



March 3, 2023

Hillary Young  
Chief Engineer  
Land Protection Division  
Oklahoma Department of Environmental Quality  
707 North Robinson, P.O. Box 1677  
Oklahoma City, Oklahoma 73101-1677

RECEIVED

MAR 06 2023

LAND PROTECTION DIVISION  
DEPT. OF ENVIRON. QLTY.

Re: Temporary Authorization Request and Class 2 Permit Modification – North of Zink Dam  
LNAPL Containment Cap and Collection System  
HF Sinclair Tulsa Refining LLC – Tulsa East Refinery  
EPA ID OKD990750960 / Permit # 990750960

Dear Ms. Young:

HF Sinclair Tulsa Refining LLC (HFSTR) is submitting this request for temporary authorization with a Class 2 permit modification to Corrective Action and Post-Closure Permit No. 990750960 (Permit) for the HFSTR East Refinery located at 902 W. 25<sup>th</sup> Street, Tulsa, Oklahoma 74107. The temporary authorization request and Class 2 permit modification are for the construction of a light non-aqueous phase liquid (LNAPL) containment cap and collection system (containment cap) at the HFSTR East Refinery along the riverbank north of Zink Dam to prevent hydrocarbon sheen and LNAPL seeps from entering the Arkansas River at the location of the proposed interim remedy. Based on discussions with Oklahoma Department of Environmental Quality (DEQ), HFSTR intends to designate this as an interim remedy via this permit modification.

On December 5, 2022, hydrocarbon sheen and discrete LNAPL seeps were identified along the riverbank north of Zink Dam. The hydrocarbon sheen and discrete LNAPL seeps are associated with historical residual hydrocarbons present along the riverbank.

The general site location is shown on **Figure 1** in the attached Operation, Maintenance and Monitoring (OM&M) Plan and the location of the hydrocarbon sheen and discrete LNAPL seeps is shown on **Figure 2** in the attached OM&M Plan. The DEQ was notified by phone on December 5, 2022, and email on December 6, 2022. Hydrocarbon sheen and LNAPL seeps have been observed regularly since December 5, 2022. The Arkansas River is at extremely low levels - approximately 609 to 612 feet above mean sea level (amsl) since December 2022 with limited water flow in the river and through Zink Dam (gates are currently lowered at 610 feet amsl). This is the likely cause of the recent hydrocarbon sheen and discrete LNAPL seeps.

Hard and sorbent booms were promptly installed on December 5, 2022. The areal extent of the hard and sorbent booms was expanded to the south on December 7, 2022. Sorbent booms and pads are used for targeted recovery at the LNAPL seeps. The sorbent booms are replaced



several times each week. The booms have provided effective containment of the hydrocarbon sheen and LNAPL seeps. Twice daily hydrocarbon sheen inspections were performed from December 5-21, 2022, and daily hydrocarbon sheen inspections were performed from December 22, 2022, to present.

A coffer dam was installed in February 2023 with completion on February 21, 2023. The hard and sorbent booms were relocated within the boundary of the coffer dam on February 9, 2023. The coffer dam provides further effective containment of the hydrocarbon sheen and LNAPL seeps, and is needed to provide a safe area for construction of the containment cap.

The permit modification requests approval of an interim remedial action for the riverbank area north of Zink Dam as shown on **Figure 1** in the attached OM&M Plan. The interim remedial action involves installation of a containment cap that will prevent hydrocarbon sheen and LNAPL seeps from entering the Arkansas River at the location of the proposed interim remedy. This interim remedy will be very similar in design to the LNAPL containment cap and collection system installed south of Zink Dam in 2022. The permit modification contains details of the installation, performance standards, and operation and maintenance of the interim remedial action.

HFSTR is required to provide Financial Assurance (FA) per the Permit, Condition III.F which references 40 Code of Federal Regulations (CFR) 264.145. Per Condition III.F.2., HFSTR will submit a cost estimate within sixty (60) days of DEQ's approval of the Class 2 modification for the LNAPL containment cap and collection system. HFSTR will then update the FA to include those estimated costs, within sixty (60) days of DEQ's approval of the cost estimate.

The remedial objective for the interim remedy identified by HFSTR is to mitigate the potential for hydrocarbon sheens and LNAPL seeps from forming along the bank of the Arkansas River north of Zink Dam at the location of the proposed interim remedy. The design must also be compatible with the City of Tulsa and Gathering Place development along the river associated with construction of the new Zink Dam and Williams Crossing Bridge. A containment cap interim remedy was selected as the most technically effective long-term solution to address potential hydrocarbon sheen and LNAPL seeps, and most compatible with the current development along the river, including consideration for long-term aesthetics. The containment cap is a proven and patented technology used at numerous similar projects, including the LNAPL Containment Cap and Collection System installed in 2022 south of Zink Dam. For these reasons, the containment cap is considered an appropriate interim remedy.

The containment cap will be placed from the bedrock at the base of the riverbed to an elevation of 630 feet amsl. **Figure 2** in the attached OM&M Plan provides a conceptual plan view of the containment cap and **Figure 3** in the attached OM&M Plan provides a conceptual cross section view of the containment cap. The low permeability layer of the containment cap will act as a baffle (like an oil/water separator) and trap the LNAPL behind it while allowing groundwater to discharge underneath through the gabion toe vent. This will allow groundwater



levels behind the containment cap to maintain equilibrium with fluctuating river levels, enhancing long-term slope stability. The gabion toe vent will be filled with an organoclay material (i.e., AquaGate+OC®) designed for use in aquatic environments to absorb hydrocarbon sheen and LNAPL if present in the groundwater passing through the toe vent. The low permeability layer will also create a physical barrier between residual hydrocarbons in the soil and the river water thus eliminating the potential for a hydrocarbon sheen. This capping system will allow containment of the full extent of the residual hydrocarbons and impacted soil along the riverbank in this area. The low permeability layer will consist of an aggregate coated with a layer of bentonite (i.e., AquaBlok®). When hydrated, the coated aggregate takes on the low-permeability property of bentonite, reinforced with the strength of the aggregate. LNAPL extraction, as needed, will be incorporated into the containment cap design in the form of ten LNAPL collection sumps that will be laid beneath the low permeability layer in a continuous collection layer of crushed stone. These sumps allow efficient removal of LNAPL via pump, vacuum truck and/or cartridges of sorbent media (e.g., petroleum absorbent socks). The number and location of sumps may be slightly field adjusted if unknown obstructions are discovered in the field during construction. The containment cap will be finished with a protective layer consisting of articulated block mattress (ABM) to reduce the potential for erosion and maintain performance.

The sequence of containment cap construction is as follows noting the coffer dam has already been installed (Note: Field adjustments may be made to maintain equivalent performance if unknown conditions are encountered during construction.):

- Grade (remove unsuitable material such as vegetation and rip rap, and place clean fill, as necessary) the riverbank to achieve the required slope of the containment cap.
- Place the toe vent gabions filled with AquaGate+OC®.
- Place a layer (12-inches thick) of washed crushed stone (LNAPL collection layer) on the prepared surface.
- Install ten LNAPL collection sumps (6-inch diameter) in the layer of crushed stone.
- Place the low permeability layer (6-inch-thick layer of AquaBlok®) on top of the crushed stone.
- Place the erosion protection layer (6-inch thick) of select crushed stone bedding on top of the low permeability layer (i.e., AquaBlok®).
- Place erosion protective layer armor (6-inch-thick ABM) over the crushed stone bedding.
- Place rip rap (large rock) along the toe vent gabion as a supporting toe buttress.



Any waste or impacted soil that is encountered from the cut portion of the project will be characterized and appropriately managed off-site based on the characterization. It is anticipated that most of the waste and impacted soil will be disposed as non-hazardous waste. The projected scope has a minimal volume of cut area and the project does not include excavation beyond what is required to install the containment cap.

### **Temporary Authorization Request**

This temporary authorization request is being submitted pursuant to Title 40, CFR Part 270.42(e)(2) and (3). Per 40 CFR 270.42(e), the permittee can request a temporary authorization for a period of 180 days if the activity meets the criteria listed in this section, namely, for this proposed interim remedial action, that the activity is in compliance with the standards of 40 CFR Part 264 (40 CFR 270.42(e)(3)(i)), and is necessary to facilitate timely implementation of closure or corrective action activities and to facilitate other changes to protect human health and the environment (40 CFR 270.42(e)(3)(ii)(A) and (E)). The temporary authorization is incorporated by reference in Oklahoma Administrative Code (OAC) 252:4-7-52(14).

Additional information on these criteria regarding this temporary authorization request is provided as follows.

- **A description of the activities to be conducted under the temporary authorization.**

The Class 2 permit modification request included in this submittal provides a detailed description of the proposed installation of a containment cap located north of Zink Dam, including an OM&M Plan.

- **An explanation of why the temporary authorization is necessary.**

The temporary authorization is necessary to accommodate a schedule that is driven by the ongoing Zink Dam and Williams Crossing Bridge construction in the Arkansas River by the City of Tulsa and Gathering Place. Submittal of a Class 2 permit modification request alone would take a minimum of 90 days for approval, and HFSTR must start construction by April 2023 to meet the schedule for the bridge and dam in the Arkansas River. In addition, the timely installation of this interim remedy while the river levels are low is paramount, due to health and safety concerns and ease of construction. Additionally, expedited construction of the containment cap will achieve this benefit in a timelier manner given proposed recreational use of the area north of Zink Dam after opening of the new dam.

As described further in the permit modification request, the interim remedial action will prevent hydrocarbon sheen and LNAPL seeps from entering the Arkansas River at the





location of the proposed interim remedy. This is clearly beneficial to human health and the environment and will have positive long-term effects on river conditions.

- **Sufficient information to ensure compliance with 40 CFR Part 264 standards.**

While 40 CFR Part 264 is not directly applicable to this interim remedial activity, certain items are mentioned here for completeness:

- 40 CFR 264.15: The cap will be inspected quarterly and repaired as necessary, and these actions will be documented per the OM&M Plan.
- 40 CFR 264.18: The cap has been designed for the conditions at the area north of Zink Dam.
- 40 CFR 264.145: HFSTR will demonstrate FA for this interim remedy according to the schedule in Permit Condition III.F.2.

As noted in the regulation at 40 CFR 270.42(e)(2)(iii), HFSTR will send a public notice regarding the temporary authorization request to all persons on the facility mailing list within seven days of submission of the temporary authorization request. The proposed public notice language and mailing lists are included as an attachment, and HFSTR will provide evidence of the public notice and mailing to DEQ.

### **Proposed Modification to Permit No. 990750960**

HFSTR proposes the following permit modifications as noted below:

#### ***Add Permit Condition III.J.8***

HFSTR is proposing to add Permit Condition III.J.8 as follows:

- The Permittee shall implement the North of Zink Dam LNAPL Containment Cap and Collection System as specified in the Permittee's *Operation, Maintenance and Monitoring Plan for the North of Zink Dam LNAPL Containment Cap and Collection System*, Permit Attachment 7. The Permittee will document the performance of the system, any necessary changes in inspections or monitoring, and any alterations of the containment cap and collection system in the semi-annual groundwater monitoring reports required by Permit Condition III.Q.2.

#### ***Provide Public Notice***

As noted previously, as part of the temporary authorization request and Class 2 permit modification request, HFSTR will mail the facility mailing list and publish notice within 7 days after submittal of the temporary authorization request and permit modification package to



DEQ. To facilitate this, a copy of the proposed public notice is included as an attachment to this letter that identifies the 60-day comment period, and provides announcement of the date, time, and place of the public meeting. In addition, HFSTR will make a copy of the permit modification request available in the Tulsa City-County Library. HFSTR will provide evidence of the mailing and publication to DEQ.

***Add (New) Attachment 7, Operation, Maintenance and Monitoring Plan for the North of Zink Dam LNAPL Containment Cap and Collection System***

HFSTR is proposing to add a new Attachment 7 to the permit documents that includes the following:

- Operation, Maintenance and Monitoring Plan for the North of Zink Dam LNAPL Containment Cap and Collection System
- The OM&M Plan includes a description of the North of Zink Dam LNAPL Containment Cap and Collection System; a proposed monitoring plan and schedule; discussion of maintenance activities; and performance standards and contingency plans.
- The OM&M Plan includes the plan set drawings for the North of Zink Dam LNAPL Containment Cap and Collection System in Appendix A. Note that as-built drawings will be included in the construction completion report.
- Appendix B of the OM&M Plan contains proposed monitoring and maintenance forms and logs.

**Modification Type and Classification**

According to 40 CFR §270.42(b), Appendix I.C.8.b, incorporated by reference in OAC 252:205-3-2(k), the requests fall under a Class 2 modification, as a change to a corrective action program.

**Modification Notice**

Per the requirements of 40 CFR §270.42(b), HFSTR will send a notice of the modification request to all persons on the facility mailing list maintained by the Director and to the appropriate units of State and local government. The notification will be made within 7 days after submittal of the temporary authorization request and permit modification to DEQ.

This Report is consistent with the reporting requirements of the December 1, 2020, Resource Conservation and Recovery Act (RCRA) Corrective Action and Post-Closure Permit for the Remediation and Monitoring of Closed Hazardous Waste Management Units (OKD990750960). The temporary authorization request and permit modification will go into the public repository today, March 3, 2023.



Thank you for your consideration of this request for temporary authorization and permit modification. If you have any questions, or require additional information, please contact Arsin Sahba at (972) 689-8540, Brian Moore at (918) 935-6695 or Jennifer Sanchez at (918) 588-1167.

Sincerely,

A handwritten signature in blue ink that reads "Jennifer Sanchez".

Jennifer Sanchez  
Environmental Manager  
HF Sinclair Tulsa Refining LLC

Attachments:

Public Notice and Mailing Lists

Permit Attachment 7, *Operation, Maintenance and Monitoring Plan for the North of Zink Dam LNAPL Containment Cap and Collection System*

cc: Arsin Sahba, HF Sinclair  
Mike Holder, HF Sinclair  
Brian Moore, HFSTR  
Catriona Smith, TRC



## **PUBLIC NOTICE AND MAILING LISTS**

**OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY  
NOTICE OF TEMPORARY AUTHORIZATION REQUEST, PERMIT MODIFICATION  
REQUEST SUBMITTAL, PUBLIC REPOSITORY AVAILABILITY, AND PUBLIC  
MEETING**

On March 3, 2023, HF Sinclair Tulsa Refining LLC (HFSTR), East Refinery (the Refinery), submitted a Temporary Authorization Request and a Class 2 application for modification of the Resource Conservation and Recovery Act (RCRA) Corrective Action and Post-Closure Permit (No. 990750960) for the Refinery. In accordance with Title 40 Code of Federal Regulations (CFR) §270.42(b) and (e), and Oklahoma Administrative Code (OAC) 252:205-3-2(k) and OAC 252:4-7-52(14), the Refinery posts this notice of the temporary authorization and modification request submittal, repository availability, public meeting announcement, and opportunity for public comment. The Refinery is located in Township 19 North, Range 12 East, Sections 13, 14, 23 and 24, Tulsa County, Oklahoma at the following address:

HF Sinclair Tulsa Refining LLC  
902 W 25<sup>th</sup> Street  
Tulsa, Oklahoma 74107

The applicant requests approval of a remedial action for the riverbank area north of Zink Dam. The remedial action involves installation of a containment cap and collection system that will prevent hydrocarbon sheen from entering the Arkansas River at the location of the proposed remedy. The applicant is requesting a temporary authorization to facilitate the timely implementation of the corrective actions while the river level is low, and to support the schedule for the dam and bridge construction. The permit modification contains details of the installation, and operation and maintenance of the remedial action.

In accordance with 40 CFR 270.42(b)(3) interested citizens are invited to review copies of the application at the HFSTR East Refinery document repository at the Tulsa City-County Library at the following address:

Tulsa City-County Library  
400 Civic Center  
Tulsa, OK 74103  
(918) 549-7323

Or at the Oklahoma Department of Environmental Quality's (DEQ's) main office in Oklahoma City at the following address:

Oklahoma Department of Environmental Quality  
707 North Robinson, PO Box 1677  
Oklahoma City, OK 73101  
Phone: (405) 702-5100

A copy of the permit modification may be accessed at:

<https://www.deq.ok.gov/land-protection-division/permit-public-participation-process/>

The designated facility contact who will address questions regarding the submittal is:

Arsin Sahba, P.G.  
Corporate Environmental Specialist - Remediation  
HF Sinclair

2828 N. Harwood, Suite 1300  
Dallas, TX 75201  
Phone: (972) 689-8540

In accordance with 40 CFR 270.42(b)(4), a public meeting to answer questions about the application has been scheduled for April 12, 2023 at 6:00 pm at the following location: Chandler Park Community Center, 6500 W. 21<sup>st</sup> Street, Tulsa, OK 74107.

In accordance with 40 CFR 270.42(b)(5), written comments will be accepted from the public for 60 days from the publication of this notice and must be postmarked by May 8, 2023. Any person may submit written comments during the comment period; only those issues relevant to the proposed modifications are open for comment. Comments should be sent to the following DEQ contact:

Hillary Young  
Chief Engineer  
Land Protection Division  
Oklahoma Department of Environmental Quality  
707 North Robinson, PO Box 1677  
Oklahoma City, OK 73101  
Phone: (405) 702-5100

The permittee's compliance history during the life of the permit being modified is available from the DEQ contact person.

Date: March 3, 2023

FIRST BAPTIST CHURCH OF  
BROKEN ARROW OKLAHOMA  
100 W ALBANY ST  
BROKEN ARROW, OK 74012-8284

OKLAHOMA POWER CO  
C/O PUBLIC SERVICE CO ATT  
PROPERTY TAX  
PO BOX 660164  
DALLAS, TX 75266

TEXAS-EMPIRE PIPELINE  
C/O ENBRIDGE PIPELINES LLC-  
ROW DEPT  
119 N 25TH ST E  
SUPERIOR, WI 54880

GARRETT AND COMPANY  
ATT CHERIE GARRETT MARTIN  
9701 N BROADWAY EXTENSION  
OKLAHOMA CITY, OK 73114

ONE BANK AND TRUST CO C/O  
SHARON GRIFFITH 8909 S YALE  
AVE STE 100  
TULSA, OK 74136

WANEMACHER, JOSEPH M &  
MARK A  
5110 S YALE STE 414  
TULSA, OK 74133

GOODWILL INDUSTRIES OF  
TULSA INC  
2800 SOUTHWEST BLVD  
TULSA, OK 74107

PUBLIC SERVICE CO OF OKLA  
212 E 6TH ST  
TULSA, OK 74119

COCHRAN, GARY G 2444 S  
OLYMPIA AVE  
TULSA, OK 74107

GRISEZ, WILLIAM R AND  
MARGARET RITA TRUSTEES  
WILLIAM R GRISEZ TRUST  
3833 S TRENTON AVE  
TULSA, OK 74105

EET INVESTMENTS LLC  
3310 S SANTA FE AVE  
TULSA, OK 74107

CITY OF TULSA  
175 E 2ND ST STE 260  
TULSA, OK 74103

RIVER PARKS AUTHORITY  
2121 S COLUMBIA, SUITE 205  
TULSA, OK 74114

CLAYBON, JOHN  
927 W 25TH ST  
TULSA, OK 74107

NALL, TIMOTHY AND BARBARA  
318 N MCKINLEY  
SAND SPRINGS, OK 74063

SOUTHWEST BOULEVARD  
PROPERTIES LLC  
C/O HOEY CONST  
3310 SOUTHWEST BLVD  
TULSA, OK 74107

NALL, TIMOTHY AND BARBARA  
PO BOX 9563  
TULSA, OK 74157

SUAP LLC  
18100 W 51ST ST S  
SAND SPRINGS, OK 74063

FRED STORER  
420 SOUTH MAIN ST., SUITE 205  
TULSA, OK 74103

AMERICAN WASTE CONTROL  
INC  
1420 W 35TH ST  
TULSA, OK 74107

BROOKS, NALL R INC  
PO BOX 9563  
TULSA, OK 74157

SCOTT HOOD  
9 ROYAL DUBLIN LN.  
BROKEN ARROW, OK 74011

LINDA ADKINS  
7223 E. 28<sup>TH</sup> PL.  
TULSA, OK 74129

LISA GRIMM  
119 S. HARVARD AVE.  
TULSA, OK 74112

\*Addresses obtained from GIS tax  
data.



Oklahoma Corp. Commission  
Jim Thorpe Bldg.  
2101 N. Lincoln Blvd #129  
Oklahoma City, OK 73105

Oklahoma Geological Survey  
Sarkeys Energy Center  
100 E. Boyd, Suite N-131  
Norman, OK 73019-0628

State Historic Preservation Office  
Oklahoma Historical Society  
800 Nazih Zuhdi Drive  
Oklahoma City, OK 73105

OK Water Resources Board  
3800 N. Classen Blvd  
Oklahoma City, Ok 73118

Oklahoma Department of Wildlife  
Conservation  
1801 N. Lincoln Blvd  
Oklahoma City, OK 73152

City of Tulsa City Council Office  
175 E. 2nd St., 4th Floor  
Tulsa, OK 74103

Director  
US Geological Survey  
202 NW 66<sup>th</sup> St., Suite 7  
Oklahoma City, OK 73116

OK Conservation Commission  
2800 Lincoln Blvd., Suite 200  
Oklahoma City, OK 73105-4210

Tulsa DEQ Regional Office  
9933 E 16th St.  
Tulsa, OK 74128-4643

Regional Administrator (6A)  
US EPA Region 6  
1201 Elm Street, Suite 500  
Dallas, TX 75270

Director, Land, Chemicals &  
Redevelopment Division  
US EPA Region 6  
1201 Elm Street, Suite 500  
Dallas, TX 75270

Field Supervisor  
US Fish & Wildlife Service  
9014 E 21<sup>st</sup> St.  
Tulsa, OK 74129-1428

US Corps of Engineers Public  
Affairs Office  
2488 E 81<sup>st</sup> Street  
Tulsa, OK 74137

Bureau of Land Management  
201 Stephenson Parkway, Suite 1200,  
Norman, OK 73072

U.S Department of Agriculture  
NRCS Oklahoma  
100 USDA, Suite 206  
Stillwater, OK 74074-2655

Tara Baker, Chairperson  
Sierra Club  
PO Box 60644  
Oklahoma City, OK 73146-0644

Oklahoma Archeological Society  
111 East Chesapeake St., Rm 102  
Norman, OK 73019-5111

County of Tulsa  
County Commissioner Office  
500 S. Denver Ave.  
Tulsa, OK 74103

Department of Environmental Quality  
Kelly Dixon, Director  
Land Protection Division  
707 N Robinson  
Oklahoma City, OK 73102

\*Addresses obtained  
through ODEQ list  
and  
confirmed/updated by  
TRC 12/09/21



**PERMIT ATTACHMENT 7  
OPERATION, MAINTENANCE AND MONITORING PLAN  
FOR THE NORTH OF ZINK DAM LNAPL CONTAINMENT CAP AND  
COLLECTION SYSTEM**

HF Sinclair Tulsa Refining LLC - Tulsa East Refinery  
RCRA Post-Closure and Corrective Action Permit  
Permit No. 990750960-PC  
March 2023

**HF SINCLAIR TULSA REFINING LLC  
TULSA EAST REFINERY  
TULSA, OKLAHOMA**

**PERMIT ATTACHMENT 7**

**OPERATION, MAINTENANCE AND MONITORING PLAN FOR  
THE NORTH OF ZINK DAM LNAPL CONTAINMENT CAP  
AND COLLECTION SYSTEM**

**MARCH 2023**

**OPERATION, MAINTENANCE AND MONITORING PLAN FOR THE  
NORTH OF ZINK DAM LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM  
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Figure 1. Site Location

Figure 2. Conceptual Plan

Figure 3. Conceptual Cross Section

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Figure 5. Groundwater and River Stage Elevation Graph

## **Appendices**

Appendix A. North of Zink Dam Containment Cap and Collection System Plan Set

Appendix B. Monitoring and Maintenance Forms and Logs

**HF Sinclair Tulsa Refining LLC  
Tulsa East Refinery  
Attachment #7  
Operation, Maintenance and Monitoring Plan for the  
North of Zink Dam LNAPL Containment Cap and Collection System  
March 2023**

## **1.0 INTRODUCTION**

### **1.1 Project Background**

This Operation, Maintenance and Monitoring Plan (herein after the OM&M Plan or Plan) has been prepared for the light non-aqueous phase liquid (LNAPL) containment cap and collection system located along the riverbank north of Zink Dam. The Plan presents the activities and methods to perform routine monitoring, inspections, and maintenance, evaluate site conditions and performance standards, and report results and findings, following the installation of the North of Zink Dam LNAPL Containment Cap and Collection System (also referred to as the North of Zink Dam LNAPL Containment Cap) at the HF Sinclair Tulsa Refining LLC (HFSTR) East Refinery (EPA ID: OKD990750960) in Tulsa, Oklahoma (Site). Refer to Figure 1 for Site location.

An LNAPL plume (SWMU-H/RPA LNAPL Plume 2) appears to extend from Solid Waste Management Unit H (SWMU-H) on the west to areas adjacent to the Arkansas River (River) north of Zink Dam on the east. Refer to Figure 2 for the location of SWMU-H/RPA LNAPL Plume 2. SWMU-H/RPA LNAPL Plume 2 is discussed in the *2018 Solid Waste Management Unit-H / River Parks Authority Perimeter Investigation Report* (Hull, 2018). Investigation work indicates that SWMU-H/RPA LNAPL Plume 2 likely consists of heavy-end hydrocarbons such as crude oil. SWMU-H/RPA LNAPL Plume 2 is located upgradient, between and downgradient of two bentonite clay barrier walls; LNAPL was present downgradient of the barrier when the barrier wall was installed. The investigation concluded that SWMU-H/RPA LNAPL Plume 2 appears to be stable and is predominantly comprised of residual phase LNAPL with some portion being intermittently mobile (Hull, 2018). The LNAPL plume adjacent to the River appears to be influenced by fluctuations in the River level and bank erosion, causing hydrocarbon sheen and discrete LNAPL seeps on the surface of the water only during extremely low water levels.

In December 2022, hydrocarbon sheen and LNAPL seeps associated with historical residual hydrocarbons were observed along the Arkansas River bank north of Zink Dam (Figure 2). The Arkansas River is at extremely low levels and this is the likely cause of the recent hydrocarbon sheen and discrete LNAPL seeps. Hard and sorbent booms are being used to provide effective containment of the hydrocarbon sheen and LNAPL seeps. The sorbent booms are replaced several times each week. At least daily inspections are performed at the area. A coffer dam was installed in February 2023 and completed

on February 21, 2023. The hard and sorbent booms were relocated within the boundary of the coffer dam on February 9, 2023. The coffer dam provides further effective containment of the hydrocarbon sheen and LNAPL seeps, and is needed to provide a safe area for construction of the containment cap.

The remedial objective identified by HFSTR is to mitigate the potential for hydrocarbon sheens and LNAPL seeps from forming along the bank of the Arkansas River north of Zink Dam in the vicinity of the North of Zink Dam Containment Cap. An LNAPL containment cap interim remedy was selected as the most technically effective long-term solution to address the hydrocarbon sheen and LNAPL seeps, most compatible with the current development along the River, and based on the effectiveness and DEQ approval of this type of interim remedy implemented south of Zink Dam in 2022.

The North of Zink Dam LNAPL Containment Cap proposed north of Zink Dam is designed similar to the containment cap system installed south of Zink Dam and is planned for construction in 2023. The Plan Set for the North of Zink Dam LNAPL Containment Cap is included in Appendix A. Details regarding the interim remedy installation will be available following construction in a separate construction completion report, which should be referenced by those performing monitoring as described in this Plan.

## **1.2 Site Setting**

The planned North of Zink Dam LNAPL Containment Cap will be located on HFSTR property adjacent to the Arkansas River upstream of the Zink Dam within the River Parks Authority (RPA) leased area (Figure 2). Figures 3 and 4 illustrate the containment cap cross section and location of existing and proposed monitoring wells and collection sumps, respectively. At the location of the proposed North of Zink Dam LNAPL Containment Cap, the River elevation has fluctuated between 609 and 612 feet relative to mean sea level (MSL) from December 2022 to February 2023 as shown on Figure 5. These recent River elevations are lower than River elevations before demolition of the former Zink Dam and expected River elevation after completion of the new Zink Dam. The recent lower River elevations are due to the new Zink Dam gates being set at 610 feet MSL and drought conditions (limited water flow in the River). After completion of the new Zink Dam, River elevations are expected to be higher since the new Zink Dam gates could be set as high as an elevation of 620 feet MSL.

In general, the lithology in the area is comprised of a flood plain alluvium from ground surface up to 40 feet below ground surface (ft-bgs) consisting of silty sand, very fine to coarse sand, gravelly sand, and discontinuous lenses of silty clay in a generally fining upward sequence. These sediments are consistently composed of relatively homogenous fine to coarse sand, with minor amounts of silt and gravel that coarsens with depth. The bedrock is a shale of the Coffeyville Formation that is encountered at the Site at depths from 15 to 40 ft-bgs and serves as the bottom of the River channel. The River channel within the Site has up to 5 to 7 feet of riverbed sand. Additional site setting geology and hydrogeology information can be found in the *Conceptual Site Model* (TRC, 2021b).



### **1.3 Purpose and Scope**

This OM&M Plan is intended to provide information related to the installation and operation, monitoring and maintenance activities for the North of Zink Dam LNAPL Containment Cap. Implementation of this Plan will aid in documenting the effectiveness and performance of the interim remedy and track the maintenance activities over time.

The Plan described herein includes monitoring and maintenance procedures for evaluating the effectiveness and performance of the North of Zink Dam LNAPL Containment Cap. Cap construction product specifications and data sheets will be included in a separate construction completion report, which will be available following construction and should be referenced in conjunction with this Plan. Monitoring and maintenance forms and logs are included in Appendix B to assist with tracking conditions and cap-related OM&M activities. This Plan should be reviewed and updated to reflect the Site conditions if changes have occurred that impact the implementation of this Plan and/or the interim remedy (North of Zink Dam LNAPL Containment Cap).

This Plan includes the following information:

- General description of North of Zink Dam LNAPL Containment Cap and Collection System components (Section 2)
- Monitoring plan and schedule (Section 3)
- Maintenance requirements (Section 4)
- Performance standards and contingency plans (Section 5)
- References (Section 6)
- Figure 1 showing the Site location
- Figure 2 showing the North of Zink Dam Containment Cap conceptual plan
- Figure 3 showing the North of Zink Dam LNAPL Containment Cap conceptual cross section
- Figure 4 showing the existing and proposed monitoring well and collection sump locations associated with the North of Zink Dam LNAPL Containment Cap
- Figure 5 showing a graph of the groundwater and river stage elevations
- Appendix A including the North of Zink Dam Containment Cap and Collection System Plan Set
- Appendix B including a routine O&M form, maintenance log and LNAPL recovery log

## 2.0 CAP DESCRIPTION

The North of Zink Dam LNAPL Containment Cap was selected as the appropriate interim remedy for the riverbank north of Zink Dam due to this technology's proven performance over time. The first containment cap using this design and construction materials was installed in 2010 along the Penobscot River in Bangor, Maine (note: The Bangor, Maine cap was designed without the organoclay containing (AquaGate+OC®) toe vent, because it was not necessary given the site-specific conditions). The cap in Bangor, Maine has been functioning effectively for the past 12 years without maintenance or repair. Visual inspections have shown no NAPL sheens being produced from within the cap footprint. The cap has undergone severe winter weather, freeze/thaw cycles, ice flows, flooding, and tidal swings of up to 20 feet occurring twice each day. This cap was designed to sequester a deposit of coal tar in the river and along the riverbank and continues to perform as designed. Additional caps using this design have been installed since 2010 and are operating without issues regarding permanence or maintenance/repair issues, including the LNAPL containment cap constructed along the riverbank south of Zink Dam under the DEQ approval dated April 28, 2022 (DEQ, 2022) for the December 2021 Class 2 Permit Modification (HFTR, 2021b) and February 2022 response to DEQ comments (HFTR, 2022). The North of Zink Dam LNAPL Containment Cap has been designed using the same technology and similar materials.

The North of Zink Dam LNAPL Containment Cap is designed using geologic materials to prevent hydrocarbon sheen and LNAPL seeps from entering the Arkansas River at the location of the proposed interim remedy. The design and effectiveness of the AquaGate+OC® (gabion toe vent) and AquaBlok® layer are described in Sections 2.3.2 and 2.3.3, respectively. The AquaBlok® material is unlikely to fail or require intensive repair based on the nature of the material to rehydrate. The gabion toe vent is unlikely to fail or require intensive repair because it is unlikely LNAPL will contact the material. In the event that a portion of the gabion toe vent clogs in the future, water will continue to flow in and around the clogged section of the gabion toe vent, and the gabion toe vent is designed to be replaced as discussed in Section 2.3.2. Refer to Figure 3 for a cross section of the containment cap and gabion toe vent. There is approximately 308 tons of AquaGate+OC® at 30% organoclay by weight which results in approximately 92 tons of organoclay in the toe vent. The organoclay can effectively adsorb 40% of its weight in LNAPL, which would result in over 36 tons (10,800 gallons) of LNAPL sorbent capacity. Based on the residual LNAPL being observed above the elevation of the gabion toe vents and the unlikely event that River levels reach the elevation of the gabion toe vent, the capacity of organoclay provides decades of effective LNAPL treatment in the toe vent.

The North of Zink Dam LNAPL Containment Cap has been designed with a conservatively stable 3:1 slope. The geotechnical analysis design calculation shows that the specific slope configuration for the proposed interim remedy is stable. The calculation performed shows that the gradation of the containment cap configuration and the proposed slope exceeds the minimum required factor of safety of the Engineering Manual 1110-2-1902 by the United States Army Corps of Engineers.

## **2.1 North of Zink Dam LNAPL Containment Cap and Collection System Description**

The North of Zink Dam LNAPL Containment Cap and Collection System will be placed from the base of the riverbed to the current top of the bank elevation. This capping system will allow containment of the documented residual hydrocarbons and impacted soil that contributed to the hydrocarbon sheen and LNAPL seeps first observed in December 2022. The North of Zink Dam LNAPL Containment Cap will be comprised of multiple layers.

- A collection layer will form the base of the cap. LNAPL extraction, as needed, will be performed from ten LNAPL collection sumps that will be laid within the collection layer. These sumps will allow efficient removal of LNAPL via pump, vacuum truck and/or cartridges of sorbent media (e.g., petroleum absorbent socks). The details of the North of Zink Dam LNAPL Containment Cap design and construction are further presented below.
- The low permeability layer of the containment cap will act as a baffle (like an oil/water separator) and trap the lighter oil behind it, while allowing groundwater to discharge underneath through the toe vent. The toe vent will allow groundwater levels behind the containment cap to maintain equilibrium with fluctuating River levels enhancing long-term slope stability. The low permeability layer will form a physical barrier between residual hydrocarbons in the soil and the River water thus eliminating the potential for a hydrocarbon sheen and LNAPL seeps. The low permeability layer will be visually and/or physically inspected as it is placed to assure its integrity. The low permeability layer will consist of AquaBlok®, which is a proprietary product that consists of an aggregate coated with a layer of bentonite. When hydrated, AquaBlok® takes on the low-permeability property of bentonite, reinforced with the strength of the aggregate.
- The south edge of the containment cap will be securely sealed against a concrete wall that extends from Zink Dam north approximately 350 feet using hydrated bentonite and/or AquaBlok®. The north end of the containment cap will be securely sealed to the existing riverbank ground surface with hydrated bentonite and/or AquaBlok®.
- An armor layer consisting of articulated block mattress (ABM), a reinforced concrete product, will be placed over a crushed aggregate bedding layer on top of the AquaBlok®. The armor layer protects the low permeability layer from damage.

The North of Zink Dam LNAPL Containment Cap is planned to be constructed at the Site in 2023. A conceptual plan is shown on Figure 2 and conceptual cross section is shown on Figure 3. The North of Zink Dam LNAPL Containment Cap Plan Set is provided in Appendix A. The following sub-sections provide a general overview of the planned construction and containment cap components. The construction completion report will include any field changes to the Plan Set in Appendix A.

## **2.2 Site Preparation & Clean Fill Placement**

The following activities have been completed or will be completed prior to constructing the North of Zink Dam LNAPL Containment Cap:

- A perimeter coffer dam to contain hydrocarbon sheen/LNAPL seeps, prevent migration to the River and allow containment cap construction under dry conditions was completed on February 21, 2023.
- The hard and sorbent booms were relocated within the coffer dam on February 9, 2023, to continue containment of hydrocarbon sheen/LNAPL seeps throughout the duration of construction activities.
- Placement of clean fill and grading to achieve design bottom elevations. The toe of the cap at the River will be excavated to bedrock.

## **2.3 LNAPL Containment Cap Components**

### **2.3.1 Collection Layer**

Approximately 12 inches of crushed aggregate (1 1/2-inch diameter) will be placed over the graded bottom to function as the collection layer, creating a porous zone for LNAPL to preferentially be collected. Appendix A contains material gradation information for the select crushed stone.

The collection layer will also include ten LNAPL collection sumps constructed of 6-inch diameter stainless steel screens and casings. The LNAPL collection sumps will be sloped from the bottom of the collection layer to near the top of the bank and will terminate at vaults where gauging and, if needed, collection of LNAPL can occur.

### **2.3.2 AquaGate+OC® Gabion/Toe Vent**

An AquaGate+OC filled gabion will serve as the toe of the cap at the intersection of the collection layer and the Arkansas River, as shown on the Plan Set. The gabion will be 3-feet high and 3-feet wide, continuing the entire length of the containment cap. The gabion will be filled with AquaGate+OC®, which is stone coated with organoclay that forms a porous treatment media to allow groundwater to flow through while physically absorbing hydrocarbon sheen and LNAPL.

The permeability of the AquaGate+OC® component of the toe vent gabion installation has been evaluated and designed to address potential plugging over time. First, the gabions will be in contact with clean crushed aggregate (Collection Layer) which will have minimal fines. Second, the gabions will be lined with a filter fabric, which will further prevent any fine solid particles from clogging the AquaGate+OC®.

Regarding the potential for plugging of the AquaGate+OC® due to sorption of LNAPL to the particles, AquaGate+OC® particles may expand slightly as they sorb materials such as LNAPL, but extensive evaluations of this situation were completed by researchers at the University of New Hampshire as

summarized in Appendix D of the response to DEQ comments letter dated February 16, 2022 (HFTR, 2022), for the Class 2 Permit Modification for the containment cap installed south of Zink Dam. Porosity was found to be reduced but was still greater than 20% in the study. In addition, approximately 810 linear feet of gabions will be installed along the entire length of the proposed North of Zink Dam LNAPL Containment Cap. If one area of the AquaGate+OC® has reduced permeability, groundwater will flow around that area and any LNAPL, if present, would be captured by the adjacent material.

The distribution of residual LNAPL ranges from 610 to 621 feet MSL at the riverbank in the location of the interim remedy. The gabions are proposed to be placed at approximately 605 to 608 feet MSL (bedrock elevation varies and gabions are 3 feet in height), which will be below the historical distribution of LNAPL (610 to 621 feet MSL). The low groundwater elevation is 611 feet MSL and the low River stage elevation is 609 feet MSL for the North of Zink Dam LNAPL Containment Cap location. For LNAPL to flow from the riverbank soil to the elevation of the gabion and be captured by the AquaGate+OC® material, the River stage would need to be at an extremely low level that has not been observed during the recent extremely low River levels (River level would need to be approximately 2 feet lower than Zink Dam with the gates fully open). In addition, the gabions will be sealed to the underlying bedrock with AquaBlok®, as described in the Plan Set (Appendix A), to prevent LNAPL from flowing under the gabions during extremely low River stage. Since extremely low River levels are not expected to be typical after the new Zink Dam is operational and maintaining higher River levels, LNAPL will rarely, if ever, be in contact with the gabion, reducing the likelihood that porosity of the material will decrease due to LNAPL clogging.

Additionally, the North of Zink Dam LNAPL Containment Cap has been designed so the gabions within the toe vent can be replaced, if needed. Each gabion is individually wrapped in wire mesh, thus individual gabions can be removed and replaced with new gabions containing new AquaGate+OC®.

Monitoring the functionality of the gabions will be represented by the visual inspections for hydrocarbon sheen, which are part of the regular monitoring and maintenance activities described in Sections 3 and 4. The visual inspections are performed at a minimum frequency of weekly. In addition, as part of the regular inspection and maintenance activities, the liquid level in the sumps will be monitored. The performance standards and contingency plans are also described in Section 5. If an issue possibly related to the performance of the gabions is noted based on the regular inspection and maintenance activities, an evaluation to determine the appropriate course of action will be performed and, if needed, a contingency plan will be communicated to DEQ.

### **2.3.3 AquaBlok® Layer**

AquaBlok® is a patented, composite-aggregate technology resembling small stones. It is typically comprised of a dense aggregate core, clay or clay-sized materials, and polymers. For typical freshwater product formulations, AquaBlok's® clay (sealant) component consists largely of bentonite clay. AquaBlok® particles expand when hydrated, with the degree of net vertical expansion determined largely by the formulation, application thickness, and salinity of the hydrating water. When a mass of particles is hydrated, the mass transforms into a continuous and relatively soft body of material. Once

developed, the hydrated AquaBlok® material acts as an effective physical, hydraulic, and chemical environmental barrier by virtue of its relatively cohesive and homogeneous character, low permeability to water, and chemically active (sorptive) nature.

The AquaBlok® material for the North of Zink Dam LNAPL Containment Cap will be comprised of a high-swell bentonite, wrapped around an aggregate core that when placed and hydrated, swells and self-compacts, filling voids between the particles to provide a uniform, low permeability layer. Testing has shown that freeze/thaw effects have no long-term impact on the performance of the material, as it has the ability to perpetually “heal” itself. AquaBlok’s® properties result from the permanent nature of the bentonite component to sustain its function, unlike mechanically compacted low-permeability soil barriers that can break down under repeated freeze/thaw cycles.

Approximately 6 inches of AquaBlok® will be placed over the collection layer to create an impermeable containment layer for the underlying hydrocarbons. Appendix A contains material gradation information and product information for the AquaBlok® planned to be used in the North of Zink Dam LNAPL Containment Cap. The bottom of the AquaBlok® will be placed at an approximate elevation of 608 feet MSL, which is conservatively 2 feet lower than the bottom distribution of residual LNAPL at 610 feet MSL and it is below the low sill elevation of the new Zink Dam (609 ft MSL). The top of the AquaBlok® will be placed at an approximate elevation of 628 feet MSL, which is conservatively 7 feet higher than the top distribution of residual LNAPL at 621 feet MSL.

Desiccation (dehydration) of the AquaBlok® material will not occur during drought or dry conditions, due to the cap design and physical properties of the bentonite component of the AquaBlok®. The AquaBlok® material will be covered by multiple layers including the ABM, thus protecting the AquaBlok® from the two most significant contributors to desiccation: solar radiation and wind. In addition, the lower end of the AquaBlok® will typically be submerged by groundwater and River water, which will allow water to wick from the lower portions of the layer to the upper portions of the layer. The capillary potential means that should the upper sections of the AquaBlok® experience dry conditions, contact with saturated soils (groundwater) or River water will provide moisture that the AquaBlok® layer will absorb and wick up to the higher portions of the cap by capillary potential. This application of a bentonite product is similar to a monitoring well seal or landfill cap where it is well established as an effective seal in dry conditions.

AquaBlok® will also be used to seal the edges of the containment cap to the bedrock beneath the gabions, the concrete wall on the south end of the cap, and the riverbank ground surface on the north end of the cap. AquaBlok® will provide an effective seal along the edges of the cap, as the material when placed initially hydrates rapidly and like the curing cycle of concrete, continues to hydrate over time. When confined under a load (provided by the subsequent layers of the containment cap, including the ABM and rip rap) the material expands slightly laterally. Depending on the relative degree of confinement, the AquaBlok® will exert a residual pressure on adjacent confining surfaces up to 300 pounds per square foot (see Attachment C of the February 2022 response to DEQ comments for the

containment cap installed south of Zink Dam [HFTR, 2022], relevant portions of testing of AquaBlok® properties completed for a Master's Thesis – Chet A. Siefring – University of Toledo, 2008, pp. 64 – 65); this, in conjunction with the cohesive nature of the bentonite portion of the material, will provide an effective seal at the edges of the containment cap. The residual pressure of the AquaBlok® material was initially observed during the set-up and testing of the AquaBlok® 2080 material during consolidation testing. The application of AquaBlok® in the proposed interim remedy will result in a partial confining pressure, which will be sufficient to provide an effective seal that will be maintained over time with the bedrock, concrete wall, and ground surface. AquaBlok® has been used in many applications where a hydraulic seal is needed between concrete water control structures and other surfaces, including as a self-compacting trench dam. Care will be taken during installation to assure proper and effective contact between the AquaBlok® and the bedrock, concrete wall, and riverbank ground surface. As described, based on the nature of the AquaBlok® material, the seal will be maintained for as long as the North of Zink Dam LNAPL Containment Cap is constructed. Regular monitoring and maintenance activities are described in Sections 3 and 4.

#### **2.3.4 Articulated Block Mattress & Geogrid Protection (Bedding) Layer**

ABM is a prefabricated unit of interconnected concrete blocks and is commonly used for bank protection along surface waters. ABM will be placed over the AquaBlok® to hold it in place, and to provide stability and protection against erosion. The ABM also provides a layer of armor against damage from incidental physical contact.

For installation, a bedding layer of approximately 6 inches of select crushed stone and reinforcing geogrid will be placed over the AquaBlok®. Then a layer of geotextile will be laid consistent with the requirements of the ABM manufacturer. A 6-inch-thick layer of ABM will then be placed on top of the geotextile. The voids in the ABM will be filled during construction. The edges and seams of the ABM will be grouted per the manufacturer guidelines.

To further grade, stabilize and protect the North of Zink Dam LNAPL Containment Cap, rip rap will be placed at the toe of the cap to cover the River face of the AquaGate+OC® toe vent. A rip rap buttress will be placed at the upstream (north) end of the cap to protect the cap during higher River flows.

Based on the site-specific design considerations, it is not anticipated that significant repairs or maintenance to the ABM, rip rap or other components of the containment cap will be required due to flood conditions. However, the North of Zink Dam LNAPL Containment Cap can be repaired, if necessary. The ABM is designed for a volumetric flow rate of 305,000 cubic feet per second (cfs). Maximum calculated volumetric flow rates of approximately 65,000 cfs have been established by United States Geological Survey (USGS) for the Arkansas River in the vicinity of the project (see Attachment E of the February 2022 response to DEQ comments for the containment cap installed south of Zink Dam [HFTR, 2022], summary design report: 100-year return period – USGS Gauge 07164500 for Arkansas River at Tulsa, Oklahoma). Therefore, the armament of the North of Zink Dam LNAPL Containment Cap is



designed to withstand a flow of more than four times the 100-year flood flow rate. For this reason, it is extremely unlikely the North of Zink Dam LNAPL Containment Cap will be damaged by flooding.

The upstream (north) edge of the of the ABM will be protected by an additional rip rap buttress, which was sized as part of the North of Zink Dam LNAPL Containment Cap design to exceed calculated minimum sizes based on 100-year flood occurrence velocities. The rip rap was sized based on a flow velocity of 15 feet per second, which exceeds the 160% velocity calculation of the project area in the Federal Emergency Management Agency (FEMA) Flood Insurance Study for Tulsa County.<sup>1</sup> In addition, the design calculations considered the scour condition anticipated by a 100-year flow occurrence. The scour condition calculation resulted in an average rip rap weight of 1,900 pounds, and the containment cap design includes conservatively sized rip rap with an average weight of 2,000 pounds. The River face of the AquaGate+OC® gabions at the toe of the cap will be covered with rip rap and buried in the existing riverbed sand.

The armament (ABM and rip rap) of the North of Zink Dam LNAPL Containment Cap is designed to withstand extreme flood conditions. If repair is required based on an unforeseen act of nature, the North of Zink Dam LNAPL Containment Cap will be repaired to match the as-built plan set so that it serves its intended function, and any repairs will be completed in accordance with a contingency plan developed consistent with Section 5.

### **2.3.5 LNAPL Collection Sumps**

Ten LNAPL collection sumps will be installed within the porous collection layer to collect, monitor, and recover LNAPL, if present. The number and location of the sumps may be slightly field adjusted if unknown field conditions or obstructions are encountered during construction. The sumps are each constructed of 6-inch diameter stainless steel pipe with stainless steel, wire-wrapped continuous slot screens (Johnson Free-Flow™ 307 80-Slot). A 6-inch expandable seal/plug (locking compression cap) will be placed at the surface inside the pipe casing to seal the sumps when not in use.

The sumps will be completed at the surface with flush-mounted steel protective covers held in place by bolts. The location of the sumps is shown in the Plan Set in Appendix A.

High and low groundwater elevations and the distribution of residual LNAPL in the riverbank at the location of the proposed interim remedy interpreted from laser induced fluorescence (LIF) boring data are shown on the cross section on Figure 3. High and low groundwater elevations of 620.5 and 611 feet MSL, respectively, were obtained from historical gauging data available for monitoring wells along the riverbank in the project area and recent monitoring activities (recent groundwater elevation data from MW-284 and MW-310 are shown on Figure 5). The vertical distribution of residual LNAPL along the riverbank at the project area was derived from the *Solid Waste Management Unit-H / River Parks*

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<sup>1</sup> The FEMA Flood Insurance Study for Tulsa County for the project area suggests a main river channel velocity of 7.9 feet per second. The 160% velocity calculation for sizing armor stone results in a design velocity of approximately 13 feet per second. As stated, 15 feet per second was used to size the rip rap for the proposed interim remedy.

*Authority Perimeter Investigation Report* dated February 2018 (Hull, 2018). The vertical distribution of residual LNAPL is from approximately 610 to 621 feet MSL. The screen at each sump location will extend from 608 feet MSL to just below the AquaBlok® layer at approximately 627 feet MSL, which is conservatively below and above the residual LNAPL extent, as shown in the cross section on Figure 3. High and low groundwater elevations and the distribution of residual LNAPL in the riverbank at the location of the proposed interim remedy are provided on the cross section shown on Figure 3. The rationale for the placement of the sump screens from 608 feet MSL to 627 feet MSL is to conservatively extend the top of the sump screen (627 feet MSL) above the top of the residual LNAPL (621 feet MSL) and extend the bottom of the sump screen (608 feet MSL) below the bottom of the residual LNAPL (610 feet MSL).

While groundwater may fluctuate above the highest elevation of residual LNAPL during extreme flood events, the groundwater is not carrying the LNAPL further upward into the soil column as evidenced by the consistent results of the LIF borings that show the top of residual LNAPL is approximately 621 feet MSL. This behavior is described in United States Environmental Protection Agency (U.S. EPA) publication EPA/540/S-95/500, which states:

*As the water table rises or falls, LNAPL will be retained in the soil pores, leaving behind a residual LNAPL "smear zone." If smearing occurs during a decline in groundwater elevations, residual LNAPL may be trapped below the water table when groundwater elevations rise" (U.S. EPA, 1995).*

This condition described as a "smear zone" is consistent with the observations from the LIF investigation (Hull, 2018). Over the period of time that LNAPL has been in the subsurface, the groundwater elevation has risen and fallen, yet LNAPL is not observed above an elevation of 621 feet MSL. The top of the containment layer (AquaBlok®) extends to 628 feet MSL across the entire proposed interim remedy as shown in the cross section and was intentionally designed to be conservatively above both the high groundwater elevation (620.5 feet MSL) and particularly above the highest extent of LNAPL (621 feet MSL). This provides assurance that there is no pathway for groundwater or LNAPL to migrate above the AquaBlok® and onto the ABM even during times of elevated groundwater levels.

During short duration extreme flood events (e.g., May/June 2019), the maximum groundwater elevation may be higher than the top of the containment layer (AquaBlok®) at 628 feet MSL. However, during these short duration flood events, the maximum LNAPL elevation will not exceed 621 feet MSL (based on the LIF borings and as described above) and thus will not migrate onto the ABM based on the following: (1) the LNAPL elevation range of 610 to 621 feet MSL represents the full range of groundwater and River elevations since LNAPL has been present along the riverbank at the location of the proposed interim remedy and (2) LNAPL is not mobilized during flood events – actually any potential LNAPL mobility occurs during extremely low River levels as evidenced by the hydrocarbon sheen and LNAPL seeps observed north of Zink Dam starting in December 2022 for which this interim remedy is intended to address.

## **2.4 As-Built Survey**

As-Built details including post-construction survey data on the completed North of Zink Dam LNAPL Containment Cap will be included in the construction completion report that will be available following installation of the containment cap.

### 3.0 MONITORING PLAN & SCHEDULE

HFSTR will monitor the interim remedy as discussed in Section 3.1. The performance standard monitoring and any contingency actions conducted will be reported in the Semi-Annual Monitoring Reports (SMRs) that are submitted to DEQ. In the unlikely event that an intensive repair is ever necessary, HFSTR would submit a proposed repair to the DEQ for review.

#### 3.1 LNAPL Containment Cap Monitoring

Listed below are the procedures for routine monitoring of the North of Zink Dam LNAPL Containment Cap upon construction completion. Monitoring activities will be coordinated by HFSTR and with the lessee, RPA (as applicable), prior to completion. If possible, monitoring should be done during clear and calm conditions to allow for more accurate measurements. Routine North of Zink Dam LNAPL Containment Cap monitoring will be conducted quarterly for the first 10 years, semi-annually for the following 5 years and then annually for the following 15 years. Monitoring activities performed for the North of Zink Dam LNAPL Containment Cap will consist of the following:

- Visual Inspections – Walking the length of the North of Zink Dam LNAPL Containment Cap and visually inspecting to ensure cap integrity is maintained (e.g., looking for signs of erosion, presence of trees/shrubs starting to grow in restricted areas, significant cap settling, etc.). Any issues identified will be documented in the attached Routine O&M Form (Appendix B) and promptly addressed in an appropriate manner (e.g., repair of erosion area[s], removal of trees/shrubs in restricted areas and/or investigation and repair of cap where it settled).
- Hydrocarbon Sheen Monitoring – Hydrocarbon sheen monitoring is performed weekly as part of the RCRA permit and includes the location of the North of Zink Dam LNAPL Containment Cap. Visual observation of the surface water along the length of the North of Zink Dam LNAPL Containment Cap interface with the Arkansas River is performed to document that no hydrocarbon sheens are present in the area. If a hydrocarbon sheen is observed, Permit Condition III.J.6 will be implemented and further investigation on the origin of the hydrocarbon sheen may be performed. The presence of a hydrocarbon sheen will trigger the contingency plan in Section 5.2.
- LNAPL Measurement and Recovery – Proposed LNAPL collection Sumps 4 through 13, existing monitoring wells MW-280, MW-284, MW-310, MW-318, SOC-166/SX-166, SOC-166R, and SOC-167/SX-167, and proposed monitoring wells (MW-388 and MW-389) will be gauged for depth to LNAPL/water and LNAPL thickness, if present. Checking the collection sumps and monitoring wells for LNAPL accumulation will be performed using an electronic oil/water interface probe or oil absorbing material (e.g., PIG® Monitoring Well Skimming Sock). Use of an electronic oil/water interface probe is the preferred method to gauge for the absence/presence and, if present, thickness of LNAPL due to the accuracy of the meter.
  - LNAPL Measurement Procedure – The interface probe will be slowly lowered into the sump or well until the sounder beeps or the light-emitting diode (LED) illuminates. If LNAPL is

present, the beep will be continuous; when water is encountered the beep will be intermittent. The probe tape should be slowly lowered down the sump or well casing until an initial beep of LNAPL or water is detected. This measurement is then recorded. If LNAPL is detected first, the probe shall be slowly lowered further until tone changes from constant to intermittent, which indicates where the oil/water interface is. The measurements will be read from the tape to the nearest 0.01-foot increment and recorded on the Routine O&M Form (Appendix B). The meter will be decontaminated prior to and following each measurement.

If LNAPL (6-inch-thick layer or greater) is observed/measured in any of the collection sumps, the LNAPL in that sump will be recovered as described below (LNAPL recovery frequency will depend upon the rate of LNAPL accumulation, if any).

If any LNAPL (0.01-feet-thick layer or greater) is observed/measured in any of the sentinel well, the contingency plan in Section 5.2 will be triggered.

- LNAPL Recovery Procedure – The LNAPL sumps are designed to allow for a variety of recovery techniques to remove accumulated LNAPL. LNAPL removal will be coordinated by HFSTR, and consideration will be given to LNAPL disposal or recycling options (e.g., reinsertion into the refining process) prior to performing LNAPL removal. This information will be documented on the Recovery Log (Appendix B). Some common LNAPL removal methods include:
  1. Pumping the LNAPL with a small battery-operated pump (i.e., peristaltic or submersible) to a container (e.g., 5-gallon bucket) for transfer to a drum or other collection area.
  2. Removing LNAPL with oil absorbent socks that can be placed in the sumps to collect LNAPL over time and can be disposed of periodically.
  3. Pumping LNAPL with a drum-vacuum or vacuum truck using a hose inserted into the sump and extraction using high vacuum.
- Water Level Elevation – Surface water elevations will be measured from a location marked on the side of the concrete wall located downstream (south) of the cap.
  - Surface Water Level Measurement Procedure – First locate the measuring point on the concrete wall. Then measure and record the distance to the surface water level at the measuring point location to the nearest 0.01 foot. Record the measurement on the Routine O&M Form in Appendix B.

### **3.2 Monitoring Schedule**

Monitoring of the North of Zink Dam LNAPL Containment Cap will be conducted on the frequency described in Section 3.1. This Plan can be updated as the monitoring schedule changes over time.

## **4.0 MAINTENANCE**

### **4.1 LNAPL Containment Cap Maintenance**

The design of the North of Zink Dam LNAPL Containment Cap is such that no routine maintenance is required; however, future maintenance may be needed if the cap becomes damaged or altered. Physical damage due to impact from a boat or other large object, or as a result of natural forces like significant storms, ice, flooding, or erosion/scouring can require maintenance or repair. All maintenance activities will be coordinated with HFSTR and the lessee, RPA (as applicable), prior to completion.

The typical maintenance items for the cap may include the following:

- Removal of trees and shrubs from the cap
- Replacing/regrading rip rap rock cover
- Replacing or mending the ABM
- Mending the geogrid layer
- Repairing the AquaBlok® layer

If any of the items listed above require maintenance or repair, the work will be done in accordance with the original design specifications and construction as described in the attached Plan Set and the construction completion report. All maintenance and/or repairs completed will be recorded in the Maintenance Log (Appendix B).

### **4.2 LNAPL Sump Maintenance**

The LNAPL sumps will require some maintenance over the long-term to keep them in proper working order. The following items will be maintained as needed:

- Keep the sump covers free from overlying materials and vegetation so they remain visible and accessible.
- Clean the bolts and threads on the flush mount sump covers and locks at least annually.
- Replace stripped, rusted, or missing bolts for the flush mount sump covers.
- Clean the expansion plug's rubber gasket and replace if/when the plug no longer seals tightly.
- Remove accumulated water in the flush mount wellhead casing to prevent backflowing into the sump or freezing in the winter months.

## **5.0 PERFORMANCE STANDARDS AND CONTINGENCY PLANS**

### **5.1 Performance Standards**

The North of Zink Dam LNAPL Containment Cap is designed to achieve the following performance standard:

1. No visible hydrocarbon sheen or LNAPL observed in the Arkansas River adjacent to the North of Zink Dam LNAPL Containment Cap during weekly inspections.
2. No notable increase in LNAPL thicknesses detected in downgradient sentinel monitoring wells MW-318 and SOC-167/SX-167.
3. No LNAPL detected in upgradient sentinel monitoring wells MW-388 and MW-389.

Construction of the interim remedy as designed, and the monitoring and maintenance of the interim remedy as described above in Sections 3 and 4, should enable the North of Zink Dam LNAPL Containment Cap to achieve these performance standards. The following Section 5.2 further describes these performance standards and a contingency plan if there are observations of hydrocarbon sheen and/or LNAPL on the surface water, notable increases in LNAPL thicknesses at downgradient sentinel monitoring wells MW-318 or SOC-167/SX-167 or LNAPL in upgradient sentinel monitoring wells MW-388 or MW-389.

HFSTR will provide updates on achieving these performance standards and any contingency actions conducted in the SMRs that are submitted to DEQ.

### **5.2 LNAPL Containment Cap Contingency Plan**

The purpose of the North of Zink Dam LNAPL Containment Cap contingency plan is to identify how to address a scenario where hydrocarbon sheen and/or LNAPL are observed on the surface water in the vicinity of the North of Zink Dam LNAPL Containment Cap, notable increases in LNAPL thicknesses are observed in downgradient sentinel monitoring wells MW-318 or SOC-167/SX-167, or LNAPL is observed in upgradient sentinel monitoring wells MW-388 or MW-389. The primary purpose of the North of Zink Dam LNAPL Containment Cap remedial action is to mitigate the potential for hydrocarbon sheens and LNAPL seeps from forming along the bank of the Arkansas River in the vicinity of the North of Zink Dam LNAPL Containment Cap. The effectiveness of the interim remedy will be monitored as described in Section 3 of this Plan to determine if the performance standards in Section 5 of this Plan are being achieved. This contingency plan is provided for implementation if any of the performance standards are not achieved. Contingency actions will be coordinated by HFSTR and with the lessee, RPA (as applicable), prior to completion.



1. Observable Hydrocarbon Sheen in the River – If hydrocarbon sheen is observed in the surface water along the length of the North of Zink Dam LNAPL Containment Cap, Permit Condition III.J.6 will be implemented, and additional observations may be made to identify potential source(s) of the hydrocarbon sheen. If the hydrocarbon sheen appears to originate from the reach of bank adjacent to the cap, then the initial action will be to conduct a visual inspection of the North of Zink Dam LNAPL Containment Cap integrity. If the hydrocarbon sheen occurs in a sufficient quantity to sample, then a secondary action may be to collect a sample of the hydrocarbon sheen for forensic analysis to determine if the hydrocarbon sheen is related to the LNAPL identified in this area (baseline data collection was conducted prior to design and implementation of the interim remedy and is summarized in the Corrective Action Plan submitted in July 2021 [TRC, 2021a]). After a determination is made, HFSTR will consider next steps based upon the outcome of the analysis as presented below:
  - Hydrocarbon Sheen not HFSTR-related (No Contingency Needed) – If the hydrocarbon sheen is determined to be emanating from a source other than the plumes associated with HFSTR, no additional response activities are recommended and HFSTR will continue routine monitoring for the North of Zink Dam LNAPL Containment Cap; however, notification of the observation will be communicated to DEQ.
  - Hydrocarbon Sheen is HFSTR-related (Contingency Plan Triggered) – If the investigation indicates that the hydrocarbon sheen is related to plumes associated with HFSTR, a contingency plan will be triggered. An evaluation to determine the appropriate course of action will be performed; the contingency plan will be communicated to DEQ.
2. Observed Notable Increase in LNAPL Thickness in Downgradient Sentinel Wells – Downgradient existing sentinel monitoring wells MW-318 and SOC-167/SX-167 will be used to evaluate the potential migration of LNAPL around the south end of the North of Zink Dam LNAPL Containment Cap. The locations of North of Zink Dam LNAPL Containment Cap downgradient sentinel wells MW-318 or SOC-167/SX-167 are shown on Figure 4. Observation of a notable increase in LNAPL thickness in these wells could indicate the potential migration of LNAPL around the southern end of the North of Zink Dam Containment Cap and Collection System.

If a notable increase in LNAPL thickness is observed in either of the two downgradient sentinel monitoring wells, additional observations should be made to confirm the notable increase in LNAPL thickness in the well. If the notable increase in LNAPL thickness is confirmed, a sample of the LNAPL may be collected and submitted for forensic analysis to determine if the LNAPL is associated with plumes from HFSTR (baseline data collection was conducted prior to design and implementation of the interim remedy and is summarized in the Corrective Action Plan submitted in July 2021 [TRC, 2021a]). The results of forensic analysis will be communicated to DEQ, and a plan will be developed as appropriate. After a determination is made, HFSTR will consider next steps based upon the outcome of the analysis as presented below:

- Notable increase in LNAPL thickness in Downgradient Sentinel Monitoring Well is not HFSTR-related (No Contingency Needed) – If a notable increase in LNAPL thickness is observed in either downgradient sentinel monitoring well and the LNAPL increase is determined to be associated with a source other than HFSTR, no additional response activities are recommended and HFSTR will continue routine monitoring for the North of Zink Dam LNAPL Containment Cap; however, notification of the observation will be communicated to DEQ and HFSTR may conduct follow-up of the non-HFSTR related LNAPL.
  - Notable increase in LNAPL thickness in Downgradient Sentinel Monitoring Well is HFSTR-related (Contingency Plan Triggered) – If analysis or other evaluation indicates that the notable increase in LNAPL thickness is related to HFSTR, prompt notification will be provided to DEQ. A new monitoring well may be installed to the south (downgradient) of downgradient sentinel monitoring well MW-318. Visual observation for hydrocarbon sheen along the riverbank downstream of the North of Zink Dam LNAPL Containment Cap will be increased in accordance with Permit Condition III.J.6. Changes to the visual observation frequency will be noted in the SMRs.
3. Observed LNAPL in Upgradient Sentinel Wells – Upgradient sentinel monitoring wells MW-388 and MW-389 will be installed at the top of the riverbank to evaluate the potential migration of LNAPL around the north end of the North of Zink Dam LNAPL Containment Cap. The locations of the North of Zink Dam LNAPL Containment Cap proposed upgradient sentinel wells MW-388 and MW-389 are shown on Figure 4. Sentinel monitoring wells MW-388 and MW-389 will be installed after installation of the North of Zink Dam LNAPL Containment Cap. Assuming no LNAPL is identified in these monitoring wells immediately after well installation, observation of LNAPL in these wells could indicate the potential migration of LNAPL around the northern end of the North of Zink Dam Containment Cap and Collection System.

If LNAPL is observed in either of the two upgradient sentinel monitoring wells, additional observations should be made to confirm the presence of LNAPL in the well. If the presence of LNAPL is confirmed, a sample of the LNAPL may be collected and submitted for forensic analysis to determine if the LNAPL is associated with plumes from HFSTR (baseline data collection was conducted prior to design and implementation of the interim remedy). The results of forensic analysis will be communicated to DEQ, and a plan will be developed as appropriate. After a determination is made, HFSTR will consider next steps based upon the outcome of the analysis as presented below:

- LNAPL observed in Upgradient Sentinel Monitoring Well is not HFSTR-related (No Contingency Needed) – If LNAPL is observed in either upgradient sentinel monitoring well and the LNAPL is determined to be emanating from a source other than HFSTR, no additional response activities are recommended and HFSTR will continue routine monitoring for the North of Zink Dam LNAPL Containment Cap; however, notification of the observation

- will be communicated to DEQ and HFSTR may conduct follow-up of the non-HFSTR related LNAPL.
- LNAPL observed in Upgradient Sentinel Monitoring Well is HFSTR-related (Contingency Plan Triggered) – If analysis or other evaluation indicates that the LNAPL is related to HFSTR, prompt notification will be provided to DEQ. A new monitoring well may be installed to the north (upgradient) of upgradient sentinel monitoring well MW-388. Visual observation for hydrocarbon sheen along the riverbank downstream of the North of Zink Dam LNAPL Containment Cap will be increased in accordance with Permit Condition III.J.6. Changes to the visual observation frequency will be noted in the SMRs.

## 6.0 REFERENCES

HollyFrontier Tulsa Refinery (HFTR). 2021a. Conceptual Design for Interim Remedy to Mitigate Hydrocarbon Sheen as submitted to the Oklahoma Department of Environmental Quality. April 2, 2021.

HFTR. 2021b. Class 2 Permit Modification Request. December 10, 2021.

HFTR. 2022. Class 2 Permit Modification Request, Response to DEQ Letter (February 2, 2022). February 16, 2022.

Hull. 2018. Solid Waste Management Unit-H / River Parks Authority Perimeter Investigation Report. February 2018.

Oklahoma Department of Environmental Quality (DEQ). 2022. Class 2 Permit Modification Request. April 28, 2022.

TRC. 2021a. Corrective Action Plan. July 2021.

TRC. 2021b. Conceptual Site Model. July 2021.

United States Environmental Protection Agency (U.S. EPA). Light Nonaqueous Phase Liquids. July 1995. (EPA/540/S-95/500)

## Figures

Figure 1. Site Location

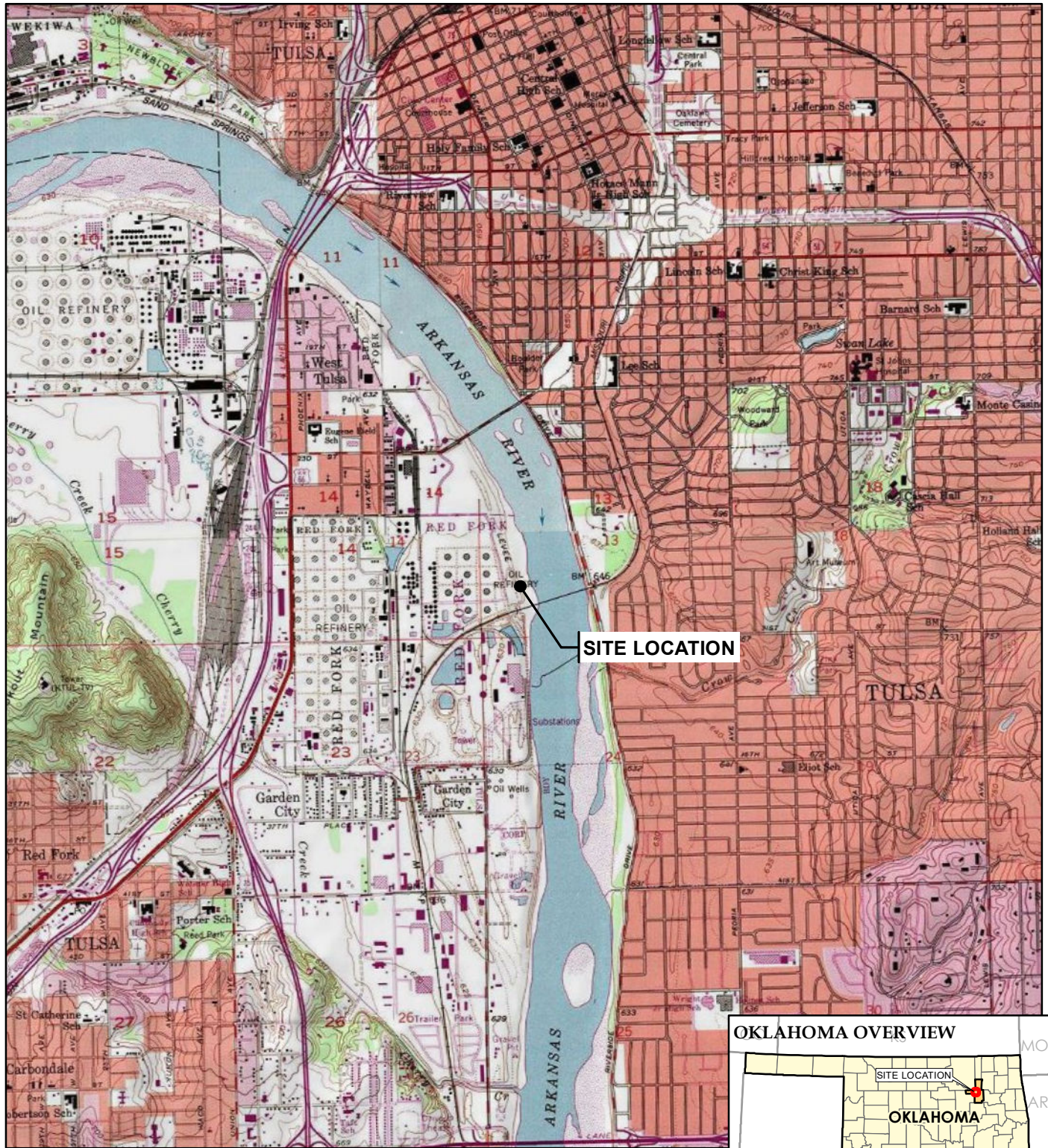
Figure 2. HFSTR North of Zink Dam Containment Cap Conceptual Location

Figure 3. HFSTR North of Zink Dam Containment Cap Conceptual Cross Section

Figure 4. Monitoring Well and Sump Locations

Figure 5. Groundwater and River Stage Elevation Graph





BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.



999 Fourier Drive  
Suite 101  
Madison, WI 53717  
Phone: 608.826.3663

TRC - GIS

PROJECT:

**HFSTR NORTH OF ZINK DAM  
LNAPL CONTAINMENT CAP, TULSA, OKLAHOMA**

TITLE:

**SITE LOCATION**

DRAWN BY:

A. FOJTIK

CHECKED BY:

A. RUETTEN

APPROVED BY:

K. VATER

DATE:

JANUARY 2023

PROJ. NO.:

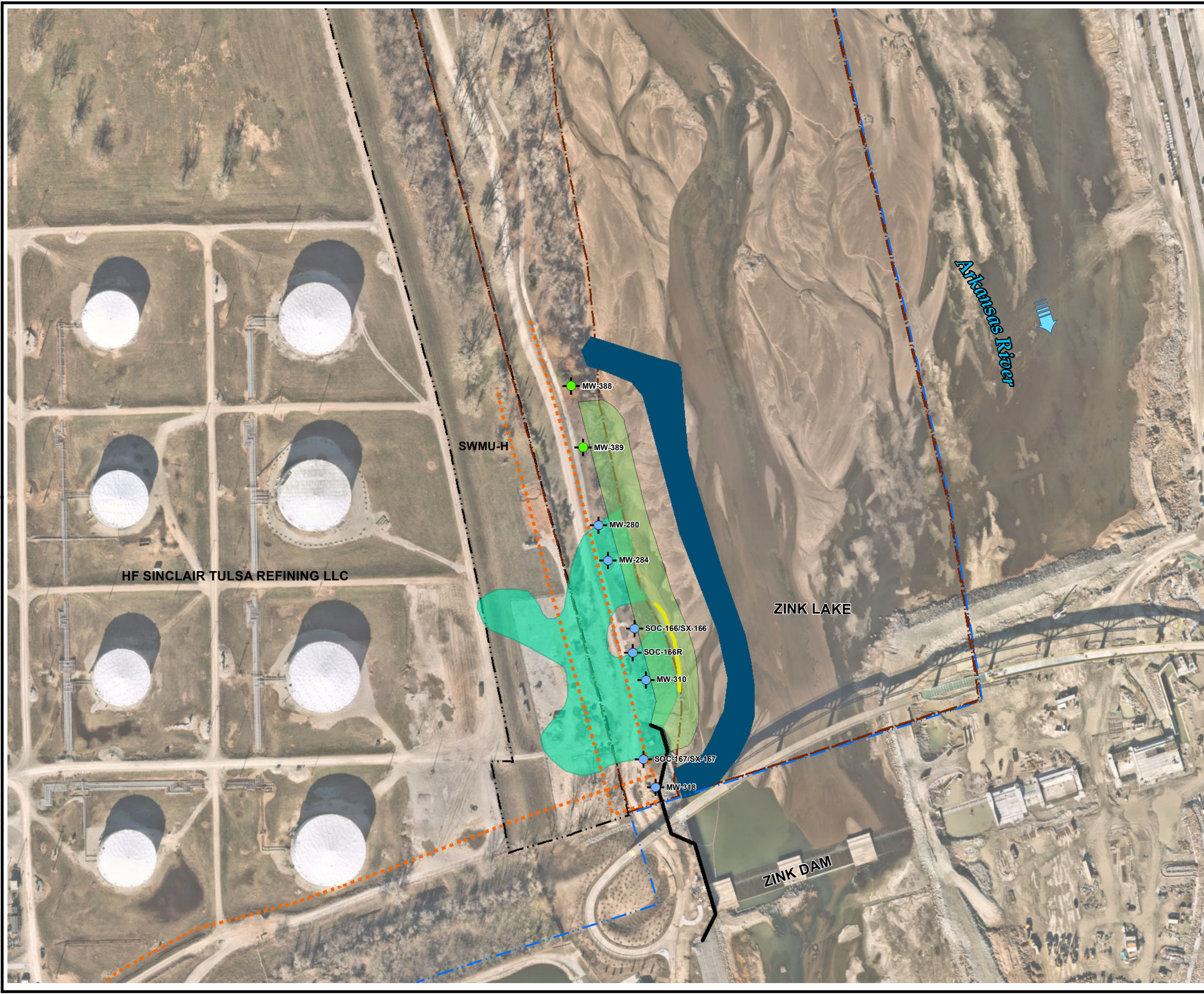
525252

FILE:

525252\_SLM.mxd

**FIGURE 1**





**LEGEND**

- PROPOSED CONTAINMENT CAP EXTENT (750 FEET ALONG TOP OF BANK)
- RIVER PARKS AUTHORITY LEASED AREA
- SWMU-H BOUNDARY
- APPROXIMATE HFSTR PROPERTY BOUNDARY
- COFFER DAM (~1,100 FEET ALONG CENTERLINE)
- SWMU-H/RPA LNAPL PLUME 2
- MONITORING WELL
- PROPOSED MONITORING WELL
- EXISTING CONCRETE WALL - PROVIDES BARRIER (NOT DESIGNED AS REMEDY)
- APPROXIMATE HYDROCARBON SHEEN/LNAPL SEEP LOCATION IDENTIFIED DECEMBER 2022
- BARRIER WALL

**NOTES**

1. IMAGERY SOURCE: NEARMAP, DECEMBER 2022.

0100200

Feet

1" = 200'

1:2,400

PROJECT:

HFSTR NORTH OF ZINK DAM  
LNAPL CONTAINMENT CAP, TULSA, OKLAHOMA

TITLE:

CONCEPTUAL PLAN

DRAWN BY: A. FOJTIK

CHECKED BY: A. RUETTEN

APPROVED BY: K. VATER

DATE: JANUARY 2023

PROJ NO.: 525252

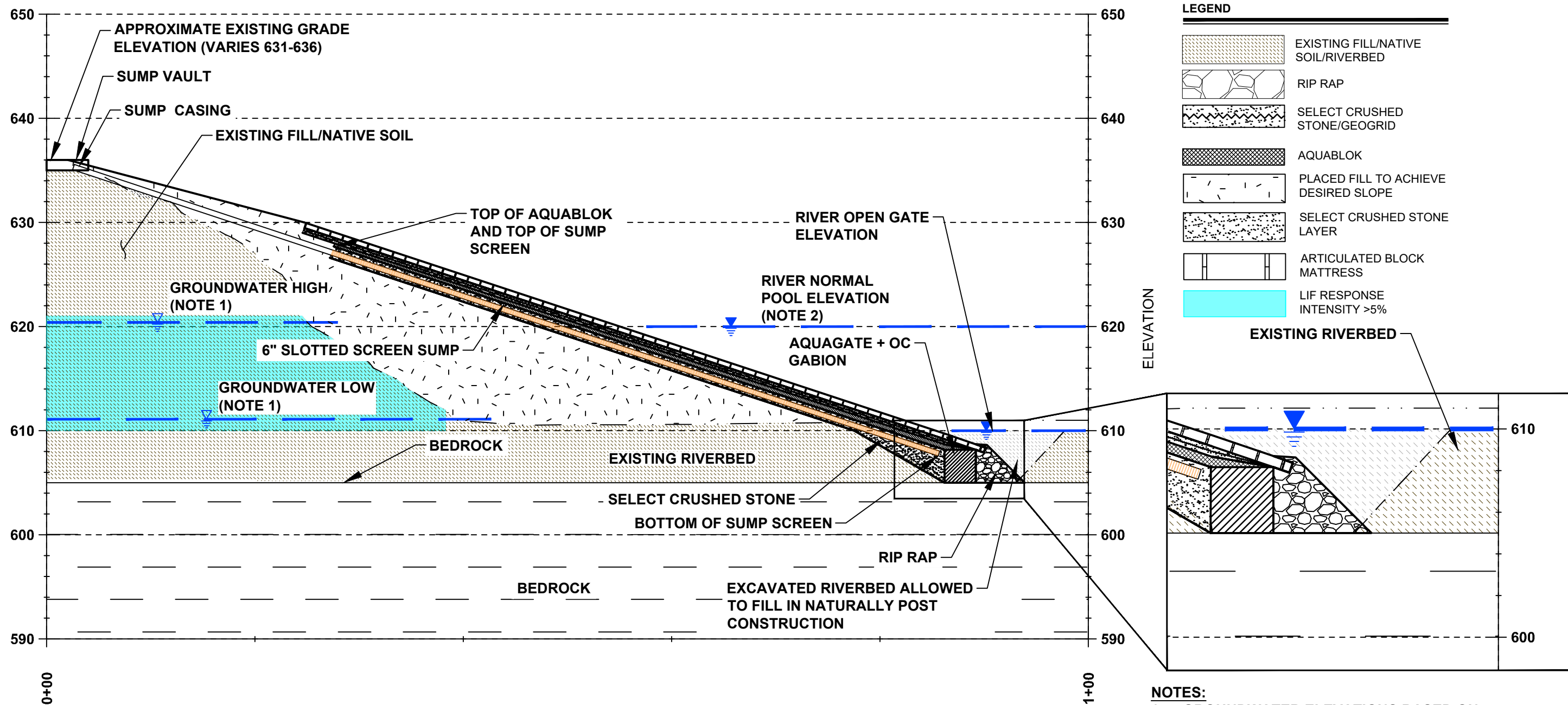
FIGURE 2

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Madison, WI 53717  
Phone: 608.826.3663  
www.TRCcompanies.com

FILE NO.: 525252\_Fig2.mxd



11x17 -- USER: T:\Users\T... Sump Sections -- ATTACHED REF: Sump Sections -- ATTACHED IMAGES  
DRAWING NAME: J:\Holly\Tortier\Tulsa\525252 - north shien remed\0001 - SUMP SECTIONS.dwg -- PLOT DATE: March 02, 2023 - 12:19PM -- LAYOUT: CONCEPTUAL CROSS SECTION WITH LIF  
Version: 2017-10-21



THIS DRAWING IS NOT INTENDED FOR BIDDING OR CONSTRUCTION. FEATURES SHOWN ARE APPROXIMATE

- NOTES:**
- 1. GROUNDWATER ELEVATIONS BASED ON HISTORICAL DATA FROM MONITORING WELLS ALONG THE RIVERBANK.
  - 2. NORMAL POOL ELEVATION OF 620 FEET BASED ON COMPLETION OF ZINK DAM AND GATES FULLY CLOSED.



PROJECT:  HFSTR NORTH OF ZINK DAM LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM TULSA, OKLAHOMA	DRAWN BY:	T. FIEBRANZ
	CHECKED BY:	M. VENNE
	APPROVED BY:	J. RICE
	DATE:	MARCH 3, 2023
	PROJ. NO.:	525252.0000
	FILE:	525252 - SUMP SECTIONS.dwg
TITLE:  CONCEPTUAL CROSS SECTION	FIGURE 3	





**LEGEND**

- CONTAINMENT CAP EXTENT
- EXISTING CONCRETE WALL - PROVIDES BARRIER (NOT DESIGNED AS REMEDY)
- LNAPl COLLECTION SUMP
- MONITORING WELL
- PROPOSED MONITORING WELL
- PROPOSED SUMP LOCATION
- RIVER STAGE MEASUREMENT LOCATION

**NOTES**

1. IMAGERY SOURCE: NEARMAP, DECEMBER 2022.

050100

Feet

1" = 100'

1:1,200

PROJECT:

HFSTR NORTH OF ZINK DAM  
LNAPl CONTAINMENT CAP, TULSA, OKLAHOMA

TITLE:

MONITORING WELL AND  
SUMP LOCATIONS

DRAWN BY: A. FOJTIK

PROJ NO.: 525252

CHECKED BY: A. RUETTEN

APPROVED BY: K. VATER

DATE: MARCH 2023

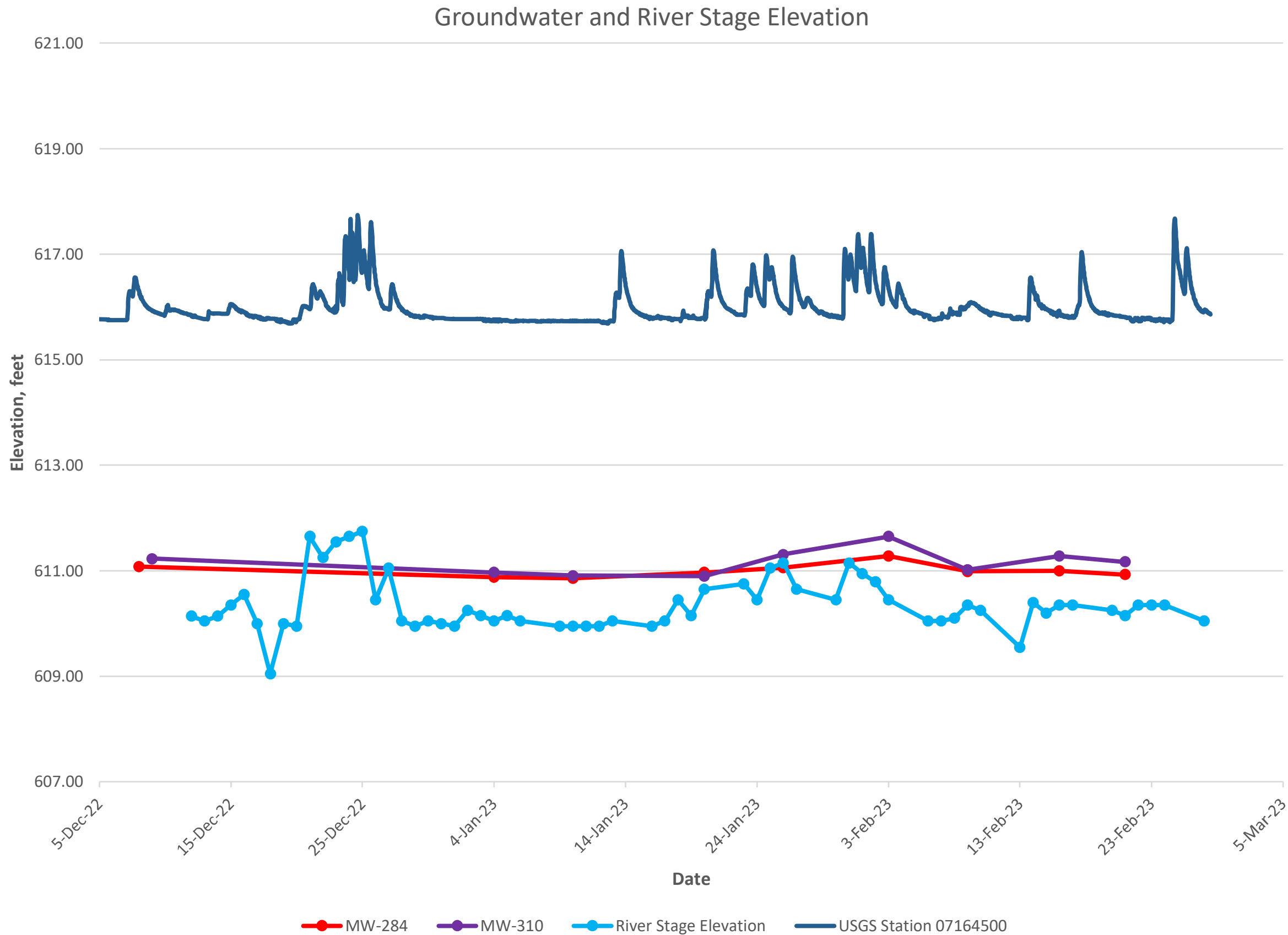
FIGURE 4


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FILE NO.:

525252\_Fig4.mxd





PROJECT:		<b>HFSTR NORTH OF ZINK DAM LNAPL CONTAINMENT CAP, TULSA, OKLAHOMA</b>	
TITLE:		<b>GROUNDWATER AND RIVER STAGE ELEVATION GRAPH</b>	
DRAWN BY:	A. FOJTIK	PROJ NO.:	525252
CHECKED BY:	M. VENNE	<b>FIGURE 5</b>	
APPROVED BY:	K. VATER		
DATE:	JANUARY 2023		
		999 Fourier Drive, Suite 101 Madison, WI 53717 Phone: 608.826.3663 www.TRCompanies.com	
FILE NO.:		525252_Fig5.mxd	

**Appendix A. HFSTR North of Zink Dam Containment Cap and Collection System  
Plan Set (March 2023)**



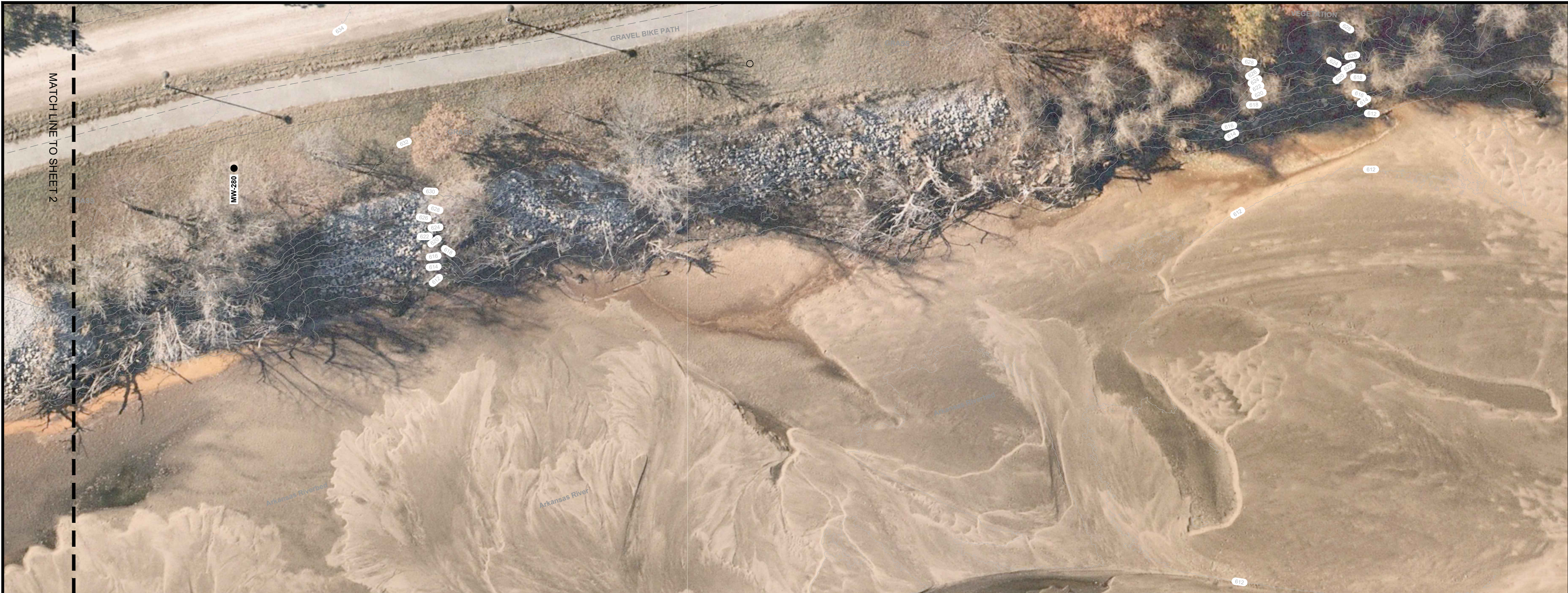








22634 -- USER: Tfidemc -- ATTACHED REF'S: EX Site Features: EX Monitoring Wells, EX EG - CONTOURS: Aerial Image Nearmap 2 email: PR - XR - Eriean Contol -- ATTACHED IMAGES: EPS525267 Date:20221217, Laid: 120917, Lon: 96.992000, Mpd: 0.75, EPS525267 Date:20221217, Laid: 124899, Lon: 96.982043, Mpd: 0.75; DRAWING NAME: J:\holy fontent\Tulsa\525252 - north shreen remedy\0000 525252 - EX Conditions.dwg -- PLOT DATE: March 03, 2023 - 10:43AM --- LAYOUT: EC - Sheet 2



#### EXISTING CONDITIONS



#### BOTTOM OF COLLECTION LAYER GRADING

#### TOPOGRAPHIC LEGEND

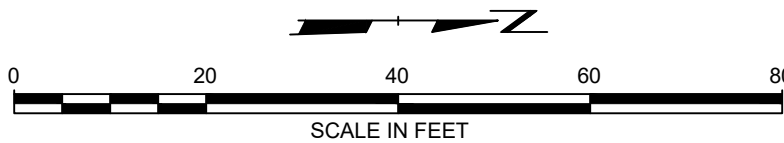
- |   |                 |         |                        |
|---|-----------------|---------|------------------------|
| ● | MONITORING WELL | — GAS — | ONG GAS LINE           |
| ☆ | LIGHT POLE      | — 625 — | GROUND SURFACE CONTOUR |
|   |                 | ~~~~~   | TREE DRIP LINE         |
|   |                 | -----   | EXISTING GRAVEL        |
|   |                 | =====   | COLLECTION SUMP        |
|   |                 | =====   | CONSTRUCTION LIMITS    |


#### SURVEY CONTROL

ON SITE HORIZONTAL AND VERTICAL CONTROL SET BY LEMKE LAND SURVEYING				
60003	413777.307	2561968.915	630.84	SET 60D NAIL
60004	413613.207	2561931.989	634.23	SET 60D NAIL
BM 1678	413887.783	2562028.026	630.50	BM CUT BOX
HORIZONTAL CONTROL DATUM: OKLAHOMA STATE PLANE NAD83 (2011) NORTH ZONE 3501				
VERTICAL CONTROL NAVD88				
CONTROL POINTS LISTED ARE NOT DISPLAYED WORK AREA ADDITIONAL CONTROL POINTS MAY BE REQUIRED BY CONTRACTOR DURING CONSTRUCTION				

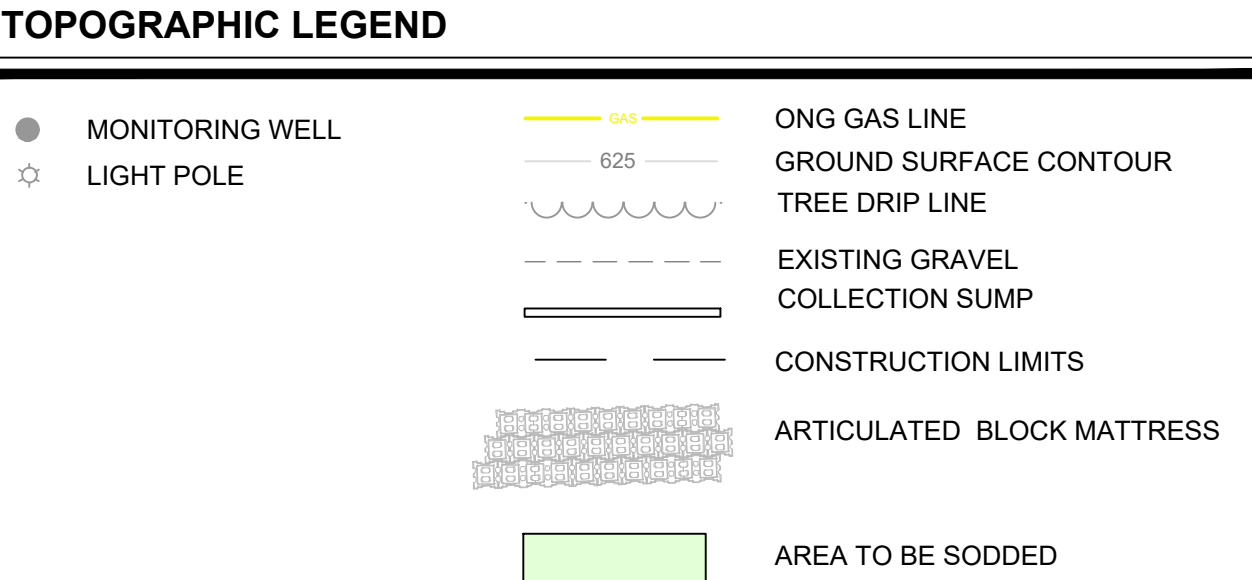
#### NOTES

- LOCATION OF FEATURES IS APPROXIMATE AND BASED ON NEARMAP AERIAL DATED DECEMBER 2022.
- TOPOGRAPHIC CONTOURS FROM LIDAR SURVEY CONDUCTED BY CROSSLAND CONSTRUCTION COMPANY, INC. ON 12/20/2022. TOPOGRAPHY IN HIGH VEGETATIVE AREAS SHOULD BE FIELD VERIFIED.
- PROTECT EXISTING MONITORING WELLS (MW-280, MW-284, MW-310, MW-318, SOC-166/SX-166, SOC-166R, SOC-167/SX-167) FROM DAMAGE DURING CONSTRUCTION.
- BIKE PATH WILL BE CLOSED BY OTHERS DURING THE WORK WITH POSSIBLE LIMITED ONE-DAY REQUIRED OPENINGS. CONTRACTOR WILL BE NOTIFIED OF OPENINGS PRIOR TO OCCURRENCE.
- INSTALL SITE CONTROLS AROUND WORK AREA/CONSTRUCTION LIMITS.
- REMOVE TREES AND VEGETATION IN WORK AREA PRIOR TO BEGINNING FILL ACTIVITIES.
- REMOVE AND STOCKPILE RIPRAP FOR FUTURE USE.
- PROTECT TREES ALONG BIKE PATH DURING WORK UNLESS OTHERWISE DIRECTED BY HFSTR. MINIMIZE OPERATING OF HEAVY EQUIPMENT WITHIN DRIPLINE OF TREES TO BE SAVED.
- UTILITY LOCATIONS ARE APPROXIMATE. A NATURAL GAS PIPELINE CROSSES THE ARKANSAS RIVER. CONTRACTOR TO HORIZONTALLY AND VERTICALLY LOCATE UTILITIES PRIOR TO START OF WORK AND PERIODICALLY THROUGHOUT THE PROJECT.
- TEN COLLECTION SUMPS TO BE INSTALLED WITHIN THE COLLECTION LAYER. SEE DETAIL 1/13 FOR INSTALLATION DETAILS.
- PLACE CLEAN FILL MATERIAL TO ACHIEVE INDICATED GRADE PRIOR TO BUILDING CAP LAYERS.



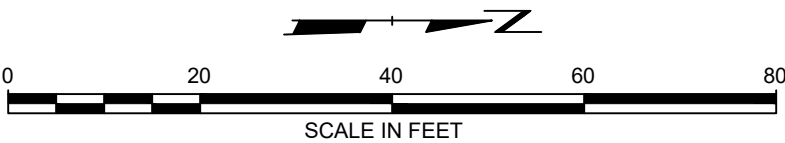
PROJECT: HFSTR NORTH OF ZINK DAM LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM TULSA, OKLAHOMA		
TITLE: EXISTING CONDITIONS AND COLLECTION LAYER GRADING		
DRAWN BY: T. FIEBRANZ	PROJ. NO.: 525252.0000	SHEET 3 OF 16
CHECKED BY: M. VENNE		
APPROVED BY: J. RICE		
DATE: MARCH 3, 2023		
		999 Fourier Drive Suite 101 Madison, WI 53717 Phone: 608.926.3600
FILE NO.:	525252 - EX Conditions.dwg	





ON SITE HORIZONTAL AND VERTICAL CONTROL SET BY LEMKE LAND SURVEYING				
60003	4137777.307	2561968.915	630.84	SET 60D NAIL
60004	413613.207	2561931.989	634.23	SET 60D NAIL
BM 1678	413887.783	2562028.026	630.50	BM CUT BOX
HORIZONTAL CONTROL DATUM: OKLAHOMA STATE PLANE NAD83 (2011) NORTH ZONE 3501				
VERTICAL CONTROL NAVD88				
CONTROL POINTS LISTED ARE NOT DISPLAYED WORK AREA ADDITIONAL CONTROL POINTS MAY BE REQUIRED BY CONTRACTOR DURING CONSTRUCTION				

1. PROPOSED CONTOURS REPRESENT THE TOP OF THE ARTICULATED BLOCK MATRESS AND FINISHED GRADE.
2. TEN COLLECTION SUMPS TO BE INSTALLED WITHIN THE COLLECTION LAYER. SEE DETAIL (A) FOR INSTALLATION DETAILS.
3. RESTORE DISTURBED AREAS BY GRADING TO MATCH SURROUNDING GRADES AND PLACING TOPSOIL IN THE TOP 24" AND SOD. USE CLEAN FILL MEETING THE REQUIREMENTS OF SPECIFICATIONS SECTIONS 9 AND 11 FOR ALL AREAS OUTSIDE OF THE ARTICULATED BLOCK MAT.
4. SUBSURFACE LAYERS ARE NOT SHOWN FOR CLARITY. REFER TO CROSS SECTIONS ON SHEETS 6 TO 11 FOR CONTAINMENT CAP LAYERS.



TITLE: **ARTICULATED BLOCK MATTRESS GRADING**



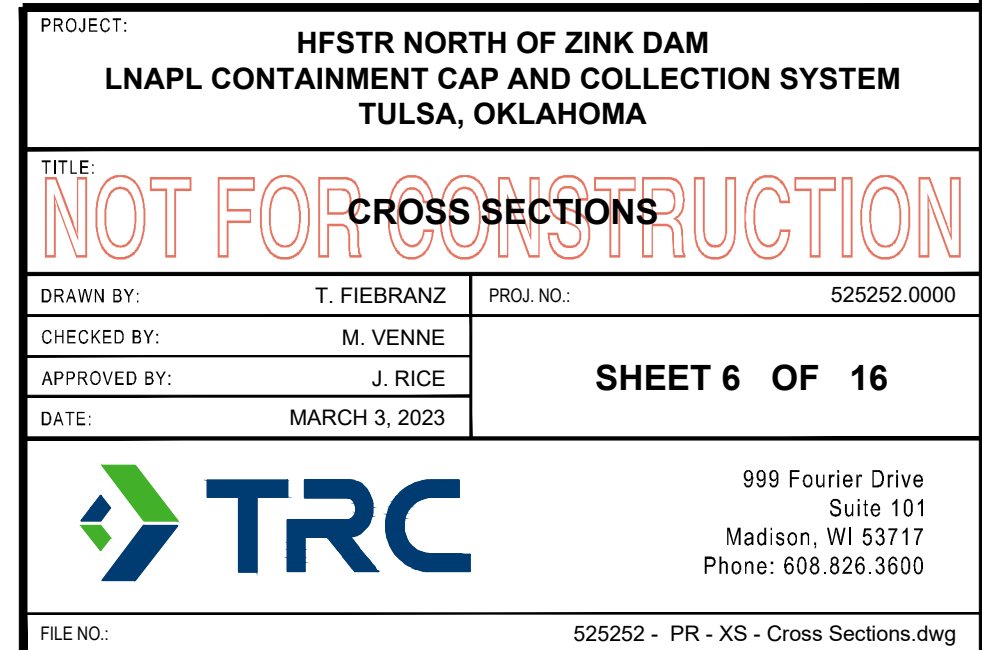
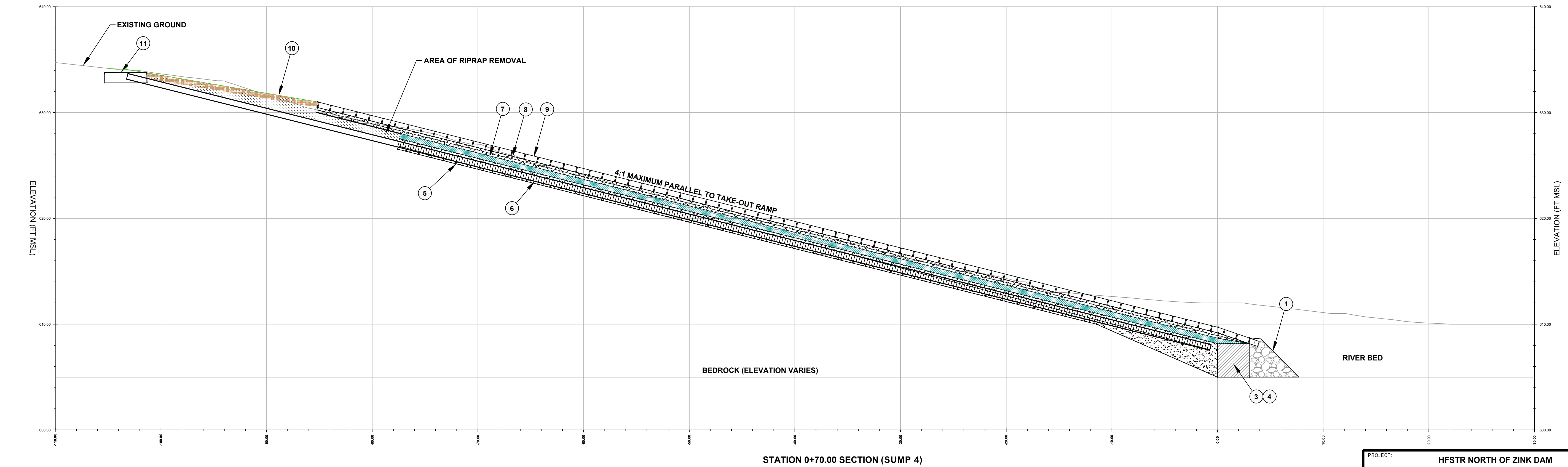
999 Fourier Drive  
Suite 101  
Madison, WI 53717  
Phone: 608.826.3600

FILE NO.: 525252 - PR - Articulated Block Layer.dwg



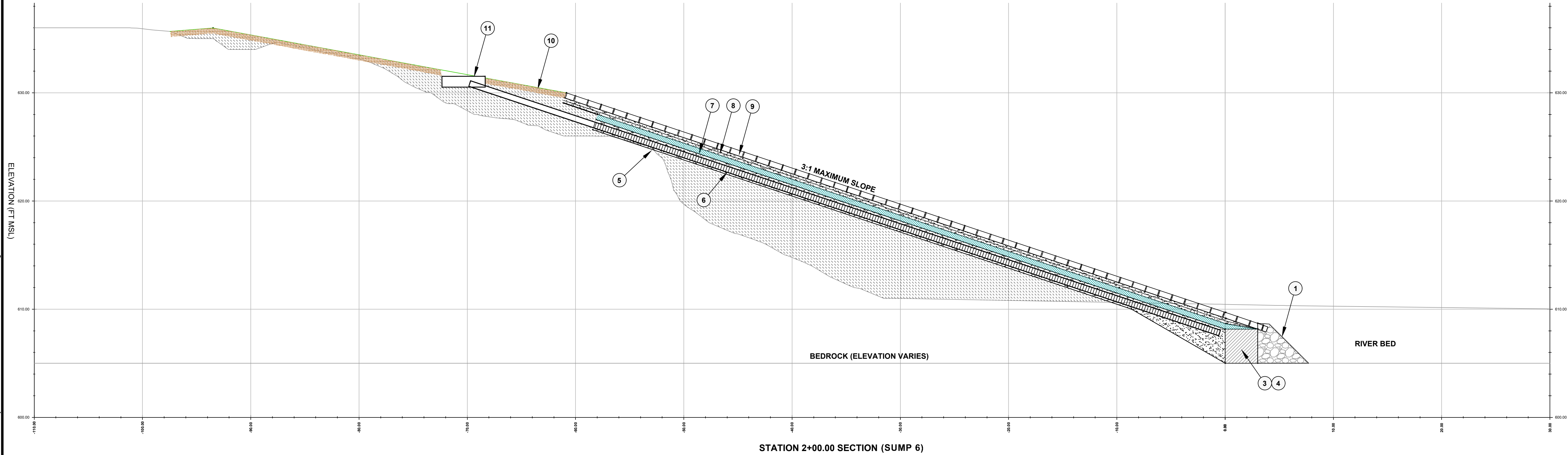
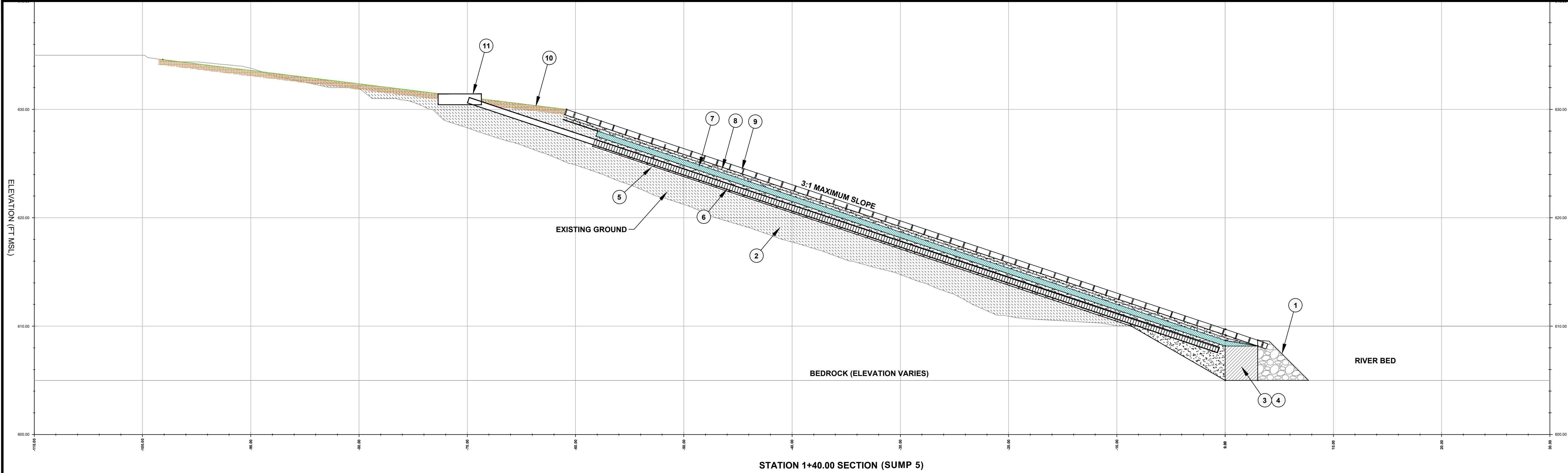








22634 -- USER: Trianz -- ATTACHED REFS: EX-Site Features: EX-Monitoring Wells, EX-EG - CONTOURS, PR - Design Cross Sections -- ATTACHED IMAGES: DRAWING NAME: J:\holy trinity\Tulsa\525252 - north sheet remed\00001.525252 - PR - XS - Cross Sections.dwg -- PLOT DATE: March 03, 2023 - 10:44AM -- LAYOUT: XS - Sheet 2

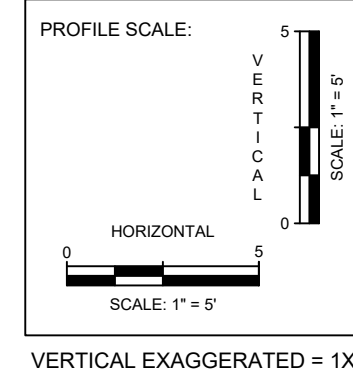


#### NOTES

- RIPRAP ARMORMENT. ANGLE OF REPOSE OF RIP RAP SHOWN AS 1:1. EXTEND RIPRAP OVER FIRST BLOCK OF ARTICULATED BLOCK MATTRESS. PLACE RIP RAP IN 1:1 SLOPE ALONG TOE OF CAP AS MATERIAL ALLOWS.
- CLEAN FILL. REMOVE ALL DEBRIS/VEGETATION/ROCK (GREATER THAN 12-INCHES IN DIMENSION). SMOOTH NATIVE SOILS AND PROVIDE CLEAN FILL TO GRADE OF BASE OF COLLECTION LAYER. ALL CONCRETE, WOOD, AND NON-ROCK DEBRIS SHALL BE CONTAINERIZED FOR OFF-SITE DISPOSAL IN ACCORDANCE WITH THE SPECIFICATIONS. ROCK DEBRIS CAN BE PLACED INTO THE DIVERSION STRUCTURE AND REMAIN ON-SITE. CONCRETE DEBRIS CAN REMAIN AND BE GRADED AS LONG AS IT IS CRUSHED TO LESS THAN 12-INCHES IN DIMENSION. CLEAN FILL SHALL MEET THE REQUIREMENTS OF SPECIFICATION PART 11.
- CAP TOE VENT. BEDROCK ELEVATION VARIES. REMOVE RIVERBED SAND/FILL AS REQUIRED TO PLACE GABION DIRECTLY ON BEDROCK SURFACE. PLACE 2 INCHES OF AQUABLOK® BENEATH GABION TO LEVEL AND SECURE THE GABION. SEE SHEET 12, DETAIL 2 FOR TYPICAL DETAILS.
- GALVANIZED WIRE GABION BASKET. FILL EACH GABION WITH AQUAGATE®+OC. SEE SHEET 12, DETAIL 3 FOR TYPICAL DETAILS.
- COLLECTION LAYER. IN GENERAL, COLLECTION LAYER SHALL BE 12 INCHES OF SELECT CRUSHED STONE FILL (SPECIFICATIONS PART 13.D.4). GRADUALLY INCREASE THICKNESS TO FULL HEIGHT OF GABION STARTING A MAXIMUM OF 10 FEET HORIZONTALLY FROM GABION. COLLECTION LAYER SHALL EXTEND UP SLOPE TO AN ELEVATION OF 628 FT MSL.
- PRODUCT RECOVERY SUMP. INSTALL 6-INCH DIAMETER SUMP SOLELY WITHIN THE COLLECTION LAYER WITH A 3 INCHES OF SELECT CRUSHED STONE ABOVE AND BELOW THE SUMP. SUMP SCREEN SHALL EXTEND FROM THE GABION AT ELEVATION OF 608 TO 627. SUMP CASING SHALL EXTEND FROM THE COLLECTION LAYER TO THE VAULT.
- AQUABLOK LAYER. PLACE 6-INCH AQUABLOK LAYER ON TOP OF COLLECTION LAYER. AT TOP ELEVATION OF 628.
- BEDDING LAYER. PLACE 3 INCHES OF SELECT CRUSHED STONE ON TOP OF AQUABLOK. PLACE GEOGRID, FOLLOWED BY ANOTHER 3 INCHES OF SELECT CRUSHED STONE. BEDDING LAYER SHALL EXTEND UP THE SLOPE TO AN ELEVATION OF 630 FT MSL.
- ARTICULATED BLOCK MATTRESS. PLACE ARTICULATED BLOCK MATTRESS ON TOP OF BEDDING LAYER. TO A TOP ELEVATION OF 630 FT.
- SOD RESTORATION. RESTORE DISTURBED AREAS ABOVE ARTICULATED BLOCK MATTRESS WITH CLEAN FILL GRADED TO MATCH EXISTING SURFACE. FINISH DISTURBED SURFACES WITH TOPSOIL AND SOD.
- SUMP VAULT. INSTALL SUMP VAULT AT THE GROUND SURFACE AT PRODUCT RECOVERY SUMP HEAD. SUMP CASING SHALL PROTRUDE A MINIMUM OF 6 INCHES WITHIN THE SUMP. MAINTAIN A MINIMUM OF 48 INCHES OF CLEARANCE IN FRONT OF THE SUMP AND 4 INCHES OF CLEARANCE ON EACH SIDE OF THE SUMP.

#### LEGEND

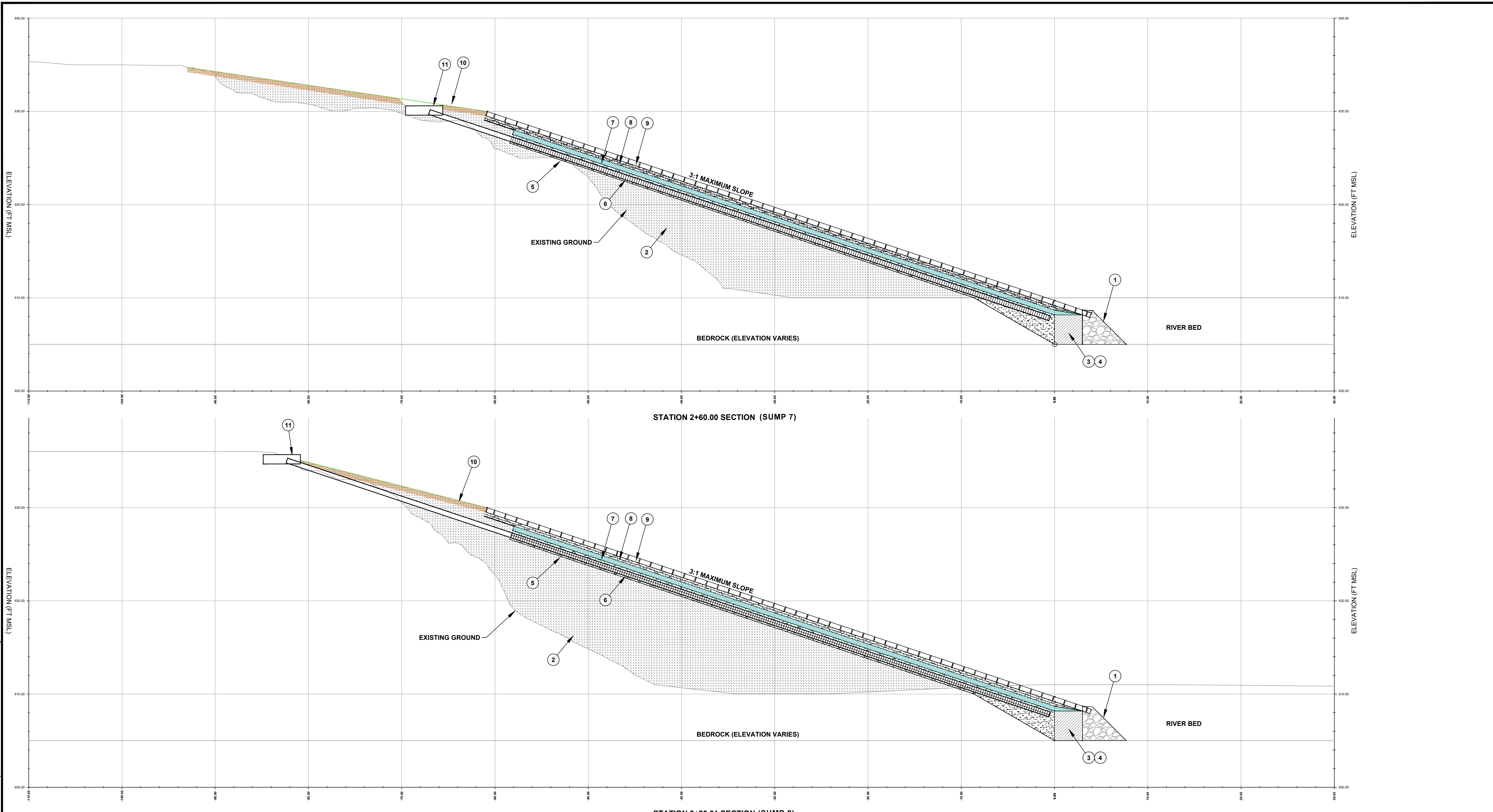
- |  |                              |
|--|------------------------------|
|  | CLEAN FILL                   |
|  | RIP RAP                      |
|  | SELECT CRUSHED STONE/GEOGRID |
|  | AQUABLOK                     |
|  | SELECT CRUSHED STONE LAYER   |
|  | ARTICULATED BLOCK MATTRESS   |
|  | TOPSOIL                      |



PROJECT: HFSTR NORTH OF ZINK DAM LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM TULSA, OKLAHOMA	
TITLE: <b>NOT FOR CONSTRUCTION</b>	
DRAWN BY: T. FIEBRANZ	PROJ. NO.: 525252.0000
CHECKED BY: M. VENNE	
APPROVED BY: J. RICE	SHEET 7 OF 16
DATE: MARCH 3, 2023	
999 Fourier Drive Suite 101 Madison, WI 53717 Phone: 608.926.3600	
FILE NO.: 525252 - PR - XS - Cross Sections.dwg	

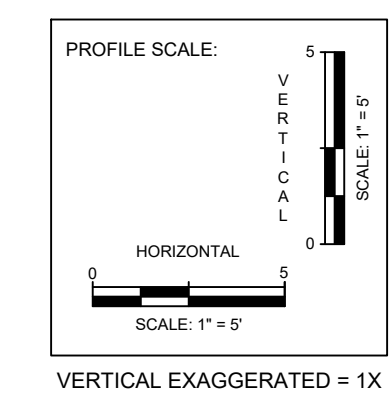


22634 -- USER: T:\a\m\c\ -- ATTACHED REFS: EX - Site Features; EX - Monitoring Wells; EX - EC - Contours; PR - Design Cross Sections -- ATTACHED IMAGES: DRAWING NAME: J:\h\oly\trm\enr\l\usa\525252 - north sheet remed\0000\525252 - PR - XS - Cross Sections.dwg -- PLOT DATE: March 03, 2023 - 10:44AM -- LAYOUT: XS - Sheet 3



- ### NOTES
- RIPRAP ARMORMENT. ANGLE OF REPOSE OF RIP RAP SHOWN AS 1:1. EXTEND RIPRAP OVER FIRST BLOCK OF ARTICULATED BLOCK MATTRESS. PLACE RIP RAP IN 1:1 SLOPE ALONG TOE OF CAP AS MATERIAL ALLOWS.
  - CLEAN FILL. REMOVE ALL DEBRIS/VEGETATION/ROCK (GREATER THAN 12-INCHES IN DIMENSION). SMOOTH NATIVE SOILS AND PROVIDE CLEAN FILL TO GRADE OF BASE OF COLLECTION LAYER. ALL CONCRETE, WOOD, AND NON-ROCK DEBRIS SHALL BE CONTAINERIZED FOR OFF-SITE DISPOSAL IN ACCORDANCE WITH THE SPECIFICATIONS. ROCK DEBRIS CAN BE PLACED INTO THE DIVERSION STRUCTURE AND REMAIN ON-SITE. CONCRETE DEBRIS CAN REMAIN AND BE GRADED AS LONG AS IT IS CRUSHED TO LESS THAN 12-INCHES IN DIMENSION. CLEAN FILL SHALL MEET THE REQUIREMENTS OF SPECIFICATION PART 11.
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  - GALVANIZED WIRE GABION BASKET. FILL EACH GABION WITH AQUAGATE+OC®. SEE SHEET 12, DETAIL 3 FOR TYPICAL DETAILS.
  - COLLECTION LAYER. IN GENERAL, COLLECTION LAYER SHALL BE 12 INCHES OF SELECT CRUSHED STONE FILL (SPECIFICATIONS PART 13.D.4). GRADUALLY INCREASE THICKNESS TO FULL HEIGHT OF GABION STARTING A MAXIMUM OF 10 FEET HORIZONTALLY FROM GABION. COLLECTION LAYER SHALL EXTEND UP SLOPE TO AN ELEVATION OF 628 FT MSL.
  - PRODUCT RECOVERY SUMP. INSTALL 6-INCH DIAMETER SUMP SOLELY WITHIN THE COLLECTION LAYER WITH A 3 INCHES OF SELECT CRUSHED STONE ABOVE AND BELOW THE SUMP. SUMP SCREEN SHALL EXTEND FROM THE GABION AT ELEVATION OF 608 TO 627. SUMP CASING SHALL EXTEND FROM THE COLLECTION LAYER TO THE VAULT.
  - AQUABLOK LAYER. PLACE 6-INCH AQUABLOK LAYER ON TOP OF COLLECTION LAYER. AT TOP ELEVATION OF 628.
  - BEDDING LAYER. PLACE 3 INCHES OF SELECT CRUSHED STONE ON TOP OF AQUABLOK. PLACE GEOGRID, FOLLOWED BY ANOTHER 3 INCHES OF SELECT CRUSHED STONE. BEDDING LAYER SHALL EXTEND UP THE SLOPE TO AN ELEVATION OF 630 FT MSL.
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  - SUMP VAULT. INSTALL SUMP VAULT AT THE GROUND SURFACE AT PRODUCT RECOVERY SUMP HEAD. SUMP CASING SHALL PROTRUDE A MINIMUM OF 6 INCHES WITHIN THE SUMP. MAINTAIN A MINIMUM OF 48 INCHES OF CLEARANCE IN FRONT OF THE SUMP AND 4 INCHES OF CLEARANCE ON EACH SIDE OF THE SUMP.

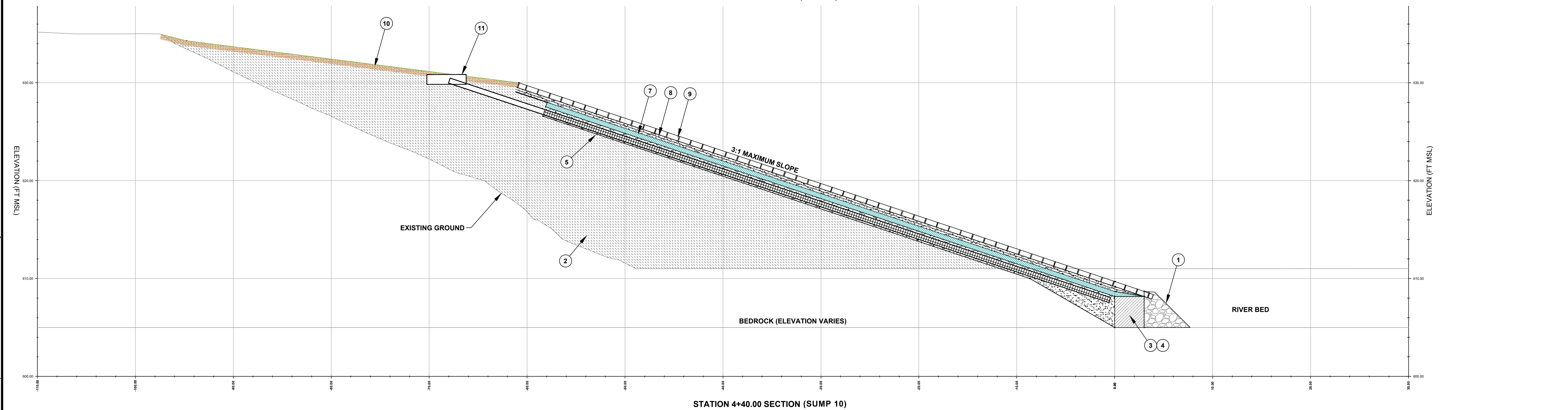
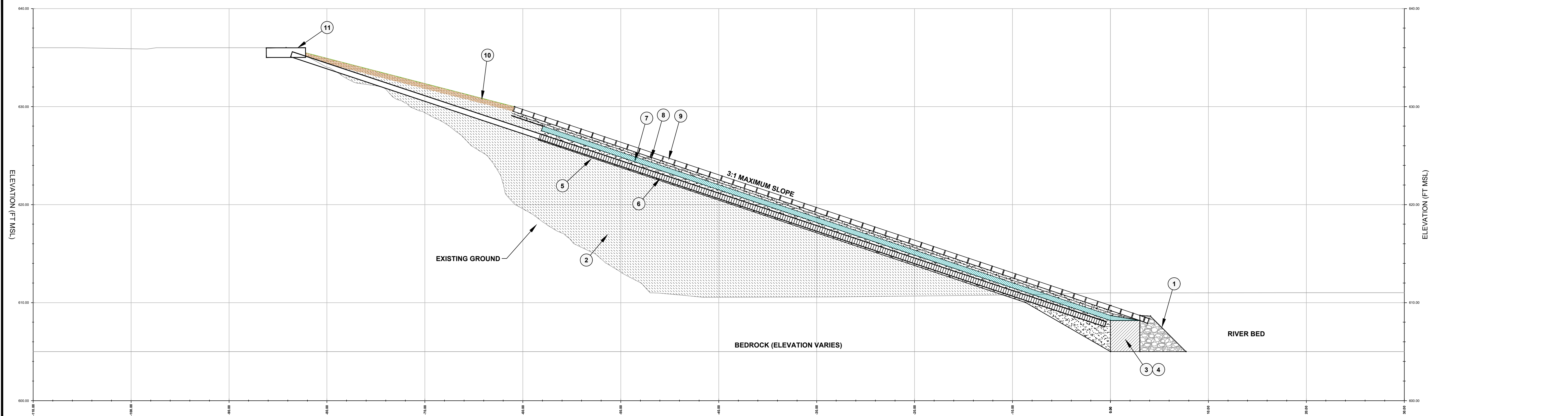
LEGEND	
	CLEAN FILL
	RIP RAP
	SELECT CRUSHED STONE/GEOGRID
	AQUABLOK
	SELECT CRUSHED STONE LAYER
	ARTICULATED BLOCK MATTRESS
	TOPSOIL



PROJECT: HFSTR NORTH OF ZINK DAM LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM TULSA, OKLAHOMA	
TITLE: NOT FOR CONSTRUCTION	
DRAWN BY: T. FIEBRANZ	PROJ. NO.: 525252.0000
CHECKED BY: M. VENNE	
APPROVED BY: J. RICE	SHEET 8 OF 16
DATE: MARCH 3, 2023	
999 Fourier Drive Suite 101 Madison, WI 53717 Phone: 608.926.3600	
FILE NO.: 525252 - PR - XS - Cross Sections.dwg	



22634 -- USER: T:\a\m\c\ -- ATTACHED REFS: EX - Site Features; EX - Monitoring Wells; EX - EC - CONTOURS; PR - Design Cross Sections -- ATTACHED IMAGES: DRAWING NAME: J:\h\oly\tr\m\l\usa\525252 - north sheet remed\0001.525252 - PR - XS - Cross Sections.dwg -- PLOT DATE: March 03, 2023 - 10:44AM -- LAYOUT: XS - Sheet 4



**NOTES**

1. RIPRAP ARMORMENT. ANGLE OF REPOSE OF RIP RAP SHOWN AS 1:1. EXTEND RIPRAP OVER FIRST BLOCK OF ARTICULATED BLOCK MATTRESS. PLACE RIP RAP IN 1:1 SLOPE ALONG TOE OF CAP AS MATERIAL ALLOWS.

2. CLEAN FILL. REMOVE ALL DEBRIS/VEGETATION/ROCK (GREATER THAN 12-INCHES IN DIMENSION). SMOOTH NATIVE SOILS AND PROVIDE CLEAN FILL TO GRADE OF BASE OF COLLECTION LAYER. ALL CONCRETE, WOOD, AND NON-ROCK DEBRIS SHALL BE CONTAINERIZED FOR OFF-SITE DISPOSAL IN ACCORDANCE WITH THE SPECIFICATIONS. ROCK DEBRIS CAN BE PLACED INTO THE DIVERSION STRUCTURE AND REMAIN ON-SITE. CONCRETE DEBRIS CAN REMAIN AND BE GRADED AS LONG AS IT IS CRUSHED TO LESS THAN 12-INCHES IN DIMENSION. CLEAN FILL SHALL MEET THE REQUIREMENTS OF SPECIFICATION PART 11.

3. CAP TOE VENT. BEDROCK ELEVATION VARIES. REMOVE RIVERBED SAND/FILL AS REQUIRED TO PLACE GABION DIRECTLY ON BEDROCK SURFACE. PLACE 2 INCHES OF AQUABLOK® BENEATH GABION TO LEVEL AND SECURE THE GABION. SEE SHEET 12, DETAIL 2 FOR TYPICAL DETAILS.

4. GALVANIZED WIRE GABION BASKET. FILL EACH GABION WITH AQUAGATE®OC®. SEE SHEET 12, DETAIL 3 FOR TYPICAL DETAILS.

5. COLLECTION LAYER. IN GENERAL, COLLECTION LAYER SHALL BE 12 INCHES OF SELECT CRUSHED STONE FILL (SPECIFICATIONS PART 13.D.4). GRADUALLY INCREASE THICKNESS TO FULL HEIGHT OF GABION STARTING A MAXIMUM OF 10 FEET HORIZONTALLY FROM GABION. COLLECTION LAYER SHALL EXTEND UP SLOPE TO AN ELEVATION OF 628 FT MSL.

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7. AQUABLOK LAYER. PLACE 6-INCH AQUABLOK LAYER ON TOP OF COLLECTION LAYER. AT TOP ELEVATION OF 628.

8. BEDDING LAYER. PLACE 3 INCHES OF SELECT CRUSHED STONE ON TOP OF AQUABLOK. PLACE GEOGRID, FOLLOWED BY ANOTHER 3 INCHES OF SELECT CRUSHED STONE. BEDDING LAYER SHALL EXTEND UP THE SLOPE TO AN ELEVATION OF 630 FT MSL.

9. ARTICULATED BLOCK MATTRESS. PLACE ARTICULATED BLOCK MATTRESS ON TOP OF BEDDING LAYER. TO A TOP ELEVATION OF 630 FT.

10. SOD RESTORATION. RESTORE DISTURBED AREAS ABOVE ARTICULATED BLOCK MATTRESS WITH CLEAN FILL GRADED TO MATCH EXISTING SURFACE. FINISH DISTURBED SURFACES WITH TOPSOIL AND SOD.

11. SUMP VAULT. INSTALL SUMP VAULT AT THE GROUND SURFACE AT PRODUCT RECOVERY SUMP HEAD. SUMP CASING SHALL PROTRUDE A MINIMUM OF 6 INCHES WITHIN THE SUMP. MAINTAIN A MINIMUM OF 48 INCHES OF CLEARANCE IN FRONT OF THE SUMP AND 4 INCHES OF CLEARANCE ON EACH SIDE OF THE SUMP.

**LEGEND**

CLEAN FILL

RIP RAP

SELECT CRUSHED STONE/ GEOGRID

AQUABLOK

SELECT CRUSHED STONE LAYER

ARTICULATED BLOCK MATTRESS

TOPSOIL

PROFILE SCALE:

5

0

5

10

15

20

25

30

35

40

45

50

55

60

65

70

75

80

85

90

95

100

VERTICAL EXAGGERATED = 1X

HORIZONTAL

SCALE: 1" = 5'

PROJECT:

HFSTR NORTH OF ZINK DAM  
LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM  
TULSA, OKLAHOMA

TITLE:

NOT FOR CONSTRUCTION

DRAWN BY:

T. FIEBRANZ

PROJ. NO.:

525252.0000

CHECKED BY:

M. VENNE

APPROVED BY:

J. RICE

DATE:

MARCH 3, 2023

FILE NO.:

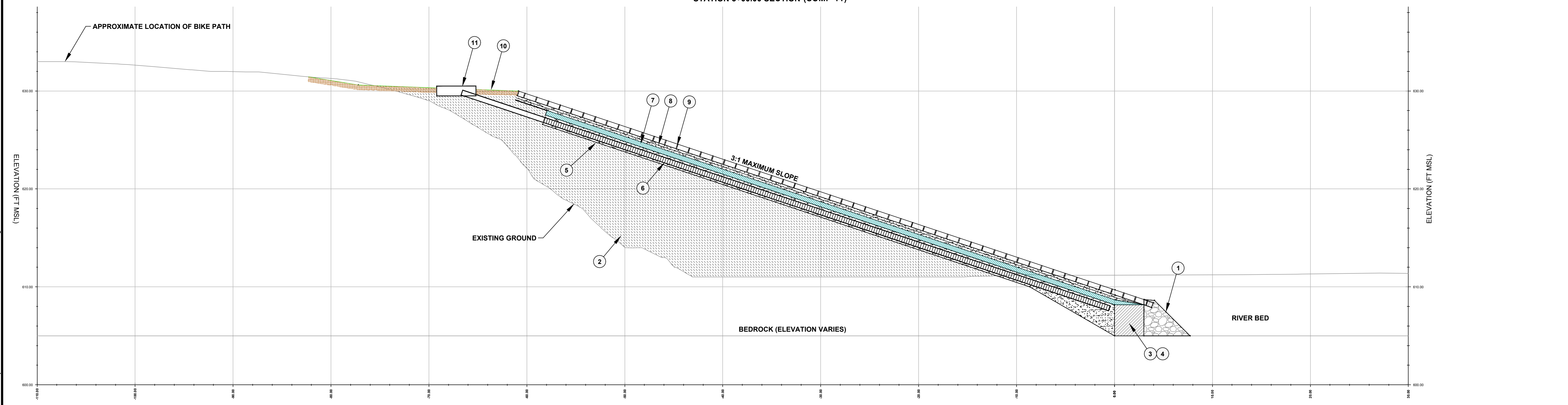
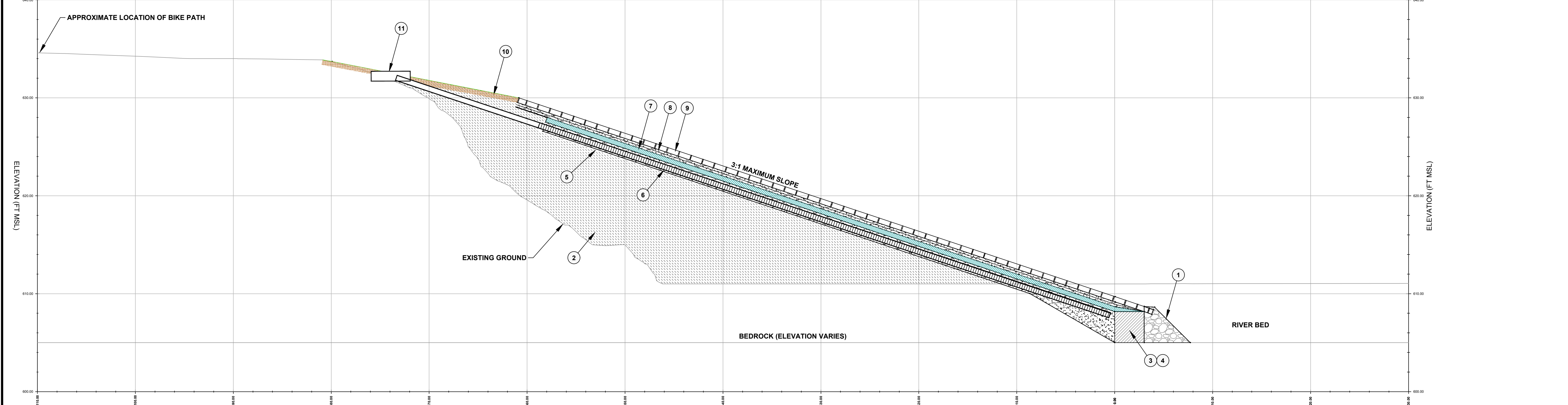
525252 - PR - XS - Cross Sections.dwg

SHEET 9 OF 16

999 Fourier Drive  
Suite 101  
Madison, WI 53717  
Phone: 608.926.3600

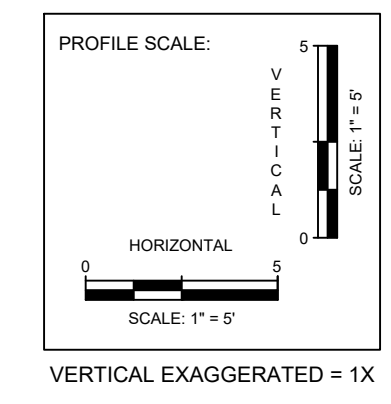


2304 -- USER: Trianz -- ATTACHED REFS: EX - SITE Features: EX - MONITORING Wells, EX - EC - CONTOURS: PR - Design Cross Sections -- ATTACHED IMAGES: DRAWING NAME: J:\holy trinity\Tulsa\525252 - north sheet remed\0000\525252 - PR - XS - Cross Sections.dwg -- PLOT DATE: March 03, 2023 - 10:44AM -- LAYOUT: XS - Sheet 5

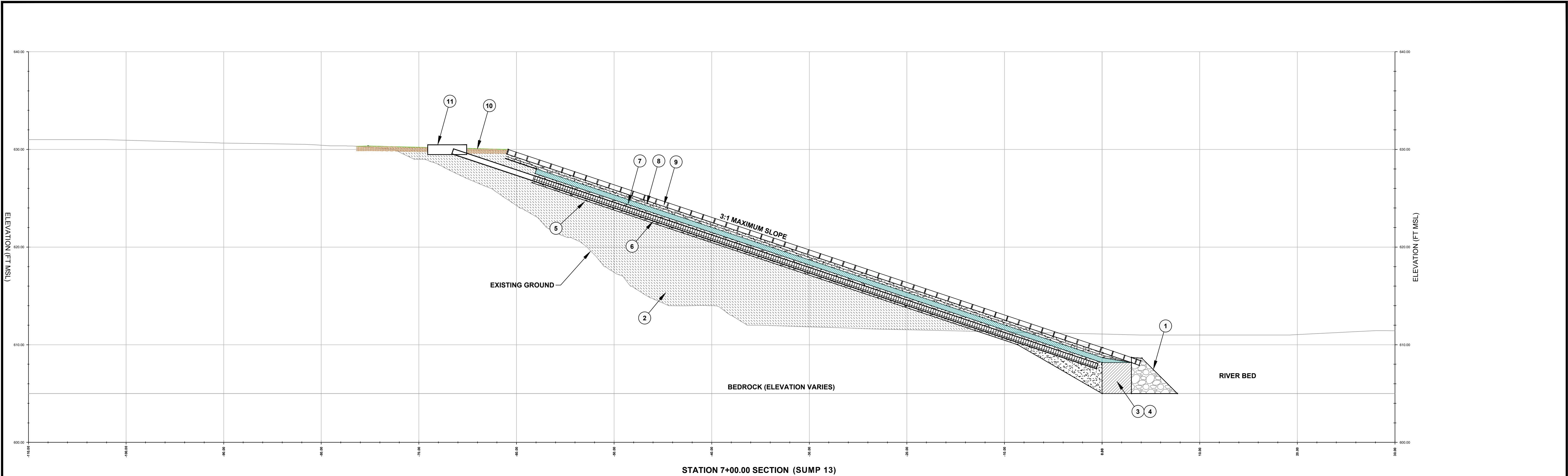


- NOTES**
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LEGEND	
	CLEAN FILL
	RIP RAP
	SELECT CRUSHED STONE/GEOGRID
	AQUABLOK
	SELECT CRUSHED STONE LAYER
	ARTICULATED BLOCK MATTRESS
	TOPSOIL



PROJECT: HFSTR NORTH OF ZINK DAM LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM TULSA, OKLAHOMA	
TITLE: <b>NOT FOR CONSTRUCTION</b>	
DRAWN BY: T. FIEBRANZ	PROJ. NO.: 525252.0000
CHECKED BY: M. VENNE	
APPROVED BY: J. RICE	SHEET 10 OF 16
DATE: MARCH 3, 2023	
999 Fourier Drive Suite 101 Madison, WI 53717 Phone: 608.926.3600	
FILE NO.: 525252 - PR - XS - Cross Sections.dwg	

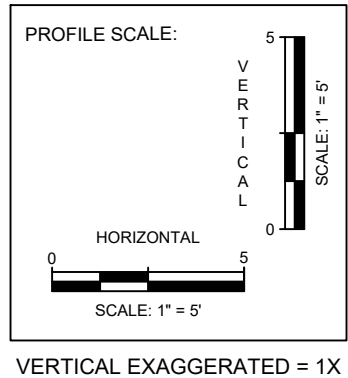


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## LEGEND

- |  |                              |
|--|------------------------------|
|  | CLEAN FILL                   |
|  | RIP RAP                      |
|  | SELECT CRUSHED STONE/GEOGRID |
|  | AQUABLOK                     |
|  | SELECT CRUSHED STONE LAYER   |
|  | ARTICULATED BLOCK MATTRESS   |
|  | TOPSOIL                      |

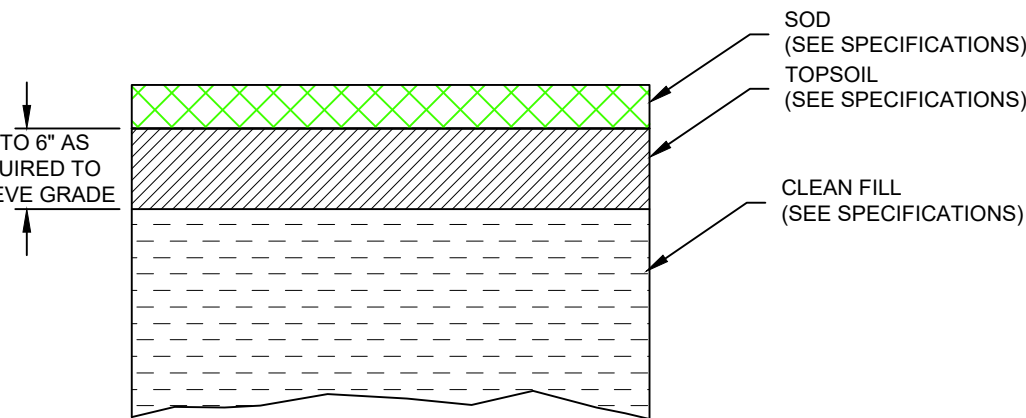


PROJECT: HFSTR NORTH OF ZINK DAM			
LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM			
TULSA, OKLAHOMA			
TITLE: NOT FOR CONSTRUCTION			
DRAWN BY: T. FIEBRANZ		PROJ. NO.: 525252.0000	
CHECKED BY: M. VENNE			
APPROVED BY: J. RICE		SHEET 11 OF 16	
DATE: MARCH 3, 2023			
		999 Fourier Drive Suite 101 Madison, WI 53717 Phone: 608.926.3600	
FILE NO:		525252 - PR - XS - Cross Sections.dwg	



NOTES

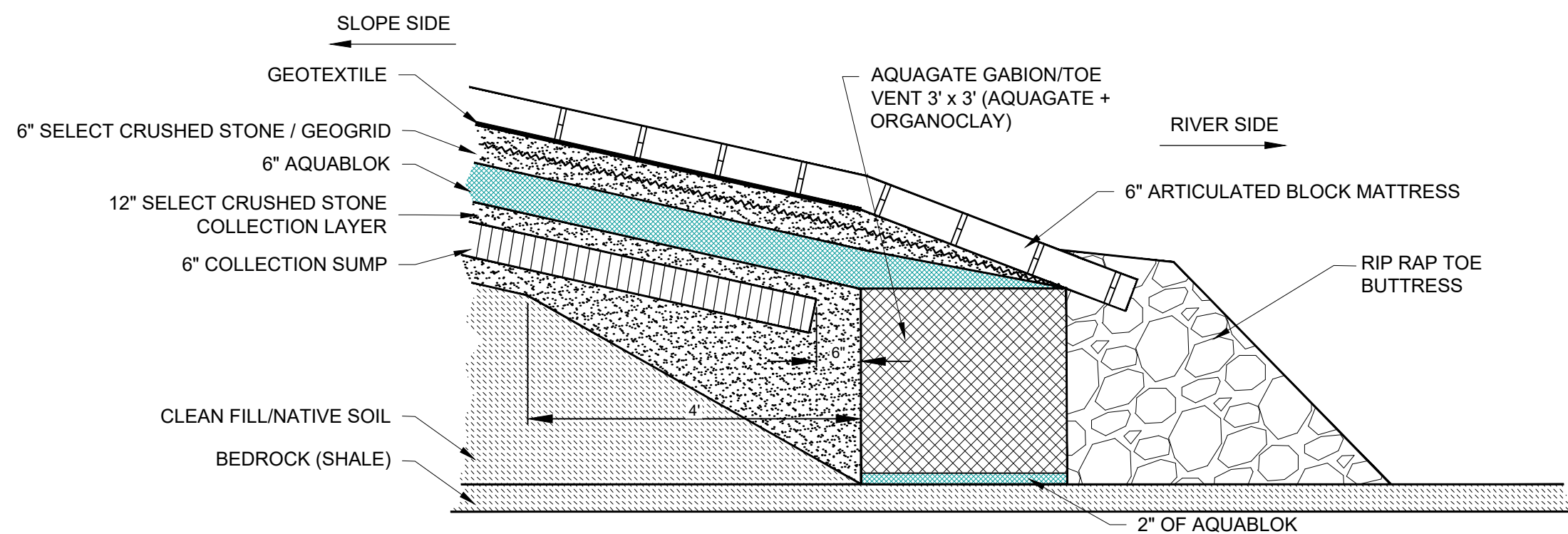
1. PLACE SOIL IN LIFTS NOT TO EXCEED 1 FOOT.
2. COMPACT EACH LIFT OF CLEAN FILL WITH SPECIALIZED COMPACTION EQUIPMENT. SPECIALIZED EQUIPMENT SHALL INCLUDE TAMPING ROLLER, VIBRATORY ROLLER, PNEUMATIC TIRE ROLLER, OR OTHER EQUIPMENT DESIGNED FOR COMPACTION AND APPROVED BY ENGINEER DURING CONSTRUCTION.
3. GRADE TO PROMOTE POSITIVE DRAINAGE AND PREVENT PONDING OF SURFACE WATER.
4. FILL RUTS AND DEPRESSION THAT APPEAR DURING CONSTRUCTION TO MAINTAIN POSITIVE DRAINAGE.



1  
12

**TYPICAL BACKFILL FOR PRE-EXISTING GRASSY AREAS**

NOT TO SCALE



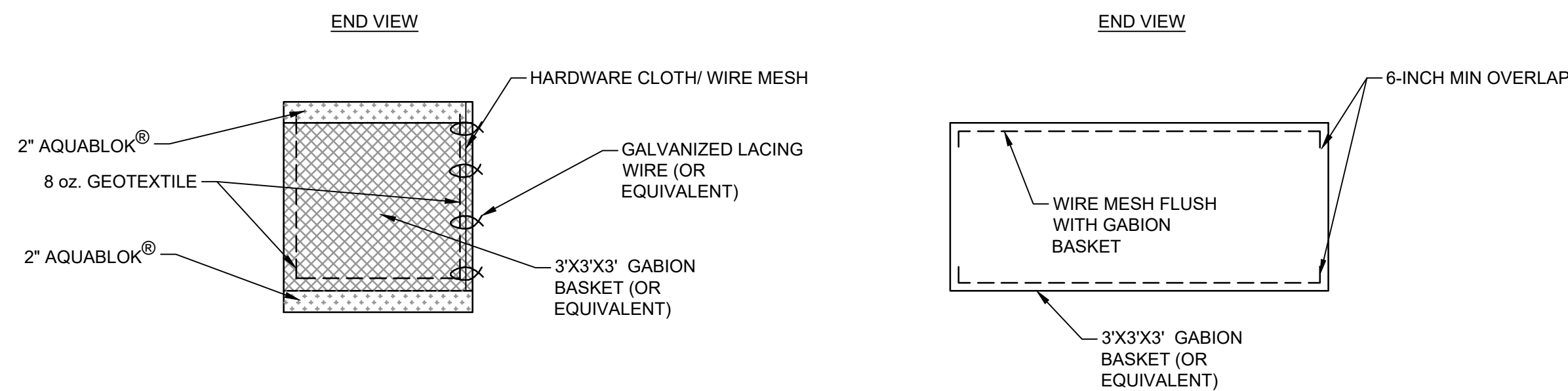
NOTES:

1. AQUABLOK, CRUSHED STONE/GEOGRID, AND ARTICULATED BLOCK MATTRESS SHALL MAINTAIN DESIGN THICKNESS AND SLOPE UNTIL THE RIVERBANK-SIDE EDGE OF THE GABION BASKET AT WHICH POINT THEY SHALL TAPER TO THE RIVER-SIDE EDGE OF THE GABION BASKET.
2. ARTICULATED BLOCK MATTRESS TO EXTEND TO THE RIVER-SIDE EDGE OF GABION.
3. A MINIMUM OF 2 INCHES OF AQUABLOK SHALL BE PLACED ON TOP OF GABION BASKET.
4. RIP RAP TO BE PLACED UP AGAINST RIVER-SIDE OF GABION BASKET AND ON TOP OF LAST 2 FT OF ARTICULATED BLOCK MATTRESS.
5. COLLECTION LAYER SHALL BE FULL HEIGHT OF GABION BASKET ALONG THE RIVERBANK-SIDE EDGE. BOTTOM OF COLLECTION LAYER SHALL TAPER TO 1 FT DESIGN THICKNESS 4 FT HORIZONTALLY FROM GABION.
6. SEAL GABION BASKET TO BEDROCK WITH A MINIMUM OF 2 INCHES OF AQUABLOK.
7. SUMP SCREEN SHALL TERMINATE A MINIMUM OF 6 INCHES (HORIZONTALLY) FROM EDGE OF GABION BASKET.

2  
12

**CAP TOE VENT DETAIL**

NOT TO SCALE



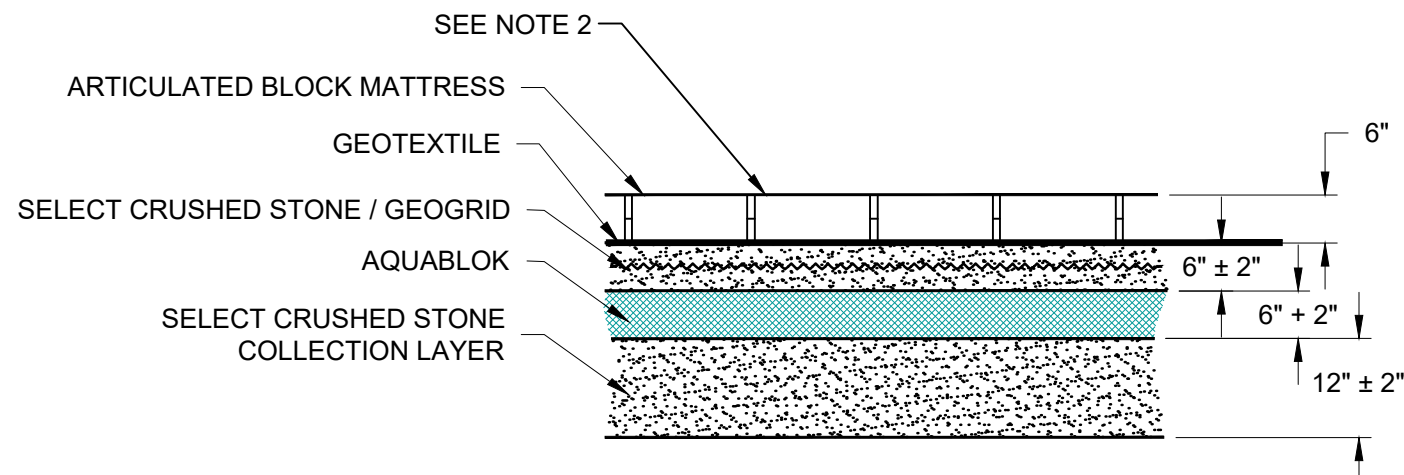
NOTES:

1. WIRE MESH SHALL BE PLACED ON THE LONG SIDES OF THE GABION BASKETS ONLY (RIVER SIDE AND BANK SIDES). WIRE MESH IS NOT NEEDED ON THE BOTTOM, TOP, OR TWO SIDES THAT CONTACT OTHER GABION BASKETS. EXCEPT THE TWO ENDS OF THE GABION BASKETS (ADJACENT TO THE TAKE-OUT RAMP AND CONCRETE WING WALL).
2. WIRE MESH SHALL BE CUT TO BE OVERSIZED BY AT LEAST 6-INCHES ON EACH END TO ENSURE THAT IF THE GABION BASKET PUSHES OUTWARD, WIRE MESH WILL NOT BE TOO SHORT.
3. GEOTEXTILE SHALL BE PLACED ON THE LONG SIDES OF THE GABION BASKETS (RIVER SIDE AND BANK SIDE). GEOTEXTILE IS NOT NEEDED ON THE BOTTOM, TOP, OR TWO SIDES THAT CONTACT OTHER GABION BASKETS. EXCEPT THE TWO ENDS OF THE GABION BASKETS (ADJACENT TO THE RIVERBANK AND ADJACENT TO THE CONCRETE WING WALL).
4. GEOTEXTILE TO BE CUT TO LAY ON THE BOTTOM OF THE BASKET TO ENSURE THAT GEOTEXTILE IS CONTINUOUS WHERE NEEDED. IN ADDITION, EXCESS GEOTEXTILE CAN BE FOLDED OVER THE TOP OF THE AQUAGATE+ORGANOCLAY.

3  
12

**TYPICAL GABION BASKET DETAIL**

NOT TO SCALE



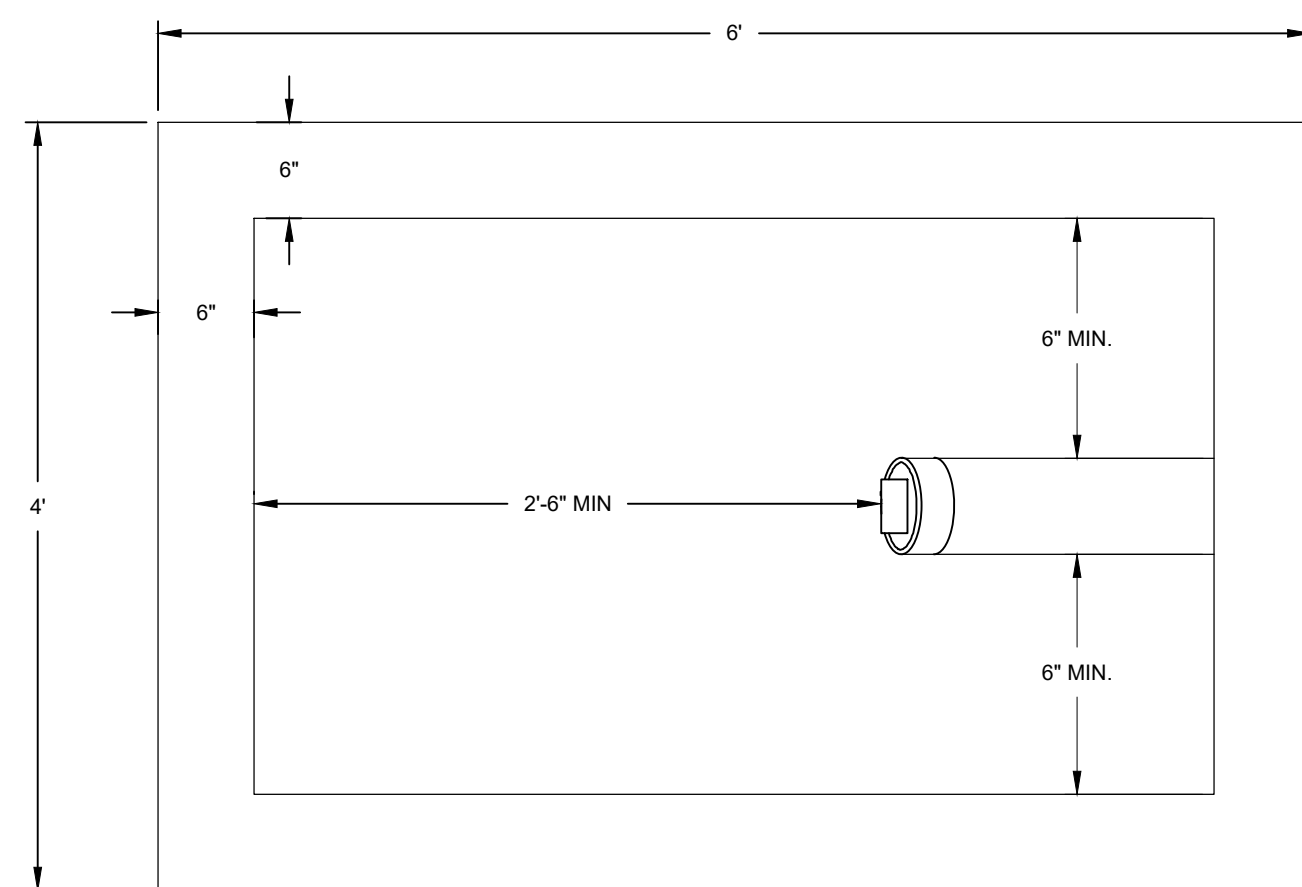
NOTES:

1. CAP SLOPE TO BE 3:1 MAXIMUM SLOPE TO EXTENTS SHOWN ON CROSS SECTIONS.
2. BACKFILL OPEN CELL ARTICULATED BLOCK MATTRESS WITH STONE MEETING THE REQUIREMENTS IN THE SPECIFICATIONS.

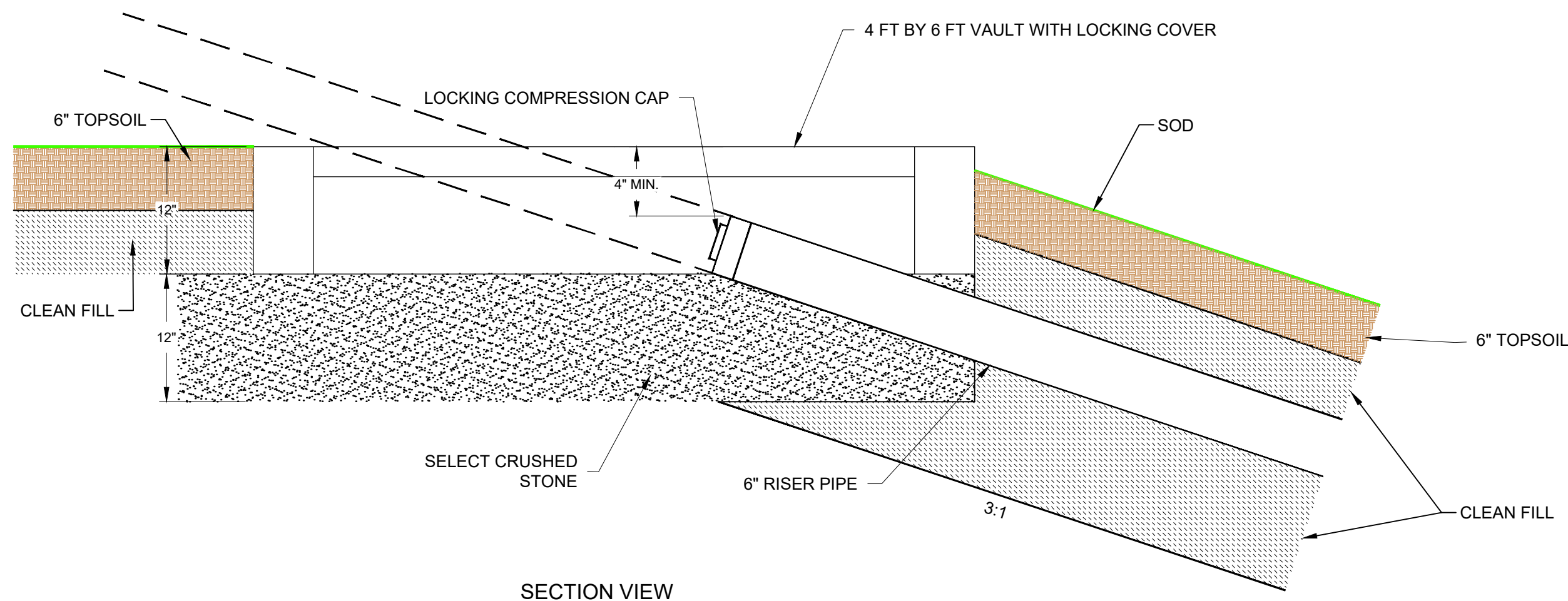
4  
12

**CAP CONSTRUCTIONS DETAIL**

NOT TO SCALE



PLAN VIEW



SECTION VIEW

NOTES:

1. VAULT SHALL BE SIZED SUCH THAT EQUIPMENT CAN BE LOWERED INTO THE SUMP WITHOUT CONTACTING THE VAULT. THIS RESULTS IN NEEDING MORE THAN 30-INCHES OF CLEARANCE WITHIN THE VAULT IN FRONT OF THE SUMP. AT LEAST 6-INCHES OF SUMP SHALL PROTRUDE WITHIN THE VAULT. THE VAULT SHALL BE 18-INCHES WIDE, MINIMUM UNLESS THE MANUFACTURER REQUIRES WIDER IN ORDER TO MEET THE TRAFFIC RATING. THE VAULT SHALL BE A MINIMUM 12-INCHES DEEP.
2. VAULT MATERIAL AND LID SHALL BE RATED FOR OUTDOOR USE, PROVIDE WATERPROOF SEAL, AND MEET TRAFFIC RATING (SEE NOTE 3). CONCRETE (PRE-CAST), REINFORCED CONCRETE, POLYMER, AND HDPE MAY BE ACCEPTABLE.
3. THE VAULT SHALL BE TRAFFIC RATED FOR CLASS FOUR, TIER 15, UP TO 15,000 POUNDS. THIS IS SOMETIMES REFERRED TO AS LIGHT TRAFFIC DUTY OR NON-DELIBERATE TRAFFIC.
4. THE LID SHALL BE REMOVABLE WITH A HANDLE/TOOL THAT HAS A LOCKING MECHANISM (OR REQUIRES A TOOL TO OPEN) TO PREVENT TAMPERING. THE LID SHALL WEIGH A MAXIMUM OF 70 POUNDS, AND PREFERABLY 30 TO 50 POUNDS.

5  
12

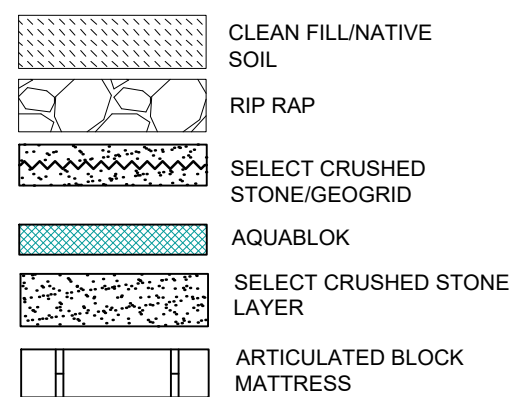
**TYPICAL VAULT DETAIL**


NOT TO SCALE

NOTES

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LEGEND

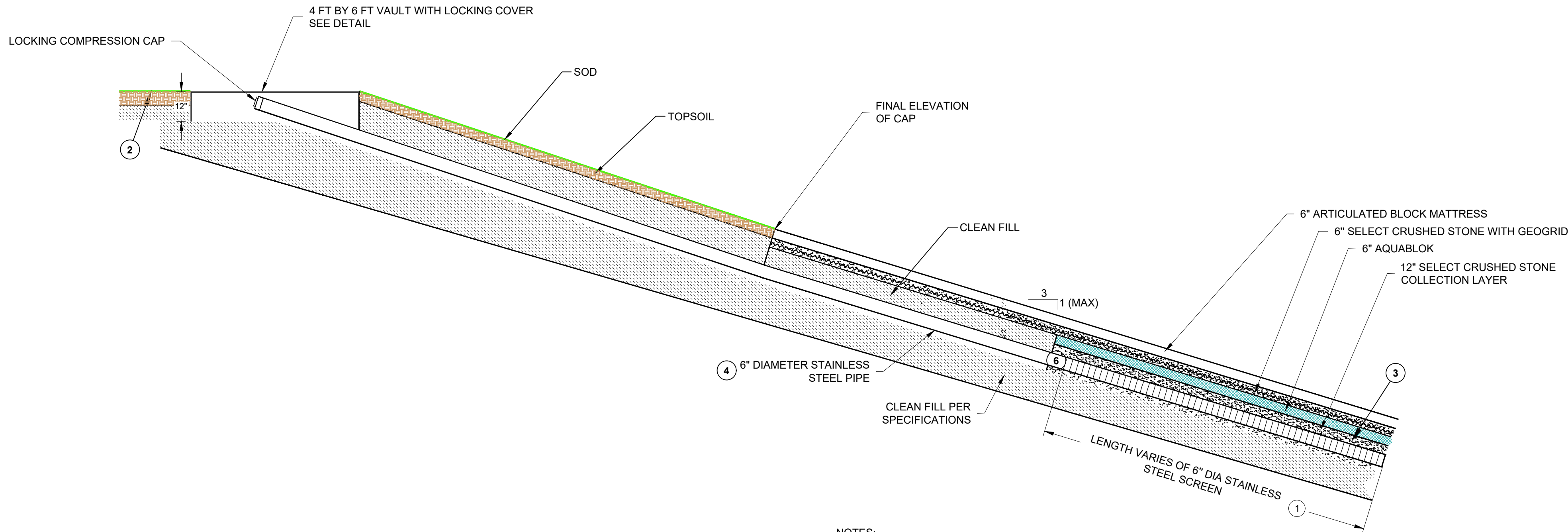


PROJECT: <b>HFSTR NORTH OF ZINK DAM</b>	
<b>LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM</b>	
<b>ISSUED FOR PERMIT</b>	
<b>TULSA, OKLAHOMA</b>	
TITLE: <b>NOT FOR CONSTRUCTION</b>	
DRAWN BY: <b>T. FIEBRANZ</b>	PROJ. NO.: <b>525252.0000</b>
CHECKED BY: <b>M. VENNE</b>	<b>SHEET 12 OF 16</b>
APPROVED BY: <b>J. RICE</b>	
DATE: <b>MARCH 3, 2023</b>	
	
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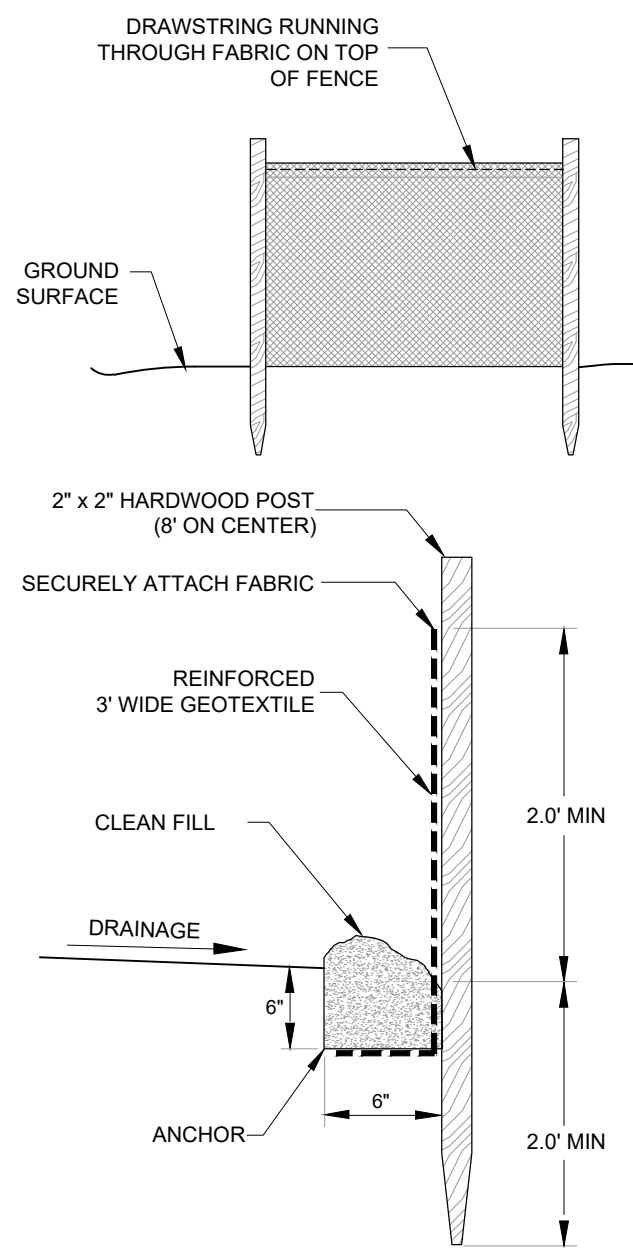
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Version: 2017-10-21



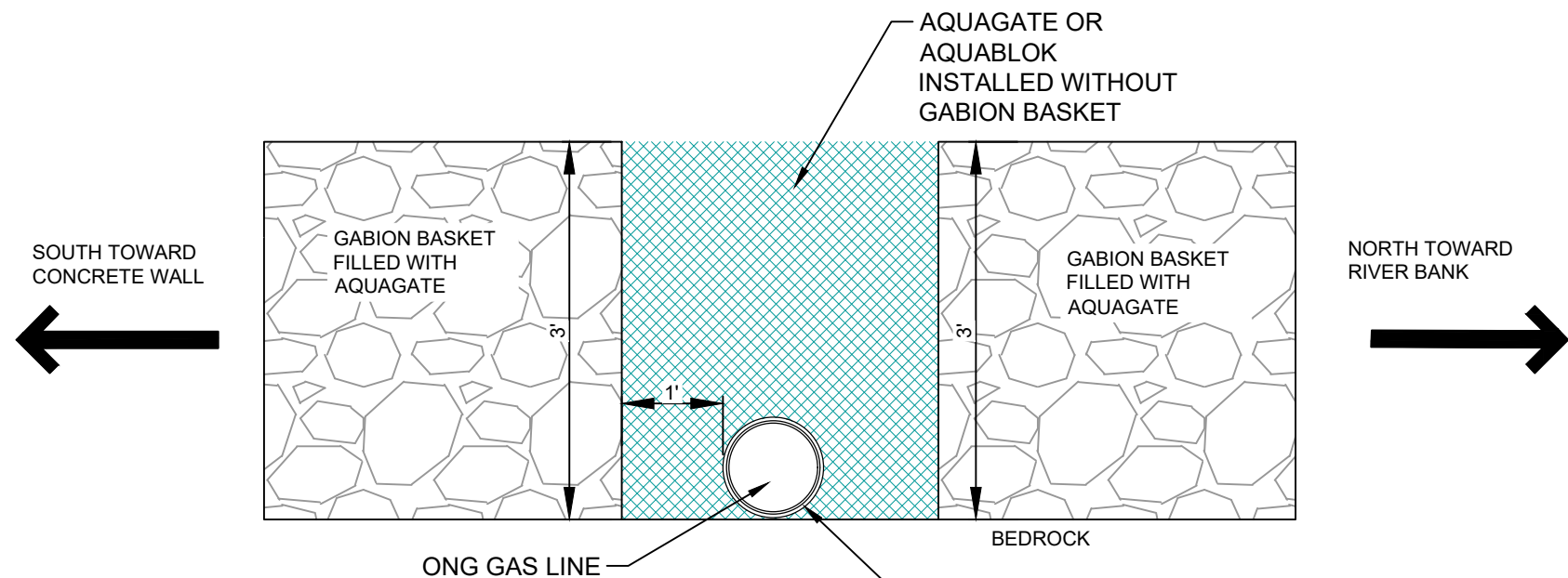
- NOTES:
1. SUMP SCREEN TO EXTEND FROM GABION UP THE BANK AT 3:1 SLOPE TO JUST BEFORE THE END OF THE COLLECTION LAYER.
  2. GRADE TO MATCH SURROUNDING GRADE AND FINAL ELEVATION OF CAP. PROVIDE CLEAN FILL AS REQUIRED. PROVIDE SOD AS FINAL SURFACE RESTORATION.
  3. COLLECTION LAYER TO BE MINIMUM 3-INCHES THICK BETWEEN TOP OF PIPE AND AQUABLOK LAYER.
  4. SCREEN AND RISER PIPE TO BE FIELD FIT.
  5. INSTALL VAULT SUCH THAT LNAPL COLLECTION SUMP CAN BE ACCESSED WITH A VACUUM TRUCK/SUBMERSIBLE PUMP.
  6. TOP OF SCREEN ELEVATION APPROXIMATELY 627 FT MSL.
  7. BOTTOM OF SCREEN ELEVATION APPROXIMATELY 608 FT MSL.

1  
13  
LNAPL COLLECTION SUMP DETAIL  
NOT TO SCALE



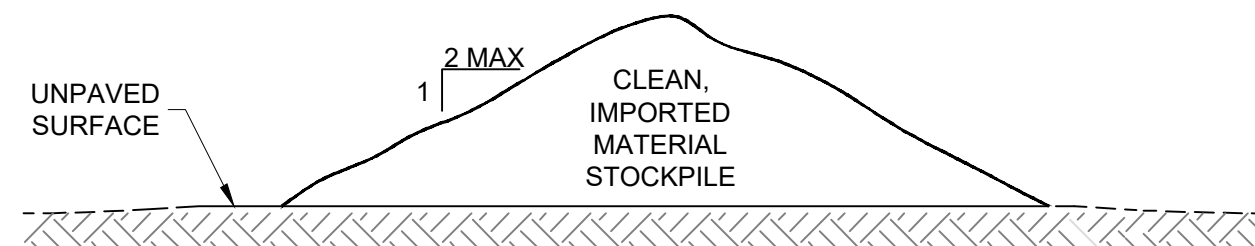
- NOTES:
1. FENCE POSTS SHALL BE PLACED 8 FEET CENTER-TO-CENTER OR CLOSER. THEY SHALL EXTEND AT LEAST 2 FEET INTO THE GROUND AND EXTEND AT LEAST 2 FEET ABOVE THE GROUND. POSTS SHALL BE CONSTRUCTED OF HARD WOOD WITH A MINIMUM DIAMETER THICKNESS OF 1½ INCHES.
  2. A METAL FENCE WITH 6 INCH OR SMALLER OPENINGS AND AT LEAST 2 FEET HIGH MAY BE UTILIZED, FASTENED TO FENCE POSTS, TO PROVIDE REINFORCEMENT AND SUPPORT TO THE GEOTEXTILE FABRIC WHERE SPACE FOR OTHER PRACTICES IS LIMITED AND HEAVY SEDIMENT LOADING IS EXPECTED.
  3. A GEOTEXTILE FABRIC RECOMMENDED FOR SUCH USE BY THE MANUFACTURER, SHALL BE BURIED AT LEAST 6 INCHES DEEP IN THE GROUND. THE FABRIC SHALL EXTEND AT LEAST 2 FEET ABOVE THE GROUND. THE FABRIC MUST BE SECURELY FASTENED TO THE POSTS USING A SYSTEM CONSISTING OF METAL FASTENERS (NAILS OR STAPLES) AND A HIGH STRENGTH REINFORCEMENT MATERIAL (NYLON WEBBING, GROMMETS, WASHERS, ETC.) PLACED BETWEEN THE FASTENER AND THE GEOTEXTILE FABRIC. THE FASTENING SYSTEM SHALL RESIST TEARING AWAY FROM THE POST. THE FABRIC SHALL INCORPORATE A DRAWSTRING IN THE TOP PORTION OF THE FENCE FOR ADDED STRENGTH.
  4. INSTALL SILT FENCE AT TOP OF BANK TO PREVENT SILT FROM ENTERING CAP LAYERS DURING CONSTRUCTION.
  5. INSPECT THE SILT FENCE PERIODICALLY AND AFTER EACH STORM EVENT, PER OPDES PERMIT REQUIREMENTS.
  6. IF FENCE FABRIC TEARS, STARTS TO DECOMPOSE, OR IN ANY WAY IS DAMAGED, REPLACE THE AFFECTED PORTION IMMEDIATELY.
  7. REMOVE DEPOSITED SEDIMENT WHEN IT REACHES 33% HEIGHT POINT OR IS CAUSING THE FABRIC TO BULGE.
  8. TAKE CARE TO AVOID UNDERMINING THE FENCE DURING CLEAN OUT.
  9. AFTER THE CONTRIBUTING DAMAGE AREA HAS BEEN STABILIZED, REMOVE SEDIMENT DEPOSITS, BRING THE DISTURBED AREA TO GRADE, STABILIZE.
  10. SILT FENCE WILL REMAIN IN PLACE UNTIL SOD IS INSTALLED AND WATERED.

2  
13  
TYPICAL SILT FENCE DETAIL  
NOT TO SCALE



- NOTES:
1. CONTRACTOR TO NOTIFY ONG 1 WEEK PRIOR TO WORK NEAR ONG LINE.
  2. CONTRACTOR TO NOTIFY ONG WHEN WITHIN 10 FT OF ONG LINE.
  3. HAND DIG OR USE NON-MECHANICAL MEANS TO EXCAVATE MATERIAL WITHIN 3 FT OF ONG LINE.

4  
13  
ONG GAS LINE DETAIL  
NOT TO SCALE



- NOTES:
1. CLEAN FILL TO INCLUDE ANY IMPORTED MATERIAL.
  2. INSTALL EROSION CONTROLS AS REQUIRED BY OWNER.
  3. PLACE STOCKPILES AS ALLOWED BY OWNER.
  4. STOCKPILES SHALL ONLY BE PLACED ON OWNER PROPERTY. BRING MATERIALS FOR DAILY USE TO THE WORK AREA.

3  
13  
TYPICAL CLEAN STOCKPILE DETAIL  
NOT TO SCALE

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LEGEND

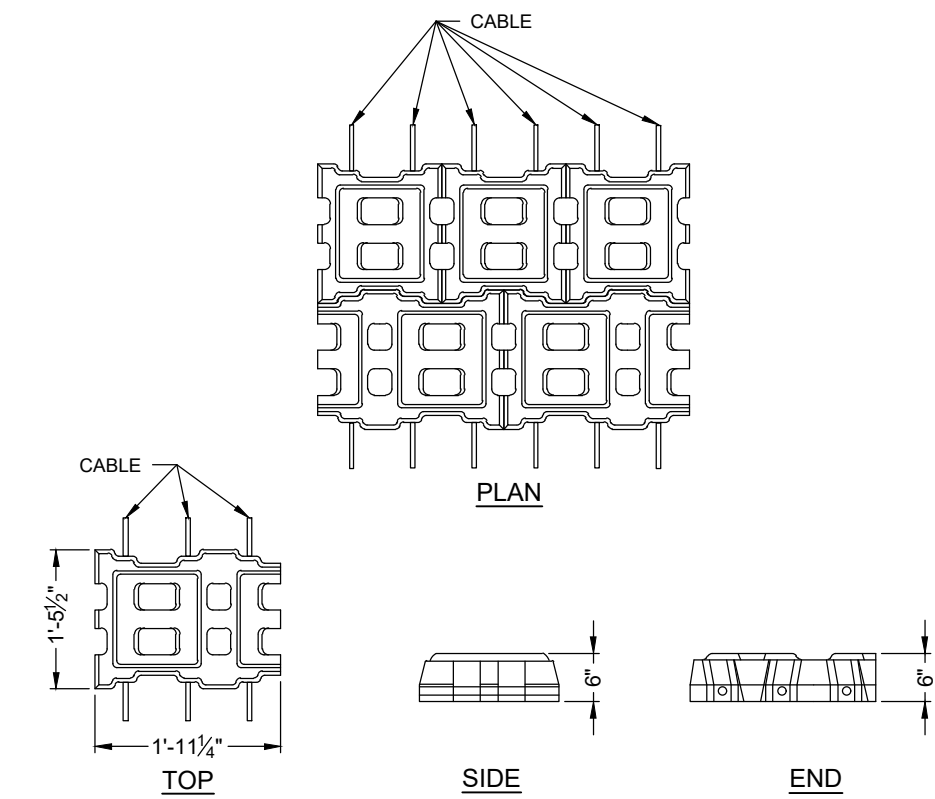
	CLEAN FILL/NATIVE SOIL
	RIP RAP
	SELECT CRUSHED STONE/GEOGRID
	AQUABLOK
	SELECT CRUSHED STONE LAYER
	ARTICULATED BLOCK MATTRESS
	TOPSOIL

PROJECT: HFSTR NORTH OF ZINK DAM	
LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM	
ISSUED FOR PERMIT	
TULSA, OKLAHOMA	
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DRAWN BY: T. FIEBRANZ	PROJ. NO.: 525252.0000
CHECKED BY: M. VENNE	
APPROVED BY: J. RICE	SHEET 13 OF 16
DATE: MARCH 3, 2023	
999 Fourier Drive Suite 101 Madison, WI 53717 Phone: 608.926.3600	
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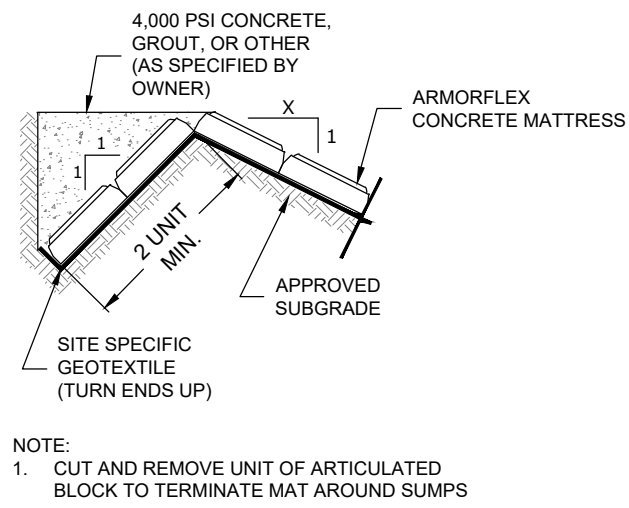


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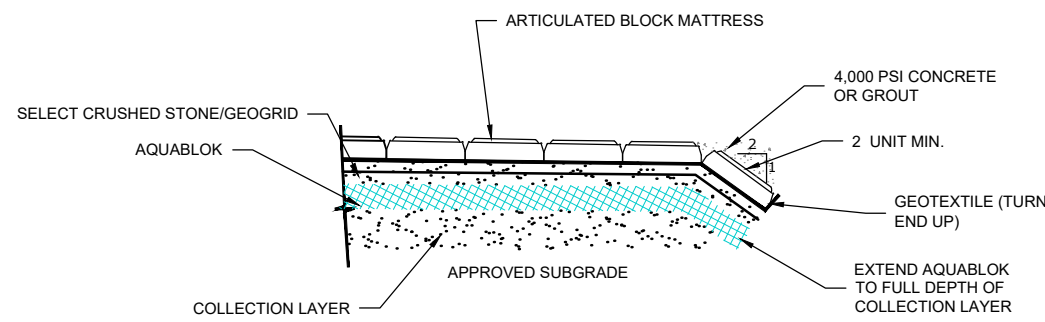
Version: 2017-10-21



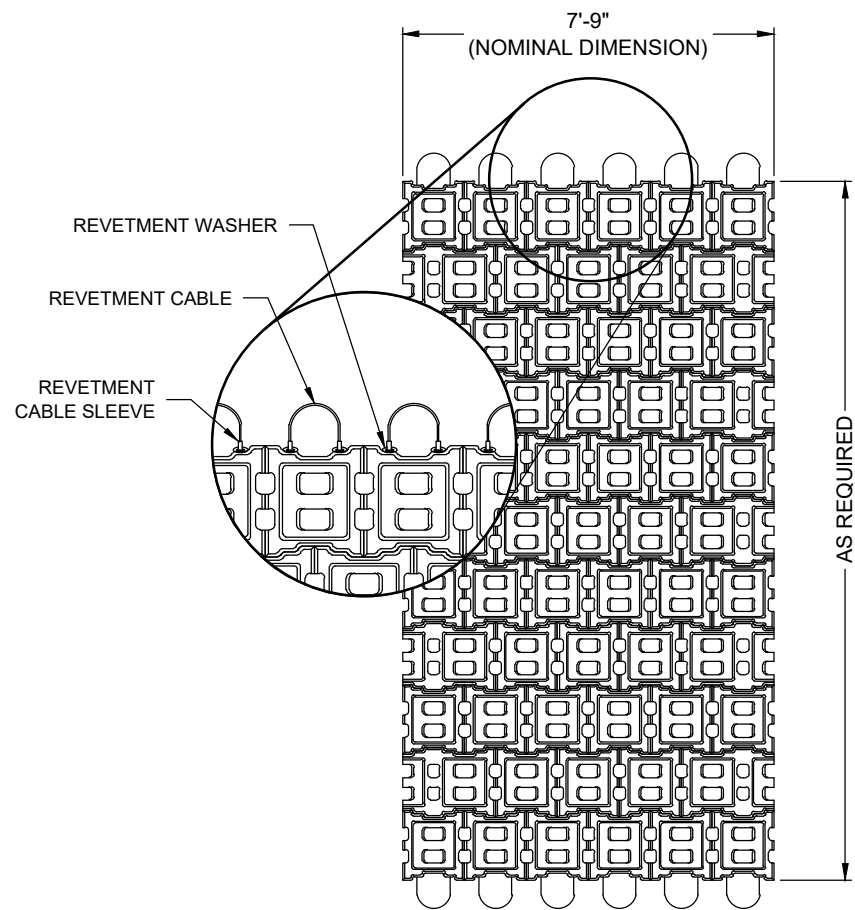
**TYPICAL 50 - 1.5 BLOCK**  
NO TO SCALE



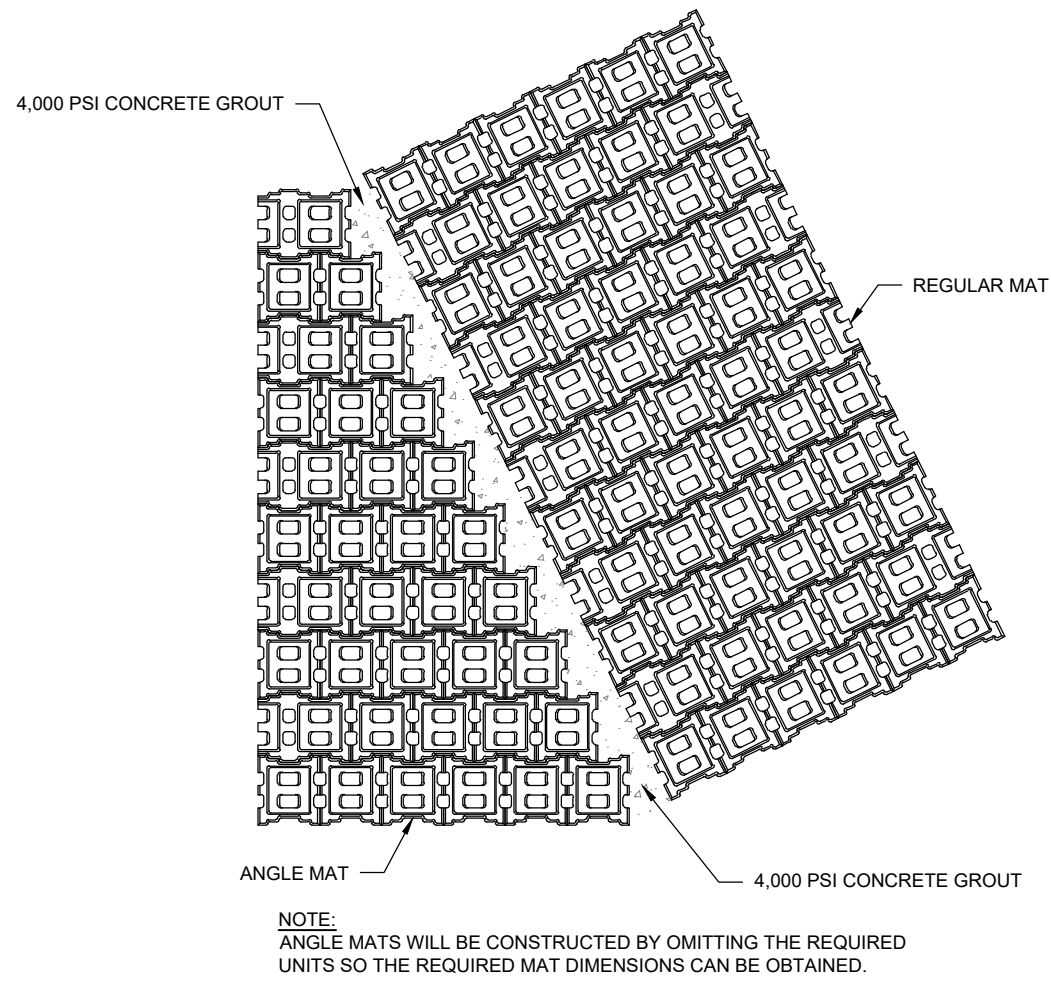
**TYPICAL MAT TERMINUS (TOP OF SLOPE)**  
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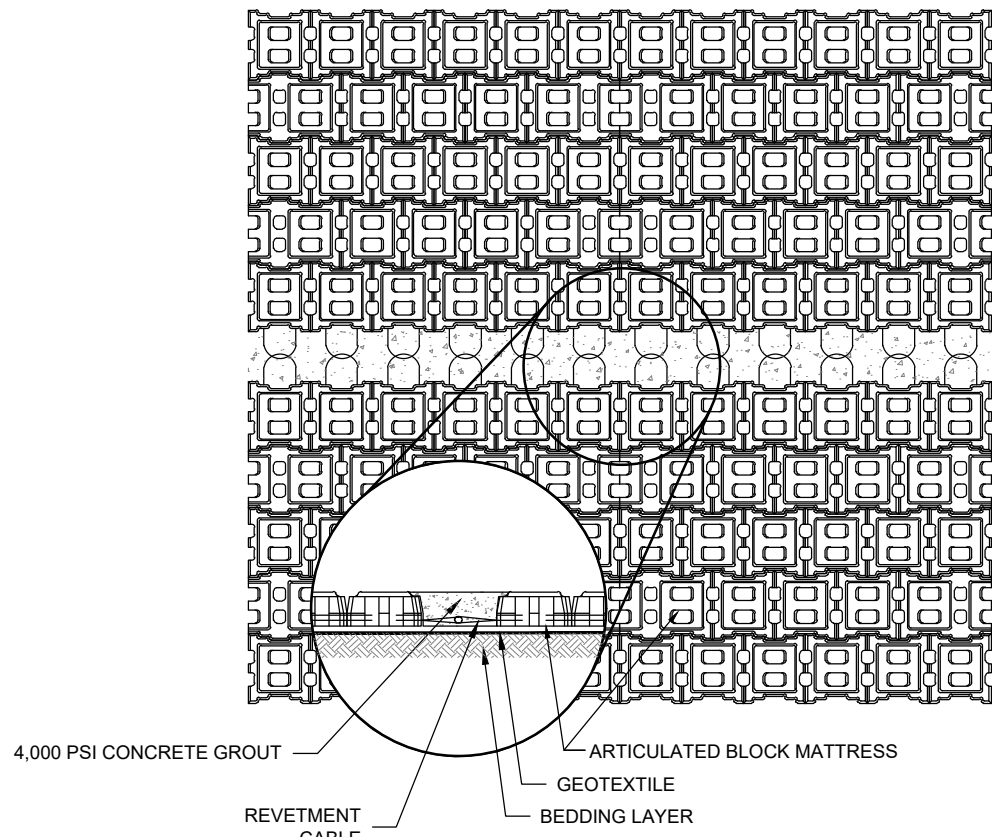
**TYPICAL MAT TERMINUS (NORTH SIDE SLOPE)**  
NOT TO SCALE



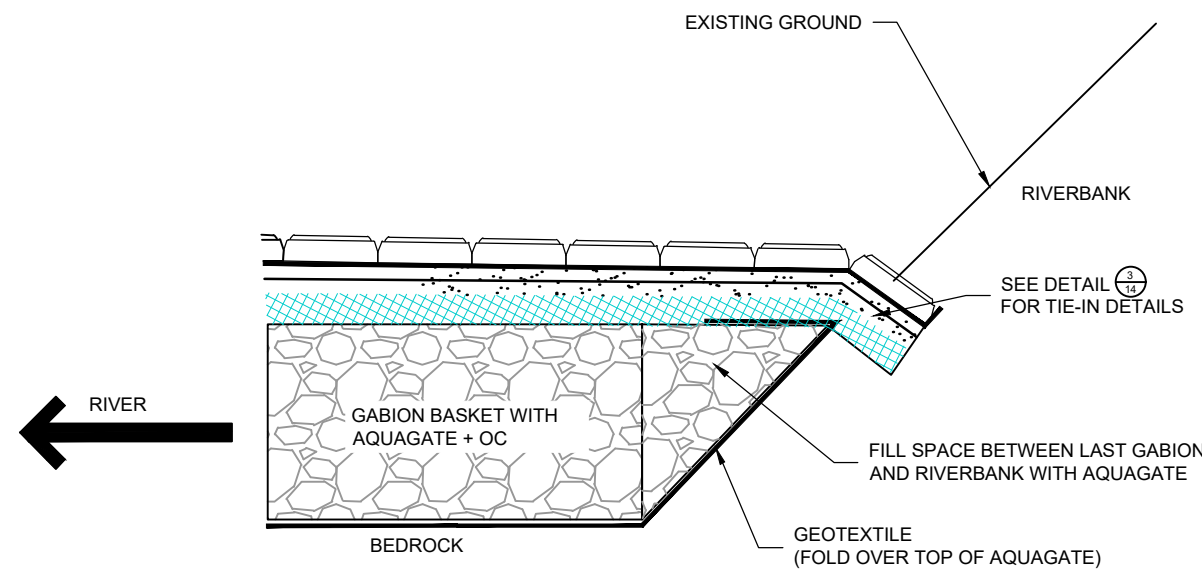
**TYPICAL 50 BLOCK 1.5 MAT**  
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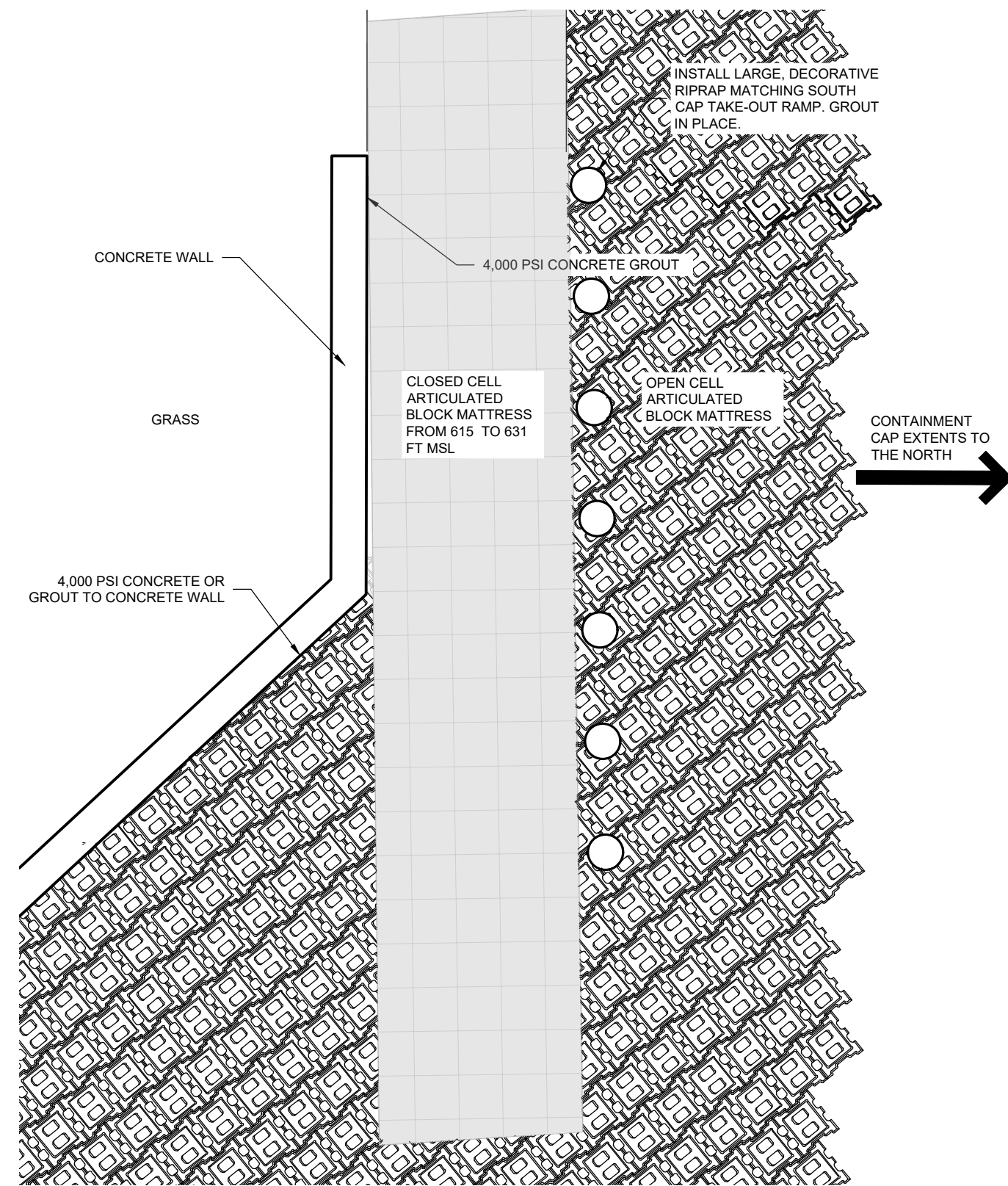
**TYPICAL ANGLE MAT**  
NO TO SCALE



**TYPICAL MAT TO MAT**  
NO TO SCALE



**GABION TIE-IN TO RIVERBANK CROSS SECTION**  
NOT TO SCALE



**TAKE-OUT RAMP PLAN VIEW DETAIL**  
NOT TO SCALE

**NOTES**

- DETAILS 1, 2, 4, 5, AND 6 ON SHEET 14 FROM CONTECH (R) ENGINEERED SOLUTIONS, ARMORFLEX, ARMORFLEX-MEDIUM BAH 50-MODEL1 (NO DATE), ARMORFLEX-MEDIUM BAH 50-MODEL2 (NO DATE), AND ARMORFLEX DETAIL - MEDIUM BAH 50 (9/26/18).
- DETAIL 3 ON SHEET 14 BASED ON CONTECH (R) ENGINEERED SOLUTIONS, ARMORFLEX DETAILS REFERENCED IN NOTE 1.

PROJECT: **HFSTR NORTH OF ZINK DAM  
LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM  
ISSUED FOR PERMIT  
TULSA, OKLAHOMA**

**NOT FOR CONSTRUCTION**

DRAWN BY: T. FIEBRANZ PROJ. NO.: 525252.0000  
CHECKED BY: M. VENNE  
APPROVED BY: J. RICE  
DATE: MARCH 3, 2023

**SHEET 14 OF 16**



999 Fourier Drive  
Suite 101  
Madison, WI 53717  
Phone: 608.926.3600

FILE NO.: 525252 -DT Detail Sheets.dwg



PART 1. SITE PREPARATION

A. CLEARING AND GRUBBING

1. PRIOR TO EXCAVATION AND FILLING, SITE TO BE CLEARED BY STRIPPING OF TREES, SHRUBS, BRUSH, LOGS, STUMPS, AND PLANT LIFE AND DISPOSAL OF DEBRIS AND SPOILS.
2. CLEARING: REMOVE TREES, SHRUBS, BRUSH, LOGS, STUMPS, AND OTHER PLANT GROWTH WITHIN CONSTRUCTION LIMITS TO A MAXIMUM OF 3 INCHES ABOVE GROUND LEVEL.
3. DISPOSAL- REMOVE ALL DEBRIS AND SPOILS WITHIN 30 DAYS OF CLEARING AND DISPOSE OF OFF-SITE. BURNING OF DEBRIS IS NOT PERMITTED. DOCUMENT DISPOSAL OF MATERIAL AT A LICENSED LANDFILL FACILITY WITHIN ONE WEEK OF DISPOSAL TO THE OWNER.
4. PRESERVE AND PROTECT FROM DAMAGE TREES, VEGETATION, LANDSCAPING, UTILITIES, MONITORING WELLS, AND OTHER FEATURES ON-SITE OUTSIDE THE EXCAVATION AND CONSTRUCTION LIMITS. CUT OR SCARRED TREES AND SHRUBS WILL BE PRUNED OR REPLACED BY THE CONTRACTOR.

B. SUBMIT LANDFILL(S) TO BE USED FOR DISPOSAL OF CLEARING AND GRUBBING MATERIAL AND CAD MATERIAL TO OWNER FOR REVIEW AND APPROVAL 5 DAYS PRIOR TO BEGINNING CONSTRUCTION.

PART 2. CONSTRUCTION FACILITIES

A. ELECTRICITY:

1. PROVIDE GENERATOR OR OTHER TEMPORARY SERVICE AS REQUIRED TO PROVIDE ELECTRICAL SERVICE TO FIELD OFFICE.

B. WATER:

1. CLEAN WATER TO BE USED TO DECONTAMINATE EQUIPMENT AND COMPLETE CONSTRUCTION OPERATIONS.
2. CONTRACTOR TO OBTAIN CLEAN WATER FROM OFF-SITE.

C. SANITARY FACILITIES.

1. PROVIDE AND MAINTAIN ENCLOSED PORTABLE SELF-CONTAINED SANITARY FACILITIES DURING CONSTRUCTION OPERATIONS.

D. FIELD OFFICE

1. PROVIDE MOBILE, HOUSE-TYPE TRAILER, OR OTHER REVIEWED BY OWNER THAT ARE FLOORED, ROOFED, AND WEATHERPROOFED, AND HAVE A MINIMUM CEILING HEIGHT OF 6'-9 INCHES.
2. FURNISH OFFICE WITH AT LEAST ONE DESK AND ONE CHAIR TO BE USED BY ENGINEER.
3. FURNISH OFFICE WITH AT LEAST 10 FOLDING CHAIRS AND ONE MINIMUM 3 FOOT BY 6 FOOT FOLDING TABLE.
4. LOCATION OF FIELD OFFICE TO BE REVIEWED BY OWNER PRIOR TO MOBILIZATION TO THE SITE. FIELD OFFICE OR OTHER OCCUPIED STRUCTURES CANNOT BE PLACED ON THE SURFACE OF SOLID WASTE MANAGEMENT UNIT H (SWMU-H).

E. GENERAL RUBBISH

1. CONTROL ACCUMULATION OF MATERIALS AND RUBBISH; PERIODICALLY DISPOSE OF OFF-SITE.
  2. MAINTAIN SITE IN A CLEAN ORDERLY CONDITION.
  3. REMOVE ALL TEMPORARY FACILITIES TO RESTORE ORIGINAL CONDITIONS AT COMPLETION OF PROJECT.
- F. SUBMIT TO THE OWNER THE LANDFILL TO BE USED FOR RUBBISH DISPOSAL A MINIMUM OF 5 DAYS PRIOR TO BEGINNING CONSTRUCTION.

PART 3. SITE CONTROLS

A. PROVIDE AND MAINTAIN BARRIERS TO PROTECT PUBLIC AND PROTECT WORK FROM UNAUTHORIZED ENTRY, VANDALISM OR THEFT. CONTRACTOR SHALL PROVIDE THESE BARRIERS AS PART OF SITE CONTROLS FOR ADJACENT PROJECTS FOR THE DURATION OF THE WORK UNDER THIS CONTRACT. BARRIERS INCLUDES ALL FENCING, SIGNS, AND ACCESS RESTRICTIONS (GATES, ETC.) ENCOMPASSING THE AREA OF WORK FOR THIS CONTRACT. OWNER SHALL NOT PAY CONTRACTOR FOR BARRIERS INSTALLED AND MAINTAINED AS PART OF ADJACENT PROJECTS.

B. PROVIDE AND MAINTAIN CONTROLS TO MINIMIZE TRANSPORT OF SOIL, WATER, OILS, AND ODORS OUTSIDE THE CONSTRUCTION LIMITS AS SHOWN ON DRAWINGS OR AS REQUIRED IN THE CONTRACT DOCUMENTS BETWEEN CONTRACTOR AND OWNER.

1. TRUCK AND EQUIPMENT DECONTAMINATION
  - a. WASH ALL EQUIPMENT TO BE FREE OF SOIL, OIL, OR CONTAMINATED WATER PRIOR TO LEAVING THE CONSTRUCTION LIMITS.
  - b. PREVENT UNCONTROLLED RELEASE OF WATER AND DEBRIS GENERATED DURING DECONTAMINATION.
  - c. PROPERLY DISPOSE OF WATER AND DEBRIS GENERATED DURING DECONTAMINATION.
2. SILT FENCE
  - a. MATERIALS TO BE USED AS SHOWN ON THE DETAILS.
  - b. INSTALL SILT FENCE AT LOCATION SHOWN ON DRAWINGS AND AS DIRECTED BY OWNER. AT A MINIMUM SILT FENCE SHALL BE INSTALLED AND MAINTAINED AT THE UPLAND CONSTRUCTION LIMITS SHOWN ON THE DRAWING.
  - c. INSTALL SILT FENCE AS SHOWN ON THE DETAILS.
3. TEMPORARY SURFACE WATER CONTROL
  - a. HARD AND OIL SORBENT BOOMS ARE PRESENT WITHIN THE EXISTING COFFER DAM AND ARE MAINTAINED BY A REPRESENTATIVE OF THE OWNER. THE BOOMS SHALL BE PRESENT UNTIL AFTER THE ARTICULATED BLOCK MATTRESS IS INSTALLED OR UNTIL AN ALTERNATE DATE DETERMINED BY THE OWNER.
  - b. FOR PURPOSES OF DEWATERING, CONTRACTOR SHALL DISCHARGE PUMP WITHIN BOOMS PROVIDED AND PLACED BY REPRESENTATIVE OF THE OWNER. COORDINATE WITH THE OWNER TO ENSURE BOOMS ARE AVAILABLE AND INSTALLED PRIOR TO DEWATER OPERATIONS BY THE CONTRACTOR.
  - c. CONTRACTOR SHALL NOTIFY OWNER OF ANY ISSUES OBSERVED WITH THE BOOMS WITHIN ONE HOUR OF THE OBSERVATION.
  - d. CONTRACTOR IS NOT RESPONSIBLE FOR PROVIDING ANY MATERIALS OR LABOR FOR THE BOOM MAINTENANCE.
  - e. CONTRACTOR SHALL ALLOW ACCESS TO OWNER AND REPRESENTATIVE OF OWNER TO MAINTAIN BOOMS WITHIN THE WORK AREA.

PART 4. LNAPL RECOVERY SUMPS

A. INSTALL LNAPL COLLECTION SUMPS FROM NEAR THE TOE OF THE COLLECTION LAYER TO THE GROUND SURFACE. SUMPS SHALL GENERALLY FOLLOW THE DESIGN SLOPE OF THE CAP AND BE PLACED SOLELY WITHIN THE COLLECTION LAYER.

B. CONSTRUCT, DEVELOP, AND COMPLETE LNAPL RECOVERY SUMPS AT SPECIFIED INTERVALS ALONG THE EXTENT OF THE CAP AS SHOWN ON THE DRAWINGS.

C. REFER TO: ANSII/AWWA C206, ASTM A53, ASTM C150, AWWA A100.

D. STEEL CASING AND SCREENS

1. CASING MATERIAL: STAINLESS STEEL, AISI TYPE 304, STANDARD WEIGHT, 6 INCH DIAMETER.
2. SCREEN MATERIAL: STAINLESS STEEL, AISI TYPE 304, WIRE-WRAPPED, CONTINUOUS SLOT. SELECT MAXIMUM WELL SLOT THAT IS LESS THAN 0.187 INCHES (JOHNSON FREE-FLOW™ 307 STAINLESS STEEL 80-SLOT MEETS CRITERIA). PLACE FROM ELEVATION OF 608 TO 627 FT MSL AS INDICATED ON THE DRAWINGS.
3. JOINTS: FLUSH-JOINT, THREADED OR WELDED.
4. FITTINGS: AISI TYPE 304 STAINLESS STEEL, END FITTING WELDED TO SCREEN BODY.

E. SUMP VAULTS

1. VAULTS SHALL BE A MINIMUM OF 48 INCHES WIDE, 12 INCHES DEEP, AND 72 INCHES LONG. VAULT SHALL BE SIZED SUCH THAT EQUIPMENT CAN BE LOWERED INTO SUMP WITHOUT CONTACTING THE VAULT. MINIMUM OF 30 INCHES OF CLEARANCE IS NEEDED WITHIN THE VAULT IN FRONT OF SUMP. MINIMUM OF 6 INCHES OF SUMP SHALL PROTRUDE WITHIN THE VAULT. PROVIDE AT LEAST 6 INCHES OF CLEARANCE BETWEEN SUMP AND INTERIOR VAULT WALL ON BOTH SIDES OF THE SUMP.
2. VAULT MATERIAL SHALL BE DURABLE, WEATHERPROOF, AND ACCEPTABLE TO MEET TRAFFIC RATING. CONCRETE (PRE-CAST), REINFORCE CONCRETE, POLYMER, AND HDPE MAY BE ACCEPTABLE.
3. VAULT SHALL BE RATED FOR CLASS FOUR, TIER 15, UP TO 15,000 POUNDS WHICH CAN BE REFERRED TO AS LIGHT TRAFFIC DUTY OR NON-DELIBERATE TRAFFIC.
4. VAULT LID MUST HAVE LOCKING MECHANISM AND BE REMOVABLE WITH A HANDLE/TOOL. LID SHALL WEIGH MAXIMUM OF 70 POUNDS, PREFERABLY 30 TO 50 POUNDS.

F. PLACEMENT

1. SET SUMP CASING AND SCREEN IN LOCATIONS NOTED ON DRAWINGS DURING INSTALLATION OF CRUSHED STONE COLLECTION LAYER AND PRIOR TO PLACEMENT OF AQUABLOK CONTROL LAYER.
2. MAINTAIN STRAIGHTNESS AND PLUMBNESS IN ACCORDANCE WITH AWWA A100.
3. VAULT SHALL BE SET AFTER ROUGH GRADING IS COMPLETE. CONTRACTOR TO GUARANTEE THAT WHEN COMPLETE, SUMP CASING SHALL BE SUFFICIENTLY INSTALLED WITHIN THE VAULT FOR THE FREE INSTALLATION AND OPERATION OF A VACUUM HOSE VALVE ATTACHMENT AND/OR INJECTION HOSE PIPING.

G. QUALITY CONTROL

1. TOLERANCES
  - a. HORIZONTAL PLANE: CENTERED WITHIN 10 FEET OF LOCATIONS SHOWN ON DRAWINGS.
  - b. VERTICAL PLANE: SCREENS SET TO INTERSECT THE CAP AT THE ELEVATIONS SHOWN ON THE DRAWINGS. SCREEN TO BE FULLY CONTAINED IN CRUSHED STONE FILL, AT A MINIMUM OF 2 INCHES BELOW AND 3 INCHES TOP OF THE CRUSHED STONE COLLECTION LAYER.
  - c. SCREENS SHALL BE PLACED WITHIN THE EXISTING LAYER OF CRUSHED STONE.
  - d. AQUABLOK SHALL BE PLACED TO THE ELEVATION SHOWN ON THE DRAWINGS OR TO THE ELEVATION OF THE TOP OF THE SUMP SCREEN, WHICHEVER IS HIGHER.
  - e. COLLECTION SUMP SHALL TERMINATE INSIDE THE VAULT WITH A MINIMUM CLEARANCE OF 3 INCHES BELOW THE VAULT LID AND 6 INCHES ABOVE THE BOTTOM OF THE VAULT.
2. PERFORM ALL WORK IN ACCORDANCE WITH APPLICABLE STATE AND LOCAL REQUIREMENTS.
3. CERTIFICATION OF WELDER QUALIFICATIONS TO BE SUBMITTED TO OWNER 10 DAYS PRIOR TO COMMENCEMENT OF CAP CONSTRUCTION. CERTIFICATION WILL VERIFY TRAINING AND CURRENT LICENSURE TO WORK ON SPECIFIED MATERIALS.

PART 5. MONITORING WELL PROTECTION

A. OUTSIDE THE FOOTPRINTS OF EXCAVATION/FILL: PROTECT EXISTING SITE MONITORING WELLS AS INDICATED ON THE DRAWINGS DURING EXCAVATION/FILL AND CONSTRUCTION ACTIVITIES USING CONCRETE BARRIERS (NO EXCEPTIONS). IMMEDIATELY NOTIFY OWNER REGARDING ANY DAMAGE TO MONITORING WELLS.

1. PROTECTION: PROTECT WELL CASINGS FROM INFILTRATION OF SURFACE WATER, OTHER WATER, SOIL, AND ANY FOREIGN MATERIALS. IMMEDIATELY NOTIFY OWNER OF NECESSARY ALTERATIONS AND/OR DAMAGE TO MONITORING WELLS.
2. REPAIR AND REPLACEMENT SHALL BE DONE AT NO EXPENSE TO THE OWNER.

PART 6. EXCAVATION AND DISPOSAL

A. EXCAVATION ON THE SITE INCLUDES DREDGING, DIGGING, STABILIZING, LOADING, HAULING, AND DISPOSING OF MATERIAL TO ACHIEVE BASE ELEVATIONS SHOWN ON THE DRAWINGS OR AS DIRECTED BY OWNER.

B. SUBMIT TO THE OWNER A SOIL EROSION AND SEDIMENTATION CONTROL PLAN, INCLUDING PRODUCTS, METHODS AND SITE LAYOUT TO BE USED A MINIMUM OF 10 DAYS PRIOR TO COMMENCEMENT OF EXCAVATION FOR REVIEW.

C. PREPARATION

1. ESTABLISH REQUIRED CONSTRUCTION SURVEY CONTROL LINES AND DATUM.
2. ESTABLISH SITE CONTROLS PRIOR TO COMMENCING EXCAVATION.

D. PROTECTION OF EXISTING SITE

1. NOTIFY ALL AREA UTILITY COMPANIES PRIOR TO COMMENCING WORK IN ACCORDANCE WITH STATE AND LOCAL REGULATIONS.
2. LOCATE, IDENTIFY, AND PROTECT EXISTING UTILITIES FROM DAMAGE.
3. PROTECT EXISTING NATURAL GAS FORCEMAIN FROM DAMAGE.
4. OUTSIDE FOOTPRINTS OF EXCAVATION: PROTECT BENCHMARKS, SURVEY MONUMENTS, MONITORING WELLS, EXISTING STRUCTURES, FENCES AND GATES, SIDEWALKS, PAVING, AND CURBS FROM DAMAGE BY EXCAVATION EQUIPMENT AND VEHICULAR TRAFFIC. NOTIFY OWNER IF FEATURE MUST BE DISTURBED AND FOR REVIEW RESTORATION OF FEATURE.
5. PROTECT EXCAVATIONS BY SLOPING, BENCHING, SHORING, BRACING, SHEET PILING, OR OTHER METHODS REQUIRED TO PREVENT CAVE-IN OR LOOSE SOIL FROM FALLING INTO THE EXCAVATION.
6. PROVIDE REINFORCEMENT OR USE OTHER MEASURES TO PREVENT DAMAGE TO STRUCTURES ADJACENT TO EXCAVATION WORK, INCLUDING THE PNEUMATIC LINE BEHIND THE EXISTING CONCRETE WALL.
7. DO NOT REMOVE OR DISTURB ANY MATERIALS OUTSIDE THE EXCAVATION AND CONSTRUCTION LIMITS.

E. EXCAVATION

1. GRADE PERIMETER OF EXCAVATION TO PREVENT SURFACE WATER DRAINAGE INTO EXCAVATION.
2. REMOVE DEBRIS, SUCH AS LOGS, BOULDERS, AND C&D MATERIAL, AS THEY ARE ENCOUNTERED.
3. NOTIFY OWNER OF UNEXPECTED SUBSURFACE CONDITIONS OR EVIDENCE OF POTENTIAL CONTAMINATION AND DISCONTINUE WORK IN AFFECTED AREA UNTIL NOTIFIED WORK CAN RESUME.
4. DREDGE SEDIMENT AND EXCAVATE SOIL TO ACHIEVE MINIMUM BASE GRADES AS SHOWN ON DRAWINGS. OWNER MAY REQUIRE ADDITIONAL REMEDIAL EXCAVATION BASED ON SITE CONDITIONS.

F. FIELD QUALITY CONTROL

1. EXCAVATE TO MINIMUM BASE GRADES AS SHOWN ON DRAWINGS. OWNER MAY REQUIRE ADDITIONAL REMEDIAL EXCAVATION BASED ON SITE CONDITIONS.
2. FOR CAP CONSTRUCTION, CLEAN FILL TO ELEVATIONS SHOWN FOR BASE GRADE OF COLLECTION LAYER WITHIN +/- 5 FEET TO +/- 5 FEET TOLERANCE OF ELEVATIONS SHOWN ON DRAWINGS. SEE CLEAN FILL QUALITY CONTROL FOR SURVEY REQUIREMENTS.

G. STOCKPILE

1. STOCKPILE EXCAVATED MATERIAL IN ACCORDANCE WITH TYPICAL EXCAVATED SOIL STOCKPILE DETAIL IN THE DRAWINGS.
2. NOTIFY OWNER IF POTENTIALLY CONTAMINATED MATERIAL IS ENCOUNTERED. POTENTIALLY CONTAMINATED MATERIAL SHALL BE SEGREGATED AND PLACED ON PLASTIC SHEETING, PLACED IN LINED ROLL-OFF CONTAINER, OR OTHER CONTAINMENT AS REVIEWED BY OWNER UNTIL CHARACTERIZATION, PROFILING AND DISPOSAL CAN BE PERFORMED. POTENTIALLY CONTAMINATED MATERIAL SHALL BE COVERED AND PROTECTED FROM PRECIPITATION AND RUNOFF.

H. STABILIZATION

1. ESTABLISH ON-SHORE STAGING AREA FOR STABILIZATION OF EXCAVATED MATERIAL IF REQUIRED FOR OFF-SITE DISPOSAL.
2. STABILIZE EXCAVATED MATERIAL ON SITE PER STABILIZATION PLAN AND IN MEANS ACCEPTABLE TO OWNER IN ORDER TO PASS PAINT FILTER TEST PRIOR TO DISPOSAL IF NECESSARY.

I. LOAD, HAUL, AND DISPOSE

1. LOAD STABILIZED MATERIAL ONTO TRUCKS OR ROLL-OFF CONTAINERS FOR OFF-SITE DISPOSAL AT A DISPOSAL FACILITY LICENSED TO ACCEPT THE WASTE AND APPROVED BY OWNER. COMPLETE ALL REQUIRED WASTE CHARACTERIZATION TESTING, WASTE PROFILE AND ASSOCIATED TESTING AS REQUIRED BY THE DISPOSAL FACILITY. OWNER WILL SIGN AS WASTE GENERATOR.
2. COVER TRUCK OR ROLL-OFF CONTAINERS LOAD PRIOR TO LEAVING SITE TO MINIMIZE DUST AND ODORS.
3. HAUL MATERIAL DIRECTLY TO APPROVED DISPOSAL FACILITY IN TRUCKS OR ROLL-OFF CONTAINERS LICENSED FOR TRANSPORT OF POTENTIALLY CONTAMINATED MATERIAL.
4. DISPOSE OF MATERIAL AT APPROVED DISPOSAL FACILITY. WASTE CHARACTERIZATION TESTING PERFORMED BY OTHERS. PROFILING AND MANIFESTS WILL BE PROVIDED BY OWNER.

PART 7. DEWATERING

A. RIVER WATER

1. CONTROL RIVER WATER IN EXCAVATIONS ADJACENT TO THE RIVER AS NECESSARY TO COMPLETE CONSTRUCTION.
2. WATER WITH HYDROCARBON SHEEN SHALL NOT BE PUMPED. PUMP INTAKE MUST BE BELOW THE WATER LEVEL AND PROTECTED WITH OIL SORBENT BOOMS. DEWATERING EFFLUENT MUST BE PROTECTED WITH HARD AND OIL SORBENT BOOMS.
3. SUBMIT DEWATERING PLAN, OR PLAN TO CONSTRUCT WITHOUT DEWATERING, TO OWNER AT LEAST 10 DAYS PRIOR TO CONSTRUCTION IN RIVER.
4. SUBMIT COPY OF ALL PERMITS REQUIRED FOR DEWATERING TO THE OWNER UPON RECEIPT FROM ISSUING AGENCIES.

PART 8. SUBMITTALS

- A. SUBMIT ALL REQUIRED INFORMATION TO OWNER AS INDICATED IN THE SPECIFICATIONS.
- B. ALL SUBMITTALS MUST BE REVIEWED IN WRITING BY THE OWNER BEFORE PRODUCT DELIVERY OR PROCEEDING WITH THE PROPOSED WORK. WORK COMPLETED OR PRODUCTS DELIVERED OR USED WITHOUT OWNER REVIEW SHALL BE REPLACED AT THE COST OF THE CONTRACTOR.
- C. AT A MINIMUM, SUBMITTALS SHALL INCLUDE CONTRACTOR CONTACT INFORMATION AND SOURCE OF AND CONTACT FOR PRODUCT.
- D. OWNER'S REVIEW OF PLANS DOES NOT GUARANTEE CONTRACTOR'S MEANS AND METHODS TO COMPLETE THE WORK.

PART 9. CLEAN TOPSOIL

- A. CONTRACTOR TO FURNISH CLEAN TOPSOIL FROM SOURCE REVIEWED AND APPROVED BY OWNER PRIOR TO PURCHASE OF MATERIAL. CLEAN TOPSOIL SHALL BE TESTED BY OTHERS.
- B. PLACE TOPSOIL IN THE TOP 6 INCHES OF DISTURBED AREAS NOT COVERED BY THE ARTICULATED BLOCK MAT AS SHOWN ON THE DRAWINGS.
- C. MATERIAL
  1. NATURAL LOAM, SANDY LOAM, SILTY LOAM, OR CLAY LOAM HUMUS-BEARING SOILS OF MINERAL ORIGIN ADAPTED TO THE SUSTENANCE OF PLANT LIFE.
  2. FREE FROM REFUSE, SUBSOILS, CONTAMINATION, MATERIALS TOXIC TO PLANT GROWTH, AND FOREIGN OBJECTS.
  3. OBTAIN TOPSOIL FROM A WELL-DRAINED OFF-SITE LOCATION THAT IS FREE OF FLOODING.
  4. TOPSOIL CANNOT BE REUSED FROM ON-SITE EXCAVATIONS.
- D. PREPARATION
  1. REMOVE VEGETATION, FOREIGN MATERIALS, UNSATISFACTORY OR POTENTIALLY CONTAMINATED SOILS, OBSTRUCTIONS, AND MATTER HARMFUL TO PLANT GROWTH FROM THE GROUND SURFACE BEFORE PLACEMENT.
  2. PREPARE SUBSOIL TO ELIMINATE UNEVEN AREAS AND LOW SPOTS. MAINTAIN LINES, LEVELS, PROFILES, AND CONTOURS. MAKE GRADUAL CHANGES TO THE GRADE. BLEND SLOPES INTO LEVEL AREAS. MEET GRADES SHOWN ON DRAWINGS.
  3. SCARIFY SUBSOIL TO A DEPTH OF 3 INCHES IN AREAS WHERE EQUIPMENT HAS COMPACTED SUBSOILS.

E. PLACEMENT

1. PLACE TOPSOIL TO A UNIFORM DEPTH OF 6 INCHES.
  2. FINISH GRADE TO WITHIN 2 INCHES OF ELEVATIONS SHOWN ON DRAWINGS OR TO MATCH EXISTING GRADE.
  3. BREAK DOWN ANY CLODS AND LUMPS IN MATERIAL.
- PART 10. EROSION CONTROL AND SOD
- A. PROVIDE EROSION CONTROL AND SOD AS SHOWN ON THE DRAWINGS. STORE, HANDLE, AND PLACE SOD AS SPECIFIED HEREIN.
  - B. SUBMIT PRODUCT DATA AND INSTALLATION PLAN TO THE OWNER A MINIMUM OF 15 DAYS PRIOR TO DELIVERY OF SOD TO SITE.
  - C. SOD SHALL CONSIST OF A LIVE, DENSE, WELL-ROOTED GROWTH OF TURF GRASS SPECIES. THE SOD SHALL BE FREE OF NUT GRASS, CRAB GRASS, AND OTHER OBNOXIOUS GRASSES.
  - D. STORAGE AND HANDLING
    1. STORE OUT OF SUNLIGHT.
    2. HANDLE WITH CARE SO AS NOT TO DAMAGE SOD.
    3. THE SOD SHALL BE MAINTAINED MOIST FROM THE TIME OF DELIVERY UNTIL THE TIME OF PLACEMENT.
  - E. ACCEPTABLE PRODUCTS
    1. BERMUDA GRASS SOD
    2. SUBSTITUTIONS ONLY ALLOWED WITH AGREEMENT OF OWNER. SAMPLE OF PRODUCT AND PRODUCT SPECIFICATIONS, AT A MINIMUM, WILL NEED TO BE SUBMITTED FOR REVIEW.
  - F. PREPARATION
    1. TOPSOIL TO BE PLACED AT GRADES AS SPECIFIED ON THE DRAWINGS.
    2. PLACE SOD DIRECTLY ON TOP OF THE TOPSOIL.
    3. REMOVE ANY SHARP OBJECTS OR OTHER UNSUITABLE MATERIALS PRIOR TO PLACEMENT OF THE SOD.
  - G. INSTALLATION TO BE PER THE MANUFACTURER'S INSTRUCTIONS AND AS FOLLOWS:

1. THE AREA TO BE SODDED SHALL BE CONSTRUCTED TO THE LINES AND GRADES INDICATED ON THE DRAWINGS OR AS DIRECTED BY THE OWNER. THE AREA TO BE SODDED SHOULD BE MOISTENED PRIOR TO SOD PLACEMENT.
2. IMMEDIATELY BEFORE PLACING THE SOD, FERTILIZER SHALL BE UNIFORMLY APPLIED AT 12 POUNDS PER 1,000 FEET.
3. THE SOD SHOULD BE PLACED ON THE PREPARED SURFACE WITH THE EDGES IN CLOSE CONTACT AND STAGGERED JOINTS TO THE EXTENT PRACTICAL. IMMEDIATELY AFTER PLACEMENT, THE SOD SHALL BE ROLLED WITH A LIGHT-WEIGHT ROLLER OR HAND TAMPER TO THE SATISFACTION OF THE OWNER.
4. WATERING AND MAINTENANCE
  - a. THE SOD SHALL BE WATERED DAILY ON WORK DAYS, UNLESS IT RAINS WITHIN THE PRECEDING 24-HOURS. WATERING WILL START THE DAY THE SOD IS PLACED AND SHALL CONTINUE UNTIL THE DATE OF SUBSTANTIAL COMPLETION.
  - b. THE CONTRACTOR SHALL NOT ALLOW ANY EQUIPMENT OR MATERIAL TO BE PLACED ON ANY PLANTED AREAS AND SHALL INSTALL SUITABLE BARRICADES TO PREVENT CONTRACTOR'S EQUIPMENT FROM TRAVELING ON OR OVER AREAS PLANTED WITH SOD.

PART 11. FILL

- A. TRANSPORT, STORE, AND INSTALL MATERIALS AS SPECIFIED HEREIN AND IN THE DRAWINGS.
- B. REFER TO: ASTM D422, ASTM D1140, ASTM D2434, AND ASTM D5084.
- C. SUBMITTALS
  1. SUBMIT TO OWNER AT LEAST 15 DAYS PRIOR TO BEGINNING CONSTRUCTION:
    - a. GRAIN SIZE DISTRIBUTION OF CLEAN FILL, SELECT CRUSHED STONE FILL, AND AQUABLOK FILL.
    - b. HYDRAULIC CONDUCTIVITY TESTING RESULTS OR MANUFACTURER'S QUALITY ASSURANCE FOR SELECT CRUSHED STONE FILL AND AQUABLOK FILL.
    - c. SOURCE OF EACH FILL MATERIAL.
  2. OWNER MAY REQUEST ADDITIONAL TESTING DURING PROJECT TO VERIFY SUPPLIED FILL MEETS SPECIFICATIONS.

D. PRODUCTS

1. CLEAN FILL
  - a. CLEAN FILL TO BE USED WHERE DRAWINGS CALL FOR BACKFILL BENEATH THE EXTENT OF THE CAP. TO ACHIEVE FINAL GRADES IN GRASSY AREAS AND ALL OTHER AREAS FILLED AS PART OF THIS PROJECT.
  - b. CONTRACTOR TO FURNISH CLEAN FILL FROM SOURCE REVIEWED AND APPROVED BY OWNER PRIOR TO PURCHASE. CLEAN FILL WILL BE TESTED BY OTHERS AND TESTING RESULTS WILL BE APPROVED BY OWNER.
  - c. FINISHED GRADES MUST CONSIST OF CLEAN TOPSOIL, CLEAN FILL OR ARTICULATED BLOCK MATTRESS.
  - d. MATERIAL TO BE FREE FROM ORGANIC MATTER, REFUSE, MASONRY, METAL, OR OTHER DEBRIS.
  - e. CLEAN FILL TO BE NATIVE GRANULAR MATERIAL WITH NO SIGN OF CONTAMINATION UPON REVIEW OF OWNER OR IMPORTED CLEAN FILL OF THE FOLLOWING GRADATION:

SIEVE SIZE	%PASSING BY WEIGHT
3"	100
1"	70-100
#200	0-30
  - f. NON-NATIVE FILL MATERIAL EXCAVATED FOR THE WORK WILL NOT BE ACCEPTED AS CLEAN FILL. E.G., CONCRETE, DEBRIS, OR ANOTHER HISTORIC FILL.
2. SELECT CRUSHED STONE FILL
  - a. SELECT CRUSHED STONE FILL TO BE USED FOR CONSTRUCTION OF COLLECTION LAYER, BEDDING LAYER, AND TOE VENT.
  - b. SELECT CRUSHED STONE FILL TO MEET REQUIREMENTS OF AASHTO 5:

SIEVE SIZE	% PASSING BY WEIGHT
1 1/2"	100
1"	90-100
3/4"	20-55
1/2"	0-10
3/8"	0-5
  - c. A MINIMUM HYDRAULIC CONDUCTIVITY OF 0.1 CM/S AT THE DRY DENSITY AND MOISTURE CONTENT ACHIEVED DURING PLACEMENT.
  - d. CRUSHED STONE FILL SHALL BE WASHED PRIOR TO PLACEMENT BELOW THE CAP AND PLACEMENT WITHIN THE RIVER CHANNEL.
  - e. ALTERNATE SELECT CRUSHED STONE FILL SHALL NOT BE USED UNLESS SUBMITTED AND REVIEWED IN WRITING BY OWNER.

3. ARTICULATED BLOCK MATTRESS FILL

- a. ARTICULATED BLOCK MATTRESS FILL TO BE USED TO BACKFILL THE VOID SPACES IN THE OPEN CELLS.
  - b. ARTICULATED BLOCK MATTRESS FILL TO MEET REQUIREMENTS OF AASHTO T-277T-11.

SIEVE SIZE	% PASSING BY WEIGHT
1"	100
3/4"	100
1/2"	100
3/8"	50
#8	10
  - c. ALTERNATE ARTICULATED BLOCK MATTRESS FILL SHALL NOT BE USED UNLESS SUBMITTED AND REVIEWED IN WRITING BY OWNER.
4. AQUABLOK 2080 FW FILL
- a. AQUABLOK 2080 FW MANUFACTURED BY AQUABLOK, LTD. FOR USE ABOVE THE COLLECTION LAYER AS INDICATED ON DRAWINGS.
  - b. MATERIAL PROVIDED BY OWNER. CONTRACTOR TO COORDINATE DELIVERY, OFFLOADING, STORAGE, HANDLING, AND PLACEMENT IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS FROM THE TIME OF RECEIPT ONSITE UNTIL OWNER ACCEPTS CONSTRUCTION COMPLETION.
5. AQUAGATE+OC FILL
- a. AQUAGATE+OC MANUFACTURED BY AQUABLOK, LTD. FOR USE IN GABION BASKETS.
  - b. MATERIAL PROVIDED BY OWNER. CONTRACTOR TO COORDINATE DELIVERY, OFFLOADING, STORAGE, HANDLING, AND PLACEMENT IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS FROM THE TIME OF RECEIPT ONSITE UNTIL OWNER ACCEPTS CONSTRUCTION COMPLETION.

E. MATERIAL STOCKPILES

1. STOCKPILE CONSTRUCTION MATERIALS ON-SITE IN SEPARATE PILES WITH SUFFICIENT QUANTITIES TO MEET PROJECT SCHEDULE AND REQUIREMENTS.
2. MAINTAIN STOCKPILES DAILY DURING CONSTRUCTION. GRADE STOCKPILES TO PROVIDE POSITIVE DRAINAGE TO PREVENT EROSION OR DETERIORATION OF MATERIALS. PROVIDE EROSION CONTROL AROUND STOCKPILES.
3. AQUABLOK AND AQUAGATE+OC TO BE STOCKPILED ON WATERPROOF MATERIAL WHICH IS RAISED TO PREVENT SURFACE DRAINAGE ONTO THE MATERIAL. STOCKPILE NO MORE AQUABLOK FILL THAN IS NEEDED TO ACCOMMODATE THE FOLLOWING DAY'S CONSTRUCTION UNLESS LONG-TERM DRY (COVERED) STORAGE IS PROVIDED.
4. REGRADE AND RESTORE STOCKPILE AREAS AT COMPLETION OF THE PROJECT.

F. PLACEMENT

1. CLEAN FILL
  - a. PLACE IN ACCORDANCE WITH DETAIL.
  - b. PLACE IN LIFTS UP TO 1 FOOT THICKNESS TO ACHIEVE GRADES AS SHOWN ON DRAWINGS.
  - c. COMPACT EACH LIFT OF UNSATURATED CLEAN FILL WITH SPECIALIZED COMPACTION EQUIPMENT. SPECIALIZED EQUIPMENT SHALL INCLUDE TAMPING ROLLER, PNEUMATIC TIRE ROLLER, VIBRATORY ROLLER OR OTHER EQUIPMENT DESIGNED FOR COMPACTION AND REVIEWED BY OWNER DURING CONSTRUCTION.
2. SELECT CRUSHED STONE FILL COLLECTION LAYER
  - a. PLACE AND SPREAD SELECT CRUSHED STONE FILL IMMEDIATELY AFTER EXCAVATION GRADES HAVE BEEN ESTABLISHED. PLACEMENT SHALL PROGRESS UPWARDS FROM THE TOE OF SLOPE. PLACE SELECT CRUSHED STONE FILL IN MULTIPLE LIFTS ALLOWING FOR PLACEMENT OF THE PRODUCT RECOVERY SUMPS AS SHOWN ON THE DRAWINGS AND AS SPECIFIED IN PRODUCT RECOVERY SUMPS.
  - b. GRADE TOP OF COLLECTION LAYER TO ACHIEVE MINIMUM THICKNESS OF 12 INCHES (+/- 1 INCH UNLESS OTHERWISE INDICATED ON THE DRAWINGS) ON TOP OF NATIVE MATERIAL AND/OR CLEAN FILL. GRADE TOP OF COLLECTION LAYER TO ACHIEVE CONSTANT POSITIVE SLOPES AS SHOWN ON THE DRAWINGS.
  - c. AFTER PLACEMENT OF THE SELECT CRUSH STONE COLLECTION LAYER AND LNAPL RECOVERY SUMPS, THE GROUNDWATER TOE VENT AREAS SHALL BE PROTECTED FROM CONTACT WITH FUGITIVE SEDIMENT AND AQUABLOK. AFTER FULL HYDRATION OF AQUABLOK, PROTECTION SHALL BE REMOVED AND THE TOE VENT COMPLETED WITH RIP RAP.
3. ARTICULATED BLOCK MATTRESS FILL
  - a. REFER TO PART 15 ARTICULATED BLOCK MATTRESS FOR PLACEMENT.
4. AQUABLOK FILL
  - a. FOLLOW MANUFACTURER REQUIREMENTS FOR INSTALLATION.
  - b. PLACE ONLY DRY GRANULAR AQUABLOK WITH NO CLUMPS. DO NOT PLACE ALREADY HYDRATED AQUABLOK FILL.
  - c. PLACE AND SPREAD AQUABLOK FILL TO THICKNESS IN ONE LIFT. PLACEMENT WILL PROGRESS UPWARD FROM THE TOE OF SLOPE IN 10 TO 20 FEET WIDE LIFTS, AS EQUIPMENT ALLOWS.
  - d. GRADE AND FINISH TO ACHIEVE A LAYER THICKNESS OF 6 INCHES +/- 1 INCH UNLESS OTHERWISE INDICATED ON DRAWINGS.
  - e. COVER AQUABLOK FILL WITH SELECT CRUSHED STONE FILL AND GEOGRID AT THE END OF EACH DAY. MAINTAIN 3 TO 5 FEET OF AN UNCOVERED EDGE OF AQUABLOK TO ACCOMMODATE PLACEMENT THE FOLLOWING DAY. OVERLAP DAILY AQUABLOK APPLICATIONS 1 TO 3 FEET.
  - f. REMOVE AND REPLACE AQUABLOK FILL THAT DOES NOT MEET SPECIFIED MATERIAL TESTING REQUIREMENTS.
5. SELECT CRUSHED STONE BEDDING LAYER
  - a. PLACE SELECT CRUSHED STONE FILL IN 3-INCH +/- 1 INCH LIFT ON TOP OF AQUABLOK FILL LAYER. PLACE GEOGRID AS SPECIFIED IN GEOGRID. PLACE ANOTHER 3 INCHES +/- 1 INCH LIFT OF SELECT CRUSHED STONE ON TOP OF THE GEOGRID.
  - b. PLACE GEOTEXTILE ON TOP OF SELECT CRUSHED STONE BEDDING LAYER PER PART 14 GEOTEXTILE.
6. AQUAGATE+OC TOE VENT
  - a. FOLLOW MANUFACTURER REQUIREMENTS FOR INSTALLATION.
  - b. PLACE AQUAGATE+OC IN GABION BASKETS PER REQUIREMENTS IN PART 16. AQUAGATE+OC GABION.

G. FIELD QUALITY CONTROL

1. GRADE STAKES FOR CAP CONSTRUCTION
  - a. ESTABLISH SURVEY GRADE STAKES STARTING AT STATION 0+25 AND STATIONS LOCATED EVERY 25 FEET THEREAFTER FOR THE EXTENT OF THE CAP.
  - b. SET THREE STAKES AT EACH STATION AT THE TOE OF SLOPE, TOP OF SLOPE, AND MID POINT OF SLOPE AT EACH STATION.
2. STAKES TO BE OF SUFFICIENT HEIGHT AND INTEGRITY TO REMAIN INTACT AND ALLOW SURVEY CONTROL FOR CONSTRUCTION OF BASE GRADE, COLLECTION, AQUABLOK AND BEDDING LAYERS. REPLACE AS NECESSARY.
3. MARK 12-INCH, 6-INCH, AND 6-INCH ABOVE TOP OF BASE GRADE TO INDICATE TOP OF COLLECTION, TOP OF AQUABLOK, AND TOP OF BEDDING LAYERS, RESPECTIVELY AT EACH SURVEY STAKE PRIOR TO PLACEMENT OF CAP MATERIALS.
4. SURVEY LOCATIONS CAN BE ADJUSTED TO ACCOMMODATE SITE CONDITIONS OR CONSTRUCTION SEQUENCING IF REVIEWED BY OWNER.
5. CLEAN FILL AND TOPSOIL IN UPLAND AREAS
  - a. SURVEY AT 50 FOOT GRID TO ACHIEVE FINAL GRADES AS SHOWN ON THE DRAWINGS +/- 6 INCHES.
  - b. SLOPE SHALL NOT EXCEED 3:1.
6. CLEAN FILL BASE LAYER WITHIN THE CAP EXTENTS
  - a. SURVEY BASE ELEVATION AT ESTABLISHED SURVEY LOCATIONS.
  - b. ACHIEVE ELEVATION GRADES SHOWN ON THE DRAWINGS WITHIN +/- 6 INCHES.
  - c. MAINTAIN POSITIVE SLOPE NOT TO EXCEED 3:1 OVER ENTIRE SURFACE OF THE CONTAINMENT CAP EXTENTS.
  - d. EXCAVATE OR FILL TO ACHIEVE BASE GRADES AS DIRECTED BY OWNER.

PROJECT:

HFSTR NORTH OF ZINK DAM  
LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM  
TULSA, OKLAHOMA

TITLE:

NOT FOR CONSTRUCTION SPECIFICATIONS

DRAWN BY:

T. FIEBRANZ

PROJ. NO.:

525252.0000

CHECKED BY:

M. VENNE

APPROVED BY:

J. RICE

SHEET 15 OF 16

DATE:

MARCH 3, 2023



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FILE NO.:

525252 - Specifications.dwg



4. TOP OF SELECT CRUSHED STONE FILL COLLECTION LAYER
- a. SURVEY ELEVATION OF TOP OF COLLECTION LAYER AT ESTABLISHED SURVEY LOCATIONS.
- b. ACHIEVE THICKNESS SHOWN ON THE DRAWINGS FOR COLLECTION LAYER WITHIN THE TOLERANCE OF +/- 1 INCH.
- c. MAINTAIN POSITIVE SLOPE NOT TO EXCEED 3:1 OVER ENTIRE SURFACE OF THE TOP OF THE COLLECTION LAYER.
- d. STEEPER SLOPES OR NEGATIVE SLOPES ONLY ALLOWED IF REQUIRED BY SITE FEATURES AND REVIEWED BY OWNER.
- e. REGRADE, FILL, AND/OR EXCAVATE SELECTED CRUSHED STONE FILL TO ACHIEVE TOP ELEVATION, THICKNESS, AND SLOPE REQUIREMENTS AS DIRECTED BY OWNER.
5. TOP OF AQUABLOK LAYER
- a. ACHIEVE MINIMUM THICKNESS SHOWN ON THE DRAWINGS FOR AQUABLOK LAYER WITHIN THE TOLERANCE OF +/- 1 INCH AT EACH SURVEY LOCATION.
- b. RECORD THICKNESS ACHIEVED AT EACH SURVEY LOCATION.
- c. ADD ADDITIONAL AQUABLOK PER THE SPECIFICATION AS DIRECTED BY THE OWNER AT LOCATIONS WHERE MINIMUM THICKNESS ARE NOT ACHIEVED.
- d. REMOVED AQUABLOK AND REPLACE AS NEEDED TO MEET SPECIFICATIONS AND AS DIRECTED BY OWNER FOR CASE WHERE MAXIMUM THICKNESS IS EXCEEDED.
- e. MAXIMUM THICKNESS MAY BE EXCEEDED IF REVIEWED BY OWNER FOR SPECIFIC LOCATIONS AND IF IT DOES NOT CAUSE SLOPE TO EXCEED 3:1.
6. MIDDLE OF BEDDING LAYER - GEOGRID BASE
- a. ACHIEVE MINIMUM THICKNESS SHOWN ON THE DRAWINGS FOR MIDDLE OF BEDDING LAYER WITHIN THE TOLERANCE OF +/- 1 INCH AT EACH SURVEY LOCATION.
- b. RECORD THICKNESS ACHIEVED AT EACH SURVEY LOCATION.
- c. ADD ADDITIONAL SELECT CRUSHED STONE PER THE SPECIFICATION AS DIRECTED BY THE OWNER AT LOCATIONS WHERE MINIMUM THICKNESS ARE NOT ACHIEVED.
- d. REMOVE SELECT CRUSHED STONE AND REPLACE AS NEEDED TO MEET SPECIFICATIONS AND AS DIRECTED BY OWNER FOR CASE WHERE MAXIMUM THICKNESS IS EXCEEDED.
- e. MAXIMUM THICKNESS MAY BE EXCEEDED IF REVIEWED BY OWNER FOR SPECIFIC LOCATIONS AND IF IT DOES NOT CAUSE SLOPE TO EXCEED 3:1.
- f. INSTALL GEOGRID ON TOP OF BEDDING LAYER-GEOGRID BASE AS SPECIFIED IN PART 13. GEOGRID.
7. BEDDING LAYER TOP
- a. ACHIEVE MINIMUM THICKNESS SHOWN ON THE DRAWINGS FOR TOP OF BEDDING LAYER WITHIN THE TOLERANCE OF +/- 1 INCH AT EACH SURVEY LOCATION, OR AS SHOWN ON DRAWINGS, ON TOP OF GEOGRID.
- b. RECORD THICKNESS ACHIEVED AT EACH SURVEY LOCATION.
- c. ADD ADDITIONAL SELECT CRUSHED STONE PER THE SPECIFICATION AS DIRECTED BY THE OWNER AT LOCATIONS WHERE MINIMUM THICKNESS ARE NOT ACHIEVED.
- d. REMOVED CRUSHED STONE AND REPLACE AS NEEDED TO MEET SPECIFICATIONS AS DIRECTED BY OWNER FOR CASE WHERE MAXIMUM THICKNESS IS EXCEEDED.
- e. MAXIMUM THICKNESS MAY BE EXCEEDED IF REVIEWED BY OWNER FOR SPECIFIC LOCATIONS AND IF IT DOES NOT CAUSE SLOPE TO EXCEED 3:1.
- f. REPAIR TOE VENT AS DIRECTED BY OWNER IF NECESSARY.
- g. REPLACE GEOGRID IF DAMAGED DURING PLACEMENT OF BEDDING LAYER TOP.
8. COMPACTION AND SETTLING
- a. CONTRACTOR TO BE RESPONSIBLE TO MAINTAIN SPECIFIED GRADES UP TO 12-MONTHS FROM COMPLETION OF WORK.

- PART 13. GEOGRID
- A. TRANSPORT, STORE, AND INSTALL GEOGRIDS AS SPECIFIED HEREIN AND IN THE DRAWINGS.
- B. REFER TO: ASTM D5261, ASTM D6637, CWO 22125, AND GRI GG4(b).
- C. SUBMITTALS:
1. QUALITY CONTROL. SUBMIT TO THE OWNER AT LEAST 5 DAYS PRIOR TO CONSTRUCTION IN THE RIVER:
- a. QUALITY CONTROL CERTIFICATE (OR A COPY) FOR EACH ROLL OF GEOGRID TO BE USED. THE QUALITY CONTROL CERTIFICATE SHOULD INCLUDE LOT, BATCH, OR ROLL NUMBERS AND IDENTIFICATION, AT A MINIMUM.
- b. RESULTS OF THE QUALITY CONTROL TESTS, INCLUDING SAMPLING FREQUENCIES AND TEST METHODS USED.
- c. OWNER MAY REQUEST ADDITIONAL TESTING (I.E. CONFORMANCE TESTING) TO VERIFY THAT THE GEOGRID MEETS THE SPECIFICATIONS.
- d. SAMPLES THAT DO NOT MEET THE SPECIFIED PROPERTIES SHALL RESULT IN REJECTION OF THE APPLICABLE ROLLS. AT THE MANUFACTURER'S DISCRETION AND EXPENSE, ADDITIONAL TESTING OF INDIVIDUAL ROLLS MAY BE PERFORMED TO MORE CLOSELY IDENTIFY THE NONCOMPLYING ROLLS AND/OR TO QUALIFY INDIVIDUAL ROLLS.
2. MANUFACTURER'S CERTIFICATION. SUBMIT TO THE OWNER, WRITTEN CERTIFICATION FROM THE MANUFACTURER THAT THE SUPPLIED GEOGRIDS MEET THE REQUIREMENTS ON THE BASIS OF THE RESULTS OF THE TEST PERFORMED BY EITHER THE MANUFACTURER'S LABORATORY OR AN OUTSIDE LABORATORY.

- D. PRODUCT MATERIAL
1. GEOGRID SHALL CONSIST OF POLYPROPYLENE (WOVEN OR NONWOVEN).
2. FURNISH MATERIALS WITH A MINIMUM AVERAGE ROLL VALUE (MARV) THAT MEETS OR EXCEEDS THE CRITERIA SPECIFIED IN THE FOLLOWING TABLE. PROVIDE TEST RESULTS FOR THESE PROCEDURES, AS WELL AS CERTIFICATION THAT THE MATERIALS' PROPERTIES MEET OR EXCEED THE SPECIFIED VALUES IN THE FOLLOWING GEOGRID TESTING TABLE.

GEOGRID TESTING TABLE		
PROPERTY	TEST METHOD	ENGLISH <sup>(1)</sup>
		UNITS
Mass/Unit Area	ASTM 5261	7 oz/yd <sup>2</sup>
Aperture Size	Measured	0.8 x 0.8"
Percent Open Area	CWO 22125	70%
Ultimate Wide Width Tensile Strength		
Machine Direction (MD)	ASTM D6637	2,400 lb/ft
Elongation at Break	ASTM D6637	10%
Long-Term Design Strength <sup>(2)</sup> (MD)		
Sand, Silt, and Clay	GRI GG4(b)	1,322 lb/ft
0.75" Minus Well Graded Gravel	GRI GG4(b)	1,300 lb/ft
2.5" Crushed Stone and Gravel	GRI GG4(b)	1,243 lb/ft

Notes:

<sup>(1)</sup> MARV = minimum average roll values are based on 95% Confidence Level.

<sup>(2)</sup>  $LTDS = \frac{T_{ULTIMATE}}{2.400}$

$FS_{ID} \times FS_{CR} \times FS_{CD} \times FS_{BD} \times FS_{JNT}$

$= \frac{2.400}{1.05 \times 1.572 \times 1.1 \times 1.0 \times 1.0}$

$FS_{ID}$  = factor of safety for installation damage.

$FS_{CR}$  = factor of safety for creep deformation (75 years).

$FS_{CD}$  = factor of safety for chemical degradation (4 < pH < 10).

$FS_{BD}$  = factor of safety for biological degradation.

$FS_{JNT}$  = factor of safety for joints (seams and connections).

$FS_{UNC}$  = factor of safety for uncertainties.

$LTDS = 1,322 \text{ lb/ft} - \text{Sand, Silt, Clay}$

$LTDS = T_{ALLOWABLE} \times FS_{UNC}$

3. MINIMUM AVERAGE ROLL VALUE SHALL BE BASED ON MANUFACTURER'S DATA AND SHALL BE CALCULATED AS THE MEAN VALUE OF THE PROPERTY OF INTEREST PLUS OR MINUS TWO STANDARD DEVIATIONS, AS APPROPRIATE, WHERE MATERIAL PROPERTIES VARY AMONG THE MACHINE AND CROSS-MACHINE DIRECTIONS. THE MARV SHALL APPLY TO THE DIRECTION PROVIDING THE LOWEST VALUE WHEN A MINIMUM VALUE IS SPECIFIED OR THE HIGHEST VALUE WHEN A MAXIMUM VALUE IS SPECIFIED.
4. ALTERNATIVE GEOGRID MATERIALS SHALL NOT BE USED UNLESS SUBMITTED TO THE OWNER AND REVIEWED IN WRITING BY THE OWNER.
5. MINIMUM AVERAGE ROLL VALUE SHALL BE BASED ON MANUFACTURER'S DATA AND SHALL BE CALCULATED AS THE MEAN VALUE OF THE PROPERTY OF INTEREST PLUS OR MINUS TWO STANDARD DEVIATIONS, AS APPROPRIATE, WHERE MATERIAL PROPERTIES VARY AMONG THE MACHINE AND CROSS-MACHINE DIRECTIONS. THE MARV SHALL APPLY TO THE DIRECTION PROVIDING THE LOWEST VALUE WHEN A MINIMUM VALUE IS SPECIFIED OR THE HIGHEST VALUE WHEN A MAXIMUM VALUE IS SPECIFIED.
6. ALTERNATIVE GEOGRID MATERIALS SHALL NOT BE USED UNLESS SUBMITTED TO THE OWNER AND REVIEWED IN WRITING BY THE OWNER.

- E. DELIVERY, STORAGE, AND HANDLING

1. UNLOAD AND HANDLE GEOGRIDS SO AS TO CAUSE NO DAMAGE.
2. PROTECT GEOGRIDS FROM SUNLIGHT, MOISTURE, MUD, DIRT, DUST, EXCESSIVE TEMPERATURES, PUNCTURE, OR OTHER DAMAGING CONDITIONS.

- F. PLACEMENT

1. PREPARE BEDDING LAYER OF SELECT CRUSHED STONE OF 3 INCHES +/- 1 INCH ABOVE THE TOP OF THE AQUABLOK GRADES.
2. PLACE GEOGRID ON PREPARED BEDDING LAYER.
3. OVERLAP ADJACENT GEOGRID PANELS A MINIMUM OF 18 INCHES.
4. GEOGRID SHALL BE INSTALLED IN ACCORDANCE WITH THE GUIDELINES PROVIDED BY THE MANUFACTURER AND AS DIRECTED BY THE OWNER.
5. TAKE ANY NECESSARY PRECAUTIONS TO PREVENT DAMAGE TO UNDERLYING LAYERS OF MATERIALS DURING PLACEMENT OF THE GEOGRID. AFTER PLACEMENT, THE GEOGRID SHALL NOT BE LEFT EXPOSED FOR A PERIOD IN EXCESS OF 1 DAY. FOLLOW THE MANUFACTURER'S RECOMMENDATIONS FOR EXPOSURE TO SUNLIGHT AND DO NOT LEAVE EXPOSED LONGER THAN THEIR RECOMMENDATION OR 1 DAY, WHICHEVER IS LESS.
6. SECURE ALL GEOGRIDS IN ACCORDANCE WITH MANUFACTURER INSTRUCTIONS. ANCHORING MATERIALS SHALL NOT PENETRATE AQUABLOK LAYER. ANCHORING MATERIALS SHALL BE INSTALLED PERMANENTLY.
7. EXAMINE THE GEOGRID SURFACE AFTER INSTALLATION TO ENSURE THAT NO POTENTIALLY HARMFUL FOREIGN OBJECTS ARE PRESENT. REMOVE ANY SUCH OBJECTS AND REPLACE ANY DAMAGED GEOGRID.
8. PLACE REMAINING LAYER OF 3 INCHES +/- 1 INCH SELECT CRUSHED STONE BED CAREFULLY ON TOP OF GEOGRID. PLACE ADDITIONAL LAYERS OF MATERIALS ON TOP OF THE GEOGRID AND SELECT CRUSHED STONE BED WITH CARE TO ENSURE THAT GEOGRID AND UNDERLYING LAYERS ARE NOT DAMAGED, THAT GEOGRID DOES NOT MOVE, AND THAT EXCESS STRESSES AT WRINKLES ARE NOT PRODUCED IN THE GEOGRID.

- G. FIELD QUALITY CONTROL
1. THE OWNER MAY RANDOMLY INSPECT GEOGRID BEFORE, DURING, AND AFTER (INCLUDING TEST PITS) INSTALLATION.
2. ANY DAMAGED OR DEFECTIVE (I.E. FRAID COATING, SEPARATED JUNCTIONS, SEPARATED LAYERS, TEARS) WILL BE REPAIRED AND/OR REPLACED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
- a. REPAIR: ANY ROLL OF GEOGRID DAMAGED BEFORE, DURING, OR AFTER INSTALLATION SHALL BE REPAIRED PER MANUFACTURER'S AND OWNER'S DIRECTION BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
- b. REPLACEMENT: ANY GEOGRID NEEDING REPLACEMENT SHALL BE REMOVED AND THE AFFECTED AREA PLUS 3 FEET OF GEOGRID TO ALL SIDES OF THE AFFECTED AREA SHALL BE REPLACED. ANCHOR REPLACEMENT SECTION PER MANUFACTURER'S AND OWNER'S DIRECTIONS.
- H. STORAGE, HANDLING, AND PLACEMENT
1. UNLOAD AND HANDLE GEOTEXTILE SO AS TO CAUSE NO DAMAGE.
2. PROTECT GEOTEXTILE FOR SUNLIGHT, MOISTURE, DIRT, PUNCTURE, OR OTHER DAMAGING CONDITIONS.
3. PLACE GEOTEXTILE AT LOCATIONS SHOWN ON DRAWINGS AND PER DETAIL WITH MINIMUM OVERLAP ADJACENT PANELS OF 12 INCHES.

- PART 14. GEOTEXTILE
- A. GEOTEXTILE TO BE PLACED UPON THE BEDDING LAYER TO THE EXTENTS SHOWN ON THE DRAWINGS AND INSIDE THE GABION BASKET PRIOR TO PLACEMENT OF AQUAGATE+OC. REFER TO PART 16 AQUAGATE+OC GABION FOR GABION BASKET INSTALLATION DETAILS.
- B. TRANSPORT, STORE, AND INSTALL MATERIALS AS SPECIFIED HEREIN, IN THE DRAWINGS, AND PER MANUFACTURER'S INSTRUCTIONS.
- C. REFERENCES: OKLAHOMA DEPARTMENT OF TRANSPORTATION CONSTRUCTION MATERIAL SPECIFICATION SECTION 712.02 AND 714.04 FOR PERMANENT EROSION CONTROL FABRICS.
- D. SUBMITTAL: SUBMIT MATERIAL SELECTION AND MANUFACTURER TO OWNER AT LEAST 15 DAYS PRIOR TO CONSTRUCTION IN THE RIVER.

- E. PRODUCT MATERIAL
1. GEOTEXTILE SHALL BE: SKAPS INDUSTRIES GE-180 NON-WOVEN GEOTEXTILE, US FABRICS US 205NW NON-WOVEN GEOTEXTILE, OR EQUAL.
2. ANY OR EQUAL PRODUCT SHALL BE SUBJECT TO REVIEW OF OWNER PRIOR TO PLACEMENT AND SHALL BE SUBMITTED CONSISTENT WITH THE SUBMITTAL REQUIREMENTS OF THIS SECTION.

- F. DELIVERY, STORAGE, AND HANDLING
1. UNLOAD AND HANDLE AS TO CAUSE NO DAMAGE.
2. PROTECT GEOTEXTILE FROM SUNLIGHT, MOISTURE, MUD, DIRT, DUST, EXCESSIVE TEMPERATURES, PUNCTURE, OR OTHER DAMAGING CONDITIONS.

- G. PLACEMENT
1. PLACE GEOTEXTILE ON COMPLETED BEDDING LAYER. SURFACE SHALL BE FREE OF RUBBISH, DEBRIS, OR OTHER FOREIGN OBJECTS THAT COULD RIP, TEAR, OR OTHERWISE DAMAGE THE GEOTEXTILE.
2. INSTALL GEOTEXTILE IN ACCORDANCE WITH THE GUIDELINES PROVIDED BY THE MANUFACTURER AND AS DIRECTED BY OWNER.
3. UPON PLACEMENT OF GEOTEXTILE, SECURE ALL GEOTEXTILE IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. ANCHORS MAY BE TEMPORARY OR PERMANENT.
- a. PLACE SANDBAGS OR WEIGHTED EQUIVALENT ON THE GEOTEXTILE TO PREVENT MOVEMENT/UPLIFT UNTIL PLACEMENT OF ARTICULATED BLOCK MATTRESS. REMOVE SANDBAGS IMMEDIATELY PRIOR OR, IF POSSIBLE, AFTER PLACEMENT OF THE ARTICULATED BLOCK MATTRESS.
- b. PENETRATING ANCHORING MATERIALS SHALL NOT PENETRATE AQUABLOK FILL LAYER.
- c. GEOTEXTILE SHOULD BE PLACED ON THE LONG SIDES OF THE GABION BASKET (RIVER SIDE AND BANK SIDE). GEOTEXTILE IS NOT NEEDED ON THE BOTTOM, TOP, OR TWO SIDES THAT CONTACT OTHER GABION BASKETS. AN EXCEPTION IS THE TWO ENDS OF THE GABION BASKETS AT THE ENDS OF THE GABION SYSTEM. GEOTEXTILE IS RECOMMENDED TO BE CUT TO LAY ON THE BOTTOM OF THE BASKET TO ENSURE THAT GEOTEXTILE IS CONTINUOUS WHERE NEEDED. EXCESS GEOTEXTILE CAN BE FOLDED OVER THE TOP OF THE AQUAGATE+OC.
4. OVERLAP GEOTEXTILE SHEETS/ROLLS BY AT LEAST 18-INCHES OR AS REQUIRED BY MANUFACTURER'S INSTALLATION INSTRUCTIONS.
5. TAKE ANY NECESSARY PRECAUTIONS TO PREVENT DAMAGE TO UNDERLYING LAYERS OF FILL MATERIALS DURING PLACEMENT OF GEOTEXTILE. AFTER PLACEMENT, THE GEOTEXTILE SHALL NOT BE LEFT EXPOSED FOR A PERIOD IN EXCESS OF 1 DAY. FOLLOW THE MANUFACTURER'S RECOMMENDATIONS FOR EXPOSURE TO SUNLIGHT AND DO NOT LEAVE EXPOSED LONGER THAN THEIR RECOMMENDATION OR 1 DAY, WHICHEVER IS LESS.
6. EXAMINE GEOTEXTILE AFTER INSTALLATION TO ENSURE THAT NO POTENTIALLY HARMFUL FOREIGN OBJECTS HAVE DAMAGED THE GEOTEXTILE.

- PART 15. ARTICULATED BLOCK MATTRESS
- A. ARTICULATED BLOCK MATTRESS SHALL BE PLACED ON TOP OF THE GEOTEXTILE AND BEDDING LAYER TO THE EXTENTS SHOWN ON THE DRAWINGS.
- B. CLOSED CELL ARTICULATED BLOCK MATTRESS SHALL BE PLACED IN THE LOCATION INDICATED ON THE DRAWINGS FOR THE TAKE-OUT RAMP. AN OPEN CELL ARTICULATED BLOCK MATTRESS SHALL BE PLACED EVERYWHERE ELSE.
- C. TRANSPORT, STORE, AND INSTALL MATERIALS AS SPECIFIED HEREIN, IN THE DRAWINGS, AND PER MANUFACTURER'S INSTRUCTIONS.
- D. REFERENCES: ASTM D 7276, ASTM D 7277, AND ASTM D 6884.
- E. SUBMITTAL:
1. SUBMIT MATERIAL SELECTION AND MANUFACTURER TO OWNER UPON CONTRACT AWARD.
2. SUBMIT SHOP DRAWINGS FOR REVIEW BY OWNER SHOWING EXTENT OF THE ARTICULATED BLOCK MATTRESS CONSTRUCTION PRIOR TO ORDERING MATERIALS FROM MANUFACTURER.

- F. PRODUCT MATERIAL
1. ARTICULATED BLOCK MATTRESS SHALL BE: CONTECH ARMORFLEX OPEN BLOCK CLASS 50 AND CLOSED BLOCK CLASS 55, WITH A NOMINAL THICKNESS OF 6-INCHES, OR EQUAL.
2. ANY EQUAL PRODUCT SHALL BE SUBJECT TO REVIEW OF OWNER PRIOR TO PLACEMENT AND SHALL BE SUBMITTED CONSISTENT WITH THE SUBMITTAL REQUIREMENTS OF THIS SECTION.
3. GROUT SHALL BE 4,000 PSI NON-SHRINKING GROUT OR CONCRETE.
- G. DELIVERY, STORAGE, AND HANDLING
1. UNLOAD AND HANDLE AS TO CAUSE NO DAMAGE.
2. STORE ARTICULATED BLOCK MATTRESS PER MANUFACTURER'S RECOMMENDATIONS. INSPECT MATERIALS UPON DELIVERY AND INTERMITTENTLY DURING STORAGE FOR ANY DAMAGE. KEEP ARTICULATED BLOCK MATTRESS FREE OF DIRT AND DEBRIS DURING STORAGE.
3. DELIVER GROUT AS REQUIRED FOR DAILY WORK. DO NOT STORE GROUT ON-SITE.
- H. PLACEMENT
1. PLACE ARTICULATED BLOCK MATTRESS ON BEDDING LAYER AND GEOTEXTILE PER MANUFACTURER'S INSTRUCTIONS AND REQUIREMENTS. NO GROOVES OR DEPRESSIONS (INCLUDING FOOTPRINTS) GREATER THAN 1/2-INCH IN DEPTH WITH A DIMENSION EXCEEDING 1-FOOT IN ANY DIRECTION ARE PERMITTED. NO FOLDS, WRINKLES, OR TENSION ARE PERMITTED IN THE GEOTEXTILE.
2. LIFT ARTICULATED BLOCK MATTRESS USING A SPREADER BAR OR AS OTHERWISE RECOMMENDED BY THE MANUFACTURER. USE PERSONNEL WITH THE APPROPRIATE TRAINING FOR LIFTING AND PLACING THE MATERIALS. HAND PLACEMENT OF THE ARTICULATED CONCRETE BLOCK SHOULD BE LIMITED ONLY TO SPECIFIC SMALL AREAS REQUIRING HAND PLACEMENT DUE TO GEOMETRY.
3. START PLACEMENT OF THE ARTICULATED BLOCK MATTRESS DOWNSTREAM AND PROCEED UPSTREAM.
4. PLACE SELECT CRUSHED STONE AS NEEDED FOR ARTICULATED BLOCK MATTRESS PLACEMENT. CRUSHED STONE SHOULD BE CONTINUOUS FROM THE CAP SLOPE ONTO THE GABION BASKET.
5. ARTICULATED BLOCK MATTRESS SHOULD EXTEND TO THE EDGE OF THE RIVER SIDE OF THE GABION NOT TO EXCEED HALF A BLOCK PAST.
6. FILL ALL LOOP ENDS, 2-INCH OR GREATER GAPS, GABION FACE CORNER, AND ALL OTHER GAPS AS DIRECTED BY OWNER WITH GROUT.
7. ARTICULATED BLOCK MATTRESS PLACED ON TOP OF THE GABION BASKET SHALL BE GROUTED BETWEEN JOINTS. FIELD QUALITY CONTROL.
8. NO INDIVIDUAL BLOCK WITHIN THE PLANE OF THE ARTICULATED BLOCK MATTRESS MAY PROTRUDE MORE THAN 1/2-INCH ABOVE THE PLANE OF THE MATTRESS. REPAIR SUBGRADE AS REQUIRED TO MITIGATE ANY PROTRUSIONS.
9. BACKFILL THE OPEN CELL BLOCKS ONE HALF TO THREE FOURTHS FULL.
10. BRUSH THE TOP OF THE SURFACE TO REMOVE ANY LOOSE STONES.

- PART 16. AQUAGATE+OC AND GABIONS
- A. GABIONS TO BE ASSEMBLED ON-SITE AND INSTALLED AT THE TOE OF THE CAP AS SHOWN ON THE DRAWINGS.
- B. TRANSPORT, STORE, AND INSTALL GABIONS AND ALL MATERIALS REQUIRED FOR THE GABIONS AS SPECIFIED HEREIN, IN THE DRAWINGS, AND IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
- C. REFERENCES: ASTM A975-97, ASTM A641/A641M-03, AND ASTM A370-97A.
- D. SUBMITTALS
1. SUBMIT SHOP DRAWINGS FOR GABION BASKETS, INCLUDING PROPOSED MANUFACTURER'S/SUPPLIERS TO OWNER FOR REVIEW PRIOR TO MOBILIZATION.
2. ALTERNATE ASSEMBLY OF THE GABIONS MAY BE ACCEPTABLE. CONTRACTOR SHOULD SUBMIT A DETAILED WRITTEN DESCRIPTION, INCLUDING DRAWINGS IF APPLICABLE, OF THE ALTERNATE PROPOSED ASSEMBLY METHOD TO THE OWNER FOR REVIEW AT LEAST 5 DAYS PRIOR TO BEGINNING ASSEMBLY.
- E. PRODUCT MATERIAL
1. GEOTEXTILE - REFER TO GEOTEXTILE SECTION
2. GALVANIZED HARDWARE CLOTH WITH A MESH OPENING OF 0.108 INCHES OR LESS, SUCH AS EDWARD J. DARBY & SON INC. ITEM #8GA.017PL-3X100.
3. GALVANIZED GABION BASKETS, SUCH AS BY MACCAFERRI.
4. AQUAGATE+OC AS MANUFACTURED BY AQUABLOK.
- F. DELIVERY, STORAGE, AND HANDLING
1. UNLOAD GALVANIZED GABION BASKETS AND OTHER PRODUCTS AS TO CAUSE NO DAMAGE.
2. PROTECT PRODUCTS FROM DAMAGE ON-SITE PRIOR TO USE. PROTECT GABION BASKETS FROM CRUSHING OR EXCESSIVE WEIGHT THAT WOULD DAMAGE THEM.
- G. ASSEMBLE GALVANIZED GABIONS INDIVIDUALLY BY ERECTING THE SIDES, ENDS, AND DIAPHRAGMS, ENSURING ALL PANELS ARE IN THE CORRECT POSITION. CONNECTIONS SHOULD BE TIED WITH EITHER APPROPRIATE LACING WIRE OR FASTENERS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
- H. ONCE ASSEMBLED, GABION BASKETS WILL BE PLACED ON A PREPARED FINAL SURFACE CONSISTING OF A 2-INCH THICK LAYER OF AQUABLOK PLACED DIRECTLY ON THE BEDROCK. GABION BASKETS TO BE JOINED TOGETHER ALONG THE VERTICAL AND TOP EDGES OF THE SIDES IN CONTACT WITH EACH OTHER WITH EITHER LACING WIRES OR FASTENERS.
- I. GABIONS WILL BE PLACED IN SUCH A WAY THAT THE LD OPENS AWAY FROM THE SLOPE TO FACILITATE PLACEMENT OF AQUAGATE+OC.
- J. GALVANIZED HARDWARE CLOTH WITH A MESH OPENING OF 0.108 INCHES OR LESS WILL BE PLACED IN THE GABIONS ALONG THE RIVER AND BANK SIDES OF THE GABION SYSTEM. MESH IS NOT NEEDED ON THE BOTTOM, TOP, OR TWO SIDES THAT CONTACT OTHER GABION BASKETS, EXCEPT AT THE CONCRETE WALL AND NORTH RIVERBANK. WIRE MESH SHALL BE CUT TO BE OVERSIZED BY AT LEAST 6 INCHES ON EACH END TO ENSURE THAT IF THE GABION BASKET PUSHES OUTWARD, THE WIRE MESH WILL NOT BE TOO SHORT.
- K. GEOTEXTILE WILL BE PLACED ON THE INTERIOR OF THE GABIONS ON THE RIVER AND BANK SIDES OF THE GABION BASKET. CUT GEOTEXTILE WITH ENOUGH GEOTEXTILE ON EACH END TO COVER ALL SIDES OF THE GABION. THE GEOTEXTILE WILL HAVE HOLES PUNCHED THROUGH THE SAME SIDE AS THE HARDWARE CLOTH TO SECURE THE GEOTEXTILE TO THE HARDWARE CLOTH AND TO THE GABION BASKET WITH LACING WIRES OR OWNER REVIEWED EQUIVALENT.
- L. AQUAGATE+OC WILL BE PLACED INSIDE THE GABIONS ON TOP OF THE GEOTEXTILE. FILL THE GABIONS PER THE MANUFACTURER'S INSTRUCTIONS, INCLUDING IN 1-FOOT LIFTS IF REQUIRED. FILL EACH GABION WITH A MINIMUM OF 27 CUBIC FEET OF AQUAGATE+OC. ANY EMPTY SPACE ABOVE THE AQUAGATE+OC SHALL BE FILLED WITH AQUABLOK TO FILL THE GABIONS ENTIRELY, BUT A MAXIMUM OF 4-INCHES OF THICKNESS OF AQUABLOK IS ALLOWABLE. IF THE THICKNESS TO BE FILLED IS GREATER THAN 4-INCHES, ADDITIONAL AQUAGATE+OC SHOULD BE ADDED BEFORE ANY AQUABLOK.
- M. AFTER FILLING IS COMPLETE, THE GEOTEXTILE WILL BE WRAPPED OVER THE TOP, THE LID WILL BE PULLED TIGHT TO THE PERIMETER EDGE AND SECURED WITH EITHER LACING WIRES OR FASTENERS.
- N. AFTER PLACEMENT OF THE AQUAGATE+OC GABIONS IS COMPLETE, PROCEED WITH CONSTRUCTION OF THE CAP FILL LAYERS, BEGINNING WITH THE SELECT CRUSHED STONE FILL COLLECTION LAYER. A MINIMUM OF 2 INCHES OF AQUABLOK SHALL BE PLACED ON TOP OF THE GABION BASKET.

PROJECT:

HFSTR NORTH OF ZINK DAM  
LNAPL CONTAINMENT CAP AND COLLECTION SYSTEM  
TULSA, OKLAHOMA

TITLE

NOT FOR CONSTRUCTION  
SPECIFICATIONS

DRAWN BY:

T. FIEBRANZ

PROJ. NO.:

525252.0000

CHECKED BY:

M. VENNE


APPROVED BY:

J. RICE

DATE:

MARCH 3, 2023

SHEET 16 OF 16



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Suite 101  
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525252 - Specifications.dwg



## **Appendix B. Monitoring and Maintenance Forms and Logs**

## **Routine O&M Form**

## Page 1 of 2

INSPECTED BY: \_\_\_\_\_ TIME OFF SITE (HH:MM AM/PM): \_\_\_\_\_

WEATHER (circle):    sunny   cloudy   overcast   rain   snow   precip:            wind:            approx. temp (deg F):

*NOTE: Take measurement from bottom & center of pipe. A weighted line or rigid metal wire "fish-tape" may be needed to get the probe down the slanted pipe to the fluid level.*

Location ID	Time	Depth to LNAPL (ft)	Depth to Water (ft)	LNAPL Thickness (ft)
Sump 4				
Sump 5				
Sump 6				
Sump 7				
Sump 8				
Sump 9				
Sump 10				
Sump 11				
Sump 12				
Sump 13				
MW-280				
MW-284				
MW-310				
MW-318				
MW-388				
MW-389				
SOC-166/SX-166				
SOC-166R				
SOC-167/SX-167				

Sump/Clean-out Observations and Maintenance Notes:

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**Routine O&M Form**  
**North of Zink Dam LNAPL Containment Cap and Collection System**  
**HF Sinclair Tulsa East Refinery, Tulsa County, Oklahoma**

DATE: \_\_\_\_\_

Page   2   of   2  

**SURFACE WATER OBSERVATIONS**

Top of Concrete Wall to Arkansas River	Depth to Surface Water (ft)
Time	
Reading	

*Note: Take direct reading measurement from location marked on side of concrete wall to the nearest 0.01 foot.*

Condition of Reference Measurement Point

(OK / Damaged)

Comment: \_\_\_\_\_  
\_\_\_\_\_

Was hydrocarbon sheen observed anywhere along the LNAPL Containment Cap and Collection System?

(YES / NO)

Comment: \_\_\_\_\_  
\_\_\_\_\_

**NORTH OF ZINK DAM LNAPL TRAPPING CAP**

After walking the length of the cap were any of the following conditions present?

Signs of erosion on or adjacent to the cap?

(YES / NO)

Comment: \_\_\_\_\_  
\_\_\_\_\_

Signs of significant settling?

(YES / NO)

Comment: \_\_\_\_\_  
\_\_\_\_\_

Trees growing on top of or within 5 feet of the cap?

(YES / NO)

Comment: \_\_\_\_\_  
\_\_\_\_\_

Shrubs growing on top of the cap?

(YES / NO)

Comment: \_\_\_\_\_  
\_\_\_\_\_

**GENERAL NOTES**

Comments/Notes: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## **Maintenance Log**



**Maintenance Log**  
**North of Zink Dam LNAPL Containment Cap and Collection System**  
**HF Sinclair Tulsa East Refinery, Tulsa County, Oklahoma**

Date	Component Description (i.e. sump, armor rock, staff gauge, etc.)	Scope of Work					Maintenance Activity Description	Condition Causing Need for Maintenance or Repair
		Maintained	Repaired	Modified	Replaced	Other		

Name:

Signature:

## **LNAPL Recovery Log**

LNAPL Recovery Log  
North of Zink Dam LNAPL Containment Cap and Collection System  
HF Sinclair Tulsa East Refinery, Tulsa County, Oklahoma

Date	Sump 4			Sump 5			Sump 6			Sump 7			Recovery Method	Total Volume Recovered (Gal)	Management Location	Notes
	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)				

Name:

Signature:

**LNAPL Recovery Log**  
**North of Zink Dam LNAPL Containment Cap and Collection System**  
**HF Sinclair Tulsa East Refinery, Tulsa County, Oklahoma**

Date	Sump 8			Sump 9			Sump 10			Recovery Method	Total Volume Recovered (Gal)	Management Location	Notes
	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)				

Name:

Signature:

**LNAPL Recovery Log**  
**North of Zink Dam LNAPL Containment Cap and Collection System**  
**HF Sinclair Tulsa East Refinery, Tulsa County, Oklahoma**

Date	Sump 11			Sump 12			Sump 13			Recovery Method	Total Volume Recovered (Gal)	Management Location	Notes
	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)	Initial LNAPL Thickness (ft)	Final LNAPL Thickness (ft)	Volume LNAPL Removed (Gal)				

Name:

Signature: