

MICHIGAN DEPARTMENT OF **TRANSPORTATION**

CULVERT (BOX, THREE-SIDED, AND ARCH) DESIGN GUIDELINES

CS: Statewide

MICHIGAN CULVERT DESIGN GUIDELINES

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1.01

INTRODUCTION

This guidance addresses procedures involved in the design, permitting, and plan preparation for all box, three-sided, and arch culverts owned by the Michigan Department of Transportation (MDOT).

The Culvert Design Guidelines is intended to be a single source reference for the MDOT Design Engineers and consultants assigned the responsibility of developing box, three-sided, and arch culvert projects. While circular and elliptical culverts are not specifically covered in this reference some portions of the reference are applicable to larger circular and elliptical culverts. Use engineering judgement to determine applicability.

The design of culverts in Michigan is based on the **MDOT Standard Specifications for Construction** and **AASHTO LRFD Bridge Design Specifications**. However, it is understood that sometimes adaptations and deviations may be necessary as these publications can be vague or leave decisions up to the judgement of the Engineer.

As procedures and guidelines change, the Culvert Design Guidelines will be continually updated to keep the text as current as possible. These updates will describe the revision, explain the reason, serve as commentary, and assign the date of its implementation.

1.01.01

References

Where national standards or specifications (e.g., AASHTO, MUTCD) are referenced herein, the designer shall utilize the current edition, including all interim revisions, as formally adopted by the Federal Highway Administration (FHWA) in 23 CFR 625 (Design Standards for Highways) at the time of project scoping, unless otherwise directed by MDOT.

A. Drainage Manual, MDOT

B. Road Design Manual, MDOT

C. Geotechnical Manual, MDOT

D. Bridge Design Manual, MDOT

E. Preconstruction Process
Documentation Manual (PPDM), MDOT

F. Standard Specifications for
Construction (SSC), MDOT

G. AASHTO LRFD Bridge Design
Specifications

H. Shop Drawing Review Process, MDOT

I. Standard Plans and Special Details,
MDOT

J. MDOT Presentation on Ultraviolet (UV)
Hardened Culvert Slip Lining (UV Liners)

K. MDOT Special Provision for Cured-In
Place Pipe (CIPP) Liner for Culverts

L. MDOT Special Provision for Slip Pipe
Liner for Culverts

M. Michigan Ancillary Structures
Inspection Manual (MiASIM)

Existing plans for recent projects, similar in nature to the proposed project, are an excellent reference. Sample plans have been provided in **Appendix D – Guidelines for Culvert Plan Preparation**.

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1.01.02

Abbreviations & Definition of Terms

When the following abbreviations are used in the guidance text, they have the meanings listed below:

ASTM..... American Society for Testing and Materials

CIP..... Cast-In-Place

EGLE.....(Michigan Department of Environment, Great Lakes, and Energy

HDPE.....High Density Polyethylene

JPA..... Joint Permit Application

NEPA.....National Environmental Policy Act

OHWM..... Ordinary High-Water Mark

PPDM.....Preconstruction Process Documentation Manual

PVC..... Polyvinyl Chloride

ROW.....Right-Of-Way

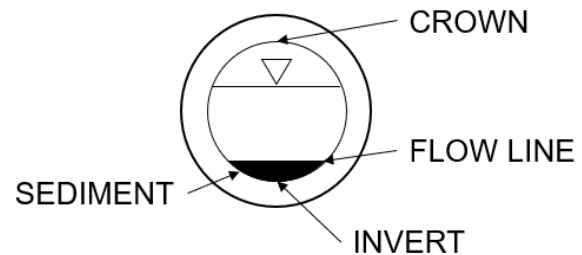
SHPO.....State Historic Preservation Office

USACE United States Army Corps of Engineers

Box Culvert. Culvert with a rectangular (box-shaped) opening, typically formed by reinforced concrete slabs and walls (top slab, bottom slab, and vertical walls).

Clear Zone. The unobstructed, traversable roadside area provided beyond the edge of the through traveled way that allows a driver to stop safely or regain control of a vehicle that has left the roadway. The required clear zone can be found in **MDOT Road Design Manual**, Section 7.01.11 Chart C. Clear Zone Distance Chart.

Crown. The highest interior elevation of a culvert, sewer, drainpipe, or tunnel. This may also be referred to as under clearance or low chord, particularly for box, three-sided, and arch culverts. See Figure below.



Easement. An interest or right held by one person in land owned by another person whereby the first person is accorded partial use of such land for a specific purpose. An easement restricts but does not abridge the rights of the fee owner to the use and enjoyment of the easement holder's rights.

Drainage Easement. An easement for directing the flow of water and to allow construction and maintenance of sewers, ditches, and such.

Flow Line. The lowest physical surface elevation in a drainage system. For storm sewers, the flow line is the same as the invert. This may not be true for culverts that are recessed.

Invert. The lowest interior elevation of a culvert, sewer, or tunnel.

Manufacturer. An entity responsible for the production of precast or metal culvert related products.

Right-of-Way (ROW). The entire area reserved for the construction, operation, and maintenance of the roadway and the improvement of the roadside such as landscaping, sidewalks, pathways, or transit stops. ROW will either be free access or limited access. Limited access ROW is when the inherent right of access to a public highway by the abutting owner or occupant is acquired along with the title to the ROW.

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Roadside. Portion of the right-of-way outside of the footprint of the roadway.

Slab Culvert. Culvert that is located on a footing and has a natural floor. Also referred to as a three-sided culvert in Michigan.

Span. The clear distance between the inside walls of culvert as measured along the centerline of roadway.

Three-Sided Structure. Three-sided arch or flat top structure with footings or precast slab foundations.

Clam Style Structure. Two three-sided structures assembled with an integral joint running along each vertical wall to form an enclosed box shape.

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1.02

CULVERT SITE PLANNING

1.02.01

Project Scoping and Survey

Understanding the project scope is critical for the Engineer to establish what deliverables (e.g., permits, easement acquisition, design exceptions, etc.) are required. To ensure consistency across culvert projects, the Engineer must follow the scoping process provided by the **MDOT PPDM Task Series 2100 – EPE Scoping Analysis** through **Series 2800 – Contamination Investigation**.

Proper survey, specifically those related to the structure and waterway, is critical to ensure a project can provide what has been scoped. The Engineer must review **MDOT PPDM Task Series 3100 – Scope Verification** through **Series 3300 – Base Plan Preparation** before survey takes place so that consistent and thorough survey can be prescribed.

1.02.02

Culvert Structure Study

Prepare a structure study when required as prescribed by the **MDOT Bridge Design Manual – Section 3.01**.

1.02.03

Culvert Type Selection

Typically, the design and selection of culvert type is limited by a few large-scale limitations of the site/project. Such limitations include bottom of road elevation in relation to the crown elevation, available right-of-way, geometry of the roadway and stream, stream width at Ordinary High-Water Mark (OHWM), discharge of stream, scour, and construction schedule. Coordinate with MDOT Project Manager during the project scoping phase to establish these limiting factors ahead of the design. For further information regarding culvert type selection

see **Subsection 1.02.04**.

Coordinate with local manufacturers during the preliminary design phase to ensure the feasibility of the culvert size and type selected. Information regarding sizing, construction, and fabrication limitations can be found in **Section 1.04** and **Section 1.05**.

1.02.04

Preferred Culvert Types

Three-sided culverts are preferred by the regulatory agencies to maintain a natural stream bottom for newly constructed culverts in the state of Michigan; however, frequently a concrete box culvert is utilized due to cost, reduced scour vulnerability, and other considerations. Three-sided culverts typically require foundation piles, which can increase construction complexity and cost. This culvert style is easily adaptable to a wide range of site conditions including those that require a low profile. Consider additional shapes where low profile is a major concern, or when other unique constraints may be present.

1. Precast Concrete Boxes – These culverts offer the advantage of rapid installation and are competitively priced compared to cast-in-place alternatives for new construction or culvert extensions. Precast concrete boxes do not typically require foundation piles, which can reduce construction complexity and cost. For these reasons, precast concrete box culverts should be used in standard box culvert applications.

2. Cast-In-Place Concrete Boxes – These culverts offer the same benefits as precast with the exception that they require more time for construction. Cast-in-place concrete boxes do not typically require foundation piles, which can reduce construction complexity and cost. They are easily adapted for site conditions and can be considered when sites limit cover or construction access (e.g., low hanging overhead utilities). For information regarding construction see **Section 1.05**.

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1.02.05

Alternative Culvert Types

1. Three-Sided Concrete Slab and Arch Culverts – Provide easier conveyance of flow during construction compared to Four-sided equivalents. These shapes are useful in scenarios where vulnerability to scour is low, allowing for shallow foundations. The corner radii of these concrete culverts are tighter than their corrugated metal equivalents, providing a wider clear span at lower flow depths and resulting in less obstruction to the waterway. These culverts require foundations that are designed to accommodate a predicted scour and that often makes them more costly when compared to Four-sided. Scour analysis is captured under **MDOT Drainage Manual – Chapter 6**.

2. Circular Pipe Culverts – Can be made from concrete, corrugated and spiral ribbed metal, along with smooth-lined corrugated plastic. These culverts are more structurally efficient than most shapes and come in a wide variety of sizes.

3. Elliptical Pipe Culverts – Can be made from concrete or corrugated metal, these culverts are typically used when vertical clearances are limited and when wider sections during low flow levels are desired.

4. Corrugated Structural Plate Pipe and Pipe Arches:

Structural plate pipe and structural plate pipe arches are field-assembled pipes from curved sections with 6-inch by 2-inch corrugations.

Whenever corrugated structural plate pipe or corrugated structural plate pipe arches are used, the following information is required on the plans: span and rise (or diameter), pay length (bottom length), nominal thickness of metal, angle with centerline, and cutoff height.

The following is an example of how the first three items mentioned above must be shown on plans:

("Corrugated Steel Structural Plate Pipe Arch 9'-4" by 6'-3", (0.138-inch thick) 58 FT.")

Detail the angle with centerline and cutoff height on the plans.

1.02.06

Other Culvert Types

1. Clamshell Concrete Box Culverts - Are an option in applications where longer spans or taller rises in spans or a large hydraulic capacity is needed. Similarly, a three-sided culvert may be placed on a precast slab to create a shape resembling a box culvert. Ensure fabrication tolerances are achievable and fit-up can be accomplished; coordinate with MDOT Bureau of Bridges and Structures early in the design process for these culvert types.

Clamshell and other two-piece culverts can also improve constructability when riprap must be placed inside the culvert for a natural stream bottom.

2. Multi-Cell Culverts – Are capable of providing an increased hydraulic capacity compared to singular culverts of a similar shape. This type of culvert configuration is typically only utilized for temporary conditions. The **MDOT Drainage Manual - Chapter 5** provides further guidance for temporary conditions.

1.02.07

Culvert Placement

A. Clear Zone Considerations

Place the culvert's headwall or outlet ending outside of the clear zone and at grade of the embankment if possible. This condition helps to eliminate roadside hazards. Clear zone widths must be established using the guidance provided in the **MDOT Road Design Manual – Chapter 7**.

For instances where end treatments cannot be placed outside of the clear zone, please refer

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to the **MDOT Drainage Manual – Table 5-1 – Guidelines for Culvert End Treatments within the Clear Zone.**

B. Stream Considerations

Place the vertical and horizontal alignment of the culvert so that it follows the guidance outlined in **MDOT Drainage Manual – Chapter 5.**

C. Utility Coordination

Compile existing utility information as part of the preliminary design phase. Avoid utility impacts when possible. If culvert work will impact site utilities, additional coordination with utility owners or temporary work like sheeting will be needed.

D. Roadway Considerations

Avoid instances where the top of the culvert intrudes into the roadway subbase to prevent premature degradation of the pavement above the culvert. In instances where this cannot be avoided, provide a layer of Road Grade Biaxial Geogrid. Consult with the Region Soils Engineer or Geotechnical Services Section. If required, apply the geogrid above the culvert and extend it beyond the culvert excavation limits in both directions per the **MDOT Standard Specifications for Construction (SSC).**

Check that the required post spacing and/or embedment does not conflict with the top of the culvert where guardrail is present. For structure (culvert) lengths that can accommodate a clear span between guardrail posts of 25'-0" or less use "Guardrail Long Span, Detail MGS-1, MGS-2 or MGS-3" (Standard Plan R-72-Series) to span the culvert. Ensure that the requirements of Standard Plan R-72-Series (e.g., headwall location and size, guardrail post locations, etc.) are met prior to specifying the use of the standard. Otherwise, extend height of headwalls to 36" above plan grade elevation and attach thrie-beam retrofit (MDOT Standard

Plan B-23-Series) to headwall as detailed on the plans.

1.02.08

Right-of-Way Coordination

Place culverts within the ROW wherever possible. Coordinate with the County, if applicable, and **MDOT Region Real Estate** staff early in the project schedule to determine real estate needs and impacts to the project schedule. County drain easements may exist outside of MDOT ROW. Any temporary work outside the ROW requires a legal agreement such as a Consent or Temporary Construction Easement. The **Real Estate Services Section** of the **Development Services Division** or **Region Real Estate** will determine just compensation for the agreement which is offered to the property owner. Permanent ROW acquisition may also need to be considered. Review Chapter 16 of the **MDOT Real Estate Procedure Manual** for more details on ROW considerations during design.

1.02.09

Underdrains

The use of underdrains must be incorporated into the culvert design to relieve hydrostatic pressure and assist with site drainage. Design of these items must follow those procedures and best practices outlined by the **MDOT Road Design Manual Chapter 4** and **MDOT Drainage Manual Chapter 5** and coordinated with the Geotechnical Services Section. For further information regarding drainage layout, see **Appendix D – Guidelines for Culvert Plan Preparation.** Underdrain use may be applicable to larger circular and elliptical culverts as well.

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1.03

ENVIRONMENTAL CLEARANCE & PERMITTING

Obtaining environmental clearance and permits is critical for the progress of culvert projects. Begin drafting these items early in the project design phase and follow guidance from the **MDOT PPDM Series 2300 – EPE Draft Analysis, Series 3700 – Mitigation/Permits**, and EGLE to obtain approval.

Applications for environmental clearances and permits must be submitted to the appropriate agencies a minimum of 120 days before the Final Plan Coordination Meeting is held.

For information on the procedures and requirements of the EGLE JPA, please review the JPA Instructions located on the EGLE/USACE JPA website.

MDOT Form 4200 – This form must be filled out and approved for new culverts, culvert repair, or culvert extensions at regulated streams and drains to secure EGLE JPAs. This form provides insight into the site changes that will take place given the proposed work on a project. For additional guidance, see Appendix A - Form 4200 – Bridge and Culvert Data Form Guidance.

1.03.01

Environmental Clearance

1. NEPA - For compliance with NEPA, the Environmental Liaison must complete a social, economic, and environmental evaluation of their project. This involves coordination with multiple agencies and permits, therefore this evaluation must be a focus during the permitting process.

2. SHPO - SHPO consultations aim to identify cultural resources within the Area of Potential Effect (APE). Establish the APE based on the potential physical, visual, auditory, vibratory, and sociocultural effects it has on its surrounding. The identification of these resources serves as an avenue to analyze design alternatives or develop strategies to mitigate impacts to these resources.

1.03.02

Permits

1. EGLE/USACE Joint Permit Application (JPA) - For any construction activity that takes place where land meets water, EGLE requires a JPA. These permits are typically broken into multiple sections considering impacts to floodplains, waterways, and wetlands.

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1.04

DESIGN CONSIDERATIONS

1.04.01

Hydraulic Design

Size the waterway opening for the culvert based on results from the hydraulic analysis. Follow the procedures and guidance provided in **MDOT PPDM Task 3520 – Hydraulic Analysis for Bridges and Culverts**, and **Scour Analysis**, **MDOT PPDM Task 3522 – Drainage Study**, **Storm Sewer Design** and **Stormwater Post-Construction Best Management Practices (PC-BMP's)**, and the **MDOT Drainage Manual - Chapter 5**.

A. End Conditions

Design of inlet and outlet conditions must be site-specific but aim to minimize entrance and exit losses at the culvert and reduce the scour vulnerability. This can be done through the addition of items such as metal or concrete end sections, riprap, and/or precast/cast in place headwalls, wingwalls, aprons, and cutoff walls. Design and construct end conditions per the **MDOT Drainage Manual – Chapter 5** and the **MDOT SSC**.

1.04.02

Structural Design

Design specifications for culverts must follow the **MDOT Bridge Design Manual** and **MDOT SSC**. Deviation from this requires site specific design. All design must follow **AASHTO LRFD Bridge Design Specifications**.

Structural live load requirements must be based on the culvert span measured along the centerline of the roadway. Precast box culverts with spans less than 10 feet may be designed in accordance with ASTM C1577 using HL-93 loading, as permitted by the **MDOT SSC**. Culverts with spans of 10 feet or greater measured along the roadway centerline shall be designed for HL-93 Modified loading in accordance with MDOT requirements. Culverts

with spans of 10 feet or greater measured along the roadway centerline also require load rating and fabrication inspection in accordance with the **MDOT SSC**.

A. Wingwalls

Use concrete gravity wingwalls such as L-shapes and T-shapes in standard applications. This wall type minimizes the footprint of the culvert and allows for easier installation.

Any permanent or temporary steel sheet piling, and channel layouts needed to facilitate construction must be laid out to account for the anchors, footings, and legs of the wingwalls.

To prevent scour and undermining, gravity wingwalls must include aprons and/or cutoff walls. Place aprons and cutoff walls according to the **MDOT Drainage Manual – Chapter 5**.

The Designer must account for the larger construction footprint required when utilizing soil/earth anchors. Earth anchors cast with wingwalls are commonly used.

While sheet pile wingwalls are not preferred, they may be considered when the following conditions exist:

1. **Overhead utilities will not impact the use of sheet piles.**
2. **Soil anchors are not needed as a part of their design.**
3. **The sheeting will be designed according to MDOT Bridge Design Manual, Chapter 7 and must be galvanized.**

The Engineer must provide a concrete cap to all sheet pile wingwall applications.

B. Skew

Utilize standard skew measurements ranging between 0 and 30-degrees (in 5-degree increments) for the skew of individual pieces. Provide skewed segments only at culvert ends

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or sheeting stage lines to avoid bends in the culvert alignment. Note: Some three-sided culverts can be manufactured with all skewed segments to align with the centerline of the roadway, depending on the angle and the span. The short side of the skewed segment should typically be kept to a minimum of 2 feet. The long side must be no more than what is allowed by the manufacturer. These limitations assist with fabrication and shop drawing review process and allows for an easier installation.

Coordinate with manufacturers during the preliminary design phase to ensure feasibility of any proposed skew angles. In instances where non-standard skew angles are desired, design to the nearest whole degree but not exceeding 45 degrees.

1.04.03

Geotechnical Design

Ensure that a subsurface investigation has been completed before the Preliminary Plan Review Meeting, per the guidelines provided in the **MDOT Geotechnical Manual – Section 6** and **MDOT PPDM Task 3510 – Perform Roadway Geotechnical**

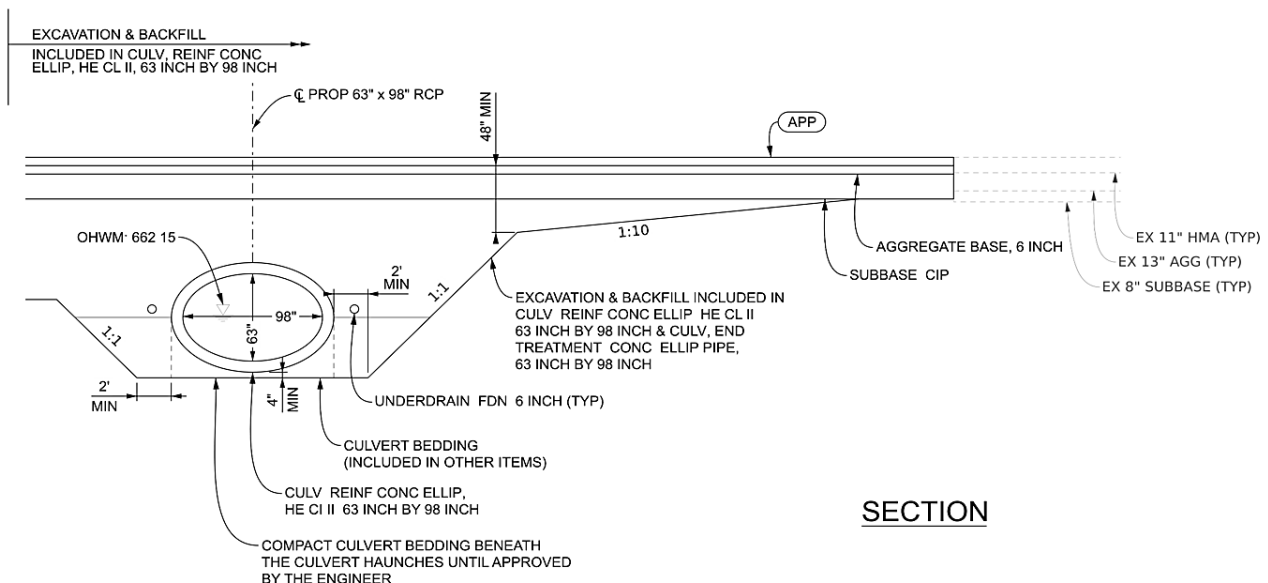
Investigation.

Create a geotechnical report upon completion of the subsurface investigation to document the site's soil conditions, geotechnical analysis, geotechnical design, and construction recommendations. This report must follow those procedures laid out by the **MDOT PPDM Task 3530 – Geotechnical Foundation Engineering Report** and assist in the determination of potential settlement and overall constructability.

A. Settlement

Settlement issues can require removal and replacement of unsuitable materials, and preloading with waiting periods. Consider differential settlement between construction stages, between an existing culvert and extensions, and between fill over and adjacent to the culvert.

To avoid a frost differential between native materials and new materials, add a 1:10 line extending from the bottom of the subbase down to 4 feet below the surface where this intersects the 1:1 from the culvert trench. See Figure below.



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B. Removal of Unsuitable Material

In situations where subgrade material does not meet the bearing requirements of the site, the material must be undercut and replaced. The design of this material and procedure must follow those outlined in the **MDOT SSC** and the **MDOT Geotechnical Manual – Section 9**.

C. Working Platforms

In situations where silty soils or low strength clay soils are expected to be present at the bottom of the excavation, a working platform made of geogrid and or filter fabric along with coarse aggregate or other suitable material may be required. The design and placement of this item must follow the procedures outlined in the **MDOT SSC**.

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1.05

CONSTRUCTION

Follow construction methods and tolerances for culverts outlined in the **MDOT SSC**.

1.05.01

Maintenance Of Traffic

As the preferred method for maintaining traffic, utilize full detours where applicable. Minimize interference with traffic of the surrounding area. Minimize both detour distance and time frame of road closure to mitigate project risk.

A. Staged Construction

Part-width closures may be utilized as an alternative to full detours. However, travel lanes must be checked for structural adequacy under construction loads.

The shy distance found in the **Work Zone Safety and Mobility Manual, Subsection 6.05.02** must be provided between the edge of the travel lane and traffic control device. Temporary traffic barriers or bridge railing is required at all stage removal lines.

Projects involving old Michigan State Highway Department standard plan culverts (typically designated by alpha-numerical references such as E-14-A-12-8) must not be designed to utilize part-width construction. To ensure safety, full detours or temporary bypasses must be used, as the old abutments lack the horizontal steel reinforcement necessary to remain stable when partially removed.

1. Retaining Walls

In situations where open cut cannot be provided for staged construction, dual-cell cofferdam sheeting, temporary or permanent retaining walls are needed. Design walls to provide proper retention of adjacent fill and/or a watertight seal for the construction zone during installation of the culvert. Limited deflection sheet piling may be required depending on live traffic clearance. The

Engineer must consider the potential for tiebacks, internal bracing, and ROW when these walls are used. This ensures proper room is provided for the installation of these items, dewatering methods, and the culvert itself. Place all items associated with temporary walls within the existing ROW.

For further information regarding ROW coordination see **Subsection 1.02.07**.

Utilize **Table 16: Fill Wall Evaluation Factors** and **Table 17: Cut Wall Evaluation Factors** of the **MDOT Geotechnical Manual** to assist with the selection of temporary wall type.

2. Precast Culverts

When staged construction is being utilized for maintenance of traffic, precast culverts are preferred. Precast culverts typically offer quicker build times and simplify design, fabrication, and construction in comparison to CIP culverts.

3. CIP Culverts

Utilize CIP culverts only under unique circumstances where the culvert size or schedule and cost are benefitted. Department concurrence between the Region Staff and Bureau of Bridges and Structures is required.

B. Temporary Bridges

If there is adequate ROW, a detour is not feasible, and there are conflicts to build the culvert in stages, a temporary bridge can be used with bypass roads around the culvert construction site. For hydraulic and scour requirements, see the **MDOT Drainage Manual – Chapter 6**.

1.05.02

Construction Access

Coordinate project phasing and clearances to allow adequate site access for required equipment to place or pour concrete for the culvert. Utilize precast culverts where construction access is limited.

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Coordinate temporary access limits with the MDOT's ROW team and clearly show on the design plans. For further details on ROW coordination, see **Subsection 1.02.07**.

1.05.03

Temporary Water Control during Construction

A water diversion plan will be developed and submitted to the Hydraulic Unit for approval. Refer to **MDOT Drainage Manual - Chapter 5**.

Designers should attempt to provide open channel flow for temporary water control when feasible to close the road and align with environmental preferences from EGLE. In instances where open channel flow cannot be provided, temporary culverts are the preferred alternative as they reduce project risk compared to pumping. Remove the temporary culverts when they are no longer needed, but abandoning in-place and filling with flowable fill and capping may be considered by the Designer with Project Manager approval. If neither of the above options fulfills project needs, bypass pumping may be used. For further acceptable water control methods refer to Chapter 5 of the **MDOT Drainage Manual** and coordinate with MDOT Construction Field Services Division. Sheet piling or cofferdams can limit ROW and grading impacts as they can be placed close to the ROW line and have less earthwork compared to digging a trench for a temporary channel or bypass pipe.

1.05.04

Shipping, Handling, and Lifting

Coordinate with MDOT and manufacturers to ensure trucks and culvert elements do not exceed legal limits specified in **MDOT Form T-2 – Information on the Movement of Oversize or Overweight Vehicles and Loads**.

Additional shipping, handling, and lifting procedures must conform to the applicable requirements of the **MDOT SSC**, including Sections 401 (Pipe Culverts) and 406 (Precast

Three-Sided, Arch, and Box Culverts) and any referenced requirements of Section 7 applicable to structural concrete and steel components.

1.05.05

Fabrication Considerations

A. Shop Drawing Review Process

MDOT's Shop Drawing Review Process must be followed when the Engineer receives shop drawings from a manufacturer. This ensures that responsibilities have been properly coordinated and consistency is provided between all parties performing the reviews.

B. Sizing

Sizing of precast culvert segments will influence the shipping capability of the manufacturer. Limit proposed segment weight to 40 tons and segment lengths to 8'-0", however coordination with manufacturers and MDOT should take place during the preliminary design phase to ensure the oversized loads are feasible and to define constructability considerations. Larger segments are possible; however, should only be implemented in unique situations.

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1.06

REHABILITATION

1.06.01

Rehabilitation Methods

Examine the following rehabilitation options in instances where localized repair options are not adequate to maintain the culvert in safe and stable condition. Common options include installing culvert liners with structural or non-structural materials, rehabilitation or replacement of end treatments, and substructure rehabilitation or partial culvert replacement. The Engineer must ensure that specified methods are designed to conform with the **MDOT SSC**.

Prior to proposing rehabilitation methods requiring personnel entry, the Engineer must consider culvert accessibility and how the contractor would complete the improvements.

A. Liner Rehabilitation

Installing a culvert liner is useful when a culvert has structural deficiency or evidence of piping. Liners are capable of adding strength to a culvert, making it possible to rehabilitate the culvert instead of replacing it. If added strength is desired, as-built plans are required to achieve site-specific culvert load rating.

Before liner installation is recommended, the Engineer must follow the guidance provided on culvert liners in the MDOT Road Design Manual and the MDOT Drainage Manual – Chapter 5. Typically, liner improvements are applied to pipe culverts, however the Engineer must determine if they may be appropriate for additional shapes. The thickness of the liner must be considered in the hydraulic analysis, so the final product meets the hydraulic requirement.

Additional references for installing culvert liners can be found in **MDOT Presentation on Ultraviolet (UV) Hardened Culvert Slip Lining (UV Liners)**, **MDOT Special Provision for Cured-In Place Pipe (CIPP) Liner for**

Culverts, and **MDOT Special Provision for Slip Pipe Liner for Culverts**.

B. Rehabilitation/Replace End Treatment

End treatments of a culvert are intended to protect the culvert from scour and maintain hydraulic efficiency at the inlet and outlet. Rehabilitation or replacement of end treatments may include repair, modification, or full replacement of headwalls, wingwalls, end sections, aprons, and cutoff walls. The selected approach should address observed deterioration, erosion, or hydraulic deficiencies and conform to the requirements of Section 401 (Pipe Culverts) and Section 406 (Precast Three-Sided, Arch, and Box Culverts) of the **MDOT SSC**.

C. Substructure Rehabilitation/Partial Culvert Replacement

Substructure rehabilitation and partial culvert replacement is meant to extend the design life of the existing culvert. Before substructure rehabilitation or partial culvert replacement is recommended, the Engineer must follow the guidance provided in Section 401. Pipe Culverts, and Section 406. Precast Three-Sided, Arch, and Box Culverts, of the **MDOT SSC**.

Partial replacement should only be performed when sufficient original design information or verified field data is available to ensure compatibility with the remaining structure. Do not replace portions of an existing culvert if the original design plans are not available.

MICHIGAN CULVERT DESIGN GUIDELINES

1.07

PLAN PREPARATION

1.07.01

Naming Culverts

When spans measured along the roadway alignment meet or exceed 10 feet, culvert plans must use the naming convention “CXX of YYYYY” where CXX is the ID of the culvert and YYYYY is the MDOT Control Section corresponding to the location of the culvert. CXX, numbers which are provided by MDOT Bureau of Bridges and Structures, must be in increments starting at 01. When culvert spans exceed 20 feet, the culvert naming convention must follow MDOT’s standard bridge naming convention provided in the **Michigan Structure Inventory and Appraisal Coding Guide**.

When spans measured along the roadway alignment are less than 10 feet, culvert plans must use the naming convention found in the **Michigan Ancillary Structures Inspection Manual (MiASIM)**.

Designers must contact the Ancillary Structures Program at MDOT-Ancillary@michigan.gov after the Preliminary Plan Review Meeting to confirm the name of culverts on the project.

Additionally, each culvert with a span of 10 feet or greater measured along the roadway alignment for a given project must be assigned their own funding category. Funding categories must be confirmed with MDOT during the Preliminary Plan Review Meeting. Include culvert spans 10 feet or greater in JobNet as a structure asset.

1.07.02

Preliminary Plan Composition

Provide preliminary plans for all culvert repair, extension, and replacement projects.

Use the following list and ordering of sheets for the Preliminary Plan phase of culvert projects. This list assumes no major work aside from the culvert is included in the project:

- A. Title Sheet
- B. Project Information Sheet
- C. Legend Sheet
- D. Note Sheet
- E. Survey Information
- F. General Plan of Site*
- G. Soil Boring Data*
- H. Construction Staging*
- I. General Plan of Structure*

***Use Appendix D – Guidelines for Culvert Plan Preparation** as a reference for these sheets.

At the Preliminary Plan phase, the culvert general plan of site must convey the culvert alignment, profile, and proposed culvert type at a minimum. If multiple culverts are used, show general plan of site sheets for each type. In the cases where staged culverts that span larger than 10 feet are anticipated, a Structure Study must be performed to identify potential construction challenges early in the project. For additional guidance, refer to the **MDOT Bridge Design Manual**.

To ensure quality and consistency of culvert plans, the checklist provided in **Appendix B – Culvert Plan Checklist – Preliminary Design Phase** must be used during plan preparation and review.

See the **MDOT Road Design Manual** and **MDOT Bridge Design Manual** for guidance on all other sheets.

MICHIGAN CULVERT DESIGN GUIDELINES

1.07.03

Final Plan Composition

Use the following list and ordering of sheets for the Final Plan stage of culvert projects. This list assumes no major work aside from the culvert is included in the project:

- A. Title Sheet
- B. Project Information sheet
- C. Legend Sheet
- D. Note Sheet
- E. Miscellaneous Quantities
- F. Survey Information
- G. Alignment
- H. Maintenance of Traffic
- I. General Plan of Site*
- J. Soil Boring Data*
- K. Construction Staging*
- L. General Plan of Structure*
- M. Culvert Details*

***Use Appendix D – Guidelines for Culvert Plan Preparation** as a reference for these sheets.

To ensure quality and consistency of culvert plans, the checklist provided in **Appendix C – Culvert Plan Checklist – Final Design Phase** must be used during plan preparation and review.

See the **MDOT Road Design Manual** and **MDOT Bridge Design Manual** for guidance on all other sheets.

1.07.04

Culvert Details

Use the culvert details provided in **Appendix D – Guidelines for Culvert Plan Preparation** as a reference when preparing culvert plans. Deviation from these details is allowed to fit project specific needs.

The details should be used for instances where precast or cast-in-place box culverts, three-sided, or arch structures are proposed.

Culvert details must follow the design criteria of the **MDOT Bridge Design Manual** and the **MDOT SSC**. Utilize **MDOT Standard Plans and Special Details** to develop culvert related details when applicable. Modifications to these details that will impact the structural capacity will require site specific design.

A. Reinforcing Steel

Refer to **MDOT Bridge Design Manual** for reinforcing requirements.

1. Skewed Cast-In-Place Sections

When the culvert segment is skewed at the stage line of a CIP culvert, the Engineer must consider the distance required to splice reinforcement. When skews are greater than 20 degrees, do not place reinforcement perpendicular to the stage line. This helps to avoid scenarios where bar splicing equipment and formwork become complicated and potentially interfere with work at or around the stage line.

B. Connections

Wingwall connections must utilize the bent plate connection shown in the details provided in **Appendix D – Guidelines for Culvert Plan Preparation**. The bent plate provided must be galvanized and no less than 1" thick.

MICHIGAN CULVERT DESIGN GUIDELINES

The last two joints at each end between culvert segments must be connected in accordance with **MDOT Standard Plan R-84-Series**.

C. Slabs & Sidewalls

The design of box culvert top and bottom slabs and sidewalls must be site specific. Walls and slab thicknesses must be as specified by ASTM or the structural design engineer used by the bridge or box manufacturer.

D. PVC Membrane

Concrete Box, Three-Sided, and Arch Culverts must be wrapped with a PVC membrane in accordance with the **MDOT Bridge Design Manual Subsection 7.02.30E**.

**MICHIGAN CULVERT
DESIGN GUIDELINES**

**APPENDIX A - FORM 4200 – BRIDGE AND CULVERT DATA FORM AND BRIDGE
AND CULVERT DATA FORM GUIDANCE**

If you require assistance accessing this information or require it in an alternative format, contact the Michigan Department of Transportation's (MDOT) Americans with Disabilities Act (ADA) coordinator at www.Michigan.gov/MDOT-ADA.

[Clear Form](#)

Michigan Department
of Transportation
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BRIDGE AND CULVERT DATA FORM

[Design Guidelines](#)

CONTROL SECTION	JOB NUMBER	STATION NUMBER	DESIGN UNIT	STRUCTURE ID NUMBER

LOCATION COORDINATES	
Latitude:	
Longitude:	

PROJECT LOCATION ADDRESS					
Address Line 1:					
Address Line 2:					
City:		State/Area:		Postal Code:	

NAME OF STREAM / RIVER / CHANNEL

A. WETLAND PROJECT INFORMATION AND IMPACTS (Part 303 – Wetlands Protection)					
1. Total acres of wetland affected by this project			Area (acre)		
Permanent:					
Temporary:					
2. Fill Activity	Volume (cu yd)	Volume (cu ft)	Length (feet)	Width (feet)	Depth (feet)
General Fill:					
Road:					
Riprap:					
Temporary Access:					
Culvert:					
Culvert Headwall and Wingwalls:					
Outfall Structure:					
3. Other	Volume (cu yd)	Volume (cu ft)	Length (feet)	Width (feet)	Depth (feet)
Excavation/Dredge in Wetland:					

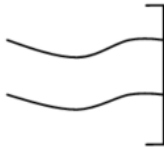
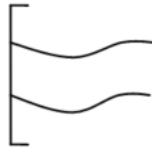
B. STREAM PROJECT INFORMATION AND IMPACTS
(Part 301 – Inland Lakes and Streams) - Below OHWM

1. Reference datum used (show on plans with description): ☐ NAVD 88 ☐ NGVD 29 ☐ IGLD 85 (Great Lakes coastal areas) ☐ Other Reference point where measurement was taken: _____					
2. Ordinary High-Water Mark (OHWM) (ft)					
3. Observed/measured water elevation (ft), and date (mm/dd/yyyy)					
4. Linear feet of stream affected by this project			Length (feet)		
Permanent:					
Temporary:					
5. Fill Activity below the OHWM	Volume (cu yd)	Volume (cu ft)	Length (feet)	Width (feet)	Depth (feet)
Backfill:					
General Fill:					
Road:					
Riprap (inside culvert or under bridge):					
Riprap (outside culvert or bridge):					
Culvert Bedding:					
Other:					
6. Excavation Activity below the OHWM	Volume (cu yd)	Volume (cu ft)	Length (feet)	Width (feet)	Depth (feet)
Earth Excavation:					
Temporary Channel:					
7. Proposed Structures below the OHWM	Volume (cu yd)	Volume (cu ft)	Length (feet)	Width (feet)	Depth (feet)
Bridge:					
Culvert:					
Culvert Headwall and Wingwalls:					
Outfall Structure:					
8. Other	Volume (cu yd)	Volume (cu ft)	Length (feet)	Width (feet)	Depth (feet)
Culvert/Bridge Removal:					
Temporary Access:					

C. BRIDGES AND CULVERTS			
	Upstream (feet)	Downstream (feet)	Cross sectional area of primary channel (square feet)
1. Width of the stream			
2. The width of the stream where the water begins to overflow its banks. Bank full width (feet)			
3. Existing and Proposed Bridge and/or Culvert Information			
	Existing	Proposed	
Number of Culvert Barrels or Bridge Spans:			
Structure Length (parallel to stream) (feet):			
Structure Span (Hydraulic Opening Perpendicular to Stream) (feet):			
Culvert Height (feet) (if bridge enter 0):			
Depth Culvert Recessed (feet) (if bridge enter 0):			
Culvert Invert Elevation Upstream (feet) (if bridge enter 0):			
Culvert Invert Elevation Downstream (feet) (if bridge enter 0):			
Bottom of Bridge Beam Elevation Upstream (feet) (if culvert enter 0):			
Bottom of Bridge Beam Elevation Downstream (feet) (if culvert enter 0):			
Stream Invert Elevation at Bridge Upstream (feet) (if culvert enter 0):			
Stream Invert Elevation at Bridge Downstream (feet) (if culvert enter 0):			
Bridge Rise from Streambed to Bottom of Beam Upstream (feet):			
Total Waterway Opening above Streambed (square feet):			
Total Waterway Opening below the 100-year Flood Elevation (square feet):			
Elevation of Road Grade at Structure (feet):			
Elevation of Low Point in Road (feet):			
Distance from Structure to Low Point in Road (feet):			
Length of Approach Fill from Structure to Existing Grade (feet):			
	Existing	Proposed	
4. Structure Type	Select	Select	
	Specify if other	Specify if other	
5. Culvert Type	Select	Select	
	Specify if other	Specify if other	
6. Culvert Material	Select	Select	
	Specify if other	Specify if other	
7. Structure Entrance Design Type	Select	Select	
	Specify if other	Specify if other	

D. FLOODPLAIN INFORMATION AND IMPACTS (Part 31 – Floodplain Regulatory Authority) – From OHWM to 100-Year Floodplain					
* Only applies if the drainage area of river, stream, or drain is greater than two square miles upstream of the structure or within the 100-year floodplain.					
1. 100-Year Floodplain Elevation				(ft)	
2. Excavation/Cut volume below the 100-year floodplain elevation				(cyd)	
3. Fill volume below the 100-year floodplain elevation				(cyd)	
4. Fill Activity between OHWM and 100-year floodplain elevation	Volume (cu yd)	Volume (cu ft)	Length (feet)	Width (feet)	Depth (feet)
Temporary Activity:					
Other:					

E. RIPARIAN OWNERS

_____		_____
_____		_____
_____		_____
_____	Select	_____
_____		_____
_____	Select	_____
_____		_____
_____		_____
_____		_____
_____		_____

Riparian Owners are needed for work requiring public notice such as culvert extension that total more than 24 feet or a new or replacement culvert with a 25 square foot (or greater) waterway area.

**MICHIGAN BRIDGE AND CULVERT
DESIGN GUIDELINES****BRIDGE AND CULVERT DATA FORM GUIDANCE**

- Control Section – Should be provided by the department.
- Job Number - Should be provided by the department.
- Station Number – Include Station Number at the intersection of the roadway alignment and centerline of culvert to indicate approximate location of the proposed culvert.
- Design Unit – Should be provided by the department.
- Structure ID Num – Should be provided by the department.
- Location Coordinates – Provide the coordinates associated with your site. For projects with multiple locations, provide the central point.
- Project Location Address – Enter the information for the project location.
- Name of Stream/River/Channel – Provide the name of the stream, river, or channel you are referencing with this section.

A. Wetland Project Information and Impacts (Part 303 – Wetlands Protection)

- A1. If there are multiple wetland impact areas, calculate the total impact by summing all areas. Enter the combined total separately for temporary and permanent impacts. An example of temporary impacts is a temporary access road.
- A2. – A3. Enter each FILL activity and associated dimensions.
Volume - Indicate the estimated volume of solid material involved in the activity, expressed in cubic feet and cubic yards. Volume input in cubic feet will auto generate once the corresponding Length, Width and Depth are entered.
Length - Indicate the proposed activity average length in linear feet.
Width - Indicate the proposed activity average width in linear feet.
Depth - Indicate the proposed activity average depth in feet.
Use average length, width, and depth in the table in order to accurately depict the area and volume.

B. Stream Project Information and Impacts (Part 301 – Inland Lakes and Streams) – Below OHWM

- B1. Stream water levels can be referenced using the National Geodetic Vertical Datum of 1929 (NGVD 29), the North American Vertical Datum of 1988 (NAVD 88) or IGLD 85 (Great Lakes coastal areas). A relative elevation can be referenced using a relative elevation conversion from a reference point or benchmark, or conversion from still water elevation. Visit the National Geodetic Survey site here <https://www.ngs.noaa.gov/datums/vertical/>. Select Other if unknown and using a relative elevation.
- B2. List the elevation of the OHWM according to the elevation reference selected B1. If using a relative elevation, list the elevation in relation to the reference description B1. For example, OHWM is 1.25 feet below the top elevation of the property boundary marker.
- B3. If the OHWM elevation listed was converted from still water, provide the observation date. If using a datum, use today's date.

BRIDGE AND CULVERT DATA FORM GUIDANCE

- B4. Enter totals of temporary and permanent impacts for these resource types.
- B5. – B8. Enter each FILL or EXCAVATION activity and associated dimensions.
- Volume - Indicate the estimated volume of solid material involved in the proposed activity, expressed in cubic feet and in cubic yards. This should represent only the volume of the physical structure or fill—excluding any voids or openings. Volume input in cubic feet will auto generate once the corresponding Length, Width and Depth are entered.
- Length - Indicate the proposed activity average length in linear feet.
- Width - Indicate the proposed activity average width in linear feet.
- Depth - Indicate the proposed activity average depth in feet.
- Use average length, width, and depth in the table in order to accurately depict the area and volume. See Figure 1-4 for guidance.

C. Bridges and Culverts

- C1. Enter values for the stream width (feet) upstream and downstream. This measurement is to be taken at the OHWM where the culvert is proposed and outside the influence of any ponding or scour holes around existing structures.
- C2. Enter value for the width of the stream where the water begins to overflow its banks. Bank full width in feet.
- C3. Enter values for existing and proposed bridge and/or culvert information. If there is no existing structure, enter 0.

Number of Culvert Barrels or Bridge Spans: Enter the number of culvert barrels or bridge spans.

Structure Length: Enter the total hydraulic length of culvert or bridge parallel to stream in feet. See Figure 3 and 5 for guidance.

Structure Span: Enter the hydraulic opening span length perpendicular to stream (for culverts this would be the culvert width for one barrel) See Figure 3 and 5 for guidance.

Culvert Height: The height of the culvert without any recess or bury depth.

Depth Culvert Buried: Enter total feet the culvert bottom will be buried. Does not apply to bridges so enter "0".

Culvert Invert Elevation Upstream: The elevation of the culvert invert on the upstream end (bottom of the culvert, as it sits below the recess, not including any fill in the culvert bottom).

Culvert Invert Elevation Downstream: The elevation of the culvert invert on the downstream end (bottom of the culvert, as it sits below the recess, not including any fill in the culvert bottom).

Bottom of Bridge Beam Elevation (Upstream) (feet): For culverts enter "0".

BRIDGE AND CULVERT DATA FORM GUIDANCE

Bottom of Bridge Beam Elevation (Downstream) (feet): For culverts enter "0".

Stream Invert Elevation at Bridge Upstream (feet): The stream bottom elevation on the upstream end of bridge.

Stream Invert Elevation at Bridge Downstream (feet): The stream bottom elevation on the downstream end of bridge.

Bridge Rise from Streambed to Bottom of Beam Upstream (feet): The height between stream bottom and bottom of beam.

Total Waterway Opening above Streambed (square feet): The total square foot area that would allow passage of water through the structure opening.

Total Waterway Opening below the 100-year Flood Elevation (square feet): This is the total square foot area that would allow passage of water that is below the 100-year flood elevation.

Elevation of Road Grade at Structure (feet): The elevation of the road grade above the structure. See Figure 6 for guidance.

Elevation of Low Point in Road (feet): Enter the elevation of the lowest point in the road nearest the structure. See Figure 6 for guidance.

Distance from Structure to Low Point in Road (feet): How far (in feet) from the mid-point of the structure to the low point in the road. See Figure 6 for guidance.

Length of Approach Fill from Structure to Existing Grade (feet): How far (in feet) from the edge of the roadway does any fill used for the structure extend before it reaches the existing grade. See Figure 3 for guidance.

- C4. Identify the type of structure.
- C5. Identify the type of culvert.
- C6. Identify the existing and proposed culvert material.
- C7. Identify the entrance design type for the existing and the proposed structure.

D. Floodplain Information and Impacts (Part 31 – Floodplain Regulatory Authority) – From OHWM to 100-Year Floodplain

- D1. If the 100-year floodplain elevation is unknown, please enter "unknown".
- D2. Provide excavation/cut volume between OHWM and 100-year floodplain elevation.
- D3. Provide fill volume between OHWM and 100-year floodplain elevation.

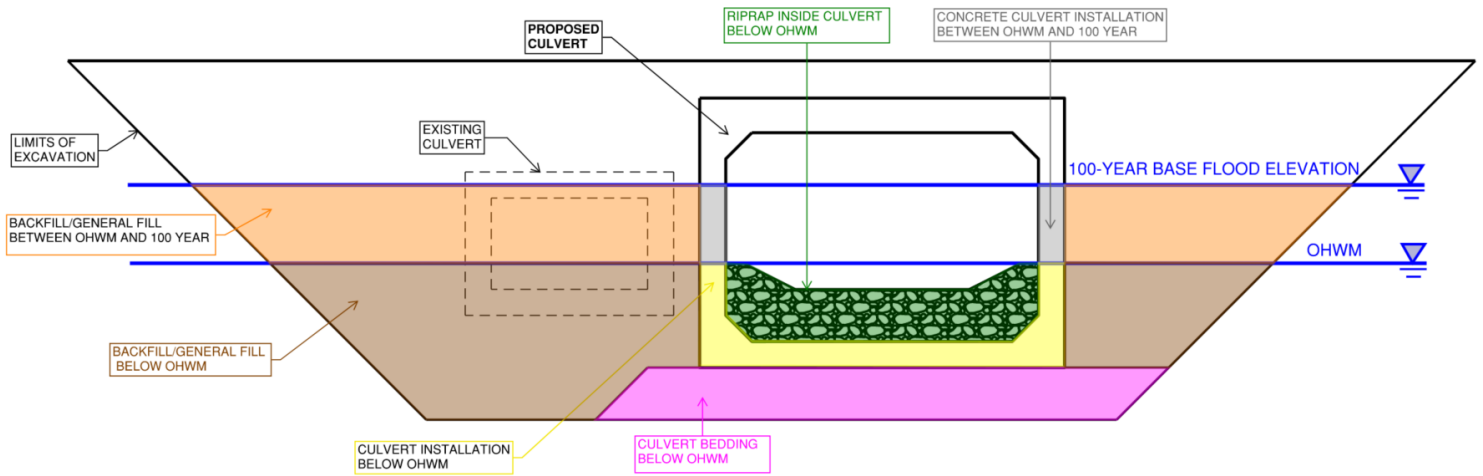
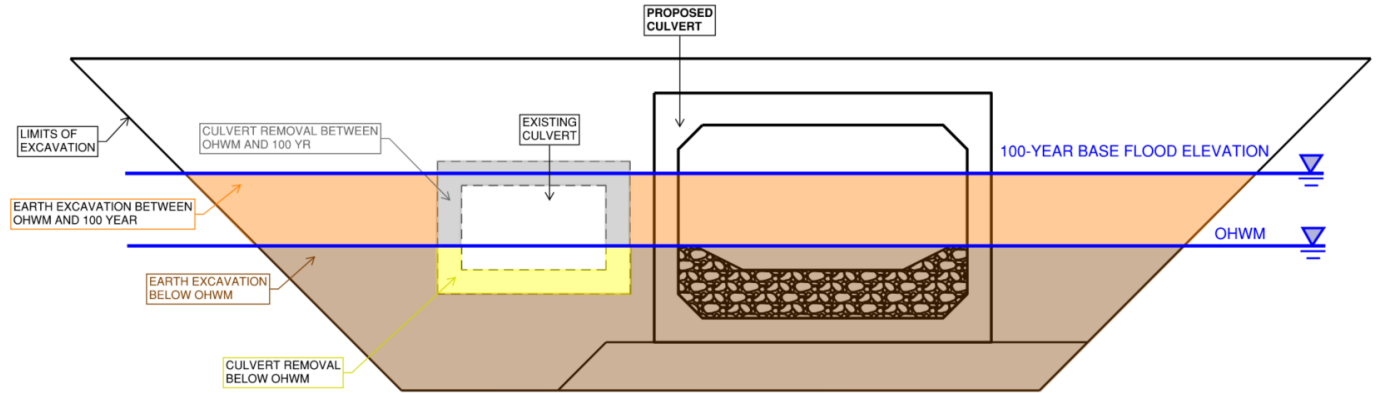
BRIDGE AND CULVERT DATA FORM GUIDANCE

- D4. Provide fill activity between OHWM and 100-year floodplain elevation.
Volume - Indicate the estimated volume of solid material involved in the activity, expressed in cubic feet. Volume input will auto generate once the corresponding Length, Width and Depth are entered.
Length - Indicate the proposed activity average length in linear feet.
Width - Indicate the proposed activity average width in linear feet.
Depth - Indicate the proposed activity average depth in feet.
Use average length, width, and depth in the table in order to accurately depict the area and volume.

E. Riparian Owners

- Include Riparian Owners' name
- Include Riparian Owners' address (street, city, state, zip code)
- Include Assessor's Parcel Number (APN)
- Select orientation of North arrow
- Select direction of stream flow
- Indicate name of roadway over culvert

BRIDGE AND CULVERT DATA FORM GUIDANCE



BRIDGE AND CULVERT DATA FORM GUIDANCE

- Length of culvert
- Width of fill (distance parallel to stream)
- Length of fill (distance perpendicular to stream)
- The horizontal distance from the edge of the roadway to the bottom of the culvert
- The horizontal distance from the edge of the roadway to the bottom of the culvert

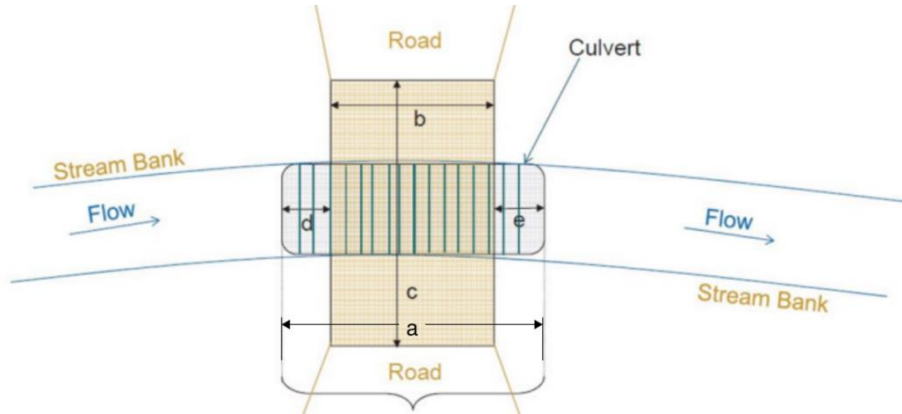


Figure 3. Culvert Plan View Quantities

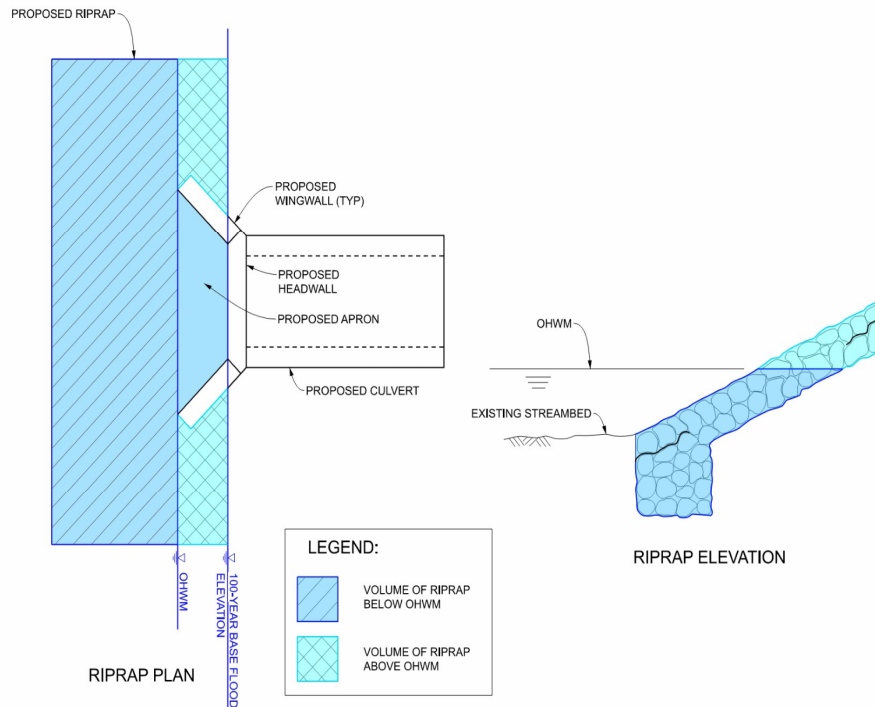


Figure 4. Riprap Quantities Outside of Culvert

BRIDGE AND CULVERT DATA FORM GUIDANCE

- a. _____ Bridge span
b. _____ Bridge width

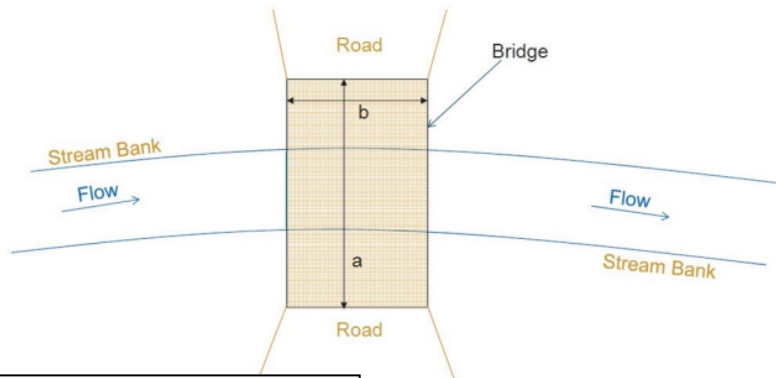


Figure 5. Bridge Plan View Quantities

Distance from Low Point in Road

- a. _____ Elevation at low point in road –OR- difference in height from road surface at that location, and above culvert
b. _____ Elevation at road grade –OR- height
c. _____ Distance from low point in road to center of crossing

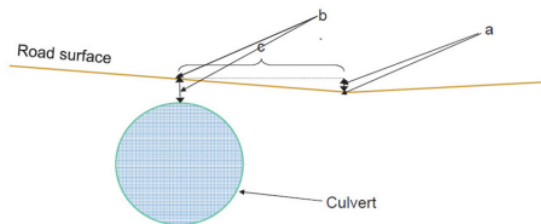


Figure 6. Road Profile View

MICHIGAN CULVERT DESIGN GUIDELINES

APPENDIX B - CULVERT PLAN CHECKLIST – PRELIMINARY PLAN PHASE

General Plan of Site Sheet

- 1) Situation Plan. Show and/or callout the following:
 - a) Centerline of the proposed culvert.
 - b) Curb and pavement edges.
 - c) North arrow.
 - d) Existing right of way limits.
 - e) Proposed consent to grade and right of way limits.
 - f) Flow direction and name of watercourse (if applicable).
 - g) Road name.
 - h) Utilities
 - i) "Caution – Critical Utility" callout (if applicable)
 - ii) "Hazardous or Flammable Material" callout (if applicable)
 - i) Existing site topography using contours. Contours should be at 2' or 5' intervals.
 - j) Outline of existing structure (if applicable).
 - k) Show and label all roadway alignments as "legal" or "non-legal". Alignments should be horizontal on the sheet, from left to right in the direction of increasing station.
 - l) Traffic directional arrows.
 - m) Riprap (if applicable).
 - i) Add in typical notes "Top of riprap must be at or below existing streambed/slope elevation."
 - n) Culvert Hydraulic Summary table (**MDOT Drainage Manual - Appendix 5-D**).
 - o) Survey and construction centerlines.
 - p) Soil boring locations.
 - q) Cofferdam/steel sheet piling (if applicable).
 - r) Angle between centerline of culvert and roadway.
 - s) Proposed structure.
 - t) Reference points of the proposed structure (see table below).

COORDINATES			
PROP. REF. PT.	NORTH	EAST	ELEV.
PT. A	630902.05	25595170.65	1308.11
PT. B	630902.12	25595180.98	1308.02

COORDINATES PROVIDED ARE TO ESTABLISH THE GEOGRAPHIC LOCATION OF THE STRUCTURE, HOWEVER SHALL NOT TAKE PRECEDENCE OVER STRUCTURAL DIMENSIONS.

- 2) Profile. Show and/or callout the following:
 - a) Proposed ground/roadway profile and grade.
 - b) Existing ground/roadway profile.
 - c) Upstream and downstream Ordinary High-Water Mark (OHWM) elevation.
 - d) Upstream and downstream 100-year flood elevation (if applicable).
 - e) Upstream and downstream culvert invert elevation.
 - f) Upstream and downstream existing culvert invert elevation.
 - g) Upstream and downstream low chord elevation.
 - h) Upstream and downstream streambed elevation (if applicable).
 - i) Proposed culvert rise and span.
 - j) Backfill and excavation limits.

MICHIGAN CULVERT DESIGN GUIDELINES

- k) Upstream and downstream bottom of culvert bedding elevation.
 - i) Callout should include a note that elevation is based on slab thickness shown on plans. If the design of the culvert requires a bottom slab with a different thickness than what is shown in these plans, adjust this elevation to accommodate the change. Do not reduce the dimensions of the culvert bedding.
- l) Cofferdam/steel sheet piling (if applicable).
- m) Reference points with stations and elevations.
- n) Vertical scale of the profile.
- 3) Text box referring to the project information sheet for survey control points and benchmarks.
- 4) Utilities text box referring to the project information sheet for utility owner contact information.
- 5) Text box referring to the location of roadway & drainage information within the plan set.
- 6) Text box describing the existing structure. This should include information on the culvert type, design loading, year constructed, and major applicable rehab work.
- 7) Notes should be placed in the bottom right corner of the sheet. The following notes from **MDOT's Bridge Design Manual** should be considered standard for every project:
 - a) *"The work covered by these plans..." (8.03.A)*
 - b) *"Locate all active underground utilities..." (8.03.E)*
 - c) *"Maintain/Detour traffic over..." (8.03.K)*
 - d) *"Plan elevations refer to..." (8.03.M)*
 - e) *"Water level is subject to change..." (8.03.R)*
 - f) *"Implement measures to prevent debris..." (8.03.V)*
 - g) *"Immediately after the construction of..." (8.03.W)*

Construction Staging Sheet(s)

- 1) For staged construction, show and/or callout the following:
 - a) Indicate lane configuration for each stage.
 - b) Traffic directional arrows for each stage.
 - c) Temporary sheeting detail (if applicable).
 - d) Temporary flow detail (if applicable).
 - e) Cross hatch portions to be removed in each stage.
 - f) Show proposed part-width portions in each stage.
 - g) Existing plan of roadway (if applicable).
 - h) Temporary Steel Sheet Piling and Temporary MSE Walls (if applicable).

Log of Borings Sheet(s)

- 1) Soil Profile (as required by culvert size or if temporary sheet piling is needed). Show and/or callout the following:
 - a) Soil strata.
 - b) Boring name or number.
 - c) Boring date.
 - d) Soil boring location with station-offsets and/or state plane northing and easting coordinates.
 - e) Blow counts with three 6" increments.
 - f) Ground surface elevation.
 - g) Depth of groundwater.
 - h) End of boring elevation.
 - i) The invert elevation of the culvert
 - j) Bottom of the excavation

MICHIGAN CULVERT DESIGN GUIDELINES

- 2) Notes should be placed in the bottom right corner of the sheet. The following notes from **MDOT's Bridge Design Manual** should be considered standard for every project:
- a) "Numbers in circles denote..." (8.04.A)
 - b) "Consistency was determined by..." (8.04.B)
 - c) "The soil boring logs represent point..." (8.04.I)
 - d) "Elevations reference the top of..." (8.04.L)

General Plan of Structure Sheet(s)

- 1) Plan View of Structure. Show and/or callout the following:
- a) Centerline of the proposed culvert.
 - b) North arrow.
 - c) Existing right of way limits.
 - d) Proposed grading limits.
 - e) Grading lines with slope indicated.
 - f) Flow direction and name of watercourse (if applicable).
 - g) Utilities
 - 1. "Caution - Critical Utility" callout (if applicable)
 - 2. "Hazardous or Flammable Material" callout (if applicable)
 - h) Show and label all roadway alignments as "legal" or "non-legal". Alignments should be oriented so that the culvert is horizontal on the sheet, from left to right or bottom to top in the direction of increasing station.
 - i) Lane and shoulder widths dimensioned.
 - j) Traffic directional arrows.
 - k) Angle between centerline of culvert and roadway.
 - l) Reference points with stations.
 - m) Riprap with dimensions.
 - 1. Add in typical notes "Top of riprap must be at or below existing streambed/slope elevation."
 - n) Cofferdam/steel sheet piling (if applicable).
 - o) Give working points at each end where the centerline of culvert meets the end of the culvert.
 - p) Proposed underdrain and flow direction.
- 2) Elevation View, along culvert centerline. Show and/or callout the following:
- a) Lane and shoulder widths dimensioned.
 - b) Roadway cross slopes.
 - c) Roadway aggregate base and subbase.
 - d) Overall culvert length dimensioned.
 - e) Number of culvert segments and length of each segment indicated.
 - f) Side slopes shown and grade indicated.
 - g) Culvert bedding and bottom of bedding labeled.
 - h) Future silt fill (streambed) (if applicable)
 - i) Low chord elevation.
 - j) Upstream and downstream bed elevation
 - k) Upstream and downstream invert elevation
 - l) Wingwalls shown.
 - m) Top of wingwall elevations provided.
 - n) Underdrain shown.
 - o) High point to underdrain dimensioned.
 - p) Show and label joint tie assembly.
 - q) Expected undercut (if applicable)
 - r) Proposed fill (if applicable)

MICHIGAN CULVERT DESIGN GUIDELINES

- 3) Riprap section details.
 - a) Add in typical notes "Top of riprap must be at or below existing streambed/slope elevation."
- 4) Miscellaneous Quantities table.
- 5) Summary of Hydraulic Analysis table. (**Drainage Manual Appendix 5-D**)
- 6) Typical Section Through Culvert. Show and/or callout the following:
 - a) Proposed roadway grade.
 - b) Limits of excavation and backfill.
 - c) Rise and Span of proposed culvert.
 - d) Thickness of side walls and top and bottom slabs.
 - e) Cofferdam/steel sheet piling (if applicable).
 - f) Culvert bedding.
 - g) Outline of existing pipe/culvert shown.
 - h) Proposed upstream and downstream invert elevation.
 - i) Proposed underdrain.
- 7) Notes should be placed in the bottom right corner of the sheet. The following notes from **MDOT's Bridge Design Manual** should be considered standard for every project. Consult **MDOT's Bridge Design Manual** for project specific notes that may apply.
 - a) *"The design of this structure is based..." (8.05.A)*
 - b) *"The drainage area contributory to this..." (8.05.G1)*
 - c) *"The existing (culvert) area below the..." (8.05.G2)*
 - d) *"Do not use broken concrete for riprap" (8.05.G5)*
 - e) *"The (existing) (adjacent) structure, provides..." (8.05.I)*
 - f) *"Place geotextile liner on all slopes prior..." (8.05.K)*
 - g) *"The riprap quantity is based on the lateral..." (8.05.T)*
 - h) *"Submit alternate methods of stream diversion..." (8.05.U)*
 - i) *"When casting items into structural precast..." (8.05.X)*
 - j) *"Contact the Region Soils Engineer..." (8.05.AA or 8.05.BB)*
 - k) *"Design headwalls to develop an ultimate moment..." (8.05.Z)*

MICHIGAN CULVERT DESIGN GUIDELINES

APPENDIX C - CULVERT PLAN CHECKLIST – FINAL PLAN PHASE

Final design phase plans should convey checklist items provided for the preliminary design phase in addition to the following checklist items.

General Plan of Site Sheet

- 1) Situation Plan. Show and/or callout the following:
 - a) Mark and label soil borings
 - b) Precast ground anchors (if applicable).
 - c) Temporary steel sheet piling and temporary MSE Walls (if applicable).
 - d) Bearing capacity of soils

Maintenance of Traffic Sheet(s)

- 1) For staged construction, show and/or callout the following:
 - a) Indicate lane configuration for each stage.
 - b) Traffic directional arrows for each stage.
 - c) Temporary sheeting detail (if applicable).
 - d) Temporary flow detail (if applicable).
 - e) Cross hatch portions to be removed in each stage.
 - f) Show proposed part-width portions in each stage.
 - g) Existing plan of roadway (if applicable).
 - h) All temporary control devices and layouts such as temporary traffic control sign locations, lane widths, type of channelizing devices, and temporary pavement markings.

Log of Borings Sheet(s)

- 1) Soil Profile. Show and/or callout the following:
 - a) Indicate proposed culvert upstream and downstream invert elevations.
 - b) Indicate upstream and downstream bottom of bedding elevations.

General Plan of Structure Sheet(s)

- 1) Plan View of Structure. Show and/or callout the following:
 - a) Mark and label soil borings.
- 2) Elevation View at Culvert End(s). Show and/or callout the following:
 - a) Proposed guardrail (if applicable)
 - b) Proposed end section or headwall, wingwalls, apron, and cutoff wall.
 - c) Top of end section or headwall and wingwall elevations.
 - d) Bottom of cutoff wall elevation.
 - e) Stream side slopes with grading indicated.
 - f) Roadway side slope grading lines with slope indicated.
 - g) Measurement from reference line to reference line.
 - h) Rise and span.
 - i) Cofferdam/steel sheet piling (if applicable).
 - j) Proposed upstream and downstream invert elevation.
 - k) 50 & 100-year flood elevations
 - l) For part width construction show distance from sheet piling to both ends of culvert.

MICHIGAN CULVERT DESIGN GUIDELINES

Removal Details Sheet(s)

- 1) Hatch areas where removal is required.
- 2) Callout the removal pay item.
- 3) Indicate stage lines (if applicable).
- 4) Cross out quantities, sheet scales, and notes not pertaining to current job number.

Structure Details Sheet(s)

- 1) Plan View of precast segments and wingwalls. Show and/or callout the following:
 - a) North arrow
 - b) Angle between centerline of culvert and roadway.
 - c) Measurement of segments including joints between segments.
 - d) Outline of wingwalls and headwall
 - e) Wingwall Angles.
 - f) Wingwall dimensions
 - g) Reference Points
 - h) Culvert centerline
- 2) Box culvert joint tie assembly detail (MDOT Standard Plan R-84-Series)
- 3) Connection Details for wingwall attachment.
- 4) Typical Culvert Section. Show and/or callout the following:
 - a) Rise and span of the culvert
 - b) Thickness of walls and slabs
 - c) Threaded inserts
 - d) Outline of headwall
 - e) Top of headwall elevations
- 5) Elevation Views of all wingwalls, headwall, apron and curtain wall with elevations given.
Show and/or callout the following:
 - a. Dimensions of element.
 - a) Rebar sizing and spacing (if applicable)
 - b) Threaded inserts
- 6) Plan of apron and cutoff wall.
 - a. Dimensions of element
 - b. Rebar sizing and spacing (if applicable)
 - c. Outline of headwall and wingwalls with dimensioning and angles
- 7) Bar Bend Diagrams (if applicable)
- 8) Concrete-Grade Quantities Table (if applicable)
- 9) Reinforcement Steel Quantities Table (if applicable)
- 10) Bar Cut Diagram Table (if applicable)
- 11) PVC Membrane Typical Detail and Limits

MICHIGAN CULVERT DESIGN GUIDELINES

APPENDIX D – GUIDELINES FOR CULVERT PLAN PREPARATION

GUIDELINES FOR CULVERT PLAN PREPARATION



FINAL ROW PLAN REVISIONS SUBMITTAL DATE:									NO SCALE		DATE:	CS:	GUIDELINES FOR CULVERT PLAN PREPARATIONS	DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION				DESIGN UNIT:	JN:			
										FILE:	TSC:				

PURPOSE AND APPLICATION

This set of sample plans is intended for use as a guideline for preparing a set of culvert construction plans for the Michigan Department of Transportation. The examples of various sheets illustrate preferred techniques to ensure the uniformity, quality, and continuity of plans.

Other sheets are examples of various plan sheets, based on the most commonly occurring situations. However, it is recognized that some projects will have unusual circumstances that may allow for some variations from the preferred techniques contained herein.

This set is not to be considered or used as a single, coordinated plan, but as a collection of individual sheet types. In many cases, copies of actual plan sheets have been used to develop the sheets contained herein. Since modifications have been made to those sheets to develop an appropriate sample, they are not to be considered an official record of the plans from which they were taken.

Where the information shown on the sample plan sheets is in conflict with the design standards or practices of Michigan Department of Transportation as contained in its Standard Specifications for Construction special provisions, design manuals or design standards, the standards and practices supersede any sample plan sheet information.

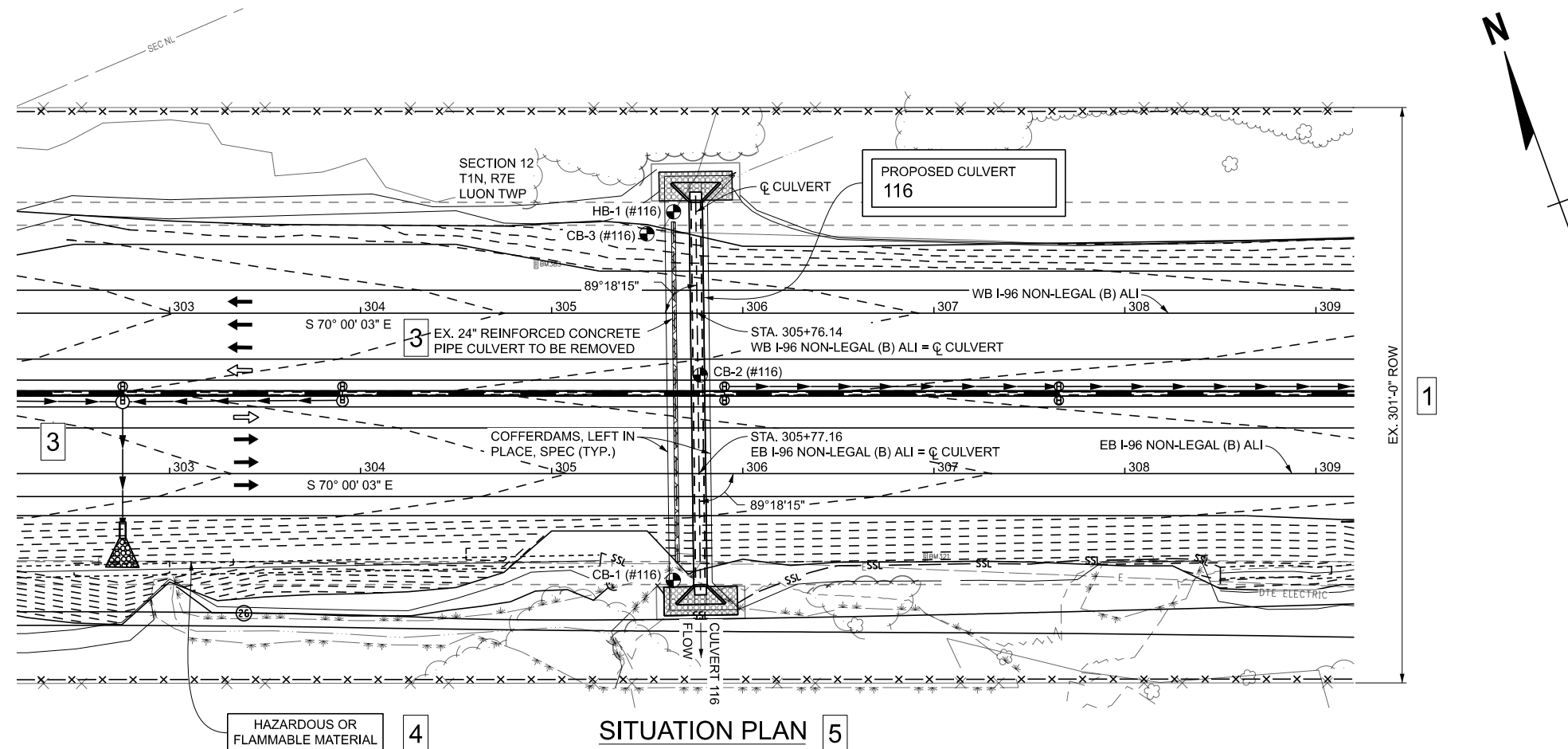
Boxed numbers refer to the plan guidelines located on the plan Guidelines Sheet at the beginning of each section.

See MDOT Guidelines for Bridge Plan Preparation for general plan preparation guidelines not specific to culverts such as guidelines for sheet layout, text, dimensions, plan notes, etc.

See MDOT Guidelines for Plan Preparation for guidelines related to sheets not specific to culverts such as survey, alignment, and typical section sheets.

Errors and omissions can be reported to MDOT-Ancillary@Michigan.gov.

FINAL ROW PLAN REVISIONS SUBMITTAL DATE:									NO SCALE	DRAWN BY:	DATE:	CS:	PLAN GUIDELINES		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION			CHK'D BY:	DESIGN UNIT:	JN:	PURPOSE AND APPLICATION			SECT 2
										FILE: culv_notes_000.dgn	TSC:					



SURVEY CONTROL & BENCHMARKS

SEE SURVEY INFORMATION SHEET FOR SURVEY CONTROL & BENCHMARKS.

UTILITIES

SEE PROJECT INFORMATION SHEET FOR UTILITIES.

ROADWAY & DRAINAGE

SEE REMOVAL, CONSTRUCTION AND DRAINAGE SHEETS FOR ROADWAY AND DRAINAGE INFORMATION.

EXISTING STRUCTURE

THE EXISTING STRUCTURE IS A 24" REINFORCED CONCRETE PIPE. REMOVAL OF EXISTING PIPE PAID FOR ON REMOVAL SHEETS.

NOTES:

THE WORK COVERED BY THESE PLANS INCLUDES REMOVAL OF THE EXISTING CULVERT, CONSTRUCTION OF THE PROPOSED BOX CULVERT, MAINTAINING DRAIN FLOW DURING CONSTRUCTION, AND PLACING RIP RAP TO THE LIMITS SHOWN. ALL OTHER WORK IS INCLUDED IN THE ROAD PLANS THAT ARE PART OF THIS CONTRACT.

LOCATE ALL ACTIVE UNDERGROUND UTILITIES PRIOR TO STARTING WORK AND CONDUCT OPERATIONS IN SUCH A MANNER AS TO ENSURE THAT THOSE UTILITIES NOT REQUIRING RELOCATION WILL NOT BE DISTURBED.

I-96 TRAFFIC IS TO BE MAINTAINED OVER THE CULVERT BY PART WIDTH CONSTRUCTION. SEE MAINTAINING TRAFFIC PLANS FOR DETAILS.

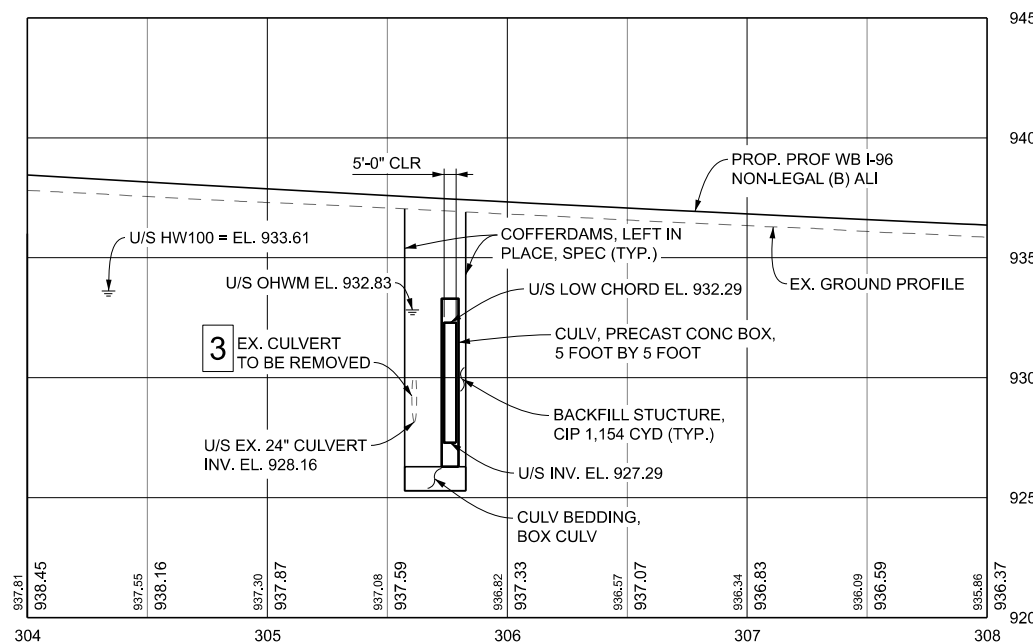
PLAN ELEVATIONS REFER TO NAVD88 DATUM.

WATER LEVEL IS SUBJECT TO CHANGE. THE CONTRACTOR IS RESPONSIBLE FOR MAKING A DETERMINATION OF WATER LEVELS THAT MAY EXIST DURING CONSTRUCTION.

IMPLEMENT MEASURE TO PREVENT DEBRIS FROM FALLING FROM THE STRUCTURE. IF DEBRIS FALLS INTO THE WATERWAY, REMOVE IT WITHIN 24 HOURS. SINCE DISTURBANCE OF THE WATERWAY BOTTOM MAY BE AS HARMFUL AS THE DEBRIS ITSELF, THE PREVENTIVE MEASURES MUST BE EFFECTIVE. REMOVAL OF DEBRIS IS INCLUDED IN RELATED ITEMS OF WORK.

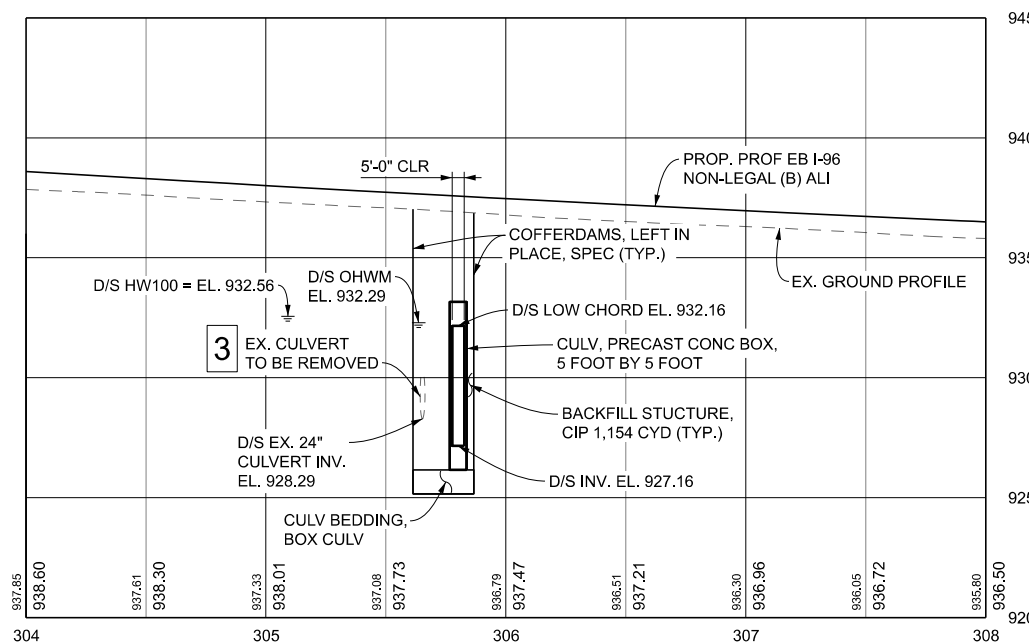
IMMEDIATELY AFTER THE CONSTRUCTION OF EACH STAGE OF CULVERT CONSTRUCTION, SLOPE PROTECTION AND SEEDING SHALL BE PLACED ON THE ADJACENT EMBANKMENT SLOPES.

FOR JOINT DETAIL BETWEEN CULVERT SECTIONS SEE STANDARD PLAN R-84.



PROFILE ALONG WB I-96 NON-LEGAL ALIGNMENT 6

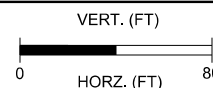
VERT. SCALE: 1" = 8'



PROFILE ALONG EB I-96 NON-LEGAL ALIGNMENT 6

VERT. SCALE: 1" = 8'

FINAL ROW PLAN REVISIONS						SUBMITTAL DATE:					
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION



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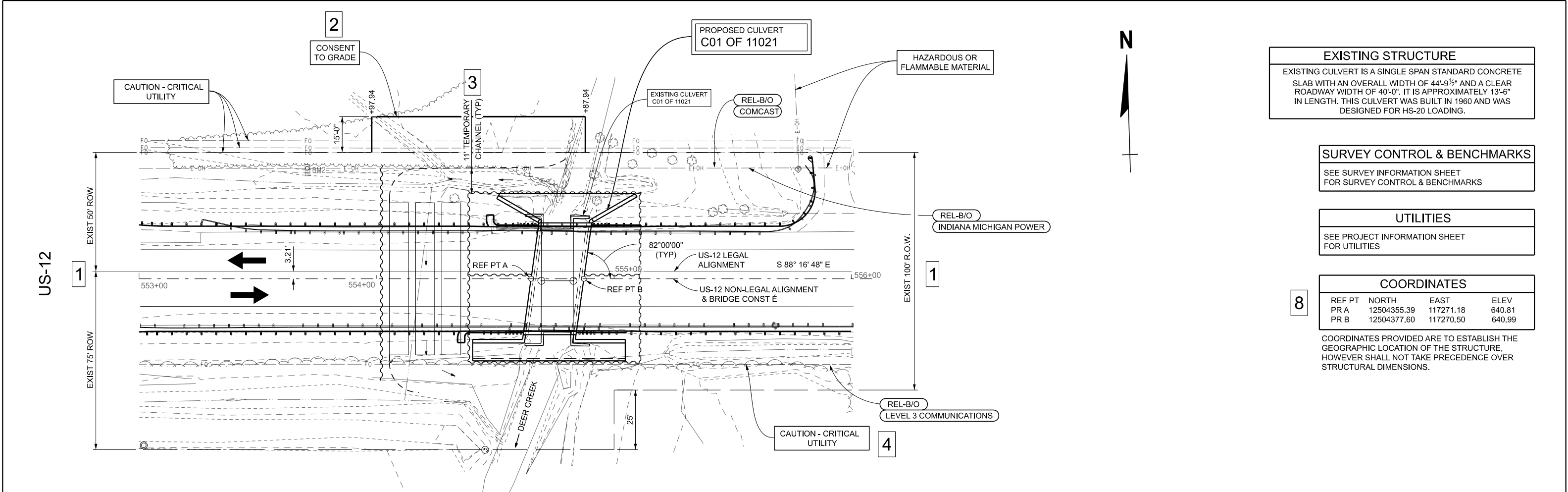
CS: C116 OF 63022
JN: 124103A

7

GENERAL PLAN OF SITE
CULVERT 116
EAST OF OLD PLANK RD

DRAWING SHEET
C116 SITE 001
SECT 2

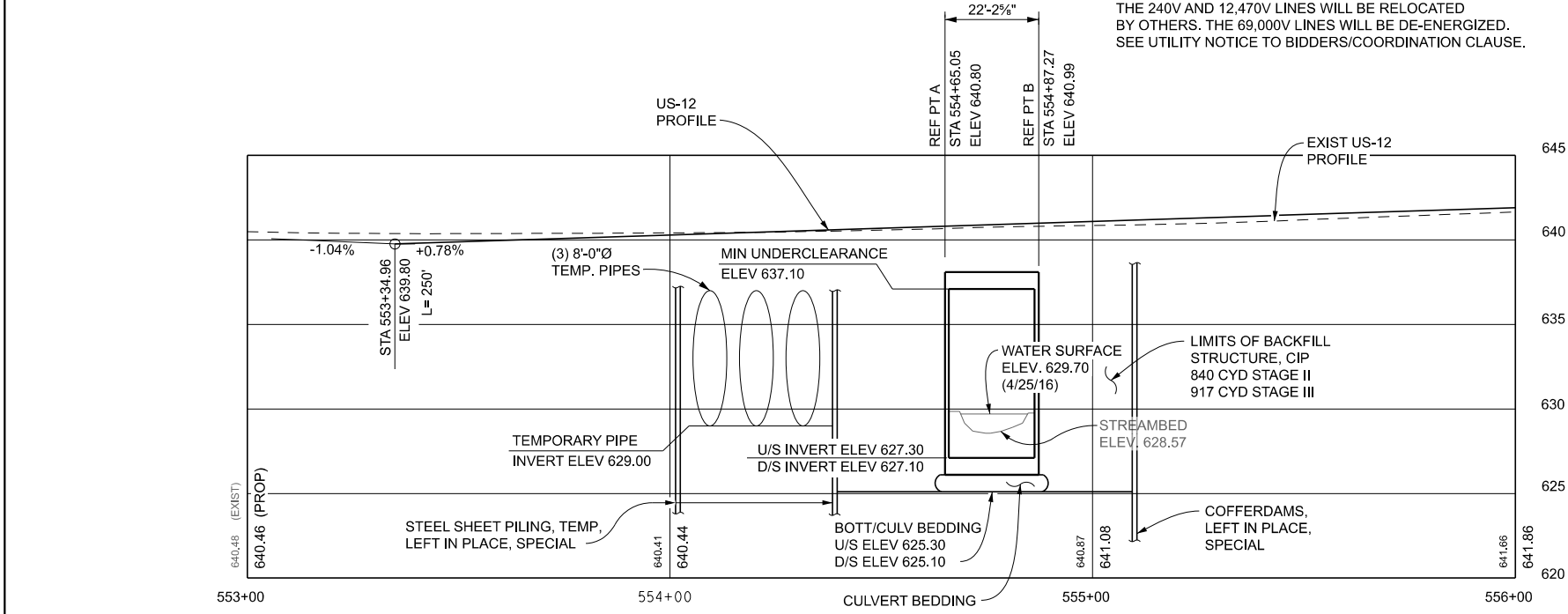
9



SITUATION PLAN

5

NOTE 1:
THE 240V AND 12,470V LINES WILL BE RELOCATED BY OTHERS. THE 69,000V LINES WILL BE DE-ENERGIZED. SEE UTILITY NOTICE TO BIDDERS/COORDINATION CLAUSE.



PROFILE ALONG US-12 NON-LEGAL ALIGNMENT

VERTICAL SCALE: 1" = 10'

6

NOTES:

THE WORK COVERED BY THESE PLANS INCLUDES REMOVAL OF EXISTING CULVERT, TEMPORARY CHANNEL EXCAVATION, TEMPORARY CHANNEL DIVERSION, CONSTRUCTION OF THE PROPOSED CULVERT, PLACING SLOPE PROTECTION TO THE LIMITS SHOWN, MAINTAINING TRAFFIC AND APPROACH WORK.

THE CONTRACTOR SHALL LOCATE ALL ACTIVE UNDERGROUND UTILITIES PRIOR TO STARTING WORK AND SHALL CONDUCT HIS OPERATIONS IN SUCH A MANNER AS TO ENSURE THAT THOSE UTILITIES NOT REQUIRING RELOCATION WILL NOT BE DISTURBED.

US-12 TRAFFIC IS TO BE MAINTAINED OVER THE BRIDGE BY PART-WIDTH CONSTRUCTION.

PLAN ELEVATIONS REFER TO NAVD 88 DATUM.

WATER LEVEL IS SUBJECT TO CHANGE. THE CONTRACTOR IS RESPONSIBLE FOR MAKING A DETERMINATION OF WATER LEVELS THAT MAY EXIST DURING CONSTRUCTION.

MEASURES SHALL BE TAKEN TO PREVENT DEBRIS FROM FALLING FROM THE STRUCTURE. IF DEBRIS FALLS INTO THE WATERWAY, IT SHALL BE REMOVED WITHIN 24 HOURS. SINCE DISTURBANCE OF THE WATERWAY BOTTOM MAY BE AS HARMFUL AS THE DEBRIS ITSELF, THE PREVENTIVE MEASURES MUST BE EFFECTIVE.

IMMEDIATELY AFTER THE CONSTRUCTION OF A WINGWALL IS COMPLETED, SLOPE PROTECTION AND SEEDING OR SODDING SHALL BE PLACED ON THE ADJACENT EMBANKMENT SLOPES.

EXISTING STRUCTURE

EXISTING CULVERT IS A SINGLE SPAN STANDARD CONCRETE SLAB WITH AN OVERALL WIDTH OF 44'-9 1/2" AND A CLEAR ROADWAY WIDTH OF 40'-0". IT IS APPROXIMATELY 13'-6" IN LENGTH. THIS CULVERT WAS BUILT IN 1960 AND WAS DESIGNED FOR HS-20 LOADING.

SURVEY CONTROL & BENCHMARKS

SEE SURVEY INFORMATION SHEET FOR SURVEY CONTROL & BENCHMARKS

UTILITIES

SEE PROJECT INFORMATION SHEET FOR UTILITIES

COORDINATES

REF PT	NORTH	EAST	ELEV
PR A	12504355.39	117271.18	640.81
PR B	12504377.60	117270.50	640.99

COORDINATES PROVIDED ARE TO ESTABLISH THE GEOGRAPHIC LOCATION OF THE STRUCTURE, HOWEVER SHALL NOT TAKE PRECEDENCE OVER STRUCTURAL DIMENSIONS.

8

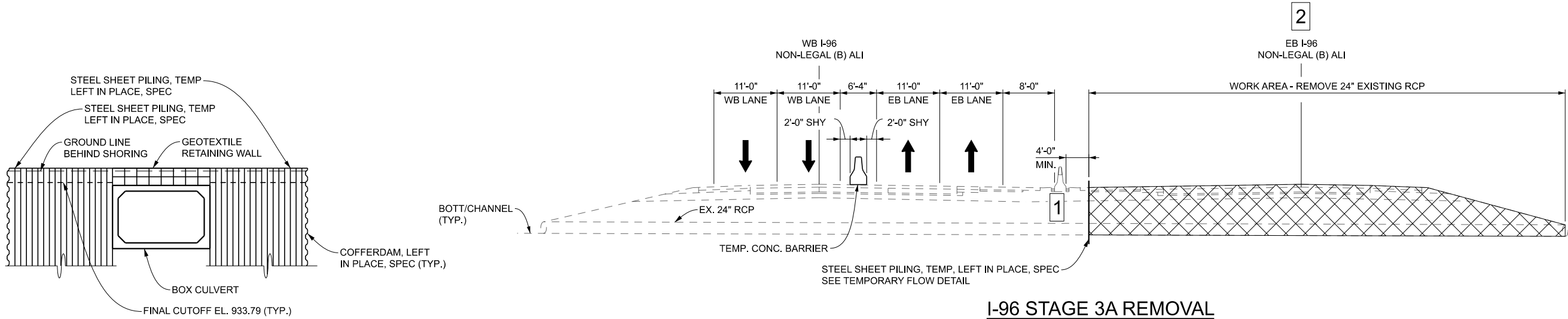
GENERAL PLAN OF SITE

- 1. Label ROW according to the MDOT Guidelines for Plan Preparation.
- 2. Show consent to grade lines if applicable. Permanent fixtures that require maintenance should be placed within existing right-of-way.
- 3. Utilities, drainage features, and any known underground obstructions should be labeled and shown on the culvert plan and profile along with any known elevation information.
- 4. Show all existing utilities. Label in accordance with the MDOT Guidelines for Plan Preparation.
- 5. Situation plan should show a topographic survey of the area within 150' beyond the outside edges of the culvert and 200' beyond the ends of the proposed structure. For information regarding what is shown on the situation plan, see the Preliminary and Final Design Phase Checklists.
- 6. Profile along Roadway alignment. Generally the vertical scale is exaggerated 5x the horizontal scale. For information regarding what is shown on the profile, see the Preliminary and Final Design Phase Checklists.
- 7. The culvert location description need only be inserted on the title block of the General Plan of Site and the General Plan of Structure. List the facility associated with the culvert control sectionfirst, then the route under/over. Finally, list the proximity of the structure to the nearest city/town, major highway or county line.
- 8. Give reference point coordinates for proposed culvert only.
- 9. Include culvert plans in Section 2
- 10. Bearing capacity of soils should be included by the structural design engineer.
- 11. A structural reinforced concrete slab may be required to provide adequate spanning over the proposed culvert and to minimize the risk of excessive cracking.

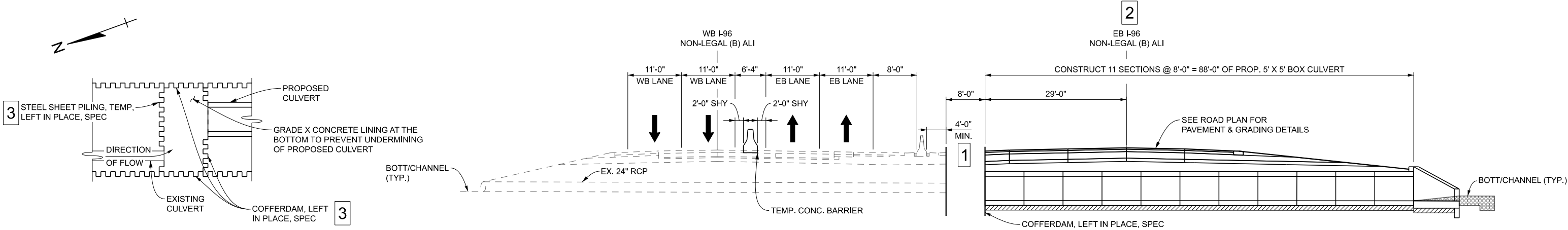
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										FILE: culv_notes_001.dgn	TSC:					

I-96 STAGE 1 & STAGE 2

NO CULVERT CONSTRUCTION OR REMOVAL AT THIS LOCATION IN THESE STAGES.
REFER TO ROADWAY MOT PLANS FOR TRAFFIC DURING THESE STAGES.



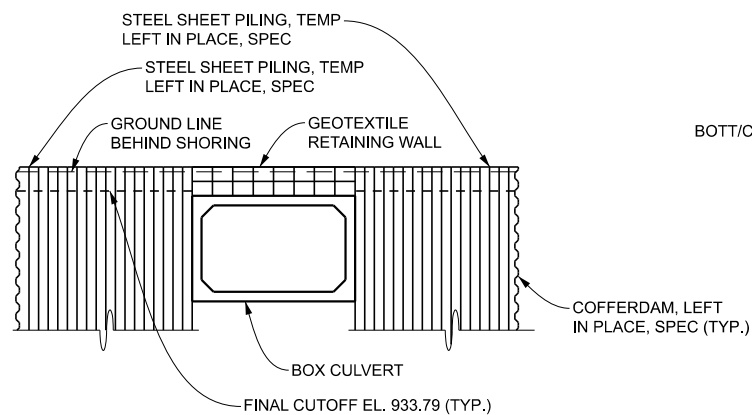
TEMPORARY SHEETING DETAIL



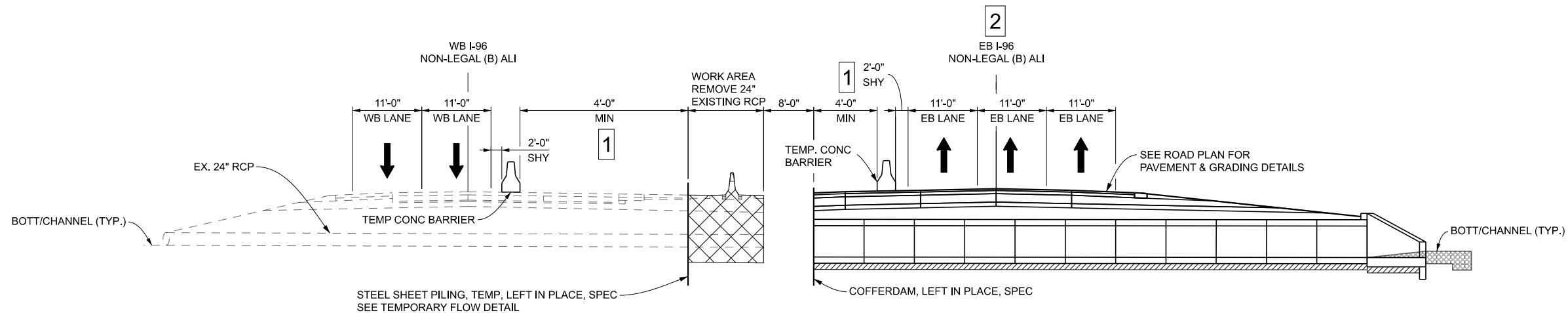
TEMPORARY FLOW DETAIL

(ONE POSSIBLE METHOD FOR MAINTAINING FLOW IS SHOWN HERE. ALTERNATIVE METHODS FOR MAINTAINING FLOW MAY BE PROPOSED BY THE CONTRACTOR.)

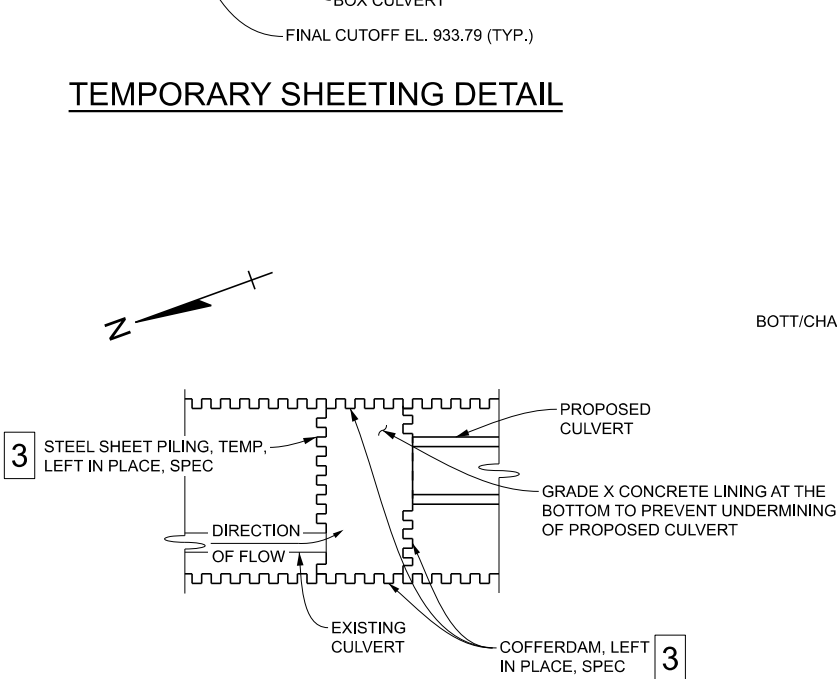
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NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CHK'D BY:	DESIGN UNIT:			JN: 124103A	CULVERT 116		C116 CONSTG 001	SECT 2		
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TEMPORARY SHEETING DETAIL

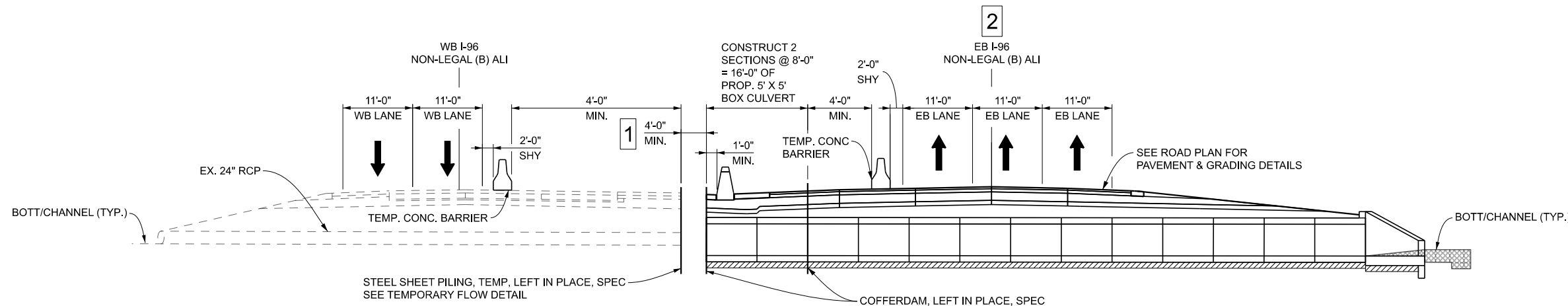


I-96 STAGE 3B REMOVAL



TEMPORARY FLOW DETAIL

(ONE POSSIBLE METHOD FOR MAINTAINING FLOW IS SHOWN HERE. ALTERNATIVE METHODS FOR MAINTAINING FLOW MAY BE PROPOSED BY THE CONTRACTOR.)

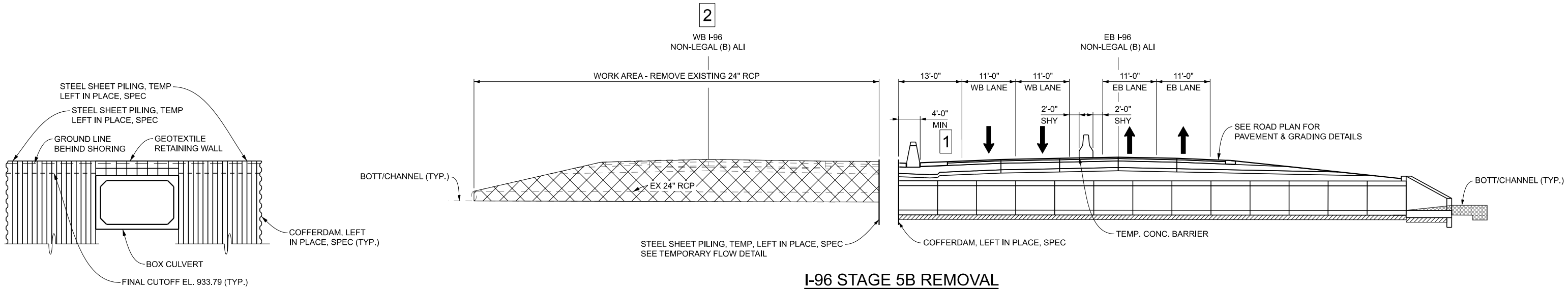


I-96 STAGE 3B CONSTRUCTION

FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:		 Michigan Department of Transportation	NO SCALE	DRAWN BY:	DATE:	CS: C116 OF 63023	CONSTRUCTION STAGING DETAILS		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CULVERT 116										
								EAST OF OLD PLANK RD										
								C116 CONSTG 002										

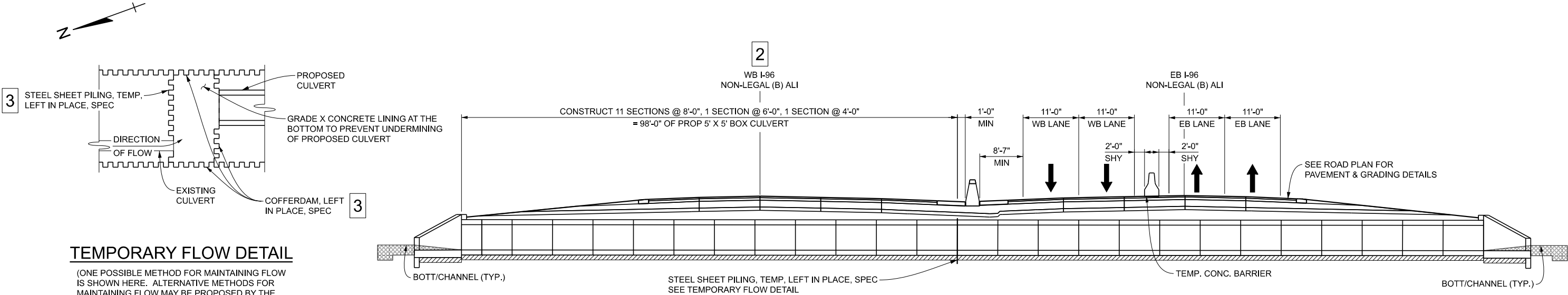
I-96 STAGE 4 & STAGE 5A

NO CULVERT CONSTRUCTION OR REMOVAL AT THIS LOCATION IN THESE STAGES.
REFER TO ROADWAY MOT PLANS FOR TRAFFIC DURING THESE STAGES.



TEMPORARY SHEETING DETAIL

I-96 STAGE 5B REMOVAL

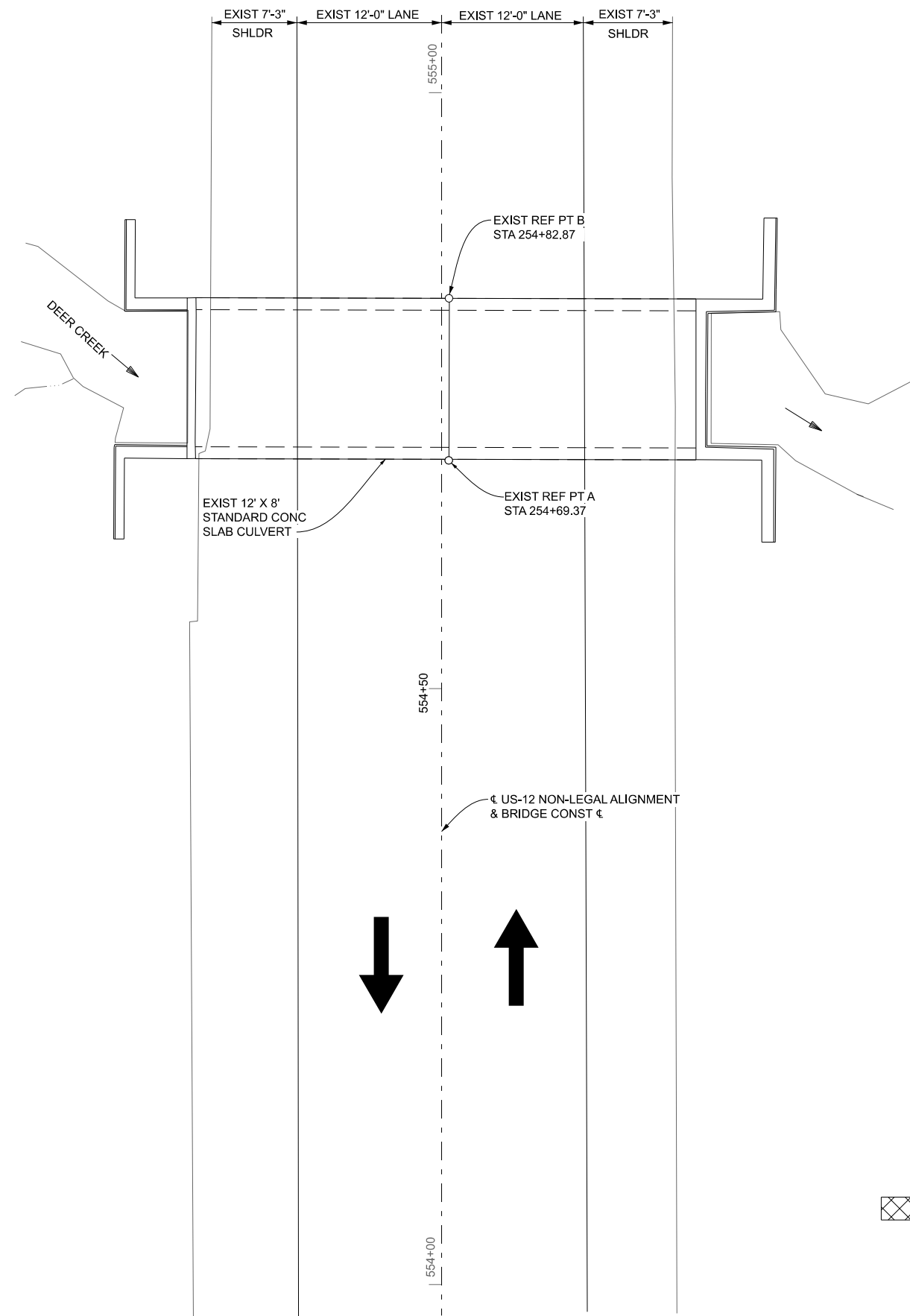


TEMPORARY FLOW DETAIL

(ONE POSSIBLE METHOD FOR MAINTAINING FLOW IS SHOWN HERE. ALTERNATIVE METHODS FOR MAINTAINING FLOW MAY BE PROPOSED BY THE CONTRACTOR.)

I-96 STAGE 5B CONSTRUCTION

FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:			NO SCALE	DRAWN BY:	DATE:	CS: C116 OF 63022	CONSTRUCTION STAGING DETAILS		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CULVERT 116							C116 CONSTG 003	SECT 2		
								EAST OF OLD PLANK RD										
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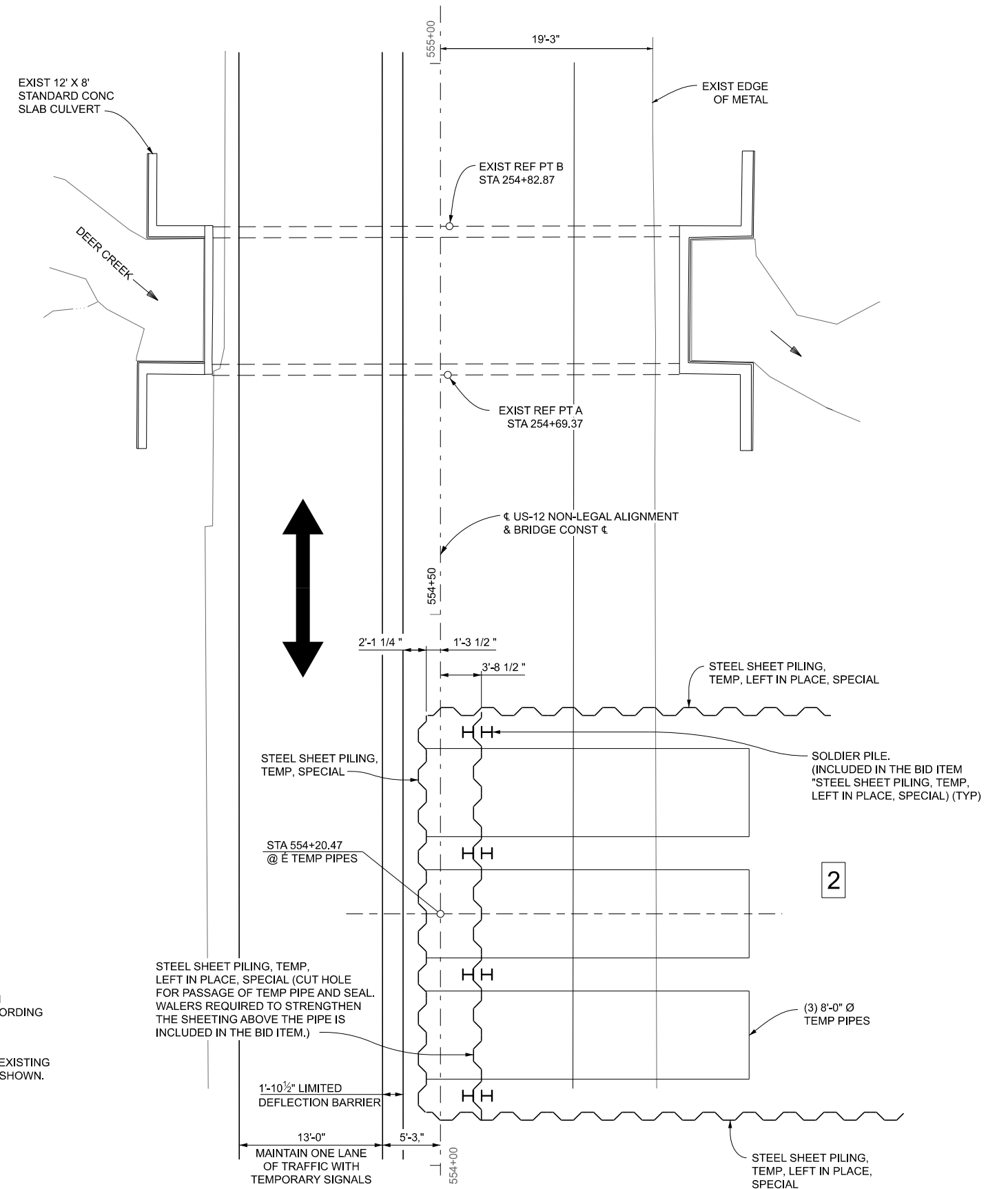
EXISTING PLAN OF ROADWAY



NOTES:

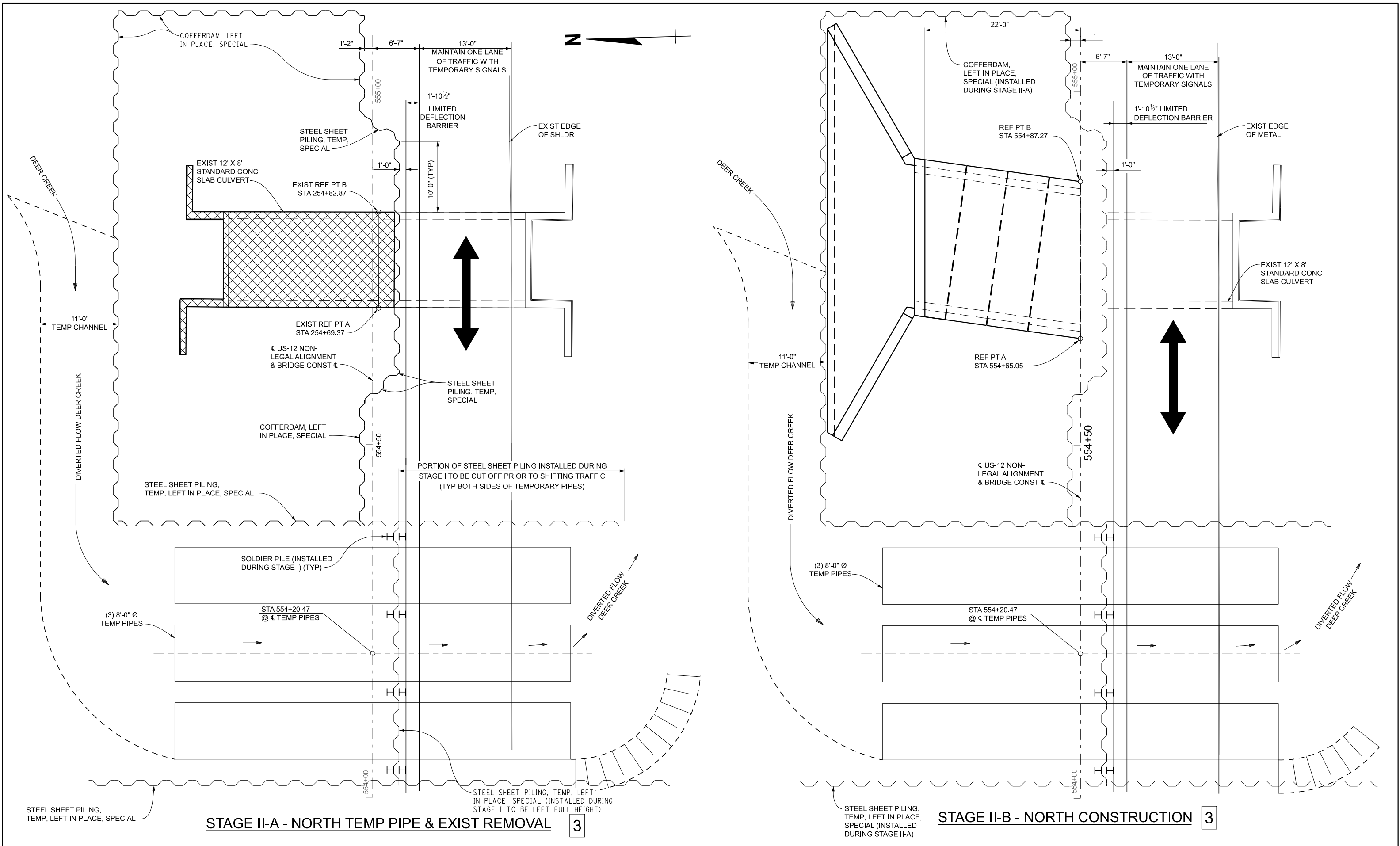
PLACEMENT OF LIMITED DEFLECTION TEMPORARY BARRIER SHALL BE ACCORDING TO STANDARD PLAN R-53-SERIES OR AS APPROVED BY THE ENGINEER.

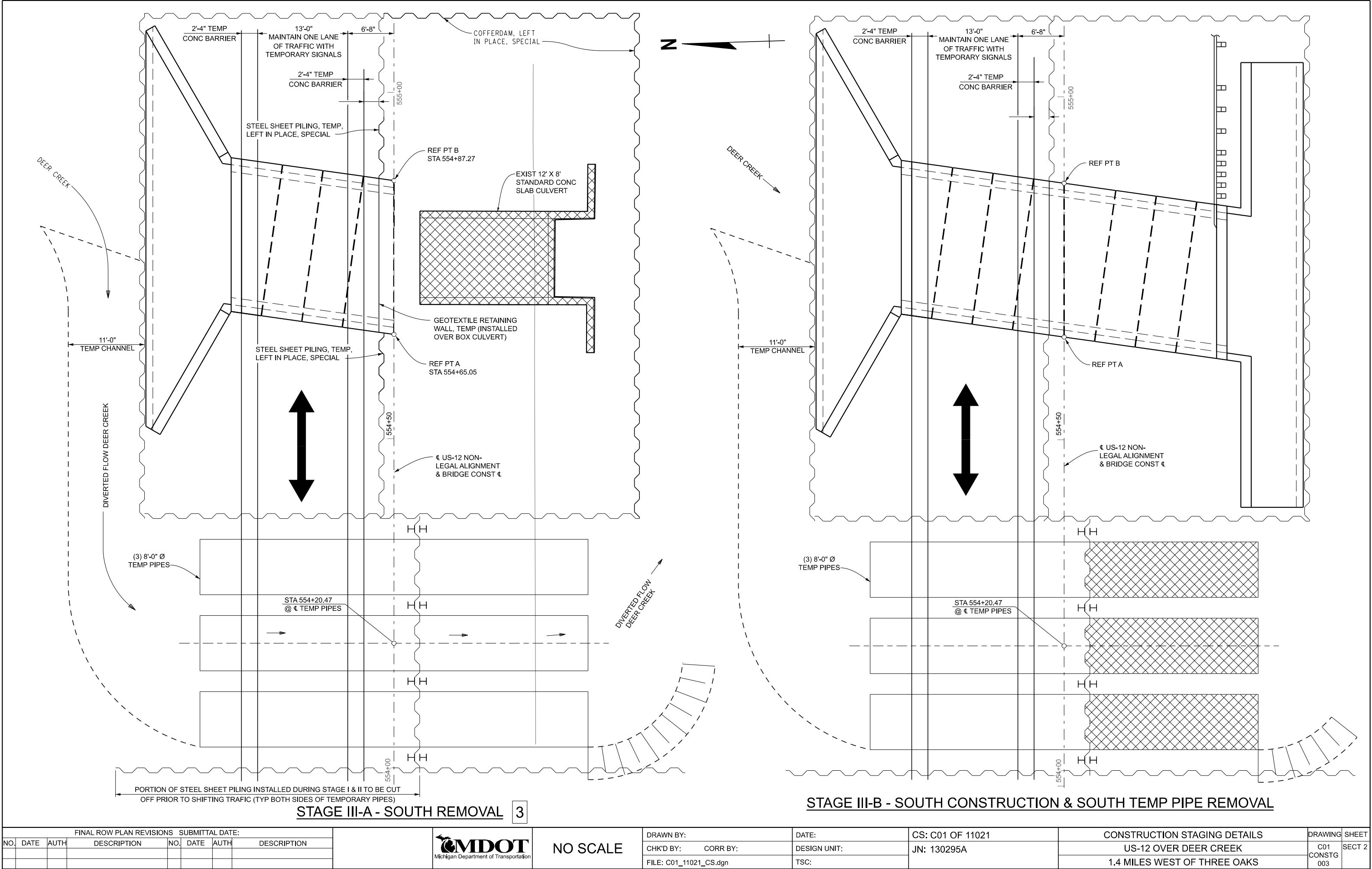
 CROSS HATCHED PORTIONS OF THE EXISTING STRUCTURE SHALL BE REMOVED AS SHOWN.



STAGE I - SOUTH TEMPORARY PIPE 3

FINAL ROW PLAN REVISIONS SUBMITTAL DATE:									NO SCALE	DRAWN BY: CHK'D BY: CORR BY: FILE: C01_11021_CS.dgn	DATE: DESIGN UNIT: TSC:	CS: C01 OF 11021 JN: 130295A	CONSTRUCTION STAGING DETAILS		DRAWING C01 CONSG 001	SHEET SECT 2
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION						US-12 OVER DEER CREEK			
													1.4 MILES WEST OF THREE OAKS			





FINAL ROW PLAN REVISIONS						SUBMITTAL DATE:					
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION				



NO SCALE

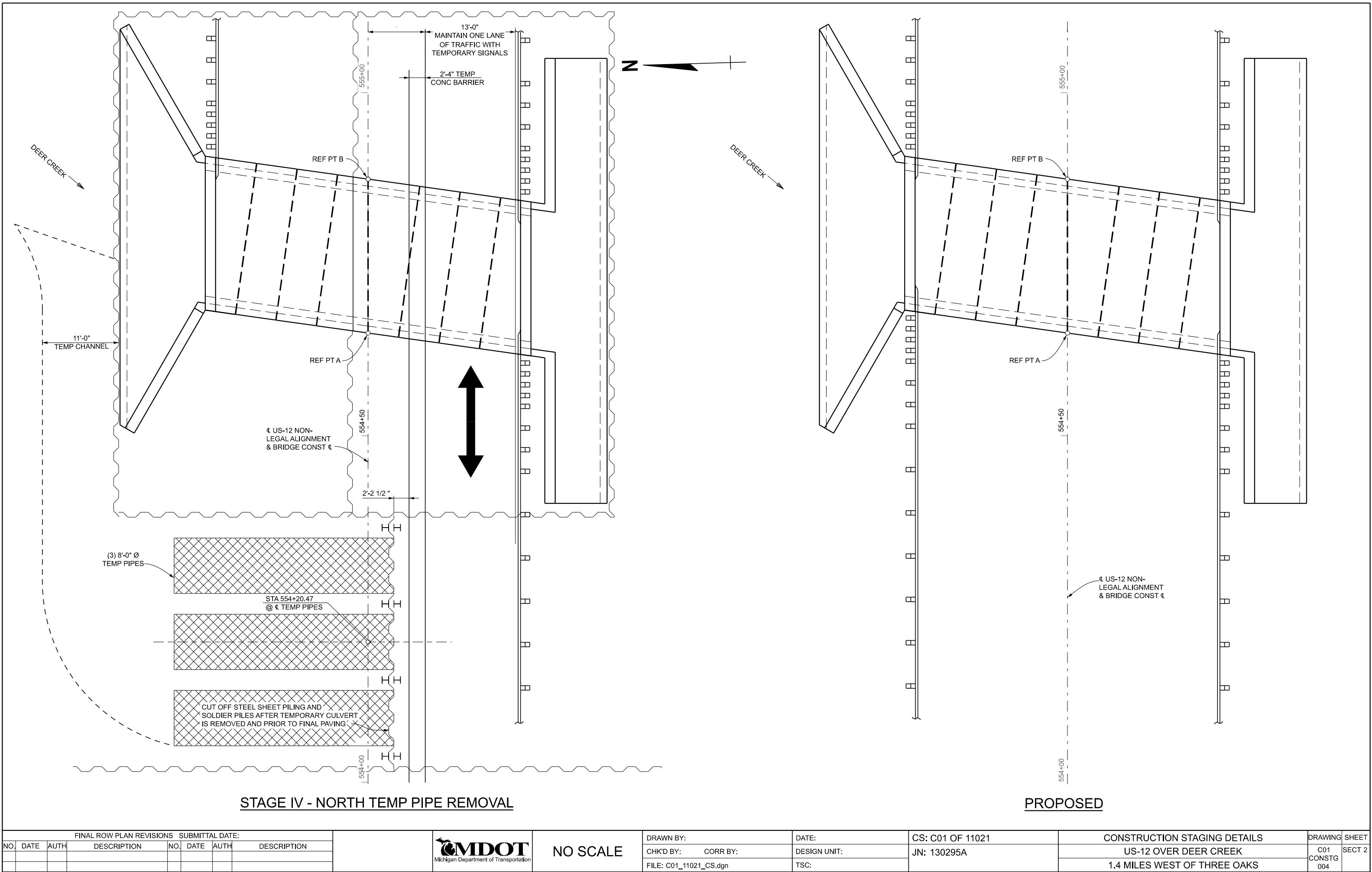
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CHK'D BY: CORR BY:
FILE: C01_11021_CS.dgn

DATE:
DESIGN UNIT:
TSC:

CS: C01 OF 11021
JN: 130295A

CONSTRUCTION STAGING DETAILS
US-12 OVER DEER CREEK
1.4 MILES WEST OF THREE OAKS

DRAWING SHEET
C01 SECT 2
CONSTG 003



STAGE IV - NORTH TEMP PIPE REMOVAL

PROPOSED

FINAL ROW PLAN REVISIONS							SUBMITTAL DATE:	
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	



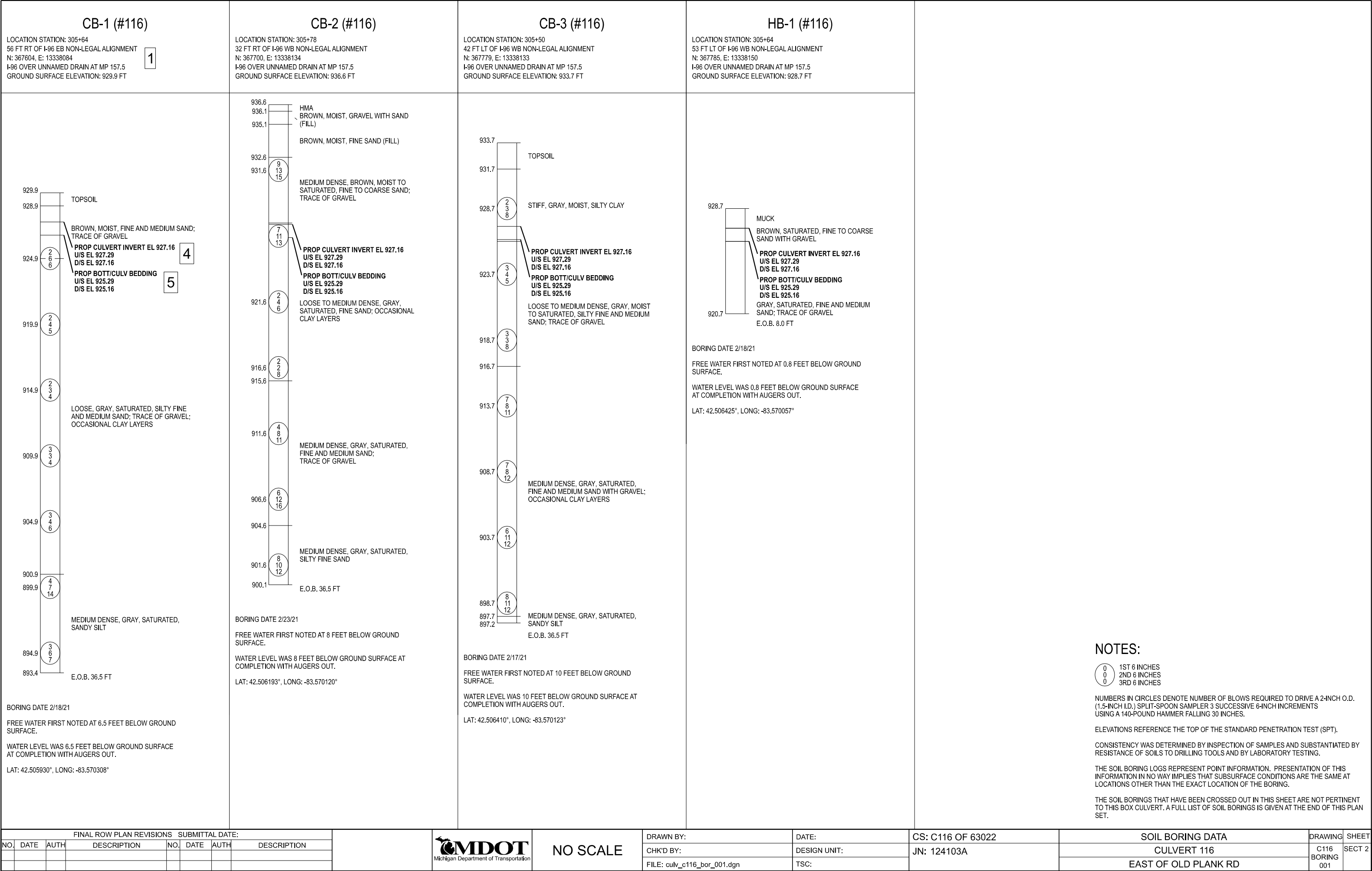
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DATE:	
DESIGN UNIT:	
TSC:	

CS: C01 OF 11021
JN: 130295A

CONSTRUCTION STAGING DETAILS		DRAWING	SHEET
US-12 OVER DEER CREEK		C01	SECT 2
1.4 MILES WEST OF THREE OAKS		CONSTG 004	



TEST HOLE NO. 1				TEST HOLE NO. 2				TEST HOLE HB1				TEST HOLE HB2				NOTES: 0 0 0 1st 6" 2nd 6" 3rd 6" NUMBERS IN CIRCLES DENOTE NUMBER OF BLOWS REQUIRED TO DRIVE A 2" O.D. (1½" I.D.) SPLIT SPOON SAMPLER 3 SUCCESSIVE 6" INCREMENTS USING A 140# HAMMER FALLING 30". CONSISTENCY WAS DETERMINED BY INSPECTION OF SAMPLES AND SUBSTANTIATED BY SOILS RESISTANCE TO DRILLING TOOLS AND BY LABORATORY TESTING. THE SOIL BORING LOGS REPRESENT POINT INFORMATION. PRESENTATION OF THIS INFORMATION IN NO WAY IMPLIES THAT SUBSURFACE CONDITIONS ARE THE SAME AT LOCATIONS OTHER THAN THE EXACT LOCATION OF THE BORING.			
LOCATION STATION: 554+58 13 FT RT OF US-12 CENTERLINE N: 117258, E: 12504348 US-12 OVER DEER CREEK GROUND SURFACE ELEVATION: 640.4 FT				LOCATION STATION: 554+93 14 FT LT OF US-12 CENTERLINE N: 117284, E: 12504384 US-12 OVER DEER CREEK GROUND SURFACE ELEVATION: 640.6 FT				LOCATION STATION: 554+64 38 FT RT OF US-12 CENTERLINE N: 117233, E: 12504353 US-12 OVER DEER CREEK GROUND SURFACE ELEVATION: 630.6 FT				LOCATION STATION: 554+73 37 FT LT OF US-12 CENTERLINE N: 117308, E: 12504364 US-12 OVER DEER CREEK GROUND SURFACE ELEVATION: 631.0 FT							
640.4 639.9 638.4 635.4 630.4 625.4 620.4 615.4 612.4 610.4 605.4 600.4 595.4 593.4 590.4 585.4 580.4 576.4 575.4 570.4 569.4 HMA MEDIUM DENSE BROWN MOIST GRAVEL WITH SAND (FILL) MEDIUM STIFF BROWN MOIST SANDY CLAY (FILL) STIFF BROWN MOIST SILTY CLAY BOTT/CULVERT U/S EL 626.30 D/S EL 626.10 BOTT/CULV BEDDING U/S EL 625.30 D/S EL 625.10 STIFF GRAY MOIST SILTY CLAY, TRACE SAND MEDIUM DENSE GRAY SATURATED CLAYEY SILT, OCCASIONAL CLAY LAYERS AND SILTY FINE SAND LENSES HARD GRAY MOIST SILTY CLAY VERY DENSE GRAY MOIST SILT, OCCASIONAL CLAY LAYERS E.O.B. 71.0 FT 3 4 BORING DATE 8/16/16 FREE WATER WAS FIRST NOTED 28 FT BELOW GROUND SURFACE. THE WATER LEVEL WAS 11 FT BELOW GROUND SURFACE AFTER COMPLETION WITH THE AUGERS OUT. LAT: 41.798846°, LONG: -86.636896°				640.6 640.3 638.6 635.6 631.6 630.6 625.6 620.6 617.6 615.6 612.6 610.6 605.6 600.6 598.6 595.6 592.6 590.6 585.6 580.6 575.6 570.6 565.6 560.6 559.1 HMA MEDIUM DENSE BROWN MOIST GRAVEL WITH SAND (FILL) MEDIUM STIFF GRAY MOIST SANDY CLAY (FILL) BOTT/CULVERT U/S EL 626.30 D/S EL 626.10 STIFF BROWN MOIST SILTY CLAY BOTT/CULV BEDDING U/S EL 625.30 D/S EL 625.10 STIFF GRAY MOIST SILTY SANDY CLAY, TRACE FINE GRAVEL STIFF TO VERY STIFF GRAY MOIST SILTY CLAY, OCCASIONAL SILT LAYERS VERY STIFF GRAY MOIST SILTY CLAY, OCCASIONAL SAND LAYERS HARD GRAY MOIST SILTY CLAY, TRACE FINE GRAVEL, OCCASIONAL SILT LAYERS E.O.B. 81.5 FT 0 2 3 4 5 6 7 9 10 12 14 15 16 17 18 20 22 23 25 27 28 30 34 50 51 BORING DATE 8/17/16 FREE WATER WAS FIRST NOTED 11 FT BELOW GROUND SURFACE. THE WATER LEVEL WAS 11 FT BELOW GROUND SURFACE AFTER COMPLETION WITH THE AUGERS OUT. LAT: 41.798919°, LONG: -86.636767°				630.6 628.6 620.6 MEDIUM STIFF BROWN MOIST SILTY CLAY, OCCASIONAL COBBLES STIFF GRAY MOIST SILTY CLAY E.O.B. 10.0 FT BORING DATE 8/22/16 FREE WATER WAS FIRST NOTED 1 FT BELOW GROUND SURFACE. THE WATER LEVEL WAS 1 FT BELOW GROUND SURFACE AFTER COMPLETION WITH THE HAND AUGER OUT. LAT: 41.798778°, LONG: -86.636875° 631.0 630.5 628.5 621.0 DARK BROWN TOPSOIL MEDIUM STIFF BROWN MOIST SILTY CLAY STIFF GRAY MOIST SILTY CLAY E.O.B. 10.0 FT BORING DATE 8/22/16 FREE WATER WAS FIRST NOTED 1.5 FT BELOW GROUND SURFACE. THE WATER LEVEL WAS 1.5 FT BELOW GROUND SURFACE AFTER COMPLETION WITH THE HAND AUGER OUT. LAT: 41.798984°, LONG: -86.636844°											
FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:				DRAWN BY:				DATE:							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CHK'D BY:	CORR BY:	DESIGN UNIT:	TSC:	CS: C01 OF 11021	JN: 130295A	SOIL BORING DATA					
														US-12 OVER DEER CREEK					
														1.4 MILES WEST OF THREE OAKS					
														C01 BORING 001	SECT 2				

NOTES:



NUMBERS IN CIRCLES DENOTE NUMBER OF BLOWS REQUIRED TO DRIVE A 2" O.D. (1½" I.D.) SPLIT SPOON SAMPLER 3 SUCCESSIVE 6" INCREMENTS USING A 140# HAMMER FALLING 30".

CONSISTENCY WAS DETERMINED BY INSPECTION OF SAMPLES AND SUBSTANTIATED BY SOILS RESISTANCE TO DRILLING TOOLS AND BY LABORATORY TESTING.

THE SOIL BORING LOGS REPRESENT POINT INFORMATION. PRESENTATION OF THIS INFORMATION IN NO WAY IMPLIES THAT SUBSURFACE CONDITIONS ARE THE SAME AT LOCATIONS OTHER THAN THE EXACT LOCATION OF THE BORING.

CONSTRUCTION STAGING

- 1. Show location of temporary concrete barrier. Ensure minimum shy distance of 1' is provided between the stage removal line and construction.
- 2. For ease of construction and installation, staged construction and removals should start on the downstream end of the culvert.
- 3. Cofferdams shall be utilized in areas where dewatering is required. Areas that only retain soil should utilize sheet piling. When laying out sheeting, the Engineer should consider the footprint of potential soil anchors to avoid potential conflicts during construction.

SOIL BORING DATA

- 1. Borings must be located with station-offsets and/or state plane northing and easting coordinates. Preferably both are shown.
- 2. Indicate bottom of footing elevations.
- 3. Indicate proposed culvert invert elevations.
- 4. Indicate bottom of bedding elevations.

12 NOTES:

THE DESIGN OF THIS STRUCTURE IS BASED ON 1.2 TIMES THE CURRENT AASHTO LRFD BRIDGE DESIGN SPECIFICATION HL-93 LOADING WITH THE EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD DEFINITION IS REPLACED BY A SINGLE 60 KIP AXLE LOAD BEFORE APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE DEFLECTION DOES NOT EXCEED 1/800 OF SPAN LENGTH.

THE RIPRAP QUANTITY IS BASED ON THE LATERAL DIMENSIONS OF THE AREA TO BE PROTECTED, REGARDLESS OF THE NUMBER OF LAYERS REQUIRED. THE ESTIMATED WEIGHT OF RIPRAP IS 262 TONS.

THE DRAINAGE AREA CONTRIBUTORY TO THIS CROSSING IS 0.21 SQUARE MILES.

THE EXISTING STRUCTURE PROVIDES A WATERWAY AREA OF 3.14 SQUARE FEET TO LOW CHORD ELEVATION 930.16.

PLACE GEOTEXTILE LINER ON ALL SLOPES PRIOR TO PLACING RIPRAP. PAYMENT FOR GEOTEXTILE LINER IS INCLUDED IN PAYMENT FOR RIPRAP.

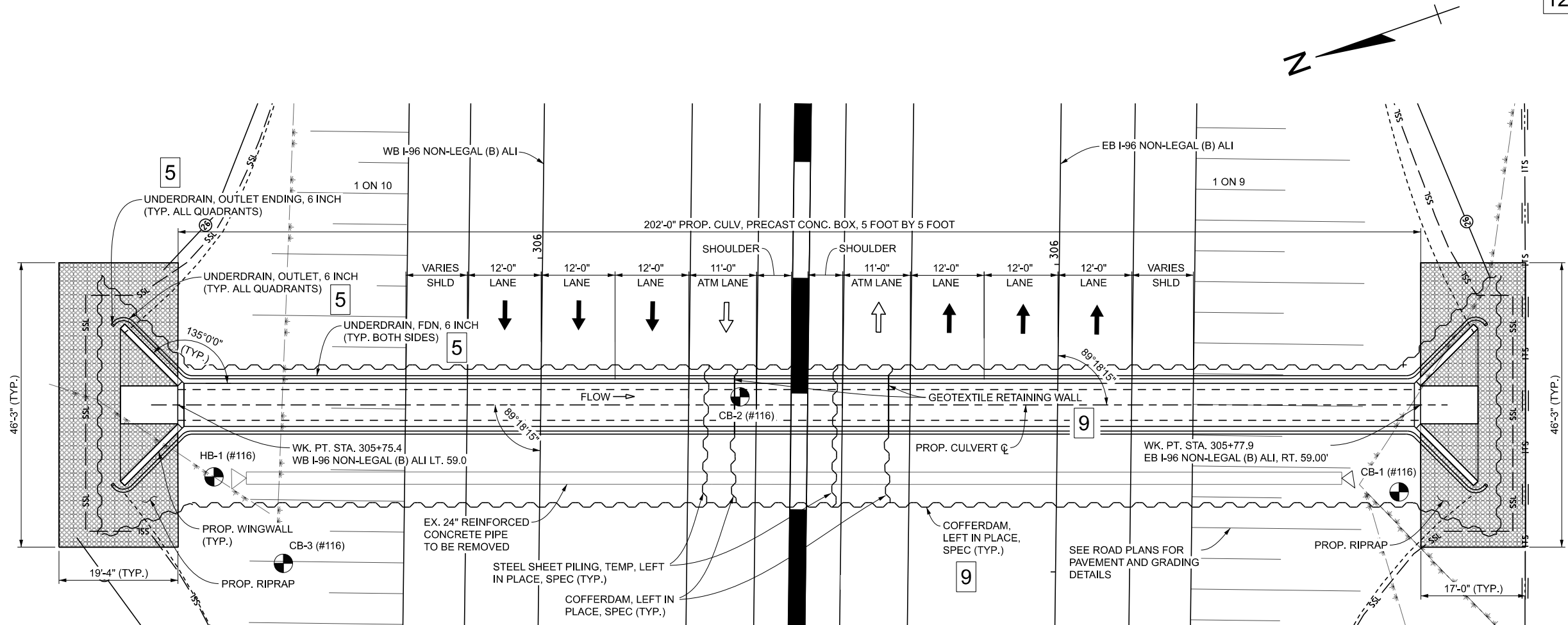
SUBMIT ALTERNATIVE METHODS OF STREAM DIVERSION TO THE ENGINEER FOR APPROVAL.

WHEN CASTING ITEMS INTO STRUCTURAL PRECAST CONCRETE TO FACILITATE CULVERT CONSTRUCTION USE ITEMS THAT ARE GALVANIZED IN ACCORDANCE WITH ASTM B633, SERVICE CONDITION 4 OR EPOXY COATED. CAST INSERTS WITH CULVERT. DO NOT FIELD INSTALL INSERTS.

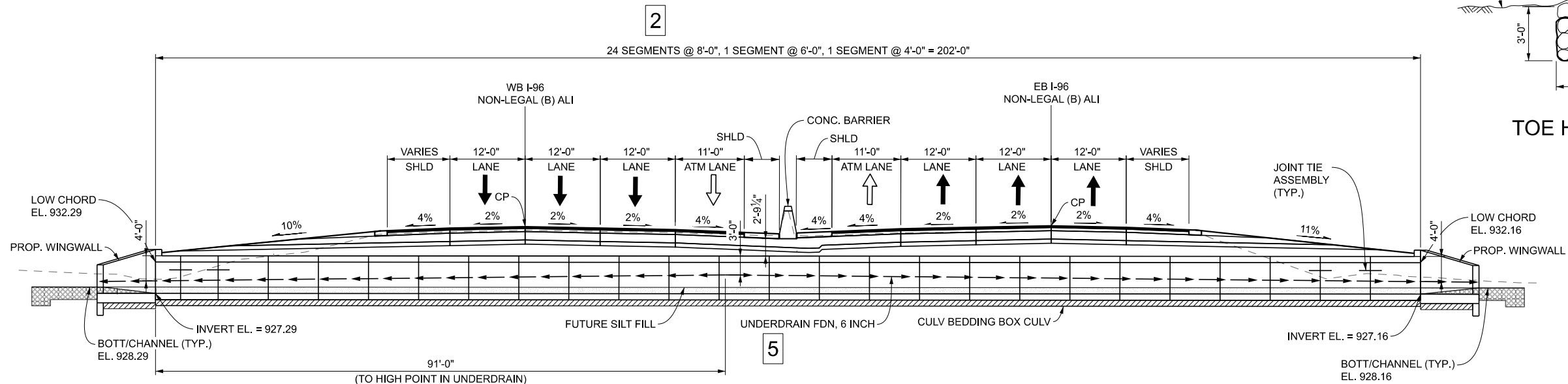
CONTACT THE REGION SOILS ENGINEER TO PERFORM A FOOTING CHECK AT LEAST 48 HOURS PRIOR TO EXCAVATING TO THE BOTTOM OF EXCAVATION.

INSTALL SHEET PILING USING EITHER AN IMPACT HAMMER OR A VARIABLE MOMENT DRIVER/EXTRACTOR OPERATED TO MINIMIZE VIBRATIONS. DO NOT USE VIBRATORY HAMMERS THAT ARE NOT VARIABLE MOMENT.

THE PLANS SHOW THE DESIGN FOR THE CIP HEADWALL, APRON, CURTAIN WALL, AND WINGWALL. CIP HEADWALL, APRON, CURTAIN WALL, AND WINGWALL WILL BE PAID FOR USING THE ITEM "CULV, PRECAST CONC BOX, 5 FOOT BY 5 FOOT". IF THE CONTRACTOR ELECTS TO USE PRECAST ELEMENTS THEY MUST BE DESIGNED, INSTALLED, AND PAID FOR IN ACCORDANCE WITH SECTION 406 OF THE 2020 STANDARD SPECIFICATIONS FOR CONSTRUCTION.

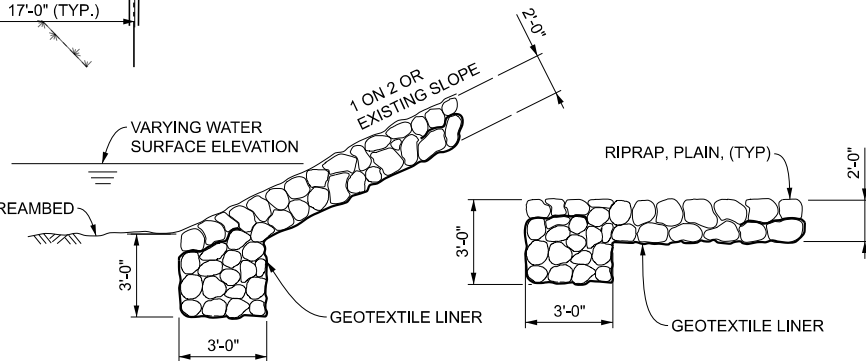


PLAN



ELEVATION

(LANE & SHOULDER WIDTHS AND CROSS SLOPES MEASURED PERPENDICULAR TO WB & EB I-96 NON-LEGAL (B) ALI)



TOE HEADER

END HEADER

RIPRAP HEADER DETAILS

(TOP OF RIPRAP MUST BE AT OR BELOW EXISTING STREAMBED/SLOPE ELEVATION.)

FINAL ROW PLAN REVISIONS						SUBMITTAL DATE:					
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION



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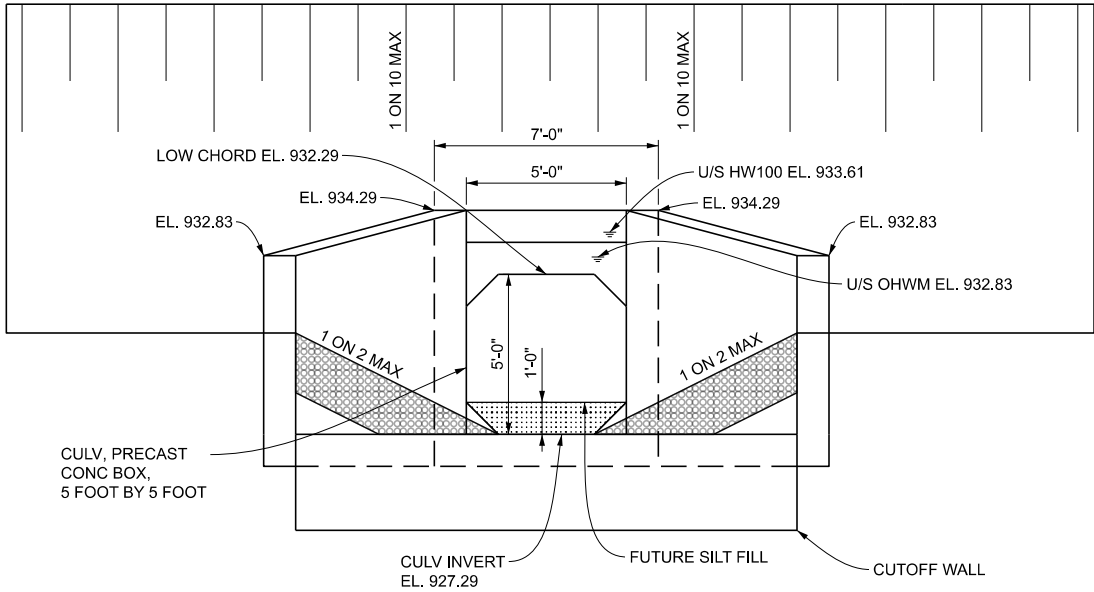
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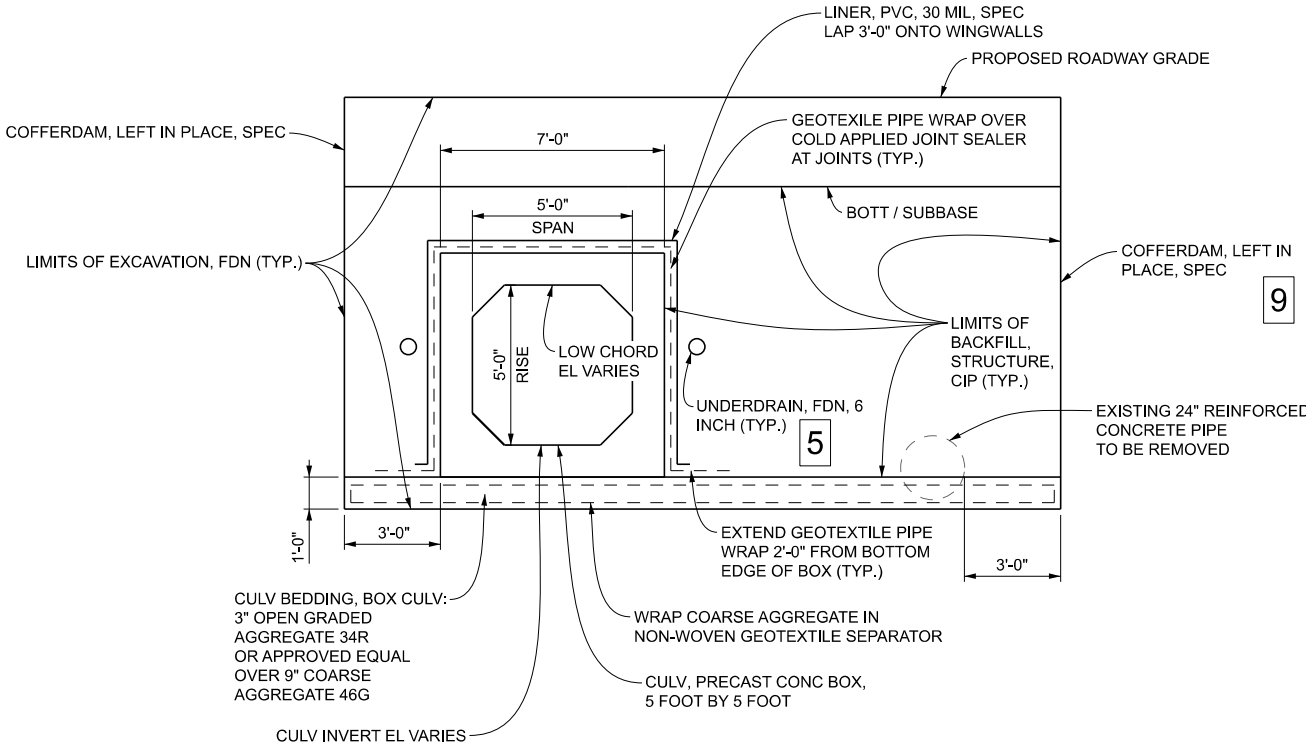
CS: C116 OF 63022
JN: 124103A

GENERAL PLAN OF STRUCTURE
CULVERT 116
EAST OF OLD PLANK RD

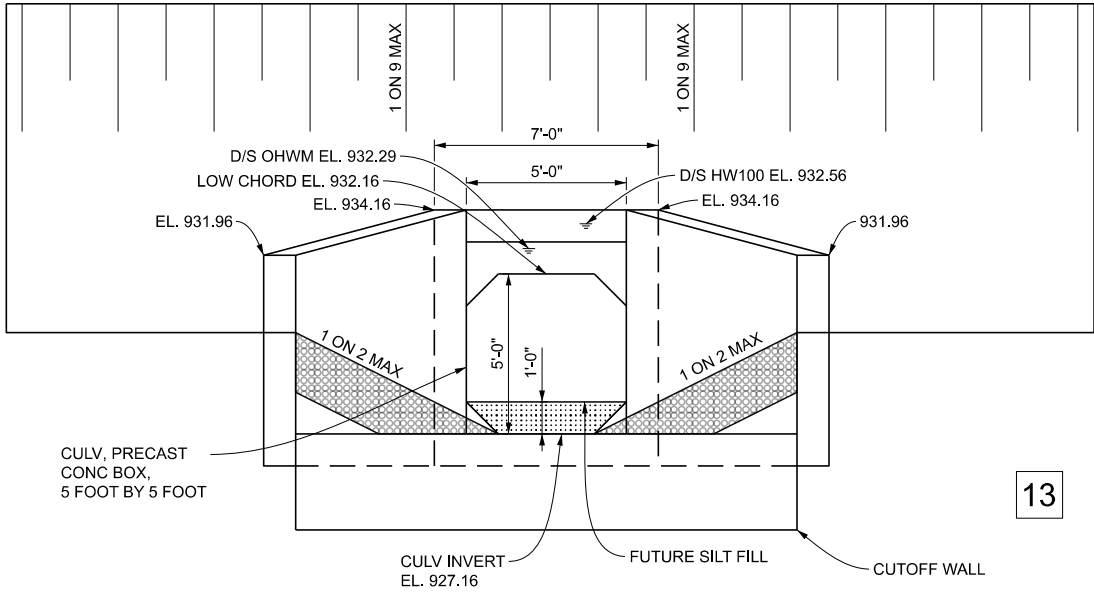
DRAWING SHEET
C116 GPSTR 001
SECT 2



CULVERT INLET ELEVATION



TYPICAL SECTION THROUGH PROPOSED CULVERT



CULVERT OUTLET ELEVATION

10

SUMMARY OF HYDRAULIC ANALYSIS			
WATERCOURSE:	EXISTING (FT)	PROPOSED (FT)	CHANGE
COUNTY:			
CULVERT TYPE	CONCRETE CIRCULAR	CONCRETE BOX	
SPAN	2 FT	5 FT	+3 FT
RISE	2 FT	5 FT	+3 FT
LENGTH	177 FT	20 FT	+25 FT
ENTRANCE TYPE	PRECAST CONC END SECTION	WINGWALLS	
U/S INVERT ELEV	928.16 FT	927.29 FT	
D/S INVERT ELEV	928.29 FT	927.16 FT	
U/S FLOWLINE	928.16 FT +/-	928.29 FT	
D/S FLOWLINE	928.29 FT +/-	928.16 FT	
Ka	0.2	0.4	
50-YEAR			
VELOCITY AT OUTLET	11.70 FT/S	3.86 FT/S	
HEADWATER	937.18 FT	933.31 FT	-3.87 FT
100-YEAR			
VELOCITY AT OUTLET	11.55 FT/S	4.39 FT/S	
HEADWATER	934.56 FT	933.61 FT	-0.95 FT
50-YEAR AND 100-YEAR FLOOD ELEVATIONS ARE FOR COMPARISON ONLY			

CONTRIBUTING DRAINAGE AREA	0.21 SQ MILES
10-YEAR DISCHARGE	42 CFS
50-YEAR DISCHARGE	65 CFS
100-YEAR DISCHARGE	76 CRS

MISCELLANEOUS QUANTITIES

CAT 0001	CAT 0009		
	1,154	Cyd	Backfill, Structure, CIP
	2,155	Cyd	Excavation, Fdn
	1	Ea	Outfall Label
202		Ft	Video Taping Sewer and Culv Pipe
	442	Ft	Underdrain, Fdn, 6 inch
40		Ft	Underdrain, Outlet, 6 inch
4		Ea	Underdrain, Outlet Ending, 6 inch
	179	Cyd	Culv Bedding, Box Culv
	202	Ft	Culv, Precast Conc Box, 5 foot by 5 foot
	577	Sft	Steel Sheet Piling, Temp, Left in Place, Spec
	138	Syd	Water Repellent Treatment, Penetrating
187		Syd	Riprap, Plain
	1	LSUM	Cofferdam, Left in Place, Spec (Culvert 116)
	4	Syd	Geotextile Retaining Wall

THE FOLLOWING ITEMS OF WORK ARE FOR REFERENCE ONLY AND ARE INTENDED FOR CIP HEADWALLS, APRON, CUTOFF WALL, AND WINGWALLS IF THE CONTRACTOR ELECTS TO USE THE CIP OPTION. THESE ITEMS WILL NOT BE PAID FOR SEPARATELY. PAYMENT FOR THESE ITEMS IS INCLUDED IN THE ITEM "CULV. PRECAST CONC BOX, 5 FOOT BY 5 FOOT" IN ACCORDANCE WITH SECTION 406 OF THE 2020 STANDARD SPECIFICATIONS FOR CONSTRUCTION.

SOIL EROSION AND SEDIMENTATION CONTROL QUANTITIES
(FOR INFORMATION ONLY)

UNIT	ITEM
1,051 Syd	Geotextile, Separator, Non-Woven
3,800 Lb	Reinforcement, Steel, Epoxy Coated
33 Cyd	Conc, Grade 3500

FINAL ROW PLAN REVISIONS SUBMITTAL DATE:							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION



NO SCALE

DRAWN BY:	DATE:	CS: C116 OF 63022
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FILE: culv_c116_gpstr_002.dgn	TSC:	

GENERAL PLAN OF STRUCTURE	1
CULVERT 116	
EAST OF OLD PLANK RD	

DRAWING	SHEET
C116 GPSTR 002	SECT 2

SOIL EROSION AND SEDIMENT CONTROL QUANTITIES			
KEY	QUANTITY		PAY ITEM
7	**	90 Ton	Riprap, Plain
13	*	180 Ft	Erosion Control, Gravel Filter Berm
26		400 Ft	Erosion Control, Silt Fence
18	*	4 Ea	Erosion Control, Filter Bag
24	*	645 Ea	Erosion Control, Sand Bag
35		370 Cyd	Excavation, Channel
27		780 Syd	Erosion Control, Temp Plastic Sheet/Geotextile Cover

ENVIRONMENTAL NOTE:
TEMPORARY RELOCATED CHANNEL SHALL BE LINED WITH EROSION CONTROL
TEMPORARY PLASTIC SHEET OR GEOTEXTILE COVER AS DIRECTED BY THE ENGINEER.

* TO BE PLACED AS DIRECTED BY THE ENGINEER.

** TO BE PLACED AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE TEMPORARY
PIPES. EXTEND 10' UPSTREAM AND DOWNSTREAM WITH A THICKNESS OF 2'.
PLACE TOP OF RIPRAP AT EL 629.00.

NOTES: 12

THE DESIGN OF THIS STRUCTURE IS BASED ON 1.2 TIMES THE CURRENT
AASHTO LRFD BRIDGE DESIGN SPECIFICATION HL-93 LOADING WITH THE
EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD
DEFINITION SHALL BE REPLACED BY A SINGLE 60 KIP AXLE LOAD BEFORE
APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED
HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE DEFLECTION DOES
NOT EXCEED 1/800 OF SPAN LENGTH.

PLACEMENT OF STANDARD AND LIMITED DEFLECTION TEMPORARY BARRIER
SHALL BE ACCORDING TO STANDARD PLAN R-53-SERIES, STANDARD PLAN
R-126-SERIES OR AS APPROVED BY THE ENGINEER.

THE CUT OFF ELEVATION FOR COFFERDAMS, LEFT IN PLACE, AND STEEL SHEET
PILING, LEFT IN PLACE, SHALL BE AS FOLLOWS (OR AS DIRECTED BY THE ENGINEER):

SECTIONS ALONG TEMP PIPE:	EL. 637.30
SECTIONS ACROSS TEMP PIPE	
(CUT OFF IN STAGE IV):	EL. 637.30
SECTIONS ACROSS UPSTREAM CHANNEL:	EL. 627.57
SECTIONS ACROSS DOWNSTREAM CHANNEL:	EL. 627.00
SECTIONS ACROSS ROADWAY EAST OF CULVERT:	EL. 638.00
SECTIONS ALONG ROADWAY, 2'-0" NORTH OF C:	
VARIES FROM EL 637.30 AT WEST END TO EL. 638.00 AT EAST END.	

THE BID ITEM "STRUCTURES, REM (C01 OF 11021)" INCLUDES THE REMOVAL OF
THE EXISTING CULVERT AND ALL MATERIAL ABOVE THE EXISTING CULVERT UP
TO THE BOTTOM OF THE CONCRETE OR HMA PAVEMENT.

APPLY LOW TEMPERATURE PROTECTION OF CONCRETE ACCORDING TO SECTION 706.
03.J. OF THE STANDARD SPECIFICATION FOR CONSTRUCTION. LOW TEMPERATURE
IS INCLUDED IN THE RELATED ITEMS OF WORK.

IN ORDER TO MAINTAIN THE INTEGRITY OF THE EXISTING STRUCTURE DURING
STAGE CONSTRUCTION, THE CONTRACTOR SHALL SAW CUT ENTIRELY THROUGH
THE ABUTMENT AND A MINIMUM OF 4" INTO THE TOP OF FOOTING FOR REMOVAL
PURPOSES.

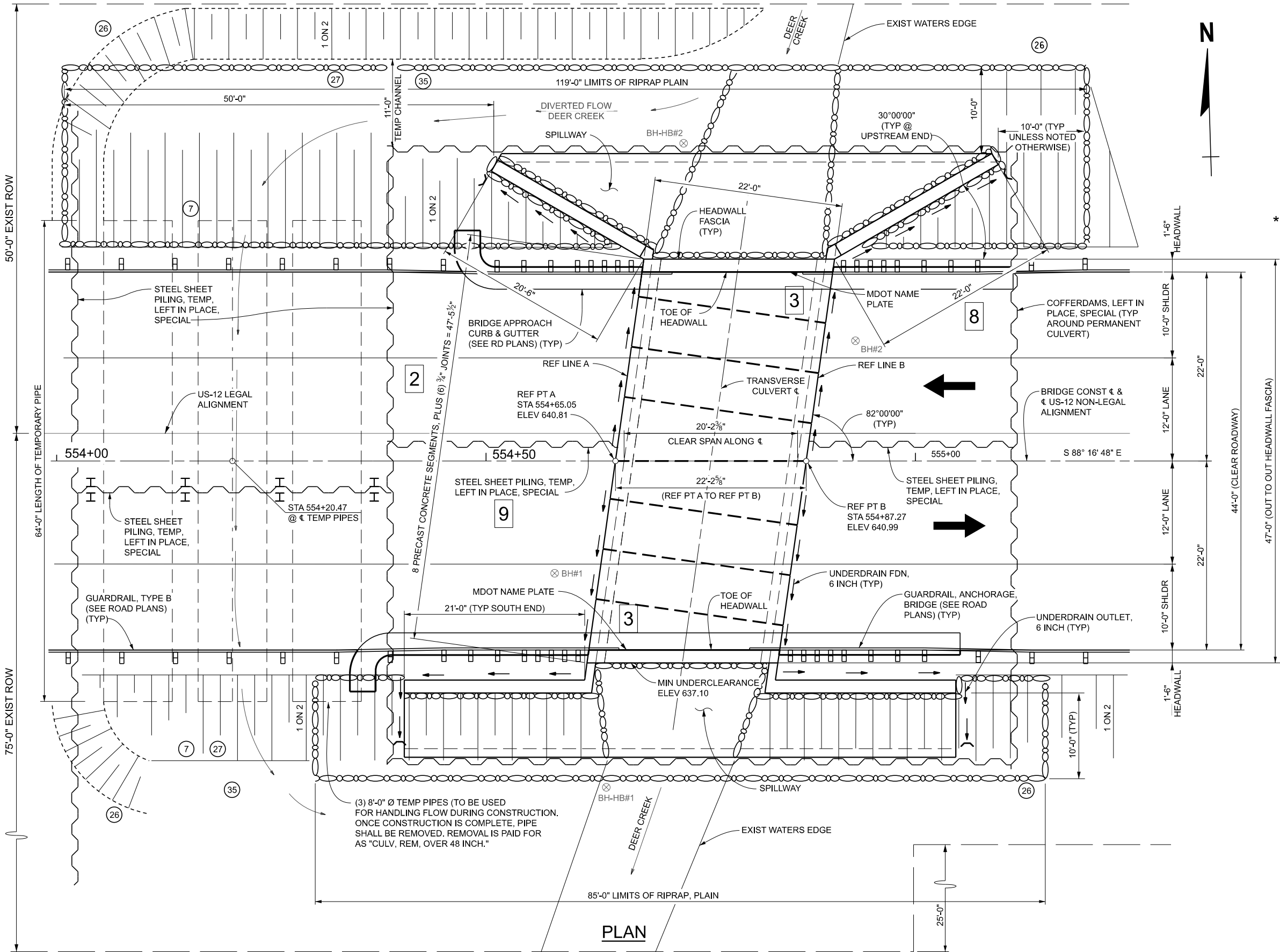
PLACE GEOTEXTILE LINER ON ALL SLOPES PRIOR TO PLACING RIPRAP.
PAYMENT FOR GEOTEXTILE LINER IS INCLUDED PAYMENT FOR RIPRAP.

WHEN CASTING ITEMS INTO STRUCTURAL PRECAST CONCRETE TO FACILITATE
BRIDGE CONSTRUCTION (FORMING, FINISHING, ETC.) USE ITEMS THAT ARE
GALVANIZED IN ACCORDANCE WITH ASTM B633. SERVICE CONDITION 4 OR EPOXY
COATED. CAST INSERTS WITH THE BEAM. DO NOT FIELD INSTALL INSERTS.

SUBMIT ALTERNATE METHODS OF STREAM DIVERSION TO THE ENGINEER
FOR APPROVAL.

DESIGN HEADWALLS TO DEVELOP AN ULTIMATE MOMENT CAPACITY (ABOUT THE
HORIZONTAL AXIS) TO RESIST A HORIZONTAL LOAD OF 24 K (KIPS) DISTRIBUTED
OVER 3.5 FEET APPLIED 32 INCHES ABOVE TOP OF PAVEMENT AND TO DEVELOP AN
ULTIMATE MOMENT CAPACITY (ABOUT THE VERTICAL AXIS) OF 16.7 KFT (KIP FEET).
PER FOOT OF HEADWALL HEIGHT. DESIGN HEADWALL CONNECTION TO DECK AND/OR
OTHER PRECAST UNITS TO RESIST THESE LOADS. SPACE BLOCKOUTS FOR THRIE
BEAM GUARDRAIL AT A DISTANCE OF 10'-7 3/4" OR LESS. CENTER TO CENTER,
ALONG HEADWALL.

CONTACT THE REGION SOILS ENGINEER TO PERFORM A FOOTING CHCK AT LEAST
48 HOURS PRIOR TO EXCAVATING TO THE BOTTOM OF THE EXCAVATION.



FINAL ROW PLAN REVISIONS					
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE



NO SCALE

DRAWN BY:
CHK'D BY: CORR BY:
FILE: C01_11021_GPSTR1.dgn

DATE:
DESIGN UNIT:
TSC:

CS: C01 OF 11021
JN: 130295A

GENERAL PLAN OF STRUCTURE
US-12 OVER DEER CREEK
1.4 MILES WEST OF THREE OAKS

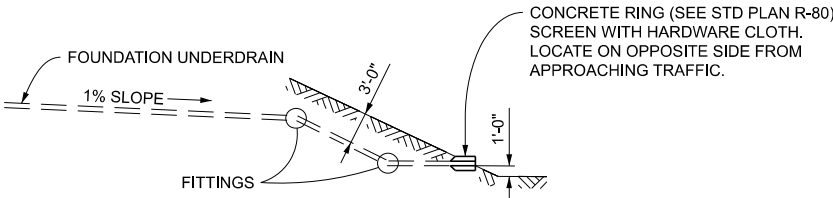
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DRAWING SHEET
C01
GPSTR
001
SECT 2

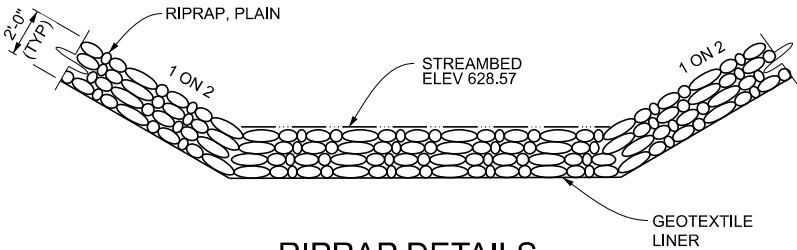
SUMMARY OF HYDRAULIC ANALYSIS							
EXISTING				PROPOSED			
FLOOD DATA	DIS-CHARGE (CFS)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE	VELOCITY IN D/S CHANNEL (FPS)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE	VELOCITY IN D/S CHANNEL (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS EL 6.38 FT U/S OF PROPOSED STRUCTURE
50 YEAR	600	637.90	6.52	637.12	3.53	169.90	-0.78
100 YEAR	700	638.71	7.6	637.65	4.12	169.90	-1.06
MAXIMUM BRIDGE AREA BELOW LOW CHORD IS 200 SQUARE FEET							

THE WATER SURFACE AND/OR ENERGY GRADE ELEVATIONS SHOWN ON THE ABOVE HYDRAULIC TABLE ARE TO BE USED FOR COMPARISON PURPOSES ONLY AND ARE NOT TO BE USED FOR ESTABLISHING A REGULATORY FLOODPLAIN.

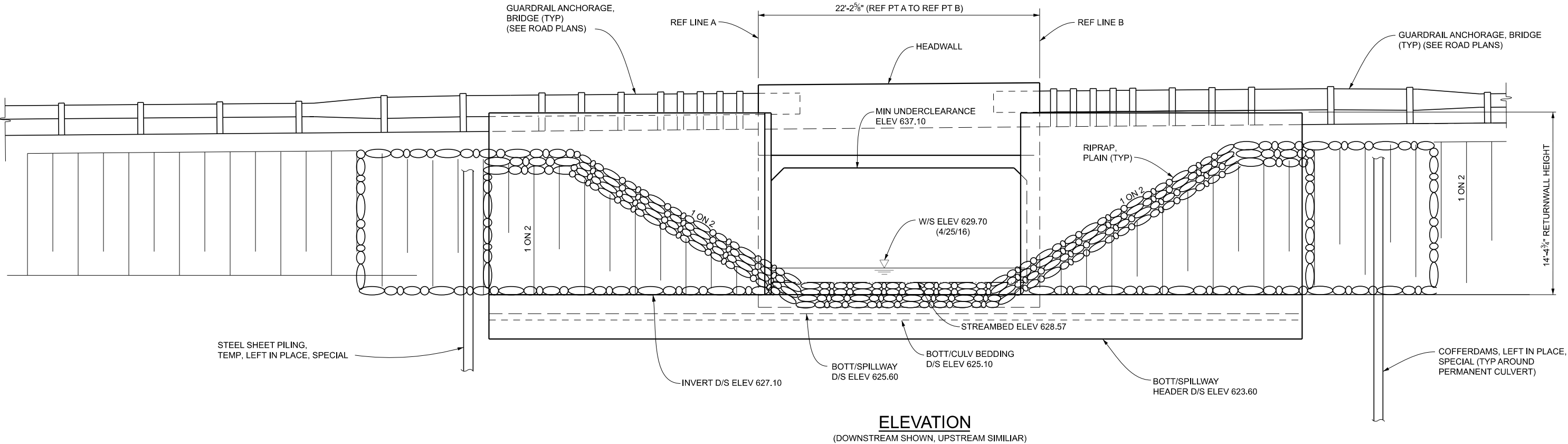
THE DRAINAGE AREA CONTRIBUTORY TO THIS CROSSING IS 2.22 SQUARE MILES.



DETAIL FOR DRAINAGE INTO DITCH



RIPRAP DETAILS



ELEVATION

(DOWNSTREAM SHOWN, UPSTREAM SIMILIAR)

MISCELLANEOUS QUANTITIES

2,997 Cyd	Backfill, Structure, CIP
1 LSUM	Cofferdams, Left in Place, Special (C01 of 11021)
68 Cyd	Culv Bedding, Box Culv
192 Ft	Culv, CI A, CSP, 96 inch
3 Ea	Culv, Rem, Over 48 inch
2,238 Cyd	Excavation, Fdn
563 Syd	Geotextile, Separator
7 Syd	Geotextile Retaining Wall, Temp
29 Cyd	Granular Material, CI IIIA
470 Cyd	Granular Material, CI III
473 Ton	Riprap, Plain
1,168 Sft	Steel Sheet Piling, Temp, Special
2,720 Sft	Steel Sheet Piling, Temp, Left in Place, Special
1 LSUM	Structures, Rem (C01 of 11021)
184 Ft	Underdrain, Fdn, 6 inch
24 Ft	Underdrain Outlet, 6 inch
4 Ea	Underdrain, Outlet Ending, 6 inch

FINAL ROW PLAN REVISIONS						SUBMITTAL DATE:	
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION



NO SCALE

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DATE:
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JN: 130295A

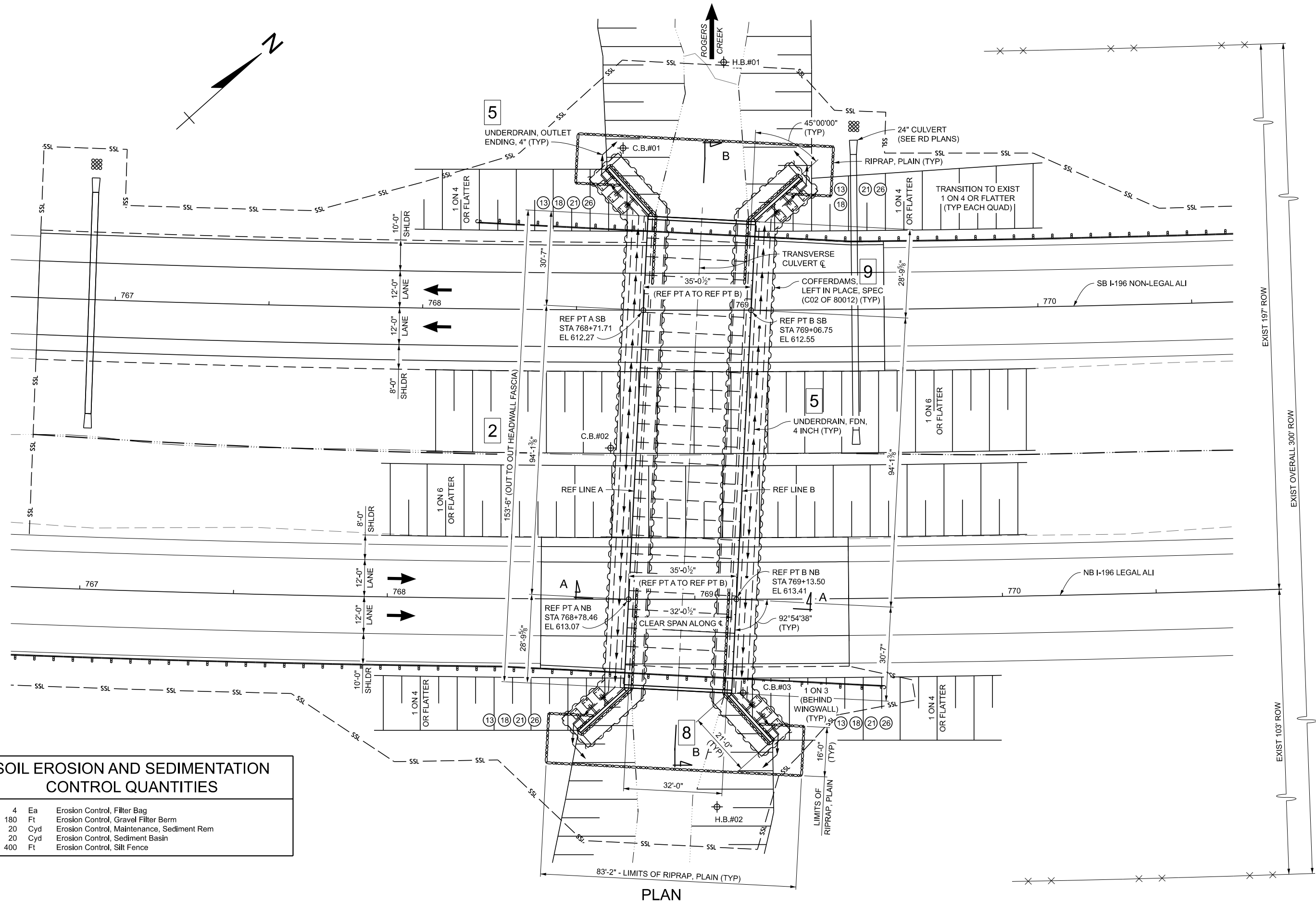
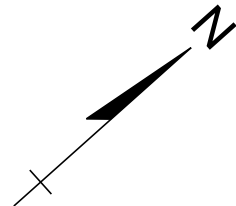
GENERAL PLAN OF STRUCTURE
US-12 OVER DEER CREEK
1.4 MILES WEST OF THREE OAKS

1

DRAWING SHEET
C01 GPSTR 002
SECT 2



FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:		 MDOT Michigan Department of Transportation	NO SCALE	DRAWN BY:	DATE:	CS: C01 OF 11021	GENERAL PLAN OF STRUCTURE		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CHK'D BY:	CORR BY:			DESIGN UNIT:	JN: 130295A	1	C02 GPSTR 003	SECT 2		
								FILE: C01_11021_GPSTR3.dgn	TSC:				US-12 OVER DEER CREEK					
											1.4 MILES WEST OF THREE OAKS							



SOIL EROSION AND SEDIMENTATION
CONTROL QUANTITIES

(18)	4	Ea	Erosion Control, Filter Bag
(13)	180	Ft	Erosion Control, Gravel Filter Berm
(21)	20	Cyd	Erosion Control, Maintenance, Sediment Rem
(26)	20	Cyd	Erosion Control, Sediment Basin
(26)	400	Ft	Erosion Control, Silt Fence

PLAN

FINAL ROW PLAN REVISIONS SUBMITTAL DATE:					
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE



NO SCALE

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CHK'D BY:
FILE: C02_80012_gpstr.dgn

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JN: 208348A

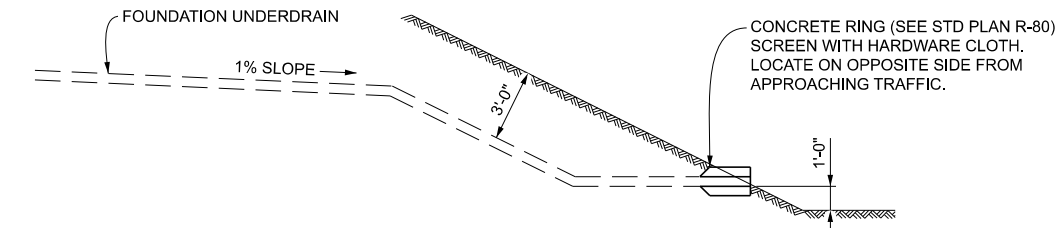
GENERAL PLAN OF STRUCTURE
I-196/US-31 OVER ROGERS CREEK
0.9 MILES NORTH OF BERRIEN COUNTY LINE

DRAWING SHEET
C02 GPSTR 001
SECT 2

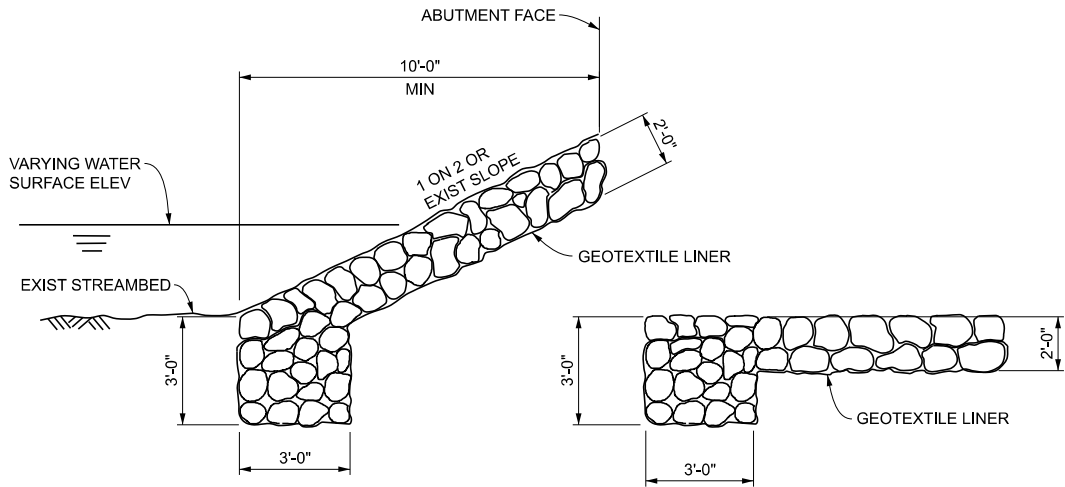
SUMMARY OF HYDRAULIC ANALYSIS							
EXISTING				PROPOSED			
FLOOD DATA	DIS-CHARGE (CFS)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE	VELOCITY IN D/S CHANNEL (FPS)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE	VELOCITY IN D/S CHANNEL (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS EL. U/S OF PROPOSED STRUCTURE
50 YEAR	650	606.86	9.48	600.84	4.02	185.38	-6.02
100 YEAR	850	612.60	12.40	601.70	4.59	215.50	-10.90

MAXIMUM BRIDGE AREA BELOW LOW CHORD IS 404.05 SQUARE FEET

THE WATER SURFACE AND/OR ENERGY GRADE ELEVATIONS SHOWN ON THE ABOVE HYDRAULIC TABLE ARE TO BE USED FOR COMPARISON PURPOSES ONLY AND ARE NOT TO BE USED FOR ESTABLISHING A REGULATORY FLOODPLAN. THE ELEVATIONS MAY BE USED PROVIDED THEY ARE VERIFIED WITH THE LAND AND WATER MANAGMENT DIVISION, MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY.



UNDERDRAIN OUTLET DETAIL



TOE HEADER

SIDE HEADER

RIPRAP HEADER DETAILS

TOP OF RIPRAP MUST BE AT OR BELOW EXISTING STREAMBED/ SLOPE ELEVATION.

AN APPROPRIATE METHOD OF WATER DIVERSION FOR PLACING RIPRAP SHALL BE PROPOSED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER. IF WATER IS SHALLOW (LESS THAN TWO FEET), TEMPORARY CONCRETE BARRIERS OR SANDBAGS MAY BE USED TO DIVERT FLOW.

THE RIPRAP SCHEME SHOWN IS A MINIMUM REQUIREMENT FOR SCOUR.

MISCELLANEOUS QUANTITIES

JN 208348A	CAT 0002		
1	LSUM	Structures, Rem (C02 of 80012)	
178	Cyd	Flowable Fill, Non-Structural	
2582	Cyd	Backfill, Structure, CIP	
8866	Cyd	Excavation, Fdn	
400	Ft	Underdrain, Fdn, 4 inch	
40	Ft	Underdrain Outlet, 4 inch	
4	Ea	Underdrain, Outlet EndIng, 4 Inch	
1	LSUM	Cofferdam, Left in Place, Spec (C02 of 80012)	
1002	Syd	Liner, PVC, 30 mil	
534	Ton	Riprap, Plain	
35	Cyd	Aggregate, Spec	
979	Ton	Riprap, Inside Culvert, Plain	

NOTES:

THE DESIGN LOADS USED FOR THE PEDESTAL WALL AND PILE FOUNDATION ARE AS FOLLOWS IN KIPS

		DC	EV	EH	LS	LL	DL	DL+LL
HL-93 MOD TRUCK	VERTICAL	6.53	7.83	0	0	5.6	14.35	19.96
	HORIZONTAL	1.63	3.35	-3.65	-0.76	2.03	0.56	2.59
HL-93 MOD 72K AXLE	VERTICAL	6.53	7.83	0	0	6.69	14.35	21.04
	HORIZONTAL	1.63	3.35	-3.65	-0.76	2.31	0.56	2.87
HL-93	VERTICAL	6.53	7.83	0	0	4.67	14.35	19.02
	HORIZONTAL	1.63	3.35	-3.65	-0.76	1.69	0.56	2.25

(+ IS UP/TOWARDS ☿ OF STREAMBED)

THE DESIGN OF THIS STRUCTURE IS BASED ON 1.2 TIMES THE CURRENT AASHTO LRFD BRIDGE DESIGN SPECIFICATION HL-93 LOADING WITH THE EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD DEFINITION IS REPLACED BY A SINGLE 60-KIP AXLE LOAD BEFORE APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE DEFLECTION DOES NOT EXCEED 1/800 OF SPAN LENGTH.

THE DRAINAGE AREA CONTRIBUTORY TO THIS CROSSING IS 5.40 SQUARE MILES.

WITHOUT THE PREVENTIVE MEASURES SHOWN ON THESE PLANS, THERE IS A POSSIBILITY THAT STREAM BED SCOUR MAY OCCUR. THE ESTIMATED TOTAL SCOUR ELEVATION IS CALCULATED TO BE 585.00 FEET AT ABUTMENTS A AND B. THESE ELEVATIONS ARE BASED ON A 100 YEAR RUNOFF EVENT.

PLACEMENT OF "RIPRAP, PLAIN" AND "RIPRAP, INSIDE CULVERT, PLAIN" MUST BE PLACED SIMULTANIOUS WITH "AGGREGATE, SPEC" TO FILL VOIDS.

10 TONS OF RIPRAP TO BE USED AT STAGING LINE AS DIRECTED BY THE ENGINEER.

BROKEN CONCRETE NOT TO BE USED FOR RIPRAP.

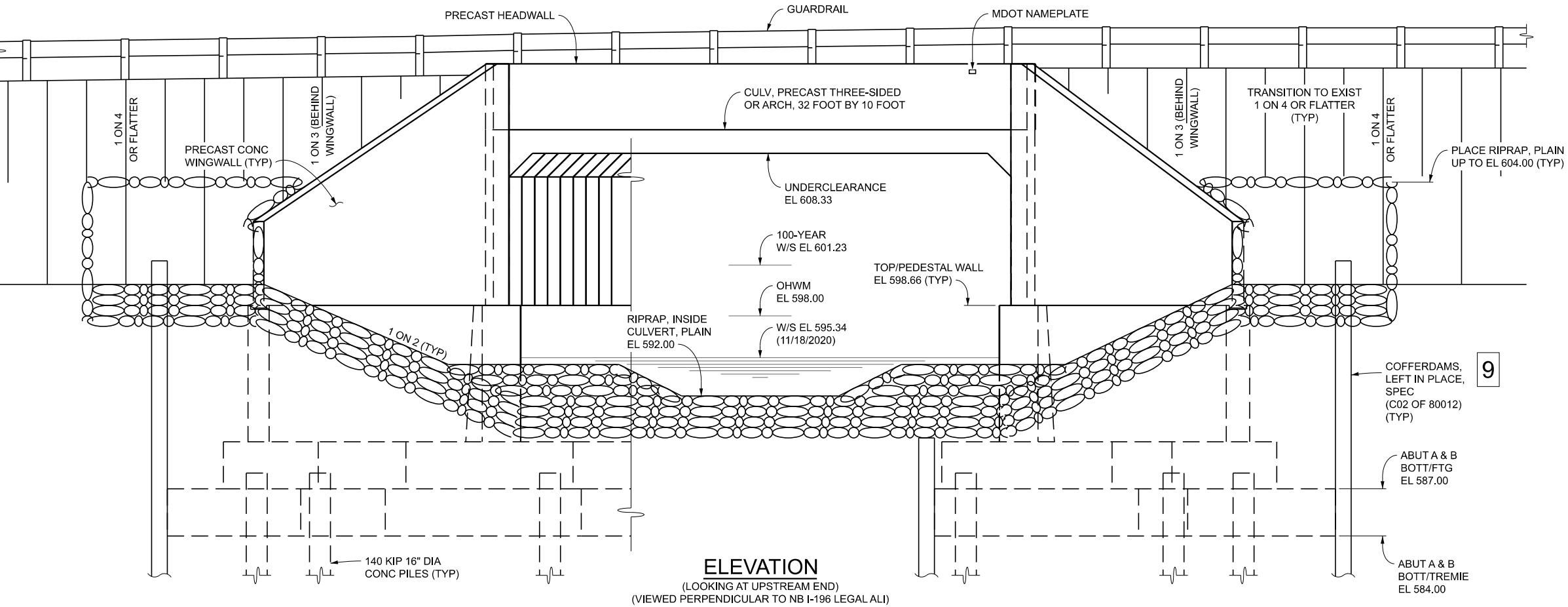
PLACE GEOTEXTILE LINER ON ALL SLOPES PRIOR TO PLACING RIPRAP. PAYMENT FOR GEOTEXTILE LINER IS INCLUDED IN PAYMENT FOR RIPRAP.

THE TREMIE SEAL DESIGN WAS BASED ON A WATER SURFACE AT EL 598.50.

SUBMIT ALTERNATE METHODS OF STREAM DIVERSION TO THE ENGINEER FOR APPROVAL.

WHEN CASTING ITEMS INTO STRUCTURAL PRECAST CONCRETE TO FACILITATE BRIDGE CONSTRUCTION (FORMING, FINISHING, ETC.) USE ITEMS THAT ARE GALVANIZED IN ACCORDANCE WITH ASTM B633, SERVICE CONDITION 4 OR EPOXY COATED. CAST INSERTS WITH THE ELEMENTS. DO NOT FIELD INSTALL INSERTS.

CONTACT THE REGION SOILS ENGINEER TO PERFORM A FOOTING CHECK AT LEAST 48 HOURS PRIOR TO EXCAVATING TO THE BOTTOM OF THE EXCAVATION.



ELEVATION
(LOOKING AT UPSTREAM END)
(VIEWED PERPENDICULAR TO NB I-196 LEGAL ALI)

FINAL ROW PLAN REVISIONS						SUBMITTAL DATE:					
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION



NO SCALE

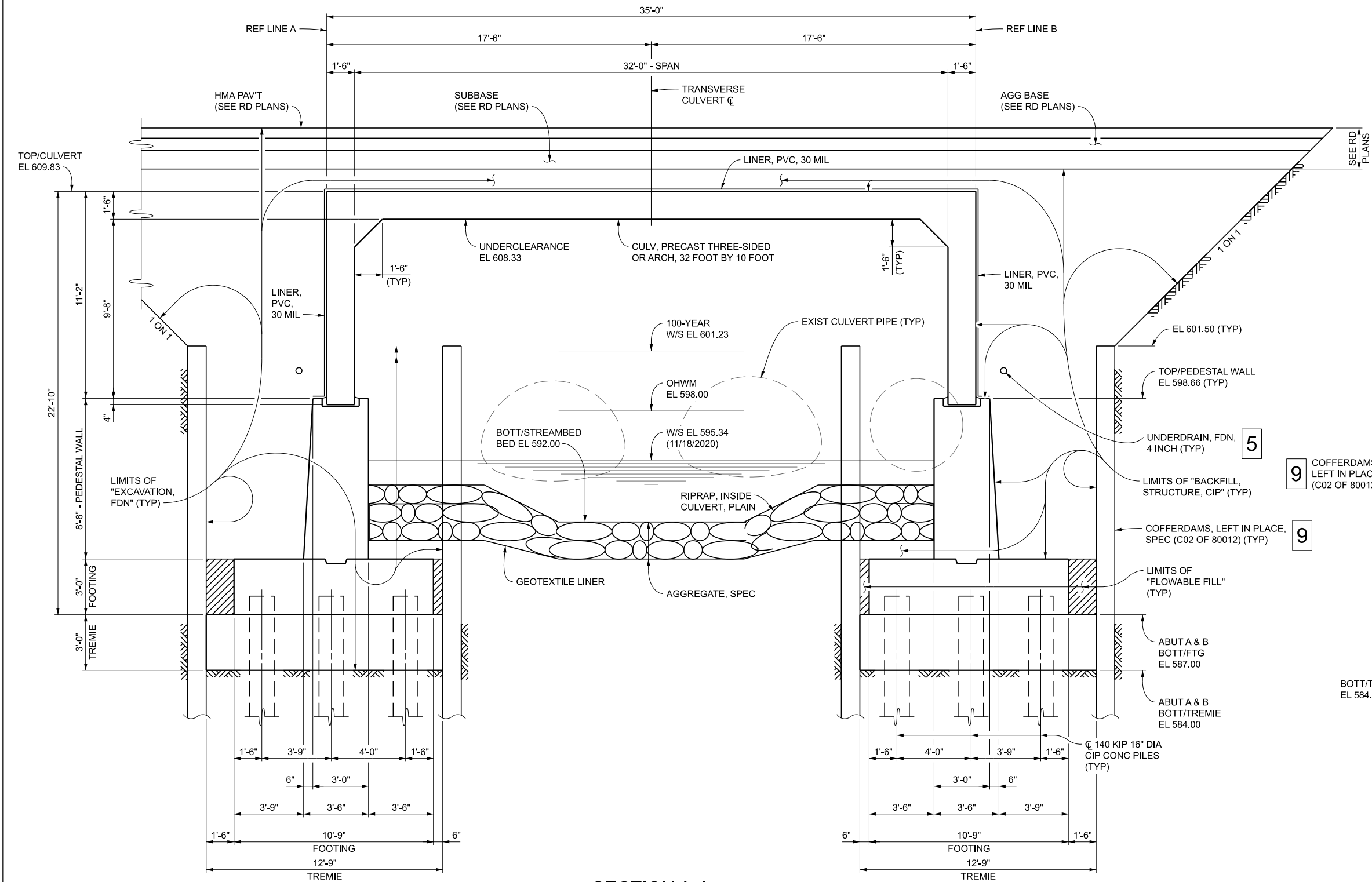
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FILE: C02_80012_gpstr.dgn

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DESIGN UNIT:
TSC:

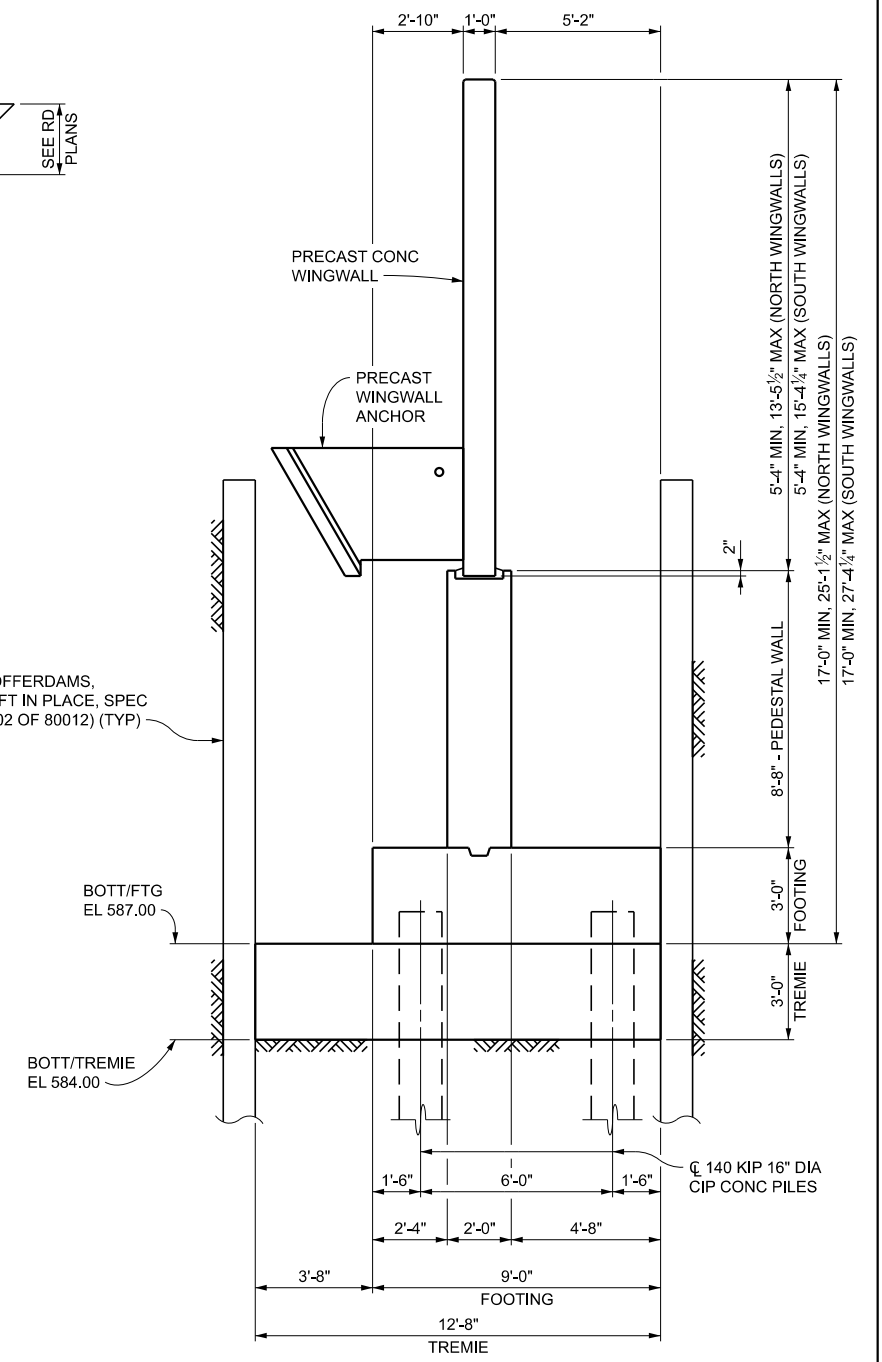
CS: C02 OF 80012
JN: 208348A

GENERAL PLAN OF STRUCTURE
I-196/US-31 OVER ROGERS CREEK
0.9 MILES NORTH OF BERRIEN COUNTY LINE

DRAWING SHEET
C02 GPSTR 002
SECT 2



SECTION A-A



TYPICAL PRECAST WINGWALL SECTION

FINAL ROW PLAN REVISIONS						SUBMITTAL DATE:					
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION



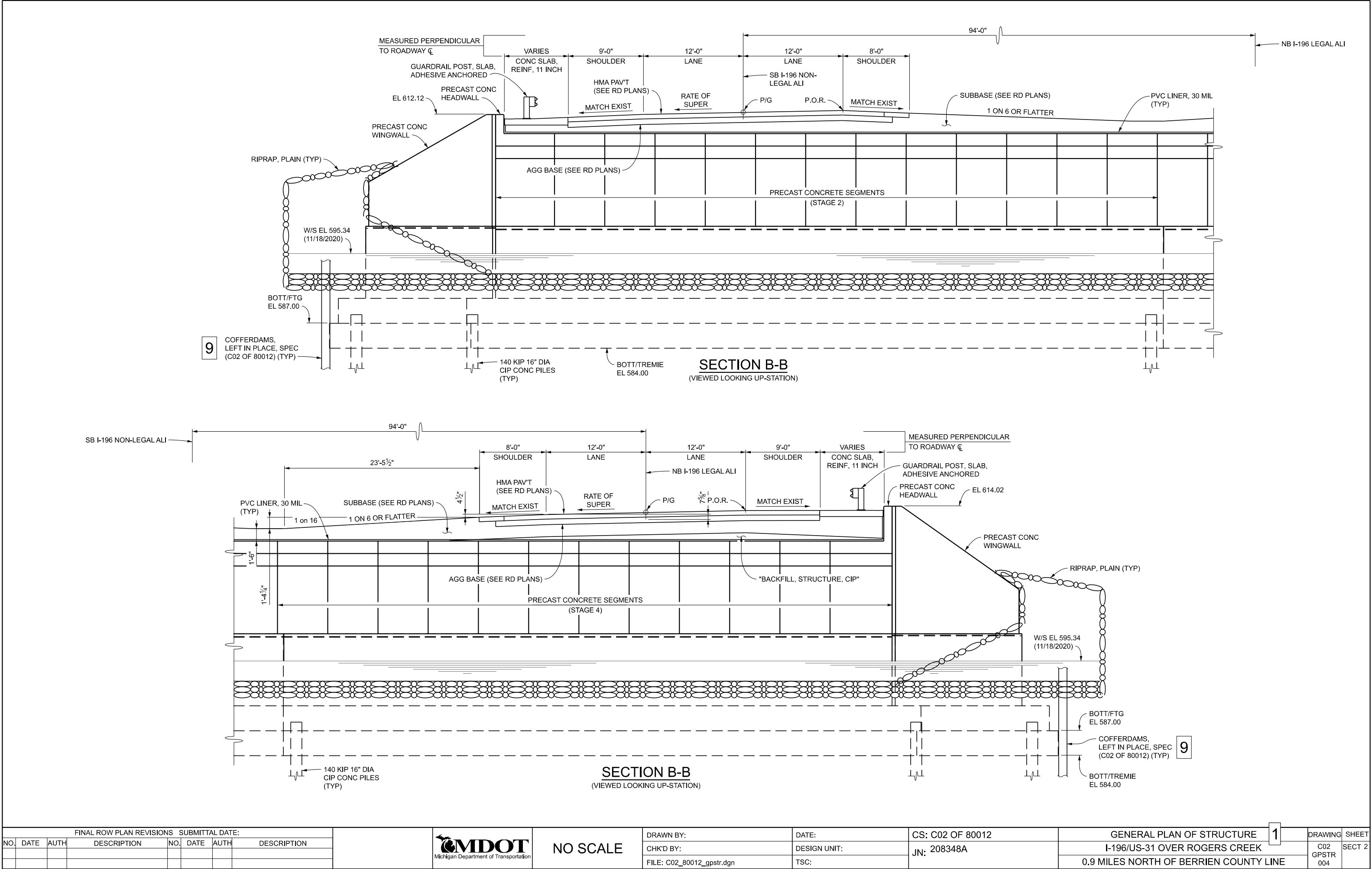
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CHK'D BY:
FILE: C02_80012_gpstr.dgn

DATE:
DESIGN UNIT:
TSC:

CS: C02 OF 80012
JN: 208348A

GENERAL PLAN OF STRUCTURE				1	DRAWING	SHEET
I-196/US-31 OVER ROGERS CREEK					C02 GPSTR 003	SECT 2
0.9 MILES NORTH OF BERRIEN COUNTY LINE						



FINAL ROW PLAN REVISIONS						SUBMITTAL DATE:	
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION



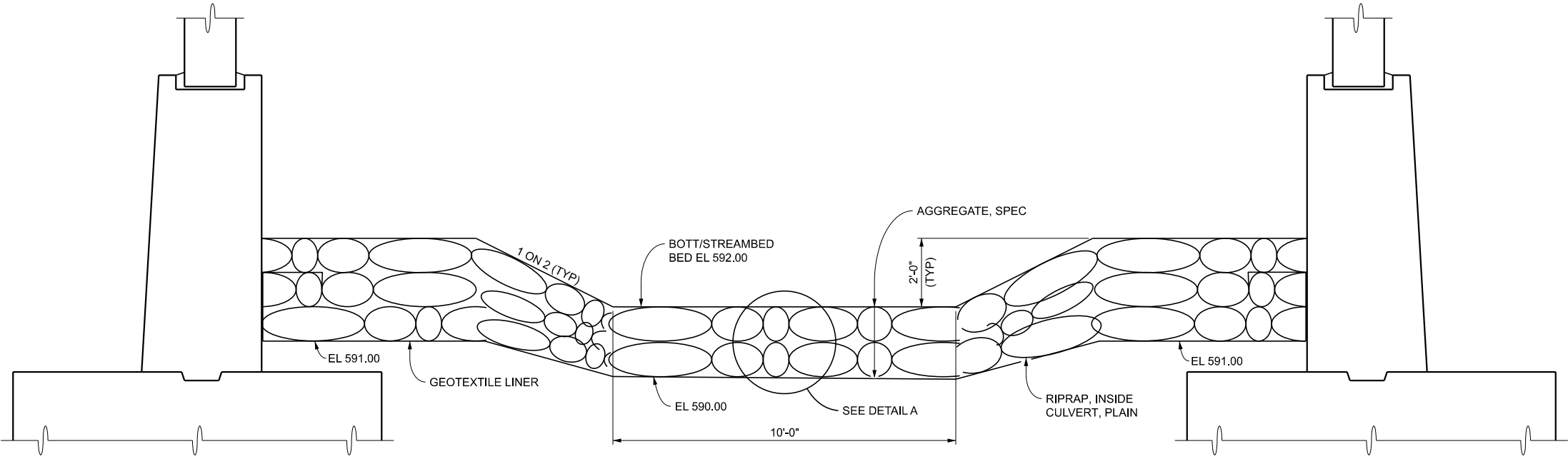
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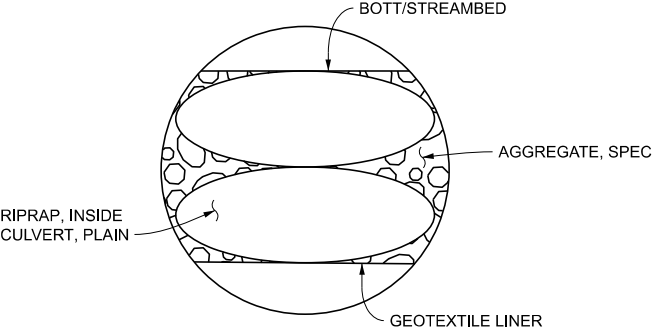
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DESIGN UNIT:
TSC:

CS: C02 OF 80012
JN: 208348A

GENERAL PLAN OF STRUCTURE		1	DRAWING	SHEET
I-196/US-31 OVER ROGERS CREEK			C02 GPSTR 004	SECT 2
0.9 MILES NORTH OF BERRIEN COUNTY LINE				

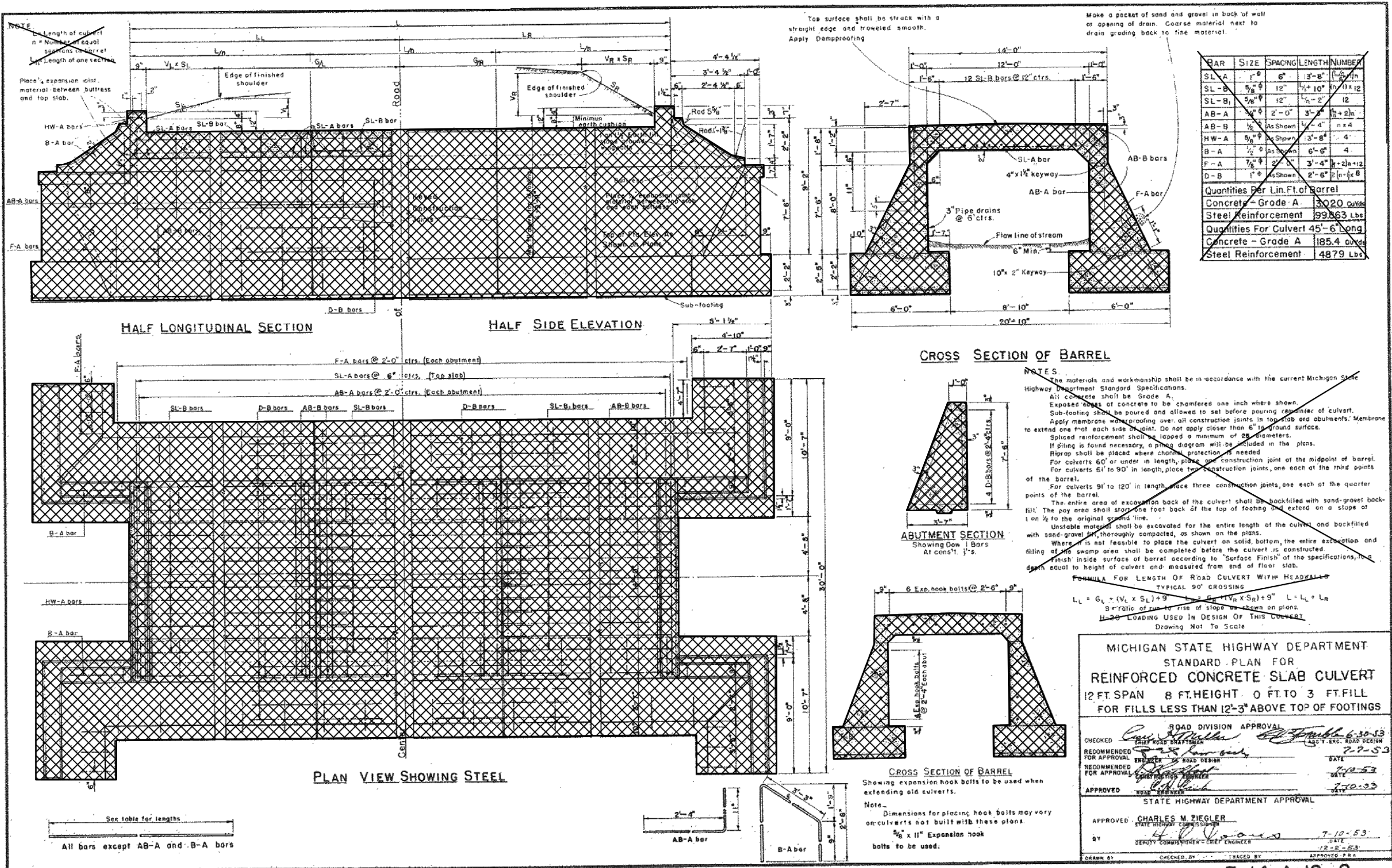


SECTION THRU PROPOSED CHANNEL



DETAIL A

FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:			NO SCALE	DRAWN BY:	DATE:	CS: C02 OF 80012	GENERAL PLAN OF STRUCTURE		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CHK'D BY:	DESIGN UNIT:			JN: 208348A	I-196/US-31 OVER ROGERS CREEK		C02 GPSTR 005	SECT 2		
													0.9 MILES NORTH OF BERRIEN COUNTY LINE					
										FILE: C02_80012_gpstr.dgn	TSC:							



JN: 130295A

THRE BEAM RETROFIT HAS BEEN ATTACHED TO THE EXISTING RAILING PRIOR TO THIS PROJECT. SEE ROAD PLANS FOR REMOVAL PAY ITEMS AND QUANTITIES.

JN: 130295A

REMOVE ENTIRE EXISTING STRUCTURE

JN: 130295A

IN ORDER TO MAINTAIN THE INTEGRITY OF THE EXISTING STRUCTURE DURING STAGE II CONSTRUCTION, THE CONTRACTOR SHALL SAW CUT ENTIRELY THROUGH THE ABUTMENT AND A MIN OF 4" INTO THE TOP OF FOOTING FOR REMOVAL PURPOSES.

GENERAL PLAN OF STRUCTURE

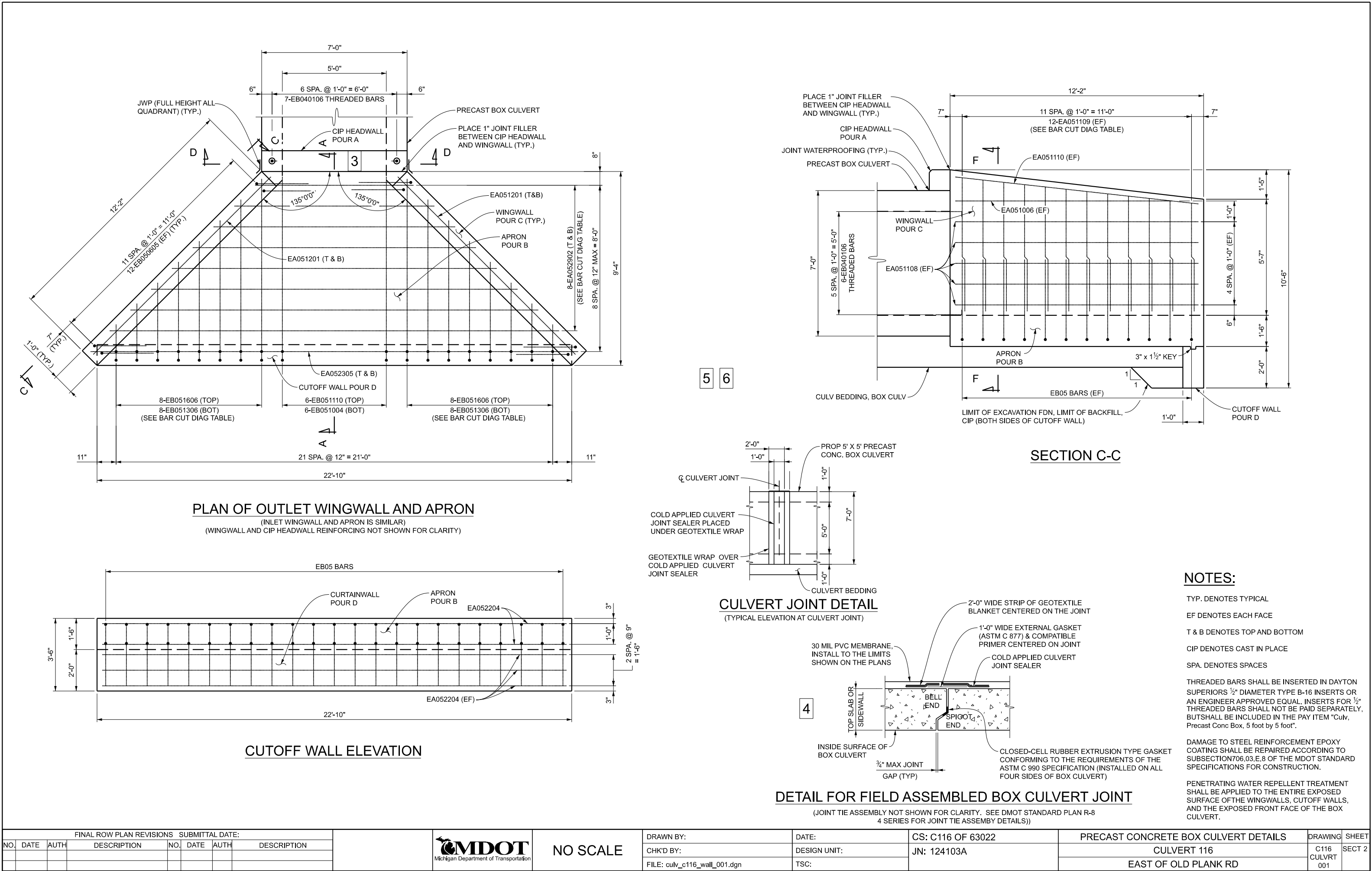
1. General plan of structure sheets should consist of the following details: Plan of proposed culvert and associated work, elevation view cut along the centerline of the culvert, riprap header details, typical cross section through the culvert, elevation view at culvert ends, and joint details. For information regarding what should be shown, see the Preliminary and Final Design Phase Checklist.
2. Culverts segments should be provided in increments of 8'-0" at a maximum. Sizing should be provided as uniformly as possible. For each segment size, the sizing and number of segments should be provided. Joints between culvert segments should be a maximum of 3/4".
3. Skewed segments should be provided at stage lines or end sections only to prevent bends in the culvert alignment. Skewed segments should be provided in 5 degree increments up to 45 degrees. For additional information see the Culvert Design Guidance.
4. To prevent reflective cracking of the pavement, the top of the culvert should be placed so that it does not interfere with the roadway subbase.
5. Underdrain should be provided on each side of the culvert above the OHWM and 6" from the culvert edge. Slope the underdrain to match the roadway above. Underdrain should outlet to the waterway where end sections should be provided.
6. To help prolong the life of the culvert, water repellent treatment should be provided on all surfaces that will be exposed, except for precast elements.
7. Dewatering methods are typically included in the pay item for the culvert. However, in some instances the dewatering procedure may be extensive enough that it is paid for separately. The Engineer should coordinate with MDOT on when this is appropriate.

8. Soil anchors should only be provided when gravity wingwalls do not suffice as they increase the footprint of culvert work. Manufacturers typically detail anchors, however, when they are proposed they should be shown for reference to help identify potential conflicts.
9. Selection of retaining walls should follow the guidance provided in the Culvert Design Guidelines.
10. Provide summary of hydraulic analysis for all culverts over water. For culverts spanning less than 20', see the Road Design Manual. For culverts spanning 20' or larger see Bridge Design Manual.
11. In instances where cast-in-place alternatives may be constructed. The Engineer should consider adding information only quantities for the contractor's reference.
12. Refer to Chapter 8 of the MDOT Bridge Design Manual for typical standard notes.
13. Provide scour tables for all culverts over water. See Bridge Design Manual.

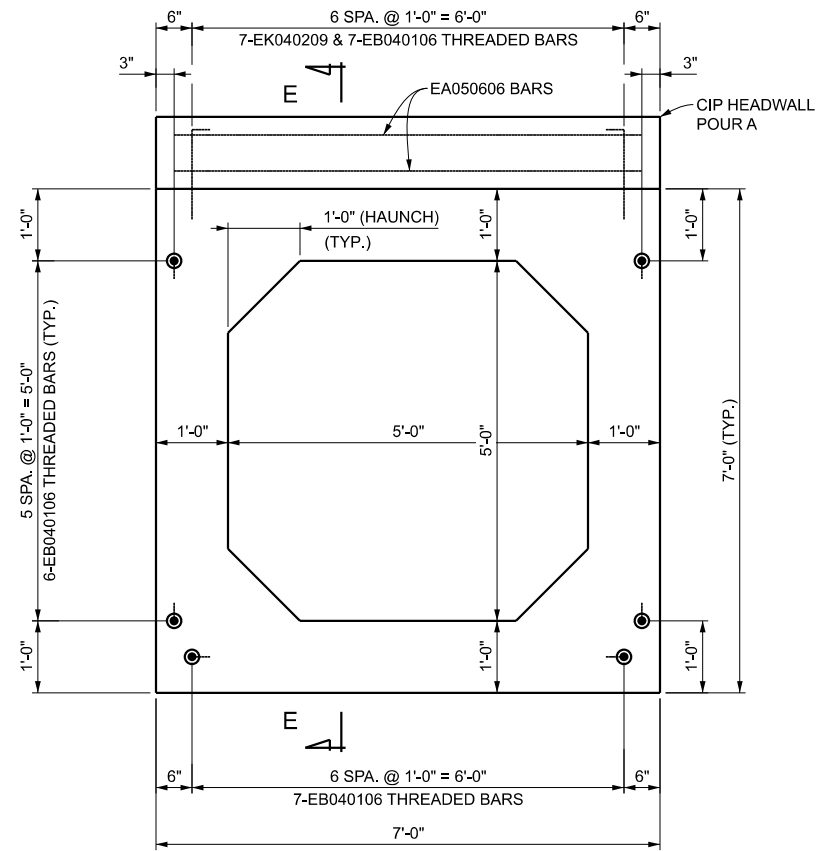
REMOVAL SHEETS

1. Reference previous plan sheets when detailing removals. Detail removal areas according to MDOT Guidelines for Plan Preparation.
2. For information regarding what should be shown on removal sheets see the Preliminary and Final Design Phase Checklist.

[illegible]

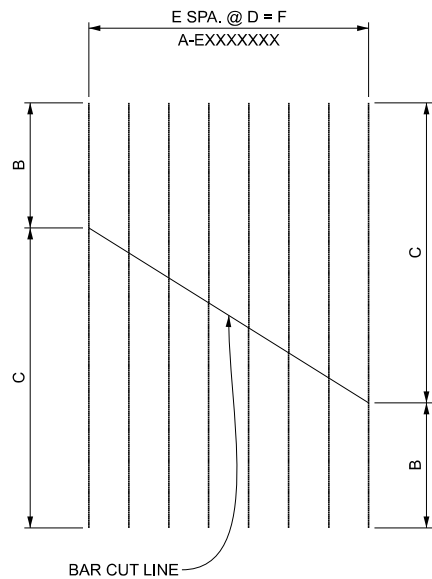


FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:		 Michigan Department of Transportation	NO SCALE	DRAWN BY:	DATE:	CS: C116 OF 63022	PRECAST CONCRETE BOX CULVERT DETAILS	DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CHK'D BY:	DESIGN UNIT:			JN: 124103A	CULVERT 116	C116 CULVRT 001	SECT 2		
								FILE: culv_c116_wall_001.dgn	TSC:				EAST OF OLD PLANK RD				

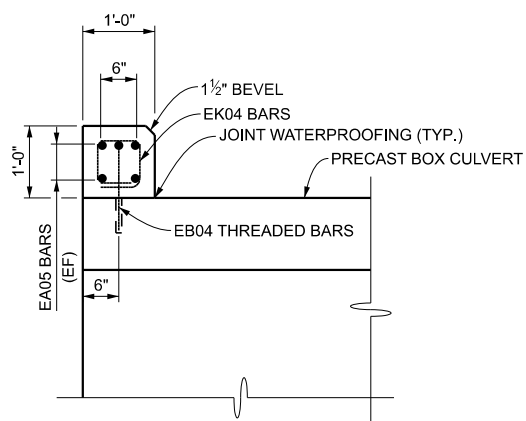


SECTION D-D

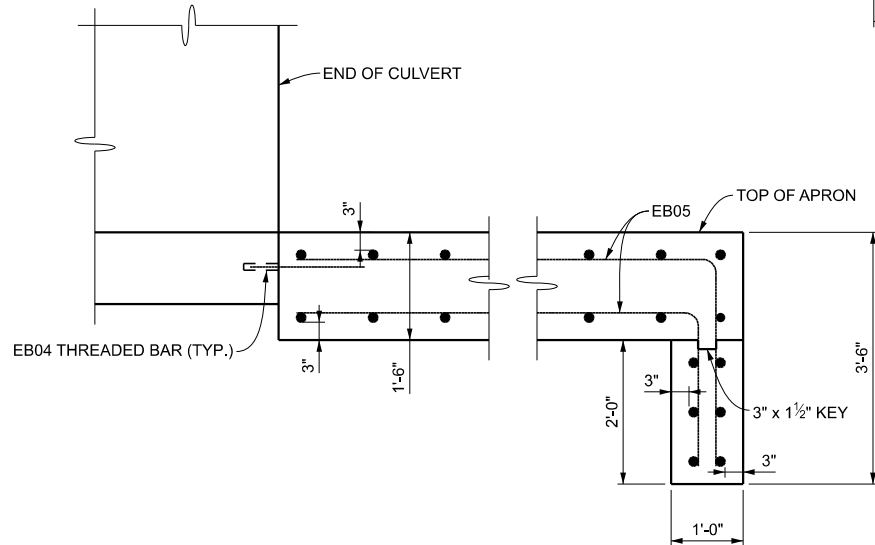
SHOWING INSERT LOCATIONS FOR 1/2" THREADED BARS
INSERTS FOR 1/2" THREADED BARS SHALL BE FABRICATOR INSTALLED



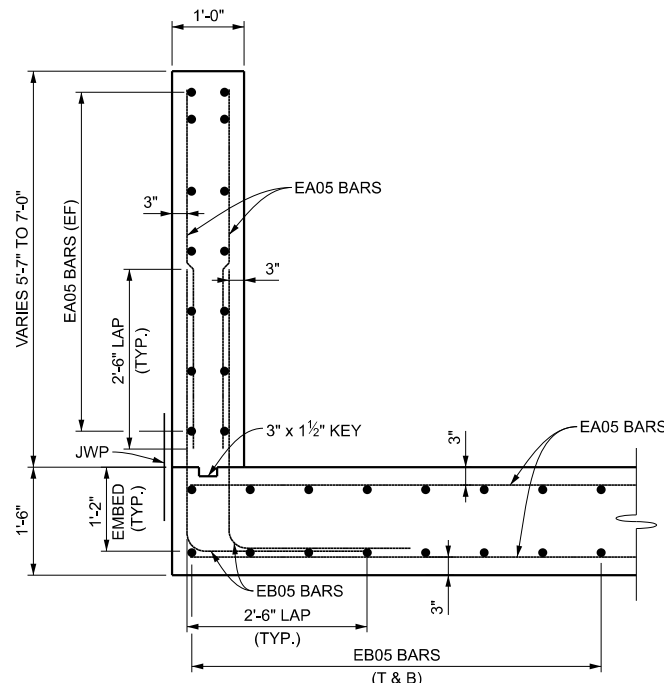
BAR CUT DIAGRAM



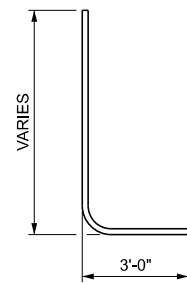
SECTION E-E



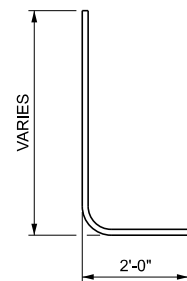
SECTION A-A



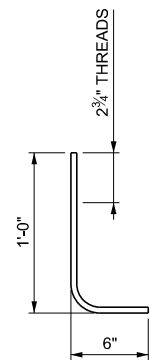
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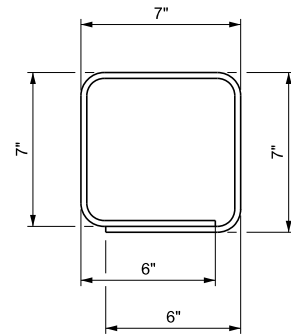


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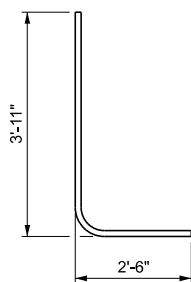


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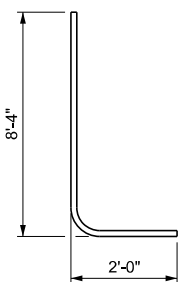
THREADED BAR INCLUDED IN
BID ITEM "Reinforcement,
Steel, Epoxy Coated"



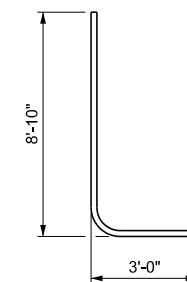
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EB050605



EB051004



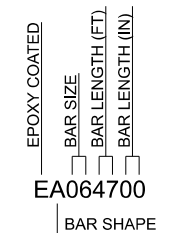
EB051110

REINFORCEMENT, STEEL, ONE END ONLY (FOR INFORMATION ONLY)			
HEADWALL	BAR	NO. REQ'D	TOTAL WT
	EA050606	4	28
	EB040106*	7	8
	EK040209	7	13
APRON	EA052305	2	49
	EA052902	8	244
	EA051201	4	51
	EB051110	6	75
	EB051004	6	65
	EB050605	48	322
	EB051606	8	138
	EB051306	8	113
WINGWALL	EB040106*	7	8
	EA051108	20	244
	EA051006	4	44
	EA051110	4	50
	EA051109	24	295
	EB040106*	12	13
CURTAINWALL	EA052204	6	140
TOTAL ONE END			1900

* DENOTES A THREADED BAR

CONCRETE-GRADE 3500 QUANTITIES (FOR INFORMATION ONLY)		
LOCATION	POUR	ONE END ONLY
CIP HEADWALL	A	0.3
APRON	B	8.4
WINGWALLS	C	5.7
CURTAINWALL	D	1.7
TOTAL ONE END		16.1

ALPHABETICAL POUR DESIGNATION IS NOT TO BE CONSTRUCTED AS A POUR SEQUENCE



EA BAR

BAR CUT DIAGRAM TABLE							
BAR MARK	A	B	C	D	E	F	LOCATION
EA051109	12	5'-3"	6'-6"	1'-0"	11	11'-0"	WINGWALL, VERTICAL
EA052902	8	7'-7"	21'-7"	1'-0"	7	7'-0"	APRON, TRANSVERSE
EB051606	8	4'-9"	11'-9"	1'-0"	7	7'-0"	APRON, LONGITUDINAL (TOP)
EB051306	8	3'-3"	10'-3"	1'-0"	7	7'-0"	APRON, LONGITUDINAL (BOT)

NOTES:

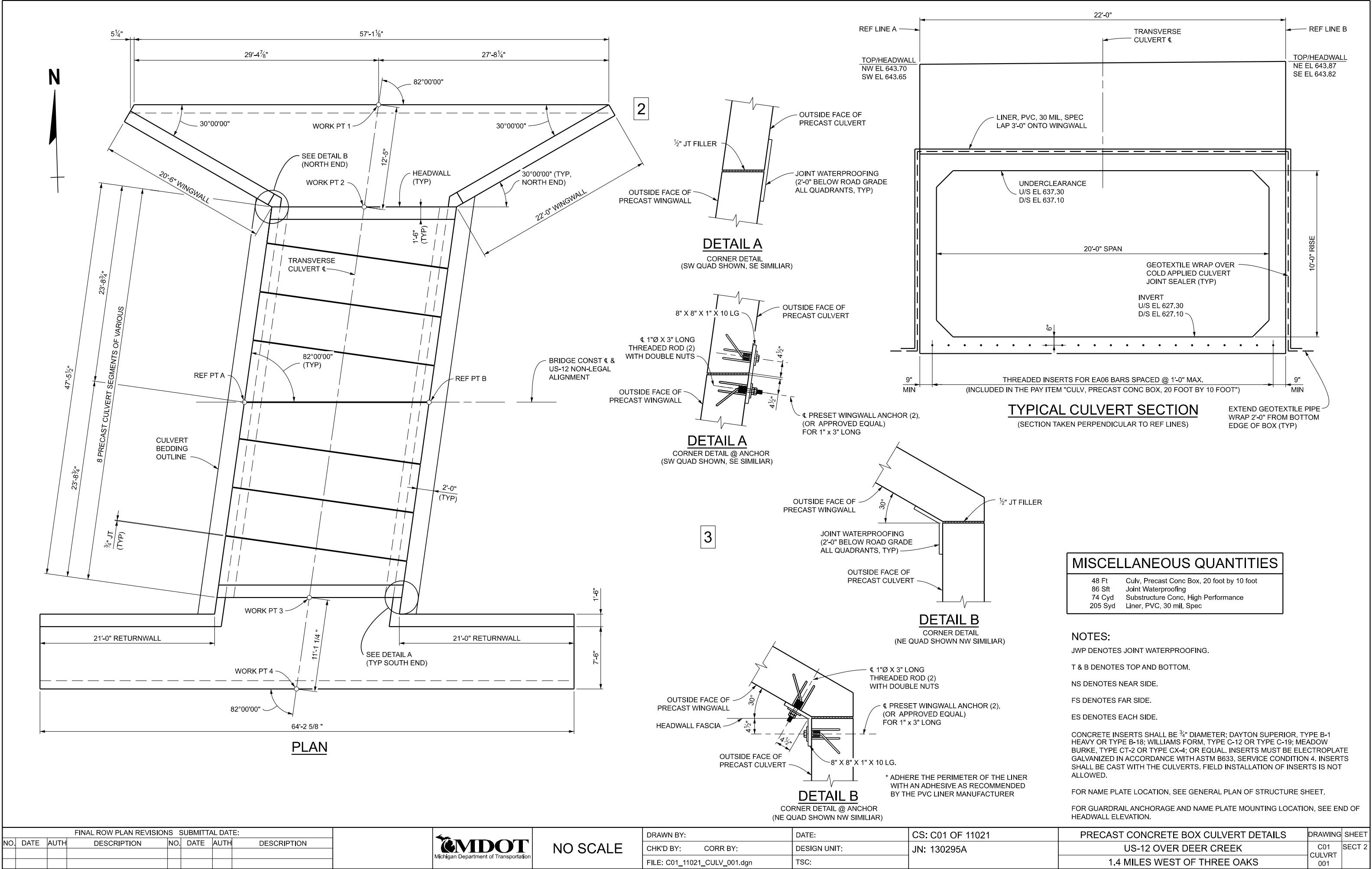
REINFORCEMENT IS TO BE SHOP CUT AS SHOWN. THE EPOXY COATING SHALL BE REPAIRED ACCORDING TO THE STANDARD SPECIFICATIONS.

ONCE CUT, APRON LONGITUDINAL REINFORCEMENT IS TO BE BENT ACCORDING TO BAR DIAGRAMS.

REINFORCEMENT CLEAR COVER
CONCRETE CAST AGAINST EARTH UNLESS PRECAST: 3in
ALL OTHER UNLESS SHOWN IN PLANS: 2in

FINAL ROW PLAN REVISIONS						SUBMITTAL DATE:									
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION								

		 Michigan Department of Transportation		NO SCALE		DRAWN BY:		DATE:		CS: C116 OF 63022		PRECAST CONCRETE BOX CULVERT DETAILS		DRAWING	
						CHK'D BY:		DESIGN UNIT:		JN: 124103A		CULVERT 116		C116	
						FILE: culv_c116_wall_002.dgn		TSC:				EAST OF OLD PLANK RD		CULVRT	
														002	
														SECT 2	



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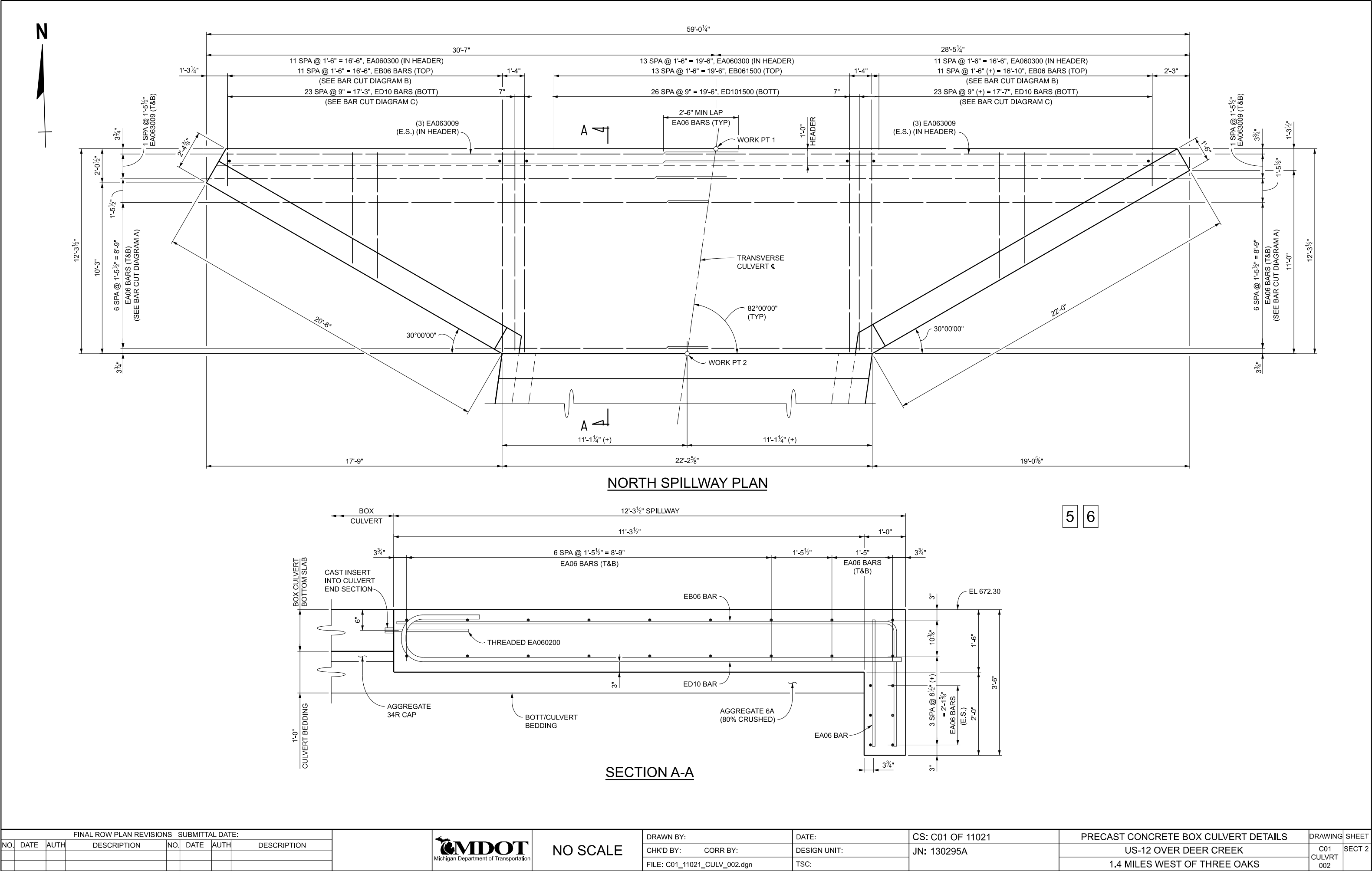


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CHK'D BY:	CORR BY:	DESIGN UNIT:
FILE: C01_11021_CULV_001.dgn		TSC:

CS: C01 OF 11021
JN: 130295A

PRECAST CONCRETE BOX CULVERT DETAILS		DRAWING	SHEET
US-12 OVER DEER CREEK		C01	SECT 2
1.4 MILES WEST OF THREE OAKS		CULVRT	001



FINAL ROW PLAN REVISIONS							SUBMITTAL DATE:						
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION						



NO SCALE

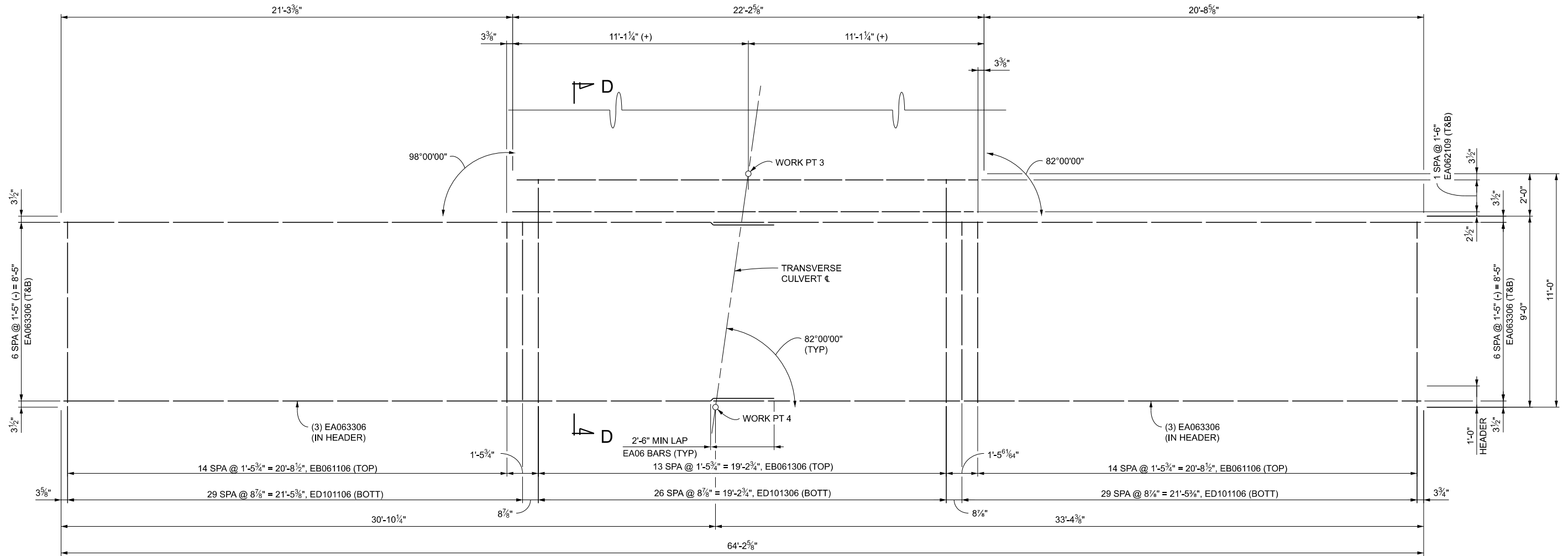
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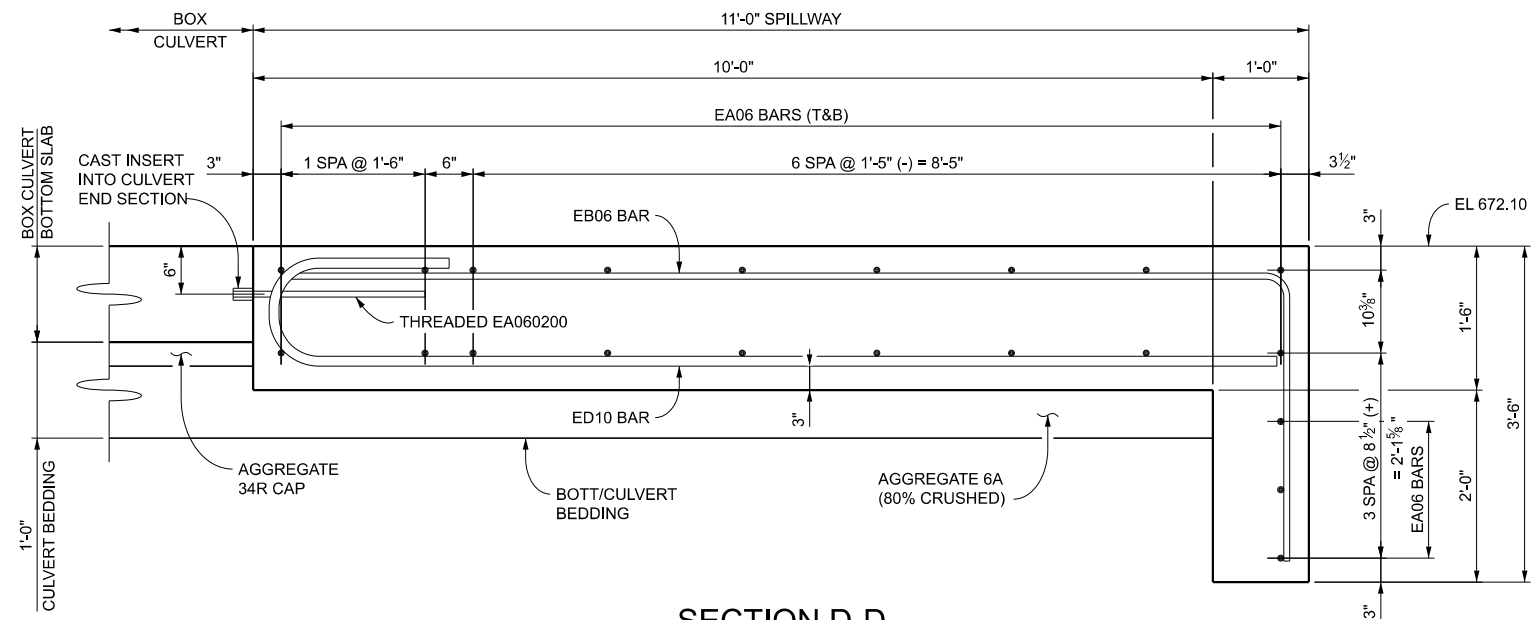
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JN: 130295A

PRECAST CONCRETE BOX CULVERT DETAILS
US-12 OVER DEER CREEK
1.4 MILES WEST OF THREE OAKS

DRAWING SHEET
C01 CULVRT 002
SECT 2



SOUTH SPILLWAY PLAN



SECTION D-D

5 6

FINAL ROW PLAN REVISIONS							SUBMITTAL DATE:						
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION						



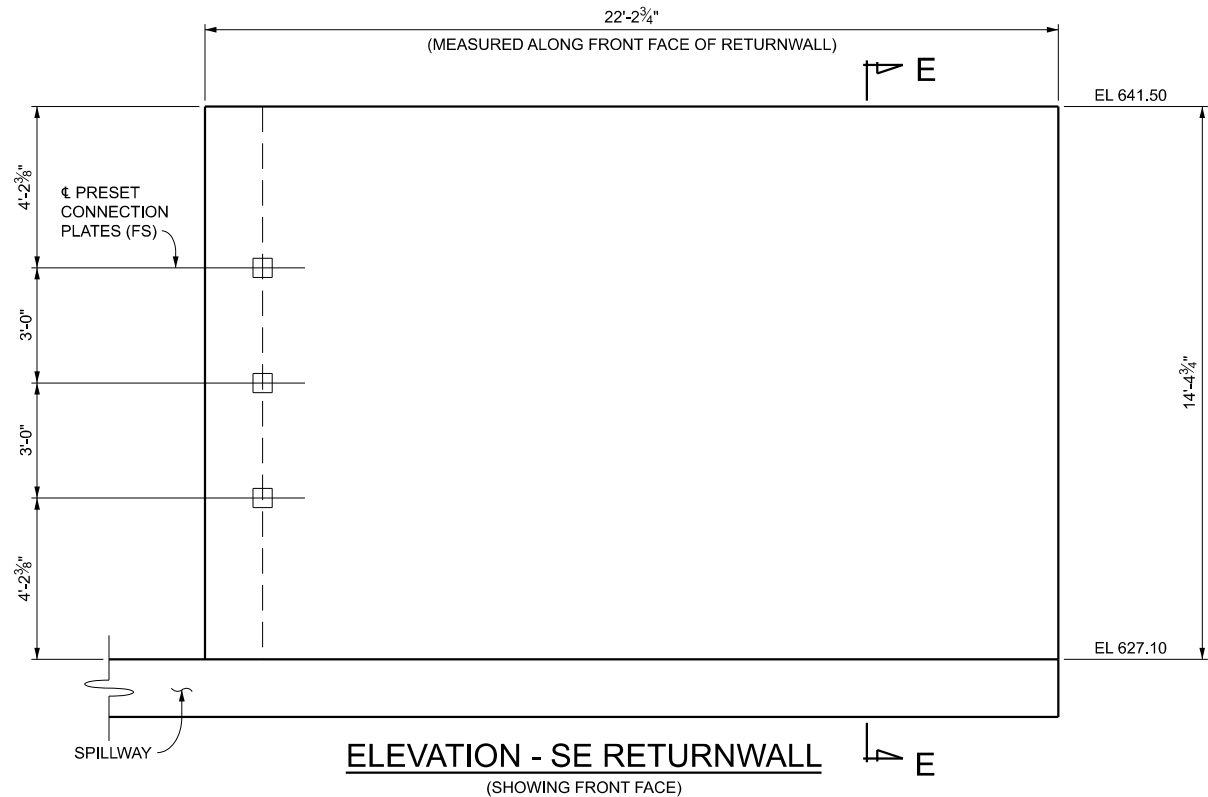
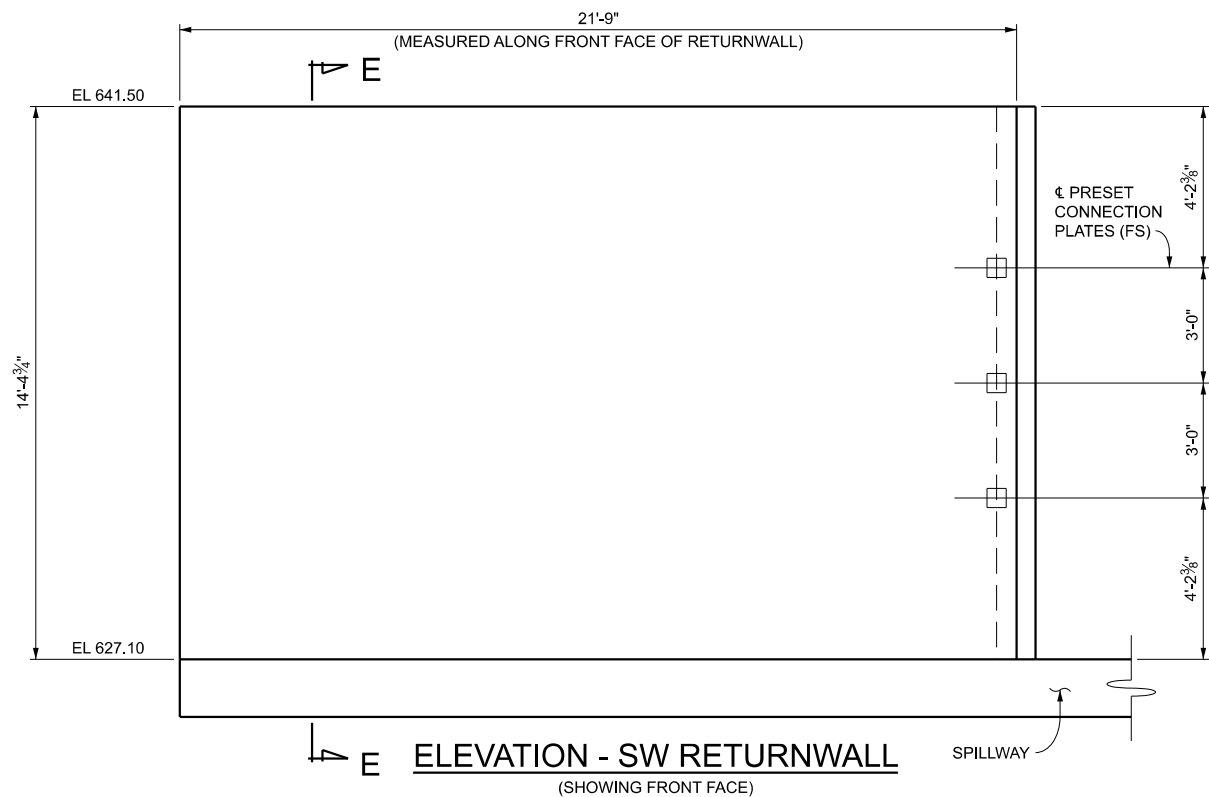
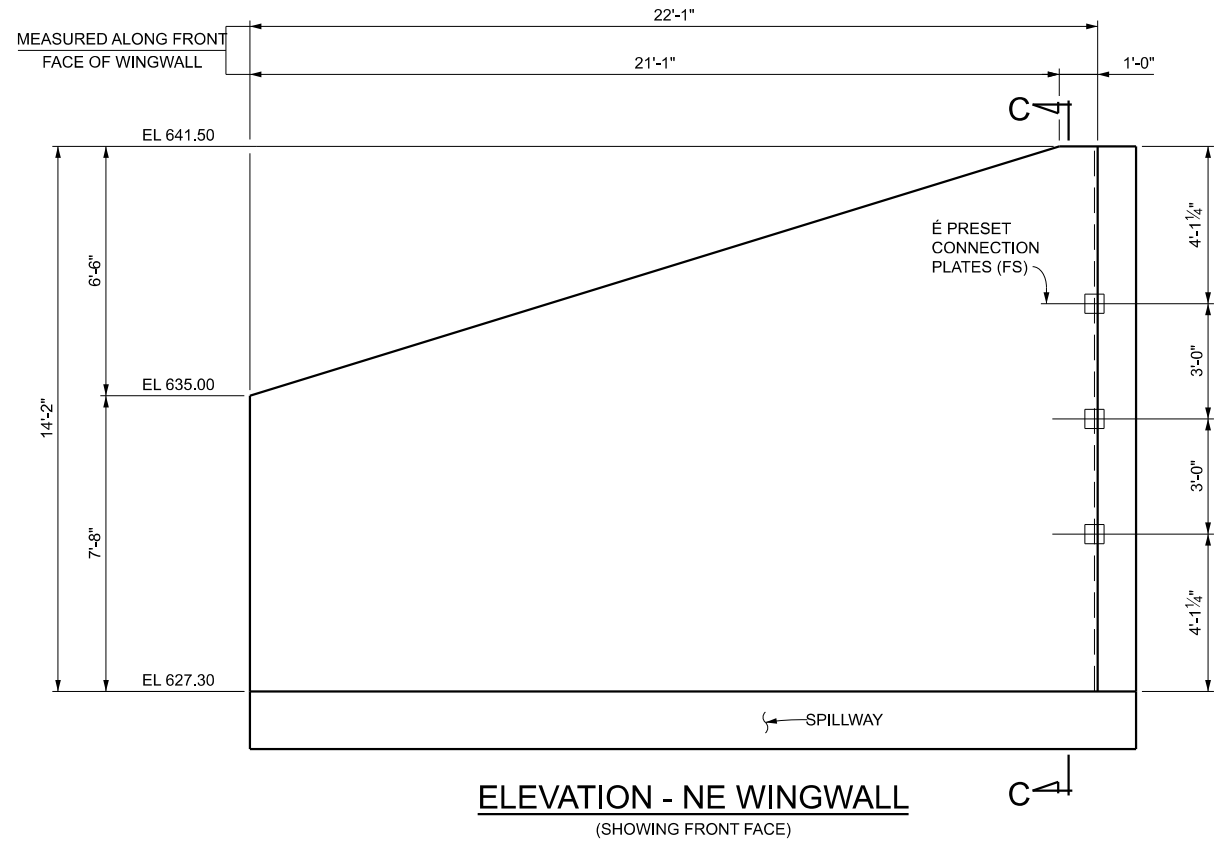
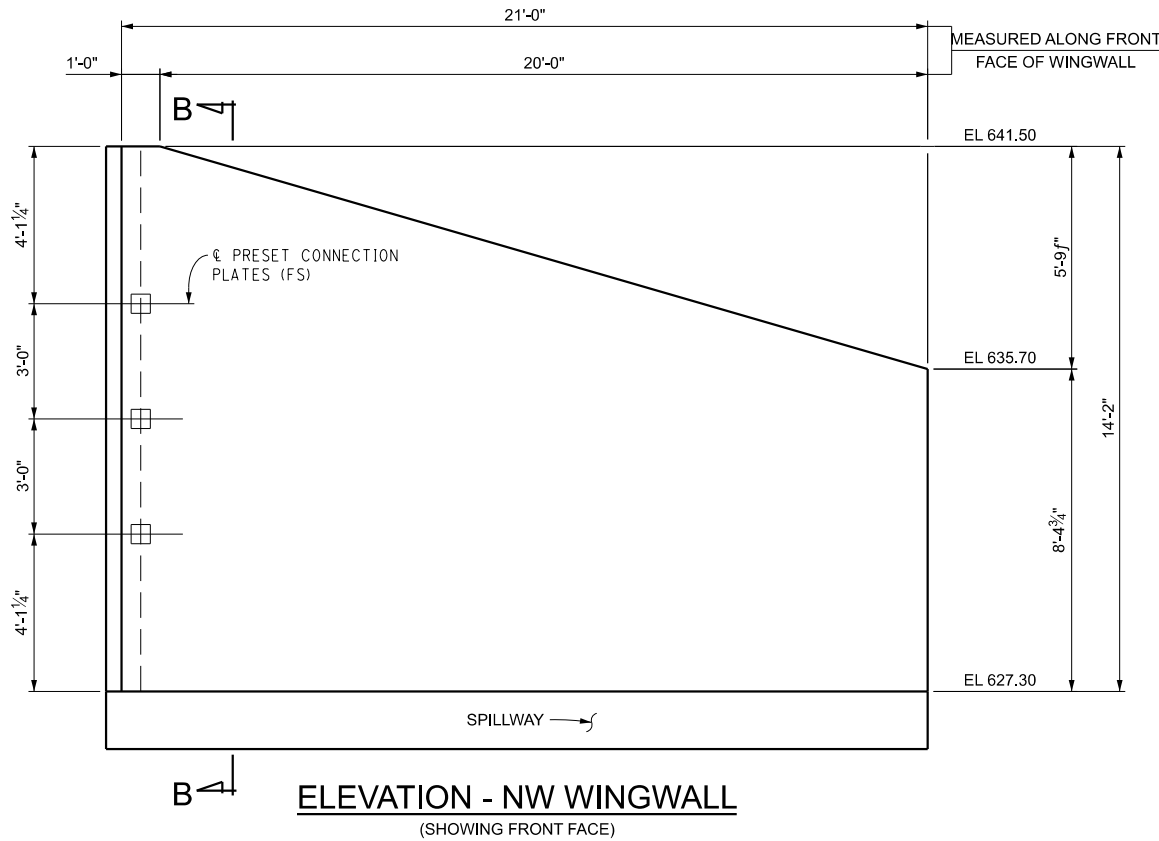
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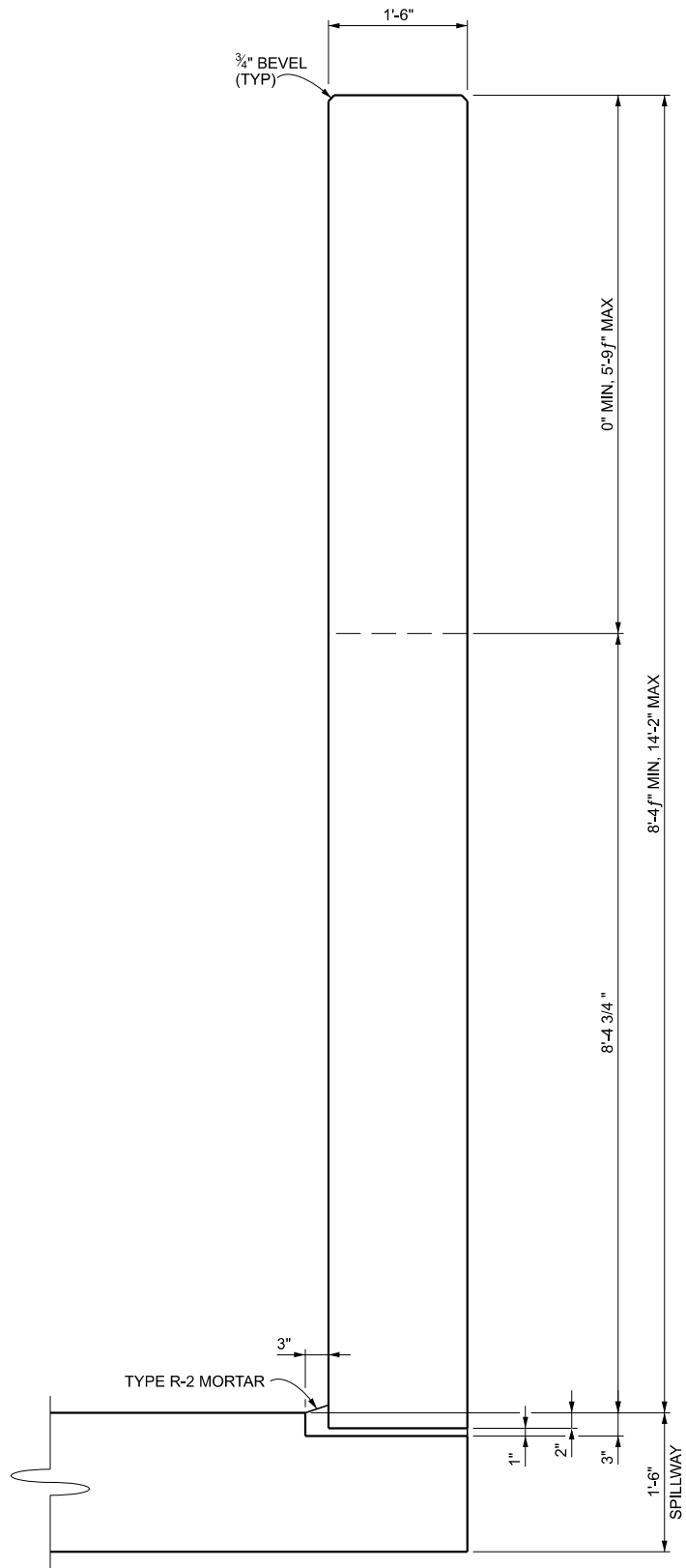
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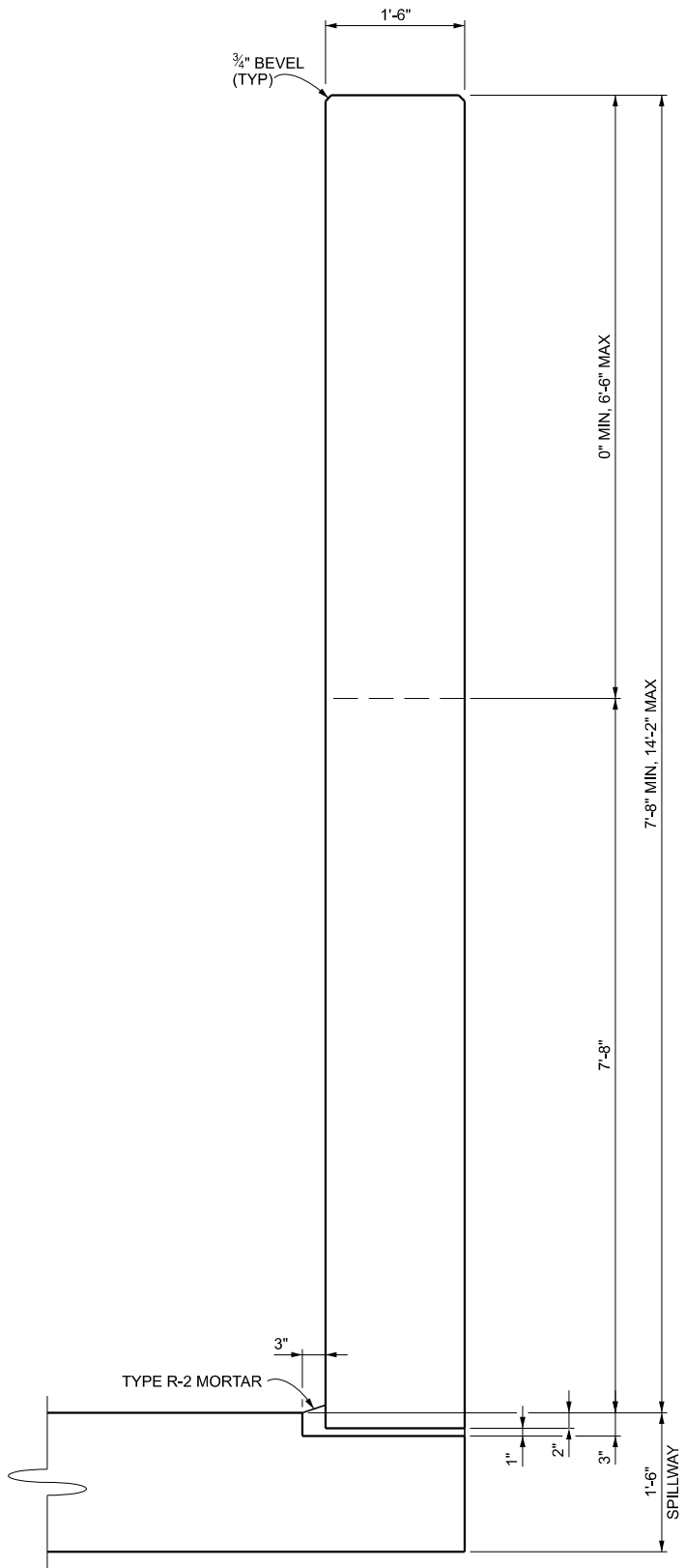
PRECAST CONCRETE BOX CULVERT DETAILS		DRAWING	SHEET
US-12 OVER DEER CREEK		C01	SECT 2
1.4 MILES WEST OF THREE OAKS		CULVRT	003



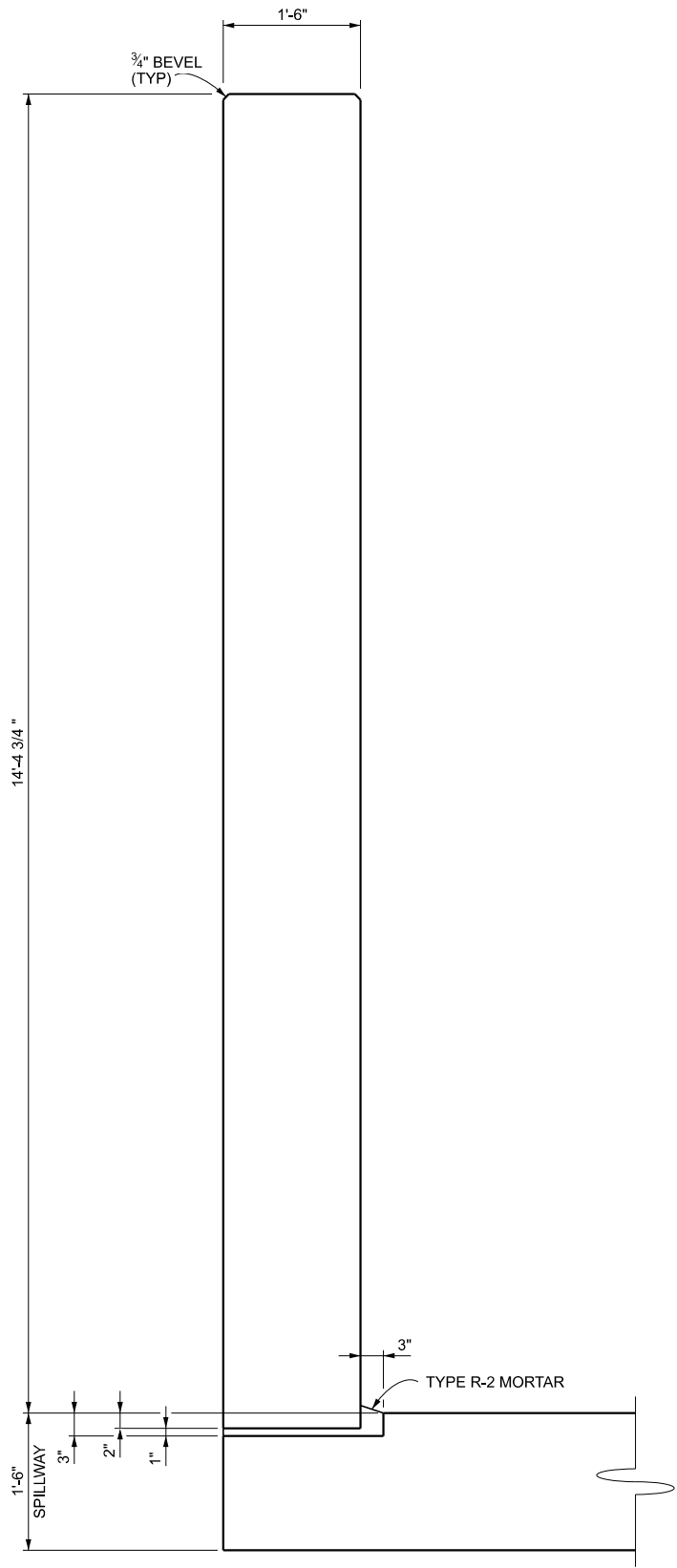
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NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CHK'D BY:	CORR BY:			DESIGN UNIT:	JN: 130295A	US-12 OVER DEER CREEK		C01 CULVRT 004	SECT 2	
														1.4 MILES WEST OF THREE OAKS				



SECTION B-B



SECTION C-C



SECTION E-E

FINAL ROW PLAN REVISIONS							SUBMITTAL DATE:						
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION						



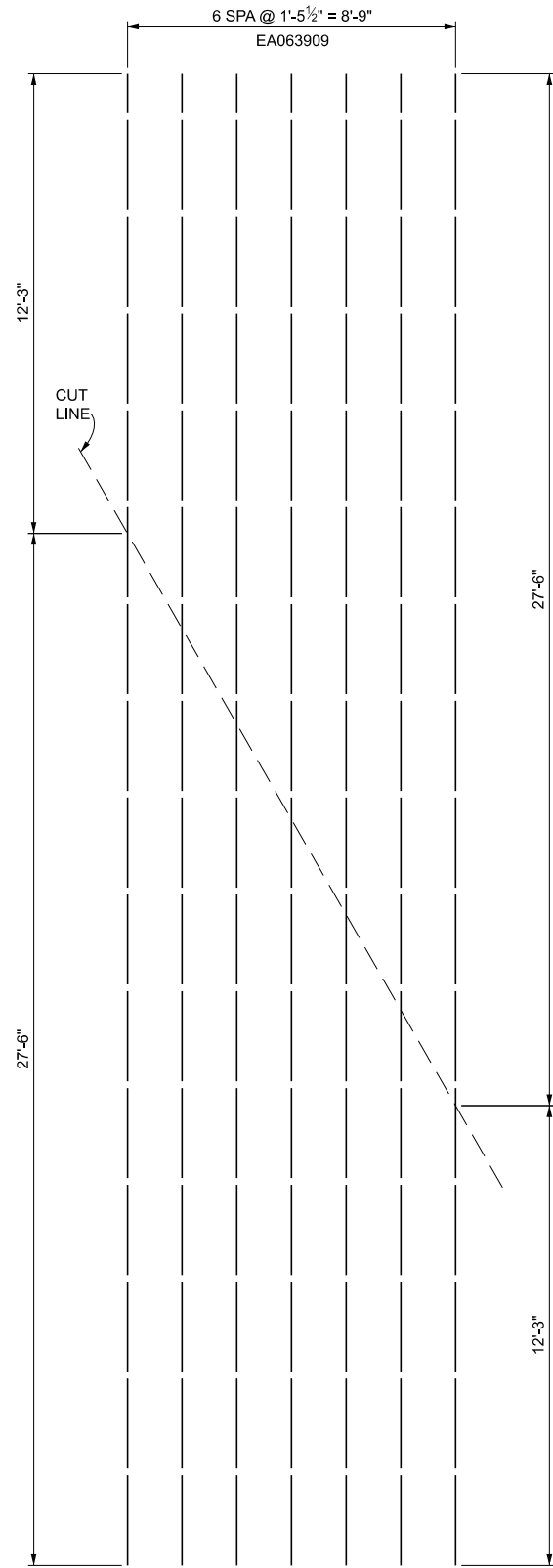
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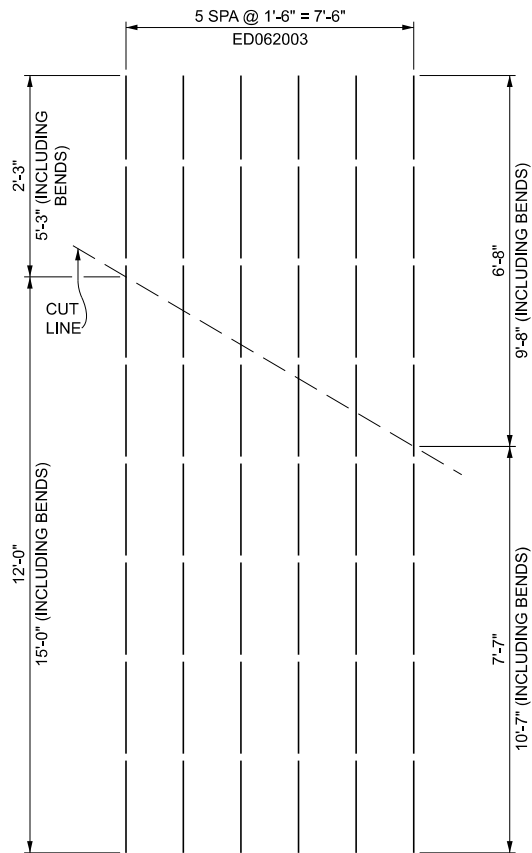
CS: C01 OF 11021
JN: 130295A

PRECAST CONCRETE BOX CULVERT DETAILS	
US-12 OVER DEER CREEK	
1.4 MILES WEST OF THREE OAKS	

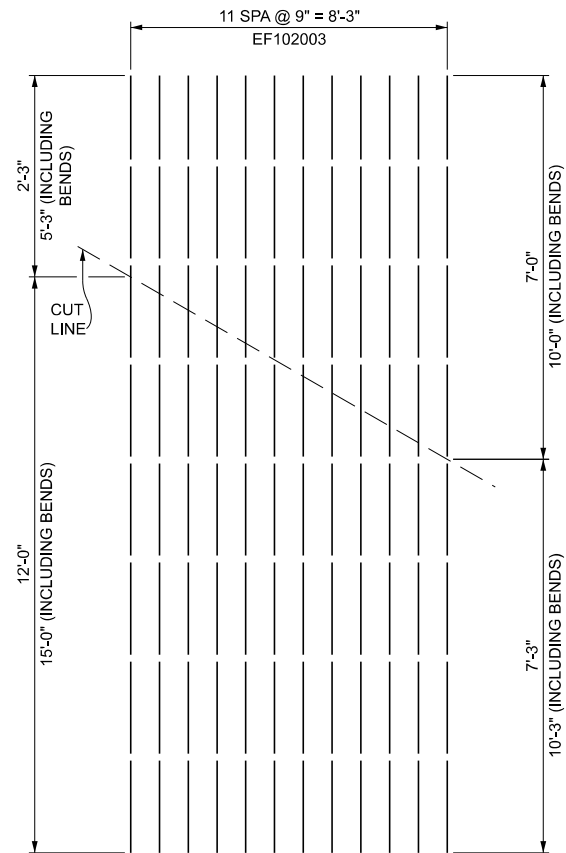
DRAWING	SHEET
C01 CULVRT 005	SECT 2



BAR CUT DIAGRAM A
(2 REQUIRED)

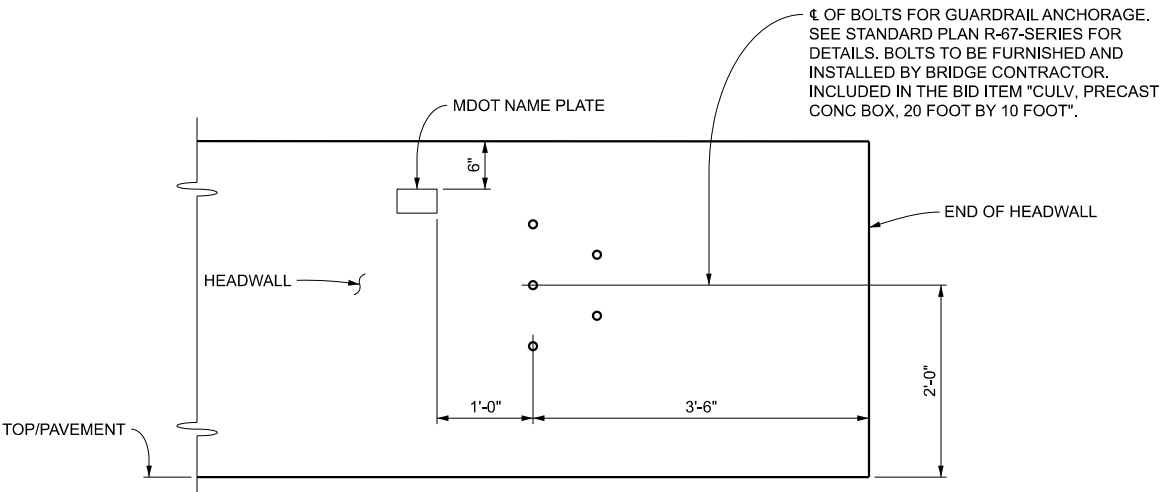


BAR CUT DIAGRAM B
(2 REQUIRED)



BAR CUT DIAGRAM C
(2 REQUIRED)

NOTE:
REINFORCEMENT IS TO BE SHOP CUT AS SHOWN. THE EPOXY COATING
SHALL BE REPLACED ACCORDING TO THE STANDARD SPECIFICATIONS.



END OF HEADWALL ELEVATION

FINAL ROW PLAN REVISIONS							SUBMITTAL DATE:	
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	



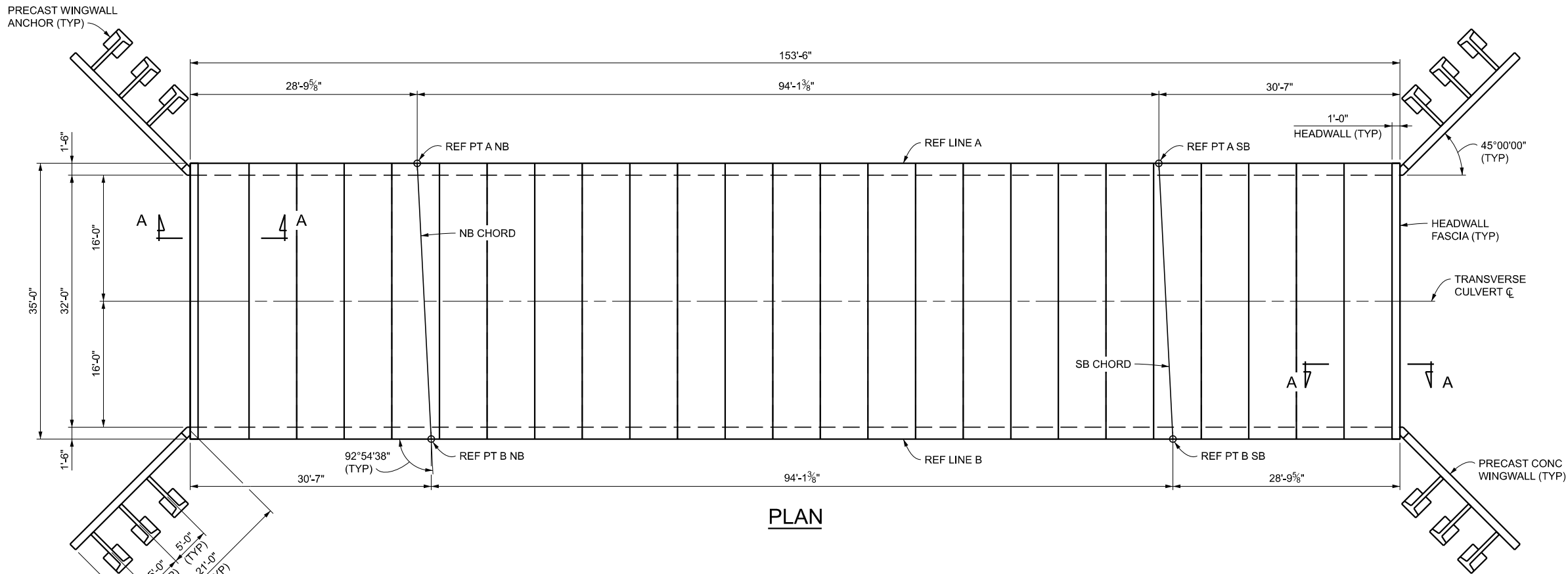
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CHK'D BY: CORR BY:	DESIGN UNIT:
FILE: C01_11021_CULV_002.dgn	TSC:

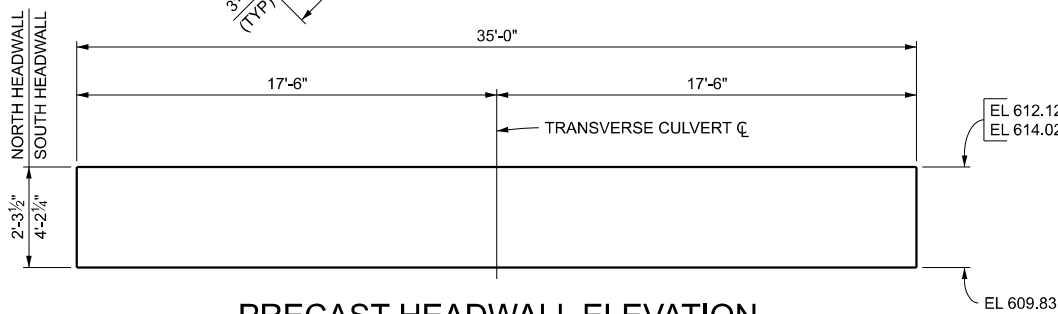
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JN: 130295A

PRECAST CONCRETE BOX CULVERT DETAILS
US-12 OVER DEER CREEK
1.4 MILES WEST OF THREE OAKS

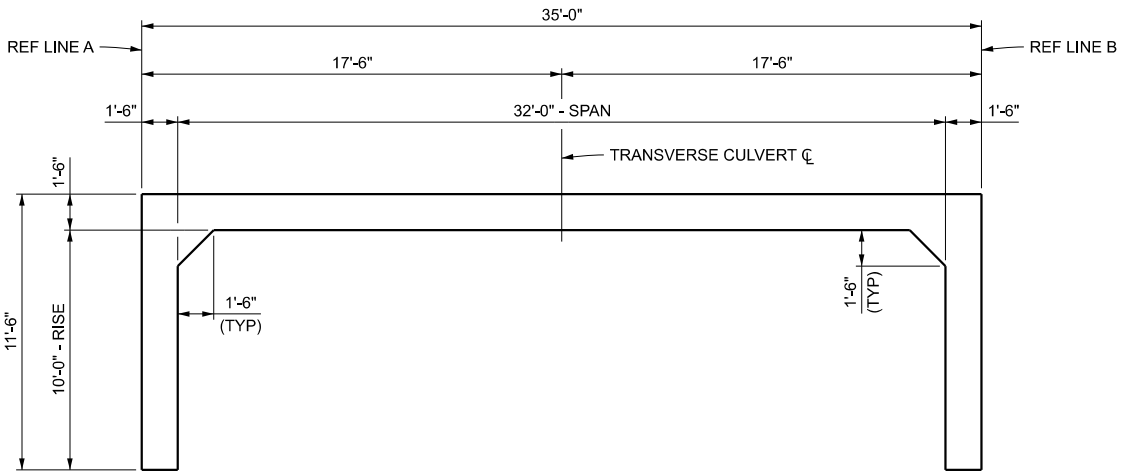
DRAWING	SHEET
C01 CULVRT 006	SECT 2



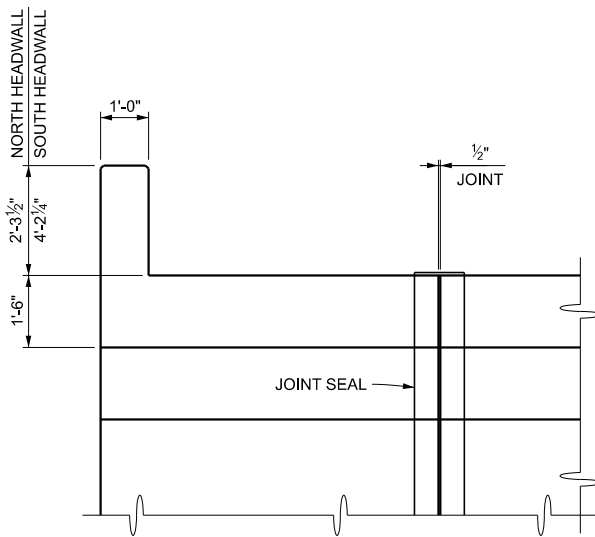
PLAN



PRECAST HEADWALL ELEVATION



TYPICAL CULVERT SECTION
(PEDESTAL WALL AND FOOTING NOT SHOWN)

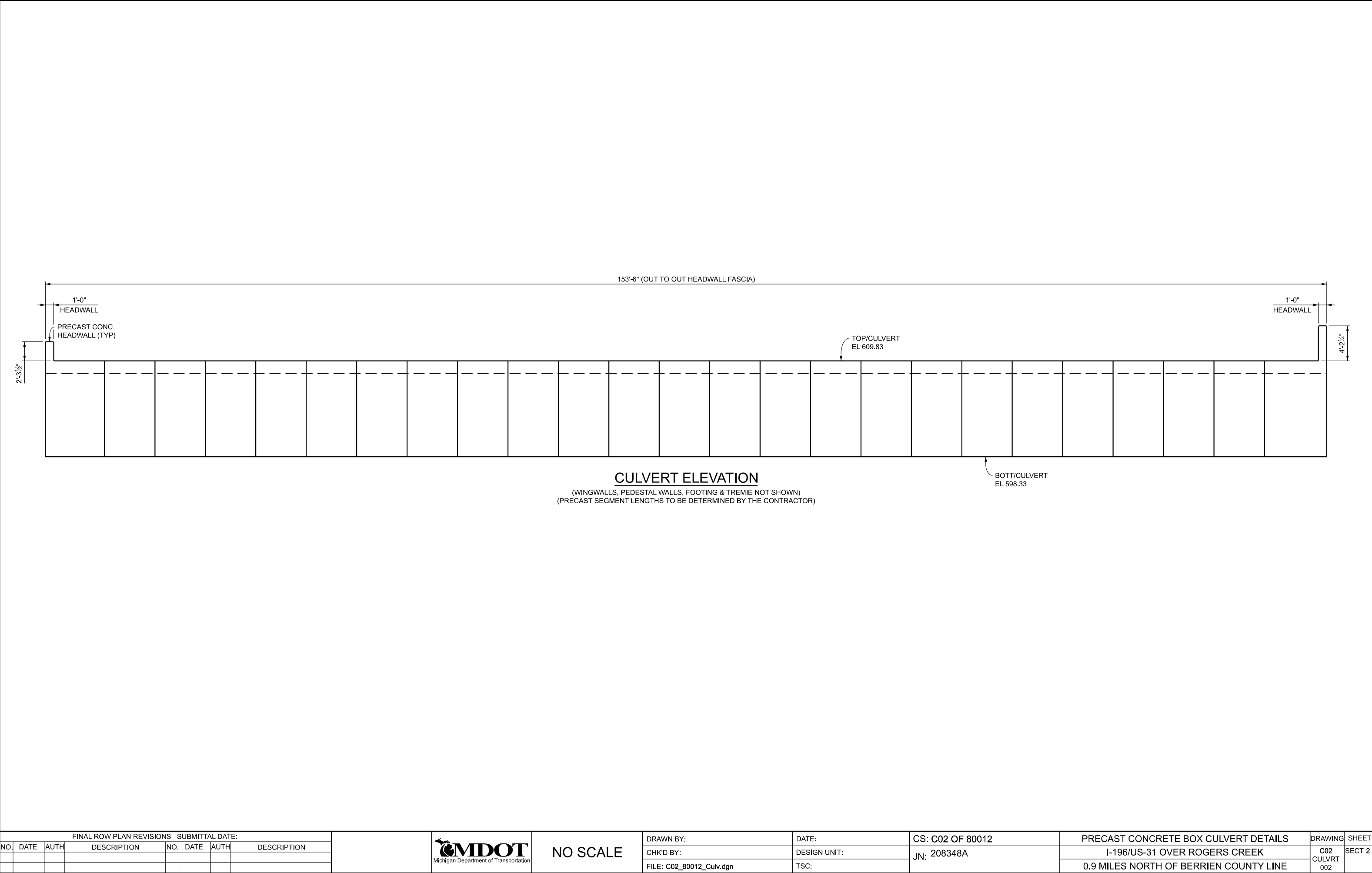


SECTION A-A

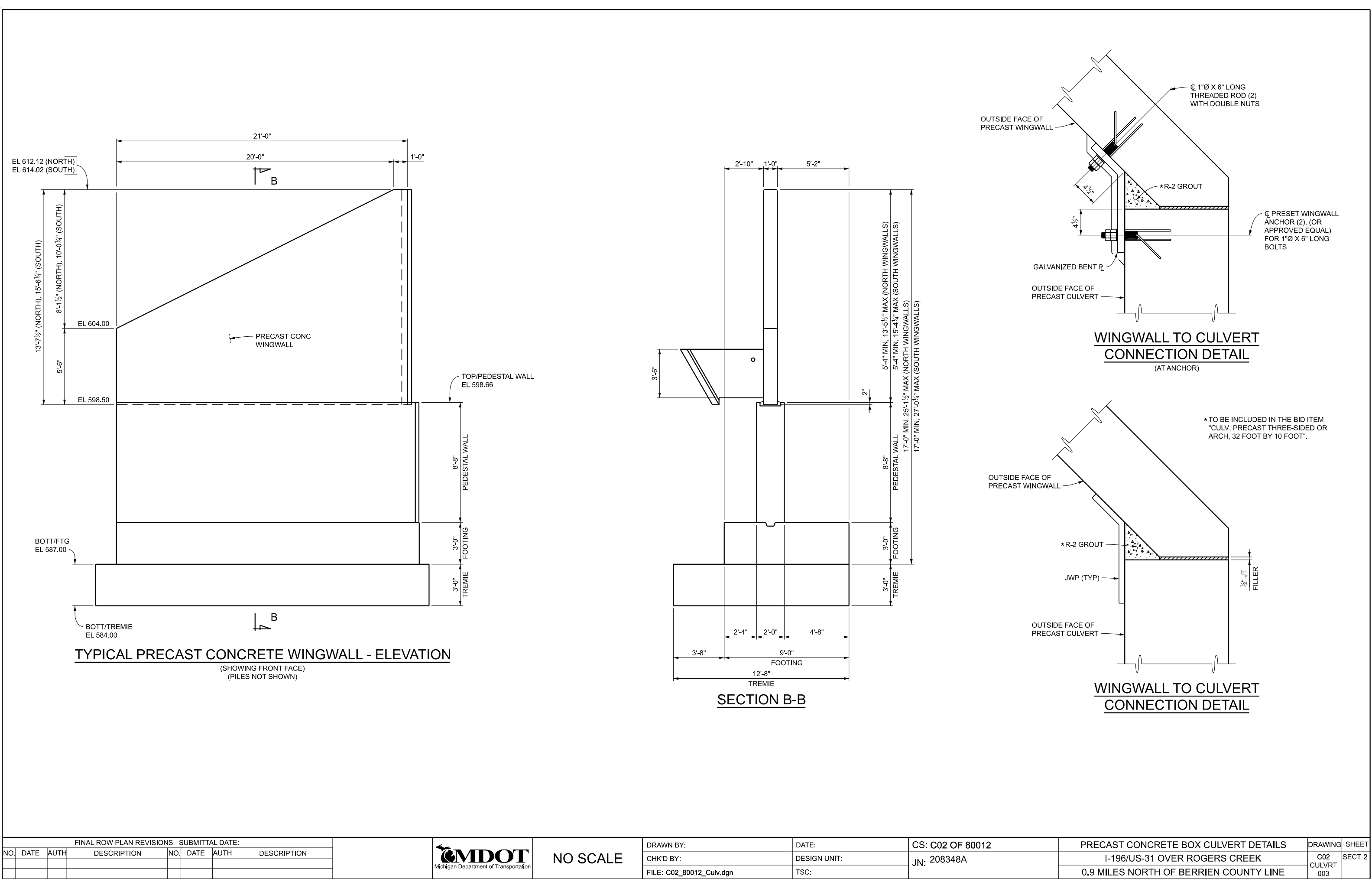
MISCELLANEOUS QUANTITIES			
JN 208348A			
CAT 0002			
154	Ft	Culv, Precast Conc Three-Sided, 32 foot by 10 foot, Spec	
139	Sft	Joint Waterproofing	

NOTES:
PRECAST CONCRETE SEGMENTS WILL FEATURE A PRESTRESSED FLAT TOP SLAB.

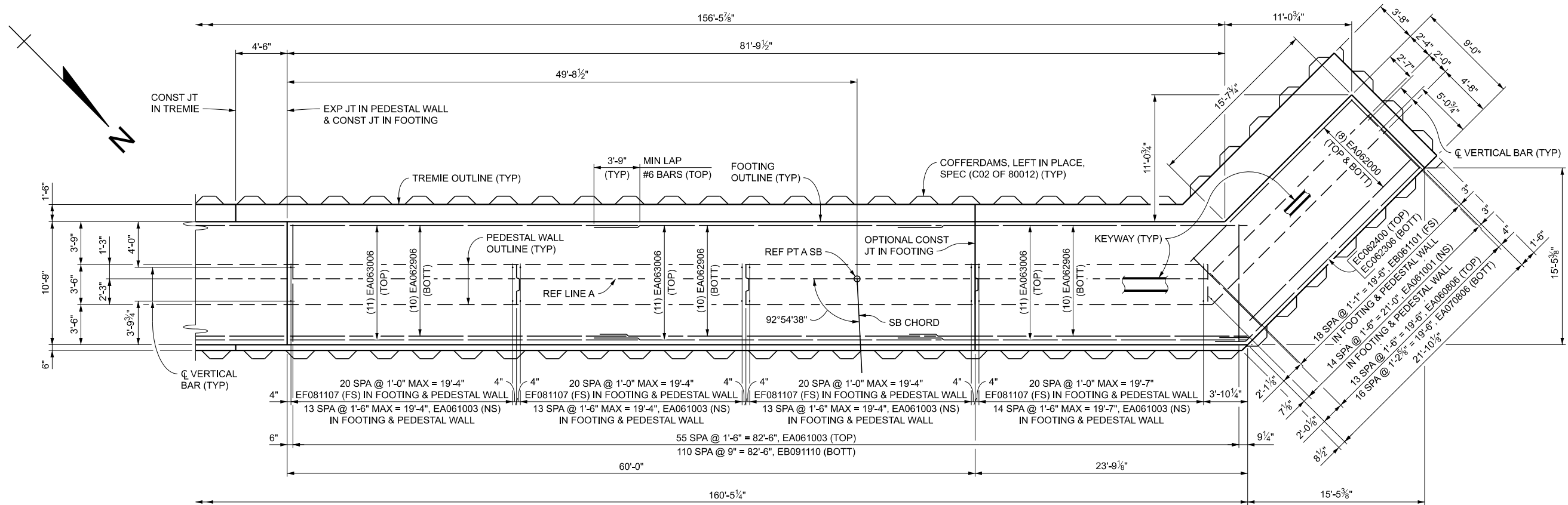
FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:				 Michigan Department of Transportation	NO SCALE	DRAWN BY: CHK'D BY: FILE: C02_80012_Culv.dgn	DATE: DESIGN UNIT: TSC:	CS: C02 OF 80012 JN: 208348A	PRECAST CONCRETE BOX CULVERT DETAILS		DRAWING C02 CULVRT 001	SHEET SECT 2
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	I-196/US-31 OVER ROGERS CREEK												
								0.9 MILES NORTH OF BERRIEN COUNTY LINE												



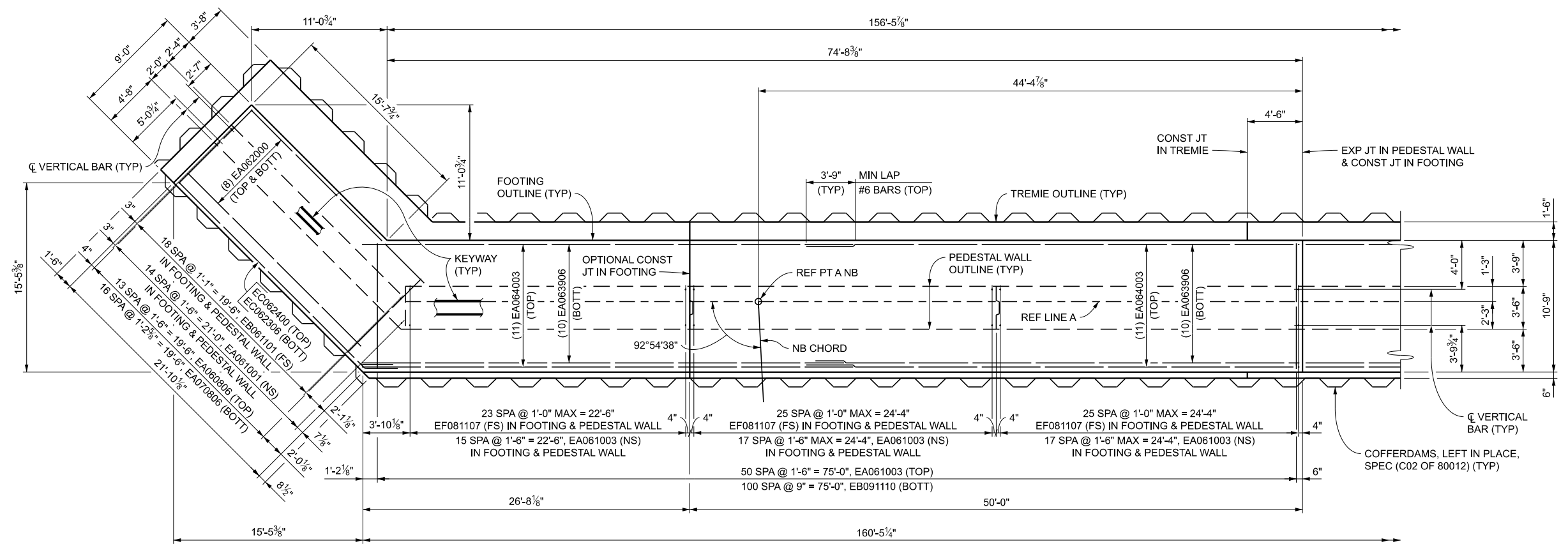
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NO.	DATE	AUTH	DESCRIPTION				NO.	DATE	AUTH			CHK'D BY:		DESIGN UNIT:		JN: 208348A		I-196/US-31 OVER ROGERS CREEK				C02 CULVRT 002	SECT 2
												FILE: C02_80012_Culv.dgn		TSC:				0.9 MILES NORTH OF BERRIEN COUNTY LINE					



FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:		 Michigan Department of Transportation	NO SCALE		DRAWN BY:		DATE:		CS: C02 OF 80012		PRECAST CONCRETE BOX CULVERT DETAILS		DRAWING	SHEET				
NO.	DATE	AUTH	DESCRIPTION				NO.	DATE	AUTH				DESCRIPTION				CHK'D BY:		DESIGN UNIT:		JN: 208348A		I-196/US-31 OVER ROGERS CREEK		C02 CULVRT 003	SECT 2
																							0.9 MILES NORTH OF BERRIEN COUNTY LINE			
																	FILE: C02_80012_Culv.dgn		TSC:							



ABUTMENT A - PLAN OF FOOTING



ABUTMENT A - PLAN OF FOOTING

MIN LAP TABLE	
EA06 BARS - 2'-6"	
UNLESS NOTED OTHERWISE	

FINAL ROW PLAN REVISIONS						SUBMITTAL DATE:					
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION				



NO SCALE

DRAWN BY:

CHK'D BY:

FILE: C02_80012_Abut.dgn

DATE:

DESIGN UNIT:

TSC:

CS: C02 OF 80012

JN: 208348A

ABUTMENT DETAILS

I-196/US-31 OVER ROGERS CREEK

0.9 MILES NORTH OF BERRIEN COUNTY LINE

DRAWING

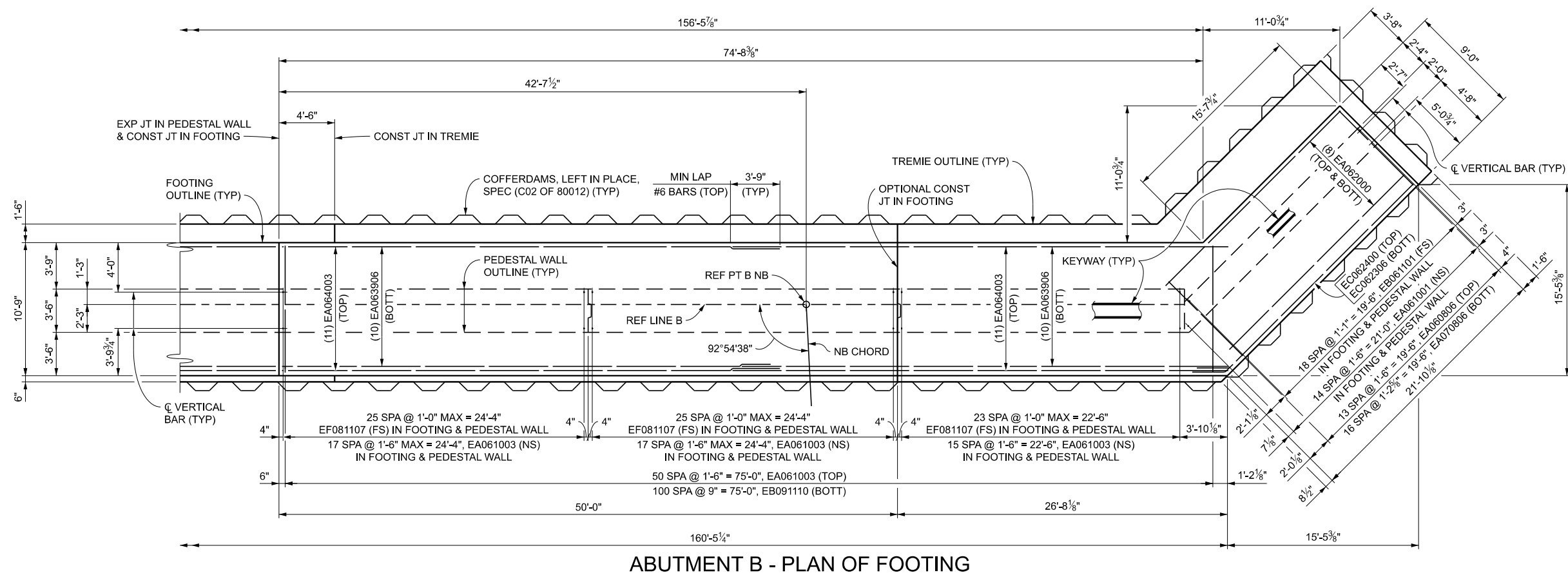
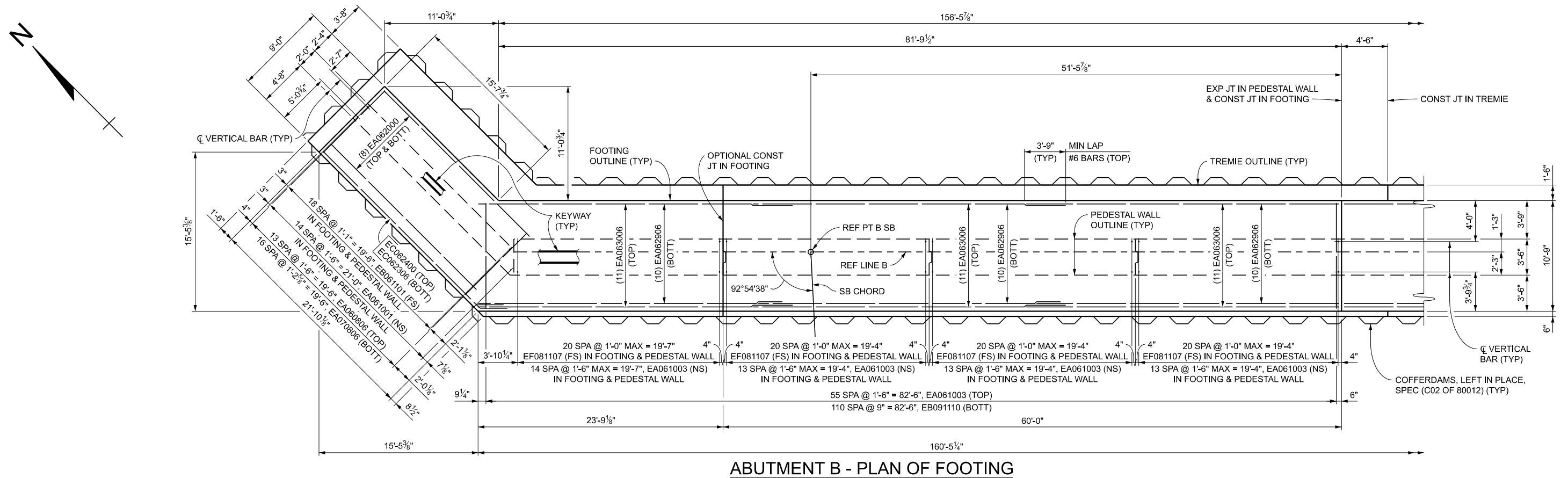
SHEET

C02 ABUT 001

SECT 2



FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:								 MDOT Michigan Department of Transportation		NO SCALE		DRAWN BY:		DATE:		CS: C02 OF 80012		ABUTMENT DETAILS		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION				NO.	DATE	AUTH	DESCRIPTION				CHK'D BY:						DESIGN UNIT:		JN: 208348A		I-196/US-31 OVER ROGERS CREEK		C02 ABUT 002	SECT 2		
														FILE: C02_80012_Abut.dgn						TSC:				0.9 MILES NORTH OF BERRIEN COUNTY LINE					



**MIN LAP
TABLE**

EA06 BARS - 2'-6"

UNLESS NOTED
OTHERWISE

FINAL ROW PLAN REVISIONS SUBMITTAL DATE:							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION



NO SCALE

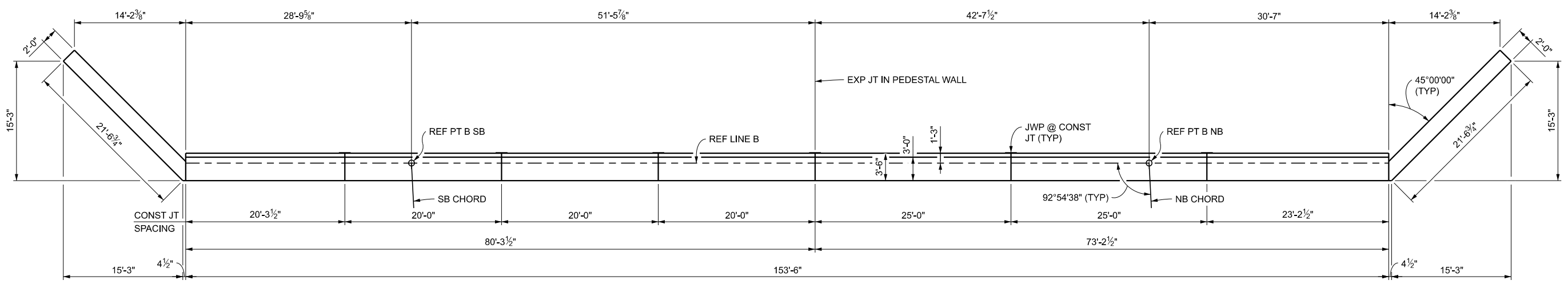
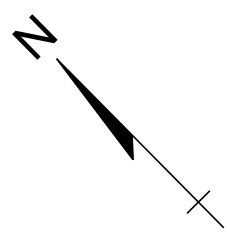
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CHK'D BY:
FILE: C02_80012_Abut.dgn

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DESIGN UNIT:
TSC:

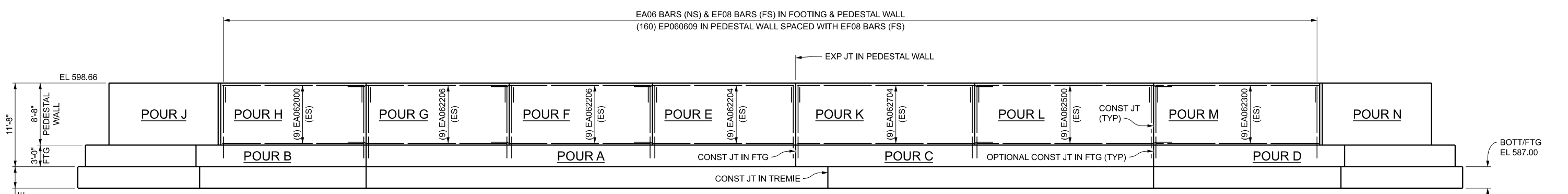
CS: C02 OF 80012
JN: 208348A

ABUTMENT DETAILS
I-196/US-31 OVER ROGERS CREEK
0.9 MILES NORTH OF BERRIEN COUNTY LINE

DRAWING	SHEET
C02 ABUT 003	SECT 2



ABUTMENT B - PLAN OF PEDESTAL WALL
(PEDESTAL WALL KEYWAY NOT SHOWN FOR CLARITY)

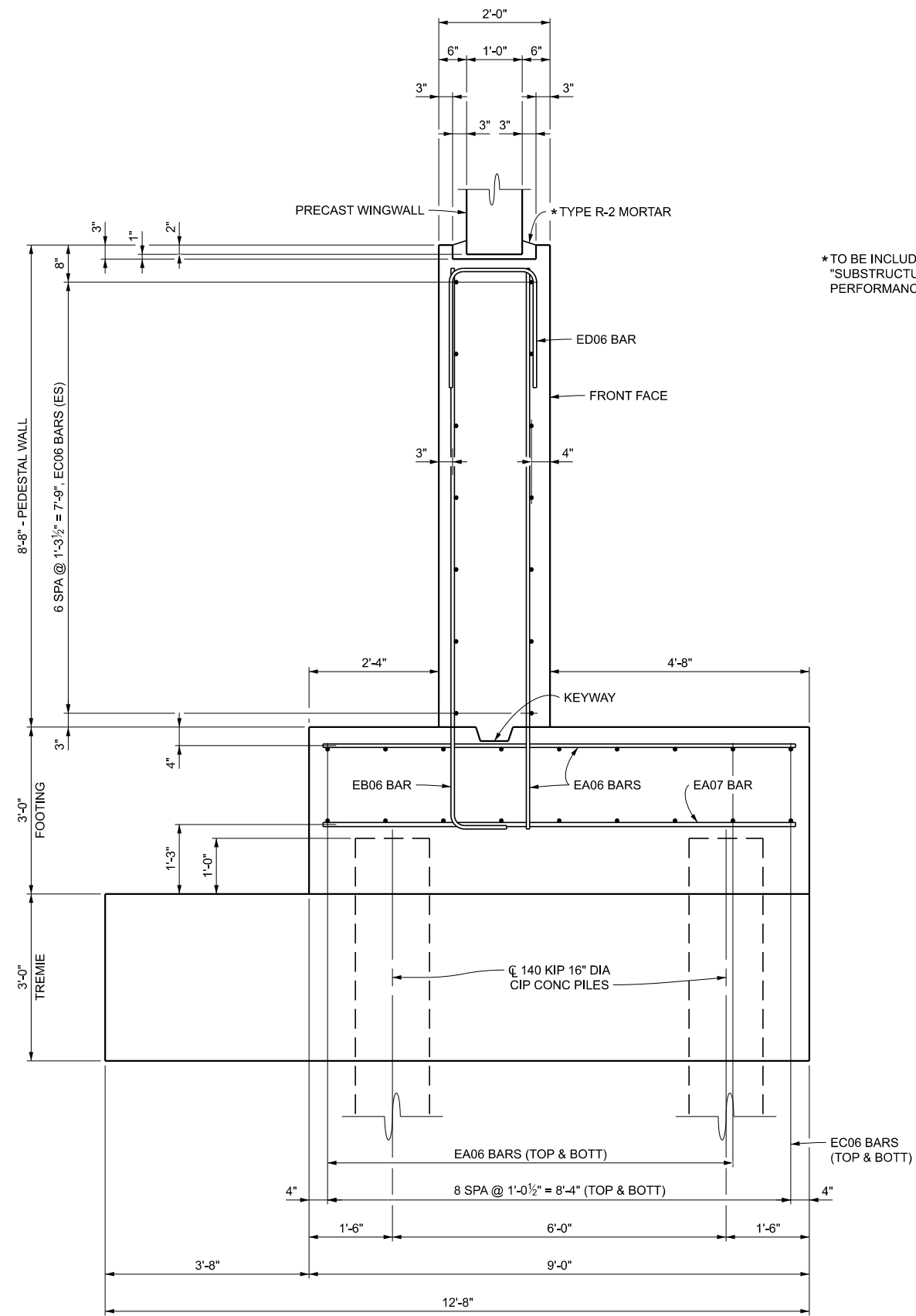


ABUTMENT B - ELEVATION
(PILES NOT SHOWN)

MIN LAP	
TABLE	
EA06 BARS - 2'-6"	

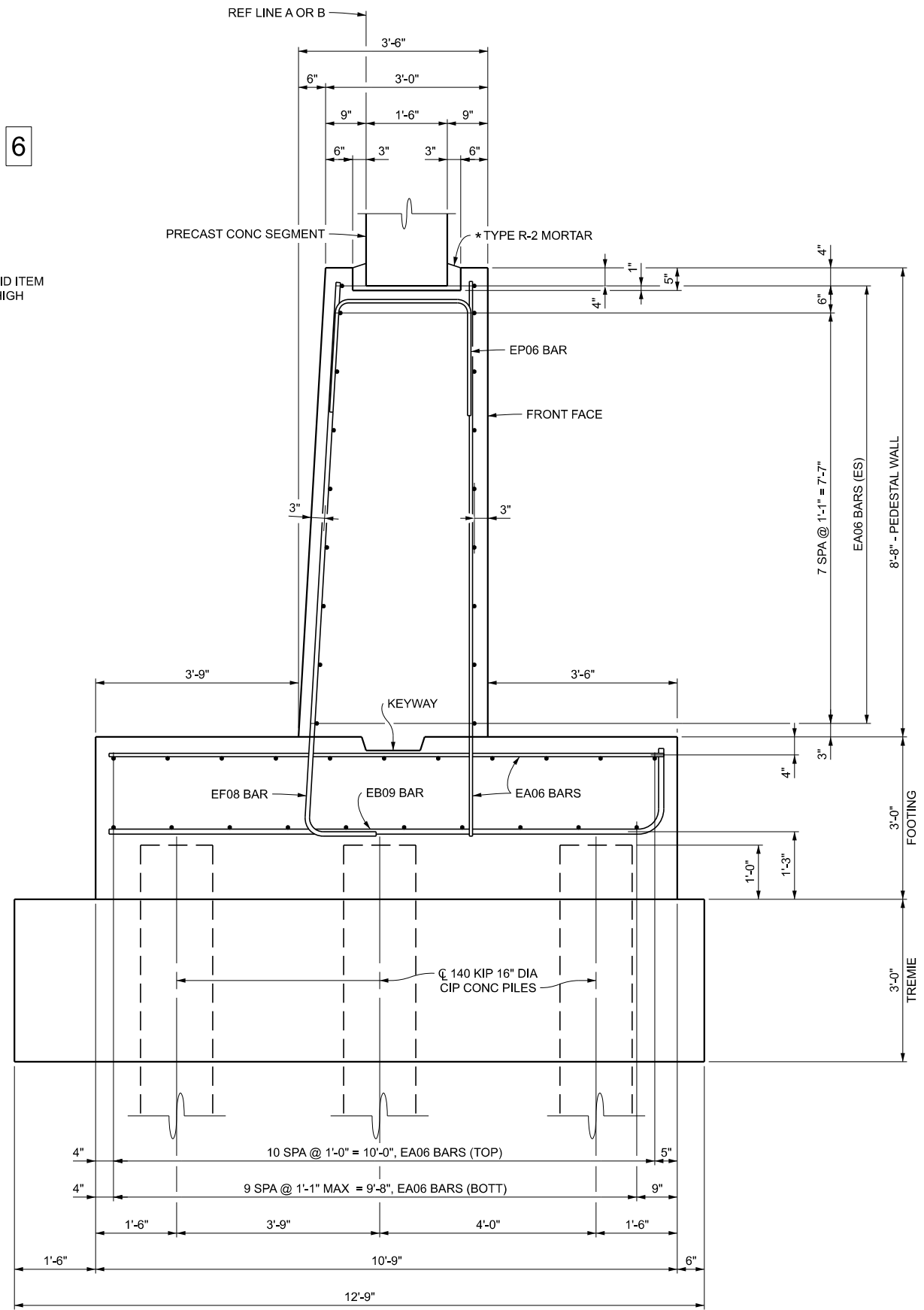
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NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CHK'D BY:	DESIGN UNIT:			JN: 208348A	I-196/US-31 OVER ROGERS CREEK	C02 ABUT 004	SECT 2		
								FILE: C02_80012_Abut.dgn	TSC:				0.9 MILES NORTH OF BERRIEN COUNTY LINE				

5 6



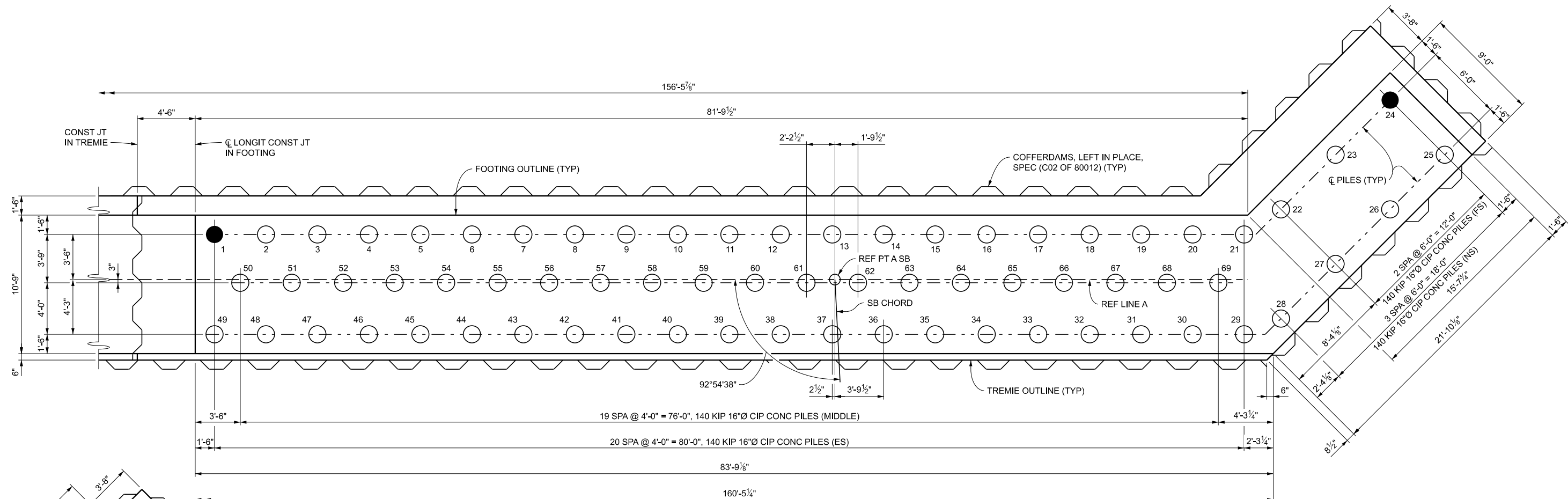
TYPICAL SECTION THRU WINGWALL FOOTING

*TO BE INCLUDED IN THE BID ITEM
"SUBSTRUCTURE CONC, HIGH
PERFORMANCE".

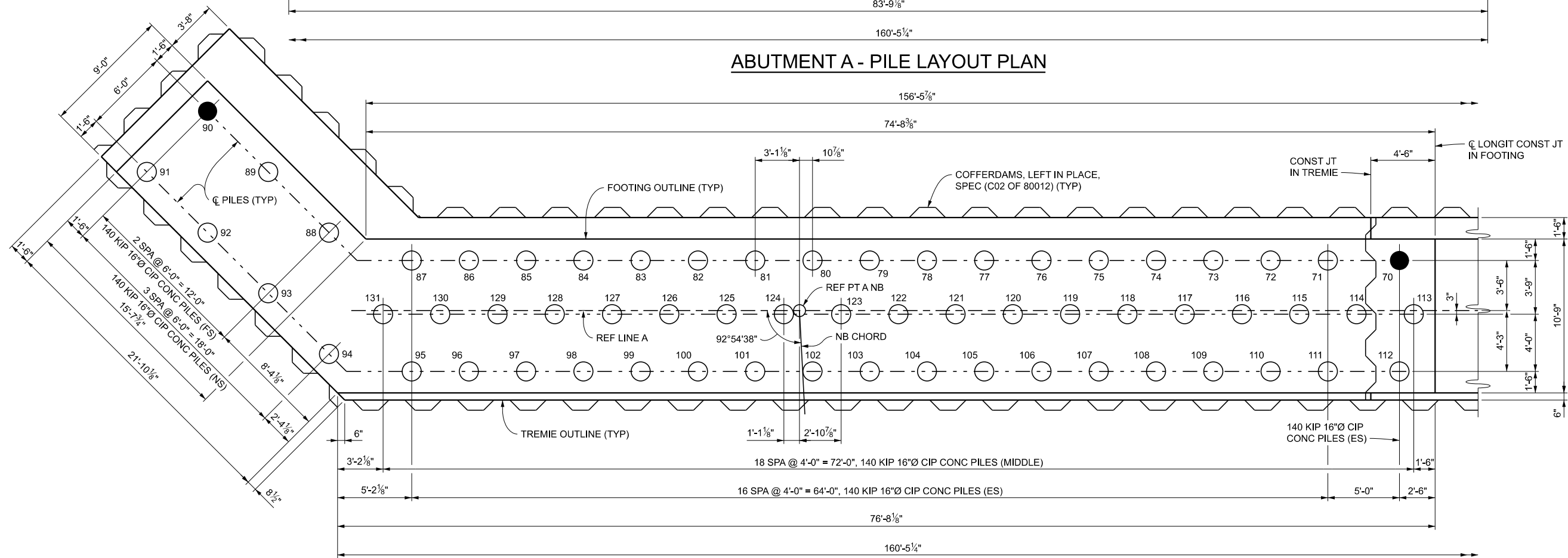


TYPICAL SECTION THRU ABUTMENT FOOTING

FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:		 Michigan Department of Transportation	NO SCALE	DRAWN BY: CHK'D BY: FILE: C02_80012_Abut.dgn	DATE: DESIGN UNIT: TSC:	CS: C02 OF 80012 JN: 208348A	ABUTMENT DETAILS		DRAWING C02 ABUT 006	SHEET SECT 2
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								0.9 MILES NORTH OF BERRIEN COUNTY LINE										

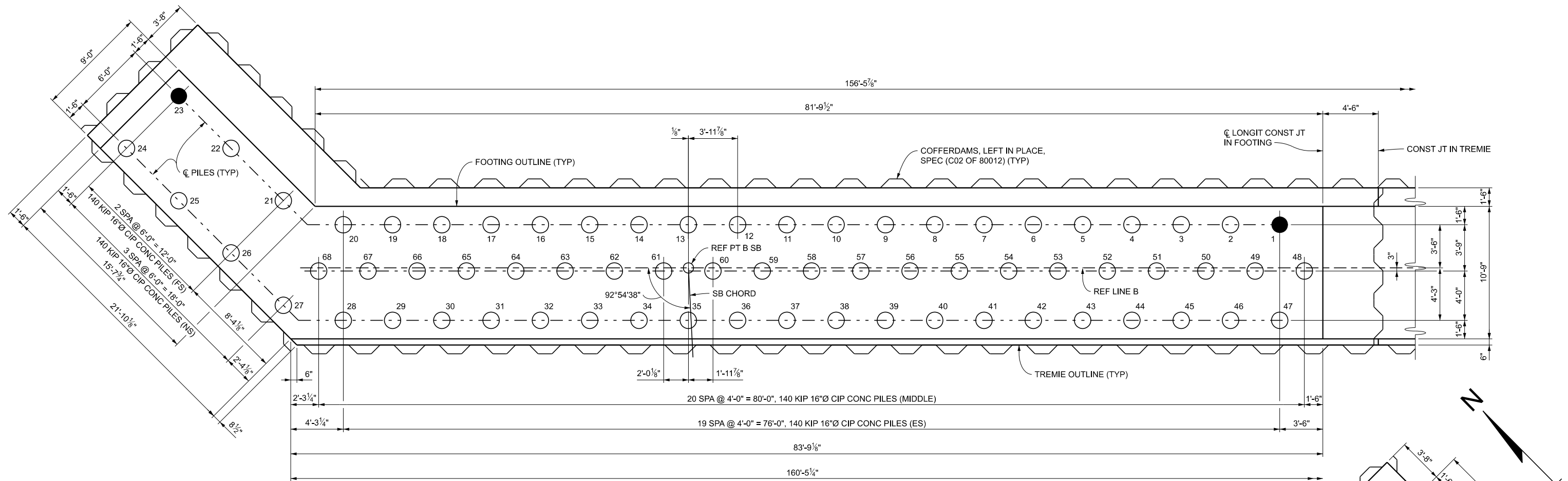


ABUTMENT A - PILE LAYOUT PLAN

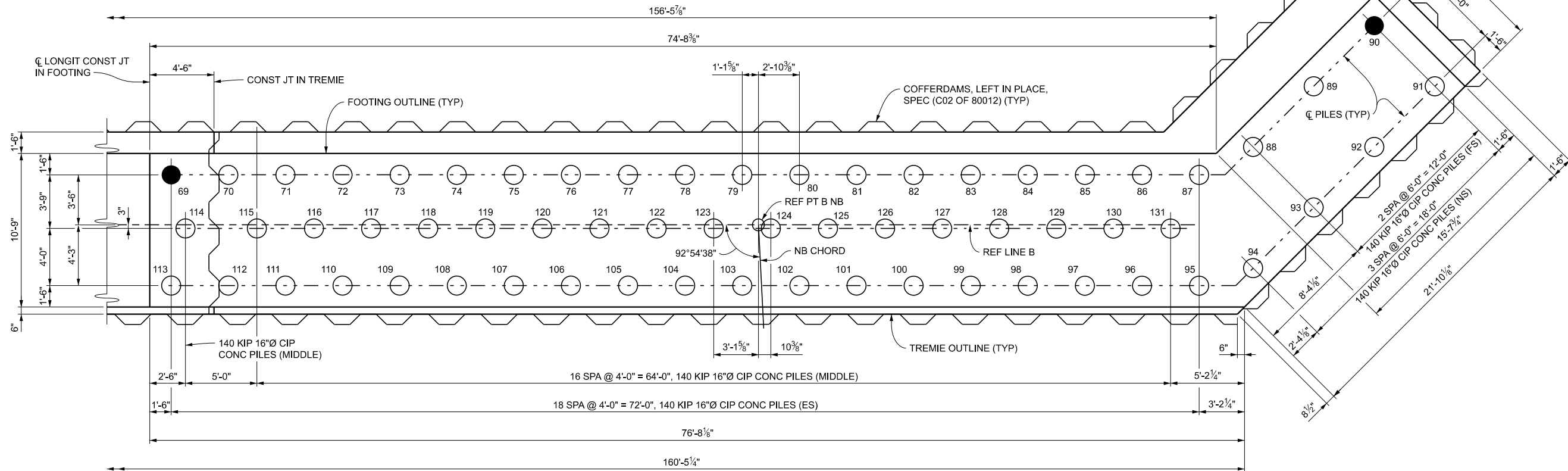


ABUTMENT A - PILE LAYOUT PLAN

FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:			NO SCALE	DRAWN BY:	DATE:	CS: C02 OF 80012	PILE DETAILS		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	I-196/US-31 OVER ROGERS CREEK										
								0.9 MILES NORTH OF BERRIEN COUNTY LINE										
										CHK'D BY:	DESIGN UNIT:	JN: 208348A			C02 PILE 001	SECT 2		
										FILE: C02_80012_Pile.dgn	TSC:							



ABUTMENT B - PILE LAYOUT PLAN



ABUTMENT B - PILE LAYOUT PLAN

FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:				 Michigan Department of Transportation	NO SCALE	DRAWN BY:		DATE:		CS: C02 OF 80012		PILE DETAILS		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CHK'D BY:		DESIGN UNIT:				JN: 208348A		I-196/US-31 OVER ROGERS CREEK		C02 PILE 002					
								FILE: C02_80012_Pile.dgn		TSC:				0.9 MILES NORTH OF BERRIEN COUNTY LINE									



FOR SPIRAL WELDED AND SEAMLESS PIPE SHELLS

* SPLIT CHILL RINGS AS RECOMMENDED BY THE MANUFACTURER MAY BE SUBSTITUTED FOR SPLICE SLEEVES AT THE OPTION OF THE CONTRACTOR.

*** DRILL OR FLAME CUT CIRCULAR HANDLING HOLES. GRIND FLAME CUT HOLES TO MAKE CIRCULAR AND REMOVE HARDENED EDGE OR CUT OFF SECTION OF PILE WITH FLAME CUT HOLES PRIOR TO SPlicing OR CONCRETE PLACEMENT.

140 KIP CAPACITY 16"Ø C.I.P. CONCRETE PILES					
LOCATION	PILE TYPE	NUMBER OF PILES	ESTIMATED LENGTH FURNISHED & DRIVEN		PILE POINTS (EACH)
			EACH LFT	TOTAL LFT	
ABUTMENT A	TEST	4	45	180	4
	VERTICAL	127	45	5,715	127
ABUTMENT B	TEST	4	45	180	4
	VERTICAL	127	45	5,715	127
TOTAL		262		11,790	262

JN 208348A			
CAT 0002			
1	LSUM	Pile Driving Equipment, Furn	
12052	Ft	Pile, CIP Conc, Furn and Driven, 16 inch	
8	Ea	Test Pile, Furn Dynamic Analysis Equipment	
12	Ea	Test Pile, Dynamic Analysis	

NOTES:

○ – DENOTES VERTICAL PILES.

● – DENOTES VERTICAL TEST PILES.

DRIVE ALL PILES TO A NOMINAL PILE DRIVING RESISTANCE NOT LESS THAN 140 KIPS. DETERMINE NOMINAL PILE DRIVING RESISTANCE (R_{NDR}) USING DYNAMIC TEST WITH SIGNAL MATCHING (P.D.A. TESTING).

IF PILE TIP ELEVATION REACHES 1.0 FOOT ABOVE MAXIMUM PILE PENETRATION ELEVATION, PILE DRIVING SHOULD BE STOPPED FOR THAT PILE AND RESTRIKES PERFORMED AFTER AT LEAST 7 DAYS

USE PILE SHELLS WITH A MINIMUM OF 0.375" NOMINAL WALL THICKNESS, 16" O.D.

THE ESTIMATED PILE LENGTH IS BASED ON THE STATIC ANALYSIS.

DRIVE PILES IN A SEQUENCE THAT BEGINS WITH THE CENTER OF THE PILE GROUP AND PROCEEDS OUTWARD IN BOTH DIRECTIONS OR FROM ONE SIDE OF THE PILE GROUP TO THE OTHER SIDE. THE CONTRACTOR MAY REQUEST ENGINEER APPROVAL TO SEQUENCE THE PILE DRIVING FROM THE CENTER OF THE PILE GROUP OUTWARD IN A CLOCKWISE OR COUNTERCLOCKWISE PATTERN IF FOUR OR MORE ROWS OF PILES EXIST.

THE ESTIMATED LOSS OF NOMINAL PILE RESISTANCE DUE TO SCOUR AFTER DRIVING IS 0 KIPS.

THE FACTORED PILE RESISTANCE AVAILABLE TO RESIST ALL FACTORED LOADS INCLUDING THE ESTIMATED FACTORED DOWNDRAW IS EQUAL TO 65 PERCENT OF NOMINAL PILE DRIVING RESISTANCE THAT IS REDUCED BY THE LOSS DUE TO SCOUR.

FINAL ROW PLAN REVISIONS								SUBMITTAL DATE:		 Michigan Department of Transportation	NO SCALE	DRAWN BY:	DATE:	CS: C02 OF 80012	PILE DETAILS		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION	CHK'D BY:	DESIGN UNIT:			JN: 208348A	I-196/US-31 OVER ROGERS CREEK	C02 PILE 003	SECT 2			
								FILE: C02_80012_Pile.dgn	TSC:				0.9 MILES NORTH OF BERRIEN COUNTY LINE					

PRECAST CONCRETE BOX CULVERT DETAILS

- 1. Precast concrete box culvert detail sheets shall consist of the following details: Plan view of precast segments and wingwalls, connection details for wingwall attachment, typical culvert section, elevation views of wingwalls, headwall, apron, and cutoff walls, and plan of apron and cutoff walls. For information regarding what should be shown on details, see the Preliminary and Final Design Phase Checklist.
- 2. Gravity walls are the preferred wingwall option and should be utilized when possible to limit the culvert footprint and potential interferences.
- 3. All steel connection pieces shall be hot-dip galvanized. Plates must be a minimum of 1" thick.
- 4. Culvert segments should be connected using Standard Plan R-84-Series
- 5. Cast-in-place details may be provided as an alternative to precast upon MDOT approval. These details should properly convey rebar sizing and spacing. Design of cast-in-place sections should follow the Culvert Design Guidelines.
- 6. Reinforcing should be detailed as conventional reinforcing steel for precast culvert shop drawings and epoxy coated reinforcing steel for alternative cast-in-place and precast headwalls and wingwalls.

FINAL ROW PLAN REVISIONS SUBMITTAL DATE:									NO SCALE	DRAWN BY:		DATE:	CS:	PLAN GUIDELINES		DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION			CHK'D BY:		DESIGN UNIT:	JN:	PRECASE CONCRETE BOX CULVERT DETAILS			SECT 2
										FILE:		TSC:					