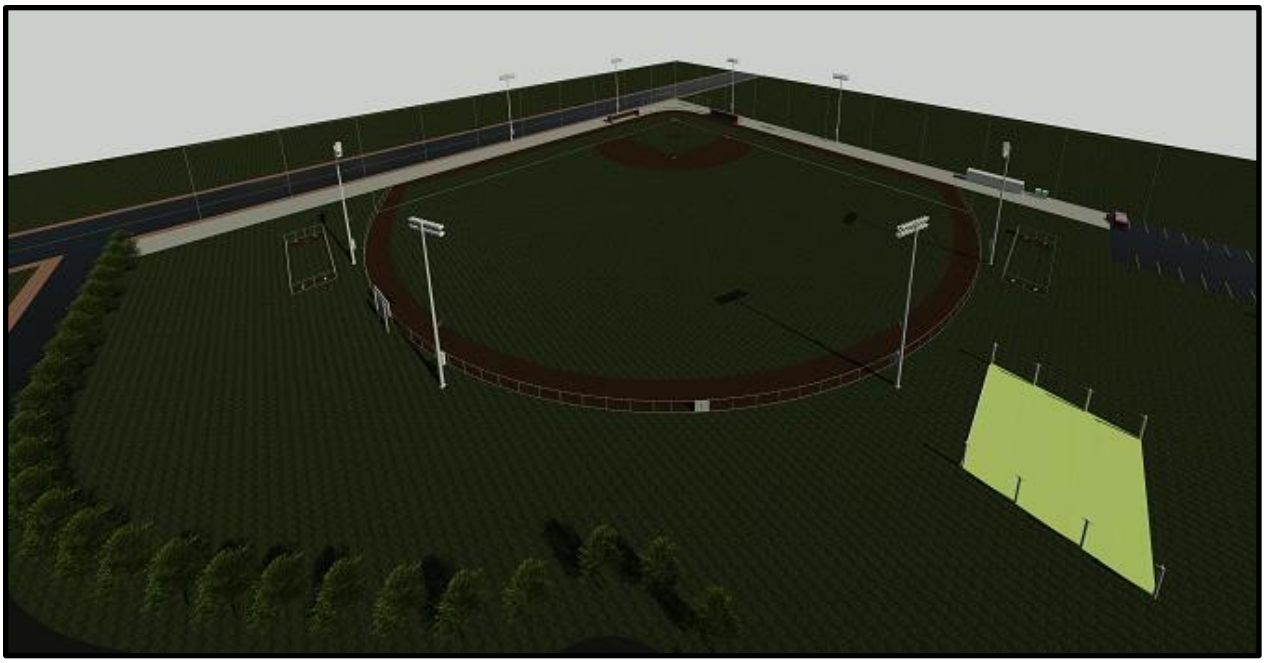

Figure 35: Rear, Bird's Eye View of the WPI Baseball Facility.

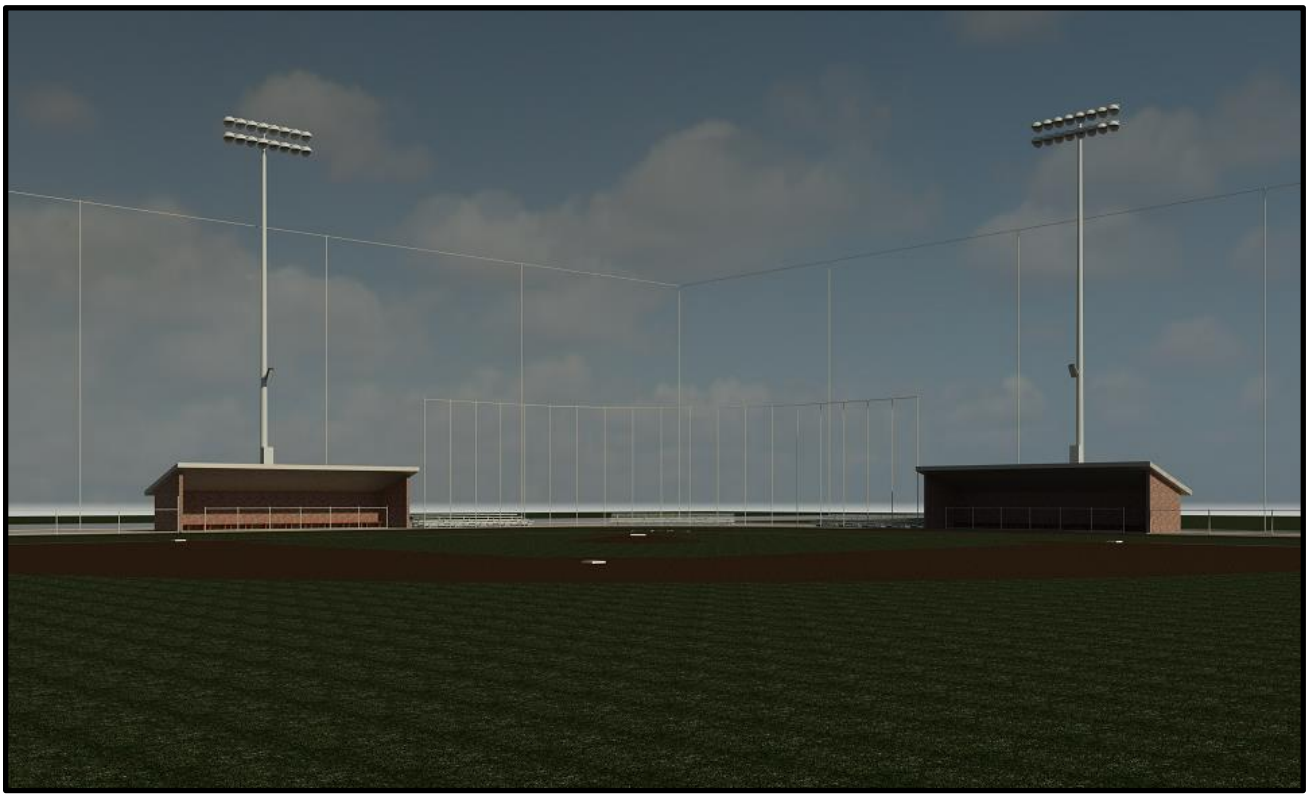

Figure 36: View of the WPI Baseball Facility from second base, displaying the pitcher's mound, infield, home plate, dugouts, railings, and fencing.

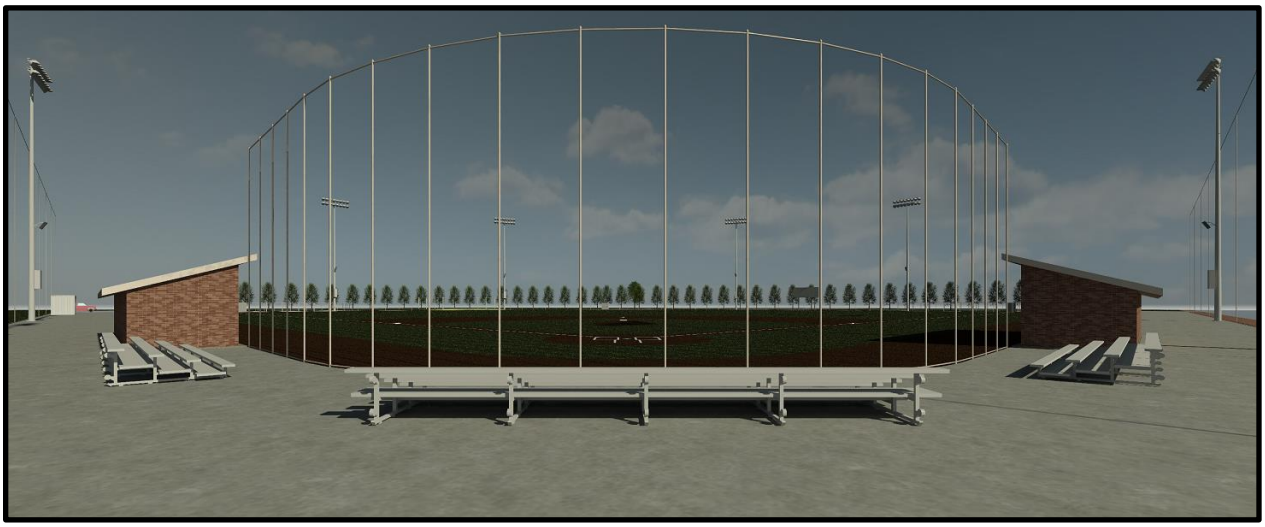

Figure 37: View of the WPI Baseball Facility from the backstop, displaying seating, dugouts, and the backstop.

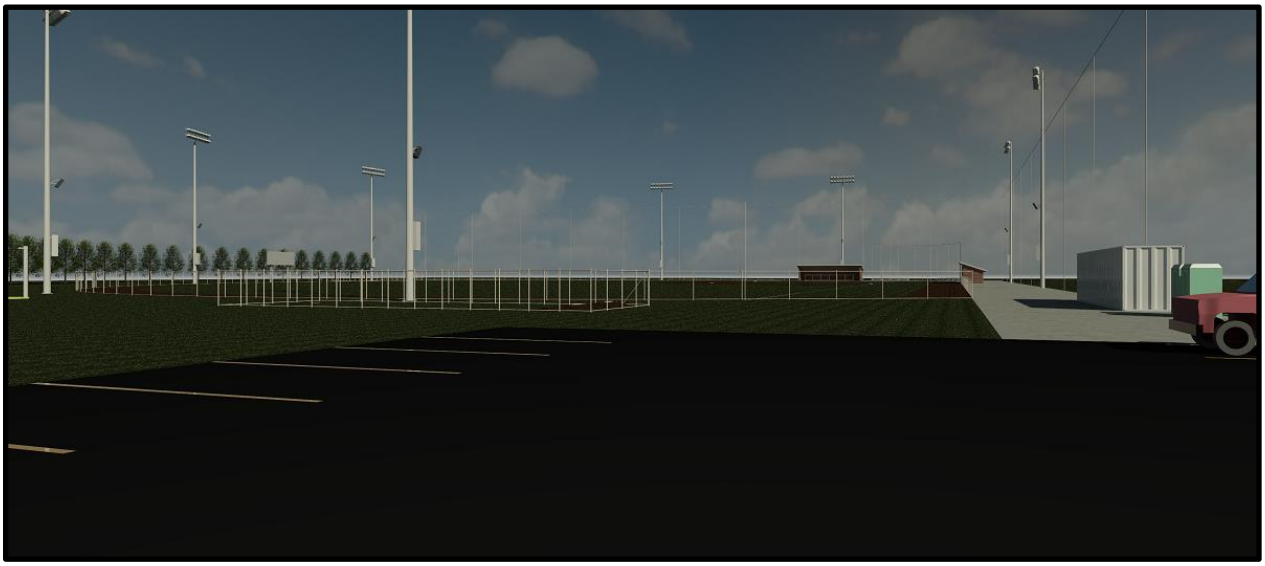

Figure 38: View of the WPI Baseball Facility from the parking lot, displaying restrooms, storage, bullpen, and batting cages.

Cost Estimate

With the site of the WPI Townhouses being selected for the final facility location, a new and more detailed cost estimate was completed, addressing all established facility elements. The cost estimate, highlighted in Table 10, displays the site work, facility components, and utilities.

The site work includes the demolition and removal of the Townhouses, along with excavation, leveling, and grading of the property. The full cost estimate with a detailed breakdown of all facility elements is included in Appendix E.

Table 10: WPI Baseball Facility Cost Estimate.

Facility Element	**Estimated Cost**
Site Work	$1,500,000
Facility Components	$1,900,000
Utilities	$200,000
Total	**$3,600,000**

5. Conclusions

The goal of this project was to develop and design a proposed home facility for the WPI Baseball team. To accomplish this, research was conducted on existing fields, and surveys and interviews were completed to establish design requirements for a new field. Several fields and potential sites were researched, visited, and evaluated using a standardized rubric and cost analysis method. Based on these results, the site of the WPI Townhouses was selected as the best location and a facility design was developed. Revit was utilized as the primary design software for modeling the field and individual facility elements. Using the modeling software, a 3D rendering of the baseball facility was created at the determined site location. In conjunction with the final design, a detailed cost analysis was completed for the chosen facility. The final facility design incorporates all the basic needs of a collegiate baseball field including a scoreboard, dugouts, bleachers, bullpens, batting cages, restrooms, storage space, lighting, foul poles, and fencing with proper dimensions. Considering these elements along with site work, such as demolition and removal of the Townhouses, leveling, and grading the cost of the proposed facility is $3,600,000.

It's clear that the proposed baseball facility would benefit the WPI Baseball program, but its positive impact would extend to the greater WPI community as well. Having a baseball facility on campus can enrich campus life for all students. It would offer opportunities for students to gather as a community and socialize, as they do at football, soccer, and basketball games. Furthermore, the facility would provide the opportunity for students to establish a club baseball team. Every season, numerous students try out for the Varsity Baseball team without making the roster. A club team would enable these students to continue playing baseball in college and would enhance the university's appeal to prospective students interested in baseball. Organized sports foster a sense of belonging and serve as a valuable outlet for stress relief. Offering another avenue for students to enjoy these benefits would enrich their overall WPI community experience.

Outside of the WPI community, the proposed baseball facility would also positively impact the Worcester community as a whole. The collegiate baseball season concludes in early May and doesn't resume until September. With WPI having no need for the field during the summer months, it presents an opportunity to be good neighbors to the surrounding community

by offering the field for use by local leagues. One such league is Southside Babe Ruth, a nonprofit baseball league for kids aged 13 to 18 based out of Worcester, which currently plays at Tivan Field at Lake Park. A new turf facility would significantly enhance the league and its appeal. Additionally, WPI could further its role as a good neighbor by permitting local high schools in Worcester to play a few home games a year at the new facility. Beyond their use for baseball, baseball fields also serve as excellent spaces for pet owners. Finding open areas for pets to exercise, especially in urban areas, can be challenging. Enclosed by fencing, baseball fields provide a safe environment for dog owners to allow their pets to run freely. This is yet another benefit that the people of Worcester would enjoy from the implementation of this facility.

Limitations

Over the course of the project, several limitations impacted the research and work that we were able to complete. One limitation was the lack of access to financial information within the WPI Athletic Department. Without full access to this knowledge, there was little certainty regarding the budget and reality of investing in a home baseball facility. Assumptions were made that WPI is financially capable and willing to provide funding for a home baseball field due to the growing need for a new facility.

Another limitation to the project was the lack of access to WPI Residential Services data regarding housing needs and the future use of the WPI Townhouses. It was assumed that the other residential buildings on campus would be sufficient to house all incoming students. This would allow the WPI Townhouses property to be cleared and developed for a new home baseball facility.

Recommendations

Moving forward, some aspects of the facility design can be further explored and developed. The designed audio system is a portable speaker that will be stored in the storage container or locker rooms on campus when not in use. An audio system can be installed with speakers attached to the light poles or safety netting posts to provide a surround-sound system for the facility.

Additionally, there is sufficient space behind the backstop to develop a larger, connected system of bleachers. Above this potential seating area, a press box could be constructed for announcers, videographers, and audio equipment. If a full press box is not feasible for future construction, a portable elevated stand with seating, roof coverage, and a table would suffice.

In each dugout, there is ample wall space to design shelving compartments and a rack system with hooks jutting outwards. Without consuming too much space in the dugouts, these systems would provide storage for bags, helmets, and gloves for players when using the field.

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Appendices

Appendix A: Final Proposal

Abstract

The Worcester Polytechnic Institute (WPI) Baseball program has gone without a designated home facility for nearly 10 years, being forced to commute to Northborough daily for practices and games. In addition to the inconvenient proximity to the University campus, there have been growing limits to field accessibility, forcing the team to relocate several practices and home games to different fields each year. These disadvantages even impact recruiting and fan support as a 20 to 30 minutes commute poses time constraints for both players and spectators. A more nearby and player-friendly complex would better suit the program, allowing student-athletes more time to balance their busy academic schedules. For a collegiate baseball facility, many elements will be considered including field layout and dimensions, batting cages, dugouts, bullpens, and field access. This project focuses on exploring several realistic field locations, evaluating options based on facility criteria, and developing the design of a baseball complex to create a more suitable home field environment.

Capstone Design Statement

The design problem focuses on locating and developing a modern home field for the WPI Baseball program. This facility is intended to meet the functional requirements of a college baseball field while adhering to a set of diverse constraints including economic, environmental, sustainability, constructability, health and safety, ethical, and social considerations.

Economic Constraints

To address economic constraints, the project will utilize a thorough cost analysis and method of budget planning by referencing comparable facility and construction costs. When considering the potential construction, materials, and renovations proposed for the facility, all costs will be evaluated to maintain a high quality design without costing an excessive amount. Several facility options will be considered to provide relatively inexpensive options by having an existing field with the proper layout and collegiate dimensions. Lastly, all economic considerations will be within a realistic spending realm for the WPI Athletic Department.

Environmental and Sustainability Considerations

The facility design and evaluation process will maintain a considerate approach which prioritizes sustainability and environmental responsibility. Wetland protection, storm water discharge and light pollution due to excessive artificial lighting will be explored to minimize environmental impacts. Eco-friendly construction techniques and methods will be considered while exploring potential construction at the facility location. LED lights and turf material will be investigated to provide sustainable solutions for the facility design.

Constructability

Constructability constraints will be addressed during the design planning stages where specific construction activities are proposed. The facility design will be developed while keeping the construction activities realistic for a recreational site and within a reasonable budget and schedule.

Ethical and Social Concerns

Ethical and social considerations will be prioritized during the evaluation and development of proposed facilities. While exploring field options, relevant University stakeholders' opinions will be sought to ensure that all social implications and concerns were taken into account. When considering the possibility of shared spaces for facility use, the location and environment of the site will be evaluated, acknowledging potential groups who may wish to use the area depending on the time of year.

Health and Safety

The health and safety considerations will be held among the top of project priorities while tending to players, spectators, and potential construction workers at the facility. When conducting site visits, safety factors will be observed and recorded as part of the field records. This design approach will aim to create a safe and healthy environment for the WPI Baseball program and all affiliated parties.

Introduction

Prior to the spring of 2013, WPI Baseball had their own on-campus facility which was replaced with the innovative rooftop field complex, forcing WPI Baseball to relocate (WPI Athletics, 2023). For the last decade, WPI Baseball has utilized the New England Baseball Complex (NEBC) in Northborough as their home field for practices and games. However, in recent years, the Program's access to these facilities has become increasingly limited as WPI is only granted selective hours of field use for weekday practices and games only. This limited access impedes the development of players and forces the team to travel by bus or car to reach the "home" field, resulting in wasted time being added to busy athletic and academic schedules each week. This project aims to locate, develop, and propose a new facility option for the WPI Baseball program while promoting construction and economic feasibility.

Background

The goal of this project is to develop a modern Division III baseball facility for the WPI Baseball program, addressing their current lack of a home field. To achieve this goal, it is necessary to research and identify the required features of a Division III baseball facility that adhere to the rules of baseball, fair play, and the safety of players. Additionally, it is important to research unique features that contribute to improving the overall experience of players and fans. Sustainable baseball field elements will be considered to improve the longevity and sustainability of the facility. This section provides background information on the required features and technical aspects of a Division III baseball facility.

Lacking a Home Field

Worcester Polytechnic Institute, although known for its academic prowess, experiences significant issues with its baseball program. The team lacks a dedicated home field which impacts the performance and experience of the WPI Baseball program. The absence of a home facility has led to several unjust ramifications that have affected the Program over recent years.

The distant proximity of the home field to campus directly impacts the university and fan support as students must drive nearly 30 minutes to watch games, making them much less likely to attend, in Figure 1 a map of the route can be seen from WPI to New England Baseball Complex (NEBC). A facility removed from campus with minimal fan attendance and support, in addition to limited field access, creates an unfavorable environment for a home field, which should create a supportive environment for the home team. This commute to the home field also poses obstacles while recruiting, as many interested recruits visit WPI to tour the campus, however, are unable to see their potential baseball facilities. As a result, many recruits may be hesitant to commit to a situation where they are inconvenienced daily by needing to commute to their home field.

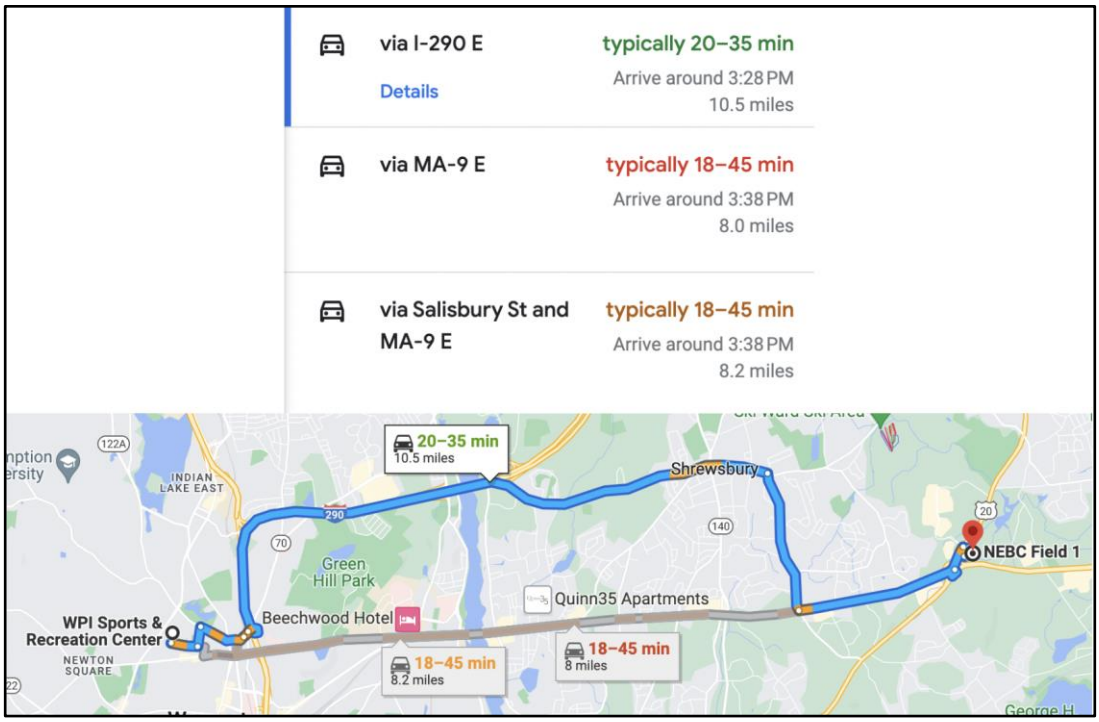

Figure 1: Map of route from WPI to NEBC with estimated departure at 3pm.

Comparison to the Competition

Additionally, the lack of a home field creates a significant disparity between WPI and the other baseball teams in the New England Women's and Men's Athletic Conference (NEWMAC). The WPI Baseball program is one of two teams in the conference with an off-campus field, and the only team to have restricted access to their "home" facilities. Consequently, the WPI Baseball team has been forced to play critical, in-conference games at neutral and unfamiliar locations, sometimes even at the opponent's home field, when they were scheduled as the home team. This situation arose multiple times in the 2021 and 2022 seasons, and poses a serious disadvantage to the Program. A home field should be a guaranteed place where teams can feel more familiar with the field and have a comfort advantage over the opponent. WPI Baseball, however, often faces the obstacles of an away team.

Facility Attributes

While designing a baseball field may seem like a trivial task, there are several components to a modern Division III baseball facility which require thought and attention, beginning with the NCAA requirements for a baseball field.

NCAA Requirements

In the 2023-2024 edition of the NCAA Baseball Rules Book (NCAA, 2023), the NCAA outlines the requirements and recommendations for an NCAA baseball field. The book outlines strict requirements for the dimensions of the playing field. The infield must be a 90 foot square, measured from the back point of each base. Dimensions for the area of the infield dirt and baselines, along with the spacing of features such as the coach's boxes and on-deck circles, can be found in Figure 2. Physically, the first, second, and third base bags should be fifteen inches squared with a thickness of three to five inches. Home plate must be seventeen inches wide and have a length of seventeen inches. The plate must be centered six inches on both sides of the batter's box. The dimensions of home plate and the batter's box are displayed in Figure 3. The pitcher's mound must be ten inches above the top surface of home plate. The pitcher's plate, commonly referred to as the rubber, must be a rectangular, rubber slab twenty-four inches by six inches in plan. The mound must slope one inch per foot beginning six inches in front of the rubber to a point six feet towards home plate. The full detailed layout and dimensions of the pitcher's mound can be found in Figure 4.

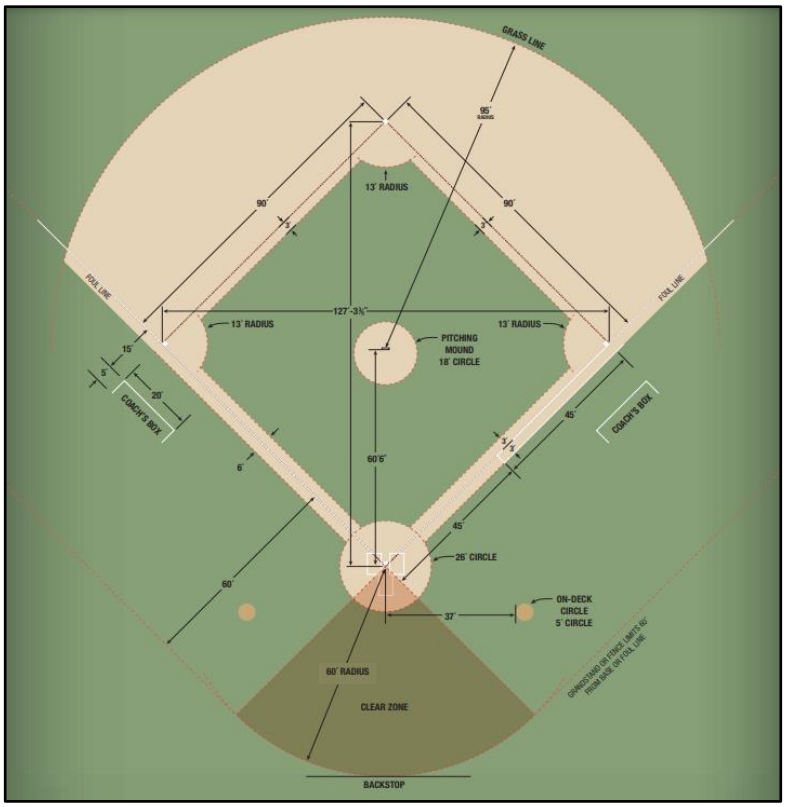

Figure 2: NCAA Baseball Field Rules Book diamond dimensions requirements (NCAA, 2023).

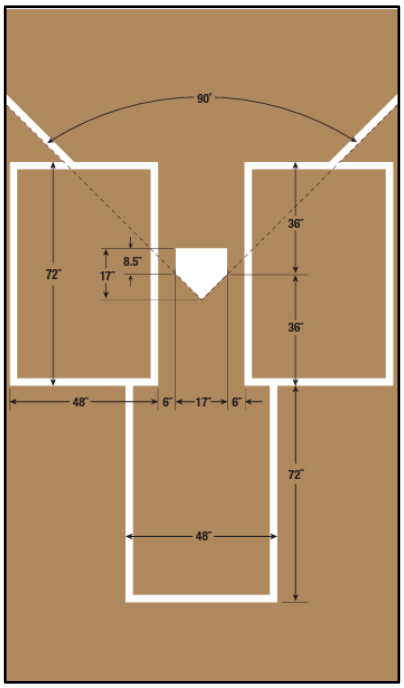

Figure 3: NCAA Baseball Field Rules Book home plate dimension requirements (NCAA, 2023).

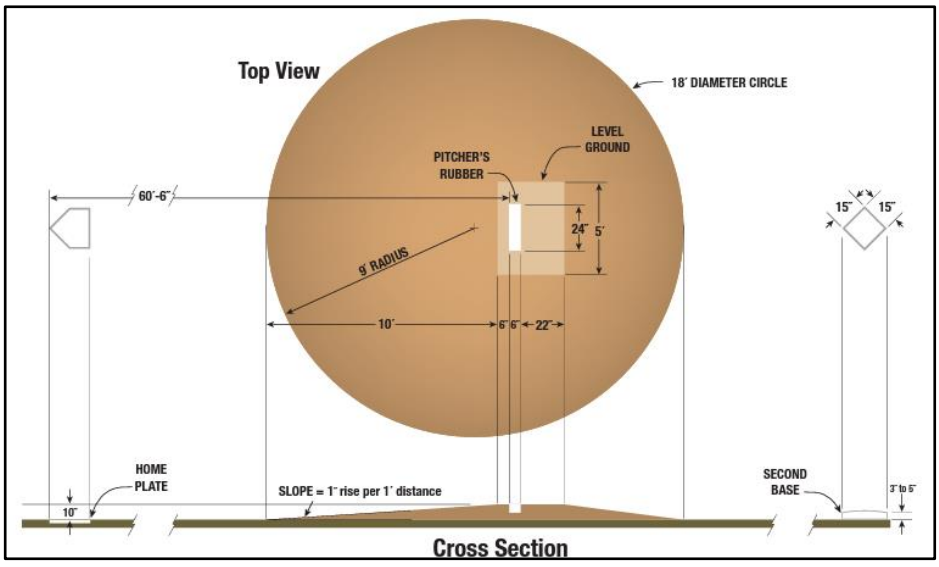

Figure 4: NCAA Baseball Field Rules Book pitcher's mound dimension requirements (NCAA, 2023).

The NCAA recommends that the playing surface be graded two-thirds of one percent beginning at the edge of the pitcher's rubber (not including the mound) to the boundaries of the field. With this grading, the field will play as a perfectly flat surface; however, the slight slope will allow the field drain. This sloping mechanism will also, in theory, prevent puddling on the playing surface and direct excess water towards foul territory.

The rule book provides several recommendations for the construction of new baseball fields. The NCAA recommends the outfield fence be located 330 feet from home plate to each foul pole, 375 feet to left and right center field, and 400 feet to straight away center field. If the distance down one line is less than 330 feet, the field should then ensure that the recommended distances for left center, right center, and center field are met. These recommendations become a requirement only for college baseball facilities owned by NCAA member institutions. Field 1 at New England Baseball Complex (NEBC) only spans 310 feet down the lines and 370 feet to center field.

A solid and secure permanent fence is recommended to enclose the outfield. The fence must be a minimum of 6 feet tall, although 8 feet is the recommended height. The rules further detail requirements for facilities that use forms of temporary fencing, both snow and flexible windscreen. Temporary fencing creates an opportunity to use the field for more than just baseball. In addition to the fence, the rule book recommends constructing a warning track in front of the outfield fences, the backstop, and the dugout fence at a minimum of 15 feet deep.

Another aspect to consider along with the field dimensions is the field layout itself. According to the NCAA rules, all new fields should be oriented considering the following factors: protection of players, comfort of spectators, season of use, latitude, east-west geographical location within time zone, prevailing winds, daylight saving time, background and obstacles or barriers. Many of these factors allude directly to the consideration of the sun. The sun plays a major factor in baseball games that is often overlooked, and it can even create a safety hazard if the field layout doesn’t consider where the sun will rise and set. The field layout should accommodate the safety of the hitter first, followed by the catcher, then the pitcher, and the rest of the position players. If the sun prevents the hitter and catcher from seeing the pitcher throw the baseball it creates a clear safety hazard. The pitcher is the next most important because the pitcher has the least amount of time to react to a ball off the bat. For safety reasons, it is critical to consider how the sun and weather patterns can affect potential sites and field layouts.

Dugouts, Bullpens, and Batting Cages

Similarly, while looking at the baseball facilities of other teams in the NEWMAC, every facility has at least one batting cage. The batting cage, or batting cages, are strategically located on the home team's side of the field so that the home team receives the competitive advantage of more swings during batting practice. The inclusion of batting cages also provides more flexibility for practice plans. Currently, NEBC does not have outdoor batting cages. This means the only hitting WPI Baseball can do outside is on-field batting practice, which requires several people and many moving parts. Batting cages are a great place for players to get in extra practice on their own or with a teammate.

Each facility in the NEWMAC has its own unique dugouts, all with different features. The NCAA has no specific requirements for dugouts. With that being said, a collegiate baseball facility should have dugouts large enough to comfortably fit up to forty-five players. Last year, WPI Baseball carried a roster of over 40 players, and many other Division III teams carry similar numbers. Unlike the major leagues, all pitchers are expected to be in the dugout during the game, not in the bullpen. The bullpen is only utilized for pitchers to warm up. Dugouts should include space to store personal bags as well as team equipment like bats and helmets. Dugouts should also create a comfortable environment to watch the game.

Unlike dugouts, the NCAA has specific requirements when it comes to a facility's bullpens. Both teams are required to have a bullpen that is constructed to the exact measurements of the mound on the playing field. This includes the exact distance, mound height, and size of home plate. Bullpens should be set up outside the playing area and oriented so that they are throwing in the same direction as they will be throwing when entering into the game. Each bullpen must have two mounds and be large enough to allow two pitchers to warm up at the same time. Bullpens can include additional features that cater to pitchers. An example of this is a plyometric wall somewhere in the bullpen. Today pitchers use plyometric balls to perform shoulder care exercises. These balls are weighted and need to be thrown into a hard surface. In addition, it is important to ensure that the pitchers have a space to hook up J-bands, another tool utilized for arm care. While these are not requirements, they are features that collegiate level pitchers look for in a bullpen.

Light Specifications

The required lighting for a baseball field in the collegiate level is 70 foot-candles in the infield and 50 foot-candles in the outfield. It is recommended to have four light poles in the infield and four in the outfield. The light horizontal uniformity for the infield is 2.0:1 and 2.5:1 for the outfield, see Figure 5 for more information and placement on the light poles (“Baseball standard intercollegiate play”, 2022).

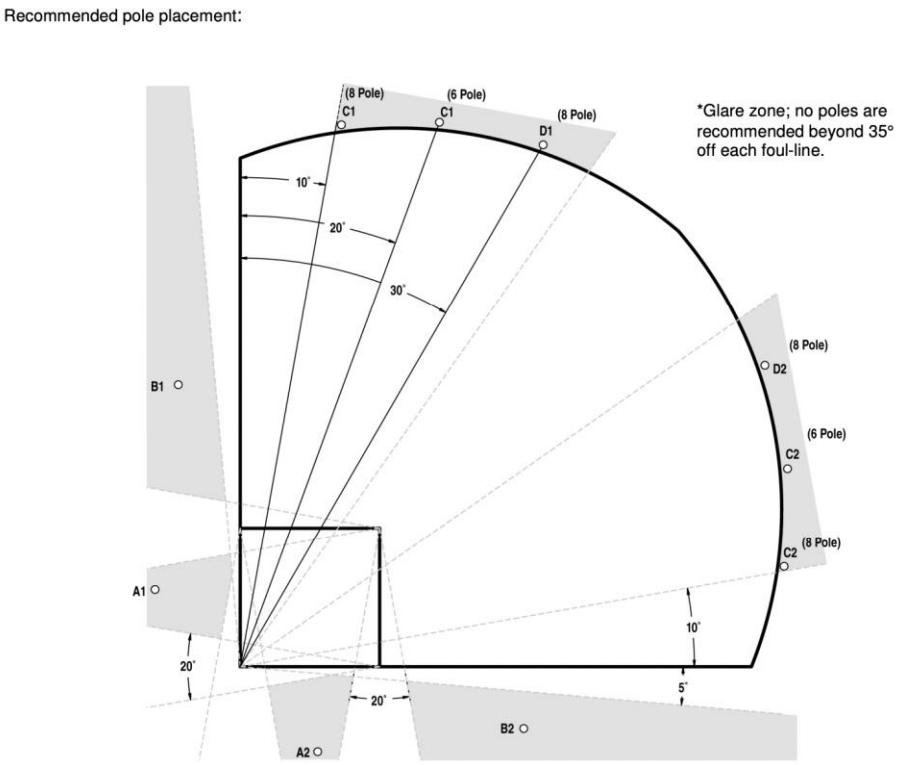

Figure 5: NCAA Baseball Best Lighting Practices (“Baseball standard intercollegiate play”, 2022)

Scoreboard and Audio Systems

A high quality scoreboard and audio system can enhance a baseball facility. While high quality systems are not essential in the sense that they don’t take away from gameplay, having them improves the experience of both players and fans. A field must have a scoreboard that at a minimum tallies the score each inning, the number of outs, the pitch count, and the number of errors and number of hits each team has. This is essential for the fans watching the game as well as players who may have lost track of what inning they are in or how many outs there are.

Division I scoreboards have become more and more advanced as programs such as Mississippi State installed Jumbotron scoreboards with video and replay capabilities (Mississippi State, 2016). Since Division III athletics do not have the same type of funding, most NEWMAC facilities have simple electronic scoreboards that can be controlled remotely. The school's name, logo, or mascot is often displayed somewhere on the scoreboard.

When installing a scoreboard it is important to consider the placement and the structural integrity of the scoreboard itself. The scoreboard should be placed somewhere that is easy to see for both players and fans. Typically the scoreboard is located somewhere behind the outfield fence. Sometimes you can also find it in foul territory down the lines closer to the outfield fence. In terms of structural integrity, the scoreboard must be able to withstand harsh weather and winds in New England. Also, if placed in the outfield, the scoreboard should be made of a strong material that can handle getting hit with potential home runs.

Division III baseball facilities use audio systems for music and game announcements. From a player's perspective, good quality music is appreciated for warmups and walk up songs. Each team prepares for a game by taking batting practice, infield-outfield practice, and other warm-ups, which can last up to two hours. The home team is expected to play music during this time, and music that is entertaining is always appreciated. Currently, WPI Athletics brings a temporary speaker system to NEBC that can barely be heard by players and fans alike. The installation of a permanent system with higher quality audio capabilities would improve the playing environment for the players and improve the production of the game for WPI Athletics.

Sustainability

Turf Fields vs. Grass Fields

Baseball fields can be made of artificial turf or natural, well-maintained grass. The benefit of a turf field is that it can be used in any climate, which is crucial considering the typical New England rain and snow during the winter and spring seasons. Rain causes no damage to a turf playing field if it is used during or after a rainstorm. However, if a grass field is used under the same weather conditions, the surface is prone to damages that would require prompt maintenance, resulting in a delay of a game.

The price of upkeep between turf and grass fields differs as grass fields have to be taken care of daily to ensure suitable conditions for games. It is also costly to maintain a good grass

field as it needs a daily intake of water and multiple man hours a day to keep the field in proper game shape. However, although a turf field typically costs more to install initally, there is much less cost with the upkeep of the field and does not require water to be suitable to play on ("Pros and cons of turf fields", 2017). Typically a turf baseball field costs anywhere between $420,000 to $1,140,000 to install, depending on the size, quality, infill, and design of the field and turf.

Baseball field construction costs	Turf baseball field	Natural grass
Construction costs	$420,000 - $1,140,000	$400,000 – $820,000
Maintenance costs	$6,000 - $10,000 x 10 years = $60,000 - $100,000	$18,000 – $44,000
Utilization time/year	2,800 hrs x 10 years = 28,000 hrs.	800 hrs. x 10 years = 8,000 hrs.
Cost per hour of use	$17 - $44	$52 - $108

Figure 6: Turf vs. Natural Grass Price Comparisons ("*Artificial Turf Field - sports venue calculator", (n.d.))*

Field Lights

LED lighting provides a long-lasting light source for a baseball field compared to metal halide lights. LED lights save about 50% more energy than metal halide lights, and require less maintenance. LED lights are able to be turned on and off easily and require no warm up time, allowing the lighting to be provided instantaneously, compared to metal halide lighting which takes time to warm up before they reach maximum brightness. LED lights range from 400 to 1500 watts, and the common wattage for a baseball field is 1500 watts. Over time metal halide lights will fade and not be strong enough to light a baseball field as they can only last 6,000 to 15,000 hours of use. Fading is not an issue for LED lights and they have a lifespan of up to 50,000 to 100,000 hours ("*Metal Halides vs. LEDs",* 2023).

Methodology

To locate and design the most suitable option for a new WPI Baseball facility, a structured methodology will be developed. The methods will include gathering relevant facility considerations, evaluating and choosing a facility location, and establishing a final facility design adhering to all local regulations and NCAA requirements, as appropriate. The section overviews the approach during the research, evaluation, determination, and design of the proposed WPI Baseball facility.

Establish Design Requirements

Initially, extensive research and surveys will be conducted to gather insight on relevant facility considerations to identify design requirements.

Review Collegiate Baseball Facilities

While establishing the essential elements to the potential WPI Baseball facility, comparisons will be made to relevant programs. Research will be conducted regarding the NEWMAC baseball facilities to establish the components of each home field. Elements that will be identified and evaluated for each facility include field conditions, facility proximity to campus, dugouts, batting cages, and light configuration. Similarly, research will examine and compare baseball facilities of the surrounding Worcester-area universities. These colleges include Anna Maria College, Worcester State University, Assumption University, and Holy Cross. Comparisons will evaluate the facility conditions among local programs.

A field note sheet will be produced to record all observations regarding field layout, field elements, safety factors, and additional notes. The field notes will be recorded individually and will examine additional elements of baseball facilities that were previously overlooked. These preliminary observation sheets will provide a set of standardized field notes to be referenced when completing future site visits.

Survey WPI Baseball Players

A comprehensive survey will be developed and electronically delivered to WPI Baseball players where they can evaluate different facility criteria. The survey will ask players to rank eight different components of a home facility from least important to most important.

The facility criteria used in the survey will be later established as evaluation criteria when comparing final facility options. The results from the survey will dictate the weighting of the criteria on the rubric, making the more important items worth more points when scoring final facility options. The survey will be distributed to the team and will be aiming to receive 30 responses regarding their preferences.

Interview WPI Athletic Faculty

Additionally, key personnel within the WPI Athletic Department will be identified, including coaches and administrators. Several conversations will take place with WPI Baseball Head Coach, Brendan Casey, as his vision for the program is an essential consideration for future options. An extensive set of interview questions will be developed and asked to WPI athletic faculty through informal interviews. These questions will focus on their preferences for the facility and will seek their priorities when considering different athletic facility components. Preliminary questions will seek their thoughts on the current baseball field situation along with any ideas for potential facility solutions. These findings will be considered when developing the facility evaluation rubric during the decision-making process.

Select a Facility Location

Establish Decision Criteria

Initially, several factors and field elements will be researched and considered before compiling them into eight separate criteria areas. This criteria will consider, but not be limited to, field conditions, field layout and dimensions, dugouts, bullpens, storage areas, facility access, and proximity to campus. This baseline facility criteria will be established prior to identifying any potential locations, avoiding any biases or possibilities of favoring certain field options. The WPI athletic faculty interview responses and survey rankings will be heavily considered when establishing the final criteria for facilities.

Once the criteria is established, a rubric will be created which provides a scoring system for evaluating the facility options. Using the survey results which will rank the importance of field components, a weighting system will be applied to the rubric, making some items more

significantly scored when evaluated. This rubric will be used following the research and designation of the final baseball field options.

Identify Facility Options

Extensive research will be completed in search for potential WPI Baseball facility options. This research will vary from using Google Earth, Google Maps, and driving around select locations throughout Worcester and nearby areas. This preliminary aspect of research will focus on identifying baseball fields which have enough space for adequate baseball facilities and a college-sized field. Also, these potential facilities must not be solely owned by another team or organization during the spring season in order to be considered 'feasible' as a field option. When visiting the sites, field note sheets will be completed individually to capture facility observations. Previous field note sheets from reviewing collegiate facilities will be referenced as standardized observation worksheets.

Several different field options will be considered and evaluated during the facility research process. These types of options include locating a vacant site with sufficient space, identifying and renovating an existing field, and a 'no-build' option. When finding vacant sites, the aim will be to locate an area with enough space to build a college-sized field along all necessary components and facilities. These essential components will be identified based on the facility considerations and finalized criteria. Another field option which will be explored is the possibility of utilizing an existing field that has potential to meet the necessary requirements. Some key elements include undivided facility access during the spring season, space for batting cages, storage, and bullpens, scoreboard, and proper field dimensions. Lastly, a no-build option will be evaluated which considers the option of not building any new facilities for the WPI Baseball program and remaining at NEBC in Northborough. While all associated travel costs may be unavailable to access, estimated transportation costs in relation with the overall Program budget will be considered. At least one field or site will be proposed for each type of facility option.

Evaluate Baseball Facilities

Utilizing the evaluation rubric, all researched and identified facility options will be compared based on the weighted scale. The researched facilities will be narrowed down to 3-5

potential fields which will be evaluated and compared on the rubric as final options. The point system will generate an objective point total for each field option, providing a systematic analysis while maintaining emphasis on more significant criteria. Additionally, a cost analysis will be completed for all options, providing a breakdown of all associated expenses. By completing a weighted evaluation and cost analysis, all relevant factors are considered to establish a well-rounded facility for the WPI Baseball program.

Facility Design & Development

For the final facility design, a more thorough cost analysis will be conducted, estimating the expenses for all identified construction plans. Sustainable development will be explored and implemented into the facility design when feasible.

Site Preparation

Once facility options are narrowed down, local building codes and zoning regulations will be investigated to identify any potential obstacles to proposed construction plans. Likewise, research will be conducted regarding any permits relevant to the facility location and address how to approach any licensing matters.

While focusing on the final facility option, all potential construction will be researched and identified depending on the current conditions of the selected location. Site work considerations will include leveling and grading, excavation, materials, and building structures. These activities are all intertwined and directly dependent on the state of the selected facility location. Despite differing field options, necessary leveling, grading, and excavation work will be established for new facility structures, while all material procurement will be outlined and estimated.

Develop Facility Drawings

If necessary for the selected field design, detailed architectural plans will be developed for the baseball facility, including field layout, locker rooms, storage facilities, and any other required field elements. If the chosen facility does not have an existing field, the orientation of the field will be adjusted to obtain the most ideal sun directions, subsequently affecting the orientation of the facility entirely.

Develop Revit Drawing of Facility Design

Following all preliminary considerations and site planning, a Revit drawing of the proposed facility will be developed to display the new field design. Utilizing MassGIS data, the topography of the selected site will be imported into Revit where the field design and facility elements will be implemented accordingly. An advanced 3D rendering of the facility will be generated to present all incorporated elements including facility seating, storage, batting cages, and miscellaneous features.

While progressing through this chronological methodology, the project will progress from gathering relevant field considerations and conducting evaluations to developing a finalized 3D design of the proposed facility. By considering all relevant factors and completing a detailed analysis of field options, all essential components are evaluated and integrated to produce a viable facility option for the WPI Baseball program.

Conclusion & Deliverables

The intended deliverables of the project include a final report, a cost estimate for the proposed design of the facility, and a 3D rendering of the facility at the determined site location. At the end of the project, numerous fields will have been considered and graded with the weighted point system. Based on the evaluation rubric, a proposed home facility option will be recommended for WPI Baseball that exceeds the other options under consideration.

Schedule

Schedule of Methods		
Methodology Activity		**Activity Timeline**
Gathering Facility Considerations		**9/4/23 - 10/13/23**
	Relevant Collegiate Programs	9/11/23 - 9/30/23
	Surveying WPI Baseball Players	9/18/23 - 9/30/23
	Interviewing WPI Athletic Faculty	9/4/23 - 10/13/23
Selecting a Facility Location		**9/30/23 - 11/10/23**
	Establishing Baseball Facility Criteria	9/30/23 - 10/13/23
	Researching Facility Options	10/7/23 - 10/27/23
	Evaluating Baseball Facilities	10/27/23 - 11/10/23
Facility Design & Development		**11/10/23 - 12/17/23**
	Site Preparation & Specifications	11/10/23 - 12/17/23
	Scoreboard CAD Model & ANSYS Analysis	11/10/23 - 12/17/23
	Contingent on if the facility will include a building	11/10/23 - 12/17/23
Developing Revit Drawing of Field Design		**1/10/23 - 2/23/23**

***Contingent on if the facility will include a building**

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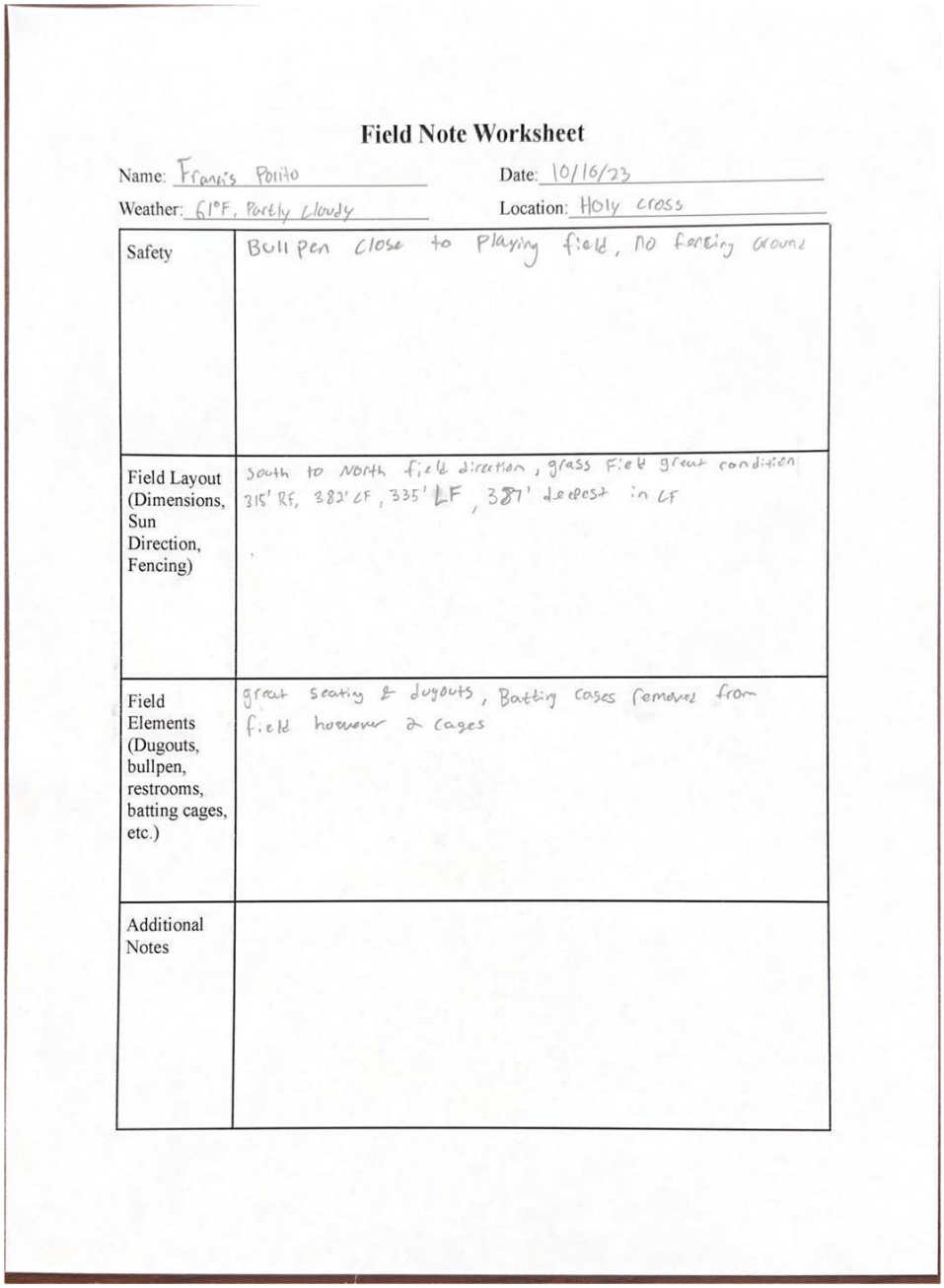
Appendix B: Observation Worksheets

Holy Cross



Field Note Worksheet

Name: Frank's Polito Date: 10/16/23

Weather: 61°F, Partly Cloudy Location: Holy cross

Safety	Bullpen close to playing field, no fencing around
Field Layout (Dimensions, Sun Direction, Fencing)	South to North field direction, grass Field great condition 315' RF, 382' CF, 335' LF, 387' deepest in CF
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	great seating & dugouts, Batting cages removed from field however 2 cages
Additional Notes	

Field Note Worksheet

Name: DJ Brooks Date: 10/10/2023

Weather: 58° and cloudy Location: Holy Cross

Safety	· Bullpens in the playing field
Field Layout (Dimensions, Sun Direction, Fencing)	· 335 to LF, 315 to RF, 390 to CF · 370: 375 to RC, 360 to LC · Home plate faces directly North · No sun danger for the hitter of catcher · Permanent solid fence
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	· Working Lights - 8 Towers · 65 Foot dugouts on both sides · walk-in/down dugout · 2 level benches · Chest fence/net Iron · Helmet + Bat storage · Bthrooms down the LF line, close enough · Bullpens in foul territory, not blocked off by fence · Throw opposite way of home plate
Additional Notes	· Plenty of seating for all fans. Stadium · Speaker system and press box · Grass Field that is well maintained · good warning track · Tarp

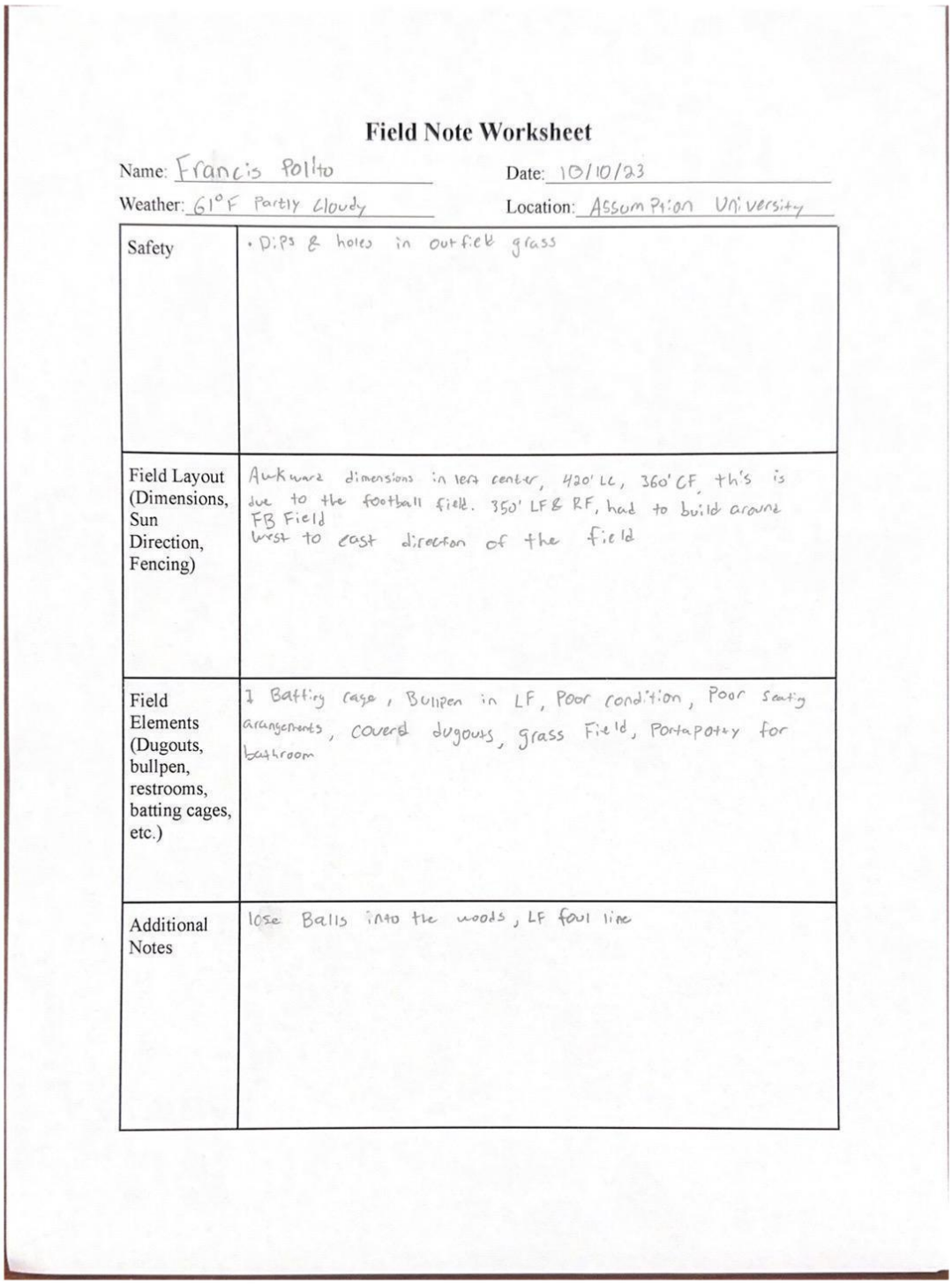
Field Note Worksheet

Name: Jake DelMonte Date: 10/10/23

Weather: 55° & Cloudy Location: Holy Cross Baseball Field

Safety	- tight foul lines to fence from bases to mid-outfield - On-field bullpens → required spotters
Field Layout (Dimensions, Sun Direction, Fencing)	- Slightly deeper in right center and right - Sun rises over first and sets over third - Tight fencing along foul lines - Great dimensions for collegiate ball - Gravel warning track
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	- Great seating surrounding field - Spacious in both dugouts - Outdoor rest areas next of left field foul pole - Batting cages far from field (removed) (2x) → only present on one side
Additional Notes	- Large, gravel warning track - Great scenery surrounding stadium - Wind coming in from RF due to EB 290

Assumption University



Field Note Worksheet

Name: Francis Polito Date: 10/10/23

Weather: 61°F Partly Cloudy Location: Assumption University

Safety	• Dips & holes in outfield grass
Field Layout (Dimensions, Sun Direction, Fencing)	Awkward dimensions in left center, 420' LC, 360' CF, this is due to the football field. 350' LF & RF, had to build around FB Field West to east direction of the field
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	1 Batting cage, Bullpen in LF, Poor condition, Poor seating arrangements, covered dugouts, grass Field, Portapotty for bathroom
Additional Notes	lose Balls into the woods, LF foul line

Field Note Worksheet

Name: DJ Brooks Date: 10/10/2023

Weather: 58° and Cloudy Location: Assumption U

Safety	· Unlevel outfield surface · Many bumps, holes etc. · Tripping hazard/ rolled ankles · Sun sets directly behind home plate · cannot see the ball in CF in the evening
Field Layout (Dimensions, Sun Direction, Fencing)	· 345 to RF, 350 to LF, 360 to CF · LC: 420 RC: 335 · Home plate is facing directly East · Rise in batters face... probably not a problem with when games are played · Permanent solid fence  Field shape is weird
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	· NO Lights · 3D Got dugouts on both base lines → 3rd 2 level benches → Helmet storage / equipment racks · Bullpens both out in LF → bat storage · Long walk for both teams · Not throwing in direction of home plate · Porta-Potty close to the playing field · Storage shed attached to the 3rd base bullpen, not a lot of room
Additional Notes	· 3 bleachers - Good amount of seating for parents · Grass field · Very run down - what can happen to grass if not maintained properly · Speaker system and press box behind home Plate · Press box for announcers

Field Note Worksheet

Name: Jake DelMonte Date: 10/10/23

Weather: 55° & Cloudy Location: Assumption College

Safety	- Unlevel outfield, many bumps and small ditches throughout grass → potential hazard while running; tripping - Right field line is close to fence along line → close to field of play - Morning sun
Field Layout (Dimensions, Sun Direction, Fencing)	- Awkward dimensions: left center is roughly 415 ft while Right center is about 330 ft. - Sun direction is problematic in mornings, rises slightly right of batter's eye, sets behind home plate → (However, rarely morning games in college)
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	- Dugouts are covered, double bench seating → longer seating area, short railing - Bullpens are tucked behind left field; far from dugouts and only appear on one side of the field - Restrooms located past courts behind field → only portapotty, no facility
Additional Notes	- Any foul balls to the left side are most likely lost in woods - Behind home plate, land is sloped downwards; how does this impact flooding?

NEBC

Field Note Worksheet

Name: Francis Polito Date: 10/10/23

Weather: 61°F, Partly Cloudy Location: NEBC Field 1

Safety	Sun Points directly in RF eye during a sunny day
Field Layout (Dimensions, Sun Direction, Fencing)	SW to NE direction, 320' LF, 373' CF, 305' RF, Turf Field
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	Bullpens on either foul line, bathroom in complex to the Left, or behind CF, NO Batting cages at NEBC, Poor Seating behind home Plate many fans bring their own Chairs, covered dugouts
Additional Notes	Lose balls into the woods RF foul line

Field Note Worksheet

Name: DJ Brooks Date: 10/10/2023

Weather: 58° and cloudy Location: NEBC

Safety	• Sun glaring off windshields in the parking lot getting in RF, CF eyes • Small gap between end of turf and bottom of fence
Field Layout (Dimensions, Sun Direction, Fencing)	• 317 LF Line, 306 RF Line, 375 CF • Left center: 350 Right center: 335-340 • Sun behind home plate and moves right behind the third base dugout at the 3PM - 4PM window • Permanent fence
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	• Field has working lights → 8 towers, none in dead center for better safety • 50 Foot dugouts • Benches have the seat level & the storage level (2 levels) • Helmet/equipment holder - NO BAT HOLDER/COMPARTMENTS • Great Dugout Fence/net → Includes a 12 x 15 storage closet • Restrooms far from field (unless used to go in building) • No access to batting cages (cars?) • Bullpen - same for both teams, out of play, pitching mound, plyo wall
Additional Notes	• Not enough seating for parents • one bleacher section • No speaker system • Turf Field → Good Turf • Plenty of parking & close

Field Note Worksheet

Name: Jake DelMarle Date: 10/10/23

Weather: 55° & Cloudy Location: New England Baseball Complex (NEBC) – Northborough (Field 1)

Safety	- small amount of space between field of play and fence along both foul lines - When sun sets, the parking lot in distance behind home plate, (from RF view) has sun reflecting off cars creating serious visibility issues after
Field Layout (Dimensions, Sun Direction, Fencing)	- 310 to right (line), 320 to left (line), 375 to center - According to prior research, sun is in ideal ~~location~~ orientation → rises over RF and sets over home plate towards third - Standard fencing ~7 Ft
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	- Dugouts are very large, - Bullpens have two mounds each - Restrooms are located below field (adjacent indoor restrooms no longer accessible - NO Batting cages ~~at~~ complex
Additional Notes	- Serious facility access issues - Cannot use field after 10am on Saturdays for the rest of the weekend

Clark University

Field Note Worksheet

Name: Frankie Polito Date: 11/3/23

Weather: 49° Sunny Location: Clark

Safety	NO fence or net in front of dugouts
Field Layout (Dimensions, Sun Direction, Fencing)	340' LF 330' RF 395' CF , NW to SE RC 405' Permanent fence & tall fense in left
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	Bullpens on each foul line, 1 Batting cage on 1st base line, restrooms close to field along with locker rooms Alright seating for fans, small dugouts for college field Have stadium lights
Additional Notes	Turf field

Field Note Worksheet

Name: DJ Brooks Date: 11/3/2023

Weather: 49° & Sunny Location: Clark

Safety	• No fence / net in front of dugouts
Field Layout (Dimensions, Sun Direction, Fencing)	340 to LF, 330 to RF, 395 to CF RC - 405 LC - 320 • Sun is behind first base dugout in the AM & sets behind the left field fence • Very tall fence in left to make up for shallowness • permant fence, sturdy but forgiving
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	• ~~smaller dugouts~~ • dugouts are 52 x 10, no fence • dugouts have enough helmet & bat storage • metal benches, have the top seat • Bullpens fenced off, plenty of space • Restrooms close to field in athletic facility • storage closet next to athletic facility, might be a garage • Turf field, ~~no~~ Mound is clay • Batting cage on first base line... 1 cage
Additional Notes	• Turf is large enough to fit a soccer field in the OF • Have lights

Field Note Worksheet

Name: Jake DelMonte Date: 11/3/23

Weather: 49° Sunny Location: Clark College

Safety	- No fence in front of dugouts → Also dugouts are closer to home plate - Home side bullpens are not enclosed
Field Layout (Dimensions, Sun Direction, Fencing)	- Left 330, Right 380, Center/Right Center 415 - Disproportionate dimensions - Fencing is about 15 ft tall - Sun direction rises over left field and sets behind home towards first base
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	- Bullpens are different on both sides - Dugouts have no front fencing separating the field of play - Batting Cage is only located on home field - Restrooms are located in central fieldhouse by front gates
Additional Notes	

WPI Townhouses

Field Note Worksheet

Name: Frankie Polito Date: 11/3/23

Weather: 49° Sunny Location: WPI Town houses

Safety	close to a busy street some concerns may be stray balls
Field Layout (Dimensions, Sun Direction, Fencing)	NO field on location, ~~can~~ enough room to put a field. North side of plot closest to park side for home plate
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	~~would have~~
Additional Notes	would have to tear down town houses & build field, storage, locker rooms etc. walking distance to WPI, would be tight for field & building but can be done w/ some design work

Field Note Worksheet

Name: DJ Brooks Date: 11/3/23

Weather: 49° sunny Location: Townhouses WPI

Safety	· Close to Park Ave · Close to Institute pond / wetland
Field Layout (Dimensions, Sun Direction, Fencing)	· Room for 330 to RF + LF · Room for 380 - 400 to CF, depending on final layout · Layout for max space looks to be sunrise behind 1B dugout & sunset in LF
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	· New construction
Additional Notes	· Would involve Demo of 28 Townhouses · Driveway should be able to stay in tact · Room to expand upon parking · Room for batting cages in LF · Might need a net to block residential / Park ave. · Similar to net @ MIT

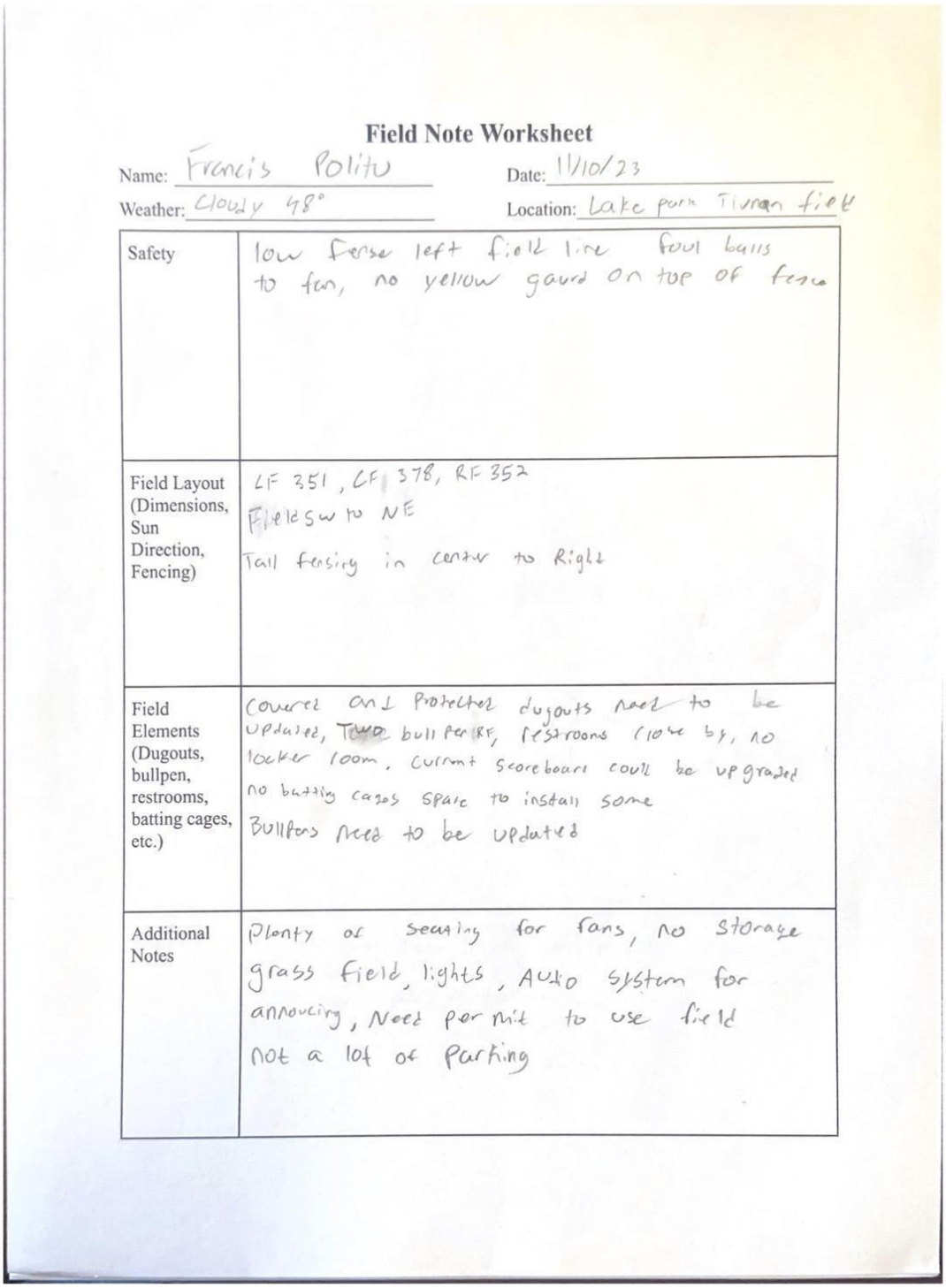
Field Note Worksheet

Name: Jake DelMonte Date: 11/3/23

Weather: 49° Sunny Location: WPI Townhouses

Safety	- Lot is adjacent to a busy street (Park Ave) - Would require tall nets to prevent foul balls from hitting cars or entering nearby properties
Field Layout (Dimensions, Sun Direction, Fencing)	- No current field - Best layout with plot of land is placing home plate near the road towards the border of the property further from campus Google Earth (with theoretical home plate) - Main driveway and side parking lot could be kept with proposed home plate (Left Center would be ~ 370)
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	N/A
Additional Notes	- Would require significant demolition → Roughly 28 different "houses" (buildings) - Lots of concrete roads, walkways, foundations to remove / excavate

Tivnan Field



Field Note Worksheet

Name: Francis Politu Date: 11/10/23

Weather: Cloudy 48° Location: Lake park Tivnan field

Safety	low fense left field line foul balls to fan, no yellow gaurd on top of fence
Field Layout (Dimensions, Sun Direction, Fencing)	LF 351, CF 378, RF 352 Field sw to NE Tall fencing in center to Right
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	Covered and Protected dugouts need to be updated, Two bullpen RF, restrooms close by, no locker room, current scoreboard could be upgraded no batting cages space to install some Bullpens need to be updated
Additional Notes	Plenty of seating for fans, no storage grass field, lights, Audio system for announcing, Need permit to use field not a lot of parking

Field Note Worksheet

Name: DJ Brooks Date: 11/10/23

Weather: 48° cloudy Location: Tivnan Field

Safety	· Low fence on LF line w/ no guard on top
Field Layout (Dimensions, Sun Direction, Fencing)	· 351 LF, 378 CF, 352 RF · RC is shallower than down the line · Sunset behind 3B dugout, rise in RF, RC · Tall fence from CF → RF · Adequate fencing · right to the LF line

Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	· Dugouts need an upgrade
	  · More depth
	  · better benches
	· Restrooms close to field & handicap accessible
	· No batting cages → there is room for them
	· No bullpen on LF line
	· Seems to be some kind of announcing system

Additional Notes	· No storage & No lockerroom · Grass field · Has lights · Tons of seating for parents / fans · Sign says "Use of this field by permit only" · See what a permit takes

Field Note Worksheet

Name: Jake DelMonte Date: 11/10/23

Weather: 48° & Cloudy Location: Tivnan

Safety	- low fence with no yellow casing on top down left field line - Road behind RF is in play with any HRs
Field Layout (Dimensions, Sun Direction, Fencing)	351 378 (~345) 352 L LC C RC R - Good sun setup, will rise behind right center, set behind 3rd baseline - 6 ft fence left to center, 10 ft fence center to right
Field Elements (Dugouts, bullpen, restrooms, batting cages, etc.)	- Dugouts could use more depth but adequate space overall - ~~Two mounds on right field side~~ AND TWO BULLPENS } no bullpen on left field side - Restrooms are by small parking lot (accessible) - Room for batting cages behind left
Additional Notes	- ~~Announcement~~/ Speaker system and right station in place - Have scoreboard - Sign says "Use ~~of~~ of this Field is by permit only - Minimal existing parking (would require street parking) - Storage unit behind dugout on 1B side

Appendix C: Facility Cost Estimates - Townhouses and New Balance Fields

Facility Cost Estimates

	(Relative to 2022) 2023 Cost Index:	103.80%	Townhouses		New Balance Fields	
Expenses	Unit Rate	Unit	Quantity	Cost	Quantity	Cost
Acquisition						
Property Cost				$ -		$ -
Access Fees	$ 35,000.00	yr.		$ -		$ -
Miscellaneous				$ -		$ -
				$ -		**$** -
Site Work						
Demolition				$ -		$ -
Demolition two-story multi-family house (2400 sq. ft)	$ 8,018.55	ea.	25.00	$ 200,463.75		$ -
Demolition small buildings, no salvage (masonry cu. ft.)	$ 0.36	cu. ft				
Selective demolition disposal (masonry cu. yd.)	$ 12.04	cu. yd.	4,075.00	$ 49,066.26		$ -
Site Prep	$ 5.00	s.f.	245,000.00	$ 1,225,000.00	122,215.00	$ 611,075.00
				$ 1,474,530.01		**$ 611,075.00**

	(Relative to 2022) 2023 Cost Index:	103.80%	Townhouses		New Balance Fields	
Expenses	Unit Rate	Unit	Quantity	Cost	Quantity	Cost
Amenities						
Dugouts						
Concrete Walls	$ 10.00	sf	690.00	$ 6,900.00	690.00	$ 6,900.00
Nylon Mesh Net Fencing 3-1/2" Mesh	$ 4.00	sf	144.00	$ 575.47	144.00	$ 575.47
Concrete Floor 6" thick, direct chute	$ 21.81	cu. yd.	10.00	$ 218.08	10.00	$ 218.08
Interior Costs	$ 1,500.00	ea.	1.00	$ 1,500.00	1.00	$ 1,500.00
Bullpens				$ -		$ -
Vinyl Covered 9 ga. Chain link fencing 6' high	$ 18.00	ea.	240.00	$ 4,319.74	240.00	$ 4,319.74
Scoreboard	$ 24,462.03	ea.	1.00	$ 24,462.03	1.00	$ 24,462.03
Sound System	$ 5,000.00	ea.	1.00	$ 5,000.00	1.00	$ 5,000.00
Fencing						
Vinyl Covered 9 ga. Chain link fencing 4' high	$ 13.13	l.f.	370.00	$ 4,858.36	395.00	$ 5,186.63
Vinyl Covered 9 ga. Chain link fencing 6' high	$ 18.00	l.f.	536.00	$ 9,647.42	573.00	$ 10,313.38
Backstop (30' w x 12' h x 1 overhang)	$ 9,499.78	ea.	1.00	$ 9,499.78		$ -
Batting Cages	$ 4,999.00	ea.	2.00	$ 9,998.00	1.00	$ 4,999.00
Seating (bleachers per seat)	$ 106.24	ea.	54.00	$ 5,736.92	54.00	$ 5,736.92
Storage (8' x 20' x 8.5' Container)	$ 2,500.00	ea.	1.00	$ 2,500.00	1.00	$ 2,500.00
				$ 85,215.80		**$ 69,211.25**

	(Relative to 2022) 2023 Cost Index:	103.80%	Townhouses		New Balance Fields	
Expenses	Unit Rate	Unit	Quantity	Cost	Quantity	Cost
Turf						
Artifical Grass Surfacing				$ -		$ -
1/2" Pile and 5/8" Cushion Pad	$ 9.18	s.f.	137,911.00	$ 1,265,460.30	127,019.00	$ 1,165,516.18
2-1/2" thick Asphaltic Base with 6" crushed stone sub-base	$ 2.58	s.f.	137,911.00	$ 356,447.53	127,019.00	$ 328,295.85
Total				**$ 1,621,907.83**		**$ 1,493,812.03**
Lighting						
40' steel pole, galvanized	$ 2,545.18	ea.	8.00	$ 20,361.41	8.00	$ 20,361.41
Total				**$ 20,361.41**		**$ 20,361.41**
Transportation						
Practice Bus Transportation (ESTIMATED avg. round trip)	$ 20.00	mi.		$ -	390.00	$ 7,800.00
Home Game Bus Transportation (ESTIMATED avg. round trip)	$ 30.00	mi.		$ -	85.80	$ 2,574.00
Total				**$** -		**$ 10,374.00**
Utility						
Utility Allowance	$ 200,000.00	ea.	1.00	$ 200,000.00		
Sewer 8" PVC	$ 160.00	l.f.	300.00	$ 48,000.00		
Drain 15" RCP Drain	$ 200.00	l.f.	300.00	$ 60,000.00		
Electrical Rigid galvanized Steel 4 @ 4' Diameter	$ 141.17	l.f.	300.00	$ 42,350.40		
Water Supply, Ductile Iron Pipe 18' L 10" diameter	$ 145.70	l.f.	300.00	$ 43,711.22		
Total	**$ 646.87**			**$ 200,000.00**		
TOTALS			**Townhouses**	**$ 3,402,015.05**	**New Balance Fields**	**$ 2,204,833.69**

Appendix D: Facility Cost Estimates – Tivnan Park and No-Build Option

Facility Cost Estimates

	(Relative to 2022) 2023 Cost Index:	103.80%	Tivnan Park		No-Build Option	
Expenses	Unit Rate	Unit	Quantity	Cost	Quantity	Cost
Acquisition						
Property Cost				$ -		$ -
Access Fees	$ 35,000.00	yr.		$ -	1.00	$ 35,000.00
Miscellaneous				$ -		$ -
				$ -		**$ 35,000.00**
Site Work						
Demolition				$ -		$ -
Demolition two-story multi-family house (2400 sq. ft)	$ 8,018.55	ea.		$ -		$ -
Demolition small buildings, no salvage (masonry cu. ft.)	$ 0.36	cu. ft	8,000.00	$ 2,906.40		
Selective demolition disposal (masonry cu. yd.)	$ 12.04	cu. yd.	300.00	$ 3,612.24		$ -
Site Prep	$ 5.00	s.f.	119,352.00	$ 596,760.00		$ -
				$ 603,278.64		**$** -

	(Relative to 2022) 2023 Cost Index:	103.80%	Tivnan Park		No-Build Option	
Expenses	Unit Rate	Unit	Quantity	Cost	Quantity	Cost
Amenities						
Dugouts						
Concrete Walls	$ 10.00	sf	690.00	$ 6,900.00		
Nylon Mesh Net Fencing 3-1/2" Mesh	$ 4.00	sf	144.00	$ 575.47		
Concrete Floor 6" thick, direct chute	$ 21.81	cu. yd.	10.00	$ 218.08		
Interior Costs	$ 1,500.00	ea.	1.00	$ 1,500.00		
Bullpens				$ -		$ -
Vinyl Covered 9 ga. Chain link fencing 6' high	$ 18.00	ea.	270.00	$ 4,859.71		
Scoreboard	$ 24,462.03	ea.	1.00	$ 24,462.03		$ -
Sound System	$ 5,000.00	ea.	1.00	$ 5,000.00		
Fencing						
Vinyl Covered 9 ga. Chain link fencing 4' high	$ 13.13	l.f.		$ -		$ -
Vinyl Covered 9 ga. Chain link fencing 6' high	$ 18.00	l.f.		$ -		$ -
Backstop (30' w x 12' h x 1 overhang)	$ 9,499.78	ea.		$ -		$ -
Batting Cages	$ 4,999.00	ea.	2.00	$ 9,998.00		
Seating (bleachers per seat)	$ 106.24	ea.		$ -		$ -
Storage (8' x 20' x 8.5' Container)	$ 2,500.00	ea.	1.00	$ 2,500.00		
				$ -		$ -
				$ 56,013.29		**$** -

	(Relative to 2022) 2023 Cost Index:	103.80%	Tivnan Park		No-Build Option	
Expenses	Unit Rate	Unit	Quantity	Cost	Quantity	Cost
Turf						
Artifical Grass Surfacing				$ -		$ -
1/2" Pile and 5/8" Cushion Pad	$ 9.18	s.f.	128,887.00	$ 1,182,656.80		$ -
2-1/2" thick Asphaltic Base with 6" crushed stone sub-base	$ 2.58	s.f.	128,887.00	$ 333,123.92		$ -
Total				**$ 1,515,780.72**		**$ -**
Lighting						
40' steel pole, galvanized	$ 2,545.18	ea.		$ -		$ -
Total				**$ -**		**$ -**
Transportation						
Practice Bus Transportation (ESTIMATED avg. round trip)	$ 20.00	mi.	370.00	$ 7,400.00	1,050.00	$ 21,000.00
Home Game Bus Transportation (ESTIMATED avg. round trip)	$ 30.00	mi.	81.40	$ 2,442.00	250.00	$ 7,500.00
Total				**$ 9,842.00**		**$ 28,500.00**
Utility						
Utility Allowance	$ 200,000.00	ea.				
Sewer 8" PVC	$ 160.00	l.f.				
Drain 15" RCP Drain	$ 200.00	l.f.				
Electrical Rigid galvanized Steel 4 @ 4' Diameter	$ 141.17	l.f.				
Water Supply, Ductile Iron Pipe 18' L 10" diameter	$ 145.70	l.f.				
Total	**$ 646.87**					
TOTALS			**Tivnan Park**	**$ 2,184,914.65**	**No-Build Option**	**$ 63,500.00**

Appendix E: Final Facility Cost Estimate

Facility Cost Estimate

	2023 Cost Index (Relative to 2022):	103.80%	Townhouses	
Expenses	**Unit Rate**	**Unit**	**Quantity**	**Cost**
Site Work				
Demolition				
Demolition two-story multi-family house (2400 sq. ft)	$ 8,018.55	ea.	25.00	$ 200,463.75
Demolition small buildings, no salvage (masonry cu. ft.)	$ 0.36	cu. ft		
Selective demolition disposal (masonry cu. yd.)	$ 12.04	cu. yd.	4,075.00	$ 49,066.26
Site Prep	$ 5.00	s.f.	245,000.00	$ 1,225,000.00
			Total	**$ 1,474,530.01**
Components				
Scoreboard	$ 24,462.03	ea.	1.00	$ 24,462.03
Dugouts				
Concrete Walls	$ 10.00	sf	690.00	$ 6,900.00
Nylon Mesh Net Fencing 3-1/2" Mesh	$ 4.00	sf	144.00	$ 575.47
Concrete Floor 6" thick, direct chute	$ 21.81	cu. yd.	10.00	$ 218.08
Interior Costs	$ 1,500.00	ea.	1.00	$ 1,500.00
Bleachers	$ 106.24	seat	60.00	$ 6,374.40
Bullpens (Vinyl Covered Chain link fencing 6')	$ 18.00	ea.	240.00	$ 4,319.74
Batting Cages	$ 4,999.00	ea.	3.00	$ 14,997.00
Restrooms (Porta Potty Wheelchair Accessible)	$ 2,009.00	ea.	2.00	$ 4,018.00
Storage (8' x 20' x 8.5' Container)	$ 2,500.00	ea.	1.00	$ 2,500.00
Light Poles (40' steel pole, galvanized)	$ 2,545.18	ea.	8.00	$ 20,361.41
Foul Poles	$ 2,069.00	ea.	2.00	$ 4,138.00
Field Material (Artifical Grass Surfacing)				
1/2" Pile and 5/8" Cushion Pad	$ 9.18	s.f.	137,911.00	$ 1,265,460.30
2-1/2" thick Asphaltic Base with 6" crushed stone	$ 2.58	s.f.	137,911.00	$ 356,447.53
Fencing				
Vinyl Covered 9 ga. Chain link fencing 4' high	$ 13.13	l.f.	370.00	$ 4,858.36
Vinyl Covered 9 ga. Chain link fencing 6' high	$ 18.00	l.f.	536.00	$ 9,647.42
Backstop (30' w x 12' h x 1 overhang)	$ 9,499.78	ea.	1.00	$ 9,499.78
Safety Netting (60' high - #36 Guage & (20) Poles	$ 100.00	l.f.	1,000.00	$ 100,000.00
			Total	**$ 1,836,277.51**
Utility				
Utility Allowance	$ 200,000.00	ea.	1.00	$ 200,000.00
Sewer 8" PVC	$ 160.00	l.f.	300.00	$ 48,000.00
Drain 15" RCP Drain	$ 200.00	l.f.	300.00	$ 60,000.00
Electrical Rigid galvanized Steel 4 @ 4' Diameter	$ 141.17	l.f.	300.00	$ 42,350.40
Water Supply, Ductile Iron Pipe 18' L 10" diameter	$ 145.70	l.f.	300.00	$ 43,711.22
			Total	**$ 200,000.00**
TOTALS			**Townhouses**	**$ 3,510,807.52**