DEPARTMENT OF TRANSPORTATION

Development of Cost-Competitive Timber Bridge Designs for Long-Term Performance

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Natural Resources Research Institute
University of Minnesota Duluth

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DEVELOPMENT OF COST-COMPETITIVE TIMBER BRIDGE DESIGNS FOR LONG-TERM PERFORMANCE

FINAL REPORT

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LIST OF ABBREVIATIONS

AASHTO - American Association of State Highway and Transportation Officials

ft – feet

Glulam - Glued-laminated timber

in - inches

km - kilometers

lb. – pounds

LCCA – life-cycle cost analysis

LCA – life-cycle assessment

LRFD – load and resistance factor design

MnDOT – Minnesota Department of Transportation

NBI - National Bridge Inventory

NCHRP - National Cooperative Highway Research Program

EXECUTIVE SUMMARY

Minnesota Department of Transportation (MnDOT) data shows that only 25 timber beam or slab bridges were constructed in Minnesota from 2000 through 2019. During the same period, over 620 concrete slab spans or prestressed concrete beam bridges were constructed. This occurred due to several factors, including misconceptions about the durability, structural adequacy and expense of constructing timber bridges. However, significant advancements in design, preservation, maintenance and inspection of modern timber bridges have been made. Recent national service-life assessment research has shown that timber is a durable option for primary structural members in highway bridges and can perform satisfactorily for 50 years or longer when properly designed, fabricated and maintained. However, both anecdotal assumptions and cost reports have indicated that timber bridges are more expensive than concrete bridges to construct (MnDOT, 2020).

In this project, information was gained through project activities informed by literature reviews, surveys of county engineers, and demonstration construction projects, with a goal of seeing an increase in the construction of cost-competitive timber-based bridges in Minnesota. To improve awareness of modern timber bridges for state and local bridge owners, design aids were developed for three bridge superstructure types: 1) steel stringers with a transverse glulam deck, 2) glulam stringer with a transverse glulam deck, and 3) spike-laminated longitudinal deck. These aids generally include the following information for each superstructure type: perspective drawing and photographic view, design information, connection detail, crash-tested bridge railing options, and flashing detail options.

Other options for improving cost-effectiveness of timber bridges include preservative selection, contracting and construction options, bridge design, fabrication, construction/installation, and design innovations to minimize long-term maintenance. Specifically, this includes the potential for streamlined MnDOT preservative approvals, winter construction, inclusion of timber designs into bid specifications to increase competition, expanded use of American Association of State Highway Transportation Officials-Load and Resistance Factor Design (AASHTO-LRFD) multiple presence factors, contractor supplied pre-letting designs, alternate designs for abutments, and other activities underway by bridge designers, engineers and suppliers.

Research and demonstration projects clearly show that the main advantage of a timber bridge is the speed of superstructure construction. It is clear from previous case studies, interviews with bridge engineers, owners, contractors, and suppliers, and demonstration projects that timber superstructures can be installed within days to weeks, as compared to months for other materials.

Two demonstration construction projects were completed. In the first project, a St. Louis County construction crew installed a steel girder with a transverse glulam deck bridge with a curbless crash-tested railing system. The bridge installation was efficient and new flashing designs were used to direct water off the bridge deck. Despite several challenging site conditions, the project was successfully installed. While the overall project costs were significant, costs for the wood-based materials and labor were similar to those for other alternative designs. In the second project, Hennepin County contracted

with a Minnesota construction firm. The previous bridge was removed in December, piles installed in January, and the timber superstructure constructed in March. However, spring rains created a long delay in other roadway work and paving, resulting in an opening delay until July. However, the timber superstructure was completed in approximately five days. The feedback from the county (design engineer, construction engineer, and construction inspector) was all positive about the timber aspects of the project. This project also was completed at a very difficult site, making a direct cost comparison to alternative designs complicated. However, it appears this project was cost-competitive based on the information collected. In the demonstration projects, life-cycle assessments (LCA) were completed for each of the two demonstration projects. The analysis was only conducted on the actual design and construction materials used in the timber-based projects. Ideally, it would have been undertaken in comparison to other bridge materials, but that was outside the scope of the project. However, the alternate concrete designs for each project could be assessed in the future and compared. Regardless, this effort created a baseline process and examples for future LCA.

Minnesota has two timber bridge component suppliers, Wheeler Lumber, LLC and Bell Structural Systems. These companies have significant experience in working with county engineers to support the design and construction of timber bridges that are cost-effective and longlasting. Further, there are other companies in the US with experience in the design, specification, and construction of timber bridge systems. It was shown that there are a number of consultant and construction firms in Minnesota that have experience in design and construction of timber bridges. At least one county (St. Louis) maintains its own construction crew that is used to build bridge projects (>1 each year).

Despite a negative perception of timber bridges by some engineers and owners, this project clearly shows that there is potential in using timber bridge systems that are capable of being cost-competive and long-lasting. The use of the enclosed design aids can help increase the awareness of modern timber systems that have excellent long-term performance.



Modern Minnesota Timber Bridges. The left bridge photo is a galvanized steel girder with transverse glued-laminated timber deck panels built by St. Louis County. The right bridge photo is a longitudinal dowel-laminated timber deck with metal spikes panelized bridge built by Hennepin County.

CHAPTER 1: INTRODUCTION

1.1 PROPOSAL SUMMARY AND OBJECTIVES

MnDOT data shows that only 25 timber beam or slab bridges were constructed in Minnesota from 2000 through 2019. During the same period, over 620 concrete slab spans or prestressed concrete beams bridges were constructed. This has occurred due to several factors, including misconceptions about the durability, structural adequacy and expense of constructing timber bridges. However, significant advancements in design, preservation, maintenance and inspection of modern timber bridges have been made. Recent national service-life assessment research has shown that timber is a durable option for primary structural members in highway bridges and can perform satisfactorily for 50 years or longer when properly designed, fabricated and maintained. However, both anecdotal assumptions and cost reports have indicated that timber bridges are more expensive than concrete bridges to construct (MnDOT, 2013).

The objective of this project was to develop a series of design, contracting and construction options and strategies for cost-competitive (initial and life-cycle costs), sustainable timber bridges in Minnesota that meet AASHTO HL-93 load requirements and LRFD Bridge Specifications. The project incorporated standard plans for timber bridge superstructures that are currently under development by USDA's Forest Service. These plans were evaluated and modified for Minnesota and when coupled with best inspection and maintenance procedures, provide new opportunities for constructing innovative, long-lasting and cost-competitive timber bridges. Finally, several bridge construction projects will be identified with partner counties that will use the developed plans, allowing the project team to assess and validate the true initial costs of construction, predict life-cycle costs, and complete a life-cycle assessment for these bridges.

The official project tasks were:

Task 1	Literature Review, Project Review, Product Review, and Engineer Survey
Task 2	Creation of Standard Superstructure Options
Task 3A, 3B:	Construction Projects and Partners to Demonstrate and Validate Cost-effective and High-Performance Timber Bridges
Task 4-6	Preliminary and final reports, publication, and development of an in-person presentation for MCEA along with a webinar-based presentation. All products resulting from this work will be posted online through the National Center for Wood Transportation Structures (www.woodcenter.org), which is hosted by Iowa State University (a subcontractor on this project).

CHAPTER 2: BACKGROUND ASSESSMENTS

2.1 LITERATURE REVIEW, PROJECT REVIEW, PRODUCT REVIEW, AND ENGINEER SURVEY

A comprehensive literature review was completed to identify previous research on modern, cost-effective, sustainable timber bridge superstructure plans, cost studies and assessment strategies for initial and life-cycle costs. Further, a review of timber bridge product, manufacturing and construction options was conducted to understand the available marketplace and construction market. To solicit information from county engineers, a survey was developed and distributed with a goal of understanding timber bridge concerns, construction protocols for bridges, and the use of county crews or engineering construction firms.

2.1.1 Literature Review

A comprehensive literature review was conducted through the University of Minnesota Duluth and the USDA Forest Products Laboratory to identify appropriate literature regarding timber bridges using the following terms: timber, vehicle bridges, cost, economics, materials, construction, superstructure, substructure, initial cost, life-cycle, maintenance, repairs, longevity, durability, design life, comparison cost, unit cost, Minnesota, and standard plans.

Based on this review, specific articles were collected and reviewed. Each of the following sections provides a summary overview of selected literature and the references cited. Within each section, they are not reported in a prioritized order. These sections included timber bridge plans, cost-effectiveness/cost studies, maintenance and environmental considerations and life-cycle assessment.

2.1.1.1 Timber Bridge Designs and Plans

Ritter (1990) composed a book summarizing all aspects of timber bridges. The material in this book include timber bridge history, wood mechanical properties, design options, and maintenance and rehabilitation methods.

Lee et al. (1995) developed standard plans for bridges utilizing southern pine. Three bridge superstructure types are included in the report: stress-laminated sawn timber, stress-laminated glulam, and longitudinal sawn stringer bridges with transverse plank. Various dimensional combinations for the timber bridges are included that meet AASHTO standards and specific load ratings.

Smith et al. (1995) conducted an analysis of the factors affecting timber selection for a bridge material. This report included information on criteria that were used to evaluate bridge material such as expected life and initial cost. A survey was sent to over 1,300 highway officials in 28 states asking to rank the level of importance for a variety of nonstructural factors that could be used in making bridge decisions. It was concluded that highway officials select prestressed and reinforced concrete over 70% of the time when deciding materials. This was credited to maintenance requirements, initial cost, and past performance carrying the most weight during material selection. The authors go on to discuss new advances in timber and the need for renewed education as it is now a more competitive bridge option.

Ritter et al. (1995) of the US Forest Service created plans for crash-tested bridge railings for longitudinal wood decks. The document includes the following design plans: glulam timber rail with curb (AASHTO Performance Level 1), glulam timber rail without curb (AASHTO Performance Level 1), steel rail (AASHTO Performance Level 1), steel rail (AASHTO Performance Level 2), and glulam timber rail with curb (NCHRP 350 Test Level 4). The plan diagrams include the following superstructure components: railing details, steel post plate, internal steel plate, rail splice details, curb splice details, approach rail transition configuration, transition block, transition connection details, curb transition, transition glulam rail boring details, and steel transition plate.

Tingley et al. (1996) of the Wood Science and Technology Institute monitored a long span (162 ft) timber glulam bridge for strain that was reinforced with fiber reinforced plastic (FRP). Three main girders (two exterior and one interior) were fitted with internal strain gauges and data was collected every 108 minutes for 70 days. The results indicated significant strength increase in the glulam bridges. According to the report this allows for a reduction in bridge cost due to lower grade substitution, smaller glulam dimensions necessary, and less transportation weight.

Spradlin and Smith (1997) of Virginia Polytechnic Institute published a report on market opportunities for wood in the United States transportation system. This technical report included how to incorporate the timber industry into a variety of product fields. These fields include highway guardrails, highway noise barrier, signs and signposts, formwork and falsework, railroads, marine wood pilings, electricity and communication transportation systems, and a section on preservative treated wood in transportation markets.

Ritter et al. (1998) of the US Forest Service produced plans for crash-tested bridge railings for longitudinal wood decks on low-volume roads. This document focuses on the need for low-volume railing designs due to timber bridges being used in rural locations. The document includes the following design plans: top-mounted railing (NCHRP 350 Test Level 1), side-mounted breakaway railing (NCHRP 350 Test Level 1), curb railing (NCHRP 350 Test Level 1), and low-volume curb railing. The plan diagrams include the general railing and curb details along with component details such as posts, post attachments, scupper block, curb splice, etc.

Ritter et al. (1998) of the US Forest Service produced plans for crash-tested wood bridge railings for concrete decks. The railing and curb plan used glulam as the timber material and each design section in the report is associated with a test level depending on the road traffic of the bridge. Timber rail attachment to the concrete deck was emphasized throughout the plans. Overall the report contains seven design options with different combinations of railing/curb or railing/no curb along with various test levels.

Faller et al. (2000) of the US Forest Service conducted tests on bridge railings for transverse timber deck bridges. The scope of the study involved two test bridges in areas with higher traffic (Test Level 4). The first bridge used a glulam railing system and the second railing used a steel tie-beam system. The testing criteria were in accordance with NCHRP Report 350 which requires three full-scale crash tests with varying vehicle speeds and weights. Another step for testing was to design the railings to meet

standards; all railing diagrams are included in the report. Sensors were installed throughout the railing systems to measure the forces and strain on the materials. The results indicated that both railing designs met the NCHRP Report 350 Test Level 4 requirements.

Pliemann (2000) conducted a study on three types of pre-designed timber bridges for Arkansas county roads. This study compared timber bridge performance vs. concrete and steel. It showed that concrete and steel bridges were deteriorating due to deicer chemicals and maintenance problems. The bridges chosen were the following: solid sawn stringers with transverse solid sawn deck, glulam stringers with transverse glulam deck, and stress-laminated full-span glulam stringers. The results are given in the form of tables listing appropriate spans and live loads correlated with timber designs. The report concluded that by following these recommendations these timber bridges should last 75 years.

Wacker and Smith (2001) from the US Forest Service published a report on standard timber bridge plans. The plans listed in the report consist of five longitudinal deck superstructure designs and two beam superstructure designs. The given plans follow AASHTO standards and the designs are associated with different loading and deflection values.

Faller et al. (2001) of the US Forest Service conducted tests on bridge railings for transverse glulam timber deck bridges. The scope of the study involved two test bridges in areas with moderate traffic (Test Level 2). The first bridge tested was a steel three-beam system, the second was a glulam timber railing system. The testing criteria were in accordance with NCHRP Report 350 Test Level 2, which requires two full-scale crash tests with varying vehicle speeds and weights. Another step for testing was to design the railings to meet standards; all railing diagrams are included in the report. Sensors were installed throughout the railing systems to measure the forces and strain on the materials. The results indicated the steel system met NCHRP standards with all steel members staying intact after the crash. The timber railing system also met the NCHRP standards with its components all intact and serviceable after the crash.

Pierce, a Sr. (2010) Principal Engineer for CHA Incorporated, prepared a technical report on heavy timber decks on steel beam bridges. This report discussed the advancements of the nail-laminated deck panels and glulam panels for New York State. This report discusses the engineering, availability, constructability, construction duration, durability, maintenance experience, and costs of these timber deck bridges. Details of standard deck installation and geometry are included along with common deterioration problems.

Araki et al. (2010) conducted a study on timber bridge durability. The five areas of influence that this report includes are material durability and antiseptic methods, climate, structures, design, and construction. Each influence is a factor in equations that predict timber bridge sustainability. Tables are listed in the report with specific numerical values for each focus area dependent on bridge characteristics such as wood species or treatment. They conclude in their report that although their data set is small, the predicted lifetimes and actual observed ones for the bridges they studied were similar.

Correia et al. (2013) of the University of Sao Paulo, Brazil conducted a study on the use of geosynthetics on asphalt wearing surfaces for timber bridge decks. The study emphasized that currently there is high

deflection, displacement, and shrinkage in timber under bridge asphalt. The research integrated geosynthetics into the wear layer as a water sealant and to provide rigidity. A case study was created when a geosynthetic layer was put into a modern timber bridge. The results indicated that the geosynthetic was successful at limiting reflective cracking and minimizing water exposure in the timber deck.

The Pennsylvania Department of Transportation (2013) provided design schematics for a 33-foot-long glulam timber bridge.

Scharmacher et al. (2014) developed a specifications report on different asphalt systems based on studies of timber bridges. The studies emphasized the adhesion between the asphalt and timber surface, and it was concluded that this adhesion is comparable to steel and concrete surfaces. Their technical conclusion for future surfacing was to seal with a vapor proof surface coating prior to installation or to use hot asphalt.

Gilham (2015) a chief engineer for Western Wood Structures Incorporated, composed a paper focused on creating a new perspective on timber bridges. The paper confronts common assumptions about timber bridge environmental challenges, durability, design options, etc. There are nine categories discussed: longevity, strength, span length, rail systems, wear surfaces, environmental considerations, economics, aesthetics, and sustainability. The report concludes that timber bridges are more than adequate as a construction option.

Chapter 8 of Wood Structures (MnDOT, 2015) contains information on timber bridge LRFD design. This section contains information relating to longitudinal and transverse decks, glulam beams, and pile caps; all specifications follow AASHTO LRFD requirements. Throughout the report there are design examples that are followed through with bending moment, bearing, shear, etc. calculations. The example bridges feature two deck types; transverse spike-laminated and transverse glulam.

Wacker and Smith (2016 – in progress) are working to development of standard plans for glulam timber bridges. In this study, they will develop updated and standardized design information for glulam highway bridges in accordance with the latest American Association of State Highway and Transportation Officials AASHTO–LRFD Bridge Design Specifications. Four different superstructure types are included: longitudinal glulam deck, stress-laminated glulam longitudinal deck, transverse glulam deck on longitudinal glulam girders, and transverse glulam deck for longitudinal steel girders. The primary output from this project will be an updated and user-friendly set of standard bridge design aids for glulam timber highway bridges. They will be available to the general public in a variety of forms through the National Center for Wood Transportation Structures website including electronic (PDF) versions of the as-printed publication, AutoCAD drawings available for download, and design example calculations derived in MathCAD (PDF) for each bridge type.

2.1.1.2 Cost effectiveness, Cost studies

A technical report prepared by Frangopol and Liu (2004) investigated the accomplishments and challenges of life-cycle cost analysis for highway bridges. Their research involved using current Bridge

Management Systems (BMS) along with BRIDGIT which is based on Markovian deterioration modeling. Their results display recent upgrades to BMS systems for calculated life-cycle costs of bridges.

Sarisley (1990) evaluated the methods and costs of stress-laminated timber bridge construction. Sarisley's method involved observing costs for a 50 ft long by 13 ft wide single-lane, two-span continuous bridge in Connecticut. All designs and materials were presented, and their associated costs are listed throughout the paper. Results showed a 32% savings in construction by using timber compared to the other alternatives of steel and concrete. The report also included suggestions to improve labor costs such as using pneumatic nailing and the prospect of using lower grade timber to decrease costs.

Orr et al. (2000) conducted a study on the costs of 327 timber bridges. 121 were demonstration projects, and 206 were not. The goal was to determine if there were cost differences between demonstration and non-demonstration bridges. The report shows the minimum, maximum, and average dollars per square meter accompanied by the number of bridges, bridge length, bridge width, and number of spans. The conclusion was that demonstration bridges cost approximately $120 more per square meter of superstructure than non-demonstration bridges, a 36% increase in cost. It was also noted that the wood-steel stress-laminated design was the most expensive.

The US Forest Service (2001) conducted life-cycle cost analyses of timber vs. concrete, pre-stressed concrete, and steel. The study selected 36 of the 116 National Bridge Inventory (NBI) fields to be used as data. The superstructure cost, substructure cost, and total bridge cost was all incorporated in the study. The results of the study found that timber bridges were cheaper to install in the Midwest compared to the Northeast. It was also discovered that initial costs were similar between timber, concrete, and steel however there was high variability across all cost comparisons due to variation in construction designs.

The US Forest Service (2011) has a standard guide for costs of bridge construction. The guide consists of tables with each component of the bridge being given in price per square foot or linear foot. The report includes a table directly comparing timber and steel pile costs along with beam costs of prestressed concrete. It also includes a detailed table of timber railing costs by component.

A poster from the Forest Service (2003) that describes four timber bridge projects and their total costs. The three bridge types include one glulam and two sawn lumber. All three bridges are one span, utilized Red Pine, and treated with CCA while having varying lengths and widths (all under 32 ft in length). The three bridges ranged in cost from $46,000-$285,900.

A master's thesis by Sowards (1998) reported a comparison of initial superstructure costs of timber bridges to those of steel, concrete, and prestressed concrete. Sowards method included using data from the NBI databases to retrieve bridge characteristics along with their costs. Data collection for costs was broken down into cost per square foot and plotted against the following factors: structure length, maximum span length, and width. Other costs plots were reported incorporating construction type, load rating, year constructed, and region. The results were that timber bridges are cost competitive with steel and concrete superstructure initial costs.

Sowards et al. (1998) of Michigan Technological University conducted a cost study of timber bridges to compare them to steel, concrete, and prestressed concrete. There were 1604 bridges (all built after 1980) identified for survey throughout the country that were found using the NBI database. Surveys inquiring about costs were sent to all 1604 bridges and later analyzed to determine costs with load ratings and span lengths as factors. The authors concluded that there was a parabolic shape between cost and short and long spans along with a positive relationship between unit cost and load rating. The main consensus was that there is high variability in timber bridge costs which might be caused by unspecified cost factors, lack of standardization in construction, and the realization that timber bridges found their market niche.

Smith and Bush (1995) published a paper through the USDA Forest Service involving research on the factors influencing the adoption of timber bridges. Research on this topic emphasized the timber market and economy. This paper consisted of a literature review of the current factors limiting the market for timber. It was concluded that the best way to understand this complex issue is to understand the decision-making process for bridge material selection.

Verna et al. (1984) prepared a technical report on the benefits and costs of timber bridges. The issue presented in this paper is deicing agents on bridges and the costs of substituting timber bridges for their immunity to deicing damage. Three cases were studied containing the following bridge types: deck replacement over steel girders, beam and deck replacement using existing abutments, and a replacement of a railroad overpass. The three cases studied yielded these results: timber is resistant to deicing agents and has low maintenance costs, it is easier to transport and handle, and timber can be more economical if components such as abutments or beams can be recycled.

Behr et al. (1990) conducted a study which compared the cost of timber, steel, and prestressed concrete bridges. Their method involved compiling initial superstructure costs of timber, steel/concrete, and prestressed concrete bridges at 20-, 40-, and 60-ft spans (all within New England area). Their report concluded that in this short span range of 20- to 60-ft timber is competitive with other bridge material options. The biggest savings for timber compared to alternatives was in the labor estimates category.

Dickson (1995) of West Virginia University conducted a technical report on timber bridges in West Virginia. Volume I includes case studies that lists the type, dimensions, year built, and superstructure/total costs of 53 bridges. Volume II lists a summary of each of the 53 bridges which includes: geometry, materials, local economic impact, bridge performance, and fabrication and erection.

Smith and Bush (1996) composed a technical report on the nonstructural factors that influence bridge material selection. Three groups of decision-making groups were selected: State DOT engineers, private consulting engineers, and local highway officials. After data was collected an analysis of variance between decision-maker groups, materials, and geographic regions was conducted. Tables listing performance scores by these three focus groups for each bridge type was included. The results were concluded to say that timber was perceived as appropriate for use in short span rural areas where road salt is corrosive to timber and steel.

Szakats and Butcher conducted a study on the design and capital cost of a 158-foot glulam bridge. The bridge consisted of two trusses, a concrete deck, and glulam beams (bridge schematics are included). It was compared against an alternative steel bridge for cost analyses. The study found that the timber bridge was less expensive for abutment costs but 30% more expensive for superstructure costs. The paper then discussed cost effective timber bridge design. This included having joints with more connectors, lightweight decking systems, and composite action between reinforced concrete decks and timber beams to reduce shrinkage and thermal effects.

Rautakopri et al. (1993) published a report through the Helsinki University of Technology on the development of wood bridges (1993). Girder, arch, cable-stayed, truss, and box-type bridges were all studied. Material properties and span vs. wood quantity were discussed in depth throughout the report for each bridge type along with bridge dimensions and designs. The report concluded that composite girder bridges with glulam beams and a concrete deck should increase in development due to being economical bridges.

The Transportation Research Board (1995) published a report on steel, concrete, and wood bridges. This study includes sections on load ratings, superstructure design, and the performance of bridges with interlayer membranes. The study on the bridge membranes concluded that the poorest performance came from bridges that used polypropylene and a coal tar sheet system.

Smith and Bush (1995) conducted a study on the factors affecting the adoption of timber bridges. In the study a survey was sent out to timber bridge manufacturers to determine sales to bridge projects. County and State entities also received surveys on timber bridge expenses and attitudes towards implementing them. Four states were chosen for these surveys and they included: Mississippi, Virginia, Washington, and Wisconsin. The results showed an average total bridge cost ranging from $30 to $70 per square foot. A table in the report also listed the bridges expected life spans, the number of bridges built between 1985 and 1992, the number of deficient timber bridges, if the state has standard timber bridge plans, number of wood treating plants, and timber resource.

Smith and Bush (1995) conducted a study of marketing practices of timber manufacturers related to the timber bridge industry. This entailed sending questionnaires to various firms; 31 companies ending up being chosen as relevant sources for the questions. Polls were also sent out to highway officials, DOT branches, etc. to find important topics for choosing bridge material. The results of the study show that decision makers focus more on long-term performance and maintenance costs while timber bridge advocates focus on the initial costs (timber bridges being less expensive initially).

Amburgey et al. (1994) conducted a study on the potential to produce prefabricated timber bridge components in Mississippi. This report consisted of the current status of Mississippi bridges, the historical development of timber bridges, the advantages of modern timber bridges, a cost analysis on manufacturing timber components, the impact of timber bridges on the timber industry, etc. Results of the study show operating expenses of timber bridge manufacturers along with costs of timber structures.

George Banzhaf and Company (1994) conducted a study on timber bridge potential in the state of Wisconsin. The goal of the study was to investigate the size of the timber bridge market, the attitude towards it, and to create a database of recent timber bridge projects. County, township, forestry, timber bridge manufacturers, and researchers were all sent a questionnaire inquiring about viewpoints towards prestressed concrete, reinforced concrete, steel, and timber bridges. Most responses emphasized life expectancy and cost effectiveness as reasons for choosing concrete over timber. The report includes multiple tables organized by county describing bridge projects with what material was chosen. The report concludes with bulleted strong and weak advantages of timber bridges according to the surveyed responses. The actual surveys used were included in the appendix.

The State Aid for Local Transportation Manual (2015) provides info on funding for local programs. This document discusses the Federal Highway Bridge Replacement and Rehabilitation Program (HBRRP), State Transportation Fund (Bridge Bonds), Town Bridge Program, Selection of Bridge Projects and Application for Bridge Funds, Plan and Grant Approval, Eligible Costs and Cost Split Determination, Payments, and the Advancing Town Bridge Funds. These program sections list the prerequisites for funding such as bridge length, expenses, bridge components, etc. There is a table that lists all components of bridge installation and associates them with funding eligibility from multiple programs.

Quintana and Coole (1994) of the USDA Forest Service composed a report on timber bridge superstructure costs on project funded bridges from 1989-1994. This is a cumulative report that lists average regional costs of superstructures by region, type (example: stress laminated or longitudinal glulam), length, and wood species. Results of each area along with associated graphs are listed in the report.

Pilon (1995) of the Michigan Department of Natural Resources created a report on manufacturing and marketing opportunities for modern timber bridges in Michigan. The method for this research involved sending surveys to different parties involved in bridge construction. The survey asked about general material uses and their performance along with their perspective on timber as a bridge material. Most responded with a high preference towards prestressed concrete as a bridge material. Tables were included in the report with percentages of importance for factors such as life costs, durability, resistance to salt, initial cost, etc. when selecting construction material. The report summed up what situations the respondents would use concrete, steel, or timber. It was noted that 31% didn't know what the best preservative for timber bridges was.

Gerold (2006) conducted a study on the economic efficiency of modern timber bridges. The research involved 56 protected (enclosed by a roof or with asphalt cover) timber bridges built within the last 20 years; all the bridges were built in Germany in all climatic regions. Notes are included in the report concerning various design ideas such as fiber orientation of the wood, sheet metal cover geometry, and asphalt applications. The study concluded with statistics on the maintenance costs of the covered bridges. The costs (as percentages of the construction costs) ranged from 0.6% to 0.7%. The lower percentages were due to the main bridge beams being protected from both the top and sides while the higher costs were from just asphalt sealant. It was concluded that these maintenance costs were comparable to that of steel and concrete.

2.1.1.3 Maintenance and Environmental Considerations

A research project completed by Phares et al. (2015) of Iowa State University created a manual for cost-effective timber bridge repairs for Minnesota timber bridges. The report outlines timber bridges in Minnesota, condition assessment options, preventative maintenance options, rehabilitation procedures, cost estimates, and other potential repair methods. The cost estimates for repair include price per square or linear foot depending on the repair.

A technical report prepared by Brooks (2000) discussed and compared the environmental effects of creosote, pentachlorophenol, and chromated copper arsenate. Two bridges with each treatment were examined for risk assessment. The results were concluded to be minimal to the surrounding biological ecosystem; creosote was the only treatment that reached the threshold effect level in sediments downriver (Brooks, 2000).

Ainge (2012) of Marquette University composed a master thesis on the repair and strengthening of bridge superstructure. The goal was to address the repair issues in Wisconsin bridges. The deterioration affecting concrete, steel, and timber is expansion joint degradation, which Ainge reports is predominantly caused by deicing chemicals. A wide variety of repairs for a variety of substructure problems are described for each bridge type. Ainge concludes that concrete warrants the most repairs due to deicing problems.

Johnson (undated) of Wheeler Lumber wrote a report on repair and rehabilitation of treated timber bridges. The report is separated into the following categories: material, inspection, repair, and rehabilitation. After these categories are discussed there are six different bridge projects that are used as examples; total repair costs are also given with the projects.

LaDoux and Bernhardt (2015) of the Western Wood Preservers Institute reported on creative and sustainable timber bridges using treated wood. Their report is structured around studying risk management and how to determine the appropriate preservative for different scenarios. The treatments discussed are Chromated Copper Arsenate (CCA), Pentachlorophenol (PCP) and Copper Naphthenate (CuN). The paper discusses how to select the proper preservative, environmental considerations, best management practices, quality assurance, and maintenance guidelines. They concluded their report by saying the contents of their paper include two decades of research and case studies, and that the guidelines given should allow for proper treatment selection.

Franke et al. (2013) of Bern University of Applied Sciences, Architecture, Wood and Civil Engineering conducted a study on the long term performance of timber bridges. Their emphasis was on moisture effects in different directions (longitudinal and axial) over time and how they affect bridge load capacity and serviceability. The method for this study was to have probes on four timber bridges in Switzerland for 25 months. The study concluded first that electrical resistance probes can measure long term moisture of timber bridges. It was also discovered that wood in the bridges does change moisture with the climate and that these variations change less the further from the surface the timber is. In the climate measured the moisture contents ranged from 12% to 22% for the outer layers. It was suggested that this kind of monitoring helps prevent decaying and structural defects in the bridge.

Dickson (1996) of West Virginia University conducted a technical report on the obstacles and opportunities of engineered wood products. The goal of this report was to discuss all the factors that play into selecting wood products. The method for this study was to have facilitated workshops with engineers, manufacturers, etc. with various topics. The timber bridge topics discussed at these workshops included: material characterization, design, construction, economics, technology transfer, and environmental effects. The key points discussed in these workshops are listed throughout the report. The study concluded the report by stating that an engineered wood planning committee was formed that was tasked with developing this area of industry.

Smith et al. (1998) of the Center for Forest Products, Marketing, and Management at the Virginia Polytechnic Institute carried out a study on the perceptions of rural timber bridges in 28 states. Their objective was to discover how the different parties (DOT, private consultants, etc.) viewed timber bridges and what factors were causing the discrepancies; an example of this would be if perception changed by education or geography. Questionnaires were sent to various institutions asking about general experiences with timber bridges. The results of the study were that timber rated the lowest on performance compared to other materials other than in the constructability area. Possible explanations for these perceptions were explored such as region (the South having higher decay rates) playing a role and previous poor timber designs leading to stereotyping. The authors noted that education about the performance of properly designed timber bridges must be shared with the engineering community.

2.1.1.4 Life-Cycle Assessment

Hammervold et al. (2013) prepared a report of a life-cycle analyses of 24 bridges with varying materials. The report findings showed wooden bridges having substantially less global warming potential and abiotic depletion potential as compared to steel and concrete. A table was presented listing global greenhouse gas emissions per square meter across bridge types such as concrete slab and girder, steel slab and girder, and wooden arch. Specific material components and their greenhouse gas emissions are also listed; examples would be creosote impregnation for timber, reinforcement for steel, mastic for concrete. The report concludes that steel bridges have the highest impact due to energy intensive production.

Svanaes (2010) of Norsk Treteknisk Institutt analyzed and presented on the environmental impacts of various wood treatments used for bridges. The environmental aspects included: global warming potential, ozone layer depletion, photochemical oxidation, acidification, eutrophication, and human toxicity. These were compared between the following sawn wood treatments: no treatment, painted four times, copper impregnated timber, creosote impregnated timber, and painted timber gate. The highest contributors were found to be the creosote and those painted four times (i.e., four coats of paint).

A master thesis by Dequidt (2012) studied the life-cycle assessment of a Norwegian bridge. His life-cycle analysis followed ISO standards and measured the greenhouse emissions of the Norwegian bridge along with including literature of previous environmental analysis. Dequidt concluded that concrete was the

biggest contributor to greenhouse gases and that the production phase (compared to construction and maintenance) accounted for most emissions.

Bergman et al. (2014) reported on a life-cycle analysis of timber superstructures vs. steel. Two wood (one alkaline copper quaternary (ACQ), one creosote treated) and two steel designs were studied, both 80 feet long. The following environmental aspects were analyzed: Fossil fuel consumption, global warming potential (GWP), ozone depletion potential (ODP), smog potential (SP), and eutrophication potential (EP). Ozone depletion and eutrophication potential were heavily influenced by creosote but not ACQ treatment or steel structures. Homogenous steel had significantly heavier impacts to the environment in the all other categories compared to timber bridges and lightweight steel.

A master thesis by Dugdale (2015) laid out a method to compare timber and steel superstructures through a structural, economic, and environmental lens. This report focused on single span highway bridges in Vermont with steel and glulam bridges being analyzed. Economic results indicated that some costs can be predicted but all bridges studied were too different with a wide range of labor costs. The environmental results indicate that timber is more difficult to recycle than steel. It was also noted that carbon emissions from the *Inventory of Carbon and Energy Database* with the given weight of materials could be used to calculate environmental impact between the two materials.

A master's thesis by Dimopoulou in 2015 studied the life-cycle assessment (LCA) and life-cycle cost (LCC) analyses of three pedestrian bridges design (timber, steel, and fiber reinforced polymer) in Sweden. The thesis used software *BridgeLCA, OpenLCA*, *Excel*, and *Ecoinvent* database to calculate the analyses, and concluded that the main impacts in a pedestrian bridge derived from the initial phase for LCA and LCC, and the most financial efficient material was timber in a life-cycle perspective, and timber was found to be the material with less effect to the environment.

A technical report prepared by Virginia Transportation Research Council in 2002 surveyed the timber bridges built in Virginia, and concluded that they had not been shown to be economically-competitive from a first cost standpoint, and life-cycle cost data could not be determined at that time (McKee and Gomez, 2002).

Morcous (2013) of the Nebraska Department of Roads conducted a life-cycle cost analysis (LCCA) using RealCost software to assess investment decisions and identify the most cost-effective improvement alternatives for different maintenance strategies using the developed deterioration models and updated cost data for Nebraska bridges. However, no timber bridges were analyzed using LCCA software.

A technical report prepared by URS Corporation for Massachusetts Department of Transportation in 2011, surveyed five bridge scenarios on function, safety, and life-cycle cost analysis (LCCA) for potential replacement alternatives, and concluded that the concrete and steel hybrid bridge is the most favorable that achieve an appropriate balance of all design criteria. The more timber materials used the less favorable.

Rodrigues et al. (2014) conducted a sustainability assessment of life cycle environmental and economical assessment of Timber-Concrete Composite (TCC) deck as potential alternative and

concluded that TCC solutions have less environmental impact and are economically competitive. The CML 2001 method was followed, which considered Abiotic Depletion (AD), Acidification (AC), Eutrophication (EU), Global Warming (GW), Ozone-layer Depletion (OD) and Photochemical Oxidation (PO). The LCA study used SigmaPro software, and the economic study was based on the ISO standard 15686-5 that covered agency cost, user cost, and third-party cost.

Du and Karoumi (2012) conducted a literature survey about the LCA implementation for railway bridges that focused on the methodology, practical operational issues and data collections, and proposed a systematic LCA framework for quantifying environmental impacts for railway bridges.

Bolin and Smith (2011) studied the cradle-to-grave LCA of alkaline copper quaternary (ACQ) treated lumber with wood plastic composite decking as comparison. Results found that ACQ treated lumber impacts were fourteen times less for fossil fuel use, almost three times less for GHG emissions, potential smog emissions, and water use, four times less for acidification, and almost half for ecological toxicity than those for WPC decking. Impacts were approximately equal for eutrophication.

Bolin and Smith (2011) studied the cradle-to-grave LCA of pentachlorophenol treated wooden utility poles with steel and concrete utility poles as comparisons. Results found that the GHG, fossil fuel use, acidification, water use, eutrophication, and ecological toxicity impact indicator values for penta-treated poles are less than those for concrete poles. The GHG, fossil fuel use, acidification, water use, and ecological toxicity impact indicator values for penta-treated poles are less than those for steel poles. The values are about equal for eutrophication. The smog impact from penta-treated poles is greater than the smog impact from both concrete and steel poles.

Du et al. (2014) studied the LCA as decision support tool for bridge procurement with five different steel and concrete designs, which provided vital knowledge guiding the decision maker to select the most LCA-feasible proposal and mitigate the environmental burden in the early stage.

Du and Karoumi (2013) conducted an LCA of two different superstructure designs of railway bridge and concluded that the maintenance scenario planning and steel recycling have the significant influence on the final results other than the traffic disturbances.

Donnelly of Old Post Consulting published a report encompassing all aspects of timber bridges. This report was a guide that included the timber bridge parts, types, wood construction materials, design standards, lumber grading, native lumber, preservative options, additional bridge elements such as guardrails, financial considerations, and finally the steps for choosing how to build a timber bridge. This last section was followed by three case-studies of timber bridges which included detailed information on all components and the final price of the bridge.

2.1.2 Timber Bridge Projects

A variety of project plans and information were obtained from the literature, from MnDOT State Aid, from bridge component suppliers and directly from counties.

The Pennsylvania Department of Transportation (2013) provides all design schematics for a 33-foot-long glulam timber bridge.

MnDOT State Aid shared a document that consists of the bridge plan for number 11526 of Cass County (2012). This bridge was a three-span bridge totaling 54 feet in length. It had a timber panel superstructure and all component costs are listed in a table. They also provided a document is from Watonwan County (2010) that contains timber bridge blueprints along with a price table listing all components. The bridge has three (30-foot) spans and the deck includes shiplap joints.

A table of timber bridge projects was provided by Wheeler Consolidated (2016) that listed the order number, customer, owner, project, comments that include dimensions, etc. All projects are from 2010-2015.

2.1.3 Timber Bridge Suppliers

2.1.3.1 Wheeler Bridge and Highway Products, Eden Prairie, MN

An initial project meeting and site visit was held with Wheeler Bridge and Highway Products Division and Erickson Engineering. Started in 1892, Wheeler provides building materials and related services that serve both public and private infrastructures. Wheeler combines engineering, manufacturing experience, and the proven capability of treated wood to offer a variety of highway related solutions. These include timber bridge spike-laminated panel system (Panel-Lam), nail-laminated and glue-laminated (glulam) transverse timber decks, glulam beams, and various steel components. Several documents were provided by Wheeler (2011, 2011, and 2015). Specific details on these bridges are in Appendix A. Wheeler owns a copper naphthenate wood treating and production plant located in Whitewood, South Dakota, and they utilize Peterson Treating in Superior, WI for waterborne treating of components.

Wheeler timber bridges has a pamphlet on steel stringer bridges with timber decks. Some features listed are that their timber railings meet AASHTO (NCHRP-350) crash test guidelines and that the ship-lapped panel connection improves asphalt wearing surface performance. It is also discussed that the bridge can be shipped as a kit, allowing for fast installation.

Typically, Wheeler is involved with 30-40 timber highway bridge projects annually within the US, and notes that pre-cast concrete box culverts are one of the primary products that they are now competing against. Competitive timber bridge projects typically include span lengths <30 ft, constructed on low-volume rural roads, where rural construction with ready-mix concrete is more expensive, and where a short construction window is needed due to long detours or other factors.

They make a significant effort to engage and work with local bridge owners, but still noted a need to further educate county engineers that timber can be a structurally sound, long-lasting, and cost-effective solution. They have reported that few customers are concerned with environmental considerations for timber, such as timber being a renewable resource that sequesters carbon, the low energy or carbon emissions from production of timber versus high energy and carbon emissions from

steel or concrete materials. They have not been able to sell life-cycle costs or life-cycle assessments to local bridge owners.

Other discussion points during the meeting included bituminous deterioration (cracking and pitting) concerns on bridge decks, the potential for using timber in winter construction projects, the need to streamline preservative approvals, the lack of timber projects for contractors resulting in marked-up costs, and that Minnesota has very few counties remaining with their own construction crews. Any improvements in improved water management design details, low-cost railing designs, or construction details need to be contractor sensitive and keep costs down.

One topic was the process that county engineers use to get copper-naphthenate approved for use in county bridge projects. It was reported that there is a fair amount of back and forth associated with getting MnDOT State Aid to waive the approval for this preservative to the county. MnDOT currently has a Treated Wood Waiver Form Template (http://www.dot.state.mn.us/stateaid/bridge/wood-treatment.html) available to help streamline their wood preservative approval process. It was also asked that MnDOT consider including education about wood preservatives, timber bridge products, timber bridge performance and other timber aspects during special training meetings which include county engineers and local bridge owners.

Considerable discussion revolved around the construction materials and manufacturing process used by Wheeler and how it drives costs. Douglas-fir is the primary construction material used by wheeler and is most often treated with copper-naphthenate. Douglas-fir materials are purchased by volume through brokers which benefits cost efficiency. They also buy dimension southern yellow pine for some projects, which is often treated with waterborne pentachlorophenol C. A tour of their production facilities for local bridge owners could be offered in the future by Wheeler to continue education potential MN customers.

As to bridge life, Wheeler indicated that they expect their project materials to last for 60-80 years minimum. Two new approaches are being implemented for mitigating the shortened service life of timber cap beams use at intermediate pier and abutment supports. Each of these new approached are aimed at providing a more robust treatment of these critical substructure components. Dual treatment, first with water-borne methods then followed by oil-borne pressure treatment, can provide a deeper penetration of preservatives to enhance the outer treated envelope of protection. Another option currently be implemented are diffusible borate preservatives introduced via strategically drilled holes that do not diminish member strength. The borate chemicals have the advantage of diffusing into the cap beams when water is present, and they can be replenished periodically to prevent premature deterioration.

They feel that one potential for cost-competitiveness is to be continually involved in the design process, and perhaps be more engaged in the development of superstructure and substructure design plans. This is a model they are doing in southwestern Wisconsin (Juneau, Clark, and Wood Counties), where Wheeler is developing the plans and the county crews are doing the construction.

As a final take-away, Wheeler noted that Minnesota poses challenges in getting timber bridges constructed, and that ongoing support and engagement from MnDOT State Aid Bridge is important to advance timber bridge construction in the state.

A comprehensive review of their firm and products can be found at: http://www.wheeler-con.com/highway-bridges/. A copy of several Wheeler publications, including *Transverse Deck Vehicle Bridges, Panel-Lam, Steel Stringer Vehicle Bridges, Timber as a Highway Bridge Material, and Rapid Construction with Timber Components* are available on their website.

2.1.3.2 Bell Structural Solutions/ALAMCO Wood Products, LLC

A site visit and meeting were held with staff from Bell Structural Solutions/ ALAMCO in New Brighton, Minnesota. Both businesses are divisions of Bell Lumber & Pole Company. ALAMCO Wood Products is in Albert Lea, Minnesota and is a manufacturer of structural glued laminated timber beams and arches for many uses, including but not limited to churches, trusses, park shelters, bridges, and utility poles. Bell Structural Solutions focuses on the delivery of specialized and engineered solutions to the commercial marketplace including such items as gazebos, pavilions, shelters, amphitheaters, band shells, trellis / arbor / pergola structures, pedestrian and vehicle bridges, commercial and industrial straight or curved laminated wood beams. In addition, they offer piling, house logs, solid sawn timbers as well as several utility pole products.

ALAMCO primarily uses glulam materials in their bridge packages for both the girders, decks, and crash-tested railing systems and works with a 3rd party engineering firm to finalize production documents. They use pentachlorophenol A as their primary treatment after production and pentachlorophenol C if treated prior to lamination. They have their own treating plants in both Minnesota and Nebraska. They have conducted a lot of timber bridge projects across the United States, with a significant number of installations since 2000 in the northeast. They also have glulam timber bridges still in service in Minnesota, installed starting in the 1960s. Many glulam bridges from that era are in adjoining Blue Earth County.

In conversations with staff, they suggested the potential for reducing costs might lie in the development of standard plans that have blanket approvals and are considered peer-engineered. Further, this approach of bulk bridge packages could result in manufacturing efficiencies, the ability to prefabricate components in advance, and to get lower costs through bridge bundling packages. They also suggested the potential for wider construction programs with timber construction. Bell has already developed several packages of standard packages for 25, 35, and 50 ft.

A comprehensive review of Bell Lumber & Pole can be found at http://www.blpole.com/. Details about the services and products for ALAMCO can be found at http://alamcowood.com/ and for Bell Structural Solutions at http://bellstructural.com/. A copy of the presentation on timber bridges and other relevant publications can be found in Appendix A.

Bell Structural Solutions promotes durability and sustainability. Their pamphlets list a 75-year lifespan for their glued laminated timber bridges treated with pentachlorophenol. They also list the fact that

deicing agents do not affect their structures along with them having the capability to handle AASHTO HS25 loading. For sustainability, Bell Structural Solutions utilizes smaller trees harvested of managed forests with an emphasis on reforestation.

2.1.4 Engineer Survey

A survey was developed for county engineers to gain additional perspective on the number and type of bridge replacement projects completed since 2005, to understand perceptions regarding potential selection of timber bridges, suggestions for cost-effective strategies, and to understand any life-cycle or environmental considerations used in bridge replacements. A listing of the survey questions is in Appendix B. This survey was sent to Minnesota county engineers and the final responses were collected, tabulated and reported in the final task report.

In April of 2016, Iowa State University conducted a survey of Minnesota County Engineers. The survey questioned the engineers about the types of bridges that they constructed, the reasons behind why that style of bridges were chosen, and the attitude and ideas that the engineers had toward timber bridges. A total of 45 engineers participated in this survey. The following report summarizes the results of this survey question by question.

Question 1: Please provide contact information.

Question 2: How many new and/or replacement bridges have you constructed since 2005?

Figure 2.1 shows the results of this question. Almost half of the engineers surveyed constructed 16 or more bridges during this time period. The remaining engineers all had constructed at least 1 bridge but were somewhat evenly distributed between 1 and 16 bridges constructed.

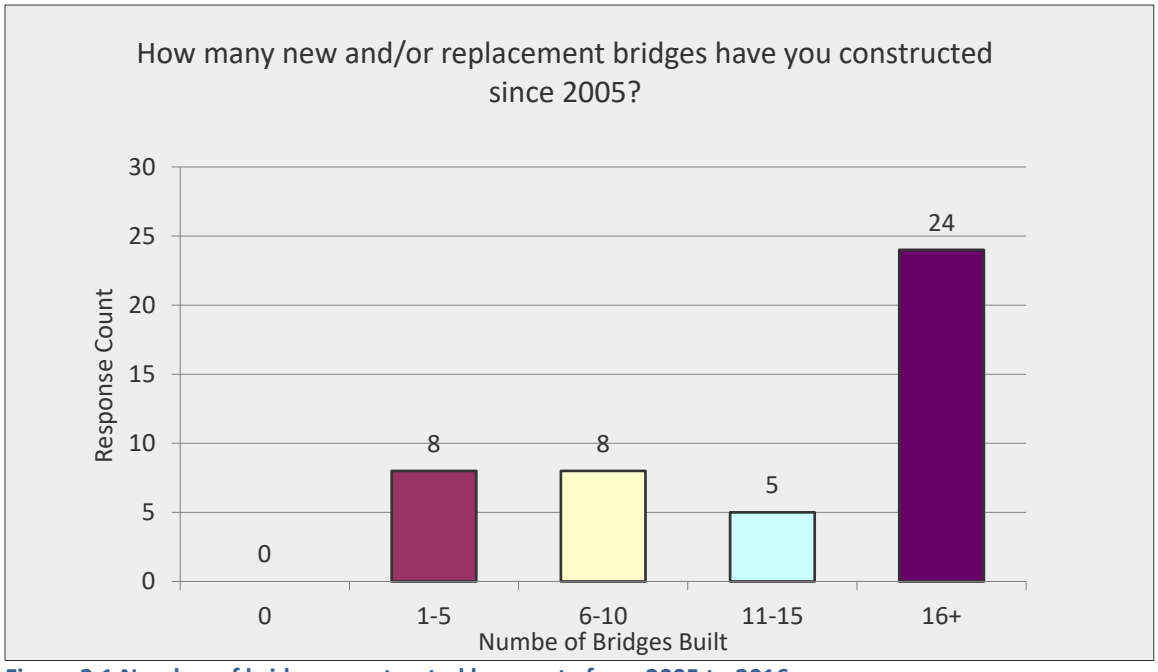


Figure 2.1 Number of bridges constructed by county from 2005 to 2016.

Question 3: How many of each of the following bridge types were constructed from 2005 to present?

Results are shown in Figure 2.2. The majority of bridges constructed were made of concrete. Timber and steel were used in constructing significantly fewer bridges.

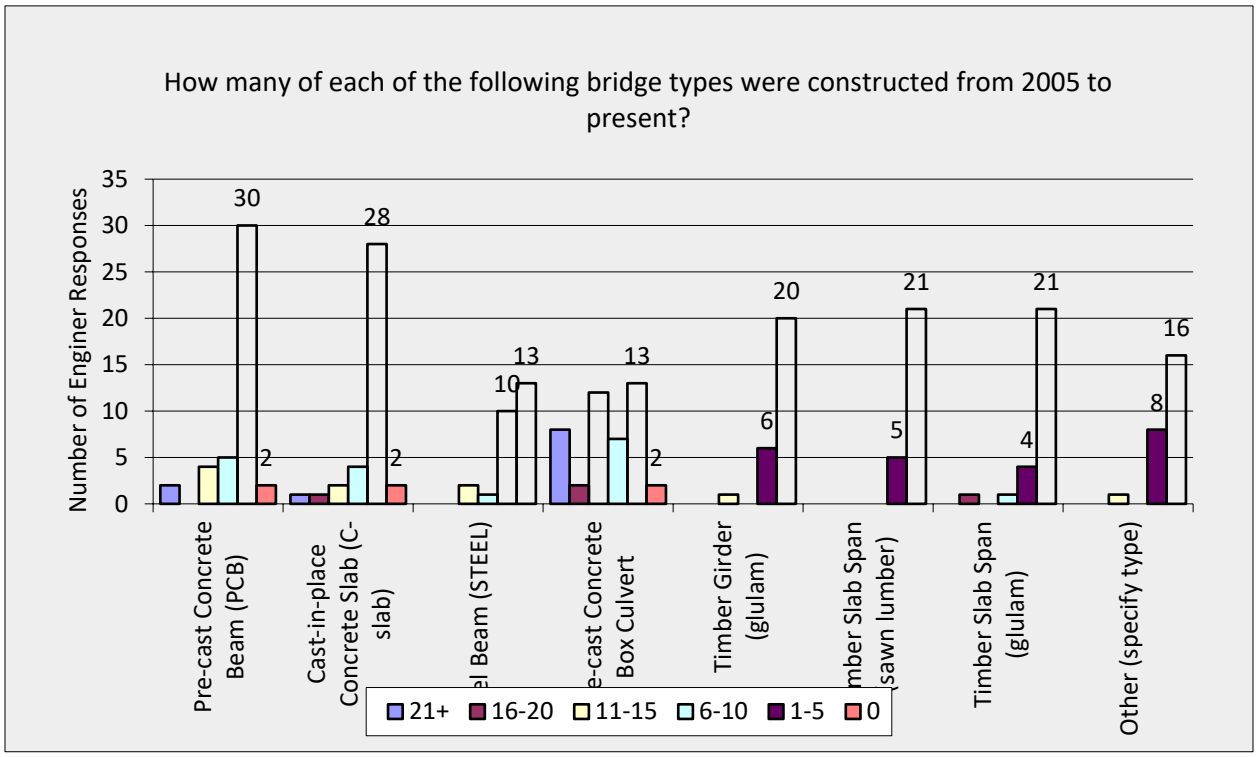


Figure 2.2 Bridges constructed by type between 2006 and 2016.

Question 4: If you have constructed a timber bridge or bridges since 2005, what factors played into your decision?

The results of this question can be seen in Figure 2.3. Though all possible responses were selected, the most common answer was "construction schedule requirements." Additionally, it is apparent from looking at this data that those who answered this question had more than one reason for choosing a timber bridge, as many of the respondents selected two or more of the possible answers. Besides the fact that each possible answer was selected, this fact also further shows that wood can be chosen as a design product for a variety of reasons. Lastly, of those who selected "Other," two answers were aesthetics and one was to pass debris.

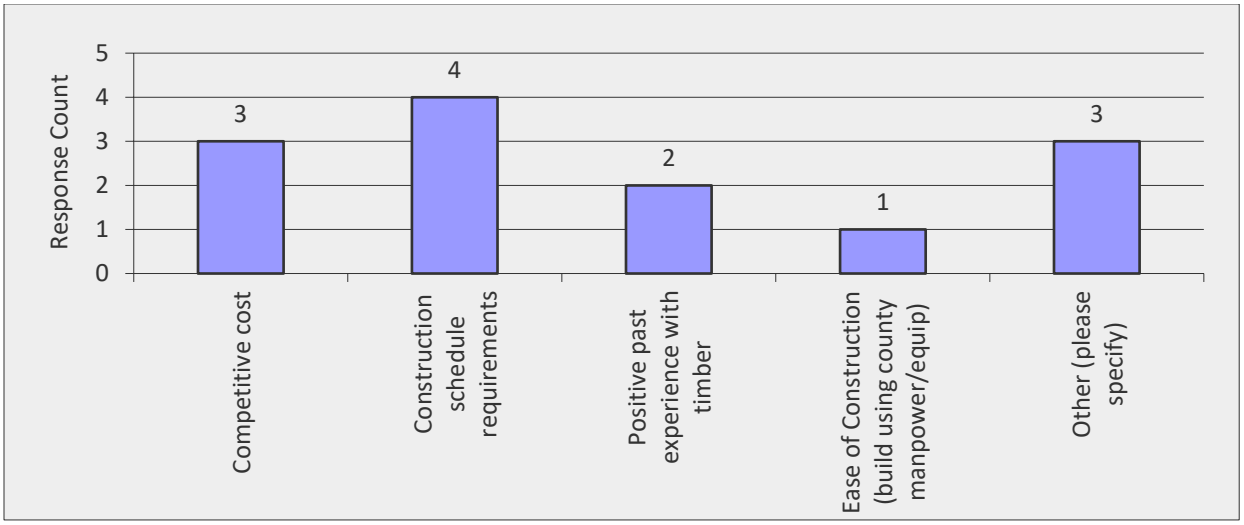


Figure 2.3 Factors that played into constructing a timber bridge between 2005 and 2016.

Question 5: Who designed the timber bridges that you constructed?

Figure 2.4 shows the result of this question. Most engineers who decided to go with a timber bridge used a consultant to design the bridge. Note that those who selected other simply stated that they did not construct timber bridges. None of the other data should be considered.

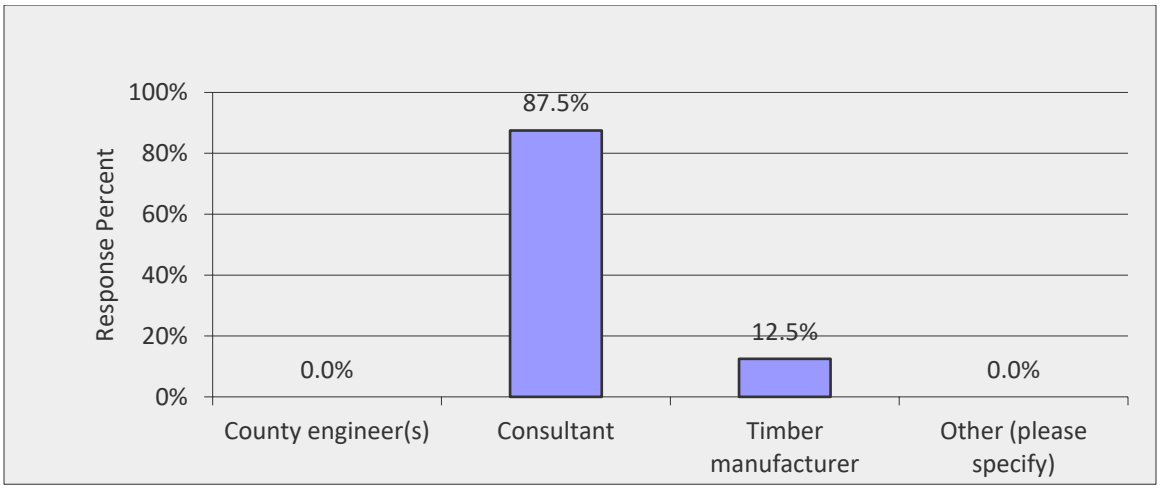


Figure 2.4 Respondent response to who designed the timber bridges constructed between 2005 and 2016.

Question 6: Who constructed the timber bridges that you built?

Engineers seemed to utilize both options; however, a majority chose to go with a contractor. It is also clear from the data that some of the engineers utilize both contractors and county crews, as some participants selected both options. The results are shown below in Figure 2.5.

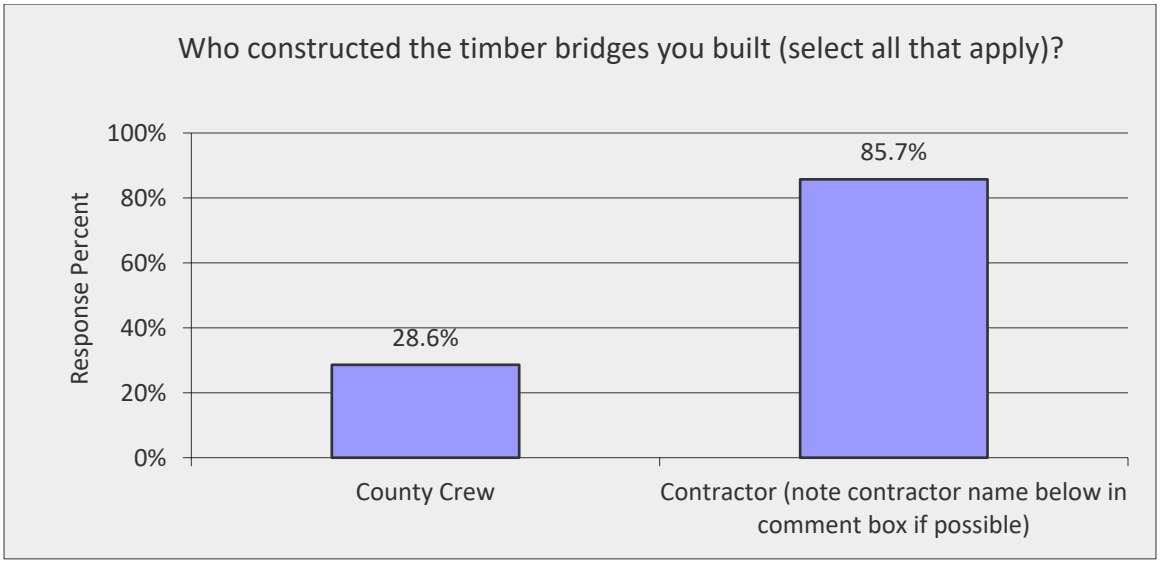


Figure 2.5 Construction labor used to construct timber bridges from 2005 to 2016.

Question 7: How were the timber bridge project(s) funded?

Figure 2.6 shows the results. It is apparent from the data that that most of the funding for timber bridges comes at the state level, although local funding is also important and a significant contributor. Also, it is apparent that the federal government funds very few timber bridge projects.

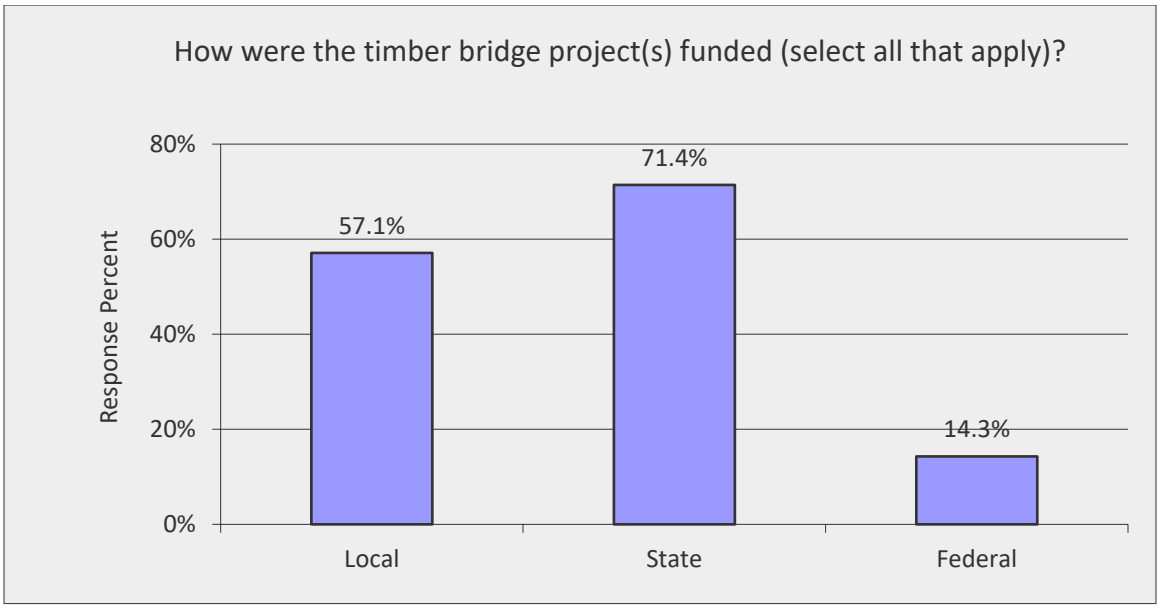


Figure 2.6 Responses showing how bridges constructed between 2005 and 2016 were funded.

Question 8: What other information or comments would/can you share regarding the decision making and construction of a new timber bridge?

There were 16 total responses, and a variety of answers were given. Some trends were that wood is great for aesthetics. Also, a common answer was that it is not cost efficient to use wood because the initial cost is more than concrete and there are more maintenance costs associated with wood. Lastly the comments seem to question wood's durability, longevity, and load capacity for high volume roads. The responses were:

1. Trail bridge. Used timber to minimize impact to surrounding area. Timber bridge is aesthetically pleasing
2. Too expensive in compared to longevity costs.
3. We do not normally choose this option.
4. In our area initial construction cost is nearly the sole consideration in structure choice. Timber costs would need to be competitive with concrete.
5. Selected timber for a natural look on a bridge leading to an island.
6. We only used timber rails on a recent bridge replacement for aesthetics.

7. We don't consider timber with the high traffic volumes we have. We've had some in the past and they are very high maintenance.
8. It was a very costly bridge. Only build because we received state park road account funding and it was in a park setting so aesthetics played a major role in deciding to go with a timber bridge.
9. We have a number of older timber bridges. We are having rotting problems with the timber pile in the water.
10. Public perception of treated material in or near water is big negative.
11. A timber bridge design meeting State Aid standard may be a nice alternative for low traffic roads.
12. Have NOT constructed on since 1998, when I started
13. Longevity of timber compared to concrete and steel
14. Last timber bridge built in 2001. I recall costs were approximately the same as simple span concrete/or series of precast concrete culverts.
15. Timber allowed us to phase the project allowing use of half the new bridge to maintain traffic.
16. Timber must be cost competitive.

Question 9: If you have not constructed a timber bridge since 2005, what are the biggest drawbacks or negatives to considering a timber bridge option for your county?

Figure 2.7 shows the results. The most popular answers were “Durability,” “Maintenance Costs,” and “Life-Cycle Cost” respectively. These results only further confirm that the greatest concern for most engineers participating in this study is the durability of wood, echoing the results of Question 8. Additionally, the participating engineers do not feel that the cost of maintenance on wood is not competitive with concrete.

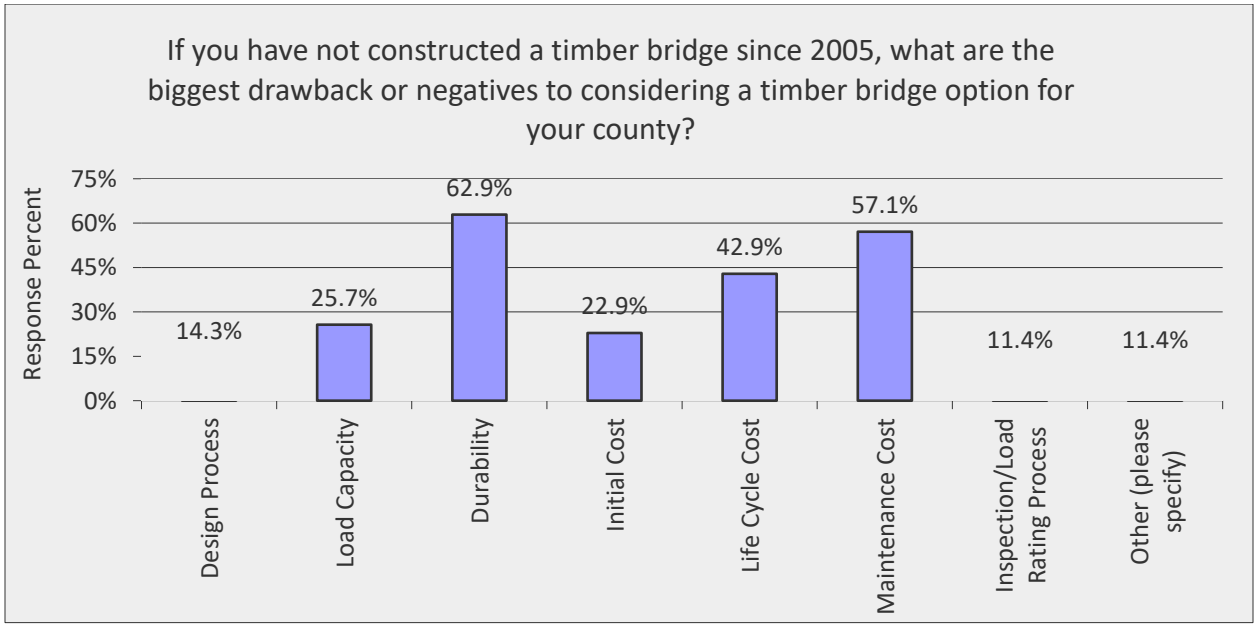


Figure 2.7 Responses to drawbacks or negatives to timber bridges.

Question 10: What suggestions do you have to reduce costs associated with timber bridge construction?

Participants were given two options for this question, “Design Process” or “Contracting or Build Strategies.” The responses on this question were dead even. Out of 19 engineers who answered this question, each option was chosen 12 times. This means that in the opinion this survey’s participants, if improvements to the cost of either of these processes are made, it could greatly help the overall cost of constructing timber bridges. Figure 2.8 shows the results.

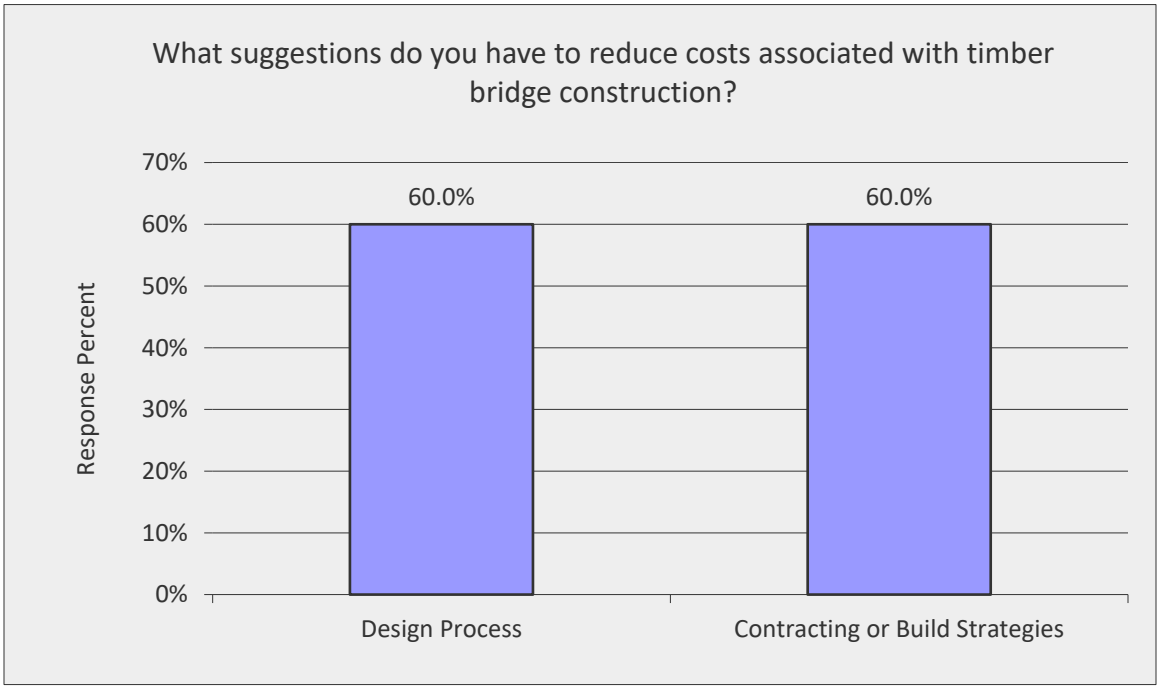


Figure 2.8 Potential timber bridge cost reduction options.

Question 11: Do you consider life-cycle cost analysis for new bridge construction projects?

Figure 2.9 shows the results of this question. “Always” and “Sometimes” were the most popular answers to this question. Each was selected 15 times out of 40 engineers who answered this question. “Never” was only selected by 10 of the participants.

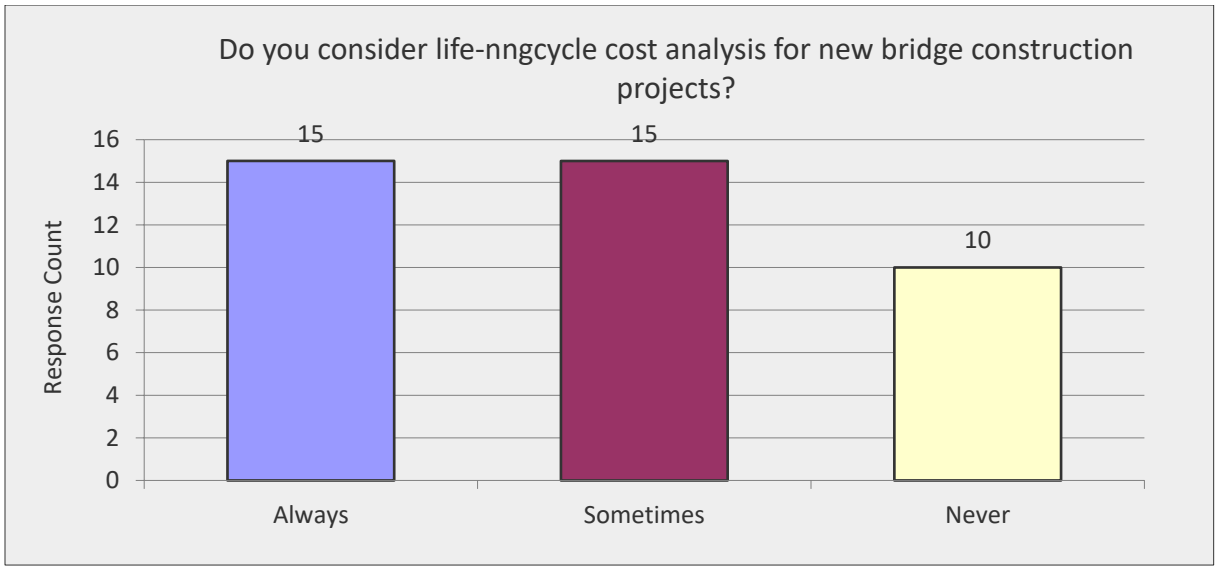


Figure 2.9 Response to the use of life-cycle analyses.

Question 12: Since you answered “Always” or “Sometimes” to the previous question, what factors do you consider in your life-cycle cost?

Although other answers were given, by far the most common responses for this question were as follows: initial cost, life-cycle cost/maintenance, durability, and expected service life of the material. The responses received were more typical for life-cycle cost analysis (LCCA) than life-cycle analysis (LCA) indication a lack of familiarity with the environmental aspects of LCA. The responses were:

1. Bituminous overlay cost, railing and deck durability
2. Ability for maintenance crew to repair timber structures.
3. Life of bridge and maintenance
4. *In reality - If the initial costs of timber bridges vs concrete bridges are the same, I assume the life-cycle cost of the concrete bridge will be better than that of timber over the long term.
5. Life and maintenance costs
6. I expect to get 20 years more than a timber from a box culvert with no more cost to install.
7. Routine maintenance
8. Damage/debris maintenance
9. Anticipated Life
10. Initial Cost

11. Longevity, maintenance, reliability, construction cost
12. Repair, maintenance, design life
13. Initial cost, long term maintenance costs, detour length,
14. Initial cost, type of roadway, construction time
15. Cost over the life of the structure
16. Maintenance and how long it will last.
17. Expected maintenance and life based on previous experience
18. Initial cost, future maintenance cost, and routine inspection costs
19. Age before replacement
20. Deterioration of components
21. Maintenance effort and cost for the expected +75 year life of a bridge.
22. Material life
23. Construction cost and expected life span
24. Maintenance
25. In-house or contracted maintenance activities. Administrative and/or engineering costs of future inspections or maintenance projects. Construction cost inflation.
26. Long term maintenance costs.
27. Life span related to the bridge materials
28. For short spans the life cycle of precast concrete box culverts is our choice every time. They last forever and are quick to build.
29. Current and long term planning of the corridor; many of our sites will facilitate the extension of box culverts sections to allow widening.
30. Durability, routine maintenance, inspection frequency
31. Initial cost and life span of structure
32. Projected life of the replacement structure and initial cost.

Question 13: Do you feel that timber bridges are a more sustainable option as wood is considered a renewable resource, typically requires less energy to manufacture, and sequesters carbon?

Nearly 50% of the engineers in this survey responded with "No" while only 10.3% responded with "yes." Figure 2.10 shows the results.

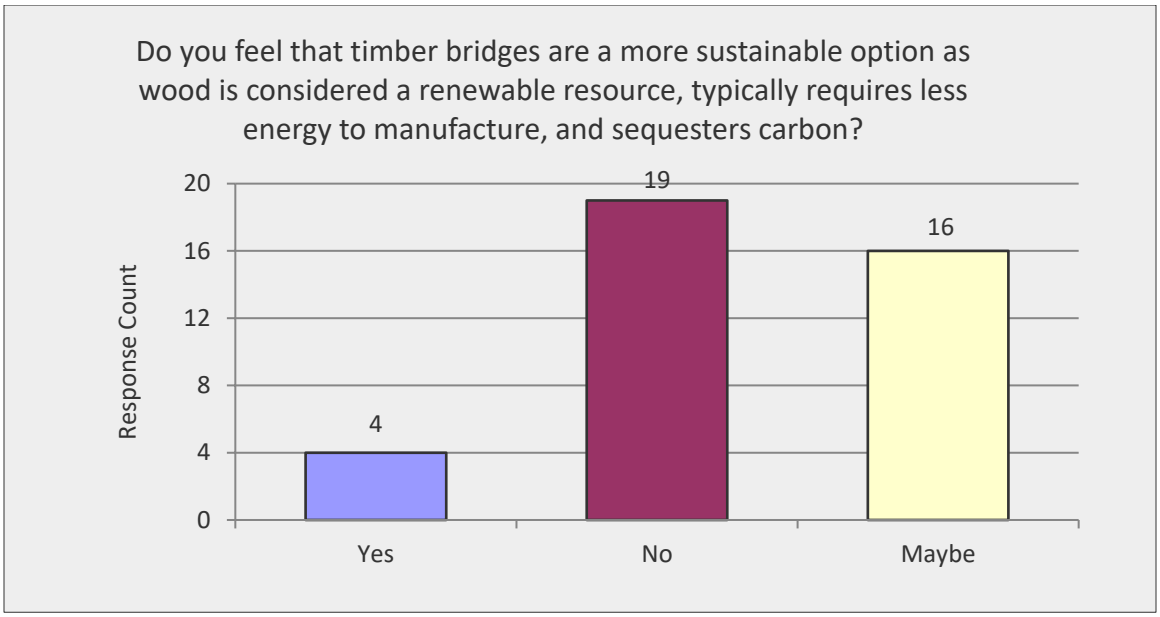


Figure 2.10 Responses that indicate whether they consider timber a more sustainable option.

Question 14: Do you factor environmental consideration for CO_2 emissions, or energy to manufacture into your bridge design and construction process?

Every engineer who answered this question responded with "no." Figure 2.11 shows the results.

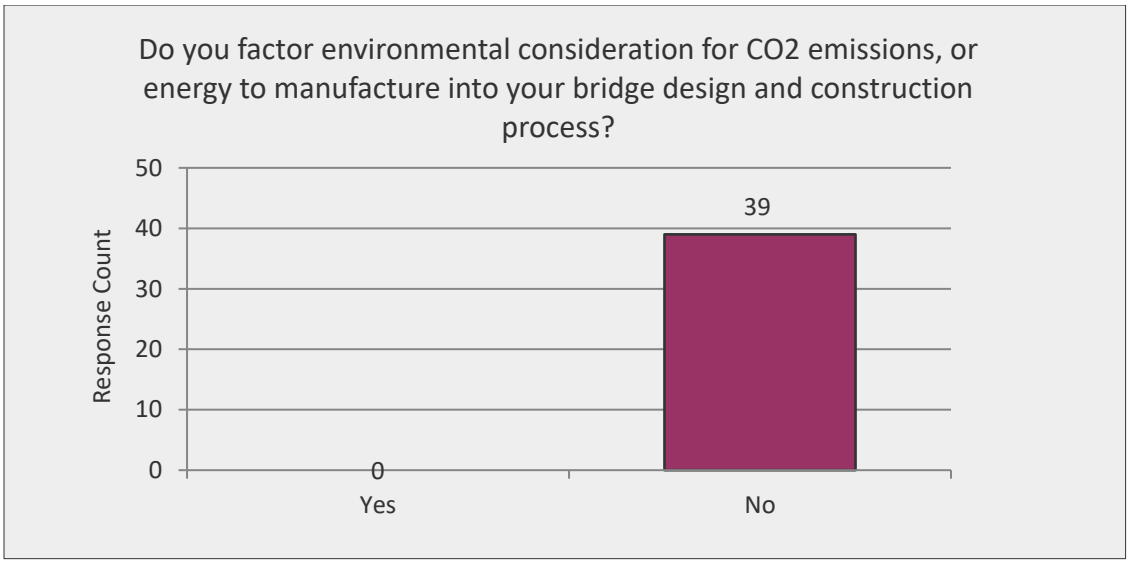


Figure 2.11 Responses on whether environment performance is considered during bridge design.

Question 15: How do you typically perform maintenance and repair of timber bridges?

The most popular response was “County Crew” with 88%. Approximately 48% responded with “Contractor.” This shows that both are used with some regularity and some engineers are not exclusive to one or the other. Figure 2.12 shows the results.

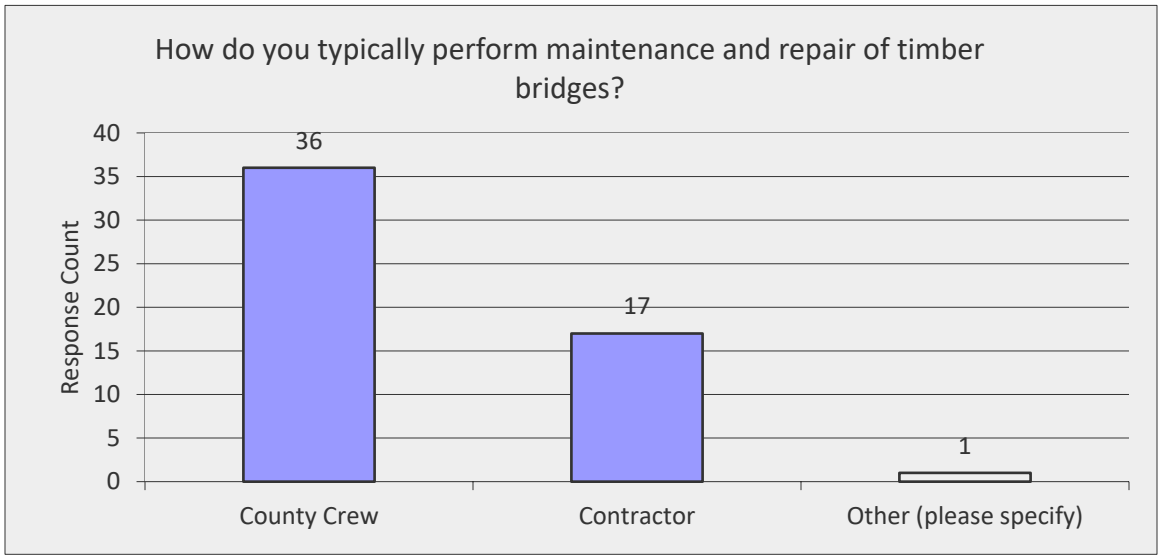


Figure 2.12 Response about who conducts ongoing bridge maintenance.

Question 16: How do you perform timber bridge inspections?

Most participants responded with “County Crew” with 91%. “Consultant” was chosen 21% of the time, showing that once again that there is some overlap where some engineers use both; however, county crews are used far more often in this case. Figure 2.13 shows the results.

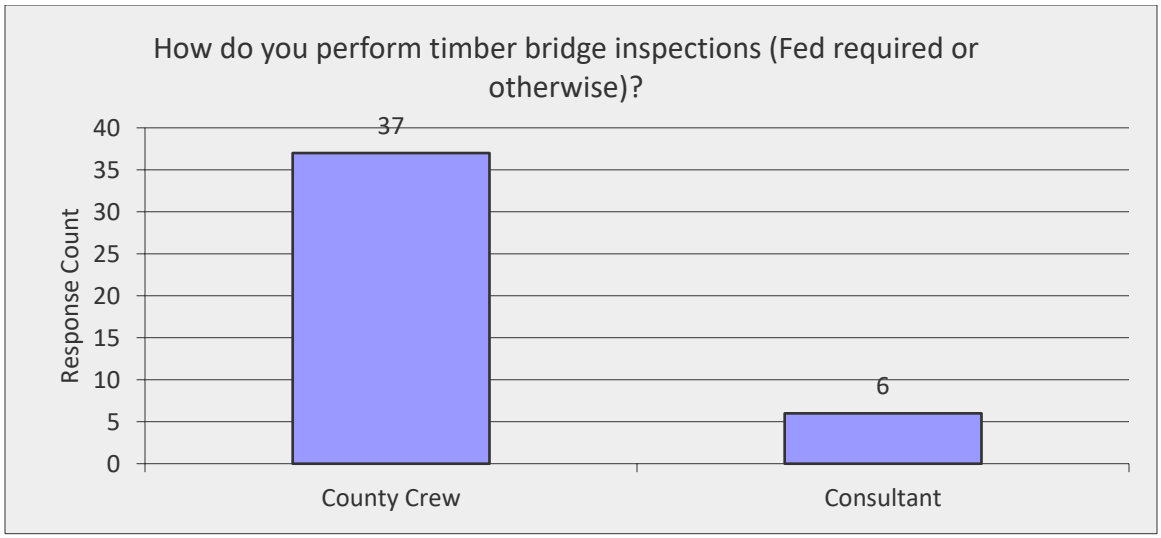


Figure 2.13 Response on who conducts ongoing bridge inspections.

The overall conclusions that can be drawn from this survey is that wood has a poor reputation among county engineers in the state of Minnesota. Concrete is by far the material of choice, as several engineers commented about how in their opinion, concrete was much better than wood. These engineers also questioned the longevity, durability, and cost of wood. Additionally, it can be concluded from this survey that many of the participating engineers are not familiar with modern timber bridge design as several comments noted that the last time that that specific engineer had worked with wood, or made a timber structure, was the late 1990s or earlier. It is also clear that there is a lack of understanding of LCA as compared to LCCA. Lastly it can be concluded that most of the maintenance and inspections are performed by the county crews. Coinciding with that fact, most of the funding for these timber bridge projects comes from the local and state levels.

2.1.5 Summary of MnDOT Cost Tables

An assessment of bridge construction costs was developed for the past five years (2011-2015) based on data provided by MnDOT State Aid office (MnDOT 2015). Table 2.1 shows the summary of costs for the following bridge types.

Table 2.1 Summary of bridge construction types and average costs for 2011-2019.

Bridge Type	Number of Bridges Constructed and Cost/Square Ft of Bridge Area								
	2019	2018	2017	2016	2015	2014	2013	2012	2011
Pre-Cast Beams (PCB)	16 $161/ft^2	17 $155/ft^2	29 $136/ft^2	23 $135/ft^2	21 $152/ft^2	23 $137/ft^2	28 $130/ft^2	29 $125/ft^2	41 $119/ft^2
Concrete Slab Span (C-SLAB)	11 $131/ft^2	21 $133/ft^2	12 $119/ft^2	17 $136/ft^2	12 $121/ft^2	11 $123/ft^2	39 $111/ft^2	24 $113/ft^2	13 $109/ft^2
Steel Beam (STEEL)		3 $561/ft^2		1 $230/ft^2	1 $457/ft^2			1 $611/ft^2	1 $1,241/ft^2
Inverted T-Beams (INV-T)				1 $284/ft^2	1 $290/ft^2			2 $213/ft^2	
Steel Truss (TRUSS)	1 $274/ft^2	2 $276/ft^2	1 $216/ft^2	1 $264/ft^2	6 $294/ft^2	7 $244/ft^2	2 $323/ft^2	2 $150/ft^2	2 $192/ft^2
Glulam Bridge Beam (Glulam)									1 $343/ft^2
Treated Timber Slab (TTS)	1 $152/ft^2	2 $216/ft^2		2 $192/ft^2				1 $222/ft^2	

CHAPTER 3: STANDARD SUPERSTRUCTURE OPTIONS

Based on the products from Task 1, standard superstructure options were developed for Minnesota with an emphasis on cost-competitive, long-lasting timber bridges with specific moisture management details. These designs included glulam beam with glulam deck, sawn timber spike-laminated panels and/or steel beam with timber deck. Design innovations and contracting options were explored to support reduced cost options.

3.1 STANDARD SUPERSTRUCTURE DESIGN AIDS

Based on the results of background material assessments highlighted in chapter 2, standard superstructure design aids were developed for three type of superstructure designs. These included:

1. Steel Stringers with a Transverse Glulam Deck
2. Glulam Stringer with a Transverse Glulam Deck
3. Longitudinal Spike-Laminated Timber Deck

The focus of this project was to develop standardized timber bridge design aids and specifications for Minnesota. These standard plan aids and specifications should assist engineers who are not familiar with timber design. The information provided in this report was developed as a cooperative effort with the Minnesota Department of Transportation, US Forest Service, Forest Products Laboratory, and the University of Minnesota Duluth with additional engagement from Wheeler Consolidated/Erickson Engineering, Laminated Concepts, Inc., and LHB Inc. Every effort has been made to present the information in a user-friendly format and allow maximum flexibility for the use of different wood materials, species, and grades. Each set of plans encompasses a basic span length and width combination, based on AASHTO LRFD Bridge Design Specifications for Highway Bridges, 5th Edition (2017). The information is intended to augment or support design requirements by the owning agency. In all cases, the design information must be verified by a Minnesota Registered Professional Engineer experienced with timber bridge design prior to plan development and construction. The Minnesota Department of Transportation, University of Minnesota Duluth and the US Forest Service hereby give notice that the information contained shall not create any warranty expressed or implied.

An example set of timber bridge construction plans and documents will be provided based on actual construction of timber bridges during Task 3A and 3B of this project or from recently constructed timber bridges in Minnesota or Iowa. These examples would provide meaningful background and information for county engineers and others that may not have significant experience with timber bridge design and construction. Each example will have detailed photographs and other documentation of the cost-effective and durable construction design details. They will include:

1. Transverse glulam deck steel beam bridge southeast of Babbitt, in St. Louis County, Minnesota. This is state bridge number 69A58 also referred to as county bridge number 516.
2. Spike-laminated longitudinal deck bridge that was constructed in Hennepin County. This is State Aid Bridge L8081 which is replaced now with 27C53.

3. Glulam stringer and transverse glulam deck (*superstructure type not built within this project*).

The Standard Design Aids are attached to this report as Appendix A, B, and C.

3.1.1 Steel Stringers with a Transverse Glulam Deck (Appendix A)

- Perspective Drawing & Photographic View
- Design Information – Glulam Deck System
    - Transverse Cross-Section Views
    - Design Notes
- Glulam Panel-to-Stringer Connections – Key Design Details
- Design Information – Steel Girders
    - Transverse Cross-Section Views
    - Design Notes
- Steel Girder Details
    - Diaphragm Configuration
    - Abutment Bearing Connections
- Crash-Tested Bridge Railing Options
    - NCHRP-350 TL-2 Glulam Railing System (without Curb)
    - NCHRP-350 TL-4 Glulam Railing System (with Curb)
- Wearing Surface and Durability Details

3.1.2 Glulam Stringer with a Transverse Glulam Deck (Appendix B)

- Perspective Drawing and Photographic View
- Design Information – Glulam Stringers
    - Cross-Section Views
    - Design Tables with Girder Sizes
    - General Notes
- Diaphragm and Stiffener Beam Details
- Glulam Deck Panel-to-Stringer Connections
- Substructure Connection Details – Concrete, Steel, and Timber Abutment
- Crash-Tested Bridge Railing Options
    - NCHRP-350 TL-4 Glulam Railing System with Curb
    - Asphalt wearing surface and waterproof membrane placement

3.1.3 Spike-Laminated Longitudinal Deck (Appendix C)

- Perspective Drawing Photographic View
- Plan & Profile Views and General Notes
    - Deck Design Maximum Span Table
- Configuration of Deck Panels
    - Cross-Section View – Layout of Panel Splices
    - Cross Section View – Stiffener Beam
    - Timber Pile Abutment Attachment Detail
- Deck Panel Configuration and Crash-Tested Bridge Railing
    - Spike Lamination Prefabrication Details
    - NCHRP-350 TL-4 Glulam Railing System with Curb

- Abutment Bearing and Drainage Details
    - Timber Pile Cap Attachment – Cross-Section View
    - Timber Pile Cap Attachment – Side View
    - Asphalt wearing surface and waterproof membrane placement
    - Metal Flashing Details
        - Inside Curbs
        - Inside Scupper Block Openings

3.2 COST-EFFICIENT DESIGN AND CONSTRUCTION CONSIDERATIONS

Timber bridge construction offers the potential for cost-efficient construction; however, the lack of current timber bridge construction has not offered significant competition or clear cost advantages. However, this project is working to identify cost saving strategies in design and construction, that when paired with improved durability details, will create options for cost-effective timber bridges with a service life of 70+ years. This includes activities including preservative selection, contracting and construction options, bridge design, fabrication, construction/installation, and design innovations to minimize long-term maintenance. Each of the following sections will provide more information.

3.2.1 Preservative Treated Wood Waiver Process

One of the challenges noted by one of the bridge component producers and suppliers in Minnesota was that the current MnDOT preservative use guidelines (MnDOT Approved/Qualified Products Treated Wood) specifically do not allow for the use of copper naphthenate. However, each local bridge owner can work with MnDOT to gain approval for components including copper naphthenate. To simplify and reduce this identified barrier, the State Aid Bridge Office, under advisement from the MnDOT Office of Environmental Stewardship and significant assistance, input and vetting from the timber industry, has developed a treated wood waiver letter for local agencies to use as a template on projects that contain treated wood, and where they wish to waive the use restrictions set forth in MnDOT's approved preservatives for the treatment of timber products. The Treated Wood Template Waiver forms will allow timber bridge owners to use a wider variety of preservative treatments that have been adopted by both the AASHTO and EPA for their project application. It gives the local owner the ability to consider factors such as environmental risk, cost, and durability in their final selection of wood preservatives, all with the understanding they can discuss the potential environmental liability associated with their selection of wood preservative with the MnDOT Office of Environmental Stewardship at any time. Complete information on this process, including access to a waiver letter, are available at: http://www.dot.state.mn.us/stateaid/bridge/wood-treatment.html.

3.2.2 Contracting and Construction

The literature review completed in Task 1 and interviews with bridge construction projects clearly shows that timber bridges can be constructed year-round, depending on the substructure selected for the project. This offers the potential for winter construction projects when bridge construction companies typically have fewer active projects. However, feedback has also been provided that many construction companies in northern Minnesota may not choose to actively bid on timber bridge construction projects during the winter. Figure 3.1 shows an actual winter construction project using a longitudinal spike-laminated timber deck.



Figure 3.1 Winter construction of a longitudinal spike-laminated timber deck.

3.2.3 Accelerated Bridge Construction

It is also clear from a wide range of timber projects that timber bridge construction projects can significantly reduce the construction duration and the length of time associated with bridge closures, or detours. This offers a unique opportunity for various timber bridge construction options. This could include either steel or glulam stringers, combined with transverse glue laminated deck systems, or a longitudinal spike laminated timber deck. These materials can be successfully used to construct projects in as few as 14 days (Hemmila, 2017). A 2014 project completed by St. Louis County replaced a high ADT bridge by using steel beams and a transverse timber deck in only 14 days, which included deconstruction. User cost savings associated with lengthy detours or other considerations make timber bridges an effective option. This has been documented through the literature review conducted during Task 1 and recent timber bridge construction projects that have occurred in St. Louis County, various Wisconsin counties, and in Iowa. Actual time associated with demonstration construction projects in Task 3 will be tracked.

3.2.4 Spike-laminated Timber Bridge Specific Considerations

Wheeler Consolidated is currently exploring the option to reduce the AASHTO-LRFD strength reductions associated with incising (i.e., small perforations in the wood surface to increase preservative penetration) on Douglas fir dimension lumber used in construction. Any lowering of the incising reduction would have a positive impact on the strength and stiffness increases of the material, resulting in potential span or load increases, which would have a positive impact on the cost-effectiveness of this bridge technique.

Further, Wheeler Consolidated is exploring the issues and design considerations of having a TL-2 crash-tested railing system for a nail-laminated transverse timber deck that could be used on steel or glulam girders. This could have a positive impact on the cost-effectiveness of this timber component.

3.2.5 Multiple presence factors

Timber bridges are typically on low volume roadways e.g. ADTT<100, hence per AASHTO Commentary, a 10% reduction in the multiple presence factors can be considered. This could potentially decrease the material costs/linear foot and improve the cost-effectiveness of a timber bridge system. In bridge design the multiple presence factor addresses the probability of multiple fully loaded lanes occurring simultaneously. The multiple presence factor goes down as more lane loads are considered.

3.2.5.1 Multiple Presence of Live Load (From AASHTO LRFD Bridge Design Specifications, Seventh Edition, 2014)

Table 3.1 Multiple Presence Factors, m

Number of Loaded Lanes	Multiple Presence Factors, *m*
1	1.20
2	1.00
3	0.85
>3	0.65

3.2.5.2 Multiple Presence of Live Load Commentary

The multiple presence factors in Table 3.1 were developed based on an ADTT of 5,000 trucks in one direction. The force effect resulting from the appropriate number of lanes may be reduced for sites with lower ADTT as follows:

- If 100 ≤ ADTT ≤ 1,000, 95 percent of the specified force effect may be used; and
- If ADTT < 100, 90 percent of the specified force effect may be used.

3.2.6 Contractor Supplied Designs

The potential exists for contractors to supply designs at no-additional-cost for timber bridge construction projects and may offer the potential to reduce costs associated with bridge designs. One example of this approach is the MnDOT Technical memorandum No. 16-02-B-01 for the use of three-sided precast concrete bridge structures. It is available at http://dotapp7.dot.state.mn.us/edms/download?docId=1694678. This document provides design and construction guidelines and a preliminary construction data sheet.

3.2.7 Geosynthetic Reinforced Soil Abutment Considerations

Options for low-cost abutments on low-volume roads, and specifically timber bridge superstructures, exist that assist with meeting cost needs, to reduce construction time, and to improve ease of construction. Actual dollar numbers aren't currently available (but have been requested) for the alternatives discussed below. However, to simply evaluate the alternative solely on upfront material cost would be a mistake. Reduced construction time, required skilled labor, need for heavy equipment, and service life are all factors that should be put into any cost analysis. It should be noted however, that abutment costs are largely dependent on local site conditions, bridge design requirements and several other factors. Context is important to ensure that valid comparisons are made. Further, often the best and most economical abutment alternative may depend on the availability of equipment to whomever is constructing the abutment (county, contractor, etc.) in addition to actual material costs.

Geosynthetic reinforced soil (GRS) abutments are a potential cost-effective option with increasing popularity. Specific details, resources, design drawings, and other reference material for GRS abutments can be found at: https://www.fhwa.dot.gov/innovation/everydaycounts/edc-3/grs-ibs.cfm.

This abutment option involves building up the abutment using alternating layers of compacted granular material and geotextile fabric in 6- to 8-in lifts. Once the GRS is constructed to the desired and required elevation, abutment caps (these may be concrete, timber, etc.) are placed directly on top of the GRS layer. Then girders and back wall are installed, and layers of GRS are added until a grade elevation just below roadway paving is achieved. In certain situations, the beams may also be set directly on the GRS abutment with no cap beam installed. Currently, two facing options exist to tie-in the vertical face under the bridge and protect the GRS from water damage in the case of a stream/river crossing: 1) CMU block, and 2) sheet pile. Pros and cons exist for both facing options, but in general the Federal Highway Administration (FHWA) notes construction cost savings of 25-60% when using GRS vs traditional foundation options.

Two projects completed in Iowa on secondary roads have shown that, using county personnel, both bridge abutments can be constructed in less than two working days. The only equipment outside of a small backhoe required was a small crane to shake the sheet pile into the ground. In areas of scour concern, use of the sheet pile facing and driving them to below scour depth exhibit significant potential for future cost/maintenance savings. Additional information on GRS abutments is in an internal Forest Service report by Brian Keierleber (2017). Figure 3.2 shows a typical GRS abutment. Figures 3.3 and 3.4 show recent pictures from a project that was completed in 2016 in northern Iowa.

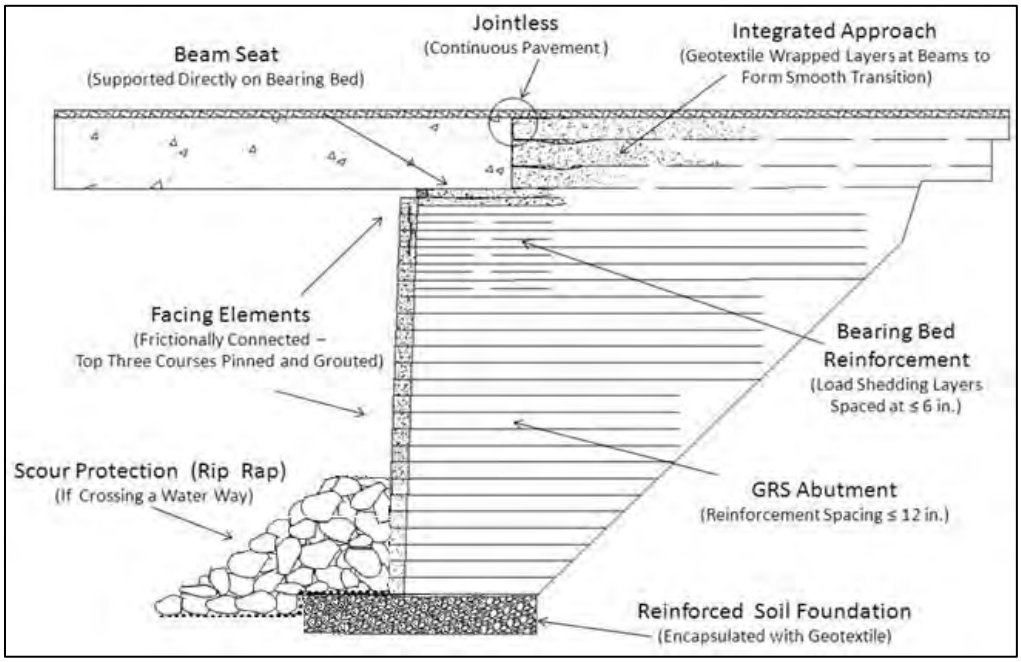


Figure 3.2 Typical geosynthetic reinforced (GRS) abutment elements.



Figure 3.3 GRS abutment during construction in Buchanan County, Iowa (2016).



Figure 3.4 GRS abutment construction and bridge deck installation in Buchanan County, Iowa.

3.2.8 Sheet Pile Abutment

Sheet pile abutments have been utilized in several counties in Iowa (Evens, 2010), as well as in Minnesota, with immediate results indicating that there is potential for this alternative to be viable on low volume roads, but numerous factors come into play when determining if they are economically viable. An experimental project was completed in Iowa in 2010 that showed the positive potential for using sheet. Factors include but are not limited to depth to bedrock, or lack thereof; length required to meet bearing needs; need for and cost of dead men for lateral stability; others.

3.2.9 Local Species and Fiber-reinforced Structural Materials

Research and demonstration bridge projects to further develop wood for transportation structures increased substantially in the United States in 1988 under a legislative action by the US Congress known as the Timber Bridge Initiative. The program was renamed the Wood in Transportation Program (Duwadi, 2000) and functioned through 2005. Significant work was accomplished to construct bridges from local wood species, usually on secondary and local US road systems. Most of the timber bridges were short-span structures. They included traditional construction using sawn timber beams and nail-laminated bridges, but most were newer designs such as glued laminated timber bridges, stress-laminated bridges, dowel-laminated bridges, glued-laminated timber arches, and other state-of-the-art engineered wood bridges such as timber bridges reinforced with fiber-reinforced polymer (FRP) composites (Figure 3.4) and structural composite lumber. Several of these projects looked at the use of wood species native to Minnesota, including red pine, red maple, jack pine, and cottonwood. However, it was noted that these species require challenges associated with lack of structural size, lack of grade required for use in timber bridges and lack of availability. While cost studies were not a specific focus of the projects, it was noted that they were not initially cost-competitive but might create local market options for these species.

3.2.10 Crash-Tested Railing System for Timber Bridges

Federal Highway Administration approved crash-tested railing systems for timber bridges are located at: https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/listing.cfm?code=long. Table 3.2 shows an overview of the crash-tested rating system for AASHTO, NCHRP 350, and MASH. MnDOT currently recognizes NCHRP-350 TL2 and TL4 systems until MASH-approved bridge railing systems become available. Table 3.3 provides an overview of the crash-tested systems by bridge type.

A variety of bridge railing systems have had full-scale crash-tests performed on wood recently and are now approved for use on highway bridges. Many of these efforts resulted from a collaboration between the Midwest Roadside Safety Facility (University of Nebraska-Lincoln) and the Forest Products Laboratory (USDA Forest Service). See Appendix C-2 for an overview of the research program. Another resource for information on crash-tested systems is: Crash-Tested Curb-Railing Systems for Low-Volume Road Applications, FPL-GTR-107.

Table 3.2 Summary of crash-testing criteria by AASHTO, NCHRP, and MASH requirements.

AASHTO Performance Level [(1)]	**Impact Conditions**		
	Small car (816 kg, 1,800 lb.)	*Pickup truck* (2,449 kg, 5,400 lb.)	*Medium* Single-unit truck (8,165 kg, 18,000 lb.)
1	80.5 km/hr (50 mph) 20 degrees	72.4 km/hr (45 mph) 20 degrees	--
2	96.6 km/hr (60 mph) 20 degrees	96.6 km/hr (60 mph) 20 degrees	80 km/hr (50 mph) 15 degrees
NCHRP 350 Test Level [(2)]	**Impact Conditions**		
	Small car (820 kg, 1,808 lb.)	*Pickup truck* (2,000 kg, 4,409lb)	*Medium Single-unit truck* (8,000 kg, 17,637 lb.)
1	50 km/hr (31 mph) 20 degrees	50 km/hr (31 mph) 25 degrees	--
2	70 km/hr (43 mph) 20 degrees	70 km/hr (43 mph) 25 degrees	--
4	100 km/hr (62 mph) 20 degrees	100 km/hr (62 mph) 25 degrees	80 km/hr (50 mph) 15 degrees
MASH Test Level [(3)]	**Impact Conditions**		
	Small car (1,016 kg, 2,420 lb.)	Pickup truck (2,270 kg, 5,000 lb.)	Medium Single-unit truck (10,000 kg, 22,046 lb.)
1	50 km/hr (31 mph) 25 degrees	50 km/hr (31 mph) 25 degrees	--
2	70 km/hr (45 mph) 25 degrees	70 km/hr (44 mph) 25 degrees	--
4	100 km/hr (62 mph) 20 degrees	100 km/hr (62 mph) 25 degrees	90 km/hr (56 mph) 15 degrees

[1]Michie, J. D. ***NCHRP Report 230: Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances.*** TRB, National Research Council, Washington, D.C., 1981.

[2]Ross, H. E., D. L. Sicking, R. A. Zimmer, and J. D. Michie. ***NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features.*** TRB, National Research Council, Washington, D.C., 1993.

[3]***Manual for Assessing Safety Hardware***. AASHTO, Washington, D.C., 2016.

Table 3.3 Overview of crash-tested railing overview by deck type.

Deck Type	Testing Protocol	Test Level 1	Test Level 2	Test Level 4
Timber Slab or **Longitudinal Deck** (spike-laminated, longitudinal glulam, or stress-laminated)	NCHRP Report 230[1] and NCHRP Report 350[2]	Curb Rail System TRR 1419	Glulam Rail with Curb System Glulam Rail without Curb System FPL-GTR-94 Link	Glulam Rail with Curb System FPL-GTR-94 Link TRR1500
Transverse Deck (nail-laminated)	MASH[3]	Timber Curb System TRR 2262	Steel Railing System TRR 2262	
Transverse Deck (Glulam)	NCHRP Report 350		Includes both Glulam and Steel Railing Systems TRR 1743	Includes both Glulam or Steel Railing Systems TRR 1696
Concrete Deck	NCHRP Report 350	Curb Rail System	Glulam Rail Curbless System	Glulam Rail with Curb System

CHAPTER 4: ST. LOUIS COUNTY TIMBER BRIDGE CONSTRUCTION PROJECT

One of the project goals was to identify several bridge construction projects with partner counties that would use the developed plans, allowing the project team to assess and validate the true initial costs of construction, predict life-cycle costs, and complete a life-cycle assessment for these bridges. Potential MnDOT and county partners were identified for planning and construction of one beam and one slab type bridges. This chapter highlights the work conducted in Task 3A, where the project team partnered with St. Louis County, Minnesota on the design, construction and validation of a bridge that was constructed between Embarrass and Babbitt, Minnesota. This bridge was constructed by St. Louis County construction crews using steel girders and a transverse glue-laminated (glulam) deck. The team worked with St. Louis County to track design, bidding, cost-tracking and construction of the bridge. Funds from the project were not used for construction.

4.1 BACKGROUND

The St. Louis County Bridge selected for this project is state bridge number 69A58 and county bridge number 516 (referred to as SLC 516). It is located approximately 7.4 miles W/SW of Babbitt, MN and crosses the Embarrass River. It is located on CR 796. It is a low volume road with average daily traffic of <10 vehicles. The original bridge, a steel pony-truss bridge, was constructed in 1919 and had a cast-in-place concrete deck at the time of removal. Figures 4.1 and 4.2 show the bridge prior to removal. Figure 4.3 shows the location of the bridge.

Funding for the construction of the project was provided by St. Louis County, Minnesota. The site work and construction were completed by construction crews from St. Louis County. The project team included St. Louis County, University of Minnesota Duluth Natural Resources Research Institute, US Forest Service Forest Products Laboratory, LHB Engineering, Laminated Concepts Inc., and Iowa State University.



Figure 4.1 Original 1919 steel pony-truss bridge that was replaced during this project.



Figure 4.2 Embarrass River flowing under St. Louis County Bridge 516.

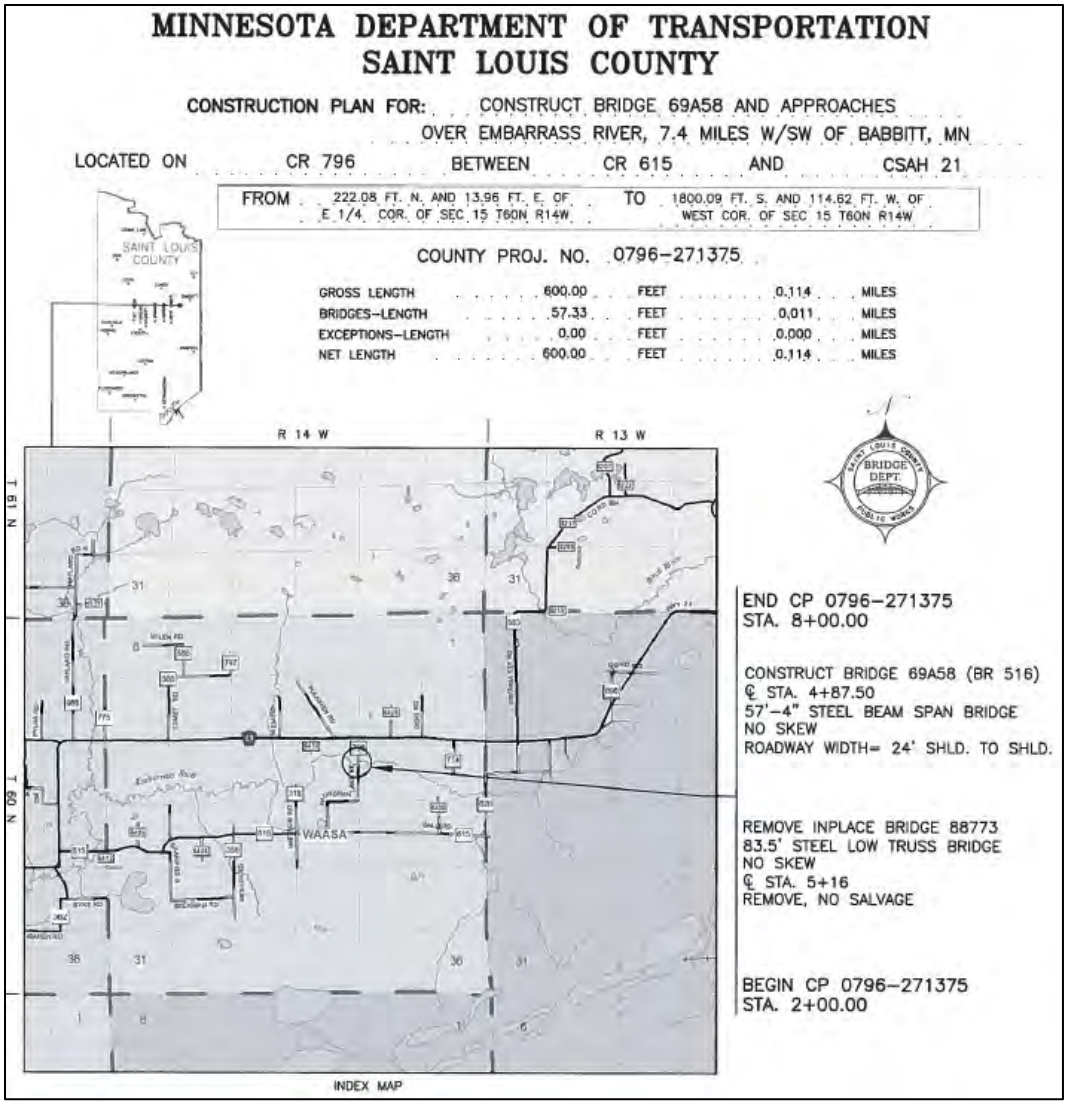


Figure 4.3 Geographic information and location of the project bridge.

4.2 OBJECTIVE AND SCOPE

The objective of this task was to identify, design and construct a demonstration bridge using standard timber design options and to develop and incorporate design details focused on long-term performance and durability. The focus would be on using a girder style bridge design using steel girders and a transverse glulam deck capable of being installed in a short time period. On-site photo and time documentation were also completed for the construction. The project team interfaced with the bridge owner, St. Louis County, and other partners to demonstrate and validate the cost parameters associated with the project and compare them to preconstruction estimates. A final life-cycle cost assessment and a life-cycle analysis was completed based on the specific bridge constructed. Funding and completion of the actual bridge construction were outside the scope of the requested project funds.

4.2.1 Design, Bid and Construction

The design and construction of SLC bridge 516 involved efforts from several agencies and organizations. An overview of the design, bid process, and construction of the bridge follows.

4.2.1.1 Design

The overall project design and site plan, developed by St. Louis County Public Works Department (MN), is in Appendix D. This includes the title sheet, and index map, statement of estimated quantities, earthwork quantities, typical section, plan and profile, bridge approach treatment, sheet pile wall, reason control plan, guardrail, traffic control, and bridge plan. The design of the steel girders was completed by St. Louis County with support from LHB Engineering. The design of the glulam deck panels and guardrail posts and rails for the project were completed by Laminated Concepts, Inc. Both design efforts were conducted in cooperation with St. Louis County to ensure that the superstructure and substructure designs were compatible.

The structural design for the bridge was done in accordance with the American Association of State Highway and Tranportation Officials (AASHTO), LRFD Bridge Design Specifications for Highway Bridges (2017). The bridge design was comprised of of a steel stringer system supporting a transverse glulam deck system and was designed for the design criteria:

- Dead load (timber 50 pounds per cubic foot (PCF) / wearing surface 140 PCF)
- Live load HL-93
- Live load deflection limit (L/425)

The design specified the following for the bridge, materials and fabrication:

1. The material and installation procedures should conform to the American National Standard for Wood Products – Structural Glued Laminated Timber ANSI A190-1 (latest edition), AITC 117-2015 Standard Specification for Structural Glued Laminated Timber of Softwood Species, AWPA Book of standards (latest edition), and the WWPI Best Management Practices for Treating Wood in Aquatic Environment.

2. The glulam manufacturer needs to be a qualified licensee of the American Institute of timber construction (AITC) or the APA–The Engineered Wood Association (APA/EWS). It was noted in design documents that all glue-laminated timber shall be factory fabricated (as far as practical). This included all cutting, drilling and other fabrication as shown on in the shop drawings. The laminator shall provide an AITC or APA/EWS Certificate of Conformance to AITC/ANSI A190.1-2007.

3. The lumber-intended for glulam production shall be visually or mechanically graded in conformance with accepted standards for LRFD unit stresses (See AASHTO Section 8) and with the National Design Specifications for Wood Construction. Glulam members shall be finished to Industrial Appearance Grade as per AITC 110-2001. All lumber utilized in these standards shall be either Coastal Douglas Fir or Southern Pine.

4. All timber should be treated with the following oil type preservatives in accordance with AASHTO Material Standards, M133 and M168 and shall conform to the AWPA Use Code Standards 8.1 Pentachlorophenol or Copper Naphthenate in Type A, heavy oil conforming to AWPA Standard UC4B, P-8 & P9. The retention level shall be 0.6 PCF. All preservative treatments shall be applied in accordance with Best Management Practices for Wood Preservatives in Aquatic Environments. Preservative treatment certification required. A Certificate of treatment shall be furnished by a certified AWPA treating facility. The treating certification shall list the identification of job, species of materials, type and retention preservative provided, as well as the AWPA standard used as the guide for treating. In the event treated glulam originates from more than one treating facility, then separate certifications shall be furnished from each facility providing timber for this project.

5. Fabricator shall provide all connection steel and hardware for joining wood members to each other and to their supports exclusive of anchoring embedded in concrete. All fasteners, except prestressing bars, shall be galvanized (ASTM A-123) mild steel ASTM A307. Washers to be cast iron or malleable iron, timber type. All steel plates and shapes to be galvanized (ASTM A-153) mild steel ASTM A-36.

Figure 4.4 shows the perspective drawing of the bridge superstructure design. The design features steel girders with diaphragms (Figures 4.4 and 4.5) with transverse glulam deck, longitudinal deck stiffeners, and the guard rail system (Figures 4.6, 4.7, 4.8, and 4.9). Drawings of galvanized flashing to protect the deck panel edges and rail posts from moisture related deterioration are shown in Figures 4.10 and 4.11.

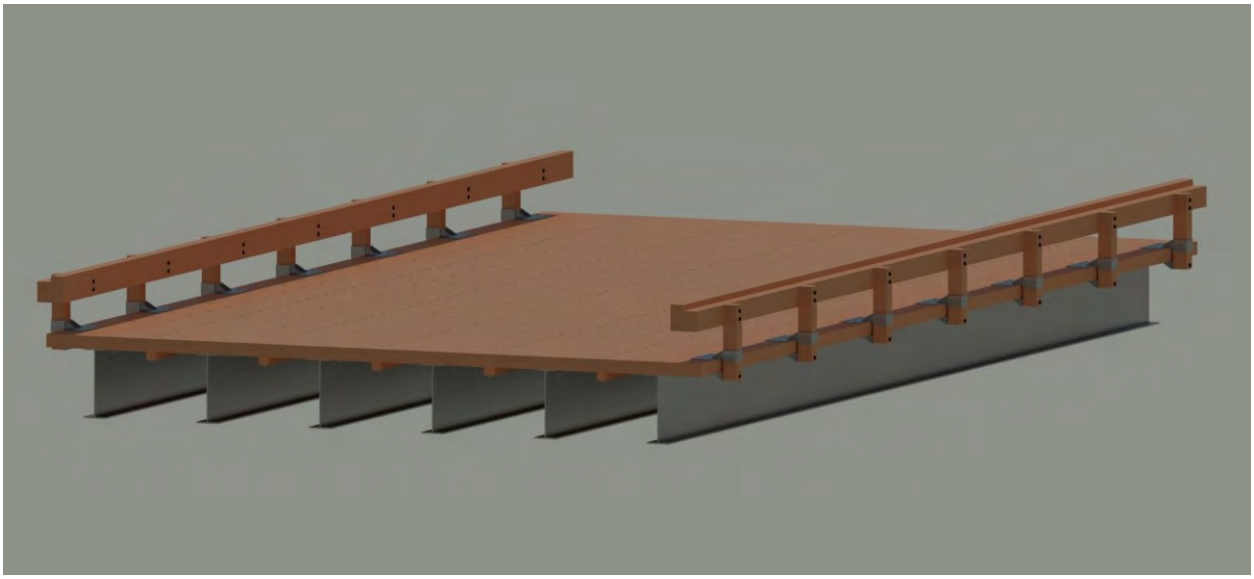


Figure 4.4 Perspective drawing of steel girder with transverse glulam timber deck, stiffeners, and railings.

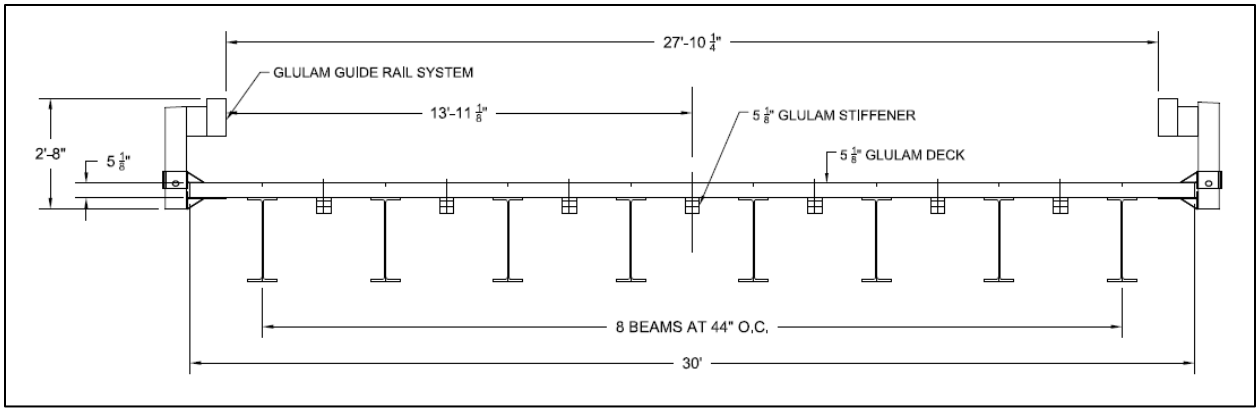


Figure 4.5 Cross-section view showing bridge steel girders, glulam deck, and stiffeners.

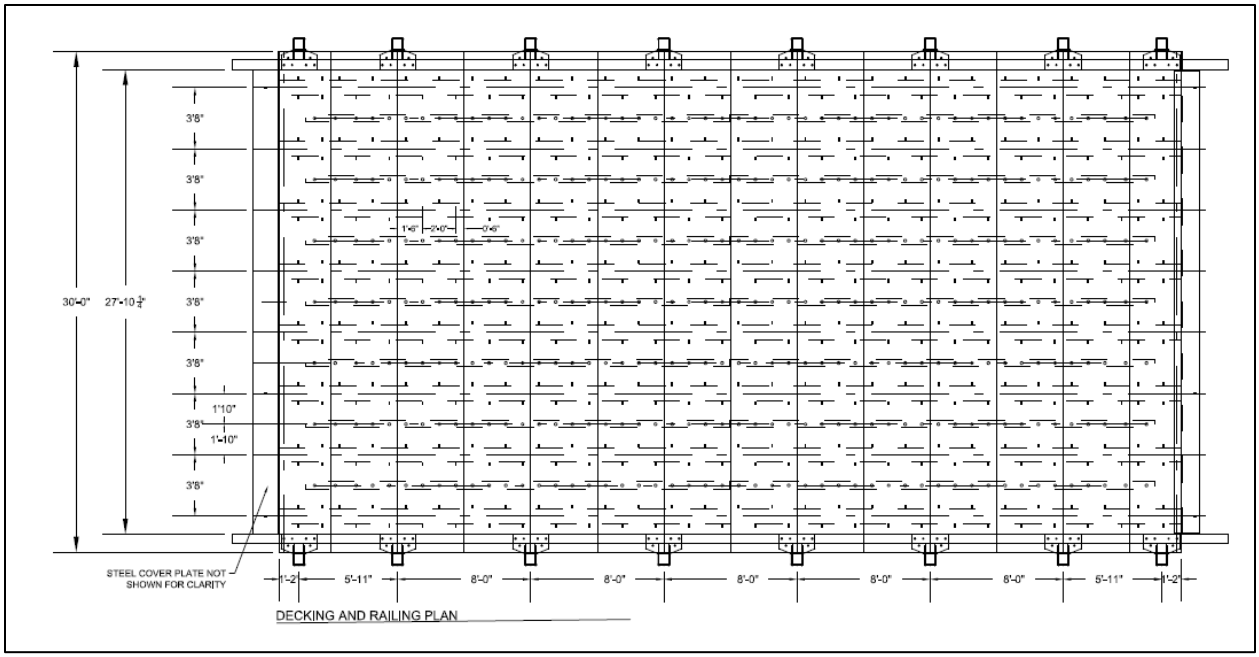


Figure 4.6 Plan view showing glulam deck, stiffeners, and railing.

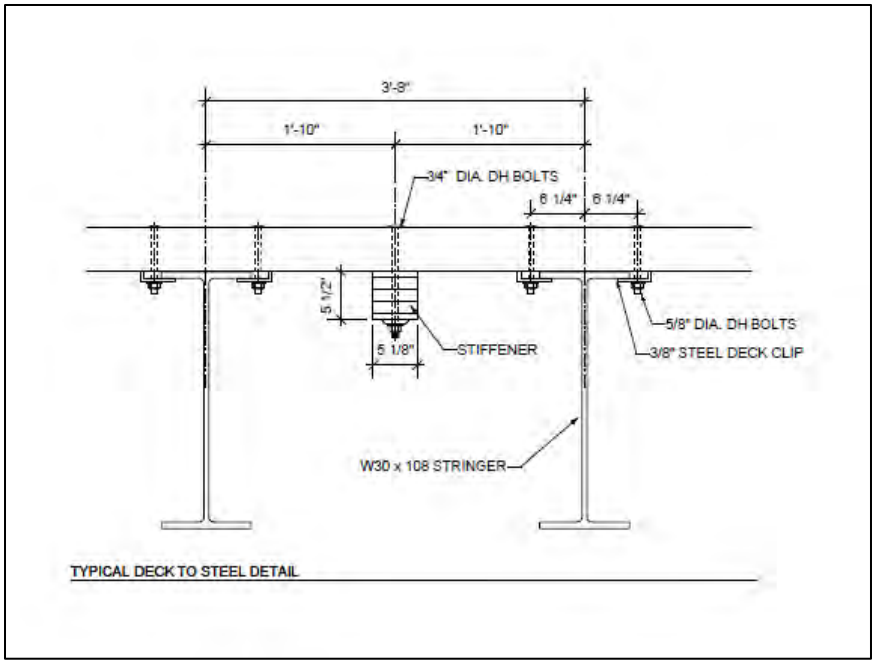


Figure 4.7 Deck and stiffener connections to steel girders detail.

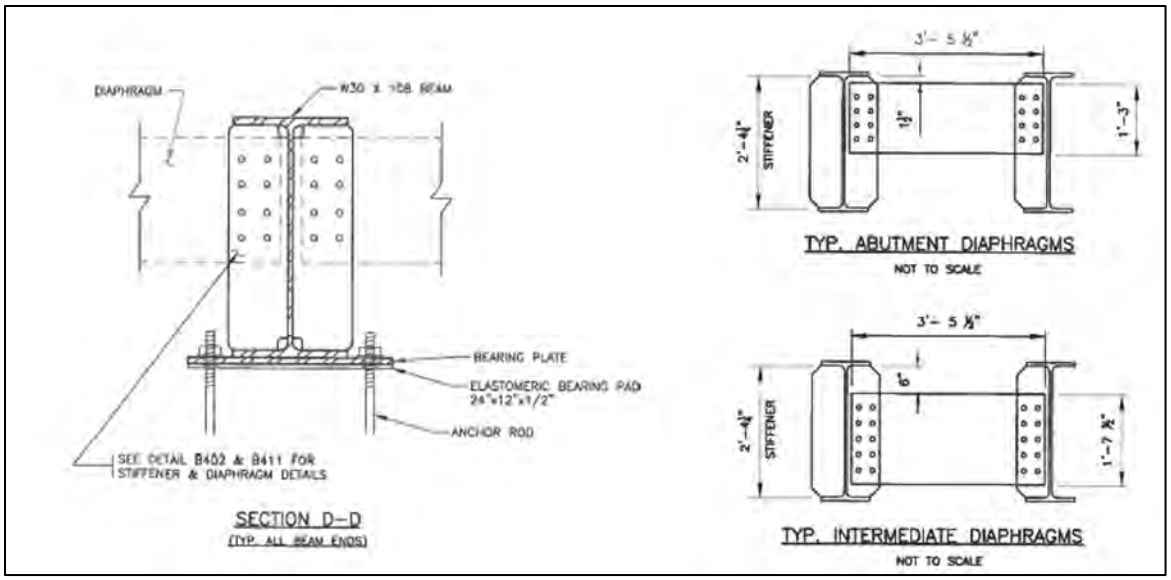


Figure 4.8 Diaphragm detail for steel girders.

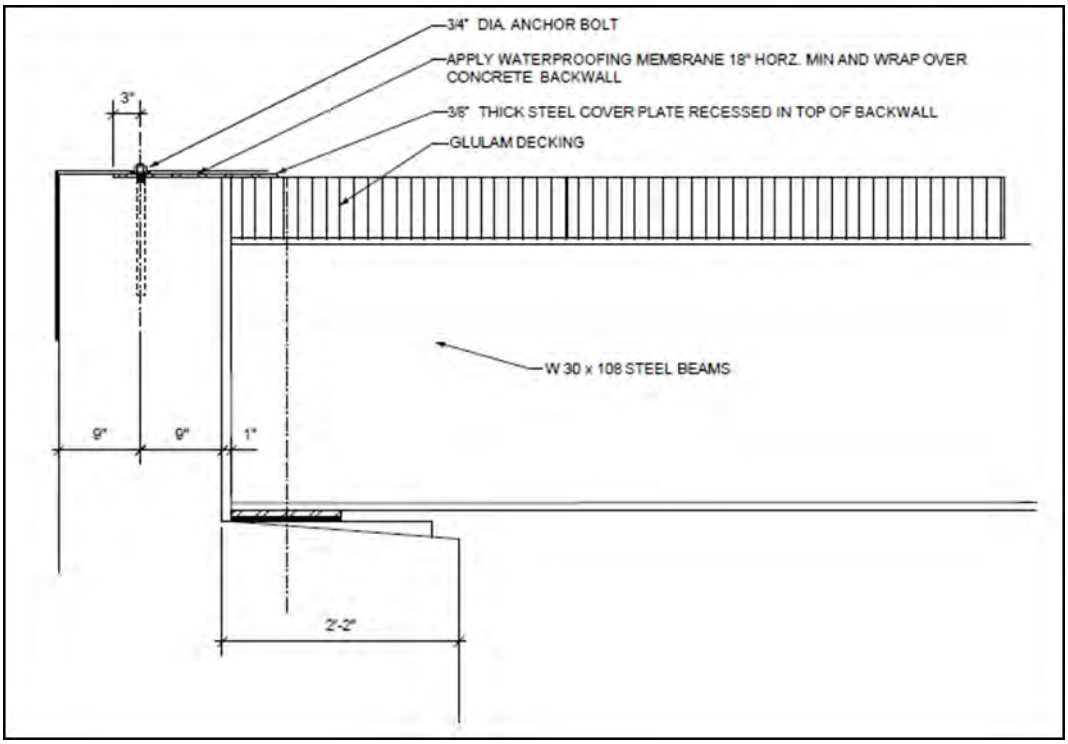


Figure 4.9 Profile view of bearing detail for SLC 516.

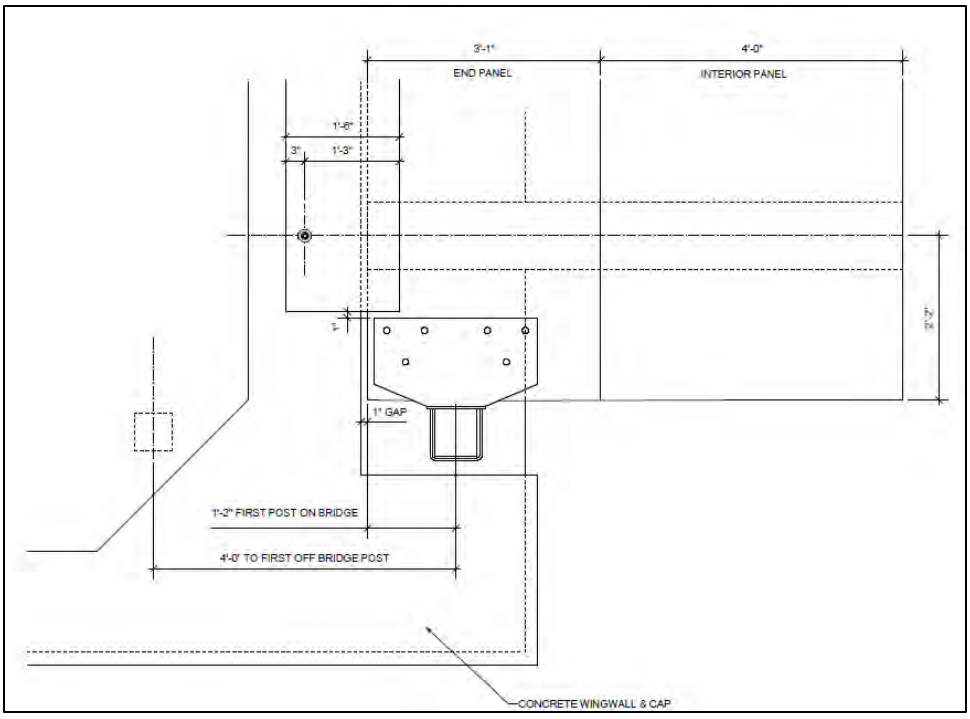


Figure 4.10 Top view of abutment, deck, and railing placement.

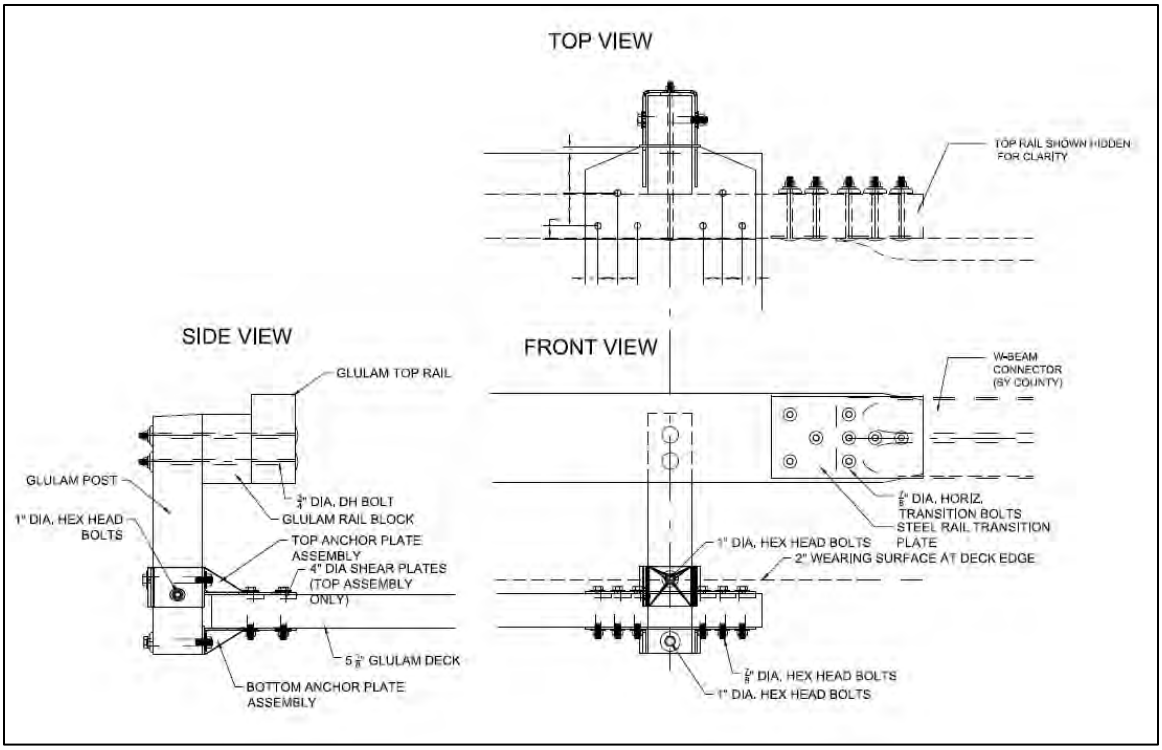


Figure 4.11 Guide rail detail.

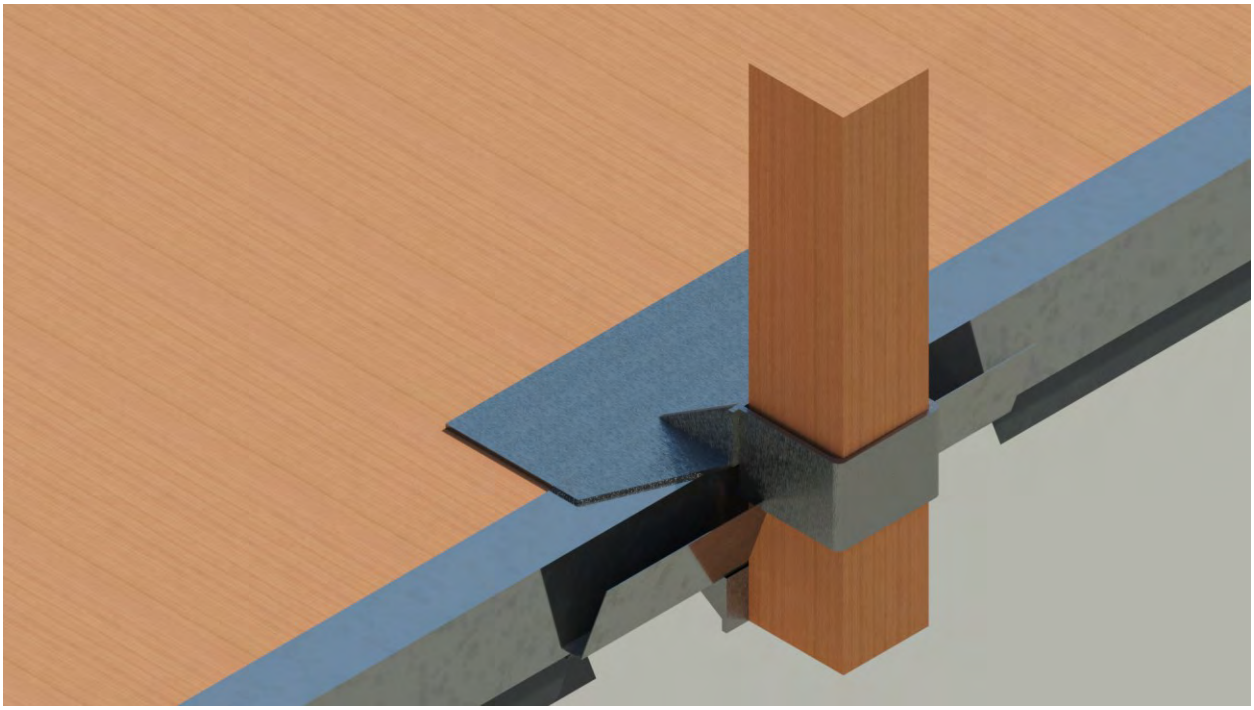


Figure 4.12 Three-dimensional rendering of proposed flashing detail between and at posts.

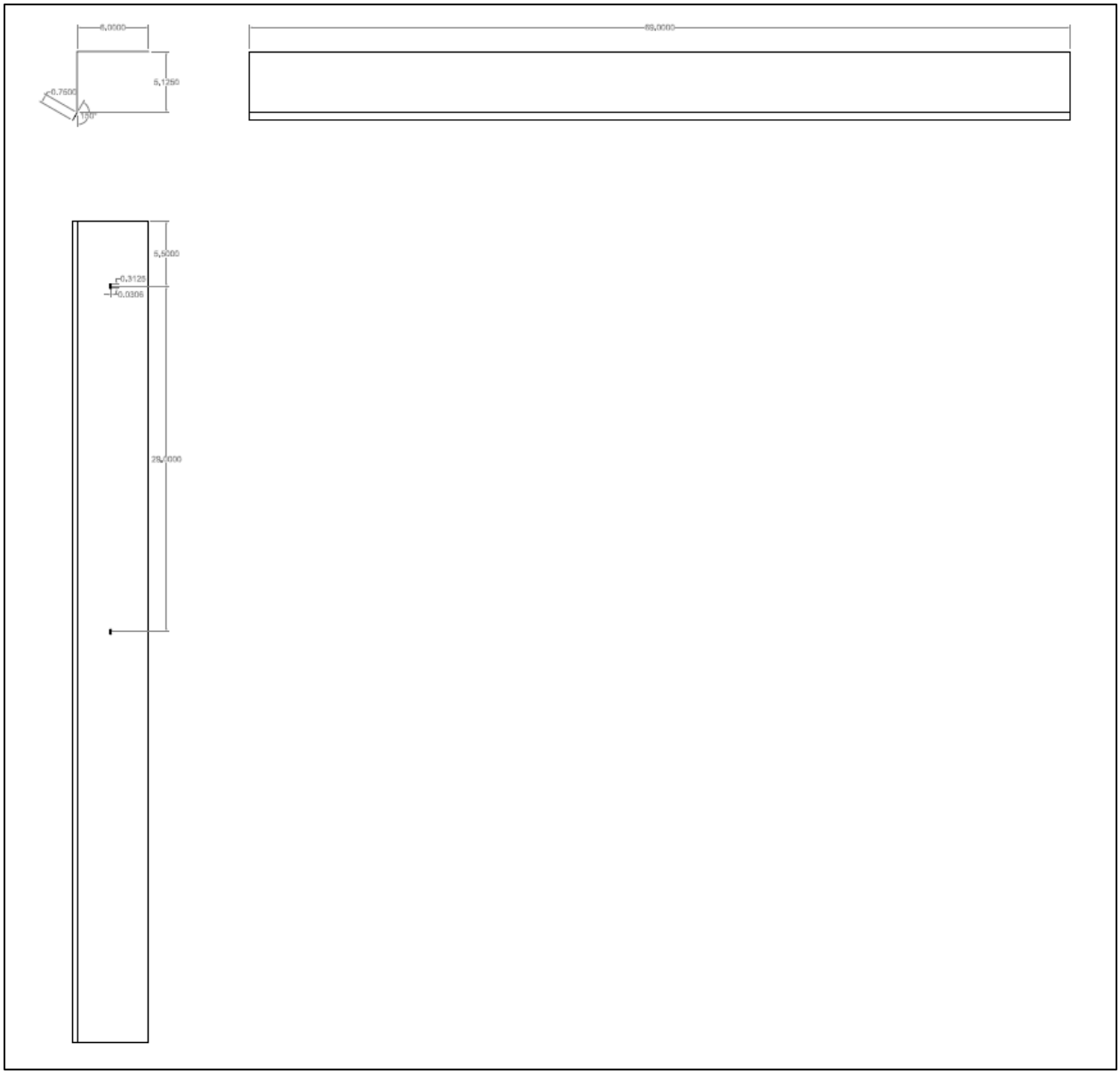


Figure 4.13 Shop drawings (3 orthogonal views) for the deck-edge flashing sections located between guardrail posts.

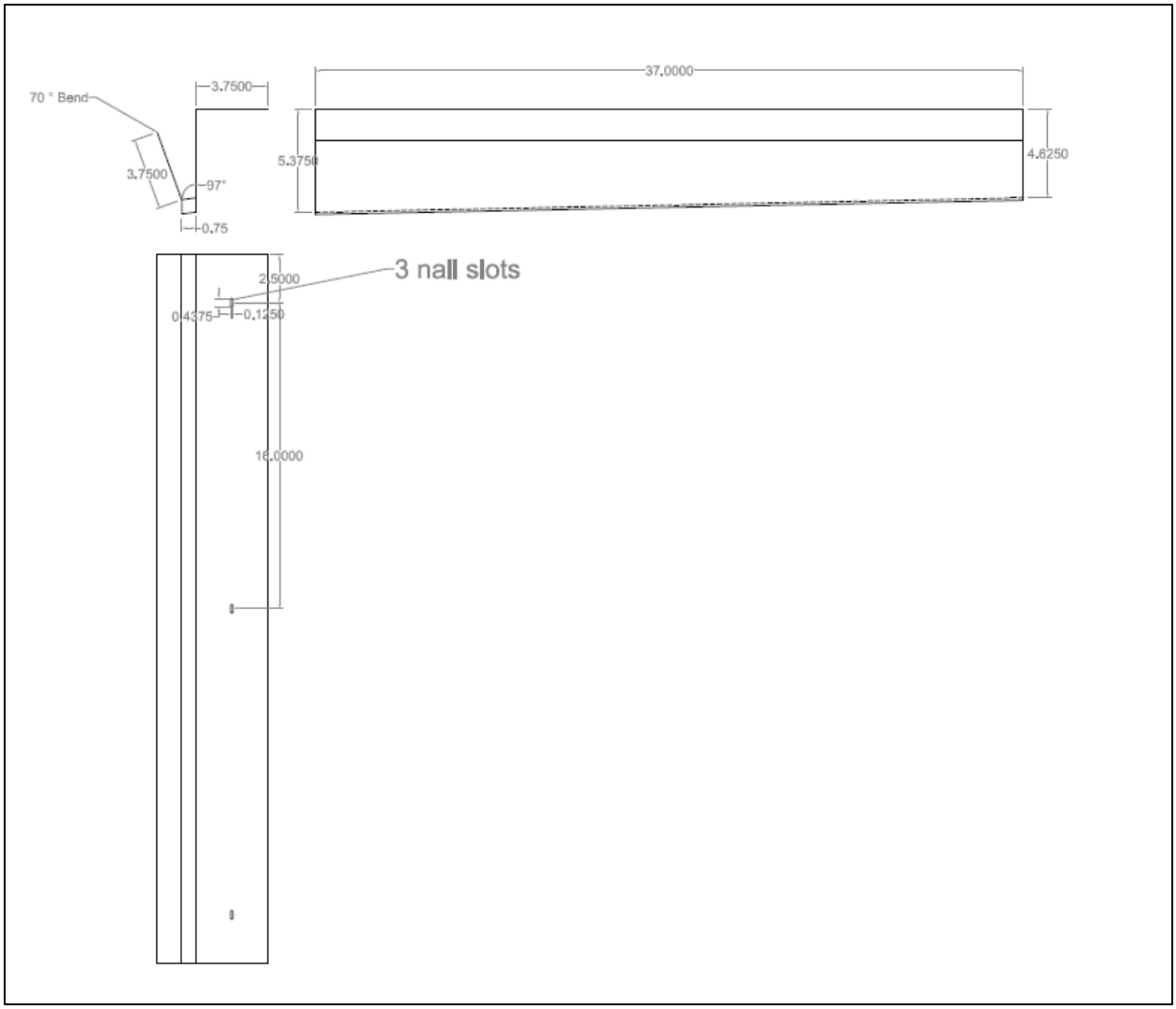


Figure 4.14 Shop drawings (3 orthogonal views) for the deck-edge flashing sections located at the guardrail posts.

4.2.1.2 Bid Process and Materials

STEEL BEAMS:

Based on the design specifications, St. Louis County solicted bids from outside vendors for the supply of the steel beams for use in this project. The steel beams were designated as W30 by 108 and including galvanizing. Two bids were received and the low bid was selected (Lejeune Steel Company). The materials were delivered to the bridge location and off-loaded by County personnel, and stored on site prior to installation.

TIMBER MATERIALS AND HARDWARE:

Based on the site parameters and design, St. Louis County distributed a bid package to three vendors in the Midwest. The bid information provided to the vendors is located in Appendix D. A formal bid application package was not prepared by the County, but instead relied on the design work completed by Laminated Concepts, Inc and approved by the County Engineer. Two bids were received for this project. The low bid was submitted was selected by St. Louis County (Bell Structural Solutions).

Based on the bid selection, shop drawings were submitted by the fabricator. However, based on the review of the drawings by the project team, the submitted shop drawings were rejected and resubmission requested. The following notes were provided to the fabricator at the time of rejection:

- Eliminate all references to field drilling.
- Provide full detailing of the deck clip for approval.
- Provide full detailing of the longitudinal stiffeners, include splice recommendations if any.
- Supplier should provide calculations to substantiate glulam grade proposed for decking.

The glulam supplier modified the shop drawings as requested and resubmitted them to St. Louis County for review. Based on the review, the comments had been addressed and corrected. The references to field drilling had been removed, full detailing of the deck clip was provided, thru-bolting slots measuring (2 in by 13/16 in) were included in the stiffeners, and a more appropriate glulam layup grade was proposed. The final shop drawings are included in Appendix D. They include a comprehensive part and material list and notes; plan and section views; and details for the glulam-to-steel beam connection, the glulam stiffener-to-glulam deck connection, and the guardrail system. Table 4.1 shows the wood material list and Table 4.2 shows the hardware material list for the bridge project.

Table 4.1 Wood material list for the project.

Number Required	Description	Size (in by in)	Length	Lamination Thickness Nominal (in)	Glulam Layup Combination
2	Deck Panel	5.125 by 37	30 ft 0 in	2	50
12	Deck Panel	5.125 by 48	30 ft 0 in	2	50
7	Stiffener	5.125 by 5.5	50 ft 0 in	2	48
16	Post	6.75 by 7.5	3 ft 13/16 in	2	48
16	Blocking	6.75 by 7.5	10 ½ in	2	47
2	Rail	6.75 by 13.5	58 ft 3 in	2	48

Table 4.2 Hardware material list for the project.

Quantity	Galvanized Description
16	Topside welded-plate assembly
16	Bottom side welded-plate assembly
4	3/16" X 12.25 x 23 plate
448	5/8"Ø X 7 1/2" DH grade bolt
350	3/4" Ø X 12" DH grade bolt
32	3/4" Ø X 24" DH grade bolt
32	7/8" Ø X 9" DH grade bolt
96	7/8" Ø X 7" machine bolt
48	1" Ø X 10" machine bolt
448	5/8" Ø nuts
382	3/4" Ø nuts
128	7/8" Ø nuts
48	1" Ø Nuts
382	3/4" Ø malleable washer
32	7/8" Ø malleable washer
16	1" Ø malleable washer
96	4" Ø (7/8" bolt) shear plate
448	3/8" deck clip

Note: Ø is the accepted symbol for diameter

Additional materials were ordered and are shown in Table 4.3. This included a steel plate for covering the gap between the abutment and the glulam deck and a waterproof membrane to cover the steel plate. This also includes bituminous overlay (SP Type 12.5 Wearing Course Mix) and a bituminous membrane that would serve as a reinforcing and waterproof layer between the two layers of bituminous. Bids were obtained for the bituminous material and paving services and the low bid was selected. A galvanized flashing was applied to the exterior edges of the glulam deck. It consists of an “at railing” post piece and a “between railing” post piece. In addition, four specific pieces were specified for the bridge ends over abutments.

Table 4.3 Materials for timber bridge superstructure.

Material	Supplier	Detail
Steel cover plate	Kraemer Construction, Inc. (Duluth, MN)	3 - 3/8” by 12 in by 10 ft, galvanized
Waterproof membrane for steel cover plate	Lowe’s Home Improvement (Hibbing, MN)	Ice and water shield, 48 inch width
Bridge and deck waterproofing membrane	Manufacturer: Protecto Wrap Company (Denver, CO) Distributor: Wausau Supply Company (Schofield, WI)	M 400 A; 60 in by 50 ft by 70 mil thickness
Railing post cap	Laminated Concepts, Inc. (Big Flats, NY)	Plastic caps for rail posts to deflect water with screws
Rubber spacers and nails	Northern State Supply (Duluth, MN)	Galvanized screws and spacers for flashing
Galvanized deck flashings	Jamar Company (Duluth, MN)	Between post: galvanized 22 gauge – 10 pieces, 69 in long At post: galvanized 22 gauge – 12 pieces, 37 in long Bridge corner at post: galvanized 22 gauge – 14 pieces, 32 in long Bridge corner between post: galvanized 22 gauge – 14 pieces, 57 in long
Copper naphthenate	Copper Care Wood Preservatives, Inc. (Columbus, NE)	Preservative treatment for any on-site holes and cuts
Cold galvanizing compound	Manufacturer: Rust-Oleum Distributor: Lowes Home improvement (Hibbing, MN)	Repair of galvanized plates or other components

4.2.1.3 Construction

REMOVAL

The previous bridge was deconstructed and removed by St. Louis County personnel during the winter of 2017-2018.

CONCRETE ABUTMENT, WING WALL AND STEEL SHEET PILING WALL

Starting in March 2018, St. Louis County’s northern bridge crew began constructing the new bridge. This included construction of a reinforced concrete abutment and sheet pile wing wall according to the plans in Appendix A. The site conditions were very difficult as the crew had to contend with very high water levels due to downstream beaver dams and high amounts of spring rainfall. To address the water, beaver dams were removed, and pumping was required during abutment construction. Figure 4.15

shows the upstream layout of the river. Figures 4.16, 4.17, 4.18, and 4.19 show the concrete abutments on the north end of the bridge and the concrete wing wall and the steel pile retaining wall.



Figure 4.15 Upstream view of the Embarrass River.



Figure 4.16 Concrete abutment, sheet pile wing wall and riprap to protect the roadway and bridge.



Figure 4.17 Upstream wing wall (driven sheet pile) with riprap to protect the roadway and bridge from scour erosion damages.



Figure 4.18 Downstream concrete abutment with riprap.

STEEL BEAMS

Eight steel beams (W30 by 108) were delivered and off-loaded at the jobsite. A crane was used to place each beam into location on steel bearing plates (0.75 in by 12in by 24 in) and neoprene pads that were attached to the abutment as shown in Figure 4.19. Steel diaphragms were attached to the beams as shown in Figures 4.20 and 4.21. The completed steel superstructure is shown in Figure 4.22. All the steel materials were galvanized.

The steel beams were installed using a crew of four individuals, which included one supervisor. The beams were installed over a three-day time period. Following installation of the beams, the bridge crew closed the construction site to await fabrication and delivery of the glulam materials.



Figure 4.19 Steel beams installed onto steel bearing plates with neoprene pads.

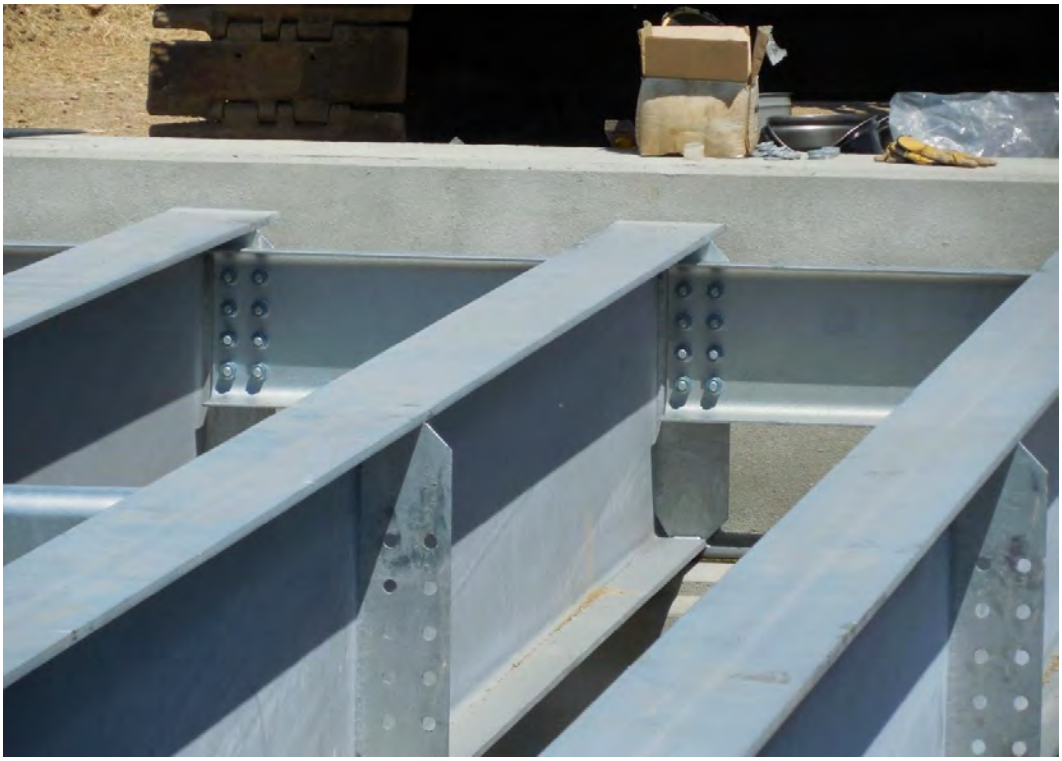


Figure 4.20 Steel diaphragm installation.



Figure 4.21 Steel diaphragm installation.



Figure 4.22 Installed steel beams and diaphragm stiffeners.

ENGINEERED GLULAM MATERIALS

Following acceptance of the bid, the fabricator, Bell Structural Solutions developed shop drawings for the project. Upon acceptance of the shop drawings by St. Louis County and the project team, glued-laminated deck, railings and posts were fabricated in Albert Lea, Minnesota. Following fabrication, holes and slots were predrilled into the materials based on the shop drawings. The wood materials were then transported to New Brighton, Minnesota and treated with pentachlorophenol wood preservative in a type A oil. Following treatment and certification, the glulam wood materials and hardware were transported to the bridge location and off-loaded. Care was used to ensure the materials were stored off the ground and a plastic tarp was used to cover the material prior to construction to minimize wetting from any rain events. Figures 4.23, 4.24, and 4.25 show the materials at the construction site prior to installation.



Figure 4.23 Glulam panels after delivery and unloading at the construction site.



Figure 4.24 Glulam stiffeners, railing, and panels after delivery.



Figure 4.25 Wood materials were covered with a plastic tarp to protect from rain.

A construction crane was used to move the wood materials into location. The glulam stiffeners were placed onto the bridge and then separated with one stiffener between each steel beam. The stiffeners were fabricated with a 13/16 in diameter slot that was 2 inches long to allow for easier insertion of the bolts through the glulam deck and the stiffener. It also allows for some dimensional movement of the wood materials due to changes in moisture content during its service life. One challenge noted was that approximately 20 thru-bolt locations, the insertion of the bolt conflicted with the steel diaphragms. Those bolts were field cut to a shorter length and installed, causing construction delays. The placement of the stiffener beams took approximately three man-hours. This included two installers and one crane operator. Figures 4.26, 4.27, 4.28, and 4.29 show the stiffeners being added to the superstructure.



Figure 4.26 Stiffeners were moved to the bridge deck using a crane.



Figure 4.27 Stiffeners were placed between each steel beam.



Figure 4.28 Stiffeners in place prior to deck installation.

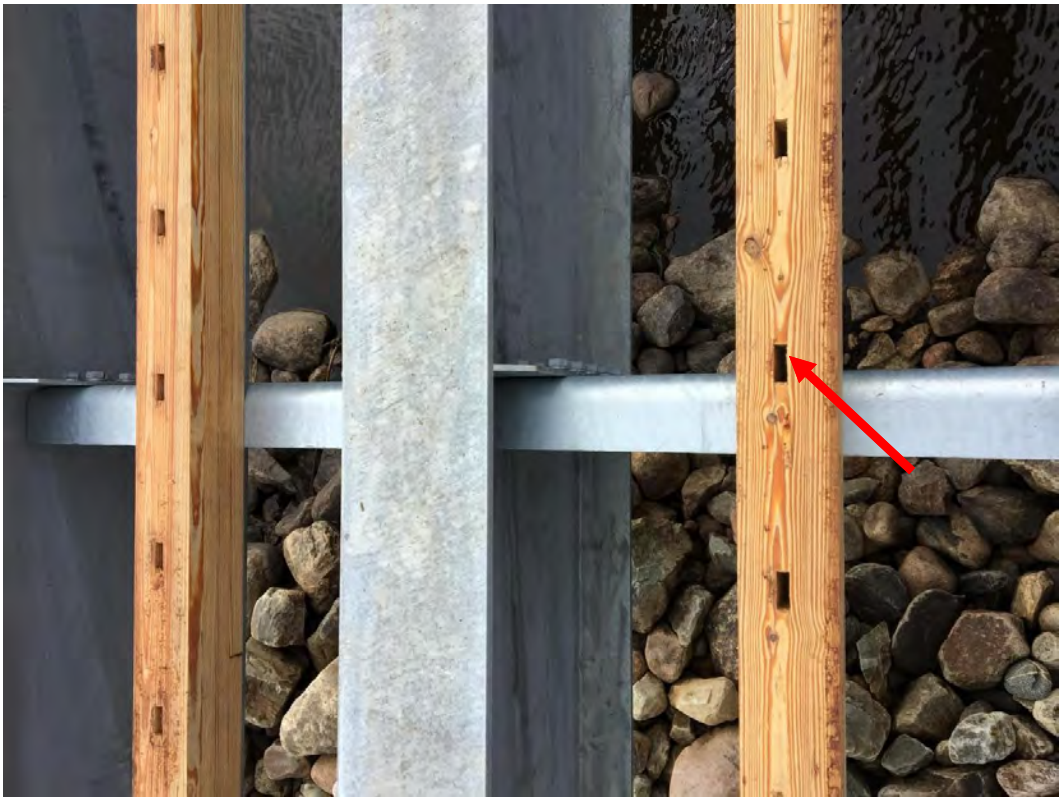


Figure 4.29 Machined slots for ease of bolt installation and dimensional movement.

Following placement of the stiffeners, the transverse glulam deck was installed onto the bridge, starting at the south end of the bridge and located on opposite end from the crane. Various techniques were used to align the panels into place and to ensure they were lined up end-to-end. This included the use of an excavator, sledge, and straps system using through bolts. The crew settled on the strap system where the crane lifted each panel into location and then pry bars were used to place the panels. A ratchet strap was also used to ensure the panels were tight edge-to-edge. The guard rail post hardware was also used to verify fit for the panels as they were installed. Deck clips were used to attach the glulam panels to the steel beams and bolts were used to connect the stiffeners to the glulam panels. Thirteen of fourteen panels were installed on day 1 and the remaining panel on day 2. The final panel had to be trimmed to width to account for as-built span dimensions between abutments. The panel cut edge was treated with several coats of copper naphthenate prior to installation. Fewer than five holes had to be drilled since they had not been drilled by the supplier. Each field drilled hole was treated with copper naphthenate preservative. Figures 4.30 to 4.42 show the deck during installation.



Figure 4.30 The first transverse panel was placed on the south side of the bridge.



Figure 4.31 A galvanized clip system was used to attach each panel to the steel beam.



Figure 4.32 Close-up of galvanized clip connection between panel and steel beam.

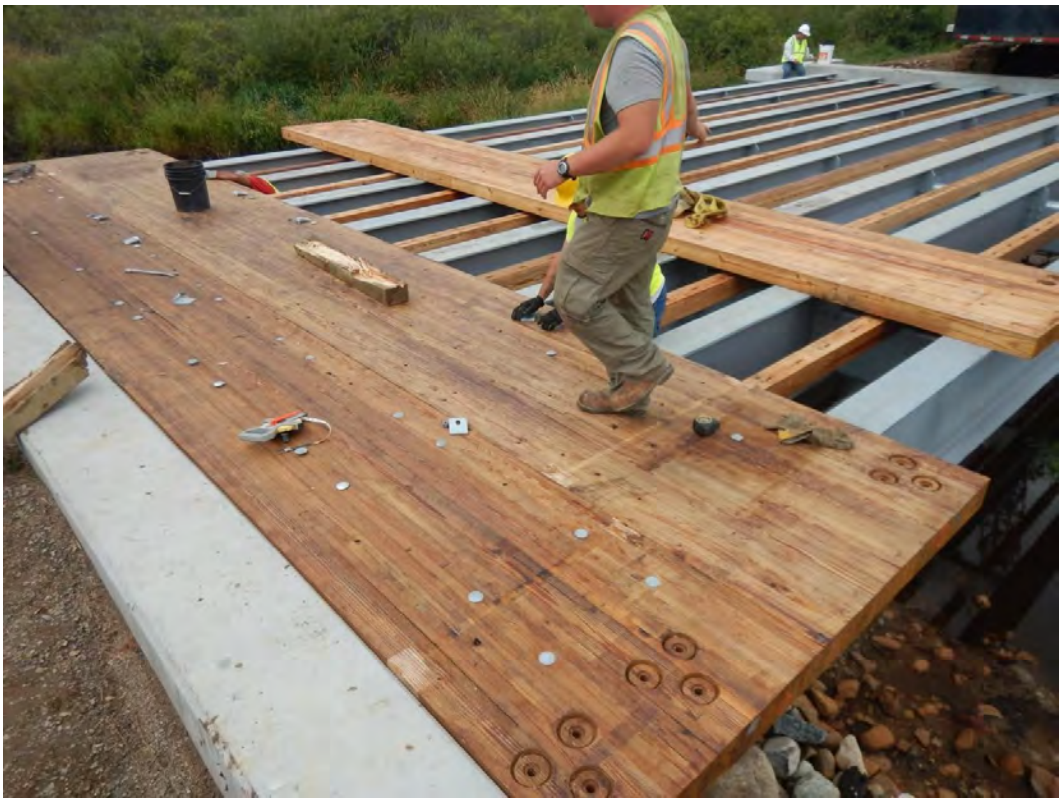


Figure 4.33 Additional panels were placed and connected to the steel beams.



Figure 4.34 Stiffener bolts were also installed during placement of the panels.



Figure 4.35 Panels were lifted using straps.



Figure 4.36 Close-up of glulam stiffener bolts, malleable washers and nuts.

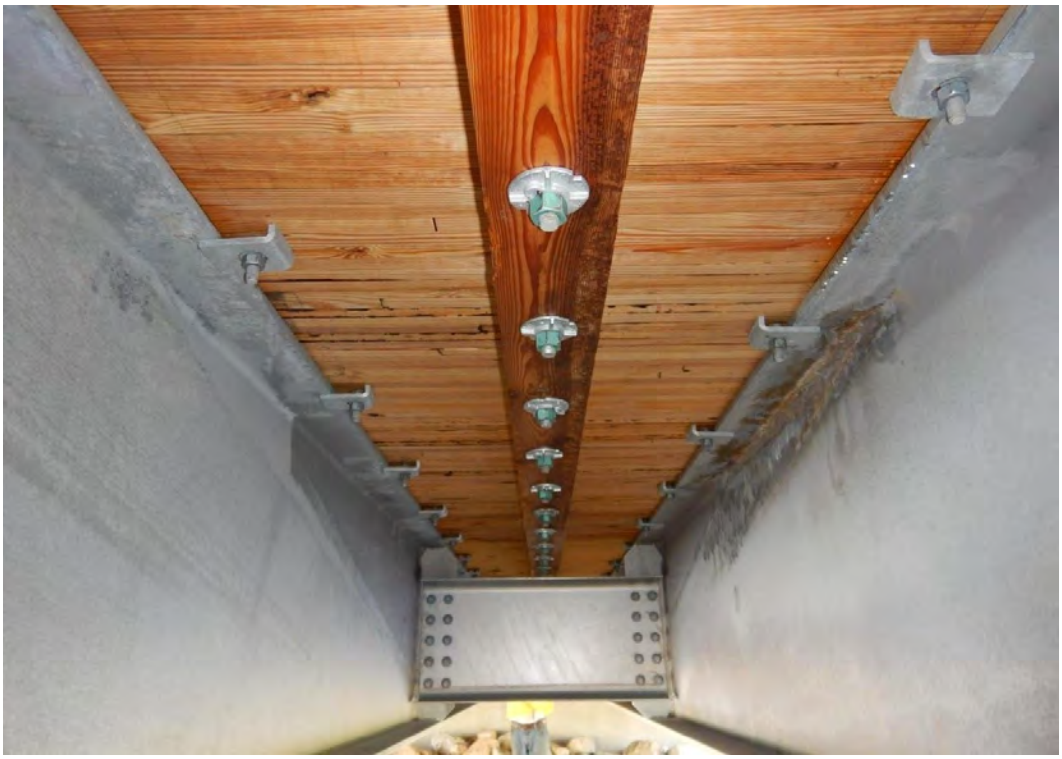


Figure 4.37 Bottom side connections.



Figure 4.38 Ongoing installation of transverse deck panels



Figure 4.39 Post hardware was test fit to ensure proper panel placement.



Figure 4.40 A ratchet tightening system was used to ensure tight edge-to-edge.



Figure 4.41 Ongoing panel placement during day 1 of panel installation.



Figure 4.42 A tarp was placed onto the bridge deck to keep panels dry during construction.

CRASH-TESTED RAIL POST, FLASHING MATERIALS

To improve long-term durability of the timber materials, a flashing system was designed and fabricated. The system was designed to wrap over the exposed end grain of the wood panels, and to also drain water away from any post hardware locations. They were installed using galvanized decking screws, and a washer head to keep the end 1/16-1/8 in away from the end grain of the panels. Previously, Figures 4.12 to 4.14 show the CAD drawings of the drip edge flashing sections and Figures 4.43 to 4.47 show the installation of these pieces. The flashing materials were installed prior to installation of the post hardware, shown in Figures 4.48 to 4.50. The bridge material supplier made an error and sent two top plates, creating additional weight during installation. Due to a short construction window, a decision was made by the St. Louis County crew to use the materials as supplied and not wait for the correct bottom plate. The TL2 railing design drawings in the first section of this report show the proper hardware for future projects.

Grinding of the top surface of the north concrete abutment was necessary to ensure a flat surface between the timber deck and the abutment face. A steel plate was attached over the abutment and timber deck. This detail is intended to minimize any potential gravel or deterioration at the joint between the abutment and the timber deck. An ice and water barrier was specified to be installed over the plate but it was installed under the plate instead. Figure 4.51 shows the installed plate and water shield on the north abutment.



Figure 4.43 Washers attached to panel end-grain to create air space under the flashing.



Figure 4.44 Flashing between rail posts was installed first using galvanized roofing nails.



Figure 4.45 Flashing at posts was installed after the between post flashings.



Figure 4.46 Installed flashing to protect timber deck edge.



Figure 4.47 Short flashing sections were installed at the bridge corners.



Figure 4.48 Post hardware plates were installed prior to post installation.



Figure 4.49 Post hardware installed over the flashing.



Figure 4.50 Fully installed flashing and rail posts.



Figure 4.51 Waterproofing membrane and steel cover plate.

BITUMINOUS OVERLAY, WATERPROOF MEMBRANE

Following installation of the timber deck, flashing, rail posts and end plates, the roadway approaches were prepared for a bituminous overlay. Based on the bridge approach design in the St. Louis County construction plan (Appendix D), fill, grading, and compacting was completed as shown in Figures 4.52 to 4.56.

Following that process, bituminous overlay was installed by KTM Paving of Hermantown, MN. A tack coat applied to the timber bridge deck prior to paving. Bituminous SP Type 12.5 Wearing Course Mix was used for the project. A minimum of 10 ft of approach was paved with this mix. The bituminous was applied in two layers, for a final bridge edge thickness of 2 inches and a centerline thickness of 5.5 inches. A bituminous membrane overlay was applied to the bridge deck by St. Louis County crews between the layers. The membrane was provided by ProtectoWrap Company (Denver, CO), through their distributor, Wausau Supply Company (Schofield, WI). The product used was M 400 A. Each roll was 60 in by 50 ft by 70 mil thickness. The process steps for installation included:

Process steps:

- The bridge deck remained uncovered for 1-2 days prior to paving. If a major rain event is expected, it was covered during the rain event only.
- Wood paving edges were put in place prior to paving and removed after completion.
- A tack coat was applied to the timber deck.
- A base layer of bituminous (approximately one inch) was applied to the deck and compacted. It required hand rolling and tamping at the bituminous edge.
- The bituminous needed to cool to 175-200 °F prior to adding the ProtectoWrap membrane.
- The ProtectoWrap membrane was rolled out on the top of the base layer and went to within 1 inch of the bituminous edge. The rolls are 5 ft wide by 50 long. Overlap was two inches on the edges and 4 inches on the ends. The wrap extended 10 ft beyond the bridge deck onto the approach roadway. Pressure rolling was done to ensure adhesion, especially at overlapped seams.
- The wear course of bituminous was applied at between 275-300 °F.
- Final compaction and removal of wood paving edges was completed with tapered bituminous edges where the wood paving edges were located.

To ensure a paving edge on this curbless rail system, a temporary timber edge was installed prior to overlay. This is shown in Figures 4.57 to 4.59. It was then removed following the paving process. Figures 4.60 to 4.70 show the paving process and the installation of the waterproof reinforcing membrane.



Figure 4.52 Leveling the approach prior to bituminous installation.



Figure 4.53 Shaping and leveling the approach prior to bituminous installation.



Figure 4.54 Shaping in preparation of the bituminous wedge.



Figure 4.55 Vibratory compaction of the approach prior to bituminous installation.



Figure 4.56 Prepared approach prior to paving.



Figure 4.57 A temporary wood paving edge was developed and installed prior to overlay.



Figure 4.58 A wood paving edge close-up prior to overlay.



Figure 4.59 The bridge deck was swept clean, paving edge installed and ready for paving.



Figure 4.60 Multiple layers of bituminous were placed and compacted to create a wedge before the bridge.



Figure 4.61 Both approaches were prepared with a bituminous wedge.



Figure 4.62 A tack coat was applied to the timber deck surface and the bituminous wedge.



Figure 4.63 First layer of bituminous overlay being deposited onto timber deck.



Figure 4.64 Overlay work along paving edge.



Figure 4.65 Hand tamping of bituminous along paving edge.



Figure 4.66 Installation of waterproof membrane between layers of bituminous.



Figure 4.67 Each row of waterproof membrane was overlapped by 4 inches according to specifications.



Figure 4.68 Multiple rows of waterproof membrane installed on top of the bituminous layer.



Figure 4.69 A second layer of bituminous overlay was added on top of the membrane.



Figure 4.70 Second layer of bituminous added to the membrane.

GUARD RAIL, POST CAPS

Following paving, the temporary paving edges were removed from the bridge deck. The railing was installed according to the construction plan and design details. The guard rails were installed and attached to the bridge rails. Finally, a plastic cap was installed on top of each timber post to protect it from precipitation that can cause deterioration. Figures 4.71 to 4.75 show the bridge railing installation and connection to roadway guard rails.



Figure 4.71 Glulam railing installation.



Figure 4.72 Glulam rail installation.



Figure 4.73 Side view showing TL2 curbless rail system used on this bridge and the installed plastic cap for moisture protection.



Figure 4.74 Guard rail attached to the glulam rail system.



Figure 4.75 Guard rail on bridge approach.

Following completion of the bridge and approach guard rails, the road was opened for traffic. Figures 4.76 to 4.78 show the completed roadway and bridge.



Figure 4.76 Roadway open for traffic facing to the south.



Figure 4.77 Underside view of completed bridge.



Figure 4.78 Side view of completed superstructure.

4.2.1.4 Construction Time-Lapse Video

A Brinno Model TLC200 Pro camera was installed at the time work was initiated on the abutment. It was placed on a post in near proximity to the southeastern corner of the bridge project. Time-lapse photos were taken every five minutes during daylight hours during the construction project. A secure digital memory card was used to store the images. During construction, the card was replaced weekly. Unfortunately, a camera malfunction occurred during the installation of the glulam timber deck and railing posts. Following completion of construction, all images were then combined into a construction video that is available at: https://www.cloudvault.usda.gov/index.php/s/2Y9QV4vAKHzUzXh

4.2.1.5 Construction Lessons Learned

During the project design, bid, and construction process, significant lessons were learned that could support improvements in future timber bridge construction projects in Minnesota. These include:

1. This was a challenging site location due to the inherent river flow direction, water levels and weather. The river flow required significant site improvements, such as a sheet pile retaining wall and improved bank work. Further, culverts were installed under both road approaches to handle potential water flow and other drainage. The abutment work was done in late winter and spring of 2018 to ensure that the construction crew was out of the river by June 1. The high-water levels during the concrete work resulted in significant additional substructure costs, plus it resulted in modification to the abutment dimensions. For these reasons, the cost data and

estimates for alternate designs were limited to the superstructure of the bridge. This included the steel girders, transverse glulam deck, railings, and bituminous overlay. Labor and construction costs for deconstruction, site preparation, abutments, and other roadway work was not included in the data.

2. This project was done by St. Louis County bridge crews. At various times, both the north and south crews participated. Based on the bridge location, the travel time was approximately 60 minutes from Hibbing, Minnesota and 90 min from Pike Lake, Minnesota. These crews were responsible for all construction at the site, including deconstruction, site preparation, gravel delivery, abutment preparation, structural member installation, and final roadwork. The bituminous overlay and the approach guard rail installation was contracted and completed by an external vendor.
3. Improved bridge timber bid documents – It is suggested that a complete bid package be used and developed for purchase of the timber bridge materials. In this project, simple plans were (shown in Appendix B) were provided to potential timber materials suppliers. Additional specifications could include scope/description, qualification of bidder, design (calculations and load rating), shop drawings and bridge plans, material specifications, manufacturing specifications, measurement and payment.
4. The bids received allowed the construction team to select the lowest cost supplier for both the steel girders and the timber deck. For the steel girders, bids received showed that painted options of beams were $2,250 – $7,020 less than the hot dip galvanized system. The glulam timber deck with TL2 glulam railings was less cost than a dowel-laminated timber deck with a TL2 bridge rail by approximately $2,500-4,000, depending on the glulam bid. Further, the dowel-laminated system does not have official crash-tested approval. The county selected southern yellow pine glulam for this project. The selection of Douglas fir glulam would have reduced the cost by approximately $1,500.
5. Communication Meetings. While meetings were held with the project engineer and bridge supervisor in advance of the project, it is recommended that information be shared with the construction crew. This should include the bridge materials supplier, the county engineering staff, bridge superintendent and bridge foreman/crew. It would create additional awareness and familiarity with plan details, construction techniques, and a question/answer session.
6. In this project, slight changes were made to the bridge abutments during construction, resulting in a slightly decreased bridge span. However, this information was not communicated to the research team. Improved communication may have allowed the bridge designer and the timber fabricator to adjust the panel dimensions and eliminate the need to field cut the last timber panel. While the field cut was treated on the construction site with copper naphthenate preservative, it is not as effective as pressure treatment at the fabricator.
7. The timber material and hardware supplier made a mistake by sending two top anchor plates for the railings, instead of one top and one bottom anchor plate. By using top anchor plates for both the top and the bottom, it resulted in increased weight and more difficulty during installation.
8. Interviews with the county bridge superintendent, the bridge construction foreman, and the bridge construction crew resulted in good feedback for this project. Specifically, they identified the positive impact of having all holes pre-drilled, which significantly resulted in shorter installation times. This also affirmed the importance of having slots instead of holes pre-drilled into the stiffener beams, as it allowed for easy installation. Other benefits noted included rapid

overall construction, low odors on the job site, minimal on-site fabrication, and a quiet construction site. They noted the negative to cutting the panel to size on site, the increased weight in the guard rail anchor plates (resulting from using a top plate for the bottom plate based on supplier error). They reported that the membrane that was placed between layers was very simple and easier than expected. It took less than one-man hour to install.

9. Perhaps the most valuable aspect to the timber construction is a compressed construction cycle. For this project, steel beams were placed and installed in five workdays, the timber deck completed in four workdays, railing posts, hardware, and rails in three workdays. While this project was significantly delayed due to other aspects, the actual construction time was minimized.

4.3 COST SUMMARY AND COMPARISON

4.3.1 As-built Design: Steel Girders and Transverse Glulam Panels

One of the goals of this project was to track and compare costs for this bridge as compared to other options. Table 4.4 provides cost estimates for the superstructure of this bridge, to include the steel beams, glulam panels, railings, durability details, and bituminous overlay. The completion of the abutments was the zero cost point for this bridge. This simplifies the cost tracking and comparisons for the project, since there was substantial site work and other complications that were site and weather specific. The construction progress was documented and the duration for each installation was:

- Steel beam installation (5 workdays)
- Timber deck installation (4 workdays)
- Railing posts, hardware (3 workdays)
- Bituminous overlay (1 workday)

Table 4.4 Cost breakdown for St. Louis County Bridge 516.

Category	Materials	Labor	Total
Superstructure – Steel[1]	$99,800	$10,735	$110,535
Superstructure – Glulam southern yellow pine, penta treatment[2]	$72,316	$9361	$81,677
Superstructure – Abutment steel plate	$3,210	$450	$3,660
Superstructure – Wearing Surface	$22,276 (installed)	$1,350	$23,626
Superstructure – Waterproof membrane	$2,411	$125	$2,536
Superstructure – Deck flashing	$856	$500	$1,356
Superstructure – Miscellaneous supplies	$400		$400
Superstructure Total	**$222,619**	**$22,521**	**$245,140**
Guard Rails - Steel	$21,350 (Installed)		$21,350

Notes:
[1]Paint Options: deduct $2,250 for zinc primer with epoxy intermediate coat and urethane topcoat; deduct $7,020 for epoxy primer and urethane topcoat
[2]Glulam Options: deduct $1,417 for Douglas fir; add $2,414 for dowel-laminated panels with glulam bridge rails

4.3.2 Alternative Design: Rolled Steel Beam with Concrete Deck

Additional cost comparisons/engineer's estimates were completed by LHB Engineering. This engineer's estimate was based on a 57.33-ft-long, 36-in steel wide flange beam span (55.17 ft bearing to bearing) with a 9-in concrete deck and a combination concrete and steel barrier. The general criteria used for determining estimate and unit process was:

- Estimate is built off as-designed abutments for SLC Bridge #516. The estimate accounts for new superstructure and theoretical alterations to the as-designed abutments to support the new superstructure.
- 28 ft – 0 in roadway and 31 ft – 4 in bridge deck out-to-out width
- 6 lines of W30X99 (galvanized) at 5 ft - 5 ½ in spacing between beams
- One-hundred (100) feet of 10 in steel pile added to account for additional superstructure dead load from concrete deck.
- Two additional cubic yards of structural concrete added to account for deeper superstructure

Figure 4.79 shows the design transverse section. Table 4.5 is an estimate of quantities and cost.

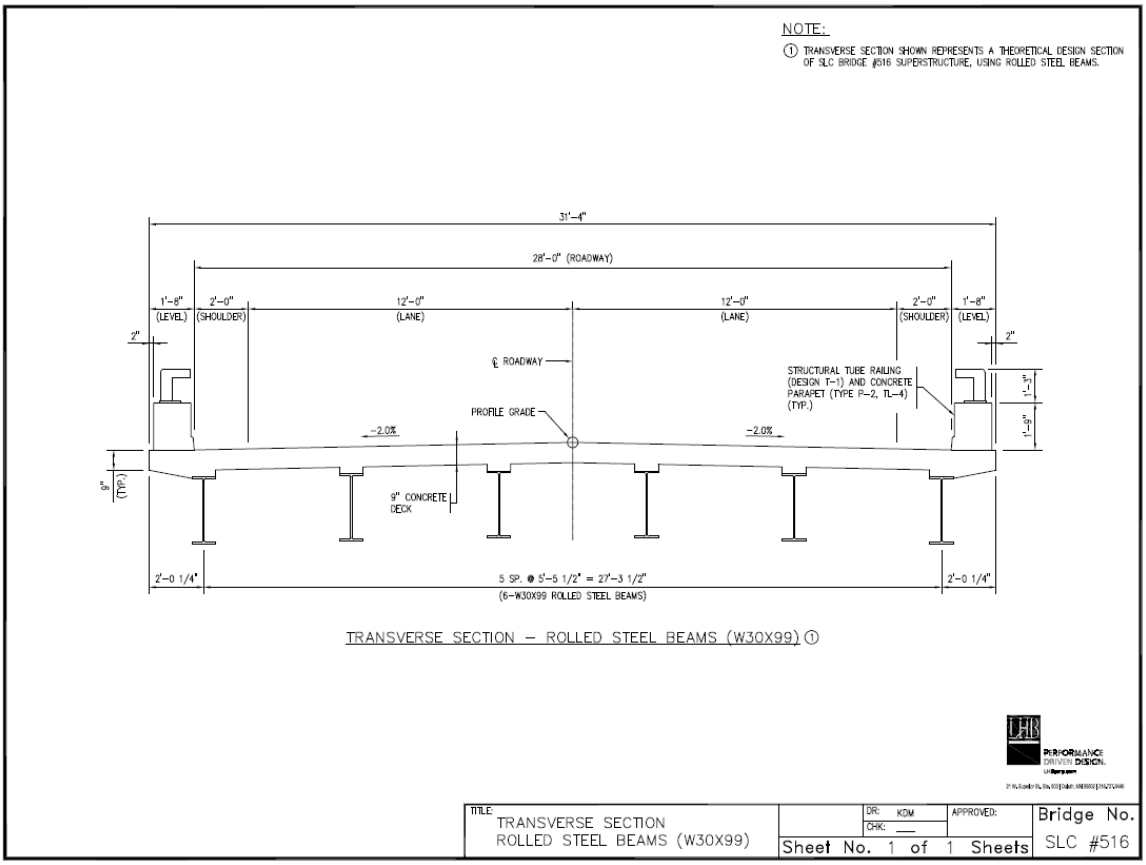


Figure 4.79 Transverse section of rolled steel beam with a concrete deck superstructure.

Table 4.5 Rolled steel beam with concrete deck bridge estimated quantities and costs

Item No.	Description	Units	Quantity	Unit Price	Total Price
2021.501	Mobilization	Lump Sum	1	$17,000.00	$17,000.00
2401.501	Structural Concrete (3b52) (P)	Cu Yd	2	$1,000.00	$2,000.00
2401.512	Bridge Slab Concrete (3y42-M) (P)	Sq. Ft	1796	$31.00	$55,676.00
2401.513	Type P-2 (Tl-4) Barrier Concrete (3s52) (P)	Lin Ft	115	$115.00	$13,225.00
2401.541	Reinforcement Bars (Epoxy Coated) (P)	Pound	12000	$1.75	$21,000.00
2401.541	Reinforcement Bars (Stainless-60ksi) (P)	Pound	320	$5.00	$1,600.00
2402.508	Structural Steel (3309)	Pound	40000	$3.25	$130,000.00
2402.584	Structural Tube Railing Design T-1 (P)	Lin Ft	103	$130.00	$13,390.00
2402.590	Elastomeric Bearing Pad Type 1	Each	12	$200.00	$2,400.00
Total					**$260,491.00**

Note:

- Items per the 2016 Edition of the Minnesota Department of Transportation Standard Specifications for Construction.
- It was estimated by LHB, Inc. that the superstructure construction duration would be 6-8 weeks minimum.

4.3.3 Alternative Design: Rectangular Prestressed Concrete Beam with Concrete Deck

Additional cost comparisons/engineer's estimates were completed by LHB Engineering. This engineer's estimate was based on a 57.33 ft prestressed concrete beam span (55.17 ft bearing to bearing) with 9 in concrete deck and a combination concrete and steel barrier. The general criteria used for determining estimate and unit process was:

- Estimate is built off as-designed abutments for SLC Bridge #516. The estimate accounts for new superstructure and theoretical alterations to the as-designed abutments to support the new superstructure.
- 28 ft – 0 in roadway and 31 ft – 4 in bridge deck out-to-out width
- 5 lines of 22 in rectangular prestressed concrete beams (22RB) at 6 ft – 8 in spacing between beams
- One-hundred (100) feet of 10 in steel pile added to account for additional superstructure dead load from concrete deck.

Figure 4.80 shows the transverse section of this design and Table 4.6 shows the statement of estimate quantities and cost.

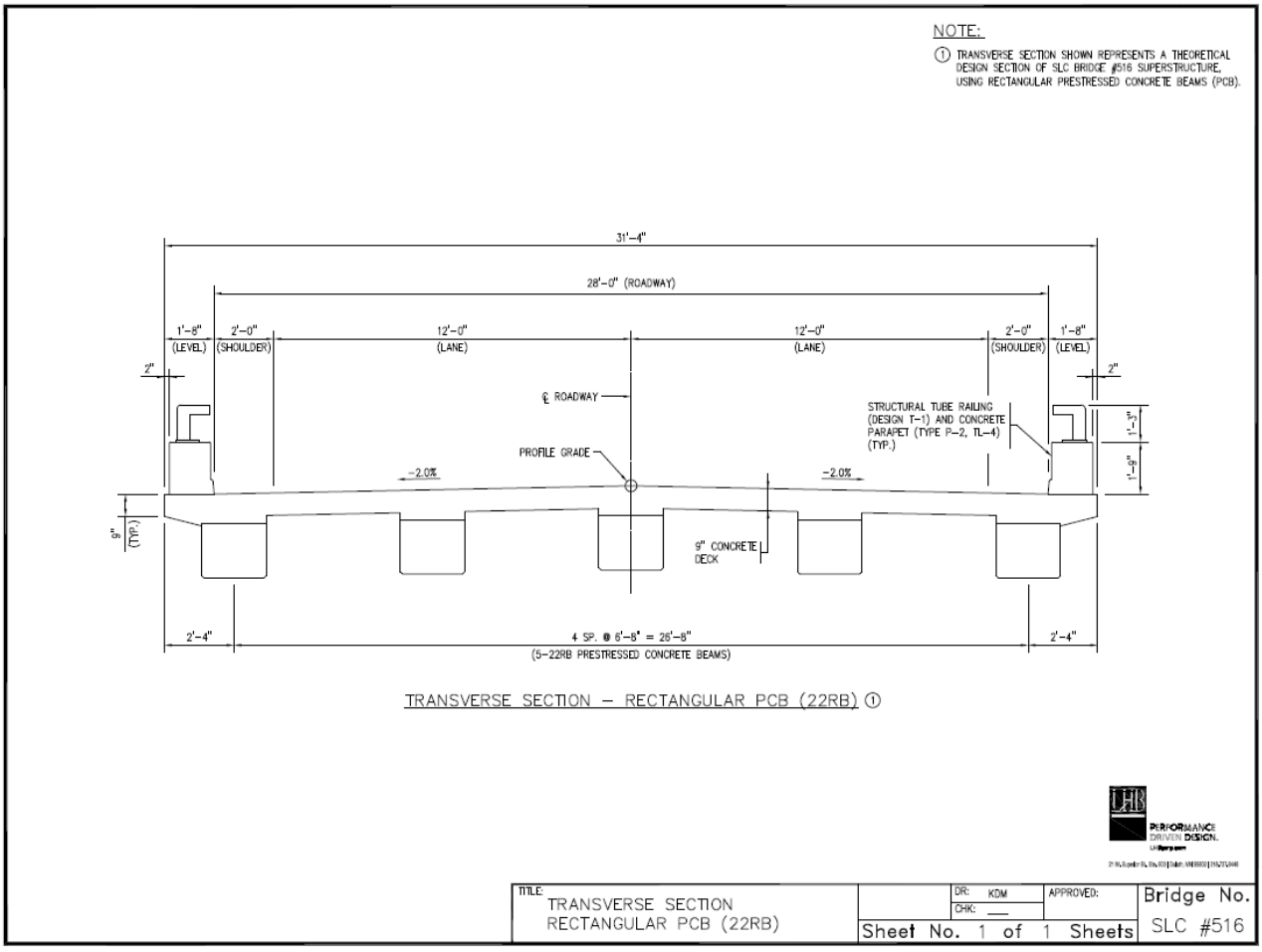


Figure 4.80 Transverse section of prestressed concrete beam with a concrete deck superstructure.

Table 4.6 Rolled steel beam with concrete deck bridge estimated quantities and costs.

Item No.	Description	Units	Quantity	Unit Price	Total Price
2021.501	Mobilization	Lump Sum	1	$13,000.00	$13,000.00
2401.512	Bridge Slab Concrete (3y42-M) (P)	Sq. Ft	1796	$31.00	$55,676.00
2401.513	Type P-2 (Tl-4) Barrier Concrete (3s52) (P)	Lin Ft	115	$115.00	$13,225.00
2401.541	Reinforcement Bars (Epoxy Coated) (P)	Pound	12000	$1.75	$21,000.00
2401.541	Reinforcement Bars (Stainless-60ksi) (P)	Pound	320	$5.00	$1,600.00
2402.584	Structural Tube Railing Design T-1 (P)	Lin Ft	103	$130.00	$13,390.00
2402.590	Elastomeric Bearing Pad Type 1	Each	10	$200.00	$2,000.00
2405.502	Prestressed Concrete Beams 22rb (P)	Lin Ft	282	$290.00	$81,780.00
2452.603	Steel H-Piling 10"	Lin Ft	100	$42.00	$4,200.00
Total					**$205,871.00**

Note:

- Items per the 2016 Edition of the Minnesota Department of Transportation Standard Specifications for Construction.
- It was estimated by LHB that the superstructure construction duration would be 6-8 weeks minimum.

Life-cycle cost assessments (LCCA) are often completed for transportation construction projects to assess the full service life costs for these projects. For this project, the comparisons for LCCA were limited to the superstructure construction and maintenance costs. Other LCCA estimates may include the cost of inspection and user costs.

For the as-built timber design and the two concrete alternatives, the following information was projected. This includes the initial construction costs, and rehabilitation costs for both the first and second rehabilitation. For this project, an estimated life of the bridge was estimated at 75 years. For this case, deck rehabilitation was estimated at 25 and 50 years for the timber project and 25 and 50 years for the concrete deck project. Estimates of deck repairs was estimated at $30,000 (2018 dollars) was estimated at 25 years and 50 years for the timber deck and at 50 years for the concrete deck options. Repair and rehabilitation options for the concrete deck could include repair of potholes, shallow overlay, and bridge deck replacement. Further maintenance could include pothole repairs at 10-year time intervals.

4.4 LIFE-CYCLE ANALYSIS

A preliminary, screening cradle-to-gate life-cycle assessment (LCA) was completed for St. Louis County, Minnesota bridge 516, which was constructed approximately 7.4 miles W/SW of Babbitt, Minnesota over the Embarrass River. The LCA utilized data from the bill of materials (BOM) and construction drawings, which were provided by the project team.

The system boundary included material and fuel consumption for timber and steel structural materials fabrication; material and fuel consumption for fabrication of steel hardware, bituminous overlay, and related components; and transport of materials to the construction site. Because this preliminary screening LCA study was cradle-to-gate, use phase activities and disposal/recycling of the timber bridge were excluded. Most of the life-cycle inventory (LCI) data was secondary data from the DATASMART LCI database (LTS, 2019a). This study also used the cut-off approach method for recycling and utilized the LTS 2019 method (LTS, 2019b) to translate the LCI data into environmental impacts, which combines the ReCiPe Endpoint (H) *v1.03* method's (Huijbregts et al., 2017) three endpoint categories (Human Health, Ecosystems, Resources) with the Cumulative Energy Demand, Climate Change, and Water Use impact categories.

A screening LCA is helpful to identify where in the product life cycle most environmental impacts occur, as well as which environmental areas are most impacted. This helps in the definition of the goal and scope of future work, if desirable. The screening LCA may also serve as a guide for a full LCA and allow for the refinement of the goal and scope moving forward, while forming the basis of the model for the full LCA. Since a screening-level LCA may use simplified assumptions, the results are only as accurate as those assumptions.

This study was modeled using *SimaPro v9.0* LCA software (Pré, 2016) and follows International Organization for Standardization (ISO) 14044 guidelines (ISO, 2006a) for internal screening LCAs; however, this LCA is not ISO-approved and is not suitable for external statements or documentation. Screening-level LCAs are used for gathering and analyzing internal information and allow for assumptions and the use of proxy data and do not usually include the exhaustive sensitivity, consistency, or uncertainty analyses required to comply with ISO 14044 guidelines for public disclosure.

4.4.1 GOAL AND SCOPE DEFINITION

The first phase of an LCA defines the goal and scope of the study. According to ISO 14044, the goal of the study should clearly specify the intended application, reasons for carrying out the study, the intended audience, and whether the results are intended to be disclosed to the public. The scope of the study describes the most important aspects of the study, including the functional unit, system boundaries, cut-off criterion, allocation, impact assessment method assumptions, and limitations. The objective of this study was to determine the potential environmental impacts of St. Louis County, Minnesota bridge 516. The results could be used to inform the Minnesota Department of Transportation (MnDOT) and their stakeholders of the environmental profile of the bridge.

4.4.1.1 Function

The function of the bridge is to support automobile, pedestrian, and bicycle traffic over the Embarrass River.

4.4.1.2 Functional Unit

A functional unit identifies the primary function(s) of a system based on which alternative systems are considered functionally equivalent (ISO, 2006b). This facilitates the determination of reference flows for each system, which in turn facilitates the comparison of two or more systems. Based on the identified function, the following functional unit was used to determine the reference flows: one steel girder and glulam bridge with a width of 30 ft and a length of 54 ft.

4.4.1.3 System Boundaries

System boundaries are established in LCA in order to include the significant life-cycle stages and unit processes, as well as the associated environmental flows in the analysis. This lays the groundwork for a meaningful assessment where all important life-cycle stages, and the flows associated with each alternative, are considered. Included in the system boundary of this study are:

- Material and fuel consumption for timber and structural steel materials fabrication;
- Material and fuel consumption for fabrication of steel hardware and related components;
- Material and fuel consumption for bituminous overlay; and
- Transport of materials to the construction site.

4.4.2 Excluded Processes

Because this preliminary screening LCA study is cradle-to-gate, use-phase activities and disposal/recycling of the bridge components are excluded. Also, the use of cold galvanizing compound was excluded because no LCI data exists; materials packaging is also excluded from the study. Typically, in an LCA, some aspects within the set boundaries are excluded due to statistical insignificance or irrelevancy to the goal and scope. Thus, the following impacts were also excluded from the scope and boundaries for this study:

- Human activities (e.g., employee travel to and from work); and
- Services (e.g., the use of purchased marketing, consultancy services and business travel).

4.4.3 Cut-off Criteria

Cut-off criteria are often used in LCA practice for the selection of processes or flows to be included in the system boundary. The processes or flows below these cut-offs or thresholds are excluded from the study. Several criteria are used in LCA practice to decide which inputs are to be considered, including mass, energy and environmental relevance. In the current study, every effort was made to include all the flows associated with the processes studied. During the interpretation phase, we used 1% of environmental load as a cut-off.

4.4.4 Allocation and Recycling

While conducting an LCA, if the life cycles of more than one product are connected, allocation of the process inputs should be avoided by using the system boundary expansion approach. If allocation cannot be avoided, an allocation method – based on physical causality (mass or energy content, for example) or any other relationship, such as economic value – should be used (ISO, 2006a). All allocations were completed based on mass.

This study used the cut-off approach method for recycling. According to this approach, the first life of a material bears the environmental burdens of its production (e.g., raw material extraction and processing) and the second life bears the burdens of refurbishment (e.g., collection and refining of scrap). The burdens from waste treatment are taken by the life after which they occur (Frischknecht, 2010). Given that DATASMART LCI data (LTS, 2019a) uses the cut-off approach for recycling, it is considered a reasonable default.

4.4.5 Impact Assessment Method

Impact assessment methods are used to convert LCI data (environmental emissions and raw material extractions) into a set of environmental impacts. ISO 14044 (ISO, 2006a) does not dictate which impact assessment method to use for a comparative assertion; however, the chosen method needs to be an internationally-accepted method if the results are intended to be used to support a comparative assertion disclosed to the public.

The impact assessment method used for this study was the LTS 2019 method (LTS, 2019b), which combines the ReCiPe Endpoint (H) *v1.03* method's (Huijbregts et al., 2017) three endpoint categories (Human Health, Ecosystems, Resources) with the Cumulative Energy Demand (CED) *v1.11* (Frischknecht, et al. 2007), Climate Change IPCC 2013 GWP 100a *v1.03* (IPCC, 2013), and Water Use (Huijbregts et al., 2017) impact categories. These six categories have been found to be of interest and readily understandable to readers of LCA reports. The LTS 2019 method (LTS, 2019b) is summarized in Table 4.7.

Table 4.7 LTS 2019 method (LTS, 2019b).

Impact Category	Method	Unit
Human Health	ReCiPe 2016 Endpoint (H) *v1.03*	DALY
Ecosystems	ReCiPe 2016 Endpoint (H) *v1.03*	species*yr
Resources	ReCiPe 2016 Endpoint (H) *v1.03*	$
Cumulative Energy Demand	CED *v1.11*	MJ
Climate Change	IPCC 2013 GWP 100a *v1.03*	kg CO_2 eq.
Water Use	ReCiPe 2016 Endpoint (H) *v1.03*	m^3

ReCiPe is one of the most recent and updated impact assessment methods available to LCA practitioners. The method addresses several environmental concerns at the midpoint level and then aggregates the midpoints into a set of three endpoint categories. Endpoint characterization models the impact on Areas of Protection (i.e., on human health, ecosystems, and resources). In other words, endpoint is a measure of the damage – at the end of the cause-effect chain – caused by a stressor in terms of human life-years lost and the years lived disabled, species disappeared, and resources lost.

The Cumulative Energy Demand (CED) of a product is the direct and indirect energy use throughout the life cycle, including the energy consumed during the extraction, manufacturing, and disposal. The CED method considers both renewable and non-renewable energy and the direct and indirect energy consumption.

The IPCC 2013 method for assessing the Global Warming Potential (i.e., Climate Change) was developed by International Panel on Climate Change (IPCC). It is one of the most widely used methods to estimate climate change potential of global warming gases in LCA studies. The global warming factors have been developed for 20-, 100-, and 500-year time horizons to address the global warming potential of emissions in the short as well as long term. This study uses the climate change factors for the 100-year time horizon.

4.4.5.1 Endpoint Categories

- **Human Health.** In this category, the damage analysis links the six midpoint categories (Climate Change, Human Toxicity, Photochemical Oxidant Formation, Particulate Matter Formation, Ionizing Radiation, and Ozone Depletion) to the Disability Adjusted Life Years (DALYs). The DALY tool is primarily a disability weighting scale of 0 – 1, where 0 represents perfect health and 1 represents death.
- **Ecosystems.** The damage to ecosystems is measured by calculating the species that disappear in each time period and area. The unit of damage assessment is species lost in one year (species*yr). The midpoint impact potentials that apply to ecosystem quality are: Climate Change, Terrestrial Acidification, Freshwater Eutrophication, Ecotoxicity, Agricultural Land Occupation, Urban Land Occupation, and Natural Land Transformation.
- **Resources.** The two midpoint categories contributing to the resources category are Fossil Depletion and Metal Depletion. The quantification of the damage is based on the marginal increase of cost due to the extraction of resources, measured as dollars per kilogram ($/kg).

4.4.5.2 Midpoint Categories

- **Cumulative Energy Demand.** This category includes non-renewable (fossil and nuclear) and renewable (biomass, water, solar, wind, and geothermal) energy sources. Characterization factors are based on the upper (or higher) heating value. Characterization factors are expressed as equivalent megajoules (MJ).
- **Climate Change.** There are several gaseous emissions that cause global warming, including carbon dioxide, methane, nitrous oxides, and fluorinated gases. This category combines the effect of the periods of time that the various greenhouse gases remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared. The global warming potential is measured as kg

equivalents of radiation CO_2 (i.e., the relative global warming potential of a gas as compared to CO_2). The IPCC model with a 100-year time horizon is used for characterization. The uptake of CO_2 from the air (i.e., sequestration of CO_2 by plants) and the subsequent emission of biogenic CO_2 (from the burning of biomass) is not included.

- **Water Use.** Water use is based on water consumption, which is the use of water in such a way that the water is evaporated, incorporated into products, transferred to other watersheds, or disposed into the sea (Falkenmark et al. 2004). Water that has been consumed, therefore, is no longer available in the watershed of origin for humans nor for ecosystems.

4.4.6 Limitations of the Study

This is a cradle-to-gate screening LCA using primary and secondary data. To make external claims per ISO 14044 (ISO, 2006a), this study would need to be expanded to include:

- Cradle-to-grave system boundary (to include distribution transport, use, and end-of-life phases);
- Primary data for key processes;
- Additional sensitivity analyses;
- Data quality requirements and indicators; and
- Critical review.

4.4.7 Limitations of LCA Methodology

LCA's ability to consider the entire life cycle of a product makes it an attractive tool for the assessment of potential environmental impacts. Nevertheless, like other environmental management analysis tools, LCA has several limitations.

With current availability of data, it is nearly impossible to follow the entire supply chain associated with the product life in a company- or manufacturer-specific way. Instead, almost all processes within the supply chains are modeled using average industry data with varying amounts of specificity (e.g., data on a more-or-less specific technology or region). This makes it difficult to accurately determine how well the unit process data represents the actual factors in the products' life cycle. It also makes it difficult to know in which region the processes are found.

Furthermore, LCA is based on a linear extrapolation of emissions with the assumption that all the emissions contribute to an environmental effect. This is contrary to threshold-driven environmental and toxicological mechanisms. Thus, while the linear extrapolation is a reasonable approach for more global and regional impact categories such as Global Warming Potential (GWP) and Acidification, it may not accurately represent the actual on-the-ground human- and ecotoxicity-related impacts.

Additionally, even if the study has been critically reviewed, it should be noted that, as for any LCA, the impact assessment results generated for this study are relative expressions and do not predict impacts on category midpoints, exceeding thresholds, or risks. It should also be noted that, even though LCA covers a wide range of environmental impact categories, some types of environmental impacts (e.g., noise, social, and economic impacts) are typically not included in LCA.

4.4.8 Life-Cycle Inventory

The second phase of an LCA is to collect life-cycle inventory (LCI) data. LCI data contains the details of the resources flowing into a process and the emissions flowing from a process to air, soil, and water.

4.4.8.1 LCI Data Collection

As previously noted, only some primary inventory data was used in this study. The primary data was mainly for transportation inputs from the glulam manufacturing and asphalt plants to the bridge construction site. Secondary/background data was used for the remaining processes, with most it readily available in the DATASMART LCI database (LTS, 2019a).

TIMBER MATERIALS PRODUCTION

The deck panels (5.125-in x 37-in x 30-ft and 5.125-in x 48-in x 30-ft), stiffeners, posts, blocking, and rails were all manufactured from pentachlorophenol-treated glued timber (glulam) designed for outdoor use. The glulam was assumed to be manufactured from softwood at 20% moisture content and bonded with a melamine formaldehyde resin. It was assumed that the yield loss in manufacturing the glulam products was 10% by weight. Selected life-cycle inventory data for the pentachlorophenol-treated glulam are listed in Table 4.8.

Table 4.8 Selected life-cycle inventory data for 1,000 ft3 of pentachlorophenol-treated glulam.

Description	LCI Data Source	Quantity	Unit
Water	Water, unspecified natural origin, US	1.3×10^{0}	gal
LPG	Liquefied petroleum gas, combusted in industrial boiler NREL/US U	7.9×10^{-1}	gal
Diesel	Diesel, combusted in industrial equipment NREL/US U	1.9×10^{1}	gal
Gasoline	Gasoline, combusted in equipment NREL/US U	1.6×10^{0}	gal
Waste wood	Wood waste, unspecified, combusted in industrial boiler NREL/US U	5.5×10^{3}	lb.
Transport	Transport, lorry 3.5-16t, fleet average/US- US-EI U	7.3×10^{3}	ton-mi
Pentachlorophenol	LCA model	6.0×10^{2}	lb.
Glulam	Glued laminated timber, outdoor use, at plant/US- US-EI U	1.0×10^{3}	ft^3
Natural gas	Natural gas, combusted in industrial boiler NREL/US U	2.0×10^{3}	ft^3
Electricity	Electricity, medium voltage, at grid, 2015/US US-EI U	9.2×10^{2}	kWh

PENTACHLOROPHENOL-TREATMENT PROCESS

LCI data was not available for pentachlorophenol in the DATASMART LCI database, so a new process was created using data from a published study on LCA of treated utility poles (Bolin and Smith 2011). It was assumed that the yield of treated wood was 100% and the species mix was assumed to be 60% Southern pine and 40% Douglas fir with an average density of 39 pounds-per-cubic-foot (39 lb./ft^3). The pentachlorophenol retention was 0.6 lb./ft^3. Selected life-cycle inventory data for the pentachlorophenol chemical are listed in Table 4.9.

Table 4.9 Selected life-cycle inventory data for 1 lb. of pentachlorophenol.

Description	LCI Data Source	Quantity	Unit
Water	Water, unspecified natural origin, US	3.5×10^{0}	gal
Electricity	Electricity, medium voltage, at grid, 2015/US US-EI U	3.7×10^{-1}	kWh
Natural gas	Natural gas, processed, at plant NREL/US U	3.3×10^{0}	ft^3
Natural gas	Natural gas, combusted in industrial boiler NREL/US U	3.4×10^{0}	ft^3
Diesel	Diesel, at refinery/l NREL/US U	1.6×10^{0}	gal
Diesel	Diesel, combusted in industrial boiler NREL/US U	6.7×10^{-4}	gal
Fuel oil	Residual fuel oil, combusted in industrial boiler NREL/US U	2.8×10^{-2}	lb.
Coal	Bituminous coal, combusted in industrial boiler NREL/US U	2.2×10^{-2}	lb.
Transport	Transport, lorry 3.5-16t, fleet average/US- US-EI U	2.8×10^{-2}	ton-mi
Transport	Transport, train, diesel powered NREL/US U	5.3×10^{-1}	ton-mi

WELDED-PLATE ASSEMBLIES

The welded-plate assemblies were assumed to be manufactured from galvanized steel sheet with a density of 490 lb./ft^3, and their sizes were calculated from the drawings provided in Appendix C of the *Development of Cost-competitive Timber Bridge Designs for Long Term Performance, Task 3A Report* (Fosnacht et al. 2018).

DIAPHRAGMS

The bridge abutment and intermediate diaphragms were assumed to be manufactured from galvanized steel sheet with a density of 490 lb./ft^3, and their sizes were estimated from the drawings provided in Appendix A of the *Task 3A Report* (Fosnacht et al., 2018). The abutment diaphragms required 14 main (large) components and 28 stiffeners. The intermediate diaphragms required 21 main (large) components and 42 stiffeners. The inputs required for shaping/cutting/drilling the abutments were excluded.

STEEL SUPPORT BEAMS

Eight W30 x 108 steel beams (108 lbs./ft) were needed to manufacture the bridge. It was assumed the beams were 54.17-ft long and were manufactured from hot-rolled sheet steel with a density of 490 lb./ft3, which was then galvanized. The manufacturing yield loss was 10% by weight. Selected life-cycle inventory data for the steel support beams are listed in Table 4.10.

Table 4.10 Selected life-cycle inventory data for 18.33 kg of steel beam.

Description	LCI Data Source	Quantity	Unit
Steel	Hot rolled sheet, steel, at plant NREL/RNA U	20.2	kg
Galvanization process	Galvanization (zinc coating) of steel parts	0.787	m^2

SHEAR PLATE, DECK CLIPS, COVER PLATES, AND FLASHING

These items were assumed to be manufactured from galvanized steel sheet with a density of 490 lb./ft^3. The flashing was 22-gauge (.0299-in thick) with a width of 5 in.

WATERPROOF MEMBRANES

Both the waterproof membrane for the steel cover plates and bridge/deck waterproofing membrane were assumed to be manufactured from butadiene styrene sheeting with a weight of 0.26 lb./ft^2. Selected life-cycle inventory data for the waterproof membrane are listed in Table 4.11.

Table 4.11 Selected life-cycle inventory data for 1 kg of waterproof membrane.

Description	LCI Data Source	Quantity	Unit
Sand	Sand (in ground)	5.3×10^{-1}	kg
Shale	Shale (in ground)	6.8×10^{-1}	kg
Pitch	Proxy Pitch 100#/CN	1.8×10^{0}	kg
Pitch	Proxy Pitch 10#/CN	2.1×10^{-1}	kg
Styrene butadiene styrene	Proxy_SBS/CN	2.5×10^{-1}	kg
Polyester	Proxy_Polyester materials/CN	7.9×10^{-1}	kg
Insulation	Proxy_Glass wool heat insulation/CN	2.6×10^{-1}	kg
Polyethylene	Proxy_PE film/CN	1.1×10^{0}	g
Transport	Transport, train, average/CN U	1.1×10^{-1}	ton-km
Transport	Transport, lorry, 2-5t, suburb, average/CN S	1.0×10^{-1}	ton-km
Coal	Hard coal supply mix/CN US-EI U	3.9×10^{-1}	kg
Electricity	Electricity mix/CN US-EI U	9.5×10^{-2}	kWh

BITUMINOUS OVERLAY

The bituminous overlay was assumed to be asphalt with a density of 145 lb./ft^3. 321.62 ft^3 of asphalt was required to cover the bridge; however, asphalt for the bridge approaches was excluded from the study. Selected life-cycle inventory data for the bituminous overlay are listed in Table 4.12.

Table 4.12 Selected life-cycle inventory data for 1 kg of bituminous overlay (mastic asphalt).

Description	LCI Data Source	Quantity	Unit
Bitumen	Bitumen, at refinery/US* US-EI U	8.0×10^{-2}	kg
Diesel	Diesel, burned in building machine/GLO US-EI U	2.2×10^{-2}	MJ
Electricity	Electricity, medium voltage, at grid/CH* US-EI U	2.8×10^{-2}	kWh
Heat	Heat, light fuel oil, at industrial furnace 1MW/US* US-EI U	1.5×10^{0}	MJ
Limestone	Limestone, milled, packed, at plant/US* US-EI U	2.6×10^{-1}	kg
Sand	Sand, at mine/US* US-EI U	6.6×10^{-1}	kg
Transport	Transport, freight, rail/US- US-EI U	1.6×10^{-2}	ton-km
Transport	Transport, lorry 20-28t, fleet average/US* US-EI U	5.4×10^{-2}	ton-km

OTHER

It was assumed each railing post cap weighed 1 lb. and was manufactured from rigid polypropylene and the rubber spacers were manufactured from 0.125-in-thick synthetic rubber with a density of 0.0311 lb./in^3. All bolts, nuts, washers, and nails were manufactured from galvanized low-alloyed steel; the weight of individual pieces was estimated using the Bolt Weight Calculator (https://www.portlandbolt.com/technical/tools/bolt-weight-calculator/).

4.4.9 Electricity Mixes

The electricity usage was modeled using the 2015 average US electricity grid process from the DATASMART LCI database (LTS 2019a). (These values are taken from 2015 US Energy Information Administration (EIA) data.) The electricity grid mix is a mix of domestic production from various sources, and the average grid mix for the electricity datasets used in this study is shown in Table 4.13.

Table 4.13 Average electricity grid mix for the US

Electricity source	2015
Hard coal	33.17%
Oil	0.69%
Natural gas	32.70 % (47% shale)
Industrial gas	0.16%
Petroleum coke	0.16%
Nuclear	19.55%
Hydro	6.11%
Cogen	0.103%
Geothermal	0.39%
Solar PV	0.61%
Wind	4.68%
Canadian imports	0.31%
Mexican imports	0.03%

4.4.10 Data Quality

The quality of the data used in this preliminary LCA is reasonably accurate and representative of the processes modeled. However, Data Quality Requirements and Indicators (DQI) have not been assigned to this study. (This includes evaluation of data reliability, completeness, geographical correlations, further technological correlation, and sample size using the Pedigree Matrix (Weidema and Wesnaes, 1996; Frischknecht et al., 2004).)

4.4.11 Results of Life-Cycle Impact Assessment

The following sections summarize the key characterized results of the LCA including contribution analyses.

4.4.11.1 Bridge Life Cycle

Table 4.14 presents the life-cycle impacts for the completed SLC 516 bridge.

Table 4.14 Life-cycle impacts of the SLC 516 bridge using the LTS 2019 method (LTS, 2019b).

Damage Category	Unit	SLC 516 Bridge
Human Health	DALY	0.836
Ecosystems	species*yr	7.10×10^{-4}
Resources	$	7.97×10^{3}
Cumulative Energy Demand	MJ	1.92×10^{6}
Climate Change	kg CO_2 eq.	1.05×10^{5}
Water Use	m^3	654

4.4.11.2 Contribution Analysis

Contribution analyses identify the environmental hot-spots within the bridge system, which are the processes that contribute disproportionately to the overall life-cycle impacts of the system. The identification of hot-spots provides a deeper understanding of what is driving the environmental performance of the completed bridge and allows for the identification of opportunities for process improvement. The contribution analysis for the completed bridge is shown in Figure 4.81.

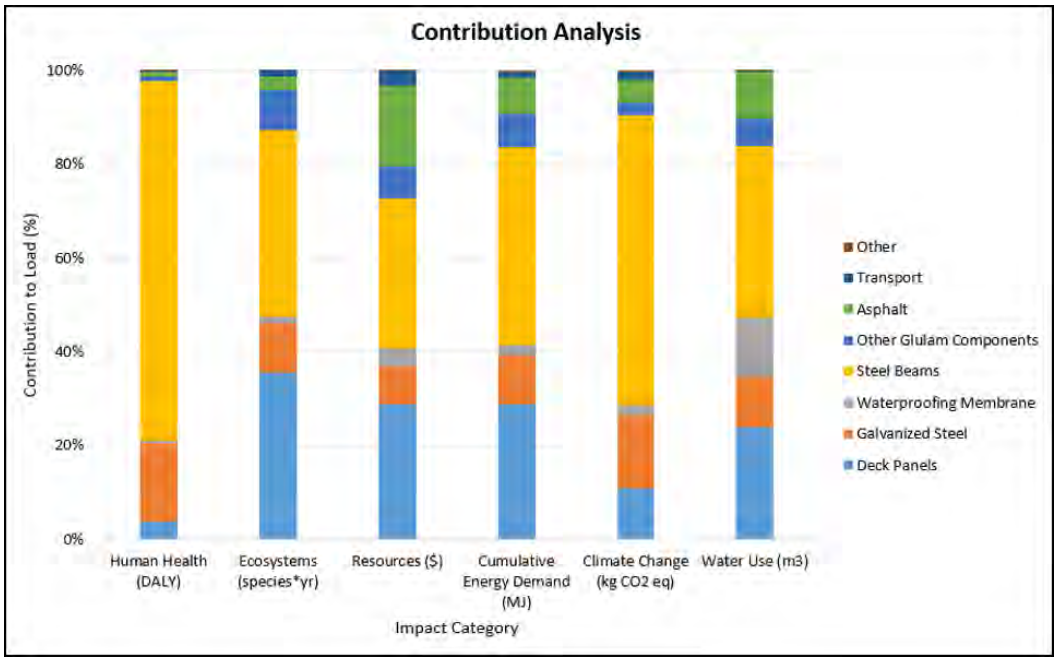


Figure 4.81 Contribution analysis for the completed SLC 516 bridge using the LTS 2019 method (LTS, 2019b).

As shown, production of the steel beam supports accounts for a large portion of the total impact in each impact category, contributing 77%, 40%, 32%, 42%, 62%, and 37% of the impacts in the Human Health, Ecosystems, Resources, Cumulative Energy Demand, Climate Change, and Water Use impact categories, respectively. The next largest contributor to the total impacts was the glulam deck panels, contributing 36%, 29%, 29%, and 24% of the impacts in the Ecosystems, Resources, Cumulative Energy Demand, and Water Use impact categories, respectively. The next largest contributor to overall impacts were the galvanized steel components (which excludes the steel beams), accounting for 17%, 10%, 10%, 16%, and 11% of the impacts in the Human Health, Ecosystems, Cumulative Energy Demand, Climate Change, and Water Use impact categories. The asphalt contributed between 1% and 17% of the impacts overall, with the highest total (17%) in the Resources impact category. The manufacture of the glulam stiffeners, posts, and rails ("Other Glulam Components") contributed a relatively minor amount to total impacts in all impact categories.

4.4.12 Life-Cycle Assessment Conclusion

The objective of the study was to understand the environmental impacts of the SLC 516 bridge on a cradle-to-gate basis. The steel beam supports account for the largest portion of total impacts in each impact category, ranging from 32% to 77%, while the glulam deck panels contribute 24% to 36% of the impacts in four of the six impact categories. The galvanized steel components and asphalt contribute an average of 12% and 7% of the impacts in each impact category, respectively.

CHAPTER 5: HENNEPIN COUNTY TIMBER BRIDGE CONSTRUCTION PROJECT

Based on the products from project tasks 1 and 2, potential MnDOT and county partners were identified for planning and construction of up to three beam or slab type bridges. A decision was subsequently made to complete two demonstration projects. In Task 3B, the project team partnered with Hennepin County, Minnesota on the design, construction and validation of a bridge that was constructed in the city of Dayton, Minnesota. This bridge was constructed by a Redstone Construction, LLC construction crew using a dowel-laminated timber deck using metal spikes. The research team worked with Hennepin County to track design, bidding, cost, and construction of the bridge. Funds from the project were not used for construction.

5.1 BACKGROUND

The new Hennepin County Bridge selected for this project is state bridge number 27C53, which replaced bridge L8081. It is located on County State Aid Highway 202 (Elm Creek Road) and crosses the Elm Creek River. It is a relatively low volume road with average daily traffic of 800 vehicles (2018). The original bridge superstructure was a longitudinal steel girder with transverse plank deck. Figures 5.1 to 5.6 show the bridge prior to removal. Figure 5.7 shows the location of the bridge. Appendix E contains the September 2018 Minnesota Structure Inventory Report for Bridge L8081. While the document shows it was constructed in 1973, it is likely that some of the piling and structural components may have been reutilized. The inventory report indicated that bridge condition required significant repairs or replacement after years in-service. In addition, the bridge was a single-lane bridge that did not safely meet the needs of the public motorists and encroached upon the natural stream conditions.

Funding for the construction of the project was provided by Hennepin County, Minnesota. The site work and construction were completed by Redstone Construction, LLC. The project team included Hennepin County, University of Minnesota Duluth Natural Resources Research Institute, US Forest Service Forest Products Laboratory, LHB Engineering and Iowa State University.

5.2 OBJECTIVE AND SCOPE

The objective of this task was to identify, design and construct a demonstration bridge using standard timber design options and to develop and incorporate design details focused on long-term performance and durability. The focus was a longitudinal dowel laminated deck with steel spikes superstructure which is a pre-fabricated panelized bridge system which reduced bridge construction times. On-site photo and time documentation were also completed for the construction. The project team collaborated with Hennepin County and other partners to demonstrate and validate the cost parameters associated with the project and compare them to preconstruction estimates. A life-cycle assessment was also completed based on the final superstructure design specifications for the bridge constructed. Finally, a detailed project report was completed that could be used to capture lessons

learned during the construction phase of the project. Research funds were not used for bridge construction.



Figure 5.1 Original steel girder bridge (L8081) that was replaced during this project.



Figure 5.2 Elm Creek Road and Hennepin County Bridge L8081 prior to removal



Figure 5.3 Superstructure condition for Hennepin County Bridge L8081.



Figure 5.4 Deteriorated steel girders in underside view of the superstructure for Hennepin County Bridge L8081.



Figure 5.5 Close up of steel girder bearing on timber pile and cap abutment for bridge L8081.



Figure 5.6 Transverse timber plank deck and steel railing system for bridge L8081.

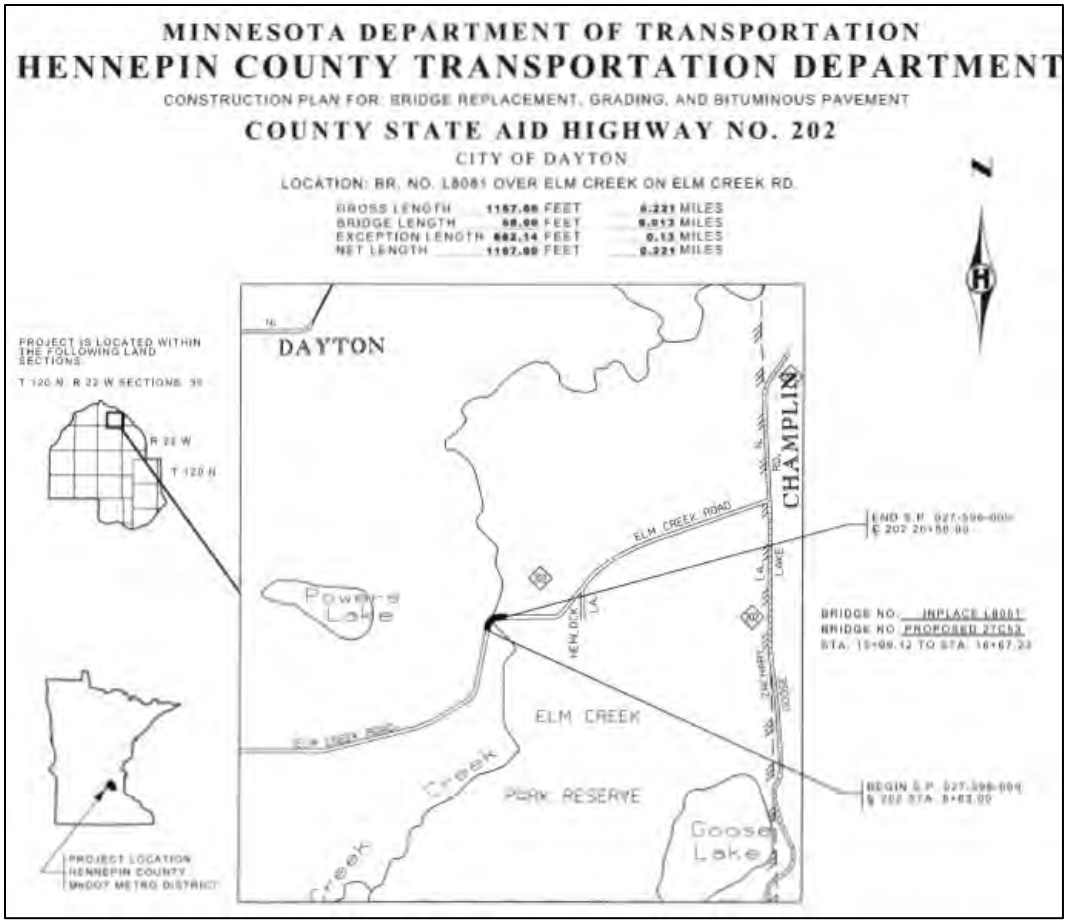


Figure 5.7 Geographic information about the site location of the project bridge.

5.3 DESIGN, BID AND CONSTRUCTION

The design, contractual, and construction processes for Hennepin County bridge number 27C53 (replacement for bridge number L8081) involved efforts from several agencies and organizations. An overview of the design, contractual bid process, and construction of the bridge follows.

5.3.1 Design

The overall project construction plan for bridge replacement, grading and bituminous pavement was developed by Hennepin County Public Works Department (Minnesota), and is included at Appendix E. The project construction plan includes the title sheet, general layout, statement of estimated quantities, earthwork tabulations and standard plates, quantity tabulations, public utility plan and tabulations, typical sections, standard plan sheets, alignment plan and tabulations, removal plan, construction plan, profiles, super elevation and turf establishment, stormwater pollution prevention plan, erosion control plan, cross-section match line, cross-sections, traffic control plan, striping and signing plan and bridge plan.

The 2018 edition of the MnDOT Standard Specifications for Highway Construction and all supplements governed the specifications (MnDOT, 2018). Detailed specifications for this project are in a document referred to as "Division SB," which is included at Appendix E. The Division SB document includes the following: bridge plans, plans and working drawings, restrictions on movement and storage of heavy loads and equipment, employee health and welfare, removal of asbestos and regulated waste, bridge and abutment construction, steel bridge construction, timber bridge construction, removal of existing bridge, structural excavations and backfills, piling, riprap, steel shells for concrete piling and fasteners.

The structural design for the bridge was done in accordance with the American Association of State Highway and Tranportation Officials (AASHTO), LRFD Bridge Design Specifications for Highway Bridges (2017). The bridge design was comprised of a longitudinal dowel-laminated timber deck with metal spikes and was designed for the design criteria:

- Live load HL-93
- Dead load (timber 50 pounds per cubic foot (PCF) / wearing surface 140 PCF)
- Design speed = 35 miles per hour (MPH)
- The tabulated design properties were:
  - F_b = 1.00 ksi prefab panels for spans 1, 2, and 3 (Douglas-fir larch No 1).
  - F_b = 1.20 ksi pile caps (Douglas-fir larch No 1).
  - F_b = 1.75 ksi rail posts (Douglas-fir larch dense select structural).
  - F_b = 1.20 ksi for all other timber.
  - F_v = 0.18 ksi
  - $F_{c\text{-}perp}$ = 0.625 ksi
  - Live load deflection criteria – L/300 for the strip width and L/425 for the final structure
- The structural steel design properties were:
  - F_y = 36 ksi specification 3306
- The reinforced concrete design properties were:
  - f'c = 4 ksi and F_y = 60 ksi

The Hennepin County construction bridge construction plan and Division SB (Appendix B and C) specified the following for the bridge, materials and fabrication associated with the timber bridge superstructure and rail construction:

1. Construction requirements shall conform to specification 2403.3.
2. All timber is to be pressure treated per specification 3491 and the special provisions. All timber in the birdge shall be treated with copper naphthenate, or other oil-based treatment as approved by the engineer, in accordance with specification 3491 and the current American Wood Preservers Association (AWPA) Standards, according to best management practices.
3. All hardware is to be galvanized per specification 3392.
4. Steel indicated in the plans was to be galvanized per specification 3394.
5. Thread on all bolts to be upset after installation.
6. All timber is to be rough unless otherwise noted.

7. The spike laminated deck panel and glue laminated crash rail shall be shop drilled and treated to minimize field treatment. All timber cut or drilled in the field shall be treated per specification 2403.3E.
8. All timber fabrication to be detailed on shop drawings. Shop drawings shall be submitted to the sealing engineer for approval prior to shipping materials.
9. Glue laminated rail construction requirements. This work shall consist of the fabrication and installation of glued laminated rails and shall be performed in accordance with the provisions of 2403.3 and the following:
    a. All applicable provisions of 2403.3.N.2 shall apply to flued laminated rail.
    b. Hardware that attaches the bridge railing to the dowel-laminated deck shall be hand tightened only during cold weather and the contractor will refrain from upsetting the hardware at this time. The contractor shall then tighten the fasteners at the Engineer's direction once weather permits and upset the hardware at the final torque.
    c. Plastic caps shall be installed on the top of each timber post. The caps shall be purpose built to timber bridge rails to prevent moisture entering the end grain. Protective plastic caps shall be incidental to the glue-laminated rail. The caps shall be black in color.
10. Timber deck expansion material. Contractor to install cork or neoprene padding material that is a minimum of 1/4 in thick between timber material and steel L brackets located on the top of each abutment and pier. The cost of installation and material shall be incidental to the glued laminated deck, Item No. 2403.618.
11. Timber deck flashing material. Contractor to install 26-gauge (minimum) galvanized flashing material on the south edge of the bridge deck for the entire length as noted in the plans. The flashing shall extend a minimum of 3 in off the deck to assure rain does not run down the end grain. Vertical flashing shall be installed on all timber curb members to protect each scupper block on the south edge. The cost of installation and material shall be incidental to the glued laminated deck, Item No. 2403.618.

Figure 5.8 shows the perspective photograph of the completed bridge superstructure. The design features longitudinal nail-laminated panels, transverse spreader beams, and the guard rail system. Selected views for these details are shown in Figures 5.8 to 5.19. Additional and significant detail for all timber components, their installation, connections and other is present in the Construction Plan (Appendix E).



Figure 5.8 Completed picture of dowel-laminated deck with metal spikes, transverse spreader beams (highlighted with red arrow), and railings.

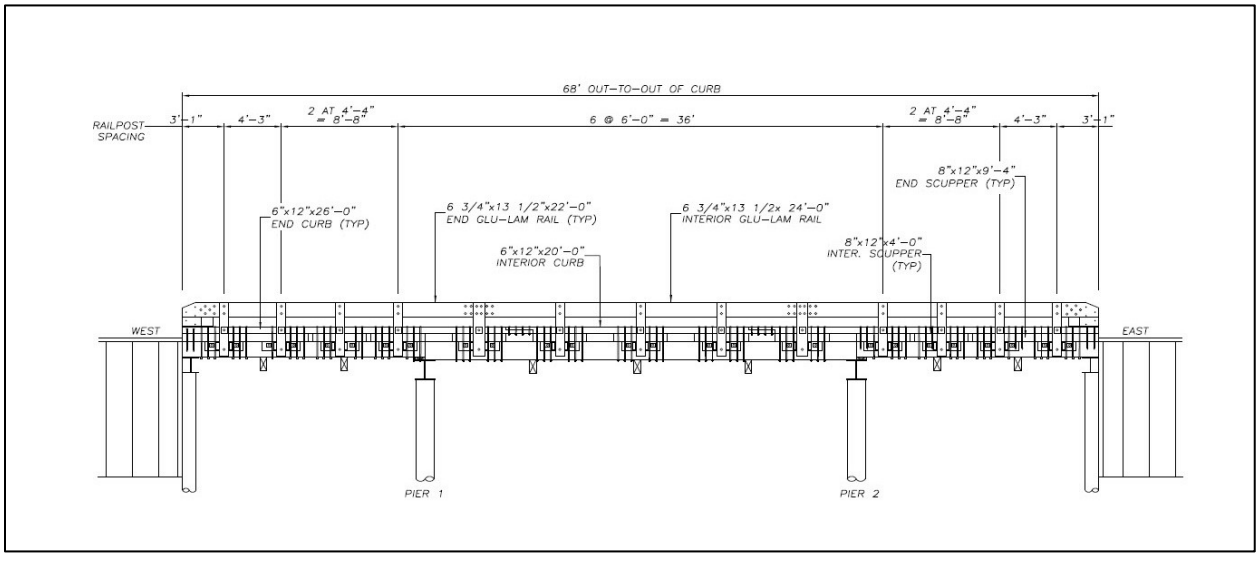


Figure 5.9 Elevation view of Hennepin County bridge 27C53.

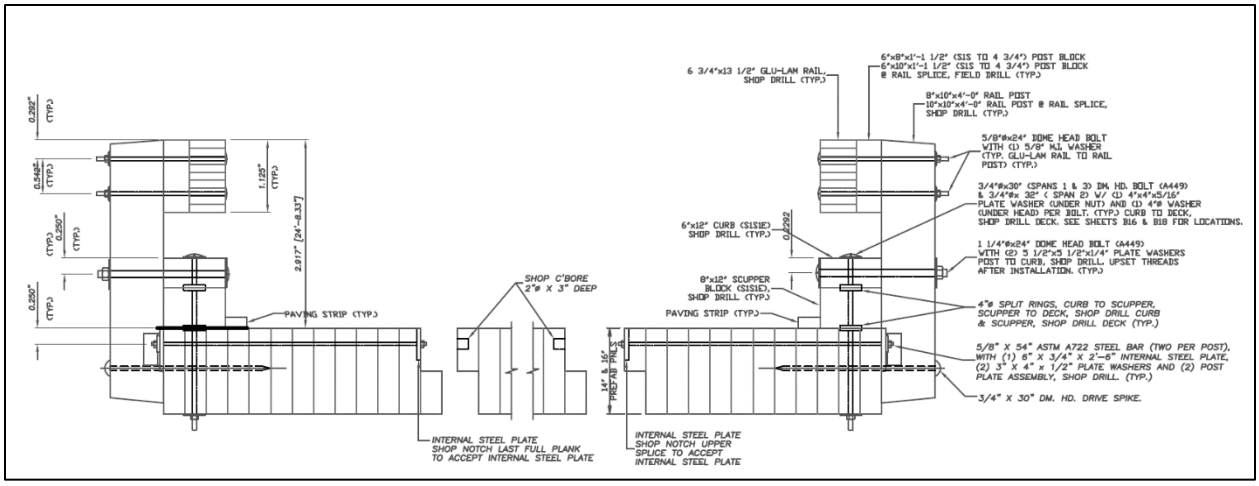


Figure 5.10 Transverse cross-section view showing dowel-laminated timber deck with metal spikes, and crash-tested bridge railing and curb system.

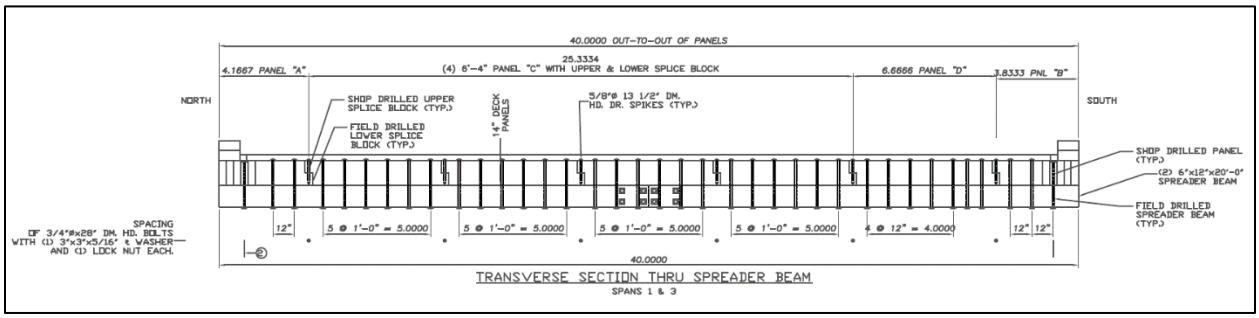


Figure 5.11 Transverse section view showing the transverse spreader beam connection details for end spans 1 and 3.

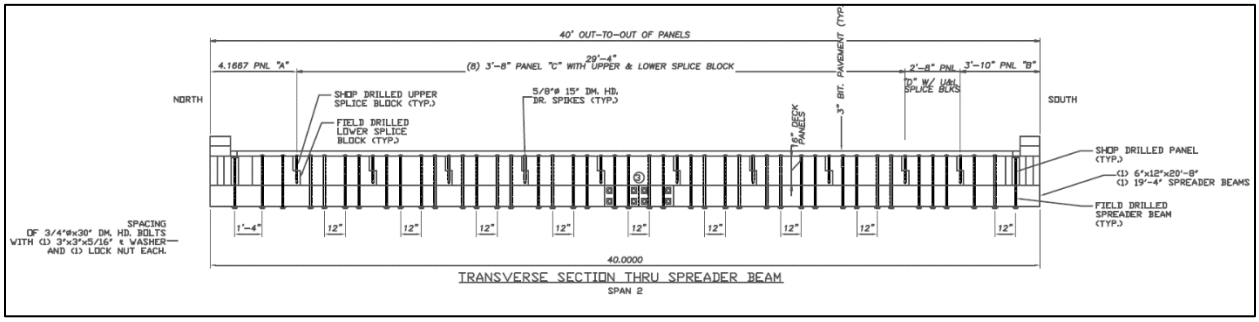


Figure 5.12 Transverse section view showing the transverse spreader beam connection details for span 2.

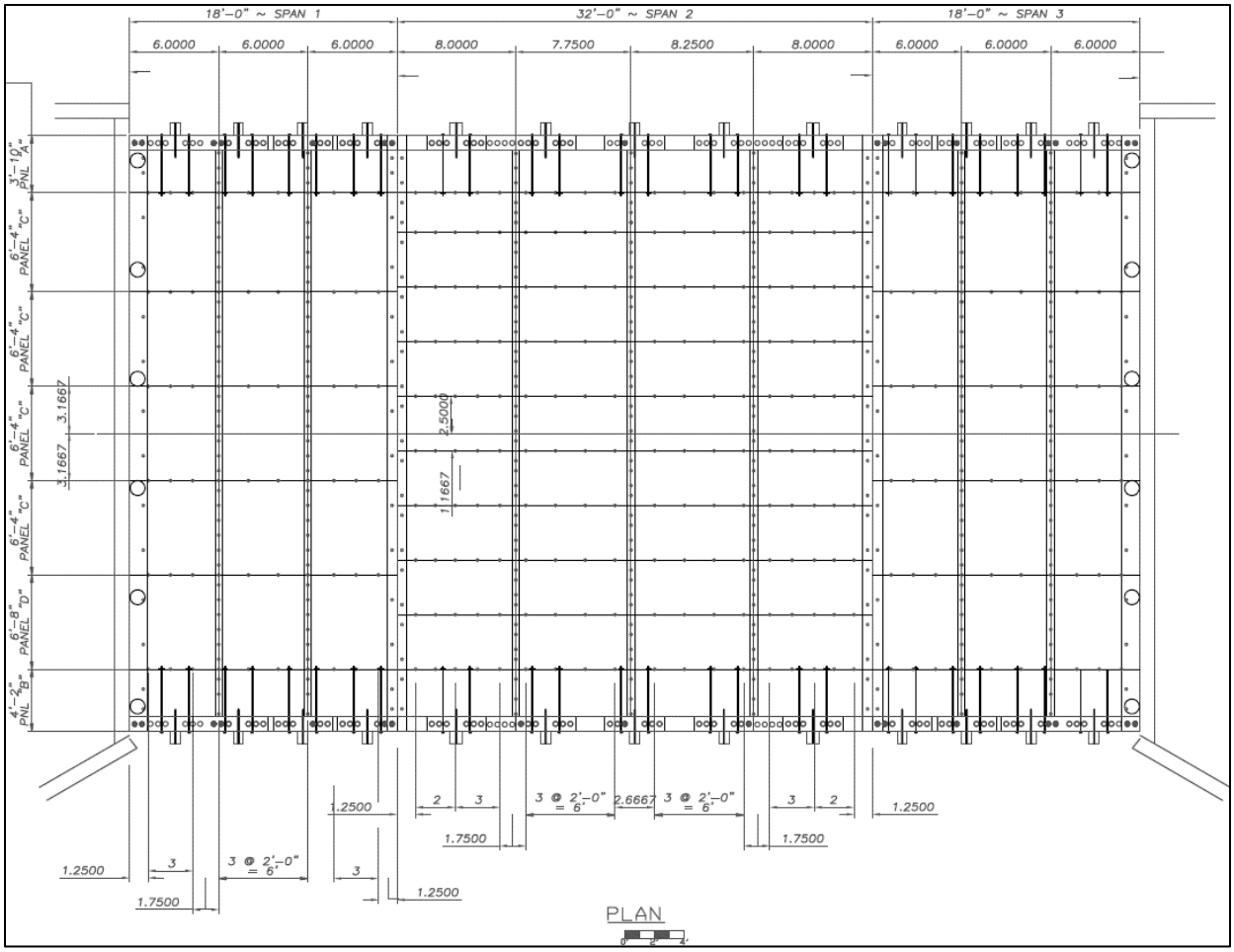


Figure 5.13 Plan view showing dowel-laminated timber deck with metal spikes, general configuration.

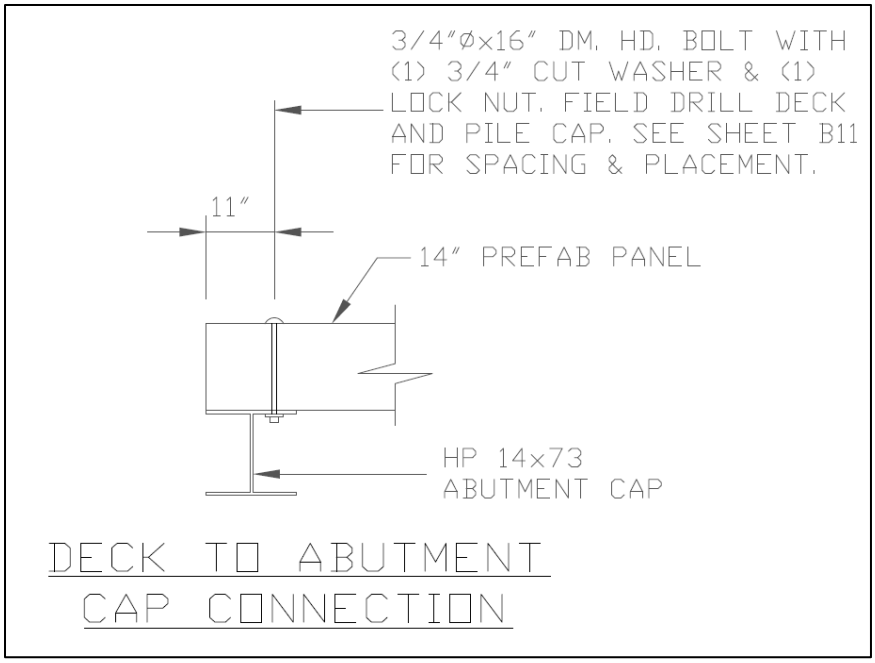


Figure 5.14 Connection details for the wood deck at the steel H-beam.

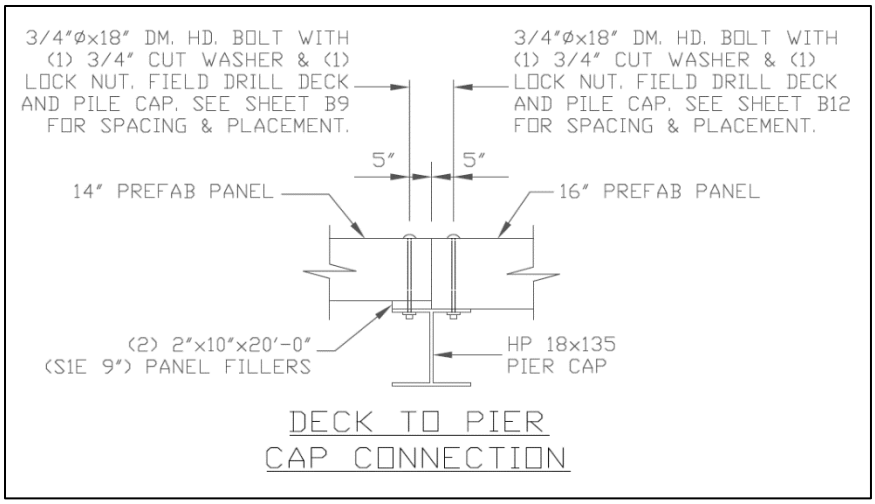


Figure 5.15 Connection detail for end-butted wood decks at the steel.

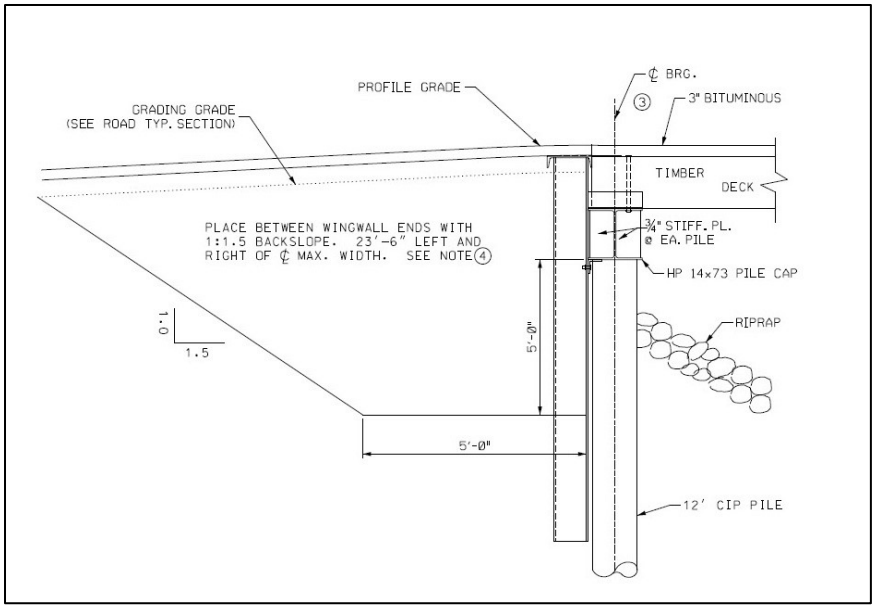


Figure 5.16 Profile view of abutment corner detail.

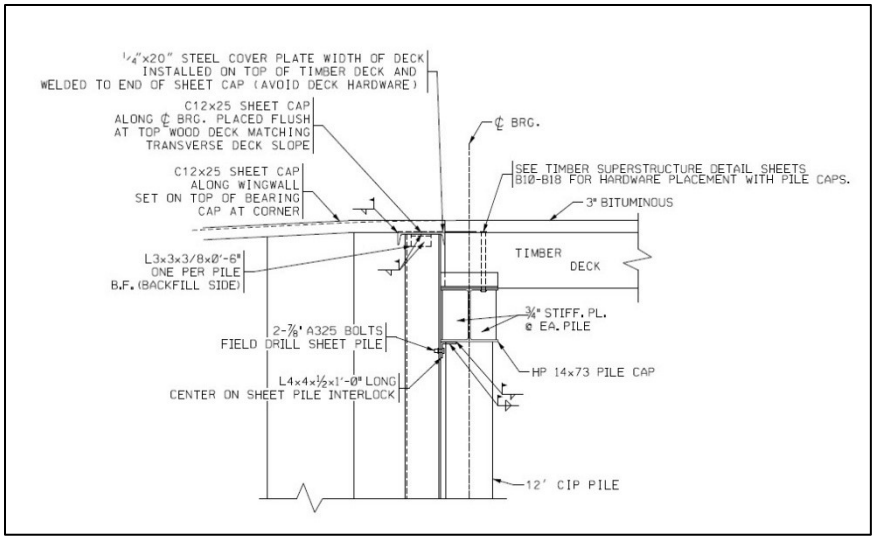


Figure 5.17 Profile view of abutment.

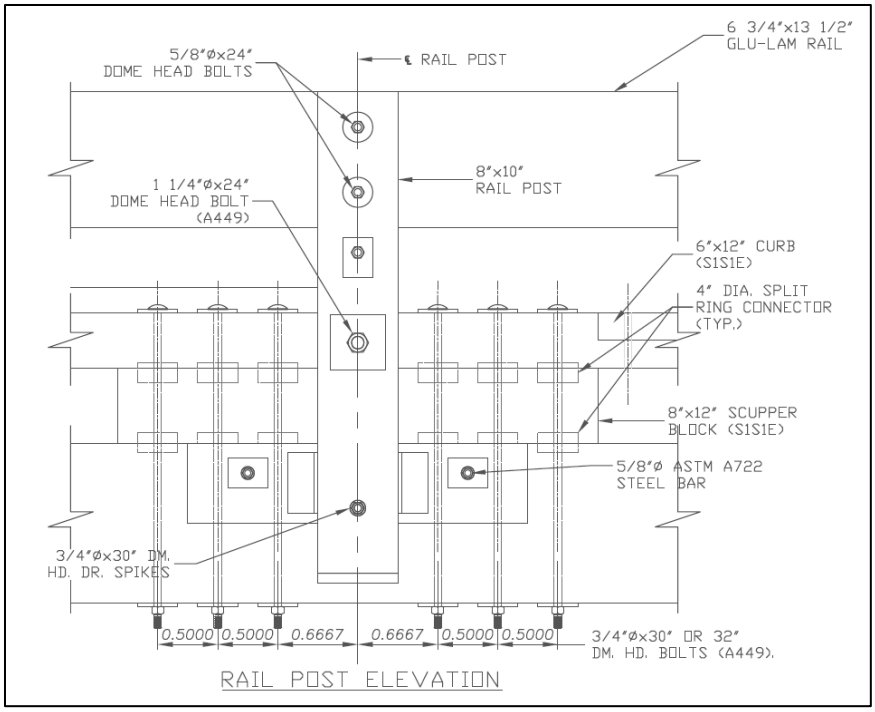


Figure 5.18 Elevation view of typical steel hardware for each bridge rail post location and revealing the hidden split-ring connectors and thru-bolts which interconnect the curb and rail system to the dowel lam deck. (Test Level 4 – NCHRP350)

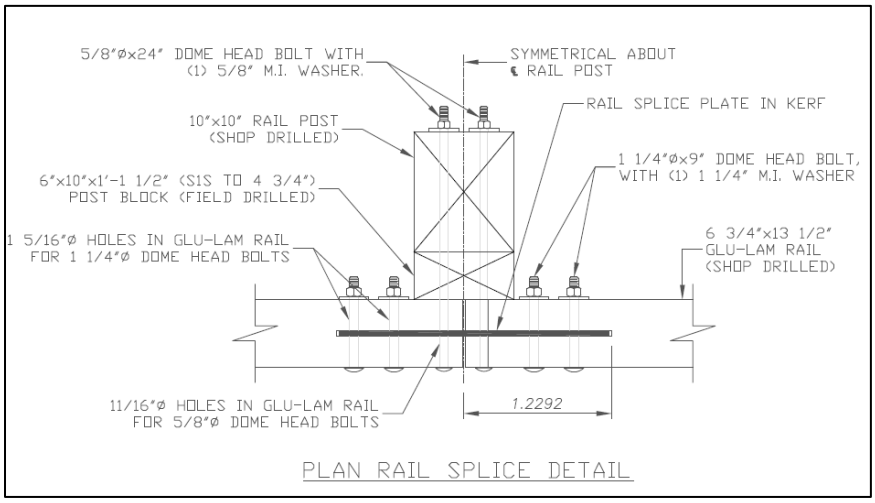


Figure 5.19 Plan view of the splice detail for the end-butted glulam rail members.

5.3.2 Bid Process and Materials

Based on the design specifications, Hennepin County solicted bids from outside vendors for bridge removal, constuction, grading and bituminous pavement. The bid process opened on August 31, 2018 and closed on September 25, 2018. Key information on the bid project are located at: https://egram.co.hennepin.mn.us/default.php?WorkOrderId=131. This location includes the project advertisement, plans and all addendum, project bid abstract, and project bid summary.

Five bids were received for this project. The low bid for the complete project was $1,396,584.80 and the high bid was $1,641,666.62. The low bid was 20.19% below the engineer's estimate. Redstone Construction LLC submitted the low bid and was awarded the contract for the project. This project included removal of bridge L8081 and significant construction to increase the bridge and roadway dimensions for the project. Within the project bid abstract, Table 5.1 shows the bid costs received from Redstone Construction were associated with the wood construction. Appendix E shows the complete project bid abstract received from each of the five companies.

Table 5.1 Bid proposal selected for the bridge construction project.

Item No.	Item	Units	Quantity	Unit Price	Total Price
2021.501	Mobilization	Lump sum	1	$158,000.00	$158,000.00
2031.502	Field Office Type D	Each	1	$15,000.00	$15,000.00
2101.501	Clearing & Grubbing	Lump sum	1	$9,000.00	$9,000.00
2104.502	Remove Sign Type C	Each	18	$35.00	$630.00
2104.503	Remove Guardrail	Lineal feet	190	$10.00	$1,900.00
2104.503	Remove Metal Culvert	Lineal feet	170	$9.00	$1,530.00
2104.503	Sawing Bituminous Pavement	Lineal feet	47	$2.25	$105.75
2104.504	Remove Bituminous Pavement (P)	Square yard	3,104	$3.75	$11,640.00
2104.601	Remove Regulated Waste Material (Bridge)	Lump sum	1	$2,450.00	$2,450.00
2105.504	Geotextile Fabric Type 6	Square yard	5,190	$2.50	$12,975.00
2105.509	Stabilizing Aggregate	Ton	100	$40.00	$4,000.00
2106.507	Common Embankment (Cv) (P)	Cubic yard	1,016	$14.00	$14,224.00
2106.507	Excavation - Common (P)	Cubic yard	1,680	$18.50	$31,080.00
2118.509	Aggregate Surfacing Class 2	Ton	196	$54.00	$10,584.00
2123.61	Street Sweeper (With Pickup Broom)	Hour	20	$130.00	$2,600.00
2130.523	Water	Gallon (1000)	6	$250.00	$1,500.00
2131.506	Calcium Chloride Solution	Gallon	185	$5.00	$925.00
2211.509	Aggregate Base Class 5 (P)	Ton	1,483	$32.50	$48,197.50
2360.509	Type Sp 12.5 Wearing Course Mix (3;C)	Ton	933	$87.00	$81,171.00
2401.601	Structure Excavation	Lump sum	1	$25,000.00	$25,000.00
2402.508	Structural Steel (3309) (P)	Pound	23,038	$3.25	$74,873.50

Item No.	Item	Units	Quantity	Unit Price	Total Price
2403.603	**Timber Railing (P)**	**Lineal feet**	**136**	**$350.00**	**$47,600.00**
2403.618	**Glued Laminated Deck Panels (P)**	**Square feet**	**2,720**	**$105.00**	**$285,600.00**
2442.501	Remove Existing Bridge	Lump sum	1	$30,000.00	$30,000.00
2452.502	Pile Points 16"	Each	16	$345.00	$5,520.00
2452.502	C-I-P Conc Test Pile 85 Ft Long 12" (P)	Each	2	$10,000.00	$20,000.00
2452.502	Pile Redriving	Each	32	$250.00	$8,000.00
2452.502	C-I-P Conc Test Pile 85 Ft Long 16" (P)	Each	2	$12,000.00	$24,000.00
2452.502	Pile Points 12"	Each	16	$240.00	$3,840.00
2452.502	Pile Analysis	Each	2	$2,200.00	$4,400.00
2452.603	C-I-P Concrete Piling 16"	Lineal feet	1,190	$55.00	$65,450.00
2452.603	C-I-P Concrete Piling 12"	Lineal feet	1,190	$40.00	$47,600.00
2452.618	Steel Sheet Piling (P)	Square feet	2,430	$36.00	$87,480.00
2501.502	28" Span Cas Pipe-Arch Apron	Each	2	$2,000.00	$4,000.00
2501.502	18" Rc Pipe Apron	Each	2	$1,500.00	$3,000.00
2501.502	24" Rc Pipe Apron	Each	4	$1,850.00	$7,400.00
2501.503	18" Rc Pipe Culvert Des 3006 Cl Iii	Lineal feet	52	$76.00	$3,952.00
2501.503	24" Rc Pipe Culvert Class Iii	Lineal feet	96	$82.50	$7,920.00
2501.603	28" Span Pipe-Arch Culvert	Lineal feet	44	$140.00	$6,160.00
2502.502	4" Precast Concrete Headwall	Each	4	$375.00	$1,500.00
2502.503	4" Perf Tp Pipe Drain	Lineal feet	1,000	$13.00	$13,000.00
2511.504	Geotextile Filter Type 7	Square yard	1,050	$2.75	$2,887.50
2511.507	Random Riprap Class Iv	Cubic yard	830	$80.00	$66,400.00
2533.503	Portable Precast Conc Barrier Des 8337	Lineal feet	50	$30.00	$1,500.00
2554.502	End Treatment-Energy Absorbing Terminal	Each	1	$3,500.00	$3,500.00
2554.502	Anchorage Assembly - Type 31	Each	3	$1,500.00	$4,500.00
2554.503	Traffic Barrier Design Type 31	Lineal feet	491	$25.00	$12,275.00
2554.503	Traffic Barrier Design Trans Type 31	Lineal feet	100	$130.00	$13,000.00
2563.601	Traffic Control	Lump sum	1	$27,500.00	$27,500.00
2563.601	Traffic Control Supervisor	Lump sum	1	$3,400.00	$3,400.00
2563.613	Portable Changeable Message Sign	Unit day	40	$50.00	$2,000.00
2564.518	Sign Panels Type C	Square feet	36.3	$60.00	$2,178.00
2572.503	Temporary Fence	Lineal feet	500	$3.00	$1,500.00
2573.501	Erosion Control Supervisor	Lump sum	1	$1,500.00	$1,500.00
2573.502	Storm Drain Inlet Protection	Each	4	$200.00	$800.00
2573.503	Silt Fence; Type Ms	Lineal feet	820	$5.25	$4,305.00
2573.503	Silt Fence; Type Sd	Lineal feet	250	$25.00	$6,250.00
2573.503	Silt Fence; Type Hi	Lineal feet	1,540	$6.75	$10,395.00

Item No.	Item	Units	Quantity	Unit Price	Total Price
2573.503	Flotation Silt Curtain Type Moving Water	Lineal feet	448	$36.50	$16,352.00
2573.51	Sediment Removal Backhoe	Hour	10	$145.00	$1,450.00
2574.507	Compost Grade 3	Cubic yard	175	$100.00	$17,500.00
2574.508	Fertilizer Type 4	Pound	100	$1.00	$100.00
2575.504	Erosion Control Blankets Category 3n	Square yard	2,615	$1.95	$5,099.25
2575.504	Rapid Stabilization Method 4	Square yard	2,787	$2.00	$5,574.00
2575.508	Seed Mixture 35-241	Pound	30	$20.00	$600.00
2582.503	4" Dble Solid Line Multi Comp Gr In	Lineal feet	1,170	$1.89	$2,211.30
Contract Total:					**$1,396,584.80**

5.3.2.1 Timber and Timber Hardware

The timber panels used in this project were dowel-laminated timber panels and manufactured by Wheeler Consolidated. More information about the company and product family is located at http://www.wheeler-con.com/highway-bridges/panel-lam-timber-vehicle-bridges/. The products supplied for this project were fabricated using individual solid-sawn Douglas fir structural timbers that were 4 in wide and the required depth for each panel. These individual timbers were pressure-treated using copper naphthenate wood preservative and then shop assembled with steel dowels (spikes) into panels. For this project, the dowels were 3/8 in diameter (Ø) x 15 in nails and 3/8 in Ø x 11 in nails for the splice joints (shiplap) blocks. The pattern of the dowels and the deck thickness were a function of the span length and the design load. The dowels were positioned in two rows near the top and the bottom and spaced approximately one foot apart. Lumber laminations were added two at a time until the panel width was achieved. Penetrating four lumber laminations, the dowel pattern was staggered and repeated to avoid driving dowels into each other (Wheeler Consolidated, 2019). For the railings, glue-laminated beams were obtained, predrilled for hardware and preservative treated. Following fabrication, panels and hardware are loaded on a construction truck and delivered to the job site for staging prior to construction. Table 5.2 shows the wood material list and Table 5.3 shows the hardware material list for the timber components of the bridge project.

Table 5.2 Wood material list for the project.

	Description	Quantity	Size	Length
Prefabricated Wood Panels	Type A18	2	1 ft 2 in by 4 ft 0 in	18 ft
	Type B18	2	1 ft 2 in by 3 ft 8 in	18 ft
	Type C18	8	1 ft 2 in by 6 ft 0 in	18 ft
	Type D18	2	1 ft 2 in by 6 ft 4 in	18 ft
	Type A32	1	1 ft 4 in by 4 ft 0 in	32 ft
	Type B32	1	1 ft 4 in by 2 ft 4 in	32 ft
	Type C32	8	1 ft 4 in by 3 ft 8 in	32 ft
	Type D32	2	1 ft 4 in by 3 ft 4 in	32 ft
Glue-laminated Timber Railing	End Rail	4	10 ¾ in by 6 in	22 ft
	Inner Rail	2	10 ¾ in by 6 in	24 ft
Spreader Beam	Rough Sawn	8	6 in by 12 in	20 ft
	Rough Sawn	3	6 in by 12 in	20 ft 8 in
	Rough Sawn	3	6 in by 12 in	19 ft 4 in
Spreader Beam Splice	Rough Sawn	8	3 in by 12 in	3 ft by 0
	Rough Sawn	6	3 in by 12 in	3 ft 4 in
Panel Filler at Pier	Smooth 1 Edge (S1E)	4	2 in by 10 in (SIE to 9 in)	20 ft
Rail Post	Rough Sawn	22	8 in by 10 in	4 ft 0 in
Rail Post Block	Smooth 1 Side (S1S)	14	6 in by 8 in (S1S to 4.75 in)	1 ft 1.5 in
Upper end Post Block	Smooth 1 Side smooth 1 Edge (S1S1E)	4	6 in by 14 in (S1S1E to 4.75 in by 13.5 in)	4 ft 11 in
Curb Transition block	S1S1E	4	8 in by 8 in (S1S1E)	2 ft 3 in
Rail Post	Rough Sawn	4	10 in by 10 in	4 ft
Rail Post Block	S1S	4	6 in by 10 in (S1S to 4.75 in)	1 ft 1.5 in
Curb – End	S1S1E	4	6 in by 12 in	26 ft
Curb – Interior	S1S1E	2	6 in by 12 in	20 ft
Scupper – End	S1S1E	4	8 in by 12 in	9 ft 4 in
Scupper – Interior	S1S1E	18	8 in by 12 in	4 ft
Edge Strip	Rough Sawn	17	3 in by 4 in	8 ft

Note: Dimensions for the prefabricated panels are for the full depth laminates and does not include the width of the 4-in ship-lap splice block.

Table 5.3 Hardware material list for the bridge superstructure.

Item	Quantity	Weight / Each (lbs.)
3/4 in Ø by 20 in hex lags (A449) – curb to panel	34	2.40
5/8 in Ø by 13.5 in DM HD DR spike – panel splice	120	1.40
5/8 in Ø by 15 in DM HD DR spike – panel splice	180	1.52
3/4 in Ø by 16 in DM HD Bolt – Panel to abutment	28	2.80
3/4 in Ø by 18 in DM HD Bolt – Panel to pier	72	3.04
3/4 in Ø by 30 in DM HD DR Spike – Post to panel	26	3.89
5/8 in Ø by 24 in DM HD Bolt – Rail to post	60	2.49
7/8 in Ø by 9 in DM HD Bolt – Rail transition	24	.30
1.25 in Ø by 9 DM HD Bolt - Rail splice	32	6.81
¾ in Ø by 28 in DM HD Bolt – Spreader beam	148	4.24
¾ in Ø by 30 in DM HD Bolt – Spreader beam	123	4.48
¾ in Ø by 32 in DM HD Bolt (A449) – Curb to panel	54	5.48
¾ in Ø by 30 in DM HD Bolt (A449) – Curb to panel	76	4.40
¾ in Ø by 8 in DM HD Bolt – Curb Splice	16	1.84
1.25 in Ø by 24 in DM HD Bolt (A449) - Post to curb	26	11.96
60d Nails		
7/8 in MI Washers	24	0.60
4 in diameter Washers - (3/4 in Ø bolts)	164	0.94
3 in by 3 in by 5/16 in Washers - (3/4 in Ø bolts)	271	0.85
4 in by 4 in by 5/16 in Washers - (3/4 in Ø bolts)	146	1.50
3/4 in Lock washers - (3/4 in Ø bolts)	371	0.20
4 in Split ring connectors	328	0.70
5.5 in by 5.5 in by ¼ in Washers - (1.25 in Ø bolts)	52	2.28
¾ in Cut washers - (3/4 in Ø bolts)	100	0.12
3 in by 4.5 in by ½ in washers - (5/8 in Ø steel bar)	52	1.81
5/8 in MI Washers	60	0.22
1/25 in MI washers	32	1.54
5/8 in Ø by 54 in A722 Steel bar with 2 nuts	52	6.00

Note: Ø is the accepted symbol for diameter
DM HD = dome head; DR = drive

Additional materials were ordered and are shown in Table 5.4. This included a steel plate for covering the gap between the abutment and the glulam deck and a waterproof membrane to cover the steel plate. This also includes bituminous overlay (SP Type 12.5 Wearing Course Mix) and a bituminous membrane that would serve as a reinforcing and waterproof layer between the two layers of bituminous. A galvanized flashing was applied to the exterior edges of the lower side of the dowel-laminated deck to direct water away from the edge of the timber railing and panels. It consisted of a flat flashing placed under the scupper block and on top of the dowel-laminated deck panels, extending at least 3 inches beyond the edge of the bridge deck. Further, individual flashing pieces were placed into the scupper opening to protect the scupper block end grain at the opening. Additional details and photographs are shown in the construction section of the report.

Table 5.4 Materials for timber bridge superstructure.

Material	Supplier	Detail
Steel cover plate	Local sourced	1/4 in by 20 in by 38 ft, galvanized
Bridge and deck waterproofing membrane	Manufacturer: Miratek Mirafi	Each roll was 3 ft by 50 ft by 2.0 mm (79 mil) thickness.
Railing post cap	Laminated Concepts, Inc. (Big Flats, NY)	Plastic caps for rail posts to deflect water with screws
Copper naphthenate	Wheeler Consolidated (Whitewood, SD)	Preservative treatment for any on-site holes and cuts

5.3.3 Construction

The focus of this project was the timber bridge superstructure. Significant detail on the timber superstructure will be provided, with lesser detail on the cast-in-place (CIP) piling installation, abutment sheet piling, or abutment and steel H-beam pier caps. For more information on the steel installation beyond what is provided in the report, please contact the Hennepin County report authors.

5.3.3.1 Bridge Removal

The existing bridge was deconstructed and removed by Redstone Construction personnel during December 2018 and January 2019. Significant site preparation was then completed to increase the width of the bridge from one lane to two lanes and to increase the road and ditch widths. Figure 5.20 shows the bridge during deconstruction. Figure 5.21 shows the removal plan and the extent of the site construction. Figure 5.22 in Appendix B show the overlay of the new bridge dimension overlaid with the location of the original bridge.



Figure 5.20 Bridge L8081 during demolition. Photo credit Hennepin County.

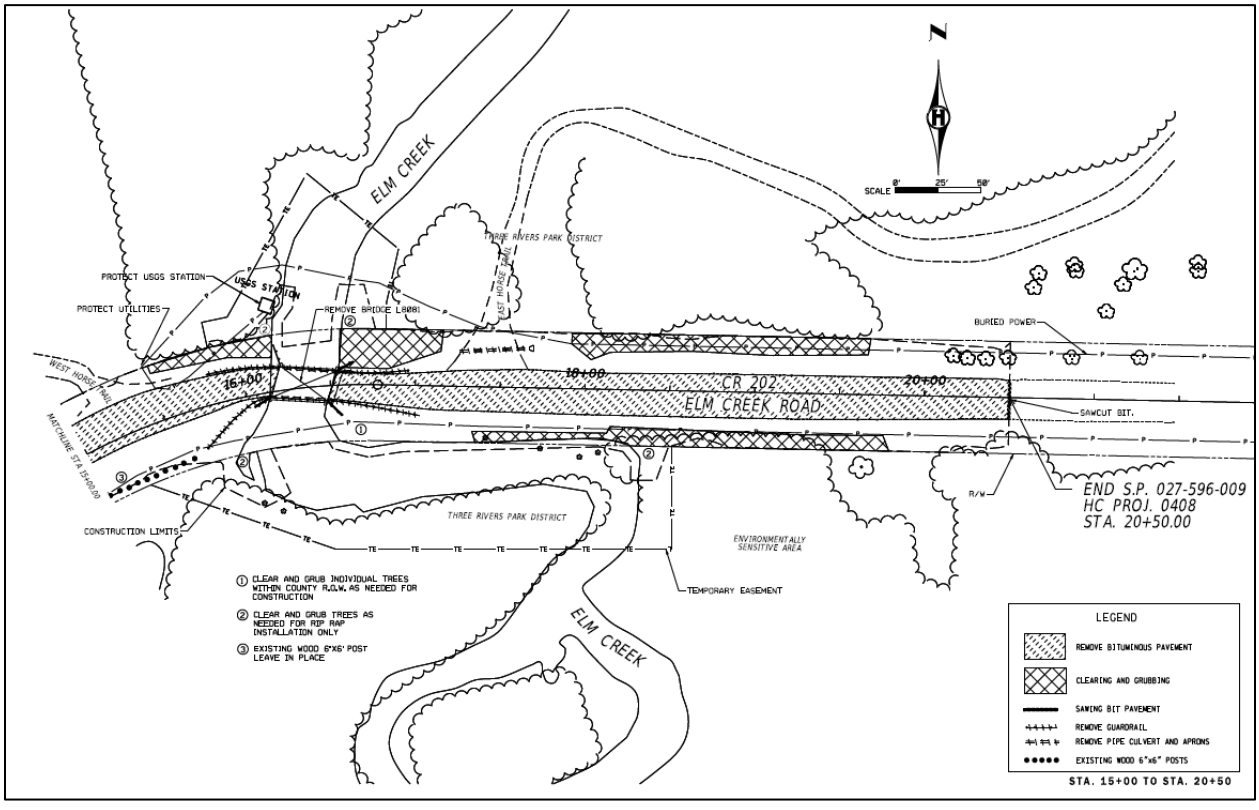


Figure 5.21 Removal plan for bridge L8081. Source: Hennepin County.

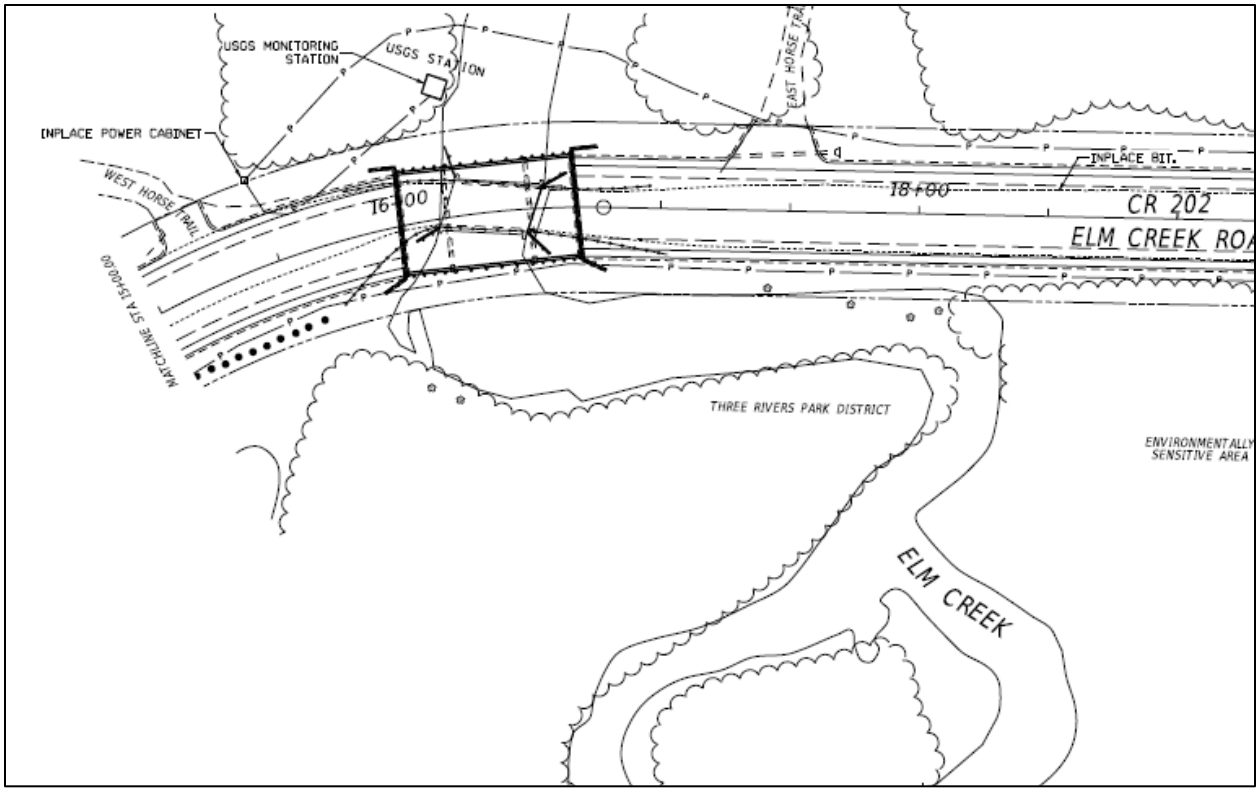


Figure 5.22 Site location showing the existing and new bridges size and orientation. Source: Hennepin County.

5.3.3.2 Cast-in-place (CIP) piling installation, abutment sheet piling, or abutment and steel H-pile caps

Starting in January 2019, the Redstone Construction crew began constructing the new bridge. This included driving CIP piling and installation of steel sheet piling according to the plans in Appendix E. These images show the elevation of the bridge and that it is a super elevated deck with a slop of 5.8% downward to the southern edge of the bridge. This was due to the location of the bridge on a curve. Figures 5.23 to 5.28 show pictures of the abutment sheet piling, CIP pilings, steel H-pile caps for the abutment and piers. Once the substructure work was completed, the project was idled to wait for spring, snow melt and timing of the timber components arrival. While it would have been possible to complete the deck installation in the winter, the decision was made to wait until spring for the timber component installation. This would then shorten the time duration between timber installation and the site earthwork requirements that would need to be completed prior to final bituminous paving.



Figure 5.23 Sheet metal abutment, CIP piling and pier supports after installation.



Figure 5.24 Sheet pile abutment wall and wing wall after installation.



Figure 5.25 Abutment construction with CIP piling, H-beam, and steel sheeting for the abutment and wing wall. Photo credit Hennepin County.



Figure 5.26 CIP piling that has been driven and filled. Photo credit Hennepin County.



Figure 5.27 Substructure showing completed abutments, piers and pollution prevention flotation prior to timber deck installation. Piles are of different heights to meet required roadway super elevation. Photo credit Hennepin County.



Figure 5.28 Completed west abutment showing sheet pile, end wing wall and steel channel cap. Photo credit Hennepin County.

5.3.3.3 Prefabricated dowel-laminated timber deck materials

Following acceptance of the bid, Wheeler Consolidated developed shop drawings for the project as detailed in Appendix E. Upon acceptance of the shop drawings by Hennepin County design engineer and Redstone Construction, the dowel-laminated deck panels, railings and posts were fabricated using preservative treated Douglas fir lumber per design in Whitewood, South Dakota. Holes and slots were predrilled as appropriate based on the shop drawings. Following fabrication, the timber materials and hardware were transported to the bridge location and off-loaded. Care was used to ensure the materials were stored off the ground and a plastic tarp was used to cover the material prior to construction to minimize wetting from any rain events.

A construction crane was used to move the timber panels into location. Span one was installed using panels A18, B18, C18 and D18. Panel A was the first panel installed into its final location on the abutment caps. 13/16 in diameter (Ø) holes were drilled through the panel and caps, treated with copper naphthenate, and 3/4 in Ø dome head bolts installed and fastened per specification. Panel C was then installed so that the upper splice of the ship lap joint was placed over the lower splice block. The panels were then drawn tight together using a lever hoist. Using the shop drilled holes in the upper splice block as a guide, holes were then drilled into the lower splice block on panel A. 5/8 in Ø dome head spikes were driven through the holes. 13/16 in diameter holes were then drilled through the panel and into the abutment cap per plan and fastened with 3/4 in Ø dome head bolts. The previous steps were then repeated for the remaining C, D, and B panels. For span 2, panels A32, B32, C32, and D32 were used to follow the same process as identified above. Panels were fastened together over pier using a similar approach; however, a timber panel filler was placed on top of the steel abutment and pier cap for span 1 and span 3. To ensure straightness during construction, all A panels were installed along the full length of the bridge, and then the remaining panels were installed across the width of the bridge. Figures 5.29 to 5.37 show the installation of the panels.

Following installation of all panels, a steel plate was attached over the abutment and timber deck. This detail is intended to minimize any potential gravel or deterioration at the joint between the abutment and the timber deck. An ice and water barrier was specified to be installed over the plate but it was installed under the plate instead. Figures 5.38 and 5.39 show the plate installation and installed water shield over the plate prior to paving.



Figure 5.29 Panel C18 being installed using a crane on span 1. Steel plates are recessed into the deck panel outer lamination approximately 3-ft for the crash-tested bridge railing and curb system. Photo credit Hennepin County.

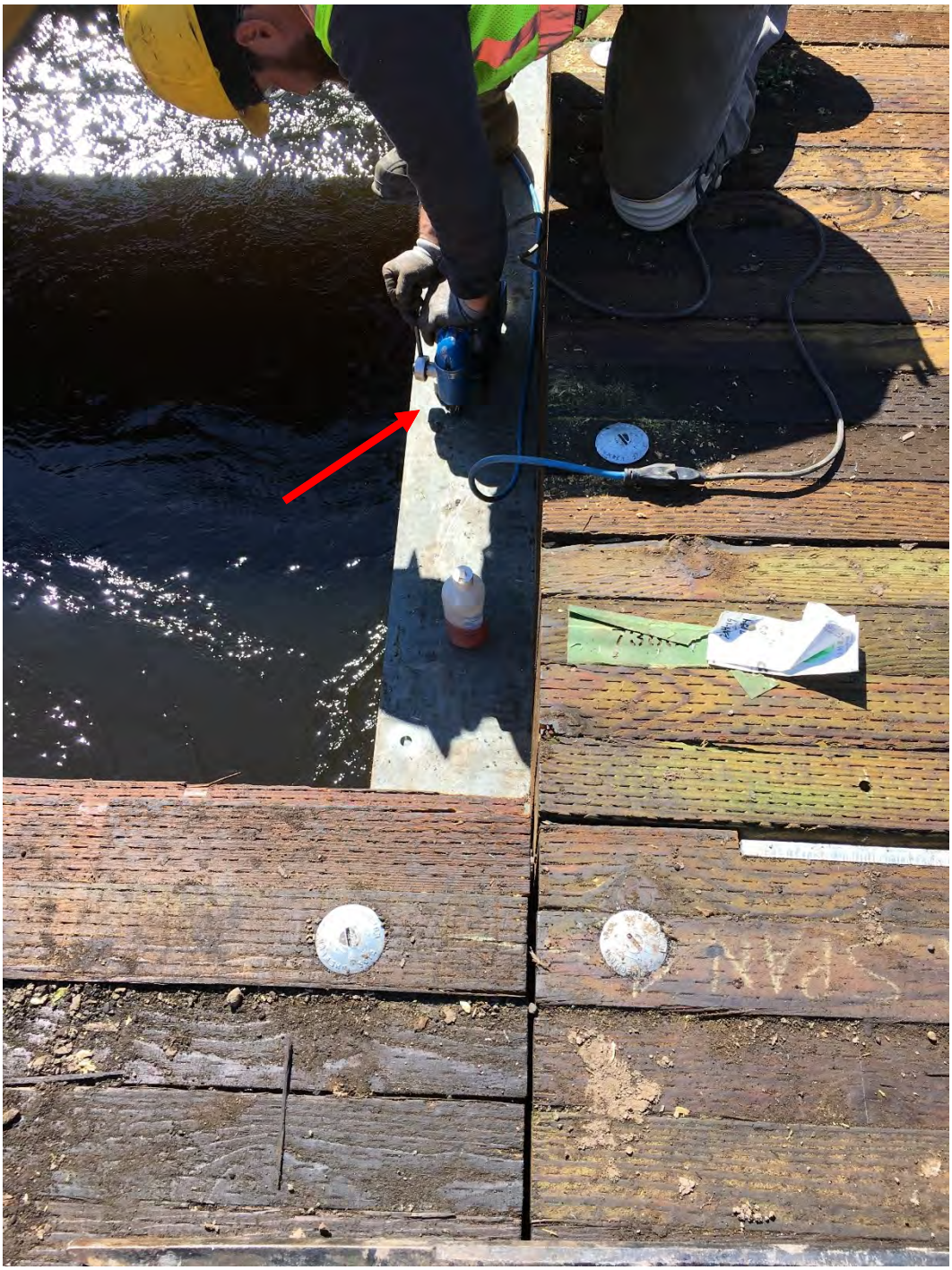


Figure 5.30 Installed panels showing dome head bolts and operator predrilling pier cap prior to installation. Photo credit Hennepin County.



Figure 5.31 Dome head drive spikes being installed into the panel splice joint. Note the embedded steel plates at this location are installed to help anchor the crash-tested bridge railing and curb system. Photo credit Hennepin County.



Figure 5.32 Installed panel for span 1 with sleeper blocking (identified with red arrow) at pier support to align top of timber decks. Photo credit Hennepin County.



Figure 5.33 Panel installation in progress for spans 1, 2, and 3. Photo credit Hennepin County.



Figure 5.34 Span 3 showing designed gap (identified with red arrow) between panel end and abutment wall. Photo credit Hennepin County.



Figure 5.35 Span 2 panels installed indicating excess width due to misalignment on downstream deck edge that required slight modification. Photo credit Hennepin County.



Figure 5.36 Panel installation and lever hoist used to tighten splice edge joints. Photo credit Hennepin County.



Figure 5.37 Extreme high stream level during deck installation. Design details ensured strong connections between the CIP, pier caps, and timber panels. Photo credit Hennepin County.



Figure 5.38 Steel plate installed over the end of the abutment cap and the end of the timber panels covering the end gap (Figure 5.32). Photo credit Hennepin County.



Figure 5.39 Steel plate at bridge transition after backfill and railings. Photo credit Hennepin County.

5.3.3.4 Crash-Tested Rail, Flashing Materials

Due to the site location on a curve, a Test Level (TL4) (Ritter et al., 1993) crash-tested railing and curb system was installed instead of a TL2 system to enhance safety. Prior to completion of the deck panel installation, the crews initiated construction of the bridge north edge railing system. Details for the railing construction are shown in the construction plan located in Appendix E. To improve long-term durability of the timber materials, a flashing system was designed and fabricated. As initially designed, the intent was to provide protection on the lower edge of the bridge deck that was 5.8% lower than the upper edge. The intent was to flash both the scupper face and the scupper opening as a protection against water. A basic flashing system was designed, but to simplify fabrication and installation, the design engineer specified a plan where a minimum 26-gauge galvanized steel flashing would be installed under the entire length of the bridge on top of the deck and below the scupper and extend a minimum of 3 inches beyond the edge of the bridge deck. Additionally, the scupper opening was flashed to protect the vertical edges of the opening from water. Figures 5.40 to 5.52 show the installation of the railing and installed flashing.



Figure 5.40 North edge of railing being installed prior to deck completion. Photo credit Hennepin County.



Figure 5.41 Prefabrication of the timber curb and scupper blocks (laid out on their side) prior to connection to the deck panels along the north deck edge. Photo credit Hennepin County.



Figure 5.42 Predrilling split ring connectors for scupper to deck connection. Photo credit Hennepin County.

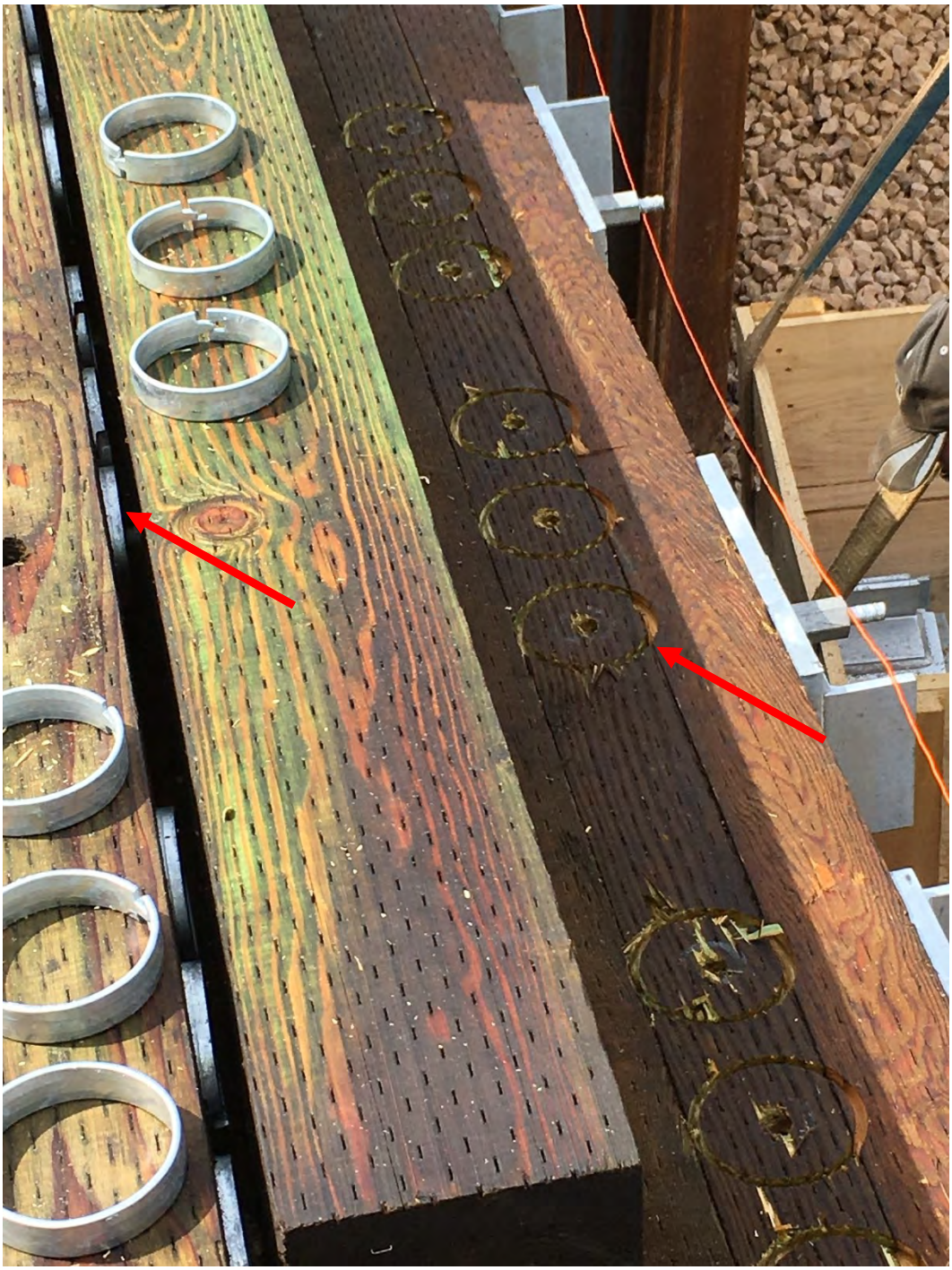


Figure 5.43 Predrilling and inserting split ring connectors at the interface of the timber deck and between the scupper blocks. Photo credit Hennepin County.



Figure 5.44 Curb and scupper aligned prior to connection to deck panels. Photo credit Hennepin County.

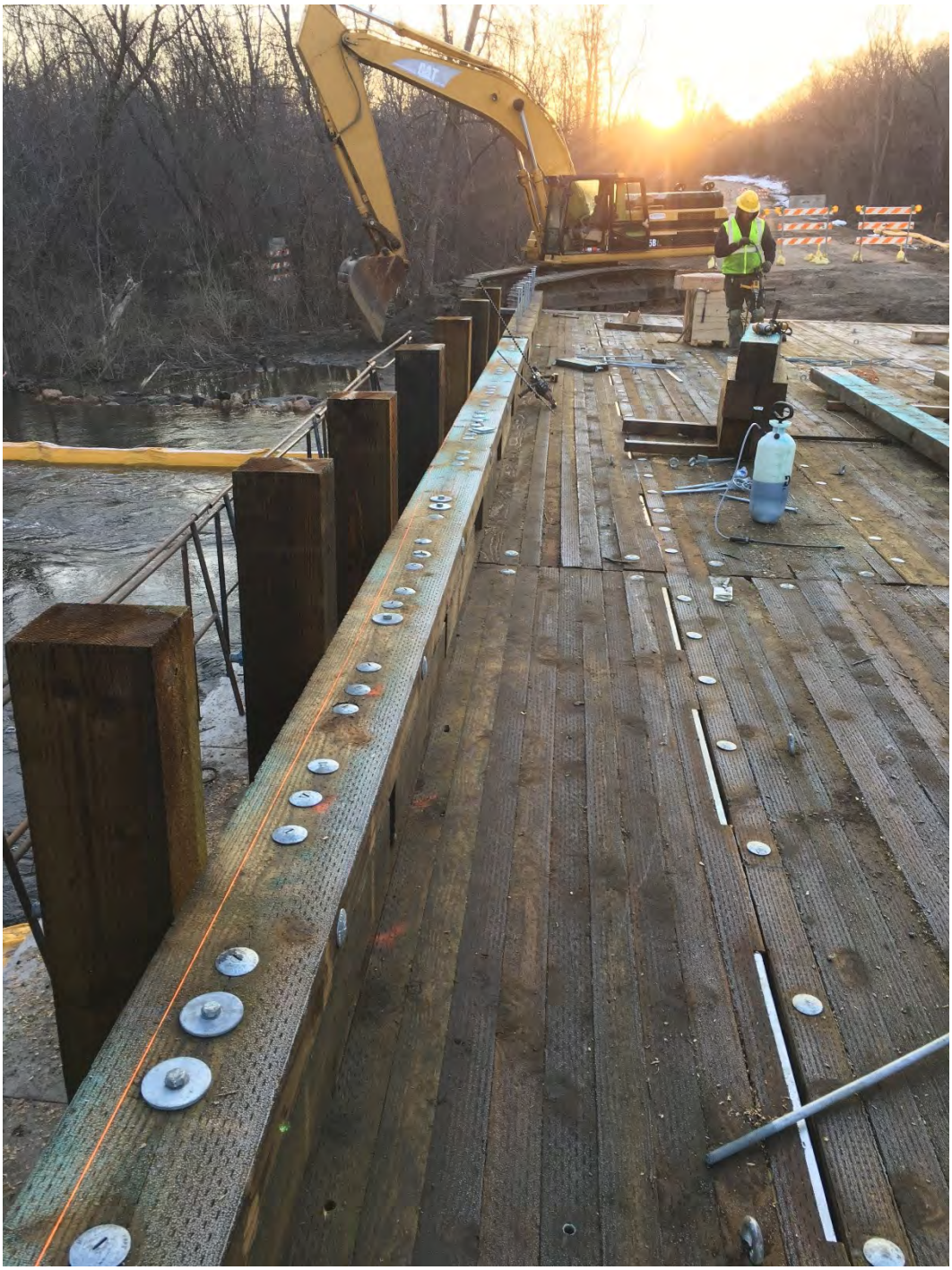


Figure 5.45 Curbs, scupper blocks, and rail posts installed along the north edge of the bridge. Embedded steel plates are to reinforce the bridge railing against vehicle impact forces. Photo credit Hennepin County.



Figure 5.46 Rail posts, spacers and railing installed on north edge of bridge. Photo credit Hennepin County.



Figure 5.47 Finalizing crash-tested bridge railing and curb system installation on north edge of bridge. Photo credit Hennepin County.



Figure 5.48 Flashing detail includes a full length horizontal flashing (yellow arrow) under the scupper and vertical flashing (red arrow) on the inside of the scupper opening.

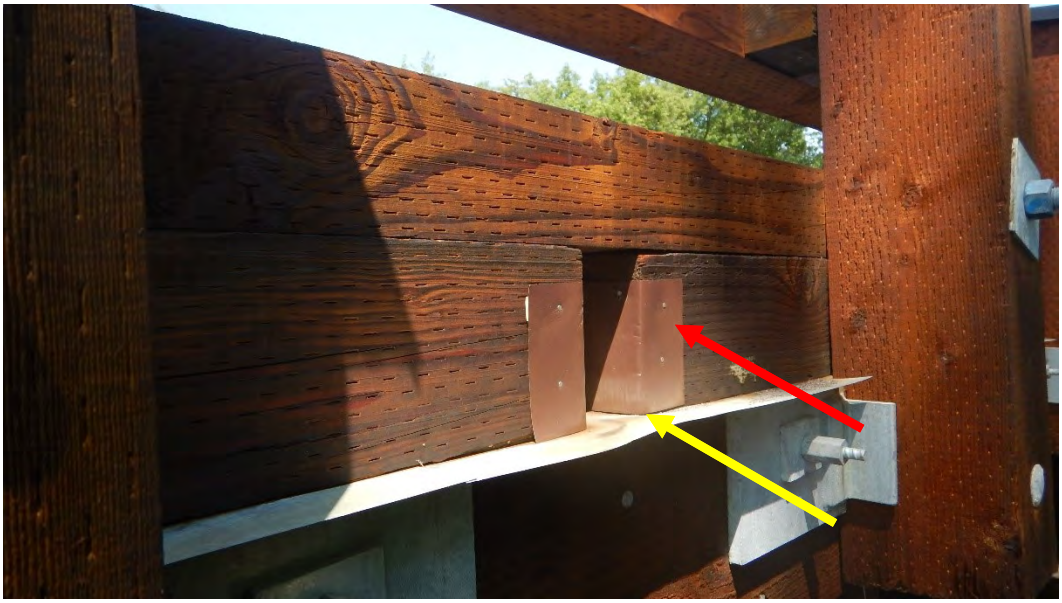


Figure 5.49 Flashing (yellow arrow) extending beyond the south bridge outside edge to divert water from the timber panels. Vertical flashing was also added (red arrow) to protect end grain in the opening.

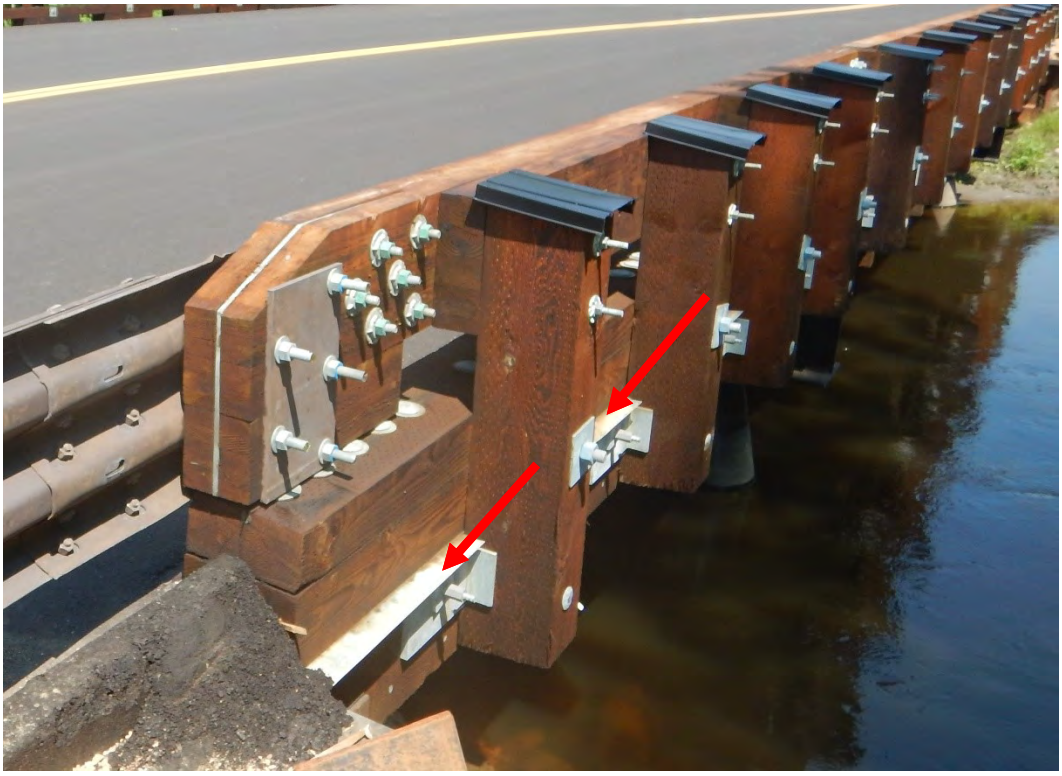


Figure 5.50 South edge of bridge flashing to divert water from bridge deck and away from timber components. Splice connection of the glulam bridge railing with the steel beam approach railing.



Figure 5.51 Plastic rail post flashing to divert water from rail post end grain. Preferred installation is for the screws to attach through the vertical side of the cap.



Figure 5.52 Completed bridge sub- and super-structure installation prior to remaining road site work. Photo credit Hennepin County.

5.3.3.5 Bituminous Overlay, Waterproof Membrane

Following installation of the timber deck, flashing, rail posts and end plates, the roadway approaches were prepared for a bituminous overlay. Based on the bridge approach design in the Hennepin County construction plan fill, grading and compacting was completed. Following that process, bituminous overlay was installed. A tack coat applied to the timber bridge deck prior to paving. Bituminous SP Type 12.5 Wearing Course Mix was used for the project. The bituminous wearing surface was applied in 2 separate layers. Layer one (base course) would be 1 in thick and layer 2 (wearing course) would be 2 in thick for a final bridge bituminous thickness of 3 in. A bituminous membrane overlay was applied between the base course and the wearing course by the construction crew and Hennepin County staff. The membrane was a Mirafi Miratak product. Each roll was 3 ft by 50 ft by 79 mil thickness.

The process steps for installation included:

- The bridge deck was uncovered for 1-2 days prior to paving to ensure a dry surface.
- A tack coat was applied to the timber deck.
- A base layer of bituminous (approximately one inch) was applied to the deck and compacted.

- The bituminous was allowed to cool to 175-200 °F (79-93 °C) prior to adding the ProtectoWrap membrane.
- The ProtectoWrap membrane was rolled out on the top of the base layer and went to within 1 inch of the bituminous edge. The rolls were 3 ft wide by 50 ft long. Overlap was two inches on the edges and 4 inches on the ends. The wrap extended 5 ft beyond the bridge deck onto the approach roadway. Pressure rolling was performed to ensure adhesion, especially at overlapped seams.
- The wear course of bituminous target was 275-300 °F (135-149 °C).
- Final compaction.

Figures 5.53 to 5.57 show the paving process and the installation of the waterproof reinforcing membrane.



Figure 5.53 Roadway approaches and bridge deck prepared for final bituminous paving. Photo credit Hennepin County.



Figure 5.54 First layer (base course) of bituminous overlay being deposited onto timber deck that had a tack coat applied (not shown). Photo credit Hennepin County.



Figure 5.55 Bituminous reinforcing membrane after installation onto the (base course) bituminous layer. Photo credit Hennepin County.



Figure 5.56 Tack coat application prior to first layer of bituminous. Photo credit Hennepin County.



Figure 5.57 Waterproof membrane installed on top of the (base course) bituminous layer in multiple rows. Each row of waterproof membrane was overlapped by 4 inches according to the manufacturers' specifications. Photo credit Hennepin County.

5.3.3.6 Guard Rail, Post Caps

Following paving, the railing was installed according to the construction plan and design details. The guard rails were installed and attached to the bridge rails. Figures 5.58 to 5.61 show the bridge railing installation and connection to roadway guard rails.



Figure 5.58 Completed installation of the crash-tested bridge railing and curb system.



Figure 5.59 Glulam rail splice connection detail with steel approach railing.



Figure 5.60 Approach semi-rigid guardrail system along north side of roadway.



Figure 5.61 View showing TL4 rail system used on this bridge and the installed plastic cap for moisture protection.

Following completion of the bridge, paving and approach guard rails, the road was opened for traffic. Figures 5.62 to 5.66 show the completed roadway and bridge.



Figure 5.62 Completed bridge and paved roadway.



Figure 5.63 Roadway open for traffic facing to the east.



Figure 5.64 Roadway open for traffic facing to the west.



Figure 5.65 Underside view of completed superstructure showing the timber spreader beams (red arrows) at the underside of the timber deck panels.



Figure 5.66 A side view of the completed bridge 27C53 open to traffic. Photo credit Hennepin County.

5.3.3.7 Construction Summary

During the project design, bid, and construction process, significant lessons were learned that could support improvements in future timber bridge construction projects in Minnesota. These include:

1. The bridge is situated in an environmentally sensitive area. This was a challenging site location due to the inherent river flow direction, water levels and weather. The location of the bridge in reference to the stream channel, the frequency of flooding in Elm Creek, and the location of the bridge on a curve presented challenges for the county design engineer. Significant effort was made to meet all appropriate federal, state and local requirements.
    a. To manage water levels and flow, ditches and culverts were used. Three flood plain culverts were added to the east side of the project. A stormwater pollution prevention plan was required and included temporary erosion control measures, permanent erosion and sediment control measures, final stabilization, and erosion and sediment controls. Additional detail is provided in Appendix E.
    b. Significant excavation and other work were required to replace the existing one lane bridge with a two lane bridge. Due to the location on a curve, the design required the timber bridge deck to have a super elevated cross slope of 5.8 percent to meet Minnesota Department of Transportation State Aid requirements.

c. The location of the bridge in a flood plain resulted in the selection of sheet steel piling abutments, CIP piling, steel H-beam abutment and pier caps. Appropriate design connections between the steel piling, caps and timber deck were specified and used.

2. This project was completed by a Redstone Construction, LLC bridge crew. Onsite monitoring and engagement were provided by Hennepin County construction engineer and the engineering technician, facilitating communication and construction monitoring. The construction crew was responsible for all construction activity at the site, including deconstruction, site preparation, gravel delivery, abutment preparation, structural member installation, and all other final roadwork.
3. A major challenge to the overall project was the weather. The project was designed and contracted for winter construction. The removal of the existing bridge was accomplished rapidly, and the installation of the bridge substructure was completed as expected just prior to winter season. Once the substructure was completed, a construction delay was initiated to wait until spring for the superstructure installation. Significant snow and cold was present throughout the winter and a rapid spring melt resulted in extremely high-water levels. Fortunately, the installation of the abutment and pier cap were competed prior to the high water. Following the timber deck installation, significant spring rains occurred, further delaying the construction of the roadway. Paving of the project was not completed until July, resulting in an extended detour. Construction of the timber superstructure was not delayed due to weather.
4. The detailed construction plan and Division Specification Book facilitated the bid process, construction and details for the project. The clarity of the information as presented provided for clear communication between the construction companies and the County, improving the construction process.
5. While a preconstruction meeting was held between the County and the winning contractor, the research project team was unable to attend. For research or demonstration projects with outside partners, it is suggested that future, early stage meetings between the project engineer, construction engineer and the engineering technician be held to clarify any research or demonstration project goals in advance of construction. Further, it is recommended that additional information on the demonstration aspects and project documentation requirements be shared with the full construction crew. It would create additional awareness and familiarity with plan details, construction techniques, and allow for a question/answer session.
6. In this project, changes were made to the plan for flashing the lower slope of the bridge to protect against water. Due to late notice on construction, a modified flashing approach was used. This is an example of where further early stage engagement by the research team would have clarified the intent of the flashing.
7. Discussions with the county representatives, resulted in good feedback for this project. Specifically, they identified the following comments:
    a. This was the first timber project that each had been involved with, and the result was positive. They affirmed the rapid installation of the timber panels, and the ability to advance the deck and railing installation rapidly. Other benefits noted included minimal on-site fabrication, a quiet construction site, and rapid assembly.
    b. They noted the positive impact of having some holes pre-drilled to maximize the treating envelope. On-site drilling was required and used to align the deck panels to both the abutment and pier caps and to connect them to each other. All field-drilled holes were field treated with preservatives in accordance with best practices.

c. The only challenge during installation was that the span two width exceeded the width of spans 1 and 3, requiring on-site modification. It was projected that one or more of the panels may have been slightly wider (but within specification), and that the 32-ft span length of span two made it challenging to close any gaps between panels. The correction was made by field removal of one laminate from the panel adjacent to the bridge edge. This was proposed by the bridge supplier and approved by the county and contractor. The modification to the panel took approximately 2 hours to accomplish and resulted in span 2 bridge width being within the acceptable tolerance range.

d. They also reported that the reinforcing membrane that was placed between layers was very simple, much more so than expected. It took less than one-person hour to install.

8. Perhaps the most valuable aspect to the project was time reduction of the construction cycle for the bridge superstructure. For this project, the timber panels were placed and installed in 5 five workdays, and the railing posts, hardware, and rails in two workdays during late winter. While this project was significantly delayed due to other aspects, the actual construction time was minimized using these materials. The timber panels and railing installation was not limited by winter construction.

5.4 COST SUMMARY AND COMPARISON

5.4.1 As-built Design: Dowel-laminated deck panels with metal spikes, transverse spreader beams, and railings.

One of the goals of this project was to track and compare costs for this bridge as compared to options utilizing alternative bridge materials. Table 5.5 provides the bid costs for the timber aspects of this bridge. Due to the use of a bid process, it was not possible to break out other details or to estimate labor costs for the timber installation. Specific design components selected for the project included the use of flashing on the south edge of the bridge deck, a waterproof membrane between layers of bituminous paving on the bridge, and a plastic cap for rail posts. However, these costs were not broken out during the bid process. For the flashing, the Division SB noted that the cost of material and installation should be considered incidental to Item Number 2403.618, laminated deck panels. For the waterproof membrane, the Division SB noted that the procurement, preparation of timber deck and the installation of the timber wear course, waterproof membrane, tack coat, and flashing were incidental to Item Number 2403.618, laminated deck panels. For the plastic post caps, the material and installation were incidental to the Item Number 2403.603, timber railing.

Table 5.5. Cost breakdown for Hennepin County Bridge 27C53.

Category	Bid Estimate
Superstructure – Timber deck panels[1]	$357,680
Superstructure – Timber Railing	$22,168
Superstructure Timber Total	$379,848

The construction progress was documented and the duration for each installation was:

- Timber deck installation (5 workdays)
- Railing posts, hardware (2 workdays)
- Bituminous overlay (1 workday)

5.4.2 Alternative Design: Continuous Concrete Slab with Concrete Deck

Additional cost comparisons/engineer's estimates were completed by LHB, Inc. This engineer's estimate was based on a three span 21 ft – 28 ft – 21 ft, 14 in deep continuous concrete slab span with single slope concrete barriers on each side of bridge. The substructures are comprised of integral reinforced concrete abutments on steel H-piling with 10 ft long wingwalls and pile bent piers with a reinforced concrete cap on 16 in diameter cast-in-place concrete piling. The general criteria used for determining estimate and unit process was:

- The estimate is built off a slightly longer superstructure (approx. 1 ft each end of bridge) due to wider abutment widths required for reinforced concrete substructure types and to match the hydraulic waterway area per Hennepin County Bridge 27C53.
- Proposed substructures include integral type reinforced concrete abutments on 6 – steel H12x53 piling (110 ft per pile) per abutment and pile bent piers with a reinforced concrete cap on 6 – 16 in diameter steel cast-in-place concrete piles (110 ft per pile) per pier.
- 38 ft – 0 in clear roadway and 41 ft – 0 in bridge slab out-to-out width.
- 14 in thick continuous reinforced concrete slab superstructure.

Figure 5.67 shows the design elevation and transverse section. Table 5.6 is an estimate of quantities and cost.

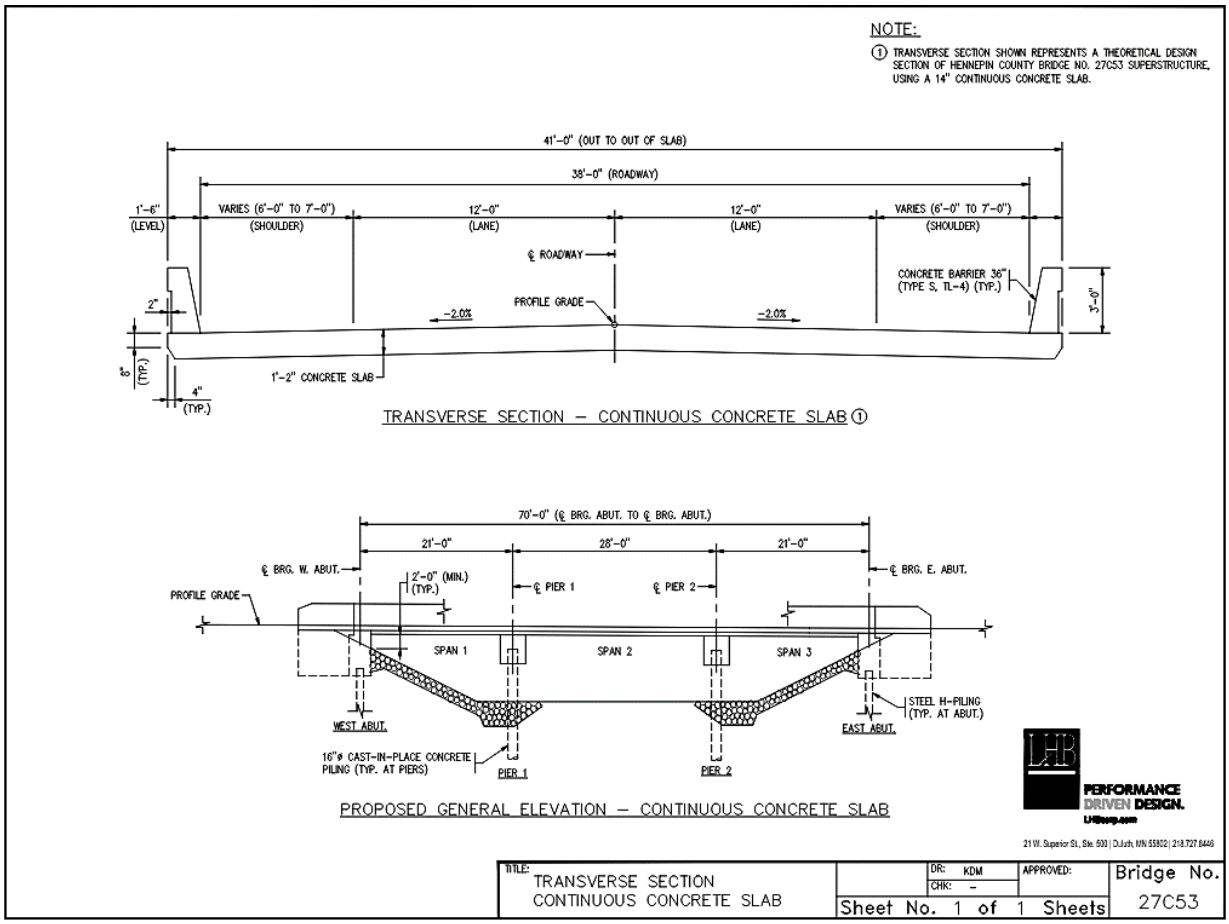


Figure 5.67 General elevation and transverse section of continuous concrete slab superstructure.

Table 5.6 Continuous concrete slab with concrete deck bridge estimated quantities and costs

Item No.	Description	Units	Quantity	Unit Price	Total Price
2021.501	Mobilization	Lump Sum	1	$60,000.00	$60,000.00
2401.503	Type S (TL-4) 36" Barrier Concrete (3S52)	Lineal Feet	190	$140.00	$26,600.00
2401.507	Structural Concrete (3B52)	Cubic Yard	110	$1,200.00	$132,000.00
2401.508	Reinforcement Bars (Epoxy Coated)	Pound	49800	$1.70	$84,660.00
2401.601	Structure Excavation	Lump Sum	1	$25,000.00	$25,000.00
2401.618	Bridge Slab Concrete (3YHPC-M)	Square Feet	2938	$52.00	$152,776.00
2442.501	Remove Existing Bridge	Lump Sum	1	$30,000.00	$30,000.00
2452.502	C-I-P Concrete Test Pile 120 ft Long 16"	Each	2	$13,000.00	$26,000.00
2452.502	Steel H-Test Pile 120 ft Long 12"	Each	2	$11,000.00	$22,000.00
2452.502	Pile Points 16"	Each	12	$350.00	$4,200.00
2452.502	Pile Tip Protection 12"	Each	12	$160.00	$1,920.00
2452.603	C-I-P Concrete Piling 16"	Lineal Feet	1100	$55.00	$60,500.00
2452.603	Steel H-Piling 12"	Lineal Feet	1100	$38.00	$41,800.00
2502.501	Drainage System Type (B910)	Lump Sum	1	$2,500.00	$2,500.00
2511.504	Geotextile Filter Type 7	Square Yard	1050	$2.75	$2,887.50
2511.507	Random Riprap Class IV	Cubic Yard	830	$80.00	$66,400.00
Total			**$739,243.50**		

Note:

- Items per the 2018 Edition of the Minnesota Department of Transportation Standard Specifications for Construction.
- It was estimated by LHB, Inc. that the substructure and superstructure construction duration would be 10-12 weeks minimum.

5.4.3 Alternative Design: Rectangular Prestressed Concrete Beams with Concrete Deck

Additional cost comparisons/engineer's estimates were completed by LHB, Inc. This engineer's estimate was based on a three span 19 ft – 32 ft – 19 ft, prestressed concrete beam spans with single slope concrete barriers on each side of bridge. The substructures are comprised of integral reinforced concrete abutments on steel H-piling with 10 ft long wingwalls and pile bent piers with a reinforced concrete cap on 16 in diameter cast-in-place concrete piling. The general criteria used for determining estimate and unit process was:

- The estimate is built off a slightly longer superstructure (approx. 1 ft each end of bridge) due to wider abutment widths required for reinforced concrete substructure types and to match the hydraulic waterway area per Hennepin County Bridge 27C53.
- Proposed substructures include integral type reinforced concrete abutments on 6 – steel H12x53 piling (110 ft per pile) per abutment and pile bent piers with a reinforced concrete cap on 6 – 16 in diameter steel cast-in-place concrete piles (110 ft per pile) per pier.
- 38 ft – 0 in clear roadway and 41 ft – 0 in bridge slab out-to-out width
- 6 lines of 14 in rectangular prestressed concrete beams (14RB) at 7 ft – 6 in spacing between beams.

Figure 5.68 shows the design elevation and transverse section. Table 5.7 is an estimate of quantities and cost.

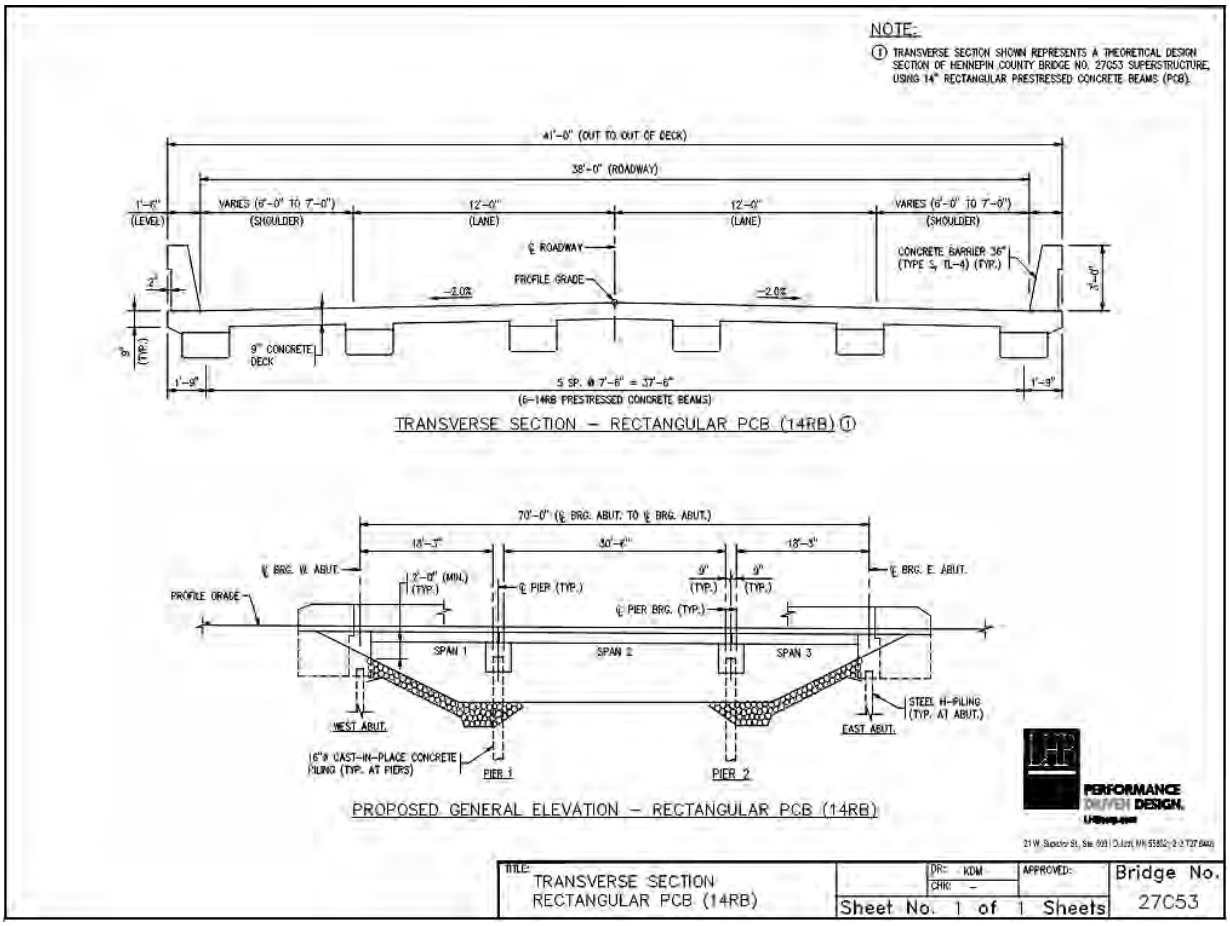


Figure 5.68 General elevation and transverse section of rectangular prestressed concrete beam with a concrete deck superstructure.

Table 5.7 Prestressed concrete beam with concrete deck bridge estimated quantities and costs.

Item No.	Description	Units	Quantity	Unit Price	Total Price
2021.501	Mobilization	Lump Sum	1	$65,000.00	$65,000.00
2401.503	Type S (TL-4) 36" Barrier Concrete (3S52)	Lineal Feet	190	$140.00	$26,600.00
2401.507	Structural Concrete (3B52)	Cubic Yard	110	$1,200.00	$132,000.00
2401.508	Reinforcement Bars (Epoxy Coated)	Pound	31800	$1.80	$57,240.00
2401.601	Structure Excavation	Lump Sum	1	$25,000.00	$25,000.00
2401.618	Bridge Slab Concrete (3YHPC-M)	Square Feet	2958	$34.00	$100,572.00
2402.502	Elastomeric Bearing Pad	Each	36	$130.00	$4,680.00
2405.503	Prestressed Concrete Beams 14RB	Lineal Feet	410	$290.00	$118,900.00
2442.501	Remove Existing Bridge	Lump Sum	1	$30,000.00	$30,000.00
2452.502	C-I-P Concrete Test Pile 120 ft Long 16"	Each	2	$13,000.00	$26,000.00
2452.502	Steel H-Test Pile 120 ft Long 12"	Each	2	$11,000.00	$22,000.00
2452.502	Pile Points 16"	Each	12	$350.00	$4,200.00
2452.502	Pile Tip Protection 12"	Each	12	$160.00	$1,920.00
2452.603	C-I-P Concrete Piling 16"	Lineal Feet	1100	$55.00	$60,500.00
2452.603	Steel H-Piling 12"	Lineal Feet	1100	$38.00	$41,800.00
2502.501	Drainage System Type (B910)	Lump Sum	1	$2,500.00	$2,500.00
2511.504	Geotextile Filter Type 7	Square Yard	1050	$2.75	$2,887.50
2511.507	Random Riprap Class IV	Cubic Yard	830	$80.00	$66,400.00
Total			**$788,199.50**		

Note:

- Items per the 2018 Edition of the Minnesota Department of Transportation Standard Specifications for Construction.
- It was estimated by LHB, Inc. that the substructure and superstructure construction duration would be 10-12 weeks minimum.

Life-cycle cost assessments (LCCA) are often completed for transportation construction projects to assess the full service life costs for these projects. For this project, the comparisons for LCCA were limited to the superstructure construction and maintenance costs. Other LCCA estimates may include the cost of inspection and user costs.

For the as-built timber design and the two concrete alternatives, the following information was projected. This includes the initial construction costs, and rehabilitation costs for both the first and second rehabilitation. For this project, an estimated life of the bridge was estimated at 75 years. For this case, deck rehabilitation was estimated at 25 and 50 years for the timber project and 25 and 50 years for the concrete deck project. Estimates of deck repairs was estimated at $30,000 (2018 dollars) was estimated at 25 years and 50 years for the timber deck and at 50 years for the concrete deck options. Repair and rehabilitation options for the concrete deck could include repair of potholes, shallow overlay, and bridge deck replacement. Further maintenance could include pothole repairs at 10 year time intervals.

5.5 LIFE-CYCLE ASSESSMENT

A preliminary, screening cradle-to-gate life-cycle assessment (LCA) was completed for Hennepin County, Minnesota bridge 27C53, which was constructed on County Road 202 in the Elm Creek Park Reserve. The LCA utilized data from the bill of materials (BOM) and construction drawings, which were provided by Hennepin County (MN), the bridge owner.

The system boundary included material and fuel consumption for timber and steel structural materials fabrication; material and fuel consumption for fabrication of steel hardware, bituminous overlay, and related components; and transport of materials to the construction site. Because this preliminary screening LCA study was cradle-to-gate, use phase activities and disposal/recycling of the timber bridge were excluded. Most of the life-cycle inventory (LCI) data was secondary data from the DATASMART LCI database (LTS, 2019a). This study also used the cut-off approach method for recycling and utilized the LTS 2019 method (LTS, 2019b) to translate the LCI data into environmental impacts, which combines the ReCiPe Endpoint (H) *v1.03* method's (Huijbregts et al., 2017) three endpoint categories (Human Health, Ecosystems, Resources) with the Cumulative Energy Demand, Climate Change, and Water Use impact categories.

A screening LCA is helpful to identify where in the product life cycle most environmental impacts occur, as well as which environmental areas are most impacted. This helps in the definition of the goal and scope of future work, if desirable. The screening LCA may also serve as a guide for a full LCA and allow for the refinement of the goal and scope moving forward, while forming the basis of the model for a full LCA. Since a screening-level LCA may use simplified assumptions, the results are only as accurate as those assumptions.

This study was modeled using *SimaPro v9.0* LCA software (Pré, 2016) and follows International Organization for Standardization (ISO) 14044 guidelines (ISO, 2006a) for internal screening LCAs; however, this LCA is not ISO-approved and is not suitable for external statements or documentation.

Screening-level LCAs are used for gathering and analyzing internal information and allow for assumptions and the use of proxy data and do not usually include the exhaustive sensitivity, consistency, or uncertainty analyses required to comply with ISO 14044 guidelines for public disclosure.

5.5.1 Goal and Scope Definition

The first phase of an LCA defines the goal and scope of the study. According to ISO 14044, the goal of the study should clearly specify the intended application, reasons for carrying out the study, the intended audience, and whether the results are intended to be disclosed to the public. The scope of the study describes the most important aspects of the study, including the functional unit, system boundaries, cut-off criterion, allocation, impact assessment method, assumptions, and limitations.

The objective of this study was to determine the potential environmental impacts of Hennepin County, Minnesota bridge 27C53. The results could be used to inform the Minnesota Department of Transportation (MnDOT) and their stakeholders of the environmental profile of the bridge.

5.5.1.1 Function

The function of the bridge is to support automobile, pedestrian, and bicycle traffic over Elm Creek in the Elm Creek Park Reserve.

5.5.1.2 Functional Unit

A functional unit identifies the primary function(s) of a system based on which alternative systems are considered functionally equivalent (ISO, 2006b). This facilitates the determination of reference flows for each system, which in turn facilitates the comparison of two or more systems. Based on the identified function, the following functional unit was used to determine the reference flows: one steel and timber bridge with a width of 40 ft and a length of 68 ft.

5.5.1.3 System Boundaries

System boundaries are established in LCA in order to include the significant life-cycle stages and unit processes, as well as the associated environmental flows in the analysis. This lays the groundwork for a meaningful assessment where all important life-cycle stages, and the flows associated with each alternative, are considered. Included in the system boundary of this study are:

- Material and fuel consumption for timber and steel materials fabrication;
- Material and fuel consumption for fabrication of steel hardware and related components;
- Material and fuel consumption for bituminous overlay; and
- Transport of materials to the construction site.

5.5.1.4 Excluded Processes

Because this preliminary screening LCA study is cradle-to-gate, use-phase activities and disposal/recycling of the bridge components are excluded. Materials packaging is also excluded from the study. Typically, in an LCA, some aspects within the set boundaries are excluded due to statistical

insignificance or irrelevancy to the goal and scope. Thus, the following impacts were also excluded from the scope and boundaries for this study:

- Human activities (e.g., employee travel to and from work); and
- Services (e.g., the use of purchased marketing, consultancy services and business travel).

5.5.1.5 Cut-off Criteria

Cut-off criteria are often used in LCA practice for the selection of processes or flows to be included in the system boundary. The processes or flows below these cut-offs or thresholds are excluded from the study. Several criteria are used in LCA practice to decide which inputs are to be considered, including mass, energy and environmental relevance. In the current study, every effort was made to include all the flows associated with the processes studied. During the interpretation phase, we used 1% of environmental load as a cut-off.

5.5.1.6 Allocation and Recycling

While conducting an LCA, if the life cycles of more than one product are connected, allocation of the process inputs should be avoided by using the system boundary expansion approach. If allocation cannot be avoided, an allocation method – based on physical causality (mass or energy content, for example) or any other relationship, such as economic value – should be used (ISO, 2006a). All allocations were completed based on mass.

This study used the cut-off approach method for recycling. According to this approach, the first life of a material bears the environmental burdens of its production (e.g., raw material extraction and processing) and the second life bears the burdens of refurbishment (e.g., collection and refining of scrap). The burdens from waste treatment are taken by the life after which they occur (Frischknecht, 2010). Given that DATASMART LCI data (LTS 2019a) uses the cut-off approach for recycling, it is considered a reasonable default.

5.5.1.7 Impact Assessment Method

Impact assessment methods are used to convert LCI data (environmental emissions and raw material extractions) into a set of environmental impacts. ISO 14044 (ISO, 2006a) does not dictate which impact assessment method to use for a comparative assertion; however, the chosen method needs to be an internationally-accepted method if the results are intended to be used to support a comparative assertion disclosed to the public.

The impact assessment method used for this study was the LTS 2019 method (LTS, 2019b), which combines the ReCiPe Endpoint (H) *v1.03* method's (Huijbregts et al., 2017) three endpoint categories (Human Health, Ecosystems, Resources) with the Cumulative Energy Demand (CED) *v1.11* (Frischknecht et al., 2007), Climate Change IPCC 2013 GWP 100a *v1.03* (IPCC 2013), and Water Use (Huijbregts et al., 2017) impact categories. These six categories have been found to be of interest and readily

understandable to readers of LCA reports. The LTS 2019 impact assessment method (LTS, 2019b) is summarized in Table 5.8.

Table 5.8 LTS 2019 impact assessment method (LTS 2019b).

Impact Category	Method	Unit
Human Health	ReCiPe 2016 Endpoint (H) *v1.03*	DALY
Ecosystems	ReCiPe 2016 Endpoint (H) *v1.03*	species*yr
Resources	ReCiPe 2016 Endpoint (H) *v1.03*	$
Cumulative Energy Demand	CED *v1.11*	MJ
Climate Change	IPCC 2013 GWP 100a *v1.03*	kg CO_2 eq.
Water Use	ReCiPe 2016 Endpoint (H) *v1.03*	m^3

ReCiPe is one of the most recent and updated impact assessment methods available to LCA practitioners. The method addresses several environmental concerns at the midpoint level and then aggregates the midpoints into a set of three endpoint categories. Endpoint characterization models the impact on Areas of Protection (i.e., on human health, ecosystems, and resources). In other words, endpoint is a measure of the damage – at the end of the cause-effect chain – caused by a stressor in terms of human life-years lost and the years lived disabled, species disappeared, and resources lost.

The Cumulative Energy Demand (CED) of a product is the direct and indirect energy use throughout the life cycle, including the energy consumed during the extraction, manufacturing, and disposal. The CED method considers both renewable and non-renewable energy and the direct and indirect energy consumption.

The IPCC 2013 method for assessing the Global Warming Potential (i.e., Climate Change) was developed by Intergovernmental Panel on Climate Change (IPCC). It is one of the most widely used methods to estimate climate change potential of global warming gases in LCA studies. The global warming factors have been developed for 20-, 100-, and 500-year time horizons to address the global warming potential of emissions in the short as well as long term. This study uses the climate change factors for the 100-year time horizon.

5.5.1.8 Endpoint Categories

- Human Health. In this category, the damage analysis links the six midpoint categories (Climate Change, Human Toxicity, Photochemical Oxidant Formation, Particulate Matter Formation, Ionizing Radiation, and Ozone Depletion) to the Disability Adjusted Life Years (DALYs). The DALY tool is primarily a disability weighting scale of 0 – 1, where 0 represents perfect health and 1 represents death.
- Ecosystems. The damage to ecosystems is measured by calculating the species that disappear in each time period and area. The unit of damage assessment is species lost in one year (species*yr). The midpoint impact potentials that apply to ecosystem quality are: Climate Change, Terrestrial

Acidification, Freshwater Eutrophication, Ecotoxicity, Agricultural Land Occupation, Urban Land Occupation, and Natural Land Transformation.

- Resources. The two midpoint categories contributing to the resources category are Fossil Depletion and Metal Depletion. The quantification of the damage is based on the marginal increase of cost due to the extraction of resources, measured as dollars per kilogram ($/kg).

5.5.1.9 Midpoint Categories

- Cumulative Energy Demand. This category includes non-renewable (fossil and nuclear) and renewable (biomass, water, solar, wind, and geothermal) energy sources. Characterization factors are based on the upper (or higher) heating value. Characterization factors are expressed as equivalent megajoules (MJ).
- Climate Change. There are several gaseous emissions that cause global warming, including carbon dioxide, methane, nitrous oxides, and fluorinated gases. This category combines the effect of the periods of time that the various greenhouse gases remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation. The global warming potential is measured as kg equivalents of radiation CO_2 (i.e., the relative global warming potential of a gas as compared to CO_2). The IPCC model with a 100-year time horizon is used for characterization. The uptake of CO_2 from the air (i.e., sequestration of CO_2 by plants) and the subsequent emission of biogenic CO_2 (from the burning of biomass) is not included.
- Water Use. Water use is based on water consumption, which is the use of water in such a way that the water is evaporated, incorporated into products, transferred to other watersheds, or disposed into the sea (Falkenmark et al., 2004). Water that has been consumed, therefore, is no longer available in the watershed of origin for humans nor for ecosystems.

5.5.1.10 Limitations of the Study

This is a cradle-to-gate screening LCA using mainly secondary data. To make external claims per ISO 14044 (ISO, 2006a), this study would need to be expanded to include:

- Cradle-to-grave system boundary (to include distribution transport, use, and end-of-life phases);
- Primary data for key processes;
- Additional sensitivity analyses;
- Data quality requirements and indicators; and
- Critical review.

5.5.1.11 Limitations of LCA Methodology

LCA's ability to consider the entire life cycle of a product makes it an attractive tool for the assessment of potential environmental impacts. Nevertheless, like other environmental management analysis tools, LCA has several limitations.

With current availability of data, it is nearly impossible to follow the entire supply chain associated with the product life in a company- or manufacturer-specific way. Instead, almost all processes within the supply chains are modeled using average industry data with varying amounts of specificity (e.g., data on a more-or-less specific technology or region). This makes it difficult to accurately determine how well the unit process data represents the actual factors in the products' life cycle. It also makes it difficult to know in which region the processes are found.

Furthermore, LCA is based on a linear extrapolation of emissions with the assumption that all the emissions contribute to an environmental effect. This is contrary to threshold-driven environmental and toxicological mechanisms. Thus, while the linear extrapolation is a reasonable approach for more global and regional impact categories such as Global Warming Potential (GWP) and Acidification, it may not accurately represent the actual on-the-ground human- and ecotoxicity-related impacts.

Additionally, even if the study has been critically reviewed, it should be noted that, as for any LCA, the impact assessment results generated for this study are relative expressions and do not predict impacts on category midpoints, exceeding thresholds, or risks. It should also be noted that, even though LCA covers a wide range of environmental impact categories, some types of environmental impacts (e.g., noise, social, and economic impacts) are typically not included in LCA.

5.5.2 Life-Cycle Inventory

The second phase of an LCA is to collect life-cycle inventory (LCI) data. LCI data contains the details of the resources flowing into a process and the emissions flowing from a process to air, soil, and water.

5.5.2.1 LCI Data Collection

As previously noted, secondary inventory data was used in this study for most processes, with most it readily available in the DATASMART LCI database (LTS, 2019a).

TREATED SOLID TIMBER PRODUCTION

The spreader beams, spreader beam splices, rail posts, post blocks, transition blocks, curbs, scuppers, and edge strips were all manufactured from copper naphthenate (CuNap)-treated solid timber. These materials were assumed to be manufactured from kiln-dried softwood. Selected life-cycle inventory data for the CuNap-treated solid timber are listed in Table 5.9.

Table 5.9 Selected life-cycle inventory data for 1,000 ft3 of CuNap-treated solid timber.

Description	LCI Data Source	Quantity	Unit
Water	Water, unspecified natural origin, US	1.3×10^{0}	gal
LPG	Liquefied petroleum gas, combusted in industrial boiler NREL/US U	7.9×10^{-1}	gal
Diesel	Diesel, combusted in industrial equipment NREL/US U	1.9×10^{1}	gal
Gasoline	Gasoline, combusted in equipment NREL/US U	1.6×10^{0}	gal
Waste wood	Wood waste, unspecified, combusted in industrial boiler NREL/US U	5.5×10^{3}	lb.
Transport	Transport, lorry 3.5-16t, fleet average/US- US-EI U	7.3×10^{3}	t-mi
Copper naphthenate	LCA model	6.0×10^{2}	lb.
Solid timber	Sawn Lumber, softwood, planed, kiln dried, at planer mill, INW/m3/RNA	1.0×10^{3}	ft^3
Natural gas	Natural gas, combusted in industrial boiler NREL/US U	2.0×10^{3}	ft^3
Electricity	Electricity, medium voltage, at grid, 2015/US US-EI U	9.2×10^{2}	kWh

TREATED GLULAM RAILING PRODUCTION

The glulam railings were manufactured from CuNap-treated glued timber (glulam) designed for outdoor use. The glulam was assumed to be manufactured from softwood at 20% moisture content and bonded with a melamine formaldehyde resin. Selected life-cycle inventory data for the CuNap-treated glulam are listed are Table 5.10.

Table 5.10 Selected life-cycle inventory data for 1,000 ft3 of CuNap-treated glulam.

Description	LCI Data Source	Quantity	Unit
Water	Water, unspecified natural origin, US	1.3×10^{0}	gal
LPG	Liquefied petroleum gas, combusted in industrial boiler NREL/US U	7.9×10^{-1}	gal
Diesel	Diesel, combusted in industrial equipment NREL/US U	1.9×10^{1}	gal
Gasoline	Gasoline, combusted in equipment NREL/US U	1.6×10^{0}	gal
Waste wood	Wood waste, unspecified, combusted in industrial boiler NREL/US U	5.5×10^{3}	lb.
Transport	Transport, lorry 3.5-16t, fleet average/US- US-EI U	7.3×10^{3}	ton-mi
Copper naphthenate	LCA model	6.0×10^{2}	lb.
Glulam	Glued laminated timber, outdoor use, at plant/US- US-EI U	1.0×10^{3}	ft^3
Natural gas	Natural gas, combusted in industrial boiler NREL/US U	2.0×10^{3}	ft^3
Electricity	Electricity, medium voltage, at grid, 2015/US US-EI U	9.2×10^{2}	kWh

CUNAP-TREATMENT PROCESS

LCI data was not available for CuNap in the DATASMART LCI database, so a new process was created based on previous literature (Bolin and Smith, 2011; Tsang et al., 2014). It was assumed that the yield of treated wood was 100%. The life-cycle inventory data for the CuNap preservative are listed in Table 5.9.

Table 5.11 Life-cycle inventory data for 293.85 g of copper naphthenate.

Description	LCI Data Source	Quantity	Unit
Oxygen	Oxygen, in air	63.96	g
Copper	Copper oxide, at plant/US- US-EI U	79.545	g
Methyl cyclopentane	Methyl cyclopentane, from naphtha, at plant/US- US-EI U	168.324	g

NAIL-LAMINATED DECK PANEL PRODUCTION

The nail-laminated deck panels (nail-lam) were manufactured from CuNap-treated solid timber, as described in Table 5.2, and 3/8-in diameter galvanized steel nails. (The length of the nails was either 11 or 15 in, depending on the size of the finished panel.)

STRUCTURAL STEEL

The rail splice plates, guardrail transition plates, post plate assemblies, and internal steel plates were assumed to be manufactured from hot-rolled sheet steel with a density of 490 lb./ft^3, which was then galvanized.

WATERPROOF MEMBRANE

The waterproof reinforcing membrane for the bridge deck was assumed to be manufactured from butadiene styrene sheeting with a weight of 0.26 lb./ft^2. Selected life-cycle inventory data for the waterproof membrane are listed in Table 5.12.

Table 5.12 Selected life-cycle inventory data for 1 kg of waterproof membrane.

Description	LCI Data Source	Quantity	Unit
Sand	Sand (in ground)	5.3×10^{-1}	kg
Shale	Shale (in ground)	6.8×10^{-1}	kg
Pitch	Proxy Pitch 100#/CN	1.8×10^{0}	kg
Pitch	Proxy Pitch 10#/CN	2.1×10^{-1}	kg
Styrene butadiene styrene	Proxy_SBS/CN	2.5×10^{-1}	kg
Polyester	Proxy_Polyester materials/CN	7.9×10^{-1}	kg
Insulation	Proxy_Glass wool heat insulation/CN	2.6×10^{-1}	kg
Polyethylene	Proxy_PE film/CN	1.1×10^{0}	g
Transport	Transport, train, average/CN U	1.1×10^{-1}	t-km
Transport	Transport, lorry, 2-5t, suburb, average/CN S	1.0×10^{-1}	t-km
Coal	Hard coal supply mix/CN US-EI U	3.9×10^{-1}	kg
Electricity	Electricity mix/CN US-EI U	9.5×10^{-2}	kWh

BITUMINOUS OVERLAY

The bituminous overlay was assumed to be asphalt with a density of 145 lb./ft^3. 646 ft^3 of asphalt was required to cover the bridge (with a 3-in thickness); however, asphalt for the bridge approaches was excluded from the study. Selected life-cycle inventory data for the bituminous overlay are listed in Table 5.13.

Table 5.13 Selected life-cycle inventory data for 1 kg of bituminous overlay (mastic asphalt).

Description	LCI Data Source	Quantity	Unit
Bitumen	Bitumen, at refinery/US* US-EI U	8.0×10^{-2}	kg
Diesel	Diesel, burned in building machine/GLO US-EI U	2.2×10^{-2}	MJ
Electricity	Electricity, medium voltage, at grid/CH* US-EI U	2.8×10^{-2}	kWh
Heat	Heat, light fuel oil, at industrial furnace 1MW/US* US-EI U	1.5×10^{0}	MJ
Limestone	Limestone, milled, packed, at plant/US* US-EI U	2.6×10^{-1}	kg
Sand	Sand, at mine/US* US-EI U	6.6×10^{-1}	kg
Transport	Transport, freight, rail/US- US-EI U	1.6×10^{-2}	t-km
Transport	Transport, lorry 20-28t, fleet average/US* US-EI U	5.4×10^{-2}	t-km

STEEL HARDWARE

All bolts, nuts, washers, and connectors were manufactured from galvanized low-alloyed steel.

ELECTRICITY MIXES

The electricity usage was modeled using the 2015 average US electricity grid process from the DATASMART LCI database (LTS, 2019a). (These values are taken from 2015 US Energy Information Administration (EIA) data.) The electricity grid mix is a mix of domestic production from various sources, and the average grid mix for the electricity datasets used in this study is shown in Table 5.14.

Table 5.14 Average electricity grid mix for the US.

Electricity source	2015
Hard coal	33.17%
Oil	0.69%
Natural gas	32.70% (47% shale)
Industrial gas	0.16%
Petroleum coke	0.16%
Nuclear	19.55%
Hydro	6.11%
Cogen	0.103%
Geothermal	0.39%
Solar PV	0.61%
Wind	4.68%
Canadian imports	0.31%
Mexican imports	0.03%

5.5.2.2 Data Quality

The quality of the data used in this preliminary LCA is reasonably accurate and representative of the processes modeled. However, Data Quality Requirements and Indicators (DQI) have not been assigned to this study. (This includes evaluation of data reliability, completeness, geographical correlations, further technological correlation, and sample size using the Pedigree Matrix (Weidema and Wesnaes, 1996; Frischknecht et al., 2004).

5.5.3 Results of Life-Cycle Impact Assessment

The following sections summarize the key characterized results of the LCA including contribution analyses.

5.5.3.1 Bridge Life Cycle

Table 5.15 presents the life-cycle impacts for the completed 27C53 bridge.

Table 5.15 Life-cycle impacts of the 27C53 bridge using the LTS 2019 method (LTS, 2019b).

Damage Category	Unit	27C53 Bridge
Human Health	DALY	0.171
Ecosystems	species*yr	2.36×10^{-4}
Resources	$	5.95×10^{3}
Cumulative Energy Demand	MJ	8.11×10^{5}
Climate Change	kg CO_2 eq.	4.11×10^{4}
Water Use	m^3	579

5.5.3.2 Contribution Analysis

Contribution analyses identify the environmental hot-spots within the bridge system, which are the processes that contribute disproportionately to the overall life-cycle impacts of the system. The identification of hot-spots provides a deeper understanding of what is driving the environmental performance of the completed bridge and allows for the identification of opportunities for process improvement. The contribution analysis for the completed bridge is shown in Figure 5.69.

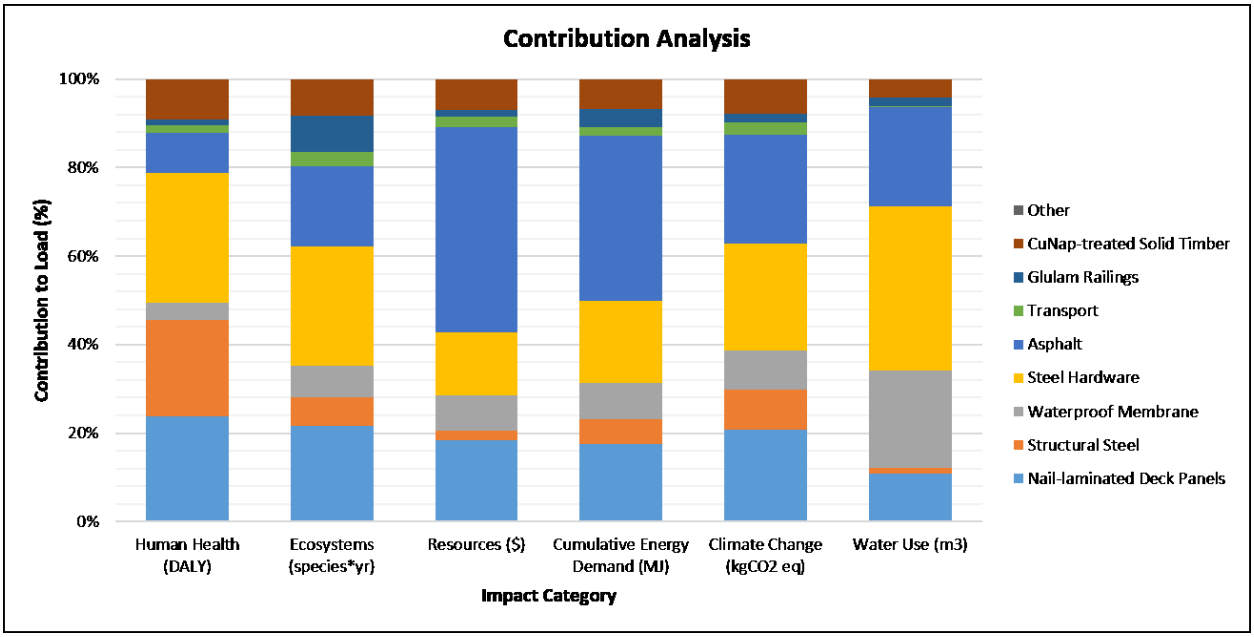


Figure 5.69 Contribution analysis for the completed 27C53 bridge using the LTS 2019 method (LTS, 2019b).

As shown, the bituminous (asphalt) overlay accounted for the largest portion of the impacts in most impact categories, contributing 18%, 46%, 37%, 25%, and 22% of the impacts in the Ecosystems, Resources, Cumulative Energy Demand, Climate Change, and Water Use impact categories, respectively. Production and use of the steel hardware also contributed a large portion of the impacts in each impact category, accounting for 14% to 37% of total impacts. The nail-laminated deck panels accounted for 24%, 22%, 18%, 18%, and 21% of the impacts in the Human Health, Ecosystems, Resources, Cumulative Energy Demand, and Climate Change impact categories, respectively. The structural steel accounted for less than 10% of the total impact in each impact category, except for Human Health, where it accounted for 22% of impacts. Likewise, the waterproof membrane accounted for less than 10% of the total impact in each impact category, except for Water Use, where it contributed 22% of impacts. The glulam railings CuNap-treated solid timber components, and transport contributed less than 10% to each impact category.

5.5.4 Life-Cycle Conclusions

In addition to strictly financial costs of the Hennepin County bridge project, one objective of the LCA study was to understand the environmental impacts of the 27C53 bridge on a cradle-to-gate basis. Environmental assessments are becoming more common in building construction, and it is projected that they will also increase in importance for the bridge construction sector. The bituminous (asphalt) overlay generally accounted for the largest impact in most impact categories, ranging from 9% to 46%, while the nail-laminated deck panels contributed 18% to 24% of the impacts in five of the six impact categories. The steel hardware, structural steel, and CuNap-treated solid timber components contributed an average of 25%, 8%, and 5% of the impacts in each impact category, respectively. While the scope of project was not to compare the environmental performance of the timber bridge to an

equivalent concrete bridge, this does provide key information for future research activity and offers a guideline for future environmental assessments.

CHAPTER 6: CONCLUSIONS

The focus of this project was to create cost-competitive timber bridge design and construction information to support new construction and improve the long-term performance of timber bridges. This information, gained through project activities informed by literature reviews, surveys of county engineers, and demonstration construction projects, was targeted to support an increase in the construction of timber-based bridges in Minnesota. Key conclusions from this report included:

- The main advantage of the timber bridge option is its accelerated construction time for bridge superstructure installation. It is clear from previous case studies, interviews with engineers, contractors, and suppliers, and demonstration projects that timber bridge superstructures can typically be installed within a 1- to 2-week timeframe, as compared to significantly longer timeframes for non-timber superstructures. Prefabrication and assembly of timber bridge components into girder systems or partial-width deck panels is accomplished at the manufacturing facility, which helps minimize traffic disruptions and significantly reduce on-site construction costs. Another significant advantage is the ability to construct timber bridge superstructures during the winter season without detrimental effects to material integrity.
- Timber-based bridge construction projects are infrequent in Minnesota, significantly trailing bridges built from steel and concrete components and/or precast concrete culverts. The majority of the timber-based bridge construction projects were in just a handful of Minnesota counties. It is clear from county surveys that there is significantly less familiarity with timber bridges than with other materials, and a general perception that timber bridges are not a long-lasting or cost-competitive bridge option. In contrast, a recent nationwide timber inspection study convened by a team of government and university researchers indicated that timber bridges can achieve a 70-year service life. The bridge service life could extend even further when key drainage and flashing details are coupled with effective nondestructive inspection and routine maintenance practices.
- Minnesota has two timber bridge component suppliers, Wheeler Lumber, LLC and Bell Structural Systems. These companies have significant experience in working with local bridge owners and engineers to support the design and construction of timber bridges that are cost-effective and long-lasting. Further, there are several bridge companies outside of Minnesota with specialized experience in the design, specification, and construction of timber-based bridge construction projects.
- Several Minnesota construction firms have experience in constructing timber bridges, but this experience is limited mainly to the spike-laminated timber deck “slab-type” bridge system. A few counties maintain their own “in-house” construction crews that construct new timber bridges each year, which may result in a cost savings. To help construction firms learn more about the key aspects of timber bridge construction, additional resources are available. The St. Louis County and the Hennepin County bridge construction case studies documented in this report should provide key details and perspectives on preferred construction methods. In addition, several construction videos on timber bridge superstructure assembly methods are

available through the National Center for Wood Transportation Structures accessible at www.woodcenter.org.

- Engineers and local bridge owners surveyed in this study reported an awareness of life-cycle cost assessment (LCCA) methods, a tool used to assess various construction or repair decisions and identify the most cost-effective approach. Several engineers and local bridge owners reported they utilize a variation of the LCCA method to manage their bridge projects. At the same time, this group also reported a general lack of awareness of life-cycle assessment (LCA) methodology. LCA looks beyond economic cost factors and evaluates the environmental impacts of a product or system on a cradle-to-grave basis in a more holistic approach. It was also evident from survey responses that there aren't any design considerations currently being used in Minnesota for improving the environmental footprint (i.e., carbon emissions, embodied energy and carbon storage) of bridge construction projects.
- Life-cycle assessments (LCA) were completed for each of the two demonstration projects. This LCA analysis work was limited to the actual design and materials used for the two demonstration projects detailed in this report. Of significant impact in these LCA studies was the use of a bituminous asphalt wearing surface in conjunction with a waterproof geotextile membrane. These results will establish key baseline data on timber bridge LCA analyses, and future investigations can extend this work by developing comparative LCAs of the design and materials for competing bridge materials. As more attention is focused on the sustainability of all constructed facilities in the future, LCA assessments will likely be a higher consideration for local bridge owners and design engineers.
- Additional measures are under consideration for improving the cost-effectiveness of Minnesota timber bridges. These measures include: a more streamlined MnDOT approval process for waivers with regard to preservative selection; contracting options that include inclusion of timber design information into the contract bidding process to foster more cost-competitive awards; further investigation into contractor supplied bridge superstructure designs to improve the cost-effectiveness of timber bridges for local roads in Minnesota.
- Several aspects of the current AASHTO-LRFD bridge design specifications can be advantageous to timber bridges and can result in significant cost savings during material fabrication. Since most timber bridges are located on secondary roads with low traffic volume, a favorable multiple-presence factor can be utilized when the average daily traffic over the bridge is projected to be less than 1,000 vehicles per day. For bridges that utilize lumber species that require incising to achieve adequate preservative treatment, a modified incising pattern option can now be justified, limiting the impact of the incising factor in the design process. In addition, the use of the impact factor, or dynamic load allowance factor, is not required for timber bridges due to favorable energy absorbing characteristics.
- To improve awareness of modern timber bridges for state and local bridge owners, design aids were developed for three bridge superstructure types: 1) steel stringers with a transverse glulam deck, 2) glulam stringer with a transverse glulam deck, and 3) spike-laminated longitudinal deck. These aids generally included the following information for each

superstructure type: perspective drawing and photographic view, design information, connection detail, crash-tested bridge railing options, and flashing detail options.

- Two demonstration construction projects were completed during this project.
    - In the first project, a St. Louis County construction crew installed a steel girder with transverse glulam deck bridge with a curbless crash-tested railing system. The bridge installation was efficient and new flashing designs were used to direct water off the bridge deck. Despite several challenging site conditions, the project was successfully installed. While the overall project costs were significant, the wood-based materials and labor were similar to that for other alternative designs.
    - In the second project, Hennepin County contracted with a Minnesota construction firm. The previous bridge was removed in December, piles were installed in January, and the timber superstructure was constructed in March. However, spring rains created a long delay in other roadway work and paving, resulting in a delayed opening until July. However, the timber superstructure was completed in approximately five days. The feedback from the county (design engineer, construction engineer, and construction inspector) was positive about all of the timber aspects of the project. This project also was completed at a very difficult site, making a direct cost comparison to alternative designs complicated. However, it appears this project was cost-competitive based on the information collected.
- Time-lapse construction videos (and a multitude of timber bridge-related resources) are available through the National Center for Wood Transportation Structures accessible at: www.woodcenter.org (hosted by Iowa State University).
- Several key details for improving the durability of Minnesota timber bridges were implemented in the bridge construction case studies and/or highlighted within this report.
- The installation of a waterproof asphalt wearing surface is instrumental for the long-term durability of timber bridges. It keeps the roadway portion of the superstructure sheltered from the detrimental moisture accumulation from rainfall and snow. It involves a base layer and a wearing layer of bituminous asphalt with the waterproof membrane sandwiched in between. The waterproof membrane is extended onto the approach roadway to protect the abutment bearings.
- The use of metal flashing is also very important in preventing moisture accumulation at deck edges along the bridge railing systems. For curbless bridge rail systems, flashing components are to be placed prior to installation of the welded steel assemblies for the rail posts and prior to asphalt wearing surface installation. For bridge rail systems with timber curbs, flashing components are to be placed after installation of the bridge railing system but prior to the installation of asphalt wearing surface. In this case, the metal flashing is placed at the inside face of the curbs and on at the bottom and sides of the scupper openings. In all cases, the metal flashing should be extended underneath the outer edge of the asphalt by a minimum of 5 inches.

- When using timber or glulam railing posts, protective post caps are highly recommended to improve the long-term durability of the rail posts. They are placed on top of posts to shelter the exposed end-grain from wetting and drying and from UV-light degradation, both which can cause significant damage over time. Detailed specifications for the post caps are included to ensure proper performance.
- Alternative substructure component options were proposed by the project to improve their performance characteristics. To address common deterioration found in large timber abutment and pier cap members, the use of diffusible borate treatments was suggested as a method to increase their longevity. These offer the advantage of having a more consistent treatment throughout the member instead of just an outer shell of treatment. Another alternative for consideration was the use of steel beam components for the abutment and pier cap members supporting the timber/glulam deck panels. Lastly, the use of a Geosynthetic-Reinforced-Soil Integrated Bridge System (GRS-IBS) was detailed from a separate FHWA demonstration bridge project located in Buchanan County, Iowa. It offers the advantage of a solid foundation while nearly eliminating all approach roadway settlement, which typically occurs at each bridge end.
- Crash-test approved bridge rail systems are required for most timber bridge applications. Several bridge rail systems are currently available for use with timber bridge superstructures primarily for Test Level 2 and Test Level 4 following the evaluation criteria outlined in NCHRP-350. Details for Test Level 2 curbless bridge rails are included for the transverse glulam deck system used in the St. Louis County case study. Details for Test Level 4 bridge rails are included for the longitudinal spike-laminated timber deck system used in the Hennepin County case study. To compensate for larger vehicles and higher speeds introduced in recent years, a new crash-test criterion (MASH, 2016) requirement for bridges was recently adopted by the Federal Highway Administration. Efforts are underway to complete additional full-size bridge rail crash-tests required to meet the new MASH 2016 standards. A research needs assessment was recently completed that set overall priorities for the full-scale crash tests for timber bridge railing to be completed as funding becomes available.
- Despite a negative preception of timber bridges by some engineers and owners, this project clearly shows that there is potential in using timber bridge systems that are capable of being cost-competive and longlasting. The use of the enclosed design aids can help increase the awareness of modern timber systems that have excellent long-term performance.

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DEPARTMENT OF TRANSPORTATION

Appendices for: Development of Cost-competitive Timber Bridge Designs for Long-Term Performance

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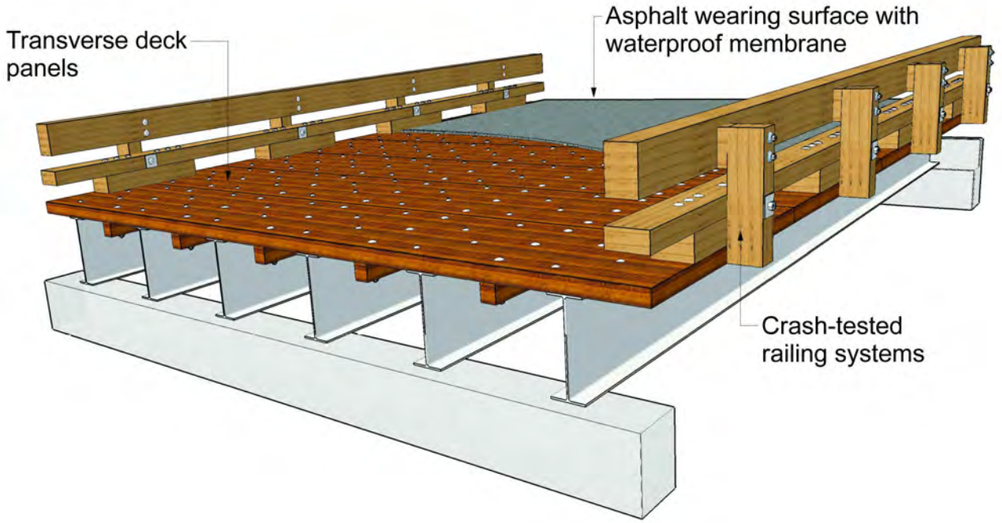
June 2020

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APPENDIX A
STEEL STRINGERS WITH A TRANSVERSE GLULAM DECK

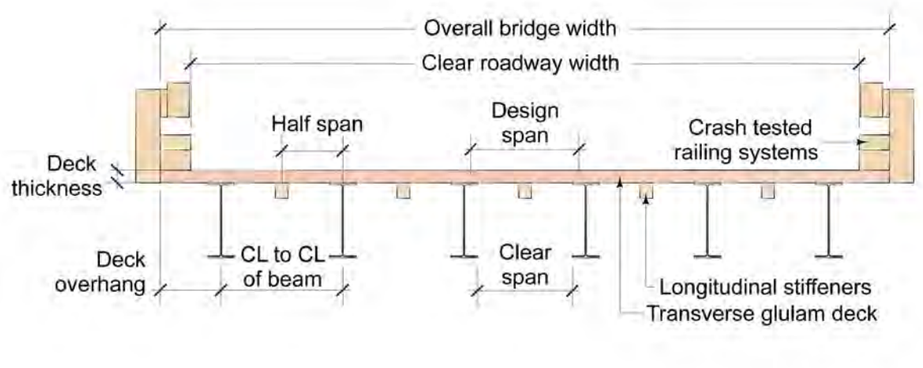
Steel Stringers with a Transverse Glulam Deck



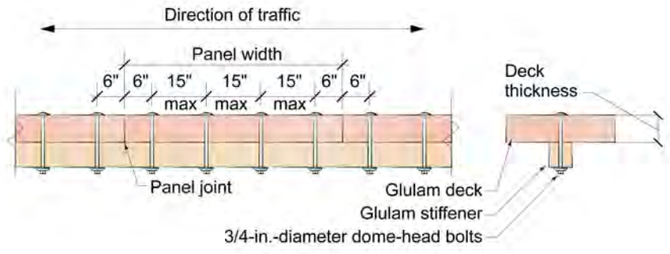


The bridge design information depicted on these drawings was developed under a cooperative research agreement between Minnesota Local Road Research Board (LRRB), Minnesota Department of Transportation, The University of Minnesota Duluth - Natural Resource Research Institute (NRRI), and the USDA Forest Service - Forest Products Laboratory.

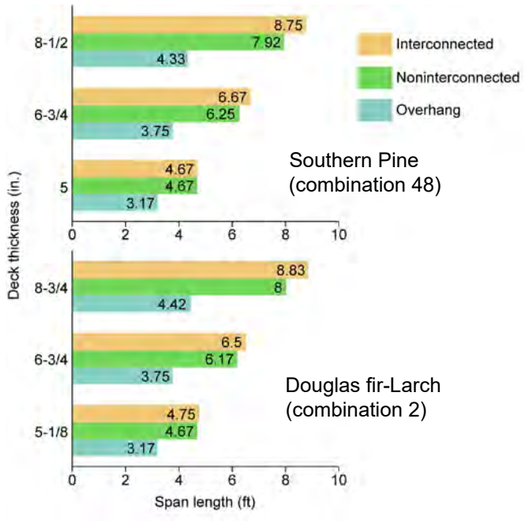
Steel Girders and Transverse Glulam Deck	Perspective Drawing / Photograph View	
Design Aids For Minnesota Timber Bridges	June 2020	Sheet Number 1



Design Span is equal to the clear span plus half width of stringer, but not to exceed clear span plus the deck thickness.
Deck overhang extends from the center of the edge stringer to the outside edge of deck.



Longitudinal Stiffener Detail



Glulam Deck Design -

Transverse glulam decking consists of glulam deck panels oriented across supporting beams (stringers). Glulam decking has been successfully used with timber, steel, and concrete stringers. The deck is attached to the stringers using specialty connectors available from timber bridge supply companies.

There are two types of transverse glulam decks: interconnected and noninterconnected. Interconnected decks use shear transfer devices between adjacent panels to minimize differential panel deflections. Decks that do not use shear transfer devices are considered to be noninterconnected.

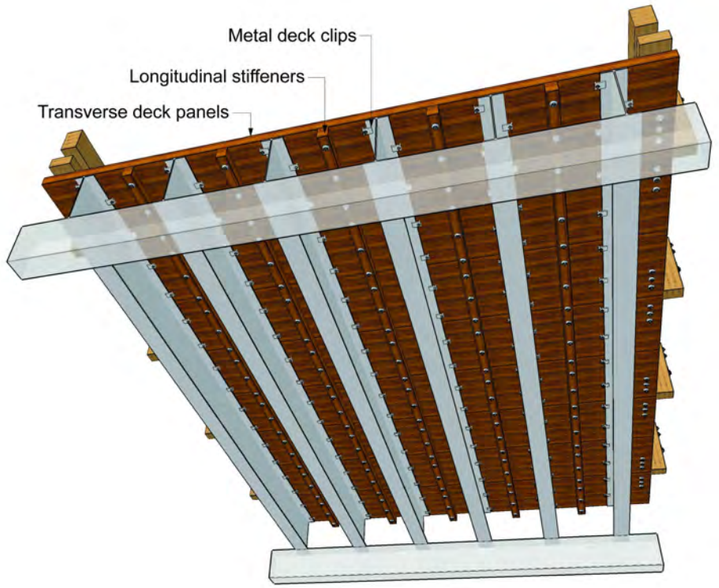
The use of a longitudinal stiffener is recommended as the shear transfer device for both types of decks. The stiffeners are placed midway between stringers. The stiffener is attached to the decking with dome-head bolts and should have slotted holes to allow for transverse movement as the glulam moisture content varies in service.

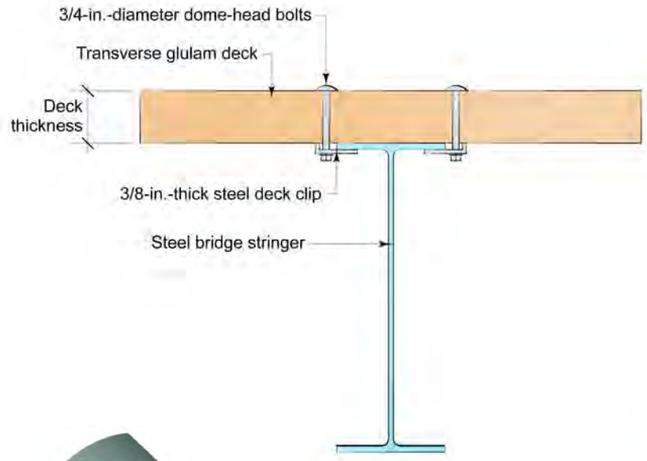
The transverse glulam deck charts show the maximum design span and overhangs for a given deck thickness and species, according to the following design parameters:

- AASHTO-LRFD Bridge Design Specifications (2017)
- HL93 live load
- 6-in. asphalt dead load
- Interconnected and noninterconnected design spans
- *L*/425 and 0.10-in. deflection limits
- Wet-stress reductions apply to all glulam members

Slots (approximately 2 by 13/16 in.) are provided by the manufacturer in the glulam stiffeners. This allows for movement from any forces caused by panel width changes. AASHTO requires that the minimum EI value of the stiffener be 80,000 kip-in2. Stiffeners must run continuous as far as practical. If need be, they can be butt-jointed at a panel midwidth. Proper fasteners must be used.

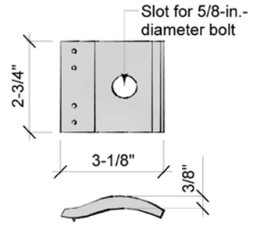
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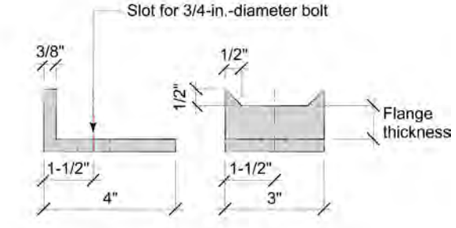




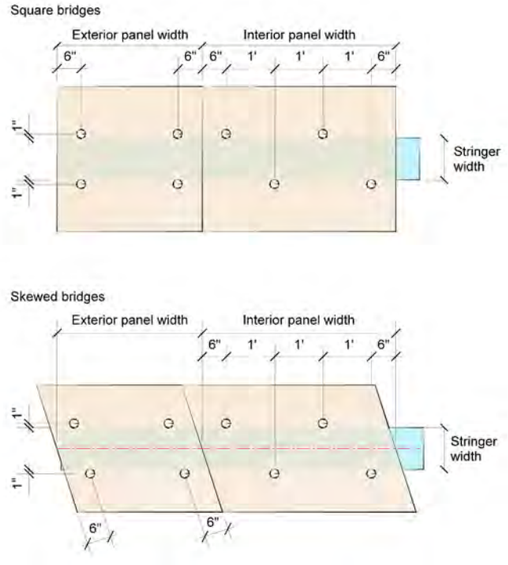




Cast Iron "C" Clips
(for steel flanges with a max. thickness of $\frac{3}{4}$ in.)



Steel Deck Clip
(suitable for all steel flange thicknesses)



Thru-Bolted Glulam Deck Clip Layout

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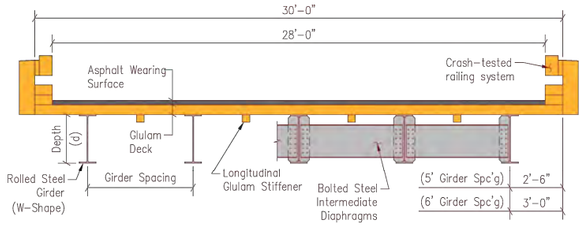
Steel Girders and Transverse Glulam Deck

Glulam Panel-to-Stringer Connections

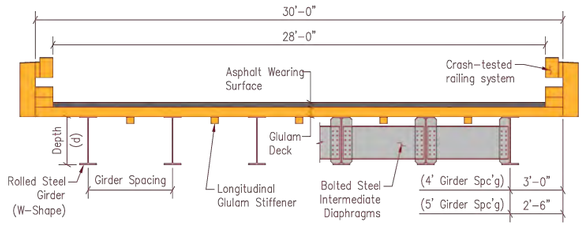
Design Aids For Minnesota Timber Bridges

June 2020

Sheet Number 3



Cross-Section -- 6-ft Girder Spacing
[5 girders with a 3 ft deck overhang]



Cross-Section -- 5 ft Girder Spacing
[6 girders with a 2.5 ft deck overhang]

ROLLED STEEL GIRDER SUPERSTRUCTURE DESIGN TABLE

SPAN LENGTH (CTR.–CTR. BRG.)	4'–0" GIRDER SPACING WITH 5" (S.P.), 5 1/8" (D.F.) OR 6 3/4" (S.P. & D.F.) NON–INTERCONNECTED & INTERCONNECTED T.G.D.		5'–0" GIRDER SPACING WITH 6 3/4" OR 8 1/2" (S.P. & D.F.) NON–INTERCONNECTED & INTERCONNECTED T.G.D.		6'–0" GIRDER SPACING WITH 6 3/4" OR 8 1/2" (S.P. & D.F.) NON–INTERCONNECTED & INTERCONNECTED T.G.D.	
	W–SHAPE	DEPTH (IN.)	W–SHAPE	DEPTH (IN.)	W–SHAPE	DEPTH (IN.)
24 FT.	–	–	W18 X 60 W21 X 57 W24 X 55	18 1/4 21 23 5/8	W18 X 71 W21 X 62 W24 X 62	18 1/2 21 23 3/4
26 FT.	–	–	W18 X 71 W21 X 62 W24 X 62	18 1/2 21 23 3/4	W18 X 76 W21 X 68 W24 X 68	18 1/4 21 1/8 23 3/4
28 FT.	–	–	W18 X 86 W21 X 68 W24 X 62	18 3/8 21 1/8 23 3/4	W18 X 97 W21 X 83 W24 X 68	18 5/8 21 3/8 23 3/4
30 FT.	–	–	W21 X 83 W24 X 68 W27 X 84	21 3/8 23 3/4 26 3/4	W21 X 93 W24 X 76 W27 X 84	21 5/8 23 7/8 26 3/4
32 FT.	–	–	W21 X 93 W24 X 76 W27 X 84	21 5/8 23 7/8 26 3/4	W24 X 84 W27 X 84 W30 X 90	24 1/8 26 3/4 29 1/2
34 FT.	–	–	W24 X 84 W27 X 84 W30 X 90	24 1/8 26 3/4 29 1/2	W27 X 84 W30 X 90 W33 X 118	26 3/4 29 1/2 32 7/8
36 FT.	–	–	W24 X 94 W27 X 84 W30 X 90	24 1/4 26 3/4 29 1/2	W27 X 94 W30 X 90 W33 X 118	26 7/8 29 1/2 32 7/8
38 FT.	–	–	W24 X 103 W27 X 94 W30 X 90	24 1/2 26 7/8 29 1/2	W27 X 102 W30 X 90 W33 X 118	27 1/8 29 1/2 32 7/8
40 FT.	–	–	W27 X 102 W30 X 90 W33 X 118	27 1/8 29 1/2 32 7/8	W27 X 114 W30 X 108 W33 X 118	27 1/4 29 7/8 32 7/8
42 FT.	–	–	W27 X 114 W30 X 99 W33 X 118	27 1/4 29 5/8 32 7/8	W30 X 116 W33 X 118 W36 X 135	30 32 7/8 35 1/2
44 FT.	–	–	W30 X 108 W33 X 118 W36 X 135	29 7/8 32 7/8 35 1/2	W33 X 118 W36 X 135	32 7/8 35 1/2
46 FT.	–	–	W30 X 116 W33 X 118 W36 X 135	30 32 7/8 35 1/2	W33 X 118 W36 X 135	32 7/8 35 1/2
48 FT.	–	–	W33 X 118 W36 X 135	32 7/8 35 1/2	W33 X 130 W36 X 135	33 1/8 35 1/2
50 FT.	–	–	W33 X 118 W36 X 135	32 7/8 35 1/2	W33 X 130 W36 X 135	33 1/8 35 1/2
52 FT.	–	–	W33 X 130 W36 X 135	33 1/8 35 1/2	W33 X 152 W36 X 135	33 1/2 35 1/2
54 FT.	–	–	W33 X 141 W36 X 135	33 1/4 35 1/2	W36 X 150	35 7/8
56 FT.	–	–	W33 X 152 W36 X 135	33 1/2 35 1/2	W36 X 160	36
58 FT.	–	–	W36 X 150	35 7/8	W36 X 170	36 1/8
60 FT.	W33 X 141 W36 X 135	33 1/4 35 1/2	W36 X 150	35 7/8	–	–
62 FT.	W33 X 152 W36 X 135	33 1/2 35 1/2	W36 X 160	36	–	–
64 FT.	W36 X 150	35 7/8	W36 X 170	36 1/8	–	–
66 FT.	W36 X 150	35 7/8	–	–	–	–
68 FT.	W36 X 160	36	–	–	–	–
70 FT.	W36 X 170	36 1/8	–	–	–	–

S.P. = southern pine; D.F. = douglas fir-larch; T.G.D = transverse glulam deck; T.G.D. thickness shown in table represents minimum required thickness for each girder spacing; Empty cells (denoted with "-") indicate that there are no acceptable rolled steel girder shapes for that span and girder spacing;

Design Notes -

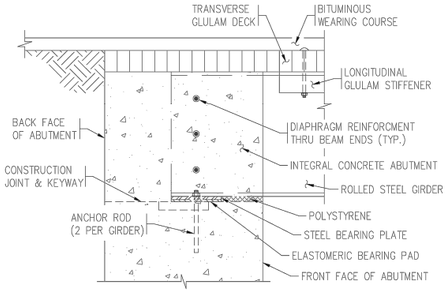
Steel stringer bridges consist of single span W-shape steel beam sections braced with steel intermediate diaphragms at quarter points of the span length. The design charts included show the maximum design span and stringer spacing for various W-shape sections, according the following design parameters:

- 2017 AASHTO-LRFD bridge design specifications
- HL93 live load
- 6 in. asphalt dead load
- L/500 steel girder deflection limit
- single span design
- single and multilane superstructures
- bridge skew < 20 degrees
- Bolted diaphragms are located over the abutment bearing and at intermediate locations at quarter-span points See more details on Sheet 5.
- structural steel (Fy - 50 ksi)
- Minimum inventory rating factor of 1.05 (AASHTO-LRFR)

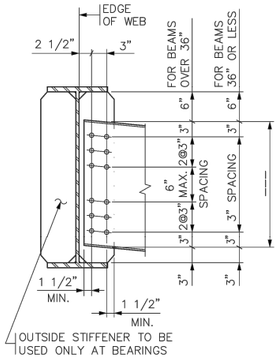
Design charts include up to W-shape girder (weight per foot and overall depth) options for the span length, girder spacing, and transverse glulam deck panel inter-connectivity. The overall depth (in.) of each W-shape is also included per the American Institute of Steel Construction Manual, 14th Edition.

Only commonly used and available shapes for steel bridge engineering were considered in developing this rolled steel girder superstructure design table. Shallow sections (less than 18 inch depth, or jumbo shapes) are not included. Do not use salvaged or re-purposed steel girders unless they have been verified to meet or exceed structural steel yield strength of 50 ksi.

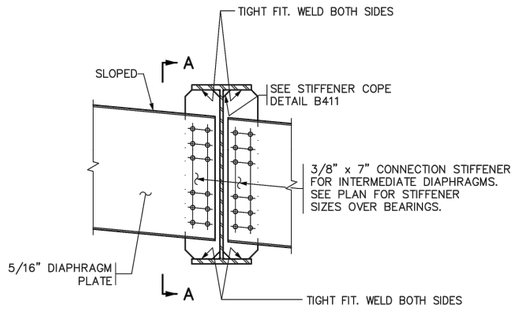
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Stringer on Concrete Abutment

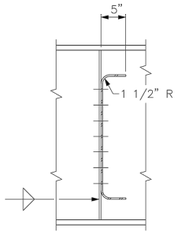


Fascia Beam

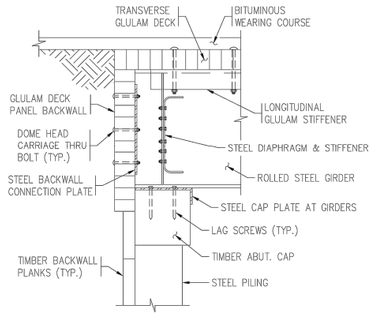


Interior Beam

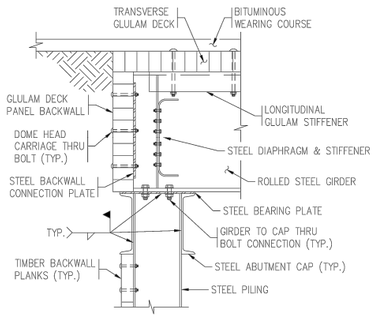
Intermediate Diaphragm Locations



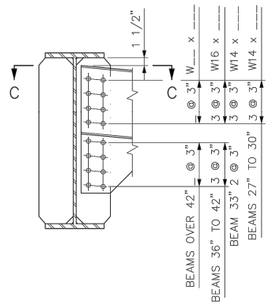
Section A-A



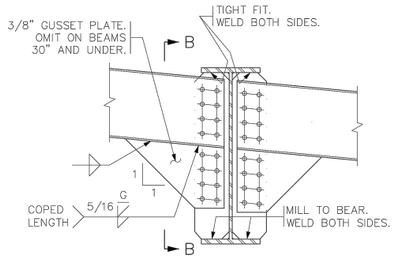
Stringer on Timber Abutment



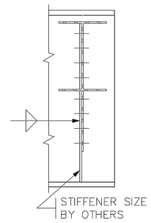
Stringer on Steel Abutment



Fascia Beam



Interior Beam



Section A-A

Abutment Diaphragm Locations

Notes -

Abutment bearing details shown are for reference only and shall be designed by others based on site specific conditions.

When a glulam deck panel backwall is used at abutment bearings, a waterproof membrane should be applied to its backside to eliminate soil contact.

When the concrete abutment is extended up to the top of deck panels, a steel cover plate should be used to prevent asphalt cracking directly over the steel girder abutment bearings.

Diaphragm topside offset should be sufficient to provide clearance for the glulam stiffener beam attached to the underside of the glulam deck.

For additional information about bolted diaphragms, refer to Minnesota DOT standard detail B402.

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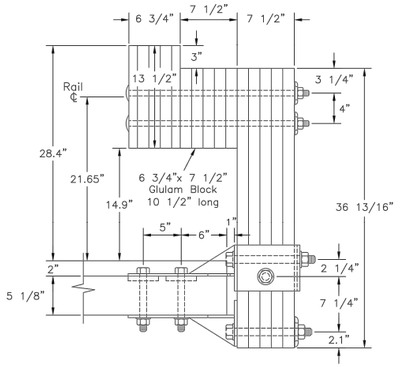
Steel Girders and Transverse Glulam Deck

Girder Diaphragm and Abutment Bearings

Design Aids For Minnesota Timber Bridges

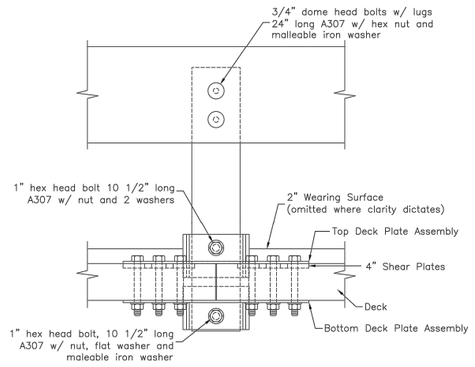
June 2020

Sheet Number 5

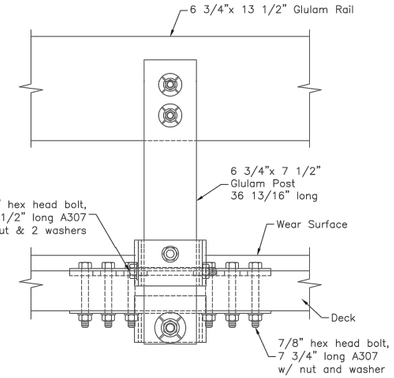


End View

Railpost spacing 8 ft. (Typ.)



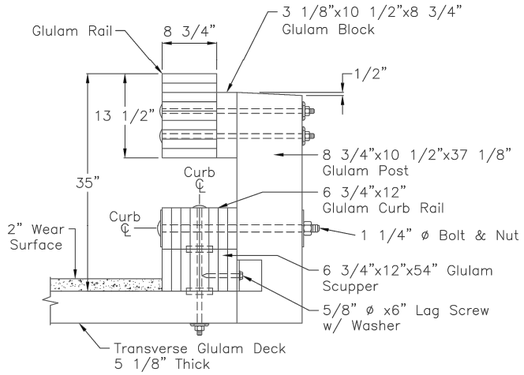
Front View



Rear View

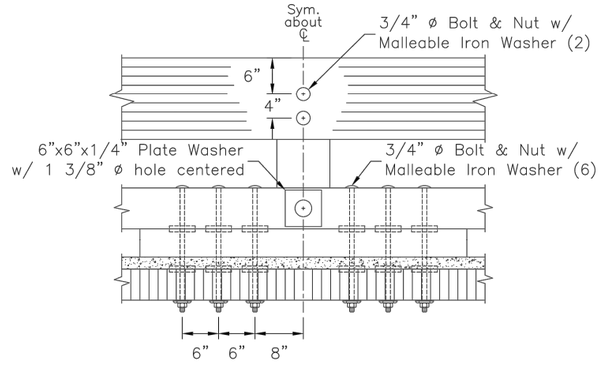
Curbless Bridge Rail - Test Level 2 (NCHRP-350)

Note: More information is available in the Transportation Research Record (**TRR-1743**) journal including steel rail and post systems and transition railings.

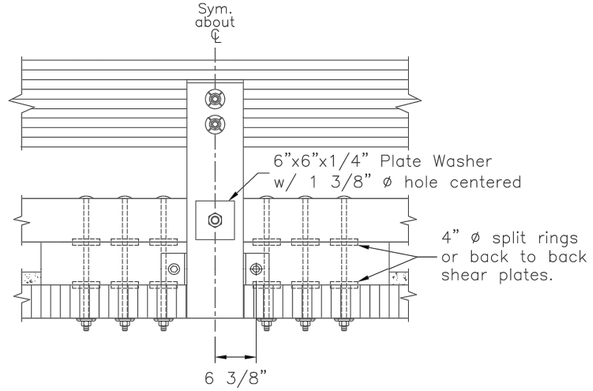


End View

Railpost spacing 8 ft. (Typ.)



Front View



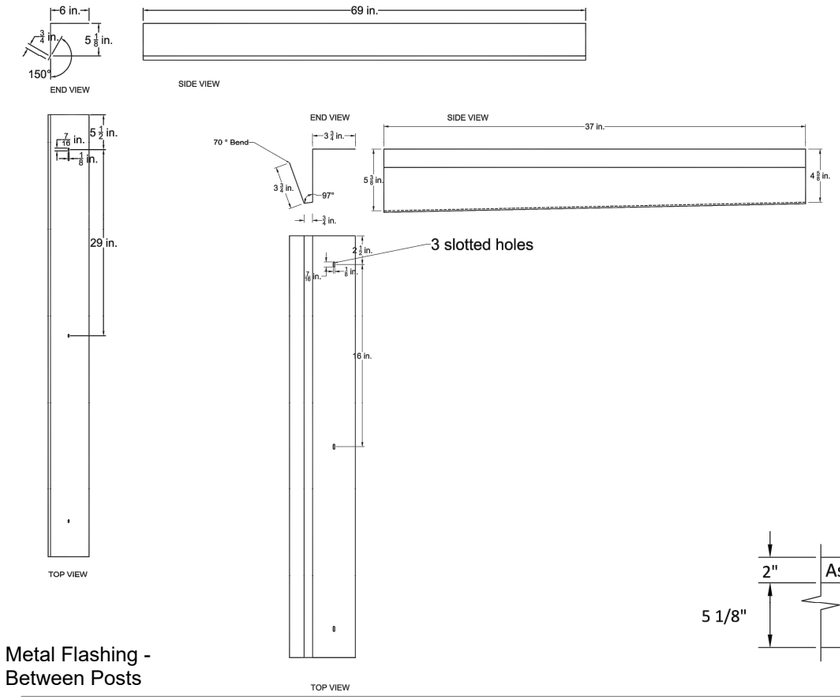
Rear View

Bridge Rail with Curb - Test Level 4 (NCHRP-350)

Note: More information is available in the Transportation Research Record (**TRR-1696**) journal including steel rail and post systems and transition railings.

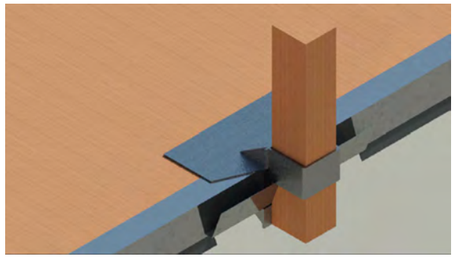
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Steel Girders and Transverse Glulam Deck	Crash-Tested Bridge Rail System
Design Aids For Minnesota Timber Bridges	June 2020 / Sheet Number 6



Metal Flashing - Between Posts

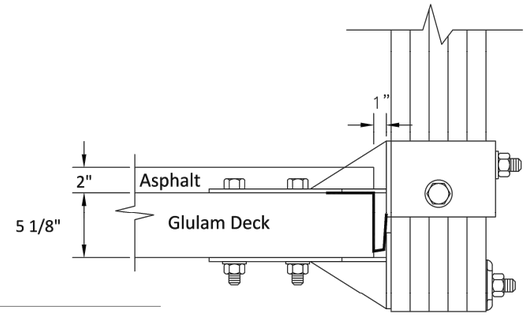
Metal Flashing - Straddling Posts



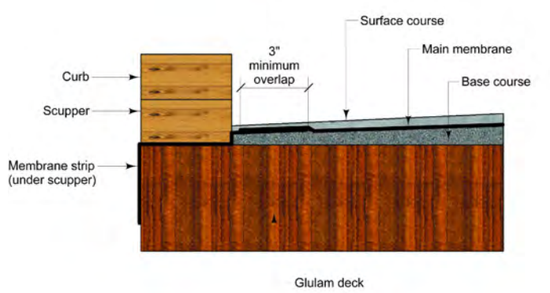
Rendering of Metal Flashing at Post



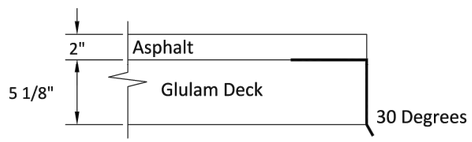
Protective Railpost Cap



End View -- Flashing Straddling Posts



Asphalt Wearing Surface Recommendation



End View -- Flashing Between Posts

Durability Detail Notes -

The use of a waterproof geotextile membrane in conjunction with an asphalt wearing surface is recommended for most timber bridge applications. Proper application of a waterproof wearing surface can help to improve the long-term durability of timber bridge decks. The waterproofing membrane should “sandwiched” between base course and finish course of asphalt paving. A membrane strip is first placed along the deck edges, prior to the installation of curbs and scupper blocks, and should be sized to extend the full deck depth (outer edge) and beyond the inside curb face by more than 3-inches. The main membrane sandwiched in between the asphalt paving layers should extend to interior curb faces, providing a minimum membrane overlap.

In some cases, the use of metal flashing in lieu of the membrane strip, may be more beneficial as with curbless bridge railing systems. In this case, the metal flashing is nailed to the top deck edge with roofing nails prior to attachment of rail post hardware assemblies. Metal flashing segments are designed for “straddling post” and “between post” locations, while maintaing a minimum overlap of 5 inches at all joints. Flahing segments at the bridge corners should be sloped to drain away from the bridge abutments.

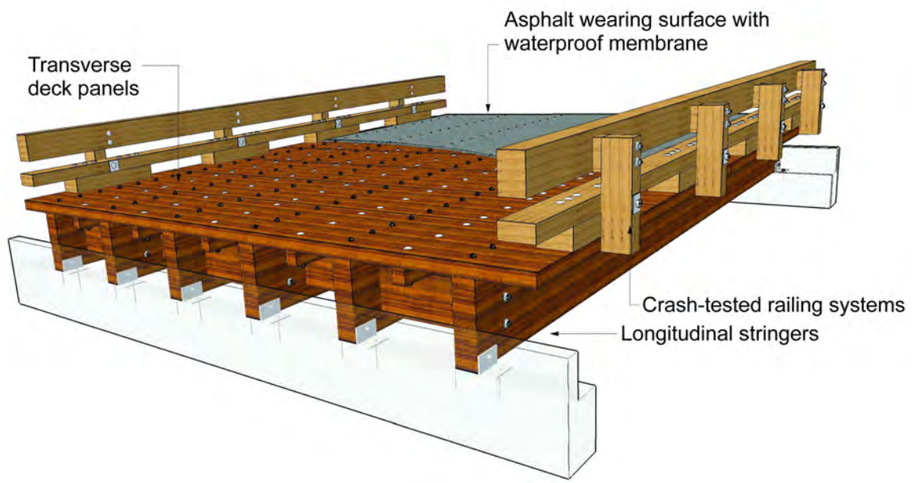
Post caps are available which shields the timber/glulam post from UV light degradation while sheltering the end grain from wetting at the same time. Post caps should be designed and manufactured to meet the following requirements:

- Manufactured from 1/8" high density polyethylene plastic, color black.
- Cap configuration shall allow for air circulation to the top of timber posts on all four sides.
- Fixing the plastic cap to the post using (stainless or galvanized) steel screws. No screws should be placed into the top of the posts, but rather into the post sides. This will prevent moisture from seeping through connections into topside end-grain of the post..
- Drip edges shall be provided on cap for the post sides and back.
- Water channel on top of cap will facilitate run-off and provide for air circulation beneath cap

The bridge design information depicted on these drawings was developed under a cooperative research agreement between Minnesota Local Road Research Board (LRRB), Minnesota Department of Transportation, The University of Minnesota Duluth - Natural Resource Research Institute (NRRI), and the USDA Forest Service - Forest Products Laboratory.

APPENDIX B
GLULAM STRINGERS AND A TRANSVERSE GLULAM DECK

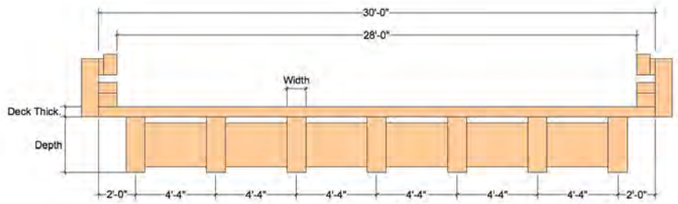
Glulam Stringers and a Transverse Glulam Deck





The bridge design information depicted on these drawings was developed under a cooperative research agreement between Minnesota Local Road Research Board (LRRB), Minnesota Department of Transportation, The University of Minnesota Duluth - Natural Resource Research Institute (NRRI), and the USDA Forest Service - Forest Products Laboratory.

Glulam Girders and Transverse Glulam Deck	Perspective Drawing / Photograph View	
Design Aids For Minnesota Timber Bridges	June 2020	Sheet Number 1



Southern Pine Stringer
24F-V3

Span (ft)	Width (in.)		Depth (in.)
24	6 3/4	x	27 1/2
26			28 7/8
28			31 5/8
30			33
32			34 3/8
34			35 3/4
36			38 1/2
38			39 7/8
40	8 1/2	x	37 1/8
42			38 1/2
44			39 7/8
46			42 5/8
48			44
50			45 3/8
52			46 3/4
54			49 1/2
56			50 7/8
58	10 1/2	x	46 3/4
60			48 1/8
62			50 7/8
64			52 1/4
66			53 5/8
68			55
70			56 3/8
72			57 3/4
74			59 1/8
76			60 1/2
78			61 7/8
80	12	x	59 1/8

Douglas Fir-Larch Stringer
24F-V4

Span (ft)	Width (in.)		Depth (in.)
24	6 3/4	x	28 1/2
26			30
28			33
30			34 1/2
32			36
34			37 1/2
36			40 1/2
38	8 3/4	x	37 1/2
40			39
42			40 1/2
44			42
46			45
48			46 1/2
50			48
52			49 1/2
54			52 1/2
56	10 3/4	x	49 1/2
58			51
60			52 1/2
62			54
64			55 1/2
66			58 1/2
68			60
70			61 1/2
72			63
74			64 1/2
76	12 1/4	x	61 1/2
78			63
80			64 1/2

General Design -

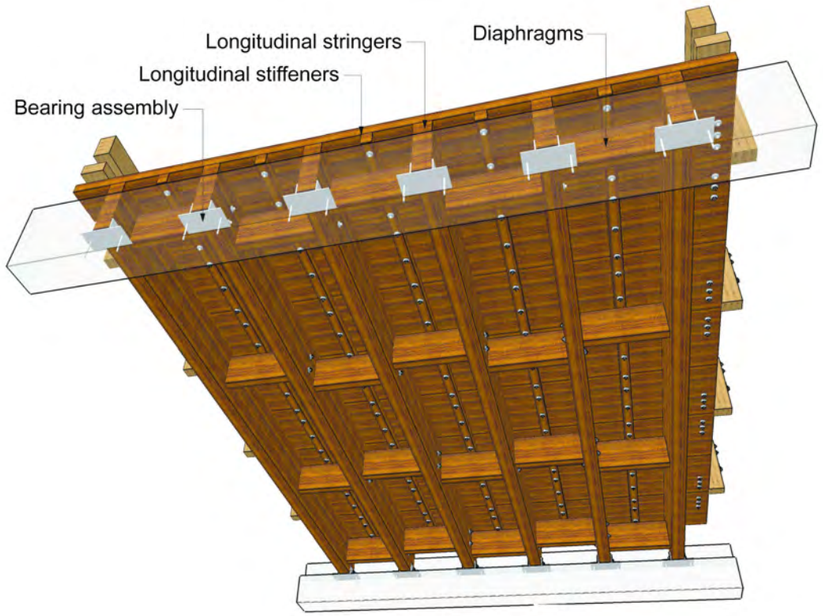
Stringer bridges with transverse glulam decking are probably the most common type of glulam timber bridge structure. For this bridge superstructure system, glulam stringers span longitudinally between the abutments. A panelized glulam deck system is placed transversely on top of the stringers. The glulam components (stringers and transverse deck panels) are interconnected with mechanical fasteners. A bridge railing system that meets FHWA crash testing requirements is installed at the deck edges. Lastly, a protective asphalt layer, in conjunction with a waterproof membrane, is placed over the transverse panels to keep them dry and to provide a durable surface against vehicle wear

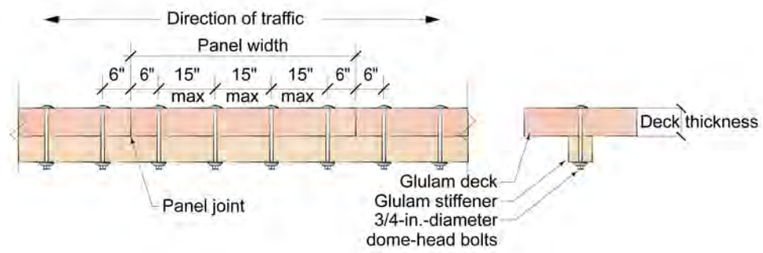
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The glulam stringer bridge charts show the optimum configuration for a given span length and glulam species combination, according to the following assumed design parameters:

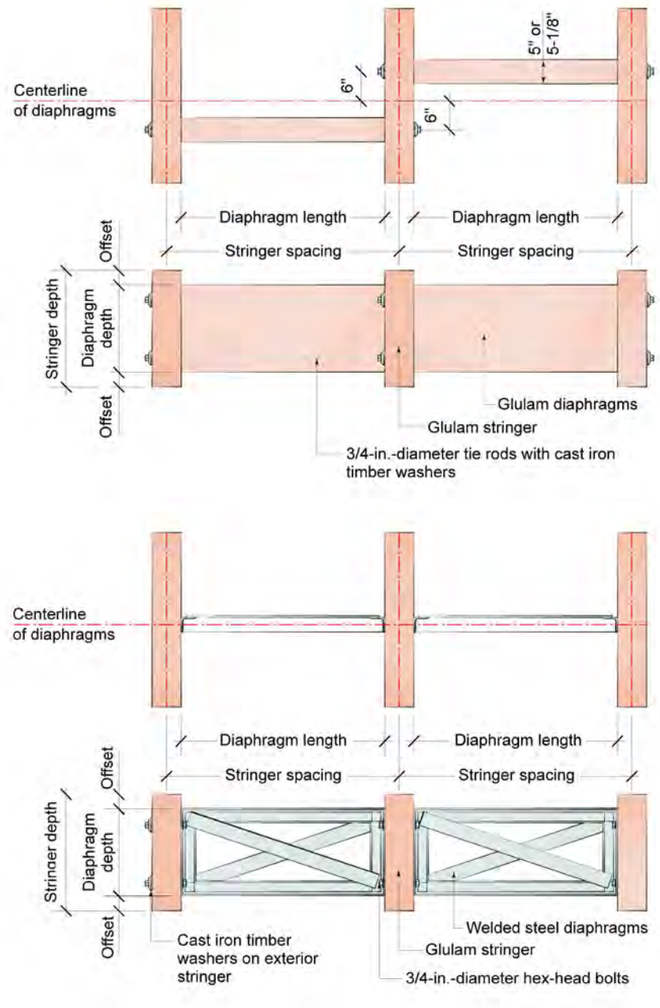
- AASHTO-LRFD Bridge Design Specifications (2017)
- HL-93 live load
- 6-in. asphalt dead load
- Multilane width of 24 ft (face-face of curb)
- Predetermined deck thickness of 5 and 6-3/4 in. for SYP bridges and 5-1/8 and 6-3/4 in. for DF bridges
- L/425 live load deflection limit
- Dry-stress design values applied to stringers only
- Wet-stress design values apply to all other elements
- Simple span designs

The bridge design information depicted on these drawings was developed under a cooperative research agreement between Minnesota Local Road Research Board (LRRB), Minnesota Department of Transportation, The University of Minnesota Duluth - Natural Resource Research Institute (NRRI), and the USDA Forest Service - Forest Products Laboratory.





Longitudinal Stiffener Detail



Diaphragm Alternatives

Interconnection of Stringers and Deck Panels -

An underside view of the bridge superstructure reveals that the longitudinal glulam stringers are braced with diaphragms and the transverse deck panels are interconnected with longitudinal stiffeners. Stringer bridges require the use of diaphragms (perpendicular to stringers) for lateral stability and to help resist global deflections. Diaphragms are manufactured from glulam timber or galvanized steel.

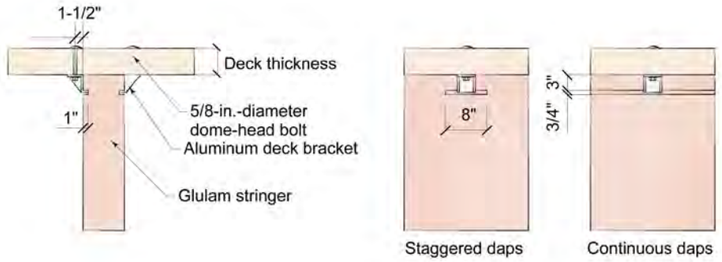
Glulam diaphragms are attached to the stringers with 3/4-in.-diameter tie rods. The diaphragms are prefabricated with grooves (ply routs) routed into the interior plies creating a chase running the length of the diaphragm. The diaphragms are offset to each other allowing access to the tie rod nuts and washers.

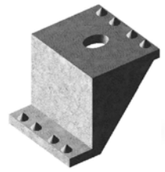
Galvanized steel diaphragms are manufactured from 3- by 3- by 3/8-in. angles with 3/8- by 3-in. plate diagonals. The diaphragms are attached to the stringers with 3/4-in.-diameter bolts and are installed in alignment.

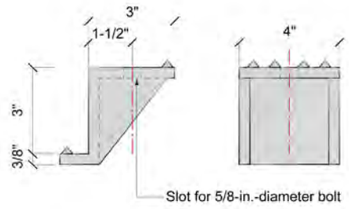
The use of longitudinal stiffeners is recommended with 5-in. and 5-1/8-in. decking to aid in the reduction of differential deflection between the deck panels. The stiffeners are placed midway between and parallel to the stringers. The stiffener is attached to the decking underside with dome-head through-bolts. Stiffeners must run continuous as far as practical. If need be, they can be butt-jointed at a panel midwidth. AASHTO requires that the minimum (EI) value of the stiffener beam be 80,000 kip-in2.

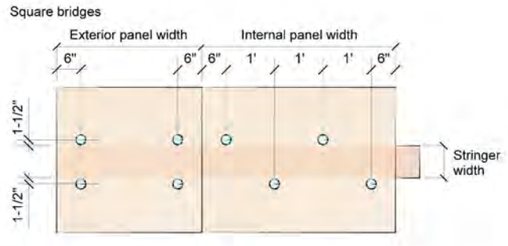
It is not uncommon for traverse glulam decking to go through minor dimensional changes throughout its service life. Although glulam material is dry when put in service, it may gain moisture, such as humidity from underlying water in hot summer months, causing it to adjust to its microclimate conditions at the bridge site. To allow for these moisture driven fluctuations in panel widths, slotted holes (approximately 2 by 13/16 in.) are provided in stiffeners during prefabrication.

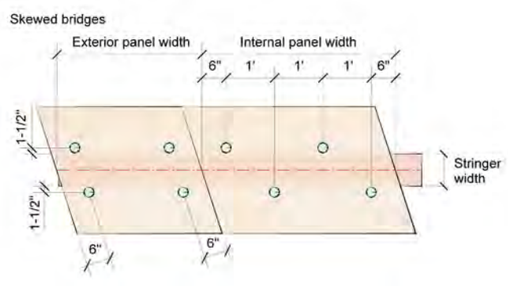
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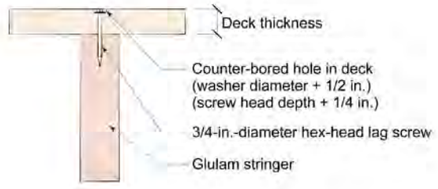


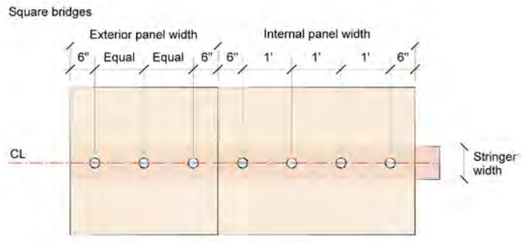


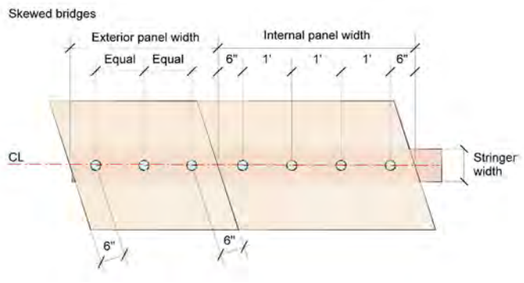




Aluminum Deck Bracket Option







Lag Screw Option

Fastening Deck Panels to Stringers -

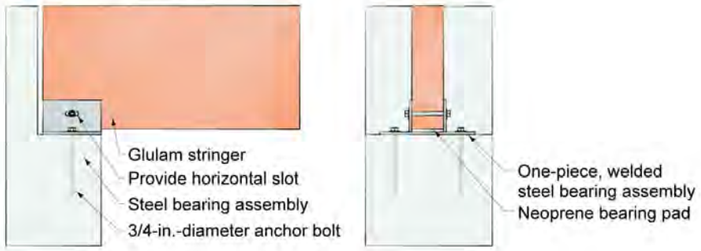
The glulam transverse deck panels are connected to the stringers using one of two fastener options: aluminum deck brackets or lag screws. Both types of fasteners attach the deck directly to the top side of the stringer.

The aluminum deck brackets are available from timber bridge supply companies. Brackets must meet the spacing requirements shown. The bolts for attaching the deck bracket are placed 1-1/2 in. from the face of the stringer. Grooves in the stringer may be continuous (full length of stringer) or discontinuous and staggered (8-in.-wide gaps) as illustrated. We recommend that the decking be provided with slotted holes (approximately 2 by 11/16 in.) for deck bracket to allow for adjustments during assembly. Deck brackets require 5/8-in.-diameter bolts.

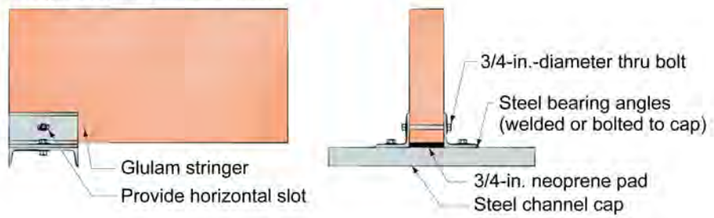
Attaching the deck panels to the stringers with lag screws requires field- drilling a pilot hole for the lag screw. The holes in the deck panel must be predrilled with the same diameter as the lags. After setting the deck panel, the predrilled holes are used as a guide to drill lead holes in the stringer. The holes in the stringer should be 1/8 in. smaller than the lag screw diameter. Doing this exposes an untreated hole in the top face of the stringer. *It is imperative* that the lead holes be field-treated according to ASPA Standard M4 prior to installing the lags. Longitudinal stiffener beams must be used if a deck is lagged to the stringers.

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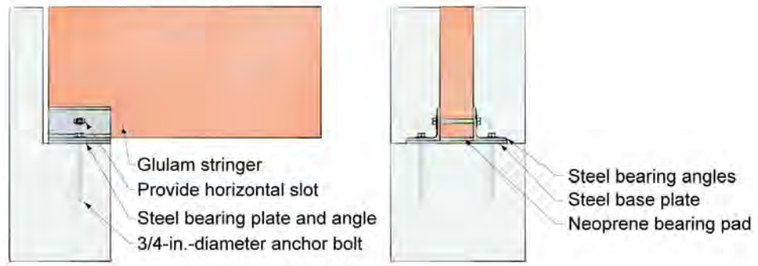
Stringer to concrete abutment detail



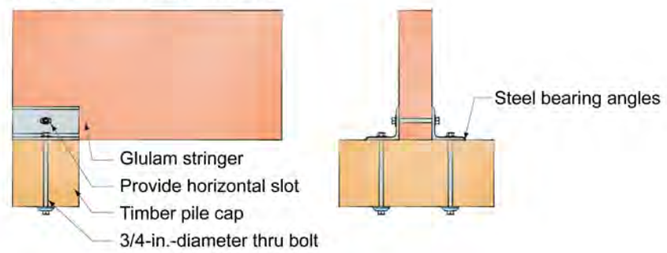
Stringer to steel abutment detail



Stringer to concrete abutment detail



Stringer to timber abutment detail



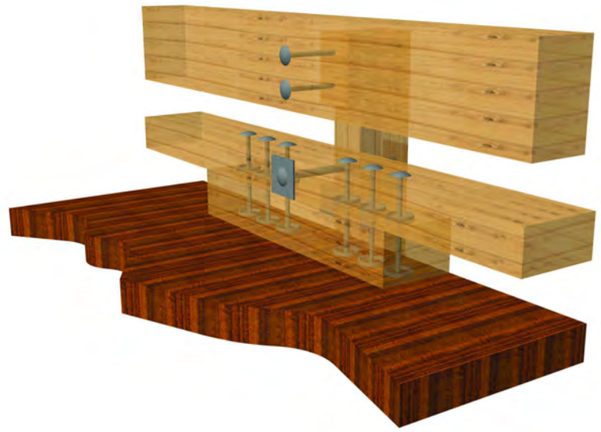
Stringer Abutment Connections -

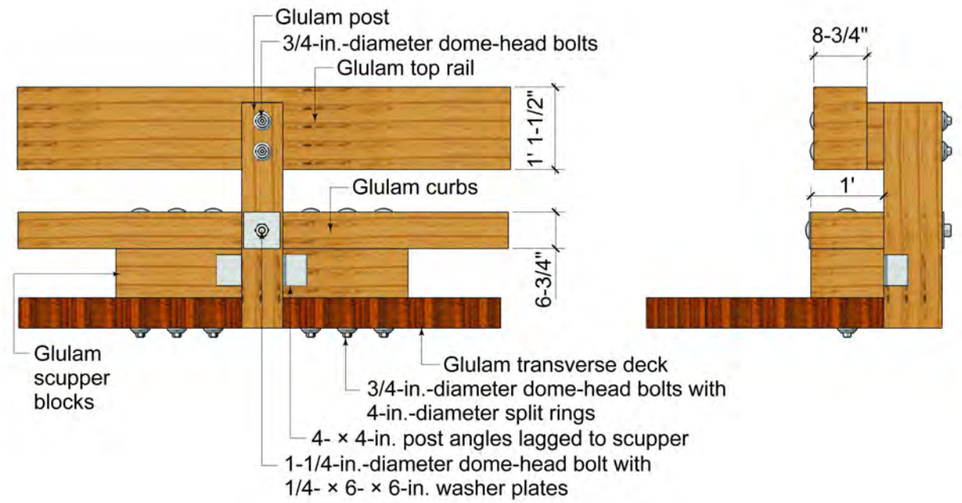
Glulam stringer bridge superstructures are anchored to all types of substructure supports.

For concrete and steel abutments, bearings consist of either a one-piece bearing assembly or a flat steel base plate with bearing angles. In either case, a 3/4-in.-thick neoprene bearing pad is placed between the concrete or steel and the glulam stringer. Holes for the anchor bolts are drilled into the concrete after the stringers are set and diaphragms tightened. After cleaning the holes, an epoxy or nonshrink grout is applied and anchors installed. For steel, the bearings can be welded or bolted to the channel in prefabricated slots.

For timber abutments, bearing angles with no neoprene bearing pad are used. Again, the angles are secured to the bearing cap with 3/4-in.-diameter bolts after the stringers are set and diaphragms tightened.

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Test Level 4 -- NCHRP-350 Test Standards

Bridge Rail and Wearing Surface -

Fully crash-tested railing systems are approved and available with glulam timber or steel options. Full-scale crash tests were successfully performed, satisfying the criteria for federal bridge funding. Please refer to the Federal Highway Administration (www.fhwa.dot.gov/safety) for additional guidance on bridge railings for timber bridges and new requirements for crash testing methodologies. Strict adherence to size and quality of the lumber, glulam, and hardware components of the crash-tested railing systems is required. Any changes or substitutions to these crash-tested designs require further analysis and approval.

There are many timber crash-tested railing types available:

Glulam or steel rails, test level 2,

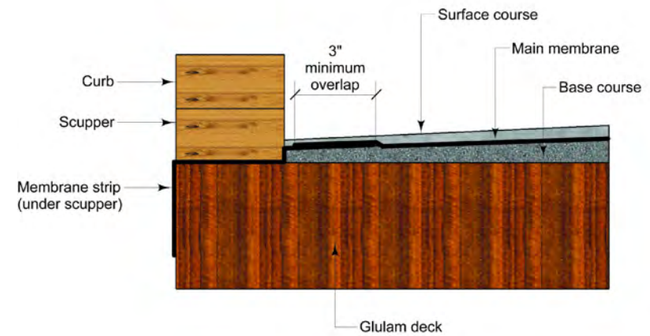
Glulam timber or steel rails, test level 4

Primarily, all glulam structures use glulam or solid timber railing elements; however, there are crash-tested design options using steel rail components.

Long-term serviceability of timber decks can be greatly increased by the proper application of a wearing surface. It is highly recommended that treated timber bridge decks receive some sort of wearing surface covering to protect them from the elements. The use of an asphalt wearing surface is most beneficial for bridges on unpaved, gravel roadways to decrease vehicle wear. Also, extending the asphalt pavement approximately 50 ft onto the roadway approaches is beneficial.

Proper application techniques favor the “sandwiching” of a waterproofing membrane between a base course and finish course of paving. Wrapping a membrane strip under the curbing provides an effective drip edge for any water runoff.

Full documentation of applications and techniques is in the document “Guidelines for Design, Installation, and Maintenance of a Waterproof Wearing Surface for Timber Bridge Decks” (Weyers and others 2001).



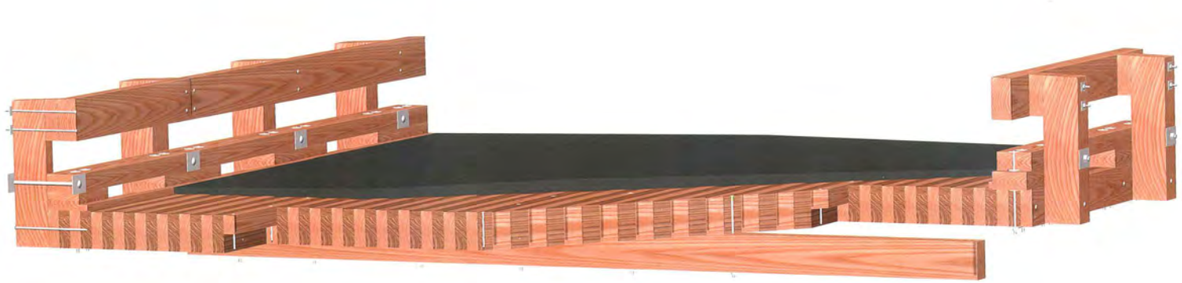
Asphalt Wearing Surface Recommendation

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Glulam Girders and Transverse Glulam Deck	Crash-Tested Bridge Rail System
Design Aids For Minnesota Timber Bridges	June 2020 / Sheet Number 6

APPENDIX C
LONGITUDINAL SPIKE-LAMINATED TIMBER DECK

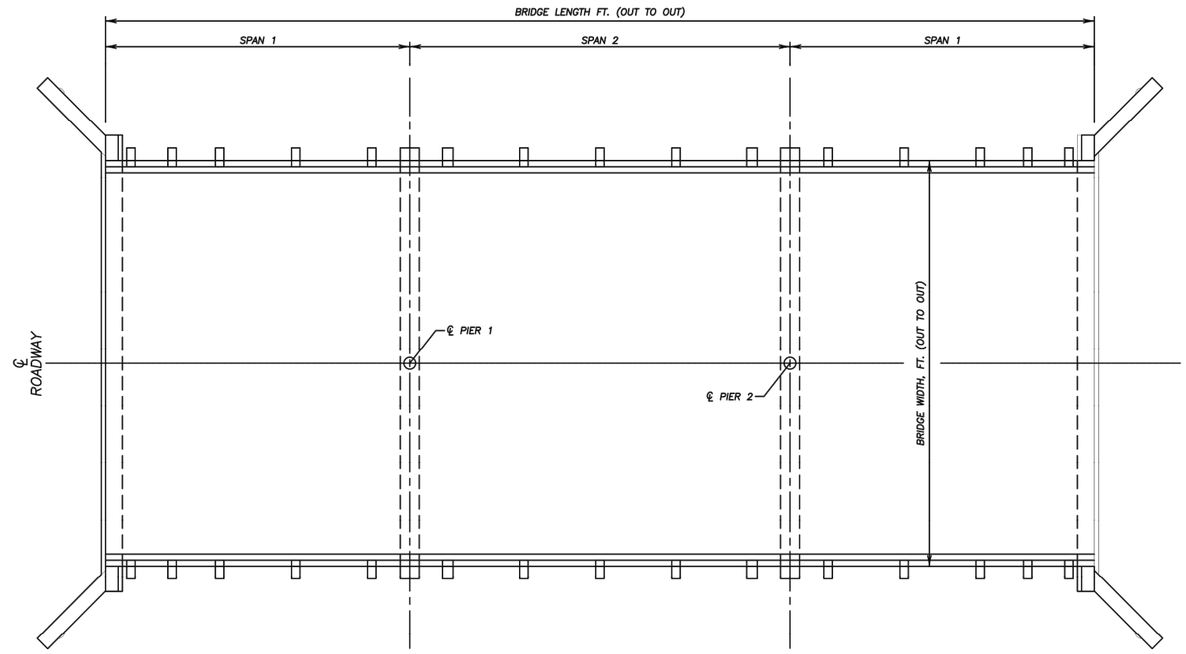
Longitudinal Spike-Laminated Timber Deck



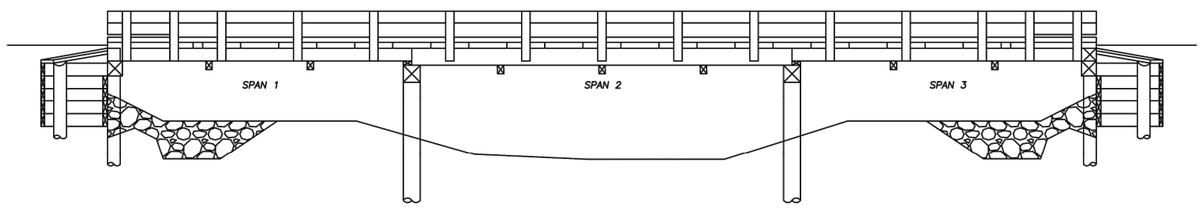


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Longitudinal Spike-Laminated Decks	Perspective Drawing / Photograph View
Design Aids For Minnesota Timber Bridges	June 2020 / Sheet Number 1



Plan View



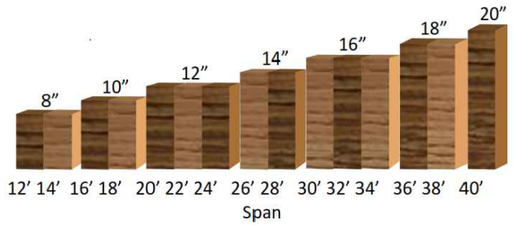
Profile View

Design Notes -

Longitudinal spike-laminated bridges consist of a series of 4-in. dimension lumber laminations that are prefabricated into partial-width deck panels. The deck panels are placed side-by-side and interconnected with a shiplap joint along the panel interface. Tranverse stiffener beams are attached to the deck underside at prescribed intervals for each bridge span to provide load transfer between panels. The design chart included shows the maximum design span for various deck thickness values, according the following design parameters:

- AASHTO-LRFD bridge design specifications, 8th Ed.
- HL93 live load
- 3 in. uniform asphalt layer dead load
- L/425 deflection limit
- single span design
- single and multilane superstructures
- bridge skew < 20 degrees
- Incising factor based on alternative guidelines in the 2018 NDS for Wood Construction
- Laminations shall be continuous and span the bridge supports without butt-joints.

Deck panels are prefabricated at the fabrication plant to ensure quality control manufacturing (See sheet 4 for additional details). Decking planks are predrilled following the prescribed repetitive pattern in lamination pairs. As lamination pairs are added to the starter set, ring shank steel spikes (3/8-in. diameter) are simultaneously driven with equal force using a mechanical press that extends the full length of deck panel, enduring all spike heads are flush with the timber plank surface. Pneumatic impact tools are not recommended for driving the steel spikes as the laminations can easily be damaged. All timber members that are to be cut or drilled after initial pressure treatment, should be field treated with an appropriate wood preservative approved by AWPA.



Maximum Span by Deck Thickness

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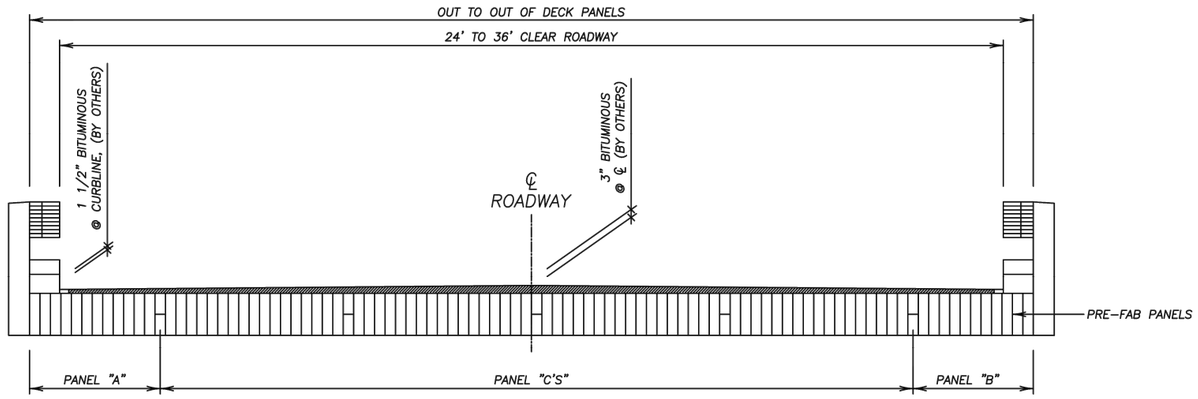
Longitudinal Spike-Laminated Decks

Plan / Profile / Design Notes

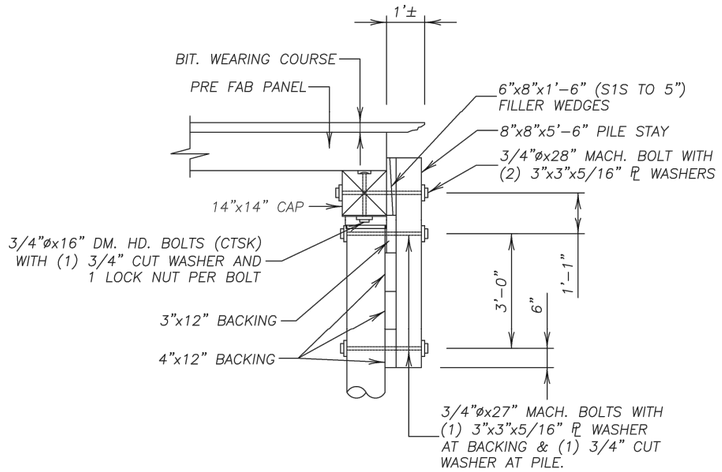
Design Aids For Minnesota Timber Bridges

June 2020

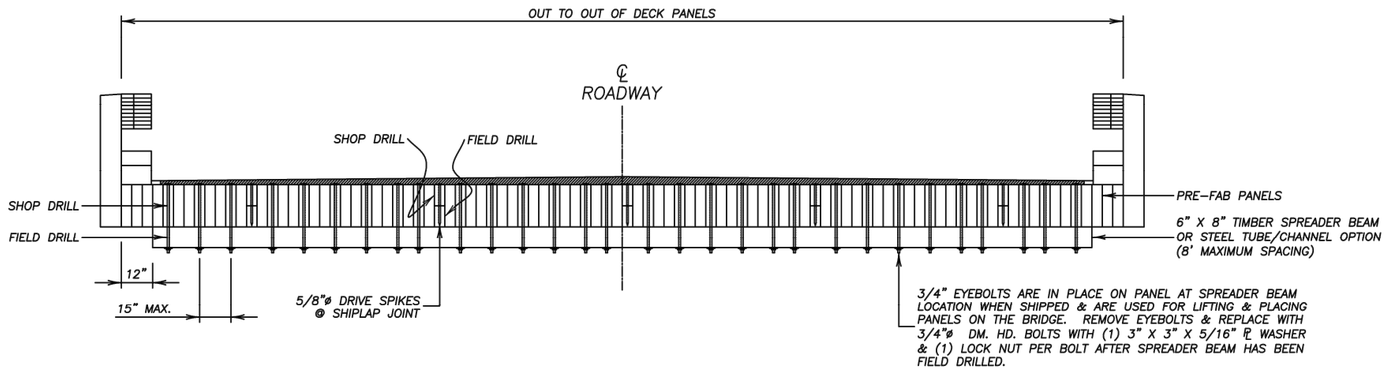
Sheet Number 2



Cross-section View of Deck - Jointed Panel Configuration



Cross-section View of Pile Abutment - Deck Attachment



Cross-section View of Deck - Stiffener Beam

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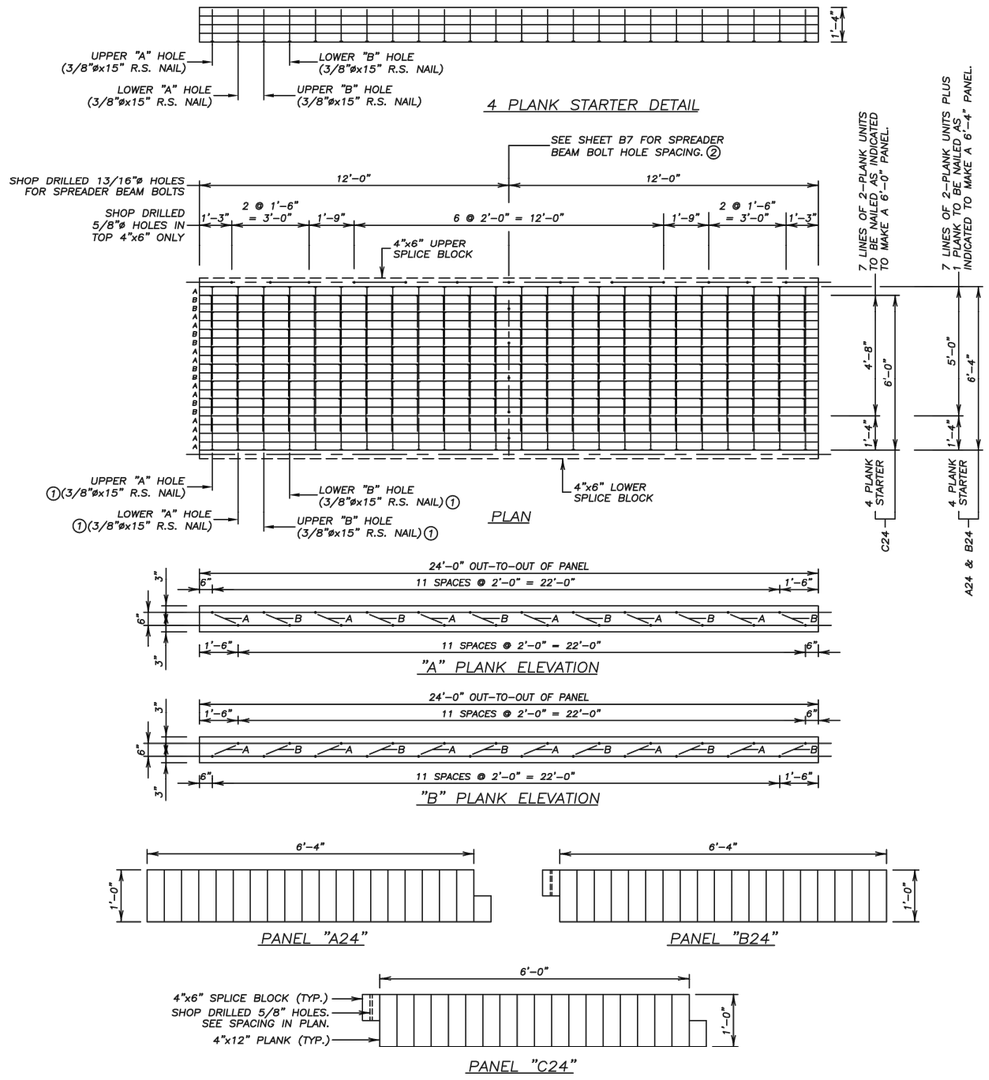
Longitudinal Spike-Laminated Decks

X-Section View / Abutment Details

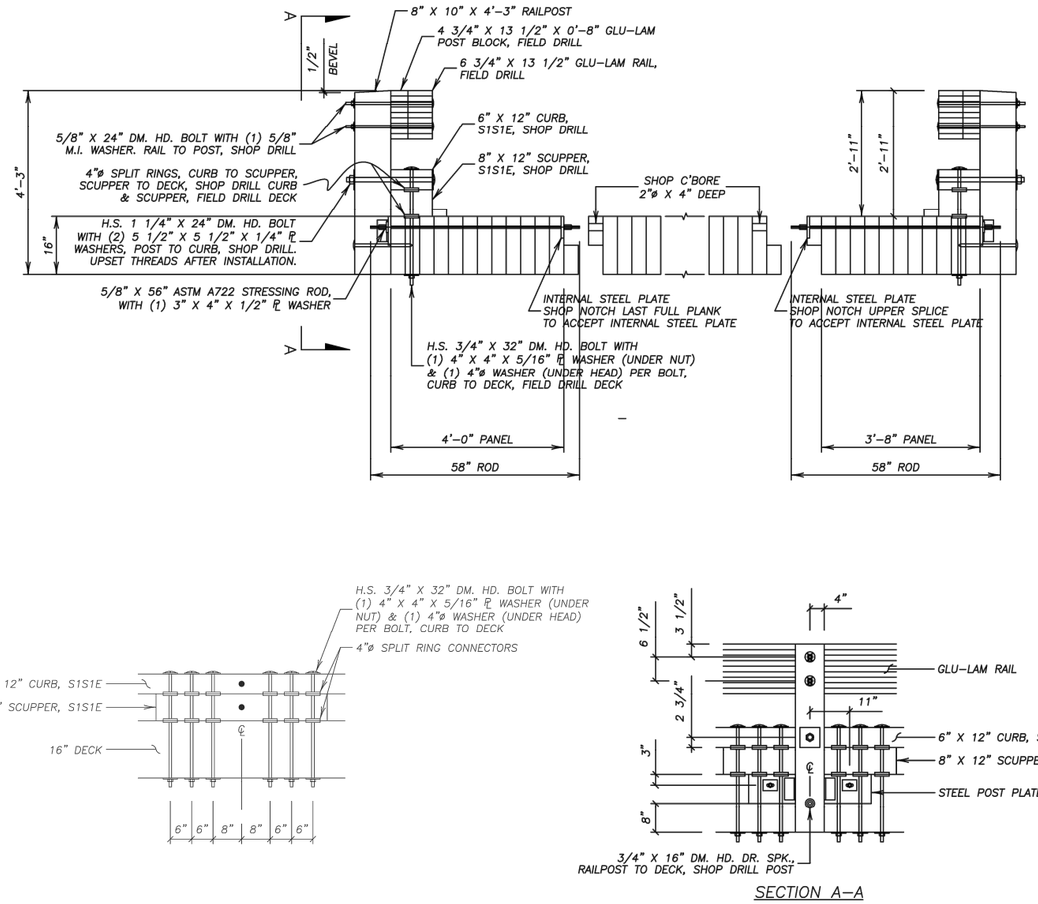
Design Aids For Minnesota Timber Bridges

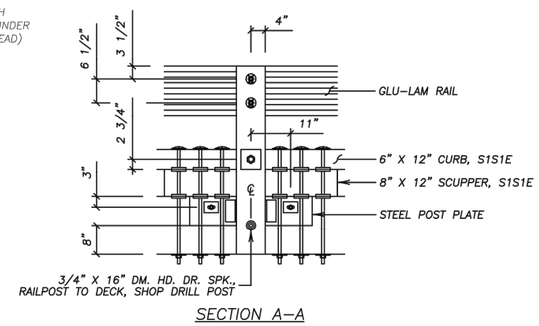
June 2020

Sheet Number 3



Laminating Process to Pre-Fabricate Deck Panels



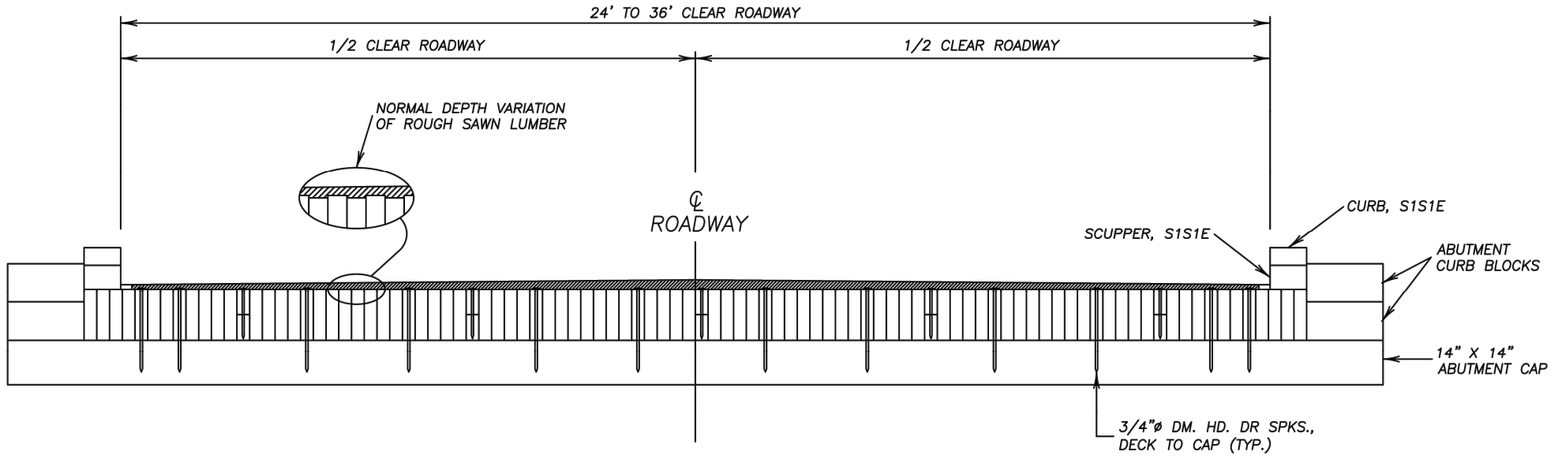


SECTION A-A

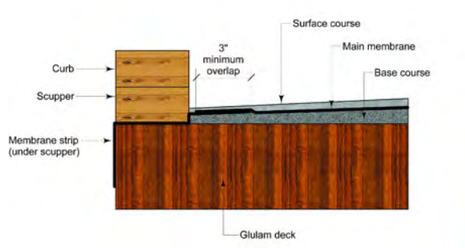
Test Level 4 System for Longitudinal Decks -- NCHRP-350 Test Standards

Note: More information is available Federal Highway Administration website (www.fhwa.dot.gov) including information on transition railings.

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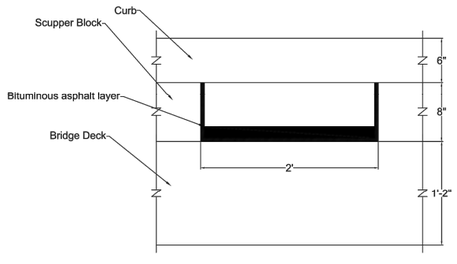
Timber Pile Cap Attachment - Section View



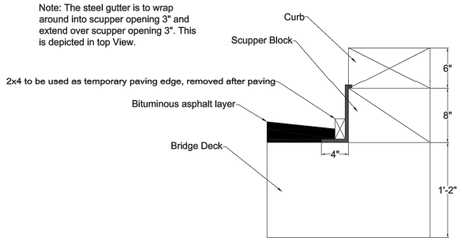
Asphalt Wearing Surface Recommendation



Protective Railpost Cap



U-Shaped Metal Flashing - Scupper Openings



Z-Shaped Flashing - Inside Curb

Detailing for Durability Notes -

The use of a waterproof geotextile membrane in conjunction with an asphalt wearing surface is recommended for most timber bridge applications. Proper application of a waterproof wearing surface can help to improve the long-term durability of timber bridge decks. The waterproofing membrane should be “sandwiched” between the base course and finish course of asphalt paving. A membrane strip is first placed along the deck edges, prior to the installation of curbs and scupper blocks, and should be sized to extend the full deck depth (outer edge) and beyond the inside curb face by more than 3-inches. The main membrane sandwiched in between the asphalt paving layers should extend to interior curb faces, providing a minimum membrane overlap.

The use of metal flashing on the inside curb face (z-shaped) and in the scupper openings u-shaped) along with sufficient overlaps, should reduce debris and moisture accumulation along the bridge edge (gutter zones). It is attached with roofing nails and the minimum overlap of flashing should be 5-inches.

Post caps are available which shields the timber or glulam post top surface from UV light degradation and shelters the end grain from wetting and drying. Post caps should be designed and manufactured to meet the following requirements:

- Manufactured from 1/8" high density polyethylene plastic, color black.
- Cap configuration shall allow for air circulation to the top of timber posts on all four sides.
- Fixing the plastic cap to the post using (stainless or galvanized) steel screws. No screws should be placed into the top of the posts, but rather into the post sides. This will prevent moisture from seeping through the connections into the topside end-grain of the post.
- Drip edges shall be provided on cap for the post sides and back.
- Water channel on top of cap will facilitate run-off and provide for air circulation beneath cap

The bridge design information depicted on these drawings was developed under a cooperative research agreement between Minnesota Local Road Research Board (LRRB), Minnesota Department of Transportation, The University of Minnesota Duluth - Natural Resource Research Institute (NRRI), and the USDA Forest Service - Forest Products Laboratory.

APPENDIX D
ST. LOUIS COUNTY TIMBER BRIDGE DEMONSTRATION PROJECT

MINNESOTA DEPARTMENT OF TRANSPORTATION
SAINT LOUIS COUNTY

CONSTRUCTION PLAN FOR: CONSTRUCT BRIDGE 69A58 AND APPROACHES OVER EMBARRASS RIVER, 7.4 MILES W/SW OF BABBITT, MN

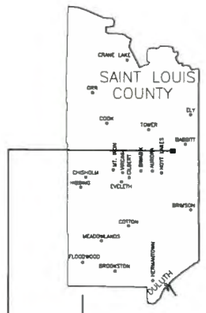
LOCATED ON CR 796 BETWEEN CR 615 AND CSAH 21

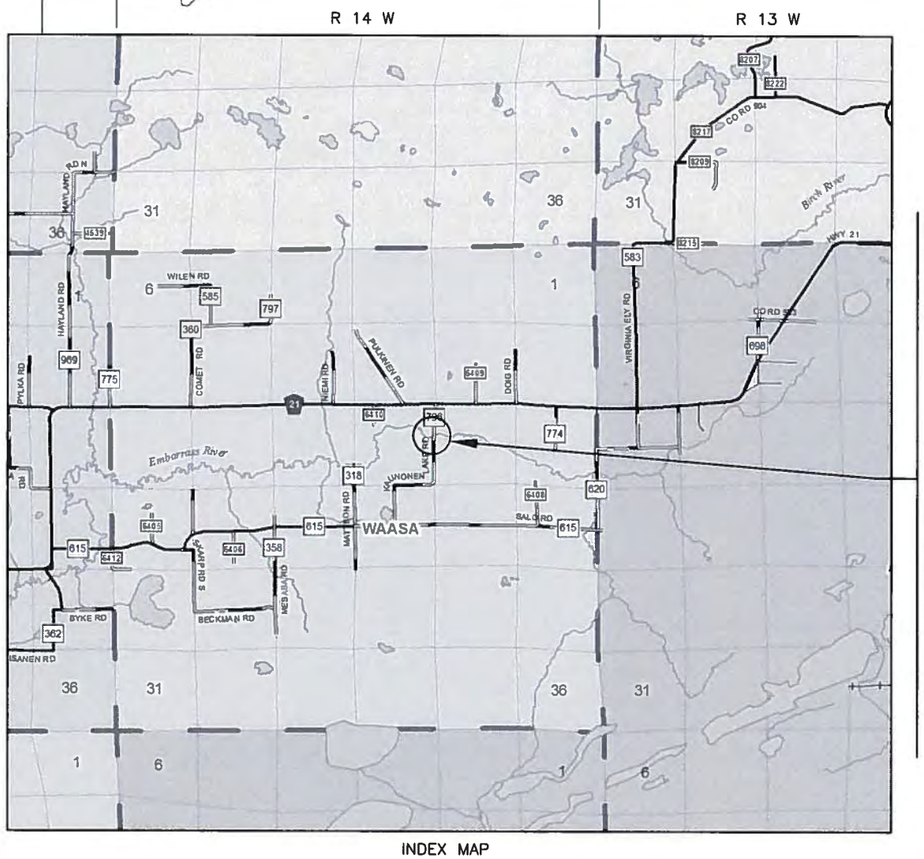
FROM 222.08 FT. N. AND 13.96 FT. E. OF E 1/4 COR. OF SEC 15 T60N R14W

TO 1800.09 FT. S. AND 114.62 FT. W. OF WEST COR. OF SEC 15 T60N R14W

COUNTY PROJ. NO. 0796-271375

GROSS LENGTH	600.00	FEET	0.114	MILES
BRIDGES-LENGTH	57.33	FEET	0.011	MILES
EXCEPTIONS-LENGTH	0.00	FEET	0.000	MILES
NET LENGTH	600.00	FEET	0.114	MILES





INDEX MAP

END CP 0796-271375
STA. 8+00.00

CONSTRUCT BRIDGE 69A58 (BR 516)
℄ STA. 4+87.50
57'-4" STEEL BEAM SPAN BRIDGE
NO SKEW
ROADWAY WIDTH= 24' SHLD. TO SHLD.

REMOVE INPLACE BRIDGE 88773
83.5' STEEL LOW TRUSS BRIDGE
NO SKEW
℄ STA. 5+16
REMOVE, NO SALVAGE

BEGIN CP 0796-271375
STA. 2+00.00

SAINT LOUIS COUNTY BRIDGE DEPT. PUBLIC WORKS

PLAN SYMBOLS

- SECTION SUBDIVISION LINE
- EXISTING R/W
- NEW R/W
- TEMP EASE
- RAILROAD R/W
- ROAD SHOULDER
- EDGE OF LAKE
- SWAMP BOUNDARY
- MISCELLANEOUS BOUNDARY
- CORPORATE OR CITY LIMITS
- PROPERTY LINE (R)
- RECREATIONAL TRAIL
- ROAD ALIGNMENT (11+00 — 12+00)
- ALIGNMENT POINTS (P.I.)
- RIVER OR CREEK
- DRAINAGE DITCH
- BRIDGE
- RAILROAD (SINGLE TRACK)
- RR CROSSING PAVEMENT MARKING
- RR CROSSING GATE
- RR CROSSBUCK SIGN
- RR CROSSBUCK SIGN W/LIGHTS
- BARBED WIRE FENCE
- CHAIN LINK FENCE (XC)
- WOVEN WIRE, COMBINATION WOVEN AND BARB (XW)
- WOOD FENCE
- BILLBOARD
- RETAINING WALL
- GUARDRAIL (CABLE)
- GUARDRAIL (PLATE BEAM)
- DRAIN TILE
- CULVERT
- CULVERT WITH APRONS
- TREELINE OR BRUSHLINE
- DECIDUOUS TREES
- CONIFER (EVERGREEN) TREES
- HEDGE
- BUSH OR SHRUB
- SWAMP OR MARSH
- MONUMENT (C,I,ACT,ACP,BCP,...)
- CONCRETE OR STONE MONUMENT
- IRON PIPE, PIN OR REBAR
- IRON PIN WITH BRASS DISK
- NAIL, PK NAIL, SPIKE, SFP, T-BAR, ...
- VERTICAL CONTROL
- HORIZONTAL CONTROL
- POWER POLE
- LIGHT POLE
- LIGHT AND TELEPHONE POLE
- LIGHT, TELEPHONE AND POWER POLE
- GUY POLE
- POLE ANCHOR
- TELEPHONE POLE
- TELEPHONE AND POWER POLE
- UNDERGROUND UTILITY PEDESTAL (TV FO E T)
- TELEPHONE MANHOLE (VAULT) (MH)
- ELECTRIC CABLE IN CONDUIT (P)
- TELEPHONE CABLE IN CONDUIT (T)
- BURIED ELECTRIC CABLE (P-BUR)
- BURIED TELEPHONE CABLE (T-BUR)
- GAS LINE (GAS)
- WATER LINE (W)
- VALVE
- FIRE HYDRANT
- WATER MANHOLE
- WELL
- LAWN SPRINKLER HEAD
- MANHOLE
- CATCH BASIN
- SEPTIC TANK (SEPTIC TANK)
- FORCE MAIN LIFT STA (LIFT)
- SEWER LINE
- PERMANENT BARRICADE
- TRAFFIC SIGNAL LIGHT
- HAND HOLE
- ENTRANCE
- BUILDING (NUMBER, 1-S-F)
- SATELLITE DISH
- STEEL TOWER (TOWER)
- FLAG POLE
- SIGN
- TYPE III BARRICADE
- CHANNELIZING DEVICE
- TYPE A WARNING LIGHT

SCALES

PLAN 0 — 50 FT.

PROFILE 0 — 50 FT. HORIZ. 0 — 5 FT. VERT.

INDEX MAP 0 — 2 MILES

PLAN REVISIONS

DATE	SHEET NO.	APPROVED BY

MINN. PROJ. NO.

GOVERNING SPECIFICATIONS

THE 2016 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" SHALL GOVERN.

INDEX OF SHEETS

SHEET NO.	DESCRIPTION
1	TITLE SHEET AND INDEX MAP
2	STATEMENT OF ESTIMATED QUANTITIES
3	EARTHWORK QUANTITIES
4-5	TYPICAL SECTION
6	PLAN AND PROFILE
7	BRIDGE APPROACH TREATMENT
8	SHEET PILE WALL
9-12	EROSION CONTROL PLAN
13-15	GUARDRAIL
16	TRAFFIC CONTROL
17-18	CROSS SECTIONS
B1-B15	BRIDGE PLAN (69A58)

THIS PLAN CONTAINS 33 SHEETS

DESIGN DESIGNATION

R VALUE= ____ ΣN18$_{20}$ = ____

ADT (Current Year)	2016	= 5
ADT (Future Year)	2036	= 6
D (Directional Distr.)		= 50-50%
T (Heavy Commercial)		=
Proj. Soil Factor		=
Shoulder Width		= 1'
Design Loading		= 7 TON

Bridge 69A58 HL 93 LIVE LOAD

Design Speed 40 MPH

Based on STOPPING Sight Distance

Height Of Eye 3.5 Height of object 2.0

Design Speed not achieved at:

STA. ____ TO STA. ____ MPH ____

STA. ____ TO STA. ____ MPH ____

Rural Minor Arterial Classification

Lanes 2- 11' Traffic 2- 1' Shoulders

Parking Lanes - None

DESIGNERS NEIL BERGSTEDT (BRIDGE DEPT)

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME: MATTHEW W. HEMMILA

SIGNATURE: Matthew W. Hemmila

DATE: 8/31/16 REG. #: 43973

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NOTES:

1. CLEARING AND GRUBBING LIMITS ARE TO THE RIGHT OF WAY AND CONSTRUCTION EASEMENTS.
2. QUANTITY IS BASED OFF OF A 90 FT LONG WALL WITH 30 FT SHEETS.

STATEMENT OF ESTIMATED QUANTITIES

SHEET	NOTE	ITEM NO.	ITEM	UNIT	QUANTITY	
					Bonding Ineligible	Bonding Eligible
		2021.501	MOBILIZATION	LUMP SUM	0.30	
2	1	2101.511	CLEARING & GRUBBING	LUMP SUM	1	
3,16-17		2106.501	EXCAVATION - COMMON (P)	CU YD	189	
3,16-17		2106.521	GRANULAR EMBANKMENT (CV) (P)	CU YD	2,003	
3,16-17		2118.607	AGGREGATE SURFACING (CV) CLASS 5 (P)	CU YD	616	
2,4-5		2357.606	BITUMINOUS MATERIAL FOR SHOULDER TACK	GALLON	90	
7		2360.501	TYPE SP 12.5 WEARING COURSE MIX (3,C)	TON	11	
7		2401.601	STRUCTURE EXCAVATION	LUMP SUM	1	
6		2442.501	REMOVE EXISTING BRIDGE	LUMP SUM	1	
2,6,17	2	2452.618	STEEL SHEET PILING (PERMANENT)	SQ FT	2,700	
3,6		2501.501	CULVERT EXCAVATION CLASS U (P)	CU YD	480	
6		2501.521	77" SPAN CAS PIPE-ARCH CULVERT	LIN FT	160	
6		2501.525	77" SPAN CAS PIPE-ARCH APRON	EACH	8	
11-12		2554.501	TRAFFIC BARRIER DESIGN SPECIAL	LIN FT	100	
11		2554.501	TRAFFIC BARRIER DESIGN B8307	LIN FT	100	
11,13		2554.523	END TREATMENT-TANGENT TERMINAL	EACH	4	
14		2563.601	TRAFFIC CONTROL	LUMP SUM	0.30	
8-9		2573.502	SILT FENCE, TYPE HI	LIN FT	1,155	
8,10		2573.505	FLOTATION SILT CURTAIN TYPE MOVING WATER	LIN FT	200	
		2573.550	EROSION CONTROL SUPERVISOR	LUMP SUM	1	
8		2574.508	FERTILIZER TYPE 3	POUND	180	
3-5		2574.525	COMMON TOPSOIL BORROW	CU YD	211	
8		2575.501	SEEDING	ACRE	1	
8		2575.502	SEED MIXTURE 25-141	POUND	30	
8		2575.571	RAPID STABILIZATION METHOD 3	M GALLON	6	

BASIS FOR QUANTITIES

BITUMINOUS MATERIAL FOR SHOULDER TACK	0.18 GALLONS PER SQ. YD.
SEED, MIXTURE 25-141	59 LBS. PER ACRE
FERTILIZER, TYPE 3	350 LBS. PER ACRE
RAPID STABILIZATION METHOD 3	6M GALLONS PER ACRE

KNOWN UTILITY COMPANIES		
TELEPHONE NO.	COMPANY	
1-800-421-9959	LAKE COUNTRY POWER	(OVERHEAD POWER)
1-800-252-1166	GOPHER STATE ONE CALL	(LOCATERS)

THE SUBSURFACE UTILITY INFORMATION IS UTILITY QUALITY LEVEL D. THIS QUALITY LEVEL WAS DETERMINED ACCORDING TO THE GUIDELINES OF CI/ASCE 38-2, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA."

STANDARD PLATES	
THE FOLLOWING STANDARD PLATES AS APPROVED BY THE F.W.H.A. SHALL APPLY TO THIS PROJECT.	
PLATE NO.	DESCRIPTION
3040 F	CORRUGATED METAL PIPE CULVERT (STANDARD CORRUGATION)
3122 K	METAL APRON FOR C.M. PIPE-ARCH CULVERT
8000 I	STANDARD BARRICADES
8307 S	W-BEAM GUARDRAIL & END ANCHORAGES

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

MATTHEW W. HEMMILA — TYPED NAME

43973 — REG. NO.

SIGNATURE

8/31/16 — DATE

CR 796 – CO. BR. 516 – ST. BR. 69A58

ESTIMATED QUANTITIES, STANDARD PLATES & UTILITIES

CP 0796-271375

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EARTHWORK SUMMARY ① ② ③

LOCATION	EXCAVATION					BITUMINOUS		EMBANKMENT									
	2105 ROCK EXC.	2106 EXC. COMMON (REG) (P)	EXC. COMMON (TOPSOIL) ④	BITUMINOUS ④	2501 CULVERT EXC. CLASS U (P)	TYPE SP 12.5 WEARING COURSE MIX (3,C)	TYPE SP 12.5 NON-WEARING COURSE MIX (3,C)	2574 COMMON TOPSOIL BORROW (LV) ⑤	2106 GRANULAR EMBANKMENT (CV) (P)	COMMON EMBANKMENT SLOPE DRESSING	2106 SELECT GRANULAR EMBANKMENT MOD. 7% (CV)(P)	2118 AGGREGATE SURFACING CL 5 (CV)(P)	2211 AGGREGATE BASE (CV) CL 5 (P)	2221 AGGREGATE SHOULDERING CL 5 (CV)(P)	2451 COARSE AGGREGATE BEDDING (CV) (P)	2451 GRANULAR BACKFILL MOD 12% (CV) (P)	COMMON EMB.	2511 RANDOM RIPRAP CL III
	CU. YD.	CU. YD.	CU. YD.	SQ. YD.	CU. YD.	TONS	TONS	CU. YD.	CU. YD.	CU. YD.	CU. YD.	CU. YD.	CU. YD.	CU. YD.	CU. YD.	CU. YD.	CU. YD.	CU. YD.
2+00 – 8+00	–	189	–	–	–	–	–	211	1583	–	–	616	–	–	–	–	–	–
FLOODPLAIN CULVERTS	–	–	–	–	480	–	–	–	420	–	–	–	–	–	–	–	–	–
TOTALS	–	189	–	–	480	–	–	211	2003	–	–	616	–	–	–	–	–	–

KEY NOTES:

① ALL EXCAVATION AND EMBANKMENT QUANTITIES SHOWN IN THIS CHART HAVE NO CONVERSION, SHRINKAGE OR COMPACTION FACTORS APPLIED TO THEM. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DETERMINE THESE FACTORS AND BID THE PROJECT ACCORDINGLY. FIELD CHANGES WILL BE MEASURED AND QUANTITIES ADJUSTED AS NECESSARY.

② ALL TYPES OF EXCAVATION AND EMBANKMENT QUANTITIES IN THE PLAN ARE DETERMINED BY THE TOTAL NEEDS OF THE PROJECT. THE EXCAVATION QUANTITIES SHOWN IN THE PLAN ARE EXCAVATED VOLUME. THE EMBANKMENT QUANTITIES ARE COMPACTED VOLUME. FOR BIDDING PURPOSES, THE CONTRACTOR SHALL DETERMINE, WITHIN EACH SEGMENT, WHERE THE EXCAVATED MATERIAL (IN COMPLIANCE WITH THE PLAN & SPECIAL PROVISIONS) WILL BE INCORPORATED INTO THE WORK, HOW MUCH ACTUAL EXCESS MAY BE GENERATED, HOW MUCH ACTUAL COMMON EMBANKMENT WILL BE AVAILABLE FROM ROADWAY EXCAVATIONS, AND HOW MUCH COMMON EMBANKMENT WILL HAVE TO BE HAULED IN FROM OUTSIDE SOURCES.

③ EXCAVATION AND BACKFILL FOR MAINLINE CULVERT AND SANITARY SEWER ARE INCIDENTAL, UNLESS A TREATMENT IS BEING CONSTRUCTED. IN THIS CASE, THE PLAN WILL IDENTIFY STRUCTURE EXCAVATION, GRANULAR BACKFILL AND AGGREGATE BEDDING AS NECESSARY.

④ FOR INFORMATION ONLY, NOT A PAY ITEM. REMOVAL OF THIS MATERIAL IS INCLUDED IN THE QUANTITY OF COMMON EXCAVATION.

⑤ TOPSOIL BORROW CALCULATED FROM DISTURBED SLOPE AREA AT A 3" DEPTH FOR THE LENGTH OF THE PROJECT.

DEFINITIONS OF EXCAVATION AND EMBANKMENT ITEMS

ROCK EXCAVATION

ROCK EXCAVATION IS DIVIDED INTO TWO CATEGORIES. THESE CATEGORIES ARE SOLID LEDGE ROCK, AND DETACHED BOULDERS GREATER THAN 2 CUBIC YARDS. IN BOTH CASES, THE CONTRACTOR SHALL EXPOSE ALL LEDGE ROCK AND LARGE DETACHED BOULDERS THAT WILL NEED TO BE EXCAVATED AND ALLOW THE ENGINEER AMPLE TIME TO FIELD CROSS SECTION OR MEASURE THE ROCK. THE ENGINEER WILL CALCULATE AND ADJUST THE QUANTITY FOR ROCK EXCAVATION AND EXCAVATION SPECIAL BASED ON THESE FIELD MEASUREMENTS. ROCK EXCAVATION, WHETHER IT BE LEDGE ROCK OR DETACHED BOULDERS, WILL ONLY BE ALLOWED TO BE USED AS REGULAR FILL OUTSIDE OF THE 1:1 SLOPES AS SHOWN ON THE TYPICALS.

EXCAVATION COMMON

EXCAVATION COMMON INCLUDES ALL EXCAVATION REQUIRED TO COMPLETE THE CONSTRUCTION, INCLUDING EXCAVATING THE INPLACE TOPSOIL AND BITUMINOUS PAVEMENT, BUT EXCLUDING STRUCTURE EXCAVATION AND ROCK EXCAVATION. THIS EXCAVATION SHALL BE USED TO MEET THE REQUIREMENTS OF REGULAR FILL AND SHALL, IF THE CONTRACTOR ELECTS, BE USED TO MEET THE REQUIREMENTS OF SELECT GRANULAR EMBANKMENT MODIFIED 7% (CV) AS DEFINED.

CULVERT EXCAVATION, CLASS U

CULVERT EXCAVATION, CLASS U, INCLUDES ALL EXCAVATION BELOW THE EXCAVATION COMMON ELEVATION WHICH IS NECESSARY FOR THE CONSTRUCTION OF CENTERLINELINE PIPE TREATMENTS. THIS QUANTITY, AND THE AREAS AFFECTED, ARE SHOWN IN CHARTS AND DETAIL DRAWINGS SHOWN IN THE PLAN.

COMMON EMBANKMENT (NOT A PAY ITEM)

COMMON EMBANKMENT IS THE FILL REQUIRED TO FILL OUT THE INSLOPES AS SHOWN ON THE TYPICALS. ALL OF THIS MATERIAL SHALL COME FROM EXCAVATED MATERIAL FROM WITHIN THE PROJECT LIMITS. THIS MATERIAL CAN BE ANY SOIL CLASSIFICATION AS APPROVED BY THE ENGINEER. THE CONTRACTOR SHALL UTILIZE THE POORER SOILS AS REGULAR FILL. ALL BOULDERS OR BLASTED ROCK PLACED IN THIS FILL SHALL BE BURIED A MINIMUM OF 1 FOOT BELOW THE TOP OF THE PROPOSED TOPSOIL TO PREVENT DAMAGE TO MOWERS AND OTHER MAINTENANCE EQUIPMENT.

COMMON EMBANKMENT – SLOPE DRESSING (NOT A PAY ITEM)

SLOPE DRESSING SHALL BE THE NATURAL TOPSOIL STRIPPED FROM THE PROJECT LIMITS OR A COMBINATION OF MINERAL SOIL AND ORGANIC MATTER FREE OF STONES, STICKS AND DEBRIS, APPROVED OF BY THE ENGINEER. THIS MATERIAL MAY COME FROM ON OR OFF THE PROJECT, NO MEASUREMENT OR DIRECT PAYMENT WILL BE MADE FOR THIS ITEM.

GRANULAR BACKFILL MOD 12% (CV)

GRANULAR BACKFILL MOD IS A PLANNED QUANTITY ITEM. ALL GRANULAR BACKFILL MATERIAL SHALL MEET ALL THE REQUIREMENTS OF GRANULAR BACKFILL AS PER 3149.2D. AS FOLLOWS:

100% TO PASS A 3 INCH SIEVE AND OF THAT PORTION PASSING A 1 INCH SIEVE, NOT MORE THAN 12% BY WEIGHT WILL PASS A NO. 200 SIEVE. THIS MATERIAL SHALL BE SCREENED OR CRUSHED PRIOR TO PLACEMENT ON THE ROADWAY.

SELECT GRANULAR EMBANKMENT MODIFIED 7% (CV)

SELECT GRANULAR EMBANKMENT MODIFIED 7% IS A PLANNED QUANTITY ITEM. PLACEMENT SHALL BE AS SHOWN ON THE TYPICAL SECTIONS. IT SHALL MEET THE REQUIREMENTS OF SELECT GRANULAR BORROW (MnDOT 3149), AND IS MODIFIED AS FOLLOWS: 100% TO PASS A 3 INCH SIEVE AND OF THAT PORTION PASSING A 1 INCH SIEVE, NOT MORE THAN 7% BY WEIGHT WILL PASS A NO. 200 SIEVE. THIS MATERIAL SHALL BE SCREENED OR CRUSHED PRIOR TO PLACEMENT ON THE ROADWAY.

COARSE AGGREGATE BEDDING (CV)

BEDDING REQUIRED TO CONSTRUCT CENTERLINE PIPE TREATMENTS AS SHOWN IN THE PLAN. COARSE AGGREGATE BEDDING SHALL BE 100% VIRGIN COARSE AGGREGATE MEETING THE FOLLOWING GRADATION REQUIREMENTS:

SIEVE SIZE	PERCENT PASSING
1 1/2 IN. [37.5 mm]	100
NO. 4 [4.75mm]	0–10

GRANULAR EMBANKMENT (CV)

ALL GRANULAR EMBANKMENT (CV) MATERIAL SHALL MEET ALL THE REQUIREMENTS OF GRANULAR BORROW AS PER 3149.2B1.

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

MATTHEW W. HEMMILA — TYPED NAME

43973 — REG. NO.

SIGNATURE

8/31/16 — DATE

CR 796 – CO. BR. 516 – ST. BR. 69A58

EARTHWORK QUANTITIES

CP 0796–271375

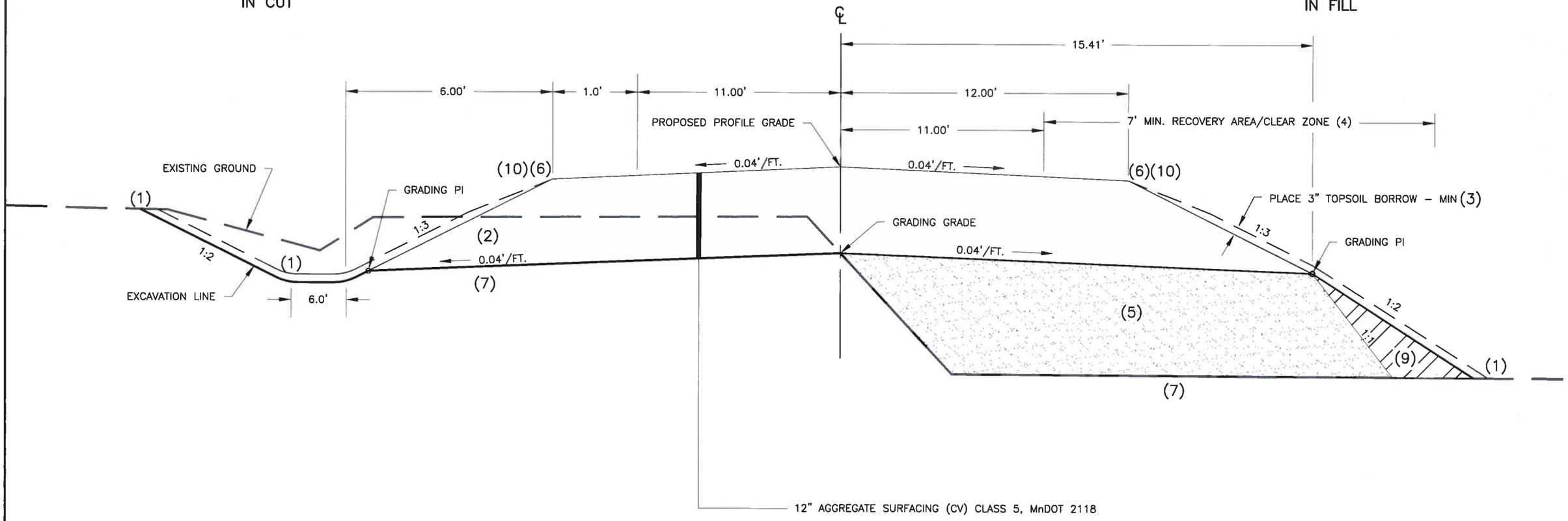
Sheet 3 of 18 Sheets

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TYPICAL SECTION
CR 796
STA. 2+00.00 TO STA. 3+08.83
STA. 6+66.17 TO STA. 8+00.00
(50' TRANSITION BETWEEN TYPICALS)

HALF SECTION IN CUT

HALF SECTION IN FILL



NOTES:

(1) ALL DITCH BOTTOMS, TOE OF FILLSLOPES, AND TOP OF BACKSLOPES SHALL BE ROUNDED.

(2) ALL EXCAVATION SHOWN ON THE TYPICAL WILL BE PAID FOR AS EXCAVATION – COMMON, MnDOT 2106.

(3) COMMON TOPSOIL BORROW, MnDOT 2574.

(4) ALL UTILITY POLES AND UNYIELDING OBJECTS SHALL BE REMOVED AND RELOCATED OUTSIDE THE CLEAR ZONE.

(5) GRANULAR EMBANKMENT (CV), MnDOT 2106.

(6) COMPACTION OF THE SHOULDER MATERIAL SHALL BE BY MECHANICAL MEANS TO A POINT THREE FEET BEYOND THE SHOULDER PI, AS APPROVED BY THE ENGINEER. THE FINISHED SHOULDER AND INSLOPE SHALL HAVE NO RIDGE WHICH WOULD TRAP RUNOFF AND CONCENTRATE FLOW.

(7) ANY ADDITIONAL EXCAVATION, AS DEEMED NECESSARY BY THE ENGINEER, WILL BE ADDED TO THE EXCAVATION – COMMON QUANTITY AND PAID FOR AT THE UNIT BID PRICE. EMBANKMENT FOR THIS WILL BE GRANULAR EMBANKMENT (CV) AND WILL BE PAID FOR AT THE UNIT BID PRICE.

~~(8) THIS MATERIAL SHALL BE SCREENED OR CRUSHED TO LESS THAN 3" PRIOR TO PLACING ON THE ROADWAY.~~

(9) COMMON EMBANKMENT – REGULAR GRADING MATERIAL, MnDOT 2106.

(10) SHOULDER TACK TO BE PLACED AT A WIDTH OF 4' CENTERED AT THE SHOULDER PI.

*DRAWING NOT TO SCALE

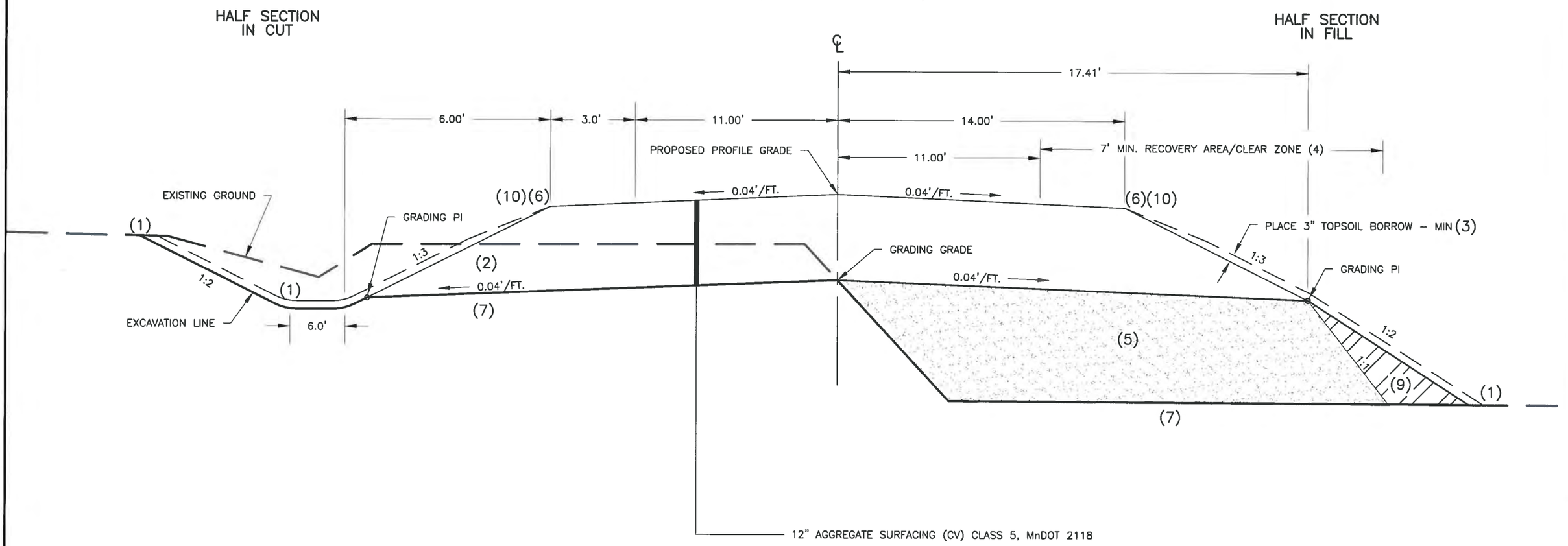
I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

MATTHEW W. HEMMILA (TYPED NAME) | 43973 (REG. NO.) | SIGNATURE | 8/31/16 (DATE)

CR 796 – CO. BR. 516 – ST. BR. 69A58	TYPICAL SECTION
CP 0796–271375	Sheet 4 of 18 Sheets

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TYPICAL SECTION
CR 796
STA. 3+58.83 TO STA. 6+16.17
(50' TRANSITION BETWEEN TYPICALS)



NOTES:

(1) ALL DITCH BOTTOMS, TOE OF FILLSLOPES, AND TOP OF BACKSLOPES SHALL BE ROUNDED.

(2) ALL EXCAVATION SHOWN ON THE TYPICAL WILL BE PAID FOR AS EXCAVATION – COMMON, MnDOT 2106.

(3) COMMON TOPSOIL BORROW, MnDOT 2574.

(4) ALL UTILITY POLES AND UNYIELDING OBJECTS SHALL BE REMOVED AND RELOCATED OUTSIDE THE CLEAR ZONE.

(5) GRANULAR EMBANKMENT (CV), MnDOT 2106.

(6) COMPACTION OF THE SHOULDER MATERIAL SHALL BE BY MECHANICAL MEANS TO A POINT THREE FEET BEYOND THE SHOULDER PI, AS APPROVED BY THE ENGINEER. THE FINISHED SHOULDER AND INSLOPE SHALL HAVE NO RIDGE WHICH WOULD TRAP RUNOFF AND CONCENTRATE FLOW.

(7) ANY ADDITIONAL EXCAVATION, AS DEEMED NECESSARY BY THE ENGINEER, WILL BE ADDED TO THE EXCAVATION – COMMON QUANTITY AND PAID FOR AT THE UNIT BID PRICE. EMBANKMENT FOR THIS WILL BE GRANULAR EMBANKMENT (CV) AND WILL BE PAID FOR AT THE UNIT BID PRICE.

~~(8) THIS MATERIAL SHALL BE SCREENED OR CRUSHED TO LESS THAN 3" PRIOR TO PLACING ON THE ROADWAY.~~

(9) COMMON EMBANKMENT – REGULAR GRADING MATERIAL, MnDOT 2106.

(10) SHOULDER TACK TO BE PLACED AT A WIDTH OF 4' CENTERED AT THE SHOULDER PI.

*DRAWING NOT TO SCALE

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

MATTHEW W. HEMMILA	43973		8/31/14
TYPED NAME	REG. NO.	SIGNATURE	DATE

CR 796 – CO. BR. 516 – ST. BR. 69A58	TYPICAL SECTION
CP 0796–271375	Sheet 5 of 18 Sheets

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CONSTRUCT BRIDGE 69A58
(CO BR 516)
℄ STA. 4+87.50
57'-4" SBS BRIDGE
NO SKEW
ROADWAY WIDTH= 28' SHLD.
TO SHLD.

REMOVE INPLACE BRIDGE 88773
83.5' STEEL TRUSS BRIDGE
NO SKEW
℄ STA. 5+15.00
REMOVE, NO SALVAGE

EMBARRASS RIVER

PROPOSED SHOULDER

80' T.E.

50' PROP. R/W

EXIST. R/W

PROPOSED & EXISTING
℄ C.R. 796
BRG. N 03°54'15" E

77" SPAN CAS ARCH CULVERT
(FLOODPLAIN)

SHEETPILE WALL W/ CAP

77" SPAN CAS ARCH CULVERT
(FLOODPLAIN)

BEGIN CP 0796-271375
STA. 2+00.00
N 3669277.69
E 4844077.08

PROPOSED
BR. 69A58

END CP 0796-271375
STA. 8+00.00
N 3669876.30
E 4844117.93

HOR. 0 — 50'
VERT. 0 — 5'
CONSTRUCTION LIMITS
FLOW ARROW

BM "B" EL. 1430.90' IN 6" SPRUCE 65' RT OF STA. 2+97

BM "A" EL. 1430.46' IN 6" SPRUCE 56' LT OF STA. 8+87

PVC STA. 1+51.29
PVC ELEV. 1431.80
0.20%

PVI STA. 2+51.29
PVI ELEV: 1432.00
200.00 VC
AD 2.36

PVT STA. 3+51.29
PVT ELEV. 1434.57
2.57%

PVC STA. 3+85.00
PVC ELEV. 1435.43
2.57%

PVI STA. 4+85.00
PVI ELEV. 1438.00
200.00 VC
AD -5.04

PVT STA. 5+85.00
PVT ELEV. 1435.52
-2.48%

PVC STA. 6+53.45
PVC ELEV. 1433.83
-2.48%

PVI STA. 7+53.45
PVI ELEV. 1431.35
200.00 VC
AD 2.58

PVT STA. 8+53.45
PVT ELEV. 1431.45
0.10%

1435
1430
1425

BEGIN CP 0796-271375
STA. 2+00.00
EL. 1432.03'

77" SPAN CAS ARCH FLOODPLAIN CULVERT
INVERT EL. 1427.80' (INLET & OUTLET)
NO SKEW

EL. 1434.0'
EL. 1433.0'

EXCAVATION LIMITS 1:1.5 (TYP)

77" SPAN CAS ARCH FLOODPLAIN CULVERT.
INVERT EL. 1427.10' (INLET & OUTLET)
NO SKEW

END CP 0796-271375
STA. 8+00.00
EL. 1431.59'

1+00	2+00	3+00	4+00	5+00	6+00	7+00	8+00	9+00
1431.58	1432.03	1432.46	1433.58	1434.46	1425.18	1428.42	1434.11	1433.08	1432.35	1431.91	1431.59	1431.59	1431.63
1431.69	1432.03	1433.41	1435.79	1436.57	1436.72	1436.24	1435.15	1433.91	1432.81	1432.04	1431.59		
	1432.57	1434.53											

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MATTHEW W. HEMMILA — TYPED NAME
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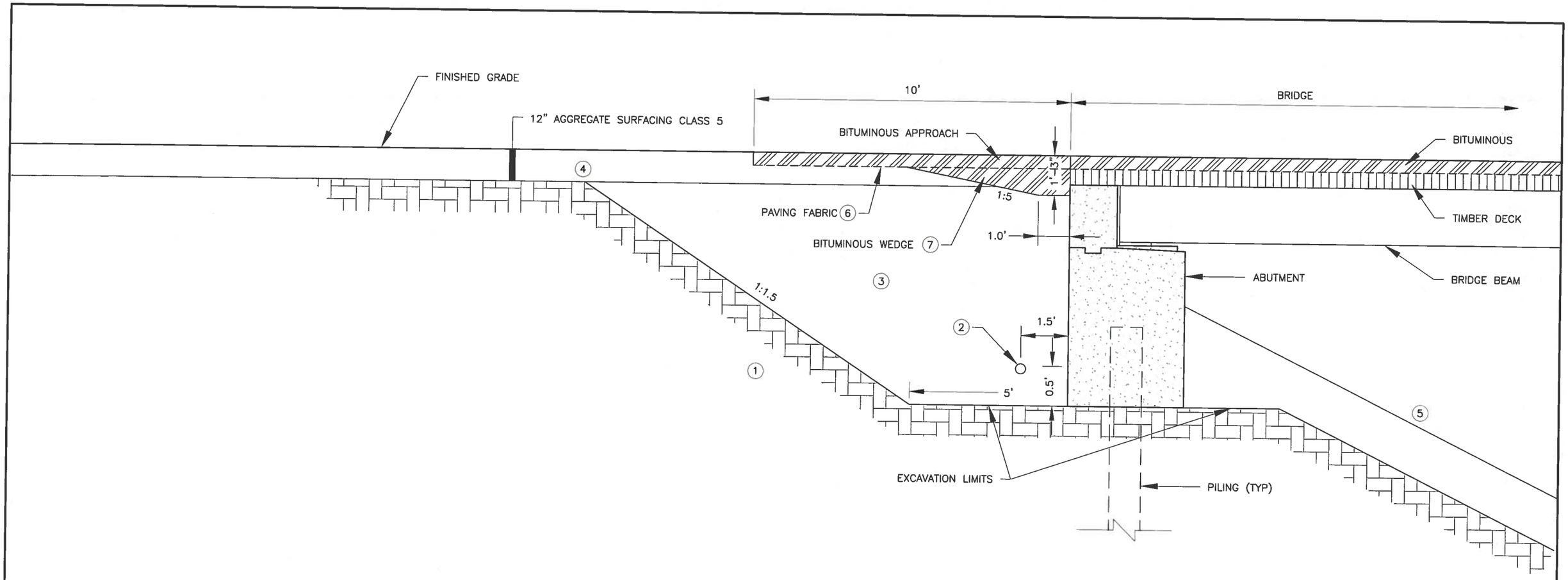
CR 796 – CO. BR. 516 – ST. BR. 69A58

PLAN AND PROFILE

CP 0796-271375

Sheet 6 of 18 Sheets

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1. NATURAL GROUND
2. DRAINAGE SYSTEM TYPE B910. SEE BRIDGE PLANS FOR DETAILS.
3. STRUCTURE EXCAVATION. BACKFILL WITH SELECT GRANULAR EMBANKMENT (INCIDENTAL). QUANTITY OF MATERIAL IS BASED ON DIMENSIONS SHOWN. Mn/DOT SPEC. 1903 SHALL NOT APPLY IF THE CONTRACTOR CHOOSES TO INCREASE DIMENSIONS IN ORDER TO FACILITATE CONSTRUCTION OPERATIONS AND ANY QUANTITY INCREASES SHALL BE CONSIDERED INCIDENTAL.
4. TOP OF SLOPE (FORMS LINE PARALLEL TO END OF BRIDGE)
5. SEE BRIDGE PLANS FOR SLOPE AND SLOPE PROTECTION.
6. PAVING FABRIC TO BE EXTENDED BEYOND THE BRIDGE DECK TO THE LENGTH OF THE BITUMINOUS APPROACH. PAVING FABRIC TO BE PAID FOR UNDER BRIDGE CONTRACT.
7. BITUMINOUS WEDGE IS TO BE CONSTRUCTED OF THE SAME MIX AS THE WEARING SURFACE AND IS TO BE PLACED BEFORE THE PAVING FABRIC. BITUMINOUS WEDGE WILL BE PLACED IN NO GREATER THAN 4" LIFTS AND COMPACTED BY HAND WHEN NOT ABLE TO USE MECHANICAL MEANS. PAYMENT FOR BITUMINOUS WEDGE IS INCLUDED IN THE APPROACH QUANTITIES AND ALL OTHER BITUMINOUS IS INCLUDED IN THE BRIDGE QUANTITIES.

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SIGNATURE

8/31/16 — DATE

CR 796 – CO. BR. 516 – ST. BR. 69A58

BRIDGE APPROACH TREATMENT

CP 0796-271375

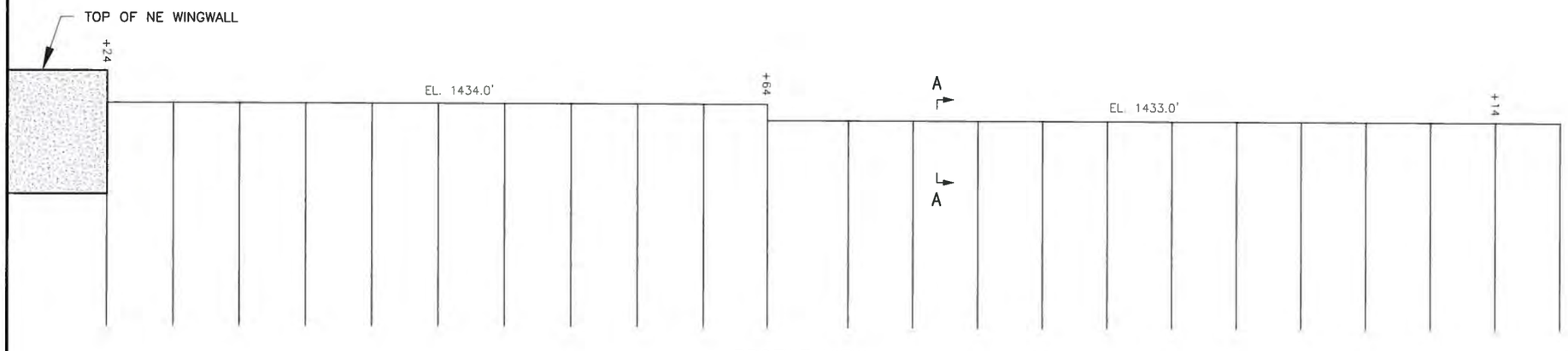
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1. RETAINING WALL LENGTH USED FOR QUANTITY CALCULATIONS IS 90 FEET.

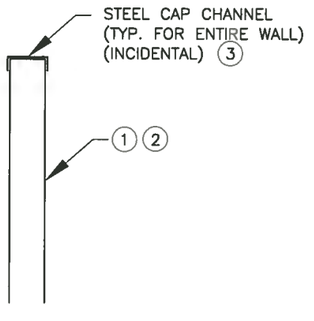
2. SHEET PILE REQUIREMENTS:
   PILES TO BE PZ22 (OR APPROVED EQUAL
   Fy = 50 KSI
   HOT ROLLED
   MIN. THICKNESS = 0.375" –PZ22
   NOMINAL HEIGHT = 30' –PZ22

3. STEEL CAP CHANNEL REQUIREMENTS:
   Fy = 50 KSI
   WEATHERING STEEL
   MC18x42.7 (OR APPROVED EQUAL)
   WELD TO SHEET PILING 1" IN 12"
   (INCIDENTAL TO SHEET PILING)

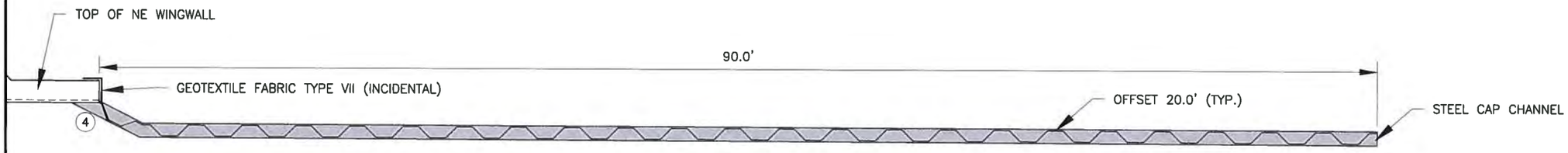
4. CONTRACTOR SHALL PROVIDE A CONNECTION TO THE WINGWALL AS APPROVED BY THE ENGINEER.



PROFILE VIEW



A–A



PLAN VIEW

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SHEET PILE WALL DETAILS

CP 0796–271375

Sheet 8 of 18 Sheets

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TEMPORARY TURF ESTABLISHMENT

RAPID STABILIZATION METHOD 3
SPEC 2575.571
APPLICATION RATE OF 6 M GALLONS PER ACRE
SEE NOTE "4"

STA TO STA	AREA (ACRES)	MINUS EC BLANKETS AND RIPRAP	TOTAL ACRES
2+00 – 8+00	0.50		0.50
		TOTAL ACRES	0.50
		2 APPLICATIONS	1.00
		6M GAL/ACRE	6.00

SILT FENCE TYPE HAND–INSTALLED

STA–STA	LT/RT	FEET
BOP–BRIDGE	RT	290
BOP–BRIDGE	LT	260
BRIDGE–EOP	RT	290
BRIDGE–EOP	LT	315
	TOTAL	1155

FLOTATION SILT CURTAIN TYPE MOVING WATER

STA–STA	LT/RT	FEET
AT BRIDGE	LT & RT	200
	TOTAL	200

GENERAL NOTES:

(1.) PRIOR TO TEMPORARY SEEDING OR EROSION CONTROL INSTALLATION, THE PROVISIONS OF MnDOT 2574.3A2 REQUIRE THE CONTRACTOR TO PROVIDE SMOOTH–ROUGH GRADING OF THE AREA TO BE COVERED, WHICH CALLS FOR THE REMOVAL OF SOIL CLODS LARGER THAN 6 INCHES AND THE FILLING OF RUTS DEEPER THAN 6 INCHES. SAID WORK IS INCIDENTAL TO THE PROJECT

(2.) THE QUANTITIES AND LOCATIONS OF ALL ITEMS SHOWN ON THE DETAIL SHEETS (EXCEPT SEEDING) ARE APPROXIMATE AND WILL BE VERIFIED IN THE FIELD BY THE ENGINEER.

(3.) PLAN BID ITEMS SHALL BE USED TO MEET THE REQUIREMENTS OF THE NPDES PERMIT, THE PLAN, AND THE SPECIFICATIONS. NO ADDITIONAL COMPENSATION SHALL BE PAID FOR THE NUMBER OF MOBILIZATIONS REQUIRED OR AREA COVERED DURING SUCH MOBILIZATIONS.

(4.) FOR TEMPORARY TURF ESTABLISHMENT, RAPID STABILIZATION METHOD 3 WILL BE USED. ESTIMATED AT 6 M GALLONS PER ACRE FOR 2 APPLICATIONS. THE NEED MAY BE MORE OR LESS THAN THE ESTIMATE BASED ON SITE CONDITIONS. SEE SPECIAL PROVISIONS.

(5.) FOR PERMANENT TURF ESTABLISHMENT: PLACE FERTILIZER TYPE 3, ANALYSIS 22–5–10 AT 350 LBS PER ACRE PRIOR TO SEED PLACEMENT AND TILL AS REQUIRED TO 3 INCH MINIMUM DEPTH. PLACE SEED MIXTURE 25–141 AT 59 LBS PER ACRE (NOTE REQUIREMENT FOR A TRACER OF HSS TYPE 5 WITH SEED WHEN USING HYDROSEEDER).

(6.) THE NORMAL WETTED PERIMETER OF ANY TEMPORARY OR PERMANENT DRAINAGE DITCH OR SWALE THAT DRAINS WATER FROM ANY PORTION OF THE CONSTRUCTION SITE, OR DIVERTS WATER AROUND THE SITE, MUST BE STABILIZED WITHIN 200 LINEAL FEET FROM THE PROPERTY EDGE, OR FROM THE POINT OF DISCHARGE INTO ANY SURFACE WATER. STABILIZATION OF THE LAST 200 LINEAL FEET MUST BE COMPLETED WITHIN 24 HOURS AFTER CONNECTING TO A SURFACE WATER.

(7.) ALL EXPOSED SOIL AREAS MUST BE STABILIZED AS SOON AS POSSIBLE TO LIMIT SOIL EROSION BUT IN NO CASE LATER THAN SEVEN (7) DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED.

FOR PERMANENT TURF ESTABLISHMENT:

SEEDING = 0.50 ACRES
SEED MIXTURE 25–141 = 30 POUNDS (59 LBS/ACRE)
FERTILIZER TYPE 3 = 180 POUNDS (350 LBS/ACRE)

EROSION CONTROL BLANKET CAT 3
TO BE PLACED AS REQUIRED FOR PERMANENT STABILIZATION ON ALL DISTURBED AREAS OF THE PROJECT

STA TO STA	LT/RT	LOCATION	SQ YD
2+00–8+00	LT/RT	ALL EXPOSED SOILS	2420
		TOTAL	2420

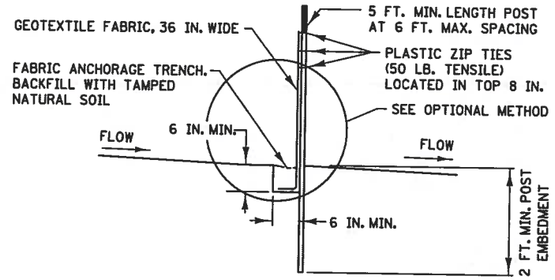
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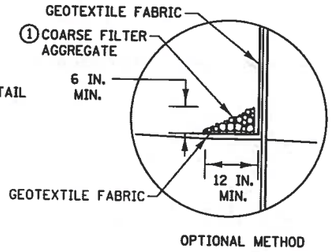
MATTHEW W. HEMMILA — TYPED NAME
43973 — REG. NO.
SIGNATURE
8/31/16 — DATE

CR 796 – CO. BR. 516 – ST. BR. 69A58 | SWPPP SHEET – QUANTITIES

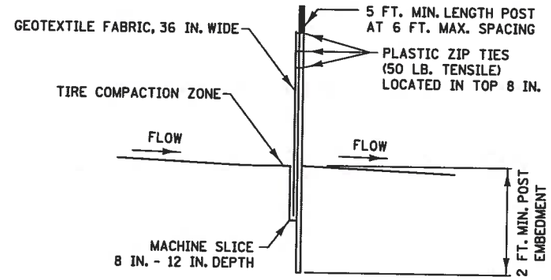
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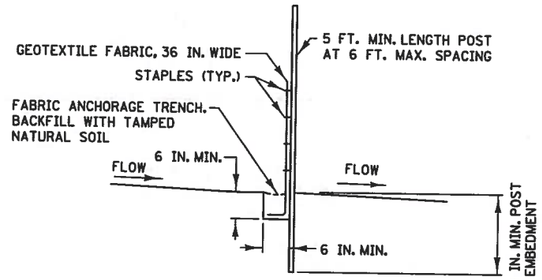




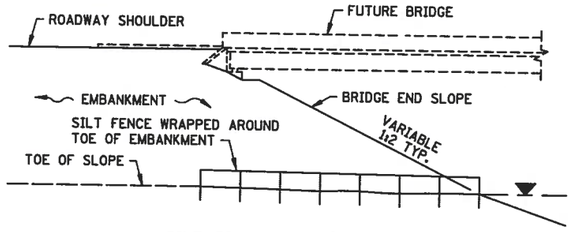
SILT FENCE TYPE HI ②
(HAND INSTALLED)



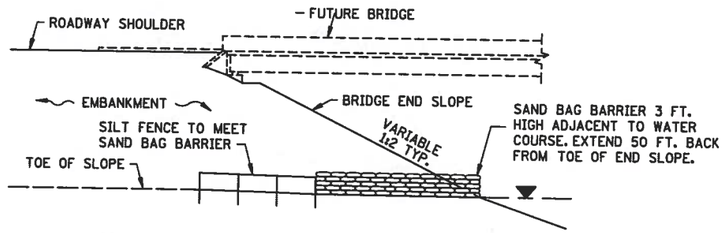
SILT FENCE TYPE MS ②
(MACHINE SLICED)



SILT FENCE TYPE PA ③
(PREASSEMBLED)

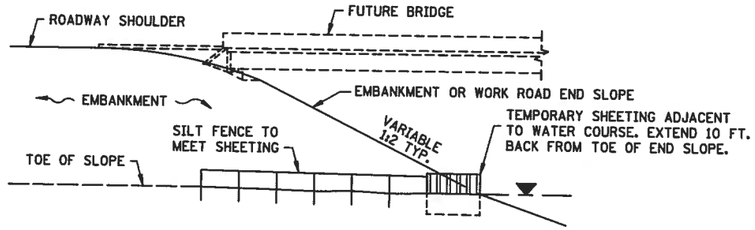


SILT FENCE ONLY ④

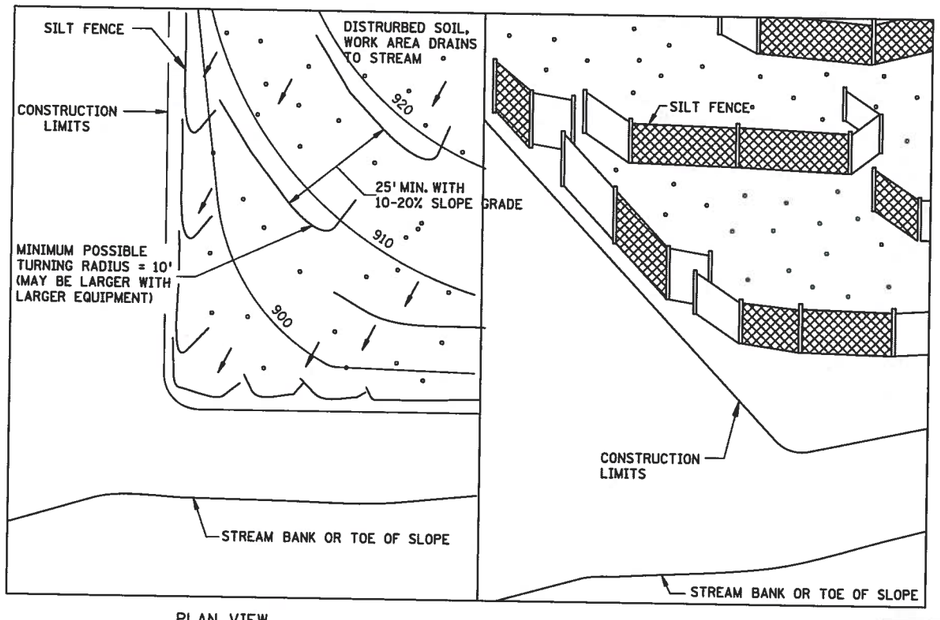


SILT FENCE WITH SAND BAGS ⑤

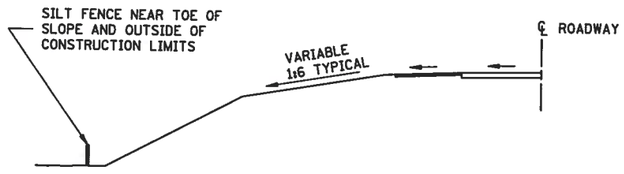
INSTALLATION AT BRIDGE EMBANKMENT ADJACENT TO WATER



SILT FENCE WITH SHEETING ⑥



J-HOOK INSTALLATION



LOCATION AT TOE OF ROADWAY EMBANKMENT

NOTES:
SEE SPECS. 2573, 3149 & 3886.
① COARSE FILTER AGGREGATE (SPEC. 3149) SHALL BE INCIDENTAL.
② TO PROTECT AREAS FROM SHEET FLOW. MAXIMUM CONTRIBUTING AREA: 1 ACRE.
③ TO PROTECT AREAS FROM SHEET FLOW. MAXIMUM CONTRIBUTING AREA: 0.25 ACRE.
④ WATER COURSE FLOW VELOCITY: STANDING. CONTRIBUTING SLOPE AREA: 1./2 ACRE.
⑤ WATER COURSE FLOW VELOCITY: 1 TO 7 FT./SEC. CONTRIBUTING SLOPE AREA: 1. ACRE.
⑥ WATER COURSE FLOW VELOCITY: 8 TO 15 FT./SEC. CONTRIBUTING SLOPE AREA: 3 ACRES.

REVISION:
APPROVED: 8-6-2014
CHIEF ENVIRONMENTAL OFFICER

REVISED:
APPROVED: 8-6-2014
STATE DESIGN ENGINEER

TEMPORARY SEDIMENT CONTROL
SILT FENCE

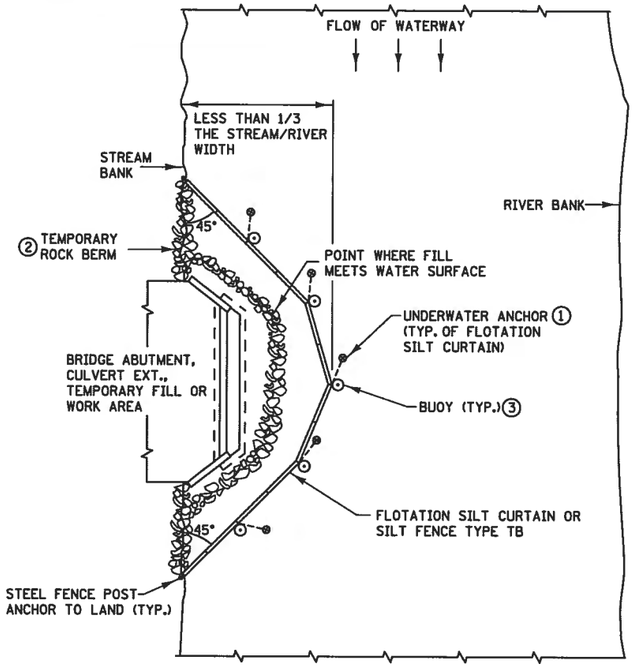
STANDARD PLAN 5-297.405 | 6 OF 7

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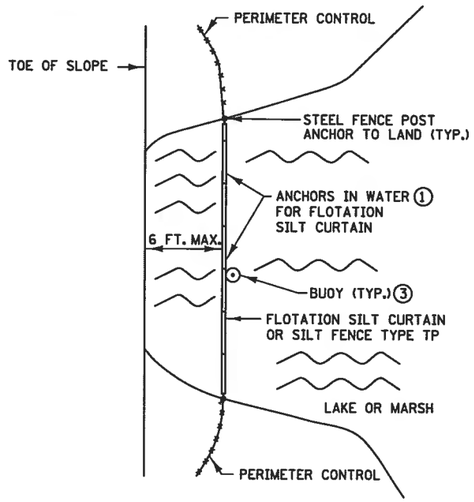
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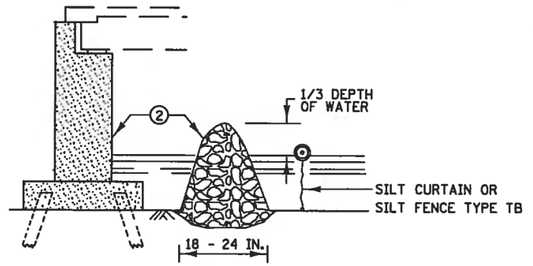
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PLAN VIEW FOR STREAM ⑤



PLAN VIEW FOR LAKE OR MARSH ⑤

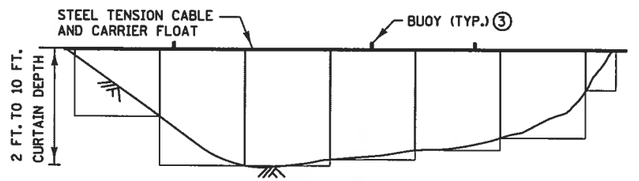


TEMPORARY ROCK BERM
FOR SEDIMENT CONTROL

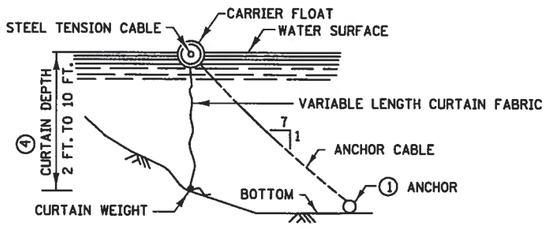
INSTALLATION GUIDELINES
SILT FENCE TYPE TB
MINIMUM WATER DEPTH: 1 FT.
MAXIMUM WATER DEPTH: 3 FT.
MAXIMUM WATER VELOCITY: 5 FT./SEC.

INSTALLATION GUIDELINES ④
FLOTATION SILT CURTAIN
TYPE: STILL WATER
MINIMUM WATER DEPTH: 3 FT.
MAXIMUM WATER DEPTH: 10 FT.
MAXIMUM WATER VELOCITY: 2 FT./SEC.
MAXIMUM WAVE HEIGHT: 1 FT

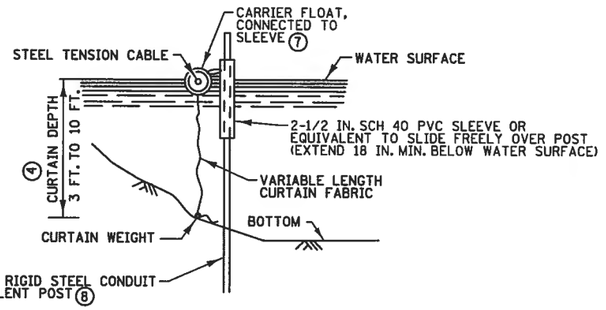
INSTALLATION GUIDELINES ④
FLOTATION SILT CURTAIN
TYPE: MOVING WATER
MINIMUM WATER DEPTH: 3 FT.
MAXIMUM WATER DEPTH: 10 FT.
MAXIMUM WATER VELOCITY: 5 FT./SEC.
MAXIMUM WAVE HEIGHT: 2 FT.



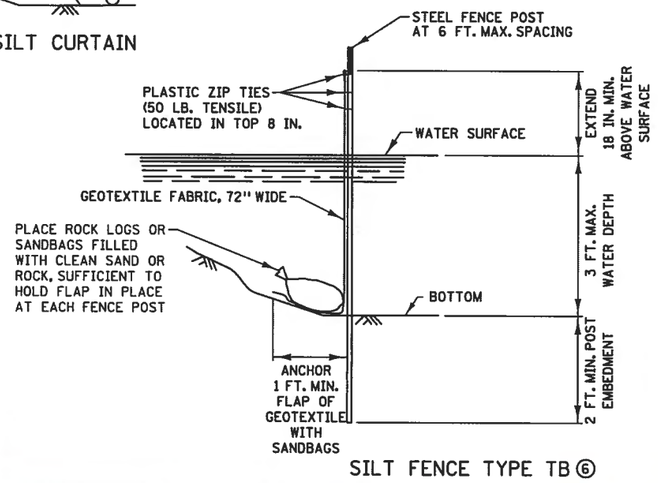
FRONT VIEW FOR FLOTATION SILT CURTAIN



FLOTATION SILT CURTAIN



ALTERNATE FLOTATION SILT CURTAIN



SILT FENCE TYPE TB ⑥

NOTES:

SEE SPECS. 2573, 3886, 3887 & 3893.

① FOR ANCHOR SPACING AND WEIGHT REQUIREMENTS, SEE SPEC. 2573.

② IN AREAS WHERE THE PLAN CALLS FOR RIPRAP AT A BRIDGE, CULVERT, OR SLOPE, A TEMPORARY ROCK BERM CONSTRUCTED FROM THE RIPRAP CAN BE USED TO PROVIDE ADDITIONAL PROTECTION. WHEN THE WORK IS COMPLETE THE RIPRAP CAN THEN BE MOVED TO THE PERMANENT LOCATION INDICATED IN THE PLANS. THE TEMPORARY ROCK BERM IS INCIDENTAL.

③ ON U.S. COAST GUARD OR OTHER MOTORIZED WATERWAYS, BUOYS ARE REQUIRED TO MARK THE ENDS AND SPECIAL AREAS FOR VISIBILITY. PLACE BUOYS AS REQUIRED FOR NAVIGATIONAL PURPOSES.

④ MINIMUM WATER DEPTH APPLIES TO THE DEEPEST POINT ALONG THE FLOTATION SILT CURTAIN OR SILT FENCE TYPE TB FOR DETERMINING APPLICABILITY OF FLOTATION SILT CURTAIN OR SILT FENCE TYPE TB.

⑤ SILT CURTAIN SHOULD BE REMOVED WHEN THE AREA CONTRIBUTING DIRECT RUNOFF HAS BEEN TEMPORARILY OR PERMANENTLY STABILIZED. SILT CURTAIN SHOULD ALSO BE REMOVED BEFORE WINTER IF ICE UP OR ICE FLOW IS ANTICIPATED.

⑥ EMBED POST INTO BOTTOM A MINIMUM OF 40% OF THE WATER DEPTH (INCLUDING WAVE HEIGHT), BUT IN NO CASE SHALL EMBEDMENT BE LESS THAN 2 FEET.

⑦ ANCHOR FLOAT MUST BE CONNECTED SECURELY TO SLEEVE WITH A MINIMUM TENSILE STRENGTH OF 100 LBS. CONNECTION METHOD MUST ALLOW FOR SLEEVE TO MOVE FREELY ON POST.

⑧ PROVIDE SUFFICIENT NUMBER OF POST ANCHORS TO MAINTAIN SILT CURTAIN POSITION.

REVISION:
APPROVED: 8-6-2014
CHIEF ENVIRONMENTAL OFFICER

REVISED:
STATE DESIGN ENGINEER
APPROVED: 8-6-2014

TEMPORARY SEDIMENT CONTROL
SILT CURTAIN OR SILT FENCE TYPE TB

STANDARD PLAN 5-297.405

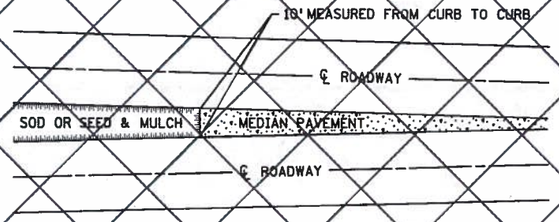
I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

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SIGNATURE
8/31/16 — DATE

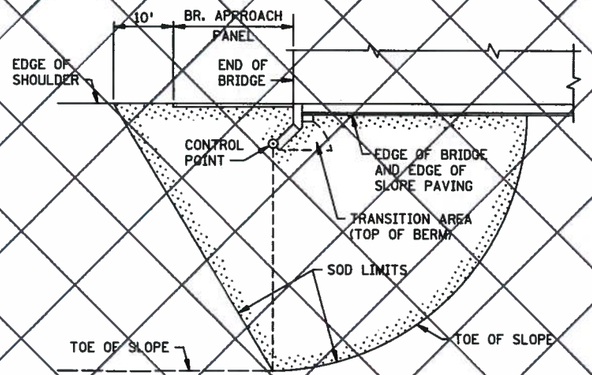
CR 796 – CO. BR. 516 – ST. BR. 69A58 | SILT CURTAIN

CP 0796–271375 | Sheet 11 of 18 Sheets

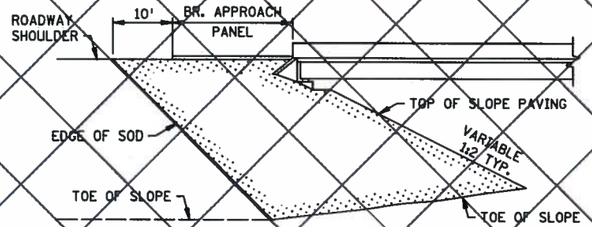
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SODDING LIMITS AT GORE AREA

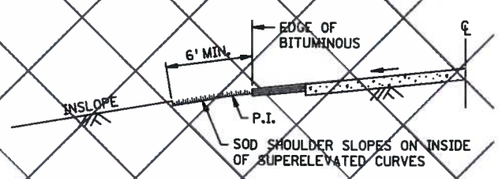


PLAN

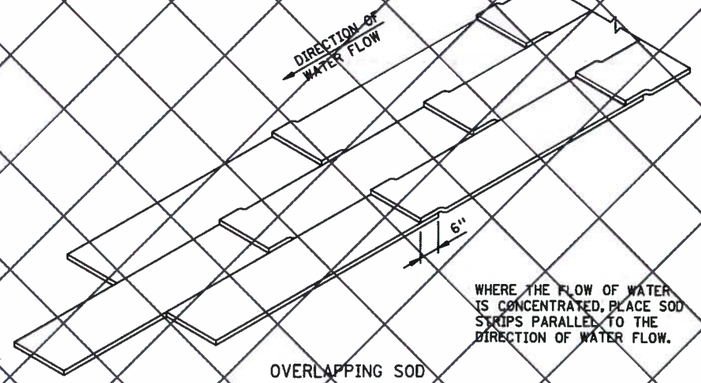


ELEVATION

SODDING LIMITS AT BRIDGE APPROACH FILLS

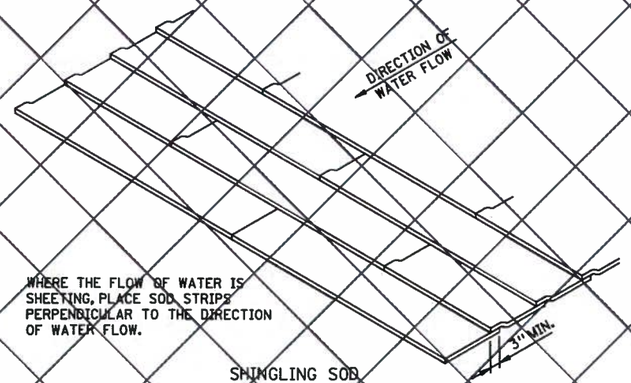


SODDING INSLOPES OF SUPERELEVATED CURVES



OVERLAPPING SOD

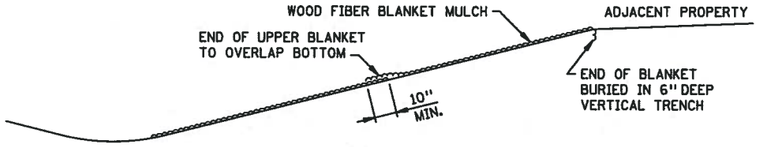
WHERE THE FLOW OF WATER IS CONCENTRATED, PLACE SOD STRIPS PARALLEL TO THE DIRECTION OF WATER FLOW.



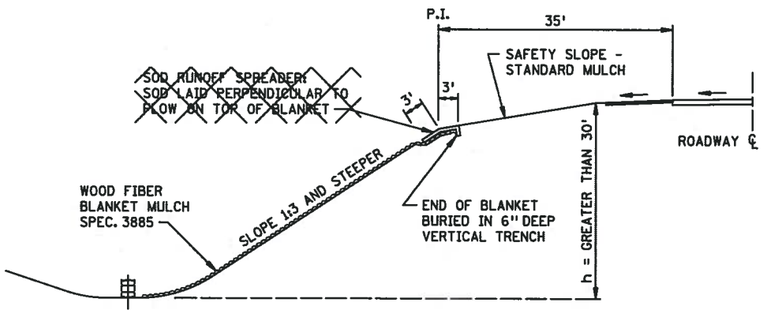
SHINGLING SOD

WHERE THE FLOW OF WATER IS SHEETING, PLACE SOD STRIPS PERPENDICULAR TO THE DIRECTION OF WATER FLOW.

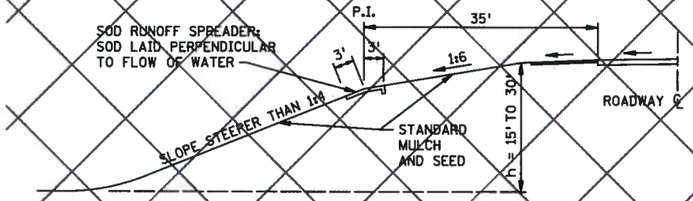
SPECIAL SOD PLACEMENT TECHNIQUES



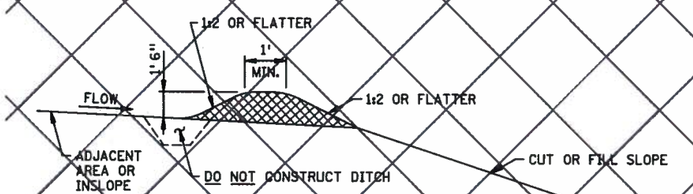
WOOD FIBER BLANKET INSTALLATION ON A CUT SLOPE



WOOD FIBER BLANKET INSTALLATION ON AN INSLOPE
(WHEN REQUIRED)



BROKEN-BACK SAFETY FILL SLOPE



PERMANENT SLOPE PROTECTION DIKE

REVISION:

APPROVED: 8-6-2014

CHIEF ENVIRONMENTAL OFFICER

REVISED:

APPROVED: 8-6-2014

STATE DESIGN ENGINEER

PERMANENT SEDIMENT CONTROL
ALONG ROADWAYS AND AT GORE AREAS & BRIDGE APPROACH FILLS

STANDARD PLAN 5-297.406 | 1 OF 1

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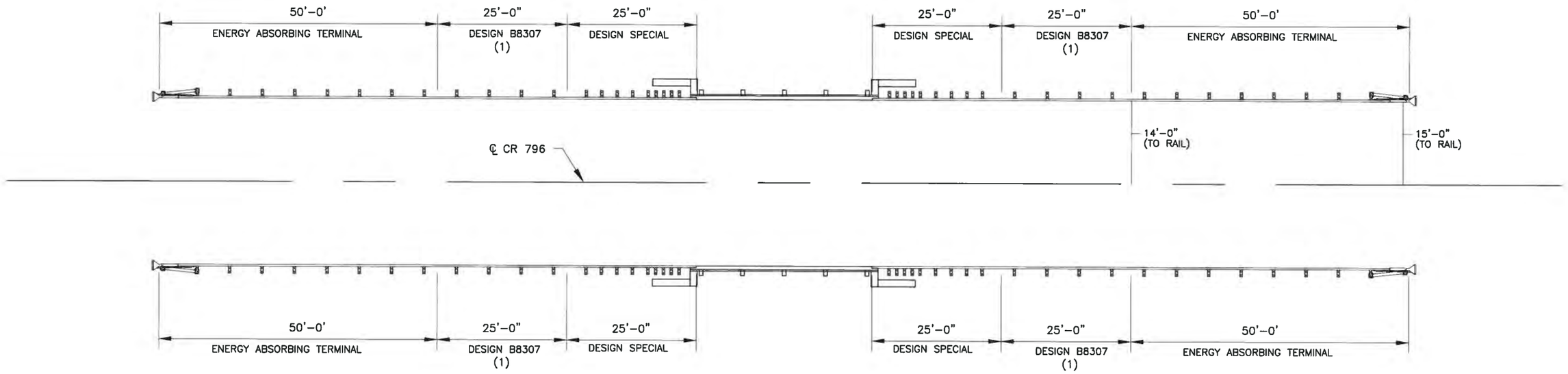
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43973 — REG. NO.
SIGNATURE
8/31/16 — DATE

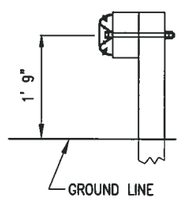
CR 796 – CO. BR. 516 – ST. BR. 69A58 | EROSION CONTROL BLANKET

CP 0796-271375 | Sheet 12 of 18 Sheets

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STATE BRIDGE NO. 69A58
COUNTY BRIDGE NO. 516





TYPICAL PROFILE VIEW

	ITEM NO.	ITEM	UNIT	QUANTITY
(2)	2554	TRAFFIC BARRIER DESIGN SPECIAL B8307	LIN FT	100
(1)(2)	2554	TRAFFIC BARRIER DESIGN B8307	LIN FT	100
(2)	2554	END TREATMENT– ENERGY ABSORBING TERMINAL	EACH	4

NOTES:

(1) TRAFFIC BARRIER DESIGN B8307 PAY LENGTH SHALL INCLUDE THE MATERIALS AND INSTALLATION OF THE PAY LENGTH STEEL PLATE BEAM GUARDRAIL, WOOD POSTS, PLATES, BOLTS, NUTS, WASHERS, RUBRAIL, SPLICES AND ALL SUCH MATERIALS AS REQUIRED IN THE PLAN AND STANDARD PLATES TO PROVIDE FOR A COMPLETE INSTALLATION.

(2) BACK FILLING SHALL BE ACCOMPLISHED IN ACCORDANCE WITH MN/DOT SPECIFICATION 2451.3D.

NOT TO SCALE

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43973 — REG NO.
SIGNATURE
8/31/16 — DATE

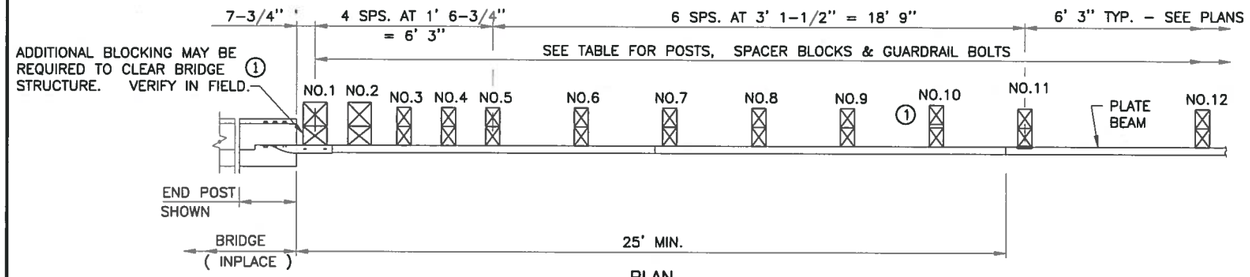
CR 796 – CO. BR. 516 – ST. BR. 69A58

GUARDRAIL LAYOUT (1 OF 3)

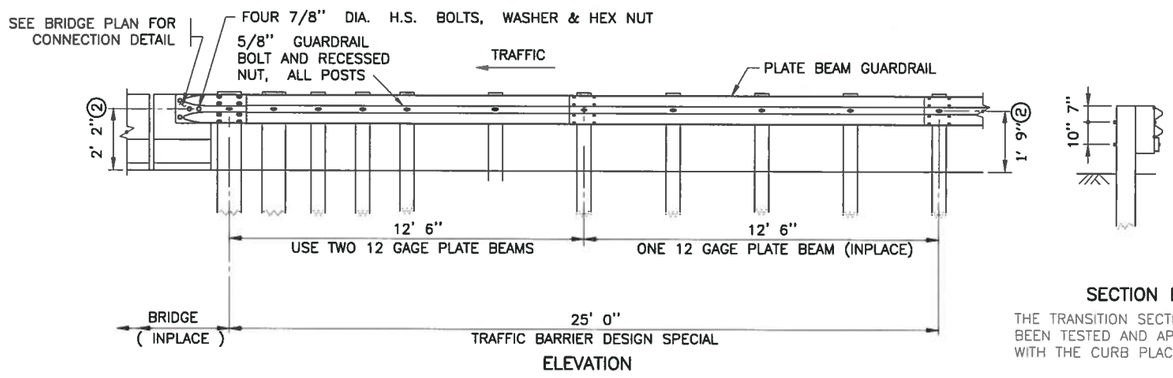
CP 0796–271375

Sheet 13 of 18 Sheets

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PLAN

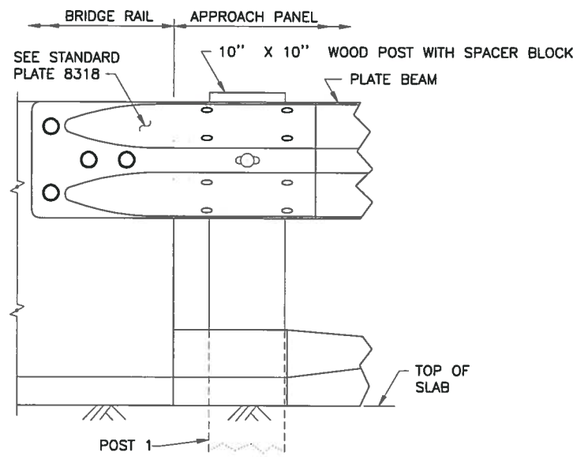


ELEVATION

SECTION B–B

THE TRANSITION SECTION HAS BEEN TESTED AND APPROVED WITH THE CURB PLACED AS SHOWN.

GENERAL ASSEMBLY DETAILS



TRAFFIC SIDE ELEVATION

RAIL ATTACHMENT DETAIL

NOTES:

STRUCTURAL STEEL TO BE 3306, EXCEPT AS NOTED.

ALL SLOTTED HOLES ARE 11/16" X 2".

ALL SQUARE HOLES ARE 11/16".

GALVANIZE STRUCTURAL SHAPES PER SPEC. 3394 AFTER FABRICATION, EXCEPT AS NOTED.

MATERIALS AND CONSTRUCTION PER SPEC. 2554, EXCEPT AS NOTED.

GALVANIZE ALL HARDWARE PER SPEC. 3392.

POST, SPACER BLOCK & BOLT TABLE

DESCRIPTION	POST NO.	SIZE
POST	1 & 2	10" X 10" X 8' 0" MIN. LONG
	3 – 5	6" X 8" X 7' 0" MIN. LONG
	6 – 12	6" X 8" X 6' 0" MIN. LONG
SPACER BLOCK	1 – 2	10" X 8" X 21"
	3 – 9	6" X 8" X 21"
	10 – 12	6" X 8" X 14"
GUARDRAIL BOLT & RECESSED NUT	1 – 2	5/8" DIA. X 20"–GUARDRAIL
	3 – 12	5/8" DIA. X 18"–GUARDRAIL
	1 – 2	5/8" DIA. X 22"–RUB RAIL
	3 – 9	5/8" DIA. X 20"–RUB RAIL

① ADDITIONAL BLOCKING MAY BE REQUIRED AT POST NO. 1 OR 10.

② HEIGHT IS 2' 2" FROM 0' TO 12' 6" FROM BRIDGE. HEIGHT TAPERS FROM 2' 2" TO 1' 9" BETWEEN 12' 6" TO 25' 0" FROM BRIDGE.

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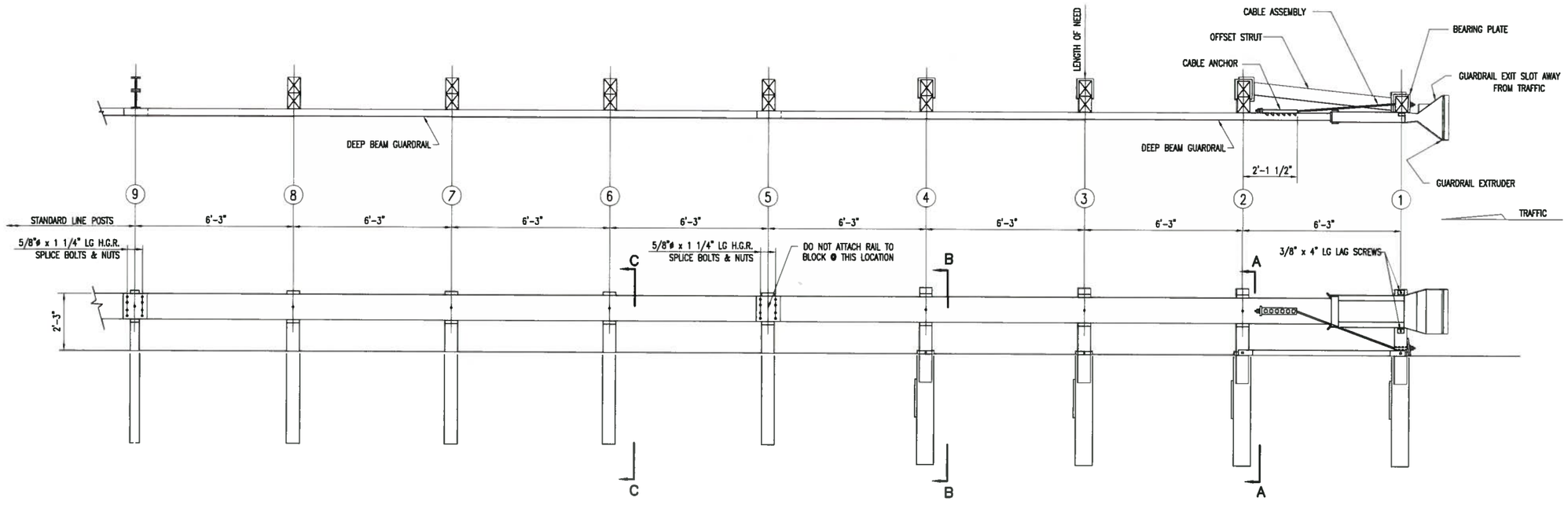
CR 796 – CO. BR. 516 – ST. BR. 69A58

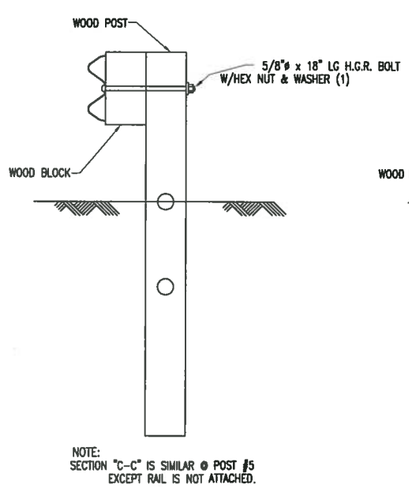
GUARDRAIL (2 OF 3)

CP 0796–271375

Sheet 14 of 18 Sheets

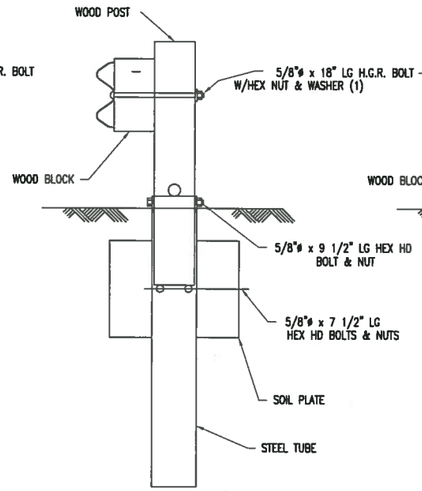
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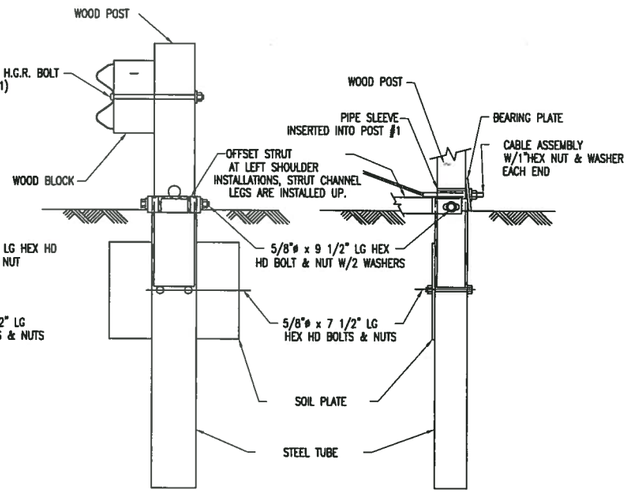


NOTE:
SECTION "C-C" IS SIMILAR @ POST #5 EXCEPT RAIL IS NOT ATTACHED.

SECTION "C-C"
(TYP @ POSTS #6, 7 & 8)



SECTION "B-B"
(TYP @ POSTS #3 & 4)



SECTION "A-A"
(@ POST #2)

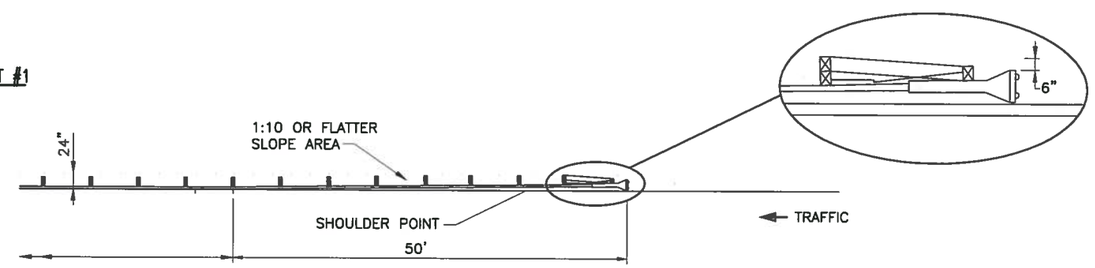
PARTIAL VIEW @ POST #1

QUANTITIES FOR TREATMENT (2)	
QTY	DESCRIPTION
1	12/25/6'3/S (GUARDRAIL)
1	12/25/6'3/S ANC (GUARDRAIL)
1	CABLE ANCHOR BRACKET
1	2" x 5 1/2" PIPE
4	4'6 TUBE SLEEVE
4	1/4" x 18" x 24" SOIL PLATE
1	5/8" x 8" x 8" BEARING PLATE
1	ET-2000 EXTRUDER
1	CABLE 3/4 x 6'6
11	5/8" WASHER
35	5/8" HEX NUT
16	5/8"ø x 1 1/4" SPLICE BOLT
8	5/8"ø x 7 1/2" HEX HD BOLT
4	5/8"ø x 9 1/2" HEX HD BOLT
7	5/8"ø x 18" POST BOLT
2	1" WASHER
2	1" HEX NUT
4	WD 6'0 POST 6 x 8
4	WD 3'9 POST 5 1/2 x 7 1/2
7	WD BLOCK 1'2 x 5 1/2 x 7 1/2
2	3/8"ø x 4" LAG SCREW
1	6'3 STRUT
1	18" x 18" REFLECTOR (AMBER & BLACK)

NOTES:

(1) THE 5/8" FLAT WASHER IS USED UNDER THE NUT, BEHIND THE POST ONLY. NO WASHER IS USED AT THE RAIL.

(2) QUANTITIES LISTED ARE FOR INFORMATIONAL PURPOSES. ANY ADDITIONAL MINOR ITEMS AND SLIGHT CHANGES IN QUANTITIES REQUIRED SHALL BE FURNISHED BY THE CONTRACTOR WITH NO ADDITIONAL COMPENSATION. SOME ITEMS LISTED ARE FROM "A GUIDE TO STANDARDIZED HIGHWAY BARRIER RAIL HARDWARE" AS APROVED BY AASHTO.



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CR 796 – CO. BR. 516 – ST. BR. 69A58

GUARDRAIL (3 OF 3)

CP 0796-271375

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ROAD CLOSURE SIGNING

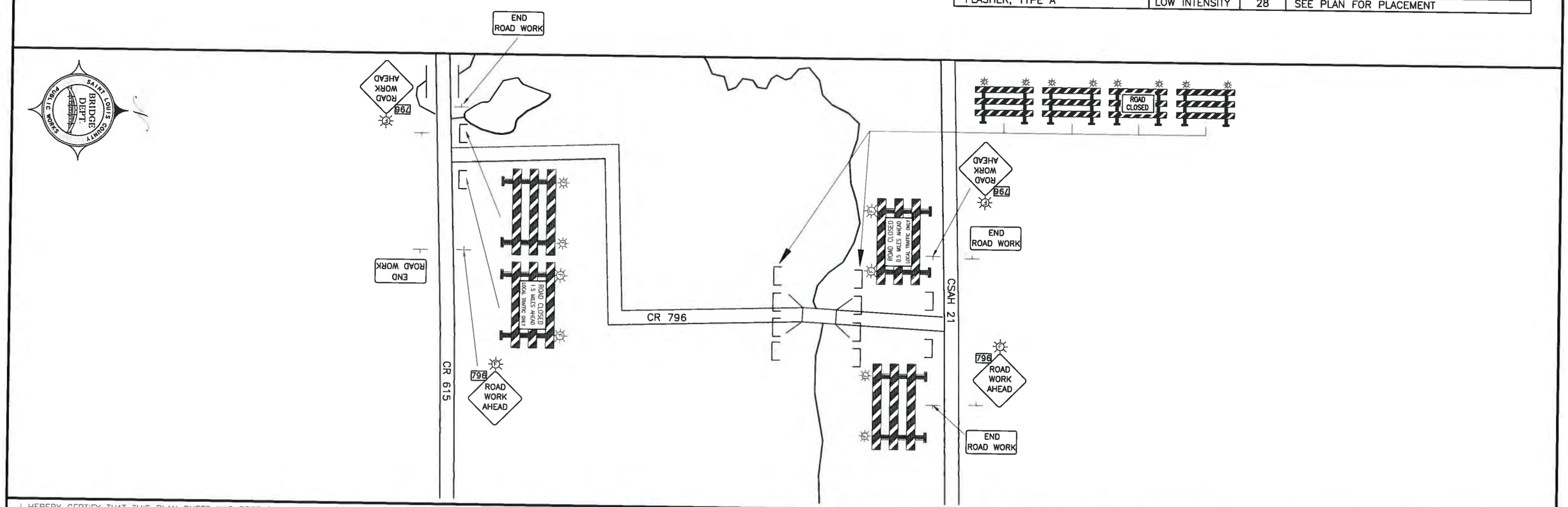
POSTED SPEED LIMIT PRIOR TO STARTING (mph)	SPACING OF ADVANCE WARNING SIGNS (feet) (A)
0 – 30	250
35 – 40	325
45 – 50	600
55	750

LEGEND:

- FLASHER
- SIGN
- BARRICADE
- WORK ZONE

1. ROAD CLOSURE SIGNING SHALL BE ERECTED PRIOR TO CONSTRUCTION OPERATIONS, AND SHALL REMAIN INPLACE FOR THE DURATION OF THE PROJECT. ALL SIGNING MUST BE REMOVED IMMEDIATELY AFTER THE PROJECT IS OPEN TO TRAFFIC.

TRAFFIC CONTROL DEVICES (2)			
ITEM	DESIGN	NO.	REMARKS
STOP SIGN	R1–1		IN PLACE–MAINTAIN ONLY
ROAD CLOSED	R11–2	x	48" x 30" MOUNTED ON BARRICADE
ROAD CLOSED 0.5 MILES AHEAD	R11–3a	1	60" x 30" MOUNTED ON BARRICADE
ROAD CLOSED 1.5 MILES AHEAD	R11–3a	1	60" x 30" MOUNTED ON BARRICADE
ROAD WORK AHEAD	W20–1	4	48" X 48" DOUBLE POST MOUNTED WITH FLASHER
DETOUR AHEAD	W20–2	x	48" x 48" DOUBLE POST MOUNTED WITH FLASHER
ROAD CLOSED AHEAD	W20–3	x	48" x 48" DOUBLE POST MOUNTED WITH FLASHER
500 FEET	W20–100p	x	42" x 18" DOUBLE POST MOUNTED
ROUTE MARKER (CR 796)	M1–X4	4	18" x 18" POST MOUNTED
DETOUR	M4–8	x	24" X 12" SINGLE POST MOUNTED
END DETOUR	M4–8a	x	24" X 18" DOUBLE POST MOUNTED
DETOUR (RIGHT)	M4–10R	x	48" X 18" MOUNTED ON BARRICADE
DETOUR (LEFT)	M4–10L	x	48" X 18" MOUNTED ON BARRICADE
ADVANCE RIGHT TURN ARROW	M5–1R	x	21" X 15" POST MOUNTED
ADVANCE LEFT TURN ARROW	M5–1L	x	21" X 15" POST MOUNTED
TURN ARROW	M6–1	x	21" X 15" POST MOUNTED
THRU ARROW	M6–3	x	21" X 15" POST MOUNTED
END ROAD WORK	G20–2a	4	48" X 24" DOUBLE POST MOUNTED
ROAD CLOSED BEGINNING XXX	G20–X1	x	72" X 60" DOUBLE POST MOUNTED
PLASTIC BARRELS			PLACE AS REQUIRED
BARRICADES	TYPE III	12	BREAKAWAY WITH FLASHERS, DOUBLE SIDED
FLASHER, TYPE A	LOW INTENSITY	28	SEE PLAN FOR PLACEMENT



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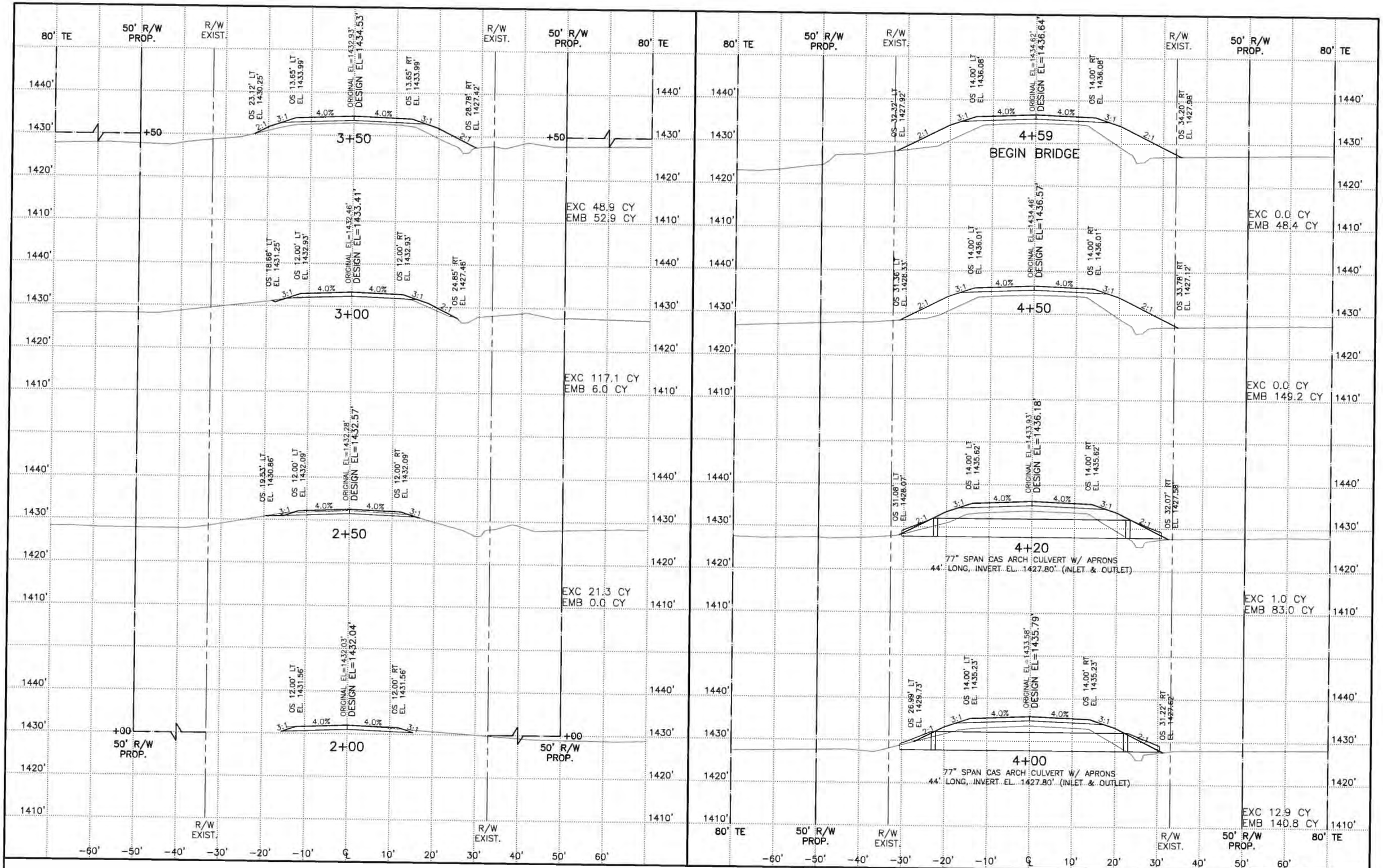
CR 796 – CO. BR. 516 – ST. BR. 69A58

TRAFFIC CONTROL

CP 0796–271375

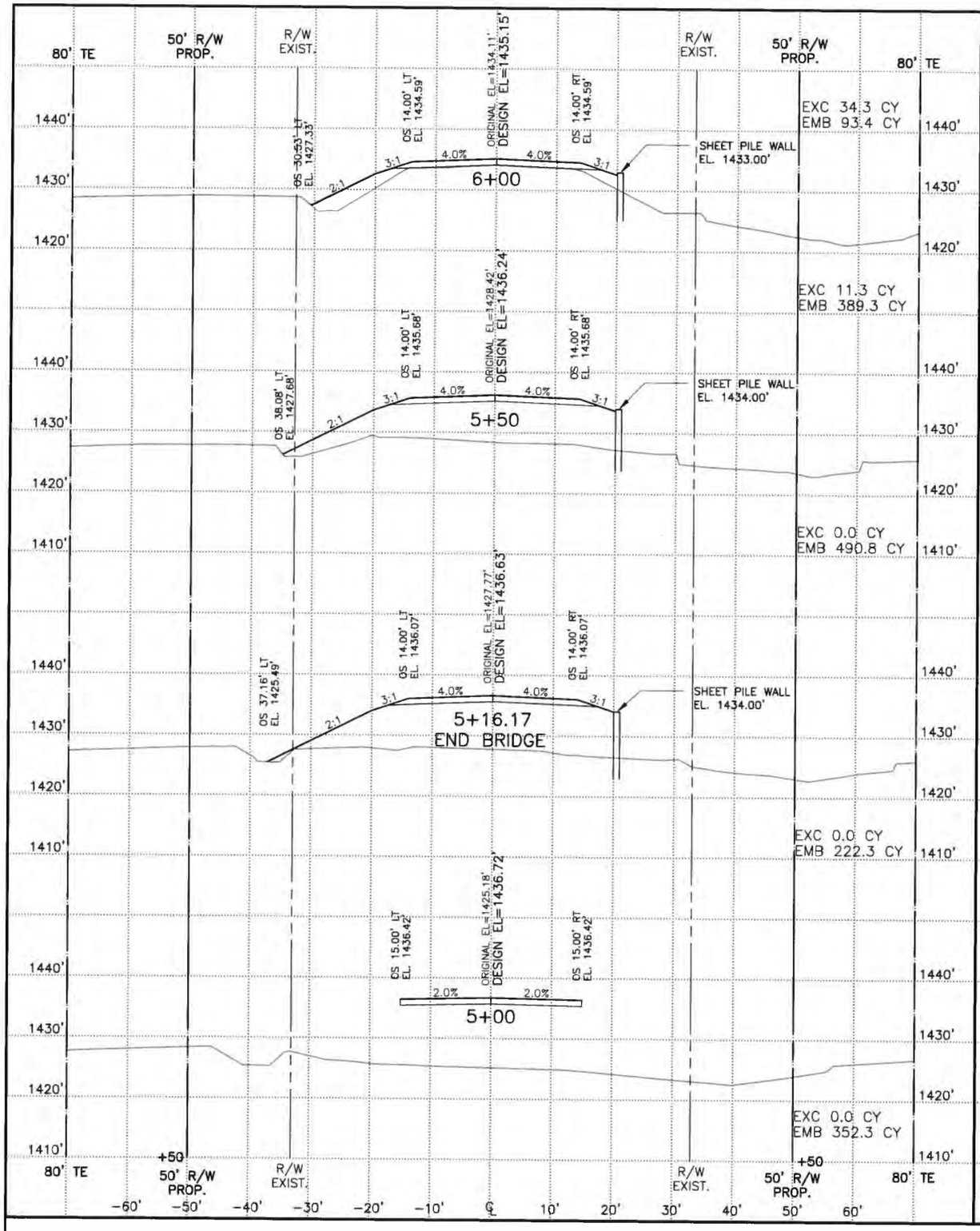
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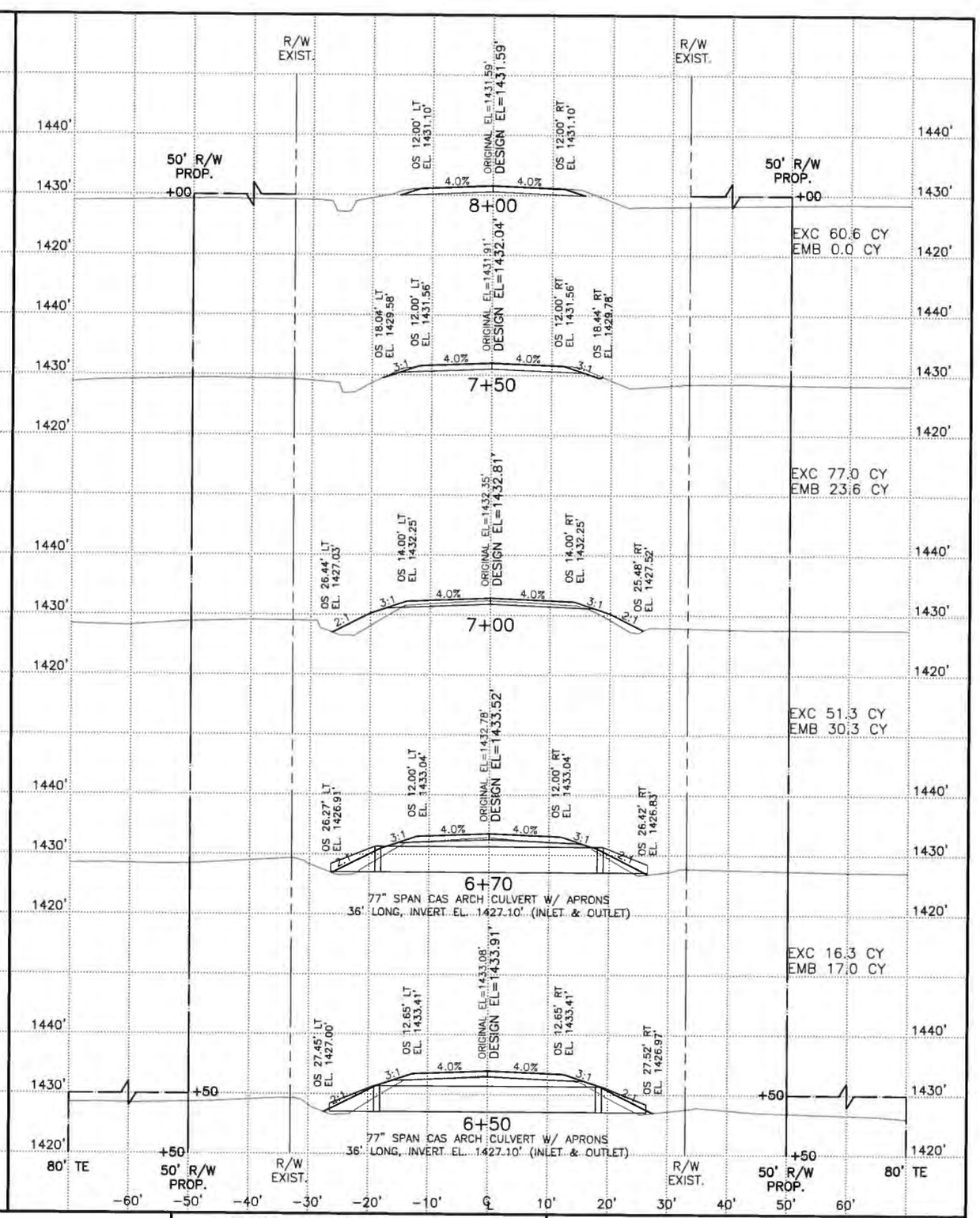
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CR 796 – CO. BR. 516 – ST. BR. 69A58	CROSS SECTIONS
CP 0796-271375	Sheet 17 of 18 Sheets

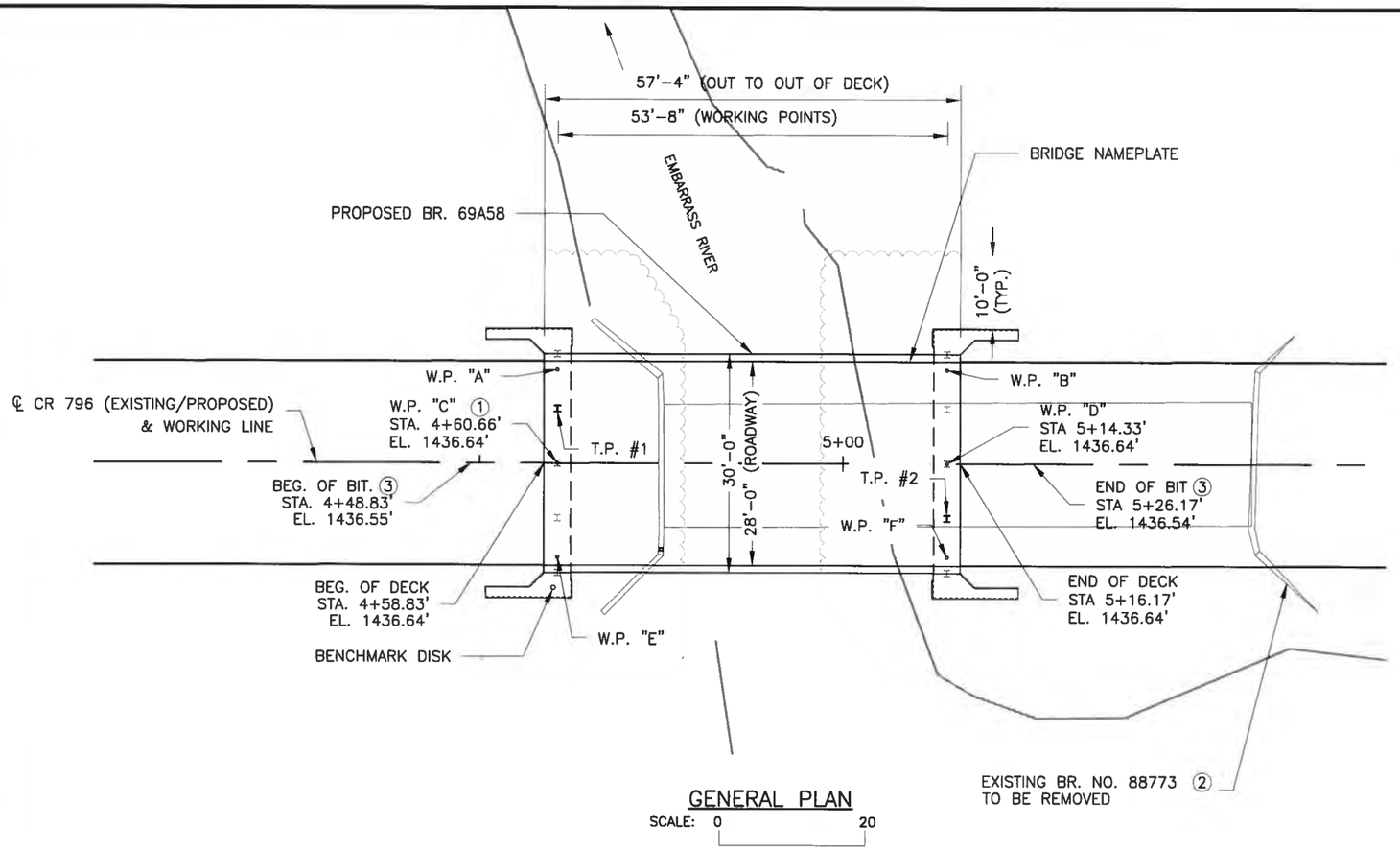
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CR 796 – CO. BR. 516 – ST. BR. 69A58 | CROSS SECTIONS

CP 0796-271375 | Sheet 18 of 18 Sheets



GENERAL PLAN

SCALE: 0 20

KEY NOTES:

1. CONTROL POINT
   ℄ CR 796 STA 4+60.66
   SOUTH WORKING LINE @ W.P. "C"
   X = 4844094.83
   Y = 3669537.75
2. CONSISTS OF 83.5' STEEL LOW TRUSS BRIDGE. THE 'REMOVE EXISTING BRIDGE' PAY ITEM WILL CONSIST OF REMOVING THE SUBSTRUCTURE/SUPERSTRUCTURE OF BRIDGE 88773 TO THE EXTENT NECESSARY TO CONSTRUCT BRIDGE 69A58.
3. REFER TO GRADING PLANS FOR APPROACH GRADING DETAILS.
4. CONTRACTOR SHALL EXCAVATE TO THESE LINES FOR 28'-0" EACH SIDE OF ℄ THEN TAPER TO NATURAL SLOPES AT 1:3 SLOPE. INCLUDED FOR PAYMENT UNDER ITEM "SLOPE PREPARATION".

CONSTRUCTION NOTES:

– THE 2016 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" AND THE 2016 EDITION OF THE "MATERIALS LAB SUPPLEMENTAL SPECIFICATIONS FOR CONSTRUCTION" SHALL GOVERN.

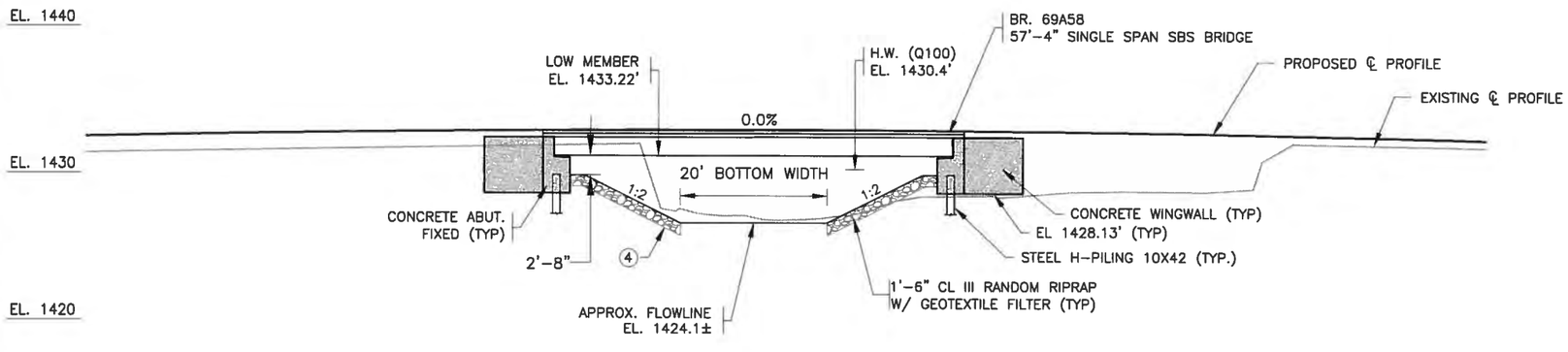
– THE BARS SIZES IN THIS PLAN ARE IN THE U.S. CUSTOMARY DESIGNATIONS.

– BARS MARKED WITH THE SUFFIX 'E' SHALL BE EPOXY COATED IN ACCORDANCE WITH SPEC. 3301

– BRIDGE APPROACH EMBANKMENTS AND TREATMENTS ARE TO BE CONSTRUCTED UNDER THE GRADING CONTRACT.

– THE PILE LOADS SHOWN IN THE PLANS AND THE CORRESPONDING NOMINAL PILE BEARING RESISTANCE (Rn) WERE COMPUTED USING LRFD METHODOLOGY. PILE BEARING RESISTANCE DETERMINED IN THE FIELD SHALL INCORPORATE THE METHODS AND/OR FORMULAS DESCRIBED IN THE SPECIAL PROVISIONS.

– THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS QUALITY LEVEL WAS DETERMINED ACCORDING TO THE GUIDELINES OF CI/ASCE 38–02 ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA."



GENERAL ELEVATION

SCALE: 0 20

COUNTY PROJ. NO. 0796–271375

DESIGN DATA AND PROJECTED TRAFFIC VOLUMES

DESIGNED IN ACCORDANCE WITH 2014 AND CURRENT INTERIM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
HL 93 LIVE LOAD

MATERIAL DESIGN PROPERTIES:
REINFORCED CONCRETE:
fc = 4 ksi CONCRETE
fy = 60 ksi PLAIN AND EPOXY COATED BARS
n = 8 FOR REINFORCEMENT
STRUCTURAL STEEL:
Fy = 50 ksi STRUCTURAL STEEL SPEC 3309 (GALVANIZED)
WOOD:
Fbo = 2.40 ksi GLUED LAMINATED TIMBER RAILS
Fbo = 1.75 ksi RAIL POSTS
Fbo = 1.20 ksi ALL OTHER TIMBER
PROJECTED A.D.T. 6 (2036)
CURRENT A.D.T. 5 (2016)
DESIGN SPEED = 40 MPH
HL 93 LRFR
BRIDGE OPERATING RATING FACTOR = 1.57
APPROXIMATE DECK AREA = 1720 S.F.

B.M. ELEV. 1430.46' (N.A.V.D. 88)

DESC: BM "A" IN 6" SPRUCE TREE
56' LT OF STA. 8+87

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNED _____
BY MATTHEW W. HEMMILA
DATE _____ LICENSE NO. 43973

BRIDGE NO. 69A58

LOCATED 0.4 MILES SOUTH OF JCT. OF CSAH 21 ON CR 796 OVER THE EMBARRASS RIVER.

57'-4" SINGLE SPAN SBS BRIDGE
IDENTIFICATION NO. 301 0° SKEW

GENERAL PLAN AND ELEVATION

SEC. 14 T 60 N R 14 W
WAASA TOWNSHIP ST. LOUIS COUNTY

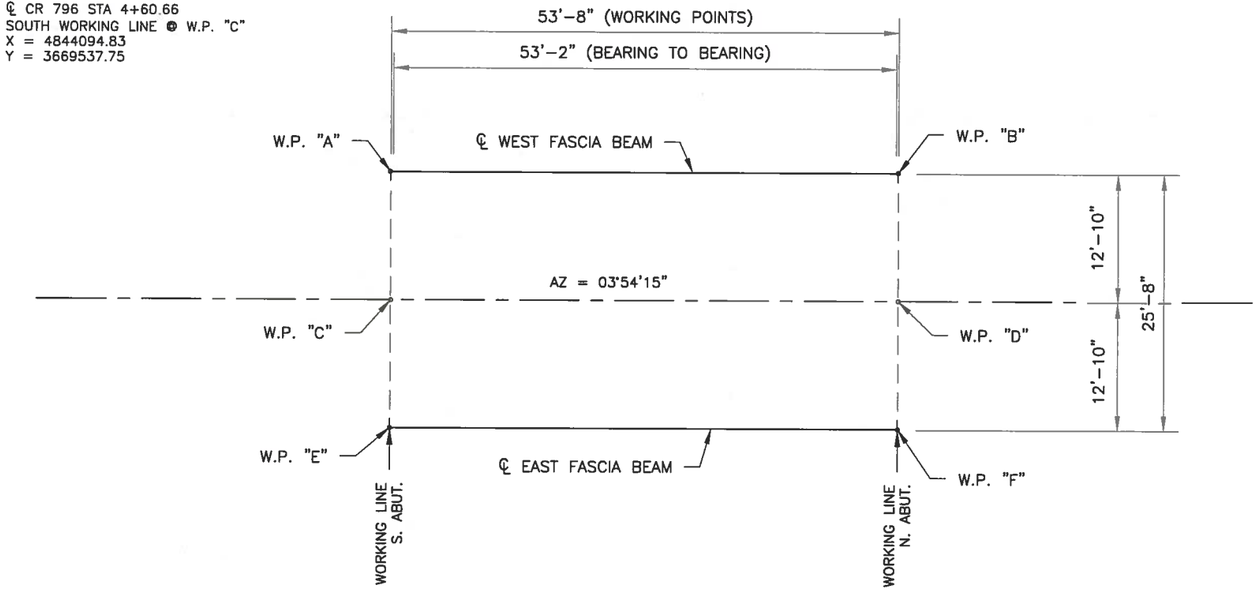
DES: MWH	DR: NSB	69A58
CHK: JWS	CHK: LJR	

ST. LOUIS COUNTY BRIDGE NO. 516

COUNTY PROJ. NO. 0796–271375 SHEET B1 OF B15 SHEETS

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(1) CONTROL POINT
℄ CR 796 STA 4+60.66
SOUTH WORKING LINE @ W.P. "C"
X = 4844094.83
Y = 3669537.75



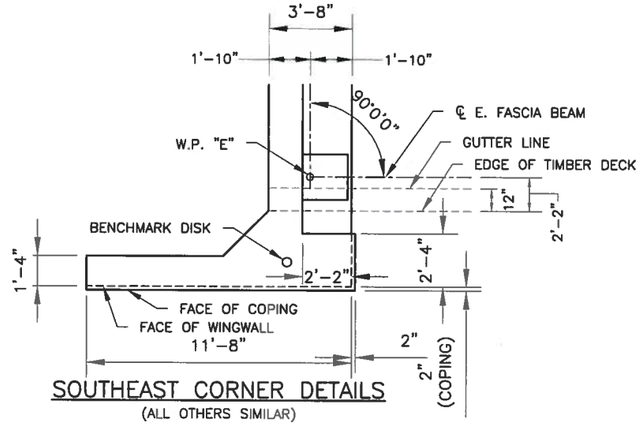
WORKING POINT LAYOUT

STATEMENT OF ESTIMATED QUANTITIES

NOTE	ITEM NO.	ITEM	UNIT	QUANTITY	
				Bonding Ineligible	Bonding Eligible
	2021.501	MOBILIZATION	LUMP SUM	0.7	
	2331.604	ASPHALT OVERLAY TEXTILE (PAVING FABRIC) HEAVY DUTY	SQ YD	206	
	2360.501	TYPE SP 12.5 WEARING COURSE MIX (3,C)	TON	46	
	2401.501	STRUCTURAL CONCRETE (3B52) (P)	CU YD	78	
	2401.541	REINFORCEMENT BARS (EPOXY COATED) (P)	POUND	8,038	
	2402.521	STRUCTURAL STEEL (3309) (P)	POUND	52,051	
	2402.590	ELASTOMERIC BEARING PAD	EACH	16	
	2403.506	HARDWARE (P)	POUND	202	
	2452.520	STEEL H-TEST PILE 80 FT LONG 10"	EACH	2	
	2452.530	PILE TIP PROTECTION 10"	EACH	10	
	2452.603	STEEL H-PILING 10"	LIN FT	600	
	2502.502	DRAINAGE SYSTEM TYPE (B910)	LUMP SUM	1	
	2511.501	RANDOM RIPRAP CLASS III	CU YD	140	
	2511.515	GEOTEXTILE FILTER TYPE VII	SQ YD	280	
	2563.601	TRAFFIC CONTROL	LUMP SUM	0.7	

TOP OF ROADWAY TO BRIDGE SEAT AT ROAD CENTERLINE

	BITUMINOUS DEPTH	DECK THICKNESS	BEAM HEIGHT	STEEL BEARING HEIGHT	ELASTOMERIC BEARING HEIGHT	TOTAL	
						INCHES	FEET
SOUTH ABUTMENT	0.417'	0.427'	2.483'	0.062'	0.042'	41.17"	3.431'
NORTH ABUTMENT	0.417'	0.427'	2.483'	0.062'	0.042'	41.17"	3.431'



SOUTHEAST CORNER DETAILS
(ALL OTHERS SIMILAR)

DIMENSIONS BETWEEN WORKING POINTS

POINT	STATION	X–COORD	Y–COORD	A	B	C	D	E	F
A	4+60.66	4844082.02	3669538.62		53.67		55.18		59.49
B	5+14.33	4844085.68	3669592.17			55.18		59.49	
C	4+60.66	4844094.83	3669537.75				53.67		55.18
D	5+14.33	4844098.48	3669591.30					55.18	
E	4+60.66	4844107.63	3669536.88						53.67
F	5+14.33	4844111.29	3669590.42						

ELEVATIONS

TOP OF RDWY	TOP OF RDWY TO BR. SEAT	BRIDGE SEAT	POINT
1436.36'	3.23'	1433.13'	A
1436.36'	3.23'	1433.13'	B
1436.64'	3.51'	1433.13'	C
1436.64'	3.51'	1433.13'	D
1436.36'	3.23'	1433.13'	E
1436.36'	3.23'	1433.13'	F

LIST OF SHEETS

NO.	DESCRIPTION
B1	GENERAL PLAN AND ELEVATION
B2	BRIDGE LAYOUT & STATEMENT OF ESTIMATED QUANTITIES
B3	TRANSVERSE SECTION & MATERIAL SUMMARY
B4–B7	ABUTMENT & WINGWALL DETAILS
B8	FRAMING PLAN
B9	BEAM & BEARING PLATE DETAILS
B10	RIPRAP SLOPE WITH GEOTEXTILE FILTER
B11	ELASTOMERIC BEARING PAD & DRAINAGE SYSTEM
B12	BRIDGE NAMEPLATE & PILE SPLICE
B13	BOLTED DIAPHRAGMS & STIFFENER DETAILS
B14	TIMBER RAIL & GUARDRAIL CONNECTION DETAIL
B15	BRIDGE SURVEY

CP 0796–271375

SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.
NAME: MATTHEW W. HEMMILA REG #: 43973 DATE 8/31/16

TITLE: BRIDGE LAYOUT & STATEMENT OF ESTIMATED QUANTITIES

DES: MWH | DR: NSB | APPROVED:
CHK: JWS | CHK: LJR

Sheet B2 of B15 Sheets

CO. BR. 516
ST. BR. NO. 69A58

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STRUCTURAL STEEL (3309)

DESCRIPTION	QUANTITY	LB/EA	POUNDS
W30x108 STEEL BEAM	433.33 FT	108 LB/FT	46,800
24"x12"x ¾" STEEL BEARING PLATE	16	61.20	980
3'-5 ½"x2'-5 ½"x 5/16" STEEL DIAPHRAGM	25	108.5	2,713
19 ¾"x7"x ⅜" STIFFENER	74	21.05	1,558
ALL STRUCTURAL STEEL IS TO BE GALVANIZED.		TOTAL	52,051

REINFORCING STEEL (EPOXY COATED)

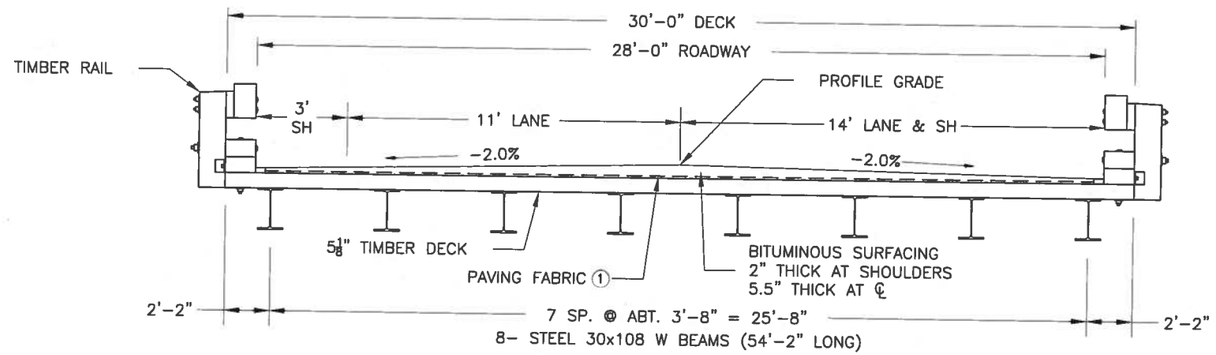
LOCATION	POUNDS
SOUTH ABUTMENT	4,019
NORTH ABUTMENT	4,019
TOTAL	8,038

HARDWARE

DESCRIPTION	QUANTITY	LB/EA	POUNDS
1" ø X 15" ANCHOR ROD	32	5.60	180
1" NUTS	32	0.42	15
1" CUT WASHERS	32	0.19	7
ALL HARDWARE IS TO BE GALVANIZED.		TOTAL	202

STRUCTURAL CONCRETE 3B52

LOCATION	CU YD
SOUTH ABUTMENT	39
NORTH ABUTMENT	39
TOTAL	78



TRANSVERSE SECTION

SCALE: 0 5'

(1) A SKIM COAT OF BITUMINOUS IS TO BE PLACED ON THE TIMBER DECK PRIOR TO PLACEMENT OF THE PAVING FABRIC IN ORDER TO CREATE AN EVEN SURFACE AS DETERMINED BY THE ENGINEER.

CP 0796-271375

SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME: MATTHEW W. HEMMILA REG #: 43973 DATE 8/31/16

TITLE: TRANSVERSE SECTION & MATERIAL SUMMARY

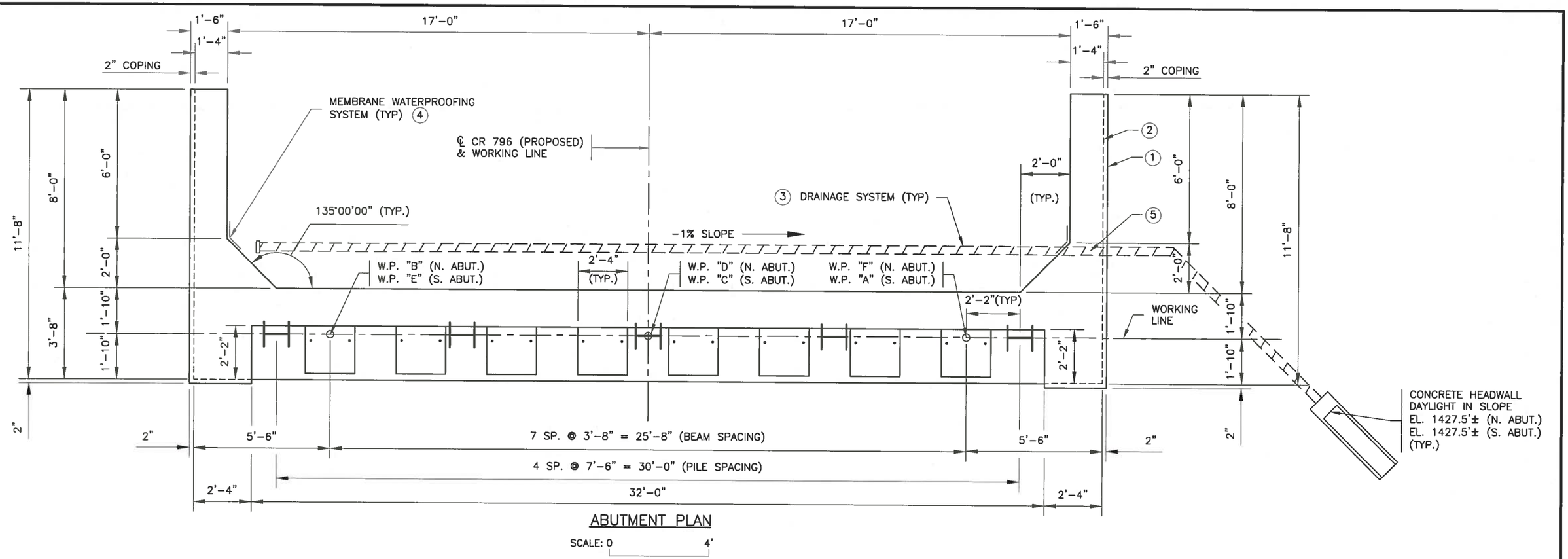
DES: MWH | DR: NSB | APPROVED:

CHK: JWS | CHK: LJR

Sheet B3 of B15 Sheets

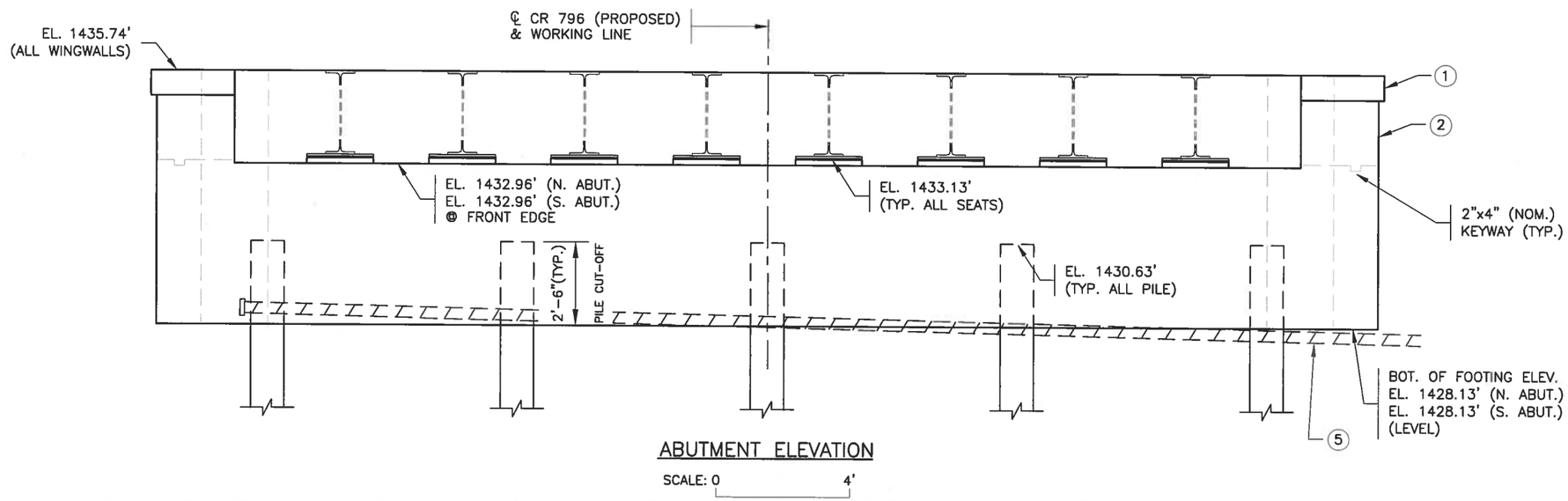
CO. BR. 516
ST. BR. NO. 69A58

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ABUTMENT PLAN

SCALE: 0 4'



ABUTMENT ELEVATION

SCALE: 0 4'

KEY NOTES

1. WINGWALL COPING (TYP).
2. FACE OF WINGWALL (TYP).
3. DRAINAGE SYSTEM TYPE (B910). SOUTH ABUTMENT IS SHOWN. ALL CONCRETE HEADWALLS ARE TO FACE DOWNSTREAM. SEE SHEET B11 FOR DETAILS.
4. TO BE USED AT OPTIONAL JOINT LOCATIONS (INCIDENTAL).
5. DRAINAGE PIPE TO BE PLACED UNDER THE WINGWALL.

CP 0796-271375

SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME: MATTHEW W. HEMMILA REG #: 43973 DATE 8/31/16

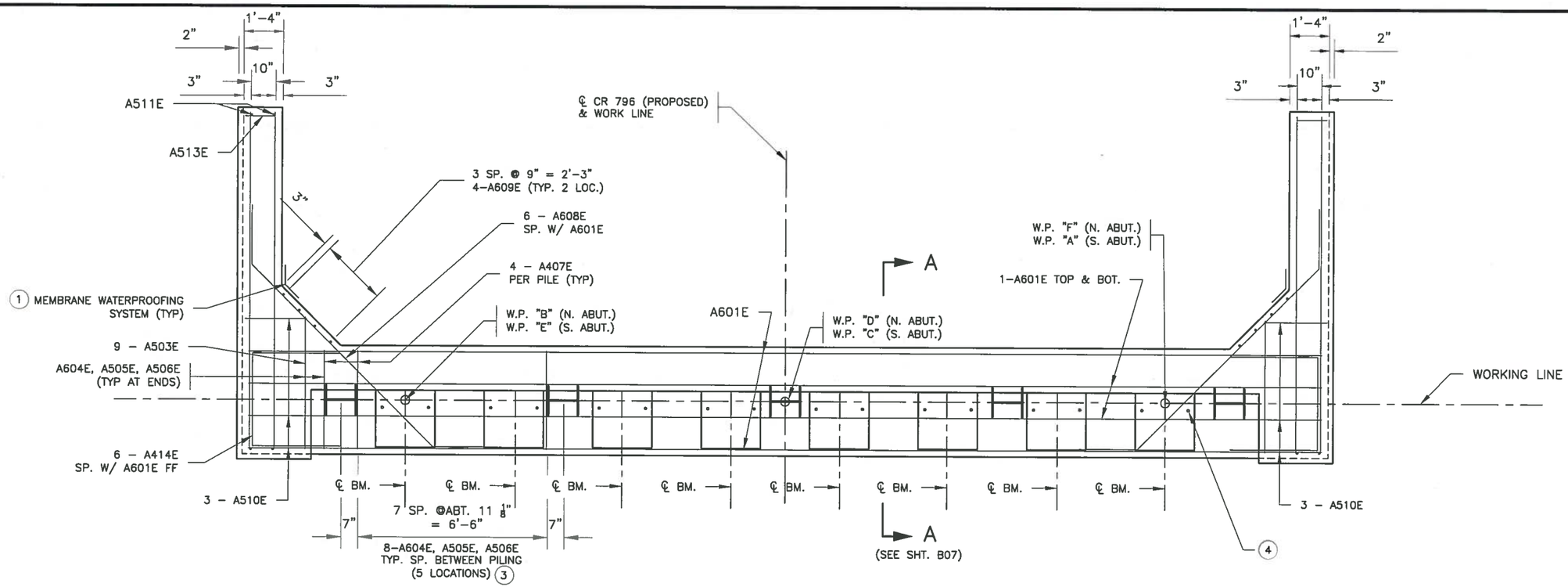
TITLE: ABUTMENT GEOMETRICS (NORTH & SOUTH ABUTMENTS)

DES: MWH	DR: NSB	APPROVED:
CHK: JWS	CHK: LJR	

Sheet B4 of B15 Sheets

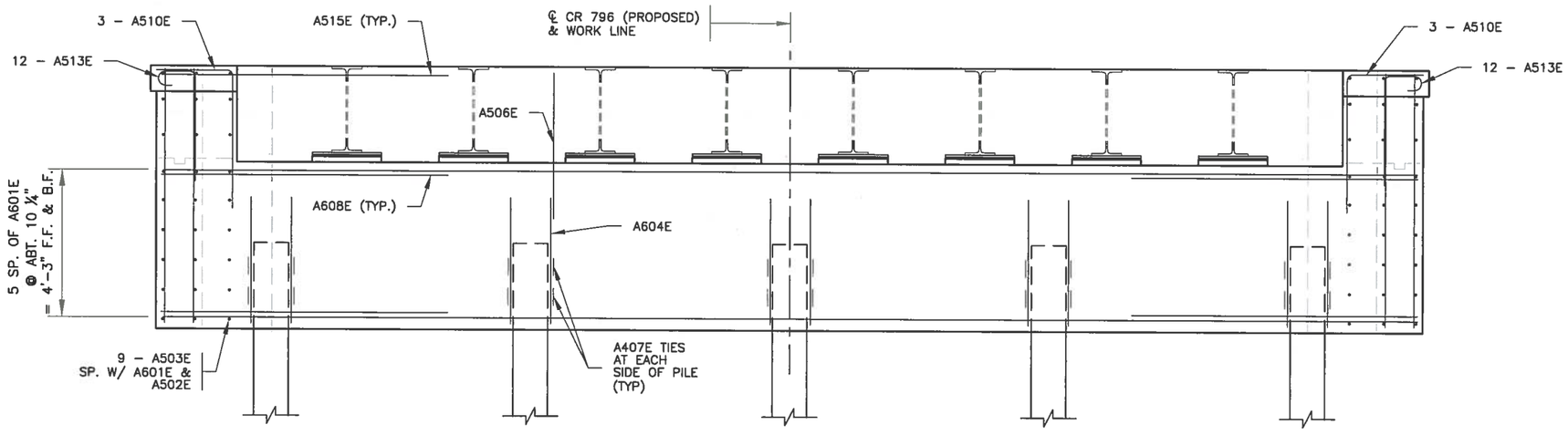
CO. BR. 516
ST. BR. NO. 69A58

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ABUTMENT PLAN

SCALE: 0 4'



ABUTMENT ELEVATION

SCALE: 0 4'

KEY NOTES

1. TO BE USED AT OPTIONAL JOINT LOCATIONS (INCIDENTAL)
2. B.F. = BACK FACE
   F.F. = FRONT FACE
3. ENSURE 2" OF CLEAR SPACE BETWEEN ANCHORS AND REINFORCEMENT BARS.
4. ANCHOR ROD (TYP.)
   SEE SHT. B9 FOR LAYOUT

CP 0796-128462

SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME: MATTHEW W. HEMMILA REG #: 43973 DATE: 8/31/16

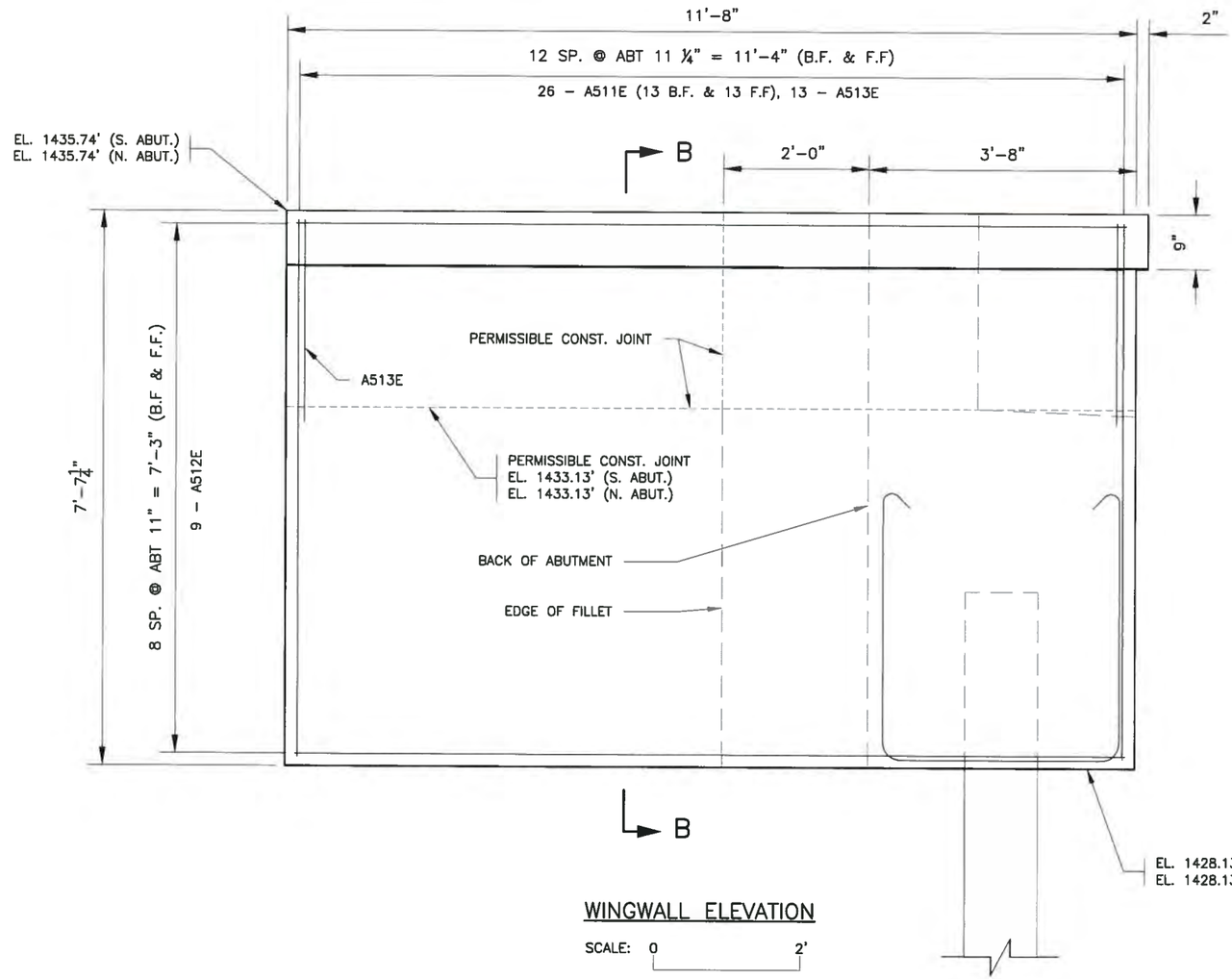
TITLE: ABUTMENT REINFORCEMENT (NORTH AND SOUTH ABUTMENTS)

DES: MWH	DR: NSB	APPROVED:
CHK: JWS	CHK: LJR	

Sheet B5 of B15 Sheets

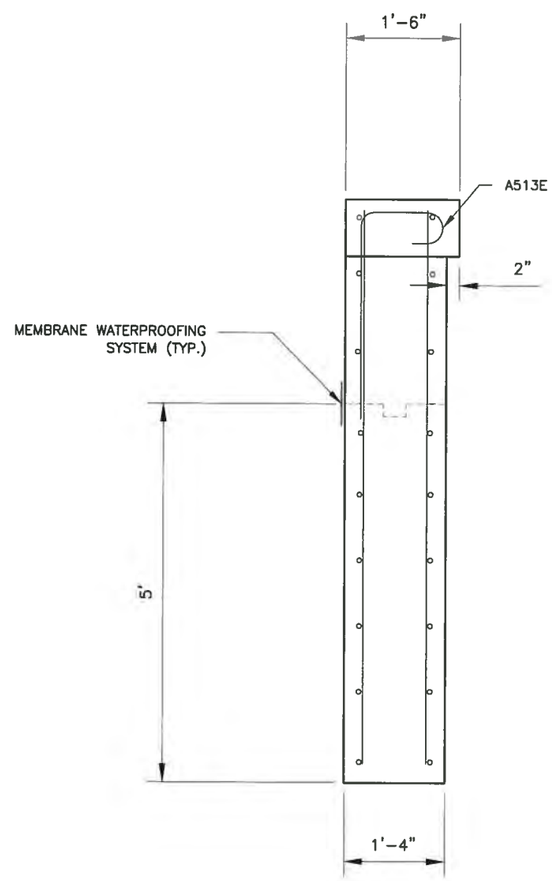
CO. BR. 516
ST. BR. NO. 69A58

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WINGWALL ELEVATION

SCALE: 0 2'



SECTION B-B

SCALE: 0 2'

CP 0796-271375	SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.	I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA. NAME: MATTHEW W. HEMMILA REG #: 43973 DATE 8/31/16	TITLE: WINGWALL REINFORCEMENT (TYPICAL)	DES: MWH DR: NSB APPROVED: CHK: JWS CHK: LJR	Sheet B6 of B15 Sheets	CO. BR. 516 ST. BR. NO. 69A58

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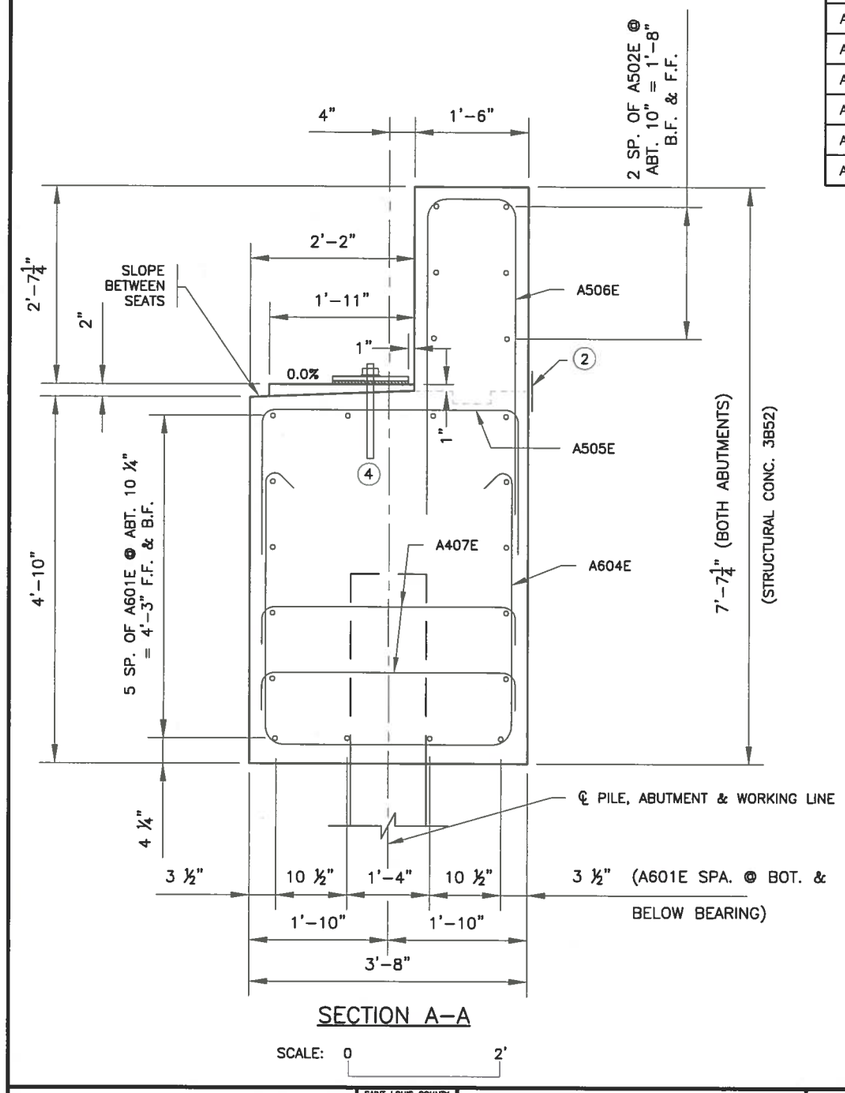
NOTE:

PROVIDE STANDARD HOOKS FOR DIMENSIONS NOT SHOWN.

BENT BAR DIMENSIONS ARE OUT-TO-OUT. ACTUAL BAR LENGTHS SHALL BE DETERMINED BASED ON DETAIL DIMENSIONS SHOWN IN THE BAR BENDING DIAGRAMS. TOTAL BAR LENGTHS SHOWN ARE FOR USE IN COMPUTING REINFORCEMENT BAR WEIGHTS FOR PAYMENT ONLY.

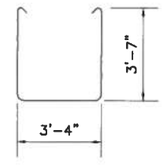
ALL REINFORCEMENT SHALL BE DELIVERED TO SITE IN BUNDLES INDENTIFIED BY SUBSTRUCTURE & BAR MARK.

QUANTITIES FOR EACH BAR MARK ARE THE SUM OF BOTH ABUTMENTS. ONE HALF OF THE QUANTITY OF EACH BAR MARK IS FOR EACH ABUTMENT.

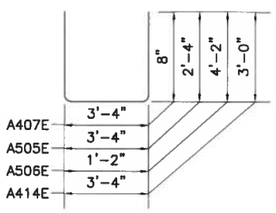


SECTION A-A

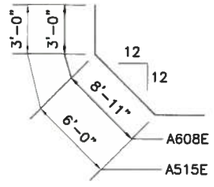
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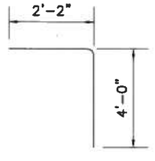
A604E



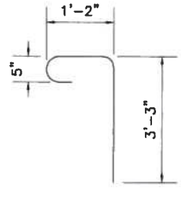
A407E, A505E, A506E, A414E



A608E, A515E



A510E



A513E

BILL OF REINFORCEMENT FOR BOTH ABUTMENTS

BAR MARK	NO. OF BARS	NO. OF SERIES	LENGTH (FT.-IN.)	SHAPE	LOCATION
A601E	32		36'-3"	STR.	ABUTMENT - HORIZONTAL
A502E	12		36'-3"	STR	ABUTMENT - HORIZONTAL
A503E	36		4'-5"	STR	ABUTMENT - HORIZONTAL
A604E	72		11'-6"	BENT	ABUTMENT - STIRRUP
A505E	72		8'-0"	BENT	ABUTMENT - SEAT TIE
A506E	72		9'-6"	BENT	ABUTMENT - PARAPET TIE
A407E	40		4'-8"	BENT	ABUTMENT - PILE TIE
A608E	24		14'-11"	BENT	ABUTMENT CHAMFER - HORIZONTAL
A609E	16		7'-3"	STR	ABUTMENT CHAMFER - VERTICAL
A510E	12		6'-2"	BENT	ABUTMENT - WING TIE
A511E	104		7'-3"	STR	WINGWALLS - VERTICAL
A512E	72		10'-4"	STR	WINGWALLS - HORIZONTAL
A513E	52		4'-11"	BENT	WINGWALL - TOP TIE
A414E	24		9'-4"	BENT	ABUTMENT - TIE
A515E	12		12'-0"	BENT	ABUTMENT CHEMFER - TOP HORIZONTAL

SUMMARY OF QUANTITIES FOR BOTH ABUTMENTS

	UNIT	S. ABUT.	N. ABUT.	TOTAL
STRUCTURAL CONCRETE (3B52)	CU YD	39	39	78
REINFORCEMENT BARS (EPOXY COATED)	POUND	4019	4019	8038
STEEL H-PILING 10" (1)	LIN FT	300	300	600
STEEL H-TEST PILE 80 FT LONG 10"	EACH	1	1	2
STRUCTURE EXCAVATION	LUMP SUM	0.50	0.50	1
PILE TIP PROTECTION 10"	EACH	5	5	10
DRAINAGE SYSTEM TYPE (B910)	LUMP SUM	0.5	0.5	1

KEY NOTES:

(1) DOES NOT INCLUDE TEST PILE

(2) MEMBRANE WATERPROOFING SYSTEM TO BE USED AT OPTIONAL JOINT LOCATIONS PER Mn/DOT SPEC. 2481.3B (INCIDENTAL)

(3) SEE BEARING PLATE DETAIL ON SHEET B9.

(4) PROVIDE 2 INCHES MINIMUM CLEAR DISTANCE BETWEEN ANCHOR RODS AND LONGITUDINAL REINFORCEMENT BARS.

NORTH & SOUTH ABUTMENTS
COMPUTED PILE LOAD - TONS/PILE

FACTORED DEAD LOAD + EARTH PRESSURE	32.0
FACTORED LIVE LOAD	26.7
* FACTORED DESIGN LOAD	58.7

* BASED ON STRENGTH I LOAD COMBINATION

NORTH & SOUTH ABUTMENTS
REQUIRED NOMINAL PILE BEARING RESISTANCE FOR H-PILES Rn - TONS/PILE

FIELD CONTROL METHOD	φ_{dyn}	** Rn
Mn/DOT PILE FORMULA 2012 (MPF12) $Rn=20\sqrt{\frac{WxH}{1000}}\times\log(\frac{10}{S})$	0.60	97.9
PDA	0.65	90.4

**Rn = (FACTORED DESIGN LOAD)/φ_{dyn}

PILE NOTES

2 - 10X42 STEEL H TEST PILES, 80' LONG
8 - 10X42 STEEL H-PILES, EST. LENGTH 75'
10 - 10X42 STEEL H-PILES REQ'D FOR 2 ABUTS.

ALL ABUTMENT PILES SHALL BE HP10X42 STEEL H-PILES.

SEE DETAIL B202 FOR PILE SPLICES.

ALL PILES SHALL HAVE PILE TIP PROTECTION.

CP 0796-271375

SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME: MATTHEW W. HEMMILA REG # 43973 DATE 8/31/16

TITLE: ABUTMENT BILL OF REINFORCEMENT

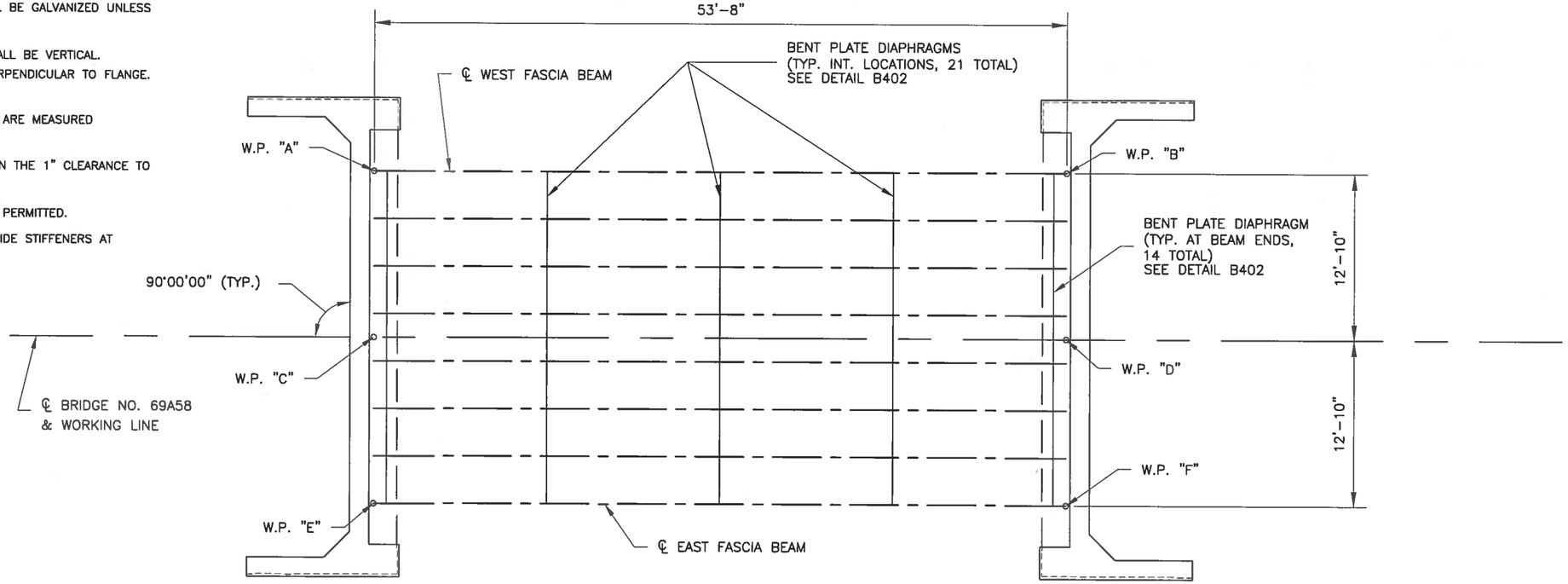
DES: MWH	DR: NSB	APPROVED:	CO. BR. 516
CHK: JWS	CHK: LJR		ST. BR. NO. 69A58

Sheet B7 of B15 Sheets

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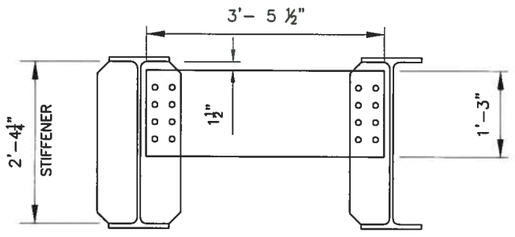
STRUCTURAL STEEL NOTES

1. ALL STRUCTURAL STEEL SHALL CONFORM TO Mn/DOT SPEC. 3309 (ASTM A709 GR. 50W) AND SHALL BE GALVANIZED UNLESS OTHERWISE NOTED.
2. BEARING STIFFENERS AT ABUTMENTS SHALL BE VERTICAL. INTERMEDIATE STIFFENERS SHALL BE PERPENDICULAR TO FLANGE. ENDS OF BEAMS SHALL BE VERTICAL.
3. ALL LENGTHS SHOWN IN FRAMING PLAN ARE MEASURED HORIZONTALLY.
4. LENGTHS OF DIAPHRAGMS ARE BASED ON THE 1" CLEARANCE TO BEAMS ACCORDING TO DETAIL B402.
5. NO FIELD OR SHOP BEAM SPLICES ARE PERMITTED.
6. NO HOLES ARE PERMITTED IN THE OUTSIDE STIFFENERS AT FASCIA BEAMS.
7. INSTALL BEAMS NORMAL CROWN UP.



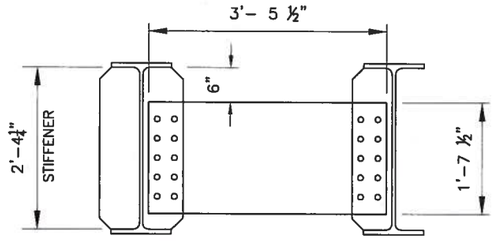
FRAMING PLAN

SCALE: 0 10



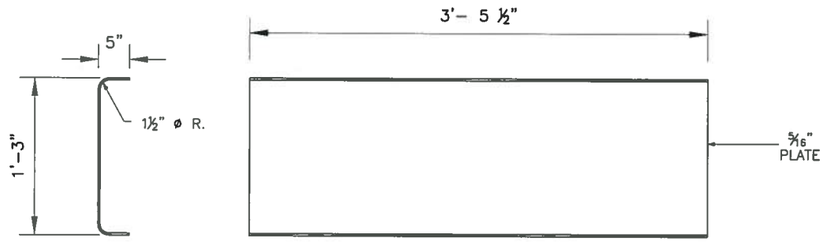
TYP. ABUTMENT DIAPHRAGMS

NOT TO SCALE



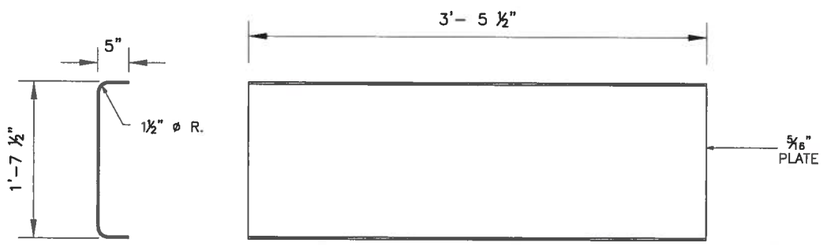
TYP. INTERMEDIATE DIAPHRAGMS

NOT TO SCALE



ABUTMENT DIAPHRAGMS

NOT TO SCALE



INTERMEDIATE DIAPHRAGMS

NOT TO SCALE

CP 0796-271375

SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME: MATTHEW W. HEMMILA REG #: 43973 DATE: 8/31/16

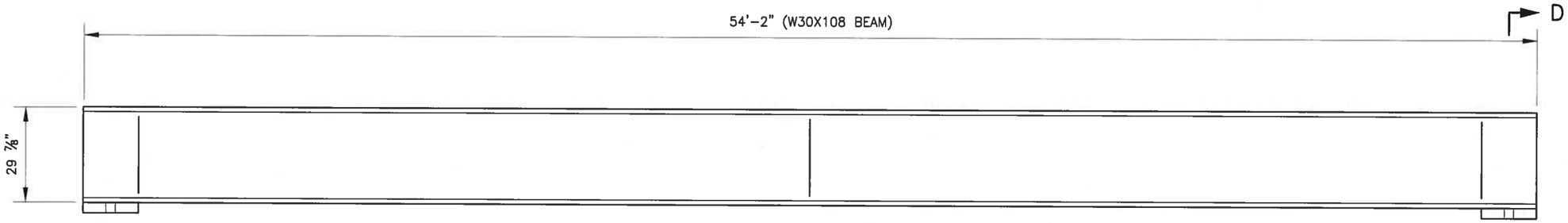
TITLE: FRAMING PLAN

DES: MWH	DR: NSB	APPROVED:
CHK: JWS	CHK: LJR	

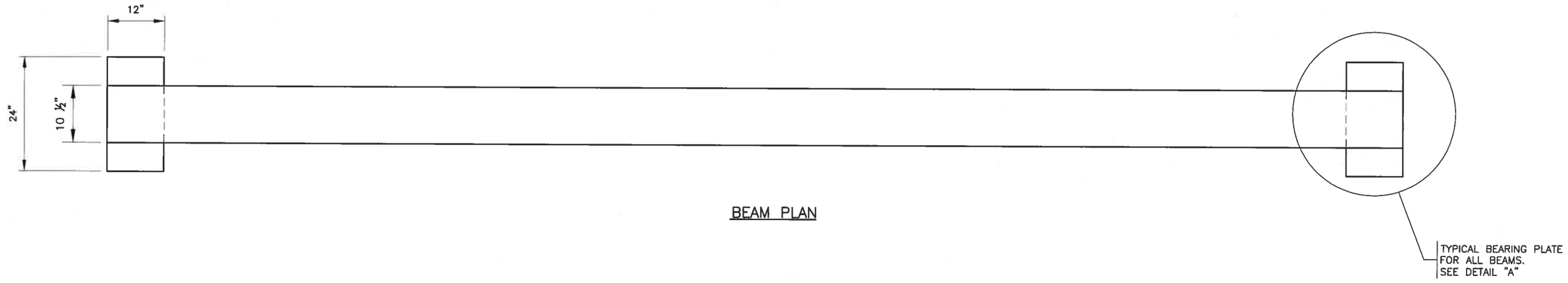
Sheet B8 of B15 Sheets

CO. BR. 516
ST. BR. NO. 69A58

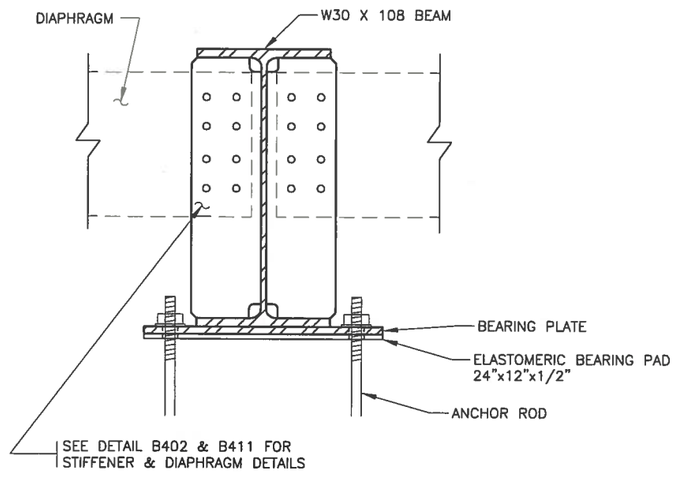
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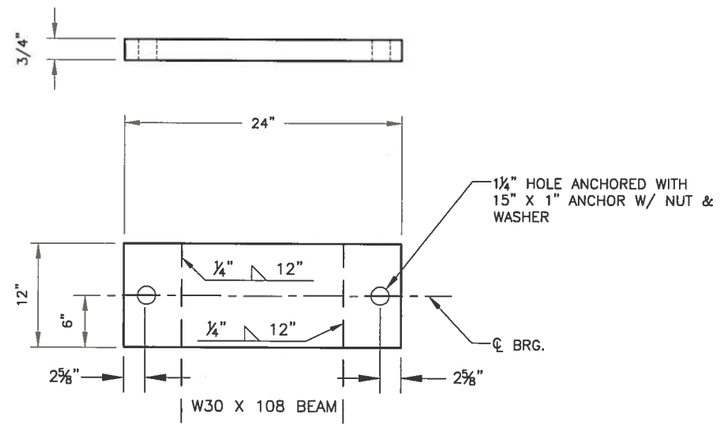
BEAM PROFILE



BEAM PLAN



SECTION D-D
(TYP. ALL BEAM ENDS)



DETAIL "A"
BEARING PLATE
PLAN VIEW

CP 0796-128462

SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

NAME: MATTHEW W. HEMMILA REG #: 43973 DATE: 8/31/16

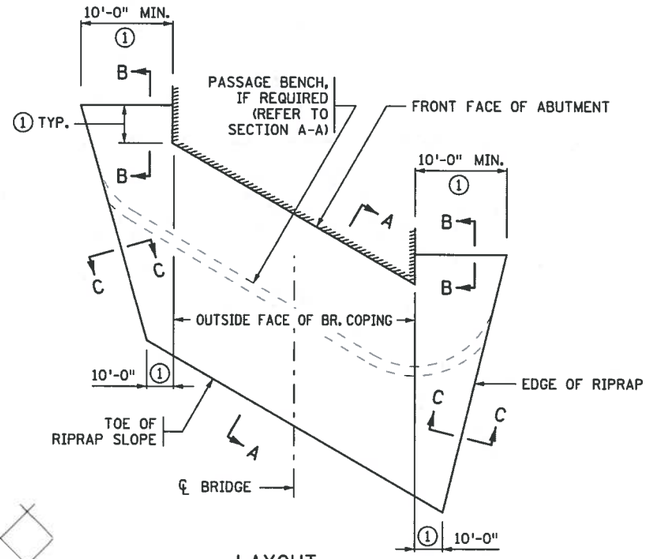
TITLE: BEAM & BEARING PLATE DETAILS

DES: MWH	DR: NSB	APPROVED:
CHK: JWS	CHK: LJR	

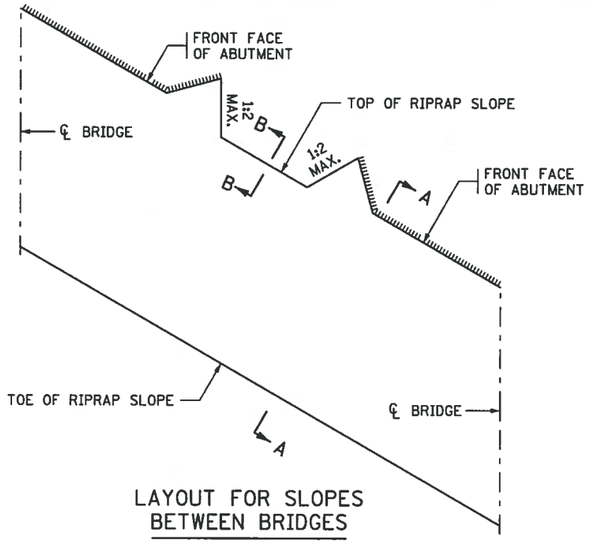
Sheet B9 of B15 Sheets

CO. BR. 516
ST. BR. NO. 69A58

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LAYOUT



LAYOUT FOR SLOPES BETWEEN BRIDGES

GENERAL NOTES

GEOTEXTILE FILTER TYPE 7 PER SPEC. 3733, BY THE SQ. YD.

RIPRAP PER SPEC. 2511, RANDOM RIPRAP CLASS ___ BY THE CU. YD.

SLOPES ARE EXPRESSED AS A RATIO OF VERTICAL DISTANCE : HORIZONTAL DISTANCE.

SLOPE BOTTOM OF TRENCHES 1:20 PARALLEL TO ABUTMENT FACE TO PROVIDE POSITIVE DRAINAGE.

(1) SEE PLAN SHEET NO.__ FOR DIMENSIONS, AND FOR ELEVATIONS OF RIPRAP TOE AND PASSAGE BENCHES.

(2) PLACE RIPRAP IN TRENCH TO HOLD THE GEOTEXTILE FABRIC IN PLACE BEFORE PLACING THE REST OF THE RIPRAP (FROM THE BOTTOM OF THE SLOPE).

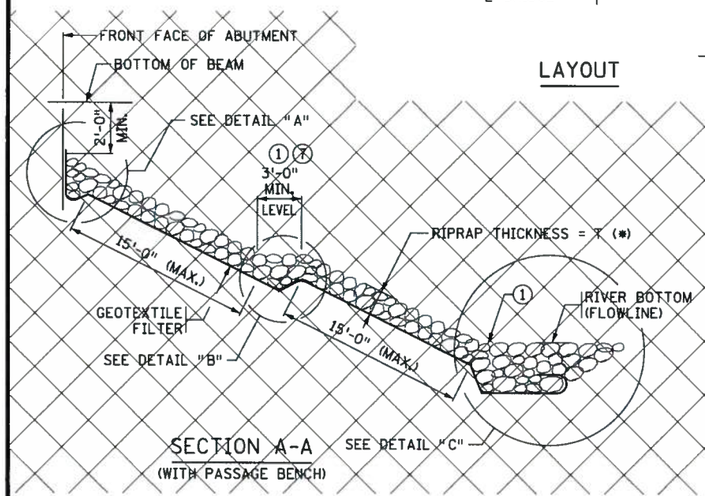
(3) OVERLAP GEOTEXTILE FILTER 2'-0" MINIMUM.

(4) WRAP GEOTEXTILE FILTER AROUND TOE, OVERHANG BETWEEN 1ST AND 2ND LAYER OF RIPRAP. USE HAND PLACEMENT OR SIMILAR METHODS TO ESTABLISH PROFILE AND PLACE FABRIC IF UNDER WATER.

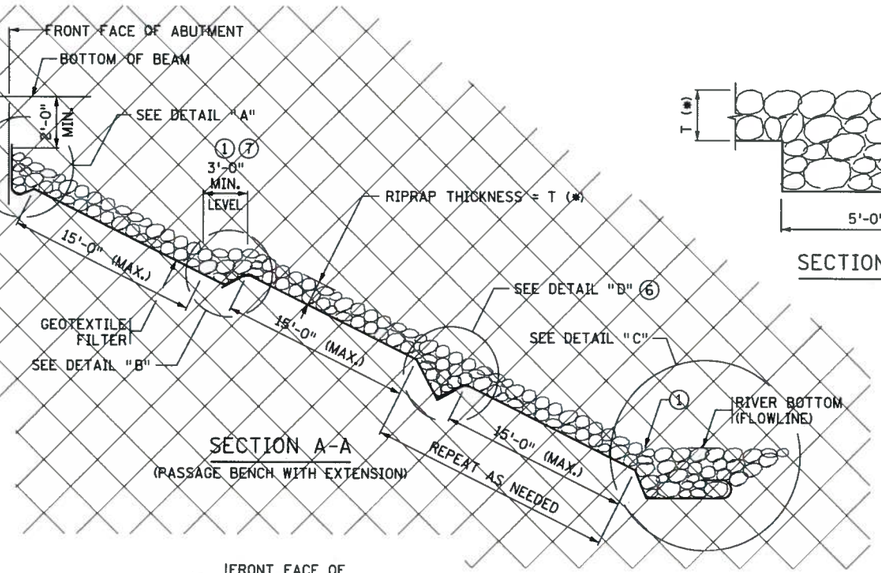
(5) BURY EDGES OF GEOTEXTILE FILTER TO DIRECT WATER FLOW OVER THE FABRIC WITHOUT UNDERMINING.

(6) OMIT THE TRENCH SHOWN IN DETAIL "D" AND THE 15'-0" MAXIMUM SPACING BETWEEN TRENCHES FOR SLOPES 1:3 OR FLATTER.

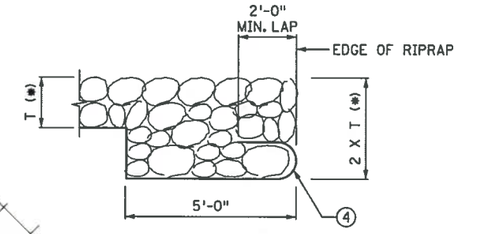
(7) SURFACE BENCHES WITH AGGREGATE CLASS 5 (INCIDENTAL TO RIPRAP). TIE BENCHES TO NATURAL GROUNDLINES OUTSIDE OF BRIDGE.



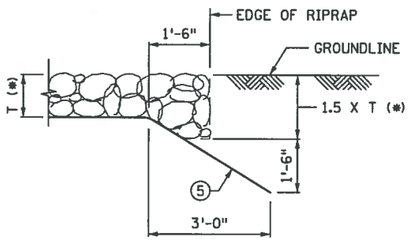
SECTION A-A
(WITH PASSAGE BENCH)



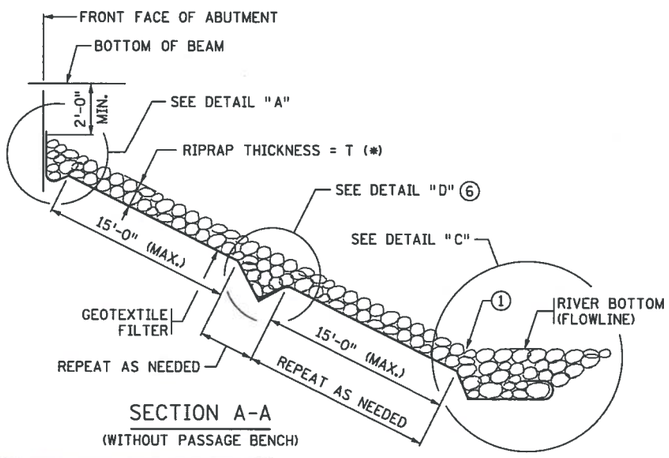
SECTION A-A
(PASSAGE BENCH WITH EXTENSION)



SECTION C-C

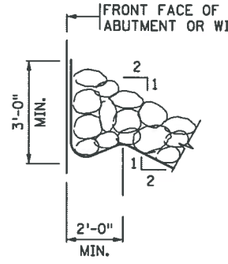


SECTION B-B

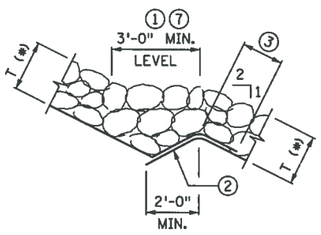


SECTION A-A
(WITHOUT PASSAGE BENCH)

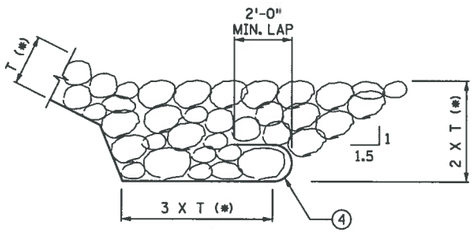
*	DIMENSION T
	CLASS III = 1'-6"
	CLASS IV = 2'-0"



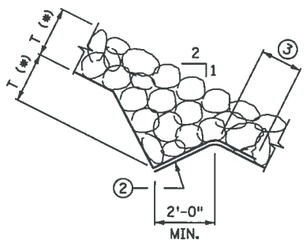
DETAIL "A"



DETAIL "B"



DETAIL "C"



DETAIL "D"

REVISED: 09-11-2014

APPROVED: MAY 24, 2011
Nancy Daubenberger
STATE BRIDGE ENGINEER

CERTIFIED BY _____ 8/31/16
LICENSED PROFESSIONAL ENGINEER — DATE
NAME: LIC. NO.

TITLE: RIPRAP SLOPE WITH GEOTEXTILE FILTER (SLOPES 1:2 AND FLATTER)

DES: DR: CHK: CHK:

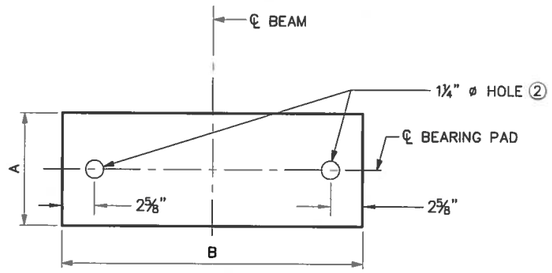
APPROVED:

SHEET NO. B10 OF B15 SHEETS

FIG. 5-397.309

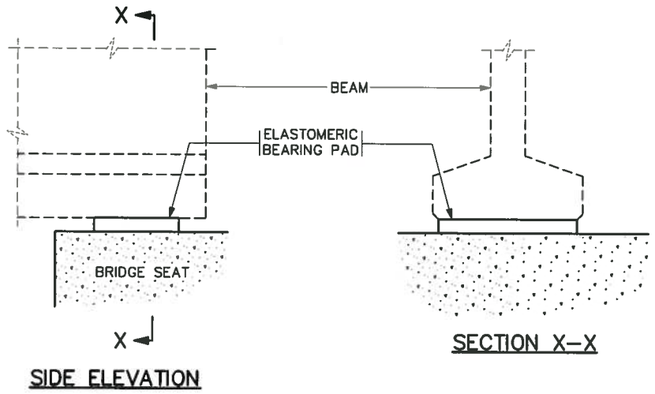
BRIDGE NO. 69A58

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PLAN

(BEAM NOT SHOWN)



SIDE ELEVATION

SECTION X–X

TABLE						
PAD TYPE	LOCATION	BEAM SIZE	BEARING PAD SIZE			SHAPE FACTOR
			A	B	D ①	
1	S. ABUTMENT	W30X108	12	24	1/2	8.0
1	N. ABUTMENT	W30X108	12	24	1/2	8.0

NOTES:

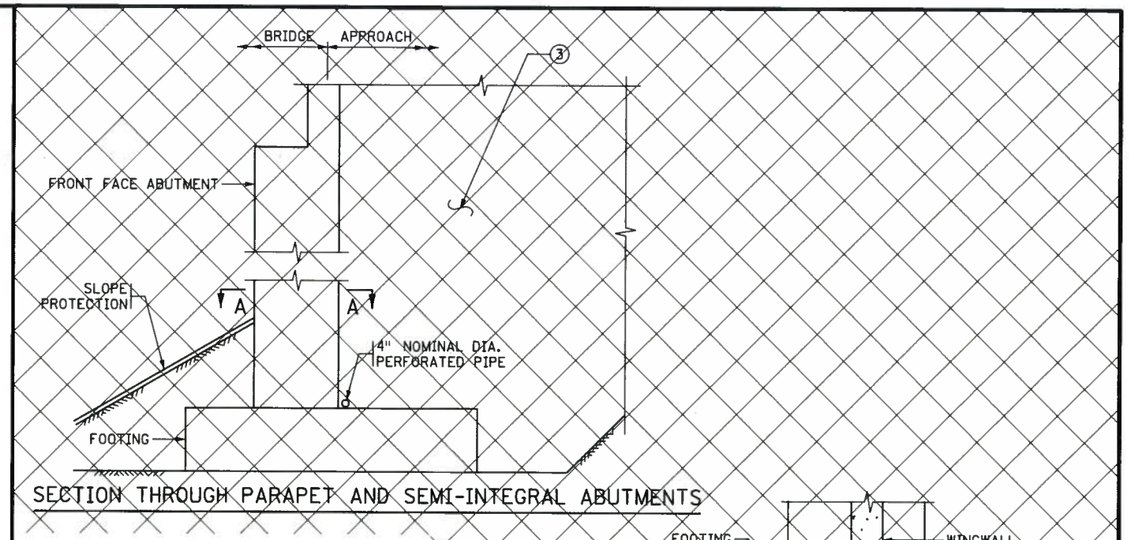
ELASTOMERIC MATERIALS AND PAD CONSTRUCTION SHALL COMPLY WITH SPEC. 3741.

PAYMENT FOR ELASTOMERIC BEARING PAD INCLUDED IN ITEM "ELASTOMERIC BEARING PAD" PER EACH.

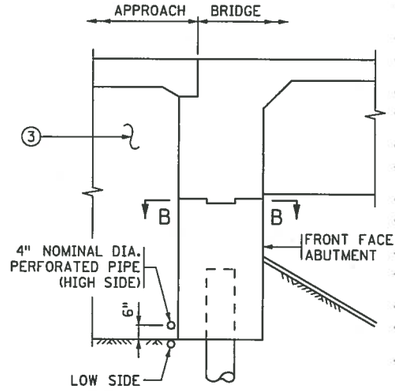
① "D" INDICATES THE THICKNESS OF THE BEARING PAD.

② HOLES ARE NOT TO BE MADE IN THE FIELD.

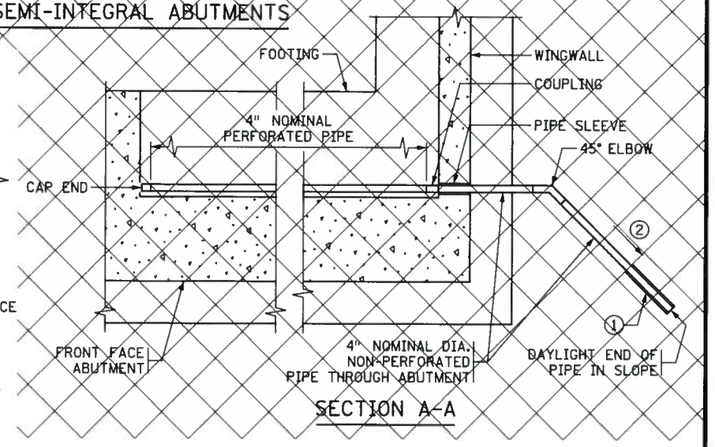
APPROVED: NOVEMBER 22, 2002	STATE OF MINNESOTA DEPARTMENT OF TRANSPORTATION	REVISION 12-17-2008 05-24-2012 01-13-2015	DETAIL NO.
MODIFIED STATE BRIDGE ENGINEER	ELASTOMERIC BEARING PAD		B305



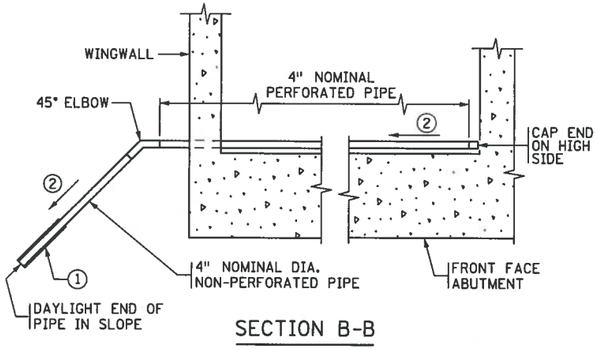
SECTION THROUGH PARAPET AND SEMI-INTEGRAL ABUTMENTS



SECTION THROUGH INTEGRAL ABUTMENT



SECTION A-A



SECTION B-B

NOTES:

PAYMENT WILL BE INCLUDED IN THE SINGLE LUMP SUM PRICE FOR "DRAINAGE SYSTEM TYPE (B910)", INCLUDES BUT IS NOT LIMITED TO 4" DIAMETER PERFORATED AND NON-PERFORATED PIPE, ELBOWS, END CAPS, COUPLINGS, SLEEVES AND PRECAST CONCRETE HEADWALLS.

ALL PIPE TO COMPLY WITH SPEC. 3245.

WRAP PERFORATED PIPE WITH GEOTEXTILE PER SPEC. 3733, TYPE 1. ATTACH TO PIPE PER SPEC. 2502.

① AT CONTRACTOR'S OPTION, MAY TIE APPROACH PANEL DRAINAGE SYSTEM AND ABUTMENT DRAINAGE SYSTEM INTO A SINGLE PRECAST CONCRETE HEADWALL OR INTO A CATCH BASIN AS LONG AS A MINIMUM OF 1% POSITIVE SLOPE CAN BE MAINTAINED.

USE PRECAST CONCRETE HEADWALL WITH RODENT SCREEN. SEE STANDARD PLATE 3131 FOR DETAILS.

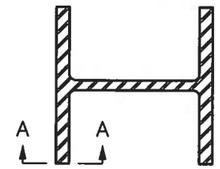
② ⅛" PER FT. MINIMUM SLOPE.

③ REFER TO GRADING PLANS FOR ABUTMENT BACKFILL REQUIREMENTS.

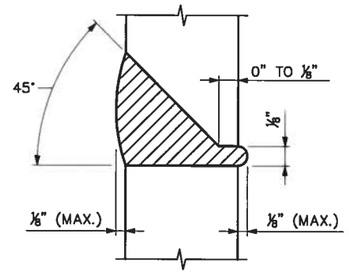
APPROVED: JANUARY 13, 2015	STATE OF MINNESOTA DEPARTMENT OF TRANSPORTATION	REVISED 12-02-2015	DETAIL NO.
Nancy Daubenberger STATE BRIDGE ENGINEER	DRAINAGE SYSTEM		B910

CP 0796-271375	SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.	I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA. NAME: MATTHEW W. HEMMILA REG #: 43973 DATE 8/31/16	TITLE: BRIDGE DETAILS (ELASTOMERIC BEARING PAD & DRAINAGE SYSTEM)	DES: MWH DR: NSB CHK: JWS CHK: LJR Sheet B11 of B15 Sheets	APPROVED:	CO. BR. 516 ST. BR. NO. 69A58

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SECTION AT JOINT



SECTION A–A

100% BUTT WELDED PILE SPLICE

NOTES:

CELLULOSIC TYPE ELECTRODES E–6010 OR E–6011 SHALL BE USED FOR 100% BUTT WELDED SPLICES.

ELECTRODES WHICH HAVE BECOME WET, SOILED OR DAMAGED SHALL NOT BE USED.

WELDING SHALL NOT BE DONE WHEN THE AMBIENT TEMPERATURE IS LOWER THAN 0° F. OR WHEN THE PILE IS WET OR EXPOSED TO FALLING RAIN OR SNOW. WHEN THE PILE METAL TEMPERATURE IS BELOW 32° F., THE PILE METAL IN THE AREA OF THE WELD SHALL BE HEATED TO A MINIMUM TEMPERATURE OF 70° F. AND MAINTAINED AT THIS TEMPERATURE DURING WELDING.

APPROVED: NOVEMBER 22, 2002

Daniel D Wozniak
STATE BRIDGE ENGINEER

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

PILE SPLICE
(STEEL H BEARING PILES 10" TO 14")

REVISION	DETAIL NO.
	B202

CP 0796–271375

SAINT LOUIS COUNTY PUBLIC WORKS
BRIDGE DEPT.

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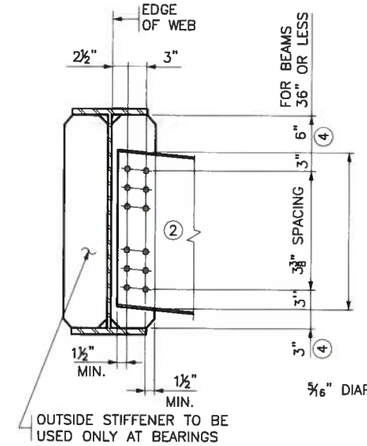
NAME: MATTHEW W. HEMMILA REG #: 43973 DATE: 8/31/16

TITLE: BRIDGE DETAILS

DES: MWH	DR: NSB	APPROVED:	CO. BR. 516
CHK: JWS	CHK: LJR		ST. BR. NO. 69A58

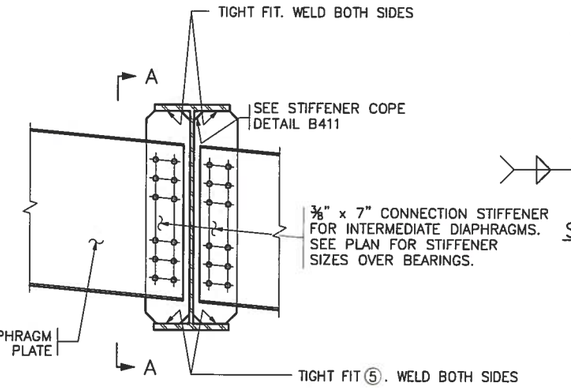
Sheet B12 of B15 Sheets

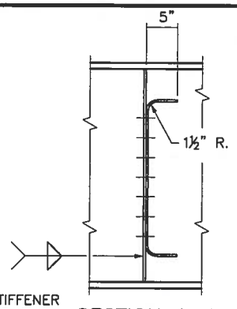
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FASCIA BEAM

AT PIER AND INTERMEDIATE DIAPHRAGMS

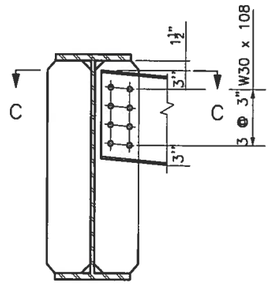




SECTION A–A

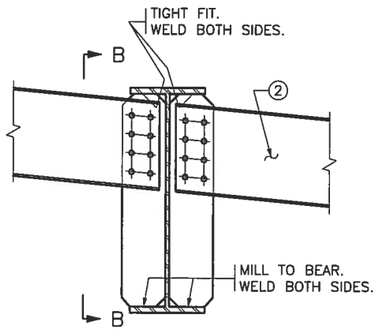
INTERIOR BEAM

AT PIER AND INTERMEDIATE DIAPHRAGMS



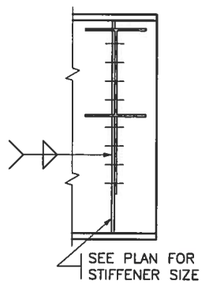
FASCIA BEAM

AT ABUTMENT DIAPHRAGMS



INTERIOR BEAM

AT ABUTMENT DIAPHRAGMS



SECTION B–B

NOTES:

ALL STEEL SHALL CONFORM TO Mn/DOT SPEC. 3309.

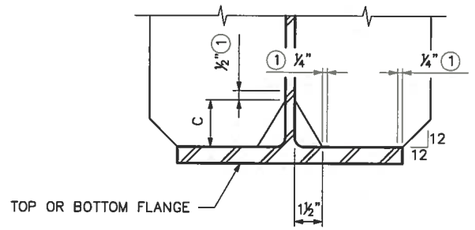
~~① USE SAME SHEAR STUD HEIGHT AS USED ON THE BEAMS.~~

② SEE FRAMING PLAN FOR SIZE OF DIAPHRAGM.

③ FOR PLATE GIRDERS, END DIAPHRAGMS SHALL BE AT LEAST THE BEAM HEIGHT.

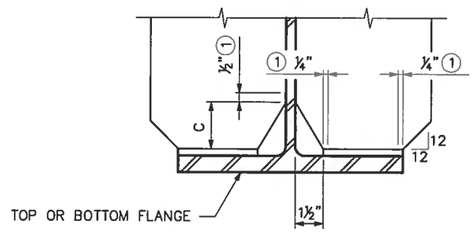
④ DIAPHRAGMS MAY BE PLACED LEVEL, PROVIDED MINIMUM CLEARANCES ARE MET.

⑤ MILL TO BEAR FOR BEARING STIFFENERS.



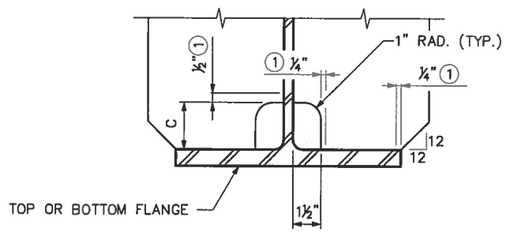
STIFFENER TO FLANGE CONNECTION

OPTION 1



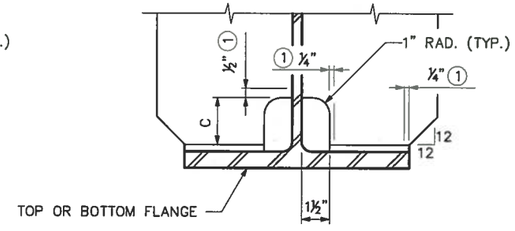
STIFFENER TO TAB PLATE CONNECTION

OPTION 1



STIFFENER TO FLANGE CONNECTION

OPTION 2

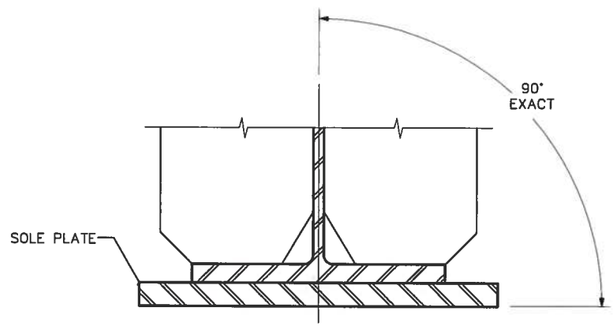


STIFFENER TO TAB PLATE CONNECTION

OPTION 2

STIFFENER COPE DETAIL

PLATE GIRDER OR ROLLED BEAM



SOLE PLATE AT BEARING

WEB THICKNESS	DIMENSION C
½", 9/16", 5/8"	2½"
11/16", ¾"	3"

NOTES:

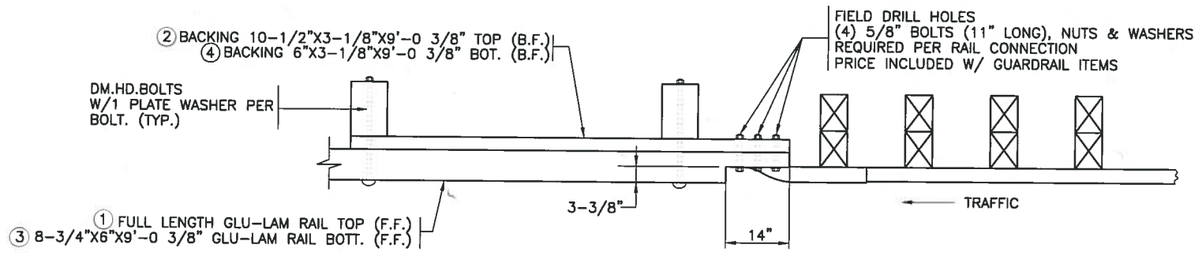
① DO NOT WELD IN THIS AREA. SEE B410 FOR CONNECTION DETAILS.

APPROVED: MARCH 26, 2009	STATE OF MINNESOTA DEPARTMENT OF TRANSPORTATION	REVISED	DETAIL NO.
MODIFIED STATE BRIDGE ENGINEER	BOLTED DIAPHRAGMS (FOR STEEL BEAMS)		B402

APPROVED: OCTOBER 22, 2008	STATE OF MINNESOTA DEPARTMENT OF TRANSPORTATION	REVISION	DETAIL NO.
Daniel L. Morgan STATE BRIDGE ENGINEER	STIFFENER DETAILS (FOR STEEL BEAMS)		B411

CP 0796–271375	SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.	I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA NAME: MATTHEW W. HEMMILA REG #: 43973 DATE 8/31/16	TITLE: BRIDGE DETAILS	DES: MWH DR: NSB APPROVED: CHK: JWS CHK: LJR Sheet B13 of B15 Sheets	CO. BR. 516 ST. BR. NO. 69A58

H:\Bridge\BR 500-599\BR 516\CP 0796-271375\Design\Working Drawings\BR 516 Design.dwg, Details 2, 8/30/2016 10:22:48 AM, bergstedtn



PLAN VIEW

① FULL LENGTH GLU-LAM RAIL TOP (F.F.)
② BACKING 10-1/2"X3-1/8"X9'-0 3/8" TOP (B.F.)
③ 8-3/4"X6"X9'-0 3/8" GLU-LAM RAIL BOTT. (F.F.)
④ BACKING 6"X3-1/8"X9'-0 3/8" BOT. (B.F.)

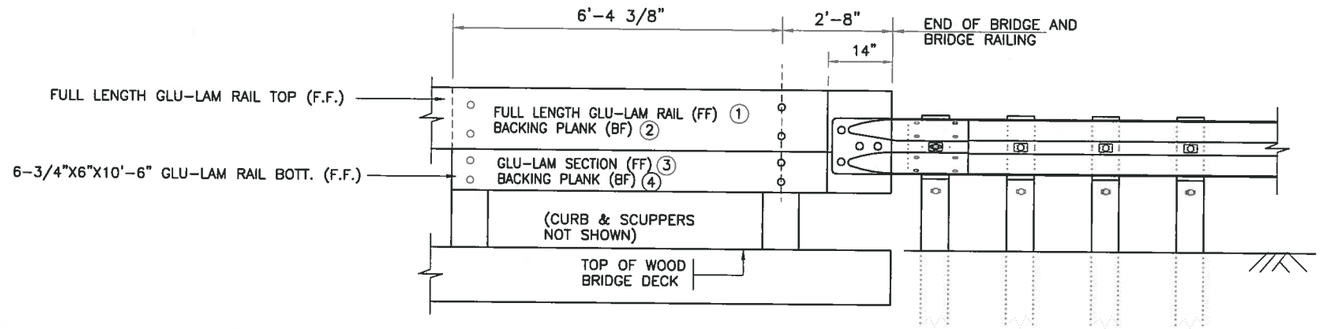
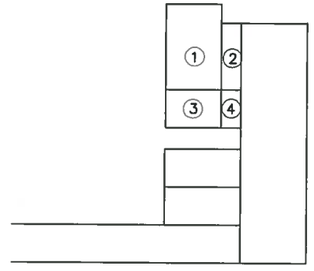


PLATE BEAM RAIL
ATTACHMENT DETAIL
(TYPICAL ALL TRAFFIC RAIL ENDS)



CROSS SECTION

CP 0796-271375

SAINT LOUIS COUNTY PUBLIC WORKS
BRIDGE DEPT.

I HEREBY CERTIFY THAT THIS PLAN, SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME: MATTHEW W. HEMMILA REG #: 43973 DATE 8/31/16

TITLE: TIMBER RAIL & GUARDRAIL CONNECTION DETAIL

DES: MWH	DR: NSB	APPROVED:
CHK: JWS	CHK: LJR	

Sheet B14 of B15 Sheets

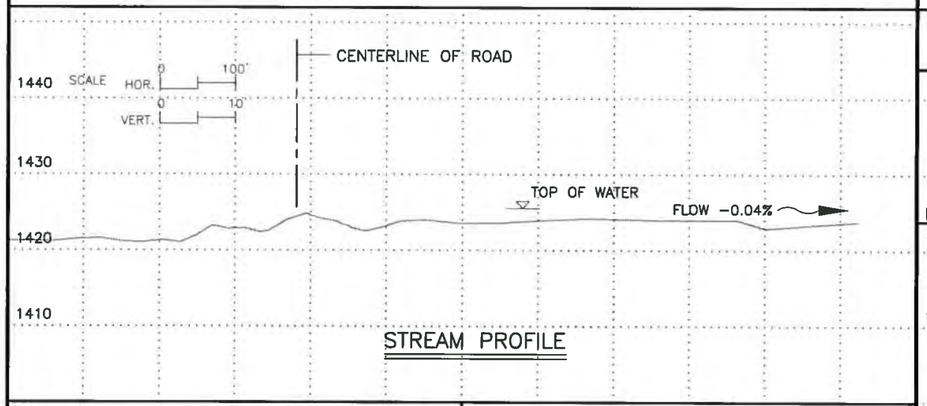
CO. BR. 516
ST. BR. NO.
69A58

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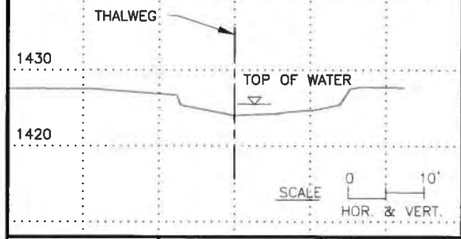
STREAM DATA

SCALES AS SHOWN

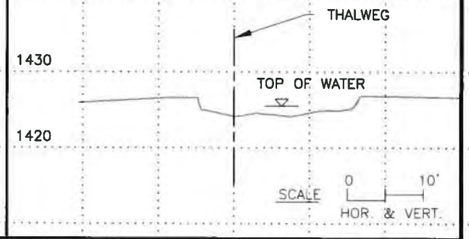


STREAM PROFILE

STREAM X-SECTION
STREAM STATION S5+50

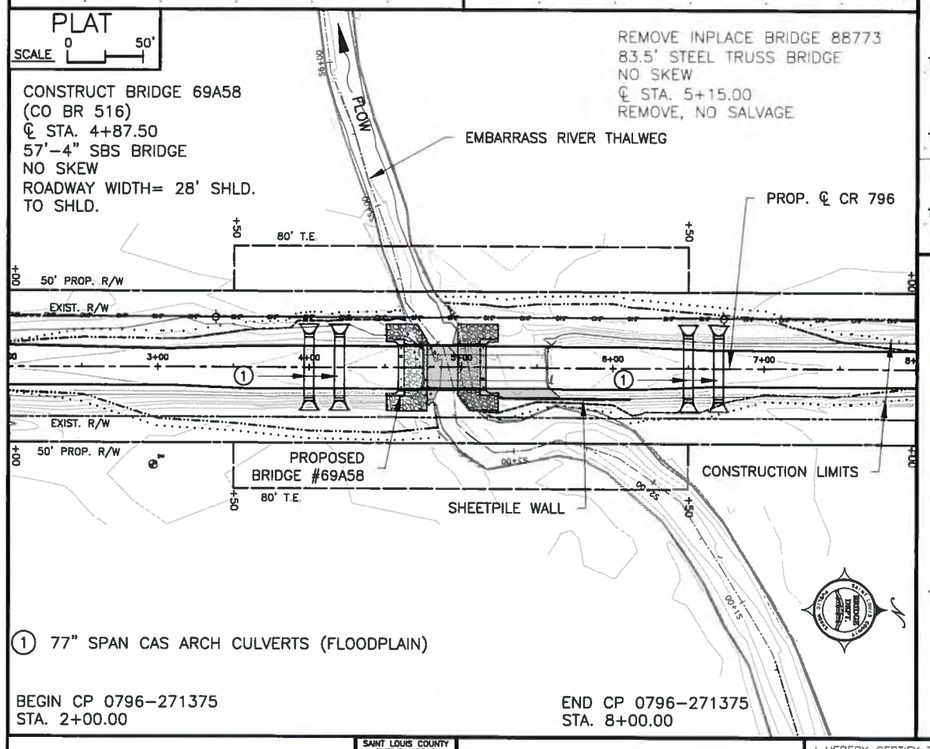


STREAM X-SECTION
STREAM STATION S7+70



PLAT

SCALE 0 50'



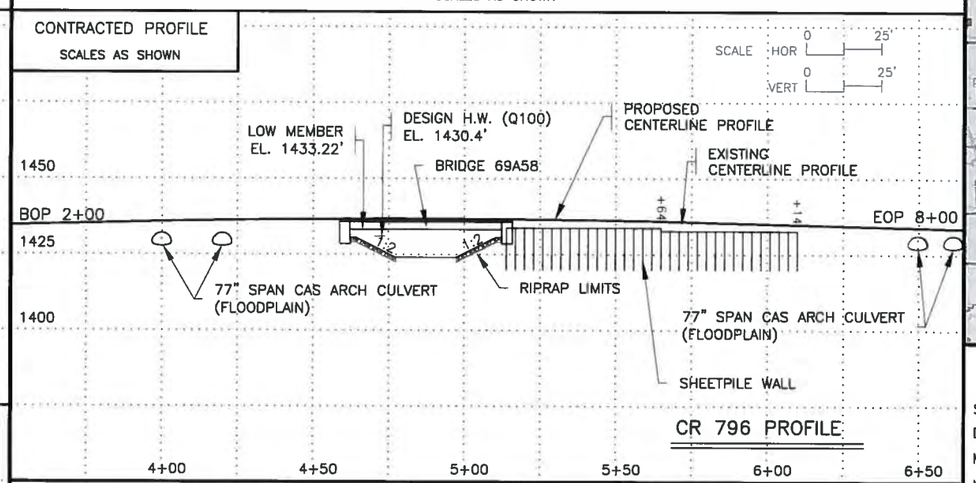
BEGIN CP 0796-271375
STA. 2+00.00

END CP 0796-271375
STA. 8+00.00

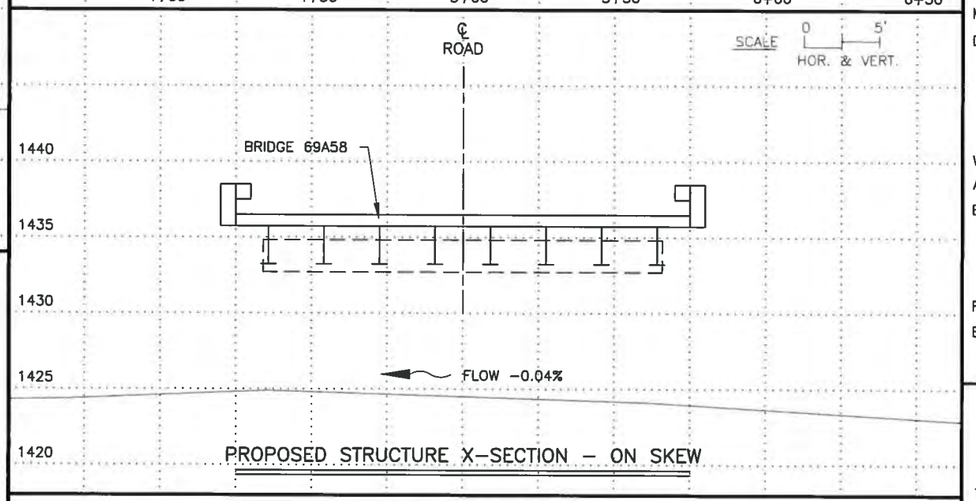
CULVERT DATA

SCALES AS SHOWN

CONTRACTED PROFILE
SCALES AS SHOWN



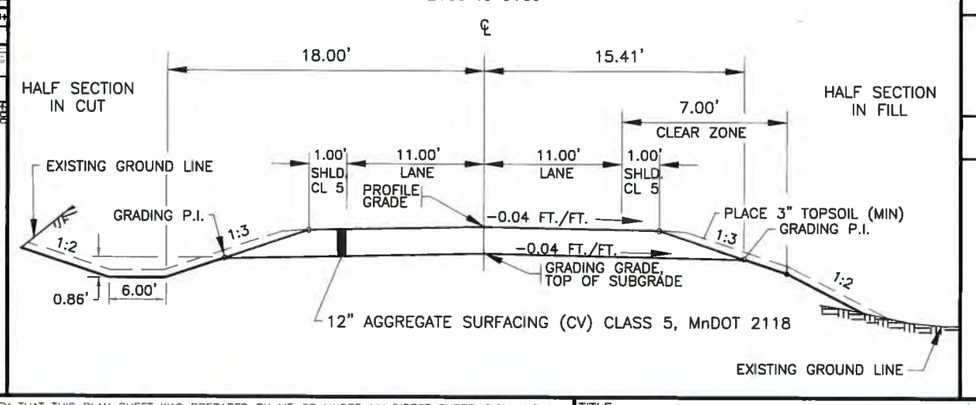
CR 796 PROFILE

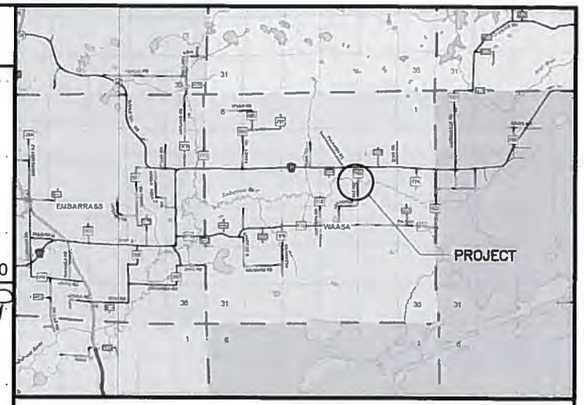


PROPOSED STRUCTURE X-SECTION – ON SKEW

TYPICAL SECTION

CR 796
NO SCALE
2+00 TO 8+00





HYDRAULIC ENGINEERS RECOMMENDATION
DATE: 3-1-16

STREAM OR DITCH DESIGNATION: EMBARRASS RIVER
DRAINAGE AREA: 31.5 SQ. MI.
MAX. FLOOD ON RECORD: (UNKNOWN) C.F.S.
MAXIMUM OBSERVED HIGHWATER ELEVATION: (UNKNOWN) FT.
DESIGN FLOOD (100 YR. FREQ.): 990 C.F.S.
- HEADWATER ELEVATION: 1430.4 FT.
- DESIGN MEAN VELOCITY THROUGH STRUCTURE: 4.3 F.P.S.
- TOTAL STAGE INCREASE: 0.5 FT.
- LOW MEMBER AT OR ABOVE ELEVATION: 1433.22 FT.

WATERWAY AREA REQUIRED BELOW ELEV. 1430.4 = 274 SQ. FT.
AT RIGHT ANGLES TO CHANNEL.
BASIC FLOOD (100 YR. FREQ.): 990 C.F.S.
- HEADWATER ELEVATION: 1430.4 FT.
- TOTAL STAGE INCREASE: 0.5 FT.
- MEAN VELOCITY THROUGH STRUCTURE: 4.3 F.P.S.

FLOWLINE ELEVATION: 1424.1 FT. SKEW ANGLE: 0°
ESTIMATED PRELIMINARY TOTAL SCOUR AT PIER EL.: N/A
(500 or OT YR. FREQ.)

SCOUR CONFIRMATION RECOMMENDATION

DATE: XX-XX-XX

TOTAL SCOUR AT PIER EL.: N/A (500 or OT YR. FREQ.)
SCOUR CODE: L

BRIDGE SURVEY SHEETS MADE FROM. ST. LOUIS COUNTY BRIDGE SURVEY DATED 2005
BENCH MARK ELEVATION 1430.46' (NAVD 88)
LOCATION STA 8+85 OFFSET 55' LT IN A 8" PINE

SAINT LOUIS COUNTY

BRIDGE PLAN

AT MILE POINT 1.6 ON CR 796
PROPOSED BRIDGE LOCATED 7.4 MILES W/SW OF
BABBITT, MINNESOTA
SEC. 14 TWP. 60N R. 14W
TOWNSHIP WAASA COUNTY ST. LOUIS
STATE BRIDGE NO. OLD 88773 NEW 69A58
COUNTY BRIDGE NO. 516

CP 0796-271375

SAINT LOUIS COUNTY PUBLIC WORKS BRIDGE DEPT.

I HEREBY CERTIFY THAT THIS PLAN SHEET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

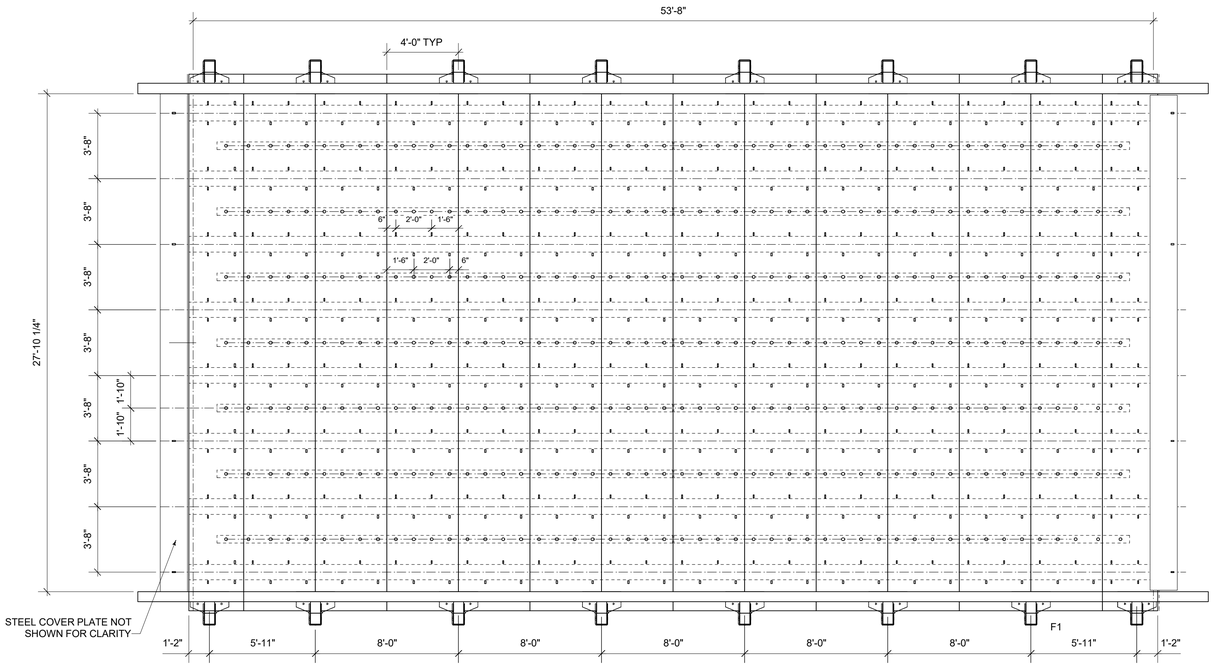
NAME: MATTHEW W. HEMMILA REG #: 43973 DATE: 8/31/16

TITLE: BRIDGE SURVEY

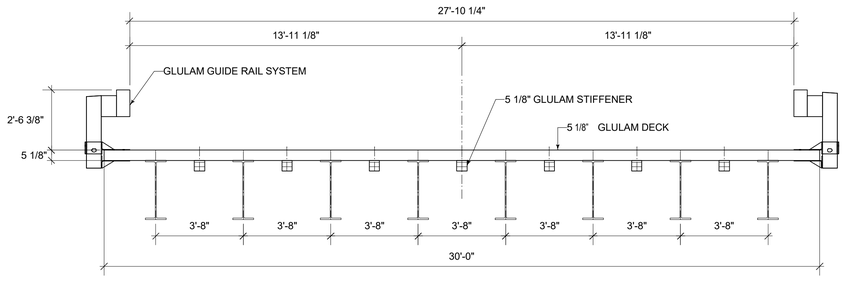
DES: MWH	DR: NSB	APPROVED:
CHK: JWS	CHK: LJR	

Sheet B15 of B15 Sheets

CO. BR. 516
ST. BR. NO. 69A58



DECKING AND RAILING PLAN



TYPICAL SECTION THRU BRIDGE

STANDARD FOR GLUED LAMINATED TIMBER BRIDGES

1. SPECIFICATION SCOPE FOR GLUED LAMINATED TIMBER SUPERSTRUCTURES

Provide a standard for production of glued laminated wood used in the bridge superstructure installation. This standard is intended to cover several types of glulam bridge structures. This standard is intended to augment, or support, design requirements that may be issued by the owner.

2. DEFINITIONS AND ABBREVIATIONS

STRUCTURAL GLUED LAMINATED TIMBER (WOOD): An engineered stress-rated product of a timber laminating plant, comprised of wood laminations bonded together with adhesives. The grains of all laminations are approximately parallel longitudinally. See AITC 117 for a more detailed explanation.

GLULAM: Structural glued laminated timber (wood)

AITC: American Institute of Timber Construction

APA/EWS: Trademark appears on products manufactured by APA - The Engineered Wood Association members

AWPA: American Wood Protection Association

AASHTO: American Association of State Highway and Transportation Officials

WWPI: Western Wood Preservers Institute

3. QUALIFICATIONS OF FABRICATOR

3.1 The glulam manufacturer shall be a qualified licensee of the AITC or APA/EWS.
3.2 All Glued laminated timber shall be factory fabricated (as far as practical). This shall include cutting drilling and other fabrication as shown on shop drawings.

4. CODES AND STANDARDS

In addition to complying with all pertinent codes and regulations, material and installation procedures shall comply with the following:

4.1 AASHTO. 2017. LRFD Standard Specifications for Highway Bridges, 5th edition.
4.2 American National Standard for Wood Products-Structural Glued Laminated Timber ANSI A190. 1- (Latest edition)
4.3 AITC 117-2015 Standard Specifications for Structural Glued Laminated Timber of Softwood Species.
4.4 AWPA Book of Standards (Latest Edition)
4.5 WWPI Best Management Practice for Treating Wood in Aquatic Environment

5. CERTIFICATIONS

5.1 Certifications required by the laminator: The laminator shall provide an AITC or APA/EWS Certificate of Conformance to AITC/ANSI A190.1-2007
5.2 Preservative treatment certification required. A Certificate of treatment shall be furnished by a certified AWPA treating facility. The treating certification shall list the identification of job, species of materials, type and retention preservative provided, as well as the AWPA standard used as the guide for treating. In the event treated timber originates from more than one treating facility then certification shall be furnished from each facility providing timber for this project.

6. STRUCTURAL DESIGN

The bridge shall be designed in accordance with good engineering practices and in accordance with the standard specifications as adopted by the American Association of State Highway and Transportation Officials (AASHTO). The Bridge design shall be a glulam system comprised of either longitudinal decks, stringer systems or transverse deck systems.

6.1 The structure shall be designed for the following loads and dimensions:
6.1.1 Dead Load (timber 50 PCF / wearing surface 140 PCF)
6.1.2 Live Load HL93
6.1.3 Wet-Stress design values shall be used when applicable
6.1.4 Live Load deflection (L/425)

7. TIMBER MATERIALS

7.1 Lumber-intended for glulam production shall be visually or mechanically graded in conformance with accepted standards for LRFD unit stresses (See AASHTO Section 8) and with the National Design Specifications for Wood Construction.
7.2 Glulam members shall be finished to Industrial Appearance Grade as per AITC 110-2001
7.3 All lumber utilized in these standards shall be either Coastal Douglas Fir orSouthern Pine.
7.4 All glulam members shall be factory fabricated (holes, cuts, etc.) prior to preservative treatment. Some minor fabrication and adjustments may be required in teh field. If so, field treat all exposed cuts, holes, etc. with an approved preservative field treatment as pr AWPA M4

8. PRESERVATIVE TREATMENT

All timber to be treated with the following oil type preservatives in accordance with AASHTO Material Standards, M133 and M168 and shall conform to the AWPA Use Code Standards

8.1 Pentachlorophenol or Copper Naphthenate in Type A, heavy oil conforming to AWPA Standard UC4B, P-8 & P9. Retention level shall be 0.6 PCF
8.2 All preservative treatments shall be applied in accordance with Best Management Practices for Wood Preservatives in Aquatic Environments.
8.3 AWPA Treatment Spec References:
AWPA M2 Inspection of Treated Timber Products
AWPA M4 Care of Preservative Treated Timber Products
AWPA P8 Oil-borne Preservatives
AWPA P9 Standards for Solvents

9. HARDWARE

9.1 Fabricator shall provide all connection steel and hardware for joining wood members to each other and to their supports exclusive of anchoring embedded in concrete.
9.2 All fasteners, except prestressing bars, shall be galvanized (ASTM A-123) mild steel ASTM A307. Washers to be cast iron or malleable iron, timber type.
9.3 All steel plates and shapes to be galvanized (ASTM A-153) mild steel ASTM A-36
9.4 Hardware Specification References
AASHTO. 2011. Standard Specifications for Transportation Materials and Methods of Sampling and Testing. 31st Edition.
M111 Zinc (Hot-Dip Galvanized) Coatings for Iron and Steel Products
M232 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM. 2011. (American Society of Testing and Materials) Annual Book of Standards
ASTM A36 Standard Specification for Structural Steel
ANSI/ASME. B18.2.1 Square and Hex Bolts and Screws (Inch Series), American Society of Mechanical Engineers

10 MATERIAL: DELIVERY, STORAGE AND HANDLING

10.1 Special care shall be taken for all materials required for the project. Shipping, storage and erection practices shall be in accordance with industry standards.
10.2 For wearing surface information, refer to the USDA Forest Service document "Guidelines for Design, Installation and Maintenance of a waterproof wearing surface for timber bridge decks" USDA paper FPL-GTR-123

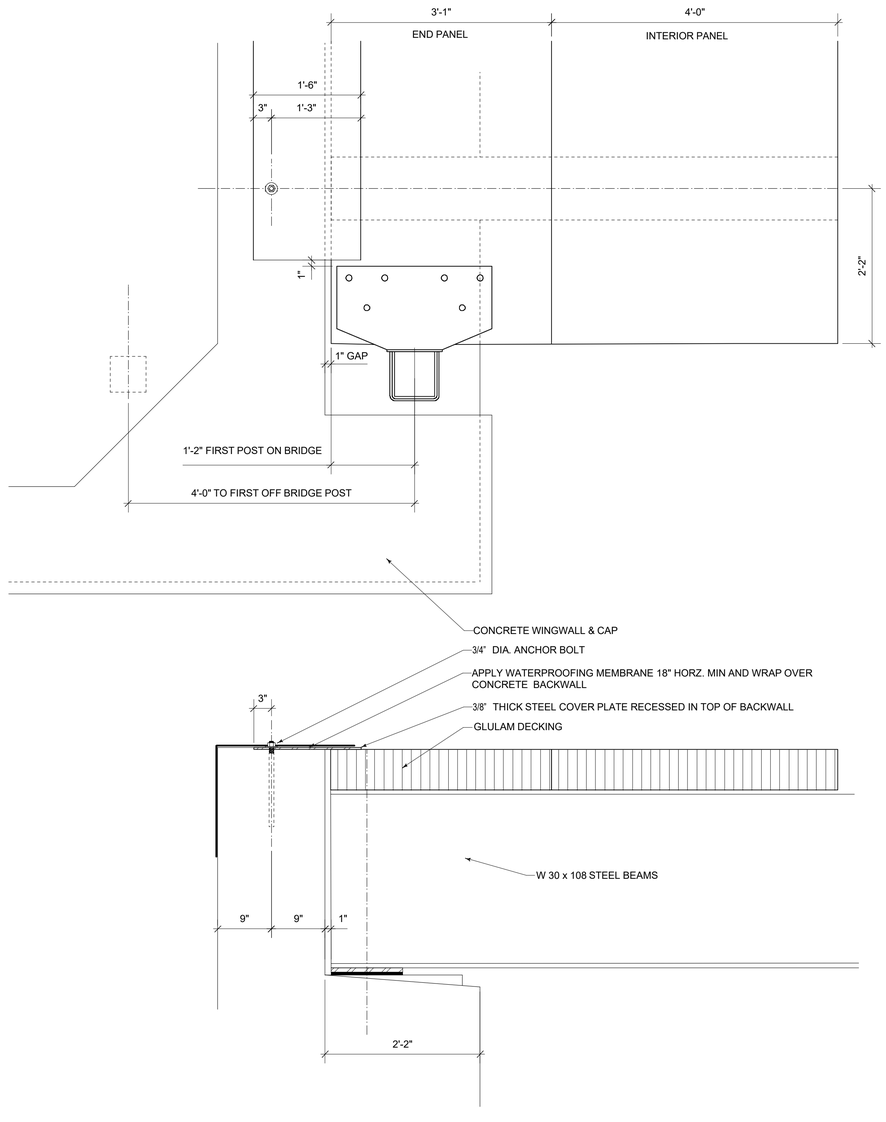
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CHK'D		DATE		NO.	DATE	BY	REVISIONS
APP'D		DATE		1	12/29/16	SS	REVISE DECK
SCALE							

PROJECT NAME: ST. LOUIS COUNTY BRIDGE NO. 516
COUNTY PROJECT NO. 0796-271375
WAASA TOWNSHIP ST. LOUIS COUNTY

PROJECT JOB NO.: 0416-58-TD

PREPARED FOR: ST. LOUIS COUNTY MINNESOTA

SHEET NO.: 1 of 2

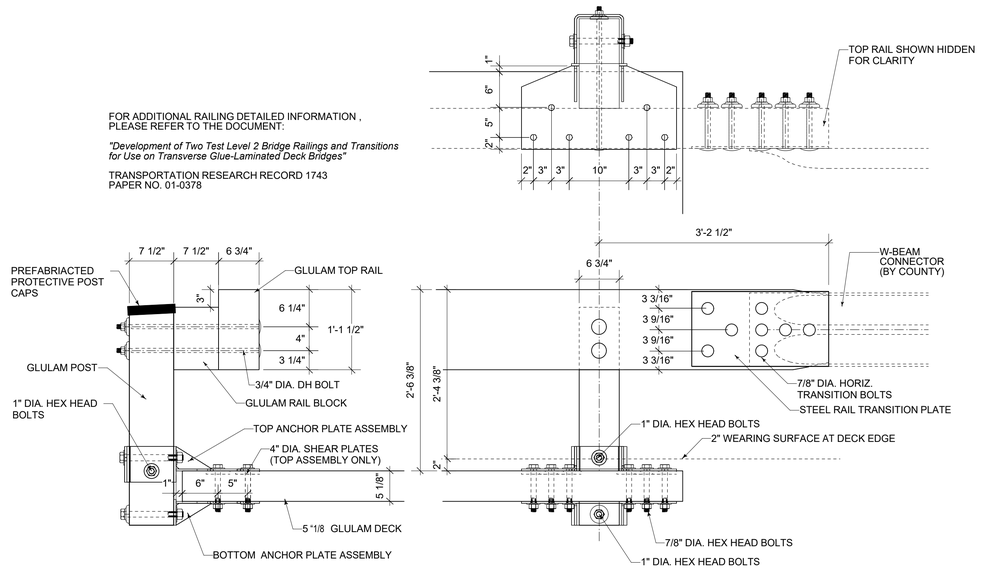


TYPICAL BEARING DETAIL

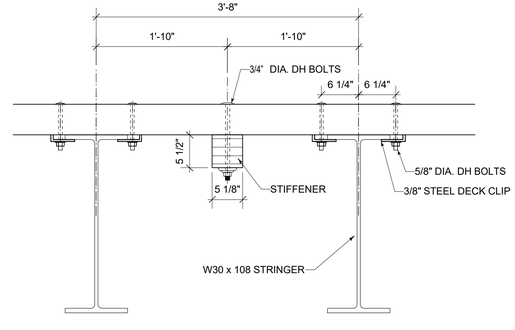
FOR ADDITIONAL RAILING DETAILED INFORMATION , PLEASE REFER TO THE DOCUMENT:

"Development of Two Test Level 2 Bridge Railings and Transitions for Use on Transverse Glue-Laminated Deck Bridges"

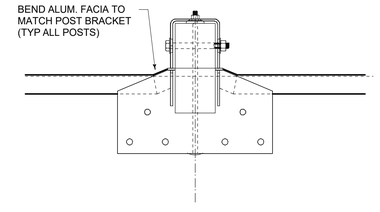
TRANSPORTATION RESEARCH RECORD 1743
PAPER NO. 01-0378



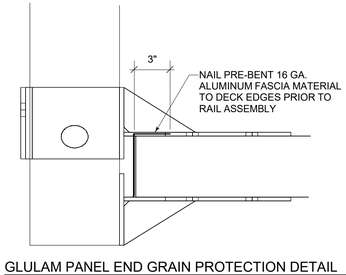
TYPICAL GUIDE RAIL DETAIL



TYPICAL DECK TO STEEL DETAIL



FACIA PLACEMENT ABOUT POST



GLULAM PANEL END GRAIN PROTECTION DETAIL

DRAWN	MSS	DATE	12/09/16	REVISIONS			
CHK'D		DATE		NO.	DATE	BY	REVISIONS
APP'D		DATE		1	12/29/16	SS	REVISE DECK
SCALE							

PROJECT NAME
ST. LOUIS COUNTY BRIDGE NO. 516
COUNTY PROJECT NO. 0796-271375
WAASA TOWNSHIP ST. LOUIS COUNTY

PROJECT JOB NO.
0416-58-TD

PREPARED FOR
ST. LOUIS COUNTY
MINNESOTA

SHEET NO.
2 of 2

PART & MATERIAL LIST

WOOD MATERIAL LIST

NO. REQD	DESCRIPTION	MARK	SIZE	LENGTH	NOM. LAMS	Layup Comb.	CAMBER	DETAIL ON SHT.	NOTES	
2	DECK PANEL	D1	5.125" X 37"	30'-0"	2"	50	NONE	ST-4		
12	DECK PANEL	D2	5.125" X 48"	30'-0"	2"	50	NONE	ST-4		
7	STIFFENER	A1	5.125" X 5.5"	50'-0"	2"	48	NONE	ST-5		
16	POST	P1	6.75" X 7.5"	3'-0 13/16"	2"	48	NONE	ST-4		
16	BLOCKING	BK1	6.75" X 7.5"	0'-10 1/2"	2"	47	NONE	ST-4		
2	RAIL	R1	6.75" X 13.5"	58'-3"	2"	48	NONE	ST-4		

HARDWARE SCHEDULE

MARK	CONN.	NO.	DESCRIPTION	DETAIL ON SHT	NOTES
MK-1	S1	16	WELD ASSEMBLY	ST-3	HDG
MK-2	S1	16	WELD ASSEMBLY	ST-3	HDG
MK-3	S4	4	3/16"X12.25X23 PLATE	ST-3	HDG
		448	5/8"Ø X 7 1/2" DH BOLT	-	HDG
		350	3/4"Ø X 12" DH BOLT	-	HDG
		32	3/4"Ø X 24" DH BOLT	-	HDG
		32	7/8"Ø X 9" DH BOLT	-	HDG
		96	7/8"Ø X 7" M.B.	-	HDG
		48	1"Ø X 10" M.B.	-	HDG
		448	5/8"Ø NUTS	-	HDG
		382	3/4"Ø NUTS	-	HDG
		128	7/8"Ø NUTS	-	HDG
		48	1"Ø NUTS	-	HDG
		382	3/4"Ø MALLEABLE WASHER	-	HDG
		32	7/8"Ø MALLEABLE WASHER	-	HDG
		16	1"Ø MALLEABLE WASHER	-	HDG
		96	4"Ø (7/8" BOLT) SHEAR PLATE	-	HDG
		448	3/8" DECK CLIP (A36)	ST-3	HDG

NOTE: ALL GLB SHALL BE FABRICATED PRIOR TO PRESSURE TREATMENT, PER NOTE 7.4 ON SHEET 1 PROJECT 0416-58-TD

APPROVER VERIFY ALL DIMENSIONS, SPACING, ETC.
SINCE ALL GLULAM WILL BE FABRICATED IN THE SHOP

CODES:

AASHTO 2017 LRFD STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 5TH ED.
AMERICAN NATIONAL STANDARD FOR WOOD PRODUCTS - STRUCTURAL GLUED LAMINATED TIMBER ANSI A190.1 (LATEST EDITION).
AITC 117-2015 STANDARD SPECIFICATIONS FOR STRUCTURAL GLUED LAMINATED TIMBER OF SOFTWOOD SPECIES.
AWPA BOOK OF STANDARDS (LATEST EDITION).
WWPI BEST MANAGEMENT PRACTICE FOR TREATING WOOD IN AQUATIC ENVIRONMENT.
NDS 2012: NATIONAL DESIGN SPECIFICATIONS.

LAMINATED WOOD SPECIFICATIONS:
SPECIES:..... SP
TREATING:.....PENTACHLOROPHENOL TYPE A WITH RETENTION OF 0.6 PCF
LAMINATION THICKNESS:....2" (NOMINAL)
STRESS COMBINATION:.....SEE MATERIAL LIST
ADHESIVE:.....RESORCINOL
APPEARENCE GRADE:.....INDUSTRIAL
GLB FINISH:.....NONE
PROTECTION:.....NONE

WOOD SHOP NOTES:
1. MATERIALS, MANUFACTURE AND QUALITY CONTROL OF GLULAM SHALL BE IN CONFORMANCE WITH "AMERICAN NATIONAL STANDARD FOR WOOD PRODUCTS - STRUCTURAL GLUED LAMINATED TIMBER ANSI/AITC A190.1-2002".
2. MEMBERS SHALL BE MARKED (IN AN UNSEEN LOCATION) WITH AN AITC QUALITY MARK AND, IN ADDITION, AN AITC CERTIFICATE OF CONFORMANCE SHALL BE PROVIDED TO INDICATE CONFORMANCE WITH "ANSI/AITC A190.1-2002".
3. ALL HOLES IN WOOD TO BE 13/16"Ø U.N.O.
4. GLULAM BEAMS SHALL BE FACTORY FABRICATED PRIOR TO PRESSURE TREATMENT.

STEEL & HARDWARE SHOP NOTES:
1. ALL STEEL PLATES TO BE ASTM A36.
2. ALL WELDING IS TO BE DONE IN ACCORDANCE WITH THE LATEST AWS STANDARDS. IF WELD ARE NOT SPECIFIED, ALL WELDS ARE TO DEVELOP FULL STRENGTH OF ALL COMPONENTS PARTS. WELDING BY OTHERS.
3. ALL BOLTS TO BE ASTM A307.
4. ALL LAGS TO CONFORM TO ANSI/ASME STANDARD B18.2.1-1996.
5. ALL HOLES IN STEEL TO BE 13/16"Ø U.N.O.
6. ALL FABRICATED STEEL TO BE HOT DIPPED GALVANIZED (WHERE NOTED).
7. ALL BOLTS, NUTS, WASHERS AND LAGS TO BE HOT DIPPED GALVANIZED (WHERE NOTED).
8. IF GALVANAZING IS USED ON FABRICATED STEEL OR HARDWARE, VERIFY HOLE TOLERANCES AND TOLERANCES OF THREADED PARTS FOR COMPATIBILITY.
9. SHAPED STEEL PLATES MAY BE CUT TO SHAPE FROM ONE LARGER PLATE OR CONSTRUCTED OF INDIVIDUAL PLATES, BEVELED, FULL PENETRATION WELDED AND THEN GROUND SMOOTH.

ERECTION NOTES:
ALL WOOD MEMBERS MUST BE PROPERLY BRACED UNTIL THE COMPLETE STRUCTURAL SYSTEM HAS BEEN CONSTRUCTUED. CORRECTION OF MINOR MISFITS AND A REASONABLE AMOUNT OF CUTTING, REAMING, REDRILLING OR ALIGNMENT WITH DRIFT PINS WILL BE CONSIDERED A LEGITIMATE EXPENSE OF ERECTION.
IN THE EVENT OF ERROR, DEFECT IN MATERIALS, AND/OR WORKMANSHIP OF SHOP WORK WHICH PREVENTS PROPER ASSEMBLING AND FITTING UP OF PARTS BY THE MODERATE USE OF DRIFTS PINS, OR A MODERATE AMOUNT OF REAMING AND SLIGHT CUTTING, IMMEDIATELY REPORT TO THE SELLER AND OBTAIN SELLER'S APPROVAL OF THE METHOD OF CORRECTION.
BOLTS THAT ARE THROUGH SLOTTED HOLES IN STEEL ARE TO BE LEFT FINGER TIGHT ONLY TO ALLOW FOR FUTURE MOVEMENT.
A MOISTURE BARRIER MUST BE PROVIDED BETWEEN WOOD MEMBERS AND MASONRY OR CONCRETE AT ALL LOCATIONS (N.I.C.).

ARCHITECT/CONTRACTOR/OWNER NOTE:
CONSIDERATION MUST BE MADE TO ACCOMODATE DEFLECTIONS OF THE STRUCTURAL FRAMING SYSTEM. CONSIDERATION MUST ALSO BE MADE TO ACCOMODATE DIMENSIONAL CHANGES IN WOOD MEMBERS DUE TO CYCLIC CHANGES IN HUMIDITY CONDITIONS.

N.I.C. = NOT IN CONTRACT.

APPROVAL OF THESE SHOP DRAWINGS WILL BE CONSIDERED AS AN ACCEPTANCE OF ALL THE DATA SHOWN THEREON UNLESS OTHERWISE NOTED BY APPROVING AGENCY.

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REVISION	DATE	DESCRIPTION
1	05-10-17	RE-ISSUED FOR APPROVAL

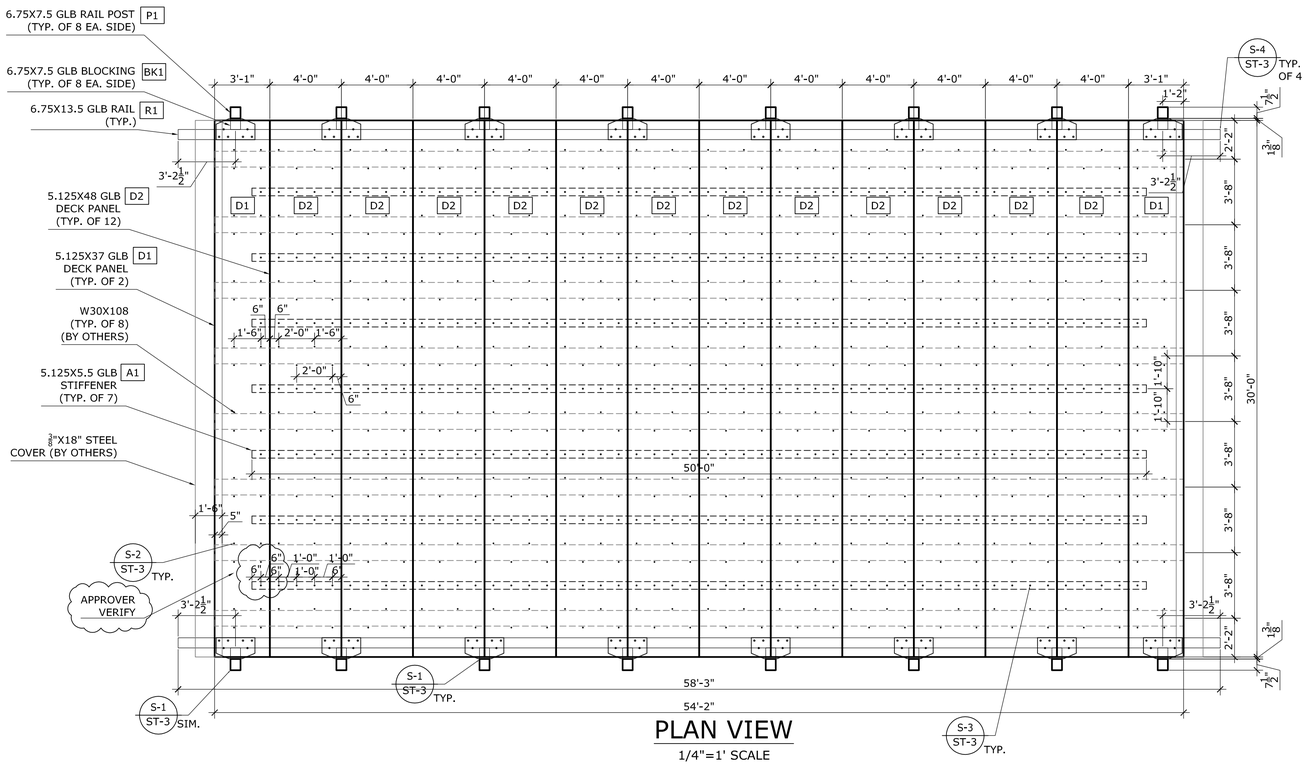
ST. LOUIS COUNTY BRIDGE NO. 516
ST. LOUIS COUNTY, MINNESOTA

MATERIAL LIST

	DATE
DESIGNED FB	03-24-2017
DRAWN FB	03-24-2017
CHECKED	

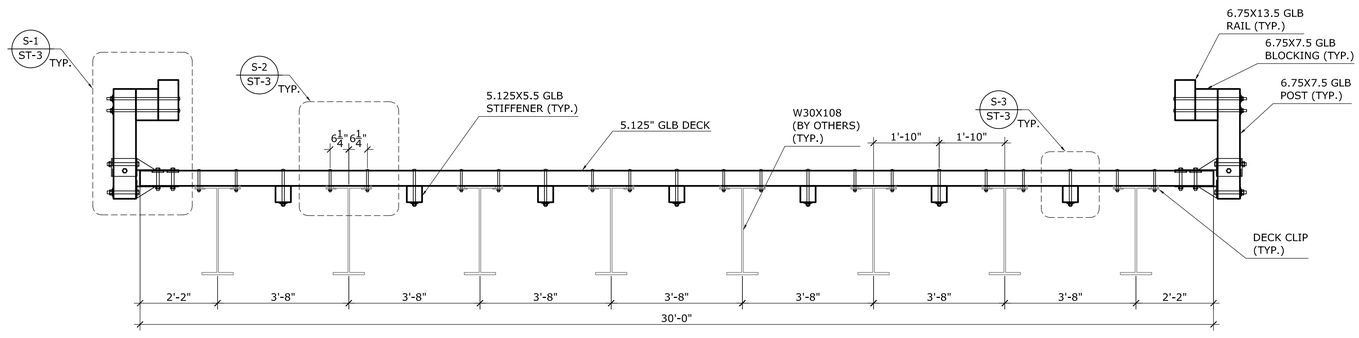
JOB NO.
2017-005

ST-01



PLAN VIEW

1/4"=1' SCALE



SECTION 1

1/2"=1' SCALE

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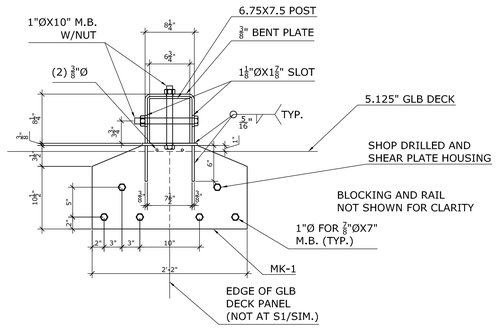
ST. LOUIS COUNTY BRIDGE NO. 516
ST. LOUIS COUNTY, MINNESOTA

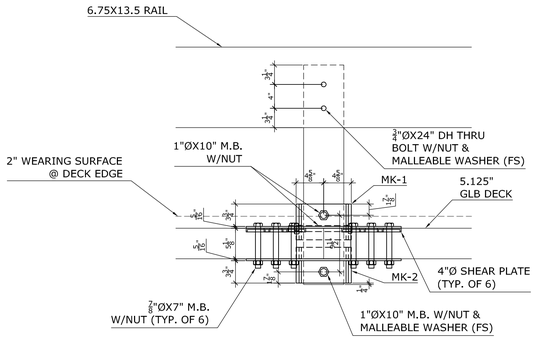
PLAN VIEW AND SECTION

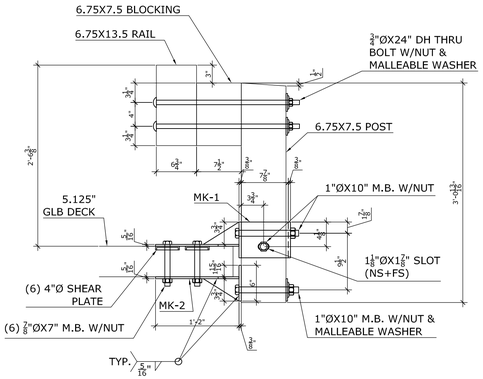
	DATE
DESIGNED FB	03-24-2017
DRAWN FB	03-24-2017
CHECKED	

JOB NO. 2017-005

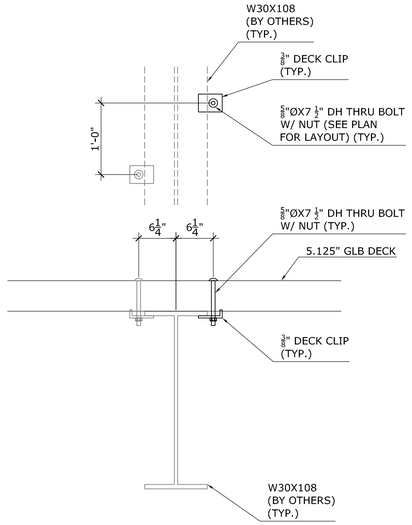
ST-02



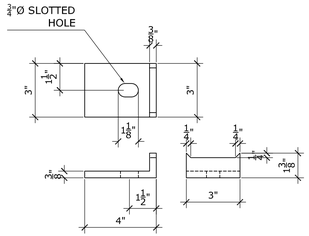




16	S1 CONNECTION
1"=1' SCALE U.N.O.	1- MK-1 1- MK-2 2- ¾"ØX24" DH BOLTS 6- ⅞"Øx7" M.B. 3- 1"ØX10" M.B. 2- ¾"Ø NUTS 6- ⅞"Ø NUTS 3- 1"Ø NUTS 2- ¾"Ø MALLEABLE WASHERS 1- 1"Ø MALLEABLE WASHER 6- 4" O.D. SHEAR PLATES



448	S2 CONNECTION
1"=1' SCALE U.N.O.	1- ⅞"Øx7 ½" DH THRU BOLT 1- ⅞"Ø NUT 1- ⅞" DECK CLIP

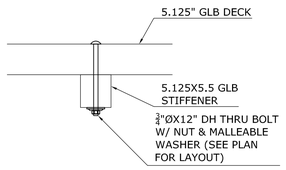


⅞" CLIP: (448) REQ'D
3"=1'-0" SCALE

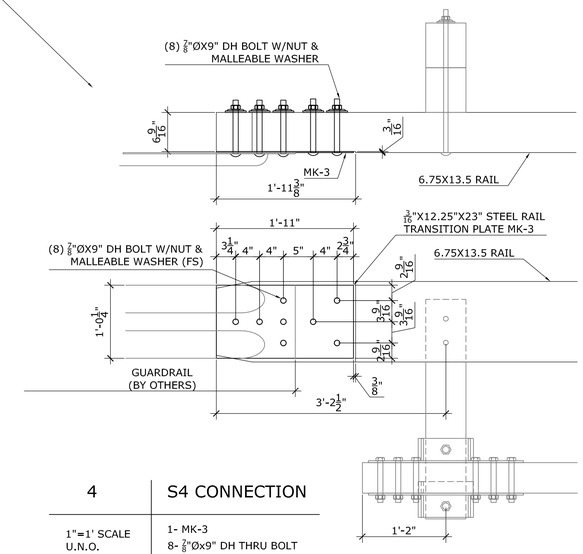
⅞" DECK CLIP DETAILED PER USDA STANDARD PLANS FOR TIMBER BRIDGE SUPERSTRUCTURE, "GLULAM DECKS FOR STEEL BRIDGES" SHEET 3 OF 7, DATED DECEMBER 2000.

ALTERNATE CLIP: CAST IRON "C" CLIP BY LAMINATED CONCEPTS, INC.

NOTE: RAILING DETAILED INFORMATION PER FIGURES 8 & 9 FROM THE DOCUMENT"DEVELOPMENT OF TWO TEST LEVEL 2 BRIDGE RAILINGS AND TRANSITIONS FOR USE ON TRANSVERSE GLUE-LAMINATED DECK BRIDGES", TRANSPORTATION RESEARCH RECORD 1743 PAPER NO. 01-0378.



350	S3 CONNECTION
1"=1' SCALE U.N.O.	1- ¾"Øx12" DH THRU BOLT 1- ¾"Ø NUT 1- ¾"Ø MALLEABLE WASHER



4	S4 CONNECTION
1"=1' SCALE U.N.O.	1- MK-3 8- ⅞"Øx9" DH THRU BOLT 8- ⅞"Ø NUT 8- ⅞"Ø MALLEABLE WASHER

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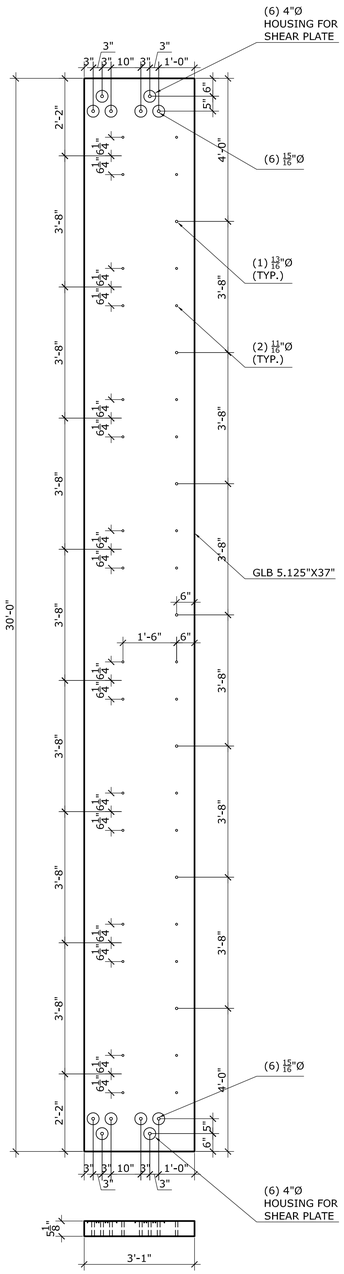
ST. LOUIS COUNTY BRIDGE NO. 516
ST. LOUIS COUNTY, MINNESOTA

DETAILS

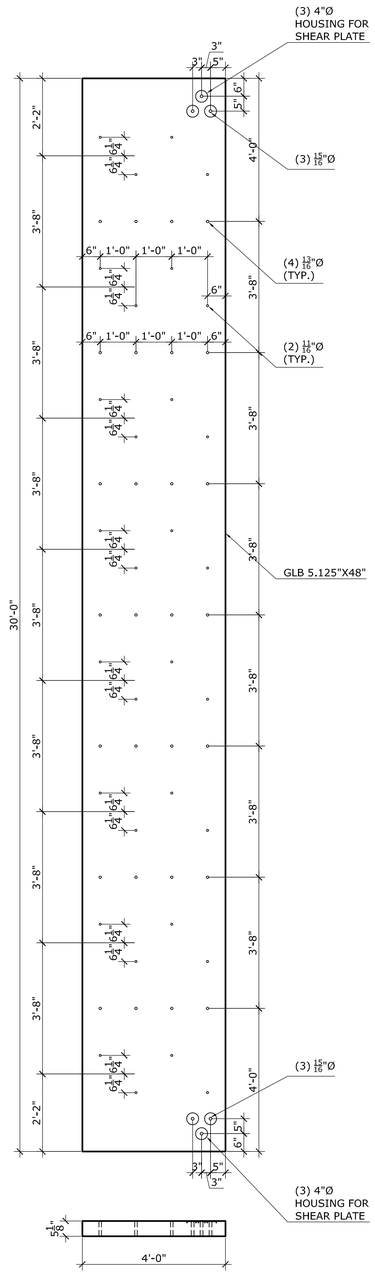
	DATE
DESIGNED FB	03-24-2017
DRAWN FB	03-24-2017
CHECKED	

JOB NO.
2017-005

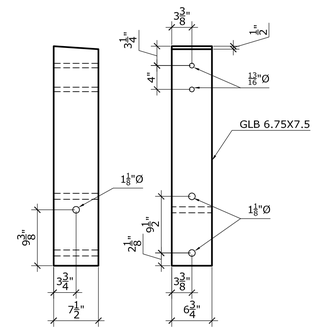
ST-03



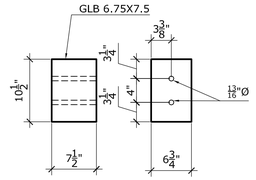
DECK D1 - (2) REQ'D
1/2"=1'-0" SCALE



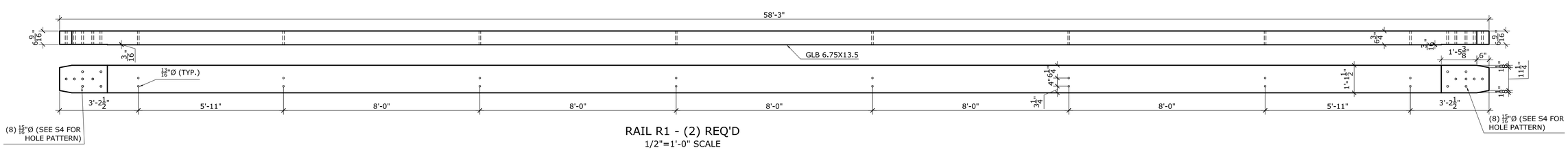
DECK D2 - (12) REQ'D
1/2"=1'-0" SCALE



1"=1'-0" SCALE



BLOCKING BK1 - (16) REQ'D
1"=1'-0" SCALE



RAIL R1 - (2) REQ'D
1/2"=1'-0" SCALE

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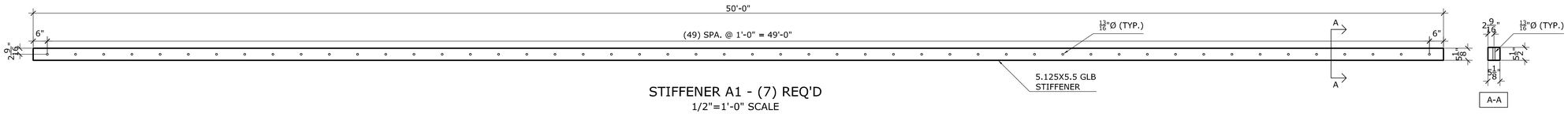
ST. LOUIS COUNTY BRIDGE NO. 516
ST. LOUIS COUNTY, MINNESOTA

DETAILS

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DESIGNED FB	03-24-2017
DRAWN FB	03-24-2017
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2017-005

ST-04



STIFFENER A1 - (7) REQ'D
1/2"=1'-0" SCALE

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ST. LOUIS COUNTY BRIDGE NO. 516
ST. LOUIS COUNTY, MINNESOTA

DETAILS

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JOB NO.
2017-005

ST-05

APPENDIX E
HENNEPIN COUNTY TIMBER BRIDGE DEMONSTRATION PROJECT

Minnesota Structure Inventory Report

Bridge ID: L8081 CR 202(ELM CRK RD) over ELM CREEK

+ GENERAL +

Agency Br. No.	190
District	05 Maint. Area
County	027 - Hennepin
City	Dayton
Township	
Desc. Loc.	1.5 MI E OF JCT CSAH 121
Sect., Twp., Range	35 - 120N - 22W
Latitude	45 d 09 m 47.54 s
Longitude	-93 d 26 m 11.87 s
Custodian	02 - County Highway Agency
Owner	02 - County Highway Agency
Year Built	1973
Date Opened to Traffic	1/1/1973
MN Year Remodeled	
FHWA Year Reconstructed	
Bridge Plan Location	4 - MUNICIPAL
Potential ABC	2 - N/A

+ STRUCTURE +

Service On	1 - Highway
Service Under	5 - Waterway
Main Span Type	3 - Steel
Main Span Design	01 - Beam Span
Main Span Detail	
Appr. Span Type	
Appr. Span Design	
Appr. Span Detail	
Skew	16 RIGHT
Culvert Type	
Barrel Length	

Number of Spans

MAIN: 1 APPR: 0 TOTAL:

Main Span Length	27.3 ft	
Structure Length	34.9 ft	
Deck Width (Out-to-Out)	17.8 ft	
Deck Material	8 - Wood or Timber	
Deck Installation Year		
Wear Surf Type	6 - Bituminous	
Wear Surf Install Year	2005	
Wear Course/Fill Depth	0.16 ft	
Deck Membrane	0 - None	
Deck Rebars	N - Not Applicable (no deck)	
Structure Area (Out-to-Out)	621 sq ft	
Roadway Area (Curb-to-Curb)	581 sq ft	
Sidewalk Width - L/R	0.00 ft	0.00 ft
Curb Height - L/R	0.67 ft	0.67 ft
Rail Codes - L/R	32	32

+ ROADWAY ON BRIDGE +

Road Name	ELM CRK RD (CR 202)
Functional Class.	09 - Rural - Local
ADT	580 YEAR 2014
HCADT	ADTT %
National Highway System	
Route Sys/Nbr	07 - CNTY / 202
Ref. Point (TIS)	
Detour Length	6 mi.
Lanes	1 Lanes ON Bridge
Control Section (TH Only)	
Function	1 - MAINLINE
Type	3 - One lane bridge for 2-way traffic
Bridge Match ID	0
Roadway Key	Route On Structure

+ RDWY DIMENSIONS ON BRIDGE +

If Divided:	NB-EB	SB-WB
Roadway Width	16.50 ft	ft
Vertical Clearance	ft	ft
Max. Vert. Clear.	ft	ft
Horizontal Clear.	ft	ft
Appr. Surface Width	22.0 ft	
Bridge Roadway Width	16.5 ft	
Median Width On Bridge	ft	

+ MISC. BRIDGE DATA +

Structure Flared	0 - No flare
Parallel Structure	N - No parallel structure
Field Conn. ID	
Cantilever ID	

Foundations (Material/Type)

Abutment	2 - TIMBER	4 - PILE BENT
Pier	N - N/A	N - N/A
Historic Status	5 - Not eligible	
On - Off System	0 - OFF	

+ PAINT +

Year Painted	1973
Painted Area	2205 sq ft
Primer Type	1 - Lead - non 3309
Finish Type	C - Lead Silica Chromate

+ BRIDGE SIGNS +

Posted Load	2 - Vehicle & Semi (Type R12-5)
Traffic	0 - Not Required
Horizontal	2 - Width Restrictions
Vertical	N - Not Applicable

+ INSPECTION +

Structurally Deficient	Y
Functionally Obsolete	N
Sufficiency Rating	19.8
Last Routine Insp Date	09/24/2018
Routine Insp Frequency	12
Inspector Name	Hagstrom, Pat
Status	P - Posted for Load

+ NBI CONDITION RATINGS +

Deck	5
Superstructure	4
Substructure	5
Channel	5
Culvert	N

+ NBI APPRAISAL RATINGS +

Structure Evaluation	3
Deck Geometry	2
Underclearances	N
Waterway Adequacy	8
Approach Alignment	4

+ SAFETY FEATURES +

Bridge Railing	0 - SUBSTANDARD
GR Transition	0 - SUBSTANDARD
Appr. Guardrail	1 - MEETS STANDARDS
GR Termini	0 - SUBSTANDARD

+ SPECIAL INSPECTIONS +

	Y/N	Freq	Date
Frac. Critical			
Underwater			
Pinned Asbly.			

+ WATERWAY +

Drainage Area (sq mi)	
Waterway Opening (sq ft)	216
Navigation Control	0 - No nav. control on waterway
Pier Protection	
Nav. Clr. (ft)	Vert. 0.0 Horiz. 0.0
Nav. Vert. Lift Bridge Clear. (ft)	
MN Scour Code	K - LIMITED RISK
Scour Evaluation Year	2009

+ CAPACITY RATINGS +

Design Load	0 - Other/Unknown
Operating Rating	2 - HS TRUCK 5.74
Inventory Rating	2 - HS TRUCK 3.44
Posting	VEH: 6 SEMI: 12 DBL: 12
Rating Date	09/29/2015

Overweight Permit Codes

A: X B: X C: X

MINNESOTA BRIDGE INSPECTION REPORT

12/06/2018

BRIDGE L8081 CR 202(ELM CRK RD) OVER ELM CREEK

County: Hennepin
City: Dayton
Township:
Section: 35 Township: 120N Range: 22W
Span Type: 3 - Steel 2 - Stringer/Multi-beam or Girder
List:
NBI Deck: 5 Super: 4 Sub: 5 Chan: 5 Culv: N

Location: 1.5 MI E OF JCT CSAH 121
Route: 07 - CNTY 202 Ref. Pt.: 003+00.990
Control Section:
Maint. Area:
Local Agency Bridge Nbr.: 190
Open, Posted, Closed: P - Posted for Load
MN Scour Code: K - LIMITED RISK

Length: 34.9 ft.
Deck Width: 17.8 ft.
Rdwy. Area/ Pct. Unsnd: 581 sq. ft. / %
Paint Area/ Pct. Unsnd: 2205 sq. ft. / 90%
Culvert: N/A
Postings: 6 12 12

Appraisal Ratings - Approach: 4 Waterway: 8
Required Bridge Signs - Load Posting: 2 - Vehicle & Semi (Type R12-5) Traffic: 0 - Not Required
Horizntal: 2 - Width Restrictions Vertical: N - Not Applicable

Unofficial Structurally Deficient Y
Unofficial Functionally Obsolete N
Unofficial Sufficiency Rating 19.8

ELEM NBR	ELEMENT NAME	REPORT TYPE	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4
31	Timber Deck	Routine	09/24/2018	621 SF	0	621	0	0
		Routine	09/11/2017	621 SF	0	621	0	0
	Notes: 31. '15-bottom of deck is leaking & some boards wet w/ small areas of mold. '16-deck has many areas of staining. Mod checks & splits on ends of planks. '17, '18-no change.							
	510 - Wearing Surfaces	Routine	09/24/2018	581 SF	461	12	108	0
		Routine	09/11/2017	581 SF	519	9	53	0
	Notes: 510. Tire wear has reduced plank thickness. New bit O/L added in '05. 1/2"-1 1/2" deflection under live load @ midspan. Many trans cracks. Old bit O/L in '01. Timber deck has been saturated w/ water in past. Numerous trans cracks in bit O/L. '13-cracks are unsealed, mod to large in size. '14-cracks are spaced 3'-5' apart. '15-vegetation growing along curb lines. Move to CS 3 because of mod to large sized cracks in bit O/L w/ spacing <5'. '16-mod-large trans cracks spaced 1'-3' apart. 2 full length mod sized long cracks. 1 SF Spall @ E. '17-spall @ E patched w/ bit. Cracks @ ends in app patches. '18-map cracking @ W end. Few minor spalls @ ends. Mod density (3'-4') in NE, cracks large in size.							
107	Steel Open Girder/Beam	Routine	09/24/2018	407 LF	0	0	380	27
		Routine	09/11/2017	407 LF	0	0	390	17
	Notes: 107. Stringers rusted. E & W 1/3 of flanges mod rusted w/ some section loss. Reinforcement plate has been bolted over 5 " X 1" hole in web of fascia beam bearing areas in NW & SW corners. N fascia channel tipped. Diaphragm added between N fascia & adj beam @ W end. Sheet rust on lower flanges @ numerous bearings. '10-exterior of fascia channels heavily sheet rusted. Approx 1" hole in bottom flange of N fascia 3' from W end. 80% of top & bottom flanges are sheet rusted. '12-N fascia channel has a 10" x 3" hole in the web +/- 10' from E abut. '13-most bottom flanges are mod-heavily sheet rusted. Hole in N fascia is now 12" x 3". A few of the beams @ the W abut do not have sheet rust on bottom flange. From plans, original bottom flange of beam is .465" or 7/16"; web thickness = .265". '14-heavy pitting of both fascias, up to 1/8" on S fascia. Hole web of N fascia by E abut is now 12" x 6"; another hole on W end is 3" x 1". The bottom of the original web in NW has a 1-1/2" x 15" area of total section loss - 2 bottom bolts of steel reinforcement plate don't hold anything. '15-hole in N fascia by E abut is 14" x 8". 1" x 1" hole in N fascia, 7' from W abut. 1-1/2" x 4" area of section loss on bottom flange of S fascia @ W abut. Most bottom flanges have some degree of sheet rust. '16-N fascia channel has numerous perforations. Hole by E abut is now 18" x 9 1/2". '17-S fascia has +/- 1 SF more section loss. '18-15' of 100% section loss on S channel fascia, 10' on N channel fascia. 4th beams from N @ E abut has 2' of beam deformed.							
	515 - Steel Protective Coating	Routine	09/24/2018	2205 SF	0	22	221	1962
		Routine	09/11/2017	2205 SF	0	220	0	1985
	Notes: 515. '16-paint is mostly gone. Remaining paint is faded, chipped or flaking. '17-no change. '18-est 1% faded, 10% flaked/peeled & 89% failed.							
216	Timber Abutment	Routine	09/24/2018	76 LF	0	69	6	1
		Routine	09/11/2017	76 LF	0	69	6	1
	Notes: 216. '13-both abuts weathered. EAST-4 cable tie-backs. '14, '15-no change. '16-splintered plank 4th from top in SE. 2nd plank from top @ N end of E has 2' of decay. '17-no change. WEST-'14-hollow sound about 2' horiz while tapping @ N end about 5' below pier cap. '15-minor crack in 3rd board from cap between 2nd & 3rd col from S. Leakage @ SW below 3rd board from cap. '16-delam between 2nd & 3rd from S, 3rd board from top. 2' x 4' backfill infiltration @ SW corner. '17, '18-no change.							
	Wingwall notes: SE pile rotted & top board deteriorated. '13, '14, '15-no change. '16-Several boards in SE have some decay, crushing. '17, '18-no change.							

BRIDGE L8081 CR 202(ELM CRK RD) OVER ELM CREEK

ELEM NBR	ELEMENT NAME	REPORT TYPE	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4
228	Timber Pile	Routine	09/24/2018	18 EA	0	13	3	2
		Routine	09/11/2017	18 EA	0	13	3	2
	Notes: 228. Piles @ abut & 2 @ each wing. '13-many checks in all @ E abut. About 12" @ the base of the 2nd post from S @ E abut is rotted. '14-3rd column from S @ E shows some decay. S column @ E also has some minor decay. '15-some checks mod in size. 3' of decay in 2nd from S @ E abut. Dry rot in 2nd from S @ W-5 boards below cap. '15-top of columns in SW & SE are mod splintered. '16-SE pile is severely decayed. Pile in NE has minor decay. '17, '18-no change.							
235	Timber Pier Cap	Routine	09/24/2018	52 LF	0	52	0	0
		Routine	09/11/2017	52 LF	0	52	0	0
	Notes: 235. 15" steel channel for beams to bear on. 3 1/4" legs. Tilted @ E abut. '13-sheet rust on steel covering both caps. '14-'15-no change. '16-added 4' in each corner for cap extensions. '17, '18-no change.							
311	Movable Bearing	Routine	09/24/2018	24 EA	0	0	0	24
		Routine	09/11/2017	24 EA	0	0	0	24
	Notes: 311. Bearings are severely sheet rusted w/ much section loss. '13-'18, annually-no change.							
330	Metal Bridge Railing	Routine	09/24/2018	69 LF	0	0	10	59
		Routine	09/11/2017	69 LF	0	0	10	59
	Notes: 330. Railings rusted & tipped out. '13-posts @ midspan spreader are mod rusted & twisted - N one is worse. S has pack rust @ connection. Small holes in railing @ most vert guardrail braces. '14-missing bolt on vert rail to S fascia beam. '15-coin sized to 3" x 3" holes in lower rail, mostly near post locations. '16-upper rails have pack rust on most outsides. Up to 1' x 4" holes. '17- lower connection has many loose bolts & areas w/ section loss & pack rust for most of the length. '18-no change.							
	515 - Steel Protective Coating	Routine	09/24/2018	230 SF	0	0	138	92
		Routine	09/11/2017	230 SF	0	0	46	184
	Notes: 515. '16-most rail has surface or freckled rust. Remaining paint is flaking, heavily faded & blistered. '17-no change. '18-est 60% flaked/peeled & 40% failed.							
800	Critical Deficiencies or Safety Hazards	Routine	09/24/2018	1 EA	1	0	0	0
		Routine	09/11/2017	1 EA	1	0	0	0
	Notes: 800. No critical structural deficiencies or serious safety hazards are present on this structure.							
822	Bituminous Approach Roadway	Routine	09/24/2018	2 EA	0	0	2	0
		Routine	09/11/2017	2 EA	0	0	2	0
	Notes: 822. Approaches settled @ both ends. '13-settlement has caused some larger cracks @ deck connection, especially the E end. '14-approaches have been patched, but dips are still prevalent. '15-some minor cracking showing through patches. Dip remains. '16-spall in E at bridge. Mod cracks in both @ abut. '17-settlement @ apps. Spall patches @ E. Large cracks @ W, minor cracks in patches @ E. '18-minor potholes in W w/ no additional settlement. Settlement is 2"-3" in SE, 1"-2" in NE.							
855	Secondary Members (Superstructure)	Routine	09/24/2018	1 EA	0	0	1	0
		Routine	09/11/2017	1 EA	0	0	1	0
	Notes: 855. Spreader beam @ midspan is moderately rusted w/ small web hole. Angle braces installed @ SW & NW corners in '07. A channel brace added to brace N fascia channel. '13-spreader beam is bowed. '14-no change. '15-mod to heavy rust on spreader beam. '16-2 areas of 100% section loss on spreader. Spreader does not contact beams except @ N fascia & 1st 3 beams on S end. '17, '18-no change.							
881	Steel Section Loss	Routine	09/24/2018	1 EA	0	0	0	1
		Routine	09/11/2017	1 EA	0	0	0	1
	Notes: 881. 5-10% section loss on flanges of 40% of stringers. BJJ did a load rating check using the 2005 rating as a basis. He assumed 15% section loss on beams and found rating was still OK as section loss on beams has not yet reached that mark. '13-field measurements taken have few bottom flanges @ 1/2". HC engineer verified section loss has not reached the 15% mark. '14-Section Loss of bottom flange measurements: 4th beam from S, 1' W of spreader beam = 13/32"; 9th beam from S, 6' W of spreader = 11/32"(worst case); 2nd beam from N, 1' W of spreader beam = 5/8"(expansion of flange from rust). At least some section loss has occurred on most beams. An estimated average would be between 8% - 10%. '15-measurement of 4th beam from S, 1' W of spreader beam = 3/8". Holes in N fascia-see element 107. '16-used calipers to measure flange thickness-1/4" @ 9th beam from S; 15/32" @ 2nd from N; 9/32" @ 4th from S. 18" x 9.5" hole in N fascia 10' from E abut. '17, '18-larger areas of channels rusted thru. No more notable section loss of beams.							

BRIDGE L8081 CR 202(ELM CRK RD) OVER ELM CREEK

ELEM NBR	ELEMENT NAME	REPORT TYPE	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4
885	Scour	Routine	09/24/2018	1 EA	1	0	0	0
		Routine	09/11/2017	1 EA	1	0	0	0
	Notes: 885. K - Limited risk. Monitoring required. '14-due to lots of rain from April to June of this year, much of the drift that had accumulated in the channel was washed away. We cross sectioned both sides of the bridge in September to get new baseline readings. Channel bottom @ E abut is slightly below the bottom of the timber boards on the E side. Continue to monitor. '15-no significant runoff events this year. Will continue to monitor. '16-major rain event on 9/22 caused closure of bridge as water touched bottom of beams. Bridge was monitored for scour during this time and on 10/13 bridge staff evaluated structure and found no concerns. Bridge was opened up to traffic on 10/14. '17, '18-no change.							
890	Load Posting or Vertical Clearance Signing	Routine	09/24/2018	1 EA	1	0	0	0
		Routine	09/11/2017	1 EA	1	0	0	0
	Notes: 890. '16-load posting signs are in place & in good condition. '17, '18-no change.							
891	Other Bridge Signing	Routine	09/24/2018	1 EA	1	0	0	0
		Routine	09/11/2017	1 EA	1	0	0	0
	Notes: 891. Horiz clearance signs @ all corners. NW clearance sign is bent. One Lane Bridge signs @ approaches. Permanent type III barricade @ SW guardrail end for EB traffic. '13-SW & NW horiz clearance signs are scraped, slightly bent. '14-no change. '15-NW & SW signs have been repaired/replaced. In September, bridge received new load rating & signs were placed in October. '16-new horiz clearance markers in all corners. '17, '18-no change.							
892	Slopes & Slope Protection	Routine	09/24/2018	1 EA	0	1	0	0
		Routine	09/11/2017	1 EA	0	1	0	0
	Notes: 892. '16-vegetated; mod erosion around NE, NW & SW wings. '17, '18-no change.							
893	Guardrail	Routine	09/24/2018	1 EA	0	1	0	0
		Routine	09/11/2017	1 EA	0	1	0	0
	Notes: 893. Guardrail continuous over bridge-attached to steel railing. All ends turned down. Plate beam has minor damage. NW has moderate damage. '13-no change. '14-SW has minor damage. '15-SW & SE ends have been replaced w/ crashworthy end treatments. '16-SW has impact damage, slightly bent & 1 post leaning. 2 posts broken in NW. '17, '18-no change.							
894	Deck & Approach Drainage	Routine	09/24/2018	1 EA	0	0	1	0
		Routine	09/11/2017	1 EA	0	0	1	0
	Notes: 894. '16-no deck drains, debris along both curbs shows runoff may not be getting off deck. '17, '18-veg along curb.							
895	Sidewalk, Curb, & Median	Routine	09/24/2018	1 EA	0	1	0	0
		Routine	09/11/2017	1 EA	0	1	0	0
	Notes: 895. Timber curb on N side is cracked and gouged. '14-no change. '15-N curb is 50% deteriorated near center of span. '16-cracks in S on W half. Large split in N @ E end. N curb is deteriorated throughout. '17-veg growing, moss beginning to cover curbs. '18-no change.							
899	Miscellaneous Items	Routine	09/24/2018	1 EA	1	0	0	0
		Routine	09/11/2017	1 EA	1	0	0	0
	Notes: 899. USGS monitoring station in NW. '14-bank erosion in NW corner is within 6' of USGS station. '16-bank erosion is within 4' of USGS station. '17-new delineators on bridge about 2' from outside beams to reduce loading on outer beams. '18-one delineator loose in SW.							
900	Protected Species	Routine	09/24/2018	1 EA	0	1	0	0
		Routine	09/11/2017	1 EA	1	0	0	0
	Notes: 900. '16-none noted. '17, '18-no change.							

General Notes: BRIDGE L8081(190) CR 202 (Elm Creek Rd)/Elm Creek 9/24/18 PTH, DSP & TSM.
Jurisdictional transfer in '05. Bridge to be replaced beginning 12/2018; HC Proj 0408, New bridge #27C53

Recommended Repairs:

31. Seal deck cracks.
107. Monitor stringers for section loss.
822. Pave bit approaches to ramp onto bridge. Seal cracks. Monitor ramped bit apps.
311. Monitor bearings.
899. Monitor channel erosion in NW near USGS station.
899. Reattach loose traffic delineator in SW.

58. Deck NBI: '16-large cracks in bit overlay. Timber planks are stained w/ many checks and splits.

BRIDGE L8081 CR 202(ELM CRK RD) OVER ELM CREEK

ELEM NBR	ELEMENT NAME	REPORT TYPE	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4

36A. Brdg Railings NBI:

36B. Transitions NBI:

36C. Appr Guardrail NBI:

36D. Appr Guardrail Terminal NBI:

59. Superstructure NBI: '16-steel beams have areas of section loss. Bearings severely rusted w/ section loss.

60. Substructure NBI: '15-moderate decay of few timber columns at abutments.

61. Channel NBI: Stream has had lateral migration to the west at the south end. Bank in NW has extensive erosion.

62. Culvert NBI:

71. Waterway Adeq NBI:

72. Appr Roadway Alignment NBI: 15 MPH curve just west of bridge.

Pat Hagstrom
Inspector's Signature

Jacob Bronder
Reviewer's Signature

PLAN SYMBOLS

COUNTY LINE
SECTION LINE
QUARTER LINE
SIXTEENTH LINE
NEW RIGHT OF WAY LINE
PRESENT RIGHT OF WAY LINE
PROPERTY LINE (EXCEPT LAND LINES)
VACATED PLATTED PROPERTY
CORPORATE OR CITY LIMITS
TRUNK HIGHWAY CENTER LINE
RETAINING WALL
RAILROAD
WATER LINE
MEANDER CORNER
DRAINAGE DITCH
DRAIN TILE
CULVERT
GUARD RAIL
BARBED WIRE FENCE
CHAIN LINK FENCE C-L C-L
STONE WALL OR FENCE
HEDGE
RAILROAD CROSSING SIGN
MARSH
WOODS, ORCHARD, BRUSH, NURSERY — WOODS
CATCH BASIN
FIRE HYDRANT
OVERPASS (HIGHWAY OVER)
UNDERPASS (HIGHWAY UNDER)
BRIDGE
BUILDING
IRON PIPE OR ROD
MONUMENT (STONE, CONCRETE OR METAL)
SMALL SIGN
CONSTRUCTION ZONE LINE — PE — PE

UTILITY SYMBOLS

POWER POLE
TELEPHONE POLE
ANCHOR
STEEL TOWER
STREET LIGHT
TELEVISION CABLE RISER
WATER MAIN
CONDUIT
TELEPHONE CABLE IN CONDUIT
ELECTRIC CABLE IN CONDUIT — P
TELEPHONE MANHOLE
ELECTRIC MANHOLE
BURIED TELEPHONE CABLE — T-BUR
BURIED ELECTRIC CABLE — P — P
STORM SEWER
SEWER MANHOLE
SANITARY SEWER — S
GAS MAIN — G
TELEVISION CABLE — TV
FIBER OPTIC — F/O

MINNESOTA DEPARTMENT OF TRANSPORTATION
HENNEPIN COUNTY TRANSPORTATION DEPARTMENT

CONSTRUCTION PLAN FOR: BRIDGE REPLACEMENT, GRADING, AND BITUMINOUS PAVEMENT

COUNTY STATE AID HIGHWAY NO. 202

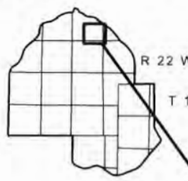
CITY OF DAYTON

LOCATION: BR. NO. L8081 OVER ELM CREEK ON ELM CREEK RD.

GROSS LENGTH	**1167.00**	FEET	**0.221**	MILES
BRIDGE LENGTH	**68.00**	FEET	**0.013**	MILES
EXCEPTION LENGTH	**682.14**	FEET	**0.13**	MILES
NET LENGTH	**1167.00**	FEET	**0.221**	MILES

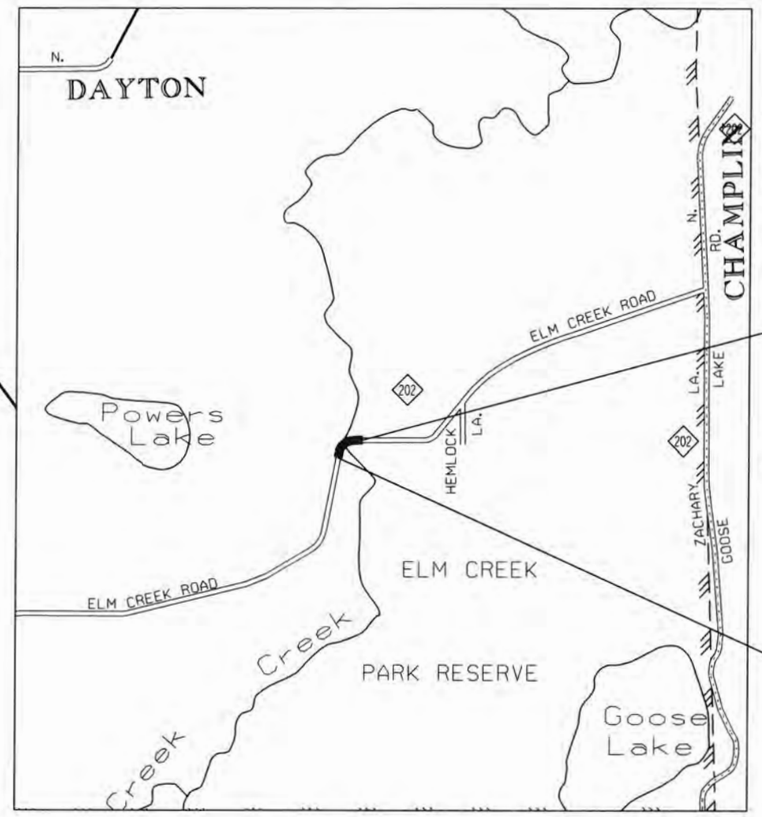
PROJECT IS LOCATED WITHIN THE FOLLOWING LAND SECTIONS:

T 120 N, R 22 W SECTIONS: 35





PROJECT LOCATION
HENNEPIN COUNTY
MnDOT METRO DISTRICT



END S.P. 027-596-009
℄ 202 20+50.00

BEGIN S.P. 027-596-009
℄ 202 STA. 8+83.00

BRIDGE NO. INPLACE L8081
BRIDGE NO. PROPOSED 27C53
STA. 15+99.12 TO STA. 16+67.23

N

SCALES

PLAN	1"= 50'
INDEX MAP	1"= 16,000'
GENERAL LAYOUT	1"= 100'
PROFILE	50' HORIZ. 5' VERT.

DESIGN DESIGNATION

ADT (CURRENT YEAR) 2018	=	**800**
ADT (DESIGN YEAR) 2038	=	**1000**
DHV (DESIGN HR. VOL.)	=	**N/A**
D (DIRECTIONAL DISTR.)	=	**N/A**
T (HEAVY COMMERCIAL)	=	**N/A**
R VALUE	=	**30**
10 TON DESIGN LOAD		

$\sum^{N18}$ (20) **86,000**
DESIGN SPEED **35 MPH**
BASED ON **STOPPING** SIGHT DISTANCE
HEIGHT OF EYE **3.5'**
HEIGHT OF OBJECT **2.0'**
FUNCTIONAL CLASS **MINOR COLLECTOR**
NO. OF TRAFFIC LANES **2**
NO. OF PARKING LANES **0**
SHOULDER WIDTH **4.0'**

DESIGN EXCEPTION: DESIGN SPEED NOT ACHIEVED AT; STA. 9+95.66 TO STA. 16+77.80 30 MPH

THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS QUALITY LEVEL WAS DETERMINED ACCORDING TO GUIDELINES OF CI/ASCE 38-02 ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA."

MINN. PROJ. NO. BROS 2718 (125)

GOVERNING SPECIFICATIONS

THE 2018 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION", AND ALL SUPPLEMENTS THERETO, SHALL GOVERN. ALL TRAFFIC CONTROL DEVICES SHALL CONFORM AND BE INSTALLED IN ACCORDANCE TO THE MOST RECENT EDITION OF THE " MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES INCLUDING "FIELD MANUAL FOR TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS".

INDEX

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2	GENERAL LAYOUT
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5	EARTHWORK TABULATIONS & STANDARD PLATES
6	QUANTITY TABULATIONS
7-8	PUBLIC UTILITY PLAN AND TABULATIONS
9	TYPICAL SECTIONS
10-33	STANDARD PLANSHEETS
34	ALIGNMENT PLAN AND TABULATIONS
35-36	REMOVAL PLAN
37-38	CONSTRUCTION PLAN
39	PROFILES
40-41	SUPER ELEVATION AND TURF ESTABLISHMENT
42-44	SWPPP
45-46	EROSION CONTROL PLAN
47-48	CROSS SECTION MATCH LINE LAYOUT
49-59	CROSS SECTIONS
TC 1-TC 7	TRAFFIC CONTROL PLAN
SS1-SS5	STRIPING AND SIGNING PLAN
B1-B26	BRIDGE PLAN

THIS PLAN CONTAINS 97 SHEETS

APPROVED — HENNEPIN COUNTY: COUNTY HIGHWAY ENGINEER — 6/12/18 DATE

RECOMMENDED FOR APPROVAL — HENNEPIN COUNTY: BRIDGE DIVISION ENGINEER — 6/12/18 DATE

APPROVED — CITY OF DAYTON ENGINEER — 6/13/18 DATE

DISTRICT STATE AID ENGINEER: REVIEWED FOR COMPLIANCE WITH STATE AND FEDERAL AID RULES/POLICY — 6/22/18 DATE

APPROVED FOR STATE AND FEDERAL AID FUNDING: STATE AID ENGINEER — 6/22/18 DATE

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

JOHN D. EKOLA, PROFESSIONAL ENGINEER — 53076 LICENSE NO. — 06/11/18 DATE

DESIGN SQUAD
J. SCHERER D. SEILER
E. KELLNER T. MATTONEN

TITLE SHEET

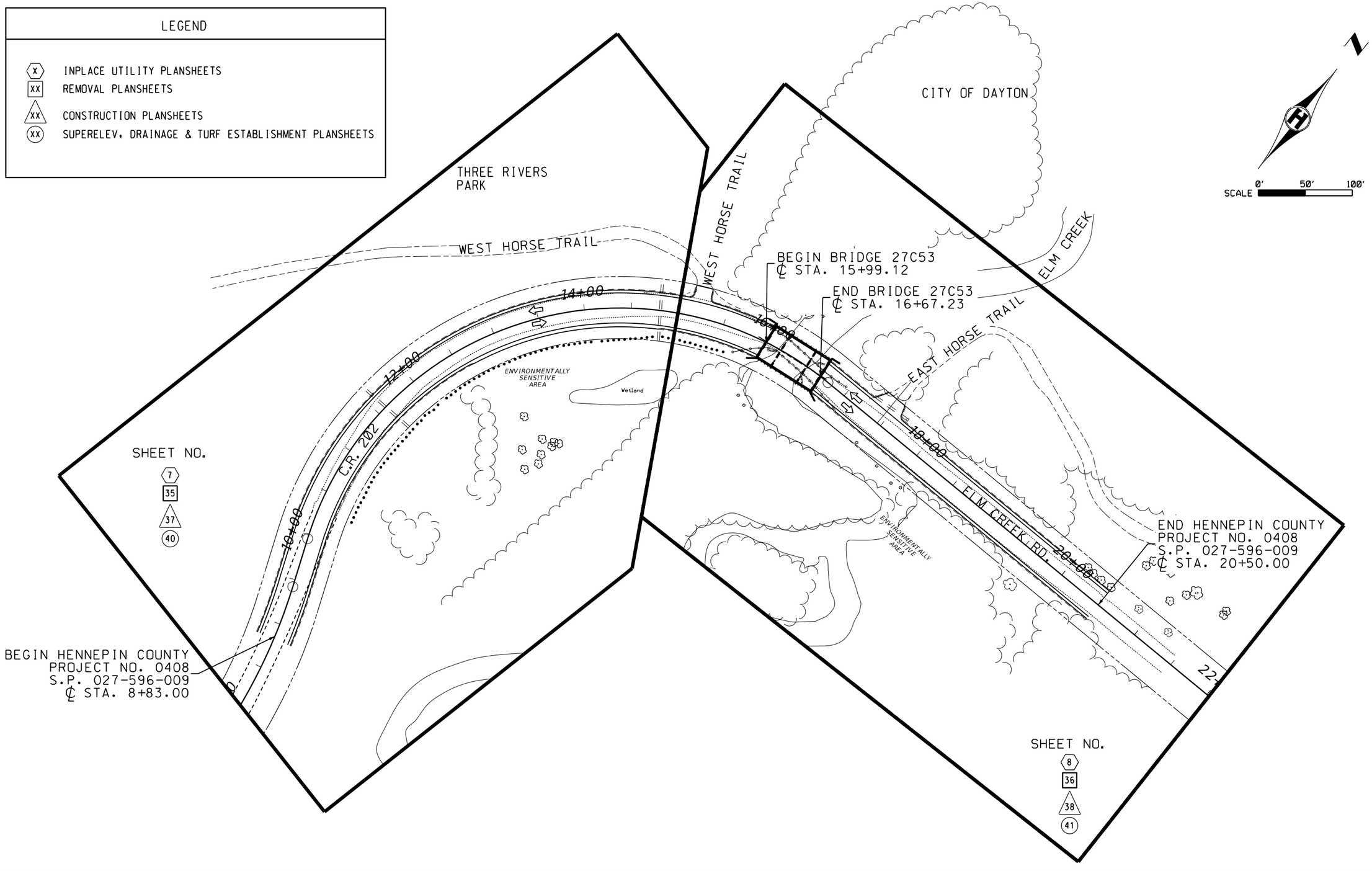
C.S.A.H. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 1 / 97

Default p=42P 6/12/2018 \\tempo\proj\202.0408.27C53\Design\Plan\0408_titlesheet.dgn

LEGEND

- (X) INPLACE UTILITY PLANSHEETS
- [XX] REMOVAL PLANSHEETS
- △XX CONSTRUCTION PLANSHEETS
- (XX) SUPERELEV., DRAINAGE & TURF ESTABLISHMENT PLANSHEETS



Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern — ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 — LICENSE NO.

6/13/18 — DATE

DESIGN BY:	D. SEILER
CAD BY:	J. SCHERER
CHECKED BY:	D. SEILER
LAST REVISION:	05/16/18

GENERAL LAYOUT

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 2 / 59

GENERAL LAYOUT [2 Sheet] 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408_gl00.dgn

NOTES

(1) AVERAGE EXISTING BITUMINOUS THICKNESS OF 4".

(2) BITUMINOUS MATERIAL FOR TACK COAT IS INCIDENTAL.

(3) SPECIAL FINISH TO BE APPLIED. SEE SPECIAL PROVISIONS.

(4) SEE CROSS SECTIONS FOR CULVERT LOCATIONS

(5) SEE BRIDGE PLANS

(6) BIT. CURB INCIDENTAL TO GUARD RAIL INSTALLATION APPROX. 75 LF

(7) WATERPROOF REINFORCING MEMBRANE. INCIDENTAL TO GLUED LAMINATED DECK SEE SHEET B2 AND SPECIAL PROVISIONS.

(8) UTILIZED FOR ROOT-RAP SEE SPECIAL PROVISION SB-13.

(9) SHALL BE PLACED UNDERNEATH ALL RANDOM RIPRAP CLASS 4

(P) PLAN QUANTITY

NOTES	TAB	SHEET NO.	ITEM NO.	ITEM DESCRIPTION		UNIT	TOTAL PROJECT QUANTITY	BRIDGE HENNEPIN COUNTY FEDERAL PARTICIPATING S.P. 027-596-009 QUANTITY	APPROACH HENNEPIN COUNTY FEDERAL PARTICIPATING S.P. 027-596-009 QUANTITY	APPROACH HENNEPIN COUNTY NON-PARTICIPATING QUANTITY
			2021.501	MOBILIZATION		LUMP SUM	1	0.9		0.1
			2031.502	FIELD OFFICE TYPE D		EACH	1	0.9		0.1
			2101.501	CLEARING & GRUBBING		LUMP SUM	1		1	
		SS1	2104.502	REMOVE SIGN TYPE C		EACH	18			18
	G	6	2104.503	SAWING BITUMINOUS PAVEMENT		LIN FT	47		47	
	G	6	2104.503	REMOVE METAL CULVERT		LIN FT	170		170	
	G	6	2104.503	REMOVE GUARDRAIL		LIN FT	190		190	
1	G	6	2104.504	REMOVE BITUMINOUS PAVEMENT	P	SQ YD	3104		2794	310
			2104.601	REMOVE REGULATED WASTE MATERIAL (BRIDGE)		LUMP SUM	1	1		
			2105.504	GEOTEXTILE FABRIC TYPE 6		SQ YD	5190		4671	519
			2105.509	STABILIZING AGGREGATE		TON	100		90	10
	A	6	2106.507	EXCAVATION - COMMON	P	CU YD	1680		1512	168
	A	6	2106.507	COMMON EMBANKMENT (CV)	P	CU YD	1016		914	102
	H	6	2118.509	AGGREGATE SURFACING CLASS 2		TON	196		176	20
			2123.610	STREET SWEEPER (WITH PICKUP BROOM)		HOUR	20		18	2
			2130.523	WATER		MGALLON	6			6
			2131.506	CALCIUM CHLORIDE SOLUTION		GALLON	185		166	19
			2211.509	AGGREGATE BASE CLASS 5	P	TON	1483		1335	148
2	H	6	2360.509	TYPE SP 12.5 WEARING COURSE MIX (3,C)		TON	933		840	93
5	A	6	2401.601	STRUCTURE EXCAVATION		LUMP SUM	1	1		
			2402.508	STRUCTURAL STEEL (3309)	P	POUND	23038	23038		
			2403.603	TIMBER RAILING	P	LIN FT	136	136		
7			2403.618	GLUED LAMINATED DECK PANELS	P	SQ FT	2720	2720		
5			2442.501	REMOVE EXISTING BRIDGE		LUMP SUM	1	1		
			2452.502	C-I-P CONC TEST PILE 85 FT LONG 12"		EACH	2	2		
			2452.502	C-I-P CONC TEST PILE 85 FT LONG 16"		EACH	2	2		
			2452.502	PILE REDRIVING		EACH	32	32		
			2452.502	PILE ANALYSIS		EACH	2	2		
			2452.502	PILE POINTS 12"		EACH	16	16		
			2452.502	PILE POINTS 16"		EACH	16	16		
			2452.603	C-I-P CONCRETE PILING 12"	P	LIN FT	1190	1190		
			2452.603	C-I-P CONCRETE PILING 16"	P	LIN FT	1190	1190		
			2452.618	STEEL SHEET PILING	P	SQ FT	2430	2430		
4	I	6	2501.502	18" RC PIPE APRON		EACH	2			2
4	I	6	2501.502	24" RC PIPE APRON		EACH	4			4
4	I	6	2501.502	28" SPAN CAS PIPE-ARCH APRON		EACH	2			2
4	I	6	2501.503	24" RC PIPE CULVERT CLASS III		LIN FT	96			96
4	I	6	2501.503	18" RC PIPE CULVERT DES 3006 CL III		LIN FT	52			52
4	I	6	2501.603	28" SPAN PIPE-ARCH CULVERT		LIN FT	44			44
			2502.502	4" PRECAST CONCRETE HEADWALL		EACH	4		4	
			2502.503	4" PERF TP PIPE DRAIN		LIN FT	1000		1000	
9			2511.504	GEOTEXTILE FILTER TYPE 7		SQ YD	1050	1050		
			2511.507	RANDOM RIPRAP CLASS IV		CU YD	830	830		
			2533.503	PORTABLE PRECAST CONC BARRIER DES 8337		LIN FT	100		100	
3			2554.502	ANCHORAGE ASSEMBLY - TYPE 31		EACH	3		3	
3			2554.502	END TREATMENT-ENERGY ABSORBING TERMINAL		EACH	1		1	
3			2554.503	TRAFFIC BARRIER DESIGN TYPE 31		LIN FT	491		491	
3,6			2554.503	TRAFFIC BARRIER DESIGN TRANS TYPE 31		LIN FT	100		100	
			2563.601	TRAFFIC CONTROL SUPERVISOR		LUMP SUM	1		1	
			2563.601	TRAFFIC CONTROL		LUMP SUM	1		1	
			2563.602	PORTABLE CHANGEABLE MESSAGE SIGN		EACH	2		2	
		SS1	2564.518	SIGN PANELS TYPE C		SQ FT	36.3		36.3	
			2572.503	TEMPORARY FENCE		LIN FT	500		450	50
			2573.501	EROSION CONTROL SUPERVISOR		LUMP SUM	1		1	
	F	6	2573.502	STORM DRAIN INLET PROTECTION		EACH	4		4	
	F	6	2573.503	SILT FENCE; TYPE HI		LIN FT	1540		1386	154

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 — LICENSE NO.

08/30/2018 — DATE

DESIGN BY: D. SEILER
CAD BY: J. SCHERER
CHECKED BY: D. SEILER
LAST REVISION: 08/30/18

STATEMENT OF ESTIMATED QUANTITIES

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 3 / 59

NOTES

(1) AVERAGE EXISTING BITUMINOUS THICKNESS OF 4".

(2) BITUMINOUS MATERIAL FOR TACK COAT IS INCIDENTAL.

(3) SPECIAL FINISH TO BE APPLIED. SEE SPECIAL PROVISIONS.

(4) SEE CROSS SECTIONS FOR CULVERT LOCATIONS

(5) SEE BRIDGE PLANS

(6) BIT. CURB INCIDENTAL TO GUARD RAIL INSTALLATION APPROX. 75 LF

(7) WATERPROOF REINFORCING MEMBRANE. INCIDENTAL TO GLUED LAMINATED DECK SEE SHEET B2 AND SPECIAL PROVISIONS.

(8) UTILIZED FOR ROOT-RAP SEE SPECIAL PROVISION SB-13.

(9) SHALL BE PLACED UNDERNEATH ALL RANDOM RIPRAP CLASS 4

(P) PLAN QUANTITY

NOTES	TAB	SHEET NO.	ITEM NO.	ITEM DESCRIPTION	UNIT	TOTAL PROJECT QUANTITY	BRIDGE HENNEPIN COUNTY FEDERAL PARTICIPATING S.P. 027-596-009 QUANTITY	APPROACH HENNEPIN COUNTY FEDERAL PARTICIPATING S.P. 027-596-009 QUANTITY	APPROACH HENNEPIN COUNTY NON-PARTICIPATING QUANTITY
	F	6	2573.503	SILT FENCE; TYPE SD	LIN FT	250		225	25
	F	6	2573.503	SILT FENCE; TYPE MS	LIN FT	820		738	82
	F	6	2573.503	FLOTATION SILT CURTAIN TYPE MOVING WATER	LIN FT	448		448	
			2573.510	SEDIMENT REMOVAL BACKHOE	HOUR	10		10	
8			2574.507	COMPOST GRADE 3	CU YD	175		175	
			2574.508	FERTILIZER TYPE 4	POUND	100		100	
	F	6	2575.504	EROSION CONTROL BLANKETS CATEGORY 3N	SQ YD	2615		2353	262
	F		2575.504	RAPID STABILIZATION METHOD 4	SQ YD	2787		2508	279
			2575.508	SEED MIXTURE 35-241	POUND	30		27	3
			2582.503	4" DBLE SOLID LINE MULTI COMP GR IN	LIN FT	1170		1053	117

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 LICENSE NO.

08/30/2018 DATE

DESIGN BY: D. SEILER
CAD BY: J. SCHERER
CHECKED BY: D. SEILER
LAST REVISION: 08/30/18

STATEMENT OF ESTIMATED QUANTITES

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 4 / 59

BASIS OF ESTIMATED QUANTITIES	
AGGREGATE BASE CLASS 5	0.0675 TONS PER CU. FT.
AGGREGATE SURFACING CLASS 2	0.0675 TONS PER CU. FT.
WATER	50 (M) GALLONS PER DIRECTIONAL MILE
CALCIUM CHLORIDE SOLUTION	0.23 GALLONS PER SQ. YD. OF GRADING
WEARING AND NON-WEARING BITUMINOUS MIXTURE	113 LBS. PER SQ. YD. PER 1" THICKNESS
BITUMINOUS MATERIAL FOR TACK COAT	0.05 GAL. PER SQ. YD.
FERTILIZER TYPE 3 SLOW RELEASE 0-10-20 (NPK)	60 POUNDS PER ACRE
SEED MIXTURE 35-241	36.5 POUNDS PER ACRE
BITUMINOUS MIXTURE FOR TACK COAT	0.05 GAL. / S.Y.

THE FOLLOWING STANDARD PLATES APPROVED BY THE FEDERAL HIGHWAY ADMINISTRATION SHALL APPLY ON THIS PROJECT.

STANDARD PLATES	
PLATE NO.	**DESCRIPTION**
3000L	REINFORCED CONCRETE PIPE (1 OF 5 SHEETS)
3000L	REINFORCED CONCRETE PIPE (2 OF 5 SHEETS)
3000L	REINFORCED CONCRETE PIPE (3 OF 5 SHEETS)
3000L	REINFORCED CONCRETE PIPE (4 OF 5 SHEETS)
3000L	REINFORCED CONCRETE PIPE (5 OF 5 SHEETS)
3006G	GASKET JOINT FOR R.C. PIPE (1 OF 2 SHEETS)
3006G	GASKET JOINT FOR R.C. PIPE (2 OF 2 SHEETS)
3007E	SHEAR REINFORCEMENT FOR PRECAST DRAINAGE STRUCTURES
3014J	REINFORCED CONCRETE PIPE ARCH (1 OF 2 SHEETS)
3014J	REINFORCED CONCRETE PIPE ARCH (2 OF 2 SHEETS)
3022C	PRECAST CONCRETE SAFETY APRON (1 OF 3 SHEETS)
3022C	PRECAST CONCRETE SAFETY APRON (2 OF 3 SHEETS)
3022C	PRECAST CONCRETE SAFETY APRON (3 OF 3 SHEETS)
3100G	CONCRETE APRON FOR REINFORCED CONCRETE PIPE
3110G	CONCRETE APRON FOR REINFORCED CONCRETE PIPE-ARCH
3131C	PRECAST CONCRETE HEADWALL FOR SUBSURFACE DRAINS
3145G	CONCRETE PIPE OR PRECAST BOX CULVERT TIES
8000J	CHANNELIZERS - TYPE A (1 OF 3 SHEETS)
8000J	CHANNELIZERS - TYPE B (2 OF 3 SHEETS)
8000J	CHANNELIZERS - TYPE C (3 OF 3 SHEETS)
8337C	TEMPORARY PORTABLE PRECAST CONCRETE BARRIER (TYPE F) (1 OF 3 SHEETS)
8337C	TEMPORARY PORTABLE PRECAST CONCRETE BARRIER (TYPE F) (2 OF 3 SHEETS)
8337C	TEMPORARY PORTABLE PRECAST CONCRETE BARRIER (TYPE F) (3 OF 3 SHEETS)
8350A	THRIE BEAM ANCHORAGE PLATE

NOTE: ADDITIONAL STANDARD PLATES CAN BE FOUND ON PLAN SHEET TC1

SOIL / CONSTRUCTION NOTES

1.) GRADING GRADE IS DEFINED AS THE BOTTOM OF THE CLASS 5 AGGREGATE.

2.) SUITABLE GRADING MATERIAL ON THIS PROJECT, WHETHER OBTAINED LOCALLY OR FROM BORROW, SHALL CONSIST OF ALL SOILS EXCEPT TOPSOIL, DEBRIS, PEAT, MUCK AND ORGANIC OR OTHER UNSTABLE MATERIAL. ALL SUITABLE GRADING MATERIAL SHOULD BE EITHER A UNIFORM SOIL TYPE OR SUFFICIENTLY MIXED AND BLENDED TO BE UNIFORM. ALL MATERIAL IS SUBJECT TO THE DISCRETION OF THE ENGINEER.

3.) GRANULAR MATERIAL SHALL MEET THE REQUIREMENTS OF MN/DOT SPEC. 3149.2B1

4.) SELECT GRANULAR MATERIAL SHALL MEET THE REQUIREMENTS OF MN/DOT SPEC. 3149.2B2

5.) SELECT GRANULAR MATERIAL MODIFIED (10%) SHALL MEET THE REQUIREMENTS OF MN/DOT SPEC. 3149.2B2, MODIFIED SUCH THAT OF THE PORTION PASSING A 1" SIEVE, NOT MORE THAN 10% SHALL PASS A NO. 200 SIEVE.

6.) GRANULAR BASELINE IS DEFINED AS THE BOTTOM OF THE SELECT GRANULAR MATERIAL.

7.) SUBGRADE EXCAVATION IS MEASURED FROM THE GRANULAR BASELINE TO THE GRADING GRADE.

8.) STRIP SOD AND TOPSOIL FROM AREAS TO BE DISTURBED BY CONSTRUCTION AND REUSE AS SLOPE DRESSING. FOR ESTIMATING PURPOSES, THE DEPTH OF THE TOPSOIL AVAILABLE IS CONSIDERED TO BE FOUR INCHES. ALL TOPSOIL STRIPPING SHALL BE CONSIDERED TO BE COMMON EXCAVATION.

9.) DISPOSITION OF EXCAVATED MATERIAL SHALL BE IN ACCORDANCE WITH MN/DOT SPEC. 2105.3D. EXCAVATED MATERIAL (EXCEPT BITUMINOUS PAVEMENT, TOPSOIL, DEBRIS, PEAT, MUCK AND ORGANIC OR OTHER UNSTABLE MATERIAL, SHALL BE REUSED, TO THE EXTENT REQUIRED, AS SUITABLE GRADING MATERIAL, GRANULAR MATERIAL, OR SELECT GRANULAR MATERIAL AS DETERMINED BY THE ENGINEER. EXCAVATED MATERIAL NOT REQUIRED FOR REUSE ON THE PROJECT AND BITUMINOUS AND OR CONCRETE ITEMS REMOVED BY CONSTRUCTION SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE DISPOSED OF OFF THE PROJECT LIMITS.
EXCESS TOPSOIL AND MUCK MATERIAL SHALL BE USED THROUGHOUT THE PROJECT WHEN DIRECTED BY THE ENGINEER.

10.) IN FILL SECTIONS, TOPSOIL AND OTHER UNSUITABLE MATERIALS SHALL BE ELIMINATED FROM THE UPPER 3 FEET OF THE GRADING GRADE BENEATH THE ROADWAY, WITHIN THE LIMITS SHOWN IN THE CROSS SECTIONS.

11.) OBTAIN COMPACTION ON THE GRADING PORTION OF PERMANENT CONSTRUCTION IN ACCORDANCE WITH THE "QUALITY COMPACTION METHOD - ROADBED EMBANKMENT" (SEE SPECIAL PROVISIONS).

12.) COMPACTION OF THE AGGREGATE BASE LAYER SHALL BE OBTAINED IN ACCORDANCE WITH THE QUALITY COMPACTION METHOD.

13.) COMPACTION OF THE GRADING AND AGGREGATE ITEMS ON DRIVEWAYS, BITUMINOUS TRAILS, BYPASSES AND OTHER TEMPORARY WORK SHALL BE DONE BY THE "QUALITY COMPACTION METHOD".

14.) WHERE CONNECTING TO INPLACE ROADWAYS AT THE TERMINI OF PROPOSED CONSTRUCTION, CUT VERTICALLY TO THE BOTTOM OF THE INPLACE SURFACING OR TO THE BOTTOM OF THE NEW SURFACING, WHICHEVER IS DEEPER, THEN 1V:4H TO THE BOTTOM OF THE RECOMMENDED SUBGRADE EXCAVATION, UNLESS OTHERWISE NOTED. USE A SAWCUT TO PROVIDE A UNIFORM JOINT.

15.) PROVIDE 1V:20H LONGITUDINAL TAPERS WHEN CHANGING EXCAVATION DEPTHS.

16.) DITCH BOTTOMS, TOE OF FILL, CUT RUNOUTS AND THE TOP EDGE OF THE BACKSLOPES SHALL BE ROUNDED REGARDLESS OF THE SECTION USED ON THE CROSS SECTION SHEETS.

17.) IN FILL SECTIONS, TOPSOIL AND OTHER UNSUITABLE MATERIALS SHALL BE ELIMINATED FROM THE UPPER 3 FEET OT THE GRADING GRADE BENEATH THE ROADWAY, WITHIN THE LIMITS SHOWN IN THE CROSS SECTIONS.

Hennepin

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Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 — LICENSE NO.

08/21/2018 — DATE

DESIGN BY:	DWS
CAD BY:	DWS
CHECKED BY:	JLS
LAST REVISION:	08/20/2018

STD PLATES, BASIS OF EST. QUANTITES, SOIL & CONSTRUCTION NOTES

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 5 / 59

A EARTHWORK TABULATION - COUNTY ROAD 202

ALIGNMENTS		EXCAVATION COMMON	EXCAVATION STRUCTURE(1)	EMBANKMENT COMMON (CV)	EMBANKMENT SELECT(1)	TOTAL EXCAVATION	TOTAL EMBANKMENT
		CU YD	CU YD	CU YD	CU YD	CU YD	CU YD
CL 202	8+83						
CL 202	9+00	18		11		18	11
CL 202	9+50	63		36		63	36
CL 202	10+00	71		25		71	25
CL 202	10+50	73		26		73	26
CL 202	11+00	79		34		79	34
CL 202	11+50	81		25		81	25
CL 202	12+50	111		19		111	19
CL 202	13+00	132		18		132	18
CL 202	13+50	141		20		141	20
CL 202	14+00	124		22		124	22
CL 202	14+50	59		49		59	49
CL 202	15+00	5		100		5	100
CL 202	15+50	0		198		0	198
CL 202	15+99	125		231	125	125	356
	Bridge		300	0		300	0
CL 202	16+67	105		0	105	105	105
CL 202	17+00	4		104		4	104
CL 202	17+50	52		55		52	55
CL 202	18+00	119		32		119	32
CL 202	18+50	113		46		113	46
CL 202	19+00	78		55		78	55
CL 202	19+50	46		87		46	87
CL 202	20+00	38		84		38	84
CL 202	20+50	43		61		43	61
	TOTAL	1680	300	1338	230	1980	1568

(1) SEE BRIDGE PLANS SHEET B6 (NOTES)

H SURFACING MATERIAL TABULATION

STATION TO STATION		TYPE SP 12.5 WEARING COURSE MIX (3,C)	AGG. BASE (CV) CLASS 5	AGG. SURFACING (CV) CLASS 2
		TON	TON	TON
CL 202 8+83	CL 202 20+50	933	1483	196
PROJ. TOTAL		933	1483	196

G REMOVALS

STATION TO STATION		REMOVE BITUMOUS PAVEMENT	SAWCUT BITUMINOUS PAVEMENT (FULL DEPTH)	REMOVE GUARDRAIL	REMOVE CULVERT
		SY	LF	LF	LF
8+83	16+00	2046			
16+67	20+50	1058			
8+83	8+83		24		
20+50	20+50		23		
15+69	20+50			48	
15+80	20+50			44	
16+67	17+02			55	
16+67	16+95			43	
11+58					65
14+82					64
17+25					41
PROJ. TOTAL		3104	47	190	170

I UNDERGROUND CONSTRUCTION DATA (CULVERTS)

INVERT NO.	STATION C.R. 202	LOCATION	FLOW LINE	GRADE	18 IN CL III	24 IN CL III	28 IN ARCH	RC PIPE APRON
			ELEV	%				EACH
IN 5000	14+72	32.0 LT	860.03	0.10				1
OUT 5001	14+72	32.0 RT	859.95	0.10	52			1
IN 5003	18+30	27.0 RT	859.60	0.00				1
OUT5002	18+30	29.0 LT	859.60	0.00			44	1
IN 5005	19+10	30.0 RT	859.60	0.00				1
OUT 5004	19+10	30.0 LT	859.60	0.00		48		1
IN 5007	19+50	30.0 RT	859.60	0.00				1
OUT 5006	19+50	30.0 LT	859.60	0.00		48		1
SHEET TOTAL					52	96	44	8

NOTES: (1) OFFSETS ARE TO END OF APRON
(2) TIE LAST 3 PIPES LEADING TO APRON

F EROSION CONTROL

STATION TO STATION				CULVERT INLET PROTECTION	SILT FENCE, TYPE MS	SILT FENCE, TYPE HI	SILT FENCE, TYPE SD	RAPID STABILIZATION METHOD 4	FLOATATION SILT CURTAIN	SEEDING 35-241
				EACH	LF		LF	SY	LIN FT	POUND
CL 202	8+83	CL 202	16+27	1	820	670	125	1713	141	13
	16+47		20+50	3		870	125	1074	307	8
PROJ. TOTAL				4	820	1540	250	2787	448	21

Hennepin

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Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER | 48041 LICENSE NO. | 06/21/2018 DATE

DESIGN BY: D. SEILER
CAD BY: J. SCHERER
CHECKED BY: D. SEILER
LAST REVISION: 05 /16 /18

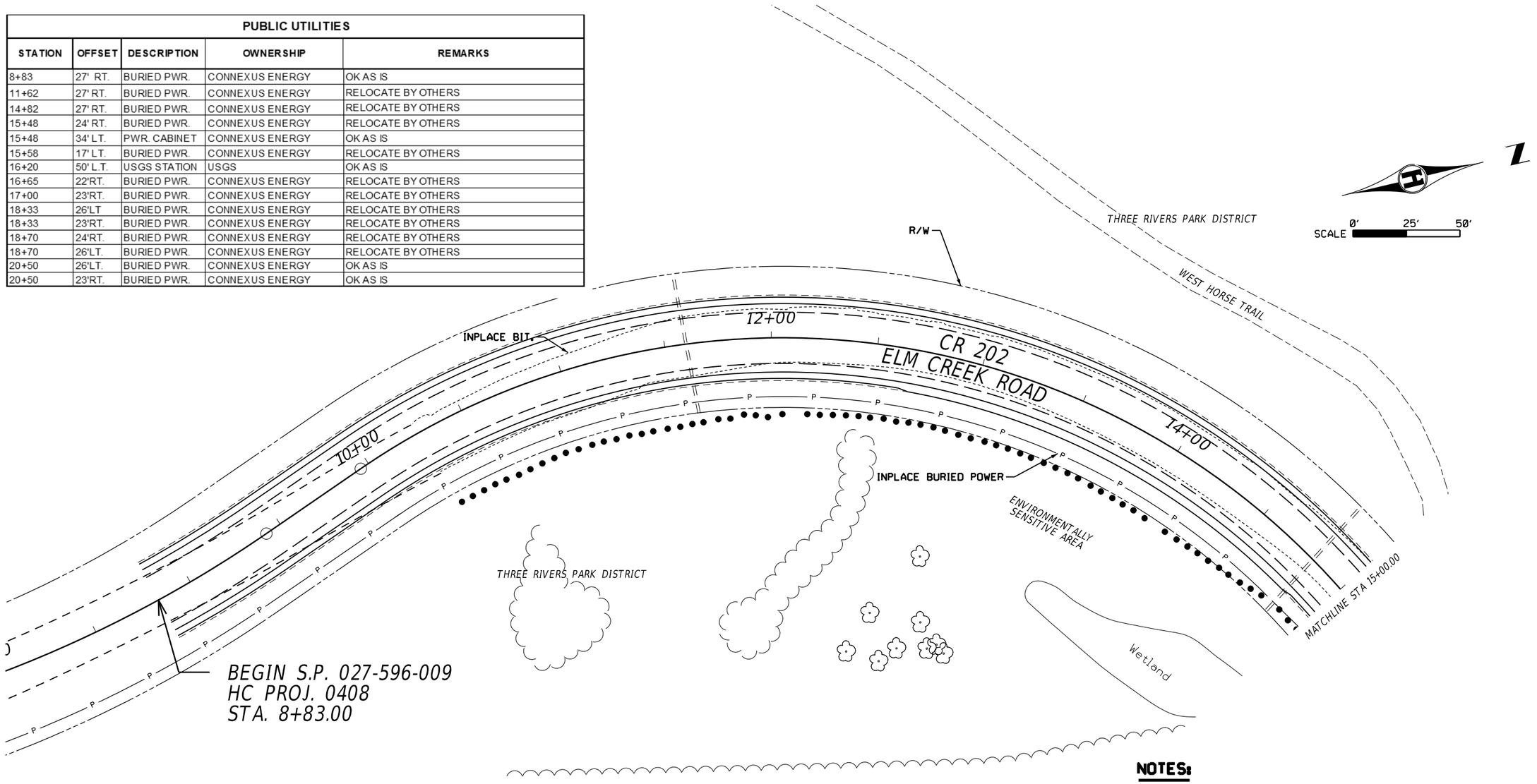
QUANTITY TABULATIONS

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 6 / 59

SURFACE MATERIAL TABULATION-1 [Sheet]pw2729 6/21/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-tb.dgn

PUBLIC UTILITIES				
STATION	OFFSET	DESCRIPTION	OWNERSHIP	REMARKS
8+83	27' RT.	BURIED PWR.	CONNEXUS ENERGY	OK AS IS
11+62	27' RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
14+82	27' RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
15+48	24' RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
15+48	34' LT.	PWR. CABINET	CONNEXUS ENERGY	OK AS IS
15+58	17' LT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
16+20	50' L.T.	USGS STATION	USGS	OK AS IS
16+65	22'RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
17+00	23'RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
18+33	26'LT	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
18+33	23'RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
18+70	24'RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
18+70	26'LT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
20+50	26'LT.	BURIED PWR.	CONNEXUS ENERGY	OK AS IS
20+50	23'RT.	BURIED PWR.	CONNEXUS ENERGY	OK AS IS



UTILITY CONTACTS:

CONNEXUS ENGERY
(763) 323-4215

14601 RAMSEY BLVD. NW
RAMSEY, MN 55303

U.S. GEOLOGICAL SURVEY
(763) 783-3255

2280 WOODALE DRIVE
MOUNDS VIEW, MN 55112

NOTES:

UTILITIES ARE SHOWN AT APPROXIMATE LOCATIONS. THE CONTRACTOR SHALL DETERMINE THE ACTUAL LOCATION OF ALL UTILITIES IN THE FIELD.

ALL UTILITY WORK SHOWN ON THESE SHEETS SHALL BE DONE BY OTHERS UNLESS NOTED.

IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO UTILIZE THE GOPHER STATE ONE CALL SYSTEM REQUIRED BY MINNESOTA STATUTE, CHAPTER 2160 FOR ALL UNDERGROUND UTILITY LOCATIONS

THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS UTILITY QUALITY LEVEL WAS DETERMINED ACCORDING TO THE GUIDELINES OF CI/ASCE 38-02, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA".

STA. 8+83 TO STA. 15+00

Hennepin

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Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 LICENSE NO.

6/13/18 DATE

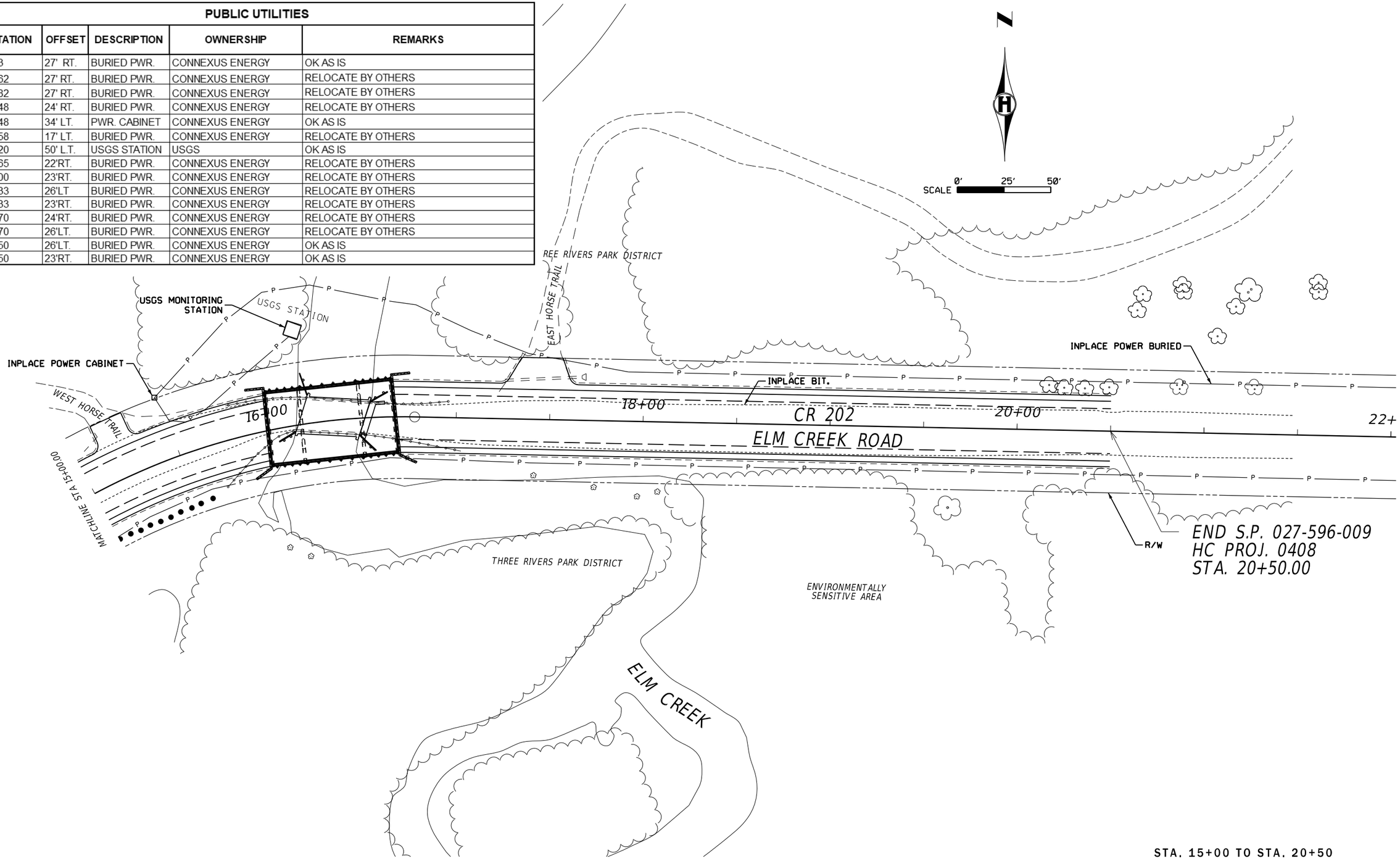
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CAD BY:	J. SCHERER
CHECKED BY:	D. SEILER
LAST REVISION:	05/18/18

PUBLIC UTILITY PLAN AND TABULATION

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 7 / 59

PUBLIC UTILITIES				
STATION	OFFSET	DESCRIPTION	OWNERSHIP	REMARKS
8+83	27' RT.	BURIED PWR.	CONNEXUS ENERGY	OK AS IS
11+62	27' RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
14+82	27' RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
15+48	24' RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
15+48	34' LT.	PWR. CABINET	CONNEXUS ENERGY	OK AS IS
15+58	17' LT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
16+20	50' L.T.	USGS STATION	USGS	OK AS IS
16+65	22'RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
17+00	23'RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
18+33	26'LT	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
18+33	23'RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
18+70	24'RT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
18+70	26'LT.	BURIED PWR.	CONNEXUS ENERGY	RELOCATE BY OTHERS
20+50	26'LT.	BURIED PWR.	CONNEXUS ENERGY	OK AS IS
20+50	23'RT.	BURIED PWR.	CONNEXUS ENERGY	OK AS IS



STA. 15+00 TO STA. 20+50

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Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER | 48041 LICENSE NO. | 6/13/18 DATE

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LAST REVISION:	05/18/18

PUBLIC UTILITY PLAN AND TABULATION

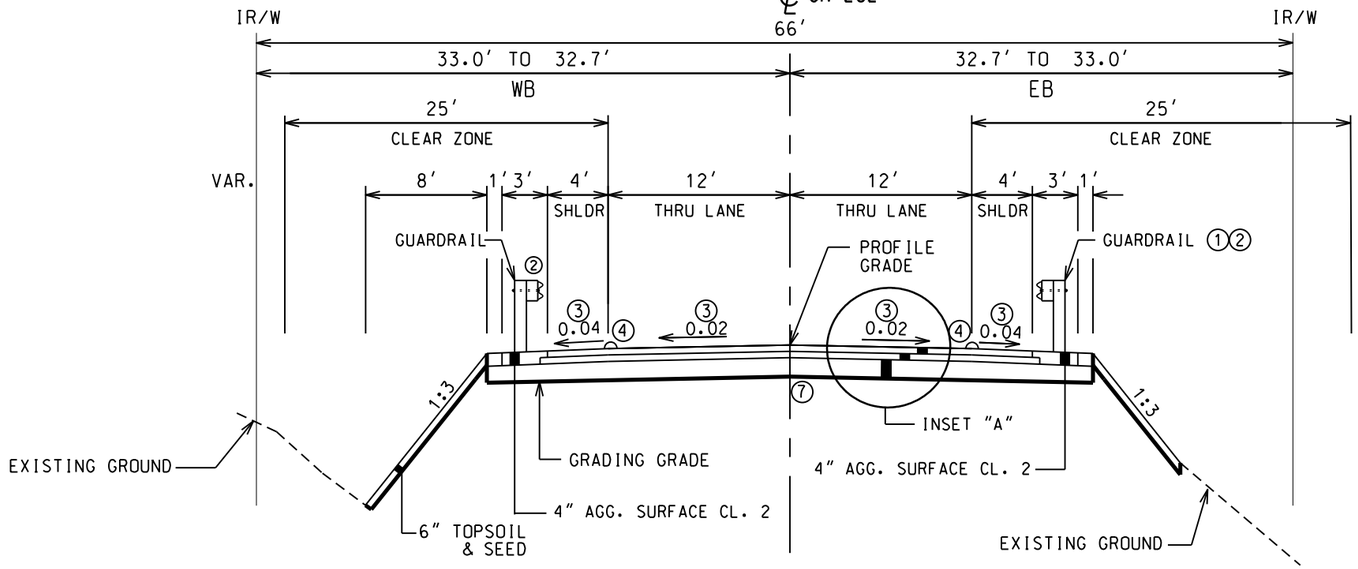
C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 8 / 59

PUBLIC UTILITY PLAN [Sheet 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408_iut100.dgn

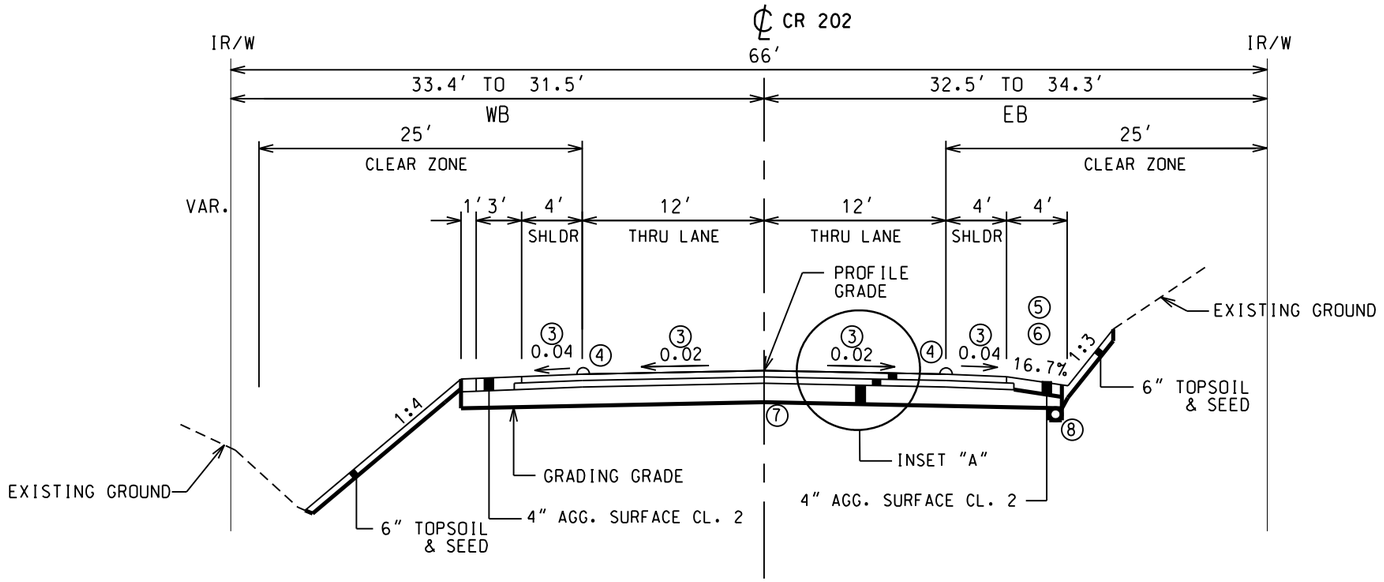
TYPICAL SECTION WITH GUARDRAIL

STA. 15+28 TO 15+99
STA. 16+67 TO 20+50

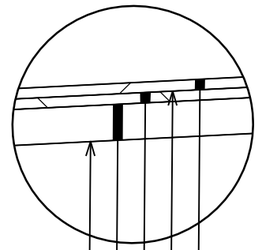


TYPICAL SECTION WITHOUT GUARDRAIL

STA. 8+83 TO 15+28



INSET A



- 2" TYPE SP 12.5 WEARING COURSE MIXTURE (3,C) (SPWEB340C)
- TACK COAT (INCIDENTAL)
- 2" TYPE SP 12.5 WEARING COURSE MIXTURE (3,C) (SPWEB340C)
- 6" AGGREGATE BASE, CL. 5
- GEOTEXTILE FABRIC TYPE VI

GENERAL NOTES:

THE GRADING GRADE X-SLOPES WILL BE THE SAME AS THE PROPOSED THRU LANES.

NOTES:

① GUARDRAIL PLACEMENT AREA - SEE CONSTRUCTION SHEETS 37-38 FOR LOCATION

② SEE MNDOT STANDARD PLAN SHEETS 23-33 FOR GUARDRAIL DETAILS AND GRADING P.I. REQUIREMENTS. PLACE 3' STRIP OF CL. 2 AGG. AT BITUMINOUS EDGE.

③ VARIABLE CROSS SLOPE. SEE SUPERELEVATION DRAINAGE AND TURF ESTABLISHMENT PLANS SHEETS 40-41 FOR CROSS SLOPE

④ MAX. 0.07 ROLLOVER IN SUPERELEVATION AREAS

⑤ EXTENDED SHOULDER STATION 12+67.7 TO 14+80.6 RIGHT

⑥ INSLOPE OF DITCH SECTION 9+80 TO 14+35 RIGHT 16.7% ALL GRADES ARE FT/FT

⑦ 12" MINIMUM ROLLOVER FOR COMPACTION AND UNIFORMITY.

⑧ 4" DRAIN TILE SEE SHEETS 40-41 FOR LOCATIONS. TILES TO DRAIN TO HEADWALL INVERTS. FINE FILTER AGGREGATE INCIDENTAL TO DRAIN TILE.

Hennepin

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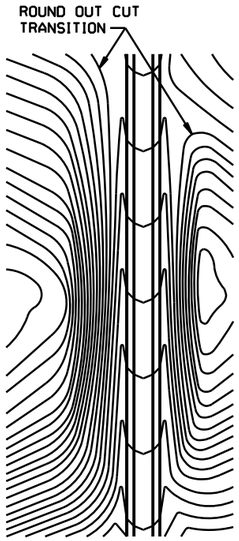
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TYPICAL SECTIONS

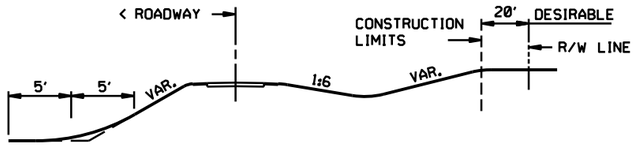
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SHEET 9 / 59

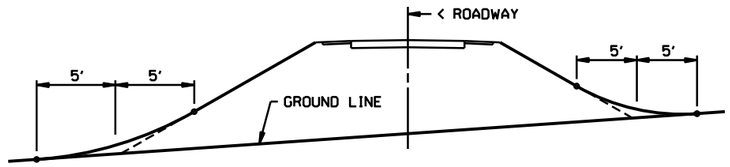
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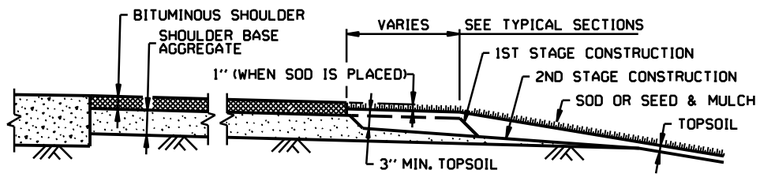
CONTOURING ROAD CUTS



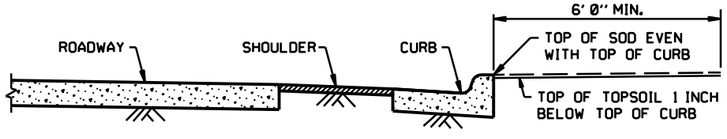
ROUNDING SHOULDERS AND BACKSLOPES



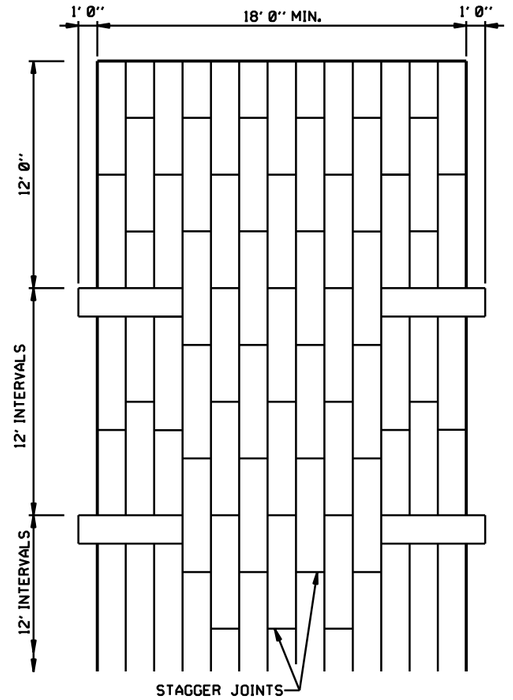
SHAPING FOR DRAINAGE ALONG THE TOE OF FILL SLOPES



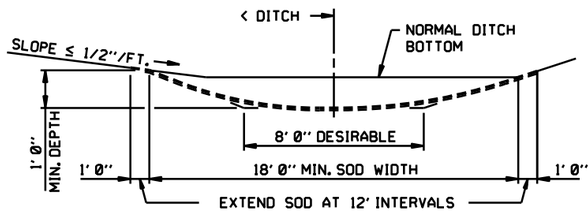
SHAPING AND TOPSOILING INSLOPES



SHAPING ADJACENT TO CURBS WHEN SOD IS PLACED

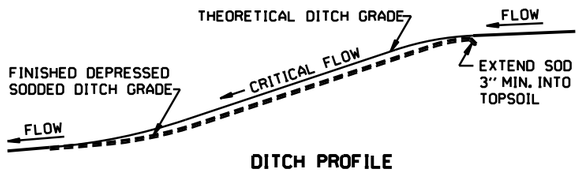


PLAN VIEW



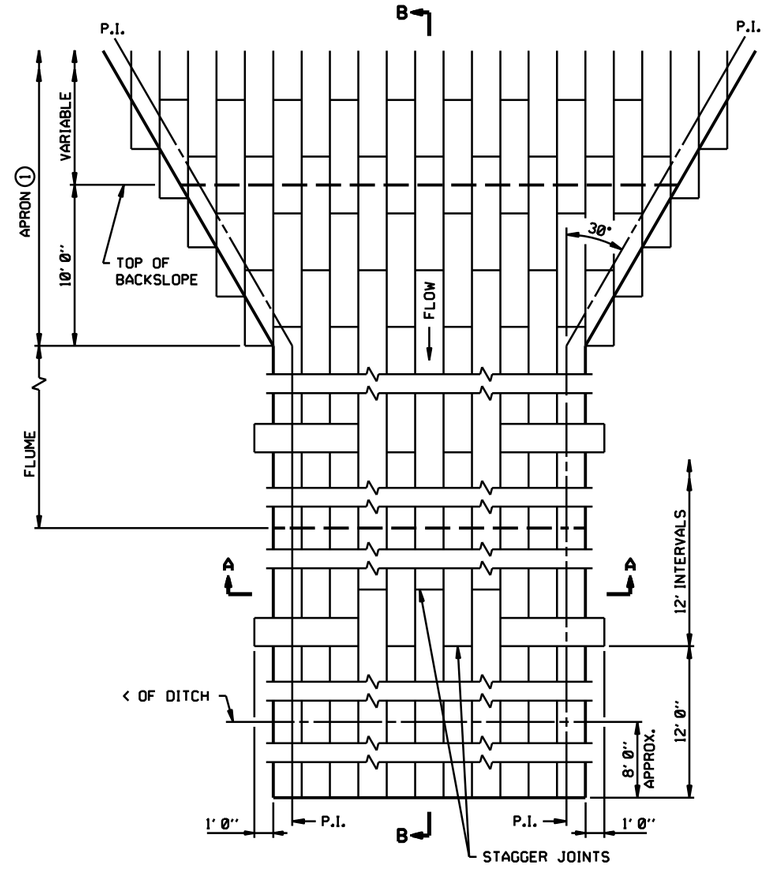
SODDED DITCH CROSS SECTION

WHERE FRONT OR BACK SLOPE IS FLAT (LESS THAN 1/2"/FT.), FIRST NOTCH DITCH AND THEN PROVIDE ROUNDING.

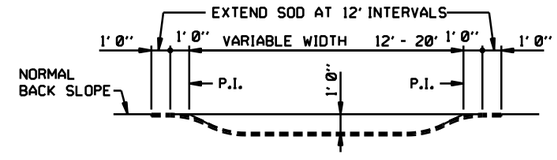


DITCH PROFILE

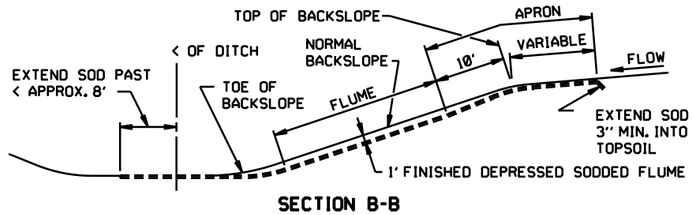
SODDED DITCH DETAILS



PLAN VIEW



SECTION A-A



SECTION B-B

SODDED FLUME DETAILS

NOTES:
SEE SPEC. 2575.3 FOR ADDITIONAL INFORMATION.
① CONSTRUCT TAPER AS DIRECTED BY THE ENGINEER.

REVISION:
APPROVED: 2-28-2017
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HENN. CO. PROJ. NO. 0408 C.R. 202
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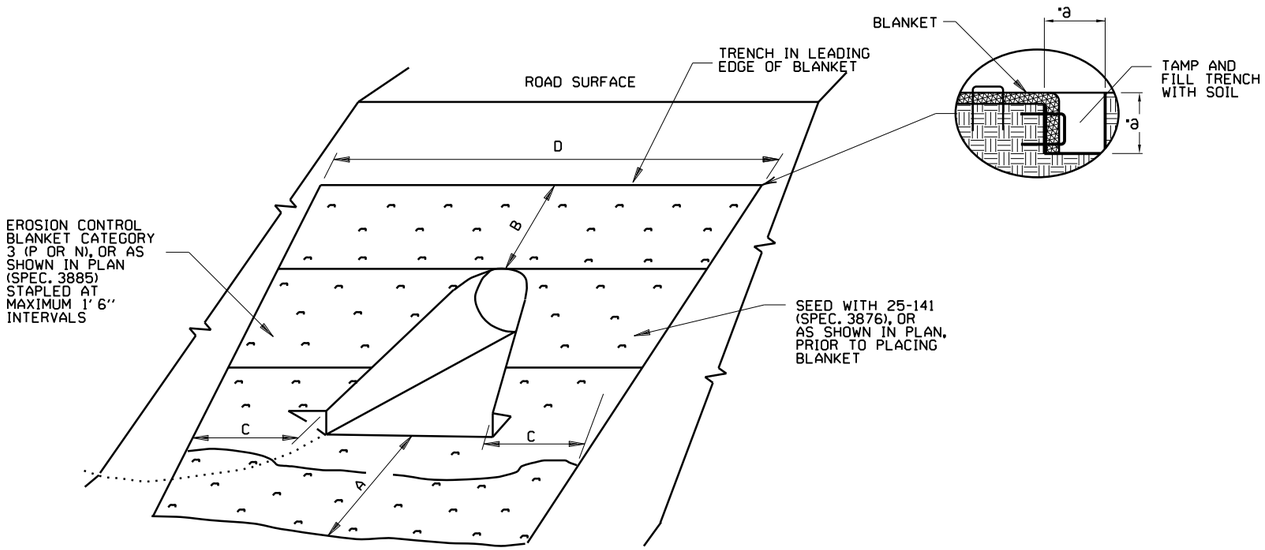
MINNESOTA DEPARTMENT OF TRANSPORTATION

STANDARD PLAN 5-297.404 | 1 OF 3

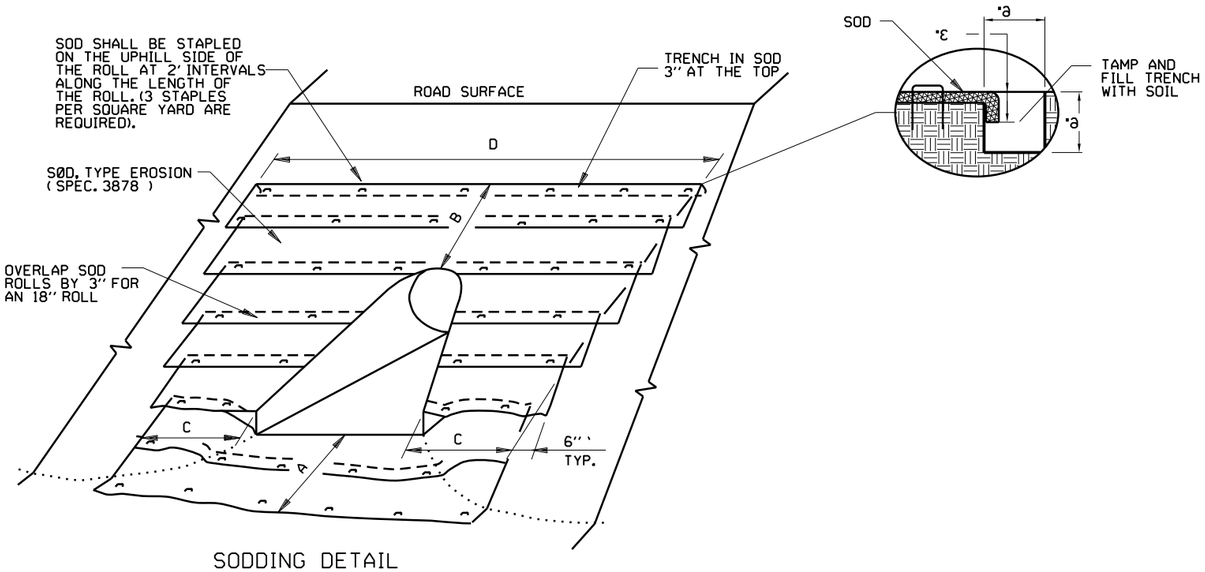
APPROVED: 2-28-2017
REVISED:
STATE DESIGN ENGINEER

PERMANENT EROSION CONTROL
ALONG ROADWAYS, DITCHES AND FLUMES

STATE PROJ. NO. (T.H.) SHEET NO. 10 OF 59 SHEETS



EROSION CONTROL BLANKET & SEED DETAIL



SODDING DETAIL

CULVERT INLET APRON①

CULVERT DIAMETER ②	SOD OR EROSION CONTROL BLANKET (SQ. YDS.)						"A"	"B"	"C"	"D"
	CIRCULAR AND ARCH PIPE METAL APRON (PLATE 3123, PLATE 3122)	CIRCULAR AND ARCH PIPE CONCRETE APRON (PLATE 3100, PLATE 3110)	CIRCULAR AND ARCH PIPE METAL SAFETY APRON 1:4 SLOPE (PLATE 3148)	CIRCULAR AND ARCH PIPE METAL SAFETY APRON 1:6 SLOPE (PLATE 3148)	CIRCULAR CORRUGATED METAL PIPE SAFETY APRON 1:6 SLOPE (PLATE 3128)	CIRCULAR CORRUGATED METAL PIPE SAFETY APRON 1:4 SLOPE (PLATE 3128)				
15"	9	9	8	8	N/A	N/A	3'	1.5'	3'	13'
18"	13	12	12	14	16	N/A	3'	3'	3'	16'
21"	14	14	14	16	18	14	3'	3'	3'	17'
24"	16	15	16	19	21	17	3'	3'	3'	18'
27"	N/A	20	N/A	N/A	N/A	N/A	3'	4.5'	3'	20'
30"	23	22	25	30	32	N/A	3'	4.5'	3'	22'
36"	34	34	39	48	51	37	4.5'	4.5'	4.5'	27'
42"	43	40	51	64	N/A	N/A	4.5'	6'	4.5'	30'
48"	54	50	66	82	N/A	N/A	4.5'	7.5'	4.5'	34'
54"	65	58	81	102	N/A	N/A	4.5'	9'	4.5'	37'
60"	69	59	91	115	N/A	N/A	4.5'	9'	4.5'	39'
66"	69	63	N/A	N/A	N/A	N/A	4.5'	9'	4.5'	39'
72"	78	72	99	122	N/A	N/A	4.5'	10.5'	4.5'	41'

CULVERT OUTLET APRON①

CULVERT DIAMETER ②	SOD OR EROSION CONTROL BLANKET (SQ. YDS.)						"A"	"B"	"C"	"D"
	CIRCULAR AND ARCH PIPE METAL APRON (PLATE 3123, PLATE 3122)	CIRCULAR AND ARCH PIPE CONCRETE APRON (PLATE 3100, PLATE 3110)	CIRCULAR AND ARCH PIPE METAL SAFETY APRON 1:4 SLOPE (PLATE 3148)	CIRCULAR AND ARCH PIPE METAL SAFETY APRON 1:6 SLOPE (PLATE 3148)	CIRCULAR CORRUGATED METAL PIPE SAFETY APRON 1:6 SLOPE (PLATE 3128)	CIRCULAR CORRUGATED METAL PIPE SAFETY APRON 1:4 SLOPE (PLATE 3128)				
15"	10	10	9	10	N/A	N/A	4.5'	1.5'	3'	13'
18"	13	13	12	14	15	N/A	6'	1.5'	3'	14'
21"	16	14	16	18	19	15	6'	1.5'	3'	15'
24"	18	18	18	21	22	18	7.5'	1.5'	3'	16'
27"	N/A	19	N/A	N/A	N/A	N/A	7.5'	1.5'	3'	17'
30"	23	23	24	28	29	N/A	9'	1.5'	3'	18'
36"	36	35	38	47	48	37	10.5'	1.5'	4.5'	23'
42"	43	40	47	58	N/A	N/A	12'	1.5'	4.5'	25'
48"	50	46	57	70	N/A	N/A	13.5'	1.5'	4.5'	27'
54"	57	50	67	84	N/A	N/A	15'	1.5'	4.5'	29'
60"	74	63	90	113	N/A	N/A	16.5'	1.5'	6'	33'
66"	75	67	N/A	N/A	N/A	N/A	16.5'	1.5'	6'	33'
72"	77	70	92	114	N/A	N/A	16.5'	1.5'	6'	34'

NOTES:

AREA SHOWN IN SQUARE YARDS IS FOR ONE CULVERT END.

QUANTITIES ARE CALCULATED TO INCLUDE SOD REQUIRED TO PROVIDE A 3" OVERLAP ON ALL 18" WIDE ROLLS. THIS ALLOWS FOR SHRINKAGE OF THE SOD.

FOR PIPE ARCHES USE EQUIVALENT PIPE DIAMETER TO APPROXIMATE AREA.

FOR CORRUGATED POLYETHYLENE PIPE METAL APRON (PLATE 3129), USE THE METAL APRON COLUMN (PLATE 3123).

AREAS AND DIMENSIONS ARE APPROXIMATE AND ARE BASED ON APRON SIDE SLOPES OF NO STEEPER THAN 1:2, UNLESS INDICATED AS FOR SAFETY APRONS.

CARE SHOULD BE TAKEN IN SELECTING SOD TO STABILIZE THE APRON. RIP-RAP SHOULD BE USED FOR FLOW VELOCITIES GREATER THAN 6 FPS.

① ADDITIONAL QUANTITIES MAY BE SHOWN IN THE PLAN OR REQUIRED BY THE ENGINEER.

② FOR ARCH PIPE USE CLOSEST CIRCULAR PIPE DIAMETER AND APRON SLOPE. (DIAMETERS LARGER THAN 72" REQUIRE SPECIAL DESIGNS.)

PLOTTED/REVISED: $$$$@DATE@$$$$

DISTRICT #: $@DISTRICT@$
IPLOT NAME: $$@IPLOT$NAME@$$
PATH & FILENAME: $$$@PATHFILENAME@$$$

REVISION:

APPROVED: 2-28-2017
CHIEF ENVIRONMENTAL OFFICER

HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

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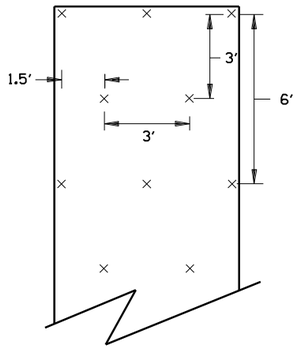
APPROVED: 2-28-2017
REVISED:

STATE DESIGN ENGINEER

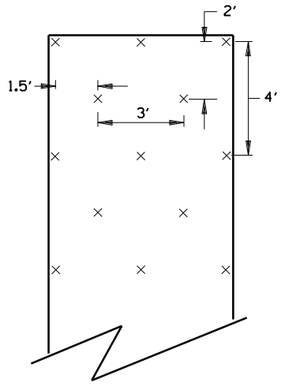
PERMANENT EROSION CONTROL
TURF ESTABLISHMENT DETAIL AT CULVERT ENDS

STATE PROJ. NO. (T.H.) SHEET NO. 11 OF 59 SHEETS

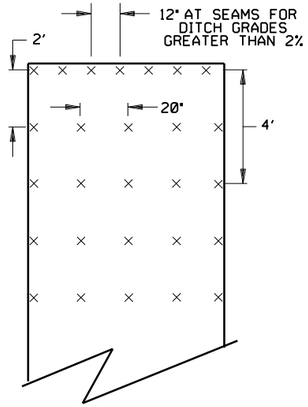
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SLOPES FLATTER THAN 1:2
(120 STAPLES PER 100 SQ YD)

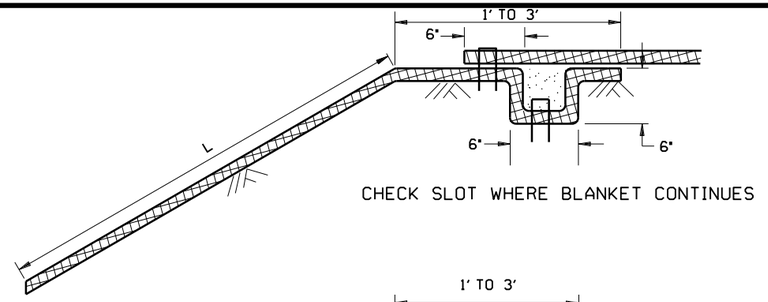


SLOPES 1:2 TO 1:1
(170 STAPLES PER 100 SQ YD)

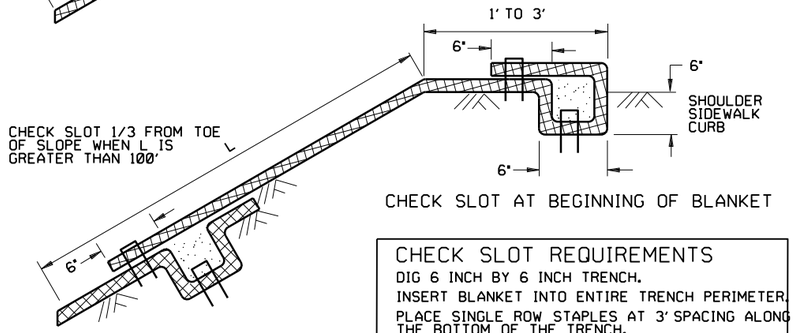


CHANNEL AND DITCH APPLICATIONS
(350 STAPLES PER 100 SQ YD)

BLANKET STAPLE PATTERN



CHECK SLOT WHERE BLANKET CONTINUES



CHECK SLOT AT BEGINNING OF BLANKET

CHECK SLOT REQUIREMENTS

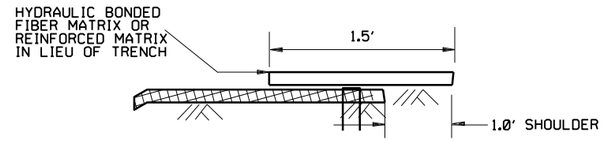
DIG 6 INCH BY 6 INCH TRENCH.

INSERT BLANKET INTO ENTIRE TRENCH PERIMETER.

PLACE SINGLE ROW STAPLES AT 3' SPACING ALONG THE BOTTOM OF THE TRENCH.

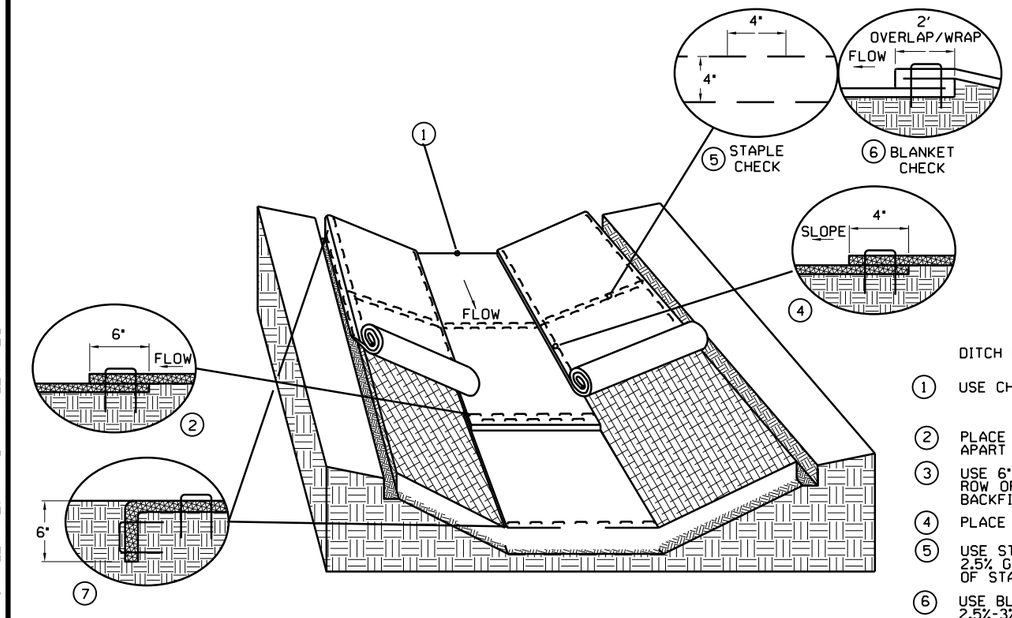
BACKFILL TRENCH WITH SOIL AND TAMP.

PLACE SINGLE ROW STAPLES AT 3' SPACING ON OVERLAP.

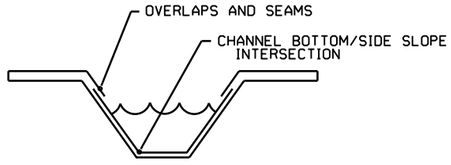


CHECK SLOT ALTERNATIVE
PLACE SINGLE ROW STAPLES AT 12" SPACING

CHECK SLOT DETAILS



DITCH BLANKET STAPLE DETAIL



DITCH BLANKET CRITICAL POINTS (7)

DITCH BLANKET STAPLE DETAIL NOTES

(1) USE CHECK SLOT DETAIL (NO ALTERNATES).

(2) PLACE DOUBLE ROW OF STAPLES STAGGERED 4" APART AND 4" ON CENTER.

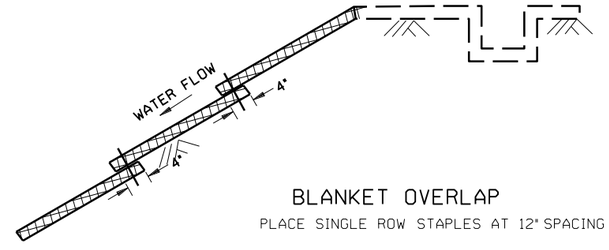
(3) USE 6" X 6" TRENCH TO PLACE BLANKET. PLACE SINGLE ROW OF STAPLES ON TOP AND TRENCH SIDES AT 12" SPACING. BACKFILL TRENCH WITH SOIL AND TAMP.

(4) PLACE SINGLE ROW OF STAPLES AT 12" SPACING.

(5) USE STAPLE CHECK FOR CHANNEL SLOPES LESS THAN 2.5% GRADE AT 100 FOOT INTERVALS. PLACE DOUBLE ROW OF STAPLES STAGGERED 4" APART AND AT 4" SPACING.

(6) USE BLANKET CHECKS FOR THE FOLLOWING SLOPES:
2.5%-3% 100 FT INTERVALS
3%-5% 50 FT INTERVALS
5%-7% 25 FT INTERVALS

(7) CRITICAL POINTS SHALL BE SECURED WITH PROPER STAPLE PATTERNS.



BLANKET OVERLAP
PLACE SINGLE ROW STAPLES AT 12" SPACING

GENERAL BLANKET INSTALLATION REQUIREMENTS

PREPARE SOIL AS PER SPECIFICATION 2574.

LAY PARALLEL OR PERPENDICULAR TO THE DIRECTION OF WATER FLOW.

OVERLAP ADJACENT STRIP EDGES A MINIMUM OF 4 INCHES.

OVERLAP BLANKET 6" (MIN.) AT EACH END. OVERLAP BOTTOM END OF UPPER BLANKET OVER TOP END OF LOWER BLANKET. STAPLE ALONG OVERLAP EVERY 1.5'.

THE UPPERMOST BLANKET OF ALL SLOPE APPLICATIONS MUST START IN A CHECK SLOT. IF SLOPE LENGTH (L) IS 100' OR GREATER, INSERT BLANKET INTO A CHECK SLOT 1/3 FROM THE BOTTOM OF THE SLOPE.

REVISION:

APPROVED: 2-28-2017
CHIEF ENVIRONMENTAL OFFICER

HENN. CO. PROJ. NO. 0408 C.R. 202
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MINNESOTA DEPARTMENT OF TRANSPORTATION

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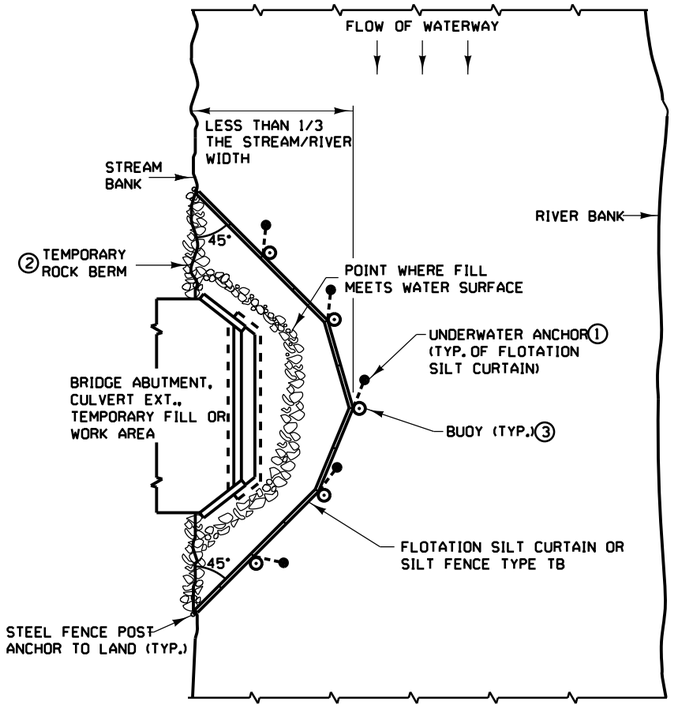
APPROVED: 2-28-2017
REVISED:

STATE DESIGN ENGINEER

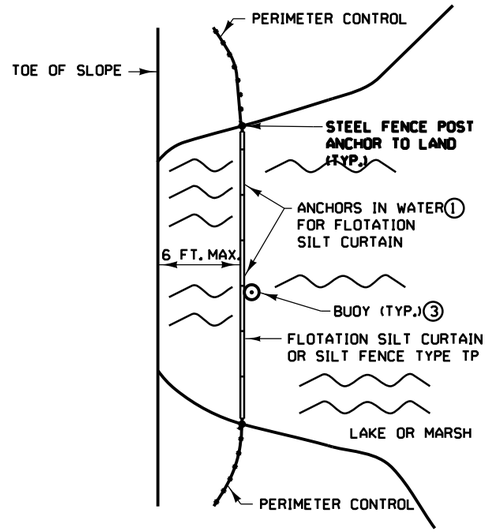
PERMANENT EROSION CONTROL
BLANKET STAPLE PATTERN FOR SLOPES

STATE PROJ. NO. (T.H.) SHEET NO. 12 OF 59 SHEETS

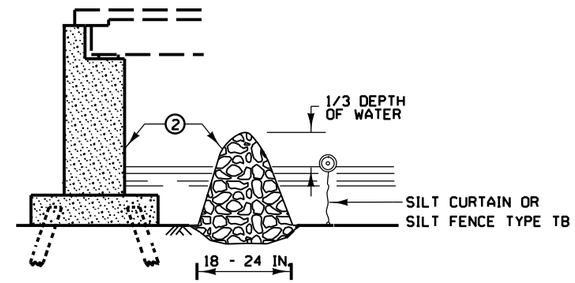
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IPLOT NAME: $$@IPLOT$NAME@$$
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PLAN VIEW FOR STREAM ⑤



PLAN VIEW FOR LAKE OR MARSH ⑤



TEMPORARY ROCK BERM
FOR SEDIMENT CONTROL

INSTALLATION GUIDELINES
SILT FENCE TYPE TB

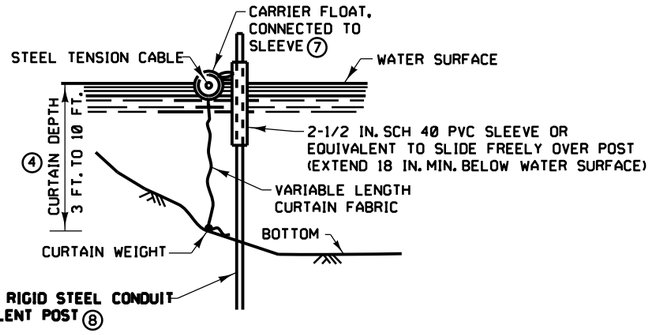
MINIMUM WATER DEPTH: 1 FT.
MAXIMUM WATER DEPTH: 3 FT.
MAXIMUM WATER VELOCITY: 5 FT./SEC.

INSTALLATION GUIDELINES ④
FLOTATION SILT CURTAIN
TYPE: STILL WATER

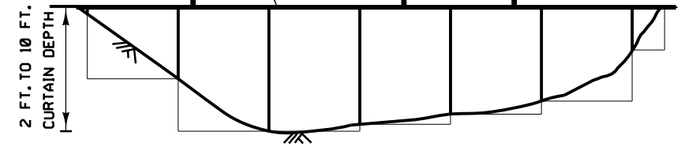
MINIMUM WATER DEPTH: 3 FT.
MAXIMUM WATER DEPTH: 10 FT.
MAXIMUM WATER VELOCITY: 2 FT./SEC.
MAXIMUM WAVE HEIGHT: 1 FT

INSTALLATION GUIDELINES ④
FLOTATION SILT CURTAIN
TYPE: MOVING WATER

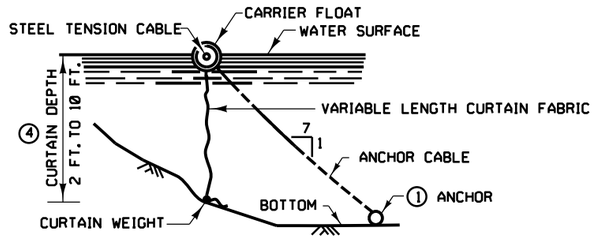
MINIMUM WATER DEPTH: 3 FT.
MAXIMUM WATER DEPTH: 10 FT.
MAXIMUM WATER VELOCITY: 5 FT./SEC.
MAXIMUM WAVE HEIGHT: 2 FT.



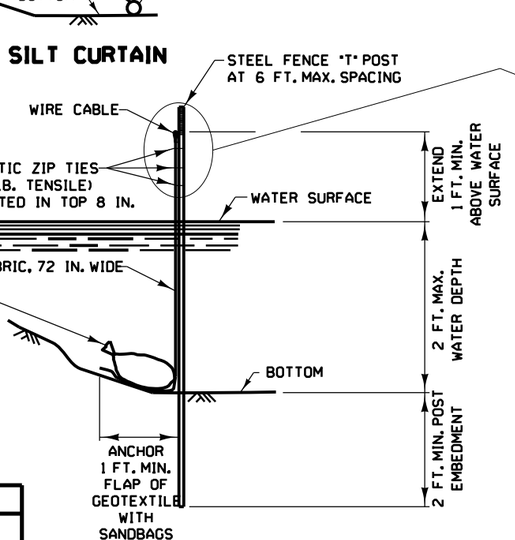
ALTERNATE FLOTATION SILT CURTAIN



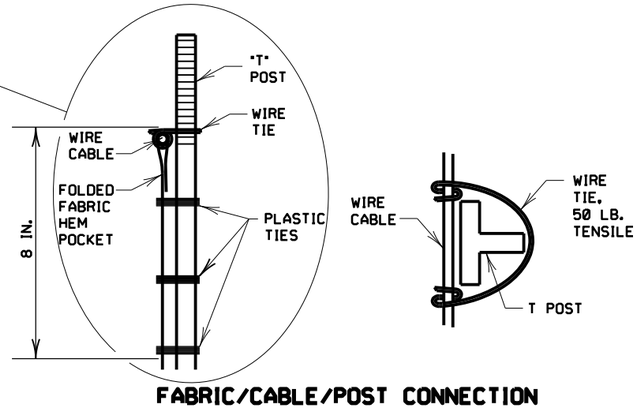
FRONT VIEW FOR FLOTATION SILT CURTAIN



FLOTATION SILT CURTAIN



SILT FENCE TYPE TB ⑥



FABRIC/CABLE/POST CONNECTION

NOTES:

SEE SPECS. 2573, 3886, 3887 & 3893.

① FOR ANCHOR SPACING AND WEIGHT REQUIREMENTS, SEE SPEC. 2573.

② IN AREAS WHERE THE PLAN CALLS FOR RIPRAP AT A BRIDGE, CULVERT, OR SLOPE, A TEMPORARY ROCK BERM CONSTRUCTED FROM THE RIPRAP CAN BE USED TO PROVIDE ADDITIONAL PROTECTION. WHEN THE WORK IS COMPLETE THE RIPRAP CAN THEN BE MOVED TO THE PERMANENT LOCATION INDICATED IN THE PLANS. THE TEMPORARY ROCK BERM IS INCIDENTAL.

③ ON U.S. COAST GUARD OR OTHER MOTORIZED WATERWAYS, BUOYS ARE REQUIRED TO MARK THE ENDS AND SPECIAL AREAS FOR VISIBILITY. PLACE BUOYS AS REQUIRED FOR NAVIGATIONAL PURPOSES.

④ MINIMUM WATER DEPTH APPLIES TO THE DEEPEST POINT ALONG THE FLOTATION SILT CURTAIN OR SILT FENCE TYPE TB FOR DETERMINING APPLICABILITY OF FLOTATION SILT CURTAIN OR SILT FENCE TYPE TB.

⑤ SILT CURTAIN SHOULD BE REMOVED WHEN THE AREA CONTRIBUTING DIRECT RUNOFF HAS BEEN TEMPORARILY OR PERMANENTLY STABILIZED. SILT CURTAIN SHOULD ALSO BE REMOVED BEFORE WINTER IF ICE UP OR ICE FLOW IS ANTICIPATED.

⑥ EMBED POST INTO BOTTOM A MINIMUM OF 40% OF THE WATER DEPTH (INCLUDING WAVE HEIGHT, BUT IN NO CASE SHALL EMBEDMENT BE LESS THAN 2 FEET.

⑦ ANCHOR FLOAT MUST BE CONNECTED SECURELY TO SLEEVE WITH A MINIMUM TENSILE STRENGTH OF 100 LBS. CONNECTION METHOD MUST ALLOW FOR SLEEVE TO MOVE FREELY ON POST.

⑧ PROVIDE SUFFICIENT NUMBER OF POST ANCHORS TO MAINTAIN SILT CURTAIN POSITION.

REVISION:

APPROVED: 2-28-2017
CHIEF ENVIRONMENTAL OFFICER

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MINNESOTA DEPARTMENT OF TRANSPORTATION

STANDARD PLAN 5-297.405 | 1 OF 8

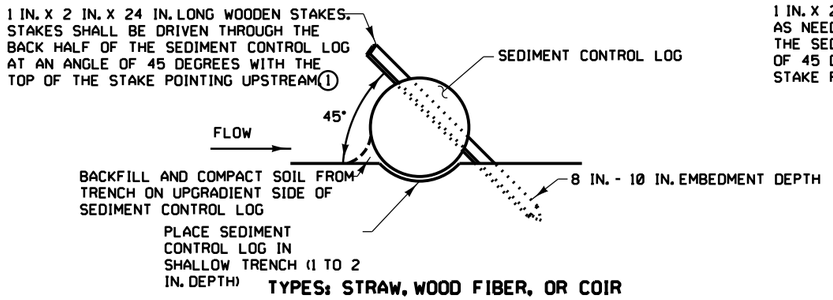
APPROVED: 2-28-2017
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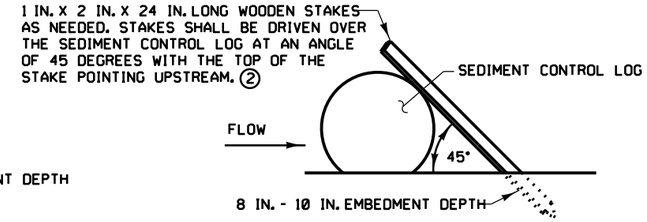
TEMPORARY SEDIMENT CONTROL
SILT CURTAIN OR SILT FENCE TYPE TB

STATE PROJ. NO. (T.H.) SHEET NO. 13 OF 59 SHEETS

PLOTTED/REVISED: $$$$@DATE@$$$$

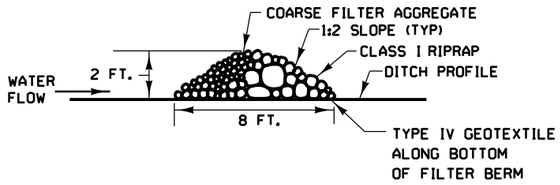


TYPES: STRAW, WOOD FIBER, OR COIR

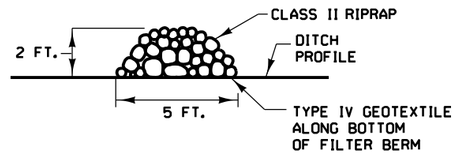


TYPES: WOOD CHIP, COMPOST, OR ROCK

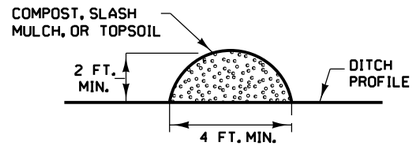
SEDIMENT CONTROL LOGS



TYPE 3 (ROCK WEEPER)

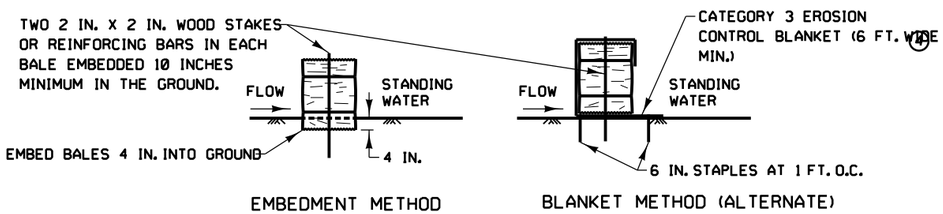


TYPE 5 (ROCK)



TYPE 1 (COMPOST), TYPE 2 (SLASH MULCH), OR TYPE 4 (TOPSOIL)

FILTER BERMS



EMBEDMENT METHOD

BLANKET METHOD (ALTERNATE)

BALE BARRIERS (3)

NOTES:

SEE SPECS. 2573, 3149, 3874, 3882, 3886, & 3897.

(1) SPACE BETWEEN STAKES SHALL BE A MAXIMUM OF 1 FOOT FOR DITCH CHECKS OR 2 FEET FOR OTHER APPLICATIONS.

(2) PLACE STAKES AS NEEDED TO PREVENT MOVEMENT OF SEDIMENT CONTROL LOGS PLACED ON SLOPES OR AS NEEDED DUE TO OTHER FACTORS. STAKES SHALL BE INCIDENTAL.

(3) TO BE USED FOR CRITICAL PERIMETER CONTROL AREAS WHERE STANDING WATER OCCURS (6 INCH MAX. DEPTH). BALES SHALL CONSIST OF TYPE 1 MULCH OF APPROXIMATELY 14 IN. X 18 IN. X 36 IN. LONG. BALES SHALL BE PLACED ON EDGE AND BUTTED TIGHT TO ADJACENT BALES.

(4) INSTEAD OF TRENCHING, PLACE BALE ON THE BLANKET AND WRAP BLANKET AROUND THE BALE. PLACE STAKE THROUGH BALE AND BLANKET.

DISTRICT *: $@DISTRICT@$
IPLOT NAME: $$@IPLOT$NAME@$$$
PATH & FILENAME: $$$@PATHFILENAME@$$$

REVISION:

APPROVED: 2-28-2017
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HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

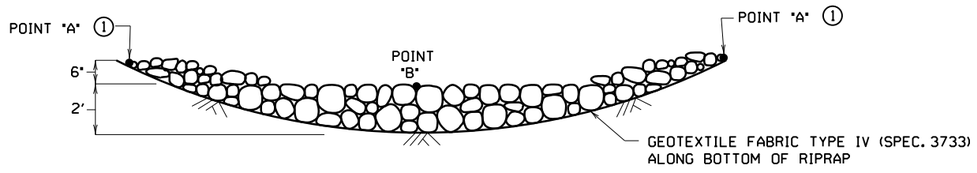
STANDARD PLAN 5-297.405 | 2 OF 8

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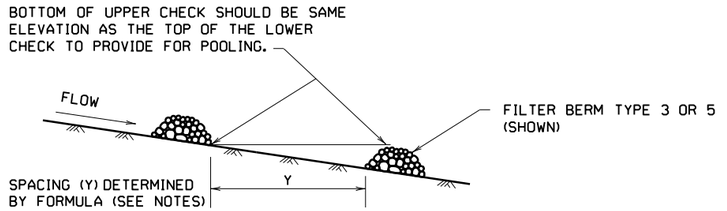
TEMPORARY SEDIMENT CONTROL
FILTER BERMS, SEDIMENT CONTROL LOGS, AND BALE BARRIERS

STATE PROJ. NO. (T.H.) SHEET NO. 14 OF 59 SHEETS

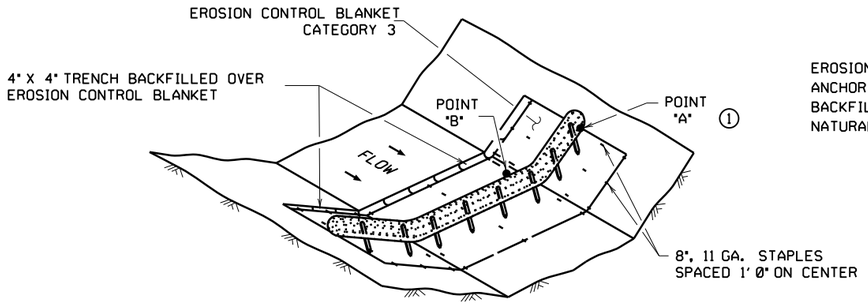
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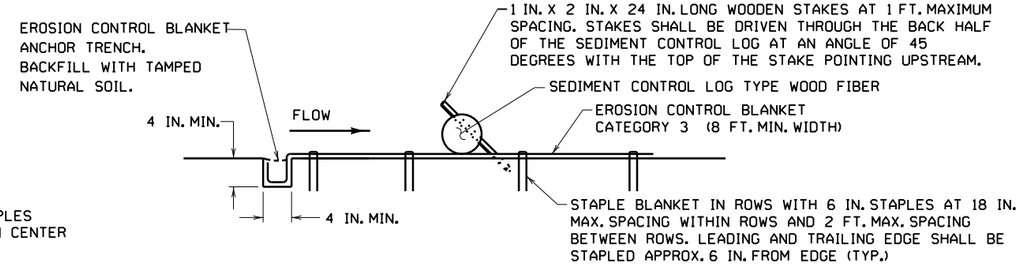


ROCK DITCH CHECKS
FILTER BERMS TYPE 3 (ROCK WEEPER) OR FILTER TYPE 5 (ROCK) ②③
(FOR USE ON ROUGH GRADED AREAS)

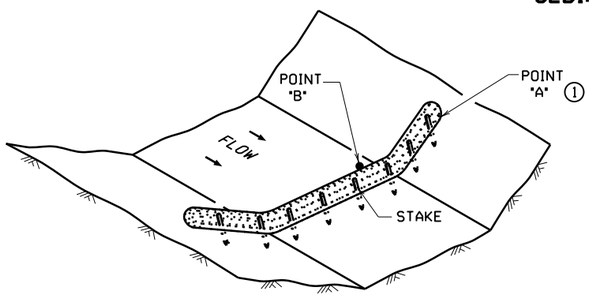


DITCH CHECK SPACING
(FOR ALL FILTER BERM TYPES)





SEDIMENT CONTROL LOG TYPE BLANKET SYSTEM ④



SEDIMENT CONTROL LOG TYPE WOOD FIBER, OR TYPE COMPOST ⑤
(FOR USE ON ROUGH GRADED AREAS)

NOTES:

SEE SPECS. 2573, 3601, 3733, 3885, 3886 & 3889.

FOR DITCH CHECKS, PLACE SEDIMENT CONTROL LOG PERPENDICULAR TO FLOW AND IN A CRESCENT SHAPE WITH THE ENDS FACING UPSTREAM.

APPROXIMATE SPACING BETWEEN EACH DITCH CHECK SHOULD BE DETERMINED FROM THE FOLLOWING SPACING FORMULA:

$$\text{APPROXIMATE SPACING OF DITCH CHECKS (FT.)} = Y = \frac{\text{DITCH CHECK HEIGHT (FT)}}{\text{\% CHANNEL SLOPE}} \times 100$$

① POINT "A" MUST BE A MINIMUM OF 6 INCHES HIGHER THAN POINT "B" TO ENSURE THAT WATER FLOWS OVER THE DIKE AND NOT AROUND THE ENDS.

② PERMANENT ROCK DITCH CHECKS PLACED WITHIN THE CLEAR ZONE ARE TO BE 18" OR LESS IN HEIGHT. A 1:6 APPROACH AND DEPARTURE SLOPE SHALL BE PROVIDED.

③ DITCH GRADE 3% - 5%, MAX. FLOW VELOCITY 12 FT./SEC..

④ DITCH GRADE 1.5% - 3%, MAX. FLOW VELOCITY 4.5 FT./SEC..

⑤ DITCH GRADE 1.5% - 3%, MAX. FLOW VELOCITY 1.5 FT./SEC..

DISTRICT ": $@DISTRICT@$
IPLOT NAME: $$@IPLOT$NAME@$$
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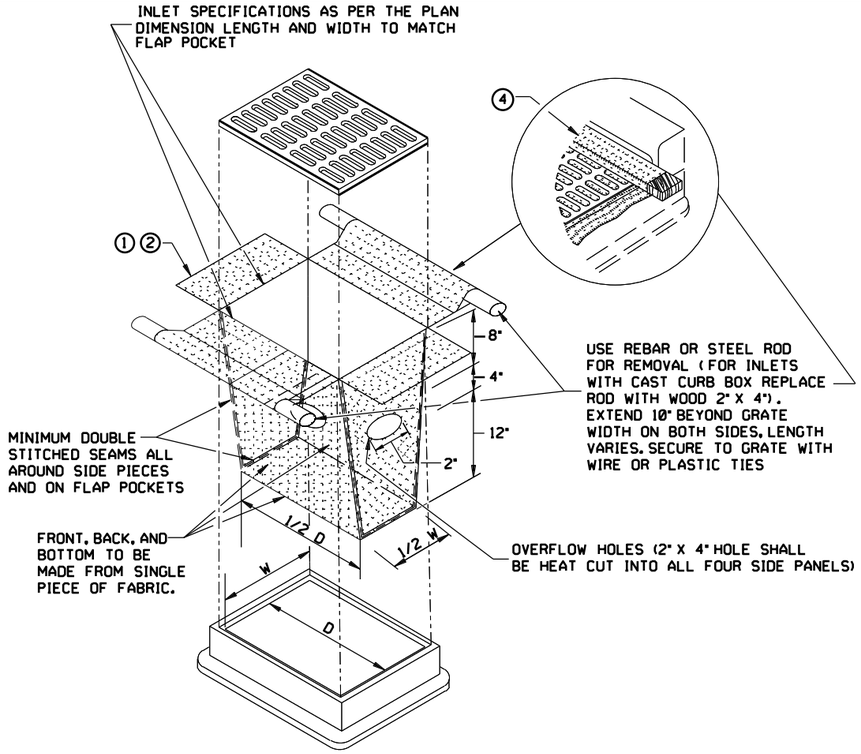
STANDARD PLAN 5-297.405 | 3 OF 8

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TEMPORARY SEDIMENT CONTROL
DITCH CHECK

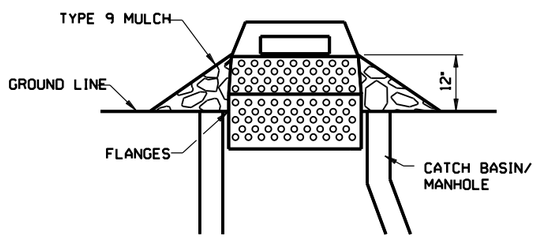
STATE PROJ. NO. (T.H.) SHEET NO. 15 OF 59 SHEETS

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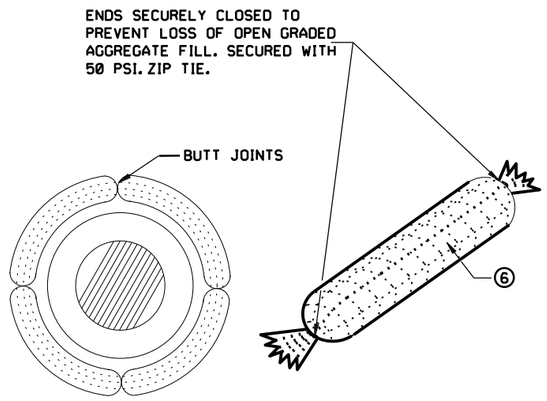
FILTER BAG INSERT ③

(CAN BE INSTALLED IN ANY INLET TYPE
WITH OR WITHOUT A CURB BOX)

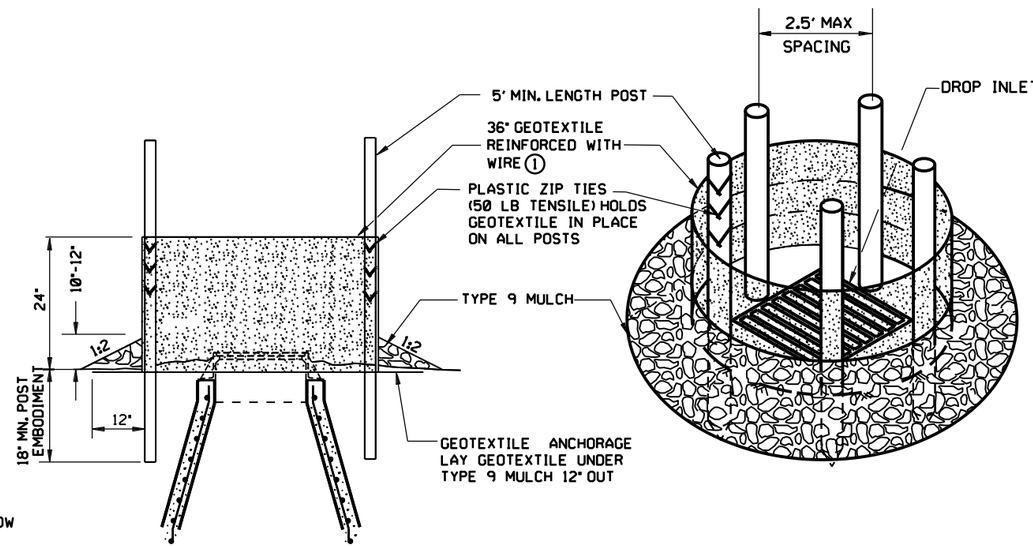


SEDIMENT CONTROL INLET HAT

NOTE:
THE SEDIMENT CONTROL BARRIER SHALL BE A METAL OR PLASTIC/POLYETHYLENE RISER SIZED TO FIT INSIDE THE CATCH BASIN/MANHOLE; HAVE PERFORATIONS TO ALLOW FOR WATER INFILTRATION; HAVE AN OVERFLOW OPENING, FLANGES AND A LID/COVER.

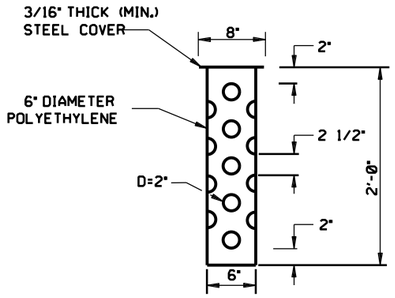


ROCK LOG/COMPOST LOG

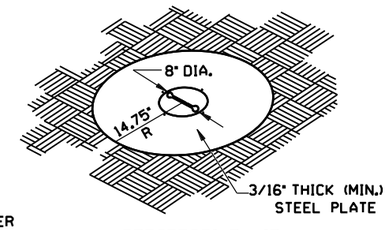


SILT FENCE RING AND ROCK FILTER BERM

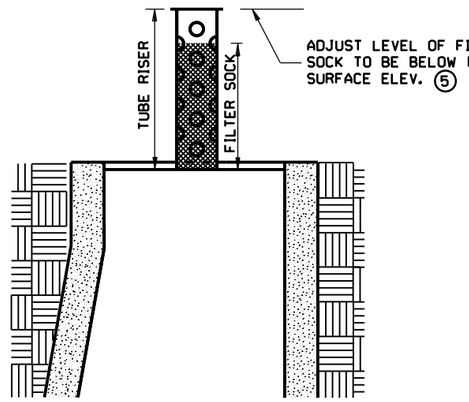
USE WHERE INLET DRAINS IN AN AREA WITH SLOPES AT 1:3 or LESS



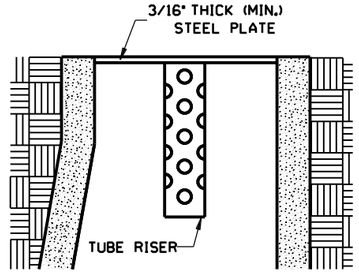
TUBE RISER



PERSPECTIVE VIEW



SECTION
(UP POSITION)



SECTION
(DOWN POSITION)

POP-UP HEAD

NOTES:

SEE SPECS. 2573, 3137, & 3886.

DEVICES MUST BE ADJUSTED ACCORDINGLY AS TO NOT CAUSE FLOODING ON ROADWAY THAT WOULD IMPEED TRAFFIC FLOW.

① ALL GEOTEXTILE USED FOR INLET PROTECTION SHALL BE MONOFILAMENT IN BOTH DIRECTIONS, MEETING SPEC. 3886.

② FINISHED SIZE, INCLUDING POCKETS WHERE REQUIRED SHALL EXTEND A MINIMUM OF 10 INCHES AROUND THE PERIMETER TO FACILITATE MAINTENANCE OR REMOVAL.

③ INSTALLATION NOTES:
DO NOT PLACE FILTER BAG INSERT IN INLETS SHALLOWER THAN 30 INCHES, MEASURED FROM THE BOTTOM OF THE INLET TO THE TOP OF THE GRATE. THE PLACED BAG SHALL HAVE A MINIMUM SIDE CLEARANCE OF 3 INCHES BETWEEN THE INLET WALLS AND THE BAG, MEASURED AT THE BOTTOM OF THE OVERFLOW HOLES. WHERE NECESSARY THE CONTRACTOR SHALL CLINCH THE BAG, USING PLASTIC ZIP TIES, TO ACHIEVE THE 3 INCH SIDE CLEARANCE.

④ FLAP POCKETS SHALL BE LARGE ENOUGH TO ACCEPT WOOD 2 INCH X 4 INCH OR USE A ROCK SOCK OR SAND BAGS IN PLACE OF THE FLAP POCKETS.

⑤ SOCK HEIGHT MUST NOT BE SO HIGH AS TO SLOW DOWN WATER FILTRATION TO CAUSE FLOODING OF THE ROADWAY.

⑥ GEOTEXTILE SOCK BETWEEN 4-10 FEET LONG AND 4-6 INCH DIAMETER. SEAM TO BE JOINED BY TWO ROWS OF STITCHING WITH A PLASTIC MESH BACKING OR PROVIDE A HEAT BONDED SEAM (OR APPROVED EQUIVALENT). FILL ROCK LOG WITH OPEN GRADED AGGREGATE CONSISTING OF SOUND DURABLE PARTICLES OF COARSE AGGREGATE CONFORMING TO SPEC. 3137 TABLE 3137-1; CA-3 GRADATION.

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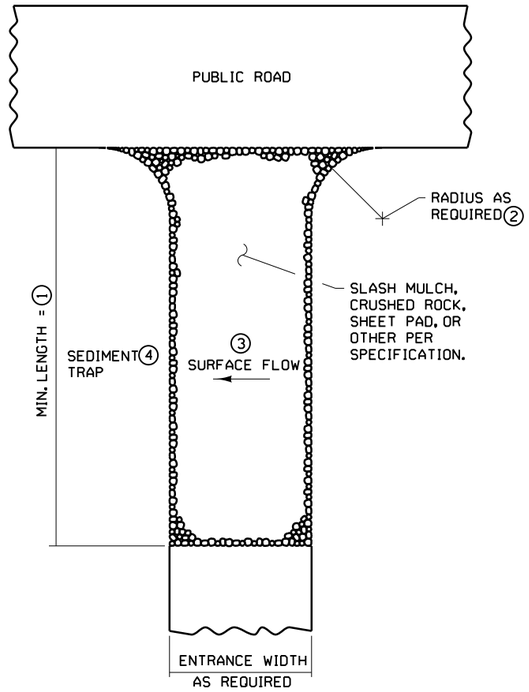
MINNESOTA DEPARTMENT OF TRANSPORTATION

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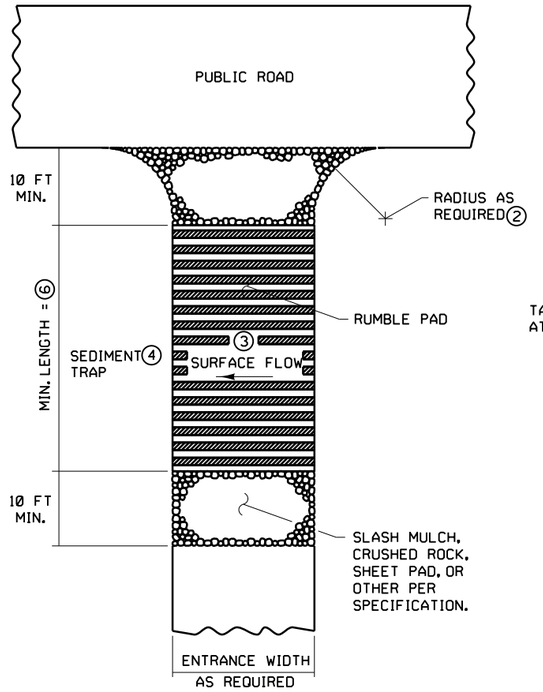
APPROVED: 2-28-2017
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TEMPORARY SEDIMENT CONTROL
STORM DRAIN INLET PROTECTION

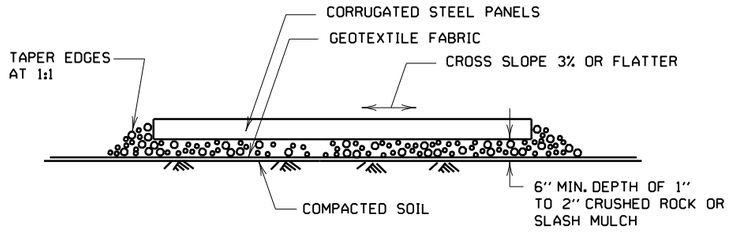
STATE PROJ. NO. (T.H.) SHEET NO. 16 OF 59 SHEETS



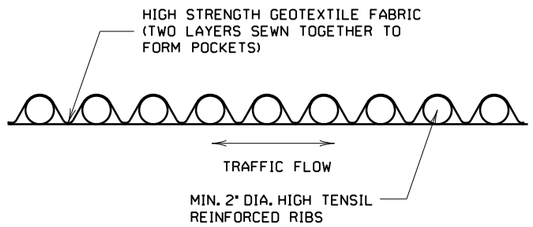
SLASH MULCH, CRUSHED ROCK, OR SHEET PAD CONSTRUCTION EXIT ⑤⑦



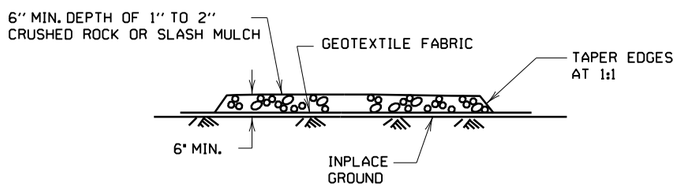
RUMBLE PAD CONSTRUCTION EXIT ⑤⑦



RUMBLE PAD



SHEET PAD



SLASH MULCH OR CRUSHED ROCK

NOTES:

SEE SPECS. 2573 & 3882.

① MINIMUM LENGTH SHALL BE THE GREATER OF 50 FEET OR A LENGTH SUFFICIENT TO ALLOW A MINIMUM OF 5 TIRE ROTATIONS ON THE PROVIDED PAD. MINIMUM LENGTH SHALL BE CALCULATED USING THE LARGEST TIRE WHICH WILL BE USED IN TYPICAL OPERATIONS.

② PROVIDE RADIUS OR WIDEN PAD SUFFICIENTLY TO PREVENT VEHICLE TIRES FROM TRACKING OFF OF PAD WHEN LEAVING SITE.

③ IF RUNOFF FROM DISTURBED AREAS FLOWS TOWARD CONSTRUCTION EXITS, PREVENT RUNOFF FROM DRAINING DIRECTLY TO PUBLIC ROAD OVER CONSTRUCTION EXIT BY CROWNING THE EXIT OR SLOPING TO ONE SIDE. IF SURFACE GRADING IS INSUFFICIENT, PROVIDE OTHER MEANS OF INTERCEPTING RUNOFF.

④ IF RUNOFF FROM CONSTRUCTION EXITS WILL DRAIN OFF OF PROJECT SITE, PROVIDE SEDIMENT TRAP WITH STABILIZED OVERFLOW.

⑤ IF A TIRE WASH OFF IS REQUIRED THE CONSTRUCTION EXITS SHALL BE GRADED TO DRAIN THE WASH WATER TO A SEDIMENT TRAP.

⑥ MINIMUM LENGTH OF RUMBLE PAD SHALL BE 20 FEET, OR AS REQUIRED TO REMOVE SEDIMENT FROM TIRES. IF SIGNIFICANT SEDIMENT IS TRACKED FROM THE SITE, THE RUMBLE PAD SHALL BE LENGTHENED OR THE DESIGN MODIFIED TO PROVIDE ADDITIONAL VIBRATION. WASH-OFF LENGTH SHALL BE AS REQUIRED TO EFFECTIVELY REMOVE CONSTRUCTION SEDIMENT FROM VEHICLE TIRES.

⑦ MAINTENANCE OF CONSTRUCTION EXITS SHALL OCCUR WHEN THE EFFECTIVENESS OF SEDIMENT REMOVAL HAS BEEN REDUCED. MAINTENANCE SHALL CONSIST OF REMOVING SEDIMENT AND CLEANING THE MATERIALS OR PLACING ADDITIONAL MATERIAL (SLASH MULCH OR CRUSHED ROCK) OVER SEDIMENT FILLED MATERIAL TO RESTORE EFFECTIVENESS.

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MINNESOTA DEPARTMENT OF TRANSPORTATION

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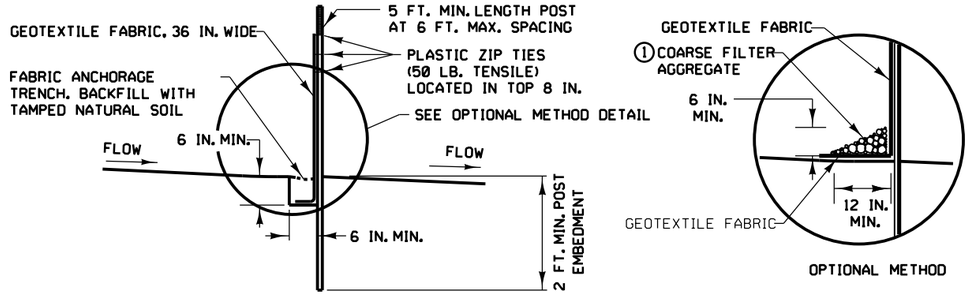
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TEMPORARY SEDIMENT CONTROL
STABILIZED CONSTRUCTION EXIT

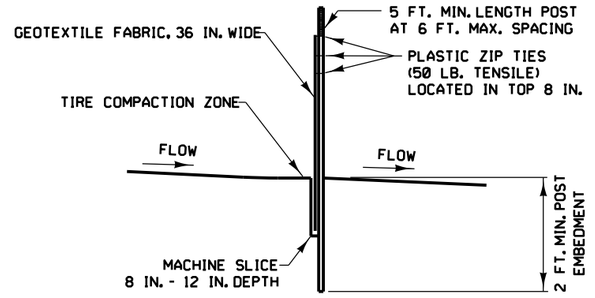
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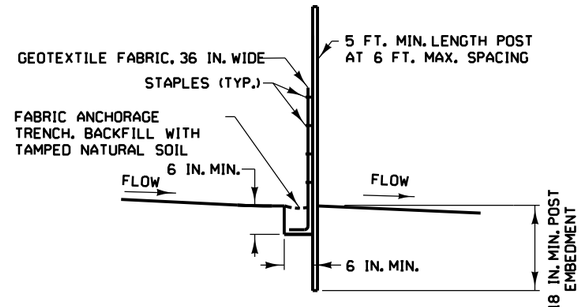
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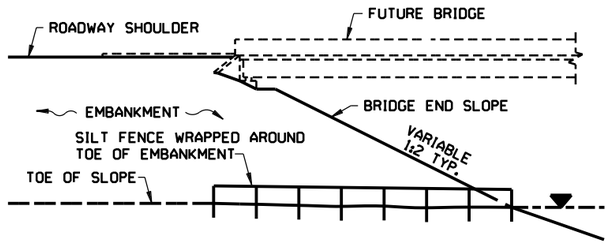
SILT FENCE TYPE HI ②
(HAND INSTALLED)



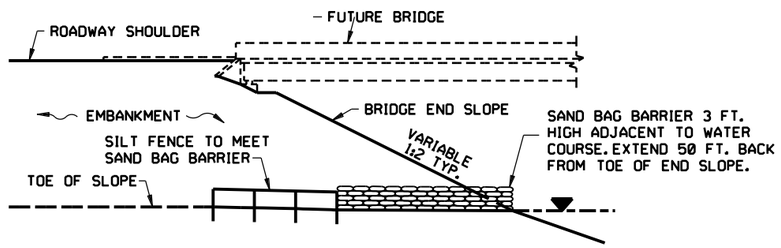
SILT FENCE TYPE MS ②
(MACHINE SLICED)



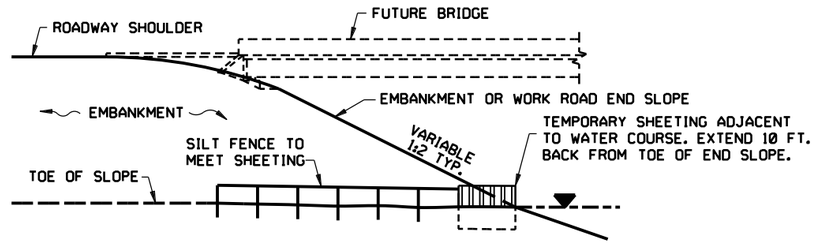
SILT FENCE TYPE PA ③
(PREASSEMBLED)



SILT FENCE ONLY ④

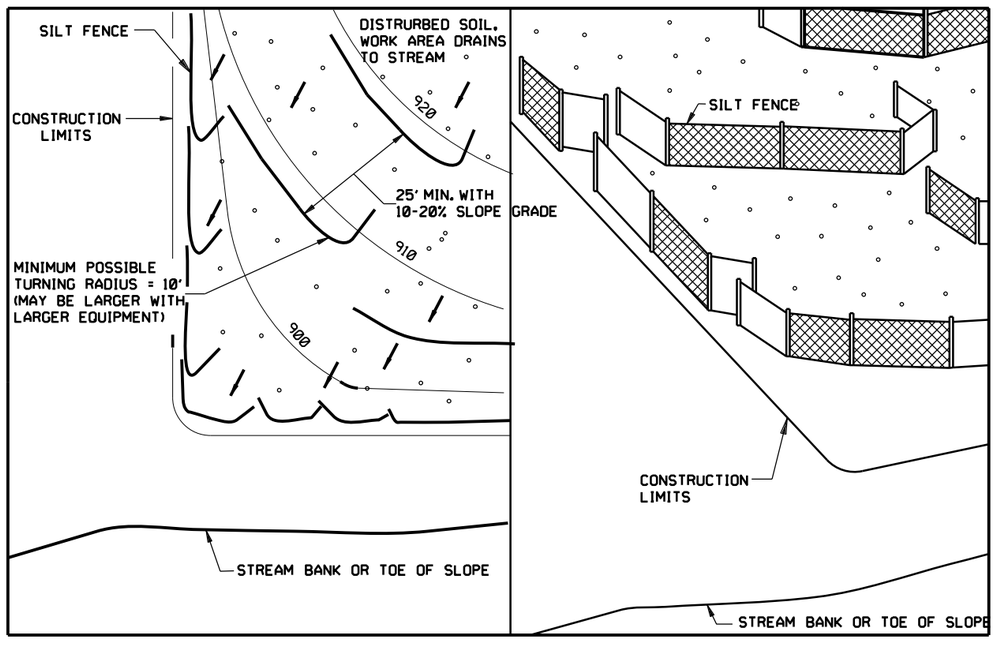


SILT FENCE WITH SAND BAGS ⑤



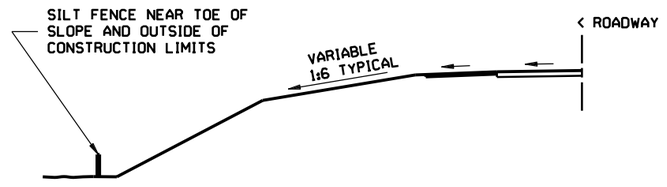
SILT FENCE WITH SHEETING ⑥

INSTALLATION AT BRIDGE EMBANKMENT ADJACENT TO WATER



PLAN VIEW **PERSPECTIVE VIEW**

J-HOOK INSTALLATION



LOCATION AT TOE OF ROADWAY EMBANKMENT

NOTES:

SEE SPECS. 2573, 3149 & 3886.

① COARSE FILTER AGGREGATE (SPEC. 3149) SHALL BE INCIDENTAL.

② TO PROTECT AREAS FROM SHEET FLOW. MAXIMUM CONTRIBUTING AREA: 1 ACRE.

③ TO PROTECT AREAS FROM SHEET FLOW. MAXIMUM CONTRIBUTING AREA: 0.25 ACRE.

④ WATER COURSE FLOW VELOCITY: STANDING.
CONTRIBUTING SLOPE AREA: 1./2 ACRE.

⑤ WATER COURSE FLOW VELOCITY: 1 TO 7 FT./SEC.
CONTRIBUTING SLOPE AREA: 1. ACRE.

⑥ WATER COURSE FLOW VELOCITY: 8 TO 15 FT./SEC.
CONTRIBUTING SLOPE AREA: 3 ACRES.

DISTRICT *: $@DISTRICT@$
IPLOT NAME: $$@IPLOT$NAME@$$
PATH & FILENAME: $$$@PATHFILENAME@$$$

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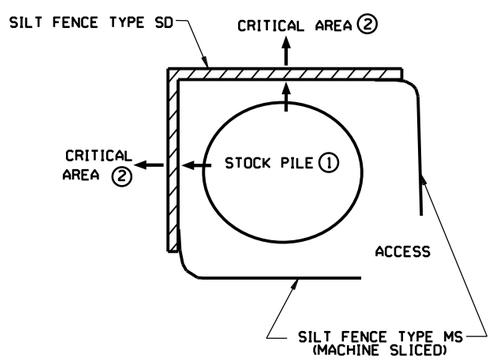
MINNESOTA DEPARTMENT OF TRANSPORTATION

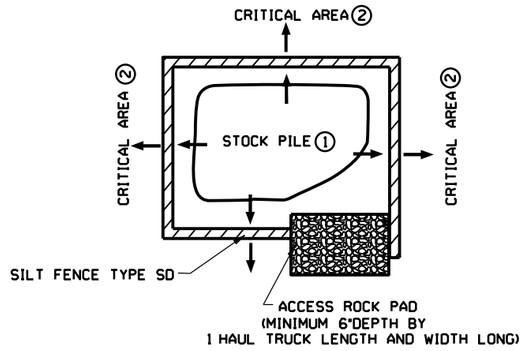
STANDARD PLAN 5-297.405 | 6 OF 8

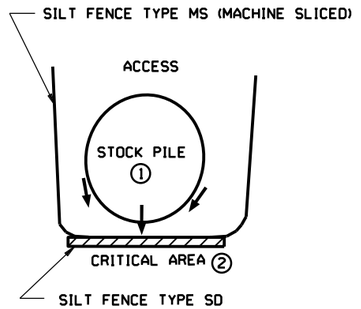
APPROVED: 2-28-2017
REVISED:
STATE DESIGN ENGINEER

TEMPORARY SEDIMENT CONTROL
SILT FENCE

STATE PROJ. NO. (T.H.) SHEET NO. 18 OF 59 SHEETS



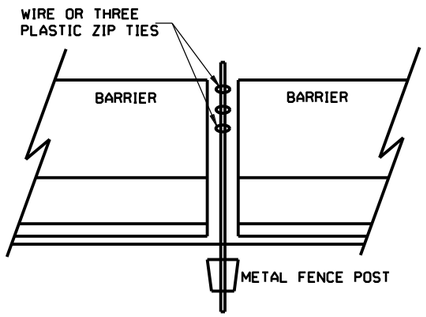




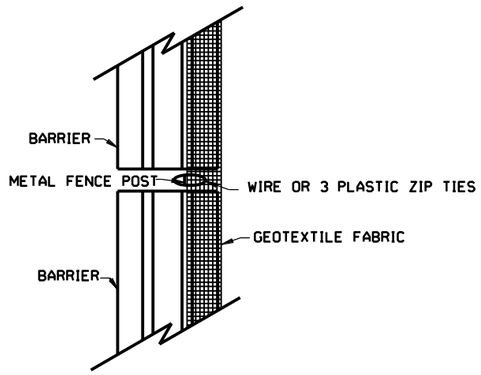
STOCK PILE CONTAINMENT



STOCKPILE SEDIMENT CONTROL

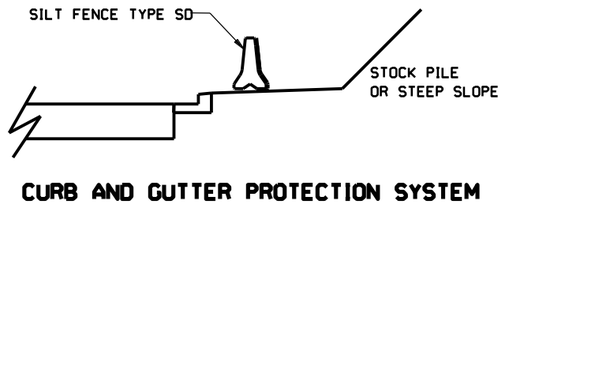


PROFILE VIEW

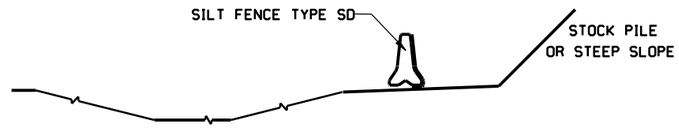


TOP VIEW

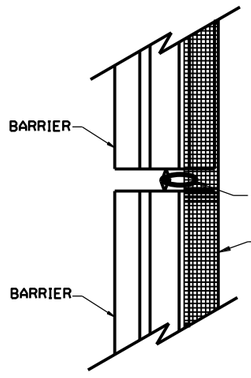
SILT FENCE TYPE SD (SUPER DUTY)
BARRIER WITHOUT LOOP BARS



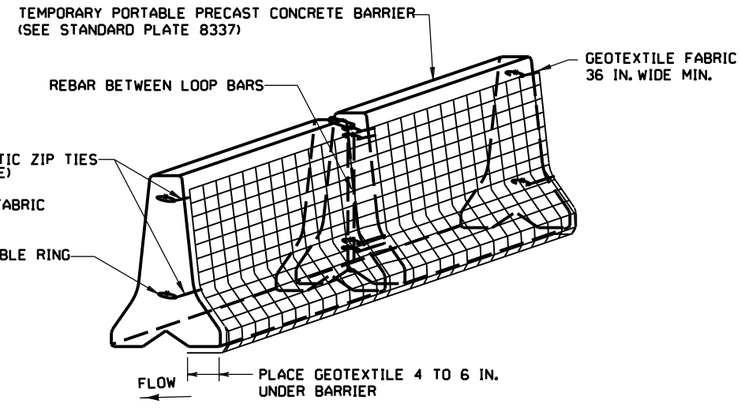
CURB AND GUTTER PROTECTION SYSTEM



DITCH PROTECTION SYSTEM



TOP VIEW



PERSPECTIVE VIEW

SILT FENCE TYPE SD (SUPER DUTY)
BARRIER WITH LOOP BARS

NOTES:

SEE SPECS. 2533, 2573 & 3886.

SILT FENCE TYPE SD USED TO PROTECT CRITICAL AREAS FROM SHEET FLOW, AND AREAS WHERE OTHER SILT FENCES CANNOT BE PLACED. MAXIMUM CONTRIBUTING AREA: 1 ACRE.

PLACE SILT FENCE TYPE SD ALONG A CONSTANT ELEVATION.

SILT FENCE TYPE SD CAN UTILIZE EITHER A CONCRETE, OR WATER FILLED, TEMPORARY MEDIAN BARRIER.

(1) PLACING STOCK PILES NEXT TO AN ENVIRONMENTALLY SENSITIVE AREA IS NOT RECOMMENDED. WHEN THERE ARE NO FEASIBLE ALTERNATIVES, PLACE SILT FENCE SD AS SHOWN OR AS DIRECTED BY THE ENGINEER.

(2) CRITICAL AREAS INCLUDE WETLANDS, JUDICIAL DITCHES, STREAMS, WATER BODIES, AND OTHER AREAS REQUIRING PROTECTION.

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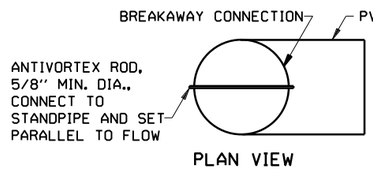
STATE DESIGN ENGINEER

TEMPORARY SEDIMENT CONTROL
SUPER DUTY SILT FENCE

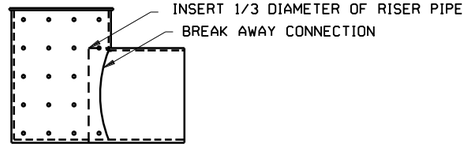
STATE PROJ. NO. (T.H.) SHEET NO. 19 OF 59 SHEETS

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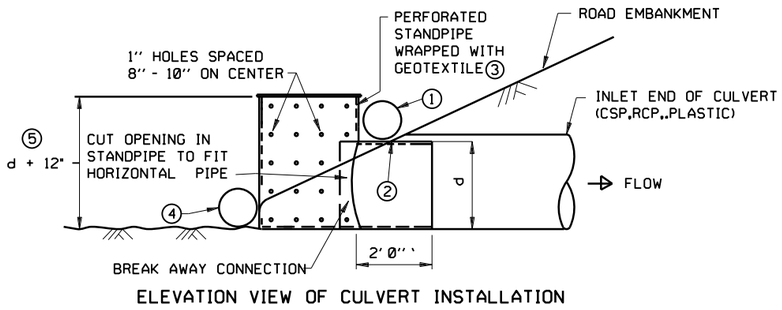
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PLAN VIEW



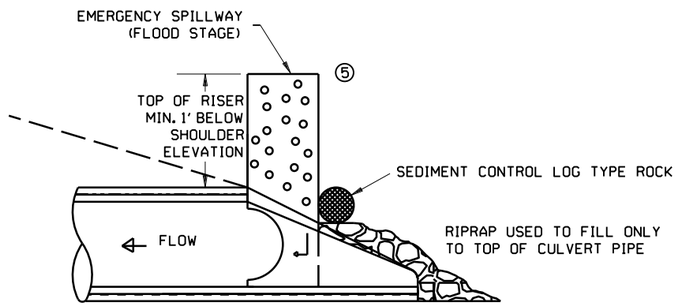
CULVERT STANDPIPE



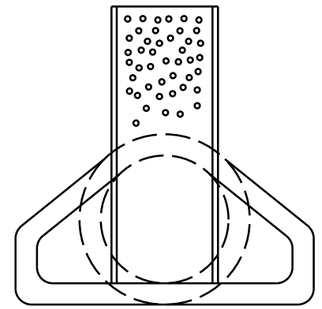
ELEVATION VIEW OF CULVERT INSTALLATION

CULVERT STANDPIPE INSERT (D-RISER)

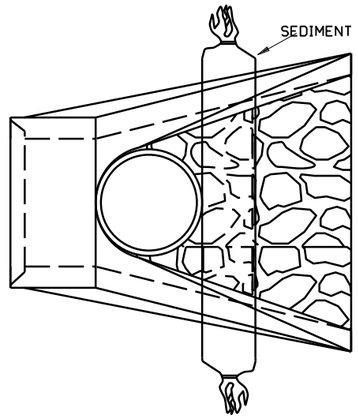
d= CULVERT SIZE: 12" - 36"



LONGITUDINAL SECTION



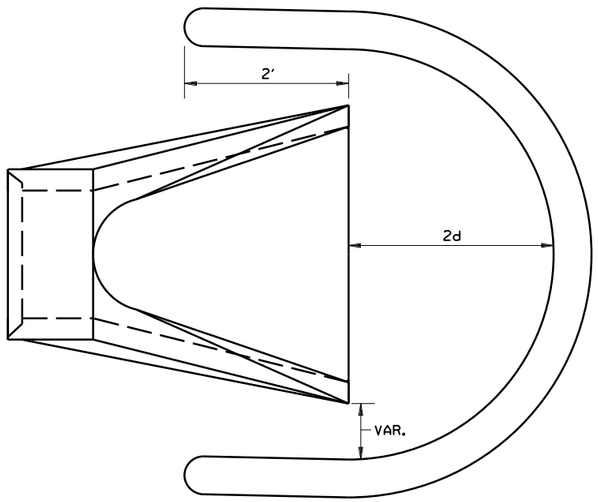
END VIEW



NOTE: SEDIMENT CONTROL LOG TYPE ROCK MAY BE WRAPPED AROUND RISER

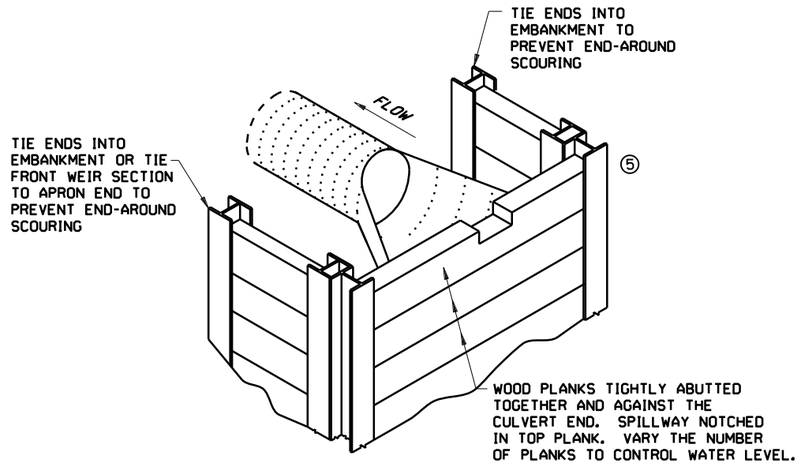
TOP VIEW

CULVERT STANDPIPE INSERT (D-RISER)



SEDIMENT CONTROL LOG WEIR (COMPOST, WOOD CHIP, OR ROCK)

d = CULVERT SIZE: 12"-36"



WOOD PLANK WEIR

NOTES:

SEE SPECS. 2573, 3891 & 3893.

FOR USE WHEN TEMPORARY PONDING IS NEEDED IN DITCH SECTIONS FOR SEDIMENT CONTROL.

MANUFACTURED ALTERNATIVES LISTED ON MnDOT'S APPROVED PRODUCTS LIST MAY BE SUBSTITUTED AT NO ADDITIONAL COST.

① ROCK LOG OR SANDBAG TO HOLD STANDPIPE AND ACT AS A SEAL BETWEEN RISER PIPE AND CULVERT.

② PLACE CULVERT APRON AND SLIDE TEMPORARY STANDPIPE INTO CSP OR RCP CULVERT.

③ ALL GEOTEXTILE USED FOR CULVERT PROTECTION SHALL BE MONOFILAMENT IN BOTH DIRECTIONS, MEETING SPEC. 3886 FOR MACHINE SLICED.

④ ROCK LOG OR RIP RAP TO HOLD STANDPIPE AND ACT AS A FILTER BETWEEN RISER PIPE AND CULVERT.

⑤ HEIGHT OVERFLOW NOT TO CAUSE FLOODING OF ROAD OR ADJACENT PROPERTIES.

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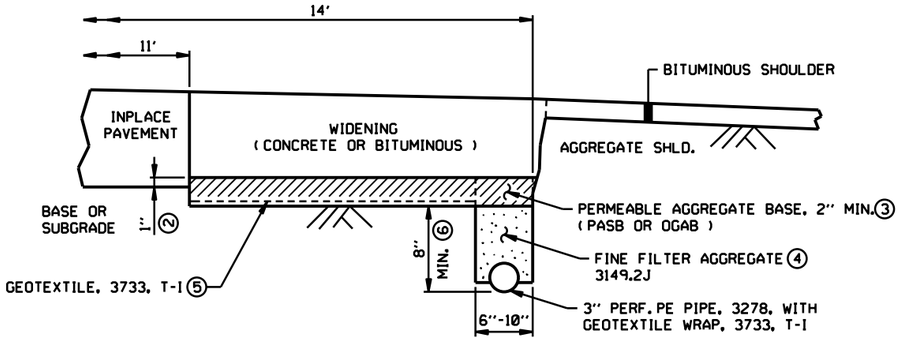
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APPROVED: 2-28-2017
REVISED:
STATE DESIGN ENGINEER

TEMPORARY SEDIMENT CONTROL
CULVERT END CONTROLS

STATE PROJ. NO. (T.H.) SHEET NO. 20 OF 59 SHEETS



SUBSURFACE DRAIN, WIDENED PAVEMENT DESIGN WITH PAVEMENT EDGE DRAIN①

NOTES:

① SEE SPECIAL PROVISIONS FOR MATERIAL AND CONSTRUCTION DETAILS.

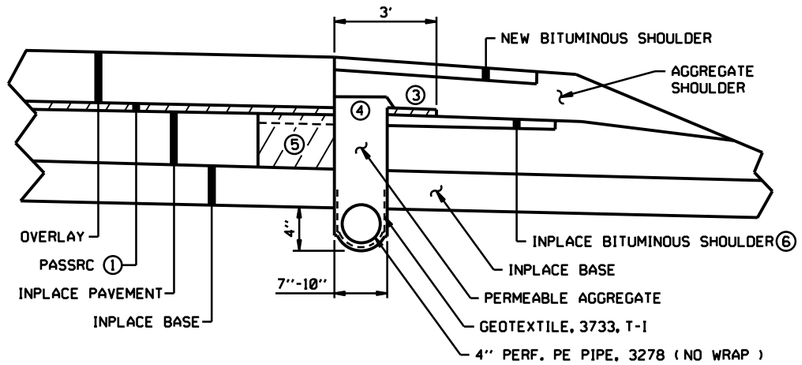
② PERMEABLE BASE SHOULD OVERLAP PAVEMENT MAXIMUM AMOUNT PERMITTED BY STRUCTURAL DESIGN, BUT BOTTOM SHOULD NOT BE ABOVE THE BOTTOM OF INPLACE PAVEMENT.

③ AS REQUIRED BY DESIGN STANDARDS.
PASB - PERMEABLE ASPHALT STABILIZED BASE.
OGAB - OPEN GRADED AGGREGATE BASE.
PAB - OPTION

④ DRAIN SHALL BE PAVEMENT EDGE DRAIN TYPE. AFTER COMPACTION, FINE FILTER AGGREGATE IN DRAIN SHALL EXTEND AT LEAST 4" ABOVE THE BOTTOM OF THE FUTURE PERMEABLE AGGREGATE BASE.

⑤ GEOTEXTILE MAY BE DELETED IF CLASS 5 OR 6 BASE EXISTS INPLACE UNDER PERMEABLE BASE.

⑥ IF CLASS 5 OR 6 BASE IS INPLACE BELOW THE PAB, BOTTOM OF PIPE SHOULD BE A MINIMUM OF 3" BELOW BASE/SUBGRADE INTERFACE OR A MINIMUM OF 8", WHICHEVER IS DEEPER.



SUBSURFACE DRAIN, PERMEABLE BASE & DRAIN USED WITH PASSRC ①②

NOTES:

① PASSRC - PERMEABLE ASPHALT STABILIZED STRESS RELIEF COURSE.

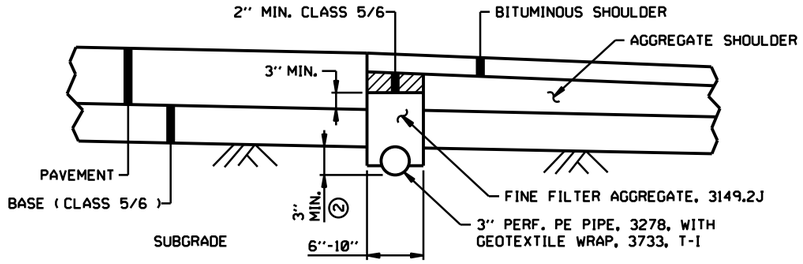
② SEE SPECIAL PROVISIONS FOR MATERIAL AND CONSTRUCTION DETAILS.

③ WIDTH AS NEEDED TO SUPPORT PAVER TRACK.

④ PERMEABLE AGGREGATE TO BE HEAPED 2" ABOVE TOP OF PASSRC AFTER COMPACTION.

⑤ INTERCEPTOR DRAINS TYPICALLY USED AT THIS LOCATION. SEE DETAIL & SPECIAL PROVISIONS IF APPLICABLE.

⑥ IF THE BITUMINOUS SHOULDER REMAINS INPLACE, THE PASSRC AND SHOULDER CAN BE REMOVED BY MILLING, TRENCHING, OR OTHER METHOD, PROVIDED THE REMAINING BITUMINOUS SHOULDER IS NOT DISTURBED/DISPLACED.

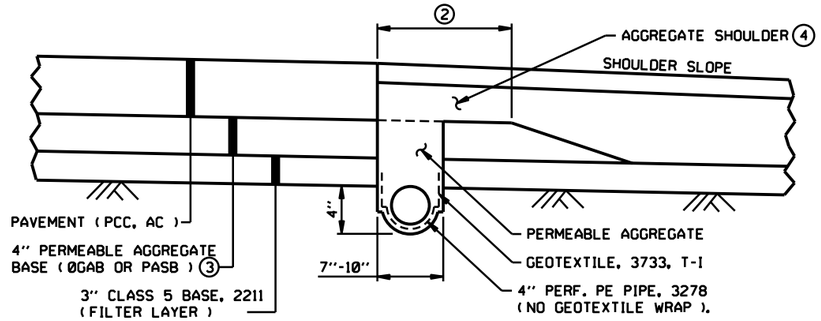


SUBSURFACE DRAIN, PAVEMENT EDGE DRAIN TYPE ①

NOTES:

① SEE SPECIAL PROVISIONS FOR MATERIAL AND CONSTRUCTION DETAILS.

② DESIGN FOR 15" COVER FROM TOP OF PIPE TO TOP OF SHOULDER (12" MINIMUM).



SUBSURFACE DRAIN, PERMEABLE AGGREGATE BASE TYPE①

(RIGHT SIDE OF ROADWAY SHOWN)

NOTES:

① SEE SPECIAL PROVISIONS FOR MATERIAL AND CONSTRUCTION DETAILS. TYPICAL SECTION SHOWN IS FOR PERMEABLE ASPHALT STABILIZED BASE (PASB). DRAIN TRENCH FOR OPEN GRADED AGGREGATE BASE (OGAB) IS MOVED 6" AWAY FROM THE PAVEMENT EDGE.

② USE 36" FOR EITHER PASB OR OGAB UNDER PCC PAVEMENT. USE 12" FOR PASB UNDER AC PAVEMENT.

③ OGAB - OPEN GRADED AGGREGATE BASE.
PASB - PERMEABLE ASPHALT STABILIZED BASE.
USE PASB WITH AC PAVEMENTS.
USE PASB OR OGAB WITH PCC PAVEMENTS.

④ CLASS 3, 5 OR 6, AS SPECIFIED

REVISION:

APPROVED: 8-6-2014
DIRECTOR, OFFICE OF MATERIALS AND ROAD RESEARCH

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STANDARD PLAN 5-297.432 | 1 OF 1

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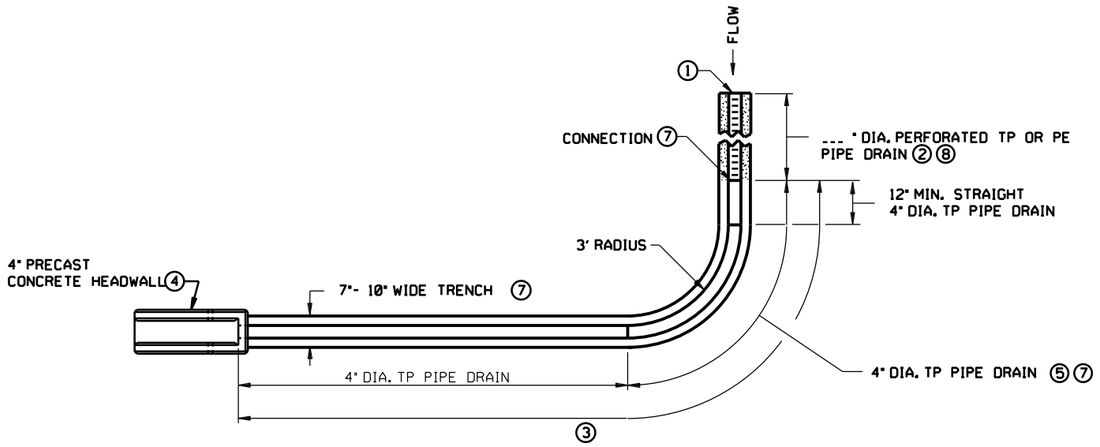
SUBSURFACE DRAINS

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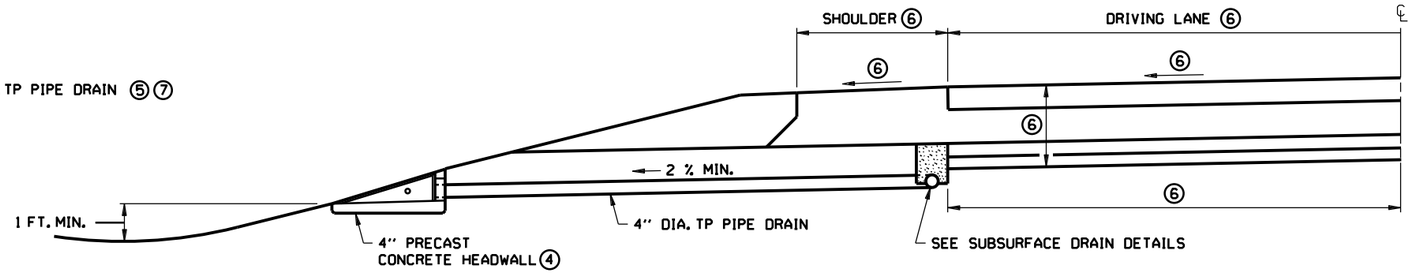
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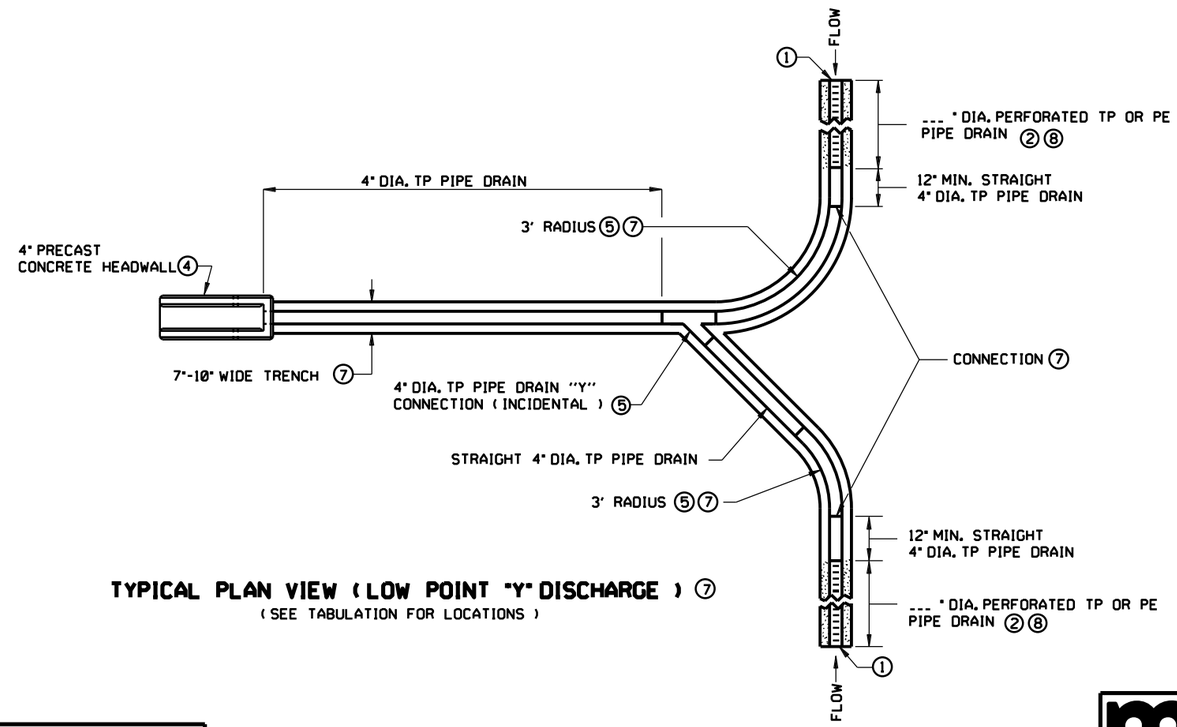


TYPICAL PLAN VIEW (SINGLE DISCHARGE 17
(SEE TABULATION FOR LOCATIONS)



SECTION VIEW

TYPICAL EDGE DRAIN AND DISCHARGE CROSS SECTION 7
(SEE TABULATION FOR LOCATIONS)



TYPICAL PLAN VIEW (LOW POINT "Y" DISCHARGE) 7
(SEE TABULATION FOR LOCATIONS)

NOTES:

1. THE UPSTREAM ENDS OF THE PERFORATED PIPE SHALL BE CAPPED AS APPROVED BY THE PROJECT ENGINEER, THE CAPS ARE INCIDENTAL. PLACE PERFORATED PIPE WITH THE PERFORATIONS DOWN.
2. MAXIMUM LENGTH 500 FT., EXCEPT 300 FT. MAXIMUM FOR GRADES LESS THAN 0.2% . LENGTH INCLUDED AND PAID FOR AS SPEC. 2502, -- INCH PERFORATED TP OR PE PIPE DRAIN.
3. LENGTH INCLUDED AND PAID FOR AS SPEC. 2502, 4 INCH DIA. TP PIPE DRAIN.
4. PRECAST CONCRETE HEADWALL STANDARD PLATE 3131 PAID FOR AS SPEC. 2502, 4 INCH PRECAST CONCRETE HEADWALL.
5. DETAILS OF CONNECTION AND COUPLING TO PIPE SHALL BE APPROVED BY THE ENGINEER. PAYMENT FOR " Y " AND EXTRA CONNECTION, 11 INCH TP PIPE AND COUPLING TO BE INCIDENTAL.
6. SEE ROADWAY TYPICAL SECTIONS FOR ADDITIONAL INFORMATION.
7. SEE SPECIAL PROVISIONS FOR MATERIAL AND CONSTRUCTION DETAILS.
8. 3 INCH OR 4 INCH DIAMETER.

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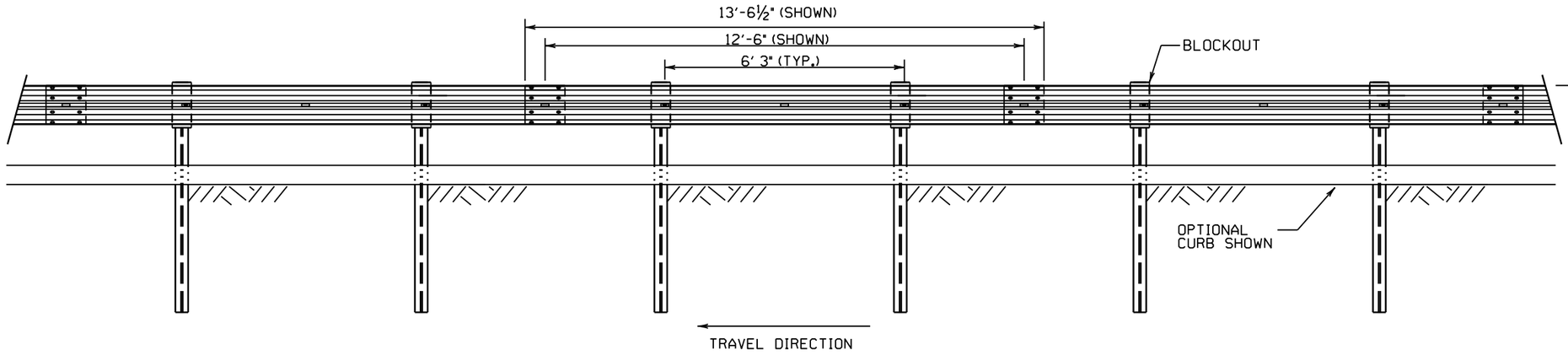
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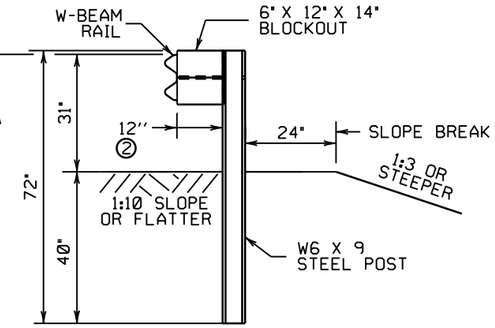
SUBSURFACE DRAINS
OUTLET PIPES FOR EDGE AND SUBCUT DRAINS

STATE PROJ. NO. (T.H.) SHEET NO. 22 OF 59 SHEETS

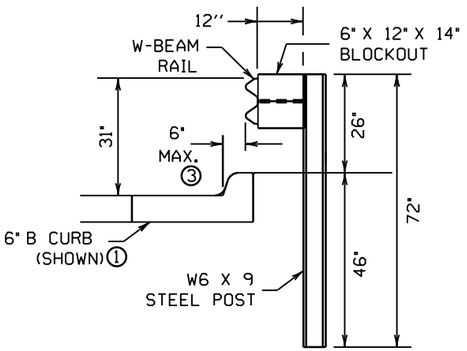
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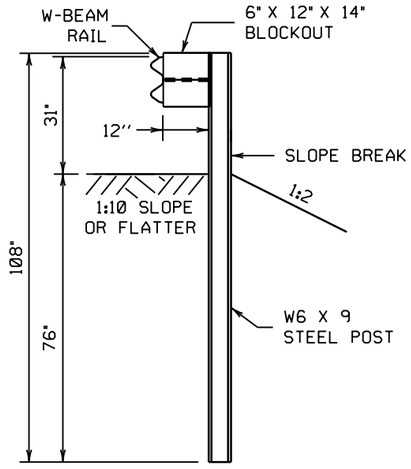
FRONT VIEW



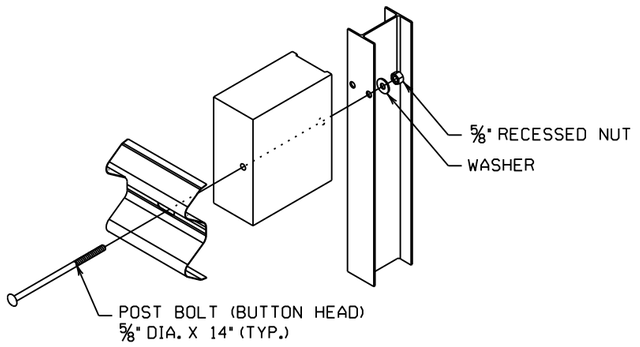
SIDE VIEW

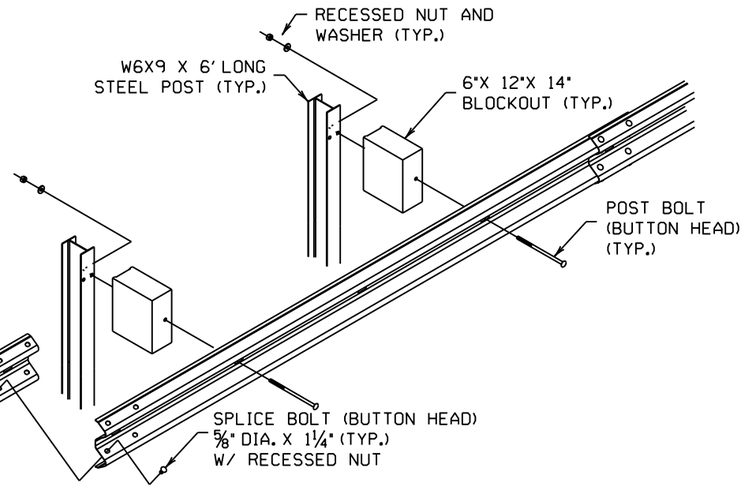


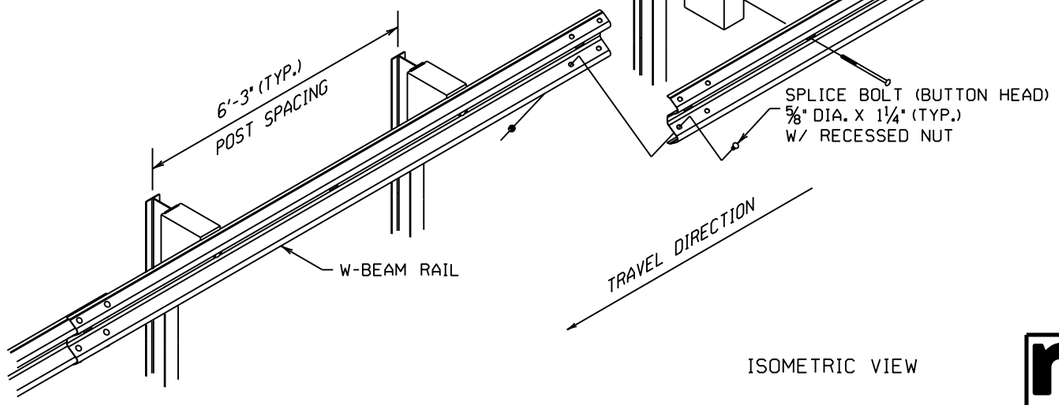
TYPE 31 GUARDRAIL
WITH CURB



TYPE 31 GUARDRAIL WITH
1:2 BACK SLOPE AT POST







ISOMETRIC VIEW

NOTES:

GUARDRAIL IS PLACED ON SLOPES 1:10 OR FLATTER WITH SLOPE EXTENDING A MINIMUM 24" BEHIND POST TO SLOPE BREAK POINT.

WOOD BLOCKOUT SHOWN. PROPRIETARY BLOCKOUTS THAT MEET THE REQUIREMENTS OF MASH MAY BE SUBSTITUTED AT NO ADDITIONAL COST. BLOCKOUTS SHALL NOT ROTATE AFTER INSTALLATION.

ALL RAIL AND HARDWARE COMPONENTS PER AASHTO SPEC. M 180

① B CURB OR D CURB ACCEPTABLE.

② MAXIMUM OF 24" MAY BE USED WHERE UNDERGROUND POST OBSTRUCTIONS ARE ENCOUNTERED.

③ 0" TO 6" MAXIMUM.

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MINNESOTA DEPARTMENT OF TRANSPORTATION

STANDARD PLAN 5-297.690 | 1 OF 2

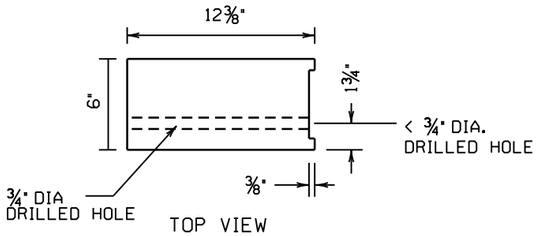
APPROVED: 7-19-2016
REVISED:

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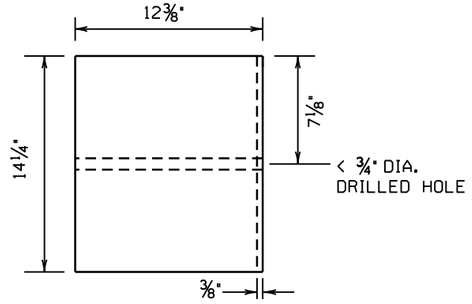
TRAFFIC BARRIER TYPE 31
ASSEMBLY DETAILS

STATE PROJ. NO. (T.H.) SHEET NO. 230F 59 SHEETS

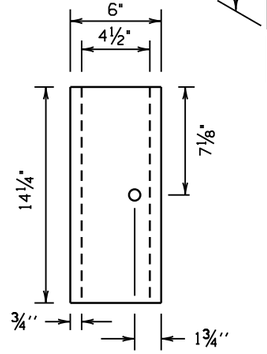
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TOP VIEW

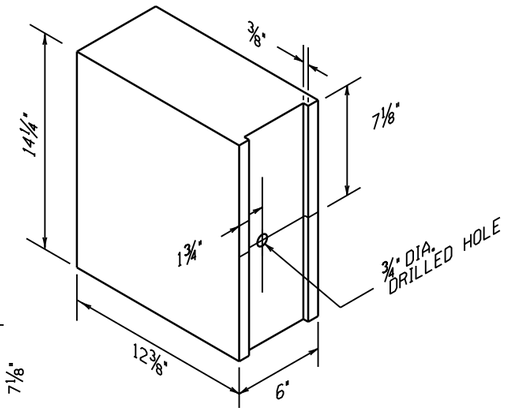


SIDE VIEW

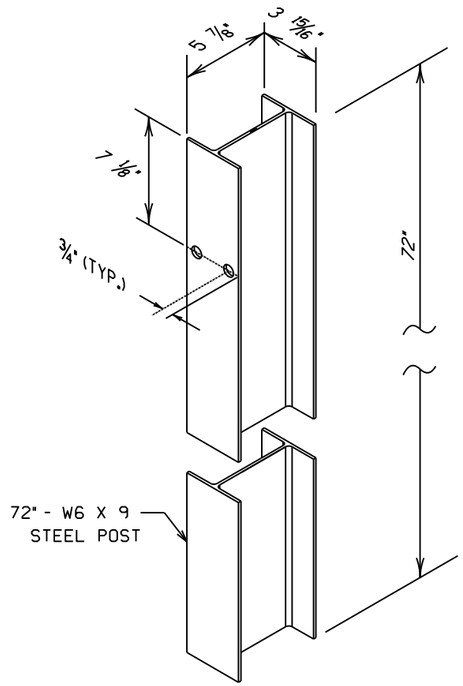


FRONT VIEW

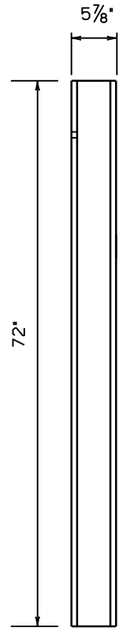
BLOCKOUT
WITH ROUTED GROOVE



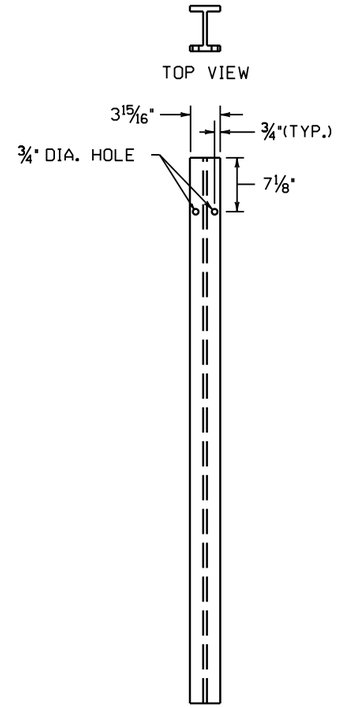
ISOMETRIC BACK VIEW



ISOMETRIC FRONT VIEW

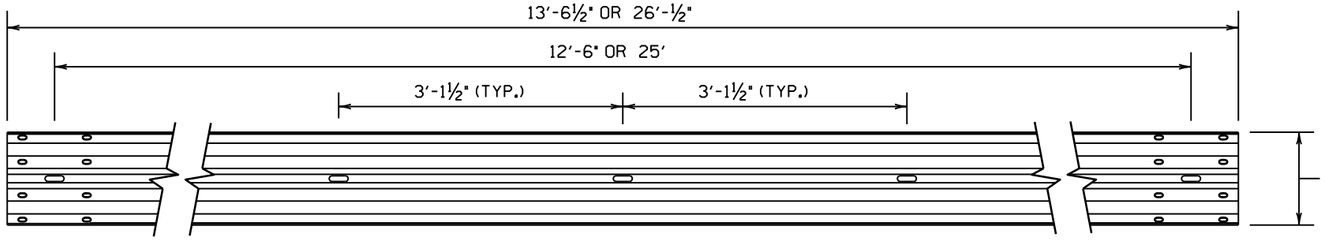


SIDE VIEW

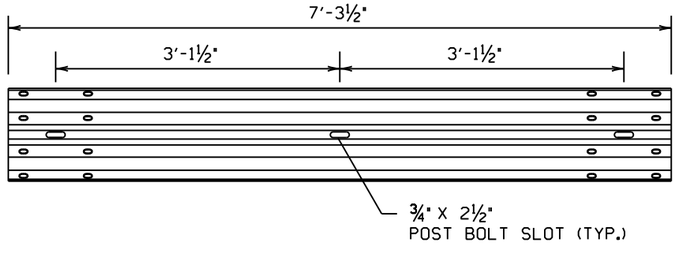


FRONT VIEW

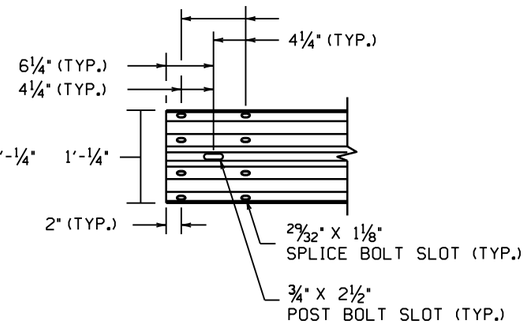
LINE POST①



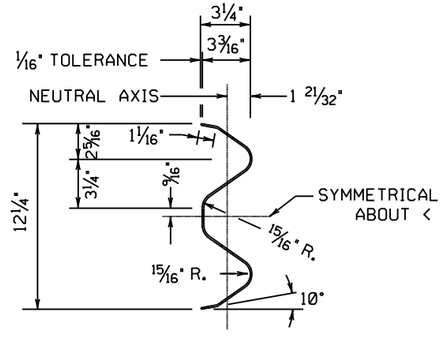
12'-6" OR 25' W-BEAM RAIL



6'-3" W-BEAM RAIL



W-BEAM RAIL
SPLICE BOLT/POST BOLT DETAIL



W-BEAM CROSS SECTION
AASHTO DESIGNATION M 180-11

NOTES:
ALL POSTS SHALL BE STAMPED INDICATING THE POST SIZE AND LENGTH. STAMP SHALL BE VISIBLE AFTER BEING PLACED.
① 72" - W6 X 9 STEEL POST SHOWN.

HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

STATE DESIGN ENGINEER

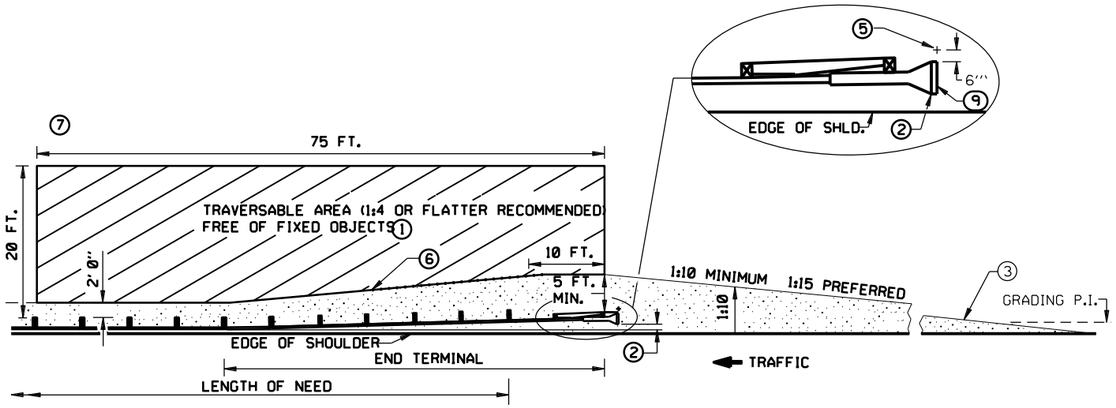
STANDARD PLAN 5-297.690 | 2 OF 2

APPROVED: 7-19-2016
REVISED:

TRAFFIC BARRIER TYPE 31
LINE POST, SPACER BLOCK, AND W-BEAM RAIL DETAILS

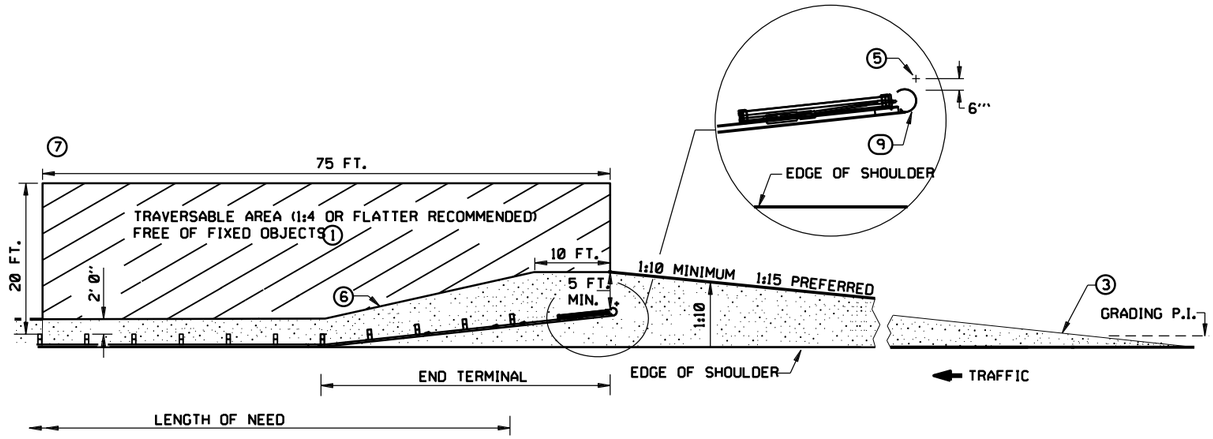
STATE PROJ. NO. (T.H.) SHEET NO. 24 OF 59 SHEETS

PLOTTED/REVISED: $$$$@DATE@$$$$



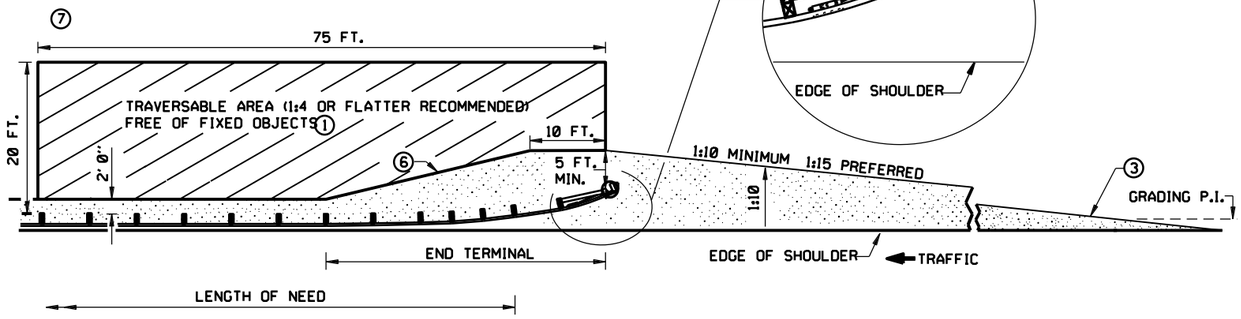
PLAN VIEW

(PROPRIETARY TANGENT TERMINAL SHOWN AS EXAMPLE)



PLAN VIEW ⑧

(PROPRIETARY FLARED TERMINAL SHOWN AS EXAMPLE)



PLAN VIEW ④ ⑧

(ELT)

NOTES:

ALL CROSS SLOPES ARE IN FOOT/FOOT UNLESS OTHERWISE NOTED.

ALL GUARDRAIL POSTS SHALL BE 6 FT. 3 IN. CENTER TO CENTER (DESIGN B), EXCEPT WHERE NOTED.

CHANGES (TO SUBJECTS COVERED BY THIS SHEET) INDICATED IN THE PLANS OR ON PLATES WITH MORE RECENT APPROVAL DATES SHALL APPLY.

GRADING AND DRAINAGE HARDWARE ARE NOT INCIDENTAL TO GUARDRAIL INSTALLATION.

① SLOPES BETWEEN 1:3 AND 1:4 PERMITTED WHEN 1:4 OR FLATTER IS NOT POSSIBLE. FOR SLOPES STEEPER THAN 1:3 THE AREA IMMEDIATELY BEHIND AND BEYOND THE END TERMINAL SHOULD, AT LEAST, BE SIMILAR IN CROSS SECTION TO THE UNSHIELDED ROADSIDE AREA UPSTREAM OF THE END TERMINAL.

② THE LAST 50 FT. OF TANGENT TERMINALS CAN BE FLARED AT 1:50 TAPER.

③ WHEN GRADING PLATFORMS ARE BUILT, THEY MUST BE SMOOTHLY TRANSITIONED TO EXISTING SIDE SLOPE SO THE ENTIRE ROADSIDE APPROACH TO THE BARRIER REMAINS TRAVERSABLE, AS WELL AS THE AREA IMMEDIATELY BEHIND IT.

④ SEE STANDARD PLATE 8329.

⑤ SNOWPLOW MARKER (X4-5) WITH A 2 LB./FT. DELINEATOR POST 8 FT. LONG (SPEC. 3401) DRIVEN INTO THE GROUND. EXTEND 3 FT. ABOVE TERMINAL. THE MARKER IS INCIDENTAL FOR WHICH NO DIRECT PAYMENT WILL BE MADE. MARK BOTH THE BEGINNING AND END OF PLATE BEAM GUARDRAIL INSTALLATION.

⑥ 1:10 OR FLATTER SLOPE P.I.

⑦ GRADUALLY BLEND SLOPE FROM TRAVERSABLE AREA TO STEEP EXISTING SLOPE (WHEN SLOPE IS STEEPER THAN 1:6).

⑧ IF THE TERRAIN BEYOND THE TERMINAL END AND IMMEDIATELY BEHIND THE BARRIER IS NOT SAFELY TRAVERSABLE, A TANGENT (ENERGY- ABSORBING) TERMINAL SHALL BE USED.

⑨ MARK THE APPROACH END OF PLATE BEAM GUARDRAIL INSTALLATIONS WITH A STRIPED OBJECT MARKER SIZED TO FIT THE END TERMINAL, HAVING ALTERNATING BLACK AND REFLECTIVE YELLOW (WIDE ANGLE PRISMATIC RETROREFLECTIVE SHEETING). STRIPES SHALL SLOPE DOWNWARD AT A 45 DEGREE ANGLE TOWARD THE SIDE ON WHICH TRAFFIC PASSES. FOR FLAT END TREATMENTS THE OBJECT MARKER SHALL FIT INSIDE THE RECESSED AREA. FOR ROUNDED END TREATMENTS THE OBJECT MARKER SHALL WRAP AROUND THE CIRCULAR END AND BE MOUNTED SO THE TOP OF THE OBJECT MARKER LINES UP WITH THE TOP OF THE END TREATMENT.

DISTRICT #: $@DISTRICT@$
IPLOT NAME: $$@IPLOT$NAME@$$
PATH & FILENAME: $$$@PATHFILENAME@$$$

HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

STATE DESIGN ENGINEER

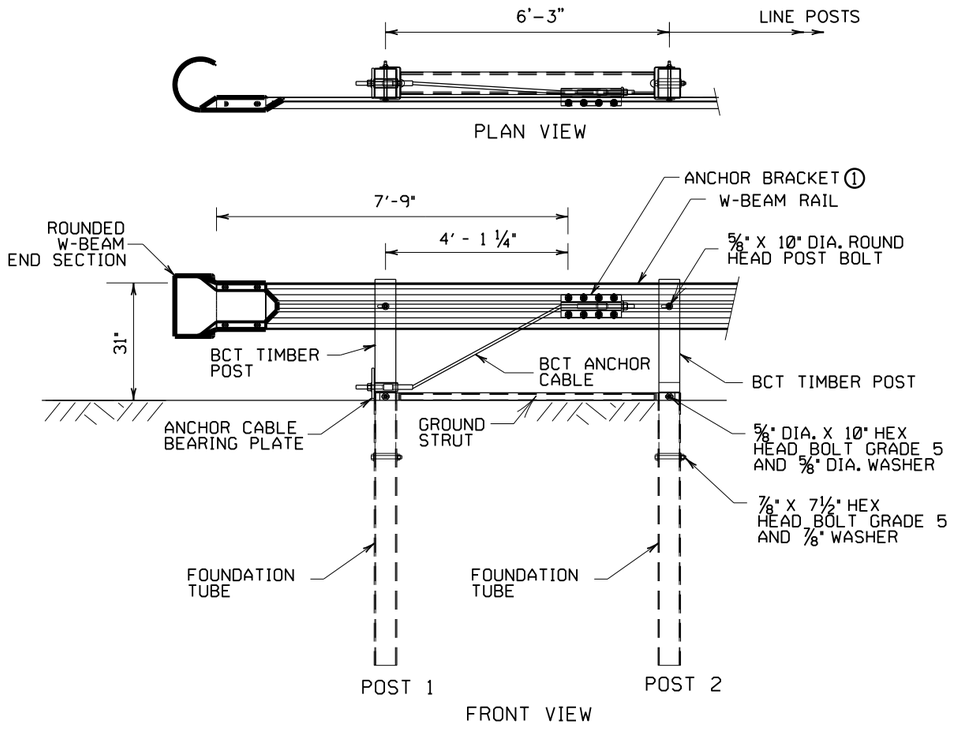
STANDARD PLAN 5-297.601 | 3 OF 3

APPROVED: 5-27-2014
REVISED:

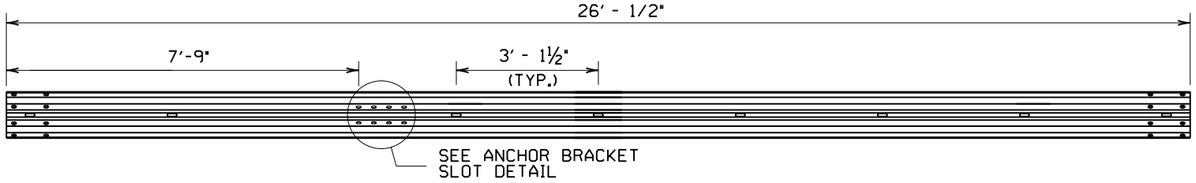
GUARDRAIL INSTALLATIONS AT MEDIANS AND END TREATMENTS
(FOR NEW CONSTRUCTION AND RETROFITS WITHOUT SITE RESTRICTIONS)

STATE PROJ. NO. (T.H.) SHEET NO. 25 OF 59 SHEETS

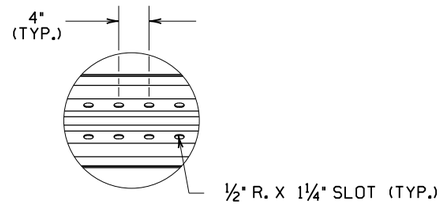
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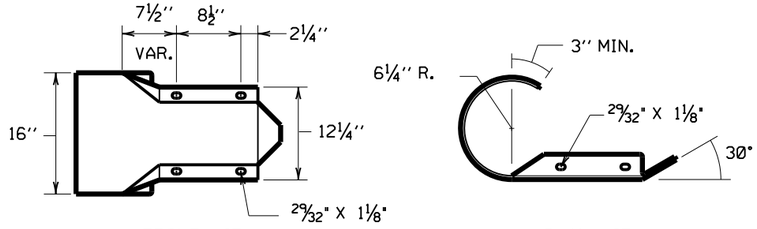
END RAIL DETAIL



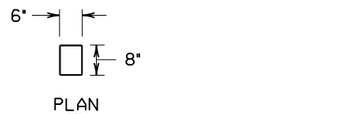
END RAIL BEAM

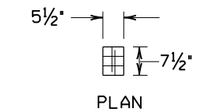


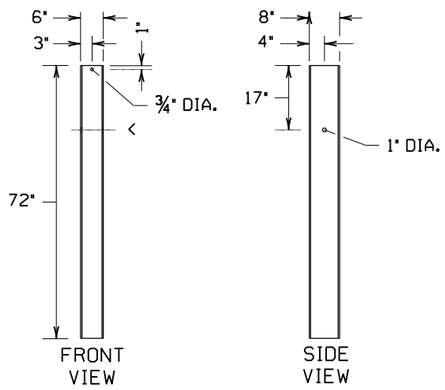
ANCHOR BRACKET SLOT DETAIL



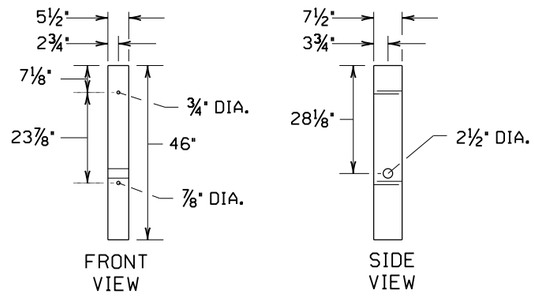
ROUNDED W-BEAM END SECTION







FOUNDATION TUBE②



BCT TIMBER POST (MGS LENGTH)

NOTES:

ALL RAIL AND HARDWARE COMPONENTS PER AASHTO SPEC. M 180.

① BRACKET BOLTED TO BEAM WITH (8) ⅝" DIA. X 1½" HEX HEAD BOLT GRADE 5 AND ⅝" DIA. WASHER.

② FOUNDATION TUBE SHALL BE MANUFACTURED USING ASTM A500B STEEL AND SHALL CONFORM TO ASTM A500 GRADE B MATERIAL.

HENN. CO. PROJ. NO. 0408 C.R. 202
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MINNESOTA DEPARTMENT OF TRANSPORTATION

STATE DESIGN ENGINEER

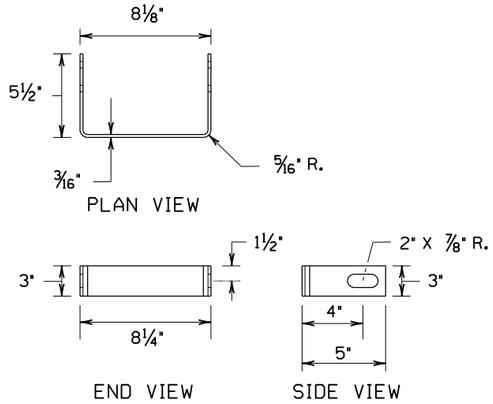
APPROVED: 7-19-2016
REVISED:

STANDARD PLAN 5-297.692 | 1 OF 2

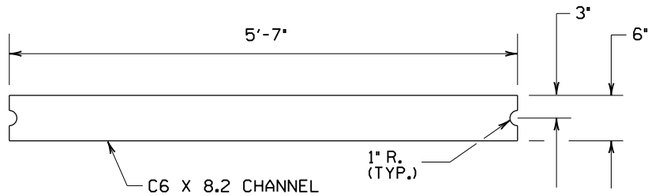
TRAFFIC BARRIER TYPE 31 END ANCHORAGE ASSEMBLY DETAILS

STATE PROJ. NO. (T.H.) SHEET NO. 26 OF 59 SHEETS

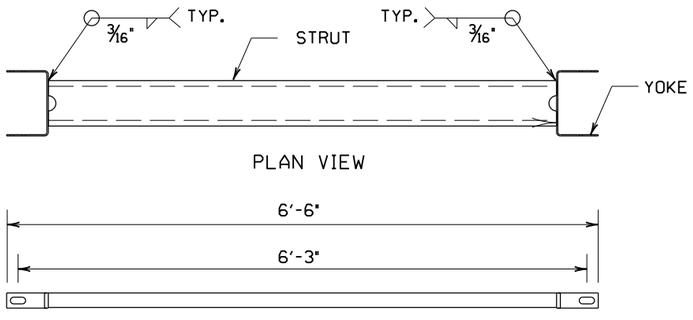
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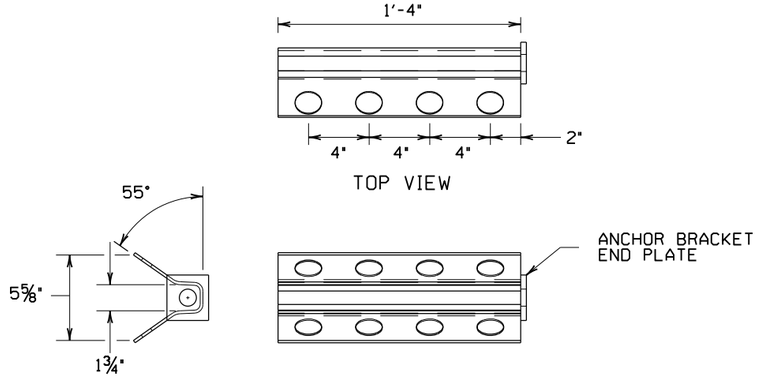
YOKE DETAILS



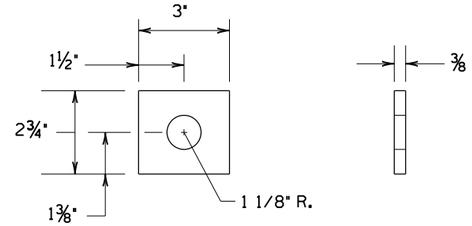
PLAN VIEW
STRUT DETAIL



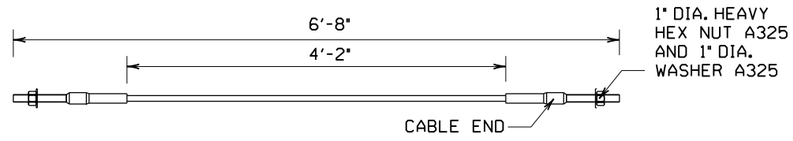
STRUT AND YOKE ASSEMBLY



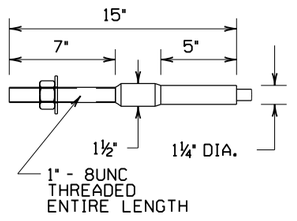
ANCHOR BRACKET



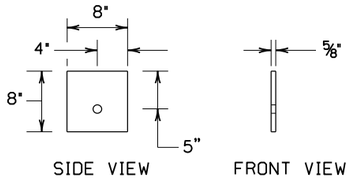
ANCHOR BRACKET END PLATE



BCT ANCHOR CABLE



BCT ANCHOR CABLE END DETAIL



BCT ANCHOR CABLE BEARING PLATE

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MINNESOTA DEPARTMENT OF TRANSPORTATION

STANDARD PLAN 5-297.692 | 2 OF 2

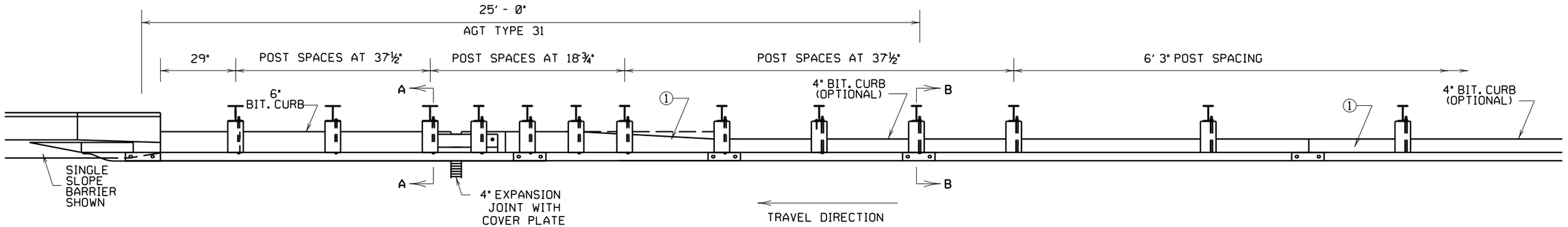
APPROVED: 7-19-2016
REVISED:

STATE DESIGN ENGINEER

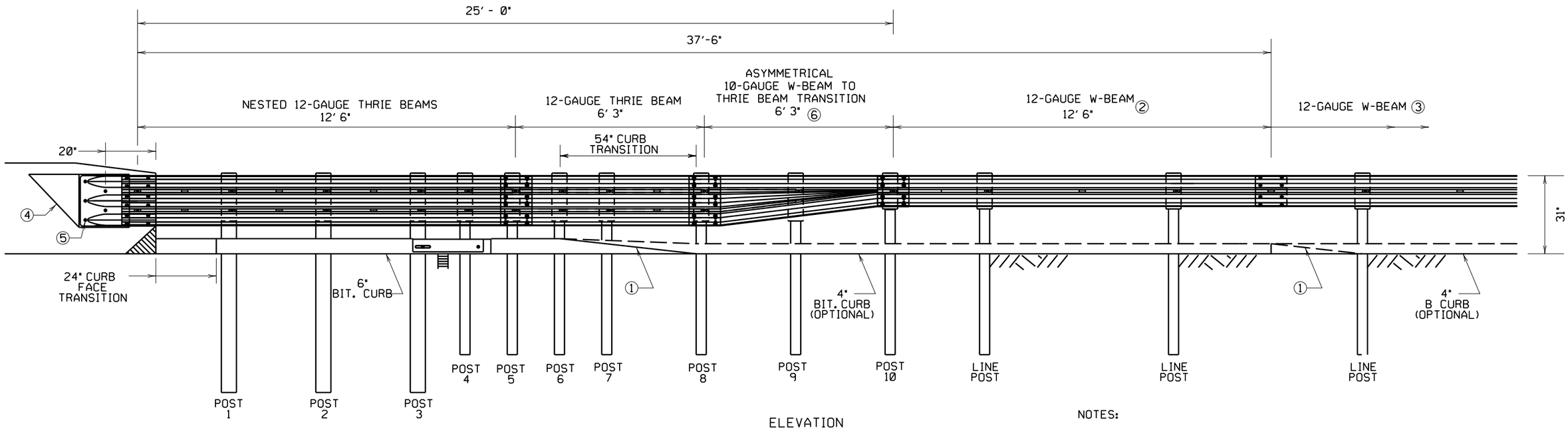
TRAFFIC BARRIER TYPE 31 END ANCHORAGE
COMPONENT DETAILS

STATE PROJ. NO. (T.H.) SHEET NO. 27 OF 59 SHEETS

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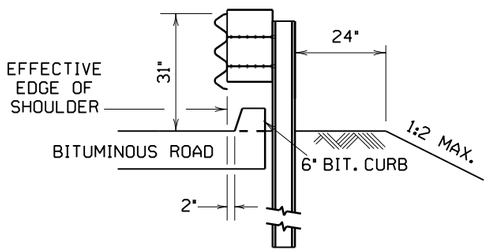


PLAN VIEW

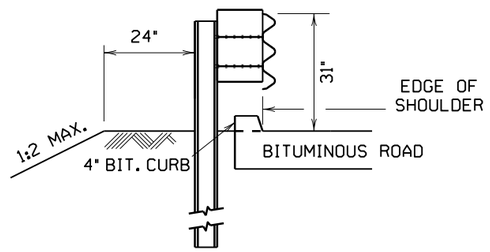


ELEVATION

APPROACH GUARDRAIL TRANSITION



SECTION A-A
(THRIE BEAM/AGT) ⑦⑧



SECTION B-B
(THRIE BEAM/AGT) ⑦⑧

TRANSITION POST/BLOCK SIZING		
POST #	STEEL POST SIZE	BLOCKOUT SIZE
1-3	84" - W6 x 15	6 x 12 x 19"
4-9	72" - W6 x 9	6 x 12 x 19"
10	72" - W6 x 9	6 x 12 x 14"

NOTES:

ALL POSTS STAMPED WITH POST SIZE AND LENGTH VISIBLE AFTER BEING PLACED.

W-BEAM RAIL SPLICE BOLTS AND NUTS AS SPECIFIED BY AASHTO SPEC. M 180.

① CURB TRANSITION, NO CHANGE IN CURB DESIGN CAN OCCUR BETWEEN POST 8 AND 37'-6" UPSTREAM FROM THE BARRIER ANCHORAGE PLATE.

② WHERE CURB EXTENDS UPSTREAM OF POST NO. 8, THIS 12'-6" SECTION OF 12-GUAGE W-BEAM RAIL SHALL BE NESTED. THIS ADDED COMPONENT IS INCIDENTAL.

③ A MINIMUM OF 12'-6" OF W-BEAM RAIL IS REQUIRED BEFORE END TREATMENT.

④ SINGLE SLOPE CONNECTION WEDGE PLATE (STANDARD PLATE 8352), INCIDENTAL.

⑤ THRIE BEAM ANCHORAGE PLATE (STANDARD PLATE 8350), INCIDENTAL.

⑥ SEE STANDARD PLAN 5-297.695.

⑦ SEE CURB DETAILS ON SHEET 4 OF 5.

⑧ BIT CURB INCIDENTAL TO GUARDRAIL INSTALLATION. (SEE SPECIAL PROVISIONS)

MODIFIED

CERTIFIED BY JOHN D. EKOLA, PROFESSIONAL ENGINEER
LIC. NO. 53076 06/20/18

HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

STANDARD PLAN 5-297.694 | 1 OF 5

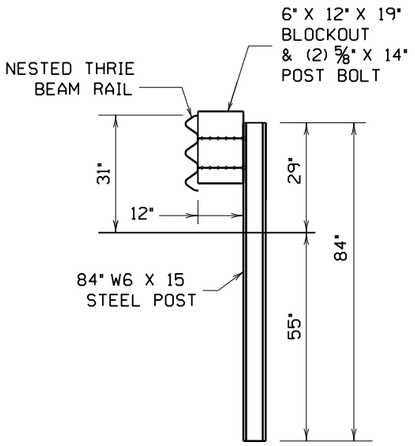
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APPROVED: 7-19-2016
REVISED:

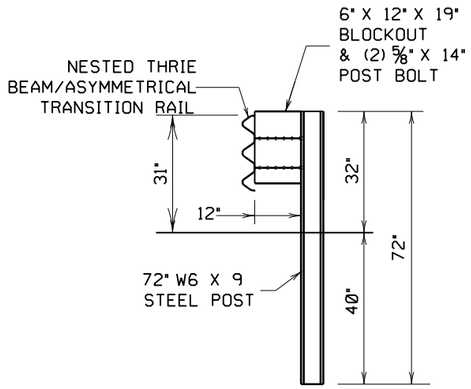
APPROACH GUARDRAIL TRANSITION (AGT) TYPE 31
ASSEMBLY DETAILS

STATE PROJ. NO. (T.H.) SHEET NO. 28 OF 59 SHEETS

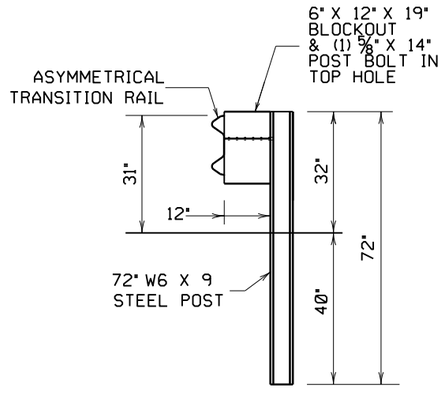
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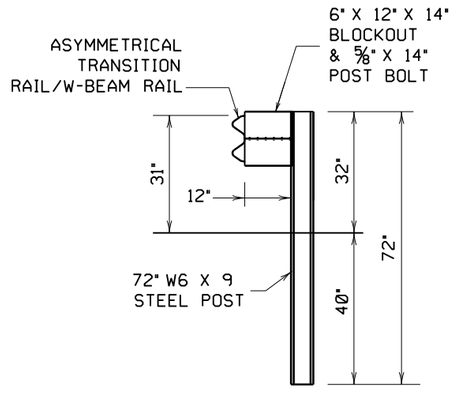
POSTS 1-3



POSTS 4-8

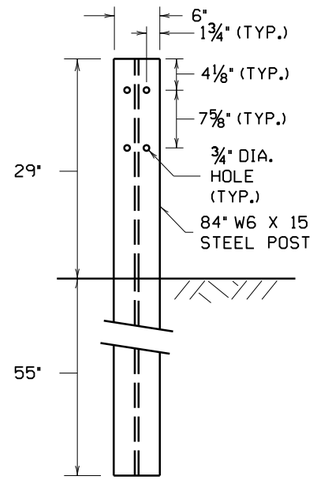


POST 9

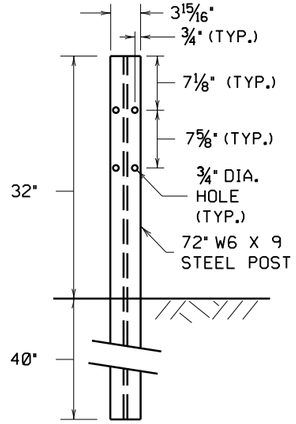


POST 10

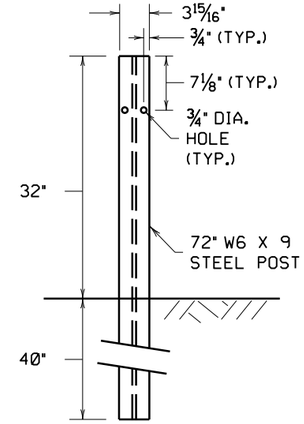
TRANSITION POSTS
WITH BLOCKOUT AND RAIL
SIDE VIEW



POSTS 1-3

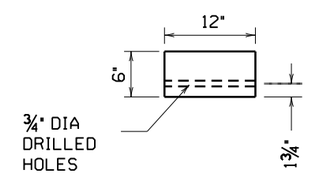


POSTS 4-8

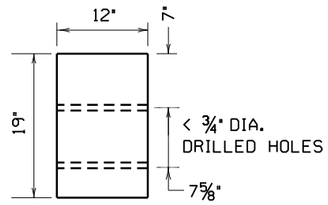


POSTS 9-10

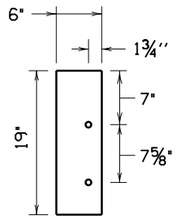
TRANSITION POSTS
FRONT VIEW



TOP VIEW

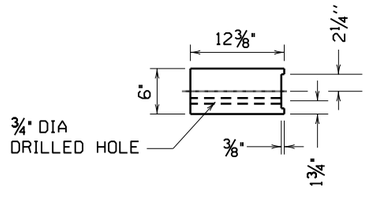


SIDE VIEW

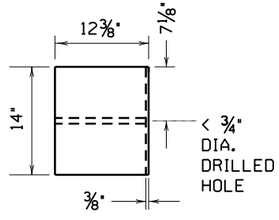


FRONT VIEW

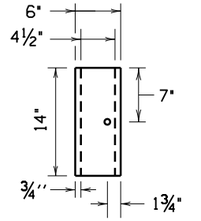
BLOCKOUT POSTS 1-9



TOP VIEW



SIDE VIEW



FRONT VIEW

BLOCKOUT POST 10

NOTES:

ALL GUARDRAIL HARDWARE PER AASHTO SPEC. M 180.

ALL POSTS STAMPED WITH POST SIZE VISIBLE AFTER BEING PLACED.

WOOD BLOCKOUTS SHOWN. PROPRIETARY BLOCKOUTS THAT MEET THE REQUIREMENTS OF MASH MAY BE SUBSTITUTED AT NO ADDITIONAL COST. BLOCKOUTS SHALL NOT ROTATE AFTER INSTALLATION.

DISTRICT *: $@DISTRICT@$
IPLOT NAME: $$@IPLOT$NAME@$$
PATH & FILENAME: $$$@PATHFILENAME@$$$

HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

STATE DESIGN ENGINEER

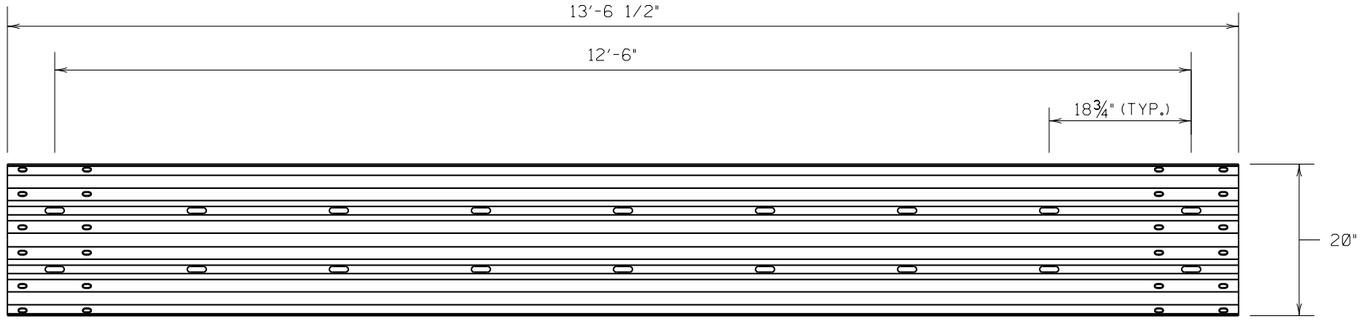
APPROVED: 7-19-2016
REVISED:

STANDARD PLAN 5-297.694 | 2 OF 5

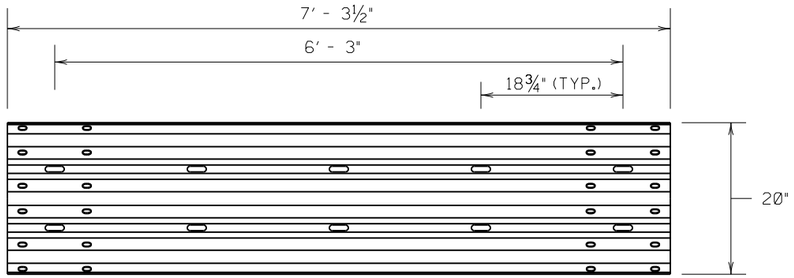
APPROACH GUARDRAIL TRANSITION (AGT) TYPE 31
COMPONENT DETAILS

STATE PROJ. NO. (T.H.) SHEET NO. 29 OF 59 SHEETS

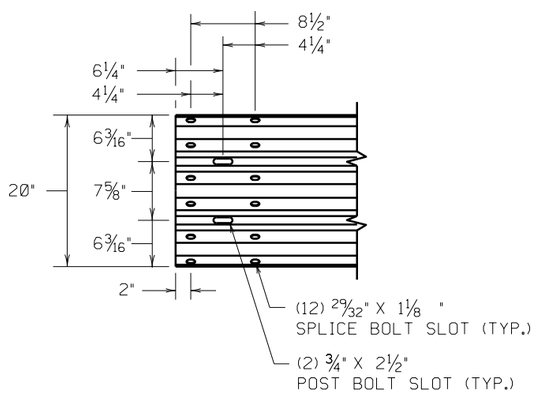
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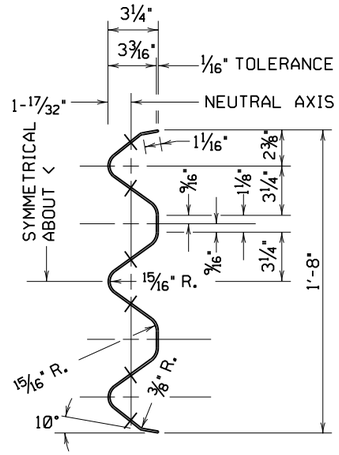
12'-6" THRIE BEAM RAIL



6'-3" THRIE BEAM RAIL



THRIE BEAM RAIL
SPLICE BOLT/POST BOLT DETAIL



THRU SECTION

NOTES:
PLATE BEAM RAIL PER AASHTO SPEC. M 180.

HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

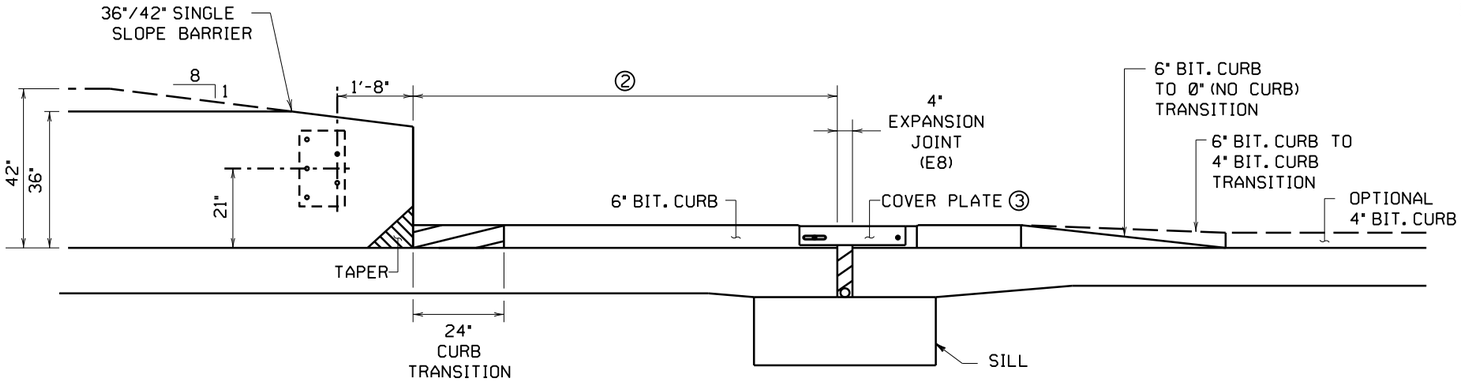
STATE DESIGN ENGINEER

STANDARD PLAN 5-297.694 | 3 OF 5

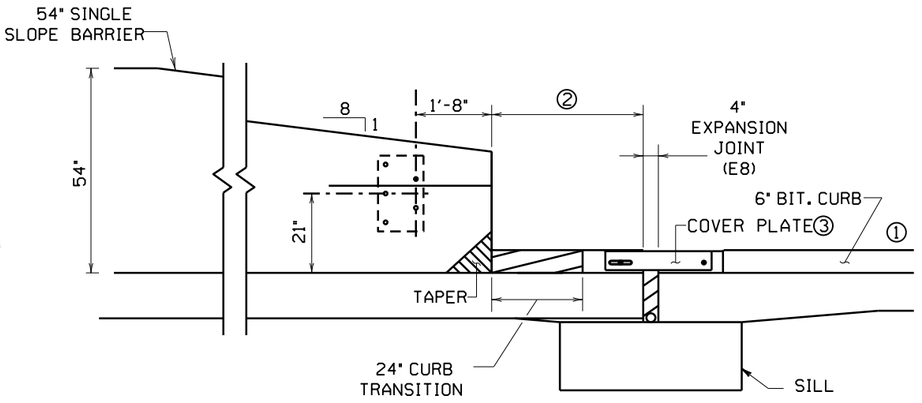
APPROVED: 7-19-2016
REVISED:

APPROACH GUARDRAIL TRANSITION (AGT) TYPE 31
THRIE-BEAM RAIL DETAILS

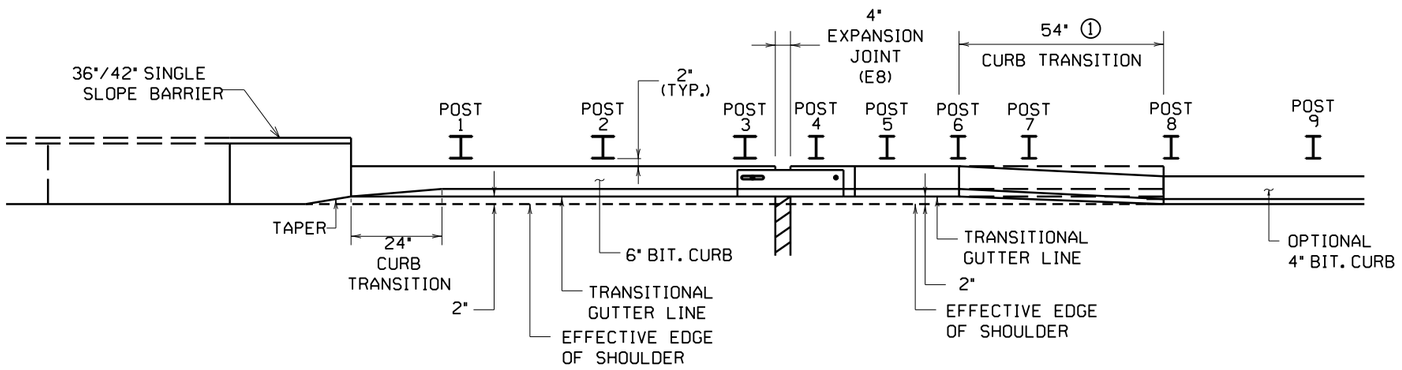
STATE PROJ. NO. (T.H.) SHEET NO. 30 OF 59 SHEETS



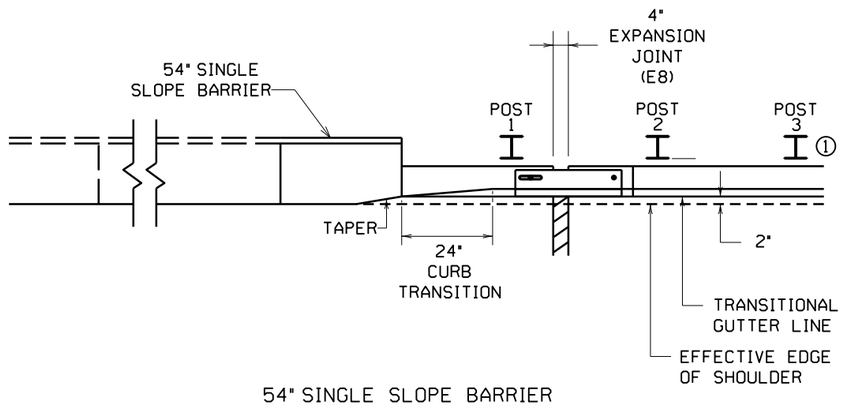
36"/42" SINGLE SLOPE BARRIER ④
FRONT VIEW



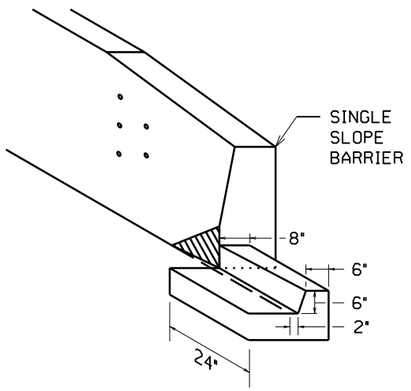
54" SINGLE SLOPE BARRIER
FRONT VIEW



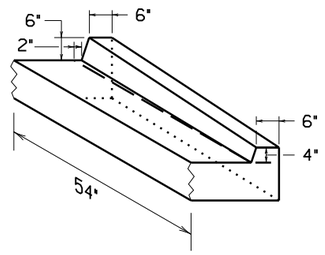
36"/42" SINGLE SLOPE BARRIER ④
PLAN VIEW



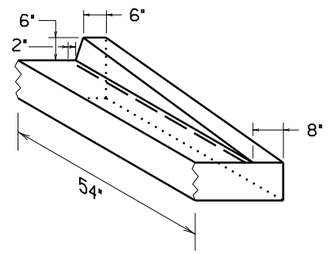
54" SINGLE SLOPE BARRIER
PLAN VIEW



24" CURB TRANSITION FROM
VERTICAL FACE TO 6" BIT. CURB
(SINGLE SLOPE BARRIER)



54" CURB TRANSITION FROM ①
6" BIT. CURB TO 4" BIT. CURB



54" CURB TRANSITION FROM ①
6" BIT CURB TO 0"-NO CURB

NOTES:

36", 42", AND 54" SINGLE SLOPE BARRIERS AVAILABLE.

① FOR ALL SINGLE SLOPE BARRIER HEIGHTS, 54" CURB TRANSITION LOCATION IS BETWEEN POSTS 6 AND POST 8.

② SEE BRIDGE APPROACH PANEL LAYOUT SHEETS FOR DIMENSION.

③ SEE STANDARD PLAN 5-297.229

④ BIT CURB INCIDENTAL TO GUARDRAIL INSTALLATION. (SEE SPECIAL PROVISIONS)

MODIFIED

CERTIFIED BY JOHN D. EKOLA, PROFESSIONAL ENGINEER
LIC. NO. 53076 06/20/18

HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

STANDARD PLAN 5-297.694 | 4 OF 5

APPROVED: 7-19-2016
REVISED:

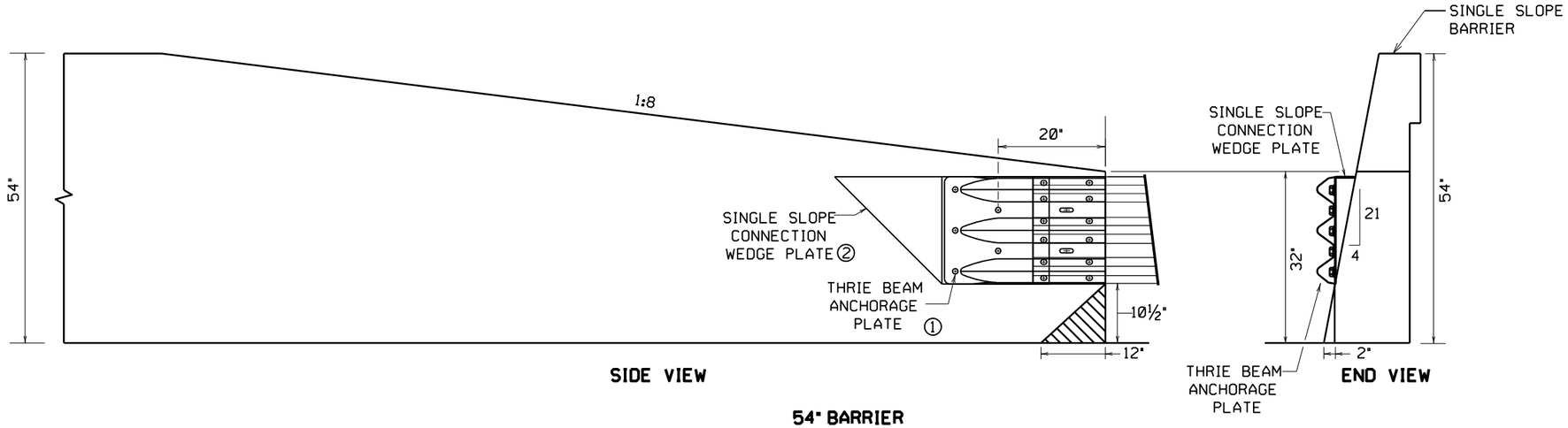
STATE DESIGN ENGINEER

APPROACH GUARDRAIL TRANSITION TYPE (AGT) 31
CURB DETAILS AT SINGLE SLOPE BARRIER

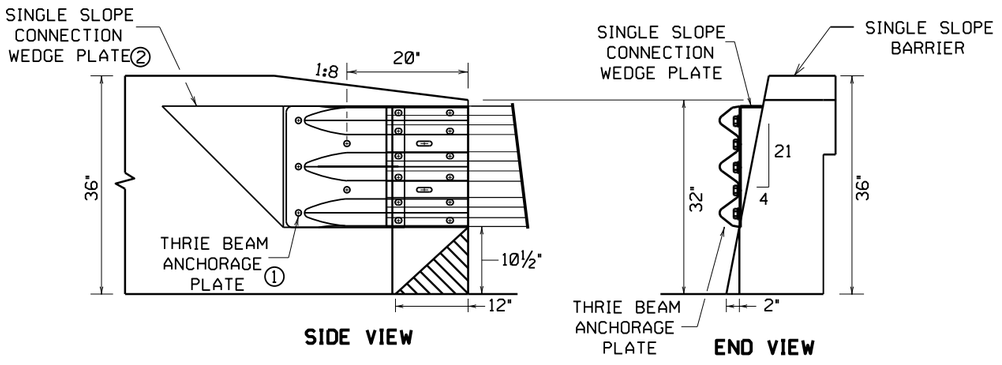
STATE PROJ. NO. (T.H.) SHEET NO. 31 OF 59 SHEETS

PLOTTED/REVISED: $$$$@DATE@$$$$

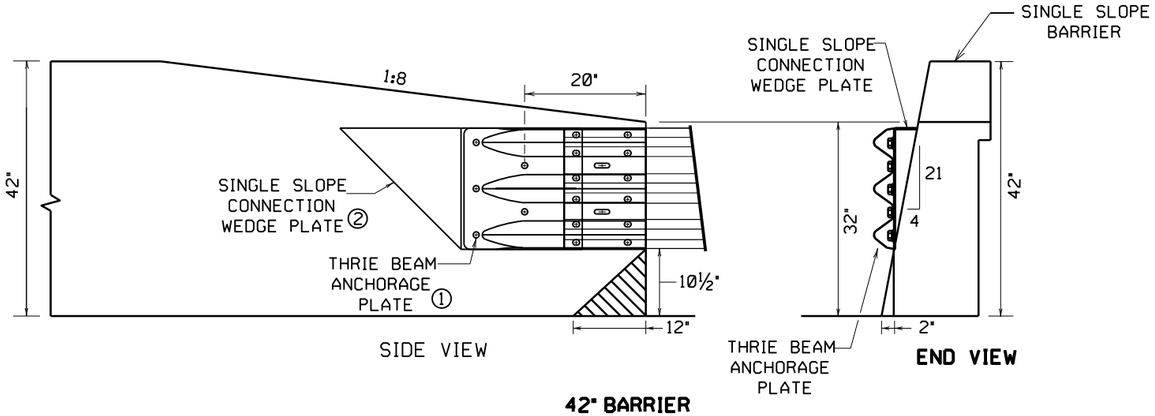
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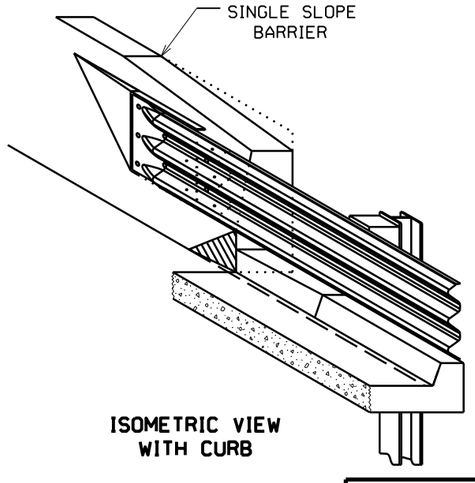
54" BARRIER



36" BARRIER



42" BARRIER



ISOMETRIC VIEW WITH CURB

NOTES:

REFER TO BRIDGE PLAN SHEET B17 FOR ADDITIONAL INFORMATION.

BIT CURB INCIDENTAL TO GUARDRAIL INSTALLATION. (SEE SPECIAL PROVISIONS)

① SEE STANDARD PLATE 8350.

② SEE STANDARD PLATE 8352.

MODIFIED

CERTIFIED BY JOHN D. EKOLA, PROFESSIONAL ENGINEER
LIC. NO. 53076 06/20/18

HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

STANDARD PLAN 5-297.694 | 5 OF 5

APPROVED: 7-19-2016
REVISED:

STATE DESIGN ENGINEER

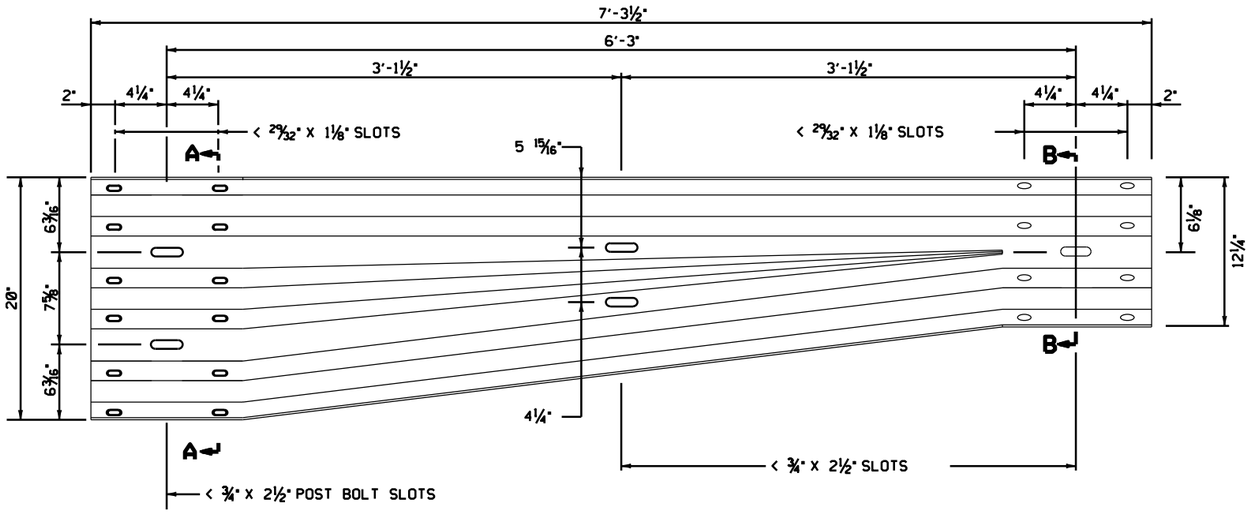
APPROACH GUARDRAIL TRANSITION TYPE (AGT) 31
CONNECTION TO SINGLE SLOPE BARRIER

STATE PROJ. NO. (T.H.) SHEET NO. 32 OF 59 SHEETS

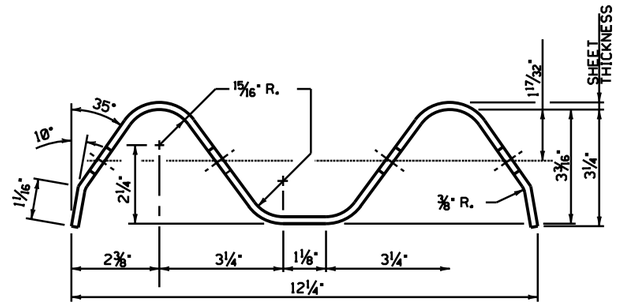
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DISTRICT *: $@DISTRICT@$
IPLOT NAME: $$@IPLOT$NAME@$$
PATH & FILENAME: $$$@PATHFILENAME@$$$

PLOTTED/REVISED: $$$$@DATE@$$$$



ASYMMETRICAL W-BEAM TO THRIE BEAM TRANSITION



SECTION B-B
STANDARD W-BEAM RAIL THRU SECTION

NOTES:

STEEL PLATE BEAM GUARDRAIL SHALL CONFORM TO AASHTO M180.

ASYMMETRICAL TRANSITION DETAIL IS MIRRORED FOR OPPOSITE SIDE INSTALLATION.

DISTRICT *: $@DISTRICT@$
IPLOT NAME: $$@IPLOT$NAME@$$
PATH & FILENAME: $$$@PATHFILENAME@$$$

HENN. CO. PROJ. NO. 0408 C.R. 202
S.P. 027-596-009

MINNESOTA DEPARTMENT OF TRANSPORTATION

STATE DESIGN ENGINEER

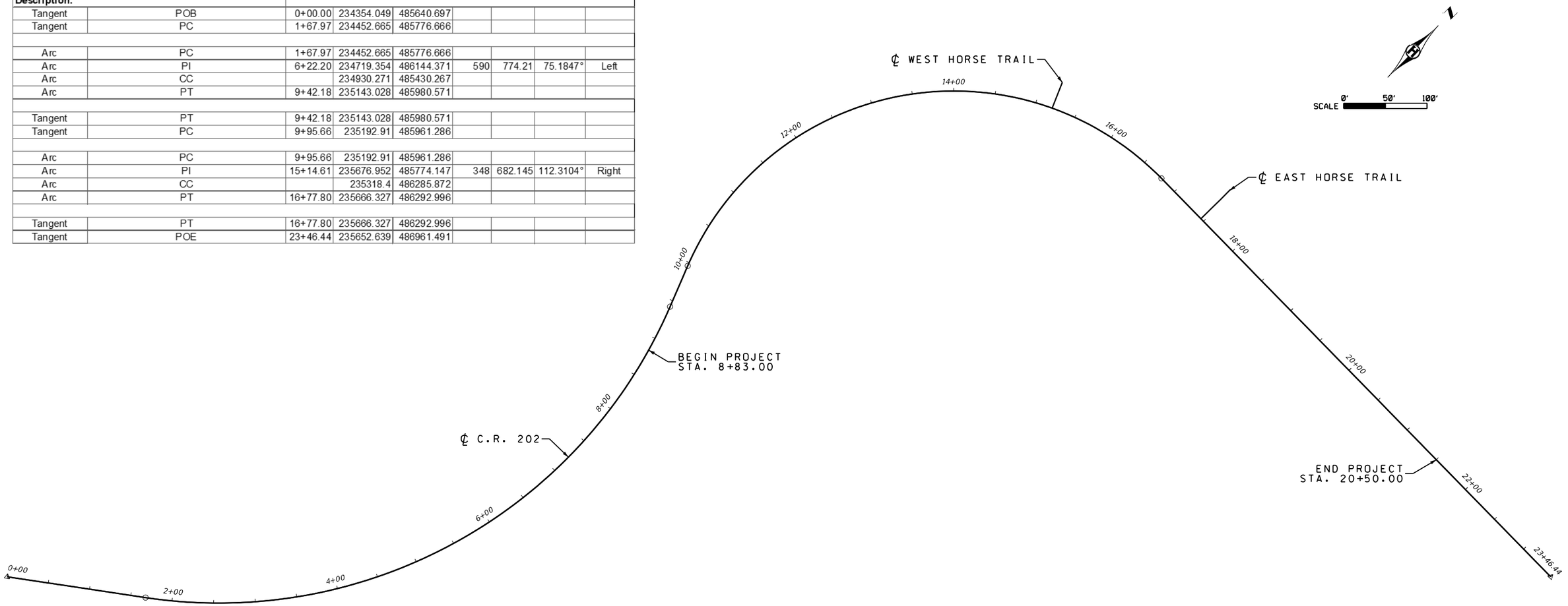
STANDARD PLAN 5-297.695 | 1 OF 1

APPROVED: 7-19-2016
REVISED:

STEEL PLATE BEAM GUARDRAIL DETAILS
ASYMMETRICAL W-BEAM/THRIE BEAM TRANSITION

STATE PROJ. NO. (T.H.) SHEET NO. 33 OF 59 SHEETS

Element	Point Type	Station	Northing	Easting	Radius	Length	Delta / Theta	Rotation Direction
Aligment Name: CR 202								
Description:								
Tangent	POB	0+00.00	234354.049	485640.697				
Tangent	PC	1+67.97	234452.665	485776.666				
Arc	PC	1+67.97	234452.665	485776.666				
Arc	PI	6+22.20	234719.354	486144.371	590	774.21	75.1847°	Left
Arc	CC		234930.271	485430.267				
Arc	PT	9+42.18	235143.028	485980.571				
Tangent	PT	9+42.18	235143.028	485980.571				
Tangent	PC	9+95.66	235192.91	485961.286				
Arc	PC	9+95.66	235192.91	485961.286				
Arc	PI	15+14.61	235676.952	485774.147	348	682.145	112.3104°	Right
Arc	CC		235318.4	486285.872				
Arc	PT	16+77.80	235666.327	486292.996				
Tangent	PT	16+77.80	235666.327	486292.996				
Tangent	POE	23+46.44	235652.639	486961.491				



COORDINATED ARE HENNEPIN COUNTY GROUND FEET,
BASED OF THE MINNESOTA COORDINATE SYSTEM,
SOUTHERN ZONE, NAD83, 1986 (NON HARN VALUES)

C.P. 10 (5/8" IRON)
N=235670.246
E=487117.535

C.P. BEND (5/8" IRON)
N=235664.952
E=486429.954

Element	Point Type	Point Number	Station	Northing	Easting	Radius	Length	Delta / Theta	Rotation Direction
Aligment Name: West Horse trail									
Description:									
Tangent	POB		0+00.00	235634.537	486140.401				
Tangent	POE		0+33.24	235665.14	486127.419				

Element	Point Type	Point Number	Station	Northing	Easting	Radius	Length	Delta / Theta	Rotation Direction
Aligment Name: East Horse trail									
Description:									
Tangent	POB		0+00.00	235664.94	486360.766				
Tangent	PI		0+12.00	235676.937	486361.011				
Tangent	PI		0+12.00	235676.937	486361.011				
Tangent	PI		0+16.00	235680.936	486361.093				
Tangent	PI		0+16.00	235680.936	486361.093				
Tangent	PI		0+33.00	235697.933	486361.441				
Tangent	PI		0+33.00	235697.933	486361.441				
Tangent	POE		0+63.00	235727.933	486361.441				

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 — LICENSE NO.

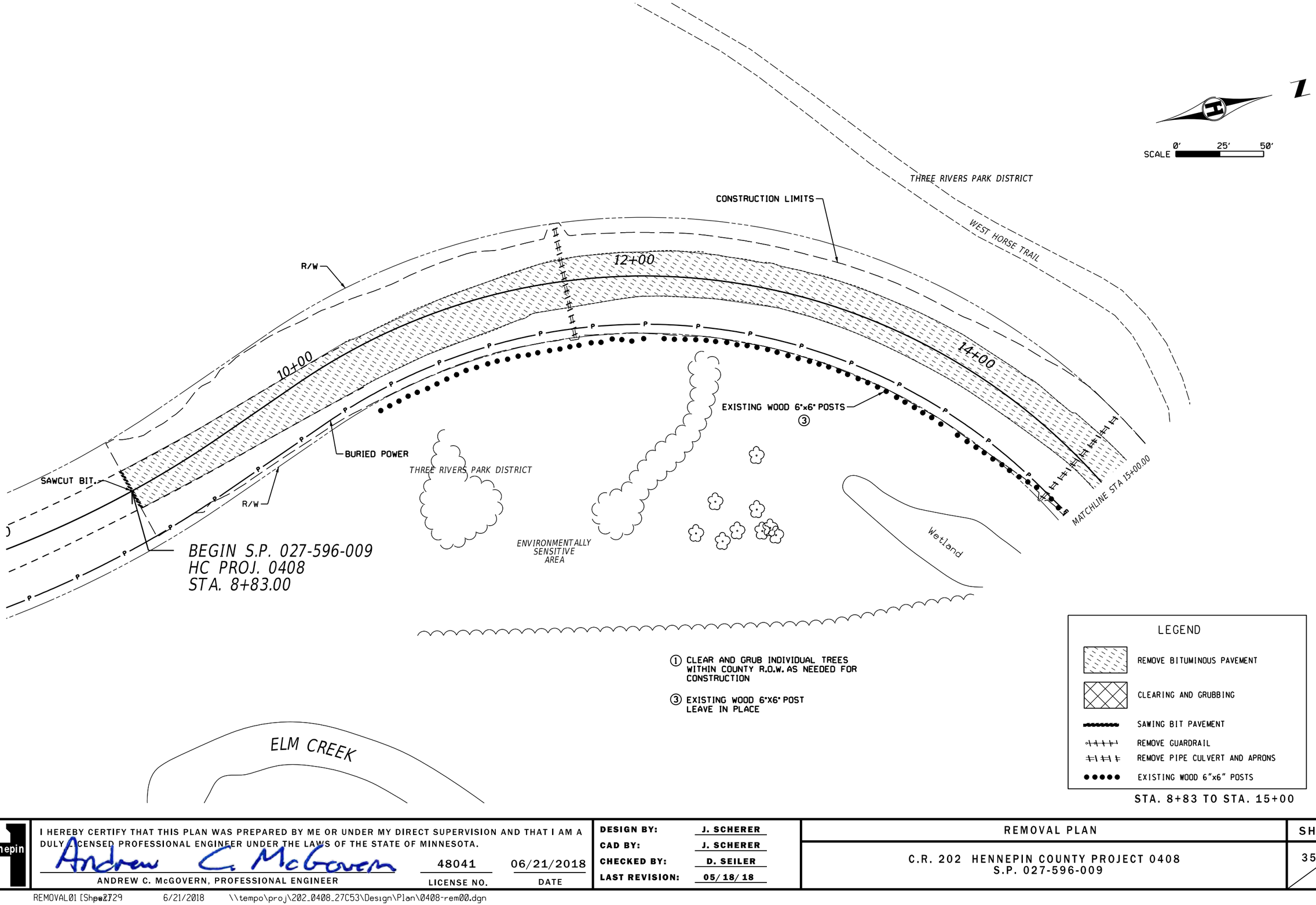
8/23 / 18 — DATE

DESIGN BY:	**D. SEILER**
CAD BY:	**J.SCHERER**
CHECKED BY:	**D. SEILER**
LAST REVISION:	**05 /22 /18**

HORIZONTAL ALIGNMENT & TABULATION

SHEET 34 / 59

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009



STA. 8+83 TO STA. 15+00

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Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 LICENSE NO.

06/21/2018 DATE

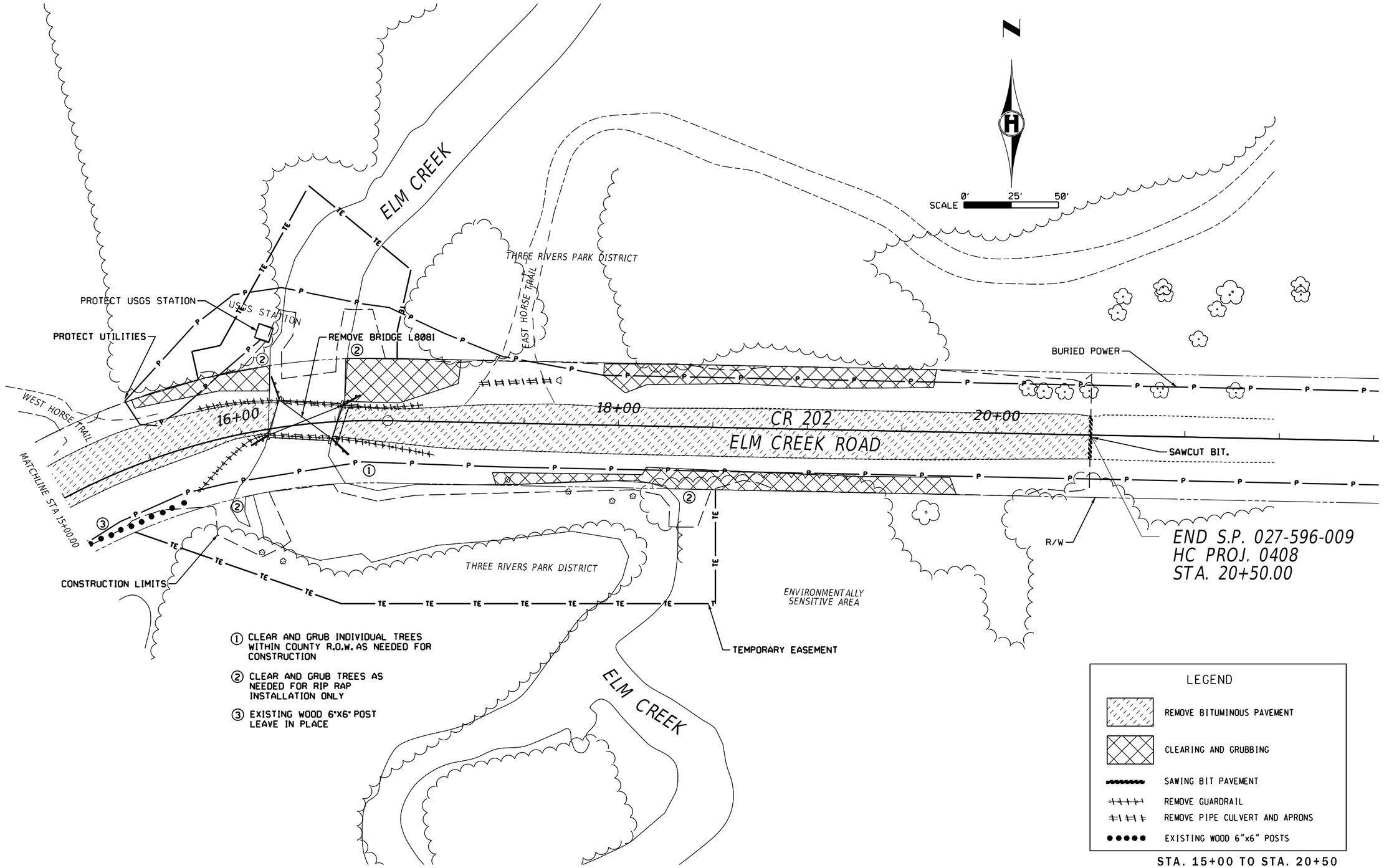
DESIGN BY:	J. SCHERER
CAD BY:	J. SCHERER
CHECKED BY:	D. SEILER
LAST REVISION:	05/18/18

REMOVAL PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 35 / 59

REMOVAL01 [Shee2729 6/21/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-rem00.dgn



STA. 15+00 TO STA. 20+50

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Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 LICENSE NO.

06/21/2018 DATE

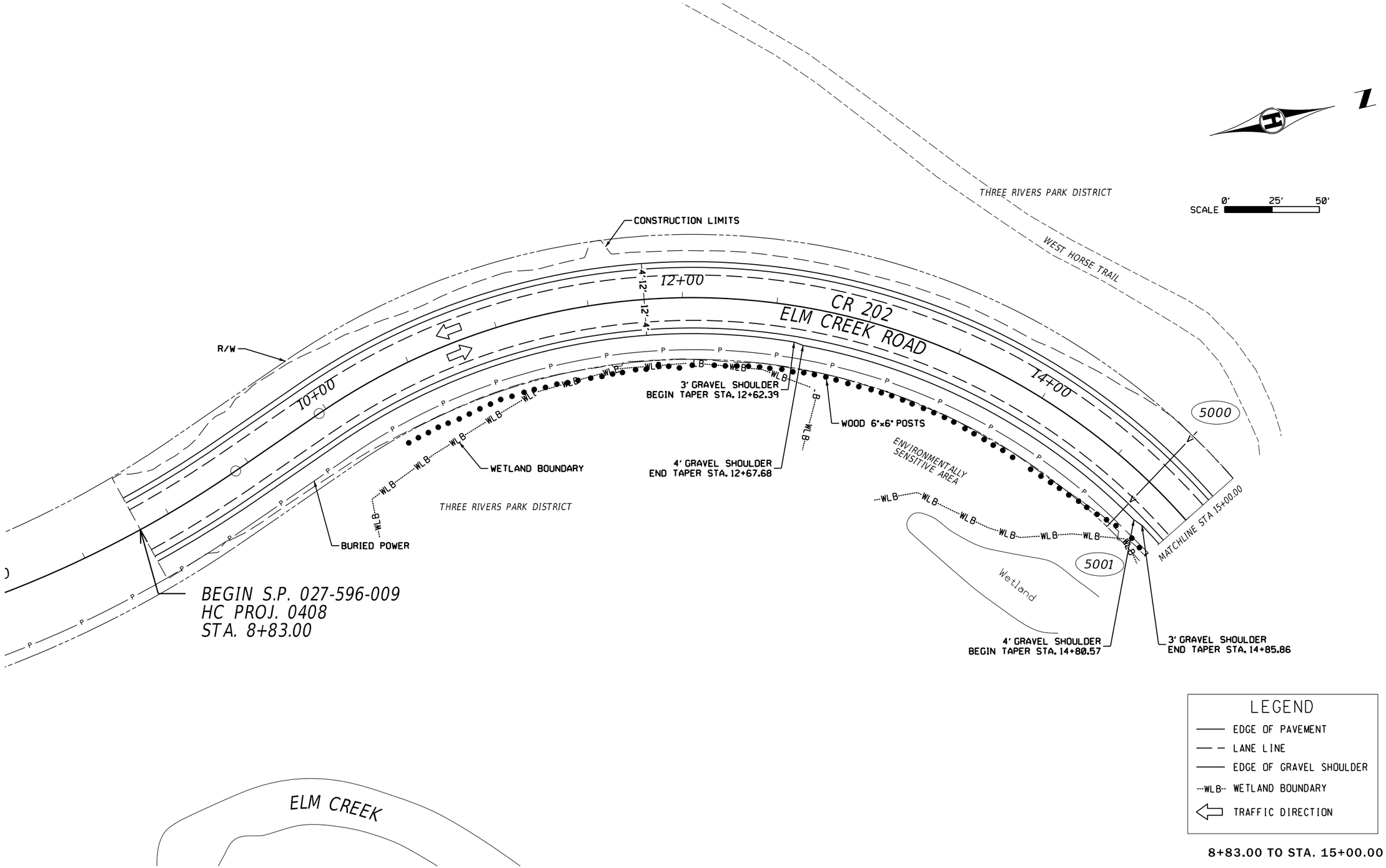
DESIGN BY:	J.SCHERER
CAD BY:	J. SCHERER
CHECKED BY:	D. SEILER
LAST REVISION:	05 /18 /18

REMOVAL PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 36 / 59

REMOVAL02 [Sheet2] 6/21/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-rem00.dgn



8+83.00 TO STA. 15+00.00

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ANDREW C. McGOVERN, PROFESSIONAL ENGINEER — 48041 LICENSE NO. — 6/13/18 DATE

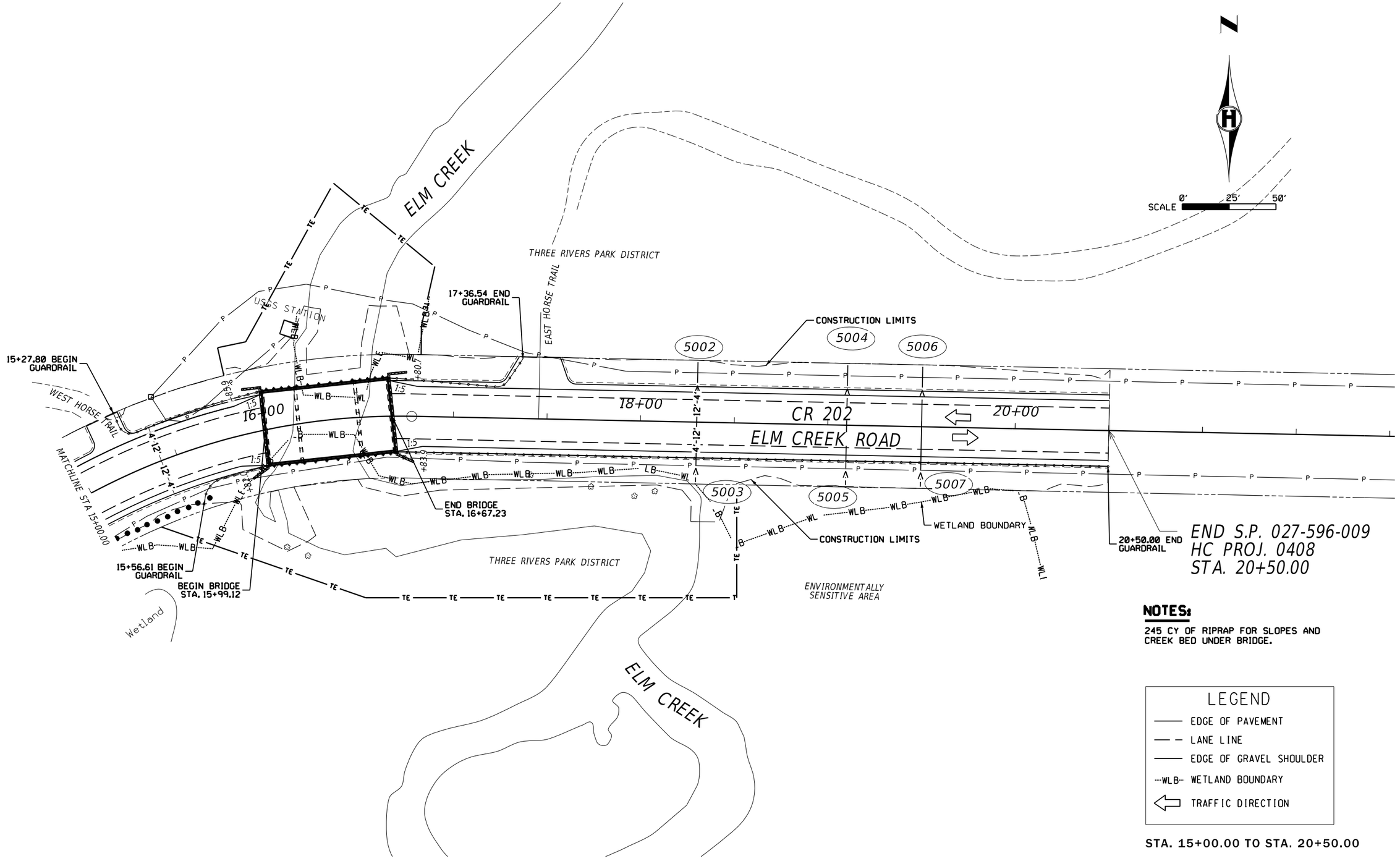
DESIGN BY:	TSM
CAD BY:	TSM
CHECKED BY:	JLS
LAST REVISION:	05/22/2018

CONSTRUCTION PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 37 / 59

CONSTRUCTION PLAN [Sheet] 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-cp00.dgn



NOTES:

245 CY OF RIPRAP FOR SLOPES AND CREEK BED UNDER BRIDGE.

LEGEND

- EDGE OF PAVEMENT
- LANE LINE
- EDGE OF GRAVEL SHOULDER
- WLB WETLAND BOUNDARY
- TRAFFIC DIRECTION

STA. 15+00.00 TO STA. 20+50.00

Hennepin

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Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 LICENSE NO.

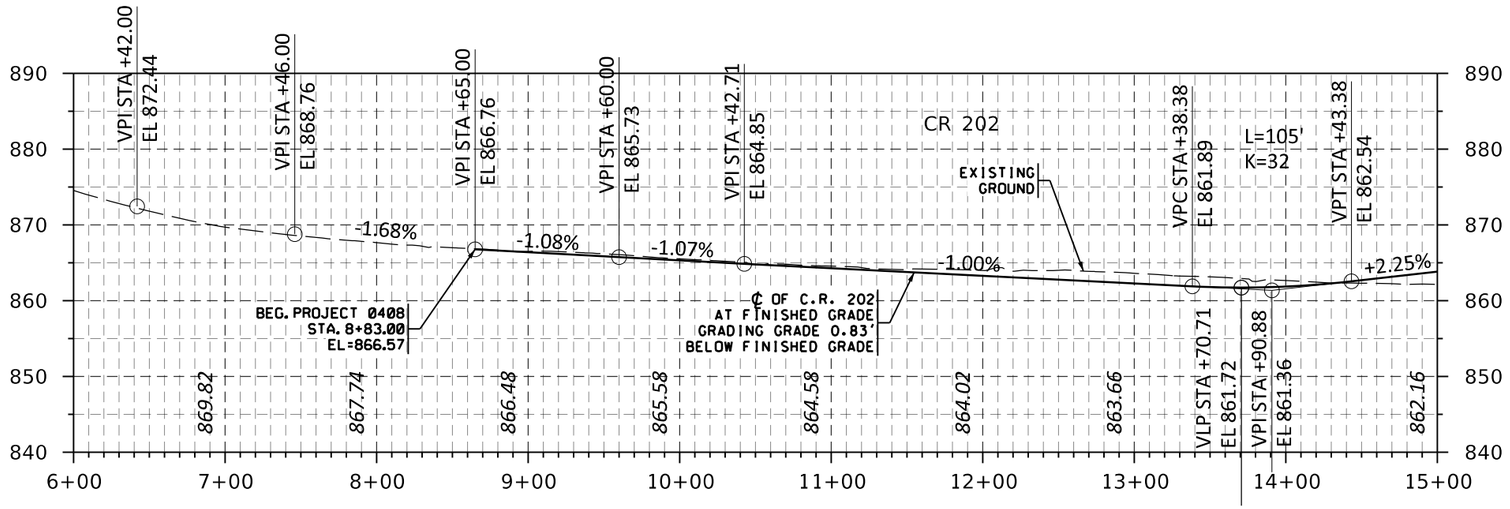
06/21/2018 DATE

DESIGN BY:	TSM
CAD BY:	TSM
CHECKED BY:	JLS
LAST REVISION:	05/22/2018

CONSTRUCTION PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 38 / 59

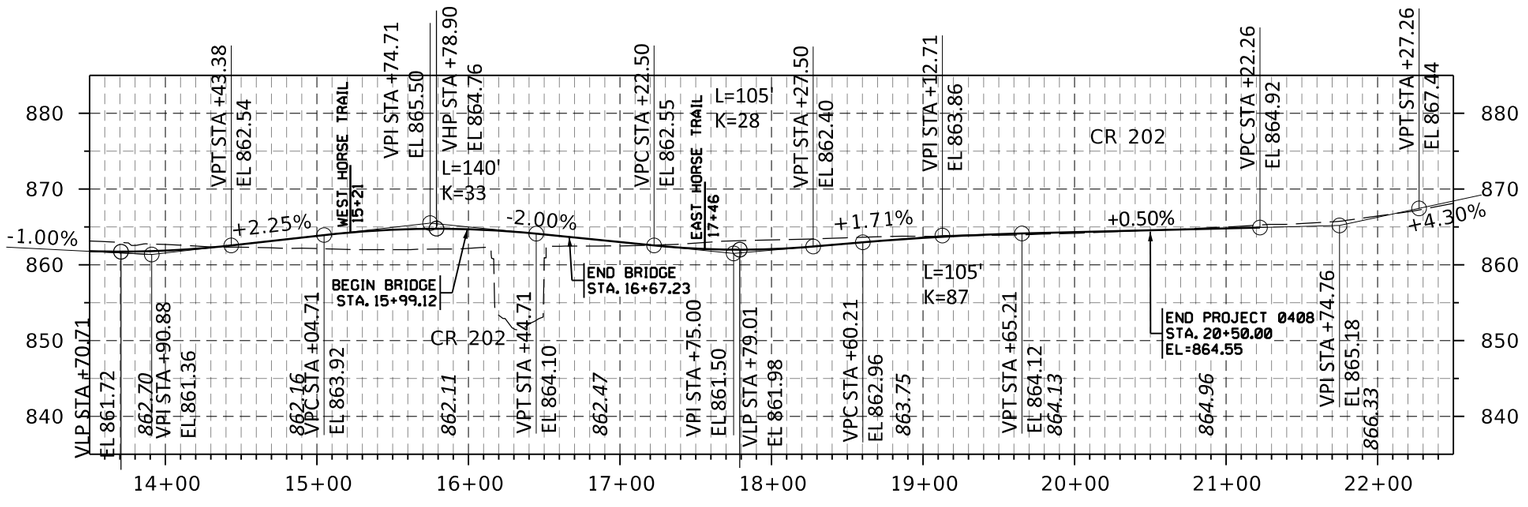


C.R. 202

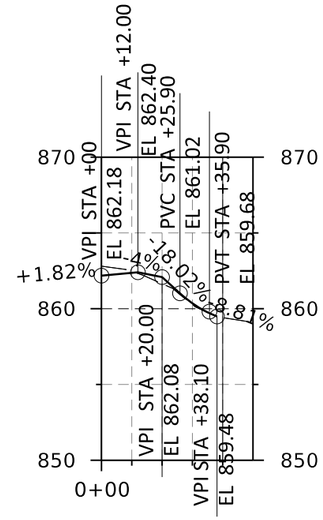
BENCH MARK DATA:
VERTICAL DATUM NGVD 1929

ELEVATION 860.618
SPIKE IN SW WING WALL OF
BRIDGE L8081 OVER ELM CREEK

ELEVATION 864.944
SPIKE IN TREE SOUTH SIDE C.R. 202
+/-600' EAST OF BRIDGE L8081



C.R. 202



EAST HORSE TRAIL

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 — LICENSE NO.

6/21/18 — DATE

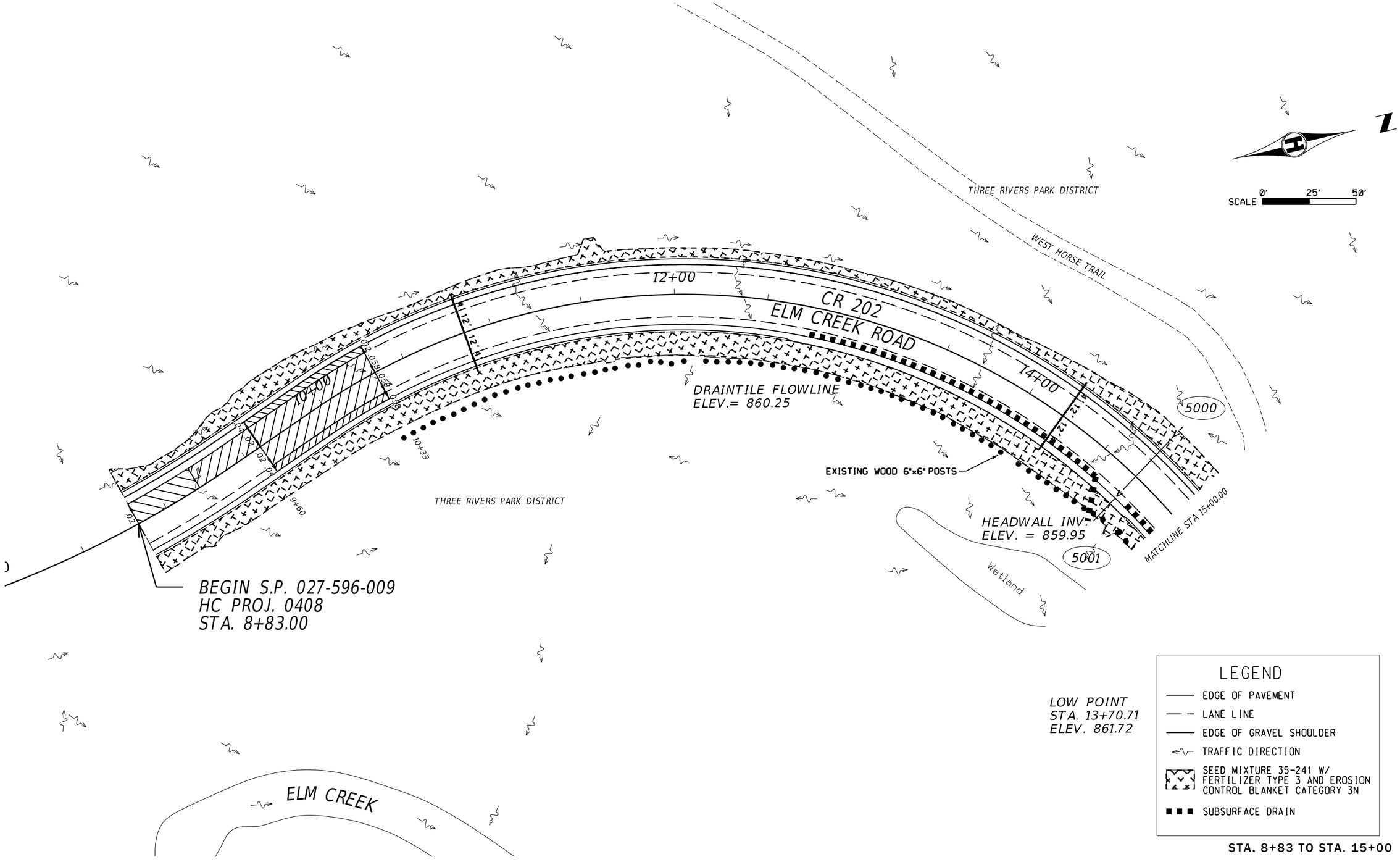
DESIGN BY:	J. SCHERER
CAD BY:	J. SCHERER
CHECKED BY:	D. SEILER
LAST REVISION:	06/05/18

PROFILE

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 39/59

PROFILE pw4519 6/19/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408_Profile00.dgn



STA. 8+83 TO STA. 15+00

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

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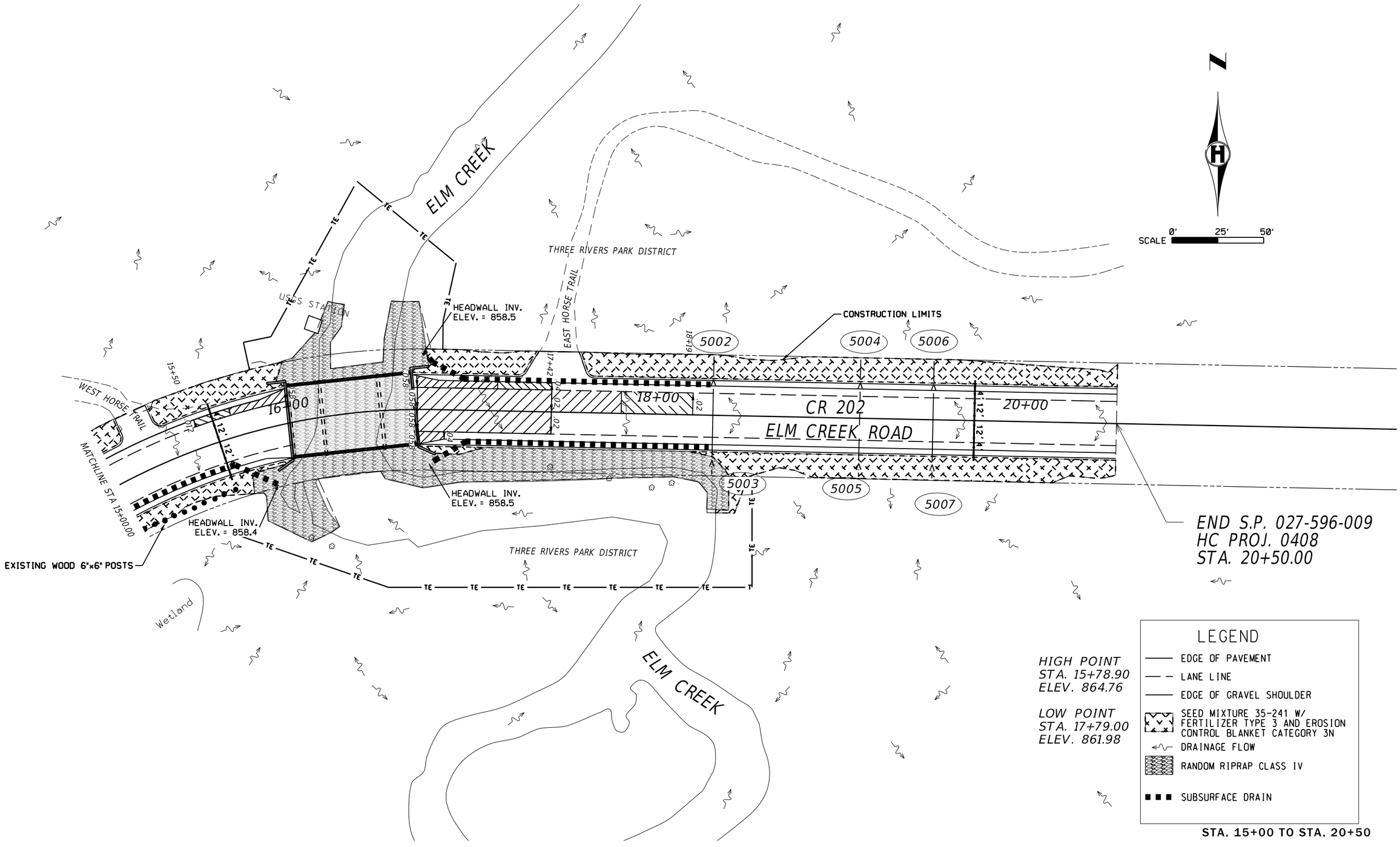
ANDREW C. McGOVERN, PROFESSIONAL ENGINEER | 48041 LICENSE NO. | 8/23/2018 DATE

DESIGN BY:	TSM
CAD BY:	TSM
CHECKED BY:	JLS
LAST REVISION:	08/23/2018

DRAINAGE, SUPERELEVATION & TURF ESTABLISHEMENT PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 40 / 59



STA. 15+00 TO STA. 20+50

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 — LICENSE NO.

08/23/2018 — DATE

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DRAINAGE, SUPERELEVATION & TURF ESTABLISHEMENT PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 41 / 59

SWPPP INTRODUCTION (PART III.A)

HENNEPIN COUNTY HAS DEVELOPED THIS STORM WATER POLLUTION PREVENTION PLAN (SWPPP) TO COMPLY WITH THE REQUIREMENTS OF THE MPCA NPDES GENERAL PERMIT NUMBER MN R100001 (GENERAL PERMIT), PARTS III AND IV AND APPENDIX A. THIS SWPPP INCLUDES A NARRATIVE THAT DESCRIBES THE TEMPORARY AND PERMANENT EROSION PREVENTION AND SEDIMENT CONTROL PLAN AND THE STORMWATER MANAGEMENT PLAN FOR THIS PROJECT. THE INFORMATION IN PARENTHESIS AFTER EACH PARAGRAPH HEADING REFERS TO THE SECTION OF THE GENERAL PERMIT THE SWPPP PARAGRAPH IS COMPLYING WITH OR REFERENCING.

PROJECT SUMMARY (PART III.A)

THIS RECONSTRUCTION PROJECT IS LOCATED IN HENNEPIN COUNTY ON C.R. 202 FROM ELM CREEK 700' WEST AND 380' EAST OF ELM CREEK (PROPOSED BRIDGE). THIS PROJECT WILL INCLUDE: REMOVAL OF BRIDGE L8081 AND REPLACING WITH BRIDGE 27C53, GRADING, BITUMINOUS SURFACING, STORM WATER DRAINAGE (DITCHES & CULVERTS) THE 3 CULVERTS EAST OF THE BRIDGE WILL BE SPECIFICALLY FOR FLOOD CONTROL, AND RIPRAP. CHANGES TO THE UTILITIES ALONG THIS PROJECT WILL INVOLVE AS NEEDED LOCAL CHANGES IN GRADE TO ACCOMMODATE CONSTRUCTION.

TOTAL PROJECT DISTURBED AREA =	1.71 ACRES
TOTAL EXISTING IMPERVIOUS SURFACE AREA =	0.80 ACRES
TOTAL PROPOSED IMPERVIOUS SURFACE AREA =	1.04 ACRES
TOTAL PROPOSED NET CHANGE IMPERVIOUS SURFACE AREA =	0.24 ACRES

PROJECT DESCRIPTION (PART III.A)

HENNEPIN COUNTY TRANSPORTATION DEPARTMENT, IN COOPERATION WITH THE CITY OF DAYTON, AND THREE RIVERS PARK DISTRICT IS USING FEDERAL FUNDING FOR BRIDGE REPLACEMENT AND MUNICIPAL FUNDS FOR ROADWAY RECONSTRUCTION. THIS PROJECT WILL IMPROVE THE ROADWAY TO STATE AID STANDARDS FOR A TWO LANE ROADWAY. REPLACE THE CURRENT ONE LANE BRIDGE WITH TWO LANE BRIDGE TO LRFD STANDARDS. THE PROJECT WILL NOT REQUIRE ANY PERMANENT RIGHT OF WAY ACQUISITIONS. THE PROJECT WILL CHANGE THE ROADWAY HORIZONTAL AND VERTICAL ALIGNMENT, CROSS SLOPE, AND OVERALL WIDTH OF THE CORRIDOR. FLOODPLAINS ARE MITIGATED WITH PROJECT EARTHWORK. NO WETLANDS WILL BE IMPACTED.

CONSTRUCTION AND OPERATION METHODS

CONSTRUCTION AND OPERATION METHODS THAT WILL CAUSE OR INVOLVE PHYSICAL MANIPULATION OF THE ENVIRONMENT FOR THE PROPOSED PROJECT ARE EXPECTED TO INCLUDE:

- EXCAVATION AND REMOVAL OF EXISTING BRIDGE AND ROADWAY.
- FLOOD PLAIN CULVERTS AND DRAINAGE CULVERT
- UTILITY RELOCATIONS
- GRADING, BASE, BITUMINOUS SURFACING.
- RIP RAP SLOPE STABILIZATION
- TEMPORARY AND PERMANENT EROSION PREVENTION, SEDIMENT CONTROL, AND TURF ESTABLISHEMENT.

TIMING AND DURATION

CONSTRUCTION OF THIS PROJECT IS SCHEDULED TO BEGIN IN THE WINTER OF 2018 AND THE COMPLETION IS SCHEDULED FOR SUMMER OF 2019. THRU TRAFFIC WILL BE DETOURED.

SWPPP IMPLEMENTATION (PART III.A)

THE CONTRACTOR IS RESPONSIBLE TO COMPLY WITH ALL ASPECTS OF THE GENERAL PERMIT AT ALL TIMES PER MNDOT STANDARD SPECIFICATION 1717.

EROSION CONTROL (EC) SUPERVISOR

DURING THE PRE-CONSTRUCTION CONFERENCE, A PERSON CERTIFIED (PER MNDOT REQUIREMENTS) AND KNOWLEDGEABLE AND EXPERIENCED IN THE APPLICATION OF EROSION PREVENTION AND SEDIMENT CONTROL BMPS, WILL BE NAMED (BY THE CONTRACTOR) AS THE EC SUPERVISOR.
THE CONTRACTOR MUST PROVIDE PROOF OF CERTIFICATION AT THE PRE-CONSTRUCTION CONFERENCE AND WILL NOT BE ALLOWED TO COMMENCE WORK UNTIL PROOF OF CERTIFICATION HAS BEEN PROVIDED TO THE PROJECT ENGINEER.
THE PROJECT SPECIAL PROVISIONS DESCRIBE IN DETAIL THE ROLE OF THE EC SUPERVISOR. FOLLOWING IS A SUMMARY OF THE EC SUPERVISOR'S RESPONSIBILITIES FOR ASSURING IMPLEMENTATION OF THE SWPPP:

1. OVERALL RESPONSIBILITY FOR ENSURING EROSION PREVENTION AND SEDIMENT CONTROL BMPS ARE ADEQUATELY INSTALLED, INSPECTED, AND MAINTAINED ON THE PROJECT BEFORE AND DURING CONSTRUCTION.
2. OVERSEE THE INSTALLATION, INSPECTION, AND MAINTENANCE OF THE EROSION PREVENTION AND SEDIMENT CONTROL BMPS BEFORE, DURING AND UNTIL THE NOTICE OF TERMINATION IS ISSUED FOR THE CONSTRUCTION (AS OUTLINED IN THIS SWPPP).
3. COORDINATE, SCHEDULE AND OVERSEE THE WORK OF SUBCONTRACTORS TO ENSURE THAT THE SWPPP WILL BE IMPLEMENTED.
4. UPDATE AND/OR AMEND THE SWPPP AS NECESSARY TO ADDRESS DEFICIENCIES IN THE PREVENTION OF STORM WATER POLLUTION IMPACTS OR CONSTRUCTION CHANGES PER THE PROJECT SPECIAL PROVISIONS.

ENSURE THAT THE SWPPP IS IMPLEMENTED AND MAINTAINED UNTIL
(A) THE CONSTRUCTION PROJECT IS COMPLETE,
(B) THE ENTIRE SITE HAS UNDERGONE FINAL STABILIZATION, AND
(C) A NOTICE OF TERMINATION HAS BEEN SUBMITTED TO THE MPCA.

MAINTAINING A QUALITY CONTROL PROGRAM SHALL CONSIST OF:

1. ENSURING PERMIT REQUIREMENTS RELATED TO THE CONTRACTOR'S AND SUBCONTRACTOR('S) CONSTRUCTION ACTIVITIES ARE ADHERED TO.
2. ENSURING THAT ALL OPERATORS AND/OR SUBCONTRACTOR(S) ON SITE HAVE THE PROPER EROSION PREVENTION AND SEDIMENT CONTROL CERTIFICATION.
3. INFORMING THE ENGINEER WHEN THE REQUIRED CERTIFIED EROSION PREVENTION SEDIMENT CONTROL PERSONNEL HAVE NOT BEEN PROVIDED.
4. CONDUCTING THE INSPECTIONS REQUIRED BY THE GENERAL PERMIT.
5. MAINTAINING THE NPDES INSPECTION LOG.
6. ENSURING CORRECTIVE ACTIONS ARE TAKEN IN THE PROPER TIME FRAME REQUIRED BY THE GENERAL PERMIT FOR PROBLEM AREAS IDENTIFIED DURING THE NPDES INSPECTIONS.
7. ENSURING THAT EROSION CONTROL IS INCORPORATED INTO THE WORK IN A TIMELY MANNER AND THAT DISTURBED AREAS ARE STABILIZED WITH MULCH/SEED, VEGETATIVE COVER OR IMPERVIOUS TARPOLINS ON A SECTION-BY-SECTION BASIS.
8. ENSURING, IN ACCORDANCE WITH MNDOT 2573.3, THAT TEMPORARY EROSION PREVENTION OR SEDIMENT CONTROL DEVICES ARE MAINTAINED.

ALL INSPECTIONS AND MAINTENANCE CONDUCTED DURING CONSTRUCTION MUST BE RECORDED IN WRITING AND THESE RECORDS MUST BE RETAINED WITH THE SWPPP. INSPECTION REPORTS MUST BE SUBMITTED TO THE PROJECT ENGINEER IN A FORMAT THAT MEETS THE PROJECT ENGINEER'S EXPECTATIONS. RECORDS OF EACH INSPECTION AND MAINTENANCE ACTIVITY SHALL INCLUDE:
1. DATE AND TIME OF INSPECTIONS
2. NAME OF PERSONS CONDUCTING INSPECTIONS
3. FINDINGS OF INSPECTIONS, INCLUDING RECOMMENDATIONS FOR CORRECTIVE ACTIONS
4. CORRECTIVE ACTIONS TAKEN INCLUDING DATES, TIMES, AND PARTY COMPLETING CORRECTIVE ACTION
5. DATE AND AMOUNT OF ALL RAINFALL EVENTS GREATER THAN 0.5 INCHES IN 24 HOURS
6. DOCUMENTATION OF OBSERVED DISCHARGES PER GENERAL PERMIT (PART IV.E.2.f)
7. DOCUMENTS AND CHANGES MADE TO THE SWPPP.

LONG TERM OPERATION AND MAINTENANCE

HENNEPIN COUNTY OPERATIONS STAFF, WILL BE RESPONSIBLE FOR THE LONG-TERM OPERATION AND MAINTENANCE OF THE PERMANENT STORM WATER SYSTEM.

CHAIN OF RESPONSIBILITY: (PART III.A.2)

AS CO-PERMITTEE, THE CONTRACTOR WILL PROVIDE AND ASSIGN AN EC SUPERVISOR WHO WILL WORK WITH THE PROJECT ENGINEER TO DEVELOP A CHAIN OF COMMAND WITH ALL OPERATORS ON SITE, AND COORDINATE, SCHEDULE AND OVERSEE THE WORK OF SUBCONTRACTORS ON THE PROJECT TO ENSURE THAT THE SWPPP IS IMPLEMENTED AND REMAINS IN EFFECT UNTIL THE CONSTRUCTION PROJECT IS COMPLETE, THE ENTIRE SITE HAS UNDERGONE FINAL STABILIZATION, AND A NOTICE OF TERMINATION HAS BEEN SUBMITTED TO THE MPCA. THIS INFORMATION WILL BE PROVIDED IN AN AMENDMENT TO THE SWPPP.

PROJECT CONTACTS

ORGANIZATION	CONTACT NAME	PHONE
HENNEPIN COUNTY DESIGN PROJECT MANAGER	JOHN EKOLA, P.E.	612-596-0370
HENNEPIN COUNTY TRANSPORTATION/DESIGN	DAVE SEILER, SWPPP DESIGNER	612-596-0391
THREE RIVERS PARK DISTRICT CONSTRUCTION CONTACT	JOSH BOWE	763-694-2063
EROSION CONTROL SUPERVISOR	CONTRACTOR	
MINNESOTA POLLUTION CONTROL AGENCY (MPCA)	PAUL ERDMANN	651-757-2883

MPCA 24 HOUR EMERGENCY NOTIFICATIONS: 651-649-5451 / 800-422-0798

SWPPP TRAINING: (PART III.A.3 & III.F)

SWPPP DESIGNER: DAVE SEILER

THE SWPPP DESIGNER IS A CERTIFIED SWPPP DESIGNER BY THE UNIVERSITY OF MINNESOTA'S EROSION AND STORM WATER MANAGEMENT CERTIFICATION PROGRAM. COPIES OF THE CERTIFICATIONS ARE ON FILE WITH HENNEPIN COUNTY TRANSPORTATION DEPARTMENT AND ARE AVAILABLE UPON REQUEST. THE SWPPP IMPLEMENTATION MUST BE CONDUCTED, INSPECTED, AND AMENDED BY INDIVIDUALS CERTIFIED BY THE SAME ORGANIZATION ABOVE OR ITS EQUIVALENT AS DETERMINED BY THE MPCA. DOCUMENTATION MUST BE MADE AVAILABLE BY THE CONTRACTOR TO BOTH THE COUNTY AND THE MPCA WITHIN 72 HOURS OF REQUEST BY EITHER HENNEPIN COUNTY OR MPCA.

DRAINAGE NARRATIVE (PART III.A.4)

HENNEPIN COUNTY, IN COOPERATION WITH THE CITY OF DAYTON, AND THREE RIVERS PARK DISTRICT IS RECONSTRUCTING 0.22 MILES OF C.R. 202 AT ELM CREEK.

THE PURPOSE OF THE PROJECT IS TO REPLACE BRIDGE L8081 WITH BRIDGE 27C53 AND RECONSTURCT 1167' OF C.R. 202 TO ACCOMMODATE THE NEW BRIDGE AND BRING THAT PORTION OF THE ROAD TO STATE AID STANDARDS.

THE PROJECT CREATES 0.24 ACRES OF NEW IMPERVIOUS AND HAS 1.71 ACRES OF FULL DEPTH RECONSTRUCTION.

Hennepin

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Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER | 48041 LICENSE NO. | 7/26/2018 DATE

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CHECKED BY:	D. McGOVERN
LAST REVISION:	06/05/2018

STORMWATER POLLUTION PREVENTION PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
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THE PROJECT WILL HAVE A NEW HORIZONTAL AND VERTICAL ALIGNMENT AND SUPERELEVATED CROSS SLOPE TO MEET STATE AID STANDARDS. TWO LANE RURAL CONSTRUCTION WITH BITUMINOUS LANES AND SHOULDERS. GUARDRAIL WILL ALSO BE INSTALLED IN DESIGNATED AREAS.

THE EXISTING TWO-LANE PORTION OF C.R. 202 CURRENTLY HAS A RURAL DRAINAGE SYSTEM UTILIZING DITCHES AND CULVERTS. THE PROPOSED TWO-LANE SECTION WILL ALSO BE A RURAL SECTION WITH DITCHES AND CULVERTS, WITH THE ADDITION OF 3 FLOOD PLANE CULVERTS. HENNEPIN COUNTY WILL MAINTAIN THE BRIDGE AND DRAINAGE STRUCTURES.

THE PROJECT WAS DESIGNED USING ATLAS 14 FOR RAINFALL INTENSITY. LOW POINTS ARE DESIGNED USING A 25 YEAR EVENT AND NO TRUE SAGS EXIST ON THE PROJECT. THE PROJECT AREA IS PRIMARILY TYPE C AND D SOILS.

INCORPORATING THIS SWPPP INTO THE FINAL PLANS (PART III.A.5)

HENNEPIN COUNTY AND THE CITY OF DAYTON WILL MEET THE SWPPP REQUIREMENTS INCORPORATING THE SWPPP ELEMENTS INTO THE PROJECT'S FINAL PLANS, SPECIFICATIONS, AND PROJECT DOCUMENTATION, AS APPROPRIATE. THE FINAL PLANS, SPECIFICATIONS, AND PROJECT DOCUMENTATION WILL COMPLY WITH THE REQUIREMENTS OF PART III.A.5A-M, AND APPENDIX A.C.1-2 OF THE GENERAL PERMIT. DRAINAGE LAYOUTS DEPICTING THE RECEIVING WATER BODIES FROM THIS PROJECT CORRIDOR IS MAINTAINED BY HENNEPIN COUNTY DEPARTMENT OF TRANSPORTATION.

LOCATION OF SWPPP REQUIREMENTS IN PROJECT PLAN

DESCRIPTION	LOCATION
TEMPORARY EROSION CONTROL MEASURES	SHEET(S) 45 - 46
PERMANENT EROSION AND SEDIMENT CONTROL MEASURES	SHEET(S) 40 - 41
DIRECTION OF FLOW	SHEET(S) 40 – 41, 45 - 46
FINAL STABILIZATION	SHEET(S) 40 - 41
SOILS AND CONSTRUCTION NOTES	SHEET(S) 5
EROSION AND SEDIMENT CONTROL DETAILS	SHEET(S) 10 - 20

ENVIRONMENTAL REVIEW MITIGATION MEASURES (PART III.A.6)

THERE ARE NO STORMWATER MITIGATION MEASURES REQUIRED AS A RESULT OF AN ENVIRONMENTAL, ARCHEOLOGICAL OR AGENCY REVIEW. ALL MITIGATION MEASURES HAVE BEEN ADDRESSED IN THIS PLAN SET OR THE SPECIAL PROVISIONS.

KARST AREAS (PART III.A.7)

THERE ARE NO KARST AREAS IDENTIFIED WITHIN THE PROJECT SITE.

IMPAIRED WATERS (PART III.A.8)

THERE ARE IMPAIRED WATERS WITHIN ONE MILE RADIUS OF THIS PROJECT SITE. ELM CREEK IS IMPAIRED FOR DISSOLVED OXYGEN.

AMENDMENT TO THE SWPPP (PART III.B)

HENNEPIN COUNTY AND THE CITY OF DAYTON WILL AMEND/UPDATE THIS SWPPP AS NEEDED AND/OR AS REQUIRED BY PROVISIONS OF THE GENERAL PERMIT TO ADDRESS DEFICIENCIES IN THE PREVENTION OF STORM WATER POLLUTION.

TEMPORARY SEDIMENTATION BASINS (PART III.C) (APPENDIX A.C.1b)

TEMPORARY SEDIMENTATION BASINS ARE NOT REQUIRED FOR THIS PROJECT. THE PROJECT WILL NOT DISTURB 10 OR MORE ACRES OF SOIL THAT DRAIN TO A COMMON LOCATION.

PERMANENT STORM WATER MANAGEMENT SYSTEM (PART III.D)

ALL STORM WATER WILL BE DISCHARGED IN A MANNER THAT DOES NOT CAUSE NUISANCE CONDITIONS, EROSION IN RECEIVING CHANNELS OR ON DOWNSLOPE PROPERTIES, OR INUNDATION IN WETLANDS CAUSING A SIGNIFICANT ADVERSE IMPACT TO THE WETLANDS.

RECORD RETENTION (PART III.E)

HENNEPIN COUNTY, THE CITY OF DAYTON AND ANY OTHER PERMITTEE WHO HAS OPERATIONAL CONTROL OVER THE SITE WILL KEEP THE FOLLOWING ITEMS ON SITE DURING CONSTRUCTION:

SWPPP
SWPPP AMENDMENTS
INSPECTION AND MAINTENANCE RECORDS

HENNEPIN COUNTY KEEPS THE FOLLOWING ITEMS ON FILE FOR A MINIMUM OF THREE (3) YEARS AFTER SUBMITAL OF THE NOTICE OF TERMINATION TO THE MPCA:

- SWPPP
- SWPPP AMENDMENTS
- ANY OTHER PERMITS REQUIRED FOR THE PROJECT
- RECORDS OF ALL INSPECTION AND MAINTENANCE CONDUCTED DURING CONSTRUCTION
- ALL PERMANENT OPERATION AND MAINTENANCE AGREEMENTS THAT HAVE BEEN IMPLEMENTED, INCLUDING ALL RIGHT OF WAY, CONTRACTS, COVENANTS AND OTHER BINDING REQUIREMENTS REGARDING PERPETUAL MAINTENANCE.
- ALL REQUIRED CALCULATIONS FOR DESIGN OF THE TEMPORARY AND PERMANENT STORM WATER MANAGEMENT SYSTEMS.

IMPLEMENTATION OF THE SWPPP DURING CONSTRUCTION (PART IV.A)

HENNEPIN COUNTY AND ITS CONTRACTOR WILL IMPLEMENT THE REQUIREMENTS OF THE GENERAL PERMIT PART IV, APPENDIX A.C.1-2, THE SWPPP, AND THE PLANS AND SPECIFICATIONS DURING CONSTRUCTION TO PREVENT EROSION AND CONTROL SEDIMENT. THE CONTRACTOR WILL SELECT, INSTALL, AND MAINTAIN ALL BMPS IN AN APPROPRIATE AND FUNCTIONAL MANNER.

THE CONTRACTOR WILL PREPARE AND SUBMIT A SITE PLAN FOR THE PROJECT ENGINEER'S APPROVAL, PER SECTION 1717 (AIR, LAND, AND WATER POLLUTION) OF THE SPECIAL PROVISIONS, FOR CONCRETE MANAGEMENT WORK IN ENVIRONMENTALLY SENSITIVE AREAS, AREAS IDENTIFIED IN THE PLANS AS "SITE PLAN REQUIREMENT AREA," ANY WORK THAT WILL REQUIRE DEWATERING, THE STAGING OF INLET PROTECTION DEVICES OVER THE LIFE OF THE CONTRACT, AND AS REQUESTED BY THE PROJECT ENGINEER. ALL SITE PLANS MUST BE SUBMITTED TO THE PROJECT ENGINEER IN WRITING. THE CONTRACTOR SHALL ALLOW A MINIMUM OF 7 DAYS FOR HENNEPIN COUNTY TO REVIEW AND APPROVE SITE PLAN SUBMITTALS.
THE CONTRACTOR WILL NOT BE ALLOWED TO COMMENCE WORK FOR WHICH A SITE PLAN IS REQUIRED UNTIL APPROVAL HAS BEEN GRANTED BY THE PROJECT ENGINEER. THE CONTRACTOR WILL NOT BE GIVEN ANY EXTRA TIME IN THE CONTRACT DUE TO THE UNTIMELY SUBMITTAL OF A SITE PLAN.

EROSION PREVENTION AND SEDIMENT CONTROL PRACTICES (PART IV.B & C) (APPENDIX A.C.1-2)

TO PREVENT EROSION AND CONTROL SEDIMENT ON THIS PROJECT DURING CONSTRUCTION, HENNEPIN COUNTY WILL PLAN AND IMPLEMENT BMPS AND CONSTRUCTION PRACTICES THAT MINIMIZE EROSION, CONTROL SEDIMENT, AND ENSURE THE CONTRACTOR COMPLIES WITH THE INSPECTIONS AND MAINTENANCE REQUIREMENTS OF PART IV.E OF THE GENERAL PERMIT.

THE EROSION PREVENTION AND SEDIMENT CONTROL BMPS SHALL BE INSTALLED AS NECESSARY TO MINIMIZE EROSION FROM DISTURBED SURFACES AND CAPTURE SEDIMENT ONSITE. ALL EROSION CONTROL MEASURES IN PLACE PRIOR TO ANY REMOVAL WORK AND/OR GROUND DISTURBING ACTIVITIES COMMENCE SHALL BE MAINTAINED UNTIL THE POTENTIAL FOR EROSION HAS BEEN ELIMINATED.

SEDIMENT CONTROL DEVICES MUST BE ESTABLISHED ON ALL DOWN-GRADIENT PERIMETERS BEFORE ANY UP-GRADIENT LAND DISTURBING ACTIVITIES BEGIN. SEDIMENT CONTROL DEVICES INCLUDE, BUT ARE NOT LIMITED TO:

A. PERIMETER CONTROL SHALL BE LOCATED ON THE CONTOUR TO CAPTURE OVERLAND, LOW-VELOCITY SHEET FLOWS DOWN-GRADIENT OF ALL EXPOSED SOILS AND PRIOR TO DISCHARGING TO SURFACE WATERS WITH THE BMP J-HOOKED AT A MAXIMUM OF 100-FOOT INTERVALS AND SHALL CONTAIN NO MORE THAN ONE QUARTER ACRE OF DRAINAGE AREA .

B. INLET PROTECTION WILL BE PLACED AS INDICATED ON THE PLAN DURING ALL PHASES OF CONSTRUCTION.

   1. INLET PROTECTION SHALL BE ANY METHOD DEPICTED IN THE EROSION CONTROL DETAILS. THE TYPE USED IS THE CHOICE OF THE CONTRACTOR OR AS DIRECTED BY THE ENGINEER

C. SEDIMENT DAMAGE FROM STOCKPILES WILL BE MINIMIZED BY PLACING A ROW OF SILT FENCE A MINIMUM OF 5 FEET FROM THE TOE OF SLOPE. IF THERE IS NOT ADEQUATE PROJECT AREA TO PLACE THE SILT FENCE A MINIMUM OF 5 FEET FROM THE TOE OF SLOPE, THE CONTRACTOR MAY SUBMIT AN ALTERNATIVE FOR APPROVAL BY THE PROJECT ENGINEER

THE CONTRACTOR SHALL PLACE VEHICLE TRACKING BMPs AS NECESSARY TO PREVENT TRACKING OF SEDIMENT ONTO PAVED SURFACES, IN COMPLIANCE WITH PART IV OF THE GENERAL PERMIT. VEHICLE TRACKING BMPs SHALL BE SUFFICIENTLY SIZED AND MAINTAINED TO PREVENT TRACK OUT. THIS WORK SHALL BE CONSIDERED INCIDENTAL. WHEN VEHICLE TRACKING BMPs DO NOT ADEQUATELY PREVENT SEDIMENT TRACKING, STREET SWEEPING MUST BE PERFORMED IN ACCORDANCE WITH THE SPECIAL PROVISIONS.

THE CONTRACTOR MUST USE METHODS AND OPERATIONAL PROCEDURES THAT PREVENT DISCHARGE OR PLACEMENT OF BITUMINOUS GRINDINGS, CUTTINGS, MILLINGS, AND OTHER BITUMINOUS WASTES IN AREAS OF EXISTING OR FUTURE VEGETATED SOILS, OR STORMWATER CONVEYANCE SYSTEMS, SUCH AS DITCHES.

THE CONTRACTOR MUST USE METHODS AND OPERATIONAL PROCEDURES THAT PREVENT CONCRETE DUST, PARTICLES, SAW CUT SLURRY, PLANNING WASTE, AND OTHER CONCRETE WASTES FROM LEAVING HENNEPIN COUNTY RIGHT OF WAY, DEPOSITING IN AREAS OF EXISTING OR FUTURE VEGETATED SOILS, OR FROM ENTERING STORMWATER CONVEYANCE SYSTEMS, SUCH AS GUTTERS AND DITCHES.

Hennepin

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STORMWATER POLLUTION PREVENTION PLAN

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DITCHES AND EXPOSED SOILS MUST BE KEPT IN AN EVEN ROUGH GRADED CONDITION IN ORDER TO BE ABLE TO APPLY EROSION CONTROL MULCHES AND BLANKETS.

STABILIZATION OF ALL EXPOSED SOIL AREAS MUST BE INITIATED IMMEDIATELY TO LIMIT SOIL EROSION BUT IN NO CASE COMPLETED LATER THAN SEVEN (7) DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED.

ALL EXPOSED SOIL AREAS WILL BE STABILIZED PRIOR TO THE ONSET OF WINTER. ANY WORK STILL BEING PERFORMED WILL BE MULCHED, SEEDED, OR BLANKETED WITHIN THE TIME FRAMES LISTED IN THE GENERAL PERMIT.

THE CONTRACTOR SHALL COMPLY WITH THE FOLLOWING INSPECTION AND MAINTENANCE REQUIREMENTS:

A. SILT FENCE MUST BE REPAIRED, REPLACE OR SUPPLEMENTED WHEN IT BECOMES NON-FUNCTIONAL OR SEDIMENT REACHES ONE-THIRD THE HEIGHT OF THE SILT FENCE.REPAIRS MUST BE MADE WITHIN 24 HOURS OF DISCOVERY.

B. INLET PROTECTION DEVICES MUST BE REPAIRED WHEN THEY BECOME NON-FUNCTIONAL OR SEDIMENT REACHES ONE-THIRD THE HEIGHT OF THE INLET PROTECTION. REPAIRS MUST BE MADE WITHIN 24 HOURS OF DISCOVERY.

C. TRACKED SEDIMENT MUST BE SWEPT WITHIN 24 HOURS OF DISCOVERY OF TRACKING ONTO PAVED SURFACES INCLUDING PAVED SURFACES DRAINING TO GUTTERS. INLETS. DITCHES. OR PONDS.PAVEMENT SHALL BE WETTED PRIOR TO SWEEPING. THIS WORK IS INCIDENTAL TO STREET SWEEPER (WITH PICKUP BROOM).

D. ANY SUBSURFACE DRAINAGE TILES DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED, REPLACED, OR REROUTED, AND CONNECTED TO THE EXISTING TILE OR DRAINAGE SYSTEM TO ENSURE THAT EXISTING UPLAND DRAINAGE IS PERPETUATED.

E. ALL OTHER NON-FUNCTIONAL BMPS MUST BE REPAIRED, REPLACED, OR SUPPLEMENTED WITHIN 24 HOURS OF DISCOVERY.

FILTER LOGS SHALL BE INSTALLED, AS NEEDED, TO TRAP SEDIMENT ON THE LOWER EDGE OF BEDS OR TREE HOLES. FILTER LOGS WILL BE LEFT TO PHOTO DEGRADE.TILLING FOR BEDS OR TREE HOLES MUST BE PLANTED AND MULCHED WITH WOODCHIPS WITHIN 1 DAYS OR STRAW MULCHED UNTIL PLANTING OPERATIONS CAN BE COMPLETED .

OUTLETS TO SURFACE WATERS SHALL BE STABILIZED WITH ENERGY DISSIPATION WITHIN 24 HOURS OF BEING CONSTRUCTED. IF SEDIMENT DEPOSITS IN A WATER OF THE STATE, THE MATERIAL MUST BE REMOVED WITHIN 7 DAYS.

DEWATERING AND BASIN DRAINING (PART IV.D)

TEMPORARY DEWATERING ACTIVITIES MAY BE REQUIRED FOR GRADING AND UTILITY WORK. THEREFORE, IT IS POSSIBLE THAT A PERMIT FOR THE TEMPORARY APPROPRIATION OF WATERS OF THE STATE, NON-IRRIGATION FROM MNDNR WILL BE REQUIRED FOR THIS PROJECT. THE CONTRACTOR WILL BE RESPONSIBLE FOR OBTAINING THIS PERMIT. ALL TEMPORARY DEWATERING SHALL BE DISCHARGED TO AN APPROVED LOCATION FOR TREATMENT PRIOR TO DISCHARGE TO THE RECEIVING WATER. THE CONTRACTOR IS REQUIRED TO SUBMIT SITE PLANS TO THE PROJECT ENGINEER FOR APPROVAL PRIOR TO COMMENCING WORK ACCORDING TO SECTION 1717 (AIR, LAND, AND WATER POLLUTION) OF THE SPECIAL PROVISIONS.

BASIN DRAINING ACTIVITIES OF TURBID OR SEDIMENT LADEN WATER WILL BE DISCHARGED TO TEMPORARY SEDIMENT BASINS WHENEVER POSSIBLE. IN THE EVENT THAT IT IS NOT POSSIBLE TO DISCHARGE THE SEDIMENT LADEN WATER TO A TEMPORARY SEDIMENT BASIN, THE WATER MUST BE TREATED SO THAT IT DOES NOT CAUSE A NUISANCE CONDITION IN THE RECEIVING WATERS OR TO DOWNSTREAM PROPERTIES. THE CONTRACTOR SHALL FOLLOW ALL REQUIREMENTS OF SECTION 2105 (DEWATERING) OF THE SPECIAL PROVISIONS.

INSPECTIONS AND MAINTENANCE (PART IV.E)

THE EROSION CONTROL SUPERVISOR WILL BE RESPONSIBLE FOR ROUTINELY INSPECTING THE CONSTRUCTION SITE EVERY 7 DAYS DURING ACTIVE CONSTRUCTION AND WITHIN 24 HOURS AFTER A RAINFALL EVENT GREATER THAN 0.5 INCHES IN 24 HOURS. ALL INSPECTIONS AND REPAIRS WILL BE COMPLETED IN ACCORDANCE WITH PART IV.E OF THE GENERAL PERMIT.

POLLUTION PREVENTION MANAGEMENT MEASURES (PART IV.F)

THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL POLLUTION PREVENTION MANAGEMENT BMPS ASSOCIATED WITH THE SWPPP. THE CONTRACTOR IS RESPONSIBLE FOR COMPLYING WITH PART IV.F OF THE GENERAL PERMIT. CONTRACTOR IS ADVISED THAT ALL LIQUID AND SOLID WASTES GENERATED BY CONCRETE WASHOUT OPERATIONS ARE TO BE CONTAINED IN A LEAK-PROOF CONTAINMENT FACILITY OR IMPERMEABLE LINER. BURNING OF ANY MATERIAL IS NOT ALLOWED WITHIN THE PROJECT BOUNDARY.

THE CONTRACTOR IS RESPONSIBLE FOR CREATING AND FOLLOWING A WRITTEN DISPOSAL PLAN FOR ALL WASTE MATERIALS. THE PLAN WILL INCLUDE HOW THE MATERIAL WILL BE DISPOSED OF AND THE LOCATION OF THE DISPOSAL SITE AND WILL BE SUBMITTED TO THE PROJECT ENGINEER.

FINAL STABILIZATION (PART IV.G)

HENNEPIN COUNTY WILL ENSURE FINAL STABILIZATION OF THE DISTURBED AREAS OF THIS PROJECT. THE CONTRACTOR SHALL COMPLY WITH PART IV.G OF THE GENERAL PERMIT AND THE CONSTRUCTION PLANS TO ENSURE FINAL STABILIZATION.

IN ADDITION, THE CONTRACTOR SHALL REMOVE ALL SEDIMENT PREVENTION AND EROSION CONTROL DEVICES THAT NEED TO BE REMOVED. THE CONTRACTOR SHALL CLEAN SEDIMENT FROM ALL CONVEYANCES AND SEDIMENT BASINS. THE CONTRACTOR WILL SUBMIT A NOTICE OF TERMINATION WITHIN 30 DAYS OF FINAL STABILIZATION.

ADDITIONAL BMPS FOR SPECIAL WATERS AND IMPAIRED WATERS (APPENDIX A.B & C)

THERE ARE NO STORM WATER DISCHARGES TO ANY SPECIAL WATERS ASSOCIATED WITH THIS PROJECT. IMPAIRED WATERS RECEIVE DISCHARGE FROM THIS PROJECT CORRIDOR AS MENTIONED PREVIOUSLY IN THIS SWPPP DOCUMENT. THE ADDITIONAL BMPS REQUIRED FOR IMPAIRED WATERS IN APPENDIX A SHALL BE INCORPORATED INTO THIS PROJECT.

REQUIREMENTS FOR DISCHARGING TO WETLANDS (APPENDIX A.D)

THIS PROJECT WILL NOT IMPACT ANY WETLANDS AND DOES NOT HAVE ANY STORM WATER DISCHARGES WITH A POTENTIAL FOR ADVERSE IMPACTS TO A WETLAND.

DISCHARGES REQUIRING ENVIRONMENTAL REVIEW (APPENDIX A.E)

HENNEPIN COUNTY AND THE CITY OF DAYTON HAVE COMPLIED WITH ALL ENVIRONMENTAL REVIEW REQUIREMENTS PERTAINING TO THIS PROJECT.

DISCHARGES AFFECTING ENDANGERED OR THREATENED SPECIES (APPENDIX A.F)

THERE ARE NO ADVERSE IMPACTS TO ANY ENDANGERED OR THREATENED SPECIES.

DISCHARGES AFFECTING HISTORIC PLACES OR ARCHEOLOGICAL SITES (APPENDIX A.G)

THERE ARE NO ADVERSE IMPACTS TO ANY HISTORIC PLACE OR ARCHELOGICAL SITES.

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

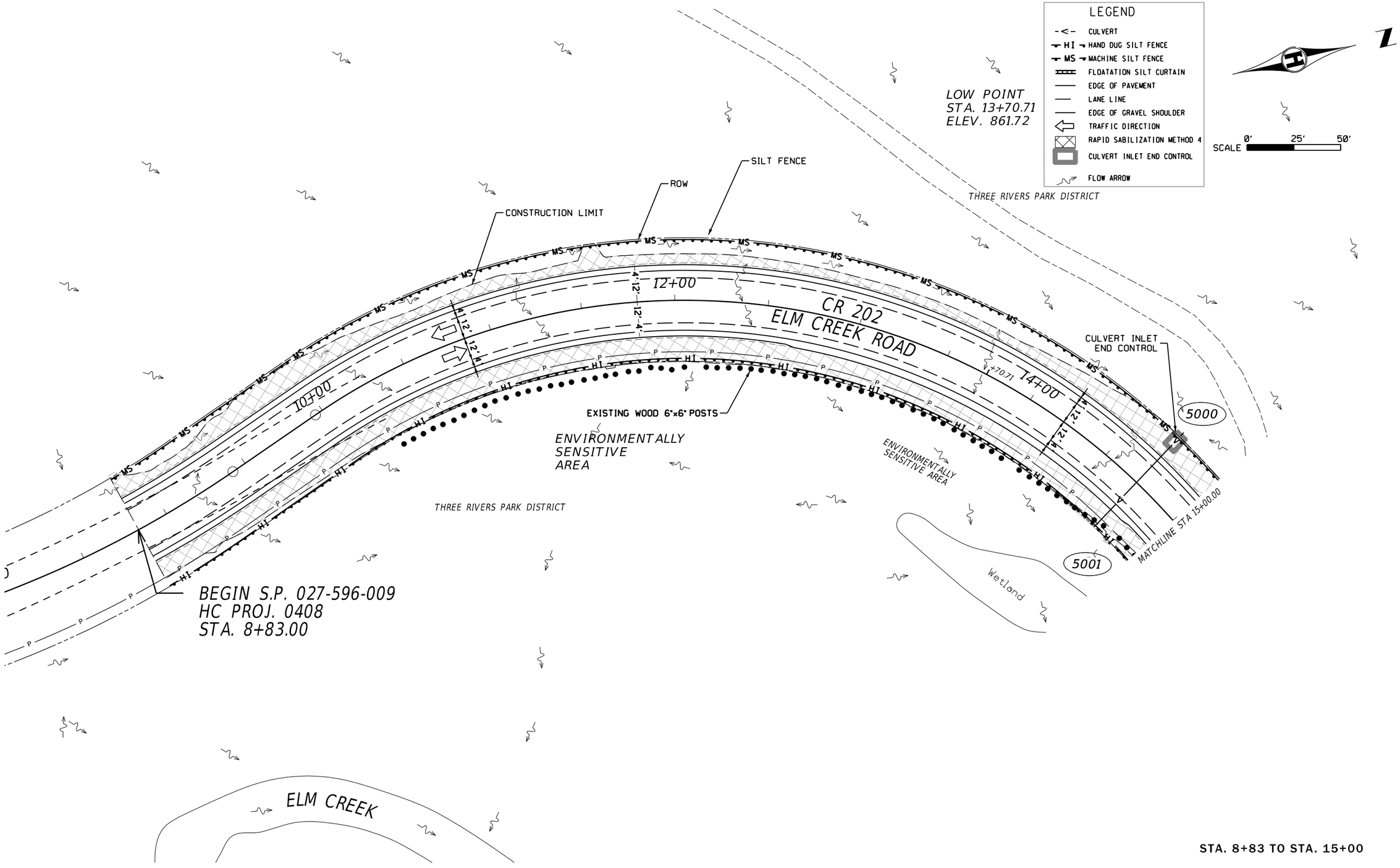
ANDREW C. McGOVERN, PROFESSIONAL ENGINEER | 48041 LICENSE NO. | 06/21/2018 DATE

DESIGN BY:	D. SEILER
CAD BY:	J. SCHERER
CHECKED BY:	D. McGOVERN
LAST REVISION:	06/05/2018

STORMWATER POLLUTION PREVENTION PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 44/59



STA. 8+83 TO STA. 15+00

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER | 48041 LICENSE NO. | 6/13/18 DATE

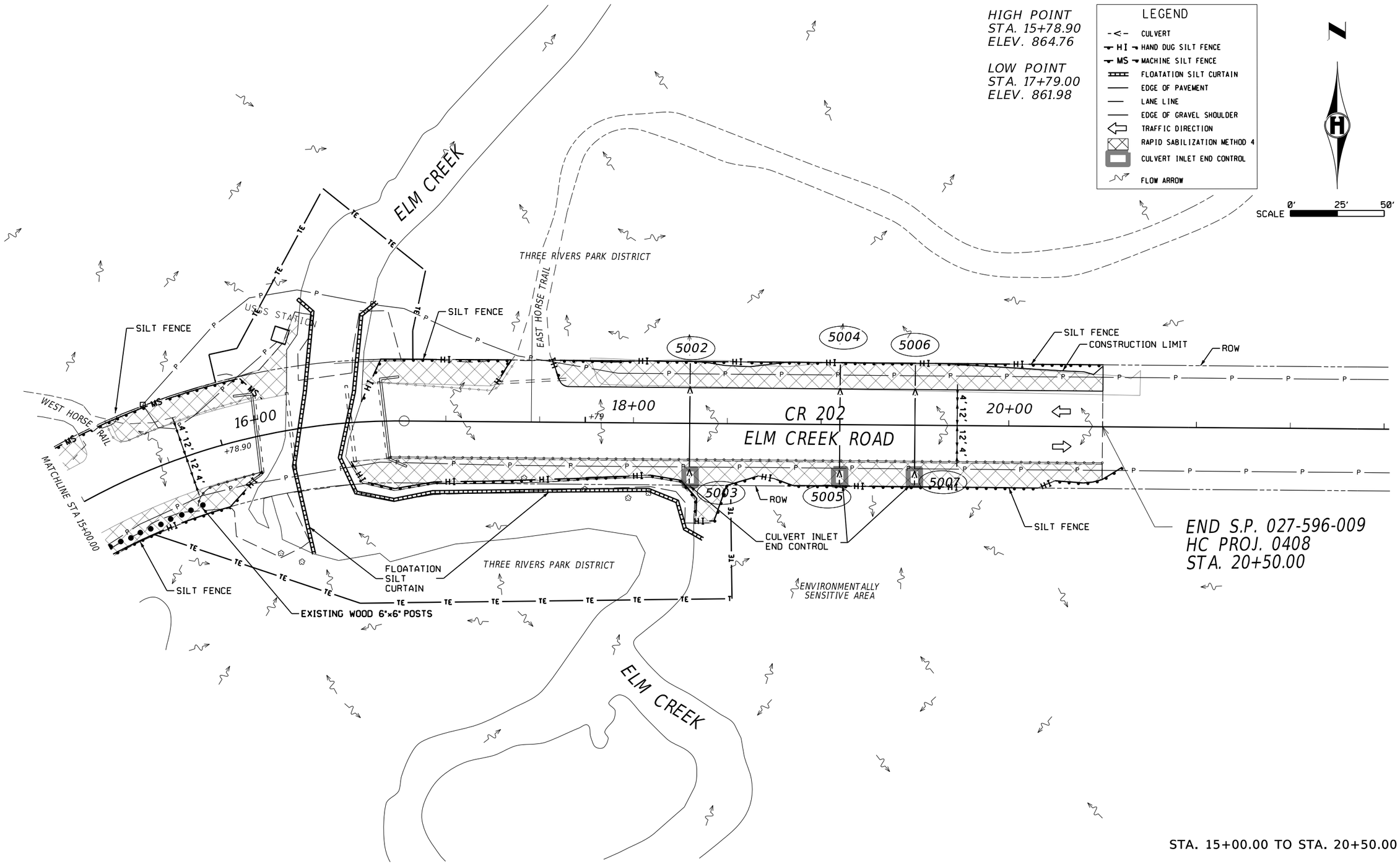
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CAD BY:	TSM
CHECKED BY:	JLS
LAST REVISION:	05/22/2018

EROSION CONTROL PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 45 / 59

EC 1 [Sheet] pw2729 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-ec.dgn



Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 LICENSE NO.

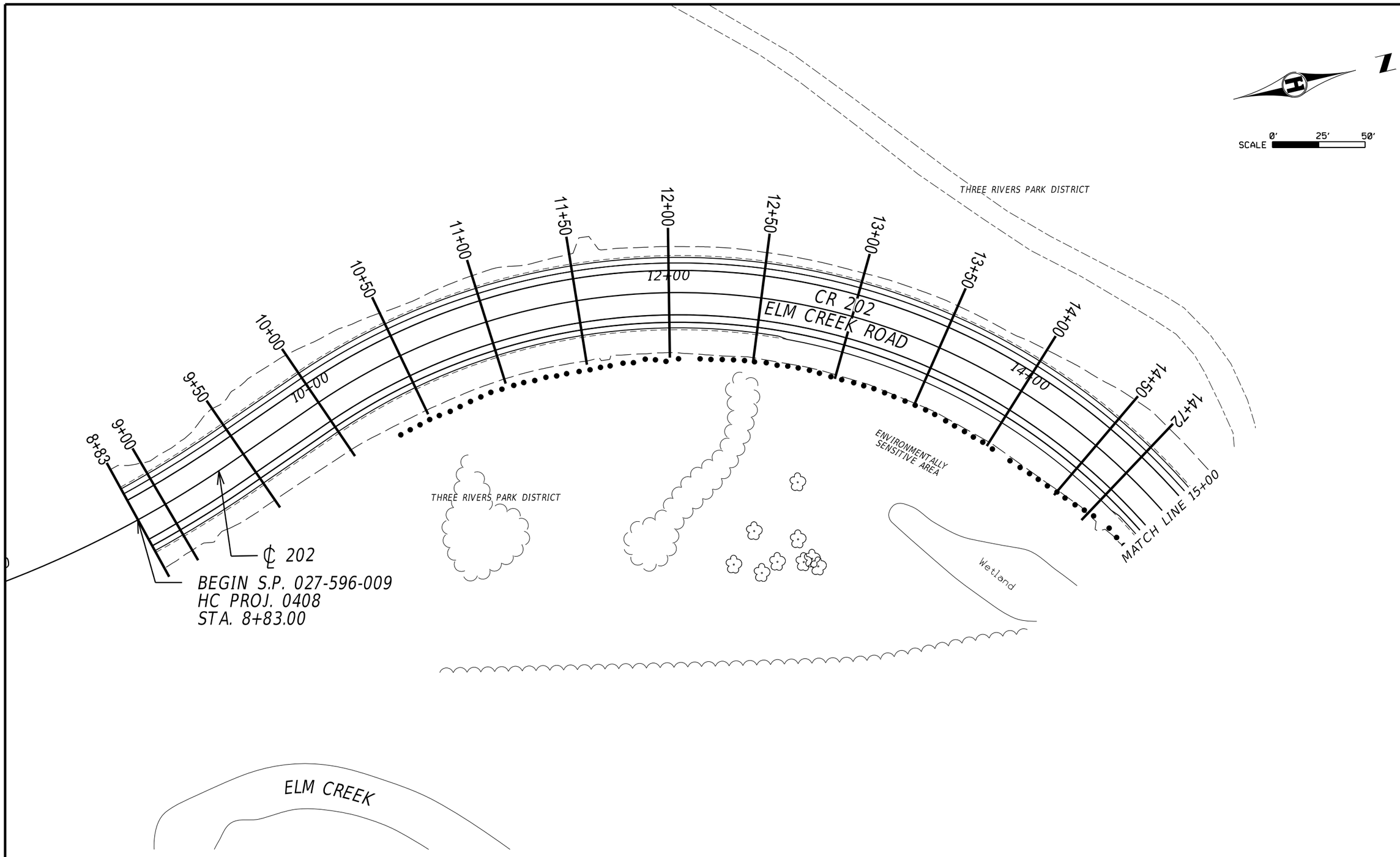
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CHECKED BY:	JLS
LAST REVISION:	05/22/2018

EROSION CONTROL PLAN

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 46 / 59



I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 LICENSE NO.

6/13/18 DATE

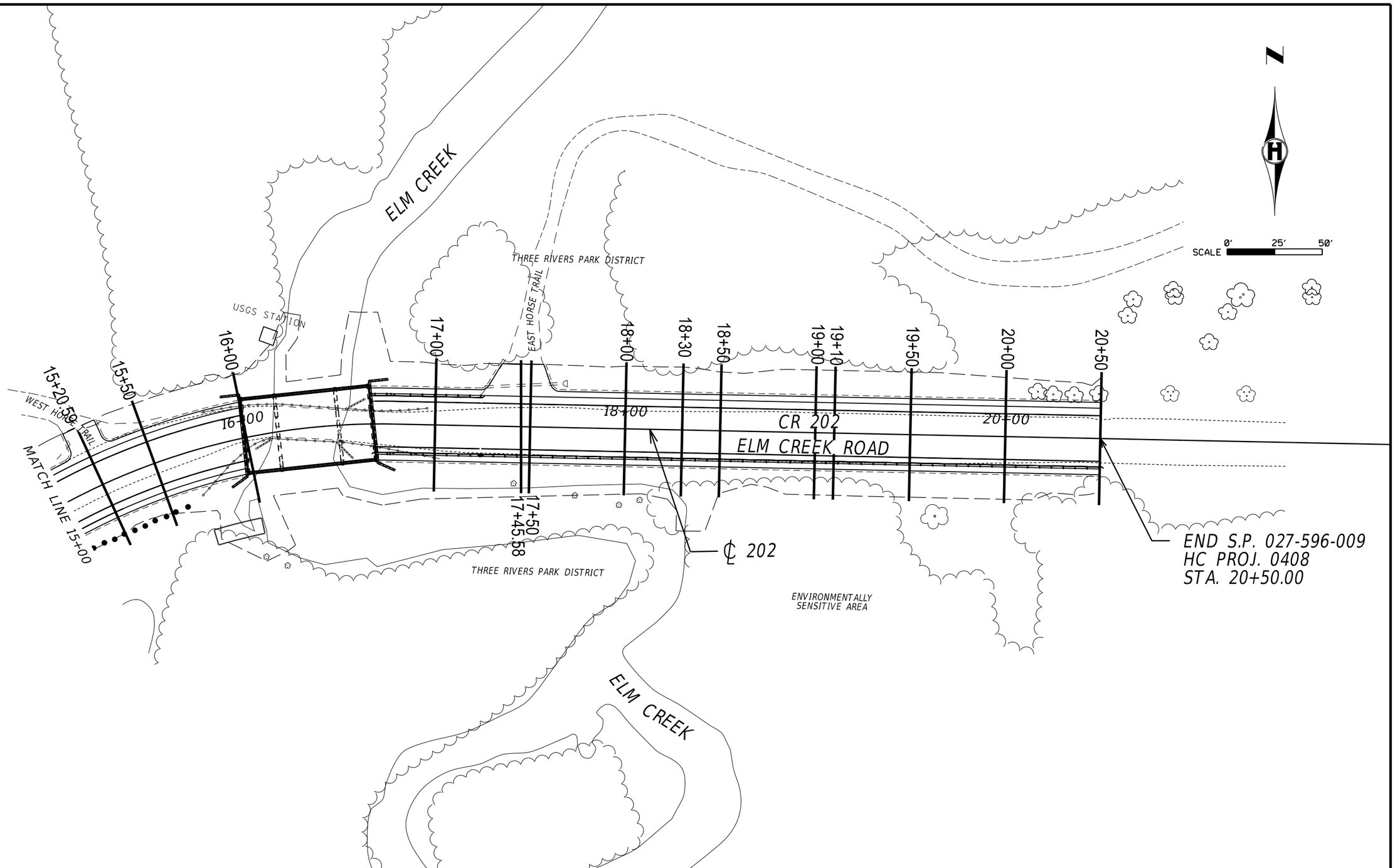
DESIGN BY:	E. KELLNER
CAD BY:	E. KELLNER
CHECKED BY:	D. SEILER
LAST REVISION:	06/06/2018

CROSS SECTION MATCH LINE LAYOUT

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 47/59

ML-1 [Sheet] pw2729 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-MatchLine.dgn



Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Andrew C. McGovern

ANDREW C. McGOVERN, PROFESSIONAL ENGINEER

48041 — LICENSE NO.

6/13/18 — DATE

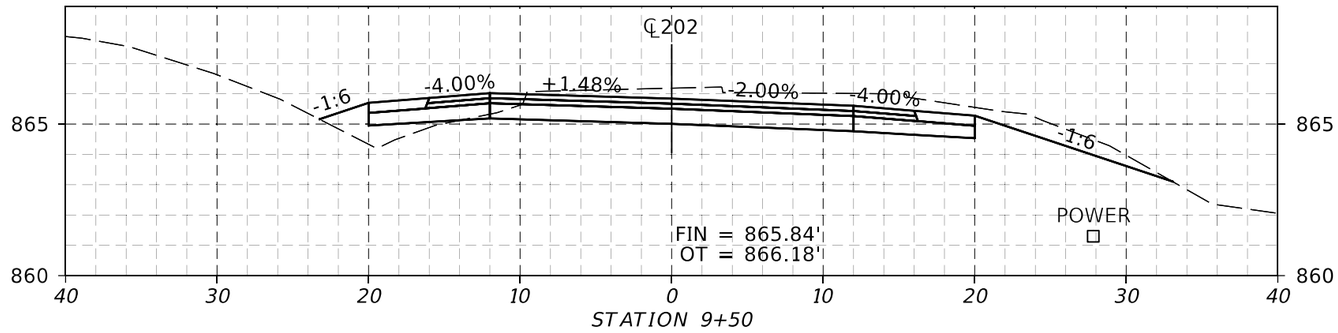
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CAD BY:	E. KELLNER
CHECKED BY:	D. SEILER
LAST REVISION:	06/05 /2018

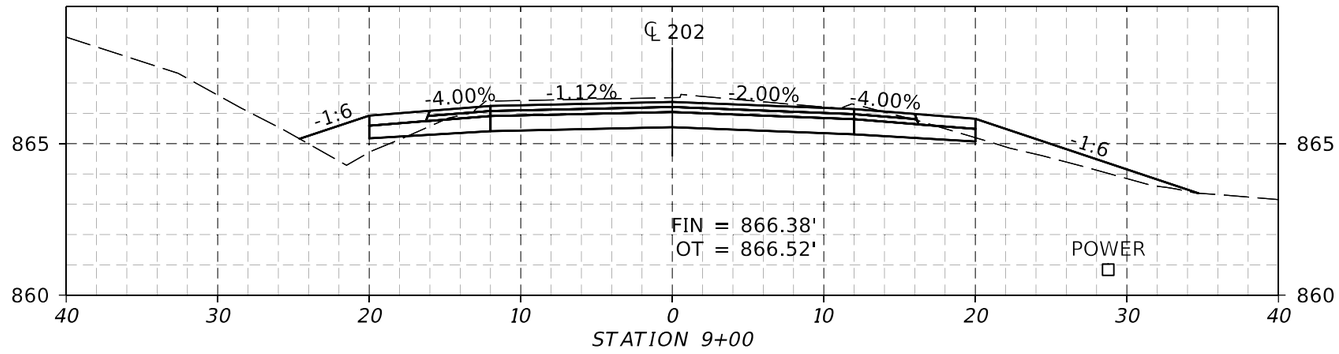
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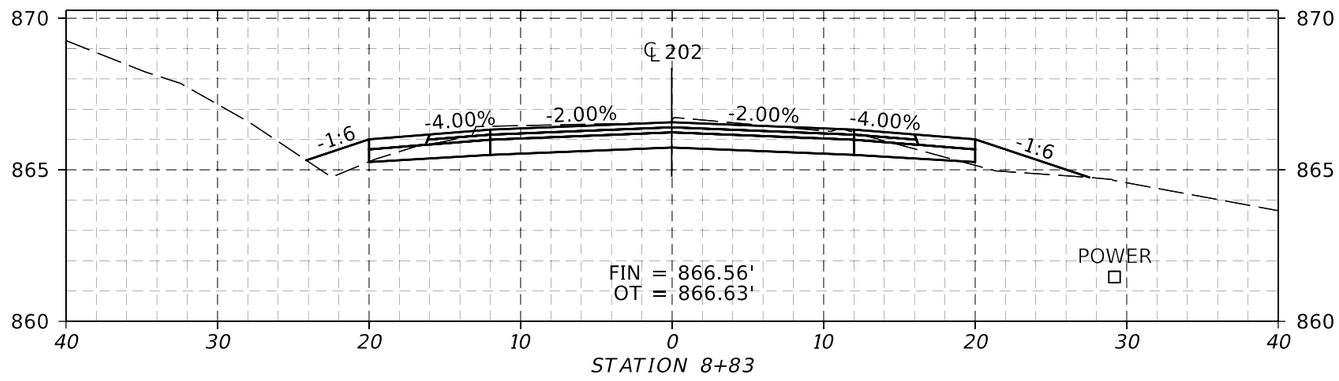
C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 48 / 59

ML-2 [Sheet] pw2729 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-MatchLine.dgn







Hennepin

SCALE H 0' 10' 20'

SCALE V 0' 5' 10'

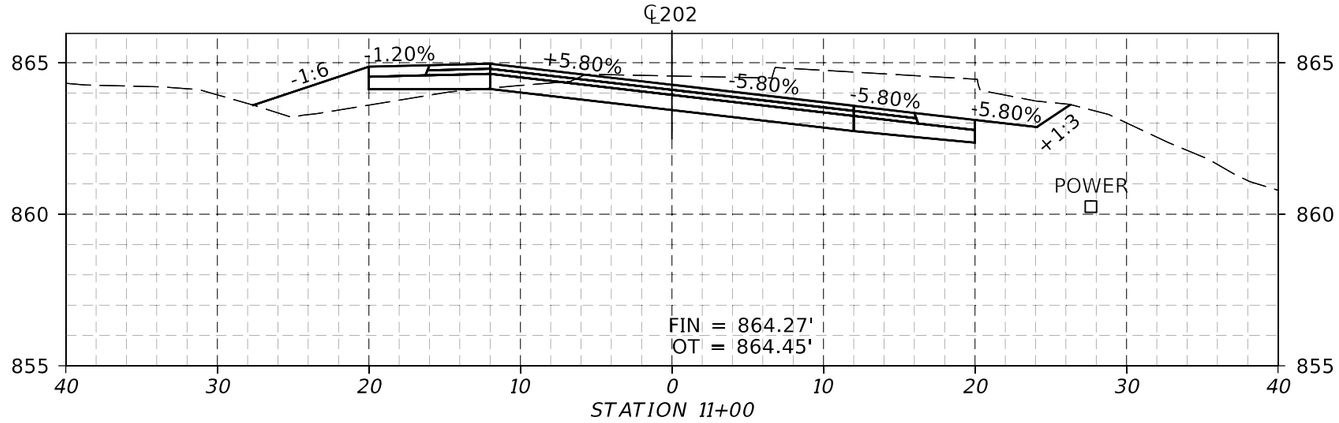
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CAD BY:	DWS
CHECKED BY:	EK
LAST REVISION:	06/12/2018

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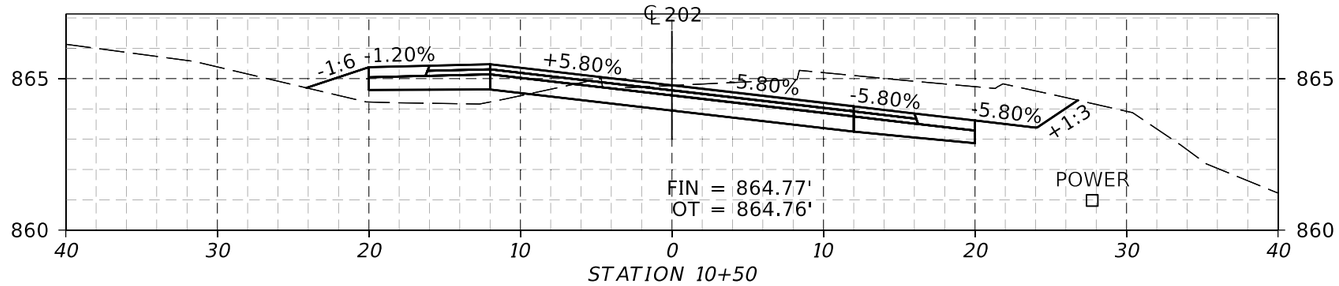
C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 49/59

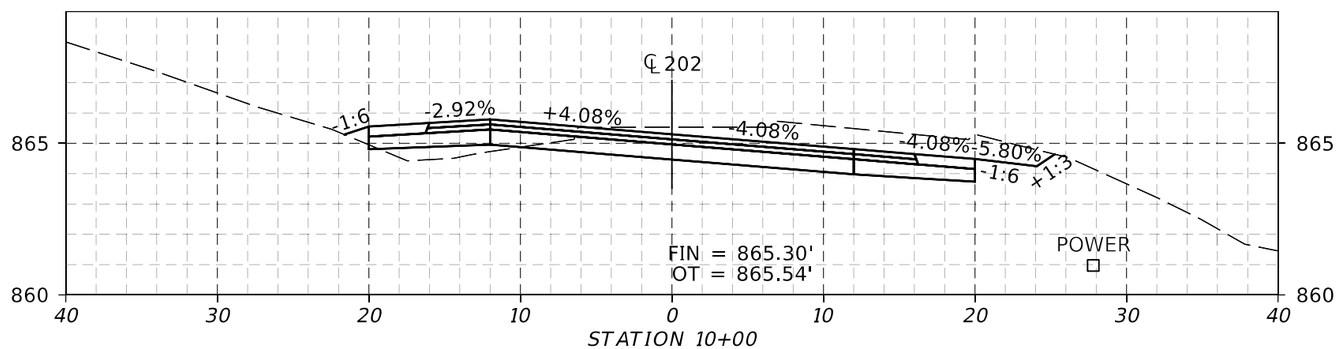
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STATION 11+00



STATION 10+50



STATION 10+00

Hennepin

SCALE H 0' 10' 20'

SCALE V 0' 5' 10'

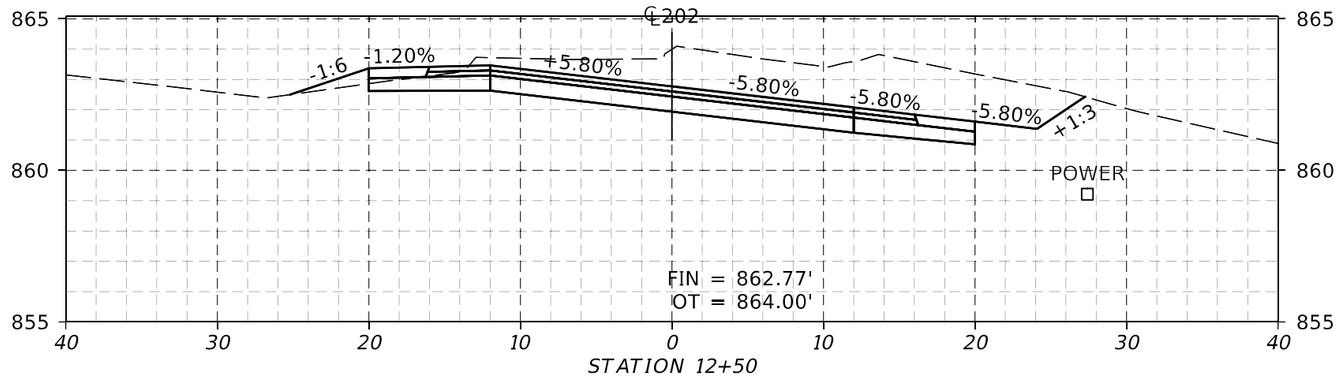
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CHECKED BY:	EK
LAST REVISION:	06/12/2018

X-SECTIONS STATION 10+00 TO STATION 12+00

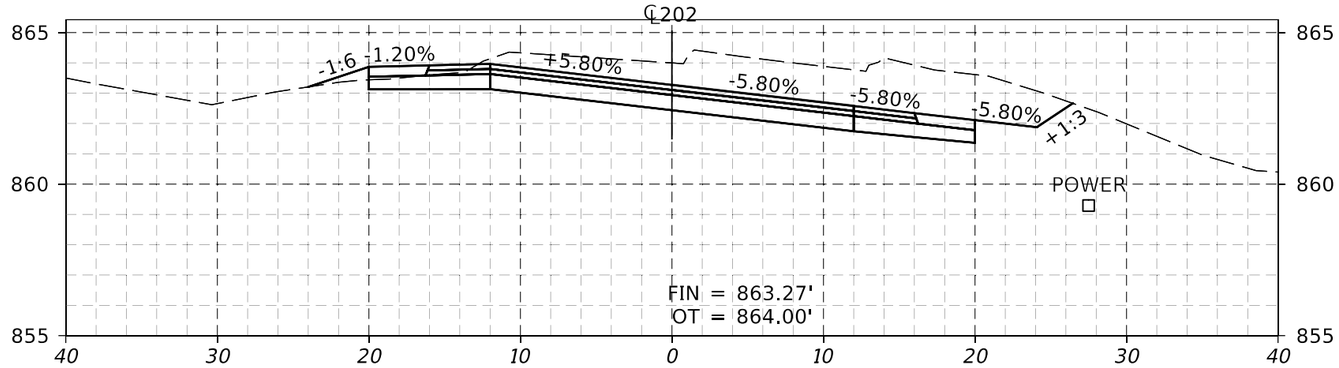
C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 50/59

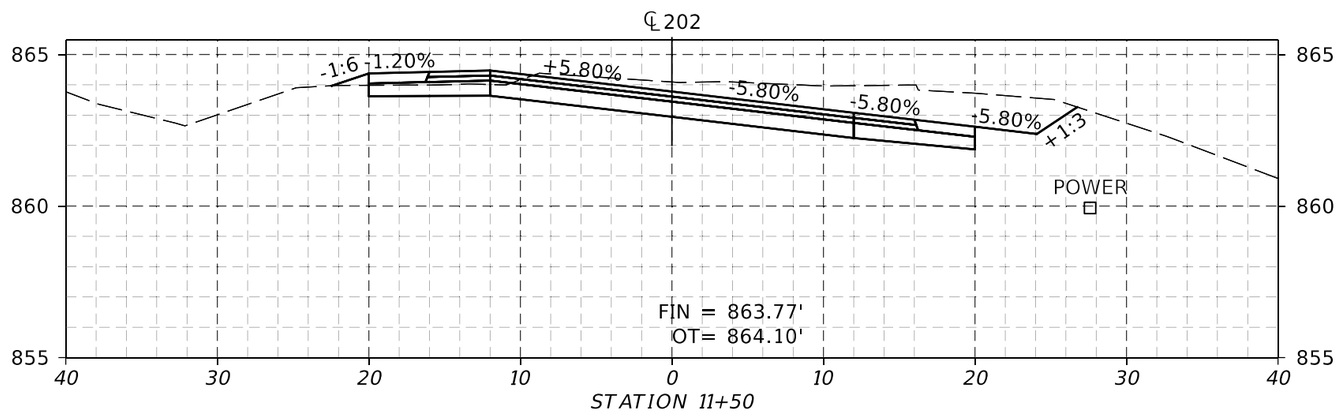
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STATION 12+50



STATION 12+00



STATION 11+50

Hennepin

SCALE H 0′ 10′ 20′

SCALE V 0′ 5′ 10′

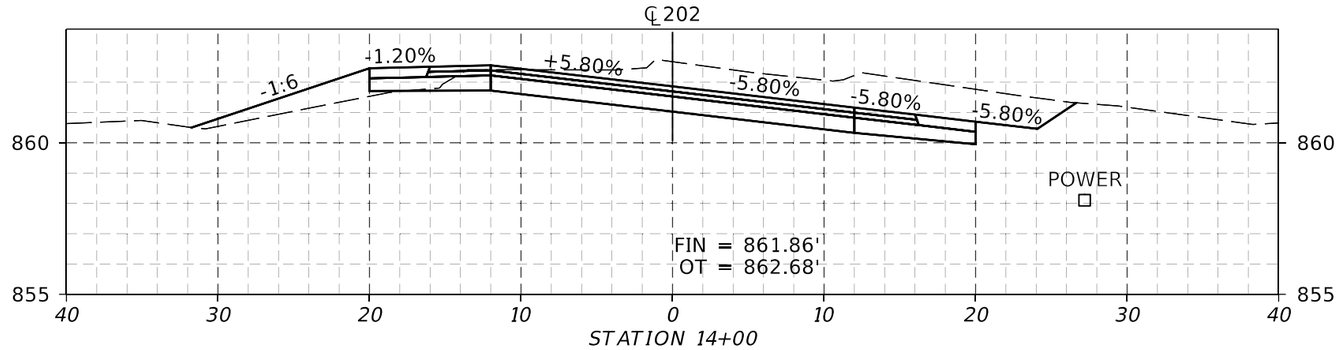
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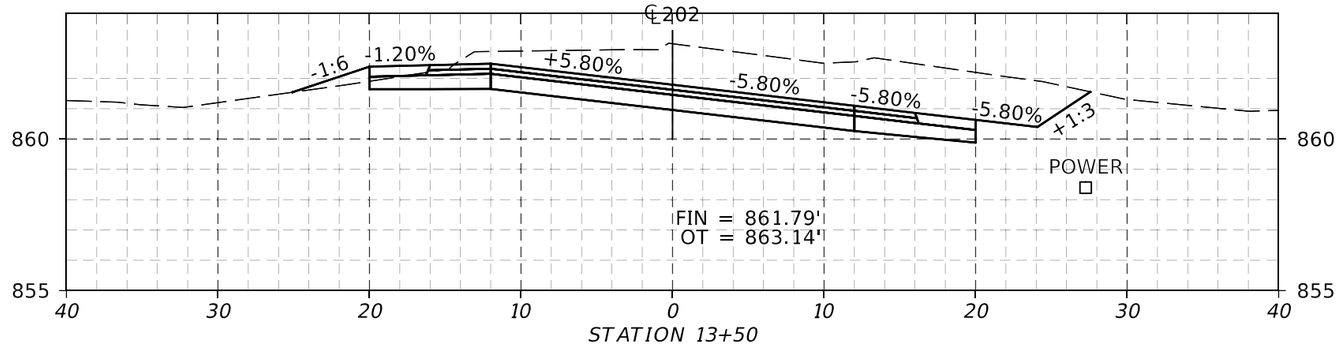
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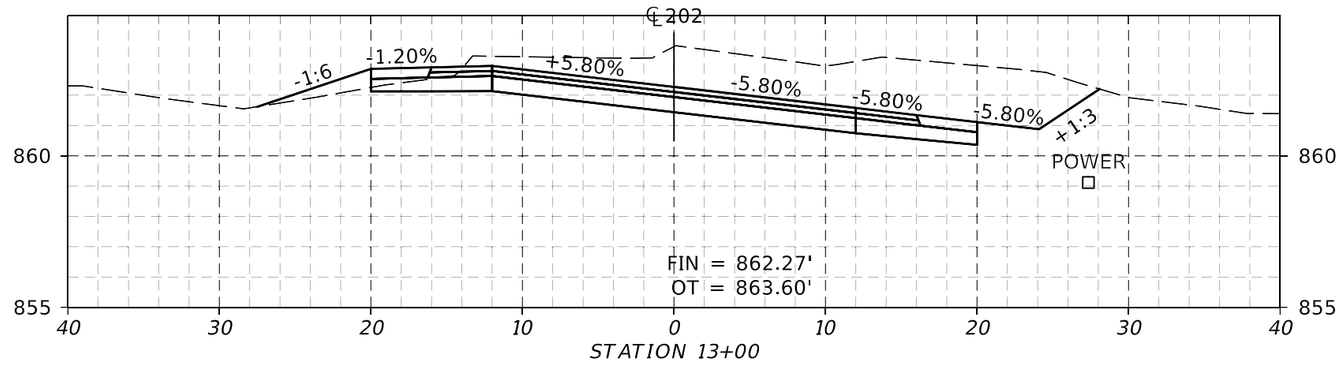
C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 51/59

11+50 - 12+50 [27x39 Sheet] 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-XS-2.dgn







Hennepin

SCALE H 0' 10' 20'

SCALE V 0' 5' 10'

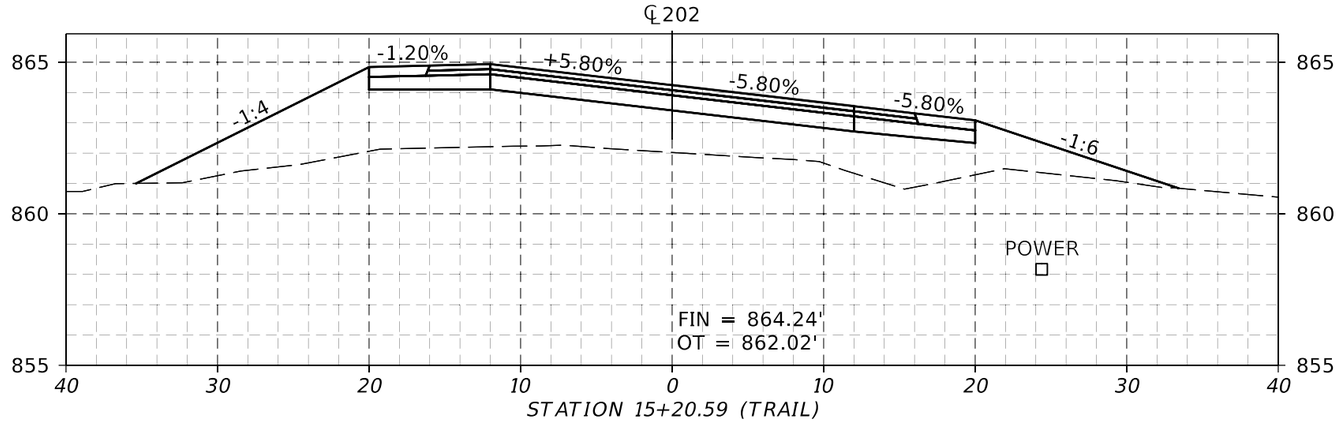
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CHECKED BY:	EK
LAST REVISION:	06/12/2018

X-SECTIONS STATION 13+00 TO STATION 14+00

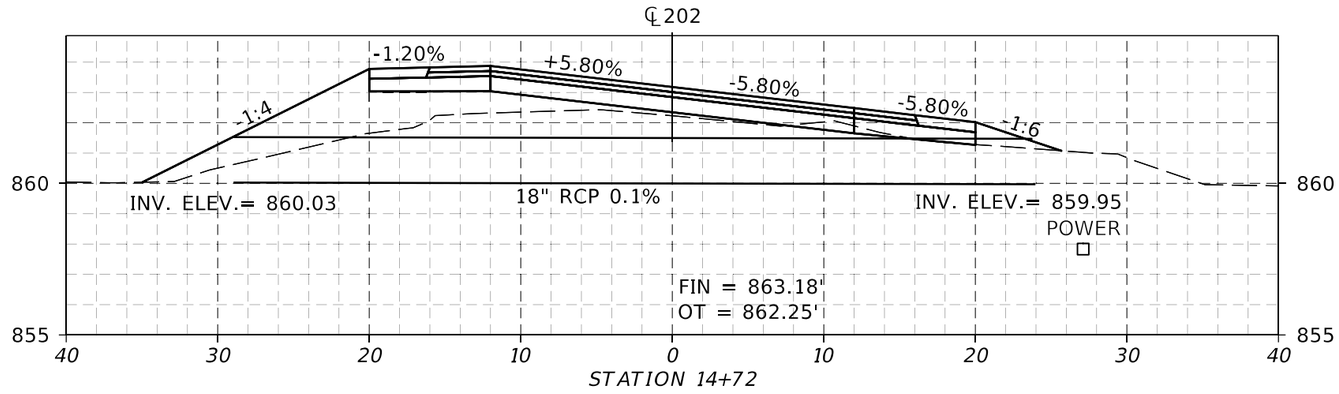
C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 52/59

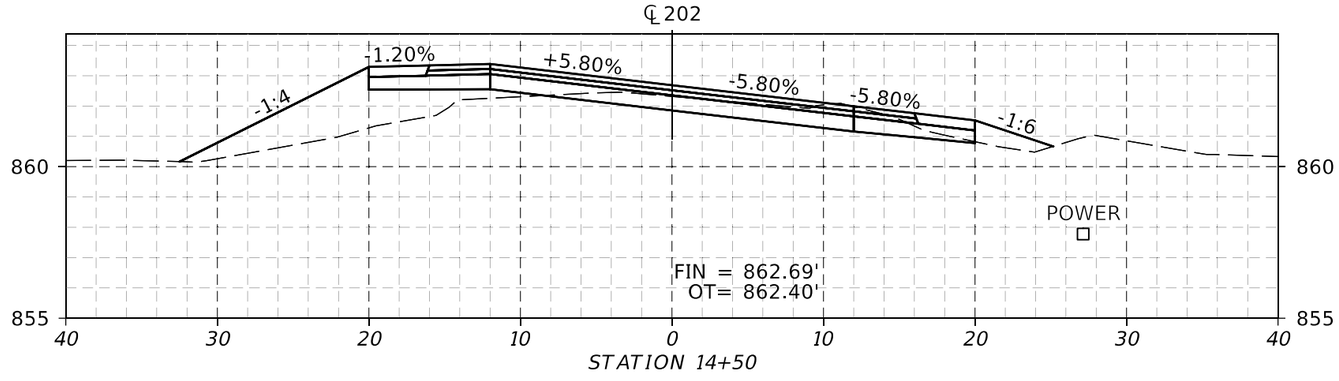
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STATION 15+20.59 (TRAIL)



STATION 14+72



STATION 14+50

Hennepin

SCALE H 0' 10' 20'

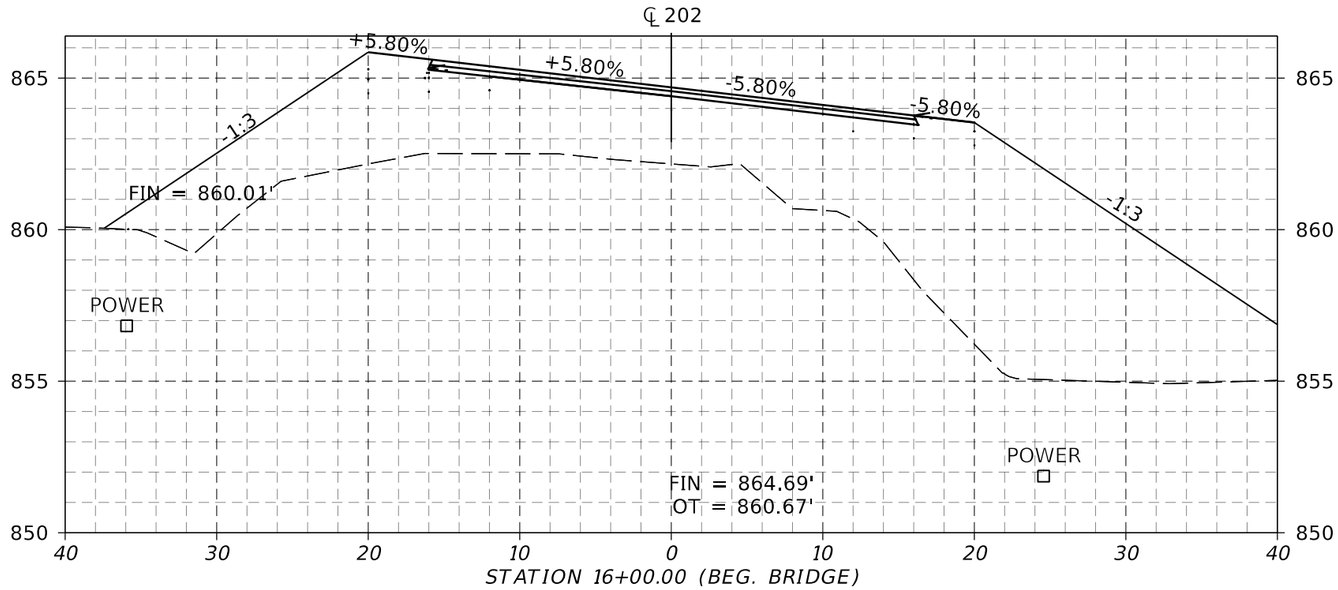
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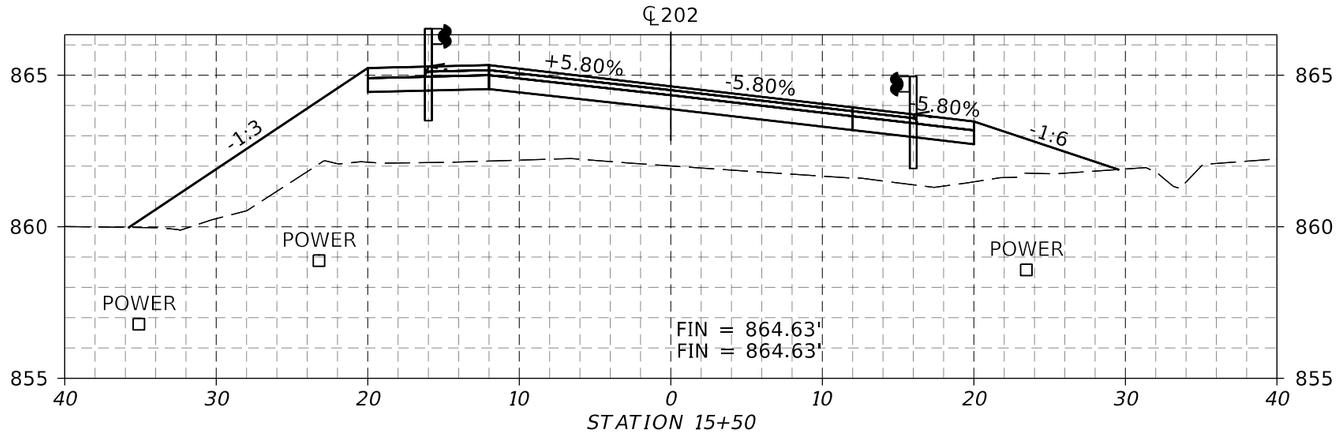
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CHECKED BY:	EK
LAST REVISION:	06/12/2018

X-SECTIONS STATION 14+50 TO STATION 15+21

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 53/59





Hennepin

SCALE H 0′ 10′ 20′

SCALE V 0′ 5′ 10′

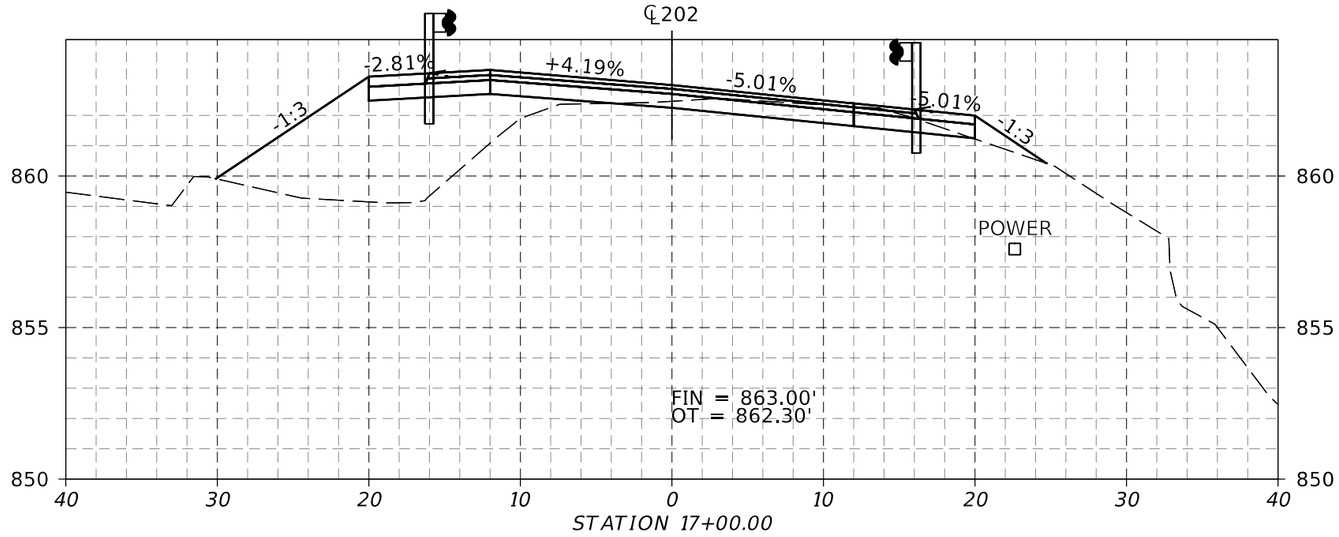
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CHECKED BY:	EK
LAST REVISION:	06/12/2018

X-SECTIONS STATION 15+50 TO STATION 16+00

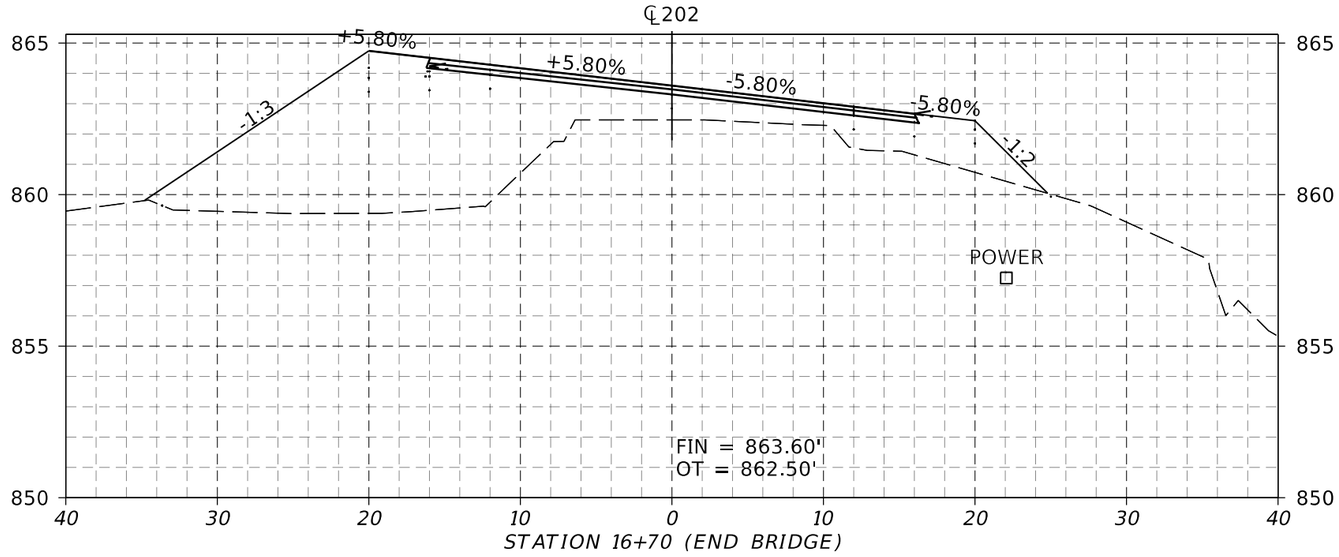
C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 54/59

15+50 - 16+00pw[37291] 8/23/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-XS-2.dgn



STATION 17+00.00



STATION 16+70 (END BRIDGE)

Hennepin

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SCALE V 0' 5' 10'

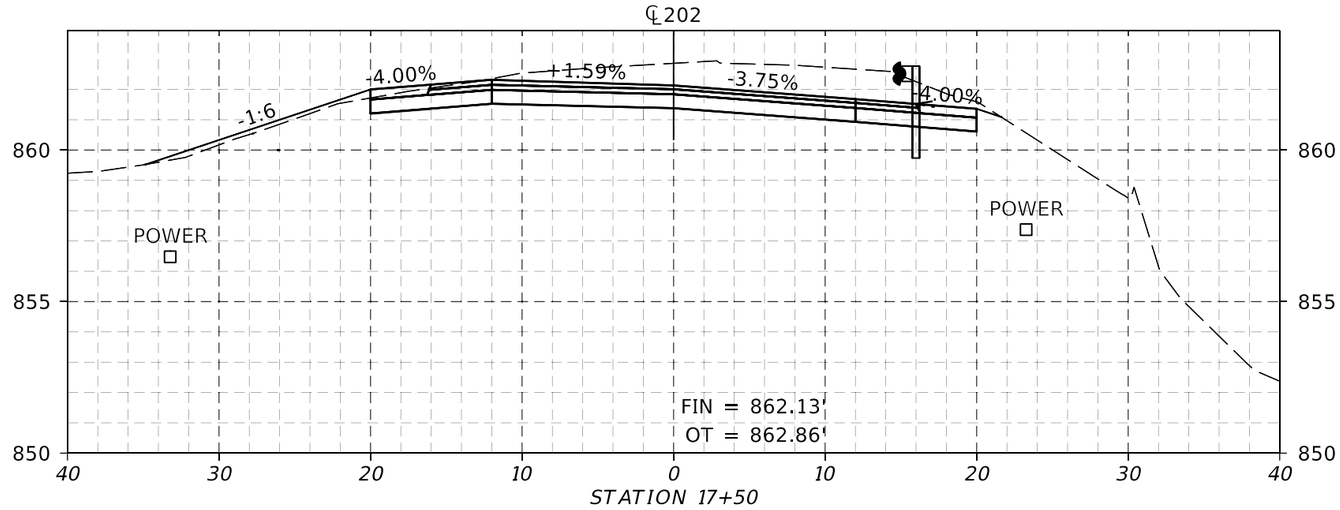
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LAST REVISION:	06/12/2018

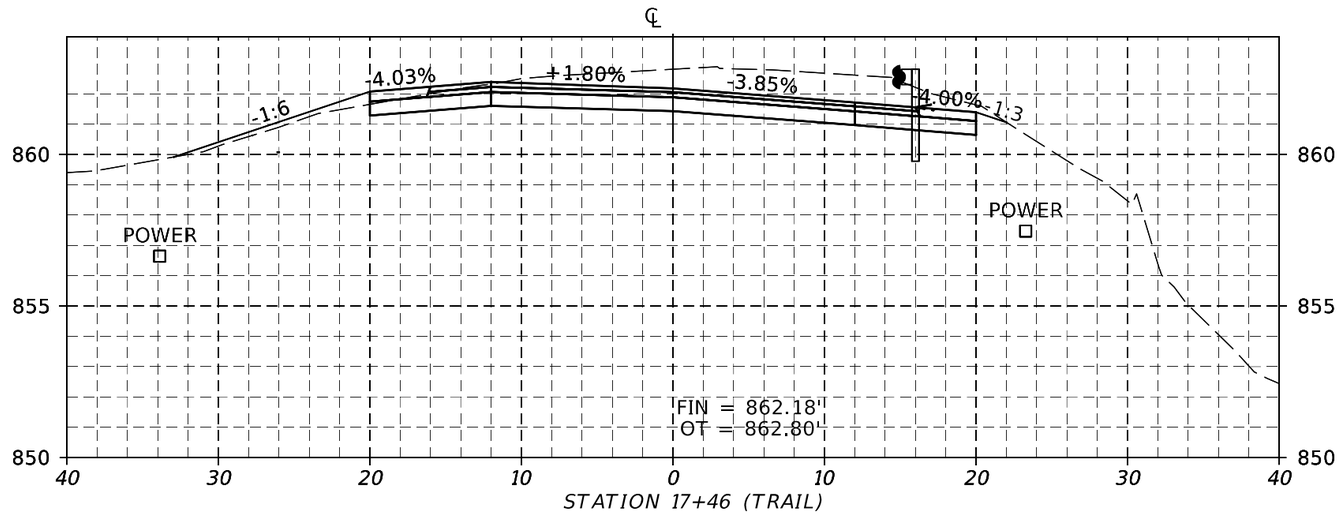
X-SECTIONS STATION 16+70 TO STATION 17+00

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 55/59

16+70 -17+00 pw:ed1 8/23/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-XS-2.dgn





Hennepin

SCALE H 0' 10' 20'

SCALE V 0' 5' 10'

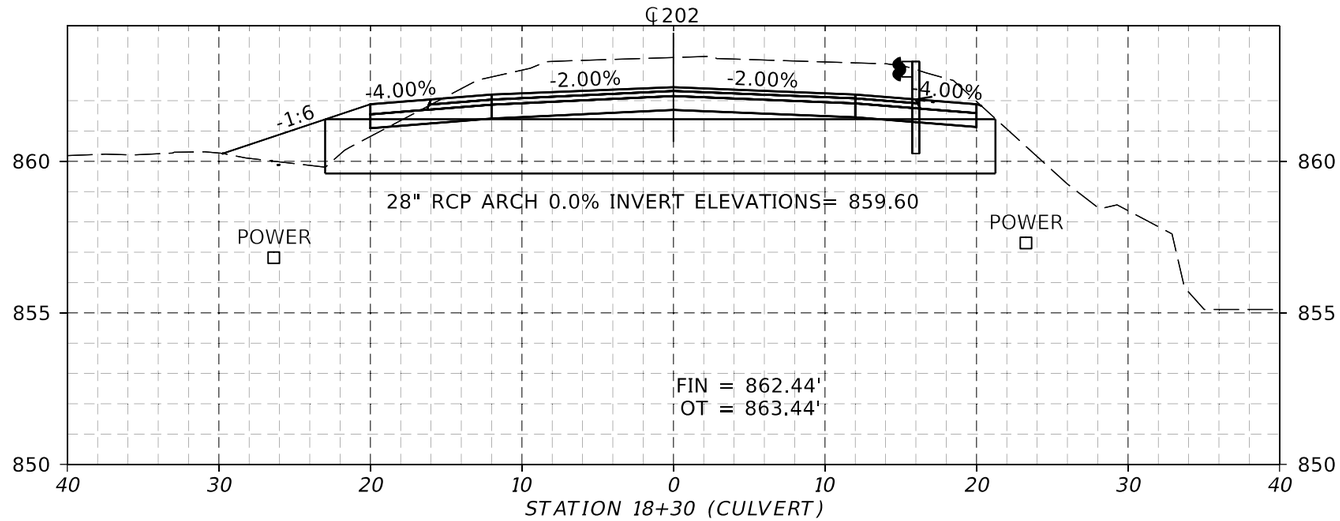
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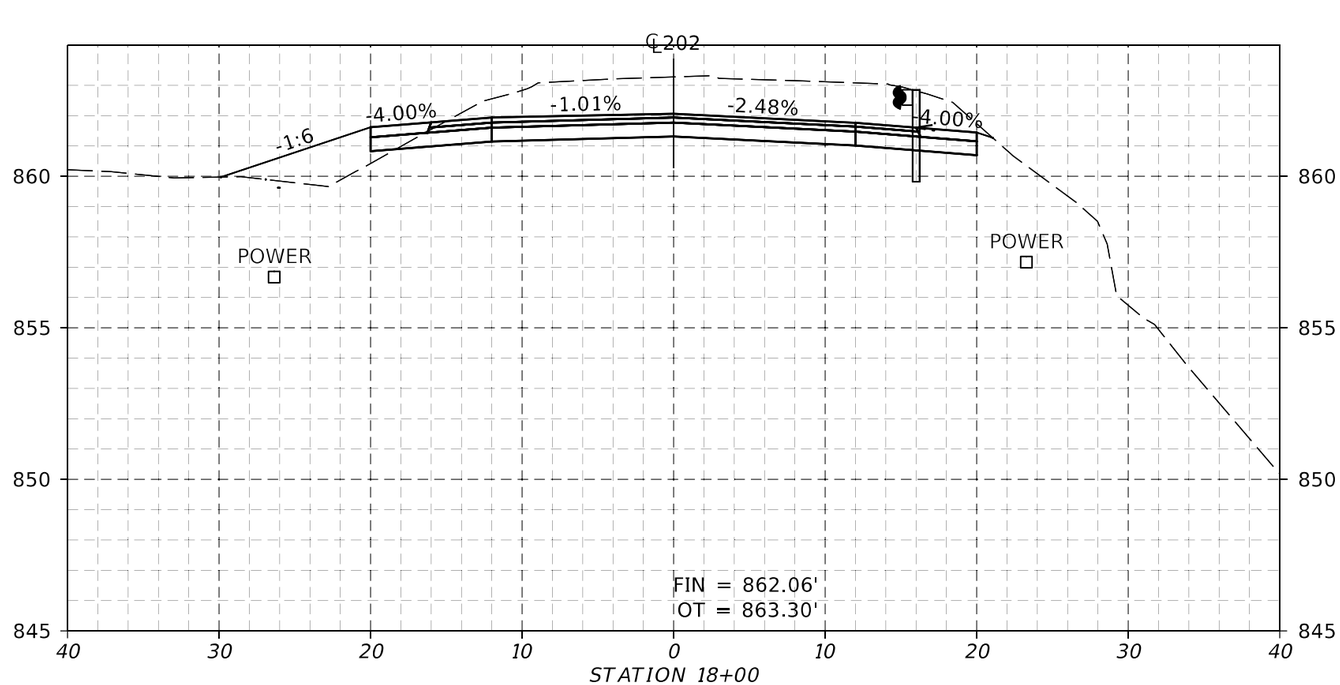
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C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 56/59

17+46 - 17+50SIGNED 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-XS-2.dgn





Hennepin

SCALE H 0' 10' 20'

SCALE V 0' 5' 10'

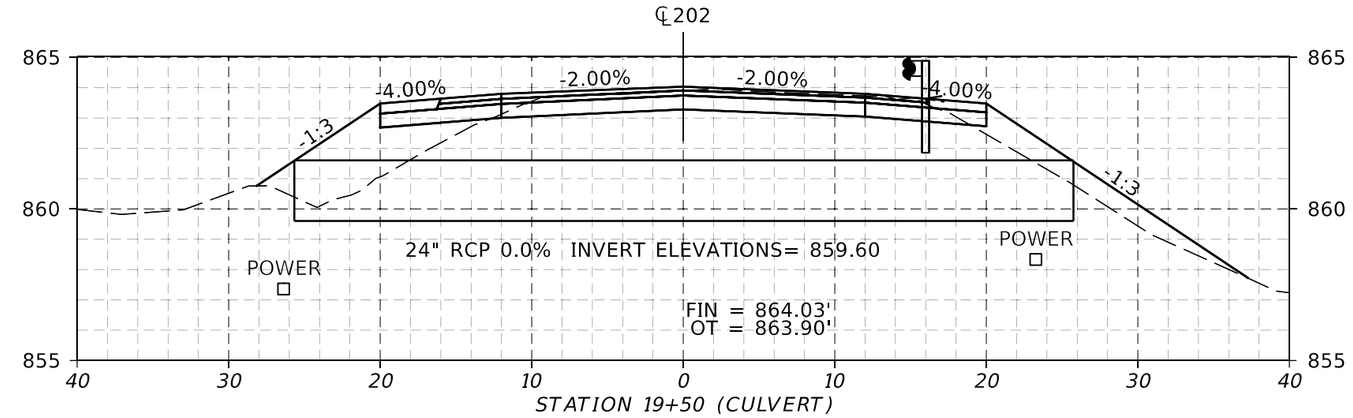
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CHECKED BY:	EK
LAST REVISION:	06/12/2018

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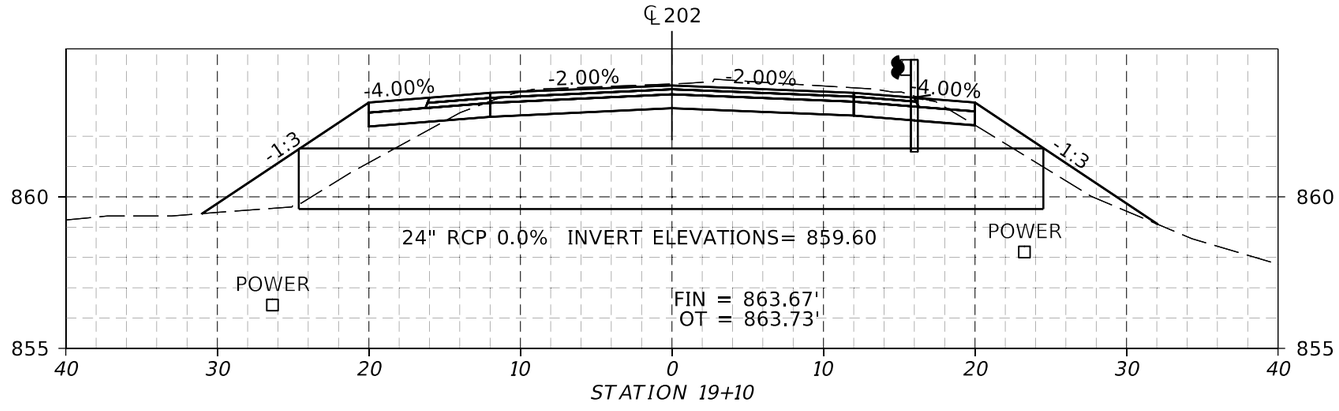
C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 57/59

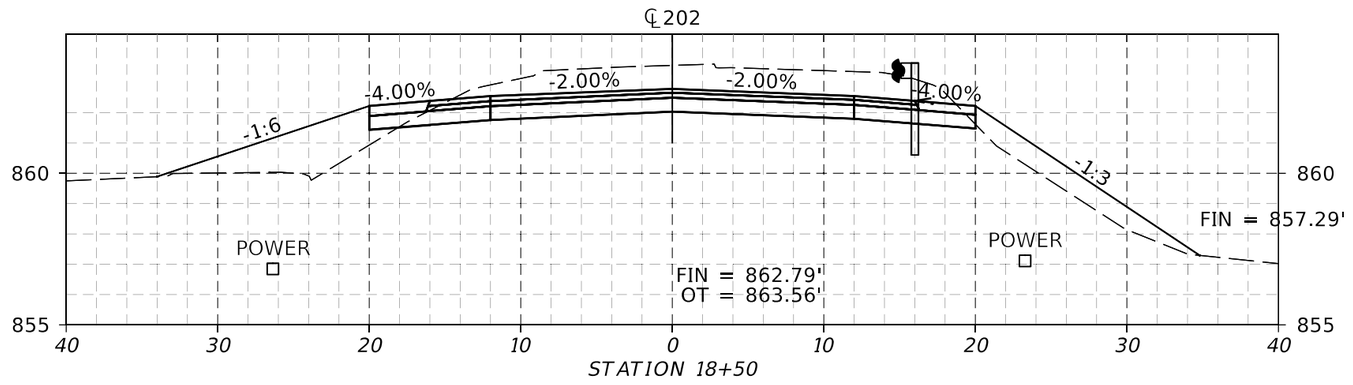
18+00 -18+30[Sheet2] 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-XS-2.dgn



STATION 19+50 (CULVERT)



STATION 19+10



STATION 18+50

Hennepin

SCALE H 0′ 10′ 20′

SCALE V 0′ 5′ 10′

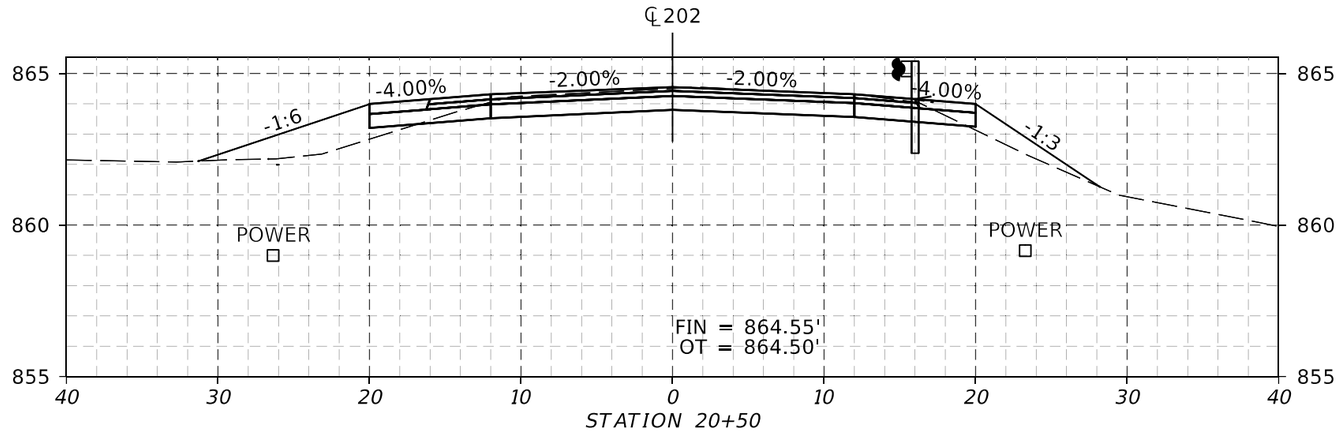
DESIGN BY:	DWS
CAD BY:	DWS
CHECKED BY:	EK
LAST REVISION:	06/12/2018

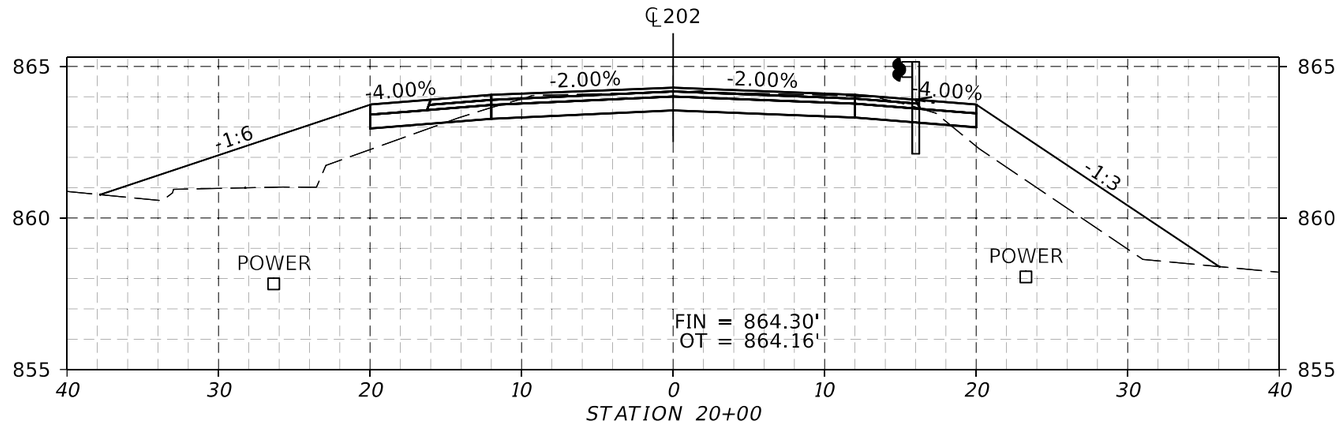
X-SECTIONS STATION 18+50 TO STATION 19+50

C.R. 202 HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET 58/59

18+50-20+00 [Sheet2] 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-XS-2.dgn





Hennepin

SCALE H 0′ 10′ 20′

SCALE V 0′ 5′ 10′

DESIGN BY:	DWS
CAD BY:	DWS
CHECKED BY:	EK
LAST REVISION:	06/12/2018

X-SECTIONS STATION 20+00 TO STATION 20+50

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S.P. 027-596-009

SHEET 59 / 59

20+00-20+50.dgn 7588et] 6/13/2018 \\tempo\proj\202_0408_27C53\Design\Plan\0408-XS-2.dgn

TABULATION OF QUANTITIES (1)		
ITEM DESCRIPTION	UNIT	TOTAL
TRAFFIC CONTROL	LS	1
PORTABLE PRECAST CONC BARRIER DES 8337	LIN FT	50
TRAFFIC CONTROL SUPERVISOR	LS	1

THE FOLLOWING STANDARD PLATES, APPROVED BY THE FEDERAL HIGHWAY ADMINISTRATION, SHALL APPLY ON THIS PROJECT.

STANDARD PLATES		
	PLATE NO.	PLATE DESCRIPTION
	8000J	CHANNELIZERS, (3 SHEETS)
	8337C	TEMPORARY PORTABLE PRECAST CONCRETE BARRIER (TYPE F), (3 SHEETS)

TRAFFIC CONTROL LEGEND

- APPROPRIATE SIGN AS INDICATED MOUNTED ON POSTS OR PORTABLE TUBULAR METAL FRAME
- 8' - TYPE III BARRICADE. UNLESS NOTED WITH APPROPRIATE SIGN AS INDICATED
- FLASHING LIGHT
- H.I. HIGH INTENSITY FLASHING LIGHT
- PORTABLE PRECAST CONCRETE BARRIER WITH DELINEATORS FACING TRAFFIC
- PERMANENT CONSTRUCTION AREA

GENERAL INFORMATION

1. ALL TRAFFIC CONTROL DEVICES SHALL CONFORM AND BE INSTALLED IN ACCORDANCE WITH THE LATEST EDITION OF THE "MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MN MUTCD) AND PART VI, "FIELD MANUAL FOR TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS".

2. ALL INPLACE PAVEMENT MARKINGS AND INPLACE TRAFFIC CONTROL DEVICES, INCLUDING OVERHEAD SIGNS ON ROADS OPEN TO TRAFFIC THAT ARE NOT CONSISTENT WITH TRAFFIC CONTROL OPERATIONS SHALL BE COVERED, REMOVED OR REVISED.

3. ALL TRAFFIC CONTROL DEVICES ARE SHOWN IN THEIR APPROXIMATE LOCATIONS. ACTUAL LOCATIONS SHALL BE DETERMINED IN THE FIELD.

4. THE CONTRACTOR SHALL FURNISH, INSTALL, MAINTAIN AND REMOVE THE TRAFFIC CONTROL DEVICES IN THIS TRAFFIC CONTROL PLAN AND ALL ADDITIONAL TRAFFIC CONTROL DEVICES AS REQUIRED TO FACILITATE TRAFFIC OPERATIONS AND FIELD CONDITIONS.

5. PORTABLE PRECAST CONCRETE BARRIER WITH DELINEATORS SHALL BE PLACED AS SHOWN IN THE PLAN. DELINEATORS SHALL HAVE A MINIMUM OF 24 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED FACING TRAFFIC ALONG AND AT THE TOP EDGE OF THE BARRIER AT APPROXIMATELY 4' SPACING.

6. TEMPORARY SIGNING SHALL BE MOUNTED ON POSTS DRIVEN INTO THE GROUND OR ON PORTABLE SUPPORTS. WHEN THE TEMPORARY SIGNS ARE REMOVED THE SIGN POSTS SHALL ALSO BE REMOVED.

7. ALL STREETS AND ENTRANCES SHALL REMAIN OPEN TO TRAFFIC AT ALL TIMES AND SHALL BE BUILT UNDER TRAFFIC AS REQUIRED UNLESS SPECIFICALLY SHOWN IN THIS TRAFFIC CONTROL PLAN. ANY TEMPORARY CLOSURE SHALL BE APPROVED BY THE ENGINEER.

8. IF THE CONTRACTOR DECIDES TO PERFORM THE CONSTRUCTION WORK IN A SEQUENCE OTHER THAN SHOWN IN THIS TRAFFIC CONTROL PLAN THE CONTRACTOR SHALL PROVIDE A COMPLETE REVISED TRAFFIC CONTROL PLAN.

9. THE CONTRACTOR SHALL REPLACE ANY INPLACE PAVEMENT MARKINGS REMOVED TO FACILITATE THE TRAFFIC CONTROL.

10. ALL WORK AS DETAILED IN NOTES 1 - 9 SHALL BE AS DIRECTED BY AND TO THE SATISFACTION OF THE ENGINEER AND ALL COSTS SHALL BE INCLUDED IN THE UNIT PRICE BID FOR TRAFFIC CONTROL (LS).

INDEX

SHEET NO.	DESCRIPTION
TC1 - TC6	TRAFFIC CONTROL DETAIL SHEETS
TC7	TRAFFIC CONTROL PLAN SHEET

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Ryan T. Allers

RYAN T. ALLERS, PROFESSIONAL ENGINEER

45896 LICENSE NO.

6/13/18 DATE

DESIGN BY:	J. WING
CAD BY:	J. WING
CHECKED BY:	R. ALLERS
LAST REVISION:	/ /

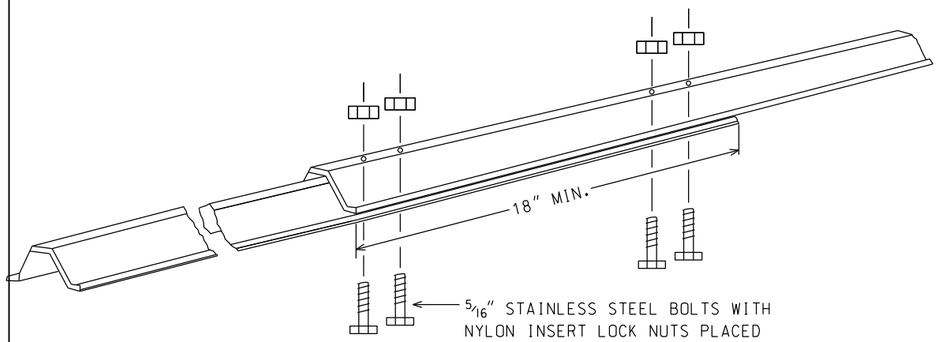
TRAFFIC CONTROL DETAIL SHEET

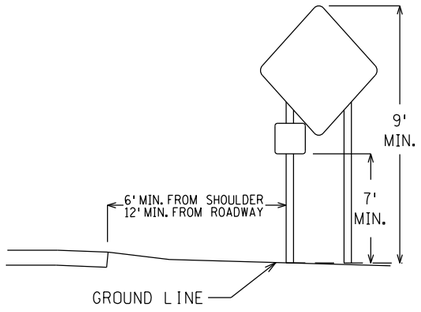
CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET TC1 / TC7

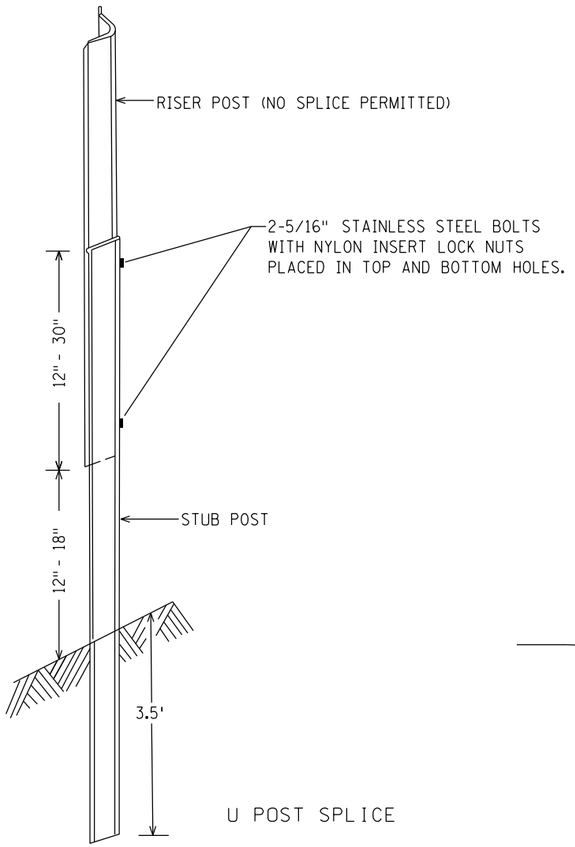
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KNEE BRACE SPLICE

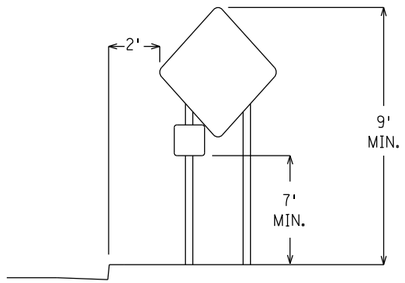




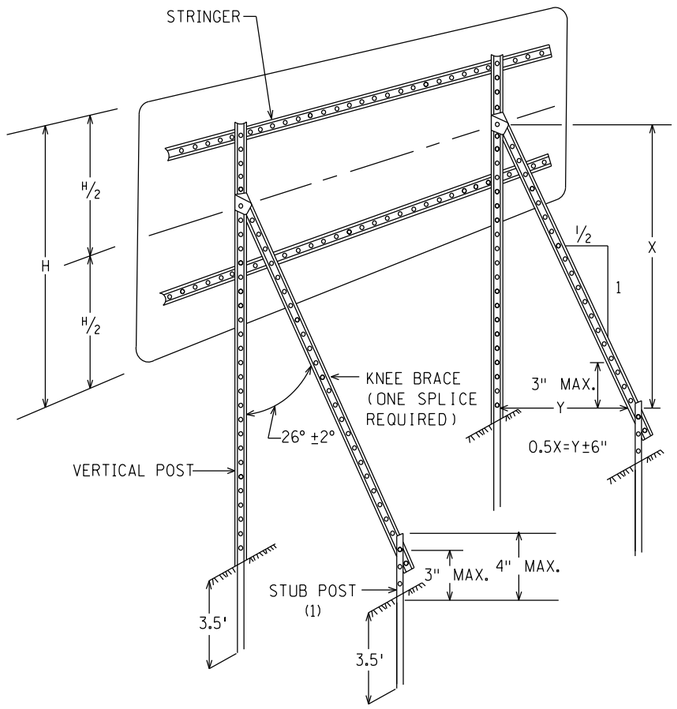
TYPICAL RURAL MOUNTING



U POST SPLICE



TYPICAL URBAN MOUNTING



(1) OFFSET STUB POST 1' TOWARD ROADWAY RELATIVE TO VERTICAL POST. ATTACH STUB POST AND KNEE BRACE BACK TO BACK.

TYPICAL "A-FRAME" INSTALLATION
TYPE "D" SIGNS

NOTES:

1. USE 3# STUB POSTS, RISER POSTS, STRINGERS, KNEE BRACES, LATERAL BRACES AND KNEE BRACE STUB POSTS. ALL SHALL CONFORM TO MN/DOT 3401.
2. MOUNTING (PUNCHING CODE) FOR TYPE "C" SIGN PANELS SHALL BE AS INDICATED IN THE STANDARD SIGNS MANUAL UNLESS OTHERWISE SPECIFIED.
3. ALL RISER (VERTICAL) "U POSTS" SHALL BE SPLICED. DRIVEN STUB POSTS SHALL BE AT LEAST 7' LONG.
4. USE STAINLESS STEEL 5/16" BOLTS, WASHERS, AND NYLON INSERT LOCK NUTS AS SHOWN FOR ALL GROUND MOUNTED AND OVERHEAD MOUNTED SIGNS.
5. STAINLESS STEEL WASHER WITH SAME DIMENSIONS SHALL BE PROVIDED BETWEEN ALL NYLON WASHERS AND BOLT HEADS.
6. BRACING STUBS SHALL BE NO MORE THAN 4" ABOVE GROUND AND EMBEDDED AT LEAST 3 1/2'.
7. A-FRAME BRACKET SHALL BE STEEL CONFORMING TO MN/DOT 3306 AND GALVANIZED IN ACCORDANCE WITH MN/DOT 3394.
8. COLLARS SHALL BE USED TO SHIM OVERLAYS AND DEMOUNTABLE LEGEND AWAY FROM PANEL WHERE INTERFERENCE WITH BOLT HEADS IS ENCOUNTERED. MN/DOT 3352.2A5.
9. 2 POST TYPE "C" SIGNS SHALL BE REINFORCED WITH AT LEAST ONE LATERAL BRACE, INSTALLATIONS WHERE THE TOTAL PANEL HEIGHT IS 60" OR MORE SHALL HAVE TWO LATERAL BRACES LOCATED APPROXIMATELY AT THE QUARTER POINTS.
10. WHERE 2 SINGLE POST TYPE "C" SIGNS ARE INSTALLED SIDE BY SIDE, THEY SHALL BE REINFORCED LATERALLY BY AT LEAST 2 BRACES, BOLTED AT EACH POST AND LOCATED APPROXIMATELY AT THE QUARTER POINTS.
11. WHERE 3 OR MORE TYPE "C" SIGNS ARE INSTALLED SIDE BY SIDE, THEY SHALL BE REINFORCED LATERALLY BY AT LEAST 2 BRACES, BOLTED AT EACH POST AND POST SECTION AND LOCATED APPROXIMATELY AT THE QUARTER POINTS AS SHOWN IN THE MODIFIED TYPE C INSTALLATION.
12. TYPE "D" SIGN PANELS SHALL BE BOLTED TO STRINGERS AT 24" MAXIMUM INTERVALS IN ACCORDANCE WITH THE TYPE "D" STRINGER AND PANEL-JOINT DETAIL (SEE STANDARD SIGNS MANUAL).

Hennepin

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RYAN T. ALLERS, PROFESSIONAL ENGINEER

45896 LICENSE NO.

6/13/18 DATE

DESIGN BY:	J. WING
CAD BY:	J. WING
CHECKED BY:	R. ALLERS
LAST REVISION:	/ /

TRAFFIC CONTROL DETAIL SHEET

CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET TC2 / TC7

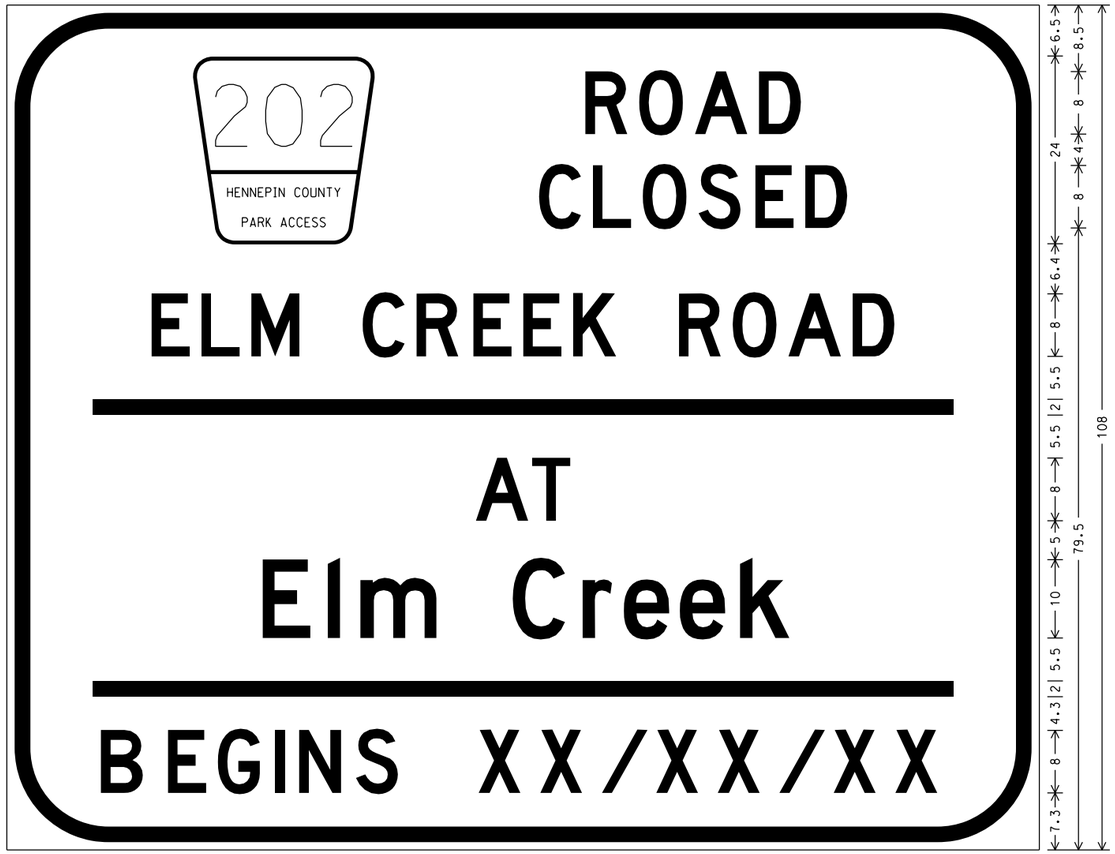
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SIGN DETAIL 1



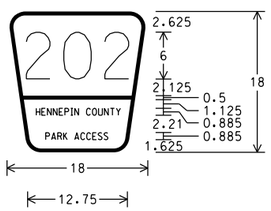
9" RADIUS, 1 MARGIN, 1.5 BORDER,
D SERIES LETTERING, DG3 SIGN SHEETING,
BLACK BORDER AND TEXT ON A ORANGE BACKGROUND.

SIGN DETAIL 2



12" RADIUS, 1 MARGIN, 2 BORDER,
D SERIES LETTERING, DG3 SIGN SHEETING,
BLACK BORDER AND TEXT ON A ORANGE BACKGROUND.

SIGN DETAIL 3



2" RADIUS,
NO MARGIN,
0.5 BORDER,
D SERIES LETTERING,
DG3 SIGN SHEETING,
WHITE BORDER AND TEXT
ON A BROWN BACKGROUND.
USE FOR SIGN DETAIL 1

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Ryan T. Allers

RYAN T. ALLERS, PROFESSIONAL ENGINEER

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6/13/18 DATE

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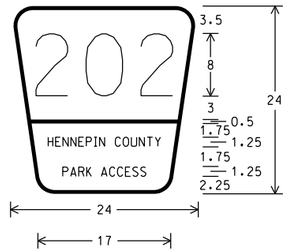
TRAFFIC CONTROL DETAIL SHEET

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S.P. 027-596-009

SHEET TC3 / TC7

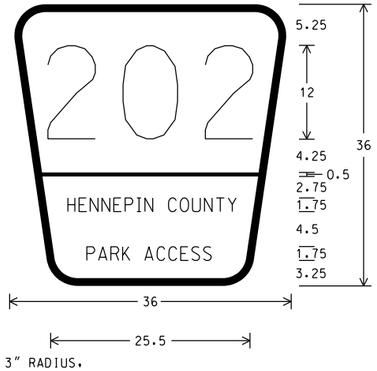
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SIGN DETAIL 4



2.5" RADIUS.
NO MARGIN.
0.5 BORDER.
D SERIES LETTERING.
DG3 SIGN SHEETING.
WHITE BORDER AND TEXT
ON A BROWN BACKGROUND.

SIGN DETAIL 5



3" RADIUS.
NO MARGIN.
0.5 BORDER.
D SERIES LETTERING.
DG3 SIGN SHEETING.
WHITE BORDER AND TEXT
ON A BROWN BACKGROUND.

TRAFFIC CONTROL DEVICES (1)					
SIGN NO.	QUAN.	MOUNTING	SIGN PANEL SIZE (IN.)	CODE NO.	PANEL LEGEND / DESCRIPTION (2)
1	7	(3)	96 X 84	(4)	WORK ZONE ADVANCE NOTICE (5)
2 (6)	1	(3)	132 X 108	(7)	WORK ZONE ADVANCE NOTICE (5)
3	2	(3)	54 X 48	G20-X1	CLOSURE NOTICE
4	2	(3)	48 X 48	W20-3	ROAD CLOSED AHEAD (8)
5	2	(9)	48 X 30	R11-2	ROAD CLOSED
6	2	(9)	60 X 30	R11-4	ROAD CLOSED TO THRU TRAFFIC
7	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-2	EAST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M5-1	ADVANCE 90° TURN ARROW LEFT (10)
8	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-2	EAST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M6-1	HORIZONTAL 90° SINGLE HEAD ARROW LEFT (10)
9	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-2	EAST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M5-1	ADVANCE 90° TURN ARROW RIGHT (10)

(1) THE QUANTITIES SHOWN WITHIN THIS TABULATION ARE FOR INFORMATION ONLY AND SHALL BE PAID FOR UNDER THE PAY ITEM TRAFFIC CONTROL (LS).
(2) ALL SIGNING SHALL USE DG3 SIGN SHEETING.
(3) POSTS OR PORTABLE TUBULAR METAL FRAME.
(4) SEE SIGN DETAIL 1 ON SHEET TC3.
(5) DATE TO BE DETERMINED BY THE ENGINEER AND THE SIGN SHALL BE INSTALL A MINIMUM OF 7 DAYS IN ADVANCE OF ROAD CLOSURE.
(6) THESE SIGNS ARE LARGER AND SHALL ONLY BE USED ALONG T.H. 610.
(7) SEE SIGN DETAIL 2 ON SHEET TC3.
(8) INCLUDES ONE HIGH INTENSITY AMBER FLASHING LIGHT ON EACH SIGN.
(9) 8' TYPE III BARRICADE LEFT WITH TWO AMBER FLASHING LIGHTS ON EACH BARRICADE.
(10) BLACK BORDER AND LEGEND ON A ORANGE BACKGROUND.
(11) SEE SIGN DETAIL 4 ON SHEET TC4.
(12) SEE SIGN DETAIL 5 ON SHEET TC4.

Hennepin

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RYAN T. ALLERS, PROFESSIONAL ENGINEER — 45896 LICENSE NO. — 6/13/18 DATE

DESIGN BY:	J. WING
CAD BY:	J. WING
CHECKED BY:	R. ALLERS
LAST REVISION:	/ /

TRAFFIC CONTROL DETAIL SHEET

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SHEET TC4 / TC7

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TRAFFIC CONTROL DEVICES (1)

SIGN NO.	QUAN.	MOUNTING	SIGN PANEL SIZE (IN.)	CODE NO.	PANEL LEGEND / DESCRIPTION (2)
10	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-2	EAST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M6-1	HORIZONTAL 90° SINGLE HEAD ARROW RIGHT (10)
11	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-2	EAST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M5-2	ADVANCE 45° TURN ARROW LEFT (10)
12	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-2	EAST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M6-2	HORIZONTAL 45° SINGLE HEAD ARROW LEFT (10)
13	7	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-2	EAST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M6-3	VERTICAL SINGLE HEAD ARROW UP (10)
14	1	(3)	24 X 12	M4-6	END (10)
			24 X 12	M4-8	DETOUR
			24 X 12	M3-2	EAST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
15 (6)	1	(3)	36 X 18	M4-8	DETOUR
			36 X 18	M3-2	EAST (10)
			36 X 36	(12)	202 HENNEPIN COUNTY PARK ACCESS
			30 X 24	M5-1	ADVANCE 90° TURN ARROW LEFT (10)
16 (6)	1	(3)	36 X 18	M4-8	DETOUR
			36 X 18	M3-2	EAST (10)
			36 X 36	(12)	202 HENNEPIN COUNTY PARK ACCESS
			30 X 24	M6-1	HORIZONTAL 90° SINGLE HEAD ARROW LEFT (10)
17 (6)	1	(3)	36 X 18	M4-8	DETOUR
			36 X 18	M3-2	EAST (10)
			36 X 36	(12)	202 HENNEPIN COUNTY PARK ACCESS
			30 X 24	M5-2	ADVANCE 45° TURN ARROW RIGHT (10)
18 (6)	1	(3)	36 X 18	M4-8	DETOUR
			36 X 18	M3-2	EAST (10)
			36 X 36	(12)	202 HENNEPIN COUNTY PARK ACCESS
			30 X 24	M6-2	HORIZONTAL 45° SINGLE HEAD ARROW RIGHT (10)
19 (6)	2	(3)	36 X 18	M4-8	DETOUR
			36 X 18	M3-2	EAST (10)
			36 X 36	(12)	202 HENNEPIN COUNTY PARK ACCESS
			30 X 24	M6-3	VERTICAL SINGLE HEAD ARROW UP (10)

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(2) ALL SIGNING SHALL USE DG3 SIGN SHEETING.
(3) POSTS OR PORTABLE TUBULAR METAL FRAME.
(4) SEE SIGN DETAIL 1 ON SHEET TC3.
(5) DATE TO BE DETERMINED BY THE ENGINEER AND THE SIGN SHALL BE INSTALL A MINIMUM OF 7 DAYS IN ADVANCE OF ROAD CLOSURE.
(6) THESE SIGNS ARE LARGER AND SHALL ONLY BE USED ALONG T.H. 610.
(7) SEE SIGN DETAIL 2 ON SHEET TC3.
(8) INCLUDES ONE HIGH INTENSITY AMBER FLASHING LIGHT ON EACH SIGN.
(9) 8' TYPE III BARRICADE LEFT WITH TWO AMBER FLASHING LIGHTS ON EACH BARRICADE.
(10) BLACK BORDER AND LEGEND ON A ORANGE BACKGROUND.
(11) SEE SIGN DETAIL 4 ON SHEET TC4.
(12) SEE SIGN DETAIL 5 ON SHEET TC4.

Hennepin

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Ryan T. Allers

RYAN T. ALLERS, PROFESSIONAL ENGINEER

45896 LICENSE NO.

6/13/18 DATE

DESIGN BY: J. WING
CAD BY: J. WING
CHECKED BY: R. ALLERS
LAST REVISION: / /

TRAFFIC CONTROL DETAIL SHEET

CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET TC5 / TC7

TRAFFIC CONTROL DEVICES (1)

SIGN NO.	QUAN.	MOUNTING	SIGN PANEL SIZE (IN.)	CODE NO.	PANEL LEGEND / DESCRIPTION (2)
20	4	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-4	WEST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M5-1	ADVANCE 90° TURN ARROW LEFT (10)
21	4	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-4	WEST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M6-1	HORIZONTAL 90° SINGLE HEAD ARROW LEFT (10)
22	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-4	WEST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M5-1	ADVANCE 90° TURN ARROW RIGHT (10)
23	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-4	WEST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M6-1	HORIZONTAL 90° SINGLE HEAD ARROW RIGHT (10)
24	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-4	WEST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M5-2	ADVANCE 45° TURN ARROW RIGHT (10)
25	1	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-4	WEST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M6-2	HORIZONTAL 45° SINGLE HEAD ARROW RIGHT (10)
26	9	(3)	24 X 12	M4-8	DETOUR
			24 X 12	M3-4	WEST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
			21 X 15	M6-3	VERTICAL SINGLE HEAD ARROW UP (10)
27	1	(3)	24 X 12	M4-6	END (10)
			24 X 12	M4-8	DETOUR
			24 X 12	M3-4	WEST (10)
			24 X 24	(11)	202 HENNEPIN COUNTY PARK ACCESS
28 (6)	1	(3)	36 X 18	M4-8	DETOUR
			36 X 18	M3-4	WEST (10)
			36 X 36	(12)	202 HENNEPIN COUNTY PARK ACCESS
			30 X 24	M5-2	ADVANCE 45° TURN ARROW RIGHT (10)
29 (6)	1	(3)	36 X 18	M4-8	DETOUR
			36 X 18	M3-4	WEST (10)
			36 X 36	(12)	202 HENNEPIN COUNTY PARK ACCESS
			30 X 24	M6-2	HORIZONTAL 45° SINGLE HEAD ARROW RIGHT (10)
30 (6)	3	(3)	36 X 18	M4-8	DETOUR
			36 X 18	M3-4	WEST (10)
			36 X 36	(12)	202 HENNEPIN COUNTY PARK ACCESS
			30 X 24	M6-3	VERTICAL SINGLE HEAD ARROW UP (10)

(1) THE QUANTITIES SHOWN WITHIN THIS TABULATION ARE FOR INFORMATION ONLY AND SHALL BE PAID FOR UNDER THE PAY ITEM TRAFFIC CONTROL (LS).
(2) ALL SIGNING SHALL USE DG3 SIGN SHEETING.
(3) POSTS OR PORTABLE TUBULAR METAL FRAME.
(4) SEE SIGN DETAIL 1 ON SHEET TC3.
(5) DATE TO BE DETERMINED BY THE ENGINEER AND THE SIGN SHALL BE INSTALL A MINIMUM OF 7 DAYS IN ADVANCE OF ROAD CLOSURE.
(6) THESE SIGNS ARE LARGER AND SHALL ONLY BE USED ALONG T.H. 610.
(7) SEE SIGN DETAIL 2 ON SHEET TC3.
(8) INCLUDES ONE HIGH INTENSITY AMBER FLASHING LIGHT ON EACH SIGN.
(9) 8' TYPE III BARRICADE LEFT WITH TWO AMBER FLASHING LIGHTS ON EACH BARRICADE.
(10) BLACK BORDER AND LEGEND ON A ORANGE BACKGROUND.
(11) SEE SIGN DETAIL 4 ON SHEET TC4.
(12) SEE SIGN DETAIL 5 ON SHEET TC4.

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Ryan T. Allers

RYAN T. ALLERS, PROFESSIONAL ENGINEER

45896 LICENSE NO.

6/13/18 DATE

DESIGN BY:	J. WING
CAD BY:	J. WING
CHECKED BY:	R. ALLERS
LAST REVISION:	/ /

TRAFFIC CONTROL DETAIL SHEET

CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET TC6 / TC7

NO SCALE

CITY OF DAYTON

CITY OF MAPLE GROVE

CITY OF CHAMPLIN

FERNBROOK LN.

C.S.A.H. 121

T.H. 610

TERRITORIAL ROAD

C.S.A.H. 81

CO. RD. 202

ELM CREEK BLVD.

BOTTINEAU BLVD.

C.S.A.H. 30

ZACHARY LN.

93RD AVE. N.

101ST AVE. N.

109TH AVE. N.

DETOUR ROUTE

GOOSE LAKE RD.

GOOSE LAKE PKWY.

CREEK RD. ELM

APPROXIMATELY 25' PORTABLE PRECAST CONCRETE BARRIER WITH DELINEATORS

WORK ZONE

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

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TRAFFIC CONTROL PLAN SHEET

CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET TC7 / TC7

Default pwz805 6/13/2018 \\Tempo\proj\202.0408.27C53\Traffic Design\TRAFFIC CONTROL\0408 TRAFFIC CONTROL LAYOUT.DGN

GENERAL

ALL TRAFFIC CONTROL DEVICES SHALL CONFORM AND BE INSTALLED IN ACCORDANCE WITH THE LATEST EDITION OF THE MNDOT "TRAFFIC ENGINEERING MANUAL" AND THE "MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MN MUTCD) AND AS DIRECTED BY THE ENGINEER. THESE GUIDELINES ARE TYPICAL AND MODIFICATIONS MAY BE REQUIRED FOR UNUSUAL CONDITIONS.

SIGNING TYPE C

ALL SIGN POSTS SHALL BE 3 POUNDS PER FOOT, GALVANIZED "U" POSTS.

THE CONTRACTOR SHALL PROVIDE AND INSTALL THE PROPOSED SIGN PANELS WITH SUPPORTS, PROPOSED PERMANENT STRIPING AND PROPOSED PAVEMENT MESSAGES AS NOTED, SHOWN ELSEWHERE IN THIS PLAN, AS DIRECTED BY AND TO THE SATISFACTION OF THE ENGINEER.

ALL SIGNS SHALL HAVE HOLES PUNCHED ONLY FOR THE NUMBER OF POSTS REQUIRED.

IF DIRECTED BY THE ENGINEER THE CONTRACTOR SHALL INSTALL THE PROPOSED SIGN PANELS ON AN INPLACE POST (TO REDUCE THE OVERALL NUMBER OF SIGN POSTS).

LATERAL BRACES MAY BE USED AS A STIFFENER FOR SIGNS IF REQUIRED BY THE ENGINEER.

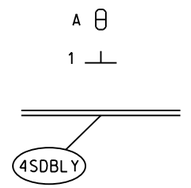
KNEE BRACES SHALL NOT BE USED UNLESS REQUIRED BY THE ENGINEER.

PERMANENT STRIPING AND PAVEMENT MARKINGS

ALL LONGITUDINAL LINES SHALL BE 4" WIDE MULTI COMPONENT GROUND IN (GROOVED), UNLESS NOTED.

THE ENGINEER'S INVOLVEMENT IN THE APPLICATION OF THE MATERIAL SHALL BE LIMITED TO FIELD CONSULTATION AND INSPECTION.
THE CONTRACTOR WILL PLACE NECESSARY "SPOTTING" AT APPROPRIATE POINTS TO PROVIDE HORIZONTAL CONTROL FOR STRIPING AND TO DETERMINE NECESSARY STARTING AND CUTOFF POINTS. LONGITUDINAL JOINTS, PAVEMENT EDGES AND EXISTING MARKINGS MAY SERVE AS HORIZONTAL CONTROL WHEN SO DIRECTED.

PERMANENT SIGNING AND STRIPING LEGEND



A — INPLACE SIGN TYPE C SIGN

1 — APPROPRIATE SIGN TYPE C AS INDICATED

4SDBLY — 4" DOUBLE SOLID LINE YELLOW MULTI COMPONENT GROUND IN

TABULATION OF QUANTITIES

ITEM DESCRIPTION	UNIT	TOTAL
4" DOUBLE SOLID LINE MULTI COMPONENT GROUND IN (1)	LF	1170
REMOVE SIGN TYPE C	EACH	18
SIGN PANELS TYPE C	SQFT	36.25

(1) COLOR SHALL BE YELLOW

INDEX

SHEET NO.	DESCRIPTION
SS1 - SS2	PERMANENT SIGNING AND STRIPING DETAIL SHEETS
SS3	INPLACE SIGNING TABULATION SHEET
SS4	PROPOSED SIGNING TABULATION SHEET
SS5	PERMANENT SIGNING AND STRIPING PLAN SHEET

Hennepin

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6/13/18 — DATE

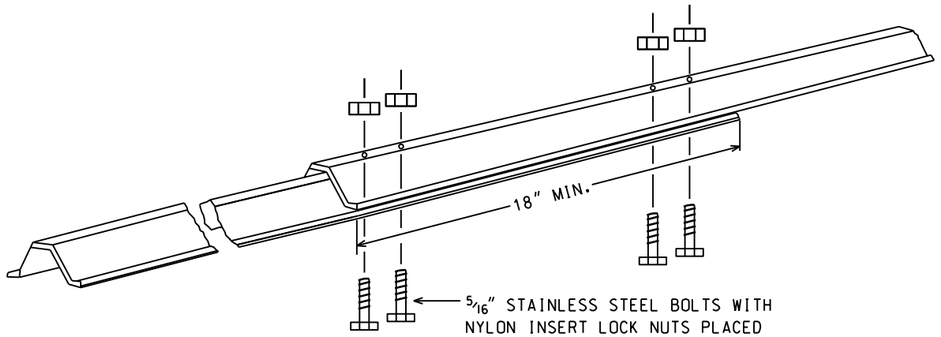
DESIGN BY: A. CHALUPSKY
CAD BY: A. CHALUPSKY
CHECKED BY: R. ALLERS
LAST REVISION: / /

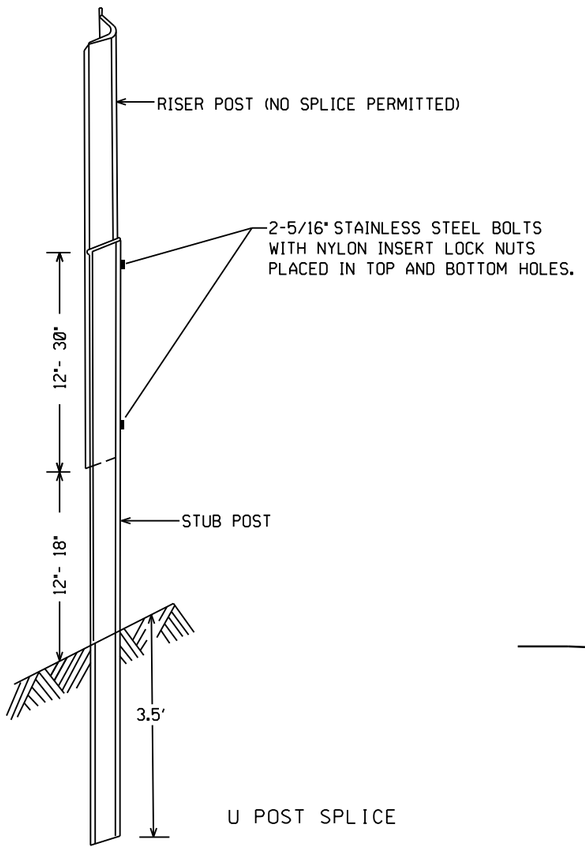
PERMANENT SIGNING AND STRIPING DETAIL SHEET

CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

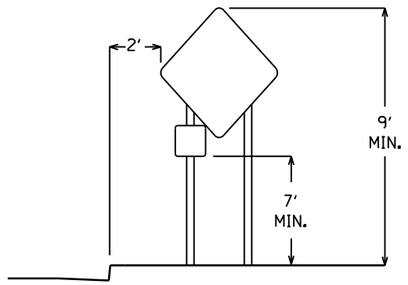
SHEET SS1 / SS5

KNEE BRACE SPLICE

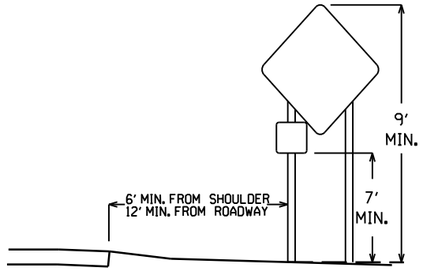




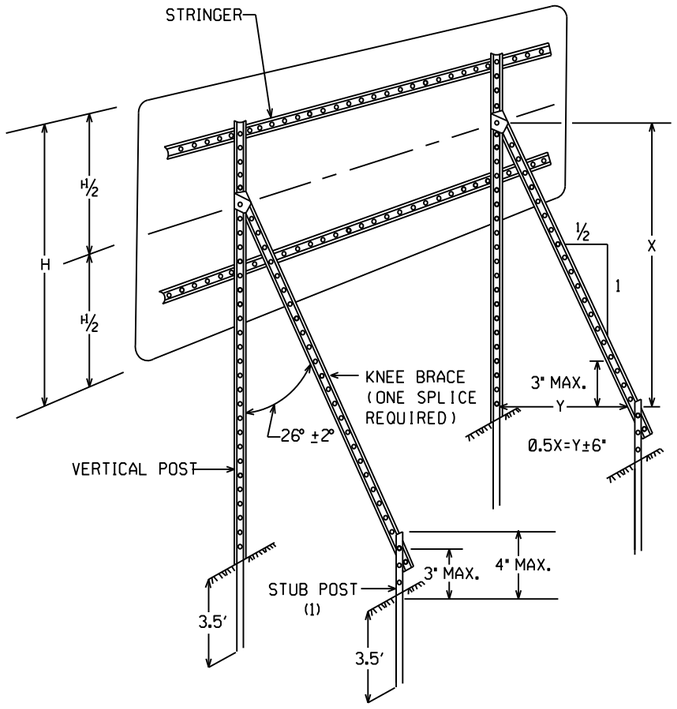
U POST SPLICE



TYPICAL URBAN MOUNTING



TYPICAL RURAL MOUNTING



(1) OFFSET STUB POST 1' TOWARD ROADWAY RELATIVE TO VERTICAL POST. ATTACH STUB POST AND KNEE BRACE BACK TO BACK.

TYPICAL "A-FRAME" INSTALLATION
TYPE "D" SIGNS

NOTES:

1. USE 3# STUB POSTS, RISER POSTS, STRINGERS, KNEE BRACES, LATERAL BRACES AND KNEE BRACE STUB POSTS. ALL SHALL CONFORM TO MN/DOT 3401.
2. MOUNTING (PUNCHING CODE) FOR TYPE "C" SIGN PANELS SHALL BE AS INDICATED IN THE STANDARD SIGNS MANUAL UNLESS OTHERWISE SPECIFIED.
3. ALL RISER (VERTICAL) "U POSTS" SHALL BE SPLICED. DRIVEN STUB POSTS SHALL BE AT LEAST 7' LONG.
4. USE STAINLESS STEEL 5/16" BOLTS, WASHERS, AND NYLON INSERT LOCK NUTS AS SHOWN FOR ALL GROUND MOUNTED AND OVERHEAD MOUNTED SIGNS.
5. STAINLESS STEEL WASHER WITH SAME DIMENSIONS SHALL BE PROVIDED BETWEEN ALL NYLON WASHERS AND BOLT HEADS.
6. BRACING STUBS SHALL BE NO MORE THAN 4" ABOVE GROUND AND EMBEDDED AT LEAST 3 1/2'.
7. A-FRAME BRACKET SHALL BE STEEL CONFORMING TO MN/DOT 3306 AND GALVANIZED IN ACCORDANCE WITH MN/DOT 3394.
8. COLLARS SHALL BE USED TO SHIM OVERLAYS AND DEMOUNTABLE LEGEND AWAY FROM PANEL WHERE INTERFERENCE WITH BOLT HEADS IS ENCOUNTERED. MN/DOT 3352.2A5.
9. 2 POST TYPE "C" SIGNS SHALL BE REINFORCED WITH AT LEAST ONE LATERAL BRACE, INSTALLATIONS WHERE THE TOTAL PANEL HEIGHT IS 60" OR MORE SHALL HAVE TWO LATERAL BRACES LOCATED APPROXIMATELY AT THE QUARTER POINTS.
10. WHERE 2 SINGLE POST TYPE "C" SIGNS ARE INSTALLED SIDE BY SIDE, THEY SHALL BE REINFORCED LATERALLY BY AT LEAST 2 BRACES, BOLTED AT EACH POST AND LOCATED APPROXIMATELY AT THE QUARTER POINTS.
11. WHERE 3 OR MORE TYPE "C" SIGNS ARE INSTALLED SIDE BY SIDE, THEY SHALL BE REINFORCED LATERALLY BY AT LEAST 2 BRACES, BOLTED AT EACH POST AND POST SECTION AND LOCATED APPROXIMATELY AT THE QUARTER POINTS AS SHOWN IN THE MODIFIED TYPE C INSTALLATION.
12. TYPE "D" SIGN PANELS SHALL BE BOLTED TO STRINGERS AT 24" MAXIMUM INTERVALS IN ACCORDANCE WITH THE TYPE "D" STRINGER AND PANEL-JOINT DETAIL (SEE STANDARD SIGNS MANUAL).

Hennepin

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Ryan T. Allers

RYAN T. ALLERS, PROFESSIONAL ENGINEER | 45896 LICENSE NO. | 6/13/18 DATE

DESIGN BY:	A. CHALUPSKY
CAD BY:	A. CHALUPSKY
CHECKED BY:	R. ALLERS
LAST REVISION:	/ /

PERMANENT SIGNING AND STRIPING DETAIL SHEET

CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET SS2 / SS5

INPLACE SIGN PANELS

SIGN NO.	SIGN TYPE	NOTES	PANEL LEGEND
A	"C"	(1)	NO PARKING
B	"C"	(2)	CURVE AHEAD
	"C"	(2)	15 MPH
C	"C"	(2)	ONE LANE BRIDGE
	"C"	(2)	NO PARKING
D	"C"	(2)	SNOWMOBILE CROSSING
E	"C"	(2)	NO PARKING
F	"C"	(2)	WEIGHT LIMIT
G	"C"	(2)	TYPE 3 OBJECT MARKER
H	"C"	(2)	TYPE 3 OBJECT MARKER
I	"C"	(2)	TYPE 3 OBJECT MARKER
J	"C"	(2)	TYPE 3 OBJECT MARKER
K	"C"	(2)	WEIGHT LIMIT
	"C"	(2)	3-POST BARRICADE
L	"C"	(2)	SNOWMOBILE CROSSING
	"C"	(2)	NO PARKING
M	"C"	(1)	NO PARKING
N	"C"	(2)	CURVE AHEAD
	"C"	(2)	15 MPH
O	"C"	(2)	ONE LANE BRIDGE

TOTAL REMOVE SIGN TYPE C: 18

(1) PROTECT AND PRESERVE INPLACE.
(2) REMOVE.

Hennepin

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Ryan T. Allers

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45896 — LICENSE NO.

6/13/18 — DATE

DESIGN BY: A. CHALUPSKY
CAD BY: A. CHALUPSKY
CHECKED BY: R. ALLERS
LAST REVISION: / /

INPLACE SIGNING TABULATION SHEET

CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET SS3 / SS5

SIGN PANELS TYPE C

SIGN NO.	QUAN.	POSTS NO.	MTG HT (FT.) (1)	SIGN PANEL SIZE (IN.)	AREA (SQ. FT.)	TOTAL AREA (SQ. FT.)	CODE NO.	PANEL LEGEND
1	1	1	7.00	30 X 30	6.25	6.25	W1-1 R	RIGHT TURN
				18 X 18	2.25	2.25	W13-1P	30 MPH
2	2	1	7.00	18 X 18	2.25	4.50	R8-3	NO PARKING
3	1	1	7.00	30 X 30	6.25	6.25	W11-6	SNOWMOBILE CROSSING
4	1	1	7.00	30 X 30	6.25	6.25	W1-1 L	LEFT TURN
				18 X 18	2.25	2.25	W13-1P	30 MPH
5	1	1	7.00	30 X 30	6.25	6.25	W11-6	SNOWMOBLIE CROSSING
				18 X 18	2.25	2.25	R8-3	NO PARKING
SUB TOTAL SIGN PANELS TYPE C : 36.25 SQ. FT.								

(1) TO BOTTOM EDGE OF LOWEST SIGN.

Hennepin

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Ryan T. Allers

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45896 LICENSE NO.

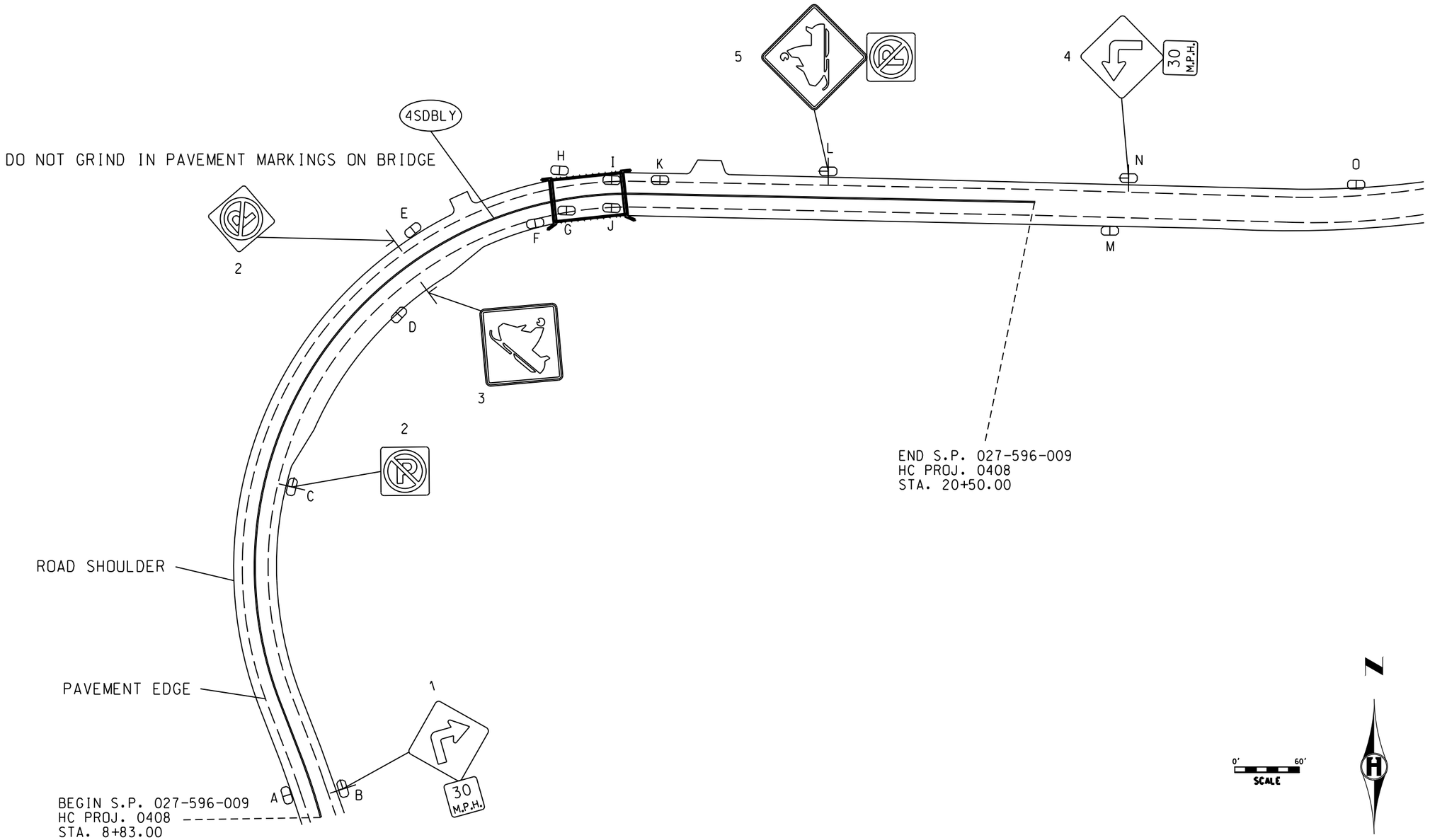
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DESIGN BY: A. CHALUPSKY
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CHECKED BY: R. ALLERS
LAST REVISION: / /

PROPOSED SIGNING TABULATION SHEET

CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET SS4 / SS5



I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Ryan T. Allers

RYAN T. ALLERS, PROFESSIONAL ENGINEER

45896 — LICENSE NO.

6/13/18 — DATE

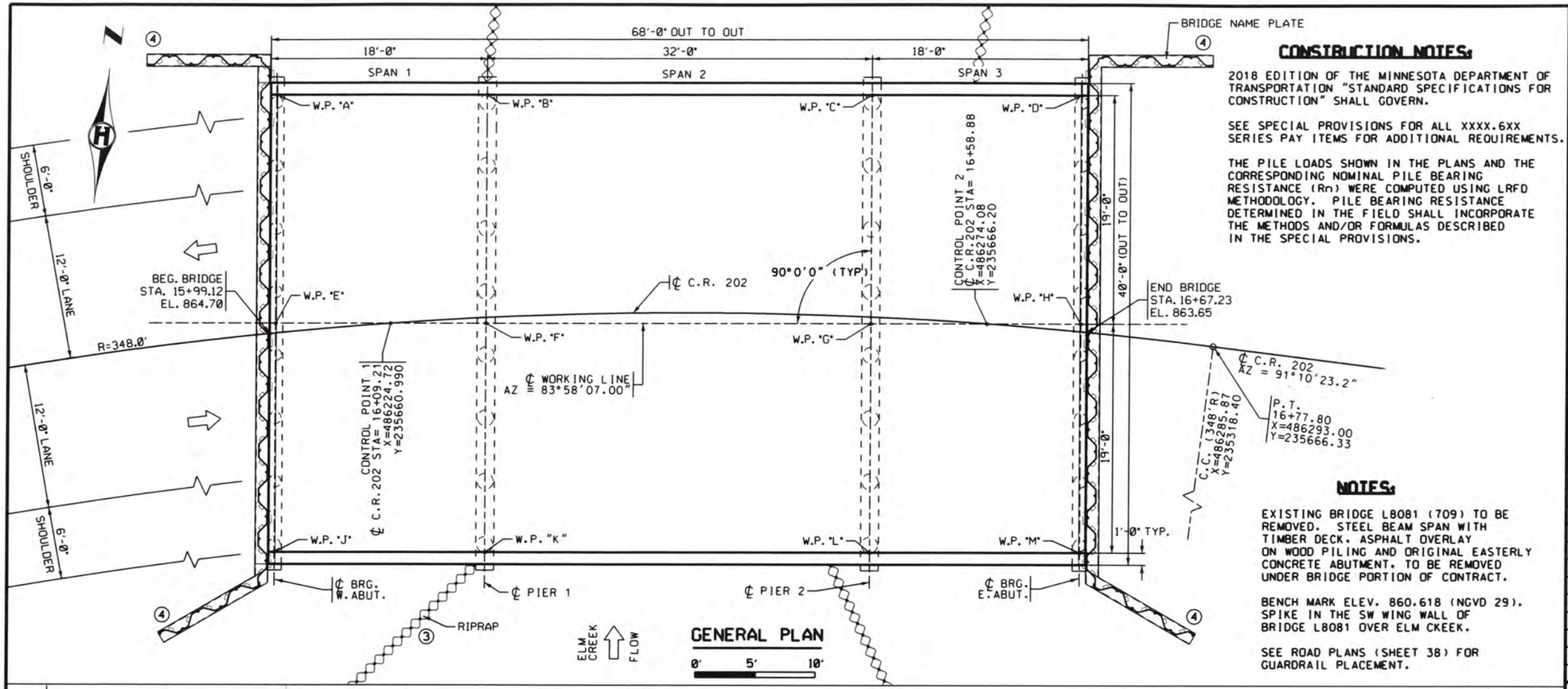
DESIGN BY:	A. CHALUPSKY
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LAST REVISION:	/ /

PERMANENT SIGNING AND STRIPING

CO. RD. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009

SHEET

SS5 / SS5



GENERAL PLAN

0' 5' 10'

CONSTRUCTION NOTES:

2018 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" SHALL GOVERN.

SEE SPECIAL PROVISIONS FOR ALL XXXX.6XX SERIES PAY ITEMS FOR ADDITIONAL REQUIREMENTS.

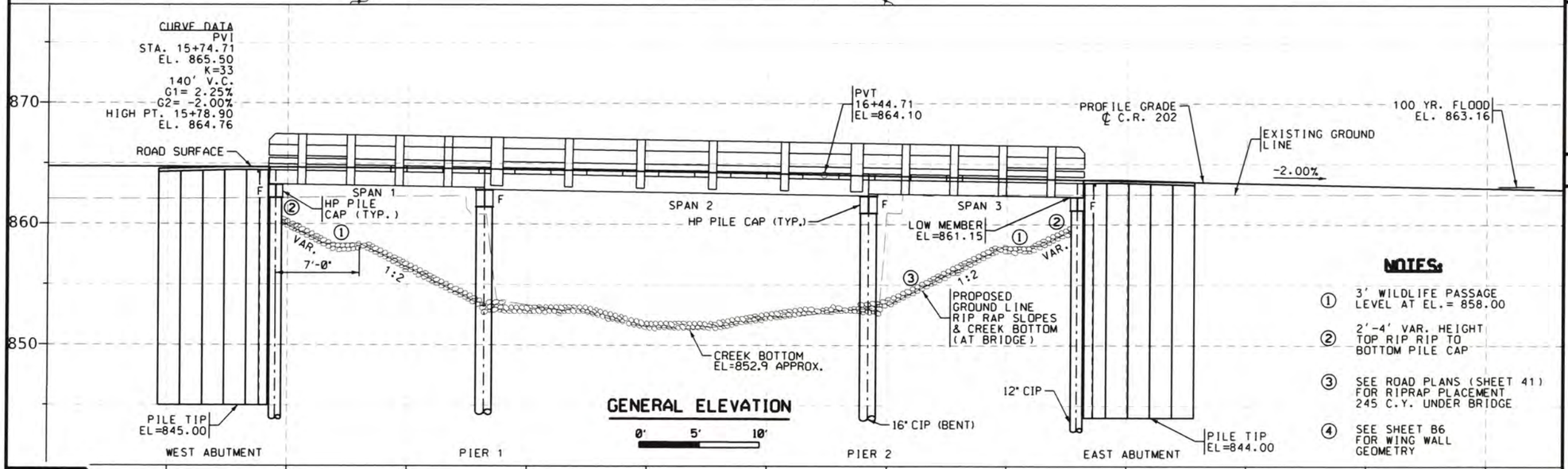
THE PILE LOADS SHOWN IN THE PLANS AND THE CORRESPONDING NOMINAL PILE BEARING RESISTANCE (Rn) WERE COMPUTED USING LRFD METHODOLOGY. PILE BEARING RESISTANCE DETERMINED IN THE FIELD SHALL INCORPORATE THE METHODS AND/OR FORMULAS DESCRIBED IN THE SPECIAL PROVISIONS.

NOTES:

EXISTING BRIDGE L8081 (709) TO BE REMOVED. STEEL BEAM SPAN WITH TIMBER DECK. ASPHALT OVERLAY ON WOOD PILING AND ORIGINAL EASTERLY CONCRETE ABUTMENT. TO BE REMOVED UNDER BRIDGE PORTION OF CONTRACT.

BENCH MARK ELEV. 860.618 (NGVD 29). SPIKE IN THE SW WING WALL OF BRIDGE L8081 OVER ELM CKEEK.

SEE ROAD PLANS (SHEET 38) FOR GUARDRAIL PLACEMENT.



GENERAL ELEVATION

0' 5' 10'

NOTES:

① 3' WILDLIFE PASSAGE LEVEL AT EL.= 858.00

② 2'-4' VAR. HEIGHT TOP RIP RIP TO BOTTOM PILE CAP

③ SEE ROAD PLANS (SHEET 41) FOR RIPRAP PLACEMENT 245 C.Y. UNDER BRIDGE

④ SEE SHEET B6 FOR WING WALL GEOMETRY

Hennepin

DES: JDE | DR: JLS
CHK: JZB | CHK: JDE

HENNEPIN COUNTY PROJ. NO. 0408 | **S.P. NO. 027-596-009** | **SHEET NO. B1 OF B26 SHEETS** | **27C53**

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MINN PROJ. NO. BROS 2718(125)

DESIGN DATA

2017 AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
LOAD AND RESISTANCE FACTOR DESIGN METHOD
HL 93 LIVE LOAD
DEAD LOAD INCLUDES 20 p.s.f. ALLOWANCE FOR FUTURE WEARING COURSE MODIFICATIONS
MATERIAL DESIGN PROPERTIES:
TIMBER:
Fbo =1.00 ksi PREFAB PANELS (SPANS 1, 2 & 3) (DOUGLAS FIR-LARCH NO. 1)
Fbo =1.20ksi PILE CAPS (DOUG. FIR-LARCH NO. 1)
Fbo =1.75ksi RAIL POSTS (DOUG. FIR-LARCH D.S.S.)
Fbo =1.20ksi ALL OTHER TIMBER (DOUGLAS FIR-LARCH NO. 1)
GLUE LAMINATED RAILING - SEE DETAIL SHEETS
STRUCTURAL STEEL:
Fy = 36 ksi spec. 3306
REINFORCED CONCRETE:
f'c = 4 ksi Fy = 60 ksi
DECK AREA=2720 SQ. FT.
DESIGN SPEED = 35 MPH
CURRENT ADT (2018)=800 PROJ. ADT (2040)=1000
HL 93 LRFR OPERATING RATING RF = 1.60

LIST OF SHEETS

NO.	DESCRIPTION
B1	GENERAL PLAN AND ELEVATION
B2	TRANSVERSE SECTION & QUANTITIES
B3	BRIDGE LAYOUT
B4	WEST ABUTMENT PLAN AND ELEVATION
B5	EAST ABUTMENT PLAN AND ELEVATION
B6-B7	ABUTMENT DETAILS
B8	PIER PLAN AND ELEVATION
B9	PIER DETAILS
B10-B18	TIMBER SUPERSTRUCTURE DETAILS
B19	STANDARD DETAILS
B20	RIPRAP SLOPE WITH GEOTEXTILE
B21	BRIDGE SURVEY
B22	BRIDGE PLAN AND PROFILE
B23-B25	BORING LOGS
B26	AS-BUILT BRIDGE DATA

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNED _____ DATE 6/12/18

NAME JOHN D. EKOLA LICENSE 53076

COUNTY OF HENNEPIN
C.R. NO. 202

BRIDGE NO. 27C53
GENERAL PLAN AND ELEVATION

C.R. NO. 202 (ELM CREEK ROAD) OVER ELM CREEK
1.5 MI. EAST OF JCT. CSAH 121
68'-0" TIMBER SLAB SPAN, 3 SPAN BRIDGE
38'-0" ROADWAY

IDENTIFICATION NO. 709

SEC 35 T 120 N R 22 W

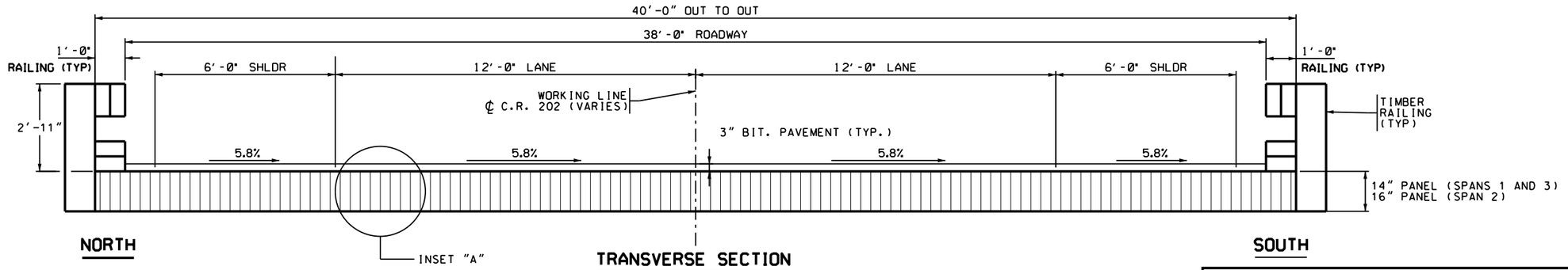
CITY OF DAYTON HENNEPIN COUNTY

APPROVED _____ COUNTY BRIDGE ENGINEER

DATE 6/12/18

APPROVED _____ STATE BRIDGE ENGINEER

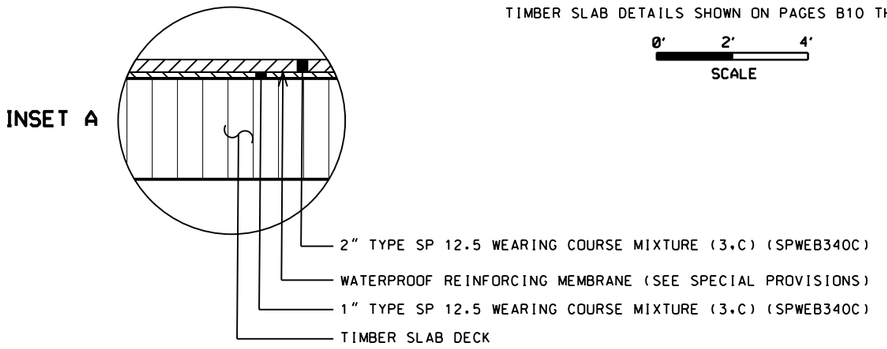
DATE 6/12/18



TRANSVERSE SECTION

TIMBER SLAB SPAN (SHOWN LEVEL)
TIMBER SLAB DETAILS SHOWN ON PAGES B10 THROUGH B14

0' 2' 4'
SCALE



ESTIMATED QUANTITIES FOR ENTIRE BRIDGE ~ FOR INFORMATION ONLY

ITEM NO.	ITEM DESCRIPTION	UNIT	PARTICIPATING QUANTITY	NON-PARTICIPATING QUANTITY	TOTAL QUANTITY
2402	STRUCTURAL STEEL (3306)	POUND			3113
2403	TREATED WOOD	M.B.M.			4.814
2403	HARDWARE	POUND			5087
2403	PREFAB WOOD PANELS TYPE A18	EACH			2
2403	PREFAB WOOD PANELS TYPE B18	EACH			2
2403	PREFAB WOOD PANELS TYPE C18	EACH			8
2403	PREFAB WOOD PANELS TYPE D18	EACH			2
2403	PREFAB WOOD PANELS TYPE A32	EACH			1
2403	PREFAB WOOD PANELS TYPE B32	EACH			1
2403	PREFAB WOOD PANELS TYPE C32	EACH			8
2403	PREFAB WOOD PANELS TYPE D32	EACH			1
2403	TIMBER RAILING	LIN. FT.			136 (P)

STATEMENT OF QUANTITIES KEYNOTES:

TIMBER SUPERSTRUCTURE QUANTITIES SHOWN FOR INFORMATIONAL PURPOSES.
ALL MATERIALS SHOWN TO BE IINCIDENTAL TO 2403.603 "TIMBER RAILING"
OR 2403.618 "GLUED LAMINATED PANELS".

TIMBER CONSTRUCTION NOTES

CONSTRUCTION REQUIREMENTS SHALL CONFORM TO SPEC. 2403.3.
ALL TIMBER IS TO BE PRESSURE TREATED PER SPEC. 3491 AND THE SPECIAL PROVISIONS.
ALL HARDWARE IS TO BE GALVANIZED PER SPEC. 3392.
STEEL INDICATED IN THE PLANS TO BE GALVANIZED SHALL BE GALVANIZED PER SPEC. 3394.
THREAD ON ALL BOLTS TO BE UPSET AFTER INSTALLATION.
ALL TIMBER IS ROUGH UNLESS OTHERWISE NOTED.
ALL TIMBER CUT OR DRILLED IN THE FIELD SHALL BE TREATED PER SPEC. 2403.3E.
ALL TIMBER FABRICATION TO BE DETAILED ON SHOP DRAWINGS. SHOP DRAWINGS SHALL BE SUBMITTED TO THE SEALING ENGINEER FOR APPROVAL PRIOR TO SHIPPING MATERIALS.

SCHEDULE OF QUANTITIES FOR ENTIRE BRIDGE

S.P. NO. 027-596-009

NOTE	ITEM NO.	ITEM DESCRIPTION	UNIT	TOTAL QUANTITY
	2021	MOBILIZATION	LUMP SUM	1
	2104	REMOVE REGULATED WASTE MATERIAL (BRIDGE)	LUMP SUM	1
3	2401	STRUCTURE EXCAVATION	LUMP SUM	1
	2402	STRUCTURAL STEEL (3309) (P)	POUND	23038
4,5	2403	TIMBER RAILING (P)	LIN FT	136
5,7	2403	GLUED LAMINATED DECK PANELS (P)	SQ FT	2720
6	2442	REMOVE EXISTING BRIDGE	LUMP SUM	1
	2452	C-I-P CONC TEST PILE 85 FT LONG 12" (P)	EACH	2
	2452	C-I-P CONC TEST PILE 85 FT LONG 16" (P)	EACH	2
1	2452	PILE REDRIVING	EACH	32
	2452	PILE ANALYSIS	EACH	2
1	2452	PILE POINTS 12"	EACH	16
1	2452	PILE POINTS 16"	EACH	16
2	2452	C-I-P CONCRETE PILING 12"	LIN FT	1190
2	2452	C-I-P CONCRETE PILING 16"	LIN FT	1190
	2452	STEEL SHEET PILING (PERMANENT) (P)	SQ FT	2430
	2511	GEOTEXTILE FILTER TYPE 7	SQ YD	1050
	2511	RANDOM RIPRAP CLASS 4	CU YD	830

(P) DENOTES PLAN QUANTITY
(1) INCLUDES TEST PILES.
(2) DOES NOT INCLUDE TEST PILES.
(3) SEE SHEET B6 FOR DETAILS
(4) PAYMENT LENGTH FOR GLUED LAMINATED RAIL IS THE END TO END LENGTH OF RAIL
(5) HARDWARE AND ACCESSORIES INCIDENTAL TO ITEM. SEE SPECIAL PROVISIONS
(6) INCLUDES EXISTING BRIDGE L8081 AND ANY OTHER MISC. SUBSTRUCTURE FROM PREVIOUS BRIDGES
(7) FLASHING (INCLUDED IN BID PRICE FOR DECK). SEE SHEETS B10 & B15. SEE SPECIAL PROVISIONS.

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

JOHN D. EKOLA, PROFESSIONAL ENGINEER — 53076 LICENSE NO. — 08/22/18 DATE

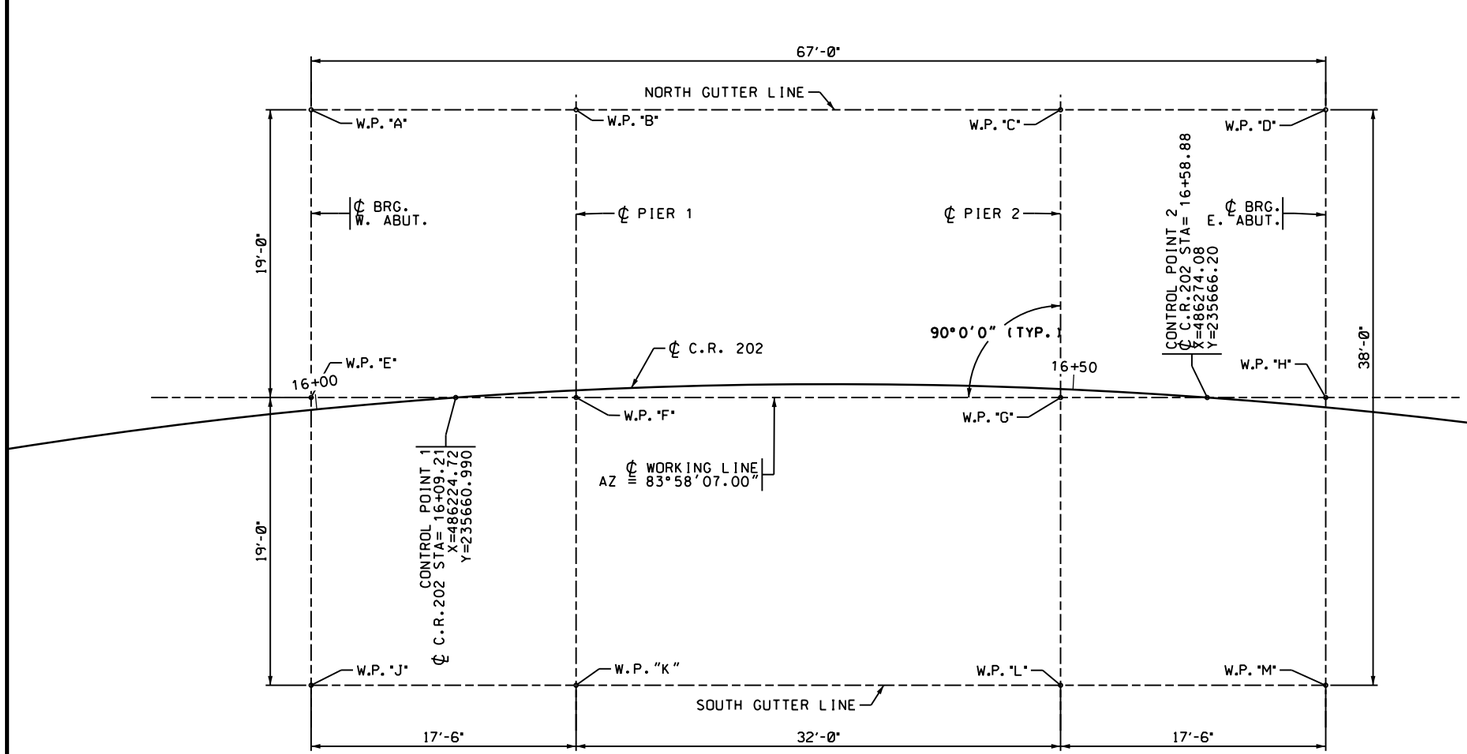
DESIGN BY:	J. EKOLA
CHECKED BY:	J. BRONDER
DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

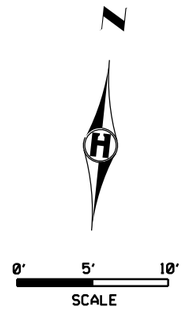
TRANSVERSE SECTION AND SCHEDULE OF QUANTITIES

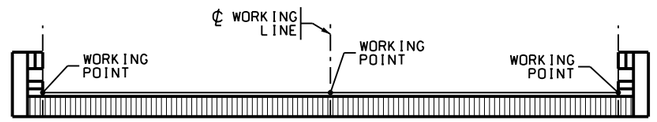
C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B2 / B26

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WORKING POINT LOCATION

WORKING POINT LOCATION

Element	Point Type	Station	Northing	Easting	Radius	Length	Delta / Theta	Rotation Direction
Aligment Name: CR 202								
Description:								
Tangent	POB	0+00.00	234354.049	485640.697				
Tangent	PC	1+67.97	234452.665	485776.666				
Arc	PC	1+67.97	234452.665	485776.666				
Arc	PI	6+22.20	234719.354	486144.371	590	774.21	75.1847°	Left
Arc	CC		234930.271	485430.267				
Arc	PT	9+42.18	235143.028	485980.571				
Tangent	PT	9+42.18	235143.028	485980.571				
Tangent	PC	9+95.66	235192.91	485961.286				
Arc	PC	9+95.66	235192.91	485961.286				
Arc	PI	15+14.61	235676.952	485774.147	348	682.145	112.3104°	Right
Arc	CC		235318.4	486285.872				
Arc	PT	16+77.80	235666.327	486292.996				
Tangent	PT	16+77.80	235666.327	486292.996				
Tangent	POE	23+46.44	235652.639	486961.491				

	DIMENSIONS BETWEEN WORKING POINTS																ELEVATION					
POINT	STATION	X-COORDINATE	Y-COORDINATE	A	B	C	D	E	F	G	H	J	K	L	M	(1)	(2)	(3)	(4)	(5)	POINT
A	16+01.47	486213.226	235678.877													865.82	1.42		864.41		A
B	16+18.02	486230.629	235680.716	17.50												865.60	1.42	1.58	864.19	864.02	B
C	16+48.42	486262.452	235684.078	49.50	32.00											865.10	1.42	1.58	863.68	863.52	C
D	16+64.98	486279.855	235685.917	67.00	49.50	17.50										864.83	1.42		863.42		D
E	15+99.70	486215.222	235659.982	19.00	25.83	53.02	69.64									864.74	1.42		863.32		E
F	16+17.15	486232.626	235661.821	25.83	19.00	37.22	53.02	17.50								864.51	1.42	1.58	863.09	862.93	F
G	16+49.20	486264.448	235665.183	53.02	37.22	19.00	25.83	49.50	32.00							863.98	1.42	1.58	862.56	862.40	G
H	16+66.66	486281.851	235667.022	69.64	53.02	25.83	19.00	67.00	49.50	17.50						863.70	1.42		862.29		H
J	15+97.72	486217.219	235641.087	38.00	41.84	62.40	77.03	19.00	25.83	53.02	69.64					863.66	1.42		862.24		J
K	16+16.17	486234.622	235642.926	41.84	38.00	49.68	62.40	25.83	19.00	37.22	53.02	17.50				863.42	1.42	1.58	862.01	861.84	K
L	16+50.08	486266.445	235646.288	62.40	49.68	38.00	41.84	53.02	37.22	19.00	25.83	49.50	32.00			862.86	1.42	1.58	861.45	861.28	L
M	16+68.54	486283.848	235648.127	77.03	62.40	41.84	38.00	69.64	53.02	25.83	19.00	67.00	49.50	17.50		862.57	1.42		861.15		M
CP-1	16+09.21	486224.720	235660.990	21.26	20.59	44.24	60.51	9.55	7.95	39.95	57.45	21.27	20.60	44.24		864.62					
CP-2	16+58.88	486274.080	235666.200	62.16	45.81	21.33	20.55	59.19	41.68	9.69	7.81	62.16	45.81	21.33		863.82					

(1) TOP OF ROADWAY.
(2) TOP ROADWAY TO BOTTOM DECK (SPANS 1 & 3)
(3) TOP OF ROADWAY BOTTOM DECK (SPAN 2)
(4) BOTTOM DECK (SPANS 1 & 3)
(5) BOTTOM DECK ELEVATION (SPAN 2)

Hennepin

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JOHN D. EKOLA, PROFESSIONAL ENGINEER

53076 — LICENSE NO.

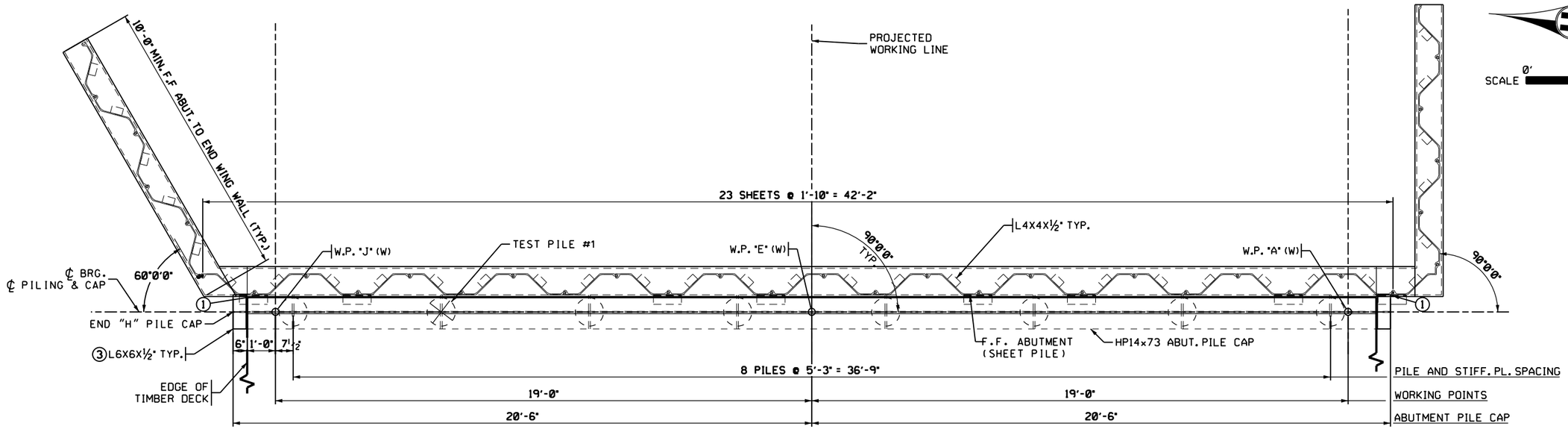
06/11/18 — DATE

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DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

BRIDGE LAYOUT

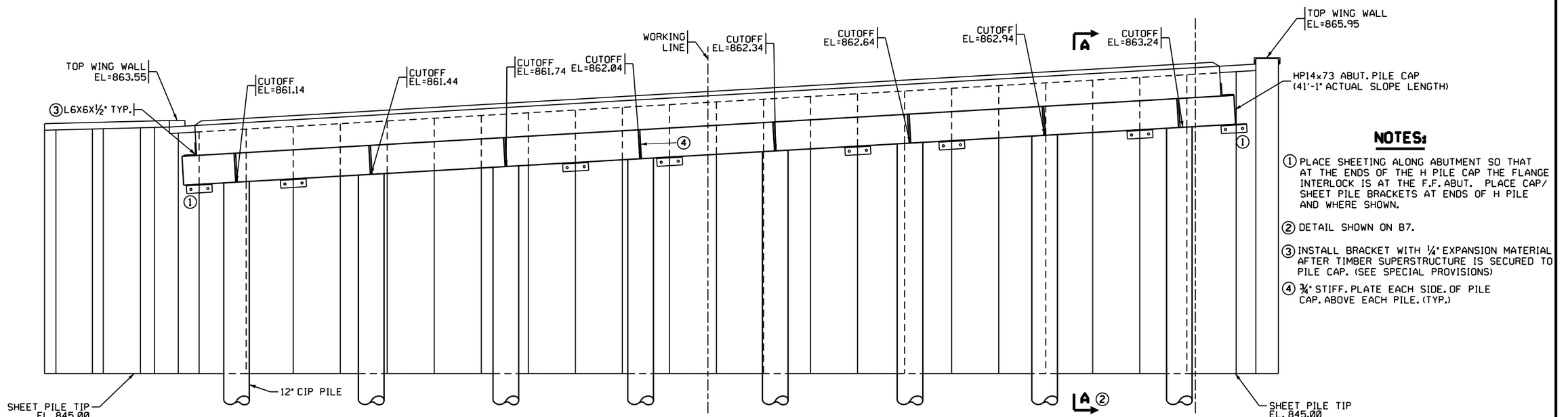
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S.P. 027-596-009
BRIDGE 27C53

SHEET B3 / B26



SOUTH **WEST ABUTMENT PLAN** **NORTH**

(DIMENSIONS SHOWN IN PLAN VIEW ARE HORIZONTAL)



SOUTH **ABUTMENT ELEVATION** **NORTH**

NOTES:

① PLACE SHEETING ALONG ABUTMENT SO THAT AT THE ENDS OF THE H PILE CAP THE FLANGE INTERLOCK IS AT THE F.F. ABUT. PLACE CAP/ SHEET PILE BRACKETS AT ENDS OF H PILE AND WHERE SHOWN.

② DETAIL SHOWN ON B7.

③ INSTALL BRACKET WITH ¼" EXPANSION MATERIAL AFTER TIMBER SUPERSTRUCTURE IS SECURED TO PILE CAP. (SEE SPECIAL PROVISIONS)

④ ¾" STIFF. PLATE EACH SIDE. OF PILE CAP. ABOVE EACH PILE. (TYP.)

Hennepin

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53076 LICENSE NO.

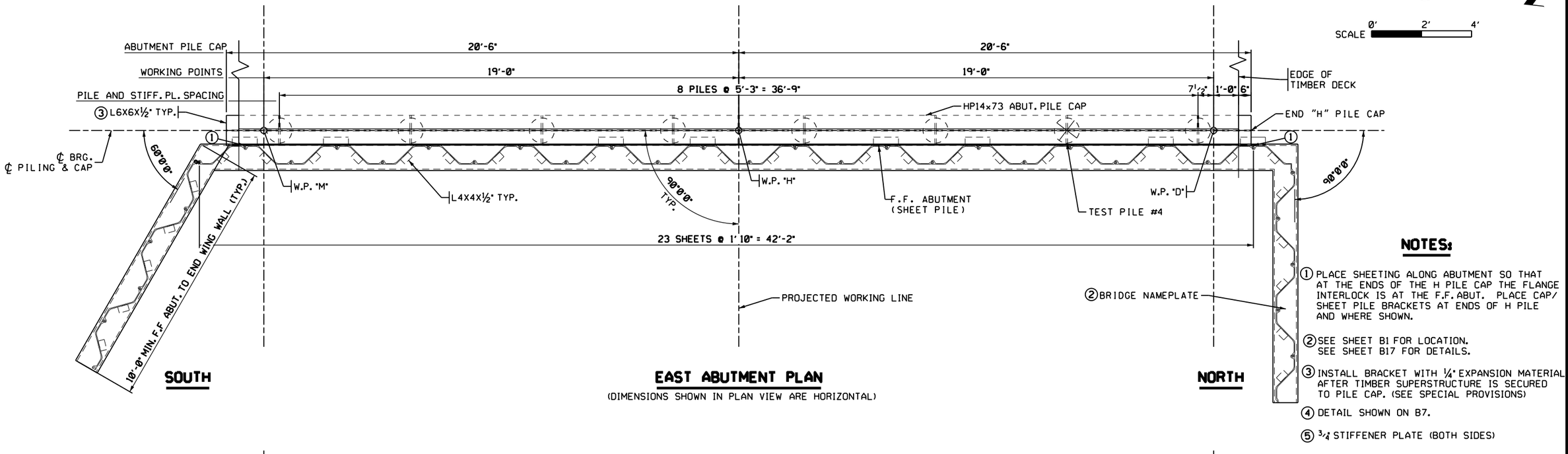
06/11/18 DATE

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CHECKED BY:	J. EKOLA

WEST ABUTMENT PLAN AND ELEVATION

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BRIDGE 27C53

SHEET B4 / B26

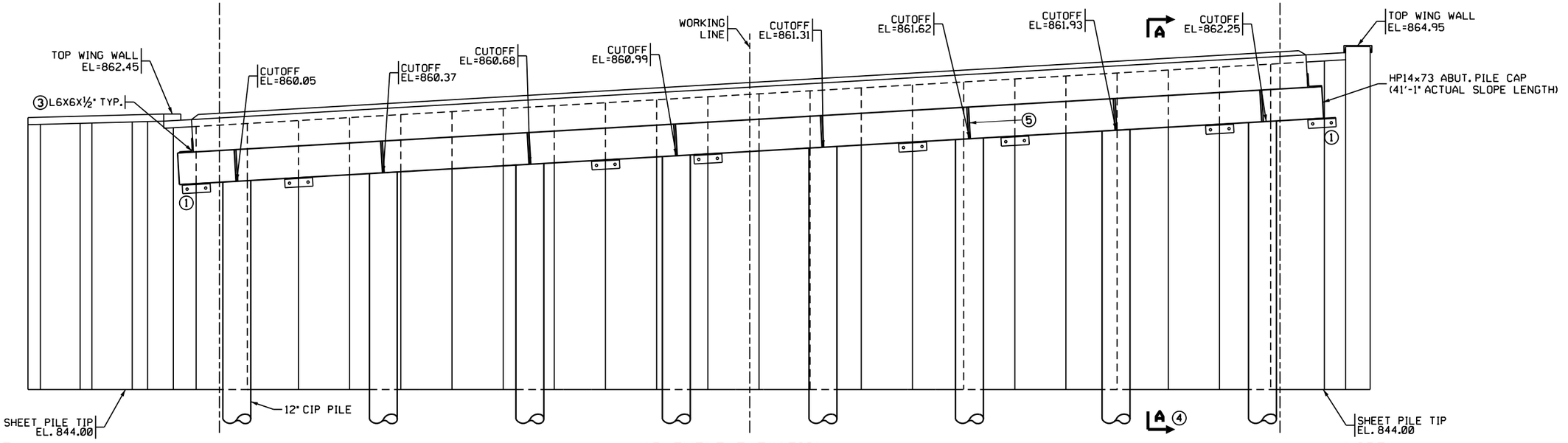


EAST ABUTMENT PLAN

(DIMENSIONS SHOWN IN PLAN VIEW ARE HORIZONTAL)

NOTES:

1. PLACE SHEETING ALONG ABUTMENT SO THAT AT THE ENDS OF THE H PILE CAP THE FLANGE INTERLOCK IS AT THE F.F. ABUT. PLACE CAP/ SHEET PILE BRACKETS AT ENDS OF H PILE AND WHERE SHOWN.
2. SEE SHEET B1 FOR LOCATION. SEE SHEET B17 FOR DETAILS.
3. INSTALL BRACKET WITH ¼" EXPANSION MATERIAL AFTER TIMBER SUPERSTRUCTURE IS SECURED TO PILE CAP. (SEE SPECIAL PROVISIONS)
4. DETAIL SHOWN ON B7.
5. ¾" STIFFENER PLATE (BOTH SIDES)



ABUTMENT ELEVATION

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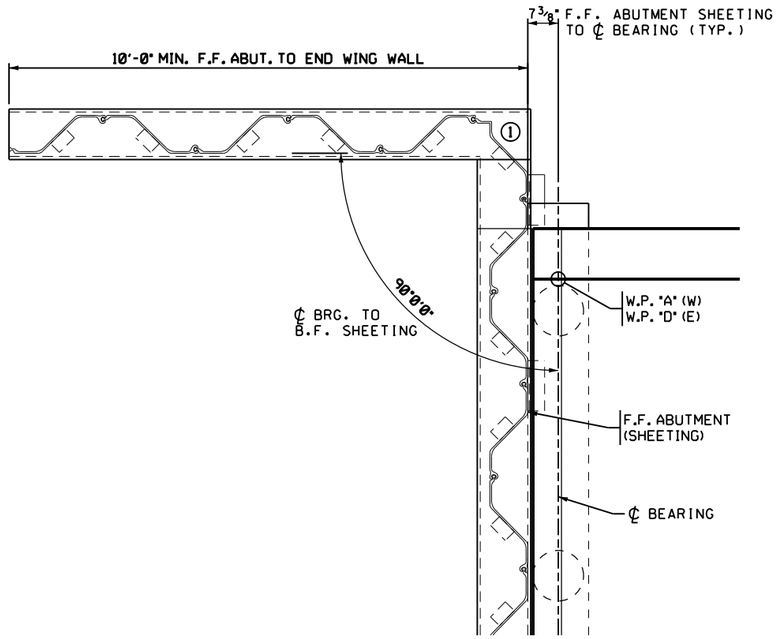
JOHN D. EKOLA, PROFESSIONAL ENGINEER — 53076 LICENSE NO. — 06/11/18 DATE

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DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

EAST ABUTMENT PLAN AND ELEVATION

C.S.A.H. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B5 / B26



NW & NE CORNER DETAILS



NOTES:

CONTRACTOR TO SUPPLY EITHER FABRICATED CORNER SHEET PILING OR ANGLED CONNECTORS TO ACHIEVE WING WALL CORNERS BEYOND H PILE CAP.

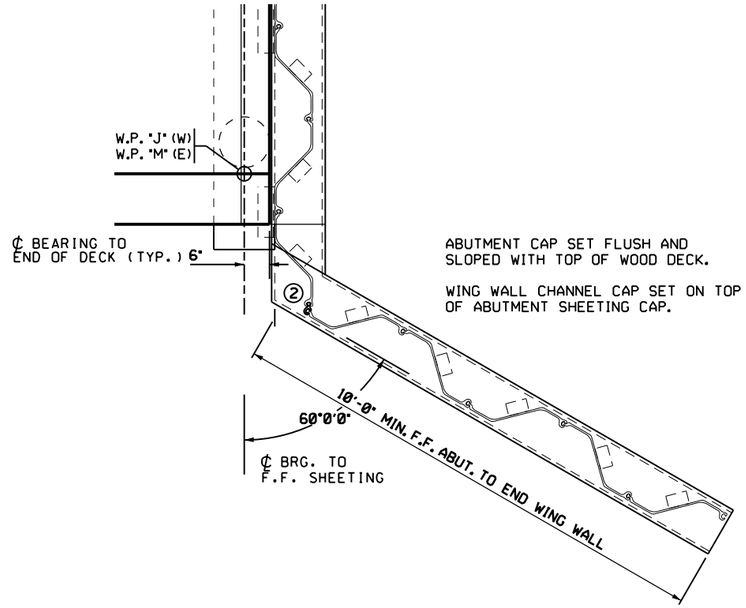
① CORNER SHOWN WITH FABRICATED CORNER PILE

② CORNER SHOWN WITH ANGLED PILE CONNECTOR

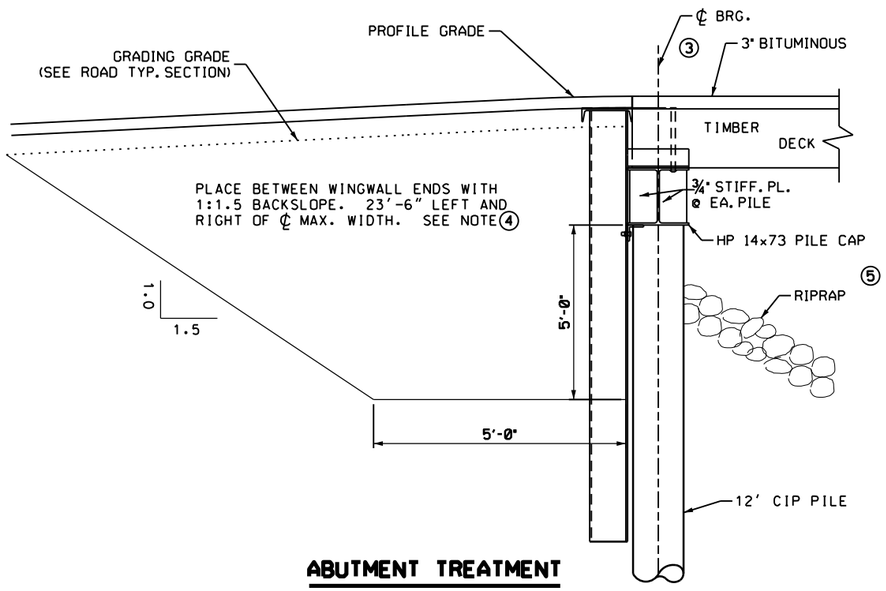
③ RAILING NOT SHOWN FOR CLARITY (SEE TIMBER SUPERSTRUCTURE DETAILS SHEETS B10-B18)

④ SELECT GRANULAR BORROW PER SPEC. 3149.2B2 APPROX QUANTITY (C.V.)=230 C.Y. SHALL BE INCLUDED IN PRICE BID FOR STRUCTURE EXCAVATION. EXCAVATED MATERIAL VOLUME INCLUDED IN EARTH WORK TABULATION UNDER COMMON EX. MATERIAL SHALL BE PLACED BY THE CONTRACTOR AFTER THE COMPLETION OF THE ABUTMENT AND TIMBER SUPERSTRUCTURE.

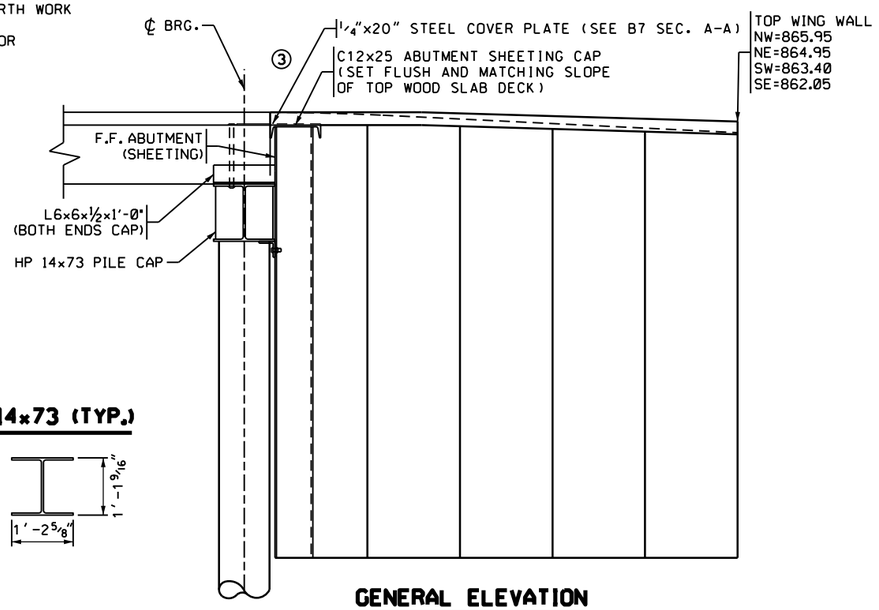
⑤ STRUCTURE EXAVATION APPROX. QUANTITY = 300 C.Y. (BOTH ABUTMENTS)



SW & SE CORNER DETAILS



ABUTMENT TREATMENT



GENERAL ELEVATION

HP 14x73 (TYP.)

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JOHN D. EKOLA, PROFESSIONAL ENGINEER

53076 — LICENSE NO.

06/11/18 — DATE

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ABUTMENT CORNER DETAILS

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BRIDGE 27C53

SHEET B6 / B26

EACH ABUTMENT COMPUTED PILE LOAD - TONS/PILE	
FACTORED DEAD LOAD	13.0
FACTORED LIVE LOAD	48.3
* FACTORED DESIGN LOAD	61.3

* BASED ON STRENGTH I LOAD COMBINATION

EACH ABUTMENT REQUIRED NOMINAL PILE BEARING RESISTANCE R_n - TONS/PILE		
FIELD CONTROL METHOD	Φ_{dyn}	$*R_n$
MnDOT Pile Formula 2012 (MPF12) $R_n = 20\sqrt{\frac{W \times H}{1000}} \times \log(\frac{10}{S})$	0.50	122.6
PDA	0.65	94.3

* R_n = FACTORED DESIGN LOAD / φ dyn

ABUTMENT PILE NOTES

PILE SPACING IS AT BOTTOM OF FOOTING.

NOMINAL PILE BEARING RESISTANCE SHALL BE DETERMINED BY THE USE OF A PILE DRIVING ANALYZER (PDA).

PILES TO HAVE NOMINAL DIAMETER OF 12".

FOR PILE SPLICE DETAIL SEE DETAIL B201.

DRIVE SPLICES ARE NOT ALLOWED.

2 CAST-IN-PLACE TEST PILES 85 FT. LONG

7 CAST-IN-PLACE PILES EST. LENGTH 85 FT. (W)

7 CAST-IN-PLACE PILES EST. LENGTH 85 FT. (E)

16 CAST-IN-PLACE PILES REQUIRED.

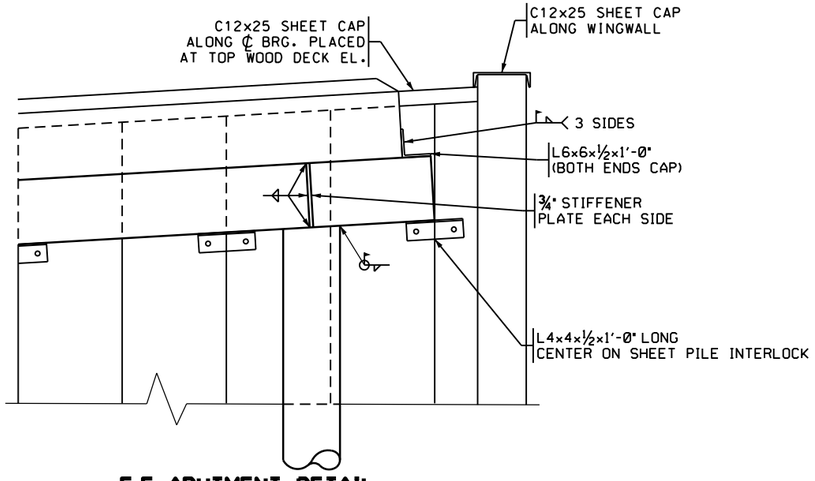
SUMMARY OF QUANTITIES FOR BOTH ABUTMENTS

ITEM	UNIT	QUANTITY
STEEL SHEET PILING	SQ. FT.	2480
STRUCTURE EXCAVATION	LUMP SUM	1
C-I-P CONCRETE PILING INSTALLED 12"	LIN. FT.	1190
C-I-P CONC TEST PILE 85 FT LONG 12"	EACH	2
PILE REDRIVING	EACH	16
PILE ANALYSIS	EACH	1
PILE POINTS 12"	EACH	16
HP14x73 x 41'-1"	EACH	2
(1) STRUCTURAL STEEL 3309 (INCLUDES HP14x73 CAPS)	POUND	11435

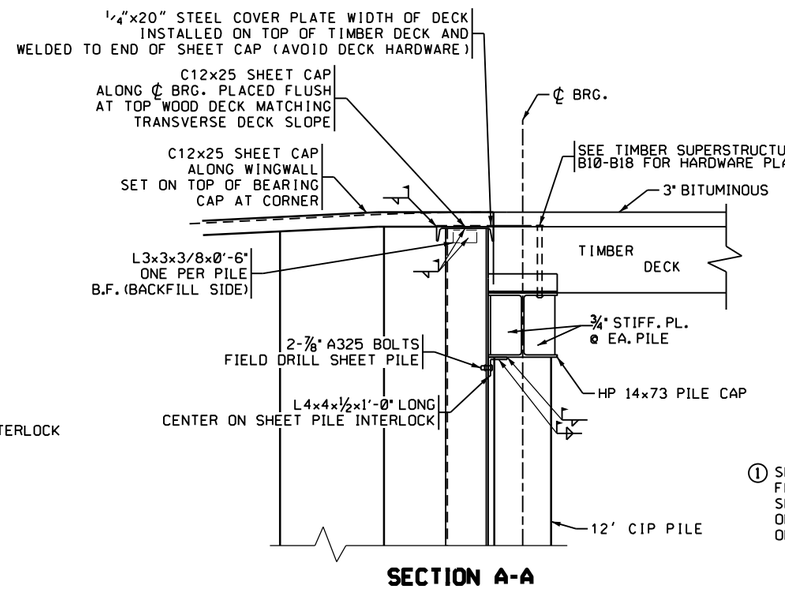
(1) INCLUDES ALL FASTENERS, STIFFENERS, PLATES AND HARDWARE FOR ABUTMENTS

NEW STEEL SHEETING ONLY.
ALL ABUTMENT STEEL SHEET PILES SHALL MEET OR EXCEED THE SECTION PROPERTIES IN THE STEEL SHEET MINIMUM SECTION PROPERTIES TABLE.
ALL ABUTMENT STEEL SHEET PILES SHALL BE MnDOT SPEC. 3373
STEEL SHEET PILING SHALL BE IN ACCORDANCE WITH 2452 AND HAVE THE FOLLOWING SECTION PROPERTIES:
MATERIAL TO BE HOT ROLLED PER ASTM A328 OR COLD FORMED PER ASTM709 GR 50W UNCOATED.

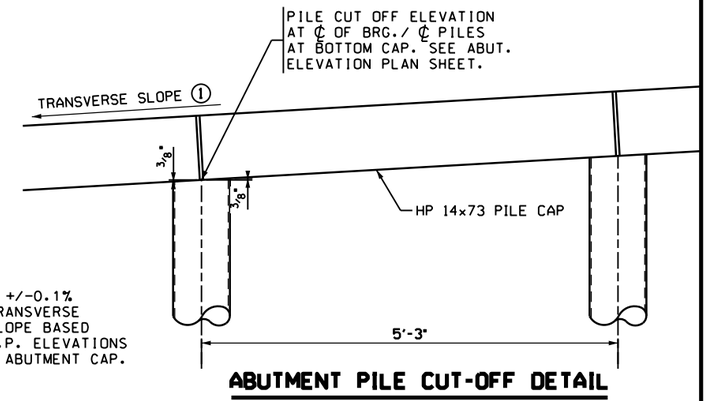
STEEL SHEET PILE MINIMUM SECTION PROPERTIES	
MOMENT OF INERTIA	84.4 IN^4 FT. MIN
SECTION MODULUS	18.1 IN^4 FT. MIN
DEPTH	9.0 INCHES
WALL THICKNESS	0.375 IN. MIN



F.F. ABUTMENT DETAIL



SECTION A-A



(1) SLOPE WILL VARY +/-0.1% FROM THE 5.8% TRANSVERSE SECTION. CAP SLOPE BASED ON GUTTERLINE W.P. ELEVATIONS ON EACH SIDE OF ABUTMENT CAP.

ABUTMENT PILE CUT-OFF DETAIL

Hennepin

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JOHN D. EKOLA, PROFESSIONAL ENGINEER

53076 LICENSE NO.

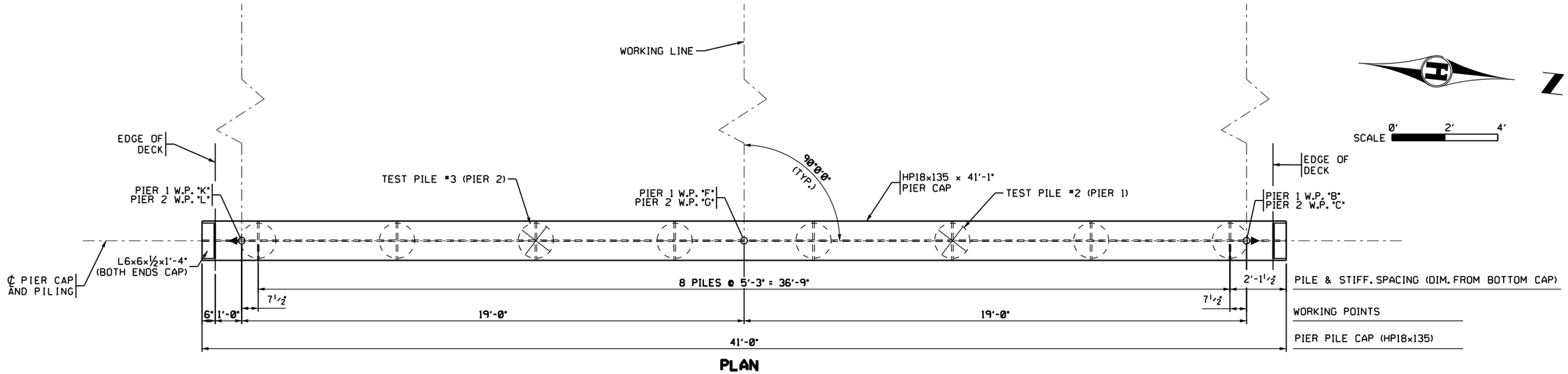
08/23/18 DATE

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DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

ABUTMENT DETAILS

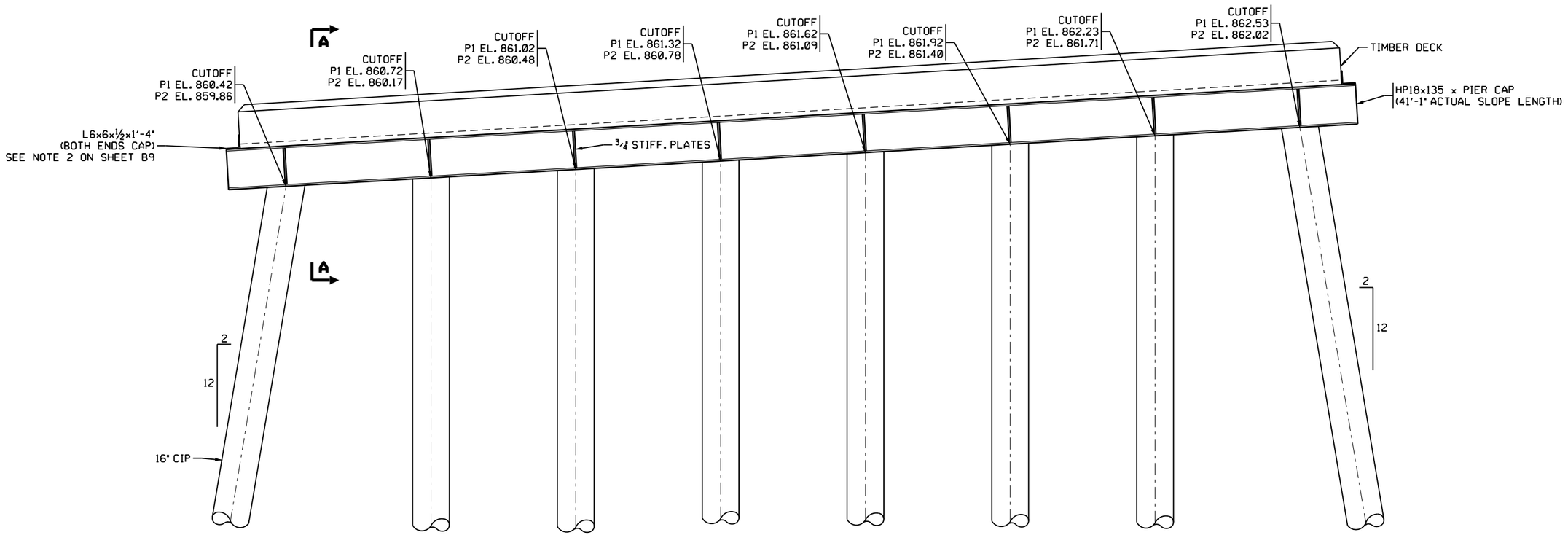
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BRIDGE 27C53

SHEET B7 / B26



PLAN

(DIMENSIONS SHOWN IN PLAN VIEW ARE HORIZONTAL)



ELEVATION

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JOHN D. EKOLA, PROFESSIONAL ENGINEER | 53076 LICENSE NO. | 06/11/18 DATE

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DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

PIER PLAN AND ELEVATION

C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B8 / B26

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PIER 1 AND 2 COMPUTED PILE LOAD - TONS/PILE	
FACTORED DEAD LOAD	31.9
FACTORED LIVE LOAD	53.9
* FACTORED DESIGN LOAD	85.8

* BASED ON STRENGTH I LOAD COMBINATION

PIER 1 AND 2 REQUIRED NOMINAL PILE BEARING RESISTANCE R_n - TONS/PILE		
FIELD CONTROL METHOD	Φ dyn	* R_n
MnDOT Pile Formula 2012 (MPF12) $R_n=20\sqrt{\frac{W\times H}{1000}}\times\log(\frac{10}{S})$	0.50	171.6
PDA	0.65	132.0

* R_n = FACTORED DESIGN LOAD / φ dyn

SUMMARY OF QUANTITIES FOR PIERS 1 AND 2		
ITEM	UNIT	QUANTITY
C-I-P CONCRETE PILING INSTALLED 16"	LIN. FT.	1190
C-I-P CONC TEST PILE 85 FT LONG 16"	EACH	2
PILE REDRIVING	EACH	16
PILE ANALYSIS	EACH	1
PILE POINTS 16"	EACH	16
HP18x135 x 41'-1"	EACH	2
(1) STRUCTURAL STEEL 3309 (INCLUDES HP18x135 CAPS)	POUND	11602

(1) INCLUDES ALL FASTENERS, STIFFENERS, PLATES AND HARDWARE FOR PIERS

PIER PILE NOTES

PILE SPACING IS AT BOTTOM OF H PILE PIER CAP.

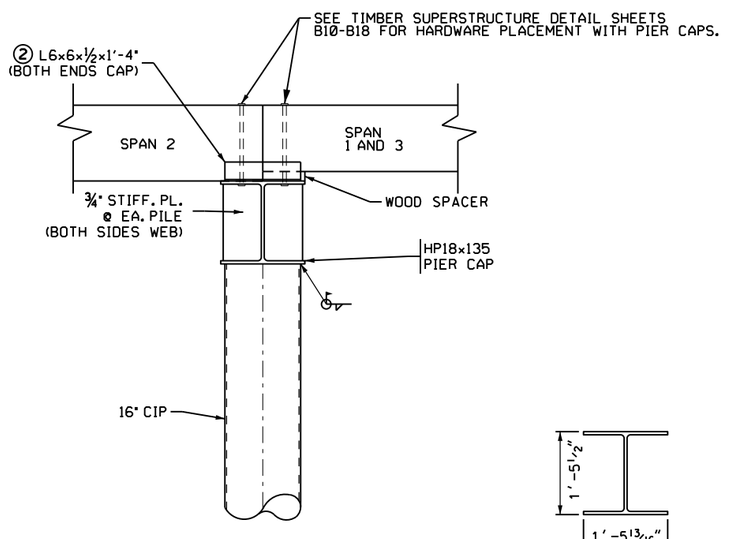
PILES MARKED THUS ◯➤ TO BE BATTERED 2 INCHES PER FOOT IN THE DIRECTION SHOWN.

NOMINAL PILE BEARING RESISTANCE SHALL BE DETERMINED BY THE USE OF A PILE DRIVING ANALYZER (PDA).

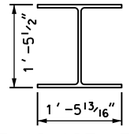
PILES TO HAVE NOMINAL DIAMETER OF 16".

FOR PILE SPLICE DETAIL SEE DETAIL B201.
DRIVE SPLICES ARE NOT ALLOWED.

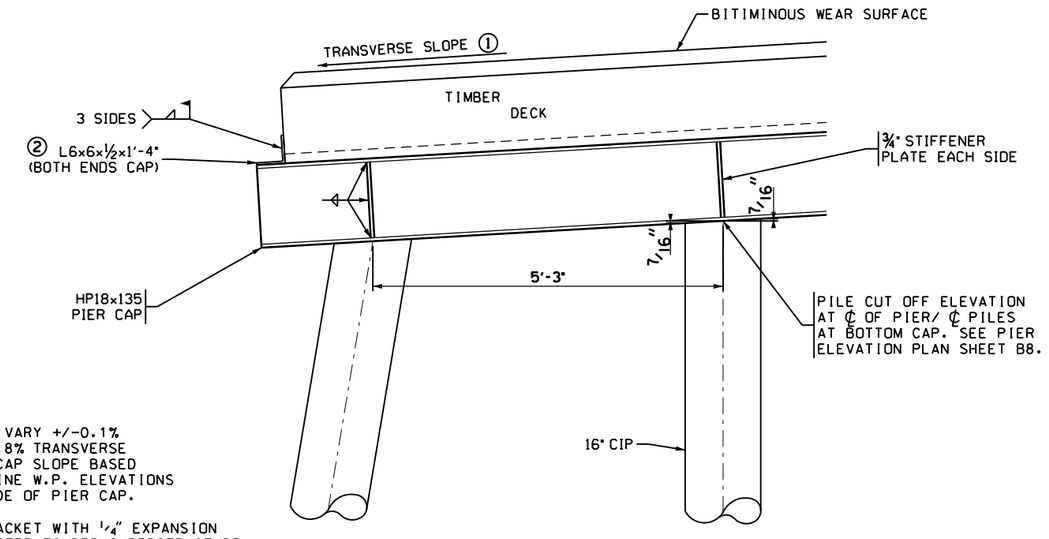
2 CAST-IN-PLACE TEST PILES 85 FT. LONG
7 CAST-IN-PLACE PILES EST. LENGTH 85 FT. (P1)
7 CAST-IN-PLACE PILES EST. LENGTH 85 FT. (P2)
16 CAST-IN-PLACE PILES REQUIRED.



SECTION A-A



HP 18x135 (TYP.)



FRONT DETAIL

① SLOPE WILL VARY +/-0.1% FROM THE 5.8% TRANSVERSE SECTION. CAP SLOPE BASED ON GUTTERLINE W.P. ELEVATIONS ON EACH SIDE OF PIER CAP.

② INSTALL BRACKET WITH ¼" EXPANSION MATERIAL AFTER TIMBER SUPERSTRUCTURE IS SECURED TO PILE CAP. (SEE SPECIAL PROVISIONS)

Hennepin

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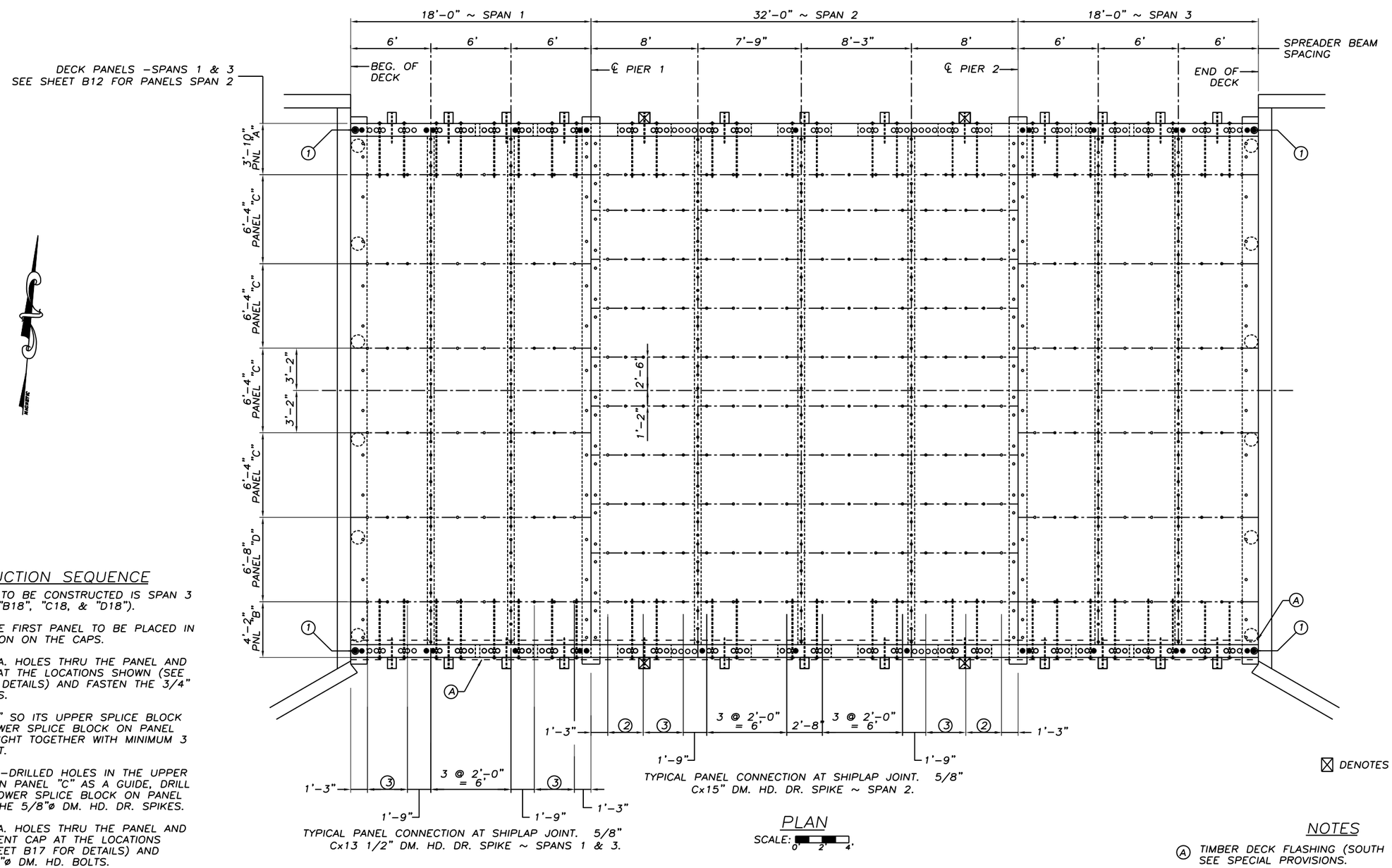
DESIGN BY:	J. EKOLA
CHECKED BY:	J. BRONDER
DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

PIER DETAILS

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BRIDGE 27C53

SHEET B9 / B26

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TYPICAL PANEL CONNECTION AT SHIPLAP JOINT. 5/8" Cx13 1/2" DM. HD. DR. SPIKE ~ SPANS 1 & 3.

TYPICAL PANEL CONNECTION AT SHIPLAP JOINT. 5/8" Cx15" DM. HD. DR. SPIKE ~ SPAN 2.

PLAN

SCALE: 0 2 4'

⊠ DENOTES RAIL SPLICE POST

CONSTRUCTION SEQUENCE

1. THE FIRST SPAN TO BE CONSTRUCTED IS SPAN 3 (PANELS "A18", "B18", "C18, & "D18").
2. PANEL "A" IS THE FIRST PANEL TO BE PLACED IN ITS FINAL LOCATION ON THE CAPS.
3. DRILL 13/16" DIA. HOLES THRU THE PANEL AND INTO THE CAPS AT THE LOCATIONS SHOWN (SEE SHEET B17 FOR DETAILS) AND FASTEN THE 3/4" C DM. HD. BOLTS.
4. PLACE PANEL "C" SO ITS UPPER SPLICE BLOCK IS OVER THE LOWER SPLICE BLOCK ON PANEL "A" AND DRAW TIGHT TOGETHER WITH MINIMUM 3 TON LEVER HOIST.
5. USING THE SHOP-DRILLED HOLES IN THE UPPER SPLICE BLOCK ON PANEL "C" AS A GUIDE, DRILL HOLES IN THE LOWER SPLICE BLOCK ON PANEL "A" AND DRIVE THE 5/8"ø DM. HD. DR. SPIKES.
6. DRILL 13/16" DIA. HOLES THRU THE PANEL AND INTO THE ABUTMENT CAP AT THE LOCATIONS SHOWN (SEE SHEET B17 FOR DETAILS) AND FASTEN THE 3/4"ø DM. HD. BOLTS.
7. REPEAT STEPS 4-6 FOR THE REMAINING "C" PANELS, "D" PANEL AND THE "B" PANEL.
8. REPEAT STEPS 2-5 FOR SPAN 2 (PANELS "A32", "B32", "C32" & "D32") AND STEPS 2-6 FOR SPAN 1 (PANELS "A18", "B18", "C18" & "D18").
9. FASTEN PANELS TOGETHER OVER PIERS AS SHOWN IN DETAIL ON SHEET B17.

(1) 3/4"ø x 20" HEX LAGS (A449) W/ 4"ø ℗ WASHER CURB TO DECK OVER CAPS AND SPREADER BEAMS AS REQUIRED.

(2) 2 SPACES @ 1'-4" = 2'-8"

(3) 2 SPACES @ 1'-6" = 3'-0"

NOTES

(A) TIMBER DECK FLASHING (SOUTH SIDE DECK ONLY) SEE SPECIAL PROVISIONS.

BOLT PROJECTIONS EXCEEDING 1" SHALL BE CUT OFF. REPAIR END OF BOLT BY PAINTING WITH AN APPROVED ZINC RICH PRIMER.

HOLES DRILLED FOR DM. HD. DR. SPIKES ARE TO BE 1/16" DIA. SMALLER THAN SPIKE SIZE.

HOLES DRILLED FOR BOLTS ARE TO BE 1/16" DIA. LARGER THAN BOLT SIZE.

SEE SHEET B18 FOR SUPERSTRUCTURE QUANTITIES.

SUPERSTRUCTURE DETAILS

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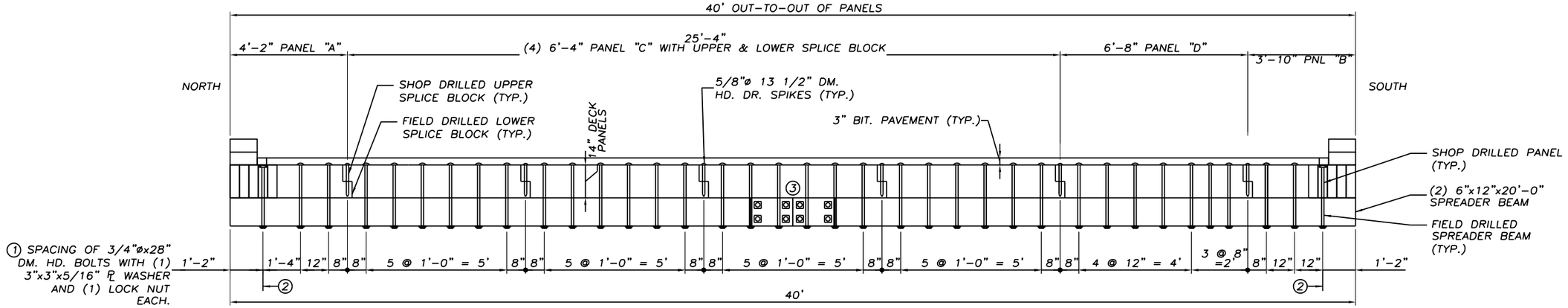
DESIGN BY:	JDE
CHECKED BY:	JZB
DRAWN BY:	JLS
CHECKED BY:	JDE

SUPERSTRUCTURE DETAILS

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SHEET B10 / B26

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TRANSVERSE SECTION THRU SPREADER BEAM

SPANS 1 & 3

SCALE: 0 2' 4'

SPREADER BEAM NOTES

EYEBOLTS FOR LIFTING SHALL NOT COINCIDE WITH SPREADER BEAM HOLES. EYEBOLT HOLES SHALL BE PLUGGED WITH 3/4" TREATED DOWELS AFTER PANELS ARE LIFTED INTO PLACE.

DECK PANELS SHALL BE SHOP DRILLED AS SHOWN.

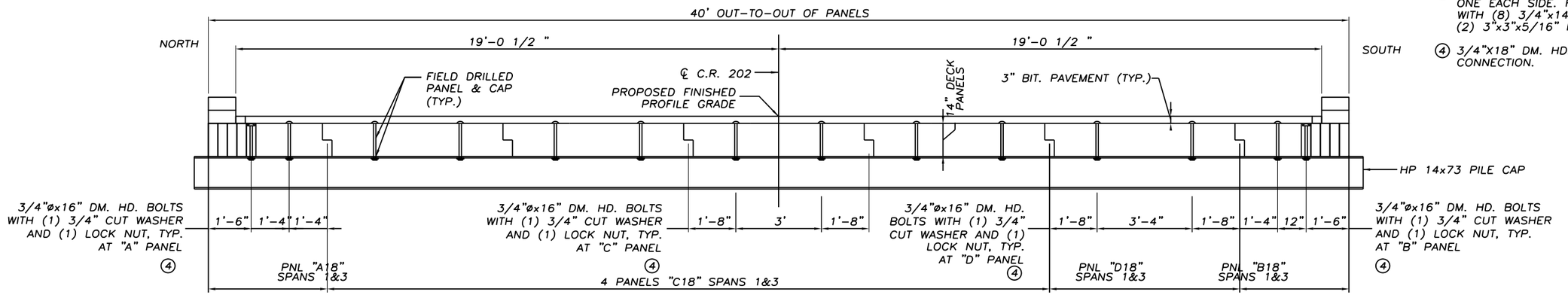
SPREADER BEAMS ARE FIELD DRILLED USING THE SHOP DRILLED HOLES IN THE DECK PANELS AS A GUIDE.

(1) SEE SPREADER BEAM NOTES ABOVE.

(2) COUNTERSINK HEAD OF DM. HD. BOLT.

(3) 3"x12"x3'-0" SPREADER BEAM SPLICE, ONE EACH SIDE. FASTEN TO SPREADER BEAM WITH (8) 3/4"x14" MACHINE BOLTS AND (2) 3"x3"x5/16" PLATE WASHERS EA. BOLT.

(4) 3/4"X18" DM. HD. BOLTS AT PIER CONNECTION.



TRANSVERSE SECTION AT ABUTMENT

CONNECTION TO PIER SIMILAR – SPANS 1 & 3 (4)

SCALE: 0 2' 4'

Hennepin

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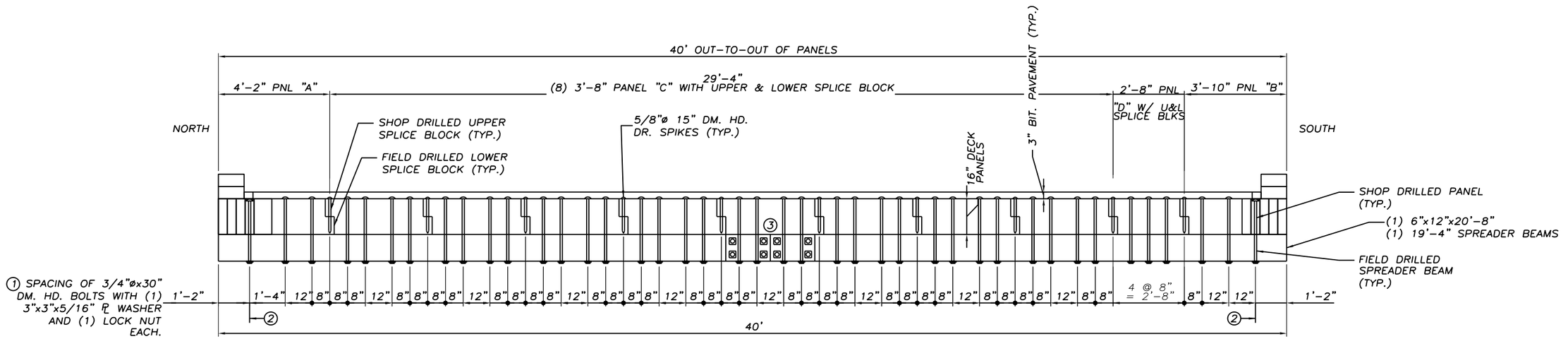
DESIGN BY:	JDE
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DRAWN BY:	JLS
CHECKED BY:	JDE

SUPERSTRUCTURE DETAILS

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SHEET B11 / B26

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TRANSVERSE SECTION THRU SPREADER BEAM

SPAN 2

SCALE: 0 2' 4'

SPREADER BEAM NOTES

EYEBOLTS FOR LIFTING SHALL NOT COINCIDE WITH SPREADER BEAM HOLES. EYEBOLT HOLES SHALL BE PLUGGED WITH 3/4" TREATED DOWELS AFTER PANELS ARE LIFTED INTO PLACE.

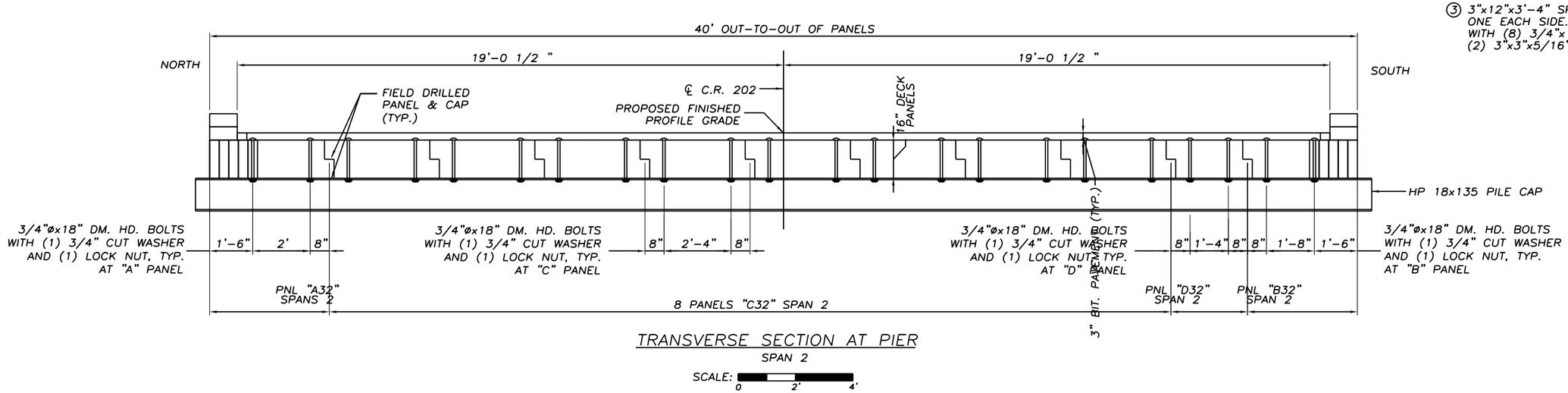
DECK PANELS SHALL BE SHOP DRILLED AS SHOWN.

SPREADER BEAMS ARE FIELD DRILLED USING THE SHOP DRILLED HOLES IN THE DECK PANELS AS A GUIDE.

(1) SEE SPREADER BEAM NOTES ABOVE.

(2) COUNTERSINK HEAD OF DM. HD. BOLT.

(3) 3"x12"x3'-4" SPREADER BEAM SPLICE, ONE EACH SIDE. FASTEN TO SPREADER BEAM WITH (8) 3/4"x14" MACHINE BOLTS AND (2) 3"x3"x5/16" PLATE WASHERS EA. BOLT.



TRANSVERSE SECTION AT PIER

SPAN 2

SCALE: 0 2' 4'

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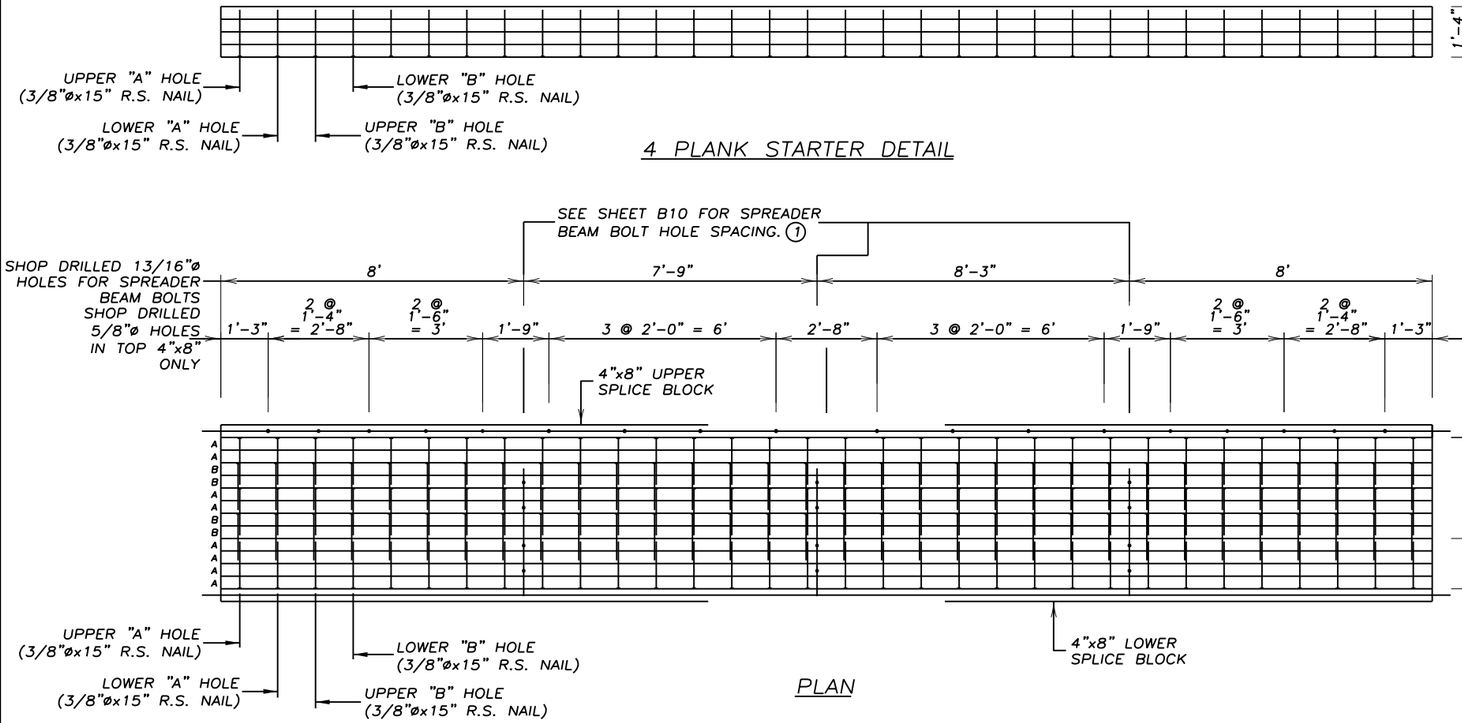
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CHECKED BY:	JDE

SUPERSTRUCTURE DETAILS

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SHEET B12 / B26

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FABRICATION NOTES

LAMINATE 4"x16" PLANKS USING 3/8"ø x11" & 3/8"ø x15" GALV. RING SHANK NAILS AS REQUIRED.

PLANKS TO BE PRESSURE TREATED AS PER SPEC. 3491 AND THE SPECIAL PROVISIONS.

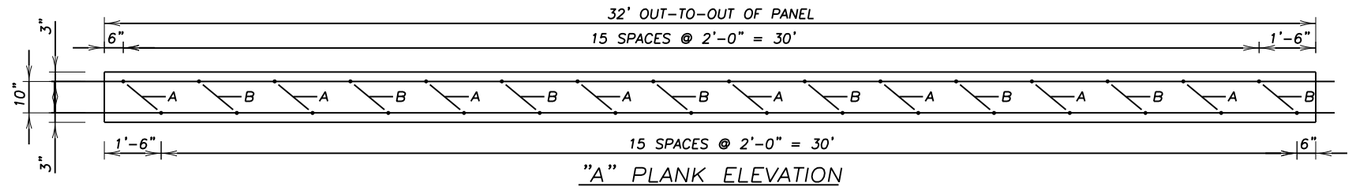
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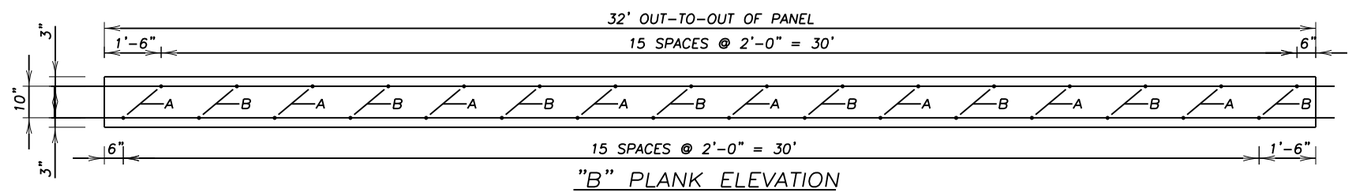
1. ALL PLANKS ARE SURFACED ONE SIDE SO THAT THE UNITS WILL BE 2'-4", 3'-4", 3'-8" OR 4'-0" WIDE AFTER FABRICATING THE PANELS.
2. PLANKS ARE TO BE PREBORED AS PER DETAILS BEFORE BEING TREATED. DRILL 5/8"ø HOLES IN THE UPPER 4"x8" PLANK AS DETAILED. DRILL 13/16"ø HOLES FOR PLACING 3/4"ø EYEBOLTS FOR HANDLING AND FOR FASTENING 3/4"ø SPREADER BEAM BOLTS.
3. FIRST FABRICATE 4 PLANK STARTER USING 4 "A" PLANKS AS SHOWN.
4. ADD 2 "B" PLANK ALTERNATING WITH 2 "A" PLANK AS REQUIRED TO MAKE A 3'-4" & 4'-0" WIDE PANEL. ADD 1 PLANK SECTION PLUS 1 PLANK TO MAKE A 2'-4" WIDE PANEL OR 2 PLANK SECTIONS PLUS 1 PLANK TO MAKE A 3'-8" WIDE PANEL. SET RING SHANK NAILS IN POSITION IN PREBORED HOLES OF 2 PLANK UNITS OR SINGLE PLANK. MECHANICAL PRESS TO BE USED TO DRIVE THE NAILS SO PLANKS ARE DRIVEN TIGHT TOGETHER TO MAKE DIMENSIONS OF 2'-4", 3'-4", 3'-8" AND 4'-0" WIDE UNITS.
5. ATTACH THE 4"x8" PLANK(S) AS SHOWN (DEPENDING ON THE PANEL TYPE) TO PANEL USING 11" GALV. RING SHANK NAILS.

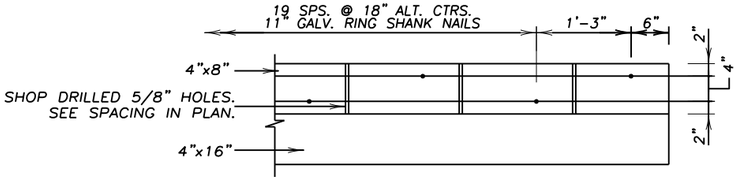
(1) LOCATION OF 13/16"ø HOLES FOR 3/4"ø SPREADER BEAM BOLTS. REFER TO SHEET B12 FOR BOLT SPACING ON PANEL A32, B32, C32 AND D32.

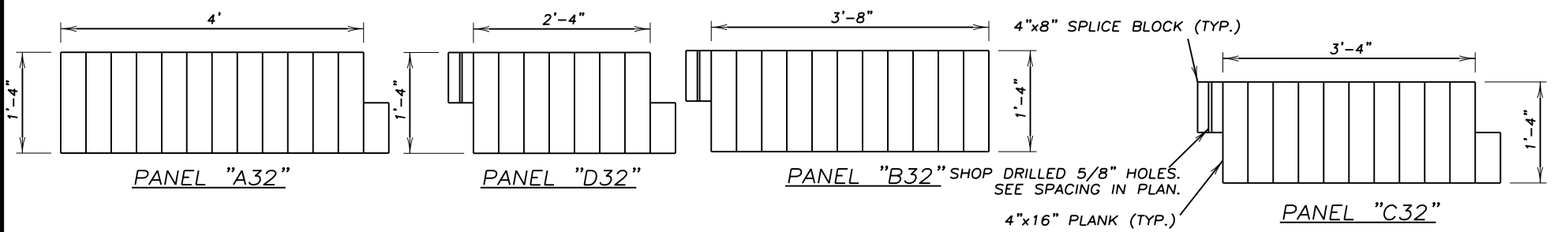
(2) SHOP ADJUST SPACING IN "A" & "B" PANELS TO MISS HOLES FOR RAILPOST CONNECTION RODS.

32' PREFAB WOOD PANEL DETAIL









TREATED TIMBER FOR PANELS

NUMBER REQUIRED				ITEM	M.B.M.			
"A32"	"B32"	"C32"	"D32"		"A32"	"B32"	"C32"	"D32"
12	11	10	7	4"x16"x32'-0"	2.048	1.874	1.707	1.195
1	1	2	2	4"x8"x32'-0"	0.086	0.086	0.171	0.171
				TOTAL M.B.M.	2.134	1.960	1.878	1.366

GALVANIZED HARDWARE FOR PANELS

NUMBER REQUIRED				ITEM	WEIGHT			
"A32"	"B32"	"C32"	"D32"		"A32"	"B32"	"C32"	"D32"
160	128	128	64	3/8"ø x15" R.S. NAILS	80	64	64	32
22	54	44	76	3/8"ø x11" R.S. NAILS	9	22	18	31
				TOTAL	89	86	82	63

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JOHN D. EKOLA, PROFESSIONAL ENGINEER

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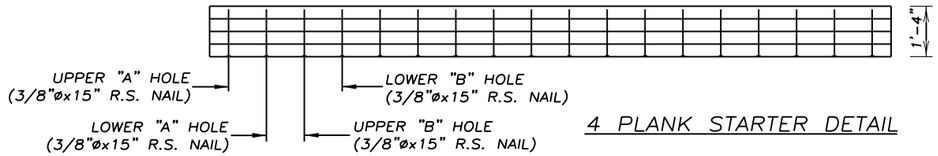
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CHECKED BY:	JZB
DRAWN BY:	JLS
CHECKED BY:	JDE

SUPERSTRUCTURE DETAILS

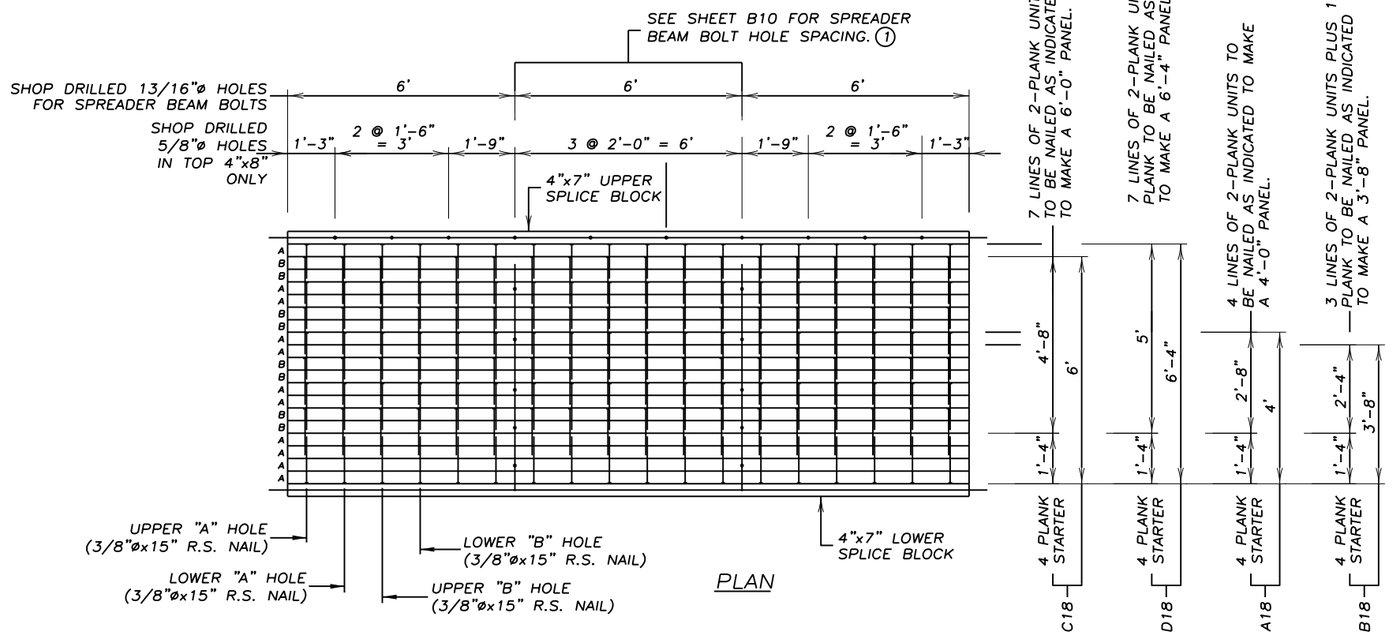
C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B13 / B26

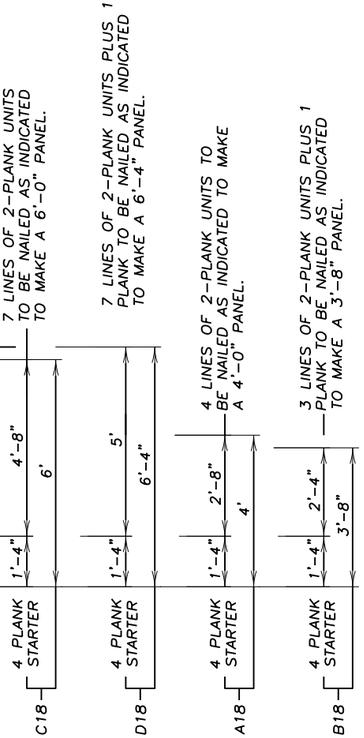
Default



4 PLANK STARTER DETAIL



PLAN



FABRICATION NOTES

LAMINATE 4"x14" PLANKS USING 3/8"ø x11" & 3/8"ø x15" GALV. RING SHANK NAILS AS REQUIRED.

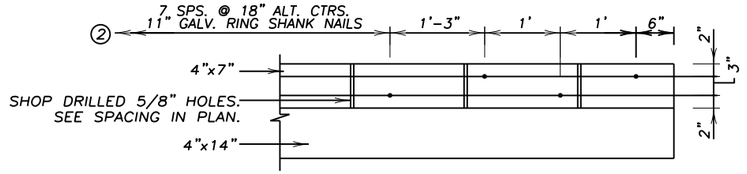
PLANKS TO BE PRESSURE TREATED AS PER SPEC. 3491 AND THE SPECIAL PROVISIONS.

CONSTRUCTION SEQUENCE:

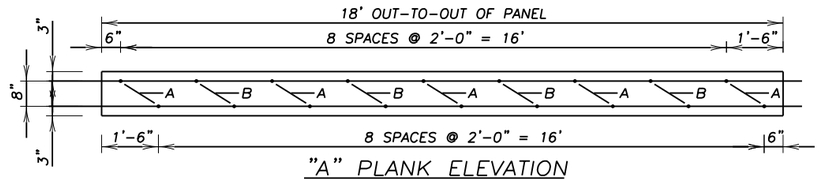
1. ALL PLANKS ARE SURFACED ONE SIDE SO THAT THE UNITS WILL BE 3'-8", 4'-0", 6'-0" OR 6'-4" WIDE AFTER FABRICATING THE PANELS.
2. PLANKS ARE TO BE PREBORED AS PER DETAILS BEFORE BEING TREATED. DRILL 5/8"ø HOLES IN THE UPPER 4"x7" PLANK AS DETAILED. DRILL 13/16"ø HOLES FOR PLACING 3/4"ø EYEBOLTS FOR HANDLING AND FOR FASTENING 3/4"ø SPREADER BEAM BOLTS.
3. FIRST FABRICATE 4 PLANK STARTER USING 4 "A" PLANKS AS SHOWN.
4. ADD 2 "B" PLANK ALTERNATING WITH 2 "A" PLANK AS REQUIRED TO MAKE A 4'-0" & 6'-0" WIDE PANEL OR ADD 2 PLANK SECTIONS PLUDS 1 PLANK TO MAKE A 3'-8" & 6'-4' WIDE PANEL. SET RING SHANK NAILS IN POSITION IN PREBORED HOLES OF 2 PLANK UNITS OR SINGLE PLANK. MECHANICAL PRESS TO BE USED TO DRIVE THE NAILS SO PLANKS ARE DRIVEN TIGHT TOGETHER TO MAKE DIMENSIONS OF 3'-8', 4'-0", 6'-0" AND 6'-4" WIDE UNITS.
5. ATTACH THE 4"x7" PLANK(S) AS SHOWN (DEPENDING ON THE PANEL TYPE) TO PANEL USING 11" GALV. RING SHANK NAILS.

(1) LOCATION OF 13/16"ø HOLES FOR 3/4"ø SPREADER BEAM BOLTS. REFER TO SHEET B10 FOR BOLT SPACING ON PANEL A18, B18, C18 AND PANEL D18.

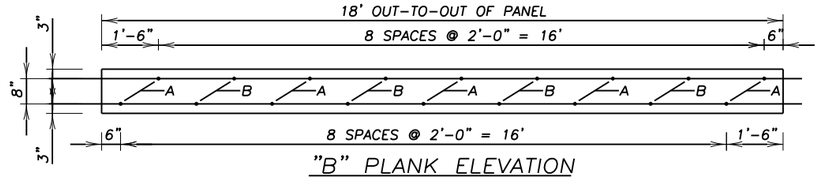
(2) SHOP ADJUST SPACING IN "A" & "B" PANELS TO MISS HOLES FOR RAILPOST CONNECTION RODS.



NAILING OF 4"x7" TIMBER TO PLANK



"A" PLANK ELEVATION



"B" PLANK ELEVATION

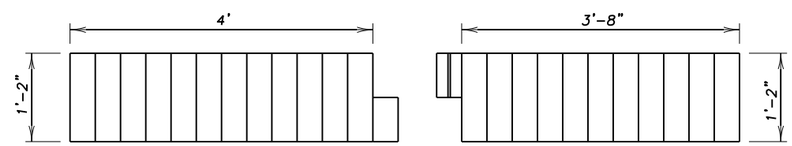
18' PREFAB WOOD PANEL DETAIL

TREATED TIMBER FOR PANELS

NUMBER REQUIRED				ITEM	M.B.M.			
"A18"	"B18"	"C18"	"D18"		"A18"	"B18"	"C18"	"D18"
12	11	18	19	4"x14"x18'-0"	1.008	0.924	1.512	1.596
1	1	2	2	4"x7"x18'-0"	0.042	0.042	0.084	0.084
				TOTAL M.B.M.	1.050	0.966	1.596	1.680

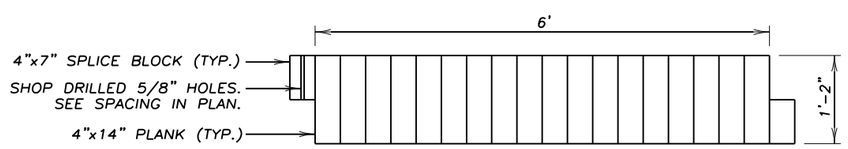
GALVANIZED HARDWARE FOR PANELS

NUMBER REQUIRED				ITEM	WEIGHT			
"A18"	"B18"	"C18"	"D18"		"A18"	"B18"	"C18"	"D18"
90	90	144	144	3/8"ø x15" R.S. NAILS	45	45	72	72
14	14	28	28	3/8"ø x11" R.S. NAILS	6	6	12	12
				TOTAL	51	51	84	84

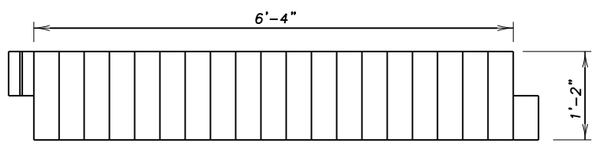


PANEL "A18"

PANEL "B18"



PANEL "C18"



PANEL "D18"

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JOHN D. EKOLA, PROFESSIONAL ENGINEER

53076 — LICENSE NO.

06/11/18 — DATE

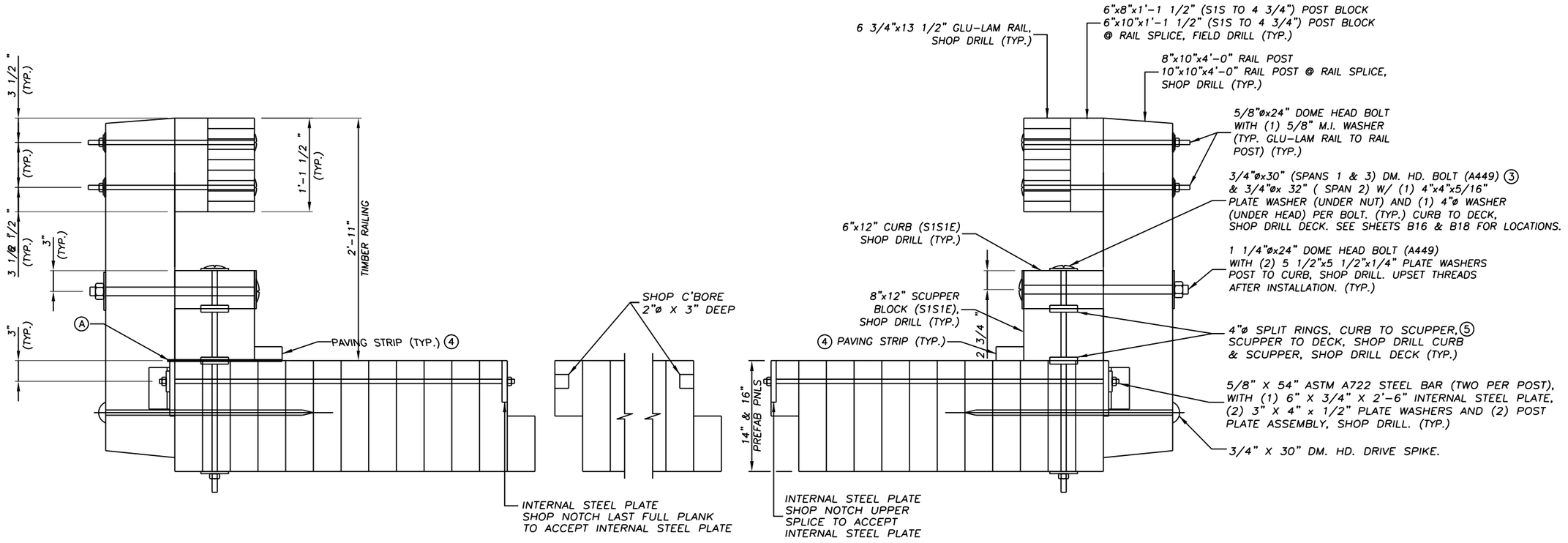
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CHECKED BY:	JDE

SUPERSTRUCTURE DETAILS

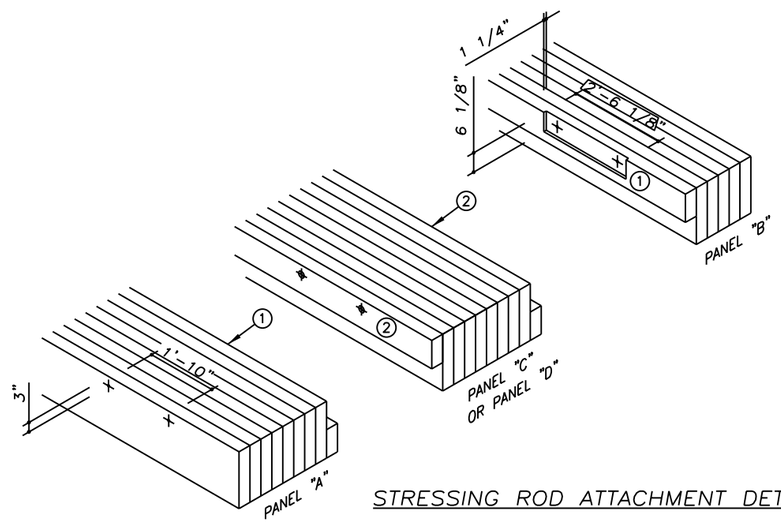
C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B14 / B26

Default



SECTION AT RAIL POST



STRESSING ROD ATTACHMENT DETAIL

TIMBER RAILING SECTIONS

NOTES:

1. SHOP NOTCH 6 1/8" X 1 1/4" X 2'-6 1/8" FOR INTERNAL PLATE.
2. SHOP C'BORE 2"ø X 3" DEEP C'BORE FOR 5/8" NUT.
3. HIGH-STRENGTH DOME HEAD BOLTS DO NOT HAVE FINS UNDER THE HEAD AT THE SHANK.
4. 3" X 4" PAVING STRIP, RGH, ATTACH TO DECK WITH 60d NAILS AT 18" CENTERS. PREDRILL HOLES TO AVOID SPLITTING.
5. SPLIT RING CONNECTORS SHALL BE MANUFACTURED FROM SAE 1010 HOT ROLLED CARBON STEEL.

A. TIMBER DECK FLASHING ON SOUTH SIDE OF BRIDGE ONLY. SEE SPECIAL PROVISIONS.

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

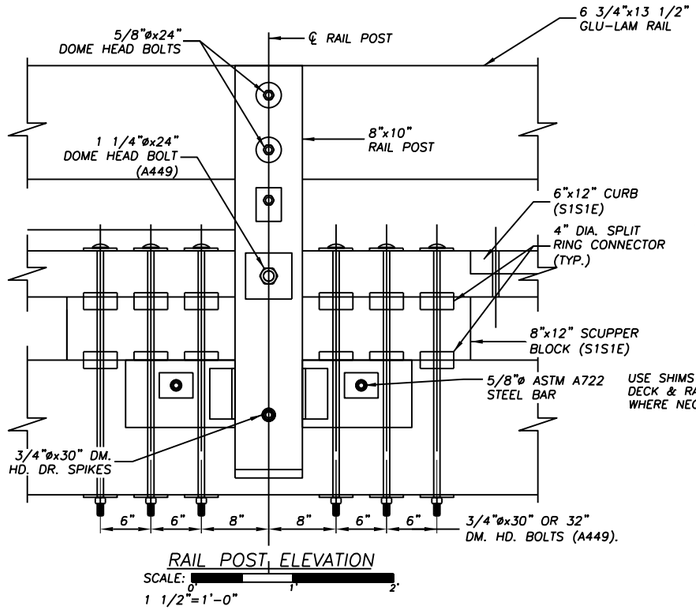
JOHN D. EKOLA, PROFESSIONAL ENGINEER | 53076 LICENSE NO. | 08/23/18 DATE

DESIGN BY:	JDE
CHECKED BY:	JZB
DRAWN BY:	JLS
CHECKED BY:	JDE

SUPERSTRUCTURE DETAILS

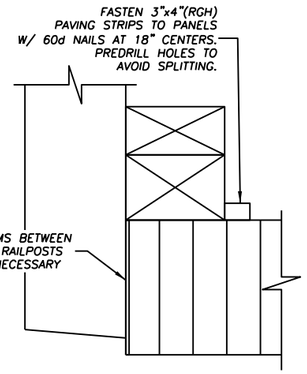
C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B15 / B26



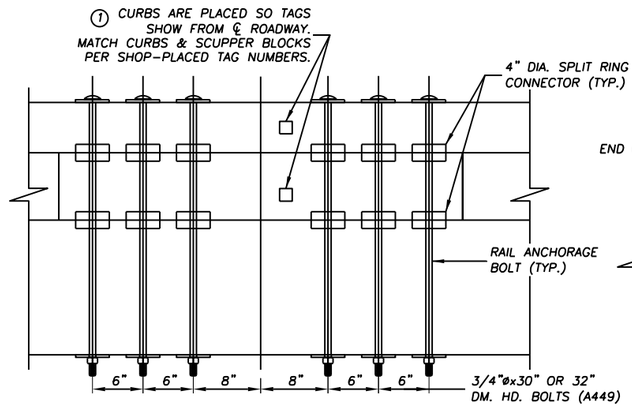
RAIL POST ELEVATION

SCALE: 0' 1' 2'
1 1/2"=1'-0"



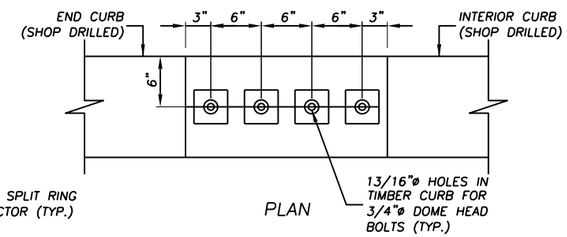
PARTIAL DECK SECTION @ EDGE STRIP

SCALE: 0' 1' 2'
1 1/2"=1'-0"

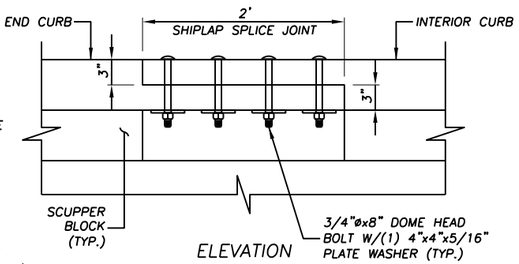


CURB & SCUPPER BLOCK ASSEMBLY DETAIL

SCALE: 0' 1' 2'
1 1/2"=1'-0"



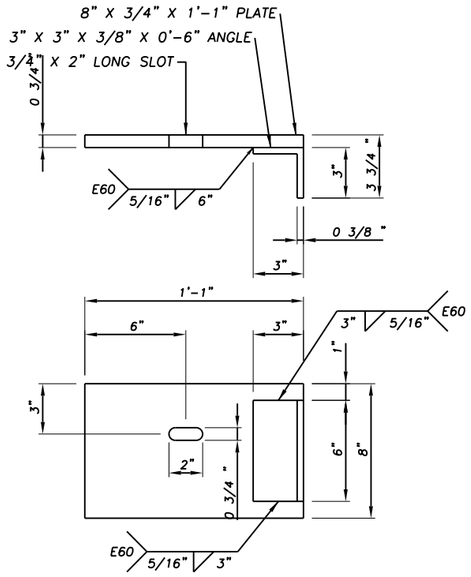
PLAN



ELEVATION

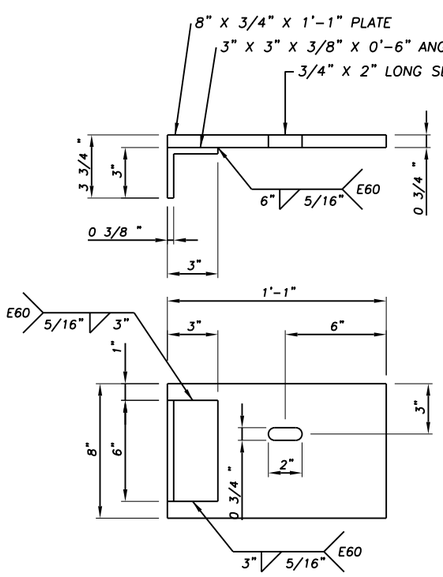
CURB SPLICE DETAIL

SCALE: 0' 1' 2'
1 1/2"=1'-0"



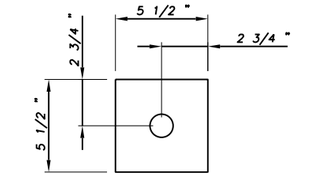
LEFT STEEL POST PLATE THUS

LEFT STEEL POST PLATE
ASTM A36, H.D.G.



RIGHT STEEL POST PLATE THUS

RIGHT STEEL POST PLATE
ASTM A36, H.D.G.



RAILPOST PLATE WASHER THUS

5 1/2" X 5 1/2" X 1/4"
1 3/8"ø HOLE
ASTM A36, H.D.G.

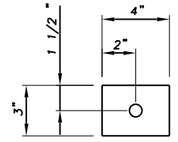
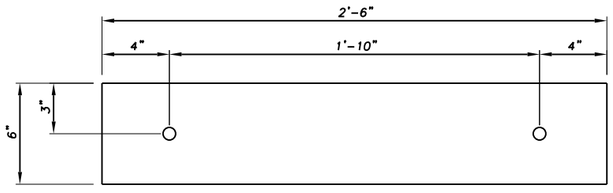


PLATE WASHER FOR POST PLATE THUS

3" X 1/2" X 0'-4"
3/4"ø HOLE
ASTM A36, H.D.G.



INTERNAL STEEL PLATE

INTERNAL STEEL PLATE THUS
6" X 3/4" X 2'-6"
ALL HOLES ARE 3/4"ø
ASTM A36, H.D.G.

TIMBER RAILING DETAILS

Hennepin

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JOHN D. EKOLA, PROFESSIONAL ENGINEER

53076 LICENSE NO.

06/11/18 DATE

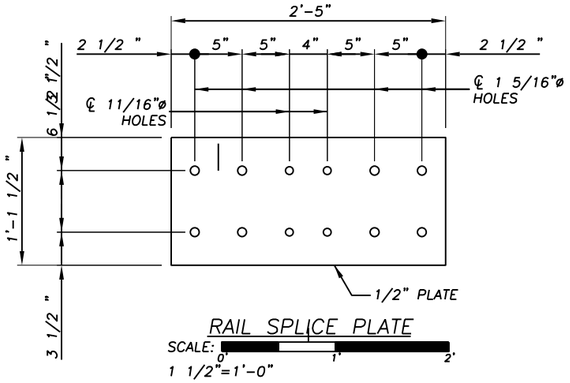
DESIGN BY:	J. EKOLA
CHECKED BY:	J. BRONDER
DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

SUPERSTRUCTURE DETAILS

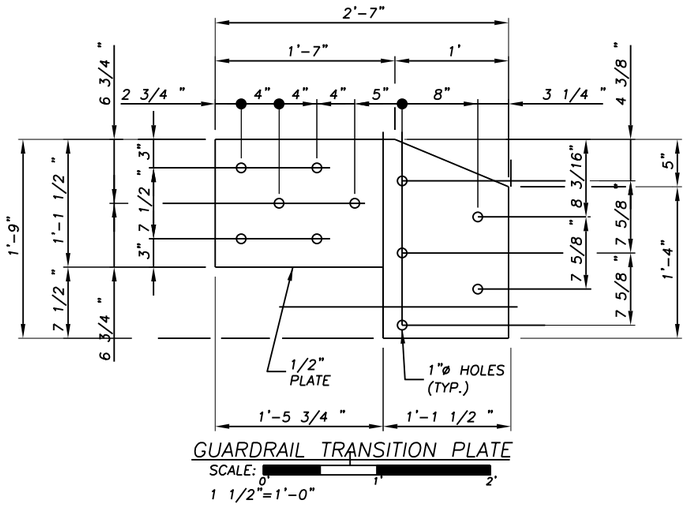
C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-569-009
BRIDGE 27C53

SHEET B16 / B26

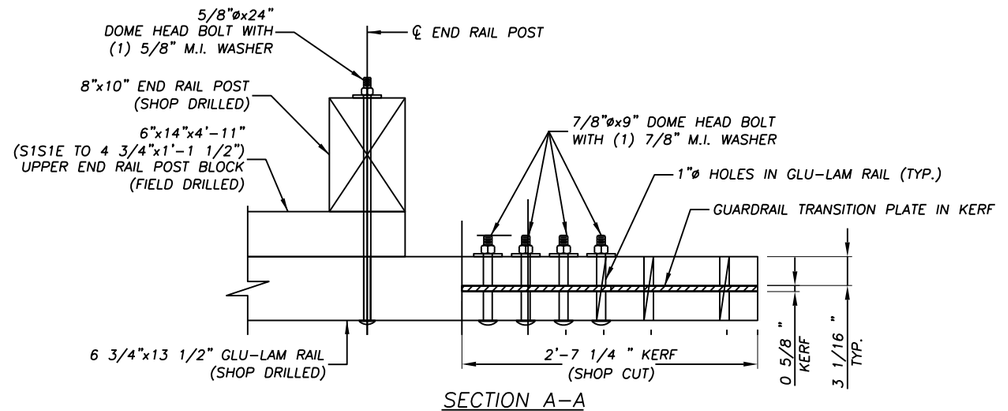
Default pw4519 6/11/2018 \\tempo\proj\202.0408.27C53\Bridge\Plan\SuperStructure.dgn



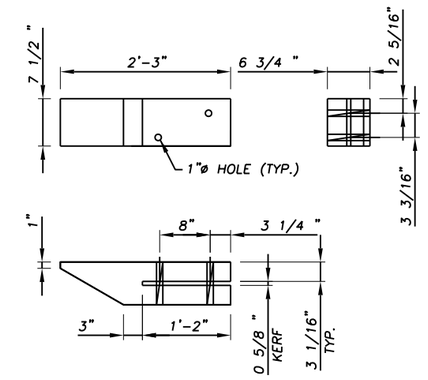
RAIL SPLICE PLATE



GUARDRAIL TRANSITION PLATE

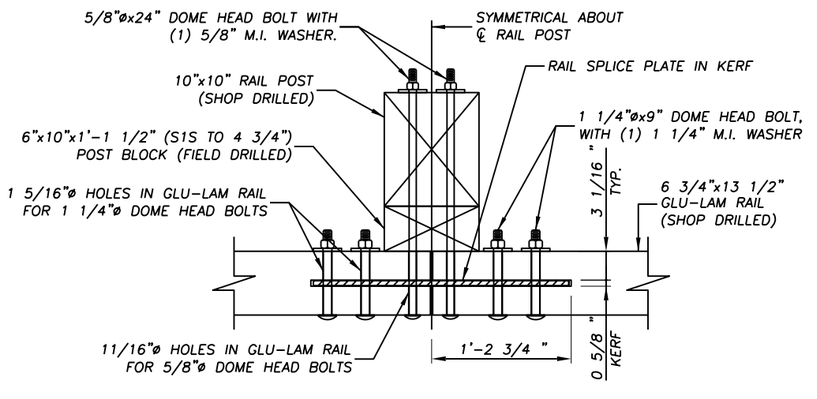


SECTION A-A

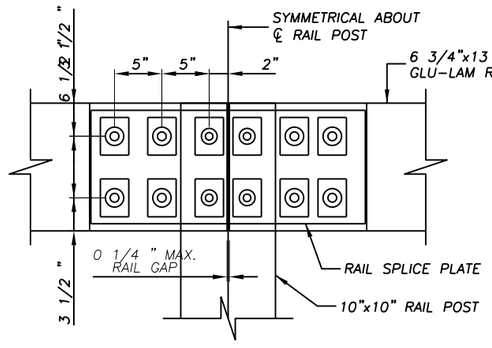


CURB TRANSITION BLOCK

SCALE: 0' 1' 2'
1 1/2"=1'-0"



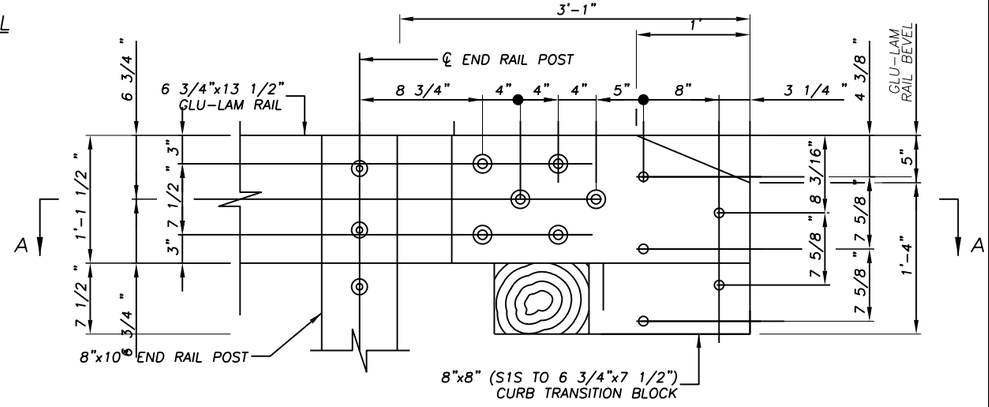
PLAN RAIL SPLICE DETAIL



ELEVATION

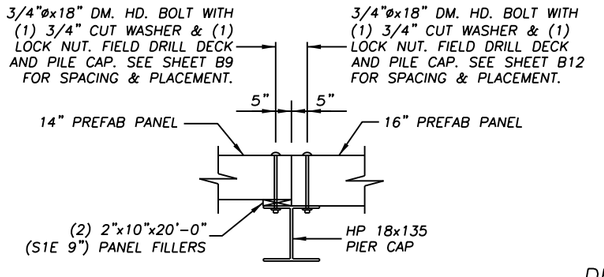
GLU-LAM RAIL SPLICE DETAIL

SCALE: 0' 1' 2'
1 1/2"=1'-0"



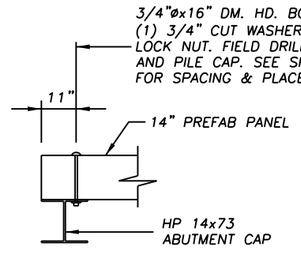
GUARDRAIL TRANSITION DETAIL (ELEVATION)

SCALE: 0' 1' 2'



DECK TO PIER CAP CONECTION

SCALE: 0' 1' 2'



DECK TO ABUTMENT CAP CONECTION

SCALE: 0' 1' 2'

TIMBER RAILING DETAILS

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JOHN D. EKOLA, PROFESSIONAL ENGINEER

53076 LICENSE NO.

06/11/18 DATE

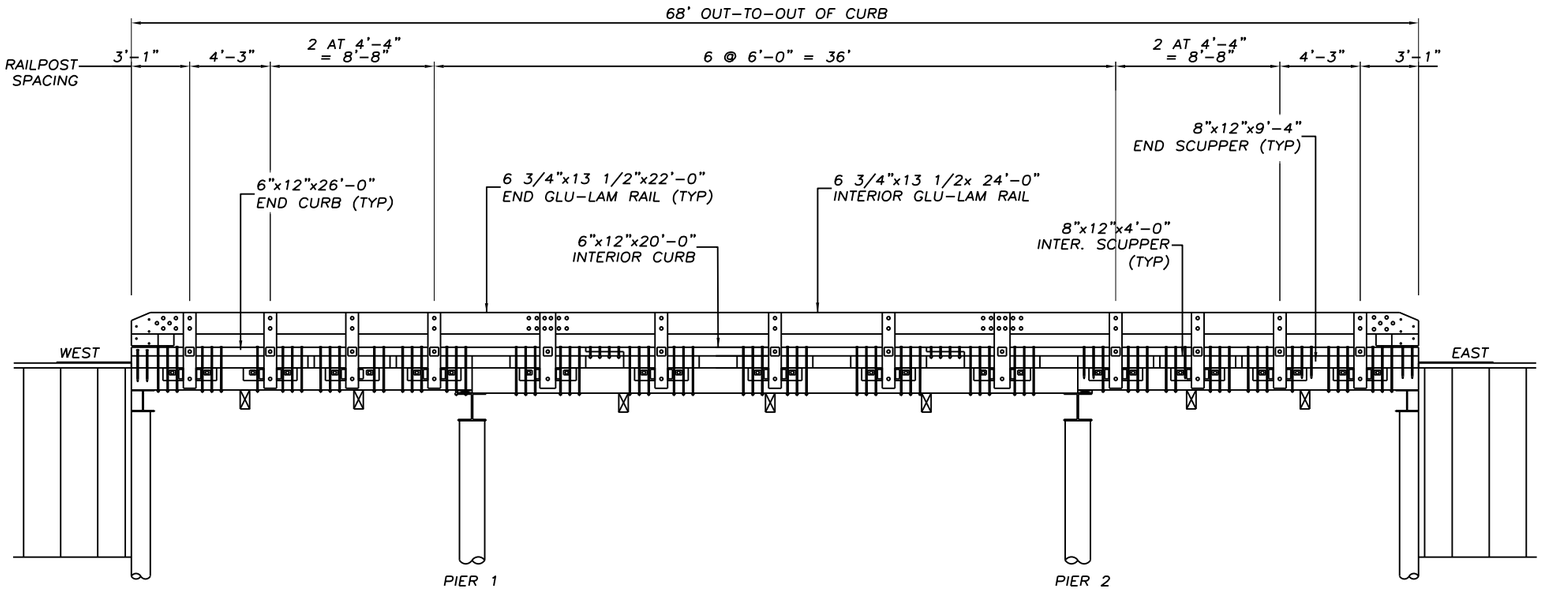
DESIGN BY:	J. EKOLA
CHECKED BY:	J. BRONDER
DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

SUPERSTRUCTURE DETAILS

C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B17 / B26

Default pw4514 6/12/2018 \\tempo\proj\202.0408.27C53\Bridge\Plan\SuperStructure.dgn



ELEVATION

SCALE: 0' 2' 4'

BILL OF TREATED TIMBER ~ SUPERSTRUCTURE					
ITEM	QTY.	FINISH	SIZE	LENGTH	F.B.M.
SPREADER BEAM	8	R	6x12	20'-0"	960
SPREADER BEAM	3	R	6x12	20'-8"	372
SPREADER BEAM	3	R	6x12	19'-4"	348
SPREADER BM SPLICE	8	R	3x12	3'-0"	72
SPREADER BM SPLICE	6	R	3x12	3'-4"	60
(5) PNL FILLER @ PIER	4	S1E	2x10	20'-0"	134
RAIL POST	22	R	8x10	4'-0"	587
(1) RAIL POST BLOCK	14	S1S	6x8	1'-1 1/2"	63
(3) UPPER END POST BLK	4	S1S1E	6x14	4'-11"	138
(4) CURB TRANSITION BLK	4	S1S1E	8x8	2'-3"	48
RAIL POST	4	R	10x10	4'-0"	134
(1) RAIL POST BLOCK	4	S1S	6x10	1'-1 1/2"	23
CURB ~ END	4	S1S1E	6x12	26'-0"	624
CURB ~ INTERIOR	2	S1S1E	6x12	20'-0"	240
SCUPPER ~ END	4	S1S1E	8x12	9'-4"	299
SCUPPER ~ INTERIOR	18	S1S1E	8x12	4'-0"	576
EDGE STRIP	17	R	3x4	8'-0"	136
TOTAL TRTD. TIMBER ~ SUPERSTRUCTURE (F.B.M.)					4814
				M.B.M.	4.814

(1) S1S TO 4 3/4"
(3) S1S1E TO 4 3/4"x13 1/2"
(4) S1S1E TO 4 3/4"x7 1/2"
(5) S1E TO 9

(2) BILL OF GLU-LAM RAILING		
END RAIL	4 PCS.	10 3/4"x6"x22'-0"
INTERIOR RAIL	2 PCS.	10 3/4"x6"x24'-0"
TOTAL GLU-LAM RAILING (LIN. FT.)		136

(2) SEE SPECIAL PROVISIONS.

BILL OF STRUCTURAL STEEL (3306) GALVANIZED				
ITEM	QTY.	SIZE	LENGTH	WT.
RAIL SPLICE PLATE	4	1/2"x13 1/2"	2'-5"	236
GUARDRAIL TRANSITION PLATE	4	1/2"x1'-9"	2'-7"	392
POST PLATE ASSEMBLY	52	SEE SHEET B16		1430
INTERNAL STEEL PLATE	26	3/4"x6"	2'-6"	1055
TOTAL STRUCTURAL STEEL (3306) (LBS.)				3113

SUPERSTRUCTURE DETAILS

BILL OF HARDWARE ~ SUPERSTRUCTURE				
WT./ea.	QTY.	ITEM		WT.
2.40	34	3/4"ø x20" HEX LAGS (A449)	~ CURB TO PANEL	82
1.40	120	5/8"ø x13 1/2" DM. HD. DR. SPIKE	~ PANEL SPLICE	168
1.52	180	5/8"ø x15" DM. HD. DR. SPIKE	~ PANEL SPLICE	274
2.80	28	3/4"ø x16" DM. HD. BOLT	~ PNL TO ABUT	79
3.04	72	3/4"ø x18" DM. HD. BOLT	~ PANEL TO PIER	219
3.89	26	3/4"ø x30" DM. HD. DR. SPIKE	~ POST TO PANEL	102
2.49	60	5/8"ø x24" DM. HD. BOLT	~ RAIL TO POST	150
4.30	24	7/8"ø x9" DM. HD. BOLT	~ RAIL TRANSITION	104
6.81	32	1 1/4"ø x9" DM. HD. BOLT	~ RAIL SPLICE	218
4.24	148	3/4"ø x28" DM. HD. BOLT	~ SPREADER BEAM	628
4.48	123	3/4"ø x30" DM. HD. BOLT	~ SPREADER BEAM	552
5.48	54	3/4"ø x32" DM. HD. BOLT (A449)	~ CURB TO PANEL	296
4.48	76	3/4"ø x30" DM. HD. BOLT (A449)	~ CURB TO PANEL	341
1.84	16	3/4"ø x8" DM. HD. BOLT	~ CURB SPLICE	30
11.96	26	1 1/4"ø x24" DM. HD. BOLT (A449)	~ POST TO CURB	311
18/#		60d NAILS	~ EDGE STRIP	6
0.60	24	7/8" M.I. WASHERS		15
0.94	164	4" DIA. PL WASHERS	(3/4"ø BOLTS)	155
0.85	271	3"x3"x5/16" PL WASHERS	(3/4"ø BOLTS)	231
1.50	146	4"x4"x5/16" PL WASHERS	(3/4"ø BOLTS)	219
0.20	371	3/4" LOCK NUTS		75
0.70	328	4" SPLIT RING CONNECTORS		230
2.28	52	5 1/2"x5 1/2"x1/4" PL WASHERS	(1 1/4"ø BOLTS)	119
0.12	100	3/4" CUT WASHERS	(3/4"ø BOLTS)	12
1.81	52	3"x4"x1/2" PL WASHERS	(5/8"ø STEEL BAR)	95
0.22	60	5/8" M.I. WASHERS		14
1.54	32	1 1/4" M.I. WASHERS		50
6.00	52	5/8"ø x54" A722 STEEL BAR W/(2) NUTS		312
TOTAL HARDWARE ~ SUPERSTRUCTURE (LBS.)				5,087

Hennepin

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JOHN D. EKOLA, PROFESSIONAL ENGINEER — 53076 LICENSE NO. — 06/11/18 DATE

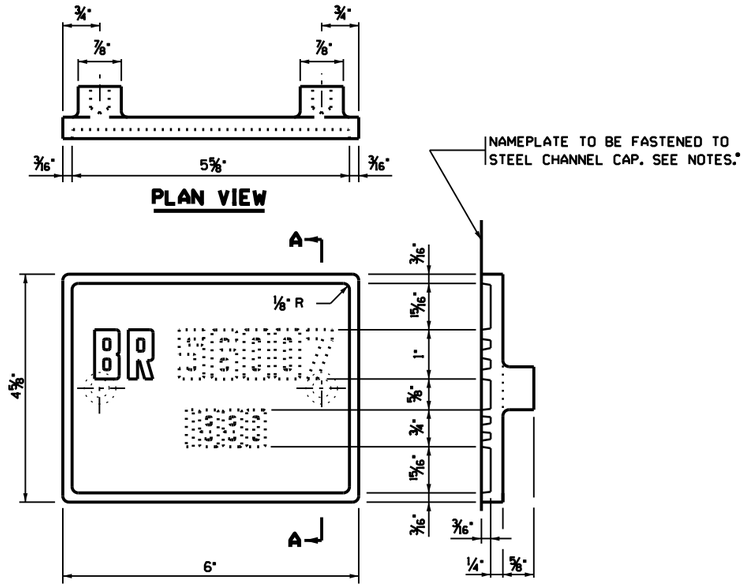
DESIGN BY:	JDE
CHECKED BY:	JZB
DRAWN BY:	JLS
CHECKED BY:	JDE

SUPERSTRUCTURE DETAILS

C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B18 / B26

Default pw4519 6/20/2018 \\tempo\proj\202.0408.27C53\Bridge\Plan\SuperStructure.dgn



THE DASHED NUMBERS SHOWN ABOVE ARE FOR ILLUSTRATION.
DATA TO BE SHOWN ON NAMEPLATE IS AS FOLLOWS:

BRIDGE 27C53

YEAR 2019



NUMBERS FOR NAMEPLATE

NOTES:

MATERIAL SHALL COMPLY WITH SPEC. 3327.

LETTERS AND NUMBERS SHALL CONFORM TO THOSE SHOWN.

DRAFT ON LETTERS AND NUMBERS SHALL NOT BE MORE THAN 3" IN 12".

HORIZONTAL SPACING OF LETTERS AND NUMBERS SHALL PRODUCE A BALANCED LAYOUT IN PROPORTION TO SPACING SHOWN.

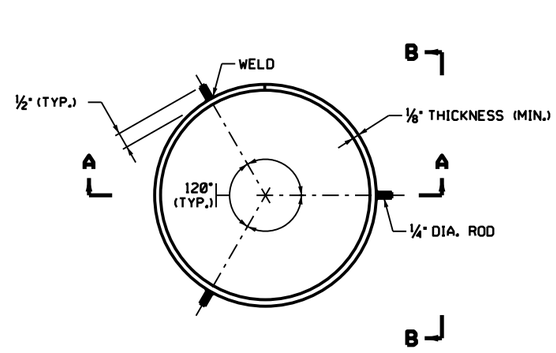
TOP SURFACE OF LETTERS, NUMBERS AND FRAMES SHALL BE BURNISHED.

~~FURNISH 2 STEEL BOLTS ⅜ DIA. x 3" LONG WITH EACH PLATE.~~

ALL DIMENSIONS FOR ¾" HIGH LETTERS AND NUMBERS SHALL BE IN DIRECT PROPORTION TO THOSE SHOWN FOR THE 1" HIGH LETTERS AND NUMBERS.

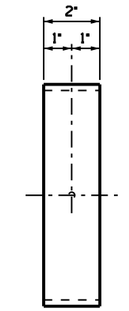
- GRIND OFF EMBEDMENT STEMS ON BACK OF PLATE AND DRILL 3⁄16 DIA. HOLES IN PLATE AND IN WEB OF CHANNEL CAP FOR ½ DIA. GALVANIZED BOLTS. FASTEN PLATE TO WEB OF CHANNEL CAP. UPSET THREADS OF BOLTS.

APPROVED: NOVEMBER 22, 2002	STATE OF MINNESOTA DEPARTMENT OF TRANSPORTATION	REVISION 09-11-2014	DETAIL NO.
Daniel T. Worgan STATE BRIDGE ENGINEER	**BRIDGE NAMEPLATE** (FOR NEW BRIDGES)		**B101**



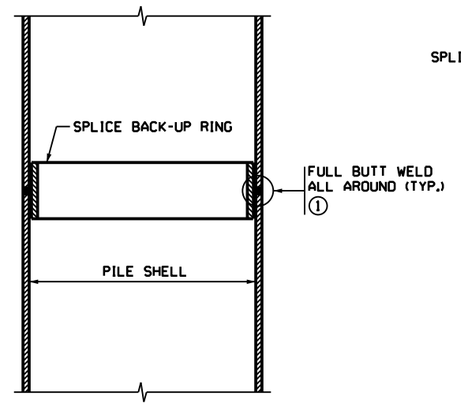
PLAN VIEW - SPLICE BACK-UP RING

PILE NOT SHOWN

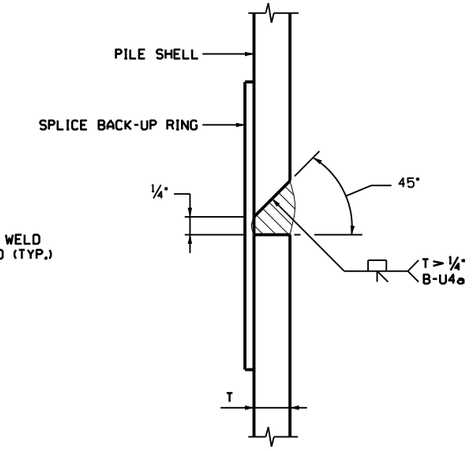


SECTION B-B

PILE NOT SHOWN



SECTION A-A



DETAIL "A" ①

NOTES:

APPROVED COMMERCIAL PILE SPLICE BACK-UP RING MAY BE USED IN LIEU OF THE TYPE DETAILED, PROVIDED THAT ¼" ROOT IS MAINTAINED. BACK-UP RING SHALL HAVE A TIGHT FIT.

WELDING ELECTRODES SHALL BE CELLULOSIC TYPE ELECTRODES E-6010 OR E-6011.

ELECTRODES WHICH HAVE BECOME WET, SOILED OR DAMAGED SHALL NOT BE USED.

WELDING SHALL NOT BE DONE WHEN THE AMBIENT TEMPERATURE IS LOWER THAN 0° F. OR WHEN THE PILE IS WET OR EXPOSED TO FALLING RAIN OR SNOW. WHEN THE PILE METAL TEMPERATURE IS BELOW 32° F., THE PILE METAL IN THE AREA OF THE WELD SHALL BE HEATED TO A MINIMUM TEMPERATURE OF 70° F. AND MAINTAINED AT THIS TEMPERATURE DURING WELDING.

① FOR PILE SHELL THICKNESSES GREATER THAN ¼", USE A B-U4a WELD CONFIGURATION. SEE DETAIL "A".

APPROVED: NOVEMBER 22, 2002	STATE OF MINNESOTA DEPARTMENT OF TRANSPORTATION	REVISION: 11-06-2013	DETAIL NO.
Daniel T. Worgan STATE BRIDGE ENGINEER	**PILE SPLICE** (CAST-IN-PLACE CONCRETE PILES)		**B201**

Hennepin

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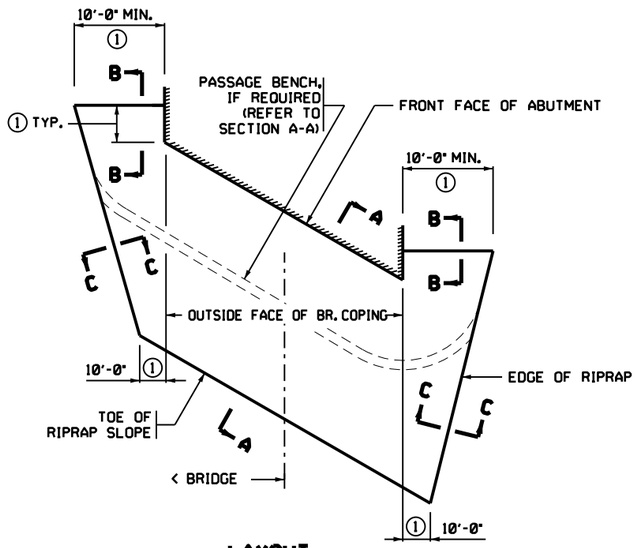
JOHN D. EKOLA, PROFESSIONAL ENGINEER — 53076 LICENSE NO. — 05/11/18 DATE

DESIGNED BY:	TSM
CHECKED BY:	JZB
DRAWN BY:	TSM
CHECKED BY:	WJM

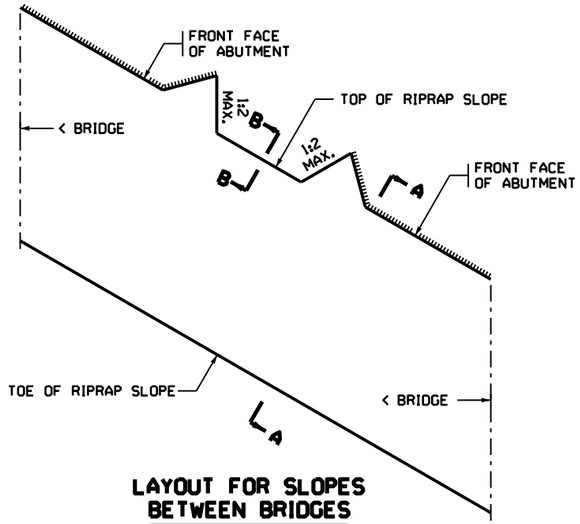
STANDARD DETAILS B101 AND B201

CR 202 / HENNEPIN COUNTY PROJECT 0408
BRIDGE 27C53 S.P. 027-596-009

SHEET B19 / B26



LAYOUT



LAYOUT FOR SLOPES BETWEEN BRIDGES

GENERAL NOTES

GEOTEXTILE FILTER TYPE 7 PER SPEC. 3733, BY THE SQ. YD.

RIPRAP PER SPEC. 2511, RANDOM RIPRAP CLASS ___ BY THE CU. YD.

SLOPES ARE EXPRESSED AS A RATIO OF VERTICAL DISTANCE : HORIZONTAL DISTANCE.

SLOPE BOTTOM OF TRENCHES 1:20 PARALLEL TO ABUTMENT FACE TO PROVIDE POSITIVE DRAINAGE.

① SEE PLAN SHEET NO.__ FOR DIMENSIONS, AND FOR ELEVATIONS OF RIPRAP TOE AND PASSAGE BENCHES.

② PLACE RIPRAP STARTING FROM THE BOTTOM OF THE SLOPE. DO NOT PLACE RIP RAP IN TRENCH UNTIL RIPRAP HAS BEEN PLACED ON ENTIRE SLOPE BENEATH THE TRENCH.

③ OVERLAP GEOTEXTILE FILTER 2'-0" MINIMUM.

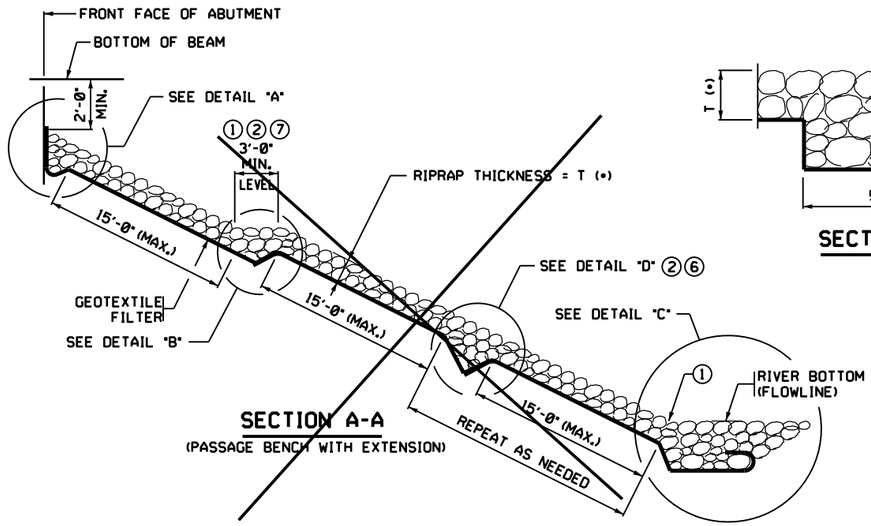
④ WRAP GEOTEXTILE FILTER AROUND TOE, OVERHANG BETWEEN 1ST AND 2ND LAYER OF RIPRAP. USE HAND PLACEMENT OR SIMILAR METHODS TO ESTABLISH PROFILE AND PLACE FABRIC IF UNDER WATER.

⑤ BURY EDGES OF GEOTEXTILE FILTER TO DIRECT WATER FLOW OVER THE FABRIC WITHOUT UNDERMINING.

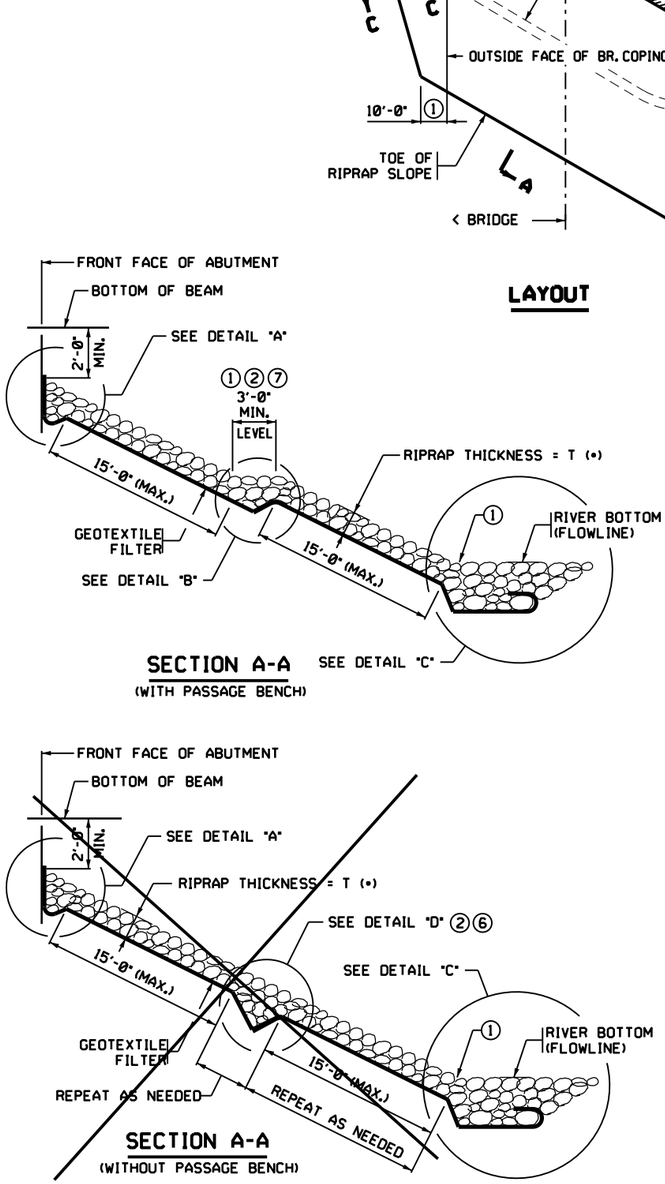
⑥ OMIT THE TRENCH SHOWN IN DETAIL "D" AND THE 15'-0" MAXIMUM SPACING BETWEEN TRENCHES FOR SLOPES 1:3 OR FLATTER.

⑦ SURFACE BENCHES WITH AGGREGATE CLASS 5 (INCIDENTAL TO RIPRAP). TIE BENCHES TO NATURAL GROUNDLINES OUTSIDE OF BRIDGE.

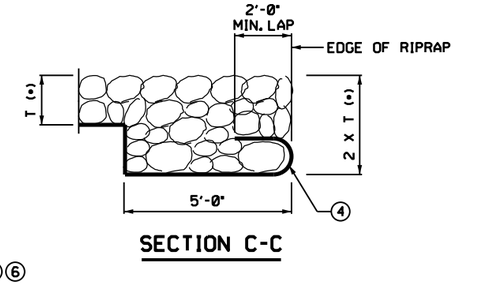
SECTION A-A
(WITH PASSAGE BENCH)



SECTION A-A
(PASSAGE BENCH WITH EXTENSION)

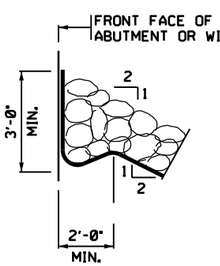


SECTION A-A
(WITHOUT PASSAGE BENCH)

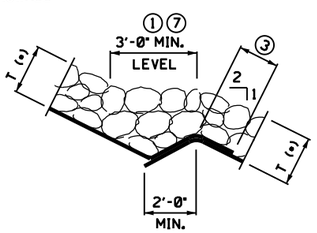


SECTION C-C

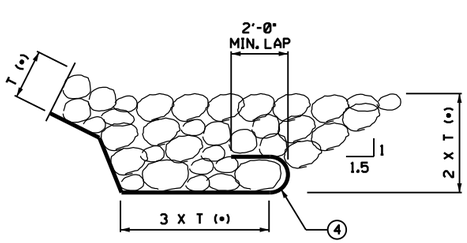
DIMENSION T
~~CLASS III = 1'-6"~~
CLASS IV = 2'-0"
~~CLASS V = 2'-6"~~



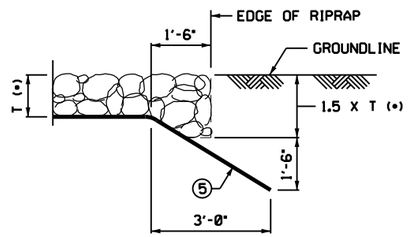
DETAIL "A"



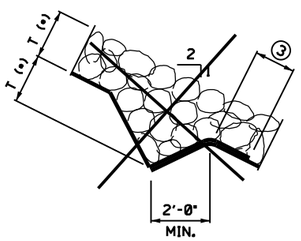
DETAIL "B"



DETAIL "C"



SECTION B-B



DETAIL "D"

REVISED: 01-05-2017

APPROVED: MAY 24, 2011
Nancy Daubenberger
STATE BRIDGE ENGINEER

CERTIFIED BY JOHN D. EKOLA, PROFESSIONAL ENGINEER 06/11/18 DATE
LIC. NO. 53076

TITLE: RIPRAP SLOPE WITH GEOTEXTILE FILTER (SLOPES 1:2 AND FLATTER)

S.P. 027-596-009 | FIG. 5-397.309

DES: TSM	DR: JLS	APPROVED:
CHK: JZB	CHK: JDE	

SHEET NO. 20 OF 26 SHEETS

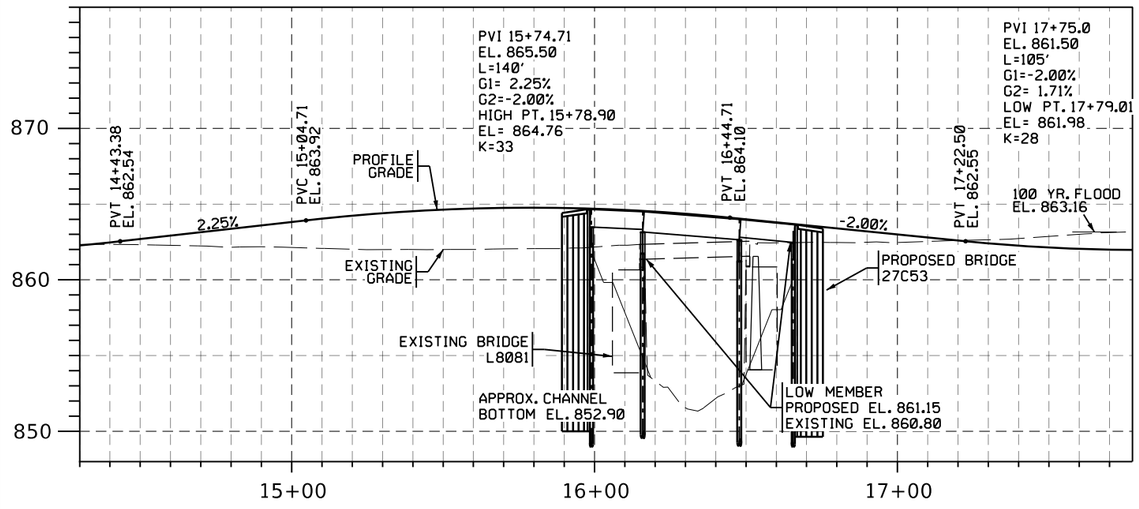
BRIDGE NO. 27C53

FILENAME: $$$$@FILENAME@$$$

SCALE: 0 — 50' HORIZONTAL; 0 — 10' VERTICAL

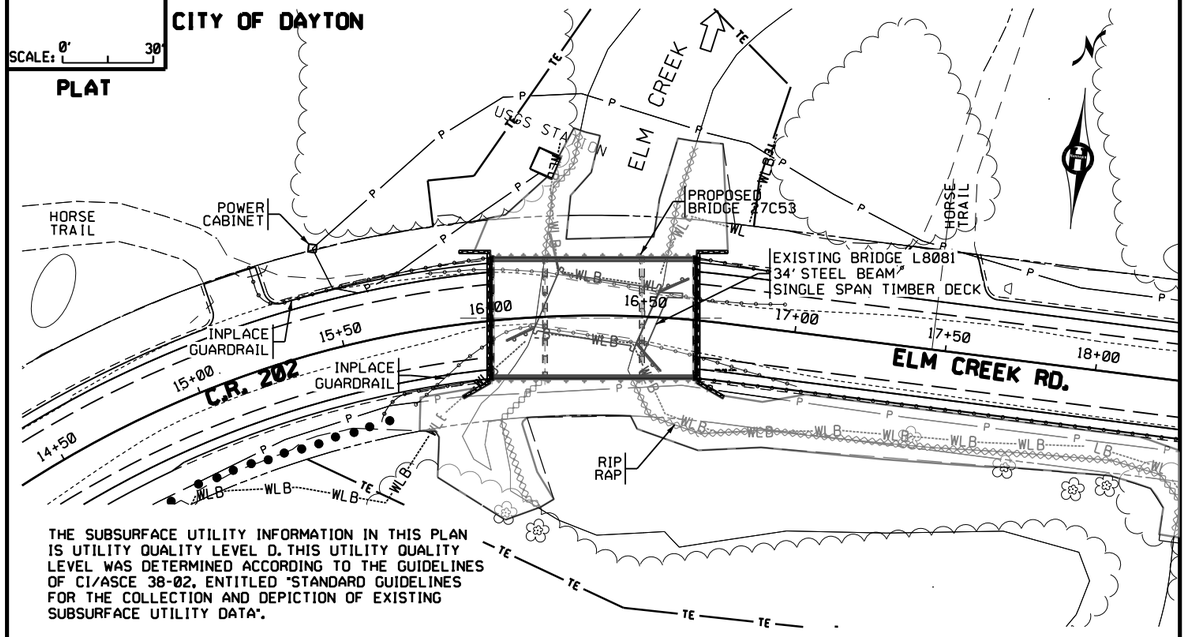
C.R. 202 (ELM CREEK RD.)

CONTRACTED PROFILE



SCALE: 0' — 30'

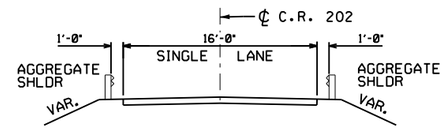
PLAT



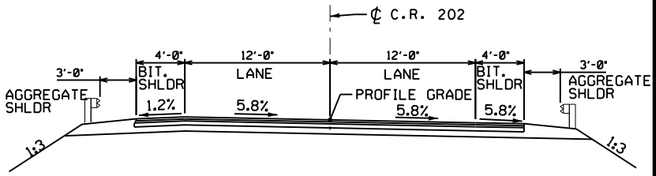
THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS UTILITY QUALITY LEVEL WAS DETERMINED ACCORDING TO THE GUIDELINES OF CI/ASCE 38-02, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA".

TYPICAL SECTIONS & PERTINENT DATA

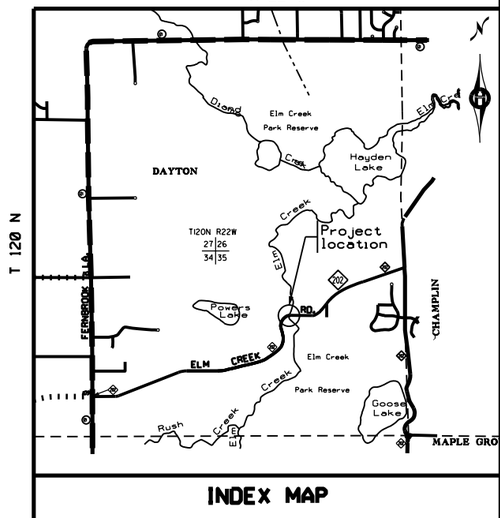
HORIZONTAL SCALE: 0 — 5' — 10'



EXISTING ROADWAY APPROACH SECTION



PROPOSED ROADWAY APPROACH SECTION



INDEX MAP

LOCATION ENGINEER'S OBSERVATIONS AT BRIDGE SITE

1. SPECIAL FEATURES: WATERFALLS, DAMS, FLOODS, ICE, DEBRIS, SLIDING BANKS, RECREATIONAL BOATING. USGS OBSERVATION STATION 40' UPSTREAM ON WEST BANK
2. OTHER BRIDGES OR CULVERTS OVER THE SAME STREAM (PARTICULARLY STRUCTURES WHICH CARRY HIGH WATER WITHOUT OVERFLOW OF ROADWAY): GIVEN LOCATION, TYPE, LENGTH, HEIGHT ABOVE HIGH WATER, CROSS-SECTIONAL AREA ETC. BRIDGE 90617 CONC BOX CULVERT ON RUSH CRK OVER FERNBROOK LN, 9500' UPSTREAM. BRIDGE 1934 CONC SLAB SPAN ON ELM CRK OVER TERRITORIAL ROAD 10,300' UPSTREAM.
3. APPARENT HIGHWATER ELEVATION. OBTAINED FROM: ITEM 4 DATA MN. DNR
4. OTHER DATA: APPROX. VELOCITY OF WATER AT TIME OF SURVEY.

HYDRAULIC ENGINEERS RECOMMENDATION

STREAM ELM CREEK
DRAINAGE AREA 86 SQ. MI.
MAX. FLOOD ON RECORD SEPTEMBER 24, 2016
DESIGN FLOOD (25 YR. FREQ.) 1860 C.F.S.
MAXIMUM OBSERVED HIGHWATER ELEVATION 860.95
DESIGN STAGE 861.57
MEAN VELOCITY THROUGH STRUCTURE 4.73 F.P.S.
TOTAL STAGE INCREASE 0 FT.
LOW MEMBER AT OR ABOVE ELEVATION 861.15
WATERWAY AREA REQUIRED BELOW EL. 861.15 = 389 SQ. FT.
AT RIGHT ANGLES TO CHANNEL
BASIC FLOOD (100 YR. FREQ.) 2880 C.F.S.
STAGE 863.09
TOTAL STAGE INCREASE 0 FT.
MEAN VELOCITY THROUGH STRUCTURE 5.56 F.P.S.
APPROX. FLOWLINE EL. 852.90 SKEW ANGLE 10 DEG.
ESTIMATED ABUTMENT SCOUR ELEV. 840.90 (100 YEAR FREQ.)
SCOUR CODE: N

BRIDGE SURVEY SHEETS MADE FROM:
COUNTY SURVEY COMPLETED 10/17/17 FILES:
202.0408.27C53\Survey\ODDEN\0408.bridge topo.dgn
& 202.0408.27C53\Survey\ODDEN\creek shots.dgn

BENCH MARK ELEVATION 860.618 (NGVD29)
LOCATION SPIKE IN SW WING WALL OF BRIDGE L8081 OVER ELM CREEK

2nd BENCH MARK ELEVATION 864.944 (NGVD29)
LOCATION SPIKE IN TREE SOUTH SIDE C.R. 202 +/-600' EAST OF BRIDGE L8081

DEPARTMENT OF TRANSPORTATION
COUNTY OF HENNEPIN
STATE OF MINNESOTA

BRIDGE SURVEY

C.R. NO. 202 (ELM CREEK RD.) OVER ELM CREEK
1.5 MI. EAST OF JCT. CSAH 121 & C.R. 202
68'-0" TIMBER SLAB SPAN, 3 SPAN BRIDGE
38'-0" ROADWAY
IDENTIFICATION NO. 709
SEC 35 T 120 N R 22 W
CITY OF DAYTON HENNEPIN COUNTY

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

JOHN D. EKOLA, PROFESSIONAL ENGINEER — 53076 LICENSE NO. — 06/11/18 DATE

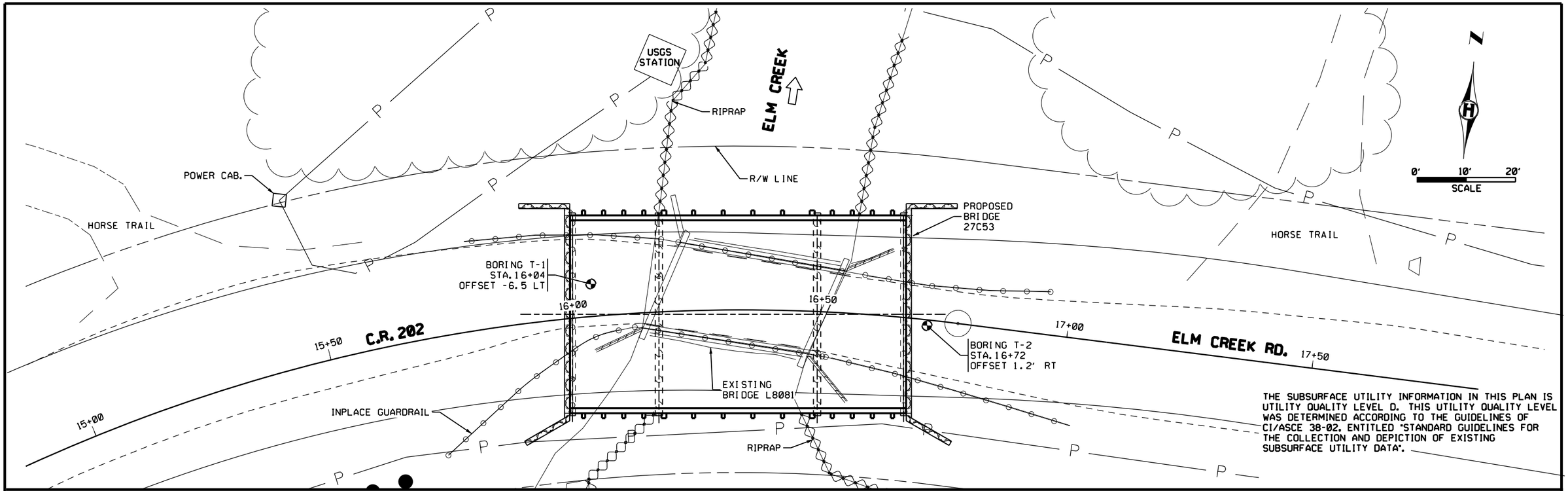
DESIGN BY:	J. EKOLA
CHECKED BY:	J. BRONDER
DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

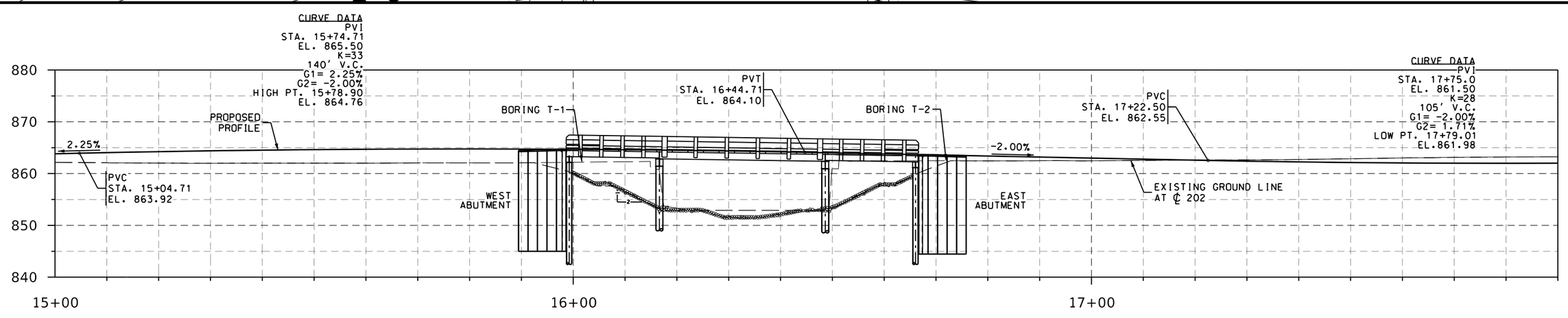
BRIDGE SURVEY

C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B21 / B26

Default px4514 6/11/2018 \\tempo\proj\202.0408.27C53\Bridge\Plan\27C53_survey1.dgn





SUBSURFACE EXPLORATION FOR FOUNDATION DESIGN

FOR THE DESIGN OF THE STRUCTURE FOUNDATION, TO OBTAIN RELATIVE DATA CONCERNING THE CHARACTER OF MATERIAL IN AND UPON WHICH THE FOUNDATION MIGHT BE BUILT, BORINGS AND/OR SOUNDINGS WERE MADE AT POINTS APPROXIMATELY AS INDICATED ON THIS DRAWING WITH THE LOG OF SUCH EXPLORATION DATA AS INTERPRETED FOR SUCH DESIGN PURPOSE AS SHOWN. THE EXPLORATIONS WERE MADE BY ORDINARY AND CONVENTIONAL METHODS AND CARE DEEMED ADEQUATE FOR SUCH PURPOSE. HOWEVER, SINCE IT IS A MATTER OF COMMON KNOWLEDGE THAT THE EXACT CHARACTER OF ANY MATERIAL AND ITS REACTION IS DIFFICULT TO DETERMINE FROM SUCH SUBSURFACE EXPLORATION AND THAT THE KIND AND CHARACTER OF MATERIAL AT THE SITE WHERE THE FOUNDATIONS ARE BUILT MAY VARY SUBSTANTIALLY FROM THAT INDICATED BY THE LOG THEY ARE MADE AVAILABLE TO THE BIDDERS SIMPLY FOR WHAT THEY ARE WORTH, WITHOUT ANY WARRANTY, EXPRESSED OR IMPLIED THAT THE MATERIAL TO BE ENCOUNTERED IN BUILDING THE FOUNDATION WILL CONFORM THEREWITH. IF THE LOG IS USED BY THE CONTRACTOR IN MAKING HIS BID, IT IS HEREBY EXPRESSLY STIPULATED THAT THE HIGHWAY DEPARTMENT ACCEPTS NO RESPONSIBILITY FOR SAID USE.

EXISTING GROUND AT ℄ C.R. 202
- - - - - - - - -

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

JOHN D. EKOLA, PROFESSIONAL ENGINEER

53076 — LICENSE NO.

08/21/18 — DATE

DESIGN BY:	J. EKOLA
CHECKED BY:	J. BRONDER
DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

BRIDGE PLAN AND PROFILE

C.R. 202 / HENNEPIN COUNTY PROJECT 0408
S.P. 027-596-009
BRIDGE 27C53

SHEET B22 / B26

Default pw45l9 8/22/2018 \\tempo\proj\202.0408.27C53\Bridge\Plan\27C53_survey2.dgn

BRAUN INTERTEC

LOG OF BORING

Braun Project B1707427
Geotechnical Evaluation
Elm Creek Bridge Replacement
Elm Creek Road (CR 202) Over Elm Creek
Champlin, MN

BORING: **T-1**
LOCATION: See attached sketch.

DRILLER: J. Chermak | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/14/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PID ppm	Tests or Notes
862.9	0.0						
861.9	1.0	PAV	5 1/2 inches of bituminous over 7 inches of aggregate base.				Benchmark: Elevations were obtained using GPS and the State of Minnesota's permanent base station network.
		FILL	FILL: Clayey Sand, trace fine Gravel, intermixed Silty Sand inclusions, brown and gray, moist.	18		0.5	
858.9	4.0			12		0.2	
		OL	ORGANIC CLAY, with interbedded Peat layers, black, moist. (Swamp Deposit)	8		0.4	
855.9	7.0						
		SM	SILTY SAND, fine-grained, gray, wet. (Swamp Deposit)	7		0.1	
854.4	8.5						
		CL	LEAN CLAY, with interbedded Silty Sand seams and organics, trace wood, gray, wet, very soft to soft. (Swamp Deposit)	3	▽	0.1	MC=39, LL=39, PL=20, PI=19
				WH		0.2	MC=67, OC=7
				2		0.1	An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling. Groundwater levels fluctuate.
848.4	14.5		END OF BORING. Water observed at a depth of 9 feet with 14 feet of hollow-stem auger in the ground. Boring then grouted.				

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\07427.GPJ BRAUN_V8_CURRENT.GDT 5/24/18 15:37

BRAUN INTERTEC

LOG OF BORING

Braun Project B1707427
Geotechnical Evaluation
Elm Creek Bridge Replacement
Elm Creek Road (CR 202) Over Elm Creek
Champlin, MN

BORING: **T-2**
LOCATION: See attached sketch.

DRILLER: J. Chermak | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/14/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PID ppm	Tests or Notes
862.7	0.0						
862.1	0.6	PAV	1 inch of bituminous over 6 inches of aggregate base.				
		FILL	FILL: Clayey Sand, trace fine Gravel, slightly organic, dark brown, moist.	18		0.3	
860.7	2.0						
		FILL	FILL: Silty Sand, fine- to medium-grained, intermixed Lean Clay inclusions and wood, dark brown to gray, moist.	10		0.1	
				3		0.1	
			- becoming waterbearing at the 8-foot depth	1	▽	0.1	
852.7	10.0						
		SP-SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, trace fine Gravel, shells and roots, slightly organic, gray, waterbearing, loose. (Swamp Deposit)	5		0.1	
				2		0.1	
848.7	14.0			10		0.1	
		CL	LEAN CLAY, slightly organic, trace of shells, gray, wet, very soft to rather soft. (Swamp Deposit)	2			MC=47, LL=36, PL=19, PI=17
				5			MC=41, OC=3
843.2	19.5						
		SP-SM	POORLY GRADED SAND with SILT, fine- to medium-grained, trace fine Gravel, gray, waterbearing, loose. (Alluvium)	5			
				7			
				9			
834.7	28.0						
		SM	SILTY SAND, fine- to medium-grained, dark gray, waterbearing, loose. (Alluvium)	10			

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\07427.GPJ BRAUN_V8_CURRENT.GDT 5/24/18 15:37

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

JOHN D. EKOLA, PROFESSIONAL ENGINEER | 53076 LICENSE NO. | 06/11/18 DATE

DESIGN BY:	J. EKOLA
CHECKED BY:	J. BRONDER
DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

LOG OF BORING T-1 & T-2

C.R. 202 / HENNEPIN COUNTY PROJECT 0408
BR 27C53 S.P. 027-596-009

SHEET B23 / B26

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BRAUN INTERTEC

LOG OF BORING

Braun Project B1707427
Geotechnical Evaluation
Elm Creek Bridge Replacement
Elm Creek Road (CR 202) Over Elm Creek
Champlin, MN

BORING: **T-2 (cont.)**
LOCATION: See attached sketch.

DRILLER: J. Chermak | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/14/17** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PID ppm	Tests or Notes
830.7	32.0						
829.7	33.0	CL	LEAN CLAY, gray, wet, medium. (Alluvium)	6			
				18			
821.7	41.0	CL	SANDY LEAN CLAY, trace fine Gravel, with occasional waterbearing Silty Sand layers, gray, wet, stiff to hard. (Glacial Till)	13			
				26			
				37			
806.7	56.0	SP-SM	POORLY GRADED SAND with SILT, fine- to medium-grained, trace fine Gravel, grayish brown, waterbearing, medium dense to dense. (Glacial Outwash)	13			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\1707427.GPJ BRAUN_V8_CURRENT.GDT 5/24/18 15:37

BRAUN INTERTEC

LOG OF BORING

Braun Project B1707427
Geotechnical Evaluation
Elm Creek Bridge Replacement
Elm Creek Road (CR 202) Over Elm Creek
Champlin, MN

BORING: **T-2 (cont.)**
LOCATION: See attached sketch.

DRILLER: J. Chermak | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/14/17** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PID ppm	Tests or Notes
798.7	64.0		POORLY GRADED SAND with SILT, fine- to medium-grained, trace fine Gravel, grayish brown, waterbearing, medium dense to dense. (Glacial Outwash) *(continued)*	33*			*no sample retrieved
				14			
				26			
782.7	80.0	SP	POORLY GRADED SAND, coarse-grained, trace fine and coarse Gravel, light brown, waterbearing, loose. (Glacial Outwash)	10			
778.7	84.0	SP	POORLY GRADED SAND, fine- to medium-grained, light brown, waterbearing, medium dense to dense. (Alluvium)	30			
				37			
769.7	93.0	SM	SILTY SAND, fine- to coarse-grained, trace fine and coarse Gravel, light brown, waterbearing, dense to very dense. (Glacial Till)	55			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\1707427.GPJ BRAUN_V8_CURRENT.GDT 5/24/18 15:38

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

JOHN D. EKOLA, PROFESSIONAL ENGINEER | 53076 LICENSE NO. | 06/11/18 DATE

DESIGN BY:	J. EKOLA
CHECKED BY:	J. BRONDER
DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

LOG OF BORING T-2

C.R. 202 / HENNEPIN COUNTY PROJECT 0408
BR 27C53 S.P. 027-596-009

SHEET B24/B26

BOR 7 pw4519 6/11/2018 \\tempo\proj\202.0408.27C53\Bridge\Plan\Borlog.dgn

BRAUN INTERTEC

LOG OF BORING

Braun Project B1707427
Geotechnical Evaluation
Elm Creek Bridge Replacement
Elm Creek Road (CR 202) Over Elm Creek
Champlin, MN

BORING: **T-2 (cont.)**
LOCATION: See attached sketch.
DRILLER: J. Chermak | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/14/17** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PID ppm	Tests or Notes
766.7	96.0		SILTY SAND, fine- to coarse-grained, trace fine and coarse Gravel, light brown, waterbearing, dense to very dense. (Glacial Till) *(continued)*	38			
757.7	105.0	SP-SM	POORLY GRADED SAND with SILT, fine- to medium-grained, trace fine Gravel, light brown, waterbearing, very dense. (Glacial Outwash)	92			
747.7	115.0	SP-SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, with fine and coarse Gravel, light brown, waterbearing, very dense. (Glacial Outwash)	68			
741.7	121.0		END OF BORING. Water observed at a depth of 8 feet with 10 feet of hollow-stem auger in the ground. Boring then grouted.				

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2017\707427.GPJ BRAUN_V8_CURRENT.GDT 5/24/18 15:38

Hennepin

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

JOHN D. EKOLA, PROFESSIONAL ENGINEER — 53076 LICENSE NO. — 06/11/18 DATE

DESIGN BY:	J. EKOLA
CHECKED BY:	J. BRONDER
DRAWN BY:	J. SCHERER
CHECKED BY:	J. EKOLA

LOG OF BORING T-2

C.R. 202 / HENNEPIN COUNTY PROJECT 0408
BR 27C53 S.P. 027-596-009

SHEET B25/B26

BOR 8 pw4514 6/11/2018 \\tempo\proj\202.0408.27C53\Bridge\Plan\Borlog.dgn

CONCRETE WEARING COURSE

☐ LOW SLUMP

☐ OTHER _____
TYPE OR MANUFACTURER

EXPANSION JOINTS

JOINT MANUFACTURER

MANUFACTURER'S IDENTIFICATION _____
MFR'S No. AND/OR LETTER DESIGNATION FOR JOINT USED

GLAND MANUFACTURER _____
NAME AND ADDRESS (CITY, STATE)

SIZE OF GLAND _____

MANUFACTURER'S IDENTIFICATION _____
MFR'S No. AND/OR LETTER DESIGNATION FOR GLAND USED

ELASTOMERIC BEARING PADS

PAD MANUFACTURER _____
NAME AND ADDRESS (CITY, STATE)

SPECIAL SURFACE FINISH

SYSTEM: _____ COLOR: _____

FINISHING ROADWAY FACES OF BARRIER RAILING

TYPE: _____ COLOR: _____

ANTI-GRAFFITI COATING

MANUFACTURER _____
NAME AND ADDRESS (CITY, STATE)

PRODUCT NAME: _____ LOCATION: _____

PAINT SYSTEM

Mn/DOT SPECIFICATION NUMBER _____
2478 OR 2479 OR OTHER

MANUFACTURER _____
NAME AND ADDRESS (CITY, STATE)

PRIME COAT _____
Mn/DOT MATERIAL SPECIFICATION NUMBER

INTERMEDIATE COAT _____
Mn/DOT MATERIAL SPECIFICATION NUMBER

FINISH COAT _____ _____
Mn/DOT MATERIAL SPECIFICATION NUMBER COLOR

PLAN QUALITY

RATE 1 (AGREE), 2 (NEUTRAL), OR 3 (DISAGREE, PLEASE COMMENT BELOW)

DIMENSIONING AND DETAILING ADEQUATELY DESCRIBED REQUIRED CONSTRUCTION. _____

BAR LISTS AND QUANTITIES WERE TYPICALLY COMPLETE AND FREE OF ERRORS. _____

SCALE OF DRAWINGS AND OVERALL LEGIBILITY OF LINES AND TEXT WAS GOOD. _____

(SB) SPECIAL PROVISIONS ADEQUATELY DESCRIBED SPECIAL WORK AND PAYMENT. _____

COMMENTS: _____

NUMBER OF BRIDGE SUPPLEMENTAL AGREEMENTS: _____ COST: $ _____

LIST SIGNIFICANT ERRORS OR OMISSIONS IN PLAN DETAILS OR PAY QUANTITIES IN THE SPACE PROVIDED AT RIGHT.

BRIDGE REMOVAL / BRIDGE OPENING

NUMBER OF AND DATE OLD BRIDGE WAS REMOVED (IF APPLICABLE):

BRIDGE NUMBER _____ DATE REMOVED _____

DATE NEW BRIDGE WAS OPENED TO TRAFFIC _____

NOTIFY THE BRIDGE OFFICE BRIDGE MANAGEMENT UNIT WITH THIS INFORMATION AS SOON AS POSSIBLE. (651) 366-4557

OTHER ITEMS ①

① UTILITIES ADDED DURING CONSTRUCTION AND SPECIALTY ITEMS.

FINAL QUANTITIES ENTERED ON SCHEDULE OF QUANTITIES: YES ☐ NO ☐

SUMMARY OF SIGNIFICANT AS-BUILT CHANGES

THE AS-BUILT INFORMATION WAS ADDED TO THE PLAN BY:

_____ _____
INSPECTOR(S) SIGNATURE DATE

CHECKED BY: _____ _____
PROJECT ENGINEER/SUPERVISOR SIGNATURE DATE

AT THE TIME OF THE FINAL, THIS COMPLETED AS-BUILT BRIDGE DATA SHEET MUST BE SUBMITTED TO THE BRIDGE OFFICE - ATTN: REGIONAL CONSTRUCTION ENGINEER (MS610).

REVISION: 10-28-2008

APPROVED: SEPTEMBER 26, 2003
STATE BRIDGE ENGINEER

AS-BUILT DETAILS
(AS NEEDED)

FIG. 5-397.900

CERTIFIED BY _____
JOHN D. EKOLA, PROFESSIONAL ENGINEER
LIC. NO. 53076 05/11/18

TITLE: AS-BUILT BRIDGE DATA
S.P. 027-596-009

DES: TSM	DR: TSM	APPROVED:	BRIDGE NO. 27C53
CHK: JDE	CHK: JLS		
SHEET NO. B26 OF B26 SHEETS			

Default pw4519 6/11/2018 \\tempo\proj\202.0408.27C53\Bridge\Plan\as-build_bridge_data.dgn

INDEX TO DIVISION SB

DIVISION SB

Section No.	Item	Page No.
HERE		

BRIDGE PLANS

The plans for this project, consisting of the sheets tabulated below, were approved by the State Bridge Engineer.

BRIDGE NO.	TOTAL SHEETS	SHEET NO.	DATE OF APPROVAL
27C53	26	B1-B26	

New or revised sheets were approved as listed below:

BRIDGE NO.	SHEET NO.	DATE OF APPROVAL

DIVISION SB

SB-1 **BRIDGE PLANS**

SB-2 **(1502) PLANS AND WORKING DRAWINGS**

SB-3 **(1513) RESTRICTIONS ON MOVEMENT AND STORAGE OF HEAVY LOADS AND EQUIPMENT**

SB-4 **(1706) EMPLOYEE HEALTH AND WELFARE**

SB-5 **(2104) REMOVAL OF ASBESTOS AND REGULATED WASTE (BRIDGE)**

SB-6 **(2105) BRIDGE ABTUMENT CONSTRUCTION**

SB-7 **(2360) PLANT MIXED ASPHALT PAVEMENT**

SB-8 **(2402) STEEL BRIDGE CONSTRUCTION**

SB-9 **(2403) TIMBER BRIDGE CONSTRUCTION**

SB-10 **(2442) REMOVAL OF EXISTING BRIDGES**

SB-11 **(2451) STRUCTURE EXCAVATIONS AND BACKFILLS**

SB-12 **(2452) PILING**

SB-13 **(2511) RIPRAP**

SB-14 **(3371) STEEL SHELLS FOR CONCRETE PILING**

SB-15 **(3391) FASTENERS**

SB-1 BRIDGE PLANS

Plans of existing structures are available at the Minnesota Department of Transportation, Bridge Office, 3485 Hadley Ave N, Oakdale, MN, 55128-3307, for review and inspection by bidders; electronic copies are also available for viewing, printing and downloading on the MnDOT Consumer Access eDOCS (Electronic Document Management System) at http://dotapp7.dot.state.mn.us/eDIGS_guest/DMResultSet/. However, the state neither warrants nor represents that existing structures conform exactly to the details shown in those plans.

SB-2 (1502) PLANS AND WORKING DRAWINGS

The provisions of 1502, "Plans and Working Drawings," are supplemented as follows:

The Department will provide revised bridge drawings, bridge specifications, or provide bridge engineering analysis for the Contractor's means and methods if:

1. Deemed necessary by the Department, in its sole discretion, to rectify materials or workmanship not meeting specifications, or
2. Requested by the Contractor in writing.

The Department may, its option, perform the work with its own staff, or by engaging a consultant pre-qualified by the Department for Work Type 3.1 "Bridge and Structure Design". If the Department is unable to perform the work, the Department may require the Contractor to have the work performed by a consultant acceptable to the Department.

If the Department performs further bridge engineering studies, bridge redesign, or provides additional bridge engineering analysis, the Contractor must reimburse the costs incurred by the Department. Work performed by the Department will be charged at actual hourly rates of pay (including overtime premium when applicable) and customary additives and overhead. Work performed by a consultant will be charged at the amount invoiced by the consultant. The Department will prepare a Change Order for reimbursement, and will deduct the costs from any payment(s) due the Contractor.

When such work is performed by the Department or its consultant, the work will be considered a review for the Department's own purposes, and will not be considered work commissioned by the Contractor.

SB-3 (1513) RESTRICTIONS ON MOVEMENT AND STORAGE OF HEAVY LOADS AND EQUIPMENT

The Contractor shall haul Materials and move and store equipment in accordance with the Highway Traffic Regulation Act and applicable provisions of Minnesota Rules when using public Roads or completed Structures, base courses, and pavements within the Project that are open to traffic and becoming a part of the permanent improvement.

The Contractor shall comply with legal load restrictions and with special restrictions required by the Contract when hauling or storing Materials and moving or storing equipment on Structures, completed Subgrades, base courses, and pavements within the Project, under construction or completed but not yet open to traffic.

The Contractor shall complete and place a cab card in each vehicle used for hauling bituminous mixture, aggregate, batch concrete, and grading material (including borrow and excess) before starting work. This cab card shall identify the truck or tractor and trailer by Minnesota or prorated license number and shall contain the tare, maximum allowable legal gross mass, supporting information, and the signature of the owner. The Contractor shall make the card available to the Engineer upon request. The Contract Unit Prices include Contractor-related costs in providing, verifying, and spot checking the cab card information, including weighing empty and loaded trucks on certified commercial scales.

The Contractor shall not operate equipment mounted on crawler tracks or steel tired wheels on or across concrete or bituminous surfaces.

When construction operations require crossing an existing pavement, Bridges, or completed portions of the Pavement Structure with otherwise prohibited equipment or loads, the Contractor shall submit methods or load distribution or bridging in writing and obtain the Engineer's written approval. This approval does not relieve the Contractor of responsibility for any damages to the work.

The Contractor will not be relieved of liability for damages resulting from the operation and movement of construction equipment because of the issuance of a special permit, or by adherence to any other restrictions imposed.

The Contractor may temporarily store or park construction Materials and Equipment on a Bridge deck during Bridge construction. Storage of Materials and Equipment shall be limited as follows:

1. No stockpiles
2. No individual stockpiles of Materials
3. No single vehicle or equipment
4. No combination vehicles, materials, and other equipment

If loading exceeds the above defined limits, the Contractor shall submit the proposed loads and structural analysis of the deck and beams certified by a Professional Engineer to the Bridge Engineer for the Bridge Engineer’s review within a minimum of 7 calendar days before placement of loads.

SB-4 (1706) EMPLOYEE HEALTH AND WELFARE

The provisions of 1706, "Employee Health and Welfare," are supplemented as follows:

The Contractor shall submit a safety plan at the preconstruction conference providing all OSHA required safety equipment (safety nets, static lines, false decks, etc.) for all work areas whose working surface is 6 feet or more above the ground, water, or other surface. Submittal of this plan will in no way relieve the Contractor of his/her responsibility for providing a safe working area.

All safety equipment, in accordance with the Contractor's plan, must be in place and operable in adequate time to allow Department personnel to perform their required inspection duties at the appropriate time. Don’t place concrete in any areas affected by such required inspection until the inspection has been completed.

The installation of safety lines, safety nets, or other systems whose purpose is to reduce the hazards of bridge work may require the attachment of anchorage devices to beams, girders, diaphragms, bracing or other components of the structure. Clamp type anchorage systems which do not require modification of structural members may be used, provided they do not interfere with proper execution of the work; if using an anchorage system which requires modification of structural members, request approval, in writing, for plan modifications as provided in MnDOT specifications. Requests to install systems which require field welding or drilling of primary stress carrying members of a bridge will not be approved. The Contractor shall indicate any portions of anchorage devices which will remain permanently in the structure.

On both ends of each pier cap extending 6 feet or more above the ground, the Contractor shall install an insert or other suitable anchorage to which safety lines can be attached. Remove any portion of said device extending outside the finished lines of the pier cap unless otherwise approved by the Engineer. The Contractor shall repair or seal any void or cavity resulting from the installation or removal of this device to prevent the ponding or entry of water as directed by the Engineer.

The Contractor shall furnish, install and remove approved anchorage systems at no increased cost to the state for materials, fabrication, erection, or removal of the bridge component or anchorage system.

SB-5 REMOVAL OF ASBESTOS AND REGULATED WASTE (BRIDGE)

Remove and dispose of any regulated waste found on existing bridges or from the utilities located on the bridge in accordance with the applicable MnDOT Standard Specifications and the following:

If, during the course of removal or renovation of utility or bridge, additional asbestos materials or regulated wastes other than that noted in the Assessment Summary are encountered, notify the Project Engineer to suspend work and furnish a documented inspection and evaluation by a MnDOT approved certified MDH contractor prior to resuming work. The work, as outlined in this paragraph, will be paid for as Extra Work.

Dispose of all asbestos and/or regulated waste in accordance with MnDOT's manual. Only those listed in this manual as pre-approved for asbestos and/or regulated waste will be allowed to work on this project. Use MnDOT approved companies for testing, waste transport and disposal as provided and described in MnDOT's manual "*Asbestos and Regulated Waste Manual For Structure Demolition Or Relocations for Construction Projects*" available on the following website: http://www.dot.state.mn.us/environment/buildingbridge/index.html. Contact Mark Vogel at 651.366.3630 or Jackie Klein at 651.366.3637, Office of Environmental Stewardship, 651.366.3630, with any questions regarding the manual.

A pre-activity meeting will be conducted to outline the action items to the satisfaction of the Engineer prior to removing any regulated materials and any bridge renovation or demolition activities.

All material shall be removed, identified, and disposed of in accordance with Section S-1701 (LAWS TO BE OBSERVED (BRIDGE)) of these Special Provisions. Permission to begin the regulated waste removals, with the exception of material needed for hazardous and regulated waste assessment or testing, will not be granted until the Engineer has copies of all required notices.

Permission to proceed with the demolition or renovation of bridges will not be granted until the Engineer has received copies of all required notifications as indicated in Section S-1701 (LAWS TO BE OBSERVED (BRIDGE)) of these Special Provisions.

Notify any utility owners at least three (3) days prior to the removal of any regulated waste which may affect the utility, allowing the utility owner time to have a representative on site.

See the attached "Asbestos and Regulated Waste Inspection Report" for information on whether or not asbestos or regulated waste was detected in the bridge(s) to be removed or renovated.

The assessment summary along with the plan or Special Provisions is intended for informational purposes. Quantity, type and analysis of any asbestos or regulated waste containing material are estimates intended as a general guide.

No measurement will be made of any portion of the asbestos or regulated waste material removal, but the complete removal thereof as specified shall be construed to be included in the single lump sum for which payment is made under Item 2104.601 "REMOVE REGULATED WASTE MATERIAL (BRIDGE)".

SB-6 BRIDGE ABUTMENT CONSTRUCTION

Do not start construction of each abutment until (at least 72 hours after) the approach fill at that abutment has been constructed to the full height and cross section.

SB-7 PLANT MIXED ASPHALT PAVEMENT

MnDOT Spec. 2360, and the following shall apply:

This work consists of installing the bituminous wear course on the timber structure. A waterproof reinforcing membrane is required prior to paving surface. The following conditions shall be followed:

- The bridge deck shall be clean and clear of all aggregate, debris and dirt prior to installation.
- The bridge deck shall be dry prior to paving.
- A tack coat will be applied to the timber deck followed by the waterproof membrane.
- A base layer of bituminous (no thicker than one inch) will be applied to the deck after the tack coat and compacted. It will likely require hand rolling and tamping at the bituminous edge.
- The bituminous needs to cool to 175-200 degrees F prior to adding the waterproof membrane.
- The waterproof membrane should be rolled out on the top of the base layer and go to within 1 inch of the bituminous edge. A broom can be used to smooth the surface as it is rolled out. Various roll sizes are available. Overlap should be two inches on the edges and 4 inches on the ends. The wrap should extend 10 ft beyond the bridge deck. A plastic release paper is on the bottom side of the membrane and can be removed by pulling at a 45 degree angle as the product is rolled out. Pressure rolling should be done to ensure contact, especially at overlapped seams.
- The wear course of bituminous should be applied at between 275-300F.
- No mastic is required when use with bituminous.
- The Contractor shall confirm these installation methods with the waterproof membrane supplier.

The following items are an acceptable waterproofing membrane for timber bridge decks:

1. ProtectoWrap 440A
2. TenCate – Mirafi – Miratak self adhearing waterproofing membrane
3. Or Engineer approved equivalent

The procurement, preparation of timber deck and installation of the timber wear course, waterproof membrane and tack coat shall be incidental to Item No. 2403.618 “GLUED LAMINATED DECK PANELS”.

SB-8 (2402) STEEL BRIDGE CONSTRUCTION

The provisions of 2402, "Steel Bridge Construction," are supplemented with the following:

SB-8.1 Connections

Delete the last paragraph of section 2402.3.B.2, "High Strength Fasteners," and add the following:

Before fasteners are delivered to the bridge site, provide documentation of rotational capacity (ROCAP) testing in accordance with ASTM F3125, Supplementary Requirement S4, "Rotational Capacity Testing". The fasteners must be received in packages that match the fastener assembly combination as tested. If documentation of ROCAP testing is not received; then perform this testing in the field prior to installation.

Before installation, ensure that the fastener condition has not changed due to weathering, mixture of tested assembly lots, or other reasons. In the event that changes have occurred, the Engineer will require re-qualification using ROCAP testing in the field for a minimum of three fastener assemblies of each combination to be used in permanent bolting.

Add the following after the third paragraph of section 2402.3.G.2.c(1), "Bolt Tension":

Perform Pre-Installation Verification (PIV) testing on all bolted connections requiring the use of Direct Tension Indicator (DTI) washers. DTIs will be required as indicated elsewhere in this Proposal. To enable more accurate bolt tensioning, the Contractor **may** propose precision bolting systems. A precision bolting system is defined as the use of tools that have been calibrated to produce repeatable results in conjunction with an installation plan that addresses snugging and tensioning of a connection.

Provide the Engineer with a detailed job-specific fastener installation plan at least four weeks before the start of steel erection. The plan will include PIV testing in accordance with the Research Council on Structural Connections (RCSC), "Specification for Structural Joints Using High-Strength Bolts" (http://www.boltcouncil.org). PIV testing requires the use of a properly calibrated hydraulic load cell in order to verify the following in the field prior to permanent bolting:

1. Ensuring the bolt crew is familiar with tightening procedures;
2. Ensuring tools and equipment are capable of performing adequately;
3. Ensuring structural bolting assemblies (including lubrication) are in suitable condition for proper bolting procedure and achieving needed results; and
4. Expanding a greater range of acceptance criteria [2402.3 G.2.d(3)] when utilized with precision bolting systems for snugging and final tightening, respectively.

For bolts that are too short to utilize a calibrated hydraulic load cell, calibrated DTIs will be used as a load cell. Once the DTIs have been calibrated, test the fastener assembly in a steel plate of similar thickness to that used in the permanent condition. Refer to the previously referenced RCSC Specification for more detail, except only one calibrated DTI needs to be used in the fastener assembly for each PIV test.

Perform PIV testing on at least three complete fastener assemblies of each combinations of diameter, length, grade, and lot to be used in the work. PIV testing must be performed no earlier than two weeks prior to permanent bolting. The fastener installation plan will be updated with the results from the PIV testing. The hydraulic load cell must have been calibrated within one year of the date of use in order to be used for PIV testing.

Add the following to section 2402.3.G.2.c, "Installation":

G.2.c(5) Quality Management for Installation

Develop a Quality Control plan that includes at a minimum the following items:

1. Materials tracking process for components of fastener assemblies (bolts, nuts, washers, etc.);
2. Procedure for tracking when permanent bolts were installed and when final tensioning occurred;
3. Record keeping of final tensioning and DTI readings;
4. Develop a snugging and tensioning sequence for each connection detail;
5. Develop a procedure that ensures the Contractor’s Quality Manager Staff will verify the fastener installation plans were followed;

6. Lists the Contractor's staff that will be performing the work using the precision bolting system tools. Include details of relevant training, experience, or both for each individual; and
7. Develop a procedure Pre-Installation Verification (PIV) tests for each lot shipped to the project site prior to installation of the permanent bolt assemblies.

Additional ROCAP and PIV tests are required whenever the condition of the fasteners is in question by the Engineer or the condition changes from when the initial ROCAP or PIV tests were performed. In the event field ROCAP testing is required, follow the procedure described in Annex A2 of ASTM F3125.

Submit Quality Control plan to Engineer at least four weeks before the start of steel erection.

Add the following to the end of section 2402.3.G.2.d(3), "Inspection Procedure for Direct Tension Indicators (DTI)":

Use the following procedure for inspection when bolting operations utilize PIV testing and precision bolting systems:

1. Verify bolting operations were performed in accordance with the job-specific fastener installation plan;
2. An initial visual inspection of the DTIs after the bolts are snug tight. Remove and replace DTIs with more than half of the protrusions completely crushed during snugging operations and recalibrate snugging procedure; and
3. After final tightening, randomly select 10 percent of the DTIs, but not less than 2 DTIs, in each connection to inspect in accordance with the job-specific fastener installation plan. The appropriate feeler gauge should be refused in at least half of the spaces between DTI protrusions.

SB-8.2 Bolted Connections

Prepare and install all bolted field connections for steel bridges using Direct Tension Indicator (DTI) washers. Ensure DTIs conform to the requirements of 3391, "Fasteners," and ASTM F959. All DTIs must have unique markings to indicate the gap locations between the protrusions and to allow the inspector to visibly differentiate them from a standard washer after installation. Mechanically galvanize supplied DTIs in accordance to 3392, "Galvanized Hardware".

Install fasteners in accordance with the DTI manufacturer's recommendations and 2402, "Steel Bridge Construction," as well as the requirements of AASHTO LRFD Bridge Construction Specifications, Third Edition, Article 11.5.6.4.7 Direct Tension Indicator Installation Method. Ensure a DTI manufacturer's representative is on-site at the beginning of the bolting operations to provide training and ensure proper installation.

Use of DTIs, as described above, are an incidental expense to the structural steel and no direct compensation will be made.

SB-9 (2403) TIMBER BRIDGE CONSTRUCTION

The provisions of 2403, "Timber Bridge Construction," are supplemented as follows:

SB-9.1 Preservative Treatment

All timber in the bridge shall be treated with Copper Naphthenate, or other oil-based treatment as approved by the Engineer, in accordance with Specification 3491 and the current AWPA Standards, according to Best Management Practices.

The spike laminated deck panels and glue laminated crash rail shall be shop drilled and treated to avoid field treatment, see plans.

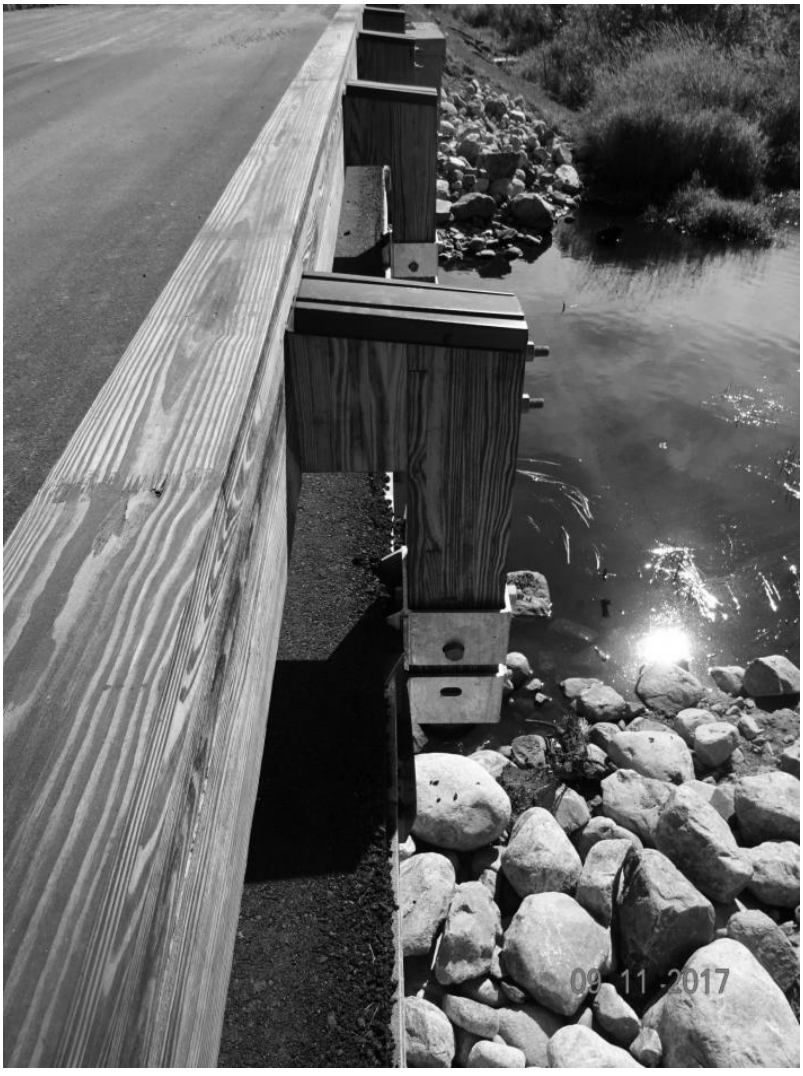
SB-9.2 Glue Laminated Rail Construction Requirements

This work shall consist of the fabrication and installation of glued laminated rails and shall be performed in accordance with the provisions of 2403.3 and the following:

All applicable provisions of 2403.3.N.2 shall apply to flued laminated rail.

Hardware that attaches the Bridge Railing to the Spike Laminated Deck shall be hand tightened only during cold weather and the Contractor will refrain from upsetting the hardware at this time. The Contractor shall then tighten the fasteners at the Engineer's direction once weather permits and upset the hardware at the final torque.

Plastic caps shall be installed on the top of each timber post. The caps shall be purpose built to timber bridge rails to prevent moisture entering the end grain. Protective plastic caps shall be incidental to the Glue Laminated Rail. The caps shall be black in color. See photo below:



SB-9.3 Timber Deck Expansion Material

Contractor to install cork or neoprene padding material that is a minimum of 1/4 inch thick between timber material and steel L brackets located on the top of each abutment and pier. The cost of installation and material shall be incidental to the Glued Laminated Deck, Item No. 2403.618.

SB-9.4 Timber Deck Flashing Material

Contractor to install 26 gag. (minimum) galvanized flashing material on the south edge of the bridge deck for the entire length as noted in the plans. The flashing shall extend a minimum of 3" off the deck to assure rain does not run down the end grain. Vertical flashing shall be installed on all timber curb members to protect each scupper block on the south edge. The cost of installation and material shall be incidental to the Glued Laminated Deck, Item No. 2403.618.

SB-9.5 Method of Measurement

Glued Laminated rails will be measured by the linear foot, based on the out to out length of the rail.

Spike laminated bridge panels will be measured by the square foot.

SB-9.6 Basis of Payment

Payment for flued laminated railing will be made as Item No. 2403.603 "Timber Railing" at the Contract price per linear foot, which shall include compensation for all costs of manufacturing, preserving, hardware, transporting, and installing the timber bridge rails complete in place.

Payment for spike laminated bridge panels will be made as Item No. 2403.618 "Glued Laminated Deck Panels" at the Contract price per square foot, which shall include compensation for all costs of manufacturing, preserving, hardware

SB-10 (2442) REMOVAL OF EXISTING BRIDGES

The provisions of 2442, "Removal of Existing Bridges," are supplemented as follows:

SB-10.1 Removal of Existing Bridges

Add the following to the end of the third paragraph of 2442.3.A, "General":

Completely remove piling and obstructions that interfere with the new structure.

SB-10.2 Supplemental Provisions

Dispose of materials in accordance with 1506, "Supervision By Contractor," 2104.3.C, "Removal Operations," MnDOT Managing regulated materials on building and bridge projects per the Office Of Environmental Stewardship and the following:

Furnish written information to the Engineer as to disposal of steel bridge beams and other steel bridge components coated with paint containing hazardous materials (i.e. Lead or PCB). Include method of stabilization and disposal; name, address, and telephone number of disposal site; certification that Contractor has notified disposal site of presence of the hazardous paint; acknowledgment by Contractor of OSHA requirements relating to lead or PCB; and certification that Contractor is familiar with proper handling and disposal of materials with lead or PCB based paint systems. Stabilize all hazardous paint that has been identified as peeling by coating with an approved product, as listed on the MnDOT Approved Products website www.dot.state.mn.us/products under "Lead Paint Encasement Product". Prevent the peeling paint from flaking off during demolition, or scrape and contain the peeling paint. If the coating option is used apply 16 mils of the product. Applying more than 16 mils of the product on a bridge over any water will require that the bridge have a diaper apron be attached under the bridge to contain the drips. Complete all work as per the MnDOT Office of Environmental Stewardship. The form supplied in this special provision must include the signature of the authorized Superintendent verifying that the information is correct.

NOTIFICATION FORM ON DISPOSAL OF BRIDGE STEEL

The Contractor is required to provide certain information on disposal of bridge steel which has been painted with lead-based paint. By signing this document, the Contractor certifies that information supplied by the Contractor is correct and that the Contractor is familiar with proper handling and disposal of materials with lead-based paint. This information must be furnished to the Project Engineer a minimum of 30 calendar days prior to removal of the bridge steel from the project site. Any change in method or location of disposal would require resubmittal and a 30 calendar day notice.

MnDOT Project No. _____ **Bridge No.** _____

Description of Bridge Steel _____

Paint System is MnDOT Spec. _____ _____
(Primer) **(Top Coat)**

Project Engineer: _____

Contractor/Subcontractor: _____
(Name, mailing address, telephone no.)

_____

I _____ certify that the following information is correct:
(print name of authorized representative)

The above bridge steel will be disposed of by the following method(s): _____
(list name,

_____
address and telephone no. of recipient, estimated delivery date, and intended use.)

_____

_____

I also certify that _____ is familiar with
(Contractor/Subcontractor name)
the requirements in OSHA 29 CFR 1926.62 relating to lead and PCBs, precautions to be taken when working with lead or PCB, and proper handling and disposal of materials with lead-based or PCB-based paint systems and that _____ has been notified of the presence of lead-based or PCB-based paint.
(name of recipient)

_____ _____
(signature) **(date)**

Received by Project Engineer/Inspector: _____ _____
(date) **(signature)**

cc: Project File
Office of Environmental Stewardship

SB-11 (2451) STRUCTURE EXCAVATIONS AND BACKFILLS

The provisions of 2451 are noted here and in Division S - 2451, "Structure Excavations and Backfills," are supplemented as follows:

SB-11.1 Structure Excavation

Excavate, sheet, shore and/or protect, prepare foundation, and place backfill necessary for construction of Bridge(s) No 27C53, which are not specifically included in the grading portion of the Contract. Dispose of surplus material.

Do not measure the excavated or backfill material. All work performed as specified above will be considered to be included in a single lump sum for which payment is made under Item No. 2401.601, "STRUCTURE EXCAVATION".

For purposes of partial payments, the portion of the lump sum Structure Excavation at each substructure unit will be defined as follows:

Bridge 27C53 Each Abutment 25%

Each Pier 25%

SB-11.2 Dewatering

For informational purposes, the current flow conditions under the existing bridge are noted below. This information can be utilized to develop a dewatering plan. All dewatering efforts and material are incidental.

Flow Event	Flow	Flowline Elevation
2 year	451 cfs	859.1 ft.
5 year	889 cfs	860.2 ft.
10 year	1,260 cfs	860.9 ft.
25 year	1,860 cfs	861.6 ft.

SB-12 (2452) PILING

The provisions of 2452, "Piling," are supplemented as follows:

SB-12.1 Commercial Drive Fit Splices for CIP Piling

Commercial drive fit splices will NOT be permitted (on this project) (on Bridge 27C53).

SB-12.2 Piling Furnished and Installed

Modify all references to "piling delivered" and "piling driven" under 2452.3, "Construction Requirements," 2452.4," Method of Measurement," and 2452.5, "Basis of Payment," to read "Piling".

Add the following to the end of 2452.3.E.1, "General":

When the conditions of this section have been met for the **test pile,** the resulting pile cut-off becomes the property of the Contractor.

Delete the following sections 2452.3.G, "Disposal of Pile Cut-Offs," 2452.4.C, "Piling Driven," and 2452.5.C, "Piling Driven".

Replace 2452.4.B, "Piling Delivered," with the following:

The Engineer will measure piling for payment by the length of acceptable piling below cut-off.

Replace 2452.5.B, "Piling Delivered," with the following:

All treated timber piles, untreated timber piles, steel pipe piles, steel H-piles, and concrete piles driven will be paid for by the linear foot. Payment will be made only for the actual number of linear feet of acceptable piling complete in place as needed for design or as directed by the Engineer.

Splices will be compensated at the rate of six (6) times the contract unit price for piling furnished and installed, if the splice was made and only after piling is driven to estimated test pile length for that structure and bearing is not achieved. Maximum of one splice will be paid per pile. No additional payment will be made for splices made solely for the Contractor's convenience.

If the quantity of driven piling is less than the estimated plan quantity, the Department will pay 50% of the cost to re-stock unused piling if the Contractor elects to re-stock piling and provides a paid invoice showing the re-stocking fee not to exceed the difference of estimated pile length in the plan and actual driven length. Payment for the Department's portion of the restocking fee will be made as a backsheet item under "Piling, Restock" superseding any claims due from 1907, "Payment for Surplus Material".

The following costs are included in the cost of the piling:

- predrilling pilot holes;
- pile sleeves;
- maintaining open holes during pile driving;
- broken, bent, damaged, or misplaced piles;
- concrete filling or concrete encasement;
- misplaced pile or corrective location or alignment measures;
- modifying or replacing pile driving equipment;
- redriving piles which have heave more than ¼";
- piles which are damaged during handling or if the Engineer determines that the damage was caused by the Contractor's carelessness or negligence while driving;
- piles which were not driven in accordance with these specifications;
- piles driven with the tops lower than the cut-off elevation;
- spudding or jetting of piles;
- cutting and trimming, and coating steel H-pile and steel shell pile;
- providing and attaching driving shoes for pipe piles;
- all labor, equipment, and necessary incidentals; and
- disposal of all pile cut-offs.

A. Method of Measurement

The Engineer will measure piling by the length of acceptable piling below cut-off elevation.

No additional payment will be made if the Contractor elects to furnish and drive thicker wall pipe piles than specified.

The cost of mobilization and demobilization for pile driving operations is included in the cost of mobilization and demobilization in accordance with 2452.5, "Basis of Payment".

The cost to control sediment in water from jetting operations is included in the cost of piling.

B. Basis of Payment

Payment for Item No. 2452.603 "C-I-P CONCRETE PILING 12" & Item No. 2452.603 "C-I-P CONCRETE PILING 16" will be made at the Contract unit price per linear foot and shall be compensation in full for furnishing and installing the Piling complete and inplace as described above, including all incidentals thereto.

SB-12.3 Pile Coating

The provisions of 2452.3.J, "Coating Steel H Piles and Steel Pile Shells," are modified as follows:

Delete 2452.3.J.2, "Galvanized Piles."

The Steel Pile Shells shall be coated with Federal Standard 595C No. 17038 (black) in a semi-gloss finish. All references to federal colors in provision 2452.3J1 shall be replaced with Federal Standard 595C No. 17038 (black) in semi-gloss finish. The steel sheet piling & miscellaneous steel components listed on plan sheets B4 through B9 are not to be painted.

SB-12.4 STEEL SHEET PILING

This work shall consist of furnishing and driving steel sheet piling in accordance with MnDOT 2452, at the locations and details in the Plans, and the following:

a. The Contractor shall furnish and place new steel sheet piling required in the Contract or by the Engineer. USED SHEET PILING WILL NOT BE ACCEPTED.

b. Measurement will be made by the total area in square feet of sheet piling that is necessary for the intended use. The Engineer may order a different area prior to driving the piling based on field conditions.

Payment will be made under Item 2452.618 (Steel Sheet Piling) at the Contract bid price per square foot, which shall be compensation in full for all costs of, furnishing and installing acceptable piling.

SB-13 (2511) RIPRAP

The provisions of 2511, "Riprap," apply in addition to:

All riprap placement above the normal water line shall be installed as root rap. Per 2577 specification and Root Rap Guidance document in appendix, root rap shall be rip rap material in conjunction with compost material and seeding. Root rap material will be compensated with item Nos. 2511.504 “Geotextile Filter Type 7”, 2511.507 “Random Riprap Class IV”, 2574.507 “Compost Grade 3”, 2574.508 “Fertilizer Type 4” & 2575.508 “Seed Mixture 35-241”. Root rap procurement, placement and cleanup costs shall be incidental to Item No. 2574.507 “Compost Grade 3”.

SB-14 (3371) STEEL SHELLS FOR CONCRETE PILING

The provisions of 3371, "Steel Shells for Concrete Piling," are supplemented as follows:

Supplement the fourth paragraph of 3371.2, "Requirements," with the following:

Give pipe containing a non-permissible irregularity as described above one of the following dispositions:

1. Remove the non-permissible irregularity by grinding in such a way that the ground area blends in smoothly with the contour of the pipe. Ensure the wall thickness in the ground area is not adversely affected. Smoothly contoured welds with a clean appearance need not be ground flush. The only permissible irregularity will be one caused from the original manufacturing of the pipe (e.g. weld seam of a Double Submerge Arc Weld process), or a field weld that has a clean appearance.
2. Cut off the section of pipe containing the non-permissible irregularity.
3. The entire pipe containing a non-permissible irregularity may be rejected at the Engineer's discretion.

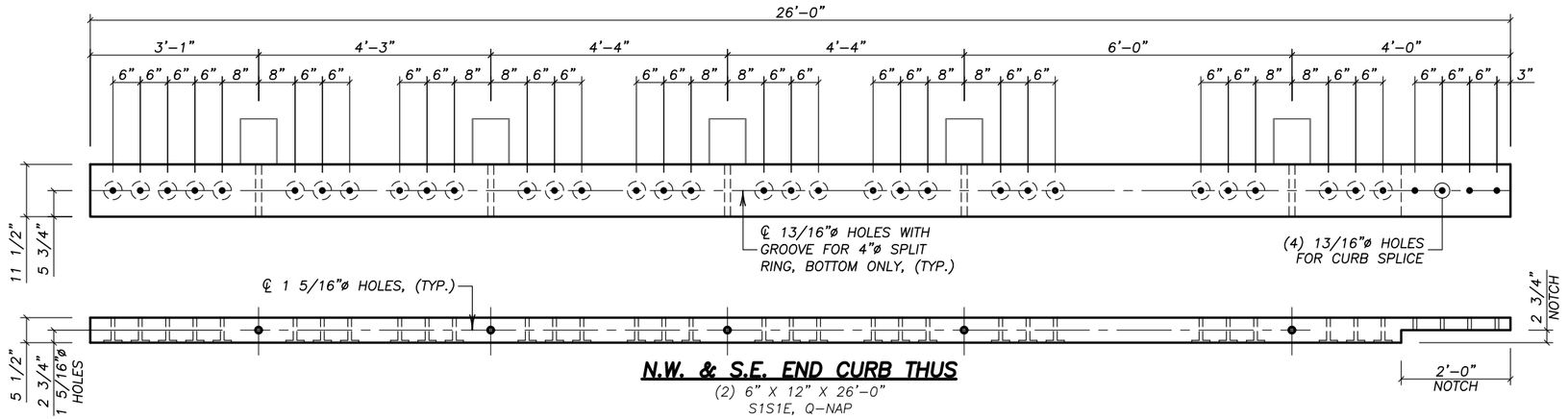
SB-15 (3391) FASTENERS

Add the following after the third paragraph of section 3391.2.B, "High Strength Structural Steel Bolts":

For bolts meeting the requirements of ASTM F3125, "Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions," include Supplementary Requirement S4 "Rotational Capacity Testing". Ship required documentation with the fastener assemblies and provided to the Engineer.

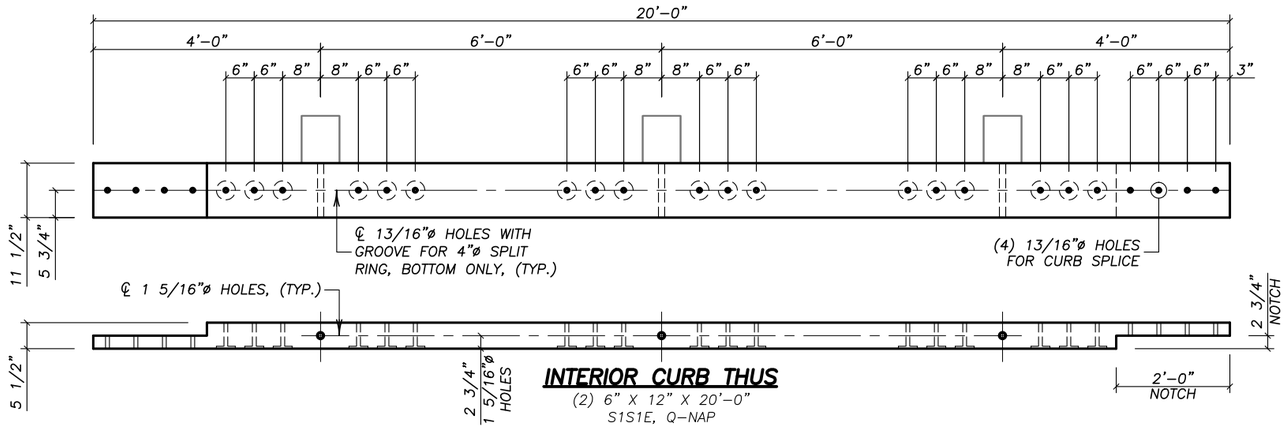
APPENDIX C. Contract Bid Abstract

2040800 - CR 202- ELM CREEK BRIDGE REPLACEMENT				Redstone Construction, LLC		Meyer Contracting Inc.		Edward Kraemer & Sons, Inc.		S.M. Hentges & Sons, Inc.		Robert R. Schroeder Construction, Inc.	
Item No.	Item	Units	Quantity	Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total Price	Unit Price	Total Price
2021.501	MOBILIZATION	LUMP SUM	1	$158,000.00	$158,000.00	$68,898.24	$68,898.24	$73,600.00	$73,600.00	$67,750.00	$67,750.00	$305,465.00	$305,465.00
2031.502	FIELD OFFICE TYPE D	EACH	1	$15,000.00	$15,000.00	$10,000.00	$10,000.00	$16,000.00	$16,000.00	$50,000.00	$50,000.00	$40,000.00	$40,000.00
2101.501	CLEARING & GRUBBING	LUMP SUM	1	$9,000.00	$9,000.00	$6,422.00	$6,422.00	$14,000.00	$14,000.00	$6,775.00	$6,775.00	$11,000.00	$11,000.00
2104.502	REMOVE SIGN TYPE C	EACH	18	$35.00	$630.00	$35.00	$630.00	$35.00	$630.00	$36.05	$648.90	$35.00	$630.00
2104.503	REMOVE GUARDRAIL	LIN FT	190	$10.00	$1,900.00	$4.60	$874.00	$4.72	$896.80	$11.00	$2,090.00	$4.72	$896.80
2104.503	REMOVE METAL CULVERT	LIN FT	170	$9.00	$1,530.00	$11.00	$1,870.00	$8.00	$1,360.00	$13.00	$2,210.00	$9.00	$1,530.00
2104.503	SAWING BITUMINOUS PAVEMENT	LIN FT	47	$2.25	$105.75	$2.30	$108.10	$20.00	$940.00	$2.35	$110.45	$8.75	$411.25
2104.504	REMOVE BITUMINOUS PAVEMENT (P)	SQ YD	3,104	$3.75	$11,640.00	$3.10	$9,622.40	$3.80	$11,795.20	$4.50	$13,968.00	$3.85	$11,950.40
2104.601	REMOVE REGULATED WASTE MATERIAL (BRIDGE)	LUMP SUM	1	$2,450.00	$2,450.00	$3,000.00	$3,000.00	$6,000.00	$6,000.00	$3,600.00	$3,600.00	$500.00	$500.00
2105.504	GEOTEXTILE FABRIC TYPE 6	SQ YD	5,190	$2.50	$12,975.00	$2.80	$14,532.00	$2.00	$10,380.00	$2.25	$11,677.50	$2.50	$12,975.00
2105.509	STABILIZING AGGREGATE	TON	100	$40.00	$4,000.00	$30.00	$3,000.00	$39.00	$3,900.00	$19.50	$1,950.00	$40.00	$4,000.00
2106.507	COMMON EMBANKMENT (CV) (P)	CU YD	1,016	$14.00	$14,224.00	$10.00	$10,160.00	$18.72	$19,019.52	$16.50	$16,764.00	$14.00	$14,224.00
2106.507	EXCAVATION - COMMON (P)	CU YD	1,680	$18.50	$31,080.00	$12.25	$20,580.00	$21.86	$36,724.80	$12.50	$21,000.00	$18.50	$31,080.00
2118.509	AGGREGATE SURFACING CLASS 2	TON	196	$54.00	$10,584.00	$33.50	$6,566.00	$21.90	$4,292.40	$35.00	$6,860.00	$54.00	$10,584.00
2123.61	STREET SWEEPER (WITH PICKUP BROOM)	HOUR	20	$130.00	$2,600.00	$138.00	$2,760.00	$130.00	$2,600.00	$165.00	$3,300.00	$130.00	$2,600.00
2130.523	WATER	M GALLON	6	$250.00	$1,500.00	$35.00	$210.00	$50.00	$300.00	$50.00	$300.00	$250.00	$1,500.00
2131.506	CALCIUM CHLORIDE SOLUTION	GALLON	185	$5.00	$925.00	$1.00	$185.00	$2.00	$370.00	$1.00	$185.00	$5.00	$925.00
2211.509	AGGREGATE BASE CLASS 5 (P)	TON	1,483	$32.50	$48,197.50	$19.00	$28,177.00	$14.42	$21,384.86	$22.00	$32,626.00	$32.50	$48,197.50
2360.509	TYPE SP 12.5 WEARING COURSE MIX (3;C)	TON	933	$87.00	$81,171.00	$93.00	$86,769.00	$93.00	$86,769.00	$95.50	$89,101.50	$87.00	$81,171.00
2401.601	STRUCTURE EXCAVATION	LUMP SUM	1	$25,000.00	$25,000.00	$117,334.41	$117,334.41	$30,800.00	$30,800.00	$81,550.00	$81,550.00	$18,000.00	$18,000.00
2402.508	STRUCTURAL STEEL (3309) (P)	POUND	23,038	$3.25	$74,873.50	$2.60	$59,898.80	$5.08	$117,033.04	$4.35	$100,215.30	$4.00	$92,152.00
2403.603	TIMBER RAILING (P)	LIN FT	136	$350.00	$47,600.00	$549.00	$74,664.00	$726.00	$98,736.00	$780.00	$106,080.00	$640.00	$87,040.00
2403.618	GLUED LAMINATED DECK PANELS (P)	SQ FT	2,720	$105.00	$285,600.00	$108.50	$295,120.00	$100.00	$272,000.00	$116.50	$316,880.00	$110.00	$299,200.00
2442.501	REMOVE EXISTING BRIDGE	LUMP SUM	1	$30,000.00	$30,000.00	$6,752.00	$6,752.00	$45,000.00	$45,000.00	$38,500.00	$38,500.00	$15,000.00	$15,000.00
2452.502	PILE POINTS 16"	EACH	16	$345.00	$5,520.00	$310.50	$4,968.00	$375.00	$6,000.00	$300.00	$4,800.00	$320.00	$5,120.00
2452.502	C-I-P CONC TEST PILE 85 FT LONG 12" (P)	EACH	2	$10,000.00	$20,000.00	$7,562.00	$15,124.00	$7,000.00	$14,000.00	$8,000.00	$16,000.00	$12,000.00	$24,000.00
2452.502	PILE REDRIVING	EACH	32	$250.00	$8,000.00	$650.00	$20,800.00	$510.00	$16,320.00	$150.00	$4,800.00	$150.00	$4,800.00
2452.502	C-I-P CONC TEST PILE 85 FT LONG 16" (P)	EACH	2	$12,000.00	$24,000.00	$9,949.00	$19,898.00	$8,500.00	$17,000.00	$9,000.00	$18,000.00	$20,000.00	$40,000.00
2452.502	PILE POINTS 12"	EACH	16	$240.00	$3,840.00	$252.50	$4,040.00	$265.00	$4,240.00	$250.00	$4,000.00	$220.00	$3,520.00
2452.502	PILE ANALYSIS	EACH	2	$2,200.00	$4,400.00	$3,907.00	$7,814.00	$2,750.00	$5,500.00	$2,300.00	$4,600.00	$2,000.00	$4,000.00
2452.603	C-I-P CONCRETE PILING 16"	LIN FT	1,190	$55.00	$65,450.00	$102.50	$121,975.00	$78.00	$92,820.00	$70.00	$83,300.00	$63.00	$74,970.00
2452.603	C-I-P CONCRETE PILING 12"	LIN FT	1,190	$40.00	$47,600.00	$64.50	$76,755.00	$56.00	$66,640.00	$48.00	$57,120.00	$38.00	$45,220.00
2452.618	STEEL SHEET PILING (P)	SQ FT	2,430	$36.00	$87,480.00	$35.25	$85,657.50	$30.00	$72,900.00	$27.00	$65,610.00	$36.00	$87,480.00
2501.502	28" SPAN CAS PIPE-ARCH APRON	EACH	2	$2,000.00	$4,000.00	$761.50	$1,523.00	$4,800.00	$9,600.00	$2,175.00	$4,350.00	$2,000.00	$4,000.00
2501.502	18" RC PIPE APRON	EACH	2	$1,500.00	$3,000.00	$1,131.00	$2,262.00	$1,900.00	$3,800.00	$1,460.00	$2,920.00	$1,500.00	$3,000.00
2501.502	24" RC PIPE APRON	EACH	4	$1,850.00	$7,400.00	$1,218.00	$4,872.00	$2,800.00	$11,200.00	$2,085.00	$8,340.00	$1,850.00	$7,400.00
2501.503	18" RC PIPE CULVERT DES 3006 CL III	LIN FT	52	$76.00	$3,952.00	$54.50	$2,834.00	$100.00	$5,200.00	$57.50	$2,990.00	$76.00	$3,952.00
2501.503	24" RC PIPE CULVERT CLASS III	LIN FT	96	$82.50	$7,920.00	$62.50	$6,000.00	$112.00	$10,752.00	$66.50	$6,384.00	$82.50	$7,920.00
2501.603	28" SPAN PIPE-ARCH CULVERT	LIN FT	44	$140.00	$6,160.00	$47.00	$2,068.00	$170.00	$7,480.00	$117.50	$5,170.00	$140.00	$6,160.00
2502.502	4" PRECAST CONCRETE HEADWALL	EACH	4	$375.00	$1,500.00	$257.50	$1,030.00	$150.00	$600.00	$240.00	$960.00	$375.00	$1,500.00
2502.503	4" PERF TP PIPE DRAIN	LIN FT	1,000	$13.00	$13,000.00	$11.25	$11,250.00	$8.00	$8,000.00	$14.50	$14,500.00	$13.10	$13,100.00
2511.504	GEOTEXTILE FILTER TYPE 7	SQ YD	1,050	$2.75	$2,887.50	$1.80	$1,890.00	$6.00	$6,300.00	$3.25	$3,412.50	$4.00	$4,200.00
2511.507	RANDOM RIPRAP CLASS IV	CU YD	830	$80.00	$66,400.00	$74.50	$61,835.00	$105.00	$87,150.00	$92.50	$76,775.00	$90.00	$74,700.00
2533.503	PORTABLE PRECAST CONC BARRIER DES 8337	LIN FT	50	$30.00	$1,500.00	$30.00	$1,500.00	$30.00	$1,500.00	$31.00	$1,550.00	$30.00	$1,500.00
2554.502	END TREATMENT-ENERGY ABSORBING TERMINAL	EACH	1	$3,500.00	$3,500.00	$2,975.00	$2,975.00	$2,921.44	$2,921.44	$3,605.00	$3,605.00	$2,921.44	$2,921.44
2554.502	ANCHORAGE ASSEMBLY - TYPE 31	EACH	3	$1,500.00	$4,500.00	$1,115.00	$3,345.00	$1,204.52	$3,613.56	$1,545.00	$4,635.00	$1,204.52	$3,613.56
2554.503	TRAFFIC BARRIER DESIGN TYPE 31	LIN FT	491	$25.00	$12,275.00	$30.50	$14,975.50	$23.62	$11,597.42	$25.75	$12,643.25	$23.62	$11,597.42
2554.503	TRAFFIC BARRIER DESIGN TRANS TYPE 31	LIN FT	100	$130.00	$13,000.00	$135.50	$13,550.00	$102.13	$10,213.00	$134.00	$13,400.00	$102.13	$10,213.00
2563.601	TRAFFIC CONTROL	LUMP SUM	1	$27,500.00	$27,500.00	$30,000.00	$30,000.00	$24,000.00	$24,000.00	$26,500.00	$26,500.00	$24,000.00	$24,000.00
2563.601	TRAFFIC CONTROL SUPERVISOR	LUMP SUM	1	$3,400.00	$3,400.00	$2,000.00	$2,000.00	$6,000.00	$6,000.00	$15,000.00	$15,000.00	$2,000.00	$2,000.00
2563.613	PORTABLE CHANGEABLE MESSAGE SIGN	UNIT DAY	40	$50.00	$2,000.00	$50.00	$2,000.00	$50.00	$2,000.00	$51.50	$2,060.00	$50.00	$2,000.00
2564.518	SIGN PANELS TYPE C	SQ FT	36.3	$60.00	$2,178.00	$60.00	$2,178.00	$60.00	$2,178.00	$62.00	$2,250.60	$60.00	$2,178.00
2572.503	TEMPORARY FENCE	LIN FT	500	$3.00	$1,500.00	$0.50	$250.00	$8.00	$4,000.00	$3.30	$1,650.00	$3.10	$1,550.00
2573.501	EROSION CONTROL SUPERVISOR	LUMP SUM	1	$1,500.00	$1,500.00	$2,000.00	$2,000.00	$500.00	$500.00	$5,000.00	$5,000.00	$500.00	$500.00
2573.502	STORM DRAIN INLET PROTECTION	EACH	4	$200.00	$800.00	$75.00	$300.00	$200.00	$800.00	$206.00	$824.00	$225.00	$900.00
2573.503	SILT FENCE; TYPE MS	LIN FT	820	$5.25	$4,305.00	$2.00	$1,640.00	$2.45	$2,009.00	$2.50	$2,050.00	$5.25	$4,305.00
2573.503	SILT FENCE; TYPE SD	LIN FT	250	$25.00	$6,250.00	$32.00	$8,000.00	$20.00	$5,000.00	$18.50	$4,625.00	$35.00	$8,750.00
2573.503	SILT FENCE; TYPE HI	LIN FT	1,540	$6.75	$10,395.00	$6.00	$9,240.00	$4.50	$6,930.00	$4.65	$7,161.00	$6.85	$10,549.00
2573.503	FLOTATION SILT CURTAIN TYPE MOVING WATER	LIN FT	448	$36.50	$16,352.00	$20.00	$8,960.00	$26.00	$11,648.00	$26.75	$11,984.00	$36.50	$16,352.00
2573.51	SEDIMENT REMOVAL BACKHOE	HOUR	10	$145.00	$1,450.00	$75.00	$750.00	$225.00	$2,250.00	$190.00	$1,900.00	$145.00	$1,450.00
2574.507	COMPOST GRADE 3	CU YD	175	$100.00	$17,500.00	$57.00	$9,975.00	$52.00	$9,100.00	$51.00	$8,925.00	$100.00	$17,500.00
2574.508	FERTILIZER TYPE 4	POUND	100	$1.00	$100.00	$0.85	$85.00	$1.00	$100.00	$1.05	$105.00	$1.00	$100.00
2575.504	EROSION CONTROL BLANKETS CATEGORY 3N	SQ YD	2,615	$1.95	$5,099.25	$1.50	$3,922.50	$2.20	$5,753.00	$2.30	$6,014.50	$1.95	$5,099.25
2575.504	RAPID STABILIZATION METHOD 4	SQ YD	2,787	$2.00	$5,574.00	$1.80	$5,016.60	$2.00	$5,574.00	$2.05	$5,713.35	$2.00	$5,574.00
2575.508	SEED MIXTURE 35-241	POUND	30	$20.00	$600.00	$15.75	$472.50	$17.00	$510.00	$17.50	$525.00	$20.00	$600.00
2582.503	4" DBLE SOLID LINE MULTI COMP GR IN	LIN FT	1,170	$1.89	$2,211.30	$1.90	$2,223.00	$1.89	$2,211.30	$1.95	$2,281.50	$2.00	$2,340.00
Contract Total:					**$1,396,584.80**		**$1,406,086.55**		**$1,440,442.34**		**$1,498,575.35**		**$1,641,666.62**



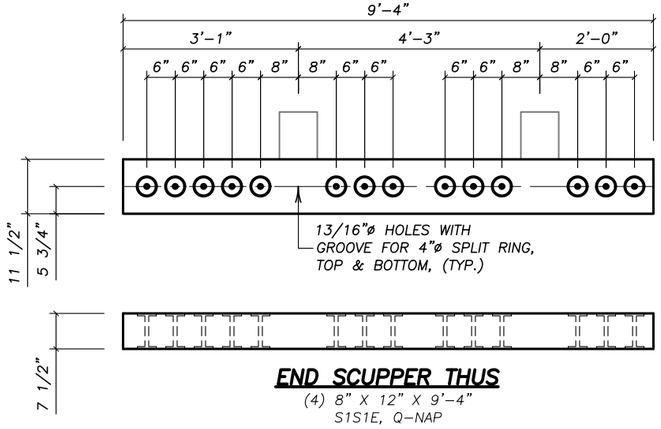
N.W. & S.E. END CURB THUS

(2) 6" X 12" X 26'-0"
S1S1E, Q-NAP



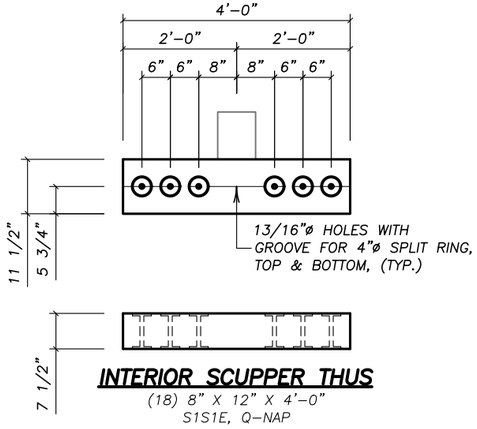
INTERIOR CURB THUS

(2) 6" X 12" X 20'-0"
S1S1E, Q-NAP



END SCUPPER THUS

(4) 8" X 12" X 9'-4"
S1S1E, Q-NAP



INTERIOR SCUPPER THUS

(18) 8" X 12" X 4'-0"
S1S1E, Q-NAP

MATCHMARK
MATCHMARK CORRESPONDING CURBS & SCUPPERS

SHEET TITLE:

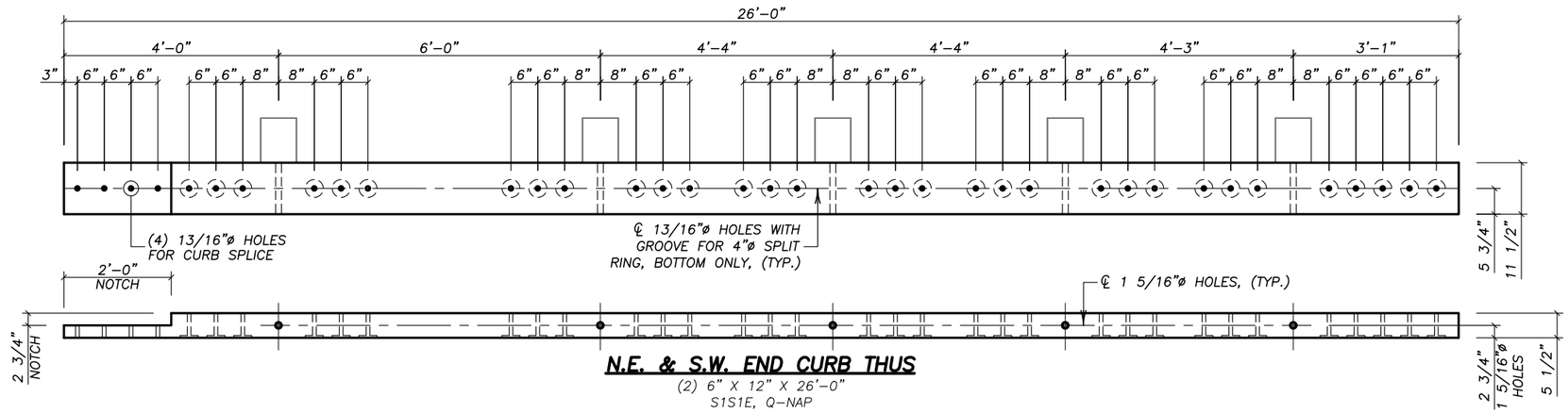
TIMBER PREFRAMING

18'/32'/18' TREATED TIMBER SPANS
40'-0" OUT TO OUT OF DECKS
C.R.202 BRIDGE NO.27C53
HENNEPIN COUNTY, MINNESOTA

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952-929-7854
info@wheeler1892.com
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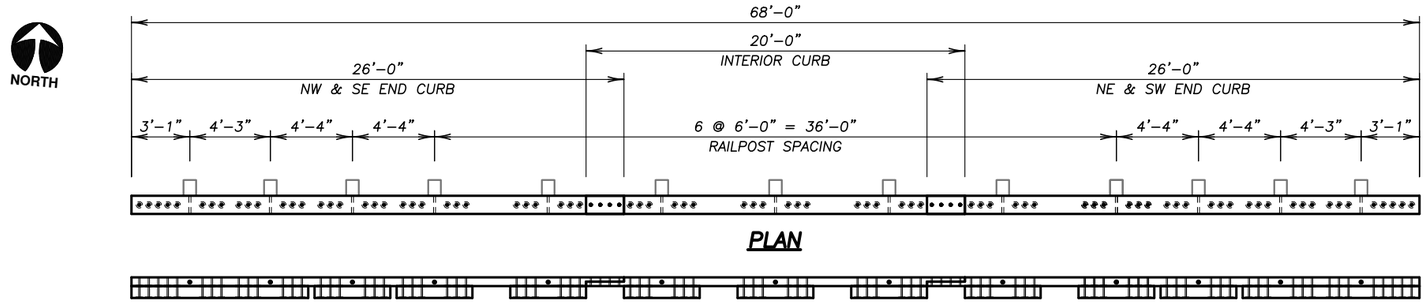
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	1 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



N.E. & S.W. END CURB THUS

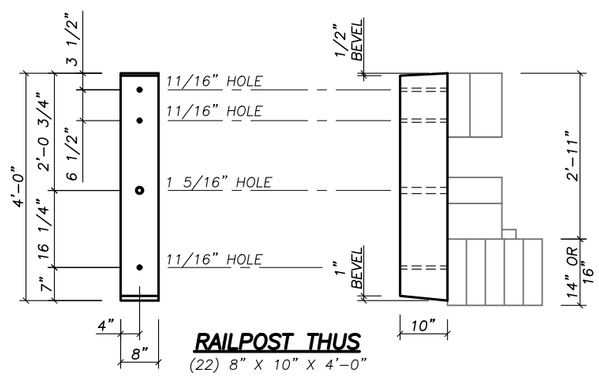
(2) 6" X 12" X 26'–0"
S1S1E, Q–NAP



PLAN

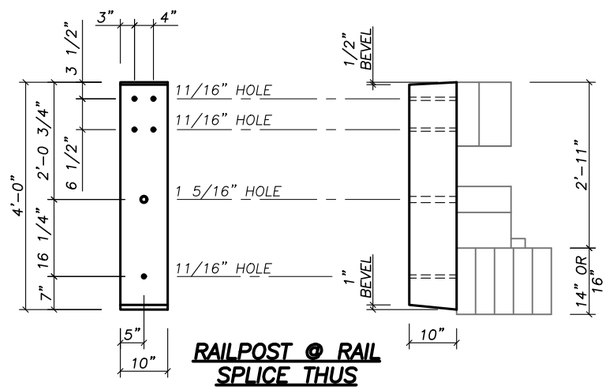
NORTH CURB LAYOUT ELEVATION

SOUTH CURB THE SAME SPUN 180 DEGREES



RAILPOST THUS

(22) 8" X 10" X 4'–0"
RGH., Q–NAP



RAILPOST @ RAIL SPLICE THUS

(4) 10" X 10" X 4'–0"
RGH., Q–NAP

MATCHMARK
MATCHMARK CORRESPONDING CURBS & SCUPPERS

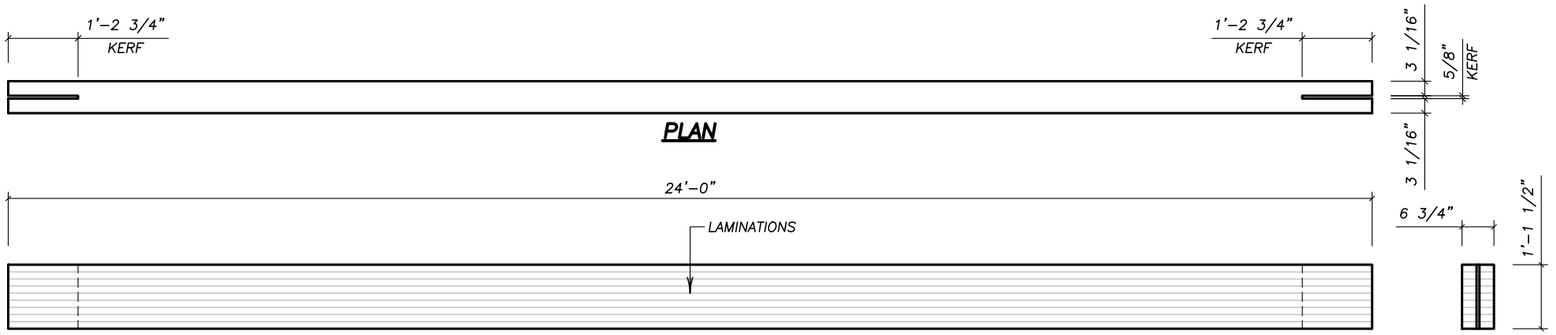
SHEET TITLE:

TIMBER PREFRAMING

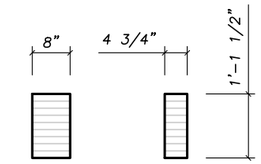
Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
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info@wheeler1892.com
wheeler1892.com

DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651–14372	2 OF 18

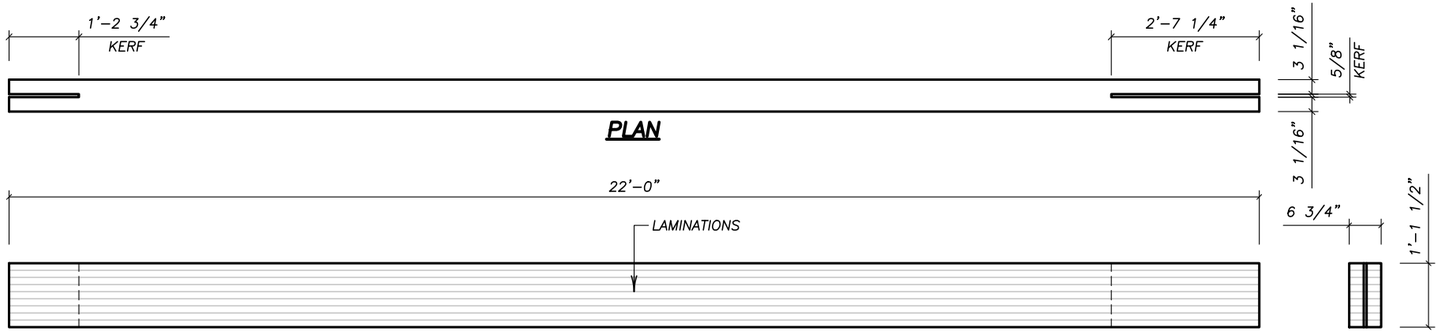
July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



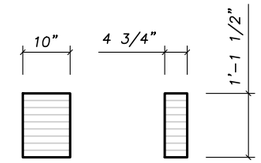
INTERIOR GLU-LAM RAIL THUS
(2) 6 3/4" X 13 1/2" X 24'-0"
COMB. NO.2, DF/DF, Q-NAP



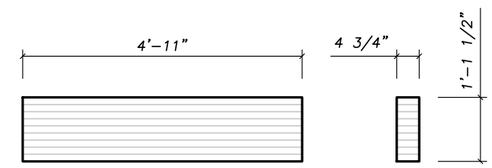
GLU-LAM RAILPOST BLOCK THUS
(14) 4 3/4" X 13 1/2" X 0'-8"
COMB. NO.2, DF/DF, Q-NAP



END GLU-LAM RAIL THUS
(4) 6 3/4" X 13 1/2" X 22'-0"
COMB. NO.2, DF/DF, Q-NAP



GLU-LAM RAILPOST BLOCK @ RAIL SPLICE THUS
(4) 4 3/4" X 13 1/2" X 0'-10"
COMB. NO.2, DF/DF, Q-NAP



GLU-LAM END RAILPOST BLOCK THUS
(4) 4 3/4" X 13 1/2" X 4'-11"
COMB. NO.2, DF/DF, Q-NAP

ALL HOLES TO BE FIELD DRILLED

SPECIFICATIONS:

GLU-LAM RAIL TO BE DOUGLAS FIR, COMBINATION NO.2, DF/DF.

GLU-LAMS TO BE INDUSTRIAL APPEARANCE GRADE COMPLYING WITH AITC 110.

GLU-LAMS ARE NOT TO BE END SEALED, SURFACE SEALED, OR WRAPPED.

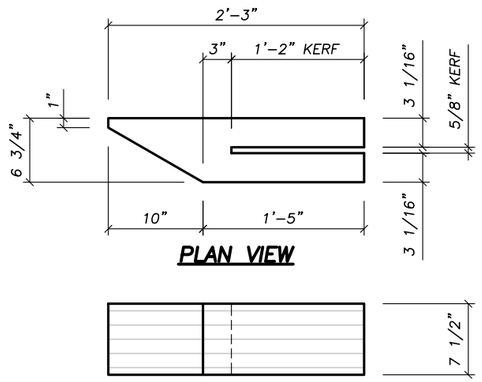
GLU-LAMS TO BE COPPER NAPHTHENATE TREATED AFTER FABRICATION IN ACCORDANCE WITH THE REQUIREMENTS OF AASHTO M133.

ENDS OF GLU-LAMS TO BE PLUMB.

GLU-LAMS SHALL BE INCISED FOR TREATING.

GLU-LAMS SHALL BE MANUFACTURED USING WET-USE ADHESIVES.

GLU-LAMS SHALL BE MARKED WITH A QUALIFIED INSPECTION AND TESTING AGENCY MARK PRIOR TO TREATMENT AND A CERTIFICATE AND TEST RESULTS INDICATING CONFORMANCE TO ANSI/AITC A190.1 SHALL BE PROVIDED.



GLU-LAM TRANSITION BLOCK THUS
(4) 6 3/4 X 7 1/2" X 2'-3"
IDENTIFIATION NO.2, DF/DF, Q-NAP

DISCLAIMER:

FABRICATION DRAWINGS ARE FOR FABRICATION PURPOSES ONLY. SIZE OF GLU-LAMS GIVEN.

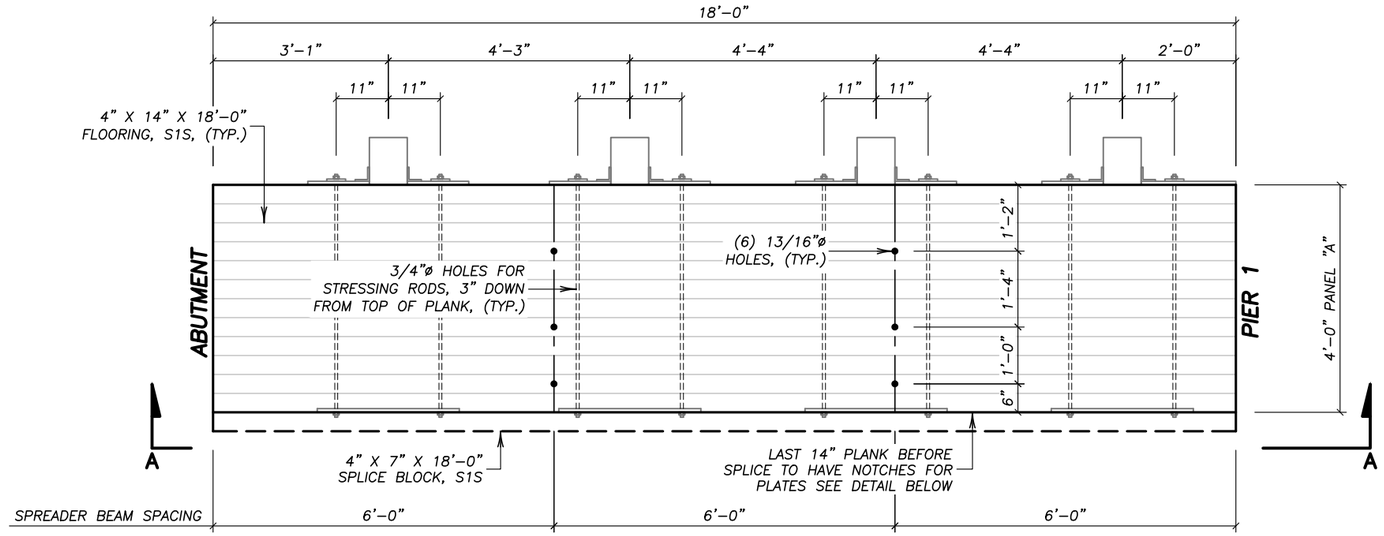
WHEELER NOT RESPONSIBLE FOR DESIGN LOADS.

SHEET TITLE:
GLU-LAM PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
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wheeler1892.com

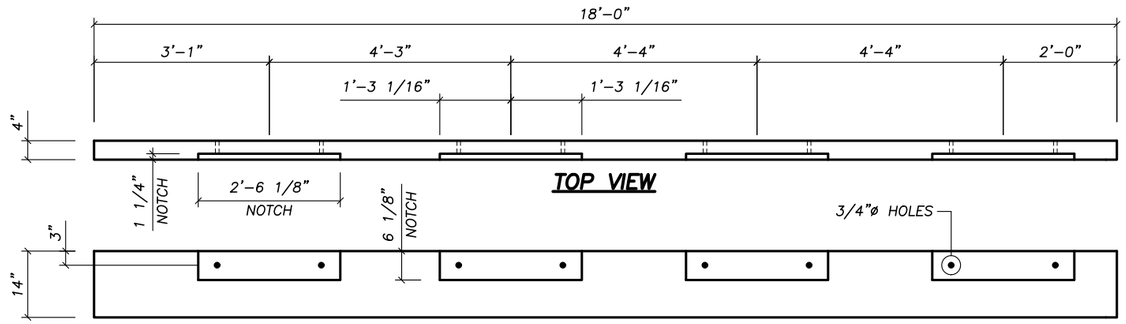
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	3 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (C:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



DOWEL LAMINATED DECK PANEL THUS – SPAN 1

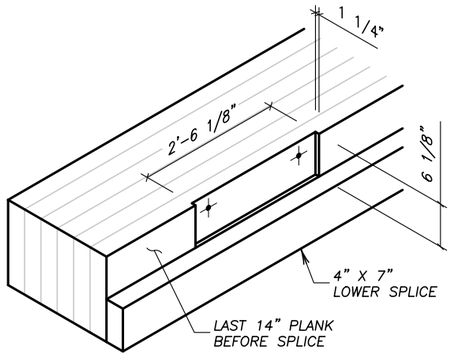
(1) 4'-0" X 18'-0" PANEL "A"
S1S, Q-NAP



TOP VIEW

SECTION A-A
LAST 14" PLANK BEFORE SPLICE ON "A" PANEL

(1) 4" X 14" X 18'-0"
S1S, Q-NAP



PANEL "A" NOTCH DETAIL

NORTH

SPAN 1	SPAN 2	SPAN 3
A	A	A
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
D	C	D
	D	
B	B	B

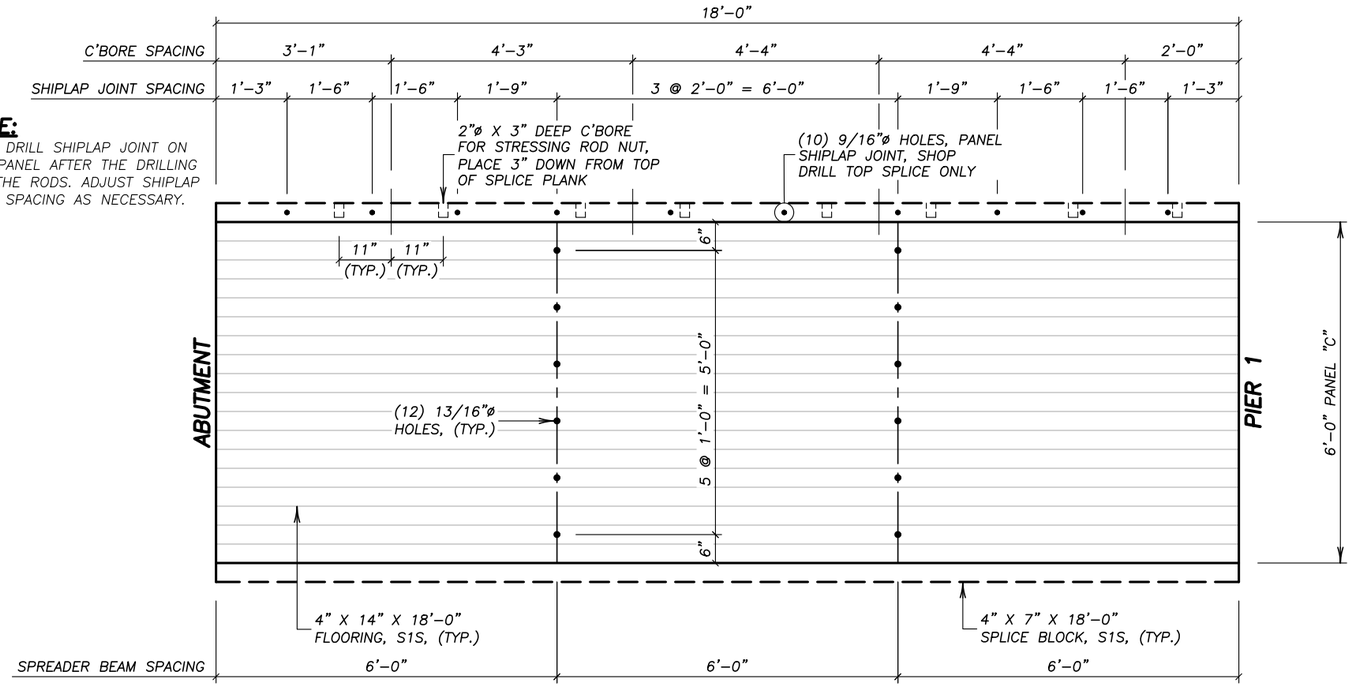
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 1 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952-929-7854
info@wheeler1892.com
wheeler1892.com

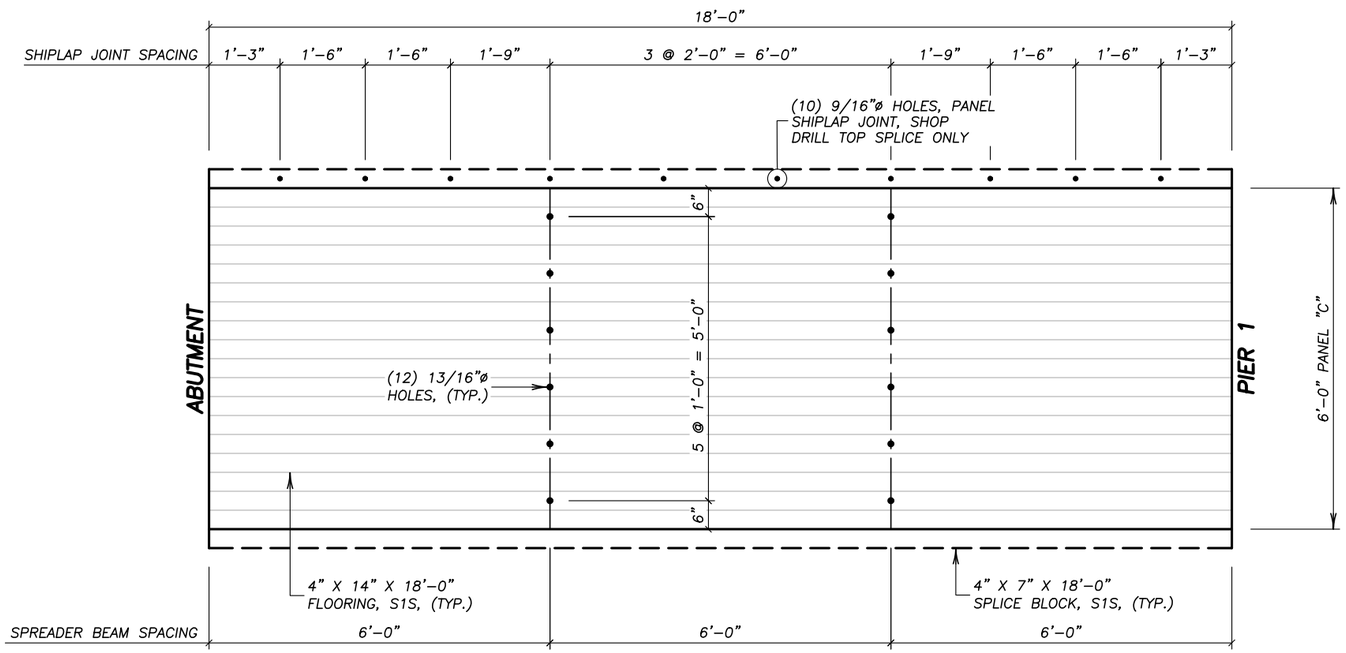
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	4 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



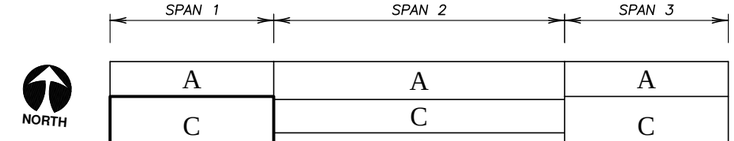
DOWEL LAMINATED DECK PANEL THUS – SPAN 1

(1) 6'–0" X 18'–0" PANEL "C"
NEXT TO "A" PANEL
S1S, Q–NAP

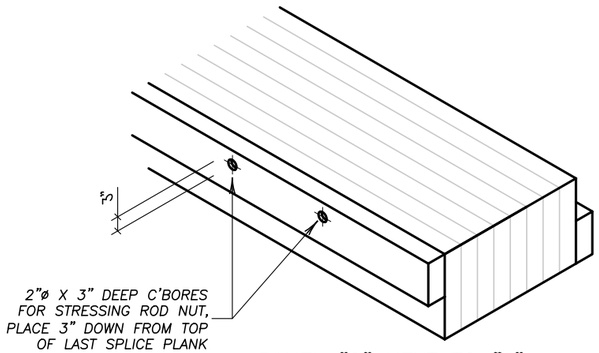


DOWEL LAMINATED DECK PANEL THUS – SPAN 1

(3) 6'–0" X 18'–0" PANEL "C"
S1S, Q–NAP



DECK PANEL DESIGNATIONS



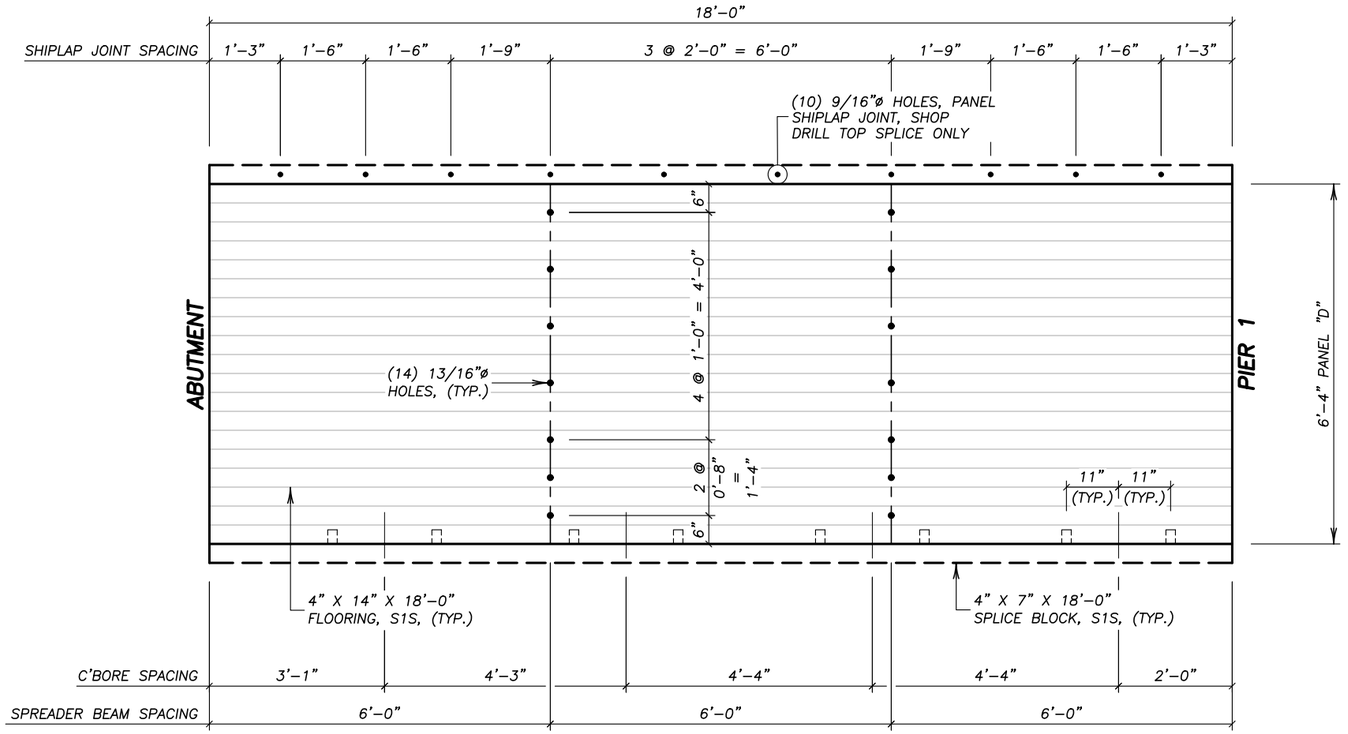
PANEL "C" NEXT TO "A"

SHEET TITLE:
SPAN 1 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952–929–7854
info@wheeler1892.com
wheeler1892.com

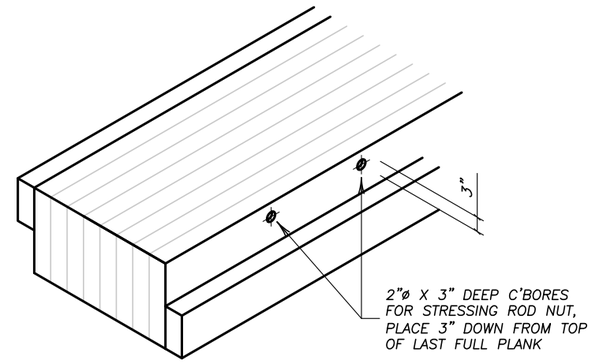
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651–14372	5 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)

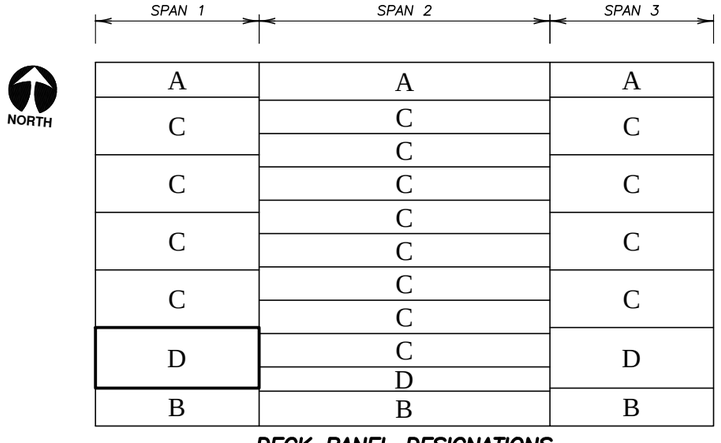


DOWEL LAMINATED DECK PANEL THUS – SPAN 1

(1) 6'-4" X 18'-0" PANEL "D"
NEXT TO "B" PANEL
S1S, Q-NAP



PANEL "D" NEXT TO "B"



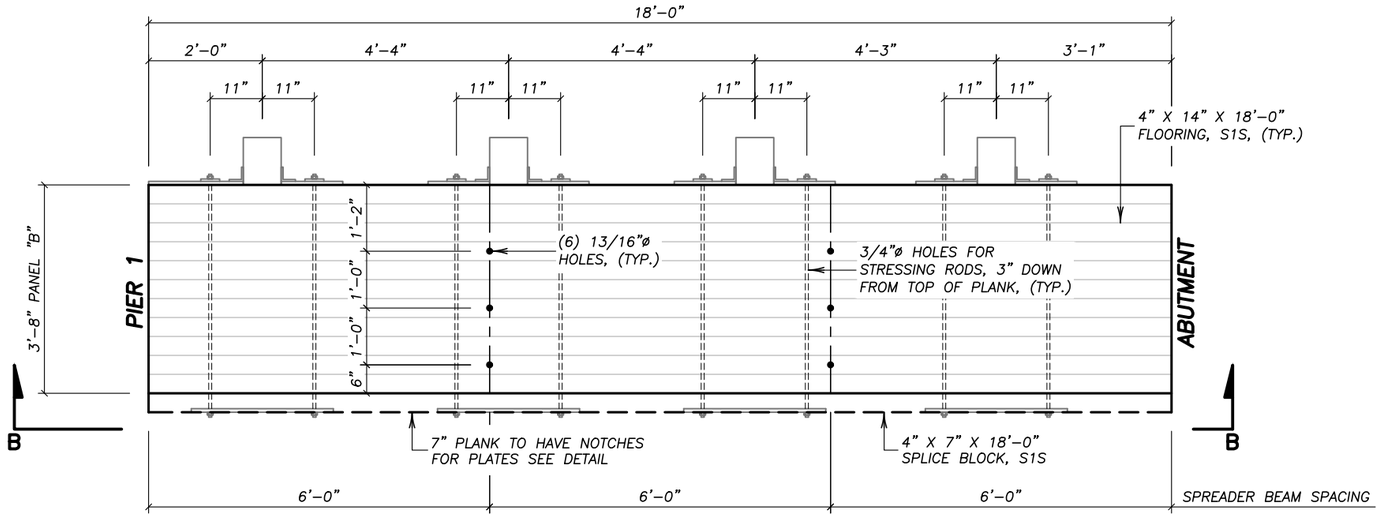
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 1 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952-929-7854
info@wheeler1892.com
wheeler1892.com

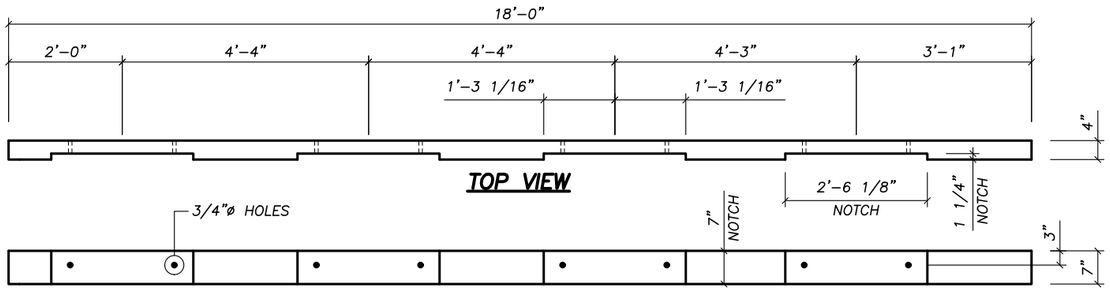
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	6 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



DOWEL LAMINATED DECK PANEL THUS – SPAN 1

(1) 3'-8" X 18'-0" PANEL "B"
S1S, Q-NAP

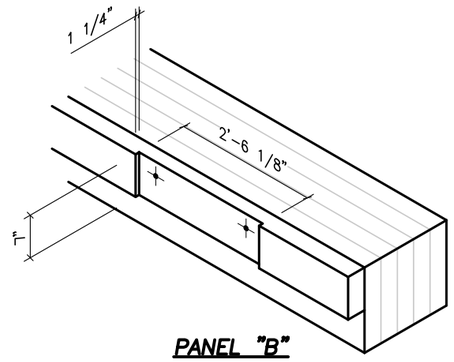


TOP VIEW

SECTION B–B

SHIPLAP JOINT "B" THUS

(1) 4" X 7" X 18'-0"
S1S, Q-NAP



PANEL "B"

NORTH

SPAN 1	SPAN 2	SPAN 3
A	A	A
C	C	C
	C	
C	C	C
C	C	C
	C	
C	C	C
	C	
D	C	D
	D	
B	B	B

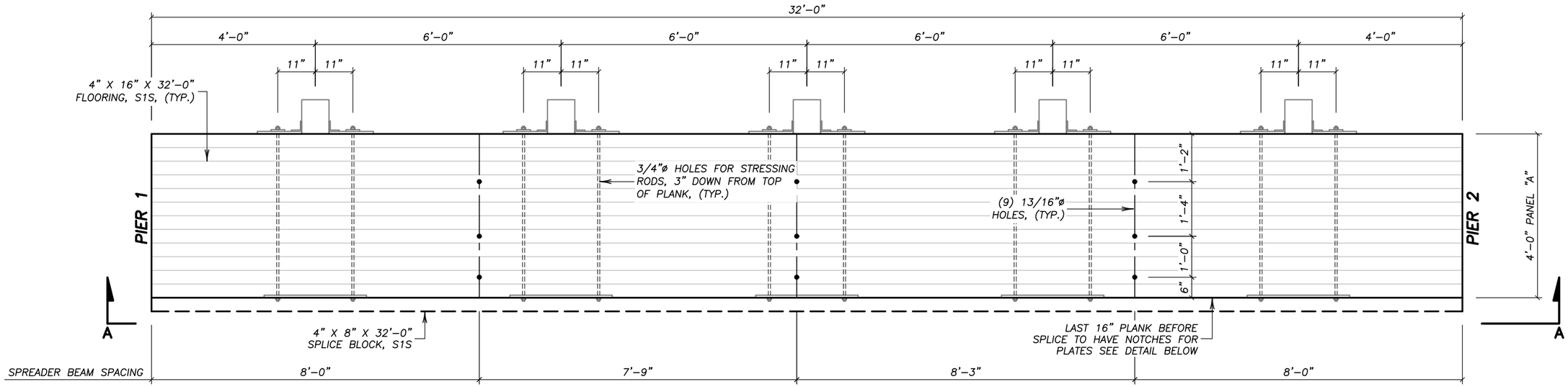
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 1 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
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wheeler1892.com

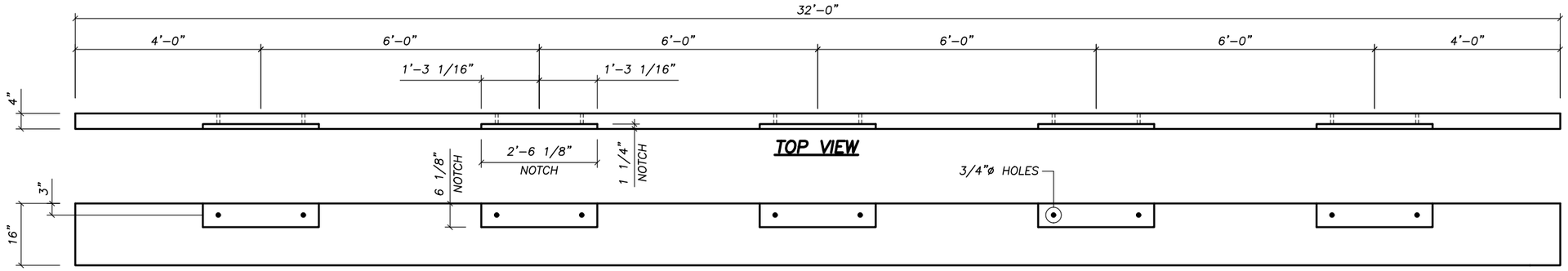
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	7 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



DOWEL LAMINATED DECK PANEL THUS – SPAN 2

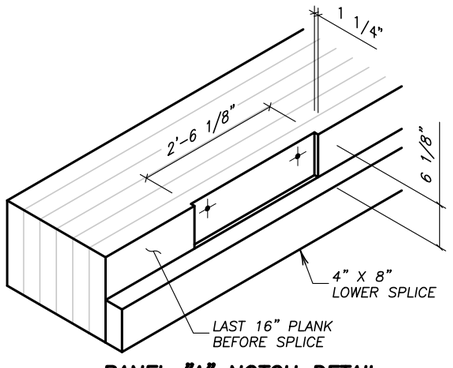
(1) 4'-0" X 32'-0" PANEL "A"
S1S, Q-NAP



TOP VIEW

SECTION A-A
LAST 16" PLANK BEFORE SPLICE ON "A" PANEL

(1) 4" X 16" X 32'-0"
S1S, Q-NAP



PANEL "A" NOTCH DETAIL

SPAN 1	SPAN 2	SPAN 3
A	A	A
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
D	C	D
	D	
B	B	B

NORTH

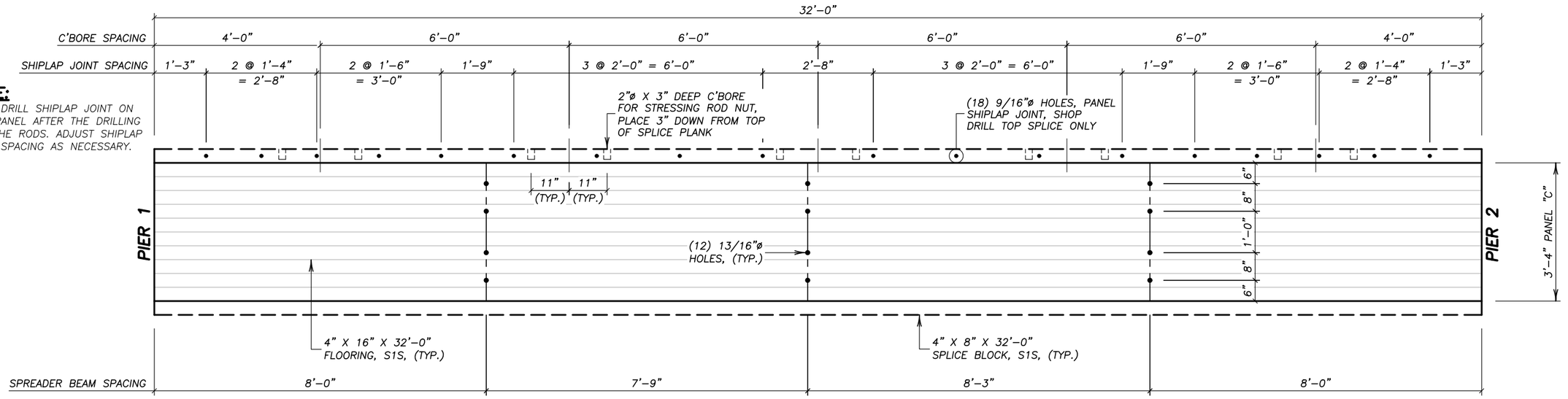
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 2 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952-929-7854
info@wheeler1892.com
wheeler1892.com

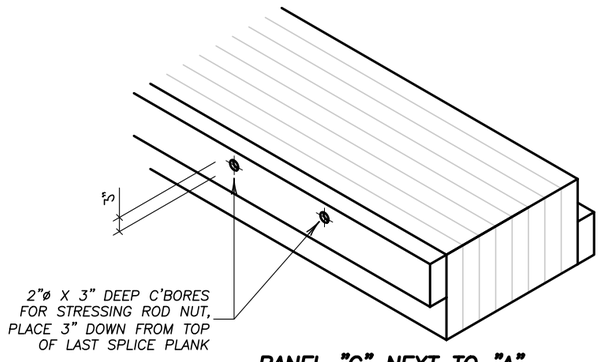
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	8 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



DOWEL LAMINATED DECK PANEL THUS – SPAN 2

(1) 3'-4" X 32'-0" PANEL "C"
NEXT TO "A" PANEL
S1S, Q-NAP



PANEL "C" NEXT TO "A"

NORTH

SPAN 1	SPAN 2	SPAN 3
A	A	A
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
D	C	D
	D	
B	B	B

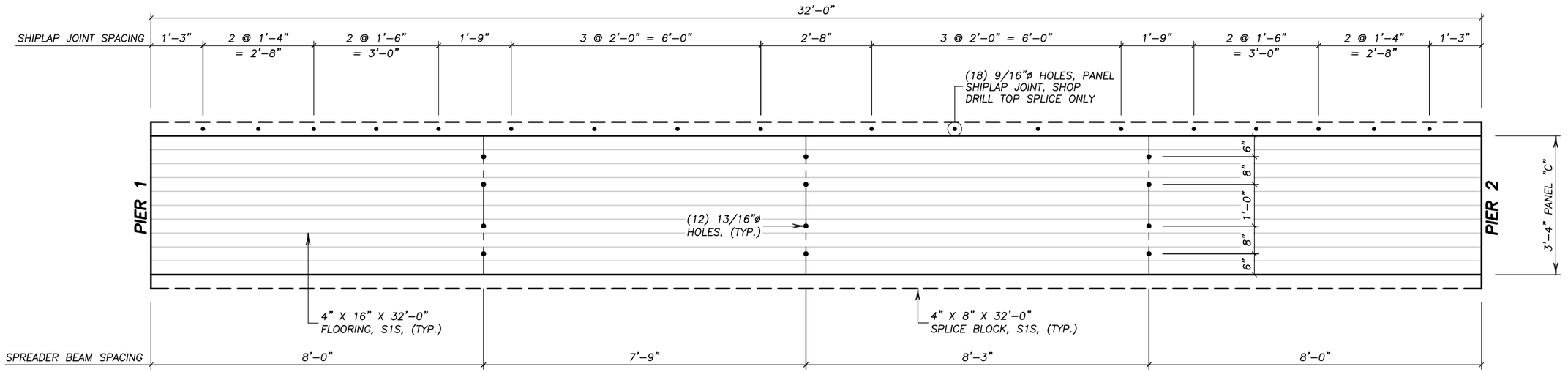
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 2 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
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wheeler1892.com

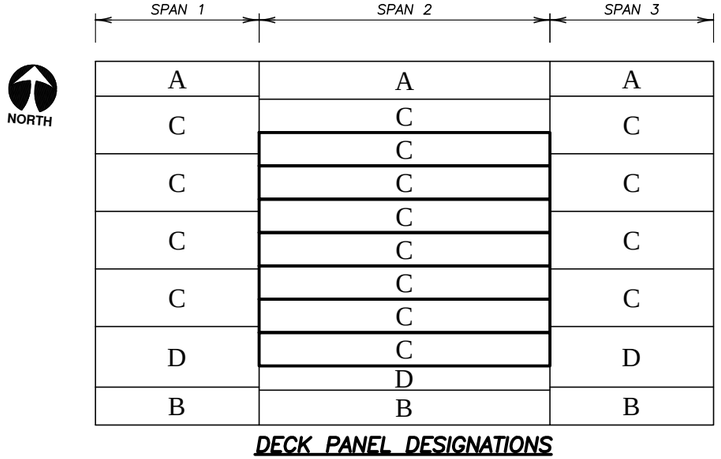
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	9 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



DOWEL LAMINATED DECK PANEL THUS – SPAN 2

(7) 3'-4" X 32'-0" PANEL "C"
S1S, Q-NAP



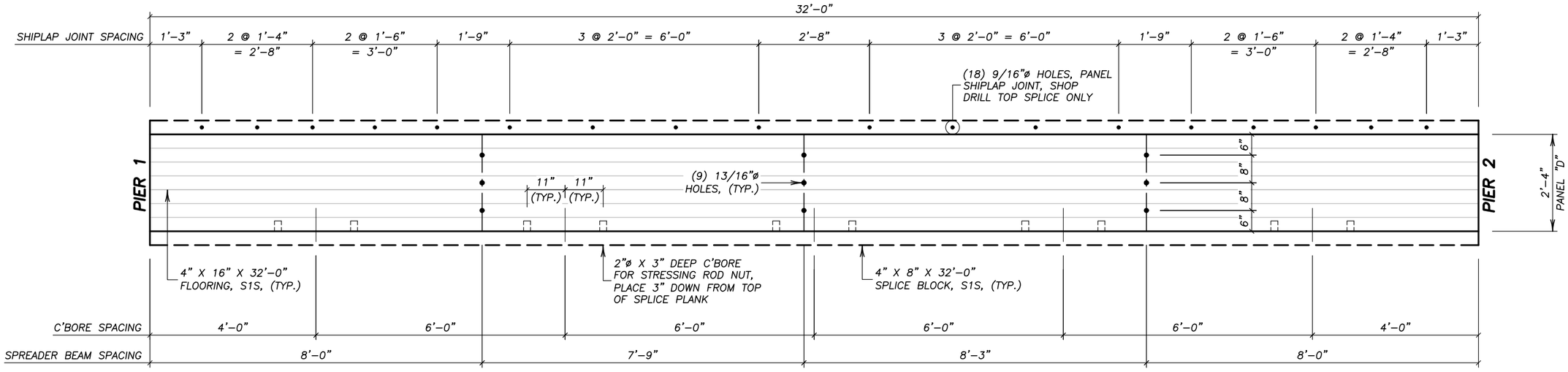
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 2 DECKS PREFRAMING

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info@wheeler1892.com
wheeler1892.com

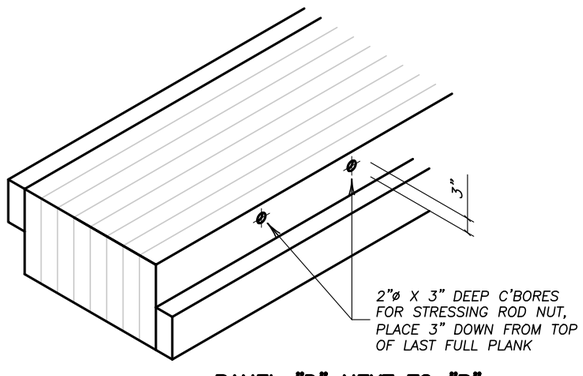
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	10 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



DOWEL LAMINATED DECK PANEL THUS – SPAN 2

(1) 2'-4" X 32'-0" PANEL "D"
NEXT TO "B" PANEL
S1S, Q-NAP



PANEL "D" NEXT TO "B"

NORTH

SPAN 1	SPAN 2	SPAN 3
A	A	A
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
D	C	D
	D	
B	B	B

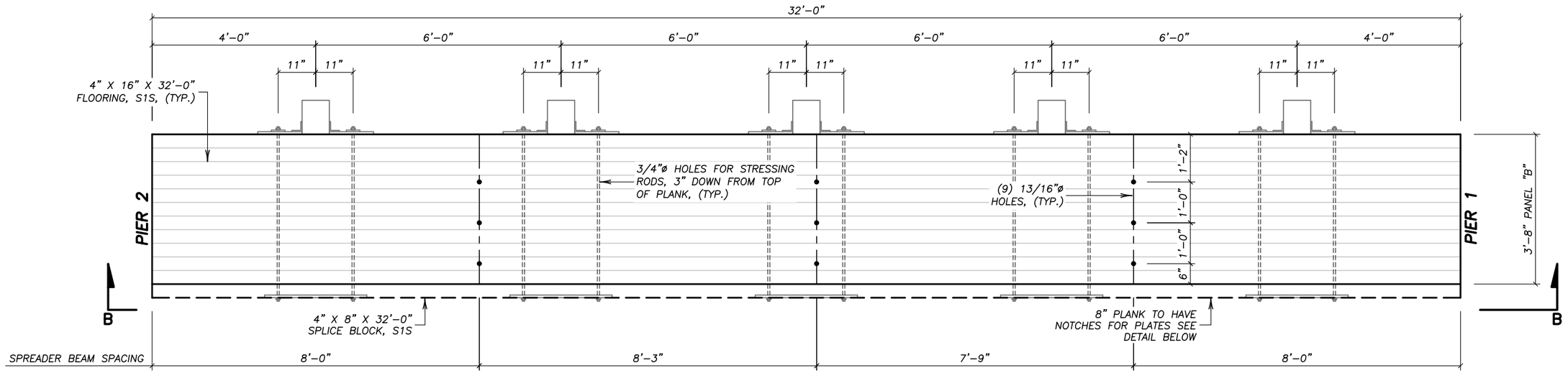
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 2 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952-929-7854
info@wheeler1892.com
wheeler1892.com

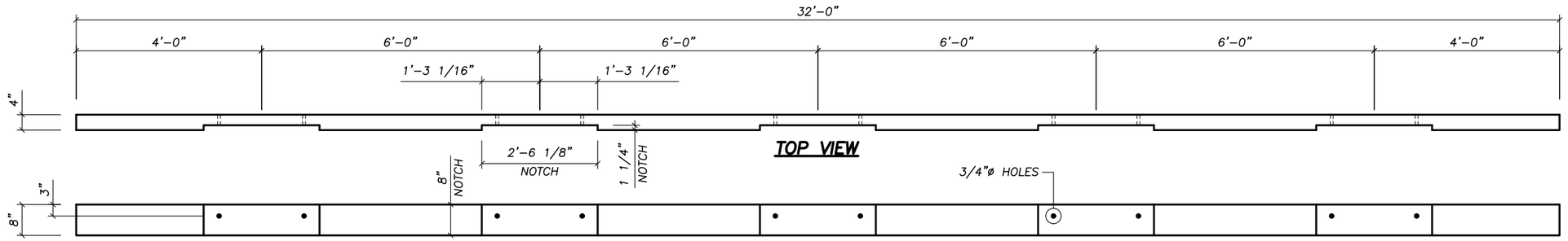
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DWN: LAF	CHK: WEH	ORDER NO. 651-14372	11 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



DOWEL LAMINATED DECK PANEL THUS – SPAN 2

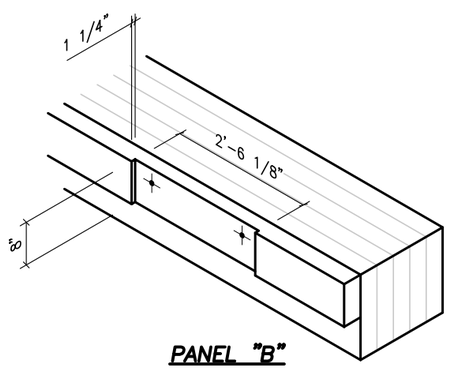
(1) 3'-8" X 32'-0" PANEL "B"
S1S, Q-NAP



TOP VIEW

SECTION B–B
SHIPLAP JOINT "B" THUS

(1) 4" X 8" X 32'-0"
S1S, Q-NAP



PANEL "B"

NORTH

SPAN 1	SPAN 2	SPAN 3
A	A	A
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
D	C	D
	D	
B	B	B

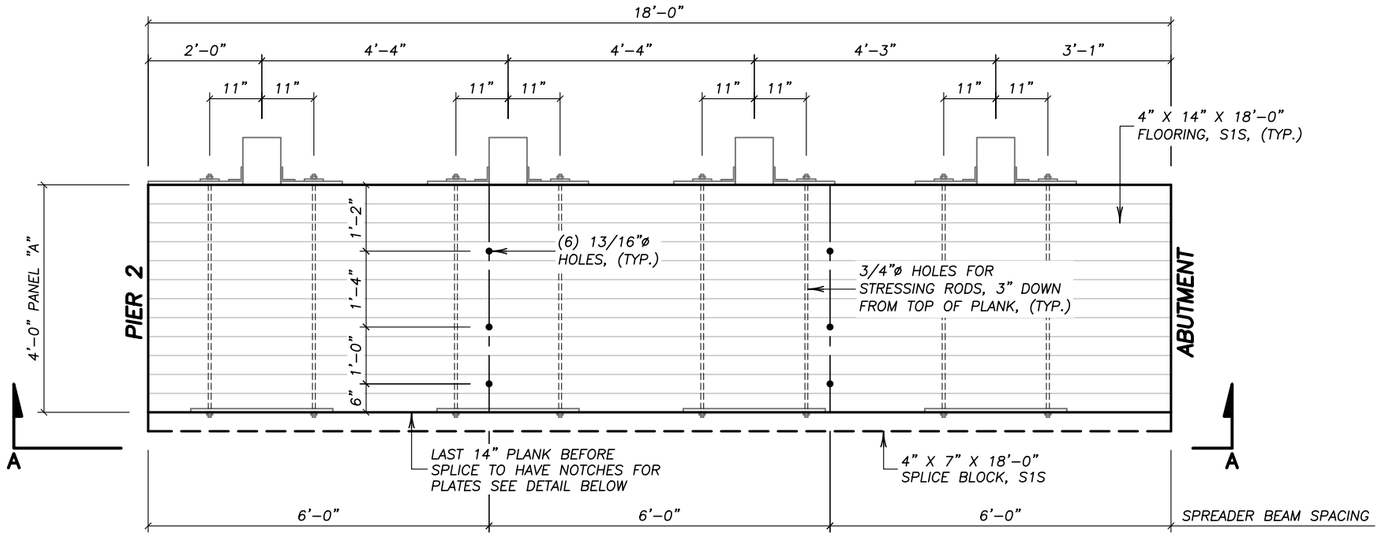
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 2 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
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952-929-7854
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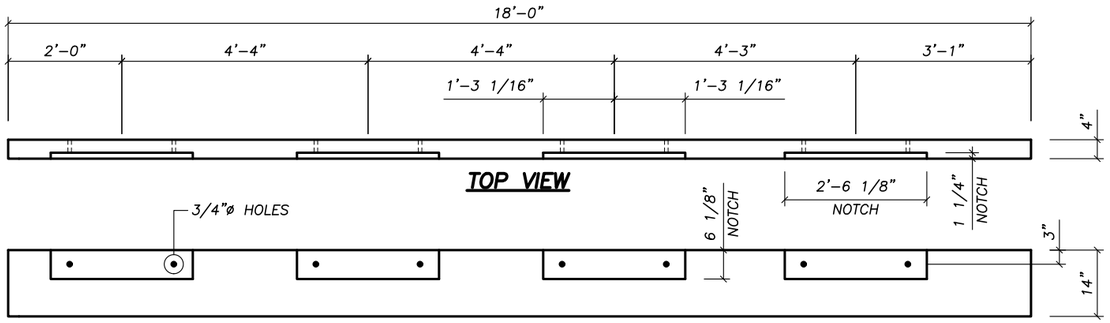
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DWN: LAF	CHK: WEH	ORDER NO. 651-14372	12 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 1428I SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 1428I SWINGEN, MN\)



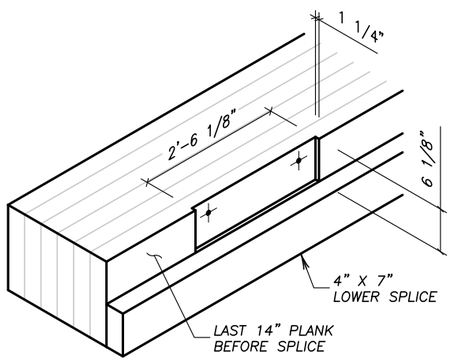
DOWEL LAMINATED DECK PANEL THUS – SPAN 3

(1) 4'-0" X 18'-0" PANEL "A"
S1S, Q-NAP



SECTION A-A
LAST 14" PLANK BEFORE SPLICE ON "A" PANEL

(1) 4" X 14" X 18'-0"
S1S, Q-NAP



PANEL "A" NOTCH DETAIL

NORTH

SPAN 1	SPAN 2	SPAN 3
A	A	A
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
	C	
D	C	D
	D	
B	B	B

DECK PANEL DESIGNATIONS

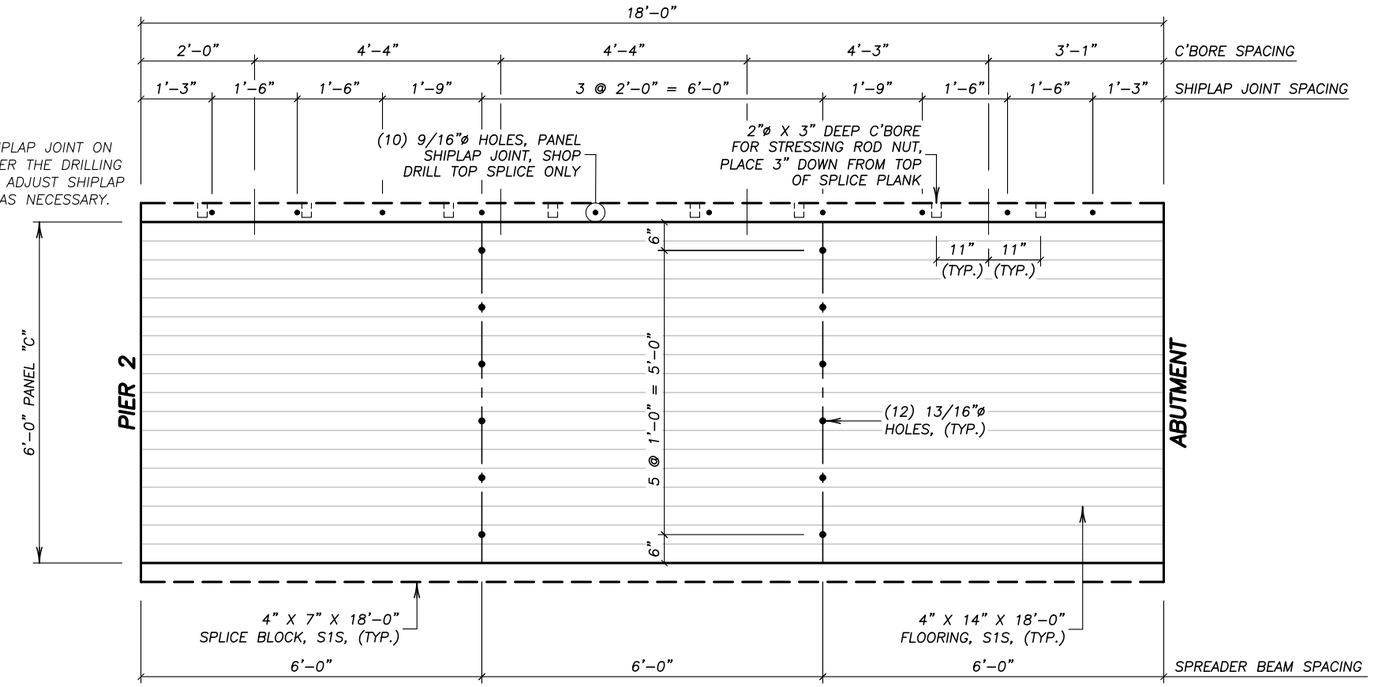
SHEET TITLE:
SPAN 3 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
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DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	13 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)

NOTE:
SHOP DRILL SHIPLAP JOINT ON THIS PANEL AFTER THE DRILLING FOR THE RODS. ADJUST SHIPLAP JOINT SPACING AS NECESSARY.



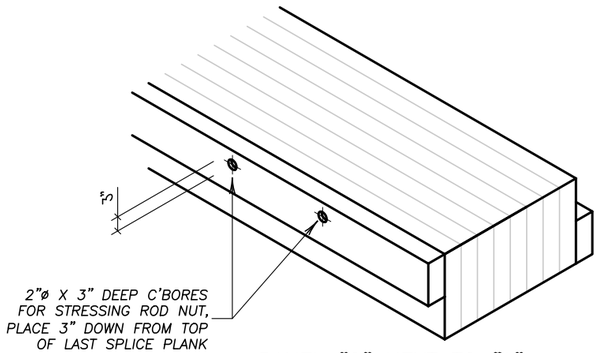
DOWEL LAMINATED DECK PANEL THUS – SPAN 3

(1) 6'-0" X 18'-0" PANEL "C"
NEXT TO "A" PANEL
S1S, Q-NAP

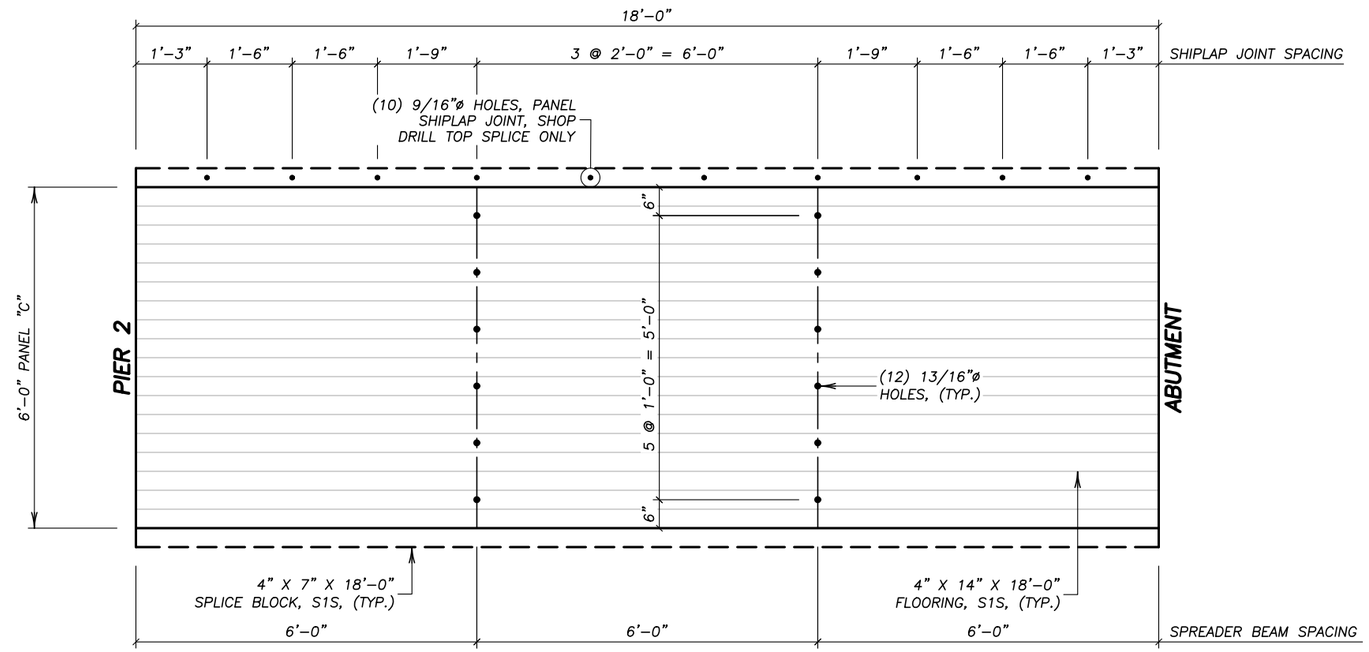


SPAN 1	SPAN 2	SPAN 3
A	A	A
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
C	C	C
	C	
D	C	D
	D	
B	B	B

DECK PANEL DESIGNATIONS



PANEL "C" NEXT TO "A"



DOWEL LAMINATED DECK PANEL THUS – SPAN 3

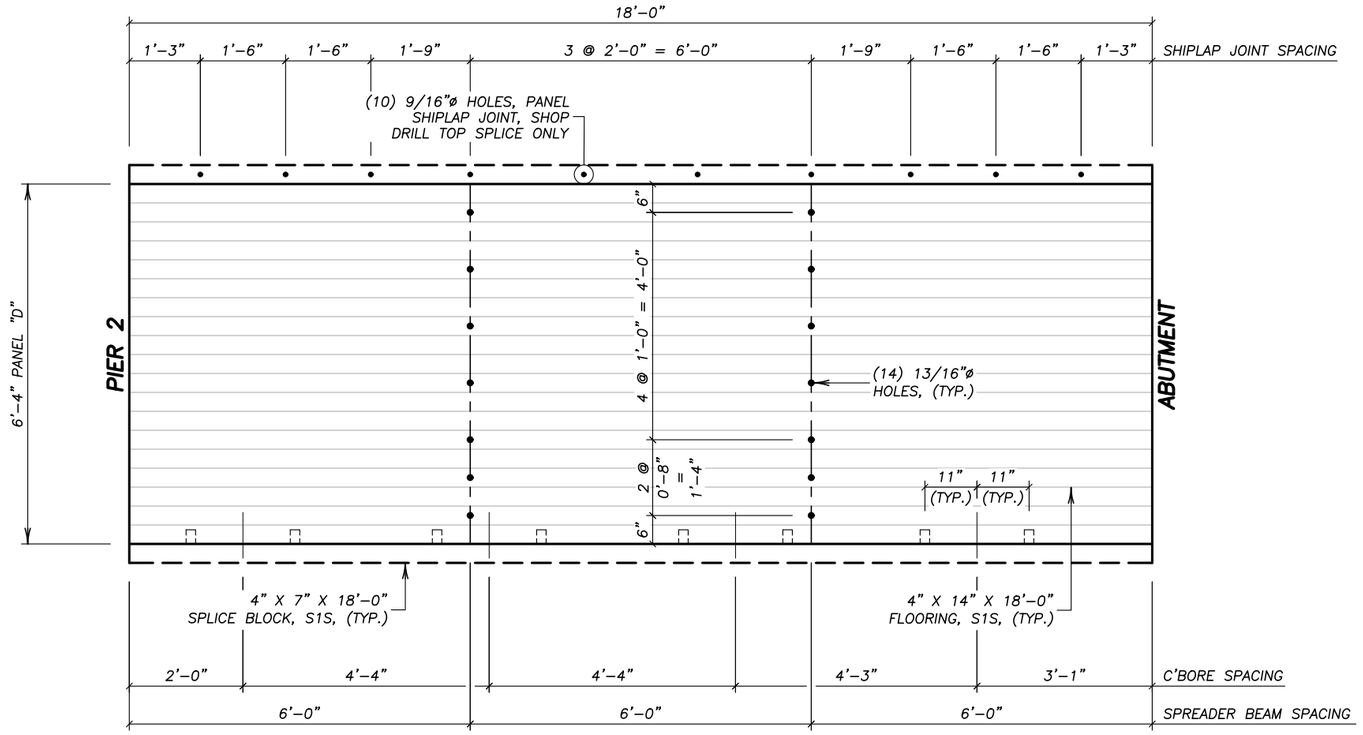
(3) 6'-0" X 18'-0" PANEL "C"
S1S, Q-NAP

SHEET TITLE:
SPAN 3 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952-929-7854
info@wheeler1892.com
wheeler1892.com

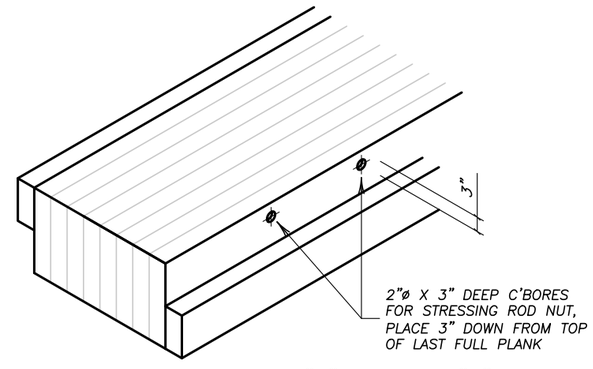
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	14 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)

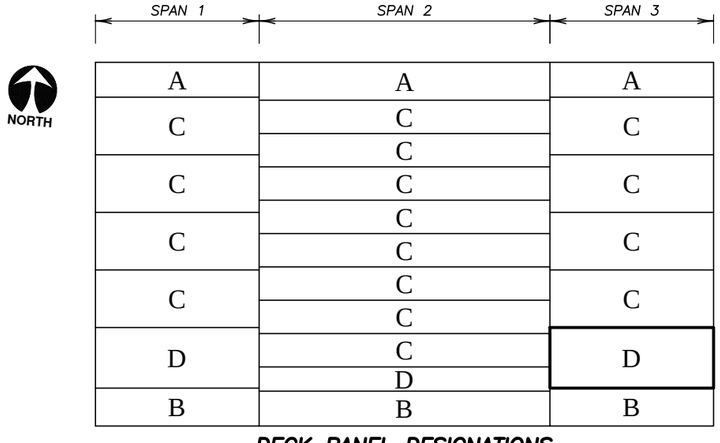


DOWEL LAMINATED DECK PANEL THUS – SPAN 3

(1) 6'-4" X 18'-0" PANEL "D"
NEXT TO "B" PANEL
S1S, Q-NAP



PANEL "D" NEXT TO "B"



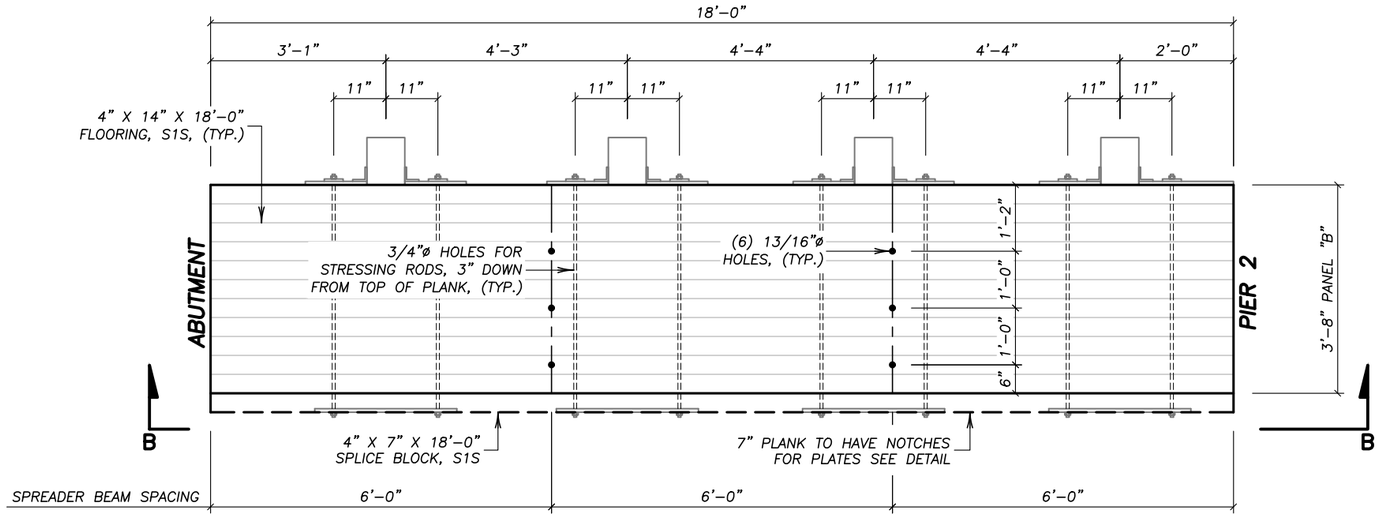
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 3 DECKS PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952-929-7854
info@wheeler1892.com
wheeler1892.com

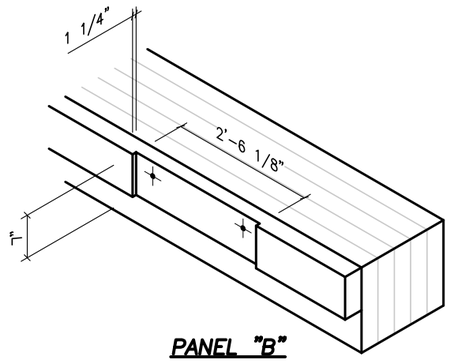
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	15 OF 18

July 26, 2018 9:15:08 a.m.
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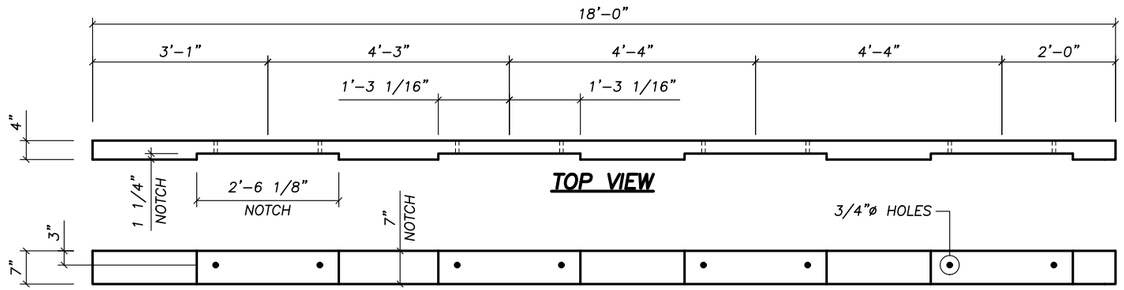


DOWEL LAMINATED DECK PANEL THUS – SPAN 3

(1) 3'-8" X 18'-0" PANEL "B"
S1S, Q-NAP



PANEL "B"



TOP VIEW

SECTION B–B
SHIPLAP JOINT "B" THUS

(1) 4" X 7" X 18'-0"
S1S, Q-NAP

NORTH

SPAN 1	SPAN 2	SPAN 3
A	A	A
C	C	C
	C	
C	C	C
C	C	C
	C	
C	C	C
	C	
D	C	D
	D	
B	B	B

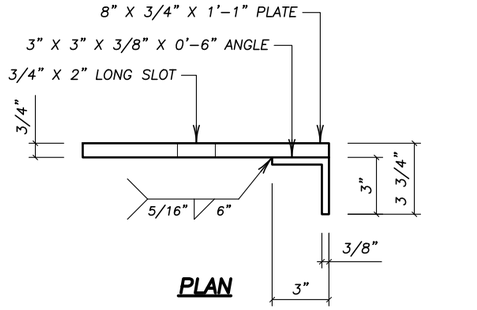
DECK PANEL DESIGNATIONS

SHEET TITLE:
SPAN 3 DECKS PREFRAMING

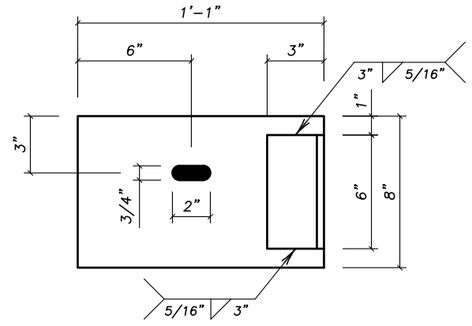
Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952-929-7854
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DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	16 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)

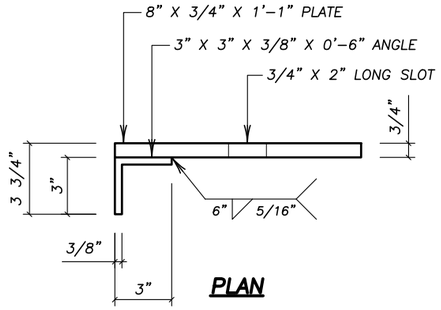


PLAN

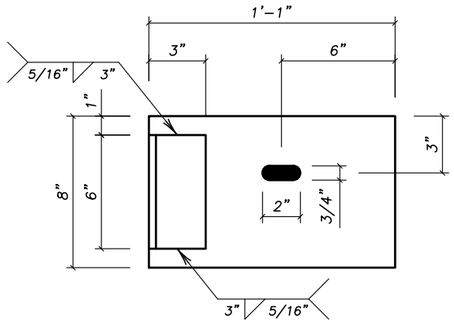


LEFT STEEL POST PLATE THUS

(22) LEFT STEEL POST PLATE
ASTM A36, H.D.G.

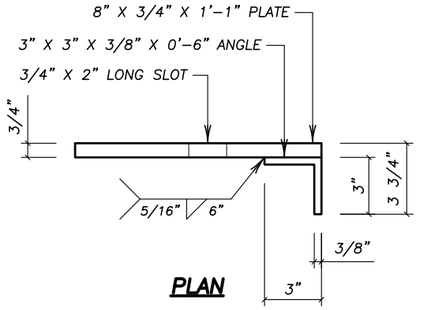


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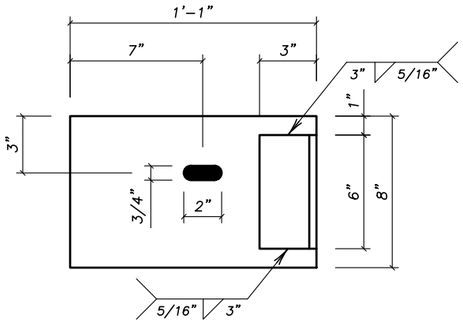


RIGHT STEEL POST PLATE THUS

(22) RIGHT STEEL POST PLATE
ASTM A36, H.D.G.

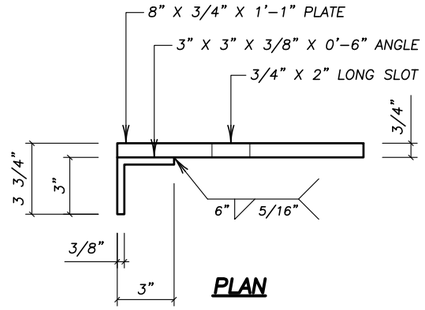


PLAN

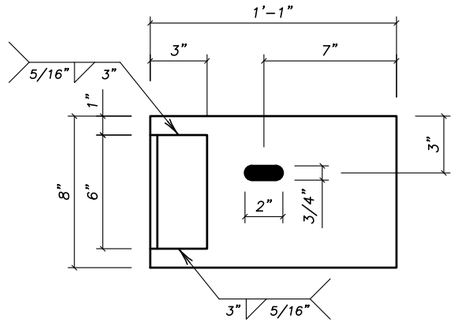


LEFT STEEL POST PLATE THUS
@ SPLICE RAILPOST

(4) LEFT STEEL POST PLATE
ASTM A36, H.D.G.



PLAN



RIGHT STEEL POST PLATE THUS
@ SPLICE RAILPOST

(4) RIGHT STEEL POST PLATE
ASTM A36, H.D.G.

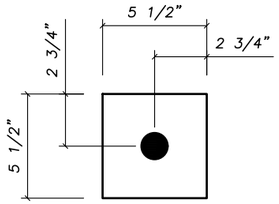
NOTE:
THE WELDING PROCESS SHALL BE THE FLUX CORE ARC WELDING PROCESS, UTILIZING E81T1-W2/W2M ELECTRODES

SHEET TITLE:
STEEL PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
Eden Prairie, MN 55344
952-929-7854
info@wheeler1892.com
wheeler1892.com

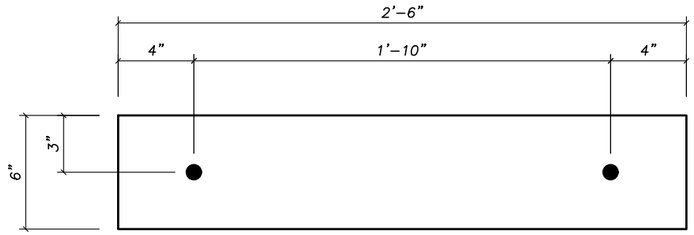
DATE: 11/20/18		TRACKING NO. T20457	SHEET NO.
DWN: LAF	CHK: WEH	ORDER NO. 651-14372	17 OF 18

July 26, 2018 9:15:08 a.m.
Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)



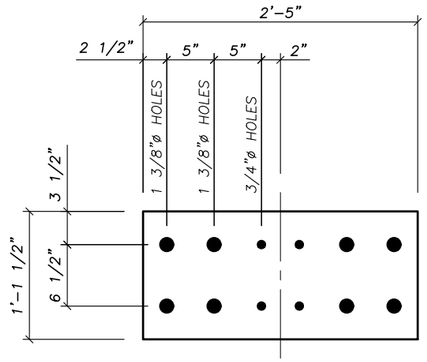
RAILPOST PLATE WASHER THUS

(52) 5 1/2" X 5 1/2" X 1/4"
1 3/8"ø HOLE
ASTM A36, H.D.G.



INTERNAL STEEL PLATE

(26) 6" X 3/4" X 2'-6"
ALL HOLES ARE 3/4"ø
ASTM A36, H.D.G.



STEEL SPLICE PLATE

(4) 1'-1 1/2" X 1/2" X 2'-5"
ASTM A36, H.D.G.

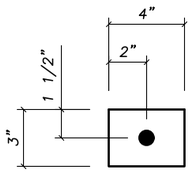
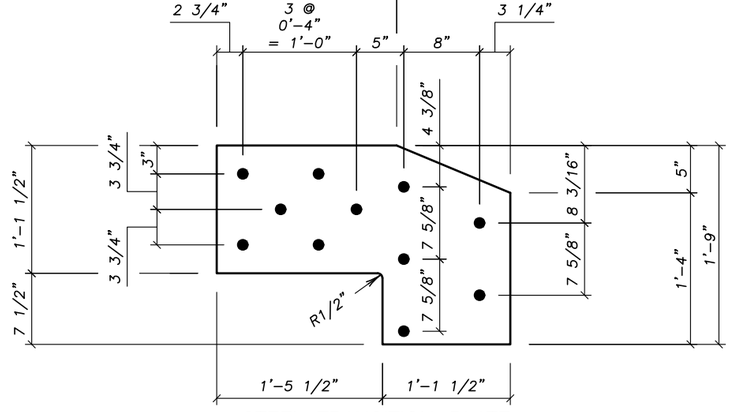


PLATE WASHER FOR POST PLATE THUS

(52) 3" X 4" X 1/2"
3/4"ø HOLE
ASTM A36, H.D.G.



STEEL TRANSITION PLATE

(4) 1'-9" X 1/2" X 2'-7"
ALL HOLES ARE 1"ø
ASTM A36, H.D.G.

SHEET TITLE:

STEEL PREFRAMING

Wheeler
9531 W.78th Street, Ste.100
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Drawing: 14281 SHOPS.DWG (FISH) (O:\AUTOCAD\T-FOLDERS\T20543 14281 SWINGEN, MN\)