THE UNIVERSITY OF IOWA
IOWA INITIATIVE
FOR SUSTAINABLE COMMUNITIES

FINAL DELIVERABLE

Title	Rerouting and Redesign of a Road in Manchester, Iowa
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UI Department	Department of Civil & Environmental Engineering
Course Name	CEE:4850:0001 Project Design & Management
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Community Partners	City of Manchester

This project was supported by the Iowa Initiative for Sustainable Communities (IISC), a community engagement program at the University of Iowa. IISC partners with rural and urban communities across the state to develop projects that university students and IISC pursues a dual mission of enhancing quality of life in Iowa while transforming teaching and learning at the University of Iowa.

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Road Evaluation and Redesign for the City of Manchester

May 14, 2021

<u>Section I</u> – Executive Summary

A Civil & Environmental Engineering project team from the University of Iowa worked to design an alternative road connecting Early Stagecoach Road and 210th Street in Manchester, Iowa, in preparation for the existing intersection of the two roads to be removed. The team has delivered a set of design drawings for one possible route as well as locations for two other alternative options to be pursued by the client. The set of design drawings includes a title sheet, typical cross sections and details, tabulations, plan and profile sheets, right-of-way sheet, traffic control, signing information, erosion control plan sheet, earthwork summary, culvert plans, and mainline cross section information. As seen below in Figure 2A, the preferred option is colored in orange, labeled as 'Alternative 1' and the other two alternatives west are shown in yellow and blue.

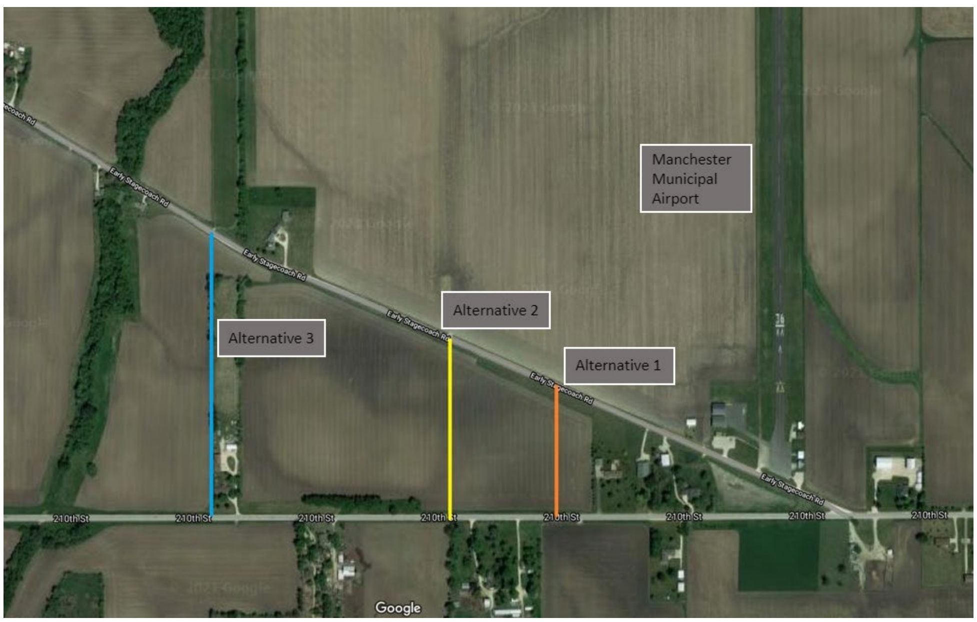


Figure 2A: Design Alternatives and Overview of Project Site Location facing north.

The preferred alternative 1 was designed and located 225' west of the property of 1543 210th Street and consists of a 70' right-of-way with 24' road surface and 4' shoulders. Road A begins 6060.31 feet from Delaware County GPS Control PT 2001-39 at an angle of North 30° West. The other two alternative locations considered were 790' west of the same property and 100' west of the property of 1501 210th Street. The design was checked with state specifications and regulations from SUDAS and the Iowa DOT.

The soil throughout the project area was consistently Kenyon loam soil and provides moderate natural drainage. The cross section of Road A consisted of 3" asphalt pavement, 6" stone base, and 12" stabilized subgrade. Each intersection was designed for a WB-67 design vehicle because of the possible larger trucks due to the surrounding fields.

During the late stages of the project, the current intersection of 210th Street and Early Stagecoach Road will be closed. During construction, a type III barricade will be used. The current gravel will be removed, and the area will be regraded to be flat. After the removals, the ditch along 210th Street will be reconstructed, and object markers will be placed where Early Stagecoach Road dead ends. After construction of Road A, straw mulch, wood excelsior mats, transition mat, and silt fences will be installed to provide erosion and sediment control. Stop signs, speed limit signs, and location signs will be installed around both intersections. Double centerlines and edge line pavement markings will be use. For drainage, two 12” corrugated metal culverts will be installed under the roadway. One will be installed near the north intersection with the other containing two pipes and will be installed near the southern intersection.

Design of this project started on January 25, 2021, and the final design report along with the design drawings and presentations were submitted May 14, 2021. Some of the existing project constraints included that Early Stagecoach Road will remain accessible for people to gain entry to their homes and to the Manchester Municipal Airport. This will include restricting access to Early Stagecoach Road from 210th Street just south of the airport at the existing intersection. Challenges of the design included making the roadway as cost efficient as possible, ensuring there is a great enough site distance at the newly rerouted intersection due to there being a large elevation difference, and that the stormwater runoff does not have any harmful environmental impacts.

The total estimated project cost depends on the final material selected. For the 6” PCC the construction will cost $305,000 and the 3” asphalt will cost $155,000. Asphalt is the suggested material because of the high-quality product for the low price. Additional information on the topics summarized here can be found in corresponding sections in this proposal.

Section II – Team Description

1. Organization Location and Contact Information

This report was prepared by a team of senior civil engineering students at the University of Iowa in the capstone design class. Claire Fienup is specializing in geography and transportation. Brian Shanahan and Mason Boyer are specializing in transportation. Daniel Garza is specializing in management.

2. Organization and Design Team Description

Each member of the team has unique and applicable prior experience in addition to all completing designs for roadway projects. Claire Fienup spent 6 months working on a road reconstruction project job site. This included coordination between different utilities, inspection of concrete paving for roads, sidewalks, and driveways, performing calculations for materials and earthwork on site, and assisted in completion of audits for Iowa DOT projects. Complications during the reconstruction such as sinkholes and unexpected utilities were mitigated in a timely manner. Claire spent another 5 months working for the City of West Des Moines analyzing traffic counts, inspecting streetlights, paving, and benchmarks, and creating a program for annual sanitary sewer inspections.

Brian Shanahan has 6 months experience working in public works as a laborer and 5 months experience as a roadway and traffic engineer intern. Brian's experience includes an award from the Asphalt Paving Association of Iowa as a scholarship recipient. During the summer of 2020, Brian was an intern for Burns and McDonnell working on highway and roadway projects for the Arkansas DOT Interstate 30 (I-30) modernization including 10 wiring diagrams and signage roadway plans. His previous labor experience with the city of Park Ridge, Illinois included collaborating with the Illinois DOT for the annual street resurfacing programs included weekly site visits and coordination with asphalt contractors. Brian has nearly 2 years research experience for the Iowa DOT working in the Laboratory for Advanced Construction Technology (LACT) at the University of Iowa including the High Rap Phase IV, Gyratory Mix Design, and Implementation Plan for Sustainable Infrastructure.

Mason Boyer has spent 4 months of experience working as a civil engineering intern with the City of West Des Moines. During that time, one of the major tasks completed was a stream channel rerouting and creation of public greenspace within a right of way of the stream. This had involved coordinating between city leadership, the landowners, and a private company. Other tasks on the job included roadway inspections such as the Mills Civic expansion in West Des Moines, sidewalk and driveway inspections, stormwater and sewer inspections, traffic analysis, and other database analysis.

Daniel Garza has spent 4 months getting experience as a civil engineering intern working with the Iowa Department of Transportation. Some of the projects he was involved with during that time were the asphalt resurfacing of U.S Highway 30 and full/partial depth repair of U.S Highway 151. Tasks involved with this role included documenting project reports with the contractor and reporting to design engineers, cost estimating other construction projects, and taking field samples and testing the material. Daniel has also spent 4 months helping with various research projects for concrete and cement-based material. Some of the researched he was involved in includes developing a standardized test method for the determination of chloride initiation of rebar to better prevent corrosion in marine environments, creep of high-performance concrete, and accelerated carbonation.

3. Individual Contributions

Each team member applied their critical tasks and previous experiences to this project. Based on prior coursework, internship experiences, and design exercises each member contributed to tasks that most suited their abilities.

Claire Fienup was the primary roadway designer. Claire used ArcMap for preliminary data analysis and Civil3D for the design based on prior knowledge and standards given by SUDAS and Iowa DOT. Additionally, Claire created drawings in Civil3D for cross sections, tabulations, right-of-way, signage, and cut and fill tabulations.

Brian Shanahan contributed his specialization knowledge of pavement engineering to work on the cost section of the asphalt and concrete roadways. As well, Brian contributed to the use of I-PAVE software to determine all necessary thicknesses and design considerations for the roadway redevelopment along with Excel file for all the construction costs. Then, Brian focused on establishing some of the sheets in Civil 3D and helped implement a new template for the plan and profile.

Mason Boyer handled the hydraulic analysis, culvert plan, and signage. Using data from the Iowa DOT and the rational method, a flowrate was calculated for the project area. The use of Civil 3D Express allowed proper sizing of the culverts to handle the flows they would be subject to. Mason assisted in the creation of the corresponding design sheets.

Daniel Garza conducted research into the soils data, traffic control, erosion control, and sediment control for the project. Using the IowaDOT Design Manual he was able to develop the necessary design sheets and documents for the project.

Section III – Design Services

1. Project Scope

This project was to undertake the rerouting of Early Stagecoach Road in Manchester, IA, while providing access to the airport and adjacent farmland. The airport, on the west reaches of the city, lays just north of Early Stagecoach as it runs to the northwest. Rerouting the road will allow the city to decrease the current displacement threshold of 305' for runway 36.

As part of this project, our team created a site plan – consisting of vertical and horizontal alignments, cross sections of the road, a corridor surface, and material volumes, determined the existing and final grading cut or fill requirements, and manage stormwater drainage and runoff.

Design drawings in accordance with Iowa DOT Design Manual includes title sheets, typical cross section, tabulation of quantities, mainline plan and profile sheets, drainage channel and culvert situation plans, earthwork quantity estimates, sediment control, right-of-way sheets, and pavement geometric quantities.

This design was done in accordance with Iowa DOT, Iowa SUDAS, Asphalt Pavement Association of Iowa (APAI) Design Guide & I-PAVE software.

2. Work Plan

Our timeline was tied to key dates within the semester's breadth in a Gantt chart in Figure 1. Specifically, with a proposal report and presentation completed by the end of the third week, a draft of the design report, drawings, presentation, and poster by week 12, and a completed design accompanied with a presentation by week 16. A formal site visit was not able to occur with the entire project group due to prolonged snow and freezing temperatures and the COVID-19 pandemic. Instead, project manager Claire had visited the project site and shared many photos and videos through a virtual site visit.

Each design task was assigned to a specific person to increase productivity. Claire Fienup focused on the alignments, cross sections, intersections, and other small design elements of creating the new road. Brian Shanahan focused on collecting standards, the pavement design, construction costs and creating design drawings. Mason Boyer focused on stormwater runoff, drainage, and culvert design. Daniel Garza focused on information about soils, erosion control, and construction costs.

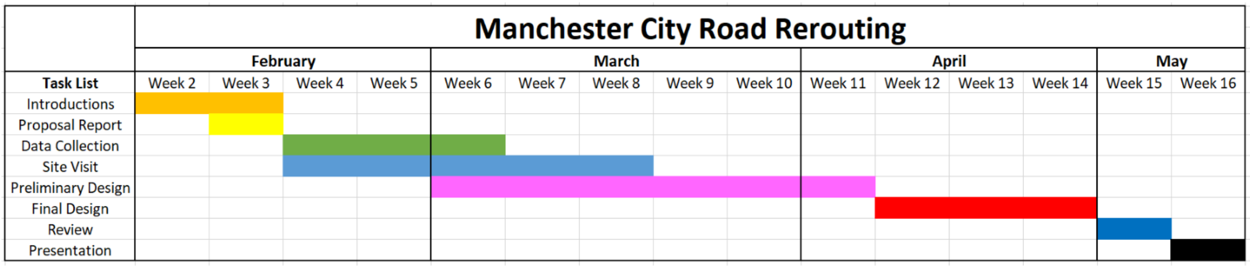


Figure 1: Gantt Chart of Project Schedule

Section IV – Constraints, Challenges, and Impacts

1. Constraints

One of the main constraints for this project was there are several homes that use Early Stagecoach Road as access for the homes and they still need to be able to conveniently reach their homes during and after the rerouting. The airport must be provided continual access during the design and construction staging. Design of the road construction including stakeholders such as the homeowners and the airport will require access from one of the entry points of the road. Another constraint for this project was that the portion of Early Stagecoach Road that passes the southern runway of the airport just off 210th Street needs to be removed. This removal will include grading the land, creating a new shoulder along 210th Street, a final treatment to the land, removing all signs for the old intersection, and adding object markers to ensure drivers know there is no longer a road there. It is required to decrease the displacement threshold for runway 36 of the airport. The last constraint was time and that the project needed to be completed in all parts including the design report, design drawings, and presentation by the end of the semester on May 11th with the client.

2. Challenges

One feature of the project that was a challenge was making sure that anyone that needs to have access to the airport will be able to access it. The airport is located just off 210th street on to Early Stagecoach

Road where it runs on a northwest to southwest angle. Most likely when construction on the rerouting of Early Stagecoach Road begins it will restrict access to the airport and the homes from 210th Street. In the design we paid close attention and make sure that there will be access to the airport from the west off Early Stagecoach Road coming from 145th Street. Another challenge we faced in the project was an environmental impact in the surrounding areas. Most of the adjacent land between 210th Street and Early Stagecoach Road is farmland. In the design we ensured the redirected route destroys as few of crops and other vegetation as possible. As well as the storm water runoff from the newly rerouted roadway does not contaminate a wider area of crops. Another environmental impact we considered is that there is a stream that runs along the airport to the west. As described earlier, the storm water runoff was evaluated to ensure it meets the necessary environmental requirements and harmful chemicals do not seep into the stream. In addition, since the rerouting moves the road closer to the steam, it was necessary to look more into the wetlands and 100-year flood plain. The design of the rerouted roadway was done as cost efficient as possible while still satisfying all the needs of the clients as well as factoring in all other factors including environmental impacts, line of site factors, and social impacts. One of the last challenges we faced with this project was ensuring the newly made intersection from the reroute at least meets the minimum requirements for sight distance. The rerouted road will pass through a higher elevation area when compared to 210th street. This will restrict the sight of drivers being sighted by other drivers.

3. Impacts

A feature of the design we briefly looked into that would potentially have a societal impact would be the resurfacing of Early Stagecoach Road into either a concrete or asphalt roadway. Currently, the portion of Early Stagecoach Road that runs by the airport is a gravel road. With the population of the state ever growing and towns expanding, it would make this an opportune time to resurface the roadway. More homes and other business can very likely expand out westward from Manchester near the airport. This would increase the volume of traffic in the area and most likely the volume of traffic that uses Early Stagecoach Road. This, however, was outside the scope of our project but should be considered if development is planned for the area. Another societal impact that was touched on a bit in the challenge section were the people that owned the homes and the farmlands on Early Stagecoach Road being economically affected in a negative way. The rerouting of the roadway has the potential to destroy a portion of one of the homeowner's crops for the year. The difference in the income made from the lost crops could be the difference for the farmer whether he/she financially makes ends meet for that year.

Also, the farmer would lose out on that portion of land for all the following years that could make it a serious negative burden. If the landowner develops the land, this will negate the previously stated concerns.

Section V – Alternative Solutions Considered

The project team initially came up with three design alternatives for Early Stagecoach Road. In alternative 1, a new road was proposed to run north south 225' west from the west property line of 1543 210th Street which was the original location suggested by the client. This allowed for some development between 1543 and the new road. In alternative 2, a new road would have run north and south between Early Stagecoach Road and 210th Street. This road would have fallen on the border of two parcels. This allowed for the property owner to decide if they want to allow development on either side of the new road. Alternative 2 would also have been the closest to a driveway which could be a hazard. Alternative 3 would run north and south between Early Stagecoach Road and 210th Street but is owned by a different person. This would not have been an ideal location since it is farther from the airport and closer to potential flooding but was an option if the landowner for alternatives 1 and 2 was not willing to develop their land.

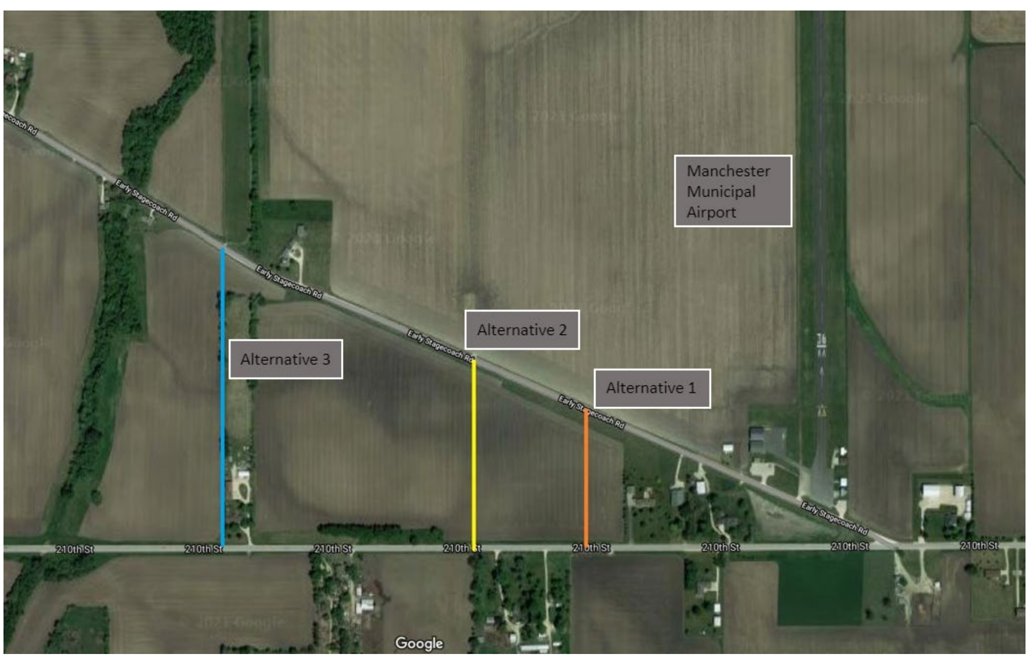


Figure 2A: Design Alternatives and Overview of Project Site Location facing north.

In all three alternatives Early Stagecoach Road would have been eliminated between the current intersection at 210th Street and the middle airport driveway. This decreased the displacement threshold as requested so that the runway would not have horizontal or vertical obstructions. Each alternative was be designed as a 70' right-of-way with a 24' asphalt road with 4' shoulders on each side. An image containing each alternative location can be found in Figure 2A of Appendix 2.

Alternative 1 was selected to be fully designed based on the initial request from the client, environmental studies, and stopping sight distance. Alternative 1 was also the shortest option which usually equates to being the cheapest option. Alternative 2 would be about 950' and alternative 3 would be about 1570' which equates to about 1.3- or 2.2-times the length and costs, respectfully, of alternative 1. For alternative 1, intersections are located approximately 1,630 feet from the original 210th Street and Early Stagecoach Road intersection along both roads. The other two alternatives would be farther away from the current intersection which is not as convenient for the airport or the local traffic. It should be noted that all three alternatives would be acceptable locations, based on drainage and sight distance, for a new road to be constructed.

Section VI – Final Design Details

1. Soils Information

The soil type located in the right-of-way area for Road A primarily consists of Kenyon loam soil (83B) with a small portion of Clyde-Floyd complex soil (391B) located on the south edge of Road A where it intersects with 210th Street. Both soil types to a varying degree have different soil particle sizes and different amounts of sand, silt, and clay in it. The soils are great for farmland areas and have desirable characteristics to promote plant growth. The drainage for the soils ranges from poorly drained for the Clyde-Floyd complex soil to moderately drained for the Kenyon loam soil. The soil in the area is somewhat limited which indicates that it has moderately favorable conditions for construction use. The conditions can be overcome or minimized with special precautions in the construction process. A map showing the area of the soils can be found in Appendix 1.

2. Cross Section and Details: Road A, Early Stagecoach Road, and 210 St

For Road A, the lane, shoulder, and right-of-way widths were all specified by the client to be 12 feet, 4 feet, and 70 feet, respectively. Road A was designed to be a local residential road for rural sections in an urban area with an average daily traffic less than 400 (see Table 2A in Appendix 2). The lane and shoulder widths were confirmed to be acceptable for the ADT and functional classification. The suggested lane width for local residential roads is 10.5 feet, but a 12-foot lane is also acceptable and needed if the area develops as commercial or industrial instead. The 12-foot lane is also better suited for trucks accessing the farm fields and the airport.

A foreslope and backslope of 4:1 was preferred for this functional classification, but to stay within the 70-foot right-of-way this had to vary. Within Civil3D, a basic daylighting assembly was used and required to stay within a 35-foot offset from the centerline of the road. The typical foreslope and backslope was set to 4:1 and with a maximum of 2:1. A bottom ditch width of 5 feet was used to transport the runoff and field drainage. The full cross section of Road A can be seen in Figure 2C of Appendix 2 or on design drawing B1.

A clear zone of 10 feet is preferred for rural areas with foreslope and backslopes of 4:1 and an ADT of less than 750 (see Table 2B in Appendix 2). Using a 70-foot right-of-way leaves the road with a 19-foot clear zone on either side of the road.

The design speed of Road A is 35 mph. The two limiting factors on this were the stopping sight distance and the vertical curvature of the land. A design speed of 55 was also considered which is typical for a rural road. The minimum rate of vertical curvature did not allow for an economical earthworks solution. Having Road A in its current location kept the road short which did not allow for cars to safely get up to speed before breaking for the intersection. The stopping sight distance for a road at 35 mph is 117.6 feet (see Figure 2B in Appendix 2).

The cross section used for 210th Street was taken in the resurfacing plans of 1999 provided by Delaware County land surveyor, Brad Burger (see Figure 2D in Appendix 2). The cross section for Early Stagecoach Road used an assumed gravel depth of 18 inches and foreslope and backslopes to match the contours in Civil3D (see Figure 2 E in Appendix 2).

3. Intersections

For a standard rural road, a design vehicle of a conventional school bus (S-Bus-36) would be used. Since the area surrounding the new road has farms that may require the use of larger trucks, a design vehicle of WB-67 was used for the intersections. From Table 2 in the Appendix 3, we used a turning radius of 41 feet. Images of both intersections created can be seen in Appendix 3.

4. Plan and Profile Sheets

The plan and profile sheet shows the combination of a plan view of the roadway with the elevation changes in a two-dimensional format. The Road A alternative is 710’ with a minor elevation increase at the Station 4+00, the red and green colors along the side of the plan view indicate the cut and fill volumes. These sheets can be found in the appendix (see Figure 4A and 4B in Appendix 4) with Plan and Profile Sheets as title or on design drawing D1.

5. Section Views

Section views of the roadway are included in 25’ increments to verify elevations and slope along the Road A corridor. These slopes show that the roadway is a sloped road and not a crown. The reason for this is that the drainage will lead off into the right-of-way and bounds of the roadway profile and two culverts are indicated at each of the two ends. These sheets can be found in the appendix (see Figure 5A and 5B in Appendix 5) with Cross Section Sheets as title or on design drawings W1 and W2.

6. Right-of-way

The client requested we create our design based on a 70-foot right-of-way. The north intersection may permanently require more right of way to account for the turning radius of the intersection. Temporary easements at both intersections may be required for construction. The total area that will be required for land acquisition is approximately 1.1 acres from one parcel of land.

The description of this land is as follows:
Road A begins 6060.31 feet from Delaware County GPS Control PT 2001-39 at an angle of North 30° West.
The centerline of the road sits 225 feet west of the west property line for 1543 210th St with 35 feet of right-of-way on either side.
THENCE (1) North 0°00’00” West, 409.42 feet to the beginning of a curve concave easterly, said curve has a radius of 1080.08 feet;
THENCE (2) northerly along said curve through a central angle of 9°35’35” an arc distance of 180.84 feet to a point of tangency;
THENCE (3) North 9°35’35” East, 120.26 feet.

Figure 6A: Right-of-Way boundaries

7. Traffic Control

The installation of Road A and the removal of the 500 ft of Early Stagecoach Road can be done in 3 primary phases. In the first phase, the intersection at 210th Street and Road A should be closed, and a detour route marked out to use Early Stagecoach Road should be indicated using signs along 145th Ave, as well as westbound traffic out of Manchester at the intersection of 210th Street and Highway 13 in accordance with Iowa DOT manual 9B-10. Construction of the new intersection should be completed during this phase, as well as a portion of Road A should be paved.

Phase 2 will see the reopening of 210th Street and the closing of Early Stagecoach Road. Again, detour signs should denote the use of 210th Street as the route into and out of Manchester for east and westbound traffic. As 210th Street sees more average daily traffic, it is recommended that the majority of Road A's construction is completed with Early Stagecoach Road as the staging point.

In phase 3, Road A should be complete and both intersections will open. Place road closure barriers at the eastern foot of Early Stagecoach Road as well as 500 ft from the intersection of Early Stagecoach Road and 210th Street, while still allowing for airport-bound traffic access to the facility as the removal of the relevant portion of Early Stagecoach Road occurs.

Along Road A should be placed at least 1 speed limit sign in each direction, as well as 1 stop sign at the intersections of Road A and Early Stagecoach Road or 210th Street for traffic on Road A. On either end of where Early Stagecoach Road had been removed, road closure barricade Type III should be placed (see Figure 7B in Appendix 7). Additional information can be found on design drawings J1 and J2.

8. Erosion & Sediment Control

Once vegetation is removed from an area and left unprotected it is susceptible to erosion. Reducing the amount of erosion with erosion control will help limit the amount of sedimentation created. To help prevent erosion along the roadway, straw mulching in conjunction with seeding will be used. The mulch will be anchored into the ground at least two inches with mulch anchoring equipment. Native grass seeding will be used to help establish a vegetation. The mulching and seeding of the ditches will be done according to Iowa DOT specifications 2601 and 4169. Since the slopes along Road A do not exceed 3H:1V, no additional slope protection will be needed in addition to the mulch and seeding. Transition mats will be used on the western side of both the culverts to help dissipate energy and prevent scour downstream. The transition mat will be installed in accordance with EC-105 Standard Road Plan and more details can be found in Appendix 8 or design drawing RR1.

To help prevent against the loss of sediment, silt fences will be used as barriers along the ditches of Road A. The silt fence will span the width of the ditch and be placed every 50 feet due to the shallow slope of the bank and should be installed in accordance with Iowa DOT specifications 2602 and 4196 as well as the Standard Road Plan EC-201. Additional information can be found in the appendix.

9. Culvert Plans

With the installation of the proposed roadway, water flowing west towards the creek would be obstructed and build up against the road. The flow is split in the north and south directions by a slight hill about 2/3 of the way from 210th Street. Two culvert pipes will be installed at Sta. 0+45 to handle flow near the southern intersection while maintaining sufficient clearance for the pavement surface. Another pipe will be installed at Sta. 5+84 instead of the intersection with Old Stagecoach as the intersection is not the lowest point in the northern section.

Protruding corrugated metal pipes are recommended for the road. The design uses a common 2-2/3 inch pitch, ½ inch rise pipe that will be 12 inches in diameter. According to USGS testing, the manning's n for this size and style of pipe is 0.013. The north location will use 33 feet of pipe and the southern will

need two 41-foot pipes to clear the roadway and adequately reach the ditches. Due to clearance problems with the road surface, the southern intersection cannot instead have one larger pipe.
The Rational Method was used to calculate the maximum flowrate that the culverts would need to handle. Designing for a peak runoff of a 10-year event and using a time of concentration calculated from within Civil 3D of 12 minutes, the 10-year, 15-minute design storm rainfall intensity was used to calculate a flow of 6.1 cfs (see Table 9A in Appendix 9). Split between the sections, the northern third has a flow of 2.0 cfs and the southern two-thirds will experience 4.1 cfs. With these flowrates, the culverts can handle incumbent water with a 12-inch diameter (see Figures 9A and 9B in Appendix 9). Design drawing V1 contains further information.

10. Pavement Details

Asphalt pavement was determined to be the preferred choice of roadway pavement from the client. After completing the I-PAVE report (see Figure 10A in Appendix 10) for Delaware County, Iowa it was determined that the minimum thicknesses were sufficient indicating 3" asphalt and 6" Portland Cement Concrete (PCC). After completing the pavement designer application using Jointed Plain Concrete Pavement using the Portland Concrete Association design method from StreetPave it was determined that the calculated minimum thickness would be 3.51 inches (see Figure 10C in Appendix 10). However, following the Iowa SUDAS it describes that the minimum concrete thickness for low volume concrete roadways as 6 inches. This comparison was completed to identify the differences between the two pavement options and further determining that the asphalt section is most preferred.

The 4" asphalt is the design recommendation in this road alternative because the low volume road may occasionally experience a heavy tractor or industrial farming equipment which will require the additional strength. The traffic input parameters for the asphalt section using I-PAVE (Low Volume Road Design guide) included: Number of Lanes, Road Classification, Annual Average Daily Traffic (AADT), Percent of Trucks, Design Lane Traffic, and the annual growth rate for the roadway. As well, the Structure input parameters included the Stone Base thickness for both rigid and flexible pavements (6 inch), Subbase Stabilization Depth for both rigid and flexible pavements (12 inch), Subgrade (CBR-California Bearing Ratio) of 3 for unsuitable soil was selected for worst case scenario and the reliability index of 80% for rural roadway and terminal serviceability, P_t of 2 was selected. The asphalt binder selection is the ST mix as a Class I project with Performance Grade (PG) 58-28S since Delaware County is in the southern 2/3 of the state of Iowa according to the 2016 Asphalt Binder and Mix Specification Update Reference Guide.

11. Signage

The location sign for the Manchester Municipal Airport from the existing intersection of 210th Street and Early Stagecoach Road should be moved to the northeast corner of the new 210th Street and Road A intersection. An additional location sign should be placed at the southeast corner of Early Stagecoach Road and Road A (see Figure 11B in Appendix 11). The posted speed limit should be 30 mph based on the design speed of 35 mph. Speed limit signs are to be posted approximately 110 feet from both intersections (see Figure 11A in Appendix 11). All sign locations can be found on design drawing N1.

12. Pavement Markings

Highbuild Waterborne markings were selected because of their longevity. DCY4 - Double Centerline (Yellow) should be used for the centerline marking. ELW4 – Edge Line (White) should be used for the edge of pavement marking (see Figure 12A in Appendix 12). Both line types have a length of 6.7 STA.

Section VII – Cost Estimate

1. Construction Costs

The total construction costs include all clearing and grubbing, excavations, cut and fills, soil compactions, granular subbase, subgrade indicated as soil compaction, topsoil, hydraulic seeding, pavement markings, culverts, and each of the roadway pavement materials. The cost estimations per each material have been based off the December 2020 annual Iowa DOT bid tabs dated as of 12/15/2020. These include all the line items corresponding to the Iowa SUDAS design manual for each material. In each of the items shown below are the average prices and each unit was selected in the dollar's column. All the Iowa bid tabs are inclusive items accounting for construction costs such as transportation, overhead, and taxes for purchasing which are all based on past projects performed by approved contractors in the State of Iowa.

The only two line items which required additional research were the PCC and asphalt which the costs per units were referenced from outside resources to establish the most appropriate costs. Asphalt surface costs were estimated based on comparison to projects done by LL Pelling and interpolating tons and similar cost structures per ton for the final material cost. The total cost for these alternatives starts with 3” Asphalt on top of 6” Subgrade at CBR = 3 to be $155,000. The 6” PCC was estimated to cost the most at $305,000 (see Table 13A in Appendix 13).

2. Contingency, Administration and Engineering Costs

According to the AACE-American Association of Cost Engineering, “Contingency Costs include any amount for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result in aggregate additional costs.”

This is a quantity to account for the uncertainties and measures for the contingency reserve in a cost estimate. A 10% contingency costs will be an additional charge such as this is used to maintain certain risk management to keep the construction project able to meet the estimate deadlines in a reasonable time. For example, depending on waste and spills of either concrete or asphalt this cost is recuperated in this contingency cost for unexpected events which may lead to reduction in supplies. Administrative and engineering costs will include 20% of the cost for asphalt additional balance to the project cost regardless of the surface material. Administrative costs account for all future costs to be incurred during any design changes related to the designs presented here. Future administrative costs include site inspections, project oversight, and travel fees. Engineering costs include redesigns related to changes during phasing the construction.

3. Total Project Costs

Table 13A: Project Cost Details for Alternative #1

Project:	Early Stagecoach Road--Road Evaluation and Redesign					
Item	**Unit**	**Dollars**	**Quantity**	**Cost**		**Rounded Cost**
Clearing and Grubbing	Acre	$ 5,140.85	0.4	$ 2,012.49		$ 2,000
Excavation - Class 10 Roadway and Borrow						
Cut/Fill	CY	$ 5.46	686.4	$ 3,747.74		$ 3,750
Soil Compaction	CY	$ 1.73	631.6	$ 1,092.62		$ 1,100
Granular subbase	Ton	$ 26.36	1151.0	$ 30,341.48		$ 30,300
Pavement						
6" pcc	SY	$ 84.05	1894.72	$ 159,251.22		$ 159,500
3" asphalt	SY	$ 12.15	1894.7	$ 23,020.85		$ 23,000
Subbase/Subgrade						
Granular Subbase 12"	SY	$ 7.23	1894.7	$ 13,698.83		$ 13,700
Soil Compaction -Subgrade	STA	$ 932.26	14.2	$ 13,247.79		$ 13,200
Traffic Control	LS	$ 16,727.00		$ 16,727.00		$ 16,700
Road Removal	ST	$ 437.43	5.0	$ 2,187.15		$ 2,175
Top soil	Cy	$ 5.87	631.6	$ 3,707.34		$ 3,700
Hydraulic Seeding	Acre	$ 1,553.22	0.4	$ 608.04		$ 610
Pavement Marking	STA	$ 14.68	14.2	$ 208.61		$ 210
Signage	SF	$ 25.00	42.0	$ 1,050.00		$ 1,050
Signage (posts)	Unit	$ 100.00	6.0	$ 600.00		$ 600
Erosion/Sediment Devices	LF	$ 3.21	1421.0	$ 4,561.54		$ 4,562
Culverts	LF	$21.00	113	$2,373.00		$ 2,375
Option 2 PCC				$ 255,414.84		$ 255,500
Option 1 Asphalt				$ 119,184.47		$ 119,000
PCC						
Contigency Costs -- 10%	0.1			$ 25,541.48		$ 25,500
Admin & Engneering	LS			$ 23,836.89		$ 23,800
Asphalt						
Contigency Costs --10%	0.1			$ 11,918.45		$ 11,900
Admin & Engneering	0.2			$ 23,836.89		$ 23,800
Total Project Cost - PCC				$ 304,793.22		$ 305,000
Total Project Cost - Asphalt				$ 154,939.81		$ 155,000

Total project costs can be broken down here for comparison: Asphalt and Concrete hard road surface. As is shown above, the PCC total material cost is $159,500 while the Asphalt total material cost is $23,000. Total project cost for the Asphalt will be $155,000 and the PCC will be $305,000. There will be an additional cost for acquiring approximately 1.1 acres of land.

4. Construction Phasing

A conservative duration of this project would be one construction season. As found below in Table 13G the estimate is broken up into four main tasks: Staging, Earthwork, Paving, and Grading/Seeding. These tasks will be defined by weekly progress and build off one another so that there is no overlap to delay any future tasks which may require extension.

Table 13G: One Construction Season weekly project duration.

Tasks	**Construction Season**					
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Staging						
Earthwork (Subgrade/Base)						
Paving						
Grading/Seeding						

5. Costs for Alternative Alignments

Alternative 2 was approximately 1.3 times the length of the most preferred selection which was 710', making alternative 2 950' and alternative 3 was approximately 2.2 times long making the length 1570'. Therefore, the costs of alternative 2 and 3 increase with respect to their increases in lengths.

Table 13H: Cost comparisons for all three alternatives

	Alternative 1 (710')	**Alternative 2 (950')**	**Alternative 3 (1570')**
3" Asphalt	$155,000	$205,000	$310,000
6" Concrete	$305,000	$405,500	$641,000

Based on these differences in costs it is concluded that the alternative 1 is the most reasonable selection based on the lowest cost and reduced distance compared to the 2nd and 3rd alternatives. Alternative 2 seems to be the most competitive back-up to alternative 1 since the distance is only slightly longer along the west end of the property boundary, and the costs include a 30% increase. Full project cost details for alternatives 2 and 3 can be found in appendix 13.

Appendices

1. **Soils Information**

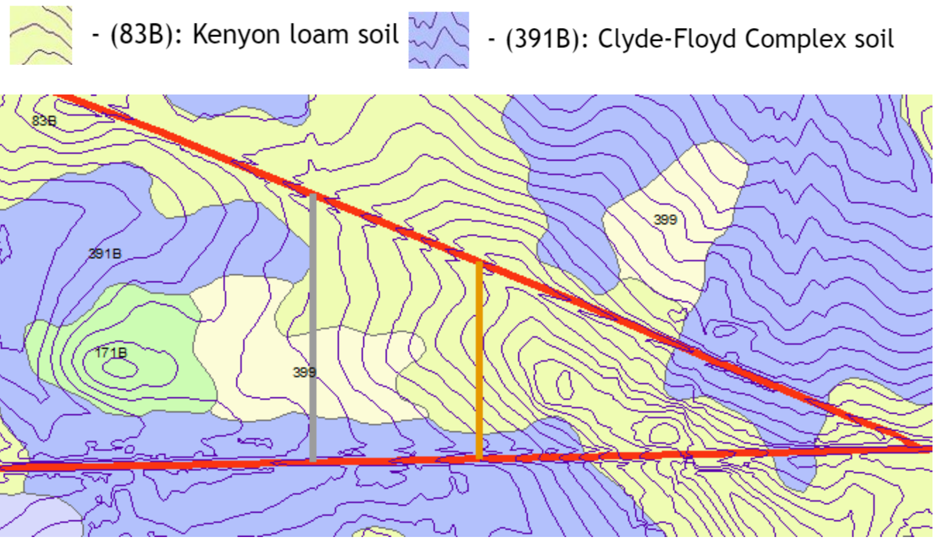


Figure 1A: Map of the soil types for design area

2. Cross Section and Details: Road A, Early Stagecoach Road, and 210 St

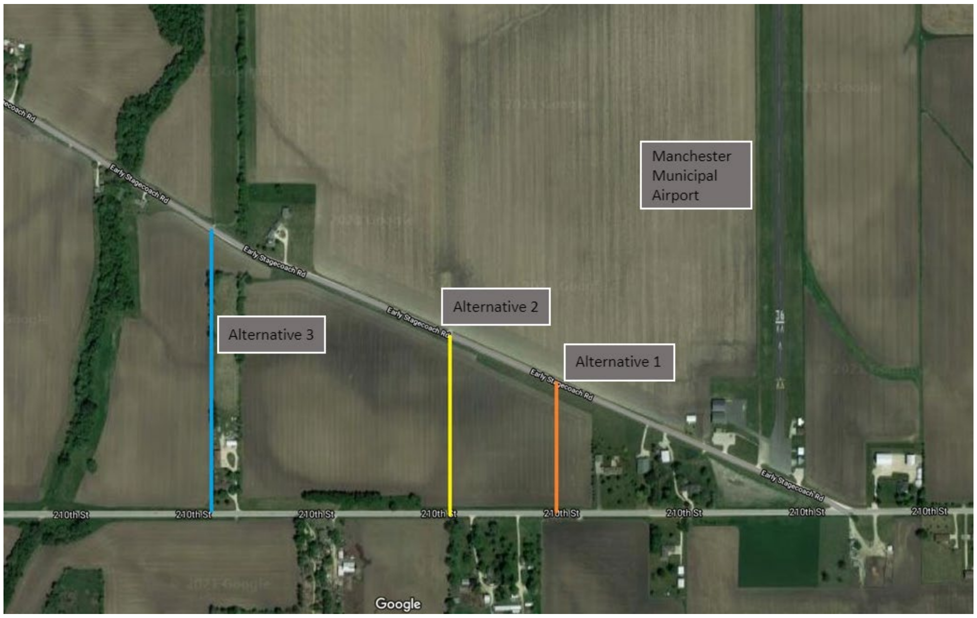


Figure 2A: Design Alternatives for Early Stagecoach Road

Table 5C-1.01: Preferred Roadway Elements

Elements Related to Functional Classification

Design Element	Local		Collector		Arterial	
	Res.	***C/I***	***Res.***	***C/I***	***Res.***	***C/I***
General						
Design level of service[1]	D	D	C/D	C/D	C/D	C/D
Lane width (single lane) (ft)[2]	10.5	12	12	12	12	12
Two-way left-turn lanes (TWLTL) (ft)	N/A	N/A	14	14	14	14
Width of new bridges (ft)[3]	See Footnote 3					
Width of bridges to remain in place (ft)[4]	----------	----------	----------	----------	----------	----------
Vertical clearance (ft)[5]	14.5	14.5	14.5	14.5	16.5	16.5
Object setback (ft)[6]	3	3	3	3	3	3
Clear zone (ft)	Refer to Table 5C-1.03, Table 5C-1.04, and 5C-1, C, 1					
Urban						
Curb offset (ft)[7]	2	2	2	3	3	3
Parking lane width (ft)	8	8	8	10	N/A	N/A
Roadway width with parking on one side[8]	26/27/31[9]	34	34	37	N/A	N/A
Roadway width without parking[10]	26	31	31	31	31	31
Raised median with left-turn lane (ft)[11]	N/A	N/A	19.5	20.5	20.5	20.5
Cul-de-sac radius (ft)	45/48[12]	45/48[12]	N/A	N/A	N/A	N/A
Rural Sections in Urban Areas						
Shoulder width (ft)						
ADT: under 400	4	4	6	6	10	10
ADT: 400 to 1,500	6	6	6	6	10	10
ADT: 1,500 to 2000	8	8	8	8	10	10
ADT: above 2,000	8	8	8	8	10	10
Foreslope (H:V)	4:1	4:1	4:1	4:1	6:1	6:1
Backslope (H:V)	4:1	4:1	4:1	4:1	4:1	4:1

Res. = Residential, C/I = Commercial/Industrial

Elements Related to Design Speed

Design Element	Design Speed, mph[13]							
	25	***30***	***35***	***40***	***45***	***50***	***55***	***60***
Stopping sight distance (ft)	155	200	250	305	360	425	495	570
Passing sight distance (ft)	900	1090	1,280	1,470	1,625	1,835	1,985	2,135
Min. horizontal curve radius (ft)[14]	198	333	510	762	1,039	926	1,190	1,500
Min. vertical curve length (ft)	50	75	105	120	135	150	165	180
Min. rate of vertical curvature, Crest (K)[15]	18	30	47	71	98	136	185	245
Min. rate of vertical curvature, Sag (K)	26	37	49	64	79	96	115	136
Minimum gradient (percent)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Maximum gradient (percent)	5	5	5	5	5	5	5	5

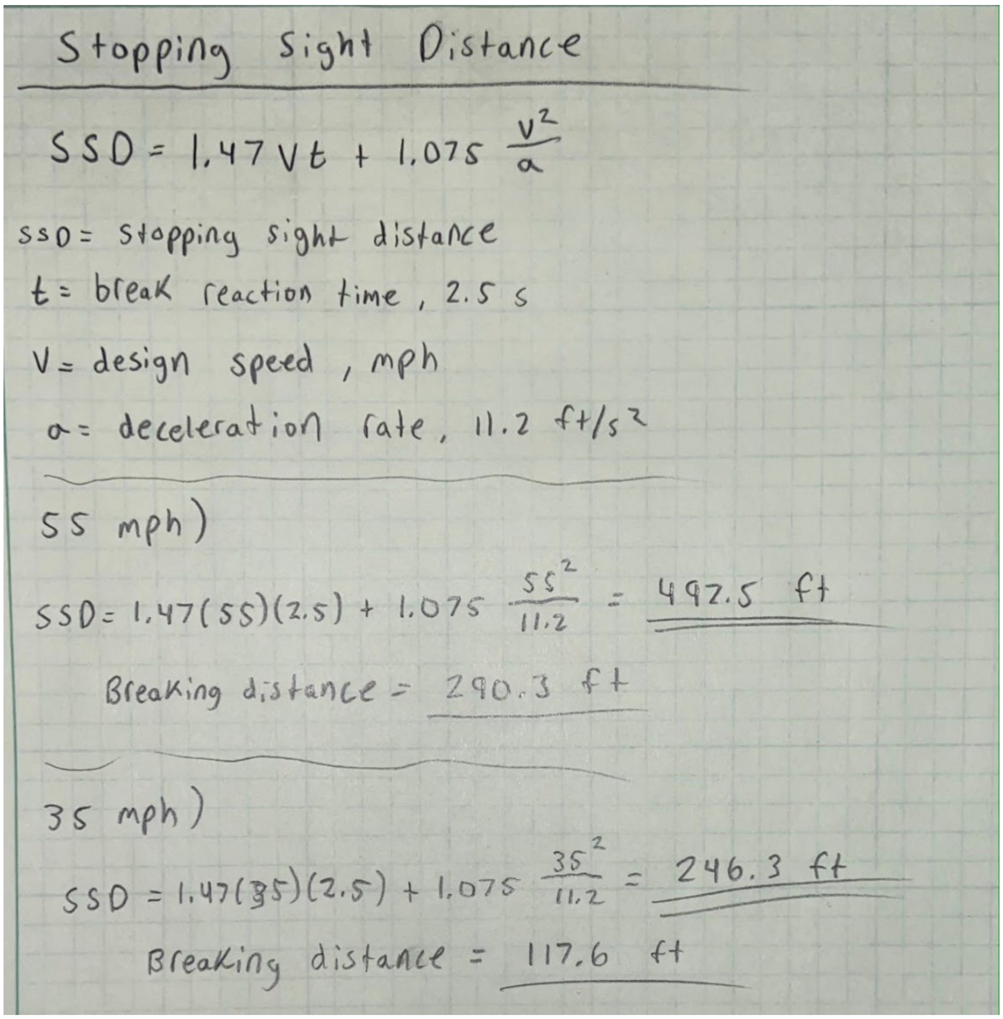
Table 1A: Preferred Roadway Elements

Table 5C-1.03: Preferred Clear Zone Distances for Rural and Urban Roadways

Design Speed mph	Design Traffic ADT	Foreslope			Backslope or Parking		
		6:1 or flatter	*5:1 to 4:1*	*3:1*	*6:1 or flatter*	*5:1 to 4:1*	*3:1*
		In feet from edge of traveled way					
Urban 40 or less	All	For low-speed urban roadways, refer to 5C-1, C, 1.					
Rural 40 or less	Under 750	10	10	*	10	10	10
	750 to 1,500	12	14	*	12	12	12
	1,500 to 6,000	14	16	*	14	14	14
	Over 6,000	16	18	*	16	16	16
Rural and Urban 45 to 50	Under 750	12	14	*	12	10	10
	750 to 1,500	16	20	*	16	14	12
	1,500 to 6,000	18	26	*	18	16	14
	Over 6,000	22	28	*	22	20	16
Rural and Urban 55	Under 750	14	18	*	12	12	10
	750 to 1,500	18	24	*	18	16	12
	1,500 to 6,000	22	30	*	22	18	16
	Over 6,000	24	32	*	24	22	18
Rural and Urban 60	Under 750	18	24	*	16	14	12
	750 to 1,500	24	32	*	22	18	14
	1,500 to 6,000	30	40	*	26	22	18
	Over 6,000	32	44	*	28	26	22

Source: Adapted from the *Roadside Design Guide*, 2006

Table 2B: Preferred Clear Zone Distances for Rural and Urban Roadways



Stopping Sight Distance

$$SSD = 1.47Vt + 1.075\frac{V^2}{a}$$

SSD = stopping sight distance

t = break reaction time, 2.5 s

V = design speed, mph

a = deceleration rate, 11.2 ft/s²

55 mph)

$$SSD = 1.47(55)(2.5) + 1.075\frac{55^2}{11.2} = 492.5 \text{ ft}$$

Breaking distance = 290.3 ft

35 mph)

$$SSD = 1.47(35)(2.5) + 1.075\frac{35^2}{11.2} = 246.3 \text{ ft}$$

Breaking distance = 117.6 ft

Figure 2B: Stopping Sight Distance Calculations

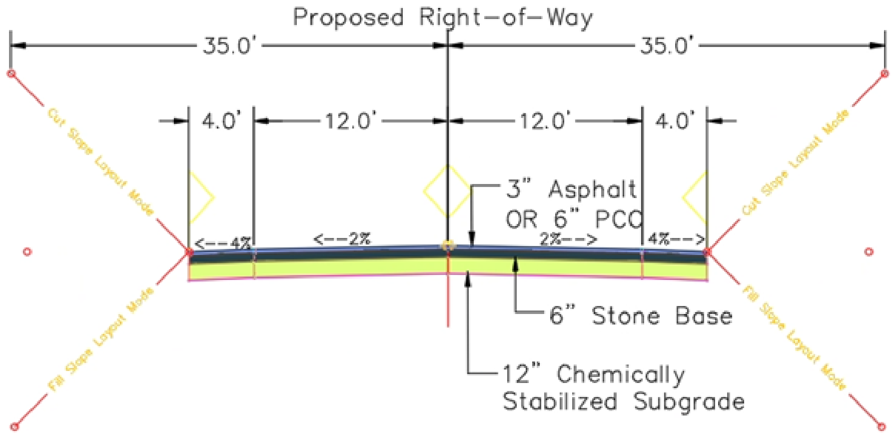


Figure 2C: Road A Typical Cross Section

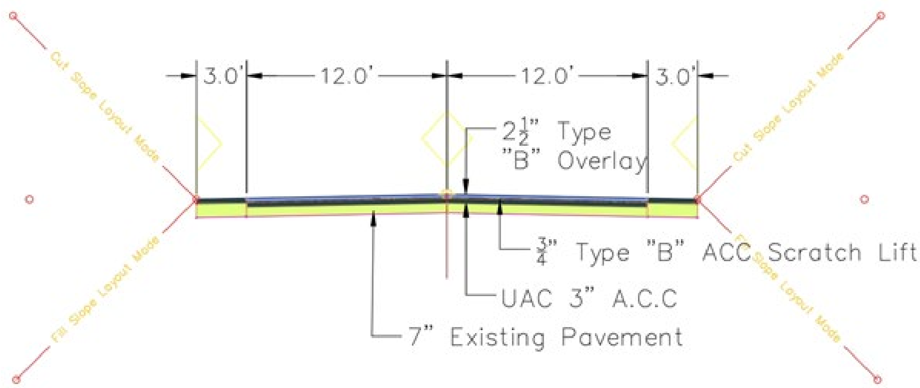


Figure 2D: 210th Street Typical Cross Section

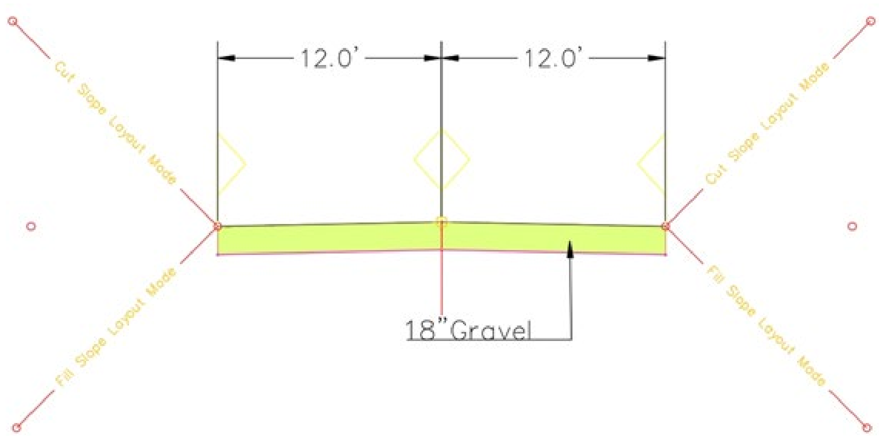


Figure 2E: Early Stagecoach Road Typical Cross Section

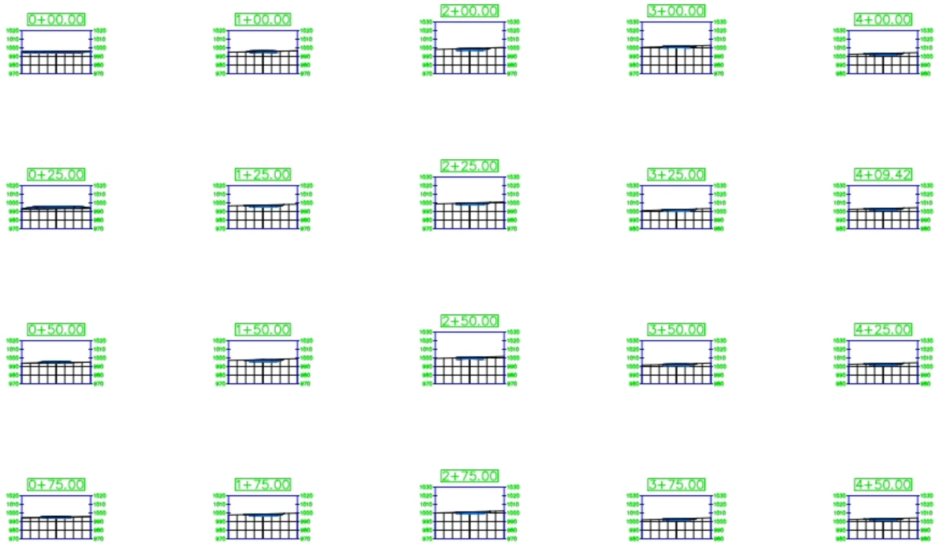


Figure 2F: Early Stagecoach Road Cross-Sections STA 0+00 to STA 4+50

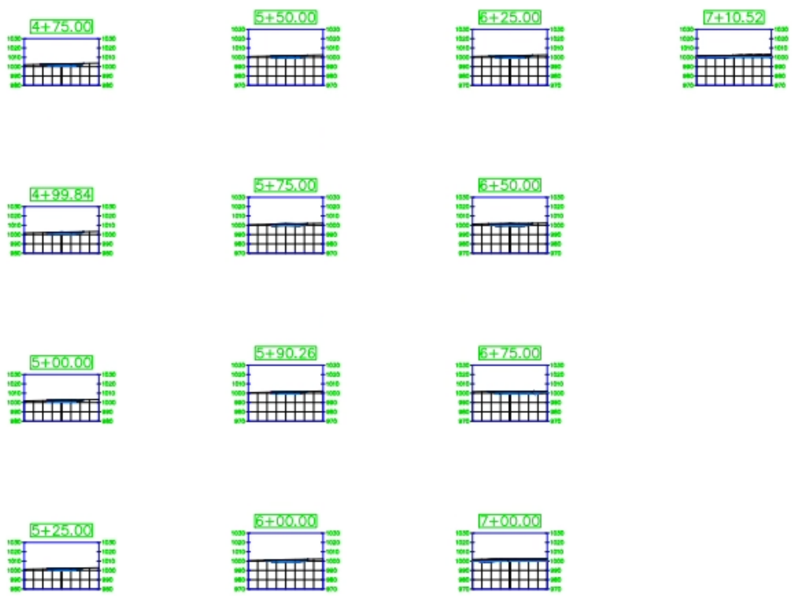


Figure 2G: Early Stagecoach Road Cross Sections STA 4+75 to STA 7+10.52

3. Intersections

Table 2: Minimum center turning radii for common design vehicles.

design vehicle	minimum center turning radius (feet)
interstate semitrailer (WB-67)	41
single-unit truck (SU-30)	38
conventional school bus (S-Bus-36)	35
passenger car (P)	21
Reference: Table 2-2b AASHTO Greenbook, 2011	

Table 3A: Minimum center turning radii for common design vehicles

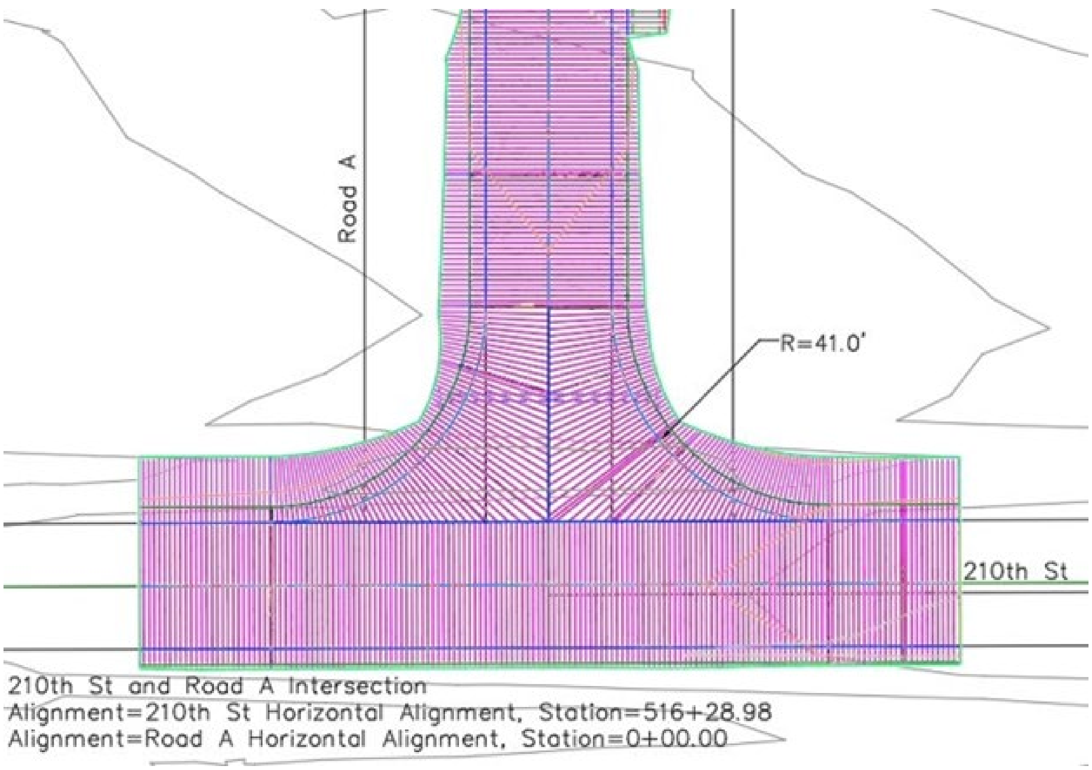


Figure 3B: 210th St and Road A Intersection

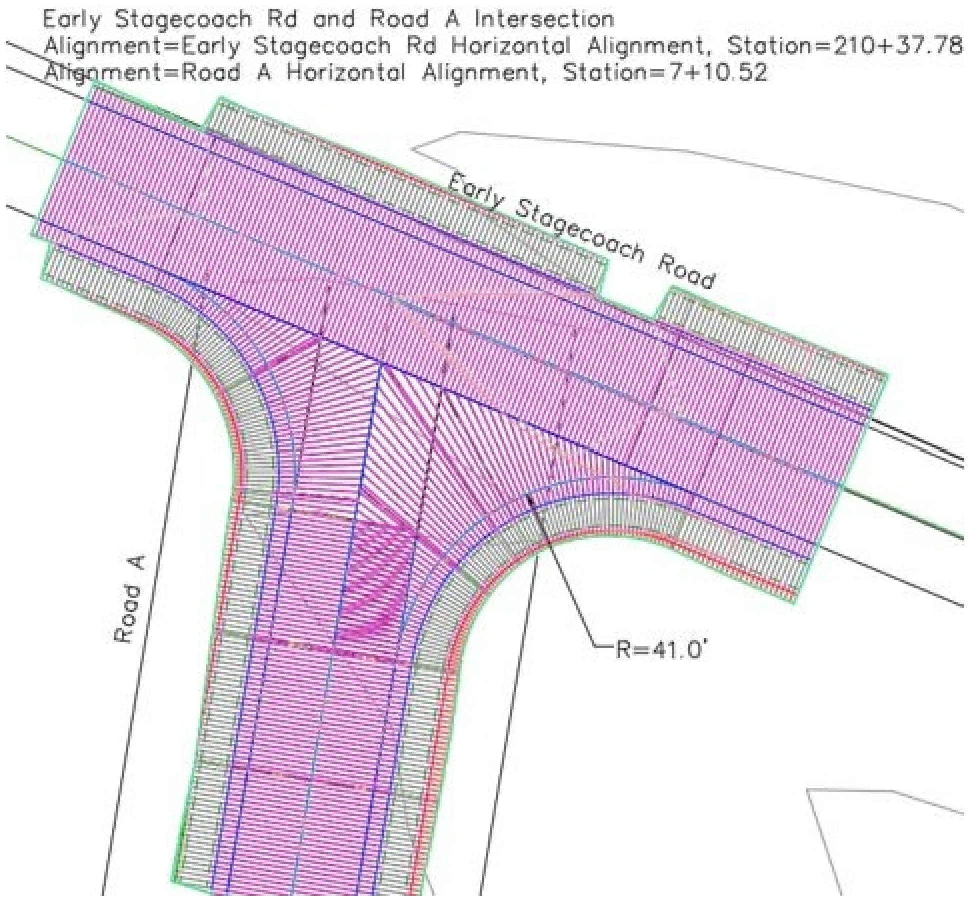


Figure 3C: Early Stagecoach Road and Road A Intersection

4. Plan and Profile Sheets

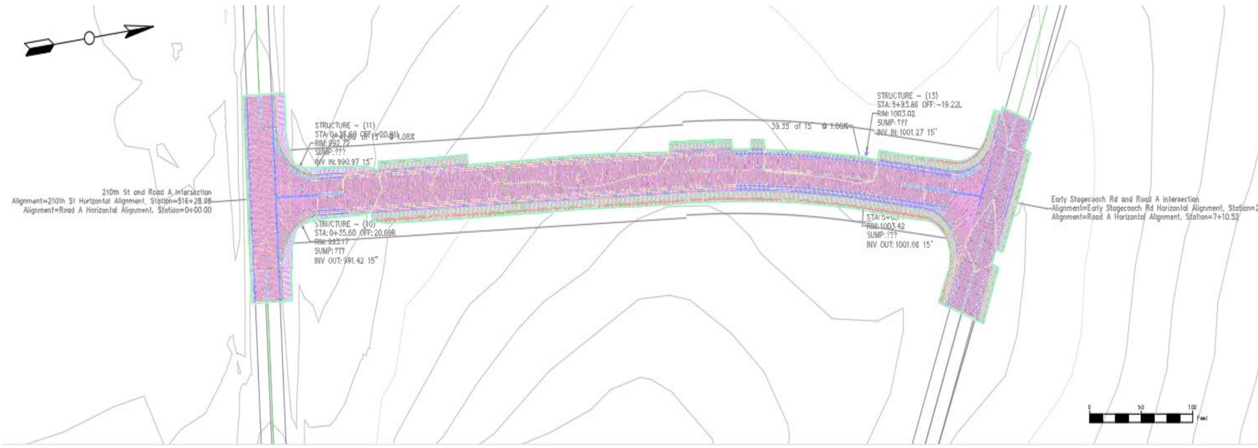


Figure 4A: Plan view of Road A

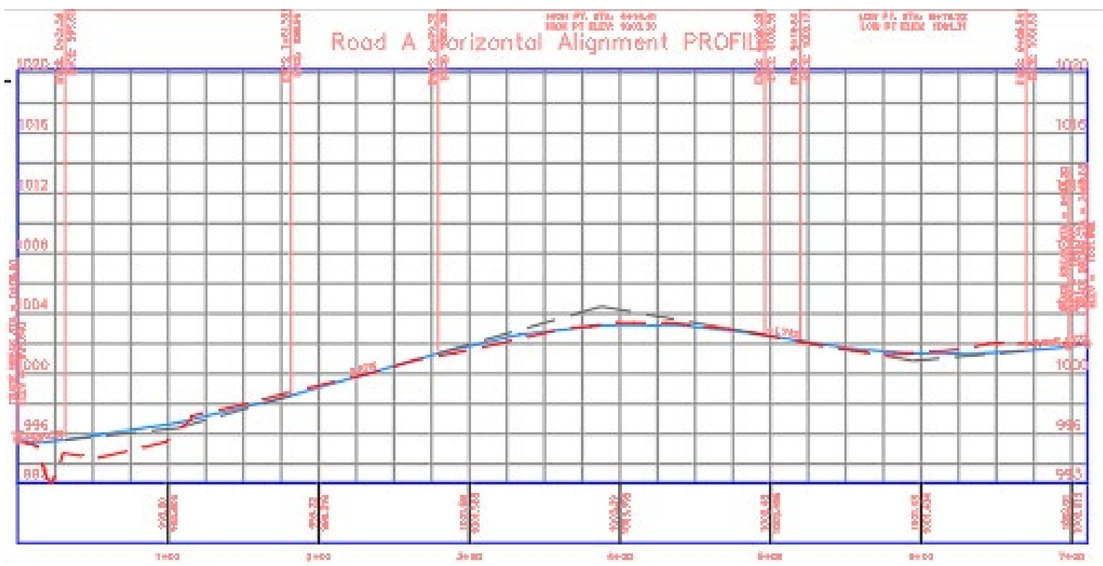


Figure 4B: Profile view of Road A

5. Right-of-way

Figure 5A: Right-of-Way boundaries

6. Traffic Control

Iowa Department of Transportation
Office of Design

9C-3

Work on Two-Lane Roadways

Design Manual
Chapter 9
Traffic Control

Originally Issued: 09-01-95
Revised: 04-15-10

When work activity encroaches onto the traveled way of a two-lane roadway, special measures must be taken to accommodate traffic and separate it from the work zone. This section presents different methods used to control traffic on two-lane, two-way roadways during construction.

One-Lane Closed

When work is performed on one lane of a two-lane, two-way facility, the remaining lane must be used by traffic traveling in both directions. Alternating one-way traffic may be accomplished in several ways.

Single Flagger

For short work areas of 100 feet (30 meters) or less on low volume roads (2000 vpd or less), traffic can be maintained with one flagger. Refer to Standard Road Plan TC-212. The flagger must have an unobstructed view of approaching traffic for at least 1/4 mile (400 meters) and the work area may not be in an existing No Passing Zone. The flagger allows traffic in the open lane to flow freely and permits stopped traffic to proceed only when there are sufficient gaps in the opposing traffic flow. If excessive delays are encountered or sight distance is limited, a second flagger must be added.

Two Flaggers

The most common method for controlling one-way traffic during daylight hours is to use two flaggers, one at each end of the work area. Standard Road Plan TC-213 may be used for work areas up to 1/4 mile (400 meters).

Figure 6A: Section 9C-3

Iowa Department of Transportation
Office of Design

9B-10

Road Closures

Design Manual
Chapter 9
Traffic Control

Originally Issued: 09-01-95

Often it becomes necessary to close a portion of a roadway to some or all traffic. There are several methods used to restrict roadway traffic. This section describes the different types of closures, their uses, and how they are paid for.

Road Closure Barricades

A road closure barricade is used to close a roadway to all traffic except contractors' equipment or officially authorized vehicles. The closure consists of a "ROAD CLOSED" sign mounted on a Type III Barricade. An orange plastic safety fence meeting Specification 4188.03 is placed completely across the roadway immediately behind the Type III Barricade. This type of closure is paid for as a Safety Closure according to Article 2518 of the *Standard Specifications*. Use Tabulation 108-13A. The contractor is paid for each road closure barricade installed. Appropriate advance warning signs such as "ROAD CLOSED AHEAD" should be erected as shown on Standard Road Plans RS-26A, RS-26B, and RS-27.

Road Closed to Thru Traffic

When the actual closure is some distance from the point where thru traffic must detour, local traffic may be allowed to use this section of roadway to access homes and businesses. A Type III Barricade containing a "ROAD CLOSED TO THRU TRAFFIC" sign and a Type A warning light should be placed at the last public road intersection prior to the closure. This type of closure is paid for as part of the lump sum Traffic Control bid item. Refer to Standard Road Plans RS-26A, RS-26B, and RS-27 for additional information.

Figure 6B: Section 9B-10

7. Sediment Control & Erosion Control

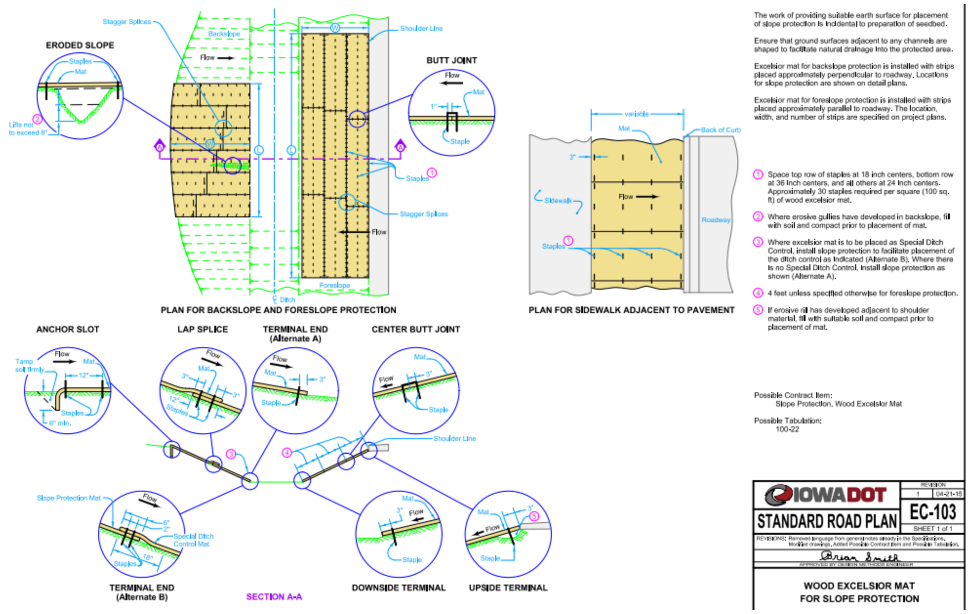


Figure 7A: EC-103

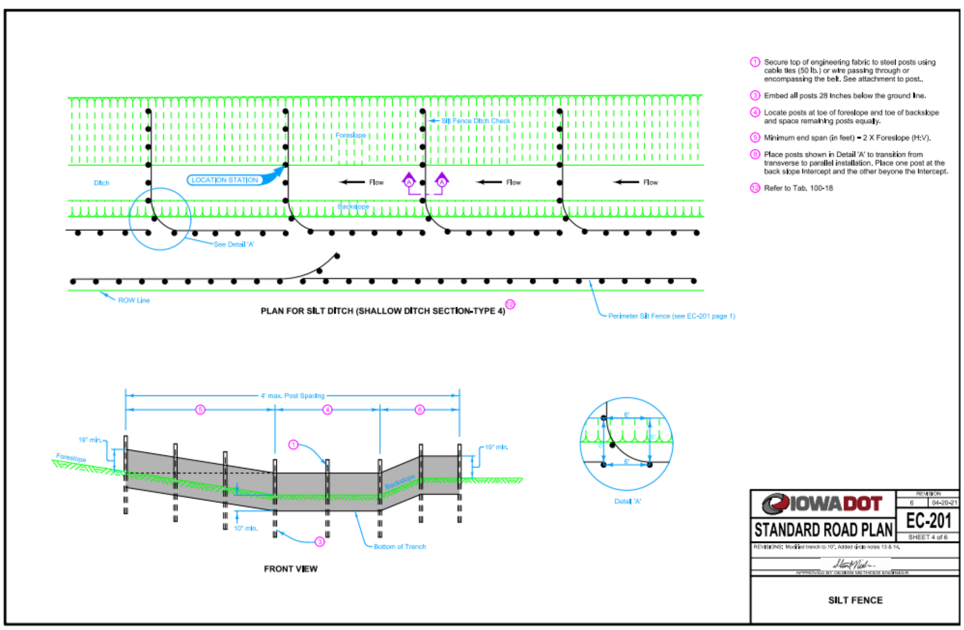


Figure 7B: EC-201

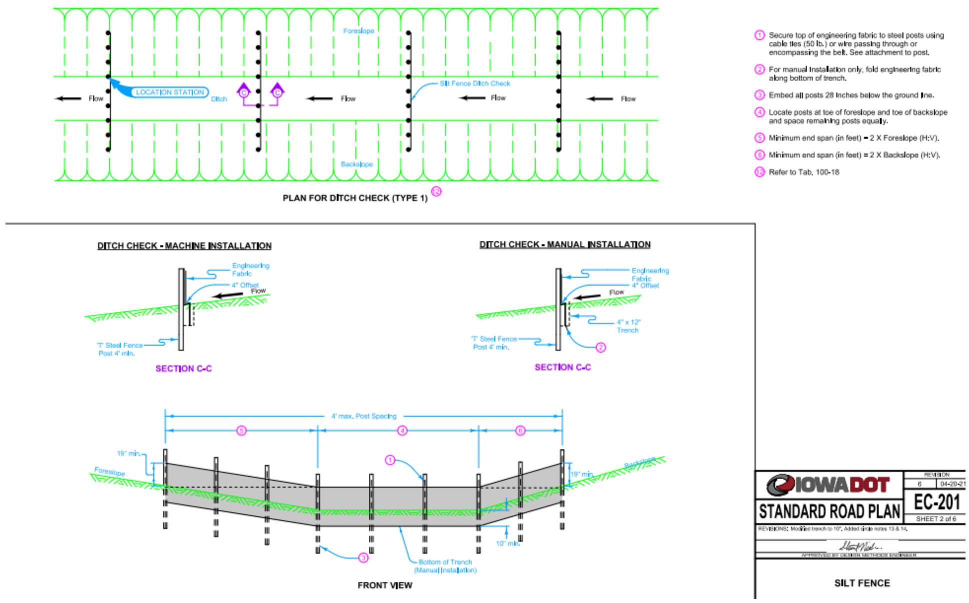


Figure 7C: EC-201

8. Culvert Plans

Table 8A: Calculations for max flow, Q

Q = c*i*A		
i =	4.68	in/hr
A =	3.99	ac
composite c	0.3295	
15% paved	0.95	
85% grass	0.22	
Q =	6.153	cfs
c data from SUDAS Table C3-S4-1		

North Culvert

Invert Elev Dn (ft)	= 1000.00
Pipe Length (ft)	= 32.69
Slope (%)	= 0.61
Invert Elev Up (ft)	= 1000.20
Rise (in)	= 12.0
Shape	= Circular
Span (in)	= 12.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Projecting
Coeff. K,M,c,Y,k	= 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

Top Elevation (ft)	= 1001.60
Top Width (ft)	= 28.00
Crest Width (ft)	= 1.25

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 2.05
Tailwater Elev (ft)	= Critical

Highlighted

Qtotal (cfs)	= 2.00
Qpipe (cfs)	= 2.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.04
Veloc Up (ft/s)	= 4.02
HGL Dn (ft)	= 1000.60
HGL Up (ft)	= 1000.81
Hw Elev (ft)	= 1001.19
Hw/D (ft)	= 0.99
Flow Regime	= Inlet Control

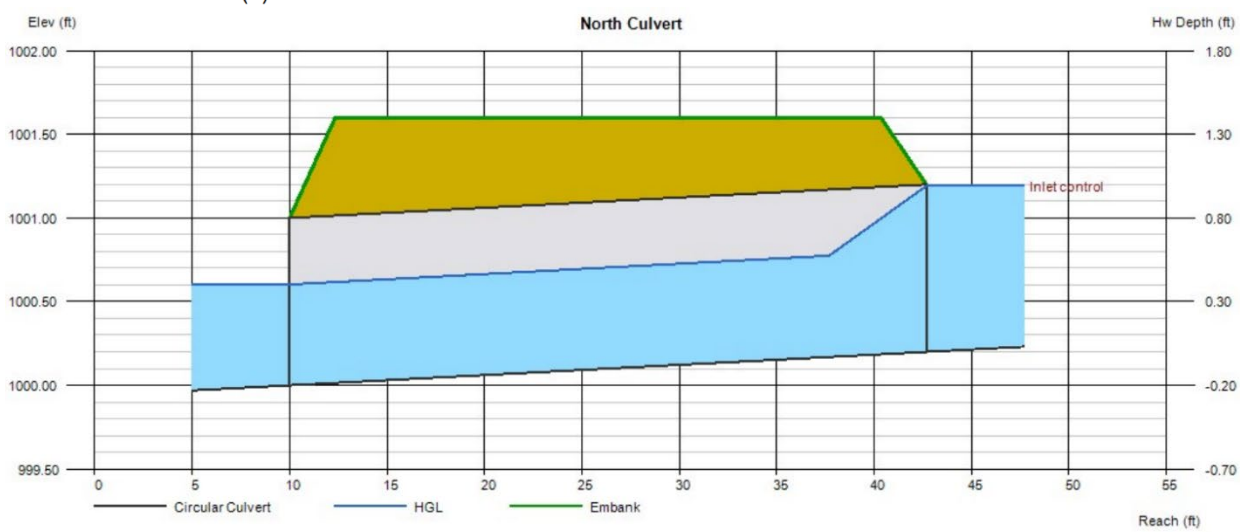


Figure 8A: North Culvert @ STA 5+84. Displayed at 2.0 cfs.

South Culvert

Invert Elev Dn (ft)	= 994.25
Pipe Length (ft)	= 40.00
Slope (%)	= 0.63
Invert Elev Up (ft)	= 994.50
Rise (in)	= 12.0
Shape	= Circular
Span (in)	= 12.0
No. Barrels	= 2
n-Value	= 0.013
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Projecting
Coeff. K,M,c,Y,k	= 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

Top Elevation (ft)	= 995.90
Top Width (ft)	= 28.00
Crest Width (ft)	= 1.25

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 4.10
Tailwater Elev (ft)	= Critical

Highlighted

Qtotal (cfs)	= 4.00
Qpipe (cfs)	= 4.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.07
Veloc Up (ft/s)	= 4.02
HGL Dn (ft)	= 994.85
HGL Up (ft)	= 995.11
Hw Elev (ft)	= 995.49
Hw/D (ft)	= 0.99
Flow Regime	= Inlet Control

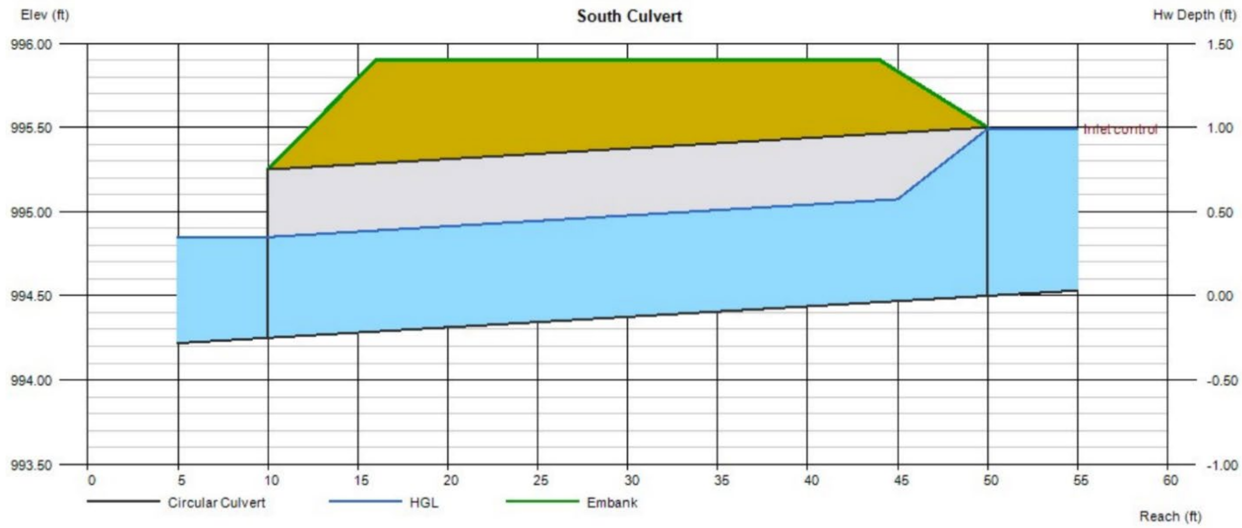


Figure 8B: South Culverts @ Sta. 0+50. Displayed at 4.1 cfs.

9. Pavement Details

I-PAVE
LOW VOLUME ROAD DESIGN GUIDE

Project Name	Early Stagecoach Road
Location	Manchester
County	Delaware
Pavement Design Period (years)	20

Flexible Thickness = 3.0"
Flexible ESALS = 4,353

Rigid Thickness = 6"
Rigid ESALs = 4,192

TRAFFIC

Total Number of Lanes (Both Directions)	2
Roadway Classification/Truck Distribution	Low (Residential)
Annual Average Daily Traffic (AADT)	110
Percent of Trucks (T)	6
Design Lane Traffic	55
Annual Growth Rate (%)	1

STRUCTURE

	Flexible	Rigid
Stone Base Thickness, in	6	6
Subbase Stabilization Depth, in	12	12
Subbase Soil Type	Unsuitable (CBR 3)	

Date 03/17/2021

Company

Login

INPUT FLEXIBLE RIGID SOIL DATA TRAFFIC PRINT CONTACT

Save Project

Project Details

Project Name	Early Stagecoach Road
Location	Manchester
County	Delaware
Pavement Design Period (years)	20

Structure

	Flexible	Rigid
Stone Base Thickness, in	6	6
Subgrade Stabilization Depth, in	12	12
Subgrade Type	Unsuitable (CBR 3)	

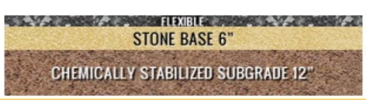
ESAL Calculation

Total Number of Lanes (Both Directions)	2
Roadway Classification/Truck Distribution	Low (Residential)
Annual Average Daily Traffic (AADT)	110
Percent of Trucks (T)	6
Design Lane Traffic	55
Growth Rate	1

Terminal Serviceability, pt	2
Reliability, R (%)	80

Effective Flexible ESALS: 4,353 Effective Rigid ESALs: 4,192

Flexible Thickness = 3.0" RUN CALCULATIONS > Rigid Thickness = 6"



*Minimum HMA is 3 inches *Minimum PCC is 6 inches

Login

INPUT FLEXIBLE RIGID SOIL DATA TRAFFIC PRINT CONTACT

log(W18) Input	3.63876919038479
log(W18) Predicted	4.29960319644925
Standard Normal Deviate, ZR	-0.841621232726619
Standard Deviation, S0	0.45
ΔPSI	2.2
Effective Subgrade Resilient Modulus, MR (psi)	5353
Structural Number, SN	1.891727049
Subgrade Layer Coeff., a3	0.1
Stabilized Depth, D3	12
Subgrade moisture coeff., m3	1
Granular Subbase Layer Coeff., a2	0.14
Granular Subbase Thickness, D2 (in)	6
Subbase moisture coeff., m2	1
HMA Layer Coefficient, a1	0.44
D1	-0.336983979545455
D1 Final	0
D1Final2	3

$$\log_{10}(W_{18}) = Z_R \times S_o + 9.36 \times \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left(\frac{\Delta PSI}{4.2-1.5}\right)}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \times \log_{10}(M_R) - 8.07$$

(these variables will be further explained in Section 3.1.2, *Inputs*)

where: W_{18} = predicted number of 80 kN (18,000 lb.) ESALs

Z_R = standard normal deviate

S_o = combined standard error of the traffic prediction and performance prediction

SN = Structural Number (an index that is indicative of the total pavement thickness required)

= $a_1D_1 + a_2D_2m_2 + a_3D_3m_3 + \ldots$

a_i = i^{th} layer coefficient

D_i = i^{th} layer thickness (inches)

m_i = i^{th} layer drainage coefficient

DPSI = difference between the initial design serviceability index, p_o, and the design terminal serviceability index, p_t

M_R = subgrade resilient modulus (in psi)

Login

INPUT FLEXIBLE RIGID SOIL DATA TRAFFIC PRINT CONTACT

log(W18) Input	3.86
log(W18) Predicted	6.06
Standard Normal Deviate, ZR	-0.842
Standard Deviation, S0	0.35
*Concrete Modulus of Rupture, Sc (psi)	646
Drainage Coeff., Cd	1
Load Transfer Coeff, J	3.2
Concrete Elastic Modulus Ec, psi	4200000
**Modulus of Subgrade Reaction, k (psi/in)	750
ΔPSI	2.5
Trial Thickness, D	4.292
Final Thickness, DF	4.5

*Wang, 2008,
http://www.intrans.iastate.edu/reports/mepdg_testing.pdf
**Method 1

*Minimum cover requirements limit thickness to 6" for 1 inch dowel bars (http://www.fhwa.dot.gov/pavement/t504030.cfm)

$$\log_{10}(W_{18}) = Z_R \times S_o + 7.35 \times \log_{10}(D+1) - 0.06 + \frac{\log_{10}\left(\frac{\Delta PSI}{4.5-1.5}\right)}{1 + \frac{1.624 \times 10^7}{(D+1)^{8.46}}} + (4.22 - 0.32p_t) \times \log_{10}\left[\frac{(S'_c)(C_d)(D^{0.75} - 1.132)}{215.63(J)\left(D^{0.75} - \frac{18.42}{\left(\frac{E_c}{k}\right)^{0.25}}\right)}\right]$$

(these variables will be further explained in Section 4.1.2, *Inputs*)

where: W_{18} = predicted number of 80 kN (18,000 lb.) ESALs

Z_R = standard normal deviate

S_o = combined standard error of the traffic prediction and performance prediction

D = slab depth (inches)

p_t = terminal serviceability index

DPSI = difference between the initial design serviceability index, p_o, and the design terminal serviceability index, p_t

S'_c = modulus of rupture of PCC (flexural strength)

C_d = drainage coefficient

J = load transfer coefficient (value depends upon the load transfer efficiency)

E_c = Elastic modulus of PCC

k = modulus of subgrade reaction

*AASHTO 1993 (http://training.ce.washington.edu/PGI/)

Login

INPUT FLEXIBLE RIGID SOIL DATA TRAFFIC PRINT CONTACT

Relative Quality of Roadbed Soil

Iowa Soil Type	CBR	Resilient Modulus, psi	Effective Resilient Modulus, psi	k-value (psi/in)	Losss of Support k-value (psi/in)
Select	7	8,877	6,776		
Suitable	5	7,157	5,482	Information	Information
Unsuitable	3	5,161	3,965		

*For resilient modulus calculation, the following equation was used:

$$M_r = 2555 * CBR^{0.64}$$

Where

M_r = Unbound Material Resilient Modulus, psi

CBR = California Bearing Ratio, %

From: Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures, APPENDIX GG-1 pg. GG 1.52

http://onlinepubs.trb.org/onlinepubs/archive/mepdg/2appendices_GG.pdf

*For stabilized soils, the following equations are used to characterize the material

$$M_r = 30000\left(\frac{a_i}{0.14}\right) \quad (20)$$

Mr, psi

*This equation is solved for M_r

M_r fly ash = 17,500 psi

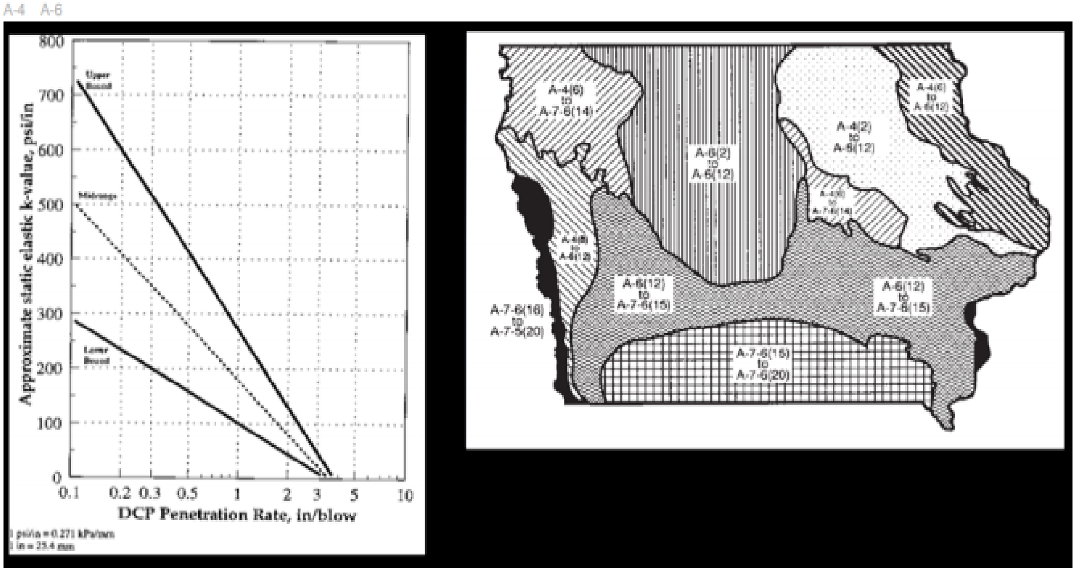
http://www.intrans.iastate.edu/reports/White%20et%20al.%202005_Stab_Vol21.pdf

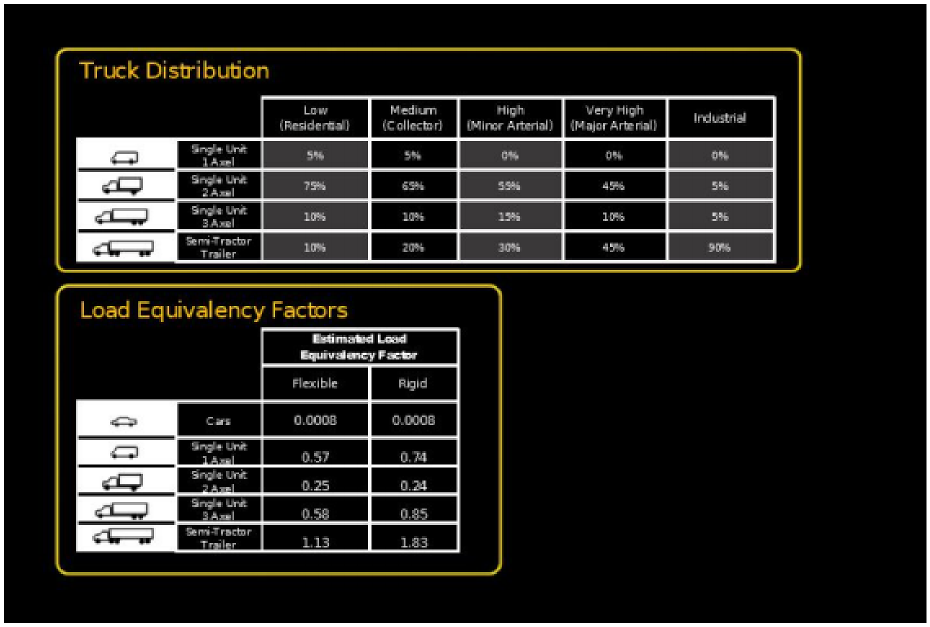
*Effective Modulus of Subgrade Reaction, psi/in

$k = M_r/19.4$

Common AASHTO Soil Type(s) in Delaware

A-4 A-6





Truck Distribution

	Low (Residential)	Medium (Collector)	High (Minor Arterial)	Very High (Major Arterial)	Industrial
Single Unit 1 Axel	5%	5%	0%	0%	0%
Single Unit 2 Axel	75%	65%	55%	45%	5%
Single Unit 3 Axel	10%	10%	15%	10%	5%
Semi-Tractor Trailer	10%	20%	30%	45%	90%

Load Equivalency Factors

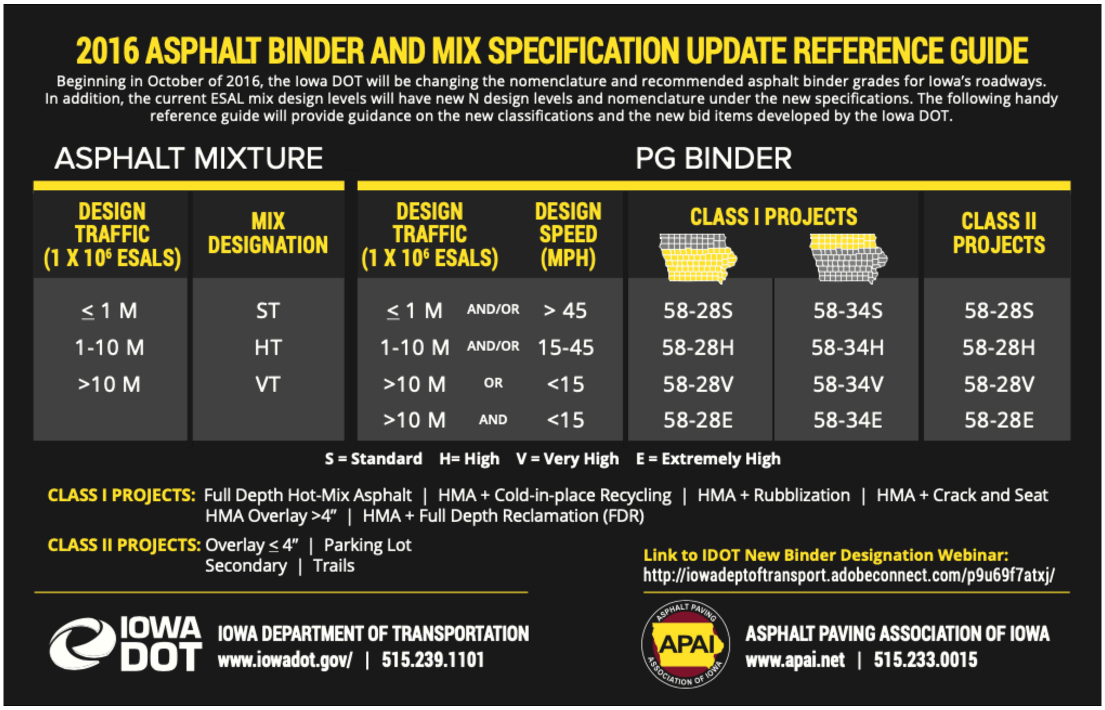
	Estimated Load Equivalency Factor	
	Flexible	Rigid
Cars	0.0008	0.0008
Single Unit 1 Axel	0.57	0.74
Single Unit 2 Axel	0.25	0.24
Single Unit 3 Axel	0.58	0.85
Semi-Tractor Trailer	1.13	1.83

Figure 9A: I-PAVE outputs: Flexible, Rigid, Soil Data, Traffic

Table 9A: Pavement Equivalent Single Axle Load (ESALs)

VEHICLE TYPES	PERCENTAG	CURRENT TRAFFIC	GROWTH FACTORS	DESIGN TRAFFIC	E.S.A.L. FACTOR	DESIGN E.S.A.L.
MOTORCYCLES	0.000	0	17.29	0	0.0001	0
PASSENGER CARS	96.000	1027	17.29	6483786	0.0020	12968
FOUR TIRE	0.000	0	17.29	0	0.0389	0
HEAVY VEHICLES						
BUSES	0.000	0	17.29	0	0.4111	0
SINGLE UNITS						
SIX TIRE TRUCKS	3.000	32	17.29	202618	0.2004	40605
THREE AXLE TRUCKS	0.000	0	17.29	0	1.1384	0
FOUR AXLE TRUCKS	0.000	0	17.29	0	3.4784	0
SINGLE-TRAILER TRUCKS						
FOUR OR LESS AXLES	0.000	0	17.29	0	0.8005	0
FIVE AXLES	0.000	0	17.29	0	1.3377	0
SIX OR MORE AXLES	0.000	0	17.29	0	1.2303	0
MULTI-TRAILER TRUCKS						
FIVE OR LESS AXLES	0.000	0	17.29	0	3.0655	0
SIX AXLES	0.000	0	17.29	0	2.1102	0
SEVEN OR MORE AXLE	1.000	11	17.29	67539	2.1102	142522
UNCLASSIFIED	0.000	0	17.29	0	1.4500	0
SUM OF ALL TYPES	100.000	1070				196094 ESALs

AVERAGE DAILY TRAFF	2140	2140	AADT
LANE DISTRIBUTION	100		
GROWTH RATE OF CA	2.0	15	17.29
GROWTH RATE OF TR	2.0	15	17.29
	Annual G.Rate in %	Life (yrs)	Growth Factor



2016 ASPHALT BINDER AND MIX SPECIFICATION UPDATE REFERENCE GUIDE

Beginning in October of 2016, the Iowa DOT will be changing the nomenclature and recommended asphalt binder grades for Iowa's roadways. In addition, the current ESAL mix design levels will have new N design levels and nomenclature under the new specifications. The following handy reference guide will provide guidance on the new classifications and the new bid items developed by the Iowa DOT.

ASPHALT MIXTURE

DESIGN TRAFFIC (1 X 10⁶ ESALS)	MIX DESIGNATION
≤ 1 M	ST
1-10 M	HT
>10 M	VT

PG BINDER

DESIGN TRAFFIC (1 X 10⁶ ESALS)		DESIGN SPEED (MPH)	CLASS I PROJECTS		CLASS II PROJECTS
≤ 1 M	AND/OR	> 45	58-28S	58-34S	58-28S
1-10 M	AND/OR	15-45	58-28H	58-34H	58-28H
>10 M	OR	<15	58-28V	58-34V	58-28V
>10 M	AND	<15	58-28E	58-34E	58-28E

S = Standard H= High V = Very High E = Extremely High

CLASS I PROJECTS: Full Depth Hot-Mix Asphalt | HMA + Cold-in-place Recycling | HMA + Rubblization | HMA + Crack and Seat HMA Overlay >4" | HMA + Full Depth Reclamation (FDR)

CLASS II PROJECTS: Overlay ≤ 4" | Parking Lot Secondary | Trails

Link to IDOT New Binder Designation Webinar: http://iowadeptoftransport.adobeconnect.com/p9u69f7atxj/

IOWA DEPARTMENT OF TRANSPORTATION
www.iowadot.gov/ | 515.239.1101

ASPHALT PAVING ASSOCIATION OF IOWA
www.apai.net | 515.233.0015

Figure 9B: 2016 Asphalt Binder and Mix Specification Update Reference Guide

DESIGN SUMMARY REPORT FOR

JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)

DATE CREATED:

Fri May 07 2021 10:29:09 GMT-0500 (Central Daylight Time)

Project Description

Project Name:	Manchester Road A	Owner:	City of Manchester, Iowa	Zip Code:	52047
Designer's Name:	Brian Shanahan	Route:	Road A		
Project Description:	Early Stagecoach Road Evaluation				

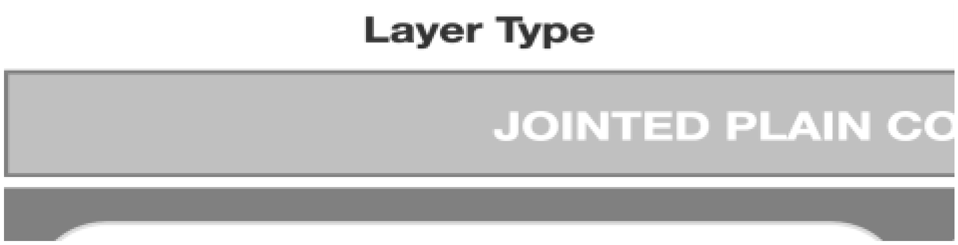
Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	3.75 in	3.75 in	Maximum Joint Spacing:	8 ft	8 ft
Calculated Minimum Thickness:	3.51 in	3.51 in			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 236 psi/in



CONCRETE

28-Day Flex Strength:	750 psi	Edge Support:	Yes
Modulus of Elasticity:	4000000 psi	Macrofibers in Concrete:	No

SUBGRADE

CBR:	3 %
Calculated MRSG Value	4,118 psi

Project Level

TRAFFIC

Spectrum Type:	Residential
Design Life:	20 years

USER DEFINED TRAFFIC

Trucks Per Day:	6
Traffic Growth Rate %:	6 % per year
Directional Distribution:	2 %
Design Lane Distribution:	2 %

GLOBAL

Reliability:	80 %
% Slabs Cracked at End of Design Life:	5 %

Avg Trucks/Day in Design Lane Over the Design Life:

Total Trucks in Design Lane Over the Design Life: 32

Figure 9C: Concrete Pavement Design Report for comparison to asphalt.

10. Signage

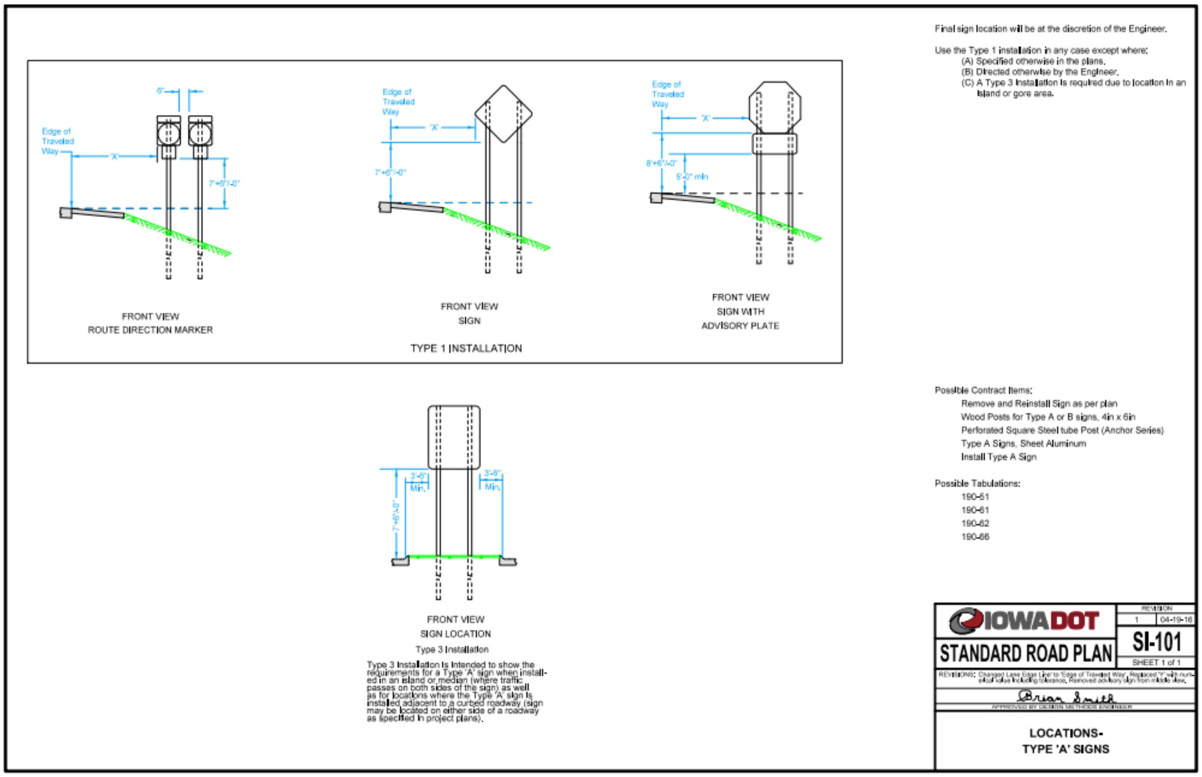


Figure 10A: SI-101

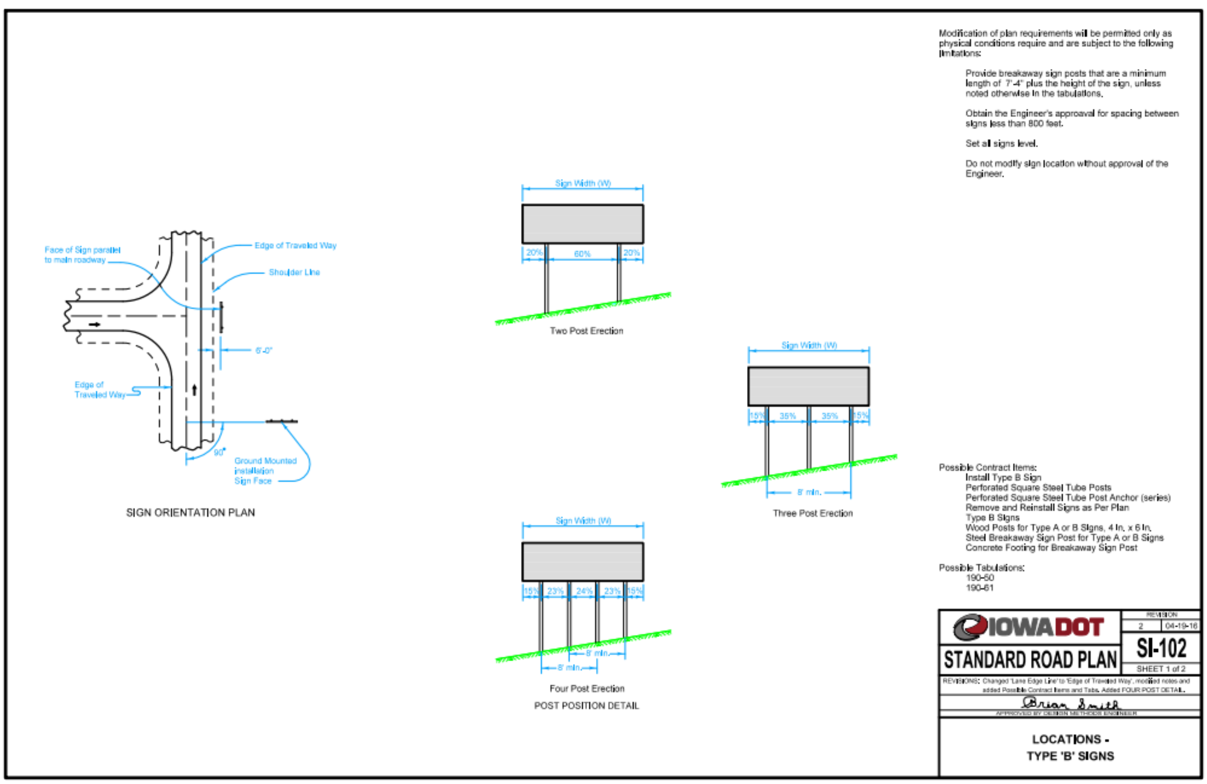


Figure 10B: SI-102

11. Pavement Markings

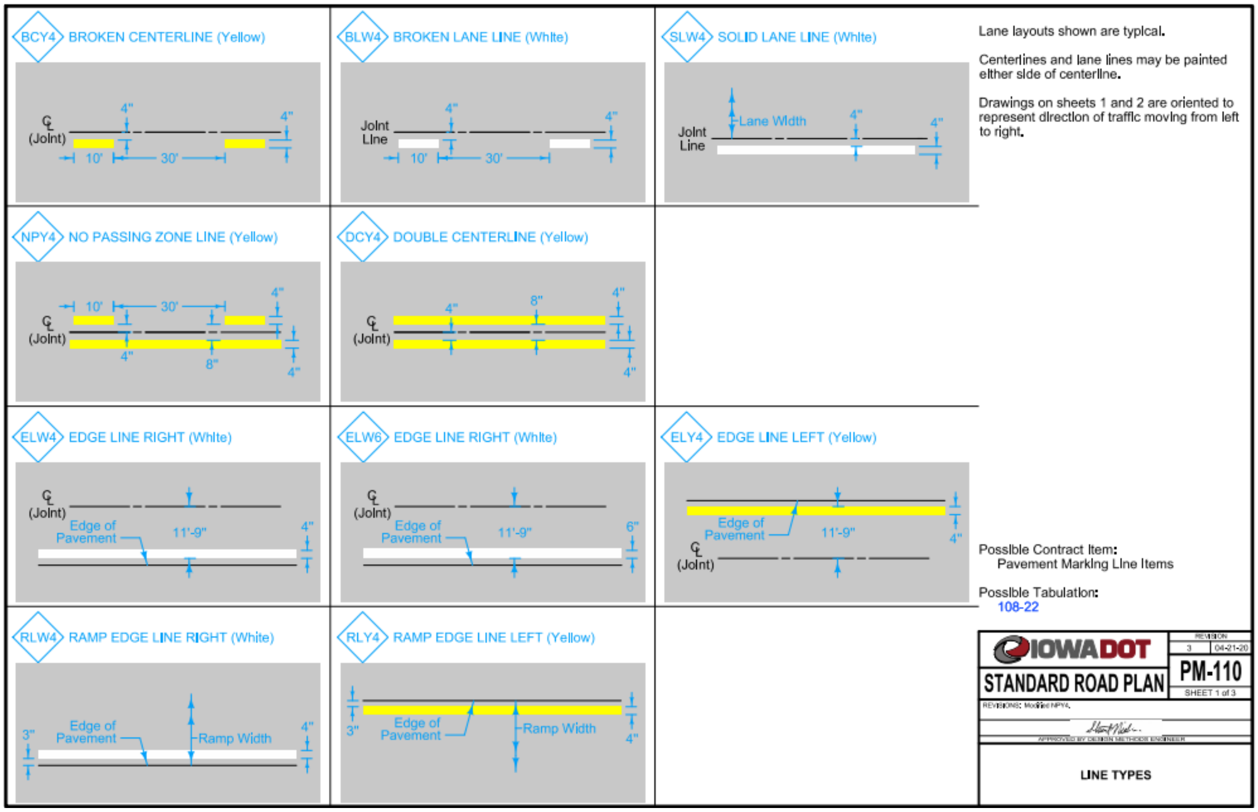


Figure 11A: PM-110

12. Cost Estimate

Table 12A: Construction Cost Estimations for Alternative 1

Project:	Early Stagecoach Road						
Item	**Unit**	**Dollars**	**Quantity**	**Cost**		**Rounded Cost**	
Clearing and Grubbing	Acre	$ 5,140.85	0.4	$ 2,012.49		$ 2,000	2101-0850001 CLEARING AND GRUBBING
Excavation - Class 10 Roadway and Borrow							
Cut/Fill	CY	$ 5.46	686.4	$ 3,747.74		$ 3,750	2102-2710070 EXCAVATION, CLASS 10, ROADWAY AND BORROW
Soil Compaction	CY	$ 1.73	631.6	$ 1,092.62		$ 1,100	COMPACTION WITH MOISTURE AND DENSITY CONTROL
Granular subbase	Ton	$ 26.36	1151.0	$ 30,341.48		$ 30,300	2111-8174100 GRANULAR SUBBASE
Pavement							
6" pcc	SY	$ 84.05	1894.72	$ 159,251.22		$ 159,500	2201-0505060 BASE, STANDARD OR SLIP FORM P.C. CONCRETE, 6 IN.
3" asphalt	SY	$ 12.15	1894.7	$ 23,020.85		$ 23,000	2213-8201030 BASE WIDENING, 3 IN. HOT MIX ASPHALT MIXTURE
Subbase/Subgrade							
Granular Subbase 12"	SY	$ 7.23	1894.7	$ 13,698.83		$ 13,700	2111-8174100 GRANULAR SUBBASE
Soil Compaction -Subgrad	STA	$ 932.26	14.2	$ 13,247.79		$ 13,200	2109-8225100 SPECIAL COMPACTION OF SUBGRADE
Top soil	Cy	$ 5.87	631.6	$ 3,707.34		$ 3,700	2105-8425015 TOPSOIL, STRIP, SALVAGE AND SPREAD
Hydraulic Seeding	Acre	$ 1,553.22	0.4	$ 608.04		$ 610	2601-2636070 HYDRAULIC SEEDING
Pavement Marking	STA	$ 14.68	14.2	$ 208.61		$ 210	2527-9263109 PAINTED PAVEMENT MARKING, WATERBORNE OR SOLVENT-BASED
Traffic Control	LS	$ 16,727.00		$ 16,727.00		$ 16,700	2528-8445110 TRAFFIC CONTROL
Road Removal	ST	$ 437.43	5.0	$ 2,187.15		$ 2,175	2102-5020010 OBLITERATE OLD ROADBED
Signage	SF	$ 25.00	57.0	$ 1,425.00		$ 1,425	Manual of Traffic Signs
Signage (posts)	Unit	$ 100.00	13.0	$ 1,300.00		$ 1,300	Manual of Traffic Signs
Signage (Stop Sign)	Unit	$ 50.00	2.0	$ 100.00		$ 100	Manual of Traffic Signs
Erosion/Sediment Devices	LF	$ 3.21	1421.0	$ 4,561.54		$ 4,562	2602-0000312 PERIMETER AND SLOPE SEDIMENT CONTROL DEVICE, 12 IN. DIA.
Culverts	LF	$21.00	69	$1,449.00		$ 1,450	2416-1160012 CULVERT, CONCRETE ENTRANCE PIPE, 12 IN. DIA.
Option 2 PCC				$ 255,665.84		$ 255,500	
Option 1 Asphalt				$ 119,435.47		$ 119,500	
PCC							
Contigency Costs -- 10%	0.1			$ 25,566.58		$ 25,600	
Admin & Engineering -- 20%	0.2			$ 51,133.17		$ 51,000	
Asphalt							
Contigency Costs --10%	0.1			$ 11,943.55		$ 11,900	
Admin & Engneering -- 20%	0.2			$ 23,887.09		$ 23,900	
Total Project Cost - PCC				$ 332,365.59		$ 332,500	
Total Project Cost - Asphalt				$ 155,266.11		$ 155,500	

Table12B: Construction Cost Estimations for Alternative 2

Project:	Early Stagecoach Road--Road Evaluation and Redesign						
Item	**Unit**	**Dollars**	**Quantity**	**Cost**		**Rounded Cost**	
Clearing and Grubbing	Acre	$ 5,140.85	0.5	$ 2,690.80		$ 2,700	2101-0850001 CLEARING AND GRUBBING
Excavation - Class 10 Roadway and Borrow							
Cut/Fill	CY	$ 5.46	686.4	$ 3,747.74		$ 3,750	2102-2710070 EXCAVATION, CLASS 10, ROADWAY AND BORROW
Soil Compaction	CY	$ 1.73	844.4	$ 1,460.89		$ 1,450	COMPACTION WITH MOISTURE AND DENSITY CONTROL
Granular subbase	Ton	$ 26.36	1539.0	$ 40,568.04		$ 40,600	2111-8174100 GRANULAR SUBBASE
Pavement							
6" pcc	SY	$ 84.05	2533.333	$ 212,926.67		$ 213,000	2201-0505060 BASE, STANDARD OR SLIP FORM P.C. CONCRETE, 6 IN.
3" asphalt	SY	$ 12.15	2533.3	$ 30,780.00		$ 30,800	2213-8201030 BASE WIDENING, 3 IN. HOT MIX ASPHALT MIXTURE
Subbase/Subgrade							
Granular Subbase 12"	SY	$ 7.23	2533.3	$ 18,316.00		$ 18,300	2111-8174100 GRANULAR SUBBASE
Soil Compaction -Subgrade	STA	$ 932.26	19.0	$ 17,712.94		$ 17,700	2109-8225100 SPECIAL COMPACTION OF SUBGRADE
Traffic Control	LS	$ 16,727.00		$ 16,727.00		$ 16,700	2528-8445110 TRAFFIC CONTROL
Road Removal	ST	$ 437.43	5.0	$ 2,187.15		$ 2,175	2102-5020010 OBLITERATE OLD ROADBED
Top soil	Cy	$ 5.87	844.4	$ 4,956.89		$ 4,950	2105-8425015 TOPSOIL, STRIP, SALVAGE AND SPREAD
Hydraulic Seeding	Acre	$ 1,553.22	0.5	$ 812.98		$ 815	2601-2636070 HYDRAULIC SEEDING
Pavement Marking	STA	$ 14.68	19.0	$ 278.92		$ 280	2527-9263109 PAINTED PAVEMENT MARKING, WATERBORNE OR SOLVENT-BASED
Signage	SF	$ 25.00	57.0	$ 1,425.00		$ 1,425	Manual of Traffic Signs
Signage (posts)	Unit	$ 100.00	13.0	$ 1,300.00		$ 1,300	Manual of Traffic Signs
Signage (Stop Sign)	Unit	$ 50.00	2.0	$ 100.00		$ 100	Manual of Traffic Signs
Erosion/Sediment Devices	LF	$ 3.21	1900.0	$ 6,099.00		$ 6,099	2602-0000312 PERIMETER AND SLOPE SEDIMENT CONTROL DEVICE, 12 IN. DIA.
Culverts	LF	$85.71	69	$5,913.99		$ 5,925	2416-1160015 CULVERT, CONCRETE ENTRANCE PIPE, 12 IN. DIA.
Option 2 PCC				$ 337,224.01		$ 337,000	
Option 1 Asphalt				$ 155,077.34		$ 155,000	
PCC							
Contigency Costs --10%	0.1			$ 33,722.40		$ 33,700	
Admin & Engineering -- 20%	0.2			$ 67,444.80		$ 67,500	
Asphalt							
Contigency Costs --10%	0.1			$ 15,507.73		$ 15,500	
Admin & Engneering -- 20%	0.2			$ 31,015.47		$ 31,000	
Total Project Cost - PCC				$ 438,391.22		$ 438,500	
Total Project Cost - Asphalt				$ 201,600.55		$ 201,500	

Table 12C: Construction Cost Estimations for Alternative 3

Project:	Early Stagecoach Road						
Item	**Unit**	**Dollars**	**Quantity**	**Cost**		**Rounded Cost**	
Clearing and Grubbing	Acre	$ 5,140.85	0.9	$ 4,446.91		$ 4,450	2101-0850001 CLEARING AND GRUBBING
Excavation - Class 10 Roadway and Borrow							
Cut/Fill	CY	$ 5.46	686.4	$ 3,747.74		$ 3,750	2102-2710070 EXCAVATION, CLASS 10, ROADWAY AND BORROW
Soil Compaction	CY	$ 1.73	1395.6	$ 2,414.31		$ 2,425	COMPACTION WITH MOISTURE AND DENSITY CONTROL
Granular subbase	Ton	$ 26.36	2543.4	$ 67,044.02		$ 67,000	2111-8174100 GRANULAR SUBBASE
Pavement							
6" pcc	SY	$ 84.05	4186.667	$ 351,889.33		$ 352,000	2201-0505060 BASE, STANDARD OR SLIP FORM P.C. CONCRETE, 6 IN.
3" asphalt	SY	$ 12.15	4186.7	$ 50,868.00		$ 51,000	2213-8201030 BASE WIDENING, 3 IN. HOT MIX ASPHALT MIXTURE
Subbase/Subgrade							
Granular Subbase 12"	SY	$ 7.23	4186.7	$ 30,269.60		$ 30,300	2111-8174100 GRANULAR SUBBASE
Soil Compaction -Subgrad	STA	$ 932.26	31.4	$ 29,272.96		$ 29,300	2109-8225100 SPECIAL COMPACTION OF SUBGRADE
Traffic Control	LS	$ 16,727.00		$ 16,727.00		$ 16,700	2528-8445110 TRAFFIC CONTROL
Road Removal	ST	$ 437.43	5.0	$ 2,187.15		$ 2,175	2102-5020010 OBLITERATE OLD ROADBED
Top soil	Cy	$ 5.87	1395.6	$ 8,191.91		$ 8,200	2105-8425015 TOPSOIL, STRIP, SALVAGE AND SPREAD
Hydraulic Seeding	Acre	$ 1,553.22	0.9	$ 1,343.56		$ 1,350	2601-2636070 HYDRAULIC SEEDING
Pavement Marking	STA	$ 14.68	31.4	$ 460.95		$ 460	2527-9263109 PAINTED PAVEMENT MARKING, WATERBORNE OR SOLVENT-BASED
Signage	SF	$ 25.00	57.0	$ 1,425.00		$ 1,425	Manual of Traffic Signs
Signage (posts)	Unit	$ 100.00	13.0	$ 1,300.00		$ 1,300	Manual of Traffic Signs
Signage (Stop Sign)	Unit	$ 50.00	2.0	$ 100.00		$ 100	Manual of Traffic Signs
Erosion/Sediment Devices	LF	$ 3.21	3140.0	$ 10,079.40		$ 10,079	2602-0000312 PERIMETER AND SLOPE SEDIMENT CONTROL DEVICE, 12 IN. DIA.
Culverts	LF	$85.71	69	$5,913.99		$ 5,925	2416-1160015 CULVERT, CONCRETE ENTRANCE PIPE, 12 IN. DIA.
Option 2 PCC				$ 536,813.84		$ 537,000	
Option 1 Asphalt				$ 235,792.51		$ 236,000	
PCC							
Contigency Costs --10%	0.1			$ 53,681.38		$ 53,500	
Admin & Engineering --20%	0.2			$ 107,362.77		$ 107,500	
Asphalt							
Contigency Costs --10%	0.1			$ 23,579.25		$ 23,600	
Admin & Engneering -- 20%	0.2			$ 47,158.50		$ 47,200	
Total Project Cost - PCC				$ 697,858.00		$ 698,000	
Total Project Cost - Asphalt				$ 306,530.26		$ 306,500	

Table 12D: Construction calculations for pricing on Alternative 1

Clearing & Grubbing				
	area = length trail X width of ROW			
	length =	710.52	ft	
	width =	24	ft	
	Area =	17052.48	sq ft	
		0.391471074	acres	43560 sqft/acre
Excavation - Cut & Fill				
	Cut	420.93	cy	
	Fill	265.47	cy	
	Total	686.4	cy	
Soil Compaction				
	length	710.52	ft	
	depth	1	ft	
	width	24	ft	
	volume	17052.48	cubic ft	27 cf/cy
		631.5733333	cy	
Granular subbase				
	length	710.52	ft	
	depth	1	ft	
	width	24	ft	
	volume	17052.48	cf	
	density	135	pcf	
	weight	2302084.8	lbs	
		1151.0424	tons	
Pavement				
	6" pcc			
	length	710.52	ft	
	depth	0.5	ft	
	width	24	ft	
	volume	8526.24	cf	
		315.7866667	cy	
		1894.72	sq yrds	
	Area			
	3"asphalt	710.52	ft	
	length	0.25	ft	
	depth	24	ft	
	width	4263.12	cf	
	volume	157.8933333	cy	
		1894.72	sq yrds	
	Area			
Top soil				
		710.52	ft	
	length	1	ft	
	depth	24	ft	
	width	17052.48	cf	
	volume	631.5733333	cy	
Seeding		710.52	ft	
	length	24	ft	
	width	17052.48	sq ft	
	area	0.391471074	acres	
Pavement Marking				
		710.52	ft	
	length	1421.04	ft	
	2xlength	14.2104	Sta	
	Stations			

Table 12E: Construction calculations for pricing on Alternative 2

Clearing & Grubbing				
	area = length trail X width of ROW			
	length =	950	ft	
	width =	24	ft	
	Area =	22800	sq ft	
		0.523415978	acres	43560 sqft/acre
Excavation - Cut & Fill				
	Cut	420.93	cy	
	Fill	265.47	cy	
	Total	686.4	cy	
Soil Compaction				
	length	950	ft	
	depth	1	ft	
	width	24	ft	
	volume	22800	cubic ft	27 cf/cy
		844.4444444	cy	
Granular subbase				
	length	950	ft	
	depth	1	ft	
	width	24	ft	
	volume	22800	cf	
	density	135	pcf	
	weight	3078000	lbs	
		1539	tons	
Pavement				
	6" pcc			
	length	950	ft	
	depth	1	ft	
	width	24	ft	
	volume	22800	cf	
		844.4444444	cy	
	Area	2533.333333	sq yrds	
	3"asphalt			
	length	950	ft	
	depth	1	ft	
	width	24	ft	
	volume	22800	cf	
		844.4444444	cy	
	Area	2533.333333	sq yrds	
Top soil				
	length	950	ft	
	depth	1	ft	
	width	24	ft	
	volume	22800	cf	
		844.4444444	cy	
Seeding	length	950	ft	
	width	24	ft	
	area	22800	sq ft	
		0.523415978	acres	
Pavement Marking				
	length	950	ft	
	2xlength	1900	ft	
	Stations	19	Sta	

Table 12F: Construction calculations for pricing on Alternative 3

Clearing & Grubbing			
	area = length trail X width of ROW		
	length =	1570	ft
	width =	24	ft
	Area =	37680	sq ft
		0.865013774	acres
Excavation - Cut & Fill			
	Cut	420.93	cy
	Fill	265.47	cy
	Total	686.4	cy
Soil Compaction			
	length	1570	ft
	depth	1	ft
	width	24	ft
	volume	37680	cubic ft
		1395.555556	cy
Granular subbase			
	length	1570	ft
	depth	1	ft
	width	24	ft
	volume	37680	cf
	density	135	pcf
	weight	5086800	lbs
		2543.4	tons
Pavement			
	6" pcc		
	length	1570	ft
	depth	1	ft
	width	24	ft
	volume	37680	cf
		1395.555556	cy
	Area	4186.666667	sq yrds
	3"asphalt		
	length	1570	ft
	depth	1	ft
	width	24	ft
	volume	37680	cf
		1395.555556	cy
	Area	4186.666667	sq yrds
Top soil			
	length	1570	ft
	depth	1	ft
	width	24	ft
	volume	37680	cf
		1395.555556	cy
Seeding	length	1570	ft
	width	24	ft
	area	37680	sq ft
		0.865013774	acres
Pavement Marking			
	length	1570	ft
	2xlength	3140	ft
	Stations	31.4	Sta

Table 12G: Project Construction Duration estimate of one season.

Tasks	**Construction Season**					
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Staging						
Earthwork (Subgrade/Base)						
Paving						
Grading/Seeding						

Table 12H: Cost comparisons for all three alternatives

	Alternative 1 (710')	**Alternative 2 (950')**	**Alternative 3 (1570')**
3" Asphalt	$155,500	$201,500	$306,500
6" Concrete	$332,500	$438,500	$698,000

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