

# Mandan Missouri River Boat Ramp Feasibility Study

February 2023

---



Prepared by:



AE2S Project #: P10200-2022-001



## Mandan Missouri River Boat Ramp

February 2023

I, Jesse G. Kist, a registered Professional Engineer under the laws of the State of North Dakota, hereby certify that this Feasibility Study for the Mandan Missouri River Boat Ramp was prepared by me or under my direct supervision.



\_\_\_\_\_  
JESSE G. KIST, PE

Date: 02/07/2023

License # PE-27402

---

Prepared by:  
Advanced Engineering and Environmental Services, LLC  
1815 Schafer St.  
Bismarck, ND 58501

## Table of Contents

INTRODUCTION .....	1
Background .....	1
Project Description .....	1
Project Team .....	2
Abbreviations and Acronyms .....	2
Vertical Elevation Datum.....	2
RIVER HYDRAULICS REVIEW .....	3
Modeling Analysis .....	3
River Hydraulics Summary.....	3
FEMA Floodplain and 2011 Flood .....	3
SITE SCHEMATIC DEVELOPMENT .....	3
General Site Requirements.....	3
Review of Local Boat Ramp Sites .....	4
Site Schematics Iterations.....	4
PREFERRED SITE LAYOUT.....	5
Site and Ramp Specifications.....	5
Design Phase Considerations.....	5
Boat Ramp Material and Construction .....	6
Parking Lot Surface Material .....	7
Stormwater Management.....	7
Tree Impact Estimates.....	8
ADDITIONAL SITE AMENITIES .....	9
BANK ARMORING .....	9
Existing Bank Armoring .....	9

Rip Rap Recommendations .....9

Permit Considerations .....9

PERMITTING NEEDS.....10

OPINIONS OF PROBABLE CONSTRUCTION COST .....11

Preferred Site Alternative ..... 11

Site Amenities ..... 11

FIGURES

- Figure 1 – Site Location Map
- Figure 2 – River Hydraulics
- Figure 3 – 2011 Flood Aerial
- Figure 4 – Preferred Layout Site Plan
- Figure 5 – Site Aerial Schematic
- Figure 6 – Bank Armoring Site Plan
- Figure 7 – Bank Armoring Schematic
- Figure 8 – USACE Structures

ATTACHMENTS

- Attachment 1 – Schematic Design Iterations
- Attachment 2 – Site Photographs
- Attachment 3 – Opinion of Probable Costs

APPENDICES

- Appendix A – NDDOT Letter
- Appendix B – ND Game & Fish Bathymetry
- Appendix C – ND Game & Fish Ramp Install Specs
- Appendix D – TrueGrid Pro Plus Permeable Pavers
- Appendix E – FEMA FIRMette

## Introduction

### *Background*

The city of Mandan is in central North Dakota along the banks of the Missouri River. The Missouri River serves as a destination for residents and tourists alike seeking recreation in the form of boating, kayaking, water sports, and fishing. While most of the river front property in Mandan is privately owned and developed, approximately 13,000 feet of frontage located north of the BNSF railway bridge is publicly owned by the State of North Dakota and Mandan Parks & Recreation and known formally as the Missouri River Natural Area or locally as “carbodies.” Mandan Parks & Recreation’s property consists of the northernmost 1,200 (+/-) feet (**Figure 1**).

Currently, there are no publicly accessible boat ramps on the Missouri River in Mandan, with the closest public ramp being at Little Heart Bottoms in Morton County, more than ten miles south of city limits. As Mandan and Bismarck have grown in recent years, so has interest in Missouri River recreation, increasing the need for a public boat ramp.

### *Project Description*

A joint group (referred to hereon as the “Project Team” and described below) consisting of Mandan Parks & Recreation, the City of Mandan, Morton County Parks & Recreation, and Morton County contracted with AE2S to develop a feasibility plan for a conceptual Missouri River Boat Ramp on the property owned by Mandan Parks & Recreation (**Figure 1**). As part of the feasibility plan development, AE2S utilized the expertise of AGL Landscape Architects (AGL) to provide design and cost estimating assistance.

The feasibility study was intended to accomplish the following tasks:

- Review site conditions and Missouri River hydraulics to provide recommendations relating to placement and orientation of a boat ramp.
- Develop conceptual schematic designs for a boat ramp and corresponding parking lot configurations.
- Coordinate with the Project Team to identify a preferred site alternative.
- Review existing site bank conditions and provide conceptual recommendations relating to bank stabilization measures necessary or beneficial to the proposed boat ramp site.
- Identify permitting needs of a boat ramp project and provide guidance on future permit pursuits.
- Develop Opinions of Probable Construction Cost (OPCC) for the preferred site alternative.
- Develop OPCC for other site improvements and amenities identified by the Project Troup. These items were identified as desired but not essential and could be included at the project’s origin or a later date.

*Project Team*

The Project Team is described in **Table 1**.

Table 1 – Project Team

Project Team	
Entity/Affiliation	Representative
Mandan Parks & Recreation	Cole Higlin, Director
	Dustin Fleck, Park Operations Manager
City of Mandan	Jim Neubauer, City Administrator
	Mitch Bitz, Public Works Director
	Andrew Stromme, City Planner
Morton County Parks & Recreation	Tim Nilsen, Parks Director
Morton County	Natalie Pierce, Director of Planning & Zoning

*Abbreviations and Acronyms*

The following abbreviations and acronyms may be used throughout this report. They are being described here to assist readers in understanding the referenced term.

- **USACE:** United States Army Corps of Engineers
- **FEMA:** Federal Emergency Management Agency
- **FHWA:** Federal Highway Administration
- **USGS:** United States Geological Survey
- **DWR:** (North Dakota) Department of Water Resources
- **G&F:** (North Dakota) Game and Fish
- **OSE:** (North Dakota) Office of the State Engineer
- **SWC:** (North Dakota) State Water Commission
- **DEQ:** (North Dakota) Department of Environmental Quality
- **MRNA:** Missouri River Natural Area
- **BNSF:** Burlington Northern Santa Fe
- **HEC-RAS:** Hydrologic Engineering Center’s River Analysis System
- **GIS:** Geographic Information System
- **AE2S:** Advanced Engineering and Environmental Services, LLC

*Vertical Elevation Datum*

All elevations reported within this report and the corresponding figures and attachments are presented in the North American Vertical Datum of 1988 (NAVD 88), unless specifically noted otherwise.

## River Hydraulics Review

### *Modeling Analysis*

AE2S developed a hydraulic model of the Missouri River that included the proposed boat ramp site as part of a separate study for the Morton County Water Resource District focused on analyzing river conditions and bank stabilization alternatives for the Missouri River Natural Area. That model was developed using Hydraulic Engineering Center's River Analysis Software (HEC-RAS). River bathymetry was obtained from the USGS and flows were obtained from the Burleigh County FEMA RiskMap model for the Missouri River and based on typical flow readings at the Bismarck USGS gage. The Missouri River in this section is narrow and deep when compared to much of the Missouri River through Bismarck-Mandan which results in relatively strong currents and high velocity flow. These conditions result in increased challenges to boaters and increased difficulty docking boats. Due to this, proper placement of a boat ramp with consideration for these conditions will be an important aspect of this boat ramp design.

### *River Hydraulics Summary*

The proposed boat ramp site is bordered on the south side by a drainage channel that extends from Interstate 94 to the Missouri River. The existing bank on the north side of the channel extends farther into the river than the bank on the south side, acting functionally similar to a rock jetty and providing an area of protection from the strong local river currents and relatively high velocity. This unique landform causes an eddy with a swirling reverse current that directs flow upstream and toward the boat ramp site. This is likely beneficial to ramp placement because boaters will not have to compensate for the strong river currents that are more typical in this stretch of the river. The flow dynamics in this area also appear to generally keep the area free of excessive sediment accumulation, as evidenced by a general lack of bar formations in this area through the record of aerial images. Certain features and river hydraulics are shown in **Figure 2**.

### *FEMA Floodplain and 2011 Flood*

The proposed site is generally located within FEMA's 500-year floodplain (**Appendix E**) and above the 2011 flood elevation, as shown in **Figure 3**. The proposed boat ramp, some site grading, and portions of the recommended rip rap will be within FEMA's 100-year floodplain and regulatory floodway.

## Site Schematic Development

### *General Site Requirements*

The development of site schematics and layouts was guided by the following requirements and preferences, as determined by the Project Team:

- Accommodate a two-lane boat ramp;
- Include space for a dock and kayak launch;
- Provide an acceptable number of trailer parking spaces, based on review of other area ramps;
- Provide a limited number of standard vehicle stalls;
- Minimize overall impacts to the property, limit tree impacts, and protect viewsheds while also ensuring a user-friendly site with adequate parking, sufficient drive lanes, and proper aesthetics.

### Review of Local Boat Ramp Sites

Existing Missouri River boat ramps in the Garrison Reach of the Missouri River were reviewed and used as references for development of the Mandan boat ramp site, particularly for selecting ramp width, number of parking spaces, and parking space dimensions. Local ramp details are presented in **Table 2**.

Table 2 – Local Ramp Details

Ramp Name	Trailer Spaces*	Standard Parking Spaces*	Ramp Width (feet)*
Keelboat Park	44	57	36
Kniefel (Misty Waters)	33	10	32
Fox Island	26	62	34
Schmidt Bottoms	N/A**	N/A**	32
Graner Bottoms	30	15	32

\*All value presented in this table were determined based on aerial imagery. Actual values may vary.

\*\*Parking lot does not have designated parking spaces.

### Site Schematics Iterations

Various alternative iterations were developed by AE2S and AGL and considered in the process of developing the preferred alternative. Those iterations are presented in **Attachment 1** and described briefly, below.

- Iteration #1:** This iteration was intended to minimize the overall site impacts by aligning the proposed site with the existing impact area at the site (dirt road and parking area). Turn around diameters shown in this iteration would likely be challenging to use and future reconsideration of this iteration should review the dimensions and adjust them, as appropriate. Additionally, the trailer parking stalls are shown as 40' long, but longer stalls are likely desirable.
- Iteration #2:** This is like iteration #1 but with increased turn diameters and the addition of slotted parking on the north side to replace iteration #1's parallel parking spaces. Future reconsideration of this iteration should consider adjusting the overall site alignment to minimize the bends in the site. Additionally, the trailer parking stalls are shown as 40' long, but longer stalls are likely desirable.
- Iteration #3:** This was intended to maximize the user experience by providing a one-way drive lane around the parking lot that eliminates head on traffic, simplifies parking and backing movements, allows for exceptionally long units to use two parking stalls, and includes a designated pullover area for staging prior to launching or post docking. While this iteration results in increased site impacts, the impacted area primarily contains invasive, nonnative tree species and small scrub trees. These impacts are recommended to be mitigated by onsite plantings of desirable, native trees and grasses.



## Preferred Site Layout

The preferred site layout for the boat ramp and parking lot, as selected by the Project Team, is presented in **Figure 4**. The preferred site layout is very similar to Iteration #3, with minor updates to the transition from the boat ramp to the loading/pullover area to increase access and function.

### Site and Ramp Specifications

Specific criteria for the preferred site layout are provided in **Table 3**.

Table 3 – Preferred Site Layout Specifics

Criteria	Recommended Range	Preferred Alternative
Ramp Slope	12-15%	~13%
Ramp Width	15' per lane	36'*
Trailer Parking Stall Count	N/A	45
Trailer Parking Width	12'	12'
Trailer Parking Length	40'+	47'
Standard Vehicle Stall Count	N/A	7
Standard Vehicle Stall Width	8.5'+	9'
Standard Vehicle Stall Length	18'+	20'
Parking Lot Surface Area	N/A	~65,000 square feet
Drive Lane Width	12' minimum	24'**
Turnaround Diameter	>60'	88'

\*Accommodates two lanes, a dock, and a kayak launch.

\*\*Extra width is to accommodate trailers backing out of parking stalls.

### Design Phase Considerations

Some specific items that should receive a more detailed review during a future design phase are described below.

- Ramp Placement:** The ramp placement shown on **Figure 4** and **Figure 5** was strategically selected based on observed river currents, the creek confluence, overall site layout, and the bathymetric data shown in **Appendix B**. However, collection of site survey and updated bathymetry near the boat ramp is recommended during the design phase and potential adjustments to the ramp placement should be reviewed and considered at that time.
- River Dredging:** Based on review of historical aerial imagery, the river adjacent to the proposed site has not historically contained large sand bar formations that would cause impacts to boats. The area appears to have remained relatively static and stable over the past several decades. Given this, significant river dredging is not expected to be necessary; however, low water during the fall of 2022 did expose a shallowly submerged bar formation in the vicinity of the proposed ramp, as evidenced on **Figure 5** and in some images included in **Attachment 2**. This bar formation should be monitored, and it is possible that dredging could be required in the future.

- **Utility Locates:** Site utilities were not located as part of this study. Location and consideration of existing utilities on the site is recommended early in the design phase.
- **Trailer Stall Size:** The proposed site layout includes 47' long trailer parking stalls that allow for longer units to utilize two spaces. The Keelboat Park and Fox Island boat ramp sites have 40' long parking stalls and do not have the ability for two stalls to be used. The Kniefel trailer stalls are 50' long. The design phase should reconsider the appropriate stall length relative to the site impacts and overall project cost. In general, the overall project cost varies directly with the parking stall lengths as stall size influences the overall site size.
- **Ramp Side Slopes:** The side slopes on each side of the boat ramp are proposed to be rip rap, to provide stability while minimizing maintenance. However, other surfacing, such as grass, could be considered. Additional material removal could reduce slopes to better accommodate other surfaces.
- **Creek Guardrail:** A drive lane in the northwest corner of the site is relatively close to the edge of slope leading down to the creek. Depending on the surfacing used for the site, a guardrail may be desirable along this area. A guardrail is not included in the opinions of probable construction cost in this report.
- **ADA Compliance:** The design phase will need to consider ADA compliance of the site and provide proper designation for handicap parking spaces.
- **Site Amenity Placement:** Various site amenities have been identified by the project group, as described later in this report. Placement of these amenities was not identified in this study. Desired placement should be made, as appropriate, during the design phase and should consider site function, user experience, and proximity to existing and/or proposed utilities.

### *Boat Ramp Material and Construction*

The boat ramp is recommended to be a concrete ramp constructed using the push method. This method involves the placement of a boulder and stone base under the entire ramp extents. Prior to placement of the stone, a survey of the entire ramp footprint will be necessary. Bathymetric data of the proposed boat ramp site was obtained by the North Dakota Game and Fish Department (ND G&F) in 2022 and is included as **Appendix B**. The ramp sections are then poured above the water, allowed to cure, and then pushed into place. A sheet of general guidelines on this construction method was provided by the ND G&F and is attached as **Appendix C**. Alternatively, the ramp could be poured in-place using a cofferdam to construct the underwater portion of the ramp. This method is less common and likely more challenging and expensive. The ND G&F has extensive experience constructing boat ramps throughout North Dakota, including on the Missouri River. It is recommended that they be asked to provide additional insight and consultation during the design phase of this proposed project.

### *Parking Lot Surface Material*

The material used to surface the parking lot will have a notable impact on the overall project cost as well as on the resulting user experience and site aesthetics. Three surface alternatives were reviewed as part of this study.

➤ **Option 1: Paved with Curb & Gutter**

Paving the parking lot with asphalt to provide a fully impervious surface, including curb and gutter around the site, was considered as option 1. This option is the most expensive and would result in the most stormwater runoff from the site. However, asphalt is a common surface for this type of site and would likely result in the best user experience.

➤ **Option 2: Permeable Pavers**

As an alternative to asphalt, permeable pavers were considered as option 2. To develop opinions of probable cost, a specific permeable paver product was selected. Pro Plus Permeable Pavers by TrueGrid were specifically reviewed (**Appendix D**) for option 2. Permeable pavers provide a durable surface that is resilient in cold weather climates. Some permeable pavers, including the TrueGrid product, even allow for parking stall lines and markings. This alternative likely removes the need for onsite stormwater infrastructure due to the permeable nature of the stone base and stone fill used in the pavers which provides stormwater attenuation and water quality treatment.

Based on the NRCS Web Soil Survey, the project site soils are classified as river sand with a hydrologic soil group classification of “A”, meaning they are very pervious. This makes the use of permeable pavers increasingly appropriate for consideration on the site. The cost for this option is likely less than option 1 as stormwater needs are eliminated. Permeable pavers would likely result in a satisfactory user experience.

➤ **Option 3: Gravel**

Option 3 is to construct a traditional gravel parking lot at the boat ramp site. A gravel parking lot will present potential water quality impacts, challenging stormwater management, decreased aesthetics, and an inability to properly mark parking spaces. While a gravel parking lot may result in the least satisfying user experience, gravel lots are common and likely the simplest and cheapest to construct.

### *Stormwater Management*

Selection of surfacing materials will influence the need for, and extent of, stormwater infrastructure on the site. Onsite stormwater attenuation to reduce proposed site peak runoff such that it does not exceed existing site conditions is not recommended due to the site being immediately adjacent to the Missouri River. Flow increases from the site will not have any tangible impact on the Missouri River, however, specific stormwater requirements will be dictated by the City Engineer.

Use of asphalt or gravel surfacing may require some form of water quality treatment, such as rain gardens or a hydrodynamic separator, as well as a means of conveying stormwater to the creek or river channel, either with pipes or a flume structure. Use of permeable pavers on the site would significantly reduce the stormwater runoff from the site and may eliminate the need to provide water quality treatment or other stormwater conveyance infrastructure. The site consists of sandy soils that are categorized as hydrologic soil group “A”, meaning that the site is very pervious.

### Tree Impact Estimates

While an effort was made during alternative development to minimize impacts to trees, the preferred site layout will result in impacts to some trees. Those impacts, as estimated by onsite reviews, are described below. The proposed site is expected to result in very little aesthetic impact to road traffic and river traffic as tree buffers will be retained between the proposed parking lot and both the river and road. Mitigation of tree impacts, in the form of onsite native tree plantings, is recommended to make up for the tree impacts caused by the project. The summaries below are focused on medium to large trees and do not address smaller shrubs or trees.

#### ➤ **Native Tree Species Impacted:**

- **Cottonwood:** All impacted cottonwoods are large/mature trees with trunk diameters typically between 1-2 feet at a height of 6 feet above adjacent grade. The general condition of the cottonwoods was estimated as fair to good. The project is estimated to require removal of 5-10 cottonwoods. Onsite replacement of impacted cottonwoods is recommended at a rate of 2:1.
- **Boxelder:** Numerous boxelder trees exist within the project's impact area. The boxelders on the site are generally in poor to fair condition. Tree size is almost exclusively small to medium for this type of tree with trunk diameters being generally in the range of 6-12 inches at a height of 6 feet above adjacent grade. Impacted boxelders are recommended to be replaced with either boxelders or other native trees at a rate of 1:1.
- **Ash:** Ash trees were not observed onsite. Impacted ash trees are recommended to be replaced with other native trees at a rate of 1:1.

#### ➤ **Non-Native/Invasive Tree Species Impacted:**

- **Russian Olive:** Numerous russian olive trees are present throughout the project site ranging from medium to large in size. Russian olives are an undesirable, invasive, non-native species. Russian olive trees have become increasing abundant and problematic in the Missouri River bottomlands and, in addition to being invasive, can be dangerous due to sharp thorns/spines present throughout the tree. Removal of all russian olive trees from the subject property is recommended.
- **Buckthorn:** Many buckthorn trees of small to medium size are present throughout the project property. Buckthorns are a non-native, invasive species that are widely considered undesirable and nonbeneficial to local ecosystems and woodlands. Removal of all buckthorns from the subject property is recommended.

## Additional Site Amenities

Additional site amenities being considered in this feasibility study are presented in **Table 4**. Prioritization and timeline for constructing these amenities is not considered in this study.

Table 4 – Additional Site Amenities

Amenity	Quantity	Description
Fish Cleaning Station	1	One fish cleaning station is desired within the boat ramp site. Potential placement was noted on the northeast area of the site, along the route of exiting traffic. This placement would provide improved accessibility to power and water.
Vault Toilet	1	One vault toilet is anticipated to accommodate the proposed boat ramp site and the existing archery range.
Kayak Launch	1	Anticipated to be placed on the south side of boat ramp.
Picnic Shelter	2	One or two picnic shelters are desired. Placement may be within the boat ramp site or the Missouri River Natural Area.
Pedestrian Benches	2	Pedestrian benches to be placed around the boat ramp site.
Pedestrian Bridge on Creek	1	A pedestrian bridge is desired between the boat ramp site and the Missouri River Natural Area to the south. Placement and style of the pedestrian bridge is to be determined at a later stage. Consideration could be made to incorporate portions of the existing BNSF rail bridge that is slated for demolition.

## Bank Armoring

### Existing Bank Armoring

Rip rap currently exists along the Missouri River shoreline adjacent to the project site. Based on visual inspection of the site, the rip rap generally appears to be in good condition; however, the top of rip rap is relatively low on the bank, leading to cut banks above the rip rap.

### Rip Rap Recommendations

Armoring of the river and creek banks adjacent to the proposed boat ramp is recommended, as generally shown on **Figure 6** and **Figure 7**. The design phase of the project should determine the appropriate rip rap size, depth, and extent. USACE permits may also dictate certain design aspects.

### Permit Considerations

The existing rip rap along the Missouri River shoreline adjacent to the project site is shown in the USACE revetment inventory (**Figure 8**), indicating that it was placed by the USACE. Projects that could impact a USACE structure require a Section 408 permit from the USACE. Rip rap placed below the ordinary high-water mark would also require a Section 404 permit from the USACE, a sovereign lands permit from the DWR, applicable permits from NDDEQ, and floodplain development related permits. Some permits may require field work, such as topographic survey, cultural survey, wetland delineations, geotechnical borings, and identification of the ordinary high-water mark. In addition to site work and permit application preparation time, considerable time may be needed to allow for review and approval of the

permit. While exact timelines are unknown at this time, 3-6 months should be expected for preparation of permits and 9-12 months for permit review and approval. Additional permitting considerations are discussed in the following section.

## Permitting Needs

Environmental permitting requirements and estimated timelines to obtain the permits are summarized in **Table 5**. Construction time permits are not included in **Table 5**. The estimated timelines provided are based on turnaround time once the application is submitted to the corresponding regulatory agency, the time required for preparation of the permit applications and associated field work and engineering wasn't specifically considered, however, as noted in the previous section, 3-6 months should be expected for the necessary field work and permit preparation. An additional 3-6 months is anticipated for construction of the project. Given these timelines, a minimum of 15-24 months should be expected from the beginning of the permitting process to construction completion.

Table 5 – Permit Considerations

Permit	Entity	Estimated Timeline	Notes
Section 404	USACE	9-12 months	The size of the proposed boat ramp and estimated material discharge into the Missouri River may require an Individual Permit. Nationwide permits #13 and #36 should specifically be referenced for this project. Additional Nationwide permits may also be relevant and applicable.
Section 408	USACE	9-12 months	Existing USACE structures along the Missouri River will likely require this project to obtain Section 408 approval prior to bank armoring. Construction of the ramp alone may not require Section 408 approval but should be verified with the USACE.
Sovereign Lands	NDDWR	90 days	A sovereign lands permit will need to be received from the DWR.
Floodplain Development & No-Rise	Local Floodplain Administrator	120 days	This will require a floodplain development permit and work within the regulatory floodway will require a no-rise analysis by an engineer.
Property Covenants & FHWA Section 4(f)	NDDOT & FHWA	90 days	Need to coordinate with agencies to ensure constraints are met. ( <b>Appendix A</b> )
SWMP	City of Mandan	60 days	A SWMP will need to be prepared by an engineer and submitted to the City Engineer.
Section 401	NDDEQ	N/A	Section 401 certifications are issued as part of the USACE 404 process. However, coordination with NDDEQ during the design phase is recommended to identify any specific requirements, expectations, or concerns the NDDEQ may have relating to Section 401 water quality standards.

## Opinions of Probable Construction Cost

Opinions of Probable Construction Cost (OPCC) were developed based on 2022 estimates and breakdowns are provided in **Attachment 3**. Additionally, summaries of the cost estimates are provided in **Table 6** and **Table 7**.

### Preferred Site Alternative

**Table 6** provides a summary of the opinions of probable construction cost (OPCC) for Options 1-3 of the preferred site alternative. All three include the same concrete boat ramp but different parking lot surfacing options. Detailed OPCC breakdowns are provided in **Attachment 3**.

Table 6 – Boat Ramp Site Options, Opinion of Probable Costs

Scenario	Construction Costs	Engineering, Design, & Permitting	Contingency (30%)	Total Cost
Option 1: Paved with Curb & Gutter	\$1,555,000	\$251,000	\$466,500	<b>\$2,272,500</b>
Option 2: Permeable Pavers	\$1,017,400	\$203,000	\$305,200	<b>\$1,525,600</b>
Option 3: Gravel	\$843,600	\$186,000	\$253,100	<b>\$1,282,700</b>

### Site Amenities

Several site amenities were identified by the project team as desirable, but not critical to the boat ramp project. Opinions of probable cost for those amenities are provided in **Table 7** and **Attachment 3**.

Table 7 – Site Amenities Opinion of Probable Cost

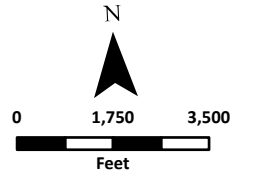
Item	Quantity	Unit Cost	Contingency (30%)	Total Cost
Decorative Signs	2	\$12,000 (x2)	\$7,200	<b>\$31,200</b>
Kayak Launch	1	\$30,000	\$9,000	<b>\$39,000</b>
Fish Cleaning Station	1	\$50,000	\$15,000	<b>\$65,000</b>
2" Waterline for Fish Cleaning Station	1	\$26,250**	\$7,875	<b>\$34,125</b>
Vault Toilet	1	\$15,000	\$4,500	<b>\$19,500</b>
Picnic Shelter	2	\$40,000 (x2)	\$24,000	<b>\$104,000</b>
Pedestrian Benches	2	\$2,000 (x2)	\$1,200	<b>\$5,200</b>
Parking Lot Lighting Allowance	1	\$50,000	\$15,000	<b>\$65,000</b>
Parking Lot Security Allowance*	1	\$25,000	\$7,500	<b>\$32,500</b>
Pedestrian Bridge Creek Crossing	1	\$275,000	\$82,500	<b>\$357,500</b>

\*Monthly fees not considered.

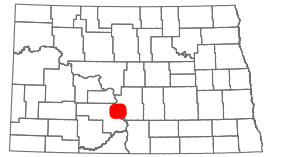
\*\*Assumed to be 750 ft with a cost of \$35/ft.

## Figures





1 inch equals 3,500 feet



Locator Map Not to Scale

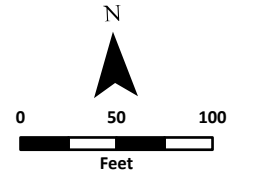
Mandan  
Morton County, ND

Figure 1  
**LOCATION**

MANDAN PARKS &  
RECREATION

Date: 12/17/2022





1 inch equals 100 feet



Locator Map Not to Scale

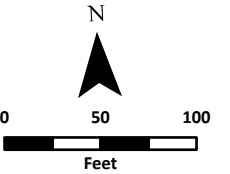
Mandan  
Morton County, ND

Figure 2  
**RIVER HYDRAULICS**

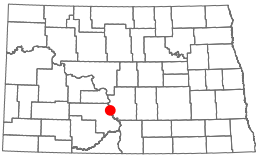
MANDAN PARKS &  
RECREATION

Date: 12/17/2022





1 inch equals 100 feet



Locator Map Not to Scale

Mandan  
Morton County, ND

Figure 3  
**2011 FLOOD AERIAL**  
**(JULY 2011)**

MANDAN PARKS &  
RECREATION

Date: 12/17/2022



State Water Commission, Department of Transportation, ND GIS Unit

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.



**CIVIL SURFACE LEGEND**

EXISTING	PROPOSED	
[Grey swatch]	[Grey swatch]	BITUMINOUS PAVEMENT
[Yellow swatch]	[Yellow swatch]	CONCRETE
[Green swatch]	[Green swatch]	RIPRAP



SHEET TITLE: **PREFERRED SITE PLAN**

CLIENT: <b>MANDAN PARKS &amp; RECREATION</b>	PREPARED BY: RFM
	CHECKED BY: JCK
	APPROVED BY: JCK
PROJECT NO: P10200-2022-001	SHEET DESIGNATOR: CIV
DATE: 12-09-2022	SHEET NO: <b>FIG 04</b>
ALT. PROJECT NO: N/A	

PRELIMINARY

MANDAN BOAT RAMP FEASIBILITY STUDY

SYM	DATE	APPR



Locator Map Not to Scale

Mandan  
Morton County, ND

Figure 5  
**SITE AERIAL  
SCHEMATIC**

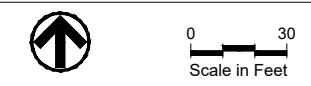
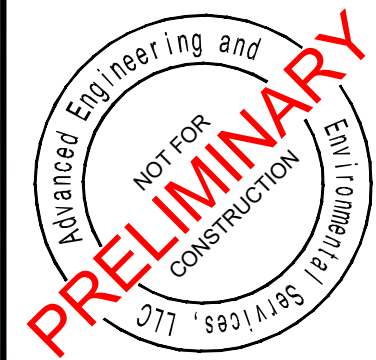
MANDAN PARKS &  
RECREATION

Date: 12/17/2022



File: W:\Mandan Park & Recreation\1000-2022\01\CAD\_Dwg\01-Civil\Design\CS-Grading.dwg

Prepared By: Richard Marell Date: Friday, December 3, 2022



**CIVIL SURFACE LEGEND**

EXISTING	PROPOSED	
[Grey swatch]	[White swatch]	BITUMINOUS PAVEMENT
[Grey swatch]	[Yellow swatch]	CONCRETE
	[Green swatch]	RIPRAP
	[Red swatch]	RIVER/CREEK RIPRAP



SHEET TITLE: **PREFERRED SITE PLAN**

CLIENT: <b>MANDAN PARKS &amp; RECREATION</b>	PREPARED BY: RFM
	CHECKED BY: JGK
	APPROVED BY: JGK
PROJECT NO: P10200-2022-001	SHEET DESIGNATOR: CIV
DATE: 12-09-2022	SHEET NO: <b>FIG 06</b>
ALT. PROJECT NO: N/A	

PRELIMINARY

MANDAN BOAT RAMP FEASIBILITY STUDY

SYMBOL	DATE	APPROVED



Locator Map Not to Scale

Mandan  
Morton County, ND

Figure 7  
**BANK ARMORING  
SCHEMATIC**

MANDAN PARKS &  
RECREATION

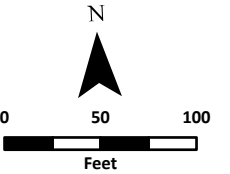
Date: 12/17/2022





**Revetments**

- Garrison Oahe PL88352 PL90483
- Section 32 PL93251
- - - USACE Private Structures Inventory
- USACE Revetments Inventory



1 inch equals 100 feet



Locator Map Not to Scale

Mandan  
Morton County, ND

Figure 8  
**USACE STRUCTURE  
INVENTORY**

MANDAN PARKS &  
RECREATION

Date: 12/17/2022



Bismarck-Mandan MPO, Maxar, Microsoft, Esri Community Maps Contributors, State of North Dakota, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA



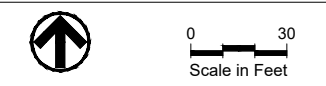
## Attachments

File: W:\Mandan Park & Recreation\1000-2022\01\CAD Draw\01-Civil\Design\CS-Grading.dwg

Drawn By: Richard Marell Date: Monday, September 19, 2022



Attachment #1



### Iteration #1

**CIVIL SURFACE LEGEND**

EXISTING	PROPOSED	
		BITUMINOUS PAVEMENT
		CONCRETE
		CURB

SHEET TITLE: #####		
CLIENT: #####	PREPARED BY: XXX	
	CHECKED BY: XXX	
	APPROVED BY: XXX	
PROJECT NO: #####	SHEET DESIGNATOR: XXX	SHEET NO: #####
DATE: #####		
ALT. PROJECT NO: #####		

APPR: \_\_\_\_\_  
 DATE: \_\_\_\_\_  
 SYM: \_\_\_\_\_

#####

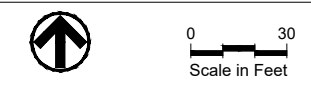
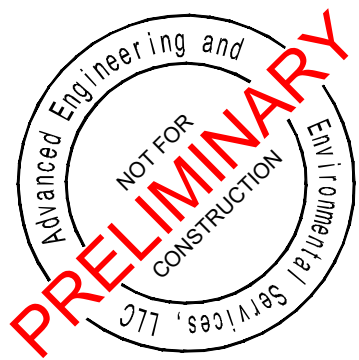
#####

File: W:\Mandan Park & Recreation\1000-2022\01\CAD Draw\01-Civil\Design\CS-Grading.dwg

Prepared By: Richard Marell Date: Monday, October 10, 2022



Attachment #1



### Iteration #2

#### CIVIL SURFACE LEGEND

EXISTING	PROPOSED	
[Grey swatch]	[White swatch]	BITUMINOUS PAVEMENT
[Light grey swatch]	[Yellow swatch]	CONCRETE
[Hatched swatch]	[Green hatched swatch]	RIPRAP
[Black line]	[Black line]	CURB

SHEET TITLE: #####		
CLIENT: #####	PREPARED BY: XXX	
	CHECKED BY: XXX	
	APPROVED BY: XXX	
PROJECT NO: #####	SHEET DESIGNATOR: XXX	SHEET NO: #####
DATE: #####		
ALT. PROJECT NO: #####		

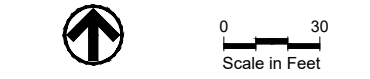
APP'R	
DATE	
SYM	

File: W:\Mardon Park & Recreation\1000-20220110AD\_Drpd\01-Civil\Design\CS-Grading.dwg

Drawn By: Richard Marell Date: Wednesday, November 2, 2022



# Attachment #1



## Iteration #3

**CIVIL SURFACE LEGEND**

EXISTING	PROPOSED	
[Light Gray Swatch]	[Dark Gray Swatch]	BITUMINOUS PAVEMENT
[Light Yellow Swatch]	[Dark Yellow Swatch]	CONCRETE
[Green Swatch]	[Green Swatch]	RIPRAP

SHEET TITLE: #####

CLIENT: #####	PREPARED BY: XXX
---------------	------------------

#####	CHECKED BY: XXX
#####	APPROVED BY: XXX

PROJECT NO: #####	SHEET DESIGNATOR: XXX	SHEET NO: #####
-------------------	-----------------------	-----------------

DATE: #####	XXX	####
-------------	-----	------

ALT. PROJECT NO: #####	XXX	####
------------------------	-----	------

APP'R
DATE
SYMBOL

#####















# Attachment #3

Mandan, ND

Option #1: Boat Ramp Feasibility Study - Paved with Curb & Gutter



7-Feb-23

Engineer's Opinion of Probable Construction Costs					
ITEM	ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1	Bonding Allowance	1	LS	\$45,300	\$45,300
2	Mobilization Allowance	1	LS	\$99,000	\$99,000
3	Traffic Control Allowance	1	LS	\$5,000	\$5,000
4	Underground Utility Allowance	1	LS	\$25,000	\$25,000
5	Erosion Control Allowance	1	LS	\$25,000	\$25,000
6	Clearing and Grubbing Allowance	1	LS	\$20,000	\$20,000
7	Common Excavation (Asphalt Area)	2,875	CY	\$26	\$74,800
8	Common Excavation (Ramp)	2,700	CY	\$26	\$70,200
9	River Dredging	500	CY	\$50	\$25,000
10	Concrete Ramp Subgrade (submerged)	500	TON	\$140	\$70,000
11	Concrete Boat Ramp	550	SY	\$125	\$68,800
12	Subgrade Prep	7,500	SY	\$3	\$22,500
13	Aggregate Base Materials	7,500	SY	\$19.00	\$142,500
14	Bituminous Surfacing	7,200	SY	\$68	\$489,600
15	Curb & Gutter	1,200	LF	\$50	\$60,000
16	Striping Allowance	1	LS	\$7,500	\$7,500
17	Approach Culvert Replacement	50	LF	\$250	\$12,500
18	Approach Culvert End Sections	2	EA	\$2,500	\$5,000
19	Grade 1 Rip Rap - Boat Ramp Side Slopes	310	TON	\$130	\$40,300
20	Grade 2 Rip Rap - River & Creek Bank Armoring	225	TON	\$140	\$31,500
21	Geotextile Fabric	1,500	SY	\$5	\$7,500
22	WQ Treatment Allowance (Rain Garden feature or Hydrodynamic Separator)	1	LS	\$100,000	\$100,000
23	Stormwater Infrastructure (flume into creek or pipe)	1	LS	\$50,000	\$50,000
24	Vegetation Restoration (seeding & erosion control blanket)	1,000	SY	\$8	\$8,000
25	Boat Dock (36' straight dock) Allowance	1	LS	\$40,000	\$40,000
26	Tree Planting & Restoration	1	LS	\$10,000	\$10,000
27	<b>Public Outreach Allowance</b>	1	LS	\$15,000	\$15,000
28	<b>Engineering, Design, and Bidding Services</b>	1	LS	\$80,000	\$80,000
29	<b>Stormwater Management Plan Allowance</b>	1	LS	\$8,000	\$8,000
30	<b>Allowance for Permitting Preparation, Coordination, and Fees</b>	1	LS	\$100,000	\$100,000
31	<b>Geotechnical Services</b>	1	LS	\$8,000	\$8,000
32	<b>Engineering Bidding &amp; Construction Services</b>	1	LS	\$40,000	\$40,000
<b>Subtotal Construction Costs</b>					<b>\$1,555,000</b>
<b>Engineering, Design, Permitting, Geotech, &amp; Construction Services</b>					<b>\$251,000</b>
<b>Unidentified Bid Items and Estimating Contingency for Construction Costs (30%)</b>					<b>\$466,500</b>
<b>TOTAL COSTS</b>					<b>\$2,272,500</b>

# Attachment #3

Mandan, ND

Option #2: Boat Ramp Feasibility Study - Permeable Pavers



7-Feb-23

Engineer's Opinion of Probable Construction Costs					
ITEM	ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1	Bonding Allowance	1	LS	\$29,700	\$29,700
2	Mobilization Allowance	1	LS	\$65,000	\$65,000
3	Traffic Control Allowance	1	LS	\$5,000	\$5,000
4	Underground Utility Allowance	1	LS	\$25,000	\$25,000
5	Erosion Control Allowance	1	LS	\$25,000	\$25,000
6	Clearing and Grubbing Allowance	1	LS	\$20,000	\$20,000
7	Common Excavation (Paver Area)	1,915	CY	\$26	\$49,800
8	Common Excavation (Ramp)	2,700	CY	\$26	\$70,200
9	River Dredging	500	CY	\$50	\$25,000
10	Concrete Ramp Subgrade (submerged)	500	TON	\$140	\$70,000
11	Concrete Ramp Subgrade base, above water	100	SY	\$20	\$2,000
12	Concrete Boat Ramp	550	SY	\$125	\$68,800
13	Subgrade Prep	7,500	SY	\$3	\$22,500
14	Truegrid Pro Permeable Pavers	67,500	SF	\$3	\$168,800
15	Truegrid Yellow SuperSpot Markers	7,500	EA	\$1.50	\$11,300
16	Aggregate Base 3/4"-1" stone	3,250	TON	\$40	\$130,000
17	Paver Fill 5/8"-3/4"	550	TON	\$40	\$22,000
18	Paver Install	100	HRS	\$150	\$15,000
19	Approach Culvert Replacement	50	LF	\$250	\$12,500
20	Approach Culvert End Sections	2	EA	\$2,500	\$5,000
21	Grade 1 Rip Rap - Boat Ramp Side Slopes	310	TON	\$130	\$40,300
22	Grade 2 Rip Rap - River & Creek Bank Armoring	225	TON	\$140	\$31,500
23	Geotextile Fabric	9,000	SY	\$5	\$45,000
24	Vegetation Restoration (seeding & erosion control blanket)	1,000	SY	\$8	\$8,000
25	Boat Dock (36' straight dock) Allowance	1	LS	\$40,000	\$40,000
26	Tree Planting & Restoration	1	LS	\$10,000	\$10,000
27	<b>Public Outreach Allowance</b>	1	LS	\$15,000	\$15,000
28	<b>Engineering, Design, and Bidding Services</b>	1	LS	\$50,000	\$50,000
29	<b>Stormwater Management Plan Allowance</b>	1	LS	\$5,000	\$5,000
30	<b>Allowance for Permitting Preparation, Coordination, and Fees</b>	1	LS	\$100,000	\$100,000
31	<b>Geotechnical Services</b>	1	LS	\$8,000	\$8,000
32	<b>Engineering Bidding &amp; Construction Services</b>	1	LS	\$25,000	\$25,000
<b>Subtotal Construction Costs</b>					<b>\$1,017,400</b>
<b>Engineering, Design, Permitting, Geotech, &amp; Construction Services</b>					<b>\$203,000</b>
<b>Unidentified Bid Items and Estimating Contingency for Construction Costs (30%)</b>					<b>\$305,200</b>
<b>TOTAL COSTS</b>					<b>\$1,525,600</b>

# Attachment #3

Mandan, ND

Option #3: Boat Ramp Feasibility Study - Gravel



7-Feb-23

Engineer's Opinion of Probable Construction Costs					
ITEM	ITEM DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1	Bonding Allowance	1	LS	\$24,600	\$24,600
2	Mobilization Allowance	1	LS	\$54,000	\$54,000
3	Traffic Control Allowance	1	LS	\$5,000	\$5,000
4	Underground Utility Allowance	1	LS	\$25,000	\$25,000
5	Erosion Control Allowance	1	LS	\$25,000	\$25,000
6	Clearing and Grubbing Allowance	1	LS	\$20,000	\$20,000
7	Common Excavation (Gravel Area)	1,200	CY	\$26	\$31,200
8	Common Excavation (Ramp)	2,700	CY	\$26	\$70,200
9	River Dredging	500	CY	\$50	\$25,000
10	Concrete Ramp Subgrade (submerged)	500	TON	\$140	\$70,000
11	Concrete Boat Ramp	550	SY	\$125	\$68,800
12	Subgrade Prep	7,500	SY	\$3	\$22,500
13	Gravel Surfacing	3,250	TON	\$30	\$97,500
14	Approach Culvert Replacement	50	LF	\$250	\$12,500
15	Approach Culvert End Sections	2	EA	\$2,500	\$5,000
16	Grade 1 Rip Rap - Boat Ramp Side Slopes	310	TON	\$130	\$40,300
17	Grade 2 Rip Rap - River & Creek Bank Armoring	225	TON	\$140	\$31,500
18	Geotextile Fabric	1,500	SY	\$5	\$7,500
19	WQ Treatment Allowance (Rain Garden feature or Hydrodynamic Separator)	1	LS	\$100,000	\$100,000
20	Stormwater Infrastructure (flume into creek or pipe)	1	LS	\$50,000	\$50,000
21	Vegetation Restoration (seeding & erosion control blanket)	1,000	SY	\$8	\$8,000
22	Boat Dock (36' straight dock) Allowance	1	LS	\$40,000	\$40,000
23	Tree Planting & Restoration	1	LS	\$10,000	\$10,000
24	<b>Public Outreach Allowance</b>	1	LS	\$15,000	\$15,000
25	<b>Engineering, Design, and Bidding Services</b>	1	LS	\$35,000	\$35,000
26	<b>Stormwater Management Plan Allowance</b>	1	LS	\$8,000	\$8,000
27	<b>Allowance for Permitting Preparation, Coordination, and Fees</b>	1	LS	\$100,000	\$100,000
28	<b>Geotechnical Services</b>	1	LS	\$8,000	\$8,000
29	<b>Engineering Bidding &amp; Construction Services</b>	1	LS	\$20,000	\$20,000
<b>Subtotal Construction Costs</b>					<b>\$843,600</b>
<b>Engineering, Design, Permitting, Geotech, &amp; Construction Services</b>					<b>\$186,000</b>
<b>Unidentified Bid Items and Estimating Contingency for Construction Costs (30%)</b>					<b>\$253,100</b>
<b>TOTAL COSTS</b>					<b>\$1,282,700</b>

# Attachment #3

Mandan, ND

Boat Ramp Feasibility Study - Site Amenities



7-Feb-23

<b>Engineer's Opinion of Probable Construction Costs</b>					
<b>ITEM</b>	<b>ITEM DESCRIPTION</b>	<b>QTY</b>	<b>UNIT</b>	<b>UNIT COST</b>	<b>TOTAL COST</b>
1	Decorative Signs	2	EA	\$12,000	\$24,000
2	Kayak Launch	1	EA	\$30,000	\$30,000
3	Fish Cleaning Station	1	EA	\$50,000	\$50,000
4	Waterline for Fish Cleaning Station	750	FT	\$100	\$75,000
5	Vault Toilet	1	EA	\$15,000	\$15,000
6	Picnic Shelter	2	EA	\$40,000	\$80,000
7	Pedestrian Benches	2	EA	\$2,000	\$4,000
8	Parking Lot Lighting Allowance	1	EA	\$50,000	\$50,000
9	Parking Lot Security Allowance	1	EA	\$25,000	\$25,000
10	Pedestrian Bridge Creek Crossing	1	EA	\$275,000	\$275,000
<b>Subtotal Construction Costs</b>					<b>\$628,000</b>
<b>Unidentified Bid Items and Estimating Contingency for Construction Costs (30%)</b>					<b>\$188,400</b>
<b>TOTAL COSTS</b>					<b>\$816,400</b>

## Appendix A

June 17, 2022

Natalie Pierce  
Director of Planning and Zoning  
2916 37<sup>th</sup> St. NW  
Mandan, ND 58554

Missouri River Natural Area

Dear Ms. Pierce

The following is a summary of our meeting on June 2, 2022, regarding the Missouri River Natural Area. As stated, the North Dakota Department of Transportation (NDDOT) would like to develop an management agreement and plan for managing the Missouri River Natural Area (MNRA), previously managed by the North Dakota Parks and Recreation (NDPR).

#### Background

NDPR has indicated that their department desires to terminate the management agreement. NDPR has previously entered into a sublease agreement with the Morton County Parks and Recreation to provide for management services for recreational access and opportunities for the general public to use trails and natural area on the MRNA property. There have been numerous requests to use the MRNA property and allow improvement such as boat ramp access, foot bridge to cross the drainage ditch, and the installation of toilets.

In an effort to resolve management of properties and balance requested improvements the NDDOT has researched the acquisition of the MNRA properties and has further discussed the restrictions for the use of the properties with the Federal Highway Administration (FHWA).

It was determined the MNRA needs to be treated as a Section 4(f) property because it is included in the on the Mandan Parks and Recreation Trail Map and on the NDPR website as a place for multiple types of recreation open to the public. However, depending on the type of funding and proposed use, some improvements could be considered.

#### Discussion

The MNRA is illustrated on the attached map and was discussed as four general areas.

Area 1 is shaded in orange. This area was previously quitclaimed at no cost to the Mandan Park District to use as a public archery range. The quitclaim deed has several covenants, conditions, restrictions, and reservations.



Area 2 is shaded in green. This area is used for the drainage ditch and access roads. This area was added to the MNRA management agreement to allow for improvements to the road and parking area.

Area 3, north of Interstate 94, is shaded in yellow. This area is under the MRNA management agreement for public use for nature trails and observation purposes.

Area 4 is shaded in yellow – south of Interstate 94. This area is under the MRNA management agreement for public use for nature trails and observation purposes.

There is a Right of Way Use Agreement in place allowing access through the interstate right of way to connect trails located in the north and south MNRA areas.

In an effort to address local improvement requests and to provide for the short- and long-term management and use of the MNRA the NDDOT proposes the following:

- 1) Area 1 may be used for a public boat ramp. It is required that is area remain in public use and that there would be no commercial activity or use allowed. The quitclaim deed with be amended as necessary.
- 2) Area 2 may be used for as part of the boat ramp access to the river. It may be possible to construct a foot bridge to provide trail connections. This area must continue to provide drainage functions. Ownership would remain with the NDDOT and use would be included approved management plan.
- 3) Area 3 would continue have a primary use as nature trails for walking and biking recreation. The management plan may address improvements such as a kiosk, signing, vaulted toilet near parking area, benches, trash receptacles, and improvements to the trails. Ownership would remain with the NDDOT and use would be included approved management plan.
- 4) Area 4 would continue have a primary use as nature trails for walking and biking recreation. The management plan would be limited to improvements such as benches, trash receptacles, and improvements to the trails. Ownership would remain with the NDDOT and use would be included approved management plan.

The local parties to the management agreement and plan would be responsible for all engineering, environmental documents, permits, costs, etc. required to implement any proposed improvements.

#### Limitations

- 1) The property must be maintained for public use purposes:
  - a. Recreational nature trails for walking and bicycles, entrances to trails must restricted to prohibit vehicle access (fence and gates).

June 17, 2022  
Natalie Pierce  
Missouri River Natural Area

- b. Improvement not specifically identified should be compatible to the nature trails. Shelters and other improvements that have high impacts in terms of use, parking, debris, etc. may detract and alter the intended use. Shelter are discouraged.
  - c. Vaulted toilets should be limited to areas outside of the main trail use as noted above for Area 2 or 3. Comfort stations will not be allowed
  - d. Fish cleaning stations may be allowed in Area 1 near the boat ramp.
- 2) No motorized or electric vehicles, except for maintenance purposes.
  - 3) No commercial uses.
  - 4) No camping.
  - 5) No hunting or trapping, fishing permitted.
  - 6) No horses or horse trails.
  - 7) Pets must be leashed and there should be receptacle for disposal of waste.
  - 8) Projects with Federal funds would require a NEPA documentation processed through the NDDOT.

This document is not intended to be an all-inclusive list but is intended to summarize the conversation held and identify potential limitations for the management plan. It is anticipated that there will be further discussion and evaluation of the proposed management plan and agreement. Would you so kind to distribute this letter to the participating parties. I will be available to answer any questions you may have.

Sincerely,

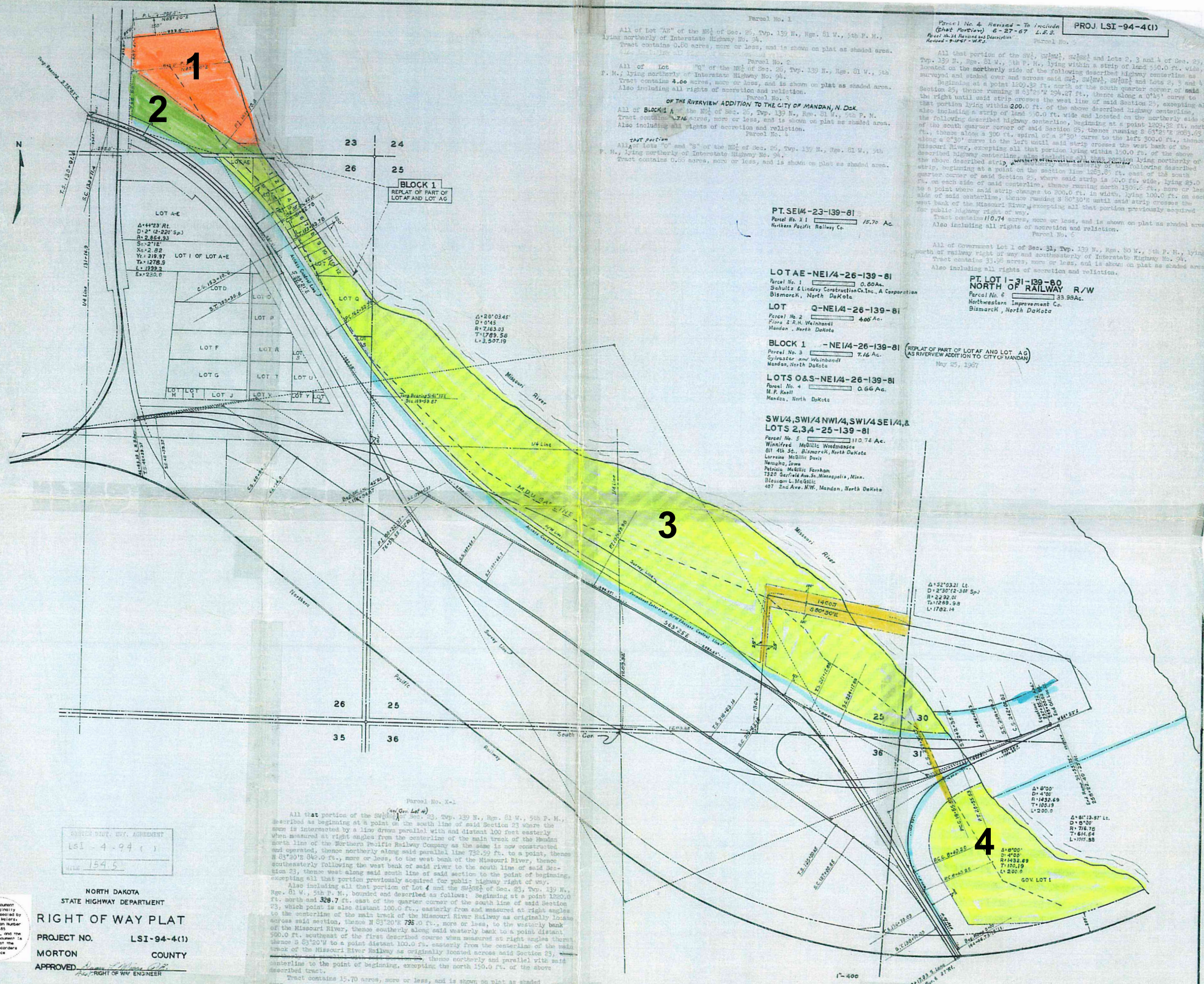


Mark S. Gaydos, Environmental and Transportation Services

19/msg

Enclosure

cc: Ron Henke, Deputy Director for Engineering  
Chad Orn, Director Office of Project Development



Parcel No. 1  
 All of Lot "A" of the NE 1/4 of Sec. 25, Twp. 139 N., Rge. 81 W., 5th P. M., lying northerly of Interstate Highway No. 24. Tract contains 0.60 acres, more or less, and is shown on plat as shaded area.

Parcel No. 2  
 All of Lot "Q" of the NE 1/4 of Sec. 25, Twp. 139 N., Rge. 81 W., 5th P. M., lying northerly of Interstate Highway No. 24. Tract contains 4.00 acres, more or less, and is shown on plat as shaded area. Also including all rights of accretion and reliction.

Parcel No. 3  
**OF THE RIVERVIEW ADDITION TO THE CITY OF MANDAN, N. DAK.**  
 All of Block "A" of the NE 1/4 of Sec. 25, Twp. 139 N., Rge. 81 W., 5th P. M. Tract contains 4.74 acres, more or less, and is shown on plat as shaded area. Also including all rights of accretion and reliction.

Parcel No. 4  
 All of Lots "O" and "S" of the NE 1/4 of Sec. 25, Twp. 139 N., Rge. 81 W., 5th P. M., lying northerly of Interstate Highway No. 24. Tract contains 0.60 acres, more or less, and is shown on plat as shaded area.

Parcel No. 5  
 All that portion of the SW 1/4, NW 1/4, SW 1/4 and Lots 2, 3 and 4 of Sec. 25, Twp. 139 N., Rge. 81 W., 5th P. M., lying within a strip of land 50.0 ft. wide, located on the northerly side of the following described highway centerline as surveyed and marked over and across said SW 1/4, NW 1/4, SW 1/4 and Lots 2, 3 and 4. Beginning at a point 150.00 ft. north of the south quarter corner of said Section 25, thence running N 83°20' E 794.27 ft., thence along a 0°45' curve to the right until said strip crosses the west line of said Section 25, excepting all that portion lying within 200.0 ft. of the above described highway centerline, also including a strip of land 50.0 ft. wide and located on the northerly side of the south quarter corner of said Section 25, thence running S 63°25' E 2033.63 ft., thence along a 390 ft. spiral of a 9°50' curve to the left 300.0 ft., thence along a 2°30' curve to the left until said strip crosses the west bank of the Missouri River, excepting all that portion lying within 150.0 ft. of the above described highway centerline, also including all that portion lying northerly of the above described strip, westerly of the west bank of the Missouri River, beginning at a point on the section line 1253.8 ft. east of the south quarter corner of said Section 25, thence running north 1505.6 ft., more or less, on each side of said centerline, thence running north 1505.6 ft., more or less, to a point where said strip changes to 300.0 ft. in width, lying 100.0 ft. on each side of said centerline, thence running S 80°30' E until said strip crosses the west bank of the Missouri River, excepting all that portion previously acquired for public highway right of way. Tract contains 110.74 acres, more or less, and is shown on plat as shaded area. Also including all rights of accretion and reliction.

Parcel No. 6  
 All of Government Lot 1 of Sec. 31, Twp. 139 N., Rge. 80 W., 5th P. M., lying north of railway right of way and southeasterly of Interstate Highway No. 24. Tract contains 31.96 acres, more or less, and is shown on plat as shaded area. Also including all rights of accretion and reliction.

**PT. SE 1/4 - 23-139-81**  
 Parcel No. 1 15.70 Ac.  
 Northern Pacific Railway Co.

**LOT A-E - NE 1/4 - 26-139-81**  
 Parcel No. 1 0.60 Ac.  
 Schultz & Linday Construction Co. Inc. A Corporation  
 Bismarck, North Dakota

**LOT Q - NE 1/4 - 26-139-81**  
 Parcel No. 2 4.00 Ac.  
 Flora & A.H. Weinhandl  
 Mandan, North Dakota

**BLOCK 1 - NE 1/4 - 26-139-81 (REPLAT OF PART OF LOT A-F AND LOT A-G AS RIVERVIEW ADDITION TO CITY OF MANDAN)**  
 Parcel No. 3 7.16 Ac.  
 Sylvester and Weinhandl  
 Mandan, North Dakota  
 May 25, 1967

**LOTS O & S - NE 1/4 - 26-139-81**  
 Parcel No. 4 0.66 Ac.  
 H.P. Beall  
 Mandan, North Dakota

**SW 1/4, SW 1/4 NW 1/4, SW 1/4 SE 1/4, & LOTS 2, 3, 4 - 25-139-81**  
 Parcel No. 5 110.74 Ac.  
 Winnifred McMillan Woodmansee  
 811 4th St., Bismarck, North Dakota  
 Lorraine McMillan Davis  
 Nemaha, Iowa  
 Patricia McMillan Fenham  
 1320 Garfield Ave. St. Marys, Minn.  
 Blossom L. McMillan  
 407 2nd Ave. NW, Mandan, North Dakota

SUBJECT MATR. ECV. AGREEMENT  
 LSI - 4-94(1)  
 FILE 1545

NORTH DAKOTA  
 STATE HIGHWAY DEPARTMENT

**RIGHT OF WAY PLAT**

PROJECT NO. LSI-94-4(1)  
 MORTON COUNTY

APPROVED: \_\_\_\_\_  
 RIGHT OF WAY ENGINEER

DATE 11-22-66

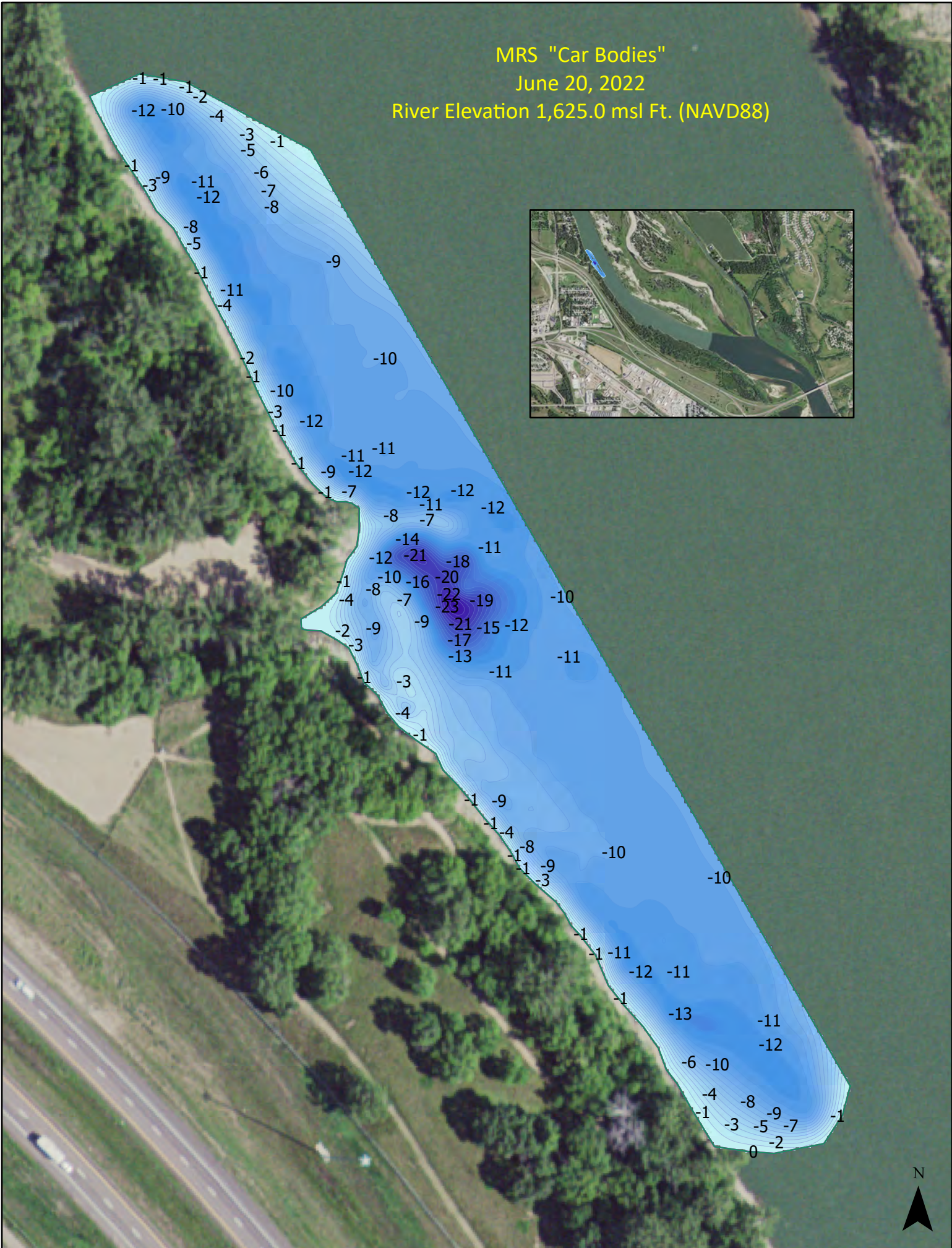
This document use or identity issued and sealed by Duane L. Heister, Registration Number 15 885 on 11/22/66 and the original document is stored at the County Recorder's Office

Parcel No. 6-1  
 (See Gen. Plat #4)  
 All that portion of the SW 1/4 of Sec. 23, Twp. 139 N., Rge. 81 W., 5th P. M., described as beginning at a point on the south line of said Section 23 where the same is intersected by a line drawn parallel with and distant 100 feet easterly when measured at right angles from the centerline of the main track of the Mandan north line of the Northern Pacific Railway Company as the same is now constructed and operated, thence northerly along said parallel line 794.27 ft. to a point, thence S 83°20' E 045.0 ft., more or less, to the west bank of the Missouri River, thence southeasterly following the west bank of said river to the south line of said Section 23, thence west along said south line of said section to the point of beginning, excepting all that portion previously acquired for public highway right of way. Also including all that portion of Lot 4 and the SW 1/4 of Sec. 23, Twp. 139 N., Rge. 81 W., 5th P. M., bounded and described as follows: Beginning at a point 1200.0 ft. north and 328.7 ft. east of the quarter corner of said Section 23, which point is also distant 100.0 ft. easterly from and measured at right angles to the centerline of the main track of the Missouri River Railway as originally located across said section, thence N 83°20' E 795.0 ft., more or less, to the westerly bank of the Missouri River, thence southerly along said westerly bank to a point distant 500.0 ft. southeast of the first described corner when measured at right angles thereon, thence S 83°20' W to a point distant 100.0 ft. easterly from the centerline of the main track of the Missouri River Railway as originally located across said Section 23, thence northerly and parallel with said centerline to the point of beginning, excepting the north 150.0 ft. of the above described tract. Tract contains 15.70 acres, more or less, and is shown on plat as shaded area.

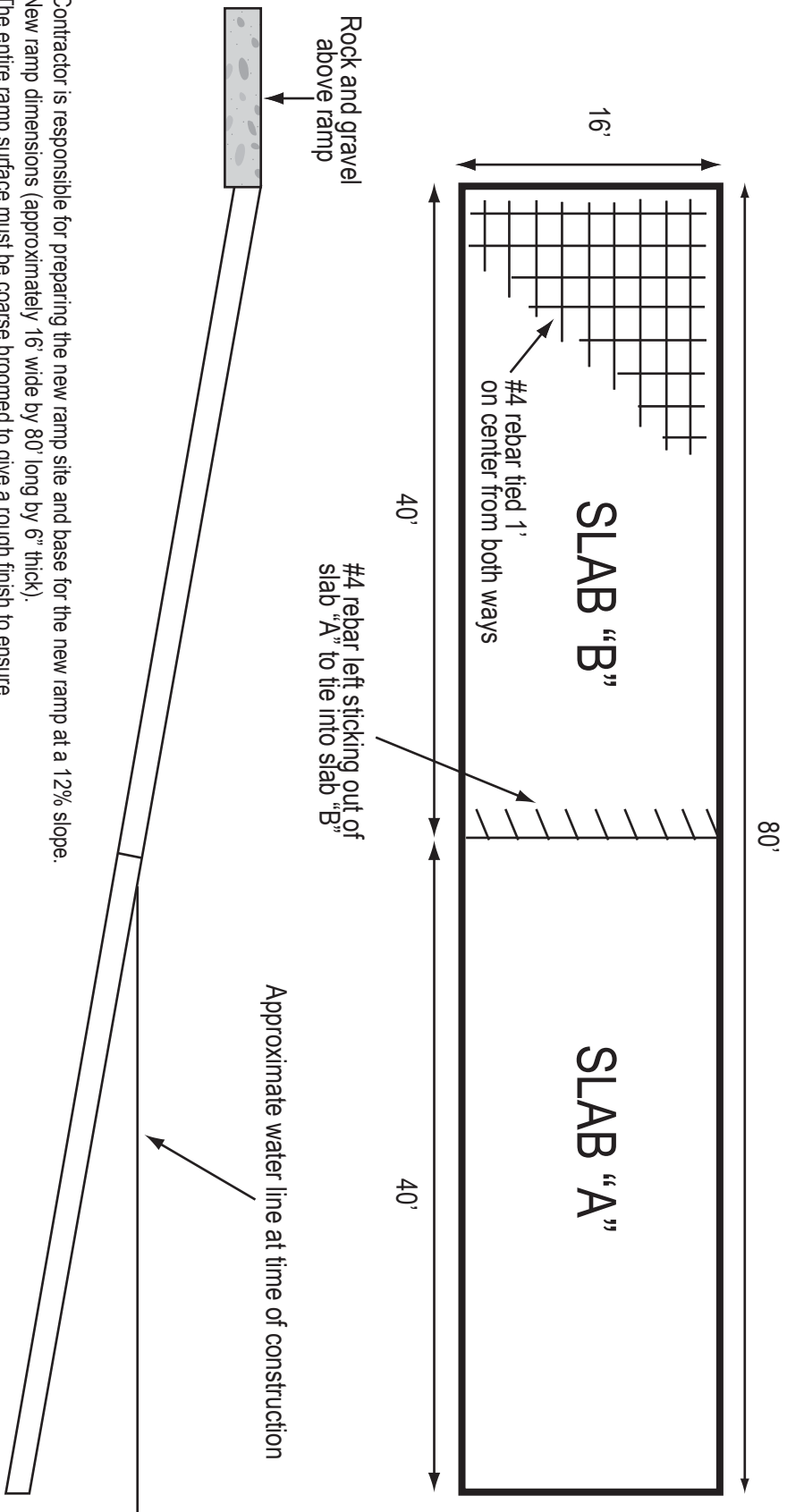
1"=400'

## Appendix B

MRS "Car Bodies"  
June 20, 2022  
River Elevation 1,625.0 msl Ft. (NAVD88)



## Appendix C



1. Contractor is responsible for preparing the new ramp site and base for the new ramp at a 12% slope.
2. New ramp dimensions (approximately 16' wide by 80' long by 6" thick).
3. The entire ramp surface must be coarse broomed to give a rough finish to ensure vehicular traction.
4. The contractor shall use type 1 cement with a 28 day compressive strength of 4000 lb/sq. inch consisting of a 6-bag mix.
5. Slab "A" will be poured in place on dry ground from the water line upward. After curing, it will be pushed out into the lake using a cat/dozer. Rebar should be left sticking out of the upper end of slab "A" so that slab "B" can be tied together with slab "A" to create one continuous concrete slab.
6. Slab "B" will then be poured in place from the upper end of slab "A", upward to the top of the bank. The top of the ramp must be located above the ordinary high water mark.
7. Class 5 road gravel shall be placed and compacted above the new ramp to provide a consistent and uniform slope and approach and turnaround for the boat ramp.
8. (Optional) Both sides of the ramp shall be rip-rapped the entire length with rock not to exceed 12" in diameter. Rip-rap shall be placed so that it is not higher than the ramp surface. Rip-rap should be bid on a cost per ton basis and listed as a separate item.

### Generic Plans - "Pour & Push" Method

(Boat Ramp Specifications)

DRAWN BY  
REVISED

NORTH DAKOTA GAME AND FISH DEPARTMENT

DATE

3/31/08

APPROVED BY

(not to scale)

DRAWING NUMBER

1 OF 1

## Appendix D



# TRUEGRID<sup>®</sup>

True to your project. True to the environment.

CATALOG

2021



# World's Strongest Permeable Pavers

[TRUEGRIDPAVER.COM](http://TRUEGRIDPAVER.COM)

855-355-GRID

US Patent #8,734,049 | US and Foreign  
Patents Pending

## DRIVEN BY PURPOSE...

We have a clarity of purpose for our business: to challenge conventional thinking and disrupt traditional paving methods; to ultimately create a better, cleaner, less toxic environment for our kids.

By offering a simple new green technology that is easily actionable, together we can make an impact now. Less flooding. Cleaner air and water. Less heat. Less thermal pollution. Less waste in the landfill. Fewer toxins from runoff pollutants as well coal tar & asphalt. A more natural landscape.

**PRO LITE**



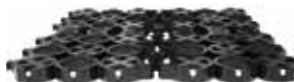
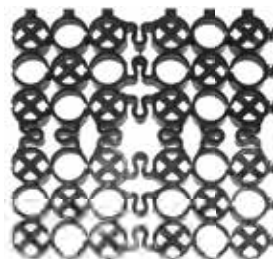
The Residential  
Paver

**PRO PLUS®**



The Commercial  
Paver

**ROOT™**



The Grass  
Paver

**MACK™**



The Industrial  
Paver



# DESIGN FEATURES



U.S. Patent No. 8,734,049

The robust cells allow our 2 lb grid to handle over 1 million lbs per square foot load! No gravel migration, compaction or dust. **100% permeability.** The grid can be pressed together by hand, no tools, no clips. With the integral X-anchors, no staking is needed. A bottom flange prevents sinking. Other systems are either too flexible & weak & can't handle trucks or traffic; or too rigid because soils move and paving cracks! The S-Flex Joints solve these problems giving our grid the best of both. A versatile design for any climate or soil or weight or traffic load.

## INDEX

Introduction	4
Sub-Base Considerations	5
The Value	6
Competition Comparison	7
Green	8
Products	9 - 13
Accessories	14 - 15
Architects	16
Developers	17
Engineers	18
City Professionals	19
Contractors	20
Horse, Livestock, Ranch & Farm	21
Works in All Climates	22
Projects	23 - 29
Case Studies	30 - 31

## PAGE

4
5
6
7
8
9 - 13
14 - 15
16
17
18
19
20
21
22
23 - 29
30 - 31



GRAVEL FILL



GRASS FILL

# INTRODUCTION TO THE TRUEGRID SYSTEM

---



In urban watersheds, almost all of the impervious surface area is represented by building rooftops and paved surfaces. In residential areas most of the paved area is represented by the roadway system and residential driveways. Parking lots and paved industrial storage areas represent an even larger portion of the impervious surface in commercial and industrial areas. Impervious pavements can produce two-thirds of the excess runoff in an urban catchment. Runoff from impervious pavements contributes a substantial loading of hydrocarbons and heavy metal pollutants, and contributes greatly to the increased temperature of surface runoff. In most urban jurisdictions, a paved roadway system with a traditional curb and gutter configuration provides a key component of the overall urban drainage system. Surface flow from adjoining tributary watersheds is conveyed directly into catch basin inlets and connected piping systems. In these traditional impervious paved systems, the runoff coefficient (runoff volume) is increased and the time of concentration is decreased resulting in increased peak rates of runoff. TRUEGRID provides a highly permeable stabilized surfaces that can be used for the movement and parking of vehicles (automobiles, trucks, construction equipment, aircraft, etc.) and storage of materials and equipment.

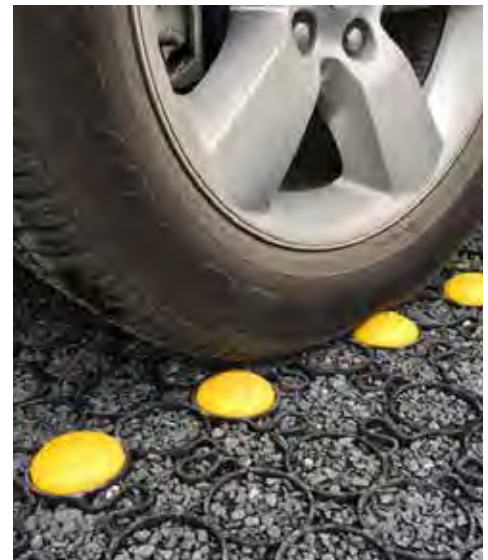
---

## Drive on the surface, drain & detain stormwater below.

---

Compared to conventional pavement, the TRUEGRID system is designed to infiltrate storm water runoff instead of shedding it off the surface. TRUEGRID will reduce the amount of runoff by allowing water to pass through surfaces that would otherwise be impervious. The storm water passes through the load bearing surface and aggregate sub base that are selected based upon the intended application and required infiltration rate. Runoff is stored in the stone aggregate sub base course / storage layer, and allowed to infiltrate into the surrounding soil (functioning like an infiltration basin).

A TRUEGRID surface has very high initial surface infiltration rates and can immediately infiltrate and store rainfall and runoff from high intensity rainstorms. In many cases, direct runoff is completely eliminated. The surface infiltration rates for TRUEGRID will in most cases exceed 800 inches/hour. This is several orders of magnitude higher than all the rainfall intensities encountered in the Southwest and Midwest USA.



Compared to conventional pavement, the TRUEGRID system is designed to infiltrate storm water runoff instead of shedding it off the surface. TRUEGRID will reduce the amount of runoff by allowing water to pass through surfaces that would otherwise be impervious. The storm water passes through the load bearing surface and aggregate sub base that are selected based upon the intended application and required infiltration rate. Runoff is stored in the stone aggregate sub base course / storage layer, and allowed to infiltrate into the surrounding soil (functioning like an infiltration basin).

# SUB-BASE CONSIDERATIONS FOR STORM WATER DETENTION

Crushed aggregate meeting ASTM No. 57 is commonly used for open-graded sub bases along with ASTM No. 2 to No. 4. These materials are widely available and they are recommended for most TRUEGRID Permeable Paver applications. These materials will have a nominal porosity (volume of voids/total volume of base) over 0.32 and a storage capacity in the void space (volume of voids/volume of aggregate) approaching 40%. A 40% void space provides 0.4 cubic feet of storage capacity for each cubic foot of aggregate (the volume of the base will need to be 2.5 times the volume of water to be stored).

**Sub-Base for Grass Infill Installations.** Should be a ¾" minus, sandy gravel road base. Although reducing the stormwater storage capacity to around 20%, this base will grow grass, support heavy loads, and drain.

## CHART A: PERMEABLE BASE

AASHTO #57 PERMEABLE SUB-BASE MATERIAL DEFINED AS:

SIEVE SIZE		PERCENT PASSING	
MM	IN	#57	TYPICAL
37.5	1½	100	100
25	1	95 - 100	97
19	¾		75
12.5	½	26 - 60	45
9.5	¾		25
4.75	#4	0 - 10	5
2.36	#8	0 - 5	2

## ENDLESS GRAVEL FILL OPTIONS



# THE VALUE TO THE TRUEGRID SYSTEM

---

**Runoff volume reduction/elimination** is achieved when TRUEGRID is placed over in situ soils and a defined volume of the water passing through the pavement is infiltrated into the angular stone base and soil subgrade below.

**Peak runoff rate reduction** is achieved when the volume of water passing through the TRUEGRID surface is “detained” for a defined period of time within the pavement cross-section and the open graded aggregate sub base beneath the pavement. The effective infiltration rate for the watershed is increased by trapping the water in the permeable surfaces and effectively increasing the time of concentration in the catchment area.

**Pollutant removal.** Infiltration of storm water runoff through the pavement surface will provide a degree of suspended solids removal followed by additional removal of colloidal solids and soluble pollutants in the aggregate sub base and sub soils. Sorption of metals to colloidal solids and within the pavement void matrix is another removal function. Soluble organic pollutants adsorbed within the pavement void matrix and the open graded aggregate sub base will be exposed to biodegradation over time.

## TYPICAL POLLUTANT REMOVAL (%)

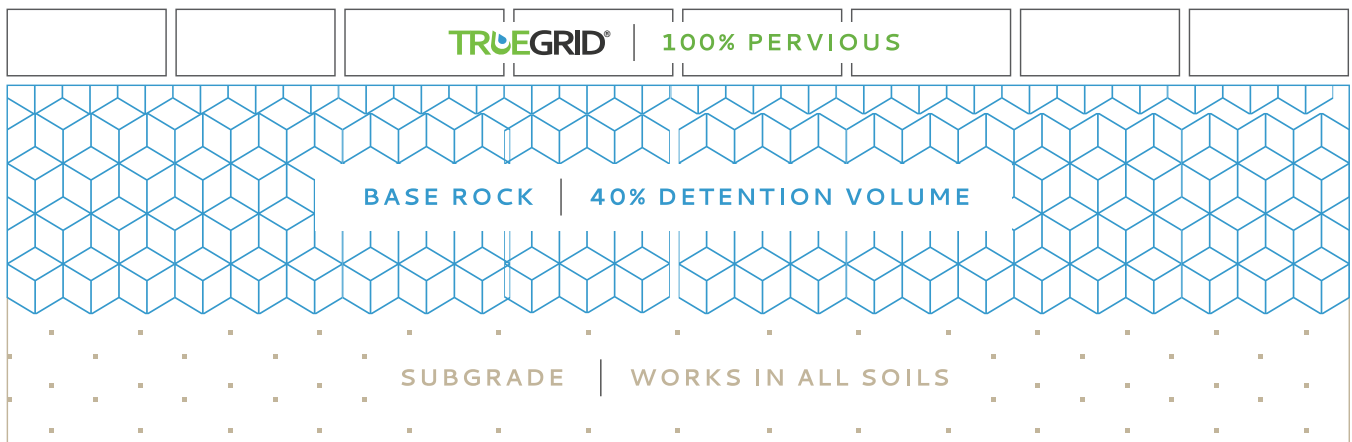
BMP TYPE	SUSPENDED SOLIDS	NITROGEN	PHOSPHOROUS	PATHOGENS	METALS
TRUEGRID	65 - 100	65 - 100	30 - 65	65 - 100	65 - 100
Dry Retention Basins	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Retention Basins	50 - 80	30 - 65	30 - 65	< 30	50 - 80
Constructed Wetlands	50 - 80	< 30	15 - 45	< 30	50 - 80
Infiltration Basins	50 - 80	50 - 80	50 - 80	65 - 100	50 - 80
Infiltration Trenches / Dry Wells	50 - 80	50 - 80	15 - 45	65 - 100	50 - 80
Grassed Swales	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Vegetated Filter Strips	50 - 80	50 - 80	50 - 80	< 30	30 - 65
Surface Sand Filters	50 - 80	< 30	50 - 80	< 30	50 - 80

**Reduces Heat Island Effect.** Heat Island Effect occurs in areas such as a city and industrial sites that have consistently higher temperatures than surrounding areas because of greater retention of heat. This retention of heat is due to buildings, concrete, and asphalt. Using TRUEGRID in these “hot spot” areas for pathways, parking lots, driveways, roofs...etc., reduces the absorbability of solar rays and thus helps steady and cool the natural environment.

**High load bearing capacity.** TRUEGRID is designed with the highest load capacities of any grid system and can withstand significant structural loads. TRUEGRID provides a stable and continuous load-bearing surface throughout parking areas.

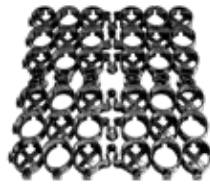
# COMPETITION COMPARISON

SPECIFICATION	TRUEGRID	ROLL-OUT PLASTIC PAVERS	CONCRETE PAVERS
Strength (filled)	9510 psi	5730 psi	5000
Flexural Strength	High	None (rolled paver)	High
Weight (lbs/sf)	1.32	0.42	37
Tensile Strength	2852 lbs	458 lbs	NA
Fill rock size	Up to 1"	Up to 3/8"	NA
Staking	<b>Not Required</b>	Required	NA
Installation	1000 sf/hr	NA	Slow
Recycled content	100% post consumer	100%	0
Porosity	90%	90%	37%
Wall thickness	<b>.250"/.150"</b>	.104"	NA
Paver depth	1.8"	1.0"	2"
Cell Size (ID)	3.2"	2.15"	NA
Flexibility	Rigid w/ Flex joints	Flexible	Rigid
Adjoining cell walls	<b>Yes</b>	No	No
Flex joints	<b>Yes</b>	No	No
Joint type	Tab	Snap	None
Shear Transfer Strength	High	Low	None



# GREEN

**TRUEGRID Permeable Pavers** are designed to provide design professionals with an eco-friendly alternative to concrete and asphalt and other impervious surfaces. Similar systems have been used in Europe for over 40 years and have been highly effective and accepted as a better alternative to impervious surfaces. TRUEGRID improved upon this concept and developed a stronger, more durable, USA made version that can handle any load and rigors concrete can handle....while being 100% permeable.

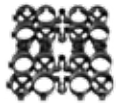


Made from 100% post-consumer recycled HDPE.

100% Permeable. Up to 100% of runoff water pollutants are removed via bioremediation.

## Impact Scorecard

MEASURE THE DIFFERENCE



150K SF  
600 Car Lot

### CO2 SAVED

967 TONS



### PLASTIC RECYCLED

204K LBS



### STORMWATER DETAINED

40K CUBIC FT



## LEED Credit Opportunities

With **TRUEGRID**



STORMWATER  
MANAGEMENT



RECYCLED  
CONTENT



INNOVATION  
& DESIGN



MATERIALS  
& RESOURCES

Tons of CO2 emissions from the manufacturing of cement are eliminated. Millions of lbs of plastic are kept out of landfill and recycled from a consumable to a 60 year life cycle useful product. Detention is added and flooding from stormwater is reduced. Coal tar & asphalt toxins are eliminated.

TRUEGRID has kept more than **12,000,000 lbs** of plastic out of landfills ...so far



# PRODUCTS

## TRUEGRID® PRO PLUS®

THE COMMERCIAL PAVER



- Works with SuperSpot® Parking Markers
- Superior Patented Design
- Engineered for Heavy Loads & Heavy Traffic
- Industry-Best Strength
- Industrial or Commercial Applications
- H20, HS20 Rated

### SPECIFICATIONS:

- Dimensions: 24" x 24" x 1.8" (4 sf)
- Pre-Assembled: 16 sf per layer (4' x 4' sheet of 4 grids)
- Compression Strength: 9510 psi filled
- Permeability: 100%
- Material: 100% Post-Consumer Recycled HDPE
- Color: Black with UV Stabilizer

### MORE:

- No Staking or Clips
- Works in All Climates & Soils
- May be Saw Cut



**SUPERSPOT® AVAILABLE**

### COMMERCIAL APPLICATIONS:

- Parking Lots
- Equipment & Truck Yards
- Storage Lots
- Drive Lanes
- Roadways
- Fire Lanes
- Rig Sites
- Event Parking





## SuperSpot® for TRUEGRID PRO PLUS

- Maintenance-Free Parking Markers
- Delineate Parking for Max Efficiency
- Create Arrows & Traffic Flow Markers
- High Visibility Profile
- Heavy Loads, Heavy Traffic
- Easy Snap-Lock Installation
- Never Stripe Again

### **SPECIFICATIONS:**

- Support Ribs for Strength
- 0.90" Domed Profile
- UV Stabilized

# ACCESSORIES

## SUPERSPOTS®

### MAINTENANCE-FREE PARKING DELINEATORS

Delineate your parking spots with easy-to-pop-in SuperSpot parking markers. No-restriping. Long-term UV resistance. Multiple color options for standard parking, fire lanes, handicapped designated spaces. Highly visible.



### PRO PLUS



### PRO LITE



### MACK



## SNOWSPOTS™

### MAINTENANCE-FREE PARKING DELINEATORS

Delineate your parking spots with easy-to-pop-in SnowSpot parking markers. Flush with surface for worry-free snow plowing. No restriping. Long term UV resistant. Yellow or white for standard striping, blue for disabled-access spaces and red for firelanes.



### SNOWSPOTS



## The Plate™

### EASY-TO-USE PARKING SPOT IDENTIFIER FOR PRO PLUS

Identify your spaces with easy-to-pop-in PLATE markers. Long-term UV resistance. Multiple color options for standard signs. Highly visible. *Patent Pending*



7.5"



# CONTRACTORS

---



- Advantageous Price & Service Differentiator
  - Eco-Friendly Offering
  - Easy-to-Install
- 

Gain a cost and speed advantage over conventional paving. Differentiate from competitors as a preferred TRUEGRID installer with a green, pervious, coded, less expensive paving system. Pave with TRUEGRID.

---

**1. Grade the site**



**2. Lay, compact base**



**3. Drop the grid**



**4. Fill the grid**



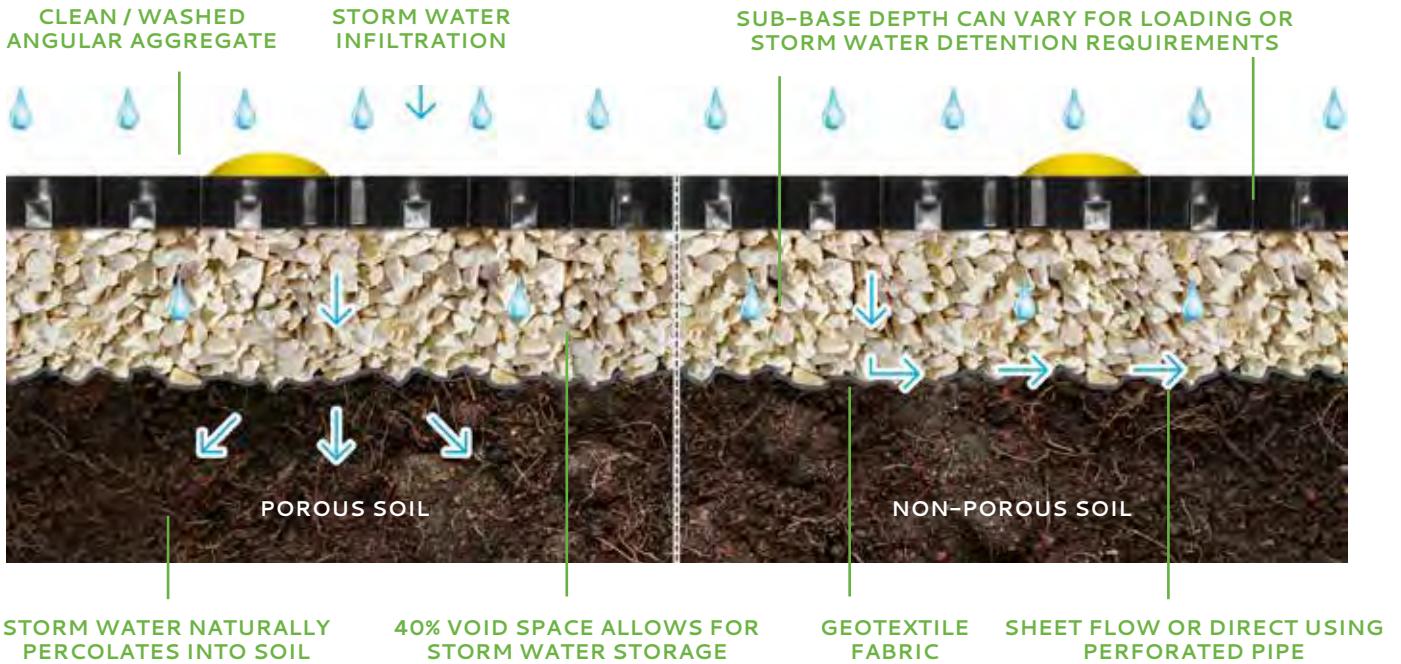
# WORKS IN ALL CLIMATES AND SOILS

## STORM WATER DETENTION

 100% PERVIOUS COVER

 1000+ INCHES/HOUR INFILTRATION RATE

 0.0 - 0.05 RUNOFF COEFFICIENT



### HOW TO CALCULATE STORM WATER DETENTION CAPACITY

$$\text{Detention Capacity} = \text{TRUEGRID Area (A)} \times \text{Total Aggregate Depth (d)} \times 40\% \text{ Void Space} = A \times d \times 0.40$$

**WHERE:**

$$d = \text{Depth of Sub-base} + \text{TRUEGRID Height}$$

**EXAMPLE:**

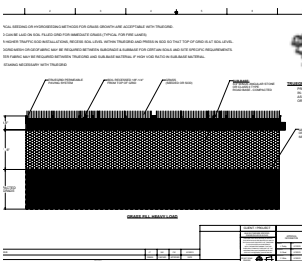
1 Acre Lot, TRUEGRID PRO PLUS, 8in Sub Base Fill & Sub Base - 3/4" Clean/Washed Angular Stone  
 Detention Capacity =  $A \times d \times 0.40$

**WHERE:**

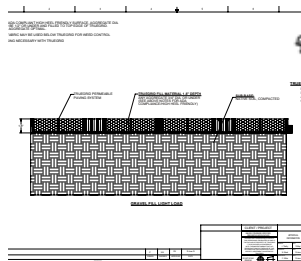
$A = 1 \text{ Acre} = 43,560 \text{ sf}$   
 $d = 8 \text{ in} + 1.8 \text{ in} = 9.8 \text{ in} = 0.8 \text{ ft}$   
 Detention Capacity =  $43,560 \times 0.8 \times 0.4 = 13,939 \text{ cf}$

Go to TECHNICAL INFO on [TRUEGRIDpaver.com](http://TRUEGRIDpaver.com) for typicals. Call for site specific questions: 1-855-355-GRID (4743)

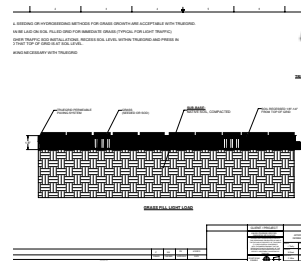
#### 1. Grass Fill Heavy Load



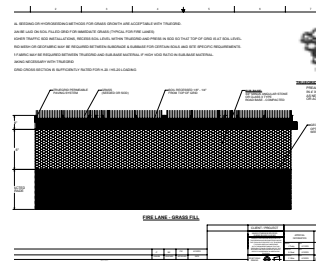
#### 2. Gravel Fill Light Load



#### 3. Grass Fill Light Load



#### 4. Fire Lane



“Design is not just what it looks like and feels like. Design is how it works.”

STEVE JOBS



**TRUEGRID**<sup>®</sup>  
True to your project. True to the environment.

6110 Abbott Drive  
Omaha, NE 68110  
© 2021

[TRUEGRIDPAVER.COM](http://TRUEGRIDPAVER.COM)

855-355-GRID



December 20, 2022

Jesse Kist  
AE2S  
(701) 220-2577

## **TRUEGRID Paver System – Pervious Parking w/Dentention**

### **Location:**

Mandan, North Dakota

### **TRUEGRID paved area:**

67,500 SF

### **Pervious cover percentage of proposed TRUEGRID area:**

100% Typical

### **TRUEGRID fill aggregate:**

Washed, uniform, angular stone, 5/8" or 3/4" diameter  
1.8" depth

### **TRUEGRID base aggregate:**

Washed, uniform, angular stone, 1" or 1.5" diameter  
8" depth

**Note:** Proper geotextile fabric to be recommended between subgrade and base stone for added stabilization, separation and permeability.

### **Total TRUEGRID Cross Section Depth:**

9.8"

### **Storm water sub-surface detainment capability in proposed TRUEGRID Cross section:**

**22,049 CF** of additional subsurface detainment below permeable surface (at 40% calculated void space in base and fill aggregate)

---

**Note:** For every additional **2"** of aggregate depth across 67,500 SF an additional **4,449 CF** of detainment can be achieved.

### **Additional:**

ADA Compliant – Yes  
H20 / HS20 Rated

### **Delineation for parking spaces or other flatline markings:**

TRUEGRID SuperSpot parking delineators or Reflector SuperSpots



True to your project. True to the environment.

MADE IN



U. S. A.

**TRUEGRID PRO PLUS 24" X 24" X1.8"**

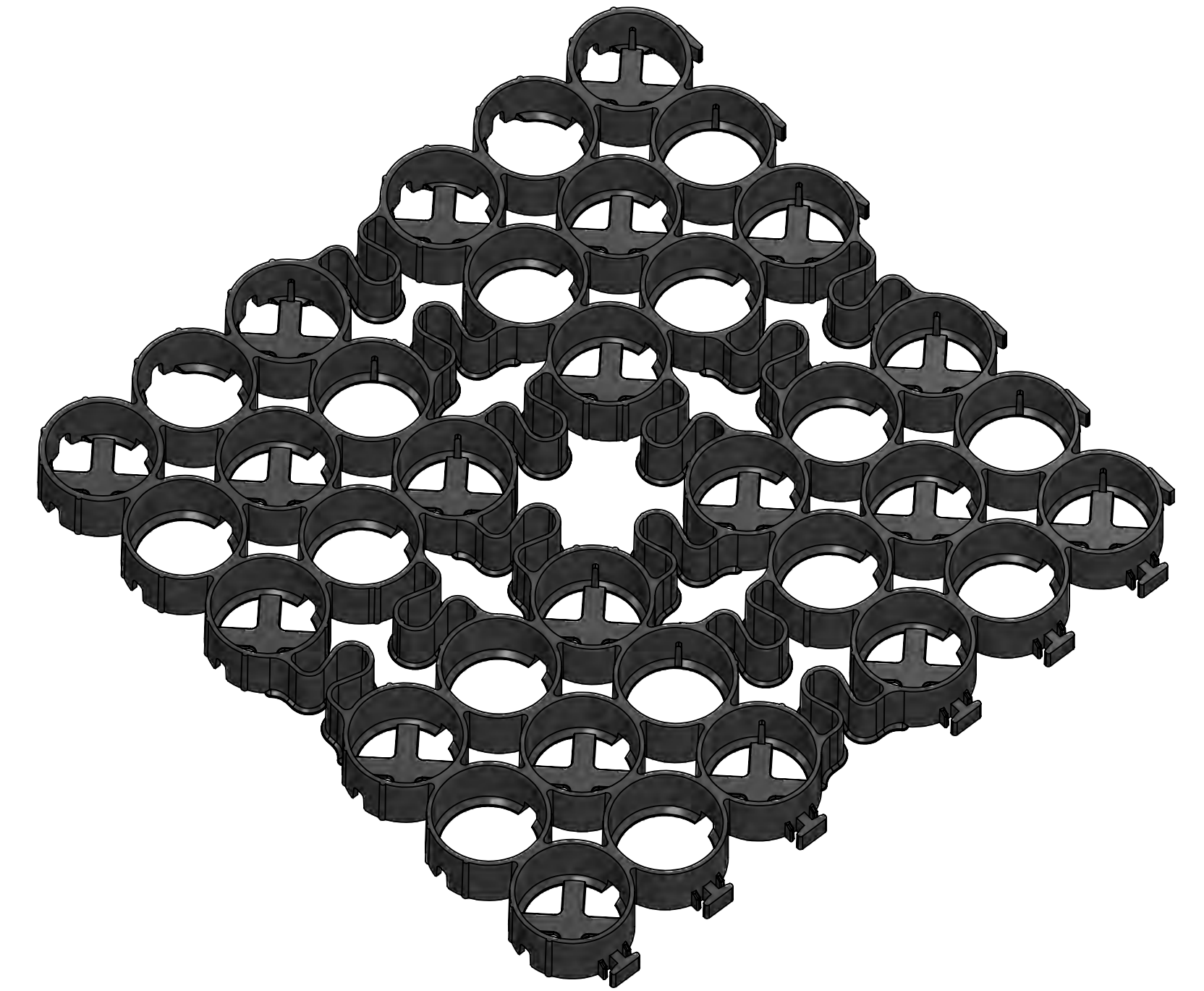
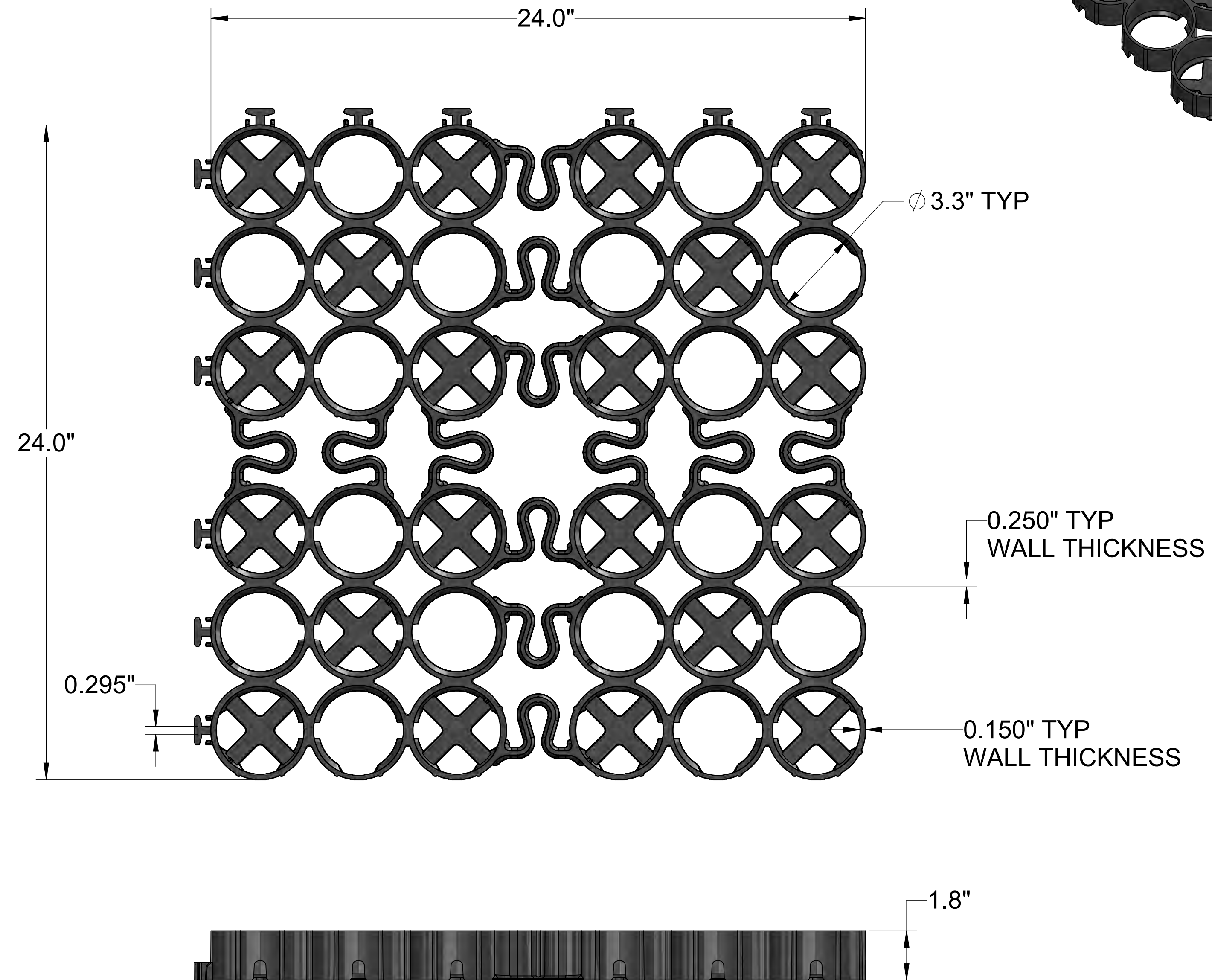
US PATENT NO. 8,734,049

**PROPRIETARY FEATURES:**

- 1) X-ANCHORS (NO STAKING NEEDED)
- 2) 3 POINT MALE/FEMALE LOCKING TABS
- 3) S-FLEX JOINTS ( BUILT IN EXPANSION JOINTS FOR SOIL MOVEMENT AND SEASONAL CHANGES)
- 4) HOOP STRENGTH DESIGN

**OTHER:**

- 1) 100 % POST-CONSUMER RECYCLED HDPE.
- 2) DELIVERED IN PREASSEMBLED 4' X 4' SHEETS THAT CAN BE RECONFIGURED, AS NEEDED.

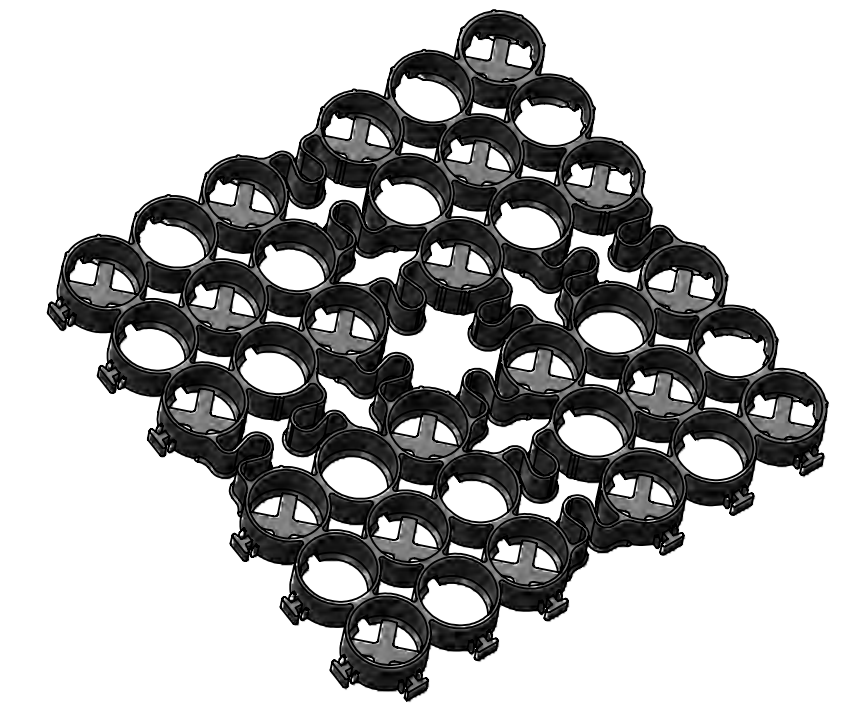


FOR PRICING OR ORDERING: CALL 1-855-355-GRID (4743). IN STOCK. FACTORY DIRECT.



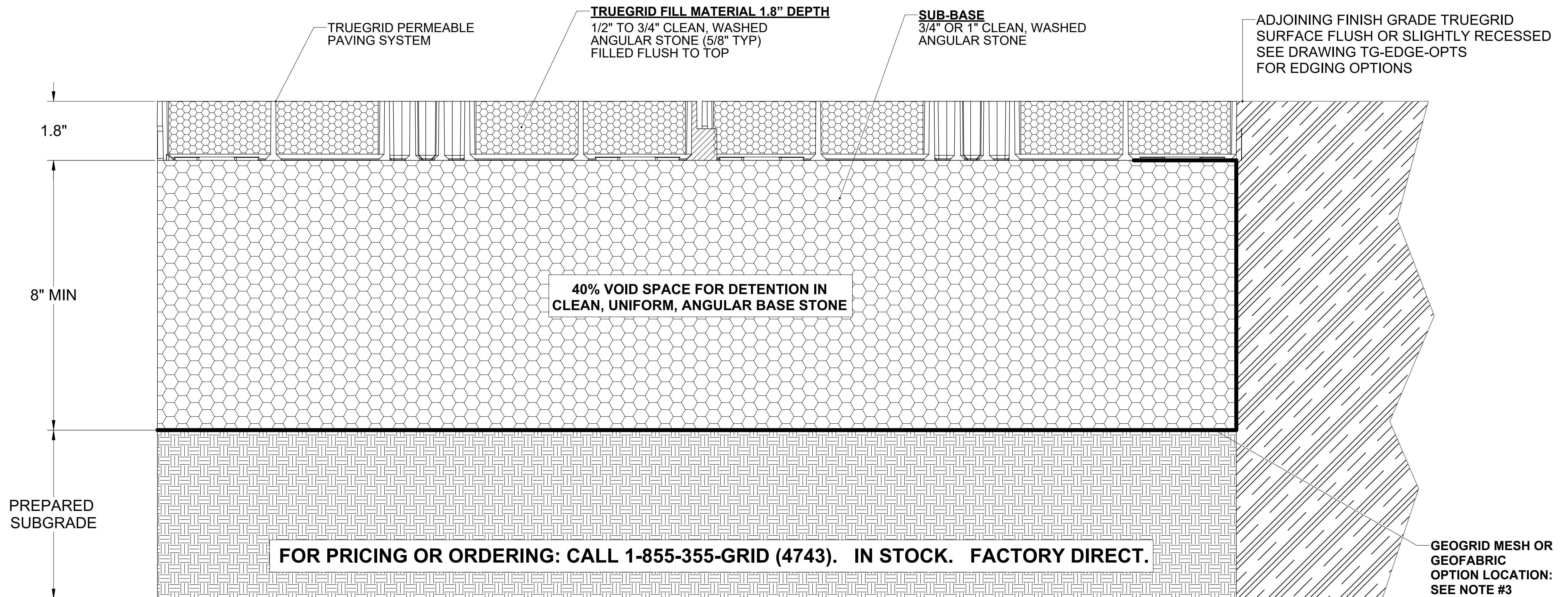
**NOTES:**

1. SUB-BASE DEPTH AND PREPARATION IS DEPENDENT ON SITE CONDITIONS PLUS LOADING REQUIREMENTS.
2. TRUEGRID PRO PLUS PRODUCTS ARE SUFFICIENTLY RATED FOR H-20 /HS-20 LOADING AND GREATER.
3. GEOGRID MESH OR GEOFABRIC MAY BE REQUIRED BETWEEN SUB-GRADE & SUB-BASE FOR CERTAIN SOILS AND SITE SPECIFIC REQUIREMENTS.
4. INCREASE SUB-BASE DEPTH FOR INCREASED STORM WATER DETENTION.
5. NO STAKING NECESSARY WITH TRUEGRID PRO PLUS WHEN SLOPE IS BELOW 20 DEGREES. ASSESS PROJECT, AS NEEDED.
6. TRUEGRID PRO PLUS IS ADA COMPLIANT WITH PROPER FILL MATERIAL.
7. FINAL ENGINEERED CROSS SECTION AGGREGATES AND DEPTH SHOULD ALLOW FOR EXPECTED INFILTRATION RATES, STORAGE CAPACITIES, OUTLET FLOW RATES, AND OTHER SITE SPECIFIC CONDITIONS AND LOAD REQUIREMENTS.
9. THIS CROSS SECTION IS FOR INFORMATION ONLY.



**TRUEGRID BLOCK REFERENCE VIEW**

PREASSEMBLED & DELIVERED IN 4' X 4' SHEET. RECONFIGURED AS NEEDED. NO EXTRA TOOLING OR ACCESSORIES REQUIRED



**FOR PRICING OR ORDERING: CALL 1-855-355-GRID (4743). IN STOCK. FACTORY DIRECT.**

**APPLICATION:**

**GRAVEL FILL HEAVY LOAD TRUEGRID PRO PLUS**

HEAVY LOAD PARKING LOT, FIRE LANES, EQUIPMENT YARD, SERVICE ROADS.

1-855-355-GRID (4743)

CLIENT / PROJECT



TRUEGRIDPAVER.com

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES  
 PROPRIETARY DESIGN RIGHTS NOTICE: THIS DESIGN WAS ORIGINATED BY AND IS THE EXCLUSIVE PROPERTY OF TRUEGRID. IT IS DISCLOSED IN CONFIDENCE WITH THE UNDERSTANDING THAT NO REPRODUCTION OR OTHER USE OF THE INFORMATION IS AUTHORIZED WITHOUT SPECIFIC AGREEMENT IN WRITING BY TRUEGRID.

DO NOT SCALE DRAWING

APPROVAL INFORMATION

DRAWN BY:	DATE:
J. Thethy	6/1/2015
CHECKED BY:	DATE:
J. Thethy	6/2/2015
APPROVED BY:	DATE:
C. White	6/2/2015
WEIGHT:	



TRUEGRID GRAVEL FILL INSTALLATION HEAVY LOAD

SIZE	D	DRAWING NUMBER:	TG-GRV-HL	REV	05
SCALE	1:1.5	SHEET	1 OF 1		

05	UPDATED FILL MATERIAL & SUBBASE NOTES	JT	JT	CW	9/4/2019
REV		DRAWN	CHECKED	APPROVED	DATE
	REVISION				

## TRUEGRID® PRO Plus Manufacturer's Product Specification Sheet

<b>Dimensions:</b>	24" x 24" x 1.8" (4 sq/ft)
<b>Pre-Assembled:</b>	16 sq/ft per layer (4' x 4' sheet) (4 grids per layer)
<b>Cell Width:</b>	3-3/16"
<b>Weight:</b>	5.22 lbs
<b>Permeability:</b>	100% w/clean, uniform stone
<b>Product Porosity:</b>	90% open
<b>Compressive strength:</b>	17,729 psi filled
<b>Material:</b>	Recycled High Density Polyethylene (100% post-consumer)
<b>Color:</b>	Black with UV Stabilizer
<b>Temperature Range:</b>	Dimensionally Stable for -58F to 194F
<b>Moisture Absorption:</b>	.01%
<b>Environmental Compatibility:</b>	Nontoxic, harmless to plants, animals, and microorganisms. Inert material, groundwater neutral
<b>Installation Speed:</b>	1000 sq/ft per man hour

### Other features of TRUEGRID

- Highly resistant to oils, gasoline, acids, salt, ammonia, and alcohol
- May be saw cut
- Patented design yields ultimate hoop strength
- Circular elements provide multi-directional crush and shear strength
- Flexible links allow expansion and contraction depending on environmental conditions
- Built in X-Anchors allows weight of filler to hold grid down without any extra staking
- Interlocking connectors

**Ground Preparation:** Depends upon site condition and local conditions.

**Suggested Sub-base:** 3/4" – 1" diameter clean/washed, angular gravel.  
Depth of this layer should be a minimum of 6" - 8". Deeper for heavier loads.  
For additional drainage, increase depth of sub-base.  
Class 2 road base (crushed concrete) is also a typical sub-base material.  
Gravel/sandy soil mix (60/40) is also common for grass fill applications.  
Level sub-base before laying TrueGrid.

**Installation:** Layout and snap together pre-assembled sheets. (4 pcs per layer = 16 sq/ft)  
If body weight does not level the grids, use plate vibrator or heavy cylinder to level.

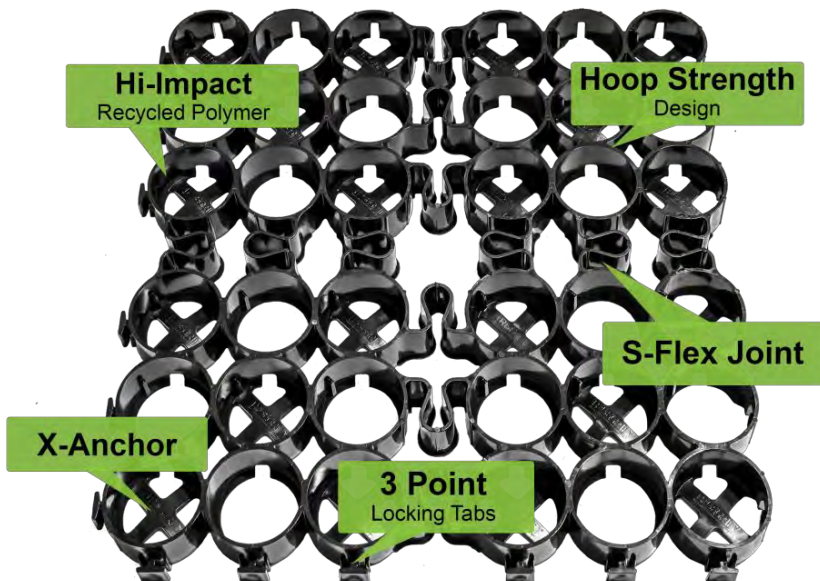
**Backfill:** Any angular or round medium may be used. Fill cells with filler of choice.  
5/8" or 3/4" diameter typical.

• TRUEGRID may be cut on site  
• Pre-cutting is not required

Angle grinder, circular saw, compass saw, or handsaw are all options for cutting TRUEGRID.

**Delivery:**

- **Pallet content:** 800 sq/ft = 50 layers per pallet = 200 pcs
- **Pallet dimensions:** 48" x 48" x 95"
- **Approximate pallet weight:** 1,050 lbs
- **Truckload:** 24 pallets or 19,200 sq/ft



For more info on TRUEGRID  
Please visit our website:

[www.truegridpaver.com](http://www.truegridpaver.com)

## The TRUEGRID® System and Storm Water Run-Off

### How does TRUEGRID help fight storm water run-off and other pollutants?

One of the many benefits of the TRUEGRID system is to reduce pollutants that are running off into rivers, lakes, bayous, and oceans. TRUEGRID's highly permeable surface and base aggregate temporarily detain storm water runoff before infiltrating into the subsoil or point out-flowing into city systems, drainage ditch, sheet flow, etc... TRUEGRID allows rainwater that would normally runoff into rivers and streams, to detain below the surface and receive water quality treatment by filtering through the base aggregate and filtering through soils below when conditions allow.

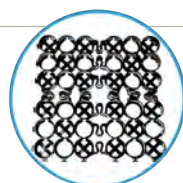
Hydrocarbons from cars, pet waste, nitrogen, and other pollutants are filtered and removed by bioremediation, before polluting the ground water. Asphalt, concrete or other impermeable surfaces would otherwise carry these pollutants direct from the surface to storm sewers, streams, and reservoirs.

TRUEGRID Permeable Pavers allows for filtered water seepage for point outflow release or groundwater recharge while preventing stream erosion problems. It captures the heavy metals that fall, preventing them from washing downstream and accumulating inadvertently in the environment. In the void spaces, naturally occurring micro-organisms digest car oils, leaving little but carbon dioxide and water.

### Structural BMP Expected Pollutant Removal Efficiency BMP (Best Management Practices)

Typical Pollutant Removal (percent)					
BMP Type	Suspended Solids	Nitrogen	Phosphorous	Pathogens	Metals
<b>TRUEGRID</b>	65 – 95	65-82	30 – 65	65 – 95	65 - 99
Dry Retention Basins	30 - 65	15 – 45	15 – 45	< 30	15 - 45
Retention Basins	50 – 80	30 - 65	30 - 65	< 30	50 – 80
Constructed Wetlands	50 – 80	< 30	15 - 45	< 30	50 – 80
Infiltration Basins	50 – 80	50 - 80	50 - 80	65-100	50 – 80
Infiltration Trenches / Dry Wells	50 – 80	50 - 80	15 - 45	65-100	50 – 80
Grassed Swales	30 – 65	15 – 45	15 – 45	< 30	15 – 45
Vegetated Filter Strips	50 – 80	50 – 80	50 – 80	< 30	30 – 65
Surface Sand Filters	50 - 80	< 30	50 – 80	< 30	50 – 80

Source: Adapted from US EPA. Note: TRUEGRID represents permeable paving in the chart above.



## TRUEGRID Performance in Snow

### Snow Melt

The large void space in the fill and base material helps speed up the melting time for snow/ice. Once the snow melts it will drain through the TRUEGRID which will also help eliminate the potential for black ice. There is no ponding or standing water in the TRUEGRID area to refreeze. In addition, TRUEGRID's stone base layer breaks any capillary connection to groundwater for additional protection against freezing.



Figure 1: Picture of parking lot 24 hours after 1" snowfall without plowing.

### Snow Plowing/Blowing

TRUEGRID systems can be successfully snow plowed with the blade raised 1/2"-1" above the grid. Any additional snow left behind will melt quickly due to the large void spaces as mentioned above. If a piece of TRUEGRID is damaged or snagged while plowing, the individual piece of grid can be replaced since the system is modular.



Figure 2: A TRUEGRID Surface immediately after plowing.



Figure 3: The same surface one hour after plowing.

### Snow Plow Equipment

There are multiple different options to ensure the blade of the snow plow stays above the grid. See figures below for common snow plow accessories.



Figure 4: Skid roller attachments.



Figure 5: Common plow blade skids.



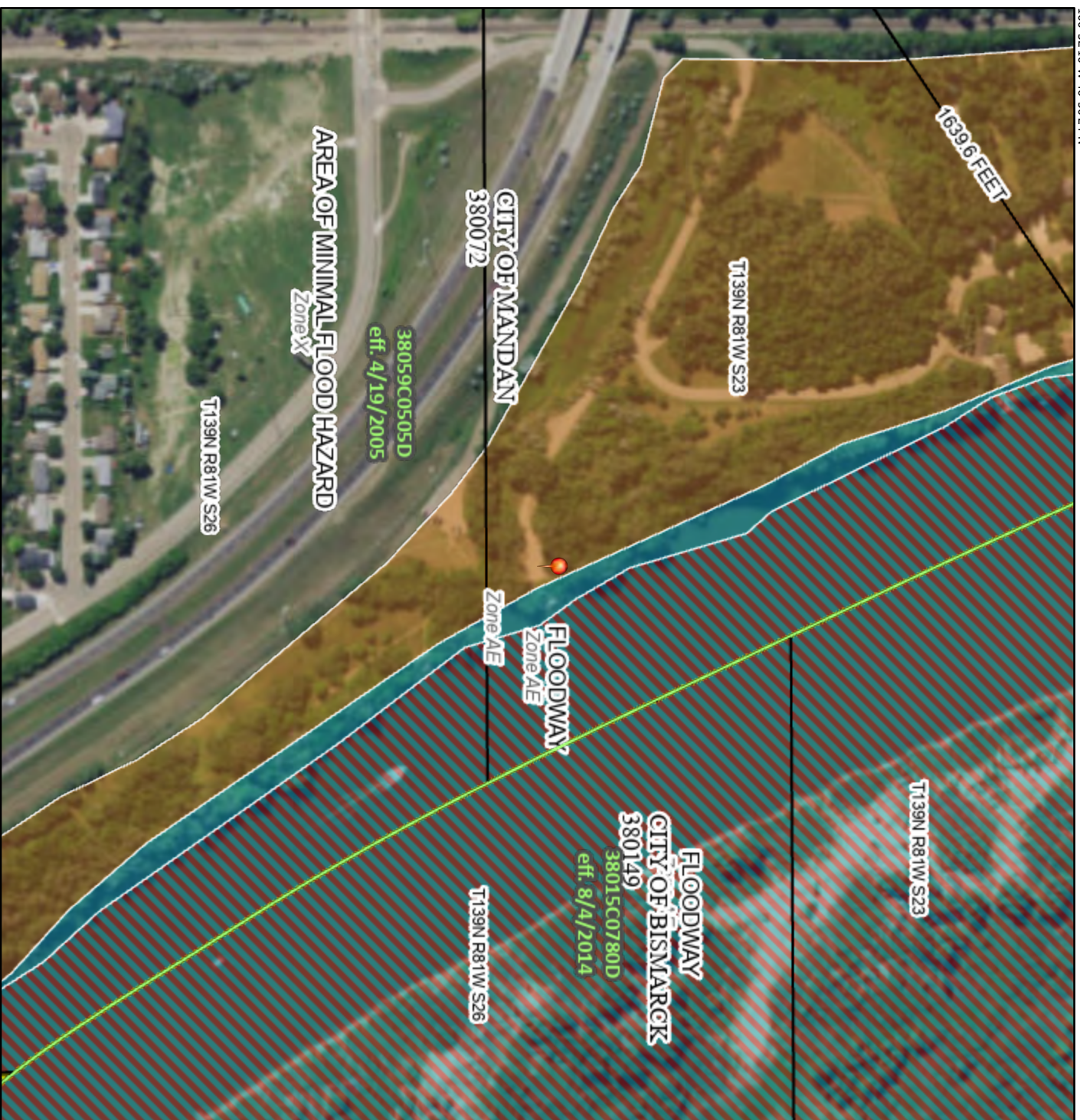
Figure 6: Sled-type skid attachments.

## Appendix E

# National Flood Hazard Layer FIRMette



100°52'10"W, 46°50'24"N



## Legend

SEE THIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

<b>SPECIAL FLOOD HAZARD AREAS</b>	<p>Without Base Flood Elevation (BFE) Zone A, V, A99 With BFE or Depth Zone AE, AO, AH, VE, AR Regulatory Floodway</p>
-----------------------------------	--

<b>OTHER AREAS OF FLOOD HAZARD</b>	<p>0.2% Annual Chance Flood Hazard, Areas of 1% annual chance Flood with average depth less than one foot or with drainage areas of less than one square mile Zone X</p> <p>Future Conditions 1% Annual Chance Flood Hazard Zone X</p> <p>Area with Reduced Flood Risk due to Levees. See Notes. Zone X</p> <p>Area with Flood Risk due to Levee Zone D</p>
------------------------------------	---

<b>OTHER AREAS</b>	<p>NO SCREEN Area of Minimal Flood Hazard Zone X</p> <p>Effective LOMRs</p> <p>Area of Undetermined Flood Hazard Zone D</p>
<b>GENERAL STRUCTURES</b>	<p>Channel, Culvert, or Storm Sewer</p> <p>Levee, Dike, or Floodwall</p>

<b>OTHER FEATURES</b>	<p>20.2 Cross Sections with 1% Annual Chance Water Surface Elevation</p> <p>17.5 Coastal Transect</p> <p>Base Flood Elevation Line (BFE)</p> <p>Limit of Study</p> <p>Jurisdiction Boundary</p> <p>Coastal Transect Baseline</p> <p>Profile Baseline</p> <p>Hydrographic Feature</p>
-----------------------	--

<b>MAP PANELS</b>	<p>Digital Data Available</p> <p>No Digital Data Available</p> <p>Unmapped</p>
-------------------	--

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **12/17/2022 at 11:07 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

0 250 500 1,000 1,500 2,000 Feet 1:6,000  
Basemap: USGS National Map: Orthoimagery. Data refreshed October, 2020