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USI Athletics' Complex

Conceptual Design & Estimate

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ABSTRACT

This report includes the conceptual design process for an Athletics' Complex for the University of Southern Indiana (USI). This process includes the preliminary sizing of the facility and the space that it will require to meet the standards of the National College Athletic Association (NCAA) and International Amateur Athletics Federation (IAAF). A location for the site was then established on the University's property at the existing intramural and rugby fields. A site survey was performed, and data was recorded and supplemented with light detection and ranging (LiDAR) to produce a topographic map of the site. Then the alignment of the complex was established which required the existing Clarke Lane to be relocated to create enough space for the Athletics' Complex. The possible alignments were analyzed and chosen to minimize the impact on the existing traffic flow. This was accomplished by routing the alignment around the Complex to the existing roadway. The impact of the increased hard surfaces and the runoff associated was analyzed to determine the impacts on the existing stormwater infrastructure. It was found that the existing infrastructure was able to handle the increase but will need to consider replacement due to its deteriorating state. A conceptual estimate was then created using parametric and historical data techniques of similar facilities. The total cost of a facility with these features was found to be $9,930,131.

TABLE OF CONTENTS

1 INTRODUCTION

The University of Southern Indiana currently does not have an Athletics' Complex to practice and host events on. The track team is traveling to Mount Vernon and Reitz high schools to use their facilities for practice. The USI soccer teams use Strassweg field located on campus. It is in the University of Southern Indiana's master plan for celebrating campus spirt to construct an Athletics' Complex which includes facilities for track and soccer teams. The University has also initiated a feasibility review process of transitioning from Division 2 to 1. The alignments of the site design of the stadium, road relocation, watershed, and conceptual estimate were analyzed in this report. The objective is to create a conceptual site design, relocate the existing roadway, analyze the impact to the watershed, and develop a conceptual cost estimate.

1.1 EXISTING SITE CONDITION

The existing site conditions are a roughly graded field. The location is currently used for intramural rugby. The field and species of grass is not desirable for soccer use. The current infrastructure managing the stormwater runoff is nearing the end of its service life. The existing culverts are in varying condition and vary in material. The current pipe materials in service consist of Corrugated Metal Pipe (CMP), C900, Dual wall smooth interior wall high density polyethylene (HDPE). The Corrugated Metal Pipe shown in Figure 1 is in failing condition. The pipe has rusted and is no longer efficiently transporting the storm water underneath the road. The upstream end of the culvert, shown in Figure 1 is covered in branches, soil, and could not be located. Clarke Lane is also aligned through the project site. It consists of a two-lane roadway connecting the University of Southern Indiana with the on-Campus apartments. The roadway has existing curb inlets, 5-foot sidewalk, and sections of guard rail displayed in Figure 2.

Figure 1: Fail culvert and covered head section.

Figure 2: Existing Clarke Lane.

1.2 SCOPE OF WORK

The project scope includes the collection the data of the existing site location. With this data recorded, a topographic map will be created to display the existing site conditions. From the topographic map the Athletics facility will be modeled into REVIT to produce a set of preliminary site plans and realistic renderings. The impact of the stadium will be analyzed to determine the increase of runoff to the watershed outlet and if the existing infrastructure will be able to handle the increased stormwater runoff. The facility will then be evaluated to determine the cost to construct the complex using parametric and historical data estimating techniques.

2 SITE DESIGN PROCESS

2.1 FACILITY SIZING

The initial step in considering the alignment and location of the stadium was the overall footprint of the facility. The National Collegiate Athletics Association (NCAA) and International Amateur Athletic Federation (IAAF) have standard dimensions for track and soccer fields. Having worked closely with the USI Track Coach, Mike Hillyard, his minimum lane demand for the track was 8 lanes. These dimensions were then considered for the location of the Athletics' Complex. The overall Athletics' Complex spans 185.568m (608.81ft) in length and 121.330m (398.06ft) in width (Figure 3). The Athletics' Complex has a total area of 200,862 ft^2.

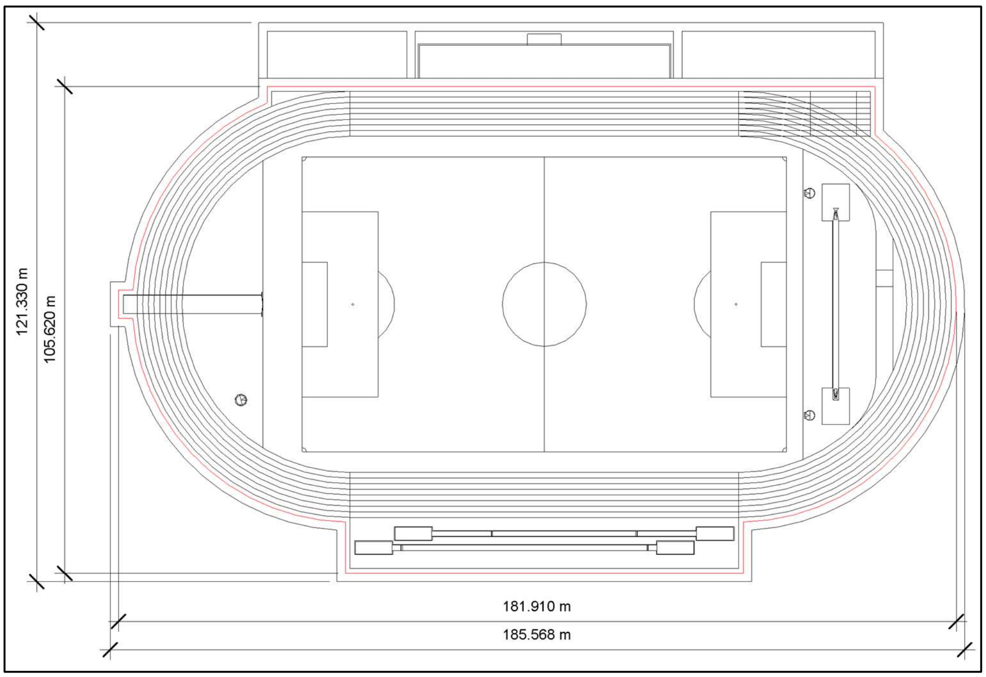

Figure 3: Overall Size requirement of an athletics' facility.

Incorporated in the total footprint of the facility are all track and field events and a soccer field, designed specifically to meet the professional standards set forth by the NCAA and IAAF. These standards, especially through the IAAF, are the same for any given facility around the world and therefore opens avenues for the University of Southern Indiana to potentially host professional meets in addition to school sanctioned meets. Additionally, a one-meter-wide walking path was placed around the facility to provide the facility with an all-encompassing atmosphere, something that is very typical in terms of American sporting events. In addition, it allows spectators to experience the competitions based on their own desires, reducing the feeling of being restricted to the grandstands. Facilities such as toilets, concessions, locker rooms and the grandstands are also factored into the footprint.

2.2 Collection of Data

A survey was conducted to model the existing site conditions. The Northing, Easting and Elevation was recorded for the proposed project site. This data was recorded by the team on September 10th, 2021, using Trimble Global Navigation Satellite System (GNSS) equipment. The base station was setup at the base of an existing light pole. This was done as it is a fixed point that will not move, allowing the team to return and set up on the same point if more data was needed. The data collected includes the existing location of site features including inlets, paved areas, exposed utilities, and existing terrain. This data was supplemented with LiDAR data collected by the state of Indiana. The LiDAR data provided the point data for the wooded areas. The data was then imported into REVIT to produce a topographic map of the site. The site features and topographic map are shown in Figure 4.

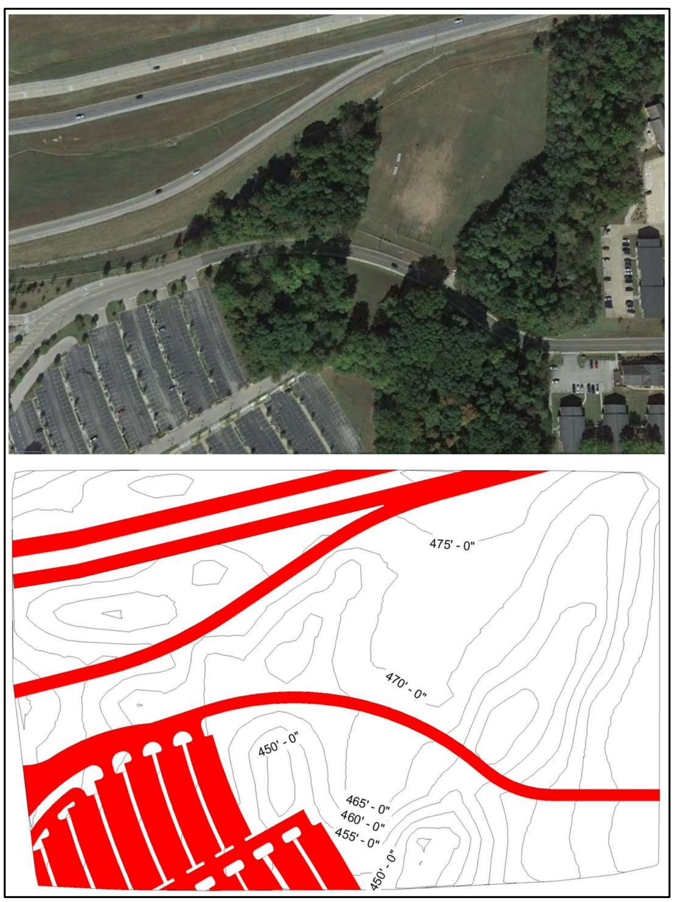

Figure 4: Project site and topographic map

2.3 *ALIGNMENTS*

2.3.1 Track Alignment

An Athletics' Complex requires an area that is open and flat to have enough space for the facility and all of it events. The existing terrain will require a great amount of excavation. The elevation of the field was taken into consideration because of the various amounts of cut and fill that would be needed, something that adds costs to the estimate of the project. The goal is to retain as much soil onsite as possible as hauling soil offsite will increase the cost of the project. The track elevation was tested at three different elevations, 462, 465, and 470 ft. The track alignment at 462 ft can be seen in Figure 5. The main consideration was the amount of cut and fill each elevation would yield. The elevation that resulted in the best net cut and fill was 462 ft. This lower elevation also benefits the Athletics' Complex as the surrounding terrain provides a natural windscreen around the facility. This was a demand from both the USI Track and Soccer coaches as a wind screen minimizes any negative effects that the wind may have. Table 1 compares the cuts and fills of the different elevations considered.

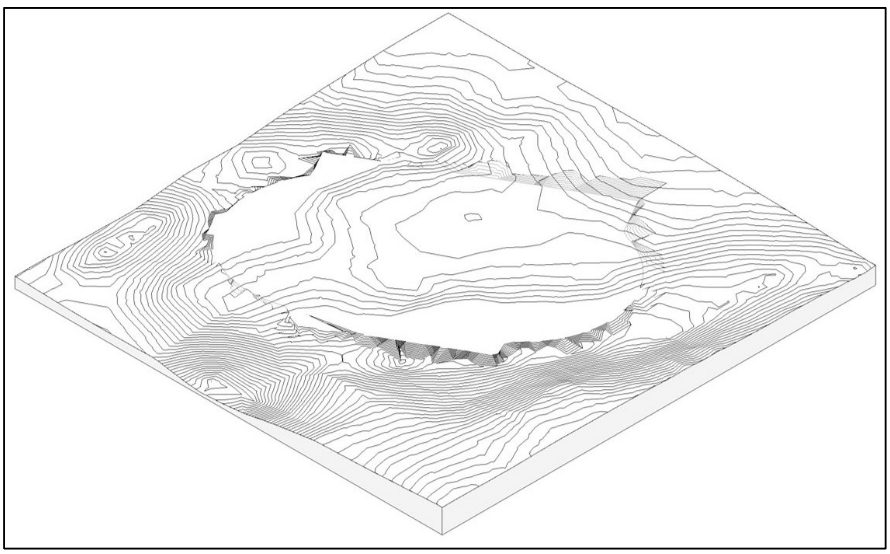

Figure 5: Track alignment at 462 ft

Table 1: Cut and fill

Elevation (ft)	Fill (CF)	Cut (CF)	Net (CF)
462	51,849	125,802	-73,954
465	291,247	741,206	-449,960
470	353,577	22,214	331,364

2.3.2 Road Relocation Alignments

The existing facilities located at the USI Rugby field are not spatially big enough to accommodate an Athletics' Complex of this size. The relocation of the existing Clarke Lane was necessary to construct the stadium and its components. Two possible alignments were considered to relocate the existing roadway to maintain traffic flow to campus. These two alignments have different impacts on the flow of traffic, the functionality of the parking lots, and public safety. These options were weighed up against each other and the deciding factor was the option with the least impact on public safety regarding traffic flow.

The first alignment considered relocates Clarke Lane around the complex and ties back into the existing roadway. This alignment is shown in Figure 6. The alignment will retain the current traffic flow pattern of the existing roadway. The downside to this option is that it will require more fill to get the road to grade because the existing terrain in the path of this alignment has sharp variations in elevation.

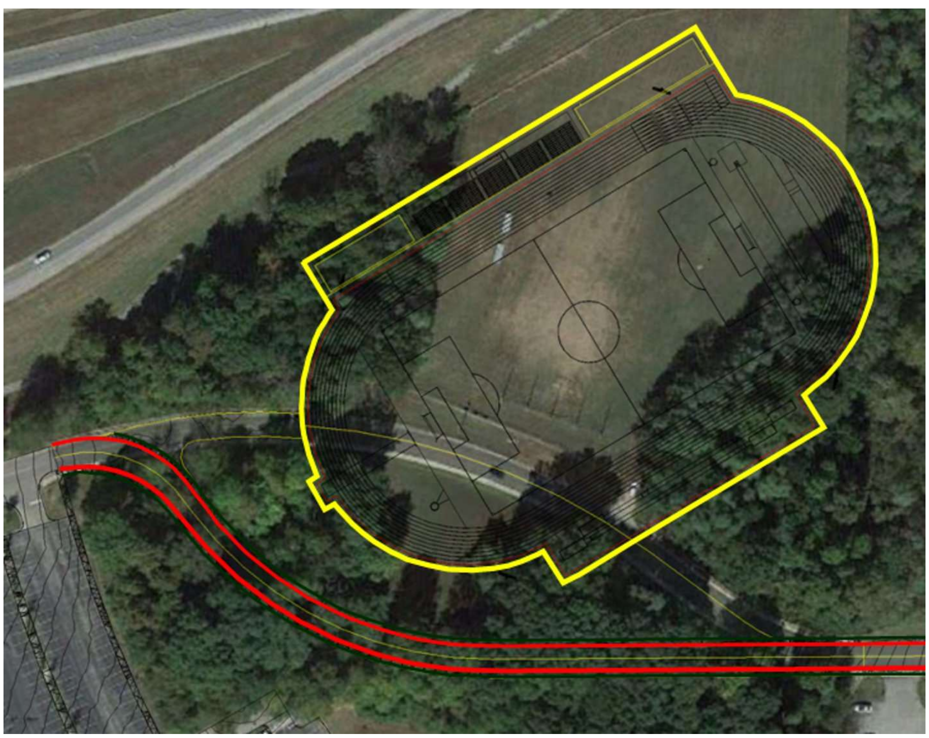

Figure 6: Road Relocation Alignment 1

The second alignment considered directs Clarke Lane straight through the woods and into the back parking lots located on the East side of campus, shown in Figure 7. As Clarke Lane connects to the parking lot there will need to be new traffic patterns implemented. A 4-way stop is recommended in addition to converting the existing parking lot into the new roadway. This will affect the existing traffic flow. There will be a total loss of one parking lot as it will need to be used to reconnect the existing traffic pattern. The public's safety is also impacted as this new route would divert traffic through the existing parking lots where pedestrian crossing is highly utilized. Ultimately this option will cost the University parking space, change the traffic flow, and endanger pedestrians.

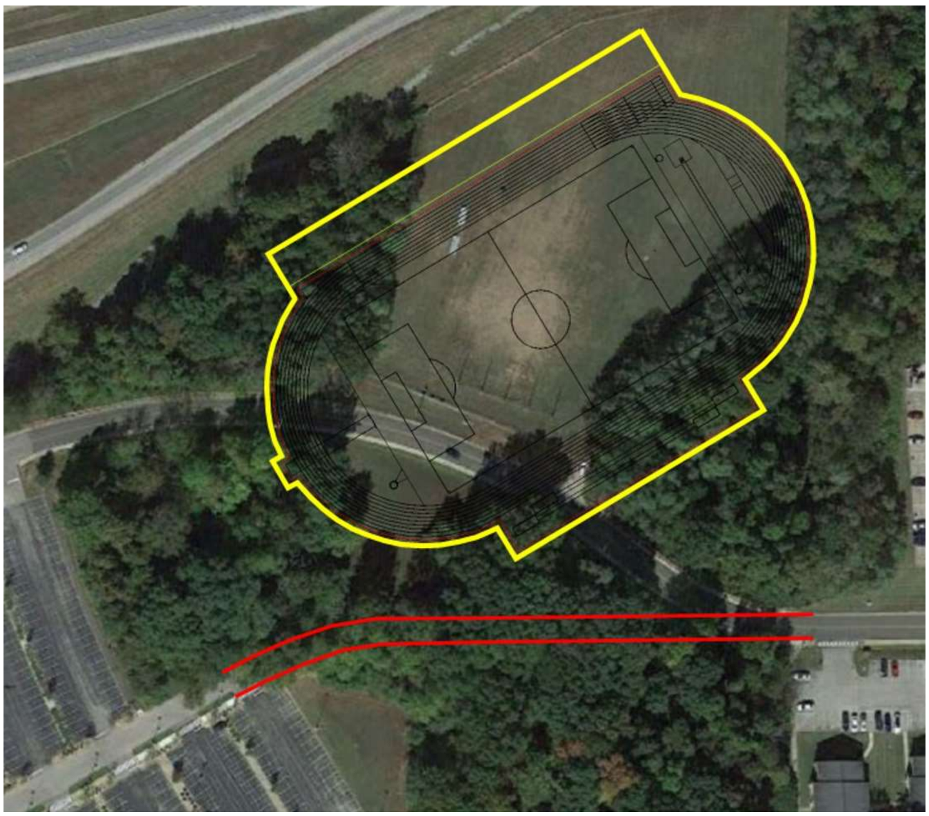

Figure 7: Road Relocation Alignment 2

Once both relocation alignments were scrutinized, the best option for the USI Athletics' Complex was road relocation alignment 1. The deciding factor when comparing the two options was maintaining traffic flow and reducing potential risk for public safety.

Once option 1 was chosen, the next task was to find a radius for the curve of the road that would allow two buses to pass one another without compromising public safety. A standard coach bus typically spans approximately 40ft, therefore a design vehicle with a length of 40ft was chosen (Figure 8) to test the design of the road alignment. Using AutoCAD Vehicle Tracking software, various road alignment designs were tested to determine their feasibility. Initially, an inner radius of 90 ft was used. this radius was tested, and it was determined that two 40 ft buses wouldn't be able to pass each other. Therefore, the inner radius was increased to 112 ft which successfully allows two buses to pass one another as can be seen in Figure 9.

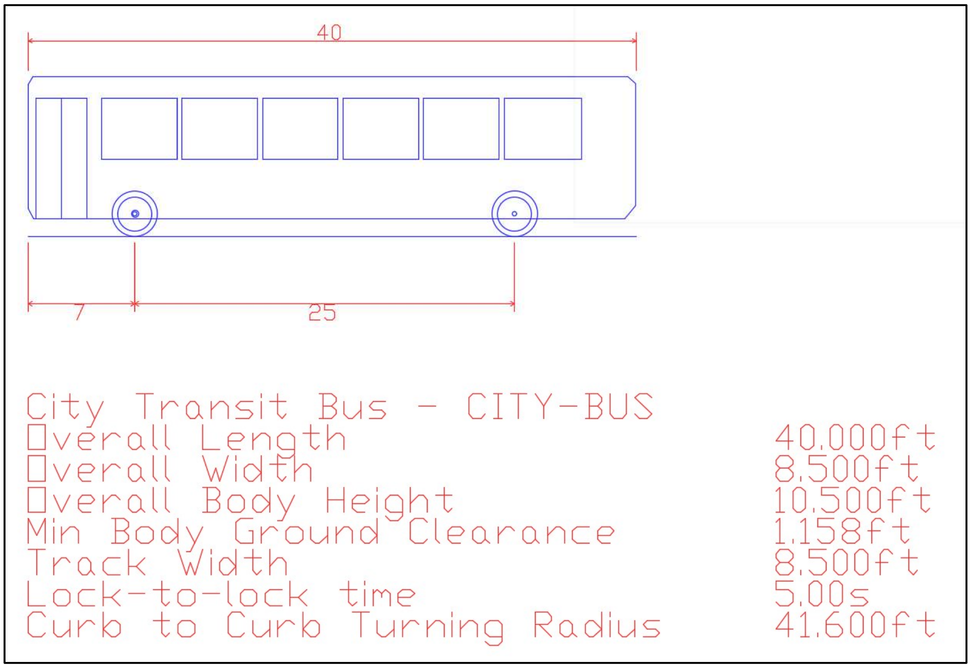

Figure 8: Design vehicle

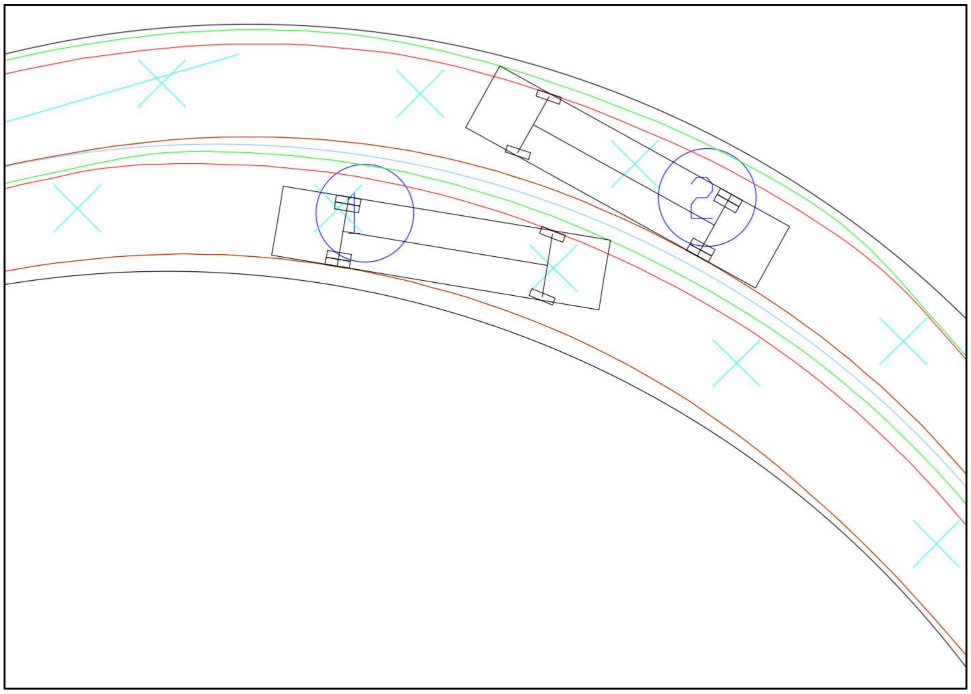

Figure 9: AutoCAD Vehicle Tracking successful passage of two buses on road alignment

2.3.3 Bathroom Requirements

The occupancy expected to be in attendance based upon previous historical data from track and soccer events is 1500 people. Referencing the International Building Codes (IBC) published by the International Code Council (ICC), it is recommended for facilities of this occupancy to contain 1 bathroom fixture for every 75 males, and 1 fixture for every 40 women using the table found in Appendix F. The restrooms for this facility will then require 29 total fixtures. For every fixture used, the total area required is 15 sf and every fixture was also paired with a sink for hand washing. The total area per fixture combined with the sink considers the cultural norms of a typical American facility and conforms to any other restroom found in the US.

2.4 AUTODESK REVIT RENDERING

A rendering adds surfaces, textures, and lighting to gain a realistic appearance. This process allows the viewer to visualize what this facility may look like post construction. Autodesk REVIT was used to create a 3-dimensional rendering of the Athletics' Complex. This software allows the surfaces created using surveying data to be modified to depict the desired design outcome, allowing the design specifications to be meet exactly based on the demands of all parties involved. To highlights the effectiveness of REVIT software in producing realistic renderings, four different partial views of the Athletics' Complex were rendered. Figure 10 is a partial view of the section of a track where the 100m dash is run. This view highlights the grandstands, press box, locker rooms, concession stands and spectator bathrooms. Figure 11 is a partial view of the entrance of the Athletics' Complex, it again highlights all the surrounding facilities around the track. Figure 12 is a partial view of the Athletics' Complex from inside the press box located on top of the grandstands. Figure 13 is a partial view from the end of the track on the other side of the Athletics' Complex.

Figure 10: Partial view of grandstands and other facilities

Figure 11: Partial view of Athletics' Complex entrance

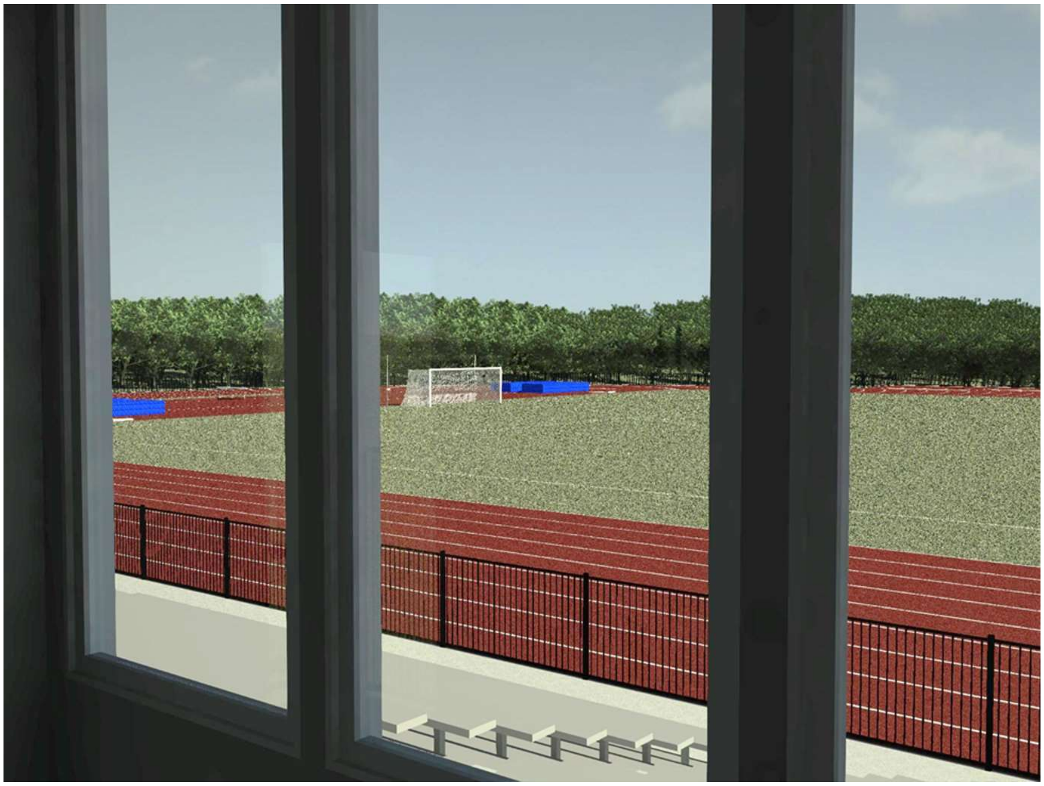

Figure 12: Partial view from press box

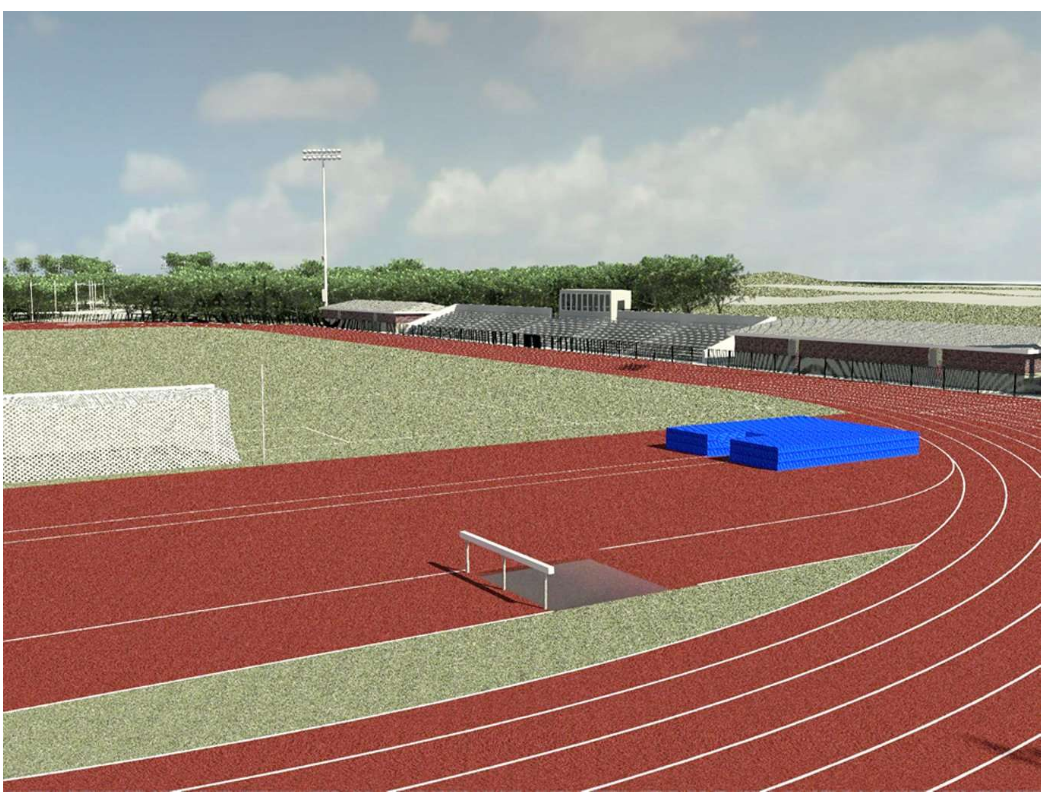

Figure 13: Partial view of Athletics' Complex from end of track

In addition to the rendering of the Athletics' Complex, the existing surface features of the USI campus were also placed into the rendering to better illustrate the location and size of the complex. This includes all vegetation, roadways, parking lots, sidewalks, and light fixtures. These features are shown in Figure 14.

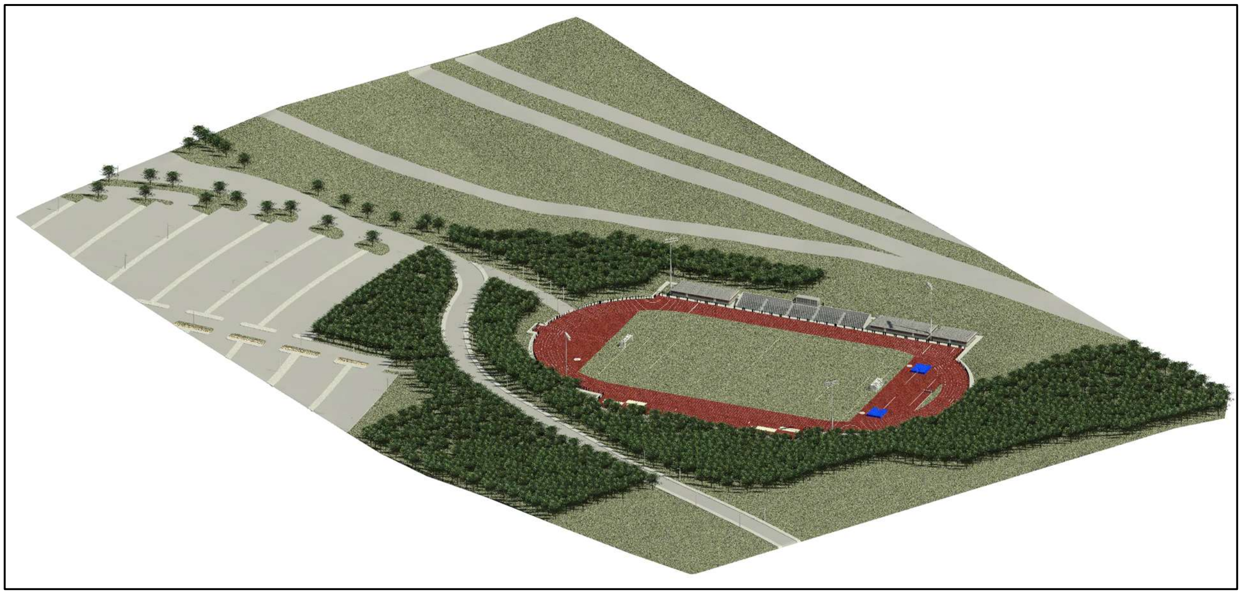

Figure 14: Complete rendering of Athletics' Complex and surrounding area

2.5 *STORM WATER MANAGEMENT*

The addition of structures and change of land use will affect the current watershed's peak discharge of storm water. This can potentially strain the existing infrastructure as it is not designed for the new land use that increases the amount of runoff. The existing watershed, shown in Figure 15 was analyzed to determine the amount of run off expected and if the existing infrastructure was adequate. The TR-55 method was used to predict discharge at the watershed outlet for different rain event frequencies. The United States Department of Agriculture (USDA) Web Soil Survey, and United States Geological Survey (USGS) SteamStats was used to determine the hydrological soil groups, watershed properties, and land usage. A single curve number was assumed as the soil types were very similar and weighted with the impermeable surfaces. Table 2 displays the assigned values of the existing land usage and the respective weighted curve number.

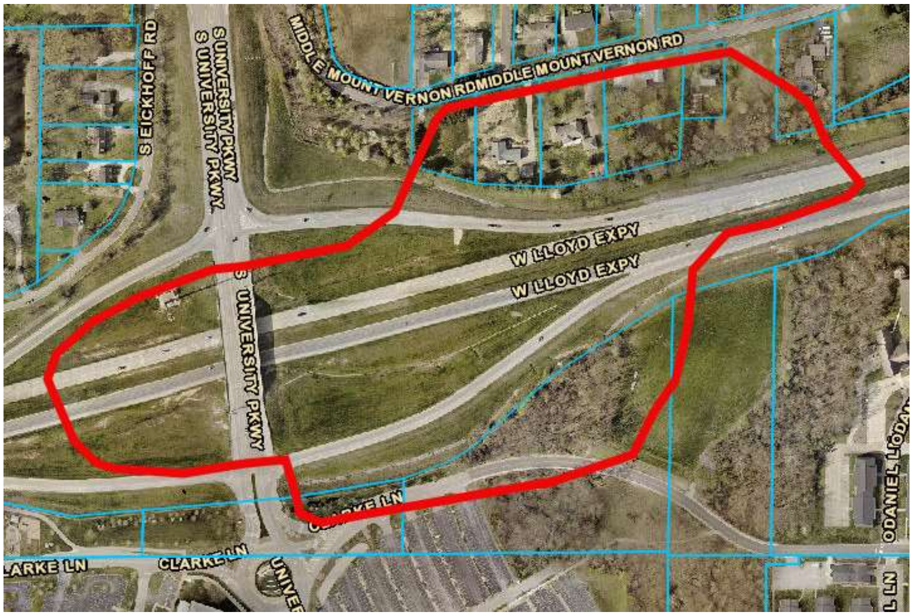

Figure 15: Outline of waterershed boundary on GIS

Table 2: TR55 Curve Number

CN	Acres	Notes
61	19.23	B type of undeveloped open areas with some woods
98	10.78	D type paved surface
Weighted CN	**74.10**	

The time of concentration, T_c, is the time needed for the water to flow from the furthest point in the watershed to the outlet. The T_c equation was used from page 17 in the document called "Time of Concentration". This equation is shown below as Equation 1.

$$T_C = \frac{l^{0.8}(\frac{1000}{CN}-9)^{0.7}}{114 \quad ^{0.5}} \qquad \text{Eq. 1}$$

Where T_c is the time of concentration in hours, l is the flow length in feet, CN is the curve number, and ϒ is the average watershed slope. This method does not best represent the post development of the watershed. For a more accurate representation, further analysis will be needed to obtain better results.

The watershed slope was determined to be 5.49% from the StreamStats analysis report. The length of the flow was found using Geographic Information System (GIS) data for Vanderburgh County shown in Figure 16. Using the data available the total flow length was found to be 1916.5 feet and the total vertical change was 34 feet. The horizontal flow length was measured perpendicular to the contour intervals to find the longest flow path.

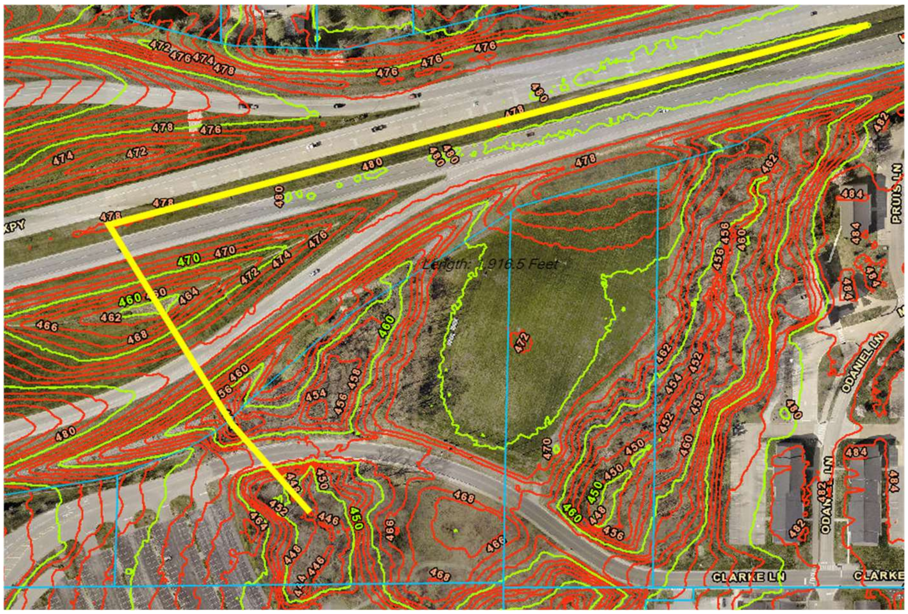

Figure 16: Flow length in watershed.

Using the document titled "Urban Hydrology for Small Watershed," (Appendix A) the rainfall depth for a 10-year frequency was obtained. The ISO lines on the 24-hour rainfall map provide the rainfall values. For a 10-year frequency the rainfall depth, P was found to be 4.75 inches per 24 hours.

Next, the potential maximum retention, S, is found using Equation 2.

$$S = \frac{1000}{CN} - 10 \text{ (in inches)} \qquad \text{Eq. 2}$$

I_a/P is also calculated using Equation 3 in order to use the graph to find q_u. Evansville, Indiana is a type 2 rainfall distribution; therefore, the rainfall distribution is used to find q_u from the graph in Appendix A. Table 3 shows the S values in inches and millimeters. Table 3 shown below summarizes the variables that assist the development of the peak discharge at the watershed outlet.

Table 3: Variables assisting in Tr-55 peak discharge method.

TR-55	
l (ft)	1916.50
CN	74.10
Υ, %	5.49
T_c (min)	27.19
T_c (hr)	0.45
Total Area (acres)	30.08
S (in)	3.45
S (mm)	88.78
Fp	1.00
P (in/24 hr)	4.75

$$\frac{I_a}{P} = \frac{0.2S}{P} \qquad \text{Eq. 3}$$

Next, Q, the rainfall excess in inches is calculated using Equation 4.

$$Q = \frac{(P-0.2S)^2}{P+0.8S}, P > 0.2S \qquad \text{Eq. 4}$$

The predevelopment unit peak discharge is then solved for using Equation 5. The Pond and Swamp Adjustment Factor, F_p, is found using the table in Appendix B. At the project location, in Evansville, Indiana, the F_p, is 1.0 with 0% being swamp and pond areas. The Peak discharge is shown in Table 4 below.

$$q_p = F_p A Q q_u \qquad \text{Eq. 5}$$

Table 4: Predevelopment discharge at watershed outlet.

Frequency	P $(\frac{in}{24hr})$	$Q\ (in)$	$\frac{I_a}{P}$	$q_u\ (\frac{cfs}{in\ mi^2})$	$q_p\ (cfs)$
10-year	4.75	2.17	0.1472	520	53.150

The post development discharge was then analyzed. The flow length and new land usages were measured shown in Figure 17. It was found that the flow length did not control. The additional hard surfaces and reduced green space increased the curve number. The pre and post development variables that assist the development of the peak discharge at the watershed outlet are shown in Table 5.

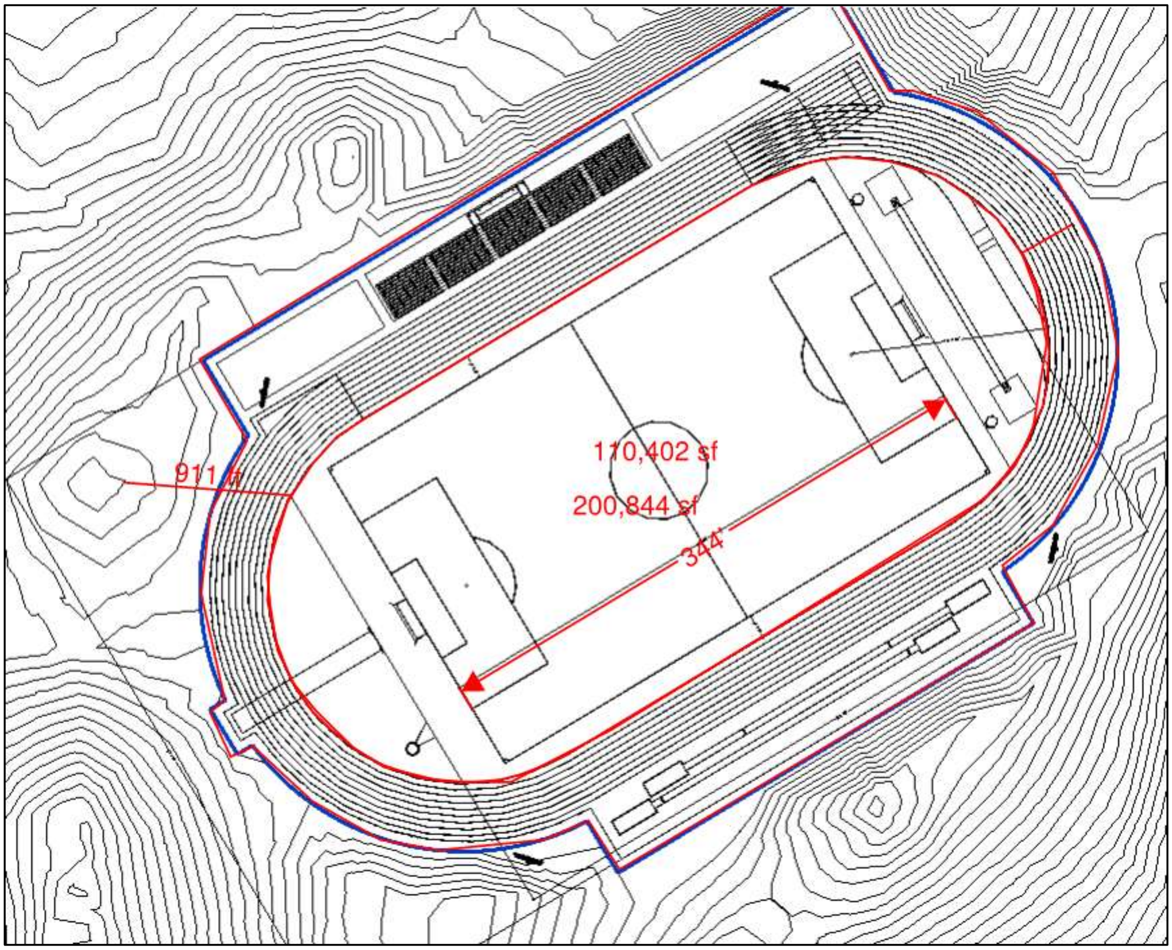

Figure 17: Flow length and area measurements.

Table 5: Comparison of pre and post development variables assisting in TR-55 peak discharge method.

TR-55		
Condition	**Post**	**Pre**
l (ft)	1916.50	1916.50
CN	76.66	74.10
ϒ, %	5.49	5.49
T_c (min)	25.25	27.19
T_c (hr)	0.42	0.45
Total Area (acres)	30.08	30.08
S (in)	3.454	3.454
S (mm)	77.35	77.35
Fp	1.00	1.00

The impact from the facility increases the peak discharge at the watershed outlet by 5.2 CFS. This change is from the increase of impermeable surfaces. From this the existing infrastructure can be sized to determine if it can meet the new demand.

After determining the peak flow, the existing infrastructure must be examined to determine if it can handle the increased stormwater runoff. The existing culvert is a 30-inch CMP. The site characteristics of the culvert are displayed in Table 6. A C_d value of 0.62 was used which is for square edged entrances. Equation 6 and the goal seek tool in Microsoft Excel was also used to determine the size of the culvert for a Type 3 flow as shown in Table 6. The existing infrastructure can handle the increased runoff from the facility.

$$Q = C_d A\sqrt{2gh} \qquad \text{Eq. 6}$$

Table 6: Culvert sizing for peak discharges.

Development	Discharge (cfs)	Culvert Diameter (ft)
Pre	58.3	2.375
Post	53.1	2.494

It was important to consider the effects that increased stormwater runoff would have on the existing infrastructure as an efficiently flowing culvert is necessary in terms of decreasing the risk of flooding, which the Athletics' Complex potentially could have compromised.

2.6 SPECTATOR SEATING

The spectator seating is 12 rows by 150 feet long. It will consist of 5 sections. The 3 interior sections will each span 31'-6", whilst the two outer sections only span 18'-9" (Figure 18). The bleachers will have a capacity of 1,011 people. There will be 4 aisles that are 4' wide equipped with a 1.9" handrail in the center of the aisle. On top of the bleachers there will be a press box with windows and roof access to allow for filming of hosted events. The press box dimensions will be 8'x36'. The press box will be able to hold up to 15 people with ample space per person.

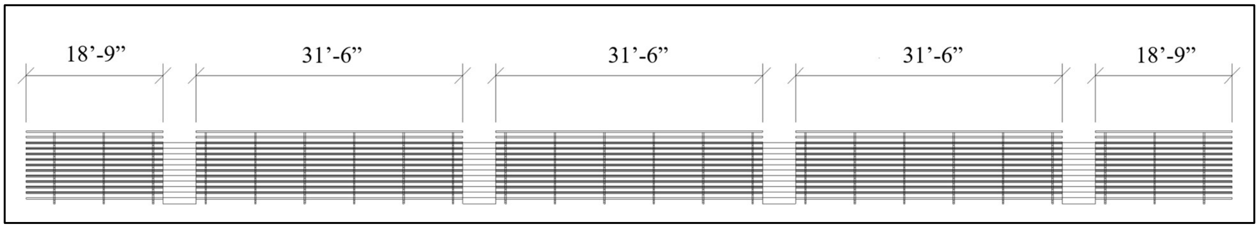

Figure 18: Shop drawing from GT GrandStands.

2.7 TRACK SURFACE

The track surface that was chosen was the Super X produced by Mondo. This was a demand set by Coach Mike Hillyard. The Mondo Super X track surface is prefabricated allowing for easy placement. The surface consists of two layers that are vulcanized together creating a continuous, uniform, and joint free surface. The process used to create the Super X surface also creates a molecular bond between the two surfaces that prevents the surfaces from separating. Performance and safety are two main factors that are considered in the creation of Super X. The top layer is rubber guaranteeing elasticity and resistance to spikes. The top layer is also embossed to prevent reflection off the track while also providing grip and good drainage. The bottom layer has a geometric structure of four-sided air cells that are deformable in two dimensions to provide shock and energy return that is laid out in the running direction to provide a biomechanical response according to the pressure produced by the athlete (Mondo Sport & Flooring, 2021).

3 ENGINEERS ESTIMATE

3.1 RATE SELECTION (UNIT PRICES AND LOCATIONS)

3.1.1 RSMeans

The RSMeans book that was used for the estimate compiles cost information all over the country to create accurate cost estimates for certain bid items. The book calculates labor rates into the cost per item to give a total accurate price. Also, these prices have factors built into them to match prices for the location of the project.

3.1.2 Historical Data

The use of historical data in creating the estimate was extremely valuable. One source of historical data used came from a spreadsheet created by the Indiana Department of

Transportation (INDOT). This spreadsheet compiled all bid items across the state for each year into a high, low, and weighted averages of prices. Each item also provides the frequency it was used to allow the user to determine how well represented the weighted average is. The Athletics' Complex estimate used the weighted average from INDOT on several items including all the road relocation bid items.

Another useful form of historical data was a price list by the Association of Educational Purchasing Agencies (AEPA). The price list used was for running track and court systems. The list has a standard and AEPA price for each item. The University of Southern Indiana does not meet the requirements to obtain the AEPA price, so the standard price was used for the Athletics' Complex. Along with the price there is a state modifier that is applied to the price. Indiana has a price modifier of 105%.

3.1.3 Parametric Estimating (LS soccer & facility)

Parametric estimating is a form of estimating that takes historical data of a similar project and has statistical factors applied to it to create a price that fits the desired bid item. The locker rooms, bathrooms, storage, and concessions pricing for the Athletics' Complex was created using parametric estimating. The price of a recent single building containing the previously stated facilities was constructed at a cost of 2 million dollars. The total square footage for this facility was then divided by the price to get a price per square foot. The price per square foot was then applied to the two buildings designed for the Athletics' Complex to calculate the price for the estimate. The estimate used for the facilities was not only in the same state as the Athletics' Complex, but the same region of that state. And since it was very recent, the current economic state was factored into the pricing, allowing for an even more accurate estimate.

3.1.4 Detailed Estimate (HeavyBid & Excel)

The detailed estimate was created in excel (Table 7) and has the list of bid items, payment units, quantity, unit price, and the total amount for each item. The table also has three principal areas being site work, road and sidewalk relocation, and track. The track principal accounts for all items that relate to the track itself and any item that is used during a track meet. Road and sidewalk relocation will account for all removal of road and sidewalk as well as the addition of the new roadway and sidewalk installation.

Table 7: Detailed Estimate of Athletics' Complex

Bid Items	Payment Units	Quantity	Unit Price	Total Amount
Site Work				
Mobilization (Max 5%)	LS			$472,863.40
Clearing & Grubbing	ACRE	8.30	$9,931.52	$82,431.62
Excavation (common)	CY	177651.00	$14.72	$2,615,022.72
Concessions, Locker Rooms, Bathrooms	SF	6767.00	$407.00	$2,754,169.00
Construction Engineering	LS			$39,553.21
Road and Sidewalk Relocation				
Asphalt Removal	SY	12300.00	$12.96	$159,408.00
Sidewalk Removal	LF	512.50	$24.99	$12,807.38
Class A 4000 psi concrete (sidewalks)	SY	10260.00	$52.77	$541,420.20
Compacted Aggregate No. 53's	CYS	380.00	$50.44	$19,167.20
QC/QA-HMA, 4, 64, BASE, 19.0 mm	Ton	752.40	$62.09	$46,716.52
QC/QA-HMA, 4, 64, Intermediate, 19.0 mm	Ton	313.50	$112.00	$35,112.00
QC/QA-HMA, 4, 64, Surface, 9.5 mm	TON	188.10	$162.00	$30,472.20
Line, Thermoplastic, Solid, Yellow, 6 IN	LFT	1710.00	$0.71	$1,214.10
Line, Thermoplastic, Solid, White, 6 IN	LFT	1710.00	$0.77	$1,316.70
30" CMP Culvert	LFT	240.00	$73.80	$17,712.00
Area Drain Inlets	EACH	4.00	$2,712.78	$10,851.12
Track				
Long Jump Pits	LS	1.00	$218.00	$218.00
Pole Vault Pits	LS	1.00	$60,940.00	$60,940.00
Hammer Throw	LS	1.00	$15,820.00	$15,820.00
Shot Put & Discus	LS	1.00	$5,277.00	$5,277.00
Steeple Chase	LS	1.00	$2,540.00	$2,540.00
Sand	CYS	52.00	$27.50	$1,430.00
Compacted Aggregate No. 53's	CYS	7376.89	$50.44	$372,090.30
QC/QA-HMA, 4, 64, BASE, 19.0 mm	TON	3651.56	$62.09	$226,725.38
QC/QA-HMA, 4, 64, Intermediate, 19.0 mm	TON	2434.37	$112.00	$272,649.83
QC/QA-HMA, 4, 64, Surface, 9.5 mm	TON	2434.37	$162.00	$394,368.51
14 mm Mondo Super-X Track Surface	SF	80345.29	$12.51	$1,055,375.56
Track Striping	SF	2446.19	$3.15	$8,090.79
4" Trench Drains	LF	2624.67	$44.76	$123,354.24
Fencing	LF	1659.00	$12.79	$21,218.61
Bleachers & Grandstand	LS			$484,835.00
Concrete Curb	LF	1312.34	$34.26	$44,960.77
Total				**$9,930,131.33**

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSION

In conclusion, the team was able to produce a conceptual design and estimate of the USI Athletics' Complex. The final estimate of the Athletics' Complex was $9,930,131.33. All aspects of the project scope were completed by team members to the best of their ability and cross examined to ensure accurate work. Combined with realistic renderings of the entire facility, the project conveys how the Athletics' Complex would change the Universities campus with the intent of motivating the University in constructing an Athletics' Complex.

4.2 TEAM PERFORMANCE

The team performed well together, distributing all the work very evenly. The use of Microsoft Teams was important as it aided in scheduling meetings and communication. It also allowed file sharing in a central location and all team members were able to access the files and work on them simultaneously, allowing for real time editing without the need to meet in person. The team utilized this function when reviewing the road alignments with Professor Bryan Donze as all members couldn't attend in person. The team also effectively settled any disagreements that arose during the project. Most of the errors were found to be from miscommunication and false interpretations of writing or comments on work. An example of this was in the process of sizing of restrooms. The meaning of certain words in different cultures lead to a different interpretation of the number of water closets, urinals, and lavatories required per person in attendance.

4.3 FUTURE RECOMMENDATIONS

The project location will need further investigation as the design is conceptual and is limited to the scope of the project. Ideally, boring logs would have been taken to record the soil conditions at the project site. The main concern would be the rock in this area, it is common on the westside of Evansville to encounter shallow rock during excavation. Although the rock in this area is very soft, it will still add costs to the project. In the case rock was found, a bid item will need to be added for rock excavation and blasting.

4.4 TEAMWORK

The workload for the project was distributed evenly amongst the team but there was overlap in all aspects of the work. The team met to collaborate on ideas and at no point did any team member make any design decisions on their own. The relocation alignment of Clarke Lane for example was weighed as a team to provide the best option for public safety and traffic flow. All team members had different alignment ideas, however, were able to mutually narrow the options down to the two best to present to the project advisors. Markus Poulsen took on the rendering and alignments portion of the complex. Having limited exposure to REVIT software, he was forced to fully immerse himself in the program and using online resources, extensively learned how to use REVIT software in the modeling of surfaces and creating views. Markus also learned how to complete an AutoCAD vehicle tracking simulation when modeling the proposed road relocation alignment. Evan Buechlein primarily focused on the watershed analysis. Here he learned how to size culverts and delineate watersheds, a very complex process. Additionally, Evan took the lead when it came to project deliverables, organizing all the files and submitting necessary documents throughout the semester. Kendall Williams was responsible for the complete cost estimate of the Athletics' Complex. With very little prior experience in estimating, Kendall had to learn how to use parametric and historical estimating techniques. Kendall also compiled numerous sources of data, using them to estimate all prices. Overall, the team was able to design a project in which they had no prior experience. Many critical skills had to be learned for the completion of the project.

4.5 ABET OUTCOME 2, DESIGN FACTOR CONSIDERATIONS

The team considered public health safety, and welfare in their decision to use the road relocation alignment 1, which maintains existing traffic flow and doesn't affect public health safety. The team considered global design factors in their design of the track facility. Using IAAF design standards, the track is designed identically to any other IAAF certified track anywhere around the world. The team considered cultural design factors in their design of the Athletics' Complex restrooms. Pairing each fixture with a sink and allowing up to 15 sf per fixture is a norm in the American bathroom culture. The team considered social design factors in their design of the track grandstands and one-meter walking path around the entire facility. This allows groups of spectators the option to support competing athletes from anywhere within the Athletics' Complex. It also gives the complex a more inclusive atmosphere and is very typical in terms of American sporting events. The team considered environmental design factors in their analysis of the watershed and existing infrastructure. To ensure the added watershed discharge from a new Athletics' Complex wouldn't compromise the existing culverts, the team considered the environmental impacts potential flooding could have. The team considered economic design factors in the estimate of the Athletics' Complex. Using recent costs from a similar project, the team was able to factor in the current economic state into their estimate of the Athletics' Complex. The team considered professional standards in the design of the track and soccer field by using standards set by the NCAA and IAAF.

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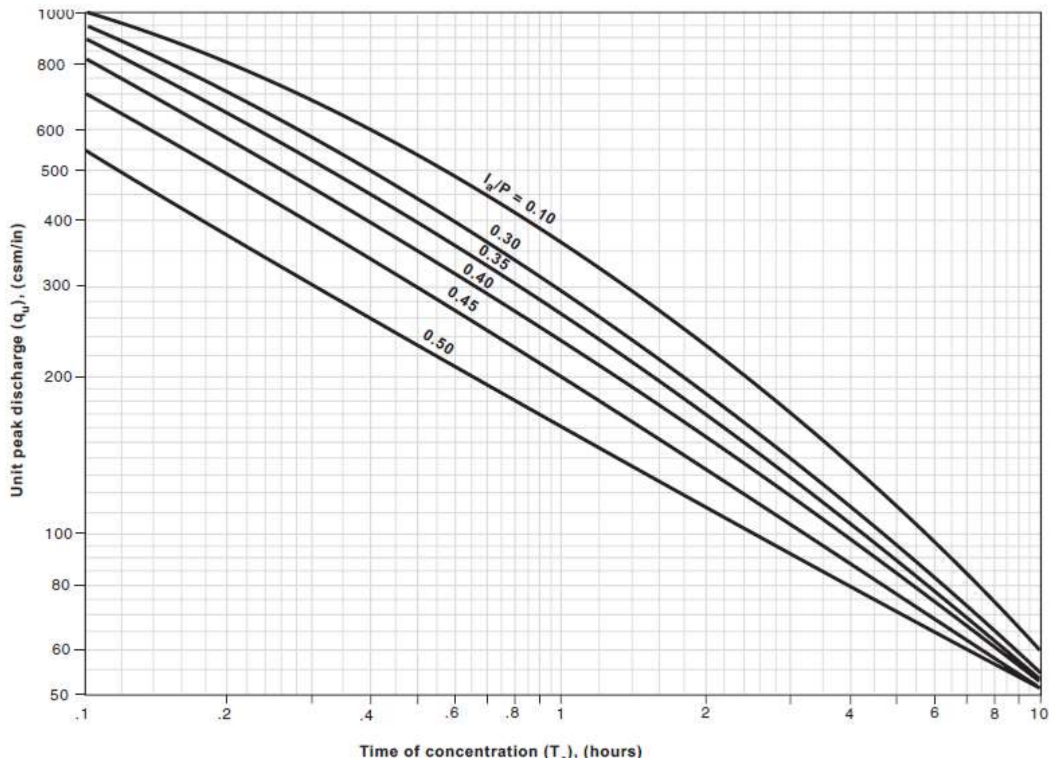
APPENDIX

APPENDIX A: UNIT PEAK DISCHARGE (Q_U) FOR NRCS (SCS) TYPE II RAINFALL DISTRIBUTION



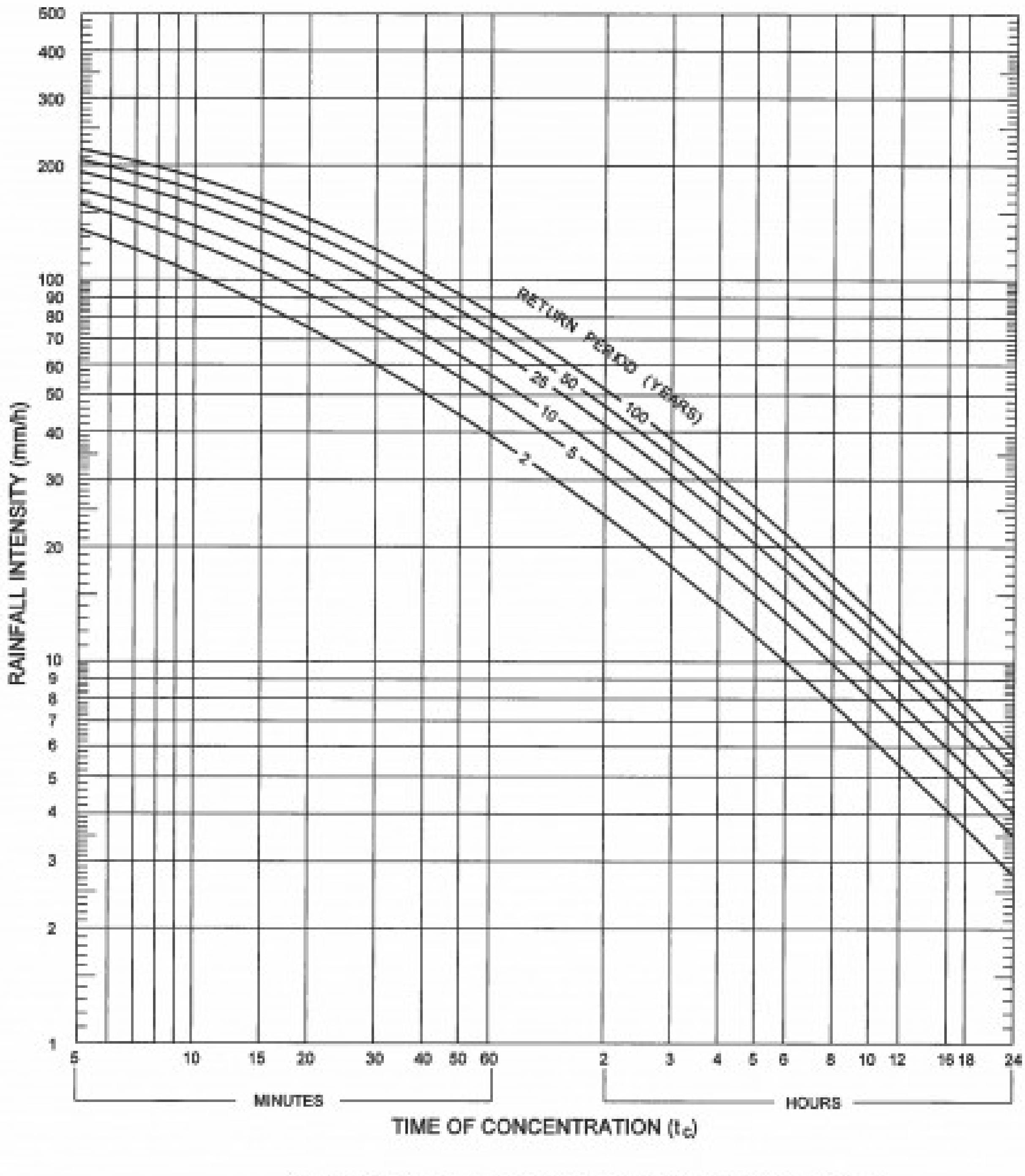
APPENDIX B: POND AND SWAMP ADJUSTMENT FACTOR, F_P

TABLE 5.22: Pond and Swamp Adjustment Factor, F_p

Percentage of pond and swamp areas	F_p
0	1.00
0.2	0.97
1.0	0.87
3.0	0.75
5.0*	0.72

*If the percentage of pond and swamp areas exceeds 5%, then consideration should be given to routing the runoff through these areas.

APPENDIX C: IDF CURVE – EVANSVILLE, INDIANA



RAINFALL INTENSITY-DURATION-FREQUENCY CURVE
(Evansville, Indiana)

APPENDIX D: TYPICAL RANGE OF VALUES FOR RUNOFF COEFFICIENTS

TABLE 11.10 Typical Range of Values for Runoff Coefficients

Land Use (Soils and Slopes)	Runoff Coefficient *(C)*
Parking lots, roofs	0.85 – 0.95
Commercial areas	0.75 – 0.95
Residential:	
single family	0.30 – 0.50
apartments	0.60 – 0.80
Industrial	0.50 – 0.90
Parks, open space	0.15 – 0.35
Forest, woodlands	0.20 – 0.40
Lawns:	
sandy soil, flat (<2%)	0.10 – 0.20
sandy soil, steep (>7%)	0.15 – 0.25
clay soil, flat (<2%)	0.25 – 0.35
clay soil, steep (>7%)	0.35 – 0.45
Crop lands:	
sandy soil	0.25 – 0.35
loam soil	0.35 – 0.45
clay soil	0.45 – 0.55

APPENDIX E: VALUES FROM STREAMSTATS

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.047	square miles
K1INDNR	Average hydraulic conductivity (ft/d) for the top 70 ft of unconsolidated deposits from InDNR well database.	8	ft per day
BSLDEM10M	Mean basin slope computed from 10 m DEM	5.49	percent

APPENDIX F: IBC 2012-chapter 29 plumbing systems, table 2902.1, minimum number of required fixtures

No.	Classification	Occupancy	Description	Water Closets (Fixtures)	
				Male	Female
1	Assembly	A-5	Stadiums, amusement parks, bleachers and grandstands for outdoor sporting events and activities	1 per 75	1 per 40