ALASKA CLEAN WATER ACTIONS:

Identification and Prioritization of Green Infrastructure Needs at Road Crossings of the Chena River and Tributaries

ACWA GRANT 23-08

Final Project Report

Concept Designs – Narrative and Drawings

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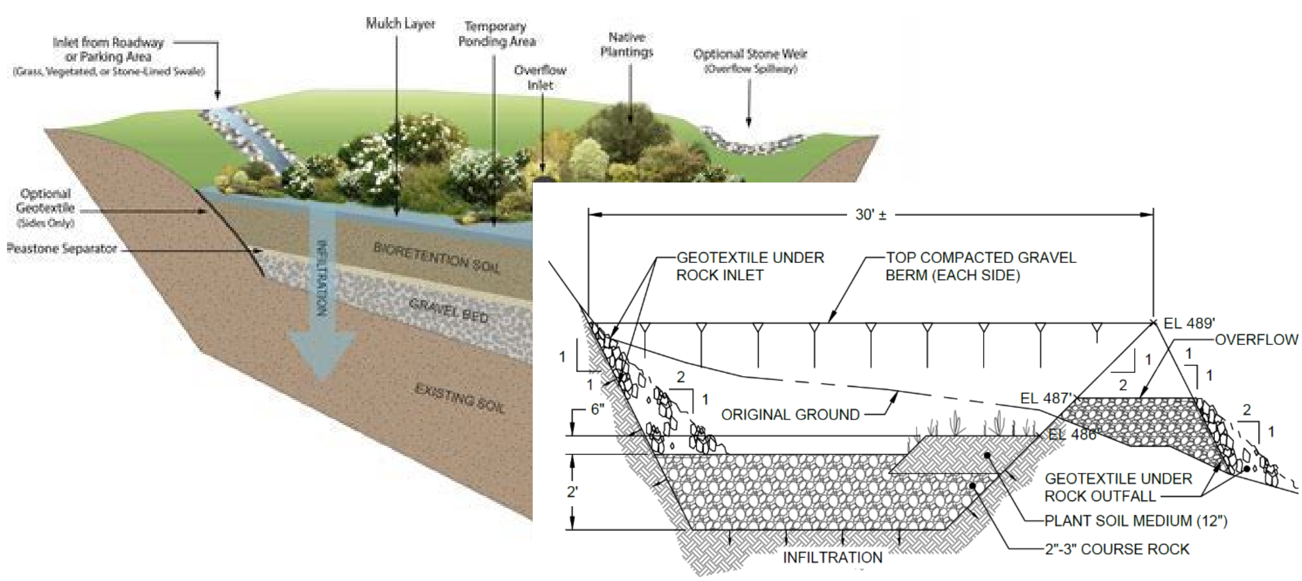


BIORETENTION / INFILTRATION BASIN TYPICAL SECTION

Preliminary Concept Design Narrative

TVWA reviewed numerous on-line sources to identify Green Infrastructure (GI) applications that potentially could be applied to culvert and bridge crossing sites evaluated in earlier phases of the project.

In this task we evaluated in practicability of application of various GI solutions and developed concept designs for the most practical solutions on four of the Top 10 sites identified in task 4a.

Culvert Crossing Pollutant Source:

When roadways cross waterways there is a concern for roadway pollutants entering the water. The potential impact increases the greater the expanse of pavement and the higher the traffic volume. High/steep slopes with limited vegetation or riprap only provides limited filtration before the polluted runoff enters into the water way. Being able to slow down or intercept and treat the runoff prior to it entering directly into the waterway is key.

GI Practices for Culvert Crossing Sites

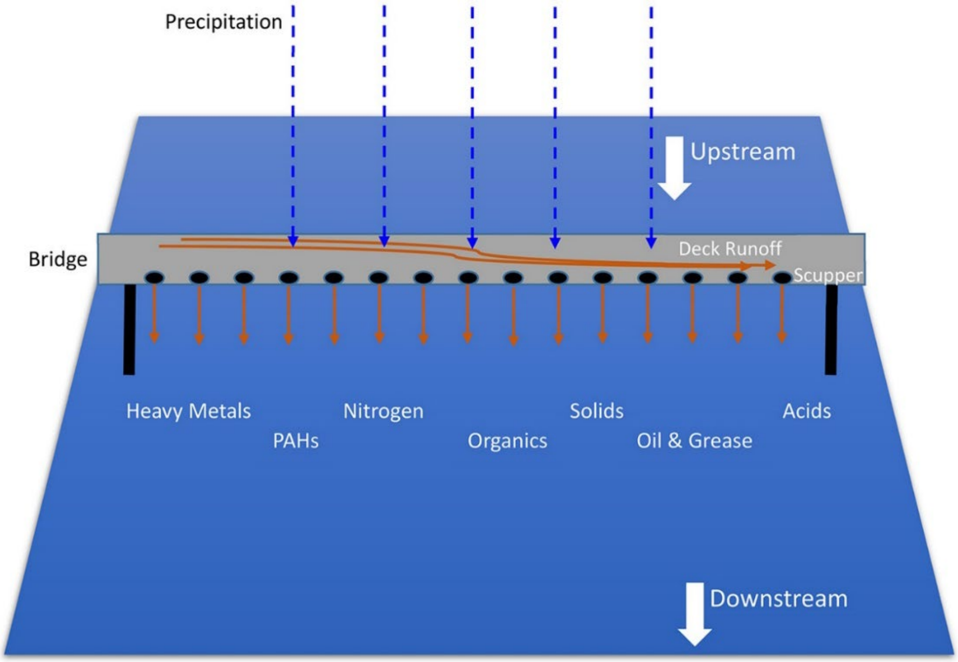
- Intercept roadway runoff (via guardrail batten board, curb etc) and convey to swales, retention basis, infiltration gallery etc.
- Replace traditional paved road shoulder with porous pavement.
- Flatten and increase infiltration and/or vegetation on the slopes where slopes are directly adjacent to the water body.
- Incorporate vegetated headwalls.
- Revetment of foot and ATV pathways that are contributing to water quality concerns.

The best solution likely would include a combination of the above practices. Design of a solution will be primarily dependent upon the topographic conditions surrounding the project area.

Bridge Deck Pollutant Sources:

The concern with bridge desks, especially with scuppers that drain directly to a waterway is illustrated in the graphic below and is well documented in a paper titled “Water quality impacts of bridge stormwater runoff from scupper drains on receiving waters: A review”, published by Science of The Total Environment Volume 726, 15 July 2020. [1]

[1] https://www.sciencedirect.com/science/article/abs/pii/S0048969720315813



Above: Polluted water drains directly into receiving waterbody

GI Applications for Bridges include solutions that intercept or direct pollutant loadings away from bridge decks by diverting runoff waters to land for treatment.[2] The design needs to assess blocking scuppers or installing a scupper collection system (see below) to then convey the runoff to the abutments for treatment. Practical land treatment options for collected runoff include retention basins, swales, infiltration gallery.

The examples below show piping systems to convey water to treatment at the abutments.

[2] https://www3.epa.gov/npdes/pubs/ch4-7b.htm#:~:text=Direct%20pollutant%20loadings%20away%20from%20bridge%20decks%20by,a%20stable%20storm%20drainage%2C%20wetland%2C%20or%20detention%20pond.

Design Narrative

Of the Top 10 Sites identified in the study (4 bridge and 6 culvert crossings) the following were selected for development of concept designs.

- Culvert Crossing: Chena Ridge Road & Cripple Creek Channel (Site 65)
- Culvert Crossing: Hurst Rd & Chena Slough (Site 33)
- Culvert Crossing: Dawson Rd & Chena Slough (Site 26)
- Bridge: Steese Hwy& Chena River (Site 59)

We applied our knowledge of Alaska conditions to aid in selection of GI applications for concept design. Generally, we considered maintenance, practicably of retrofitting existing facilities, potential construction costs and issues as well as partnering opportunities and environmental permitting.

A preliminary topographic survey (GPS) was conducted to help assure that the concepts could be applied to the existing terrain and roadway facilities. *A big shout out goes to Craig Ranson, Surveyor at RESPEC, Inc, a local Engineering and Land Development Consulting firm. Craig volunteered his time and company equipment to complete the survey work.*

Dawson Road and Chena Slough Site 26

Install diversion berm that slopes so that runoff is diverted away from open water. The concept is to provide a longer flow path for the runoff to slow the water to allow sedimentation and infiltration.

The concept was developed as a potential test project that a group of volunteer labors could complete the installation. Fiber rolls that are often considered temporary measures were used for ease of acquisition and installation on the sloped ground behind guardrail. Use of fiber rolls were selected for this concept design versus construction of a gravel/rock berm that would require skilled operator of a backhoe and temporary removal of the guardrail, making it more costly and a “real” construction project.

Fiber rolls have been observed to hold together for long periods 5+ years in Alaskan conditions on slopes where there is no traffic. This time period will allow sediment to build up, creating a soil berm. Observations should be planned once the project is constructed to monitor the function.

Anticipated Final Design Coordination and/or Permit Requirements:

This design does not require work within the water, nor does it appear that wetlands would be involved as such no environmental permits are anticipated.

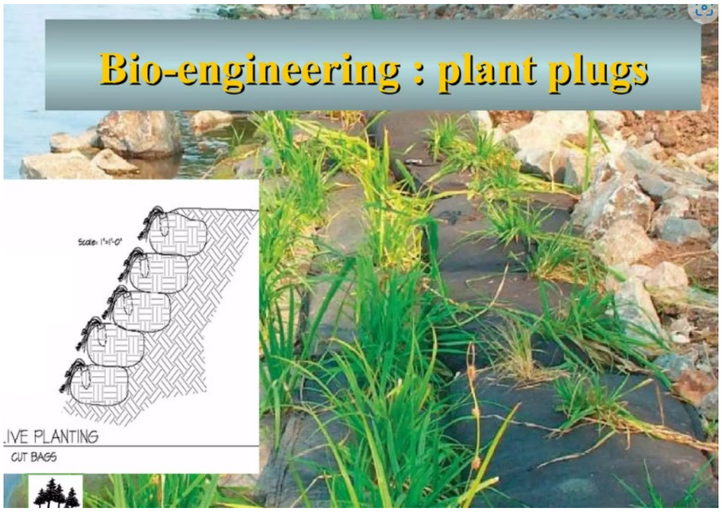
Materials and volunteers will be along the shoulders of the roadway. It is likely that the ADOT&PF will require submittal of a written workplan including traffic control plan for approval.

Hurst Road and Chena Slough Site 33

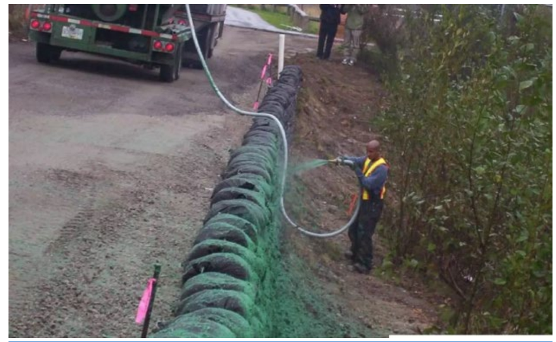
The Green Infrastructure concept for Hurst Road/Chena Slough crossing involves raising and regrading the roadway section 120' each side of culvert crossing. This will redirect runoff from the road to towards constructed pervious swale along the shoulders (Porous Pavement). The swales will be sloped to outfall into bioretention/infiltration basins on the north side and to existing vegetated ditches on the south side of Hurst Road.

To accommodate raising the grade of the road without causing shoulder slopes to extent into the stream, the concept design envisions constructing a Geosynthetic Wrap Face Vegetated (GWFV) reinforced soil wall or Cement/Sand bad headwall, (see photos).

https://geosyntheticsmagazine.com/2017/10/01/gwfv-walls-and-slopes/



https://www.slideshare.net/slideshow/green-solutions-for-culvert-headwalls-v14/41424341



Anticipated Final Design Coordination and/or Permit Requirements:

This design does not require extension or modification of the existing culvert but does require some work at or just below the Ordinary High Water (OHW) line, thus requiring a Fish Habitat permit from the Alaska Fish and Game. Further a Section 10/404 permit from the US Corps of Engineers for the construction of the infiltration basins and headwalls. Section 404 if for fill within wetlands and Section 10 is for the portion that would be placed within navigable waters. The footprint and volume of material is anticipated to be fairly small and may fit under a Nationwide permit. Nationwide Permit 43, Stormwater Management Facilities, would probably be appropriate. Depending upon the final design details and construction methods it is also possible a Department of Natural Resources Dewatering permit maybe required.

Permit summary:

- AF&G Fish Habitat
- USCOE Section 10/404, may fall under NWP 43
- ADNR Dewatering

Chena Ridge Road & Cripple Creek Channel (Site 65)

At this culvert crossing location the roadway is on a downhill slope and on a curve with a superelevation. This roadway configuration directs the runoff from the full pavement width to the south side. This GI design employs an Interceptor French Drain concept; the runoff enters a swale constructed of porous rock (2.5 feet deep) with a drainpipe in the bottom. On the southside of the swale is a diversion berm to help keep the water from overtopping the shallow swale. The swale & berm combined with the downhill grade of the road will direct the runoff to the downgrade side where it will outfall into an area that is heavily vegetated, area nearly 100' from the Cripple Creek channel.

The construction concept is relatively simply. However, because of the narrow (5-6' wide) shoulder behind the guardrail and the existing steep fore slope, construction will need to be done with small equipment (such as a mini excavator and hand compactors. Removal and reinstallation of the existing guardrail will likely be necessary.

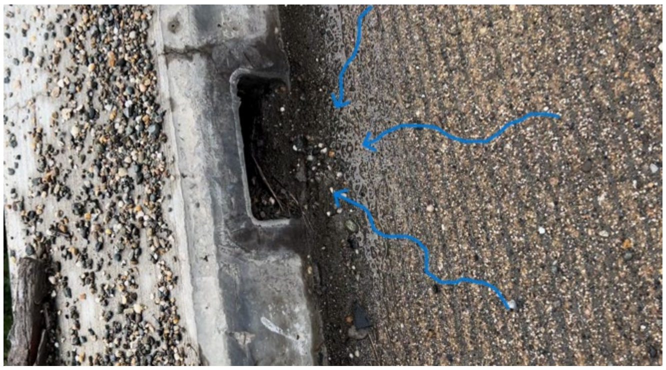
Anticipated Final Design Coordination and/or Permit Requirements:

This design does not require work within the water, nor does it appear that wetlands would be involved as such no environmental permits are anticipated. The ADOT&PF will require submittal of a written workplan including traffic control plan for approval.

This project may be able to be accomplished as a partner project with DOT maintenance (equipment and operators) and TVWA/Fish & Game grant funding for detailed design and construction material costs.

Steese Hwy and Chena River Bridge, Site 59.

The Steese Bridge is on a curve, with the roadway rising up over the river. The road lanes slope to the east and runoff generally drains to the curb on the east side. There is a penetration in the curb (open scupper), see photo below.



OPEN SCUPPER (ON BRIDGE DECK)

On the riverside of the curb is a channel pipe that allows the runoff to drain directly to the river.

Scupper outfall on Riverside

Enlargement of Scupper outfall

This concept design involves intercepting the runoff from the bridge deck via a downspout adapter attached to a downspout pipe that connects to an 8” carrying pipe that is attached to the bridge girder. The carrying pipe will slope to drain to the northeast abutment at which point it will run down the slope and enter a trench drain under an existing bicycle path and outfall into a bioretention basin.

TRENCH DRAIN FOR UNDER BICYCLE PATH

It should be noted that there are also additional drop drains in the bridge deck that appear to be primarily for overflow is the curb scupper drains become blocked/iced up. During final design intercepting these drains could be considered.

Anticipated Final Design Coordination and/or Permit Requirements:

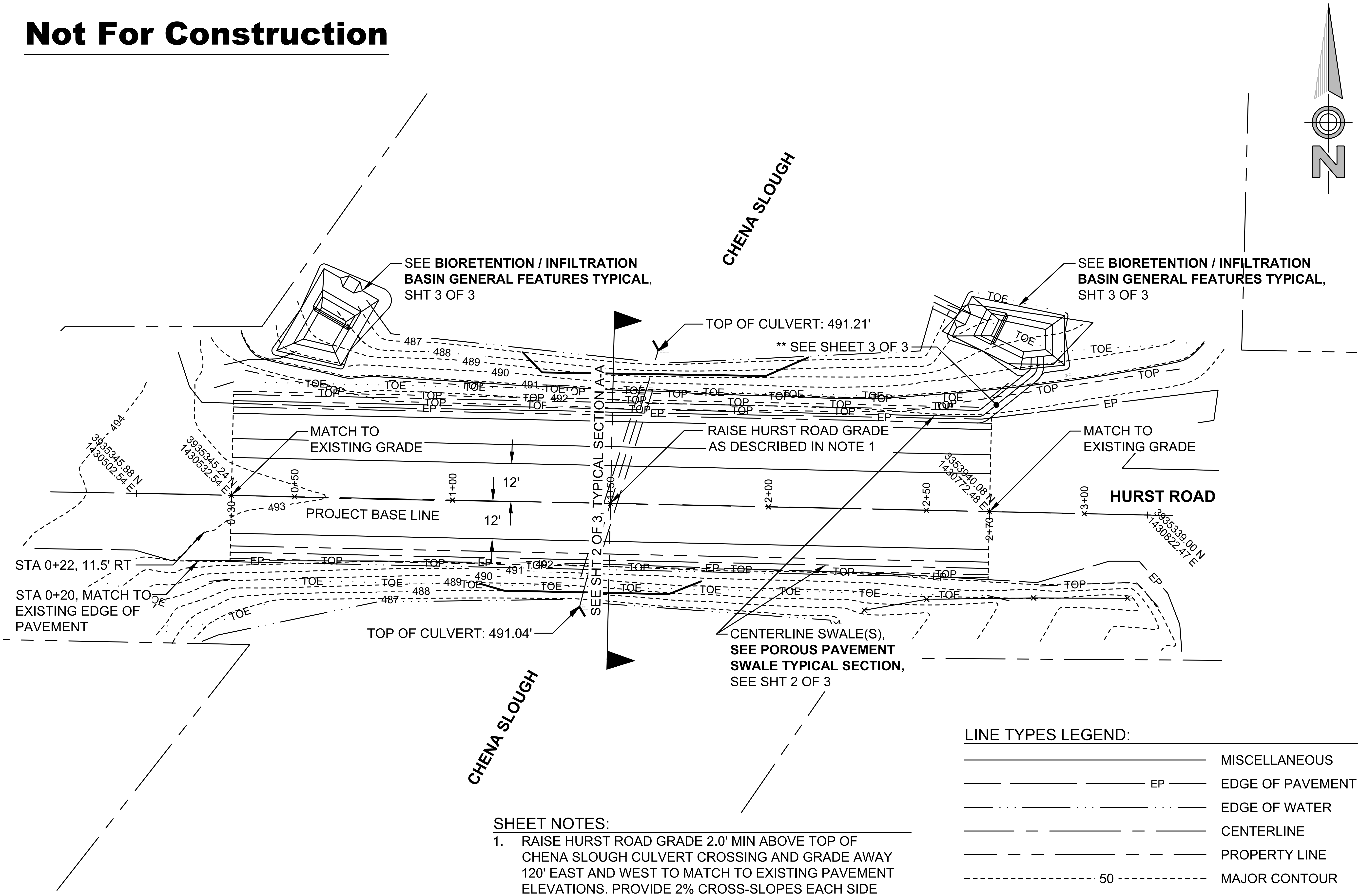
This concept design will need coordination with the DOT Bridge section as no analysis was done relative to the capacity of the bridge structure. This project is most expensive of the four concepts, but also has the greatest potential to improve water quality.

DOT would be the best sponsor for this project. No environmental permits should be required as long as there is care taken during construction to assure no debris is dropped into the river.

CONCEPT DESIGN DRAWINGS

Hurst Road and Chena Slough Site 33

Not For Construction



LINE TYPES LEGEND:

————————	MISCELLANEOUS
—— —— —— EP ——	EDGE OF PAVEMENT
—— · · · —— · · · ——	EDGE OF WATER
—— — —— — ——	CENTERLINE
—— — — —— — — ——	PROPERTY LINE
- - - - 50 - - - -	MAJOR CONTOUR
- - - - 49 - - - -	MINOR CONTOUR
· · · TOE · · · TOE · · · TOE	TOE OF BANK
— — — TOP — — — TOP —	TOP OF BANK

SHEET NOTES:

1. RAISE HURST ROAD GRADE 2.0' MIN ABOVE TOP OF CHENA SLOUGH CULVERT CROSSING AND GRADE AWAY 120' EAST AND WEST TO MATCH TO EXISTING PAVEMENT ELEVATIONS. PROVIDE 2% CROSS-SLOPES EACH SIDE OF BASELINE TO DIRECT RUNOFF DRAINAGE TOWARD THE LOCATION OF THE BIO-RETENTION BASINS AND VEGETATIVE SWALES AT THE SIDES OF THE SLOUGH SHOWN THIS SHEET.

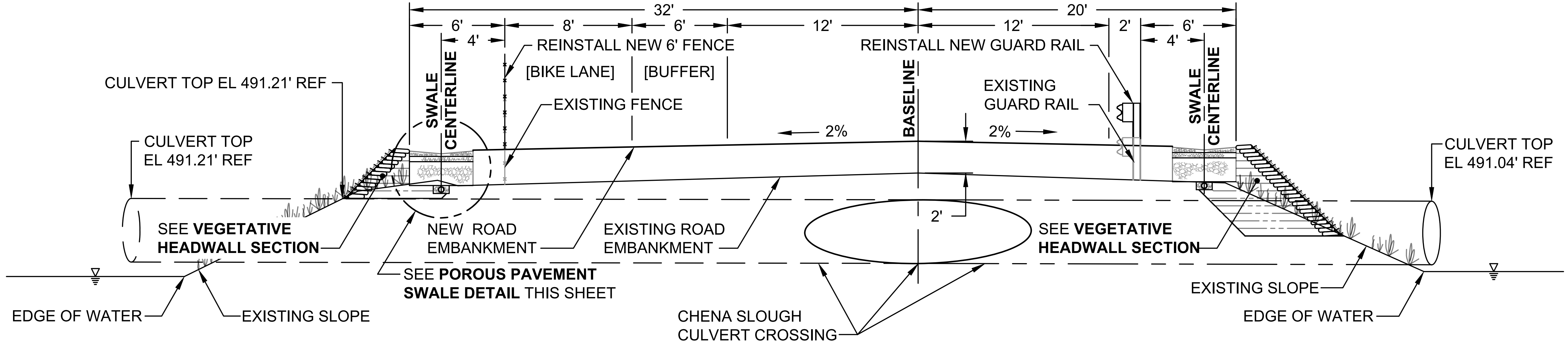
HURST ROAD PROJECT SITE PLAN

[NOT TO SCALE]

Tanana Valley Watershed Assoc (TVWA)

IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

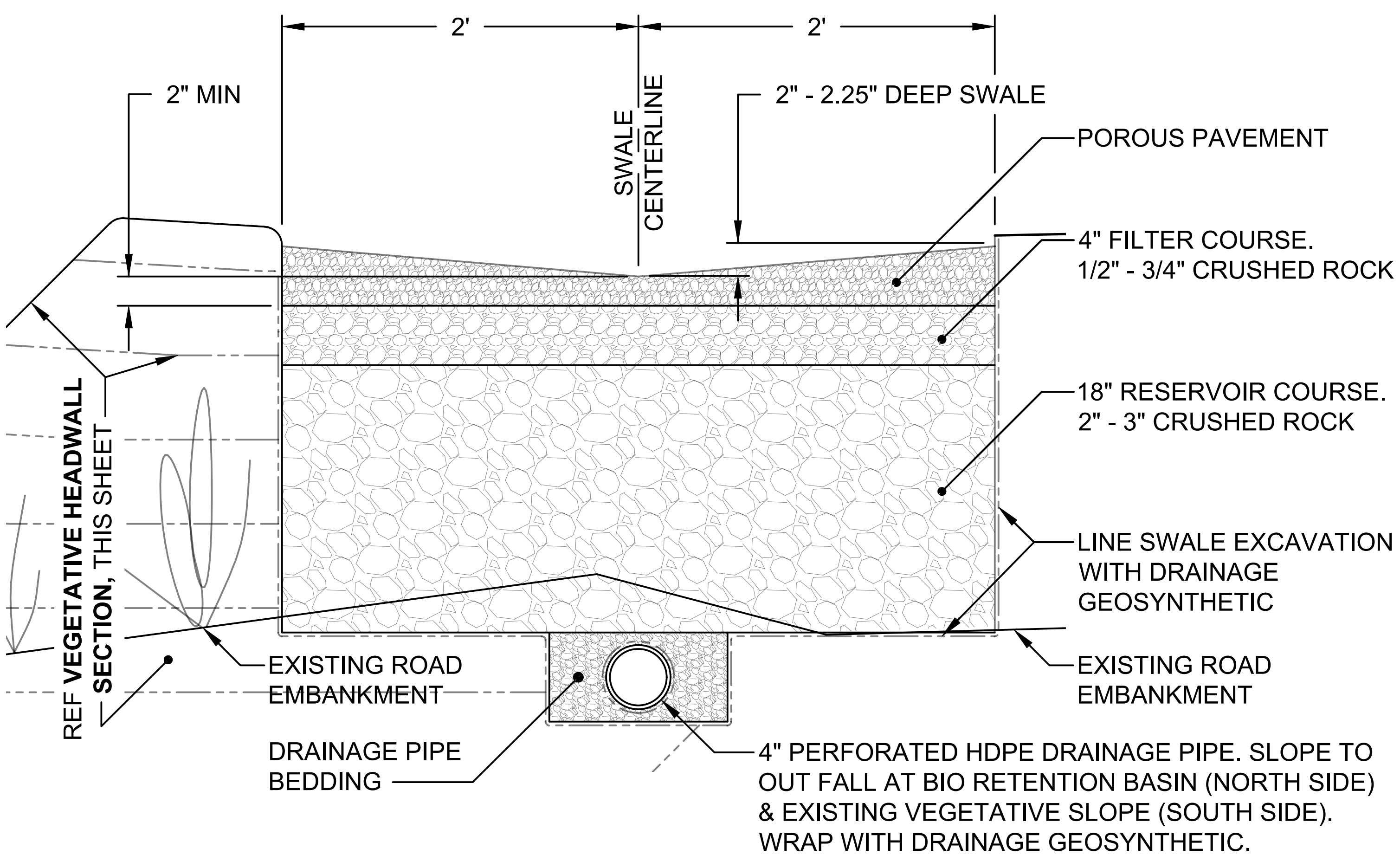
- SITE PLAN -
HURST ROAD
NORTH POLE, ALASKA



HURST ROAD
TYPICAL SECTION A-A

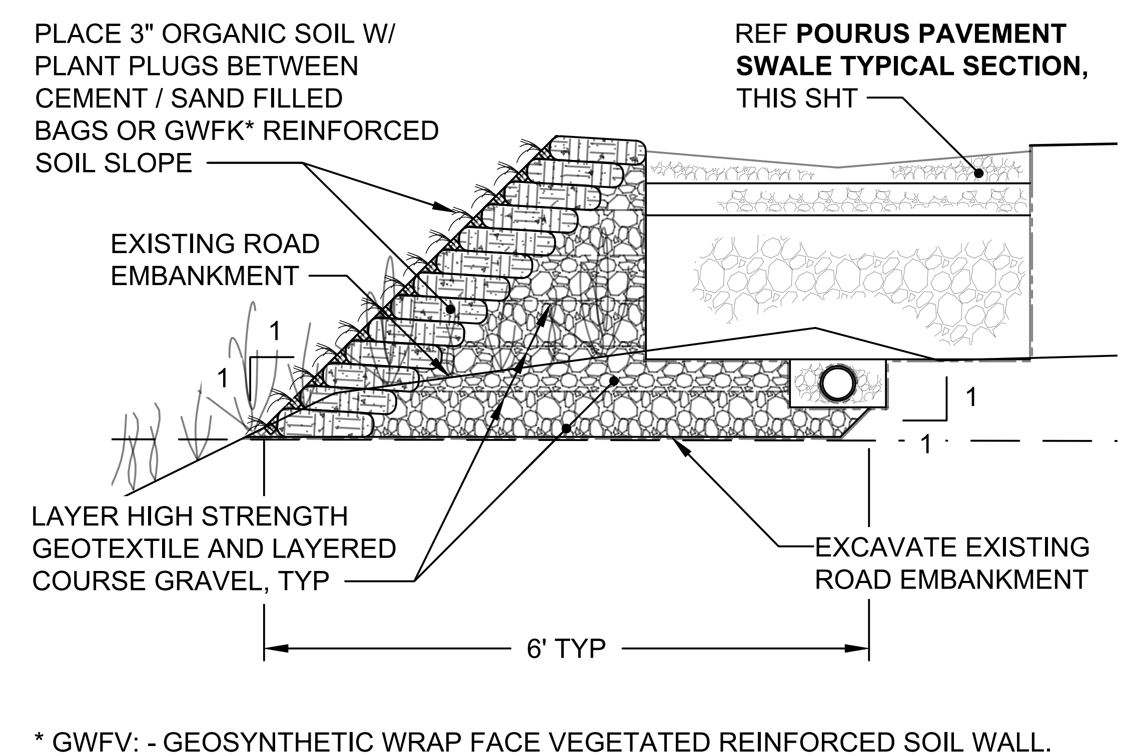
[NOT TO SCALE]

Not For Construction



POROUS PAVEMENT SWALE
TYPICAL SECTION

[NOT TO SCALE]



* GWFV: - GEOSYNTHETIC WRAP FACE VEGETATED REINFORCED SOIL WALL.

VEGETATIVE
HEADWALL SECTION

NORTH AND SOUTH EMBANKMENT SLOPES SIMILAR [NOT TO SCALE]

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IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

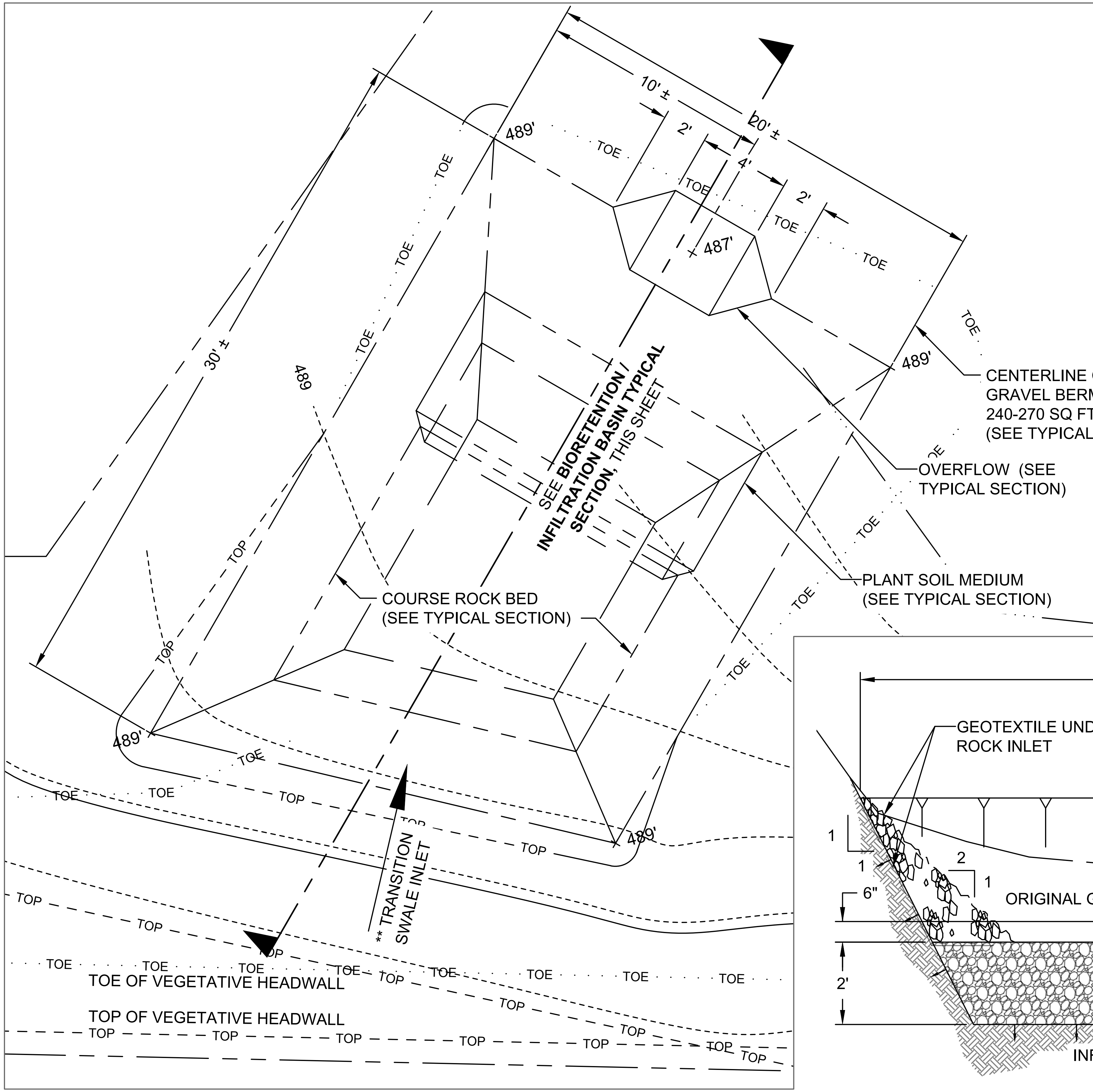
- TYPICAL SECTIONS -
HURST ROAD
NORTH POLE, ALASKA

2
OF 3 **SHEETS**

LINE TYPES LEGEND:

- MISCELLANEOUS
- EP — EDGE OF PAVEMENT
- EDGE OF WATER
- CENTERLINE
- PROPERTY LINE
- 50 — MAJOR CONTOUR
- 49 — MINOR CONTOUR
- TOE TOE TOE — TOE OF BANK
- TOP TOP — TOP OF BANK

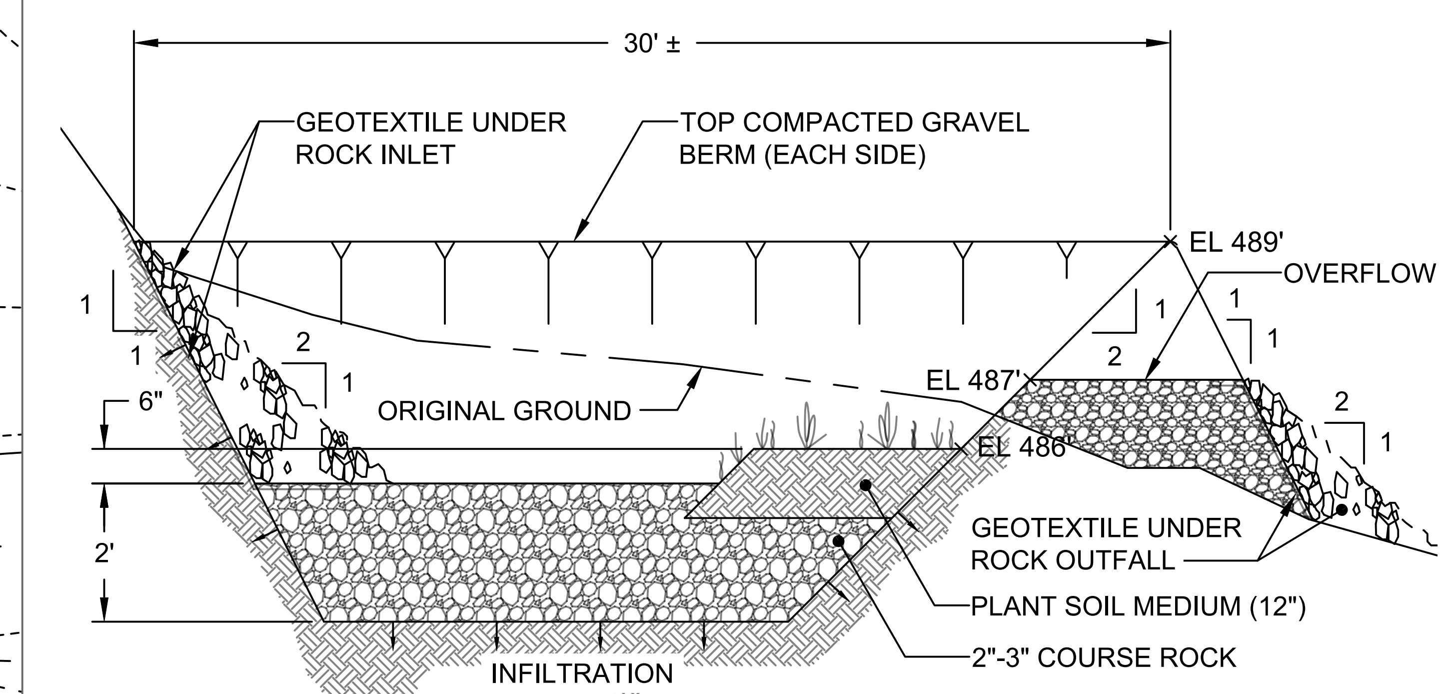
Not For Construction



BIORETENTION / INFILTRATION BASIN GENERAL FEATURES TYPICAL

[NOT TO SCALE]

** REFERENCES TO TRANSITION SWALES ARE TYPICALLY TO BE COURSE ROCK OUTFALL CHANNELS TO CARRY ROADWAY SWALE RUNOFF FROM NEW ROADWAY GRADE TO BIORETENTION / INFILTRATION BASINS. SEE EXAMPLE LAYOUT ON HURST ROAD PROJECT SITE PLAN, SHEET 1 OF 3.



BIORETENTION / INFILTRATION BASIN TYPICAL SECTION

[NOT TO SCALE]

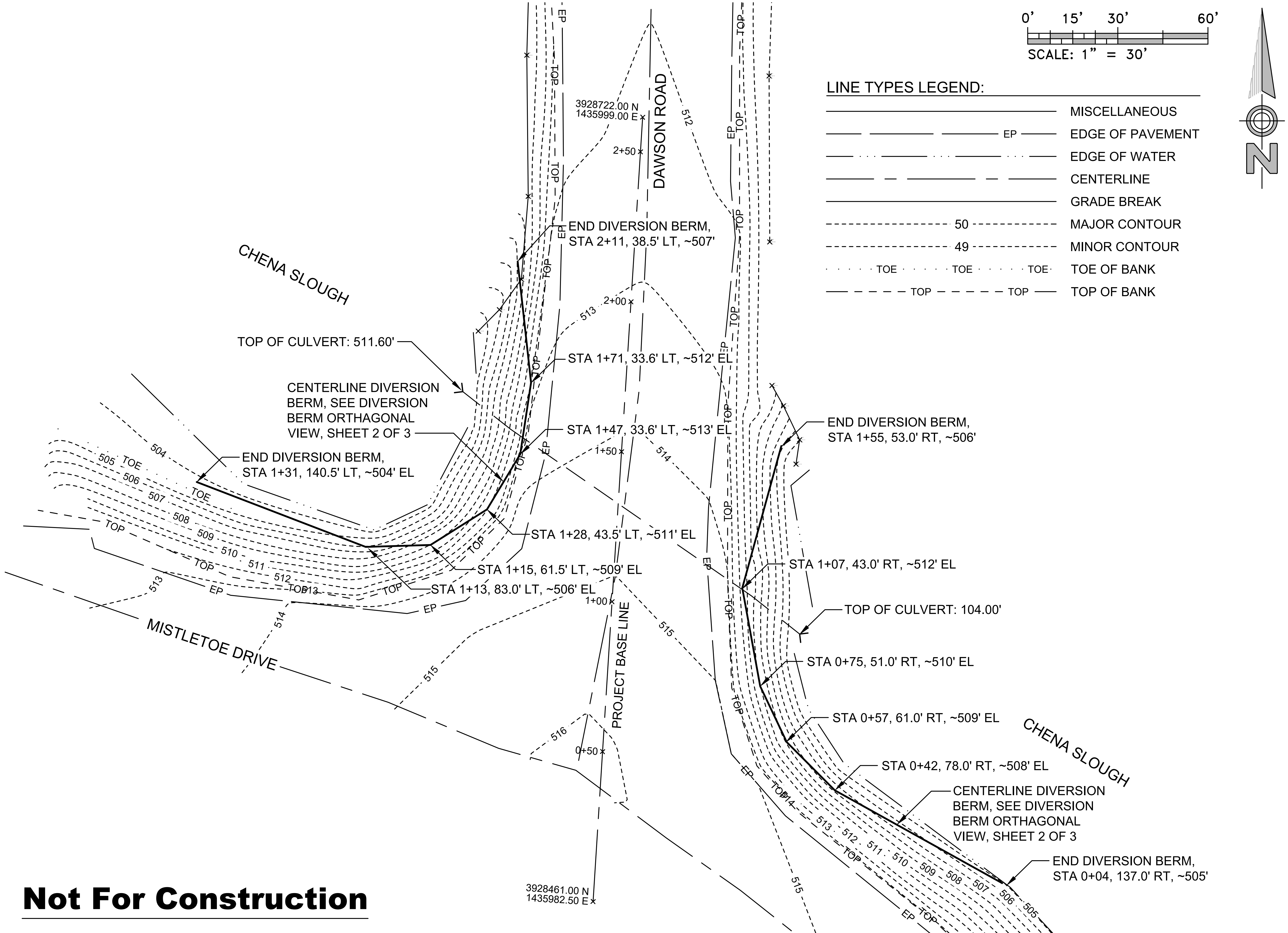
Tanana Valley Watershed Assoc (TVWA)

IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

- BIORETENTION/INFILTRATION BASINS TYP PLAN & SECTION -
HURST ROAD
NORTH POLE, ALASKA

CONCEPT DESIGN DRAWINGS

Dawson Road and Chena Slough Site 26



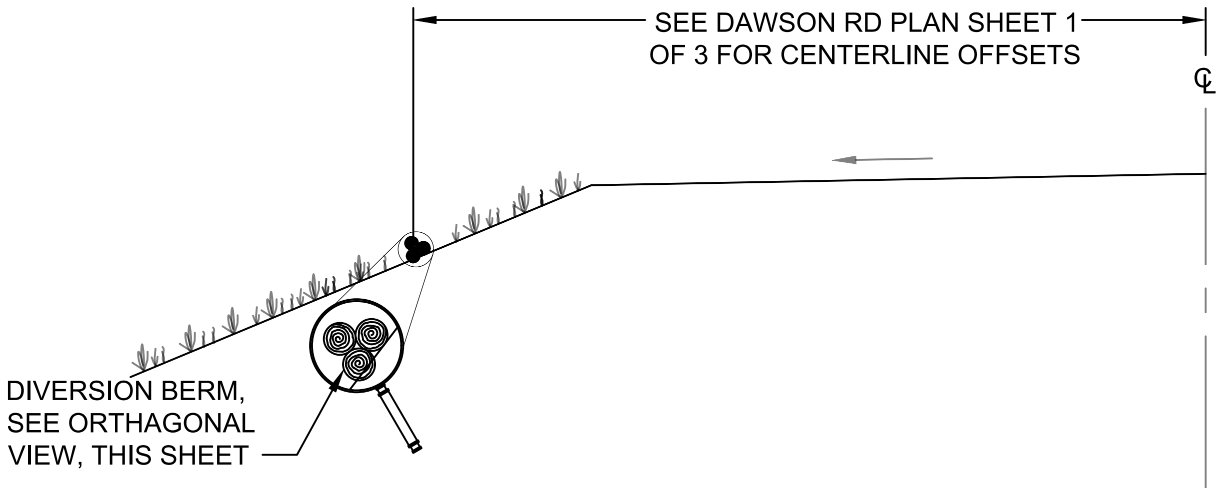
Not For Construction

Tanana Valley Watershed Assoc (TVWA)

IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

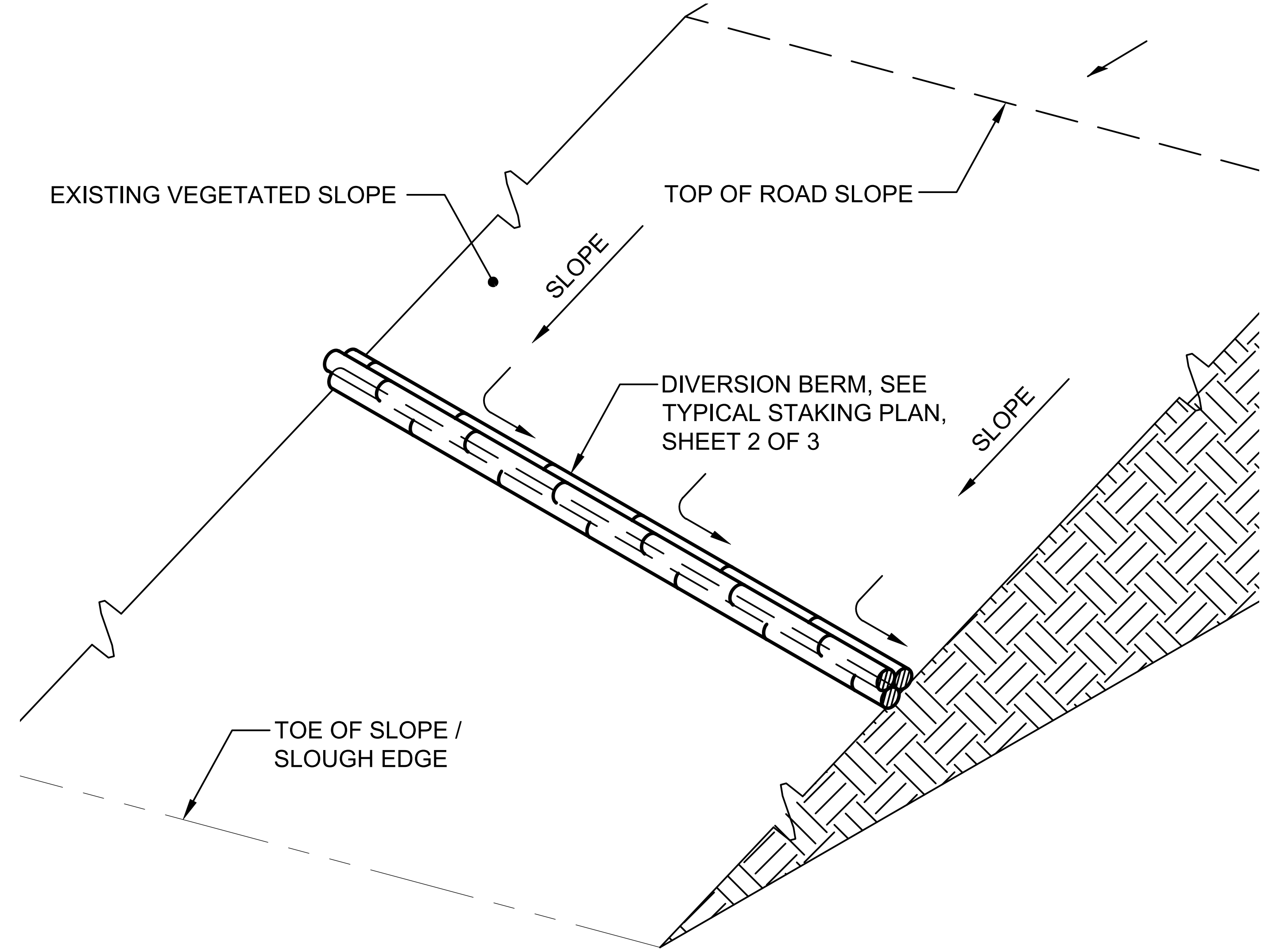
- SITE PLAN -
DAWSON ROAD & MISTLETOE
NORTH POLE, ALASKA

1
OF 3 SHEETS



DIVERSION BERM:
TYPICAL SECTION

TYPICAL SECTION [NOT TO SCALE]



DIVERSION BERM:
ORTHAGONAL VIEW

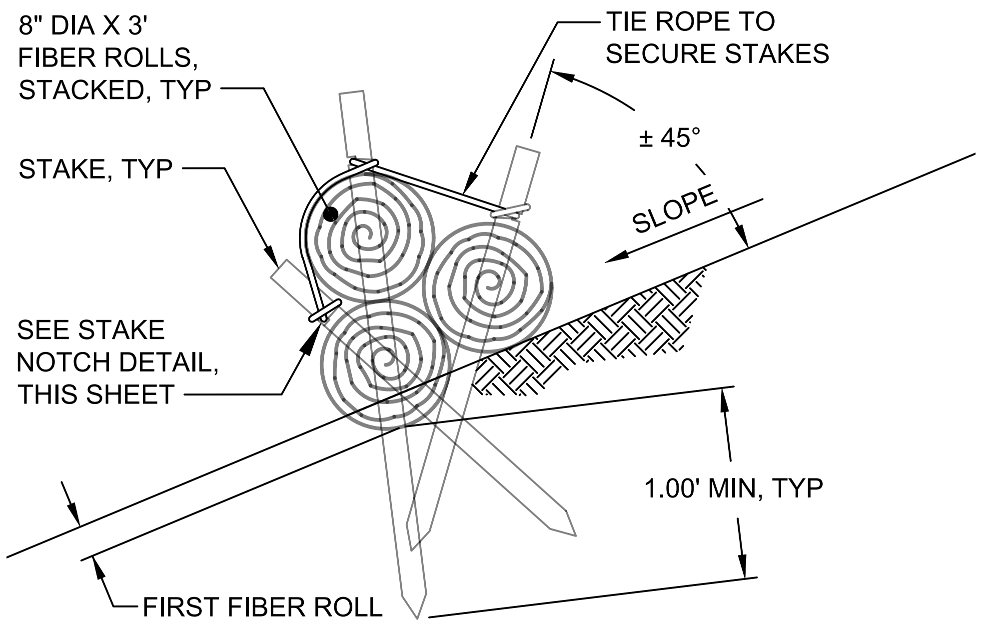
[NOT TO SCALE]

Not For Construction

Tanana Valley Watershed Assoc (TVWA)

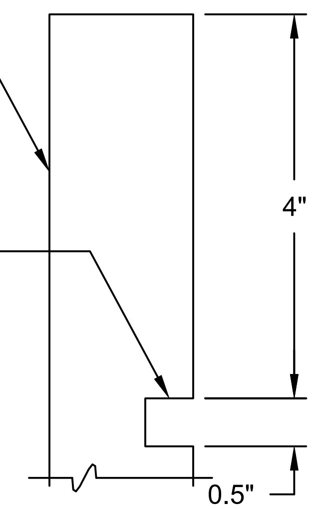
IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

- DETAILS -
DAWSON ROAD & MISTLETOE DRIVE
NORTH POLE, ALASKA



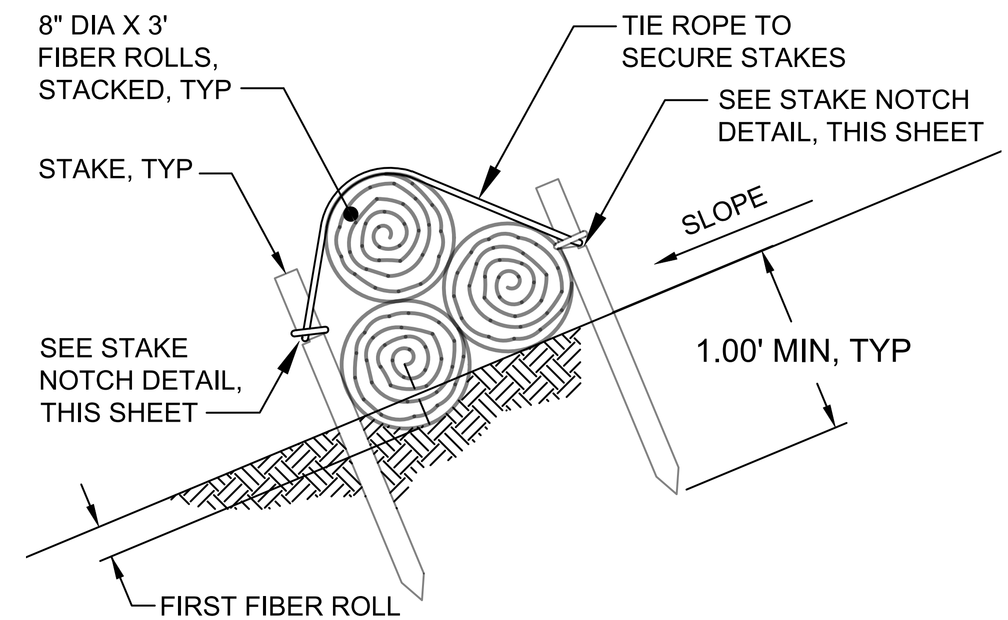
DIVERSION BERM: STAKING DETAIL 1

EVERY 10' STAGGERED W/ STAKING DETAIL 2
[NOT TO SCALE]



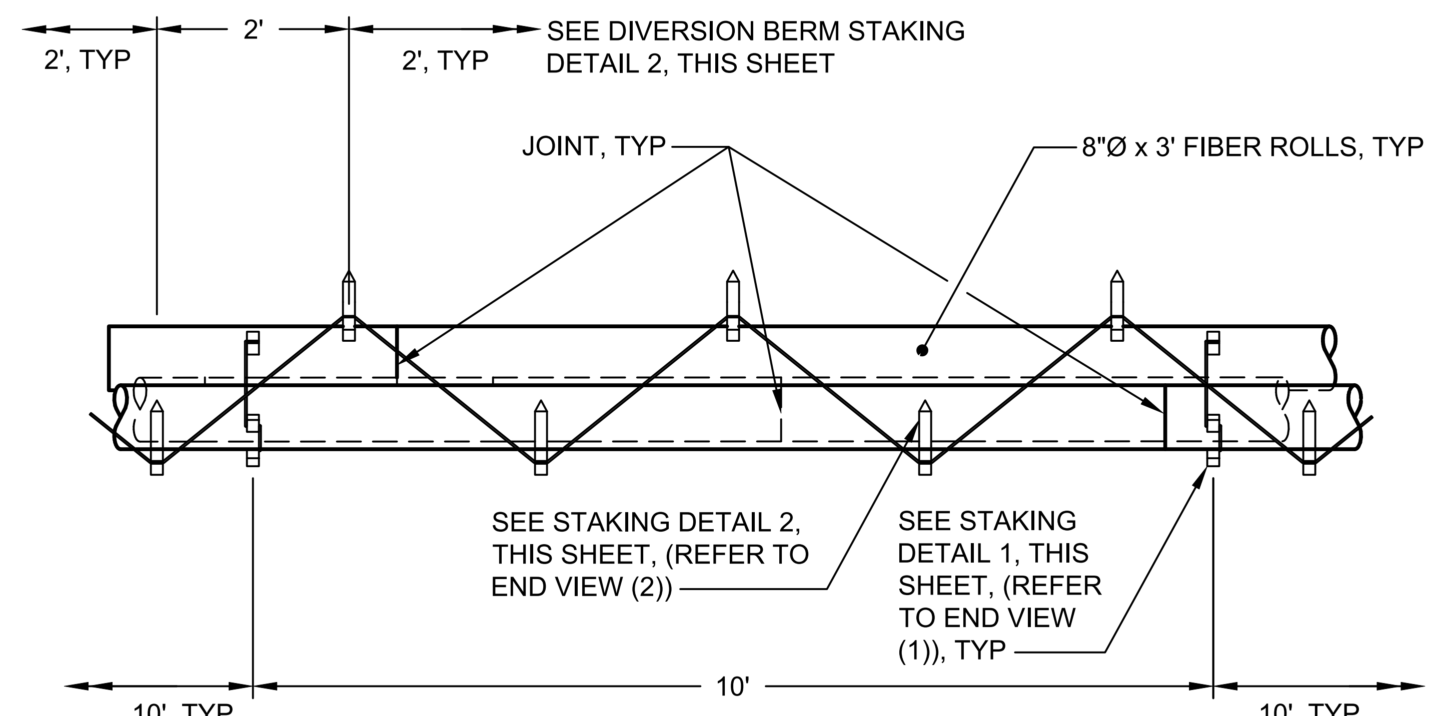
STAKE NOTCH DETAIL

ELEVATION [1/2" = 1"]



DIVERSION BERM: STAKING DETAIL 2

STAGGERED 2' AND ROPE TOGETHER
[NOT TO SCALE]



PLAN VIEW

Not For Construction

DIVERSION BERM: TYPICAL STAKING PLAN

[NOT TO SCALE]

Tanana Valley Watershed Assoc (TVWA)

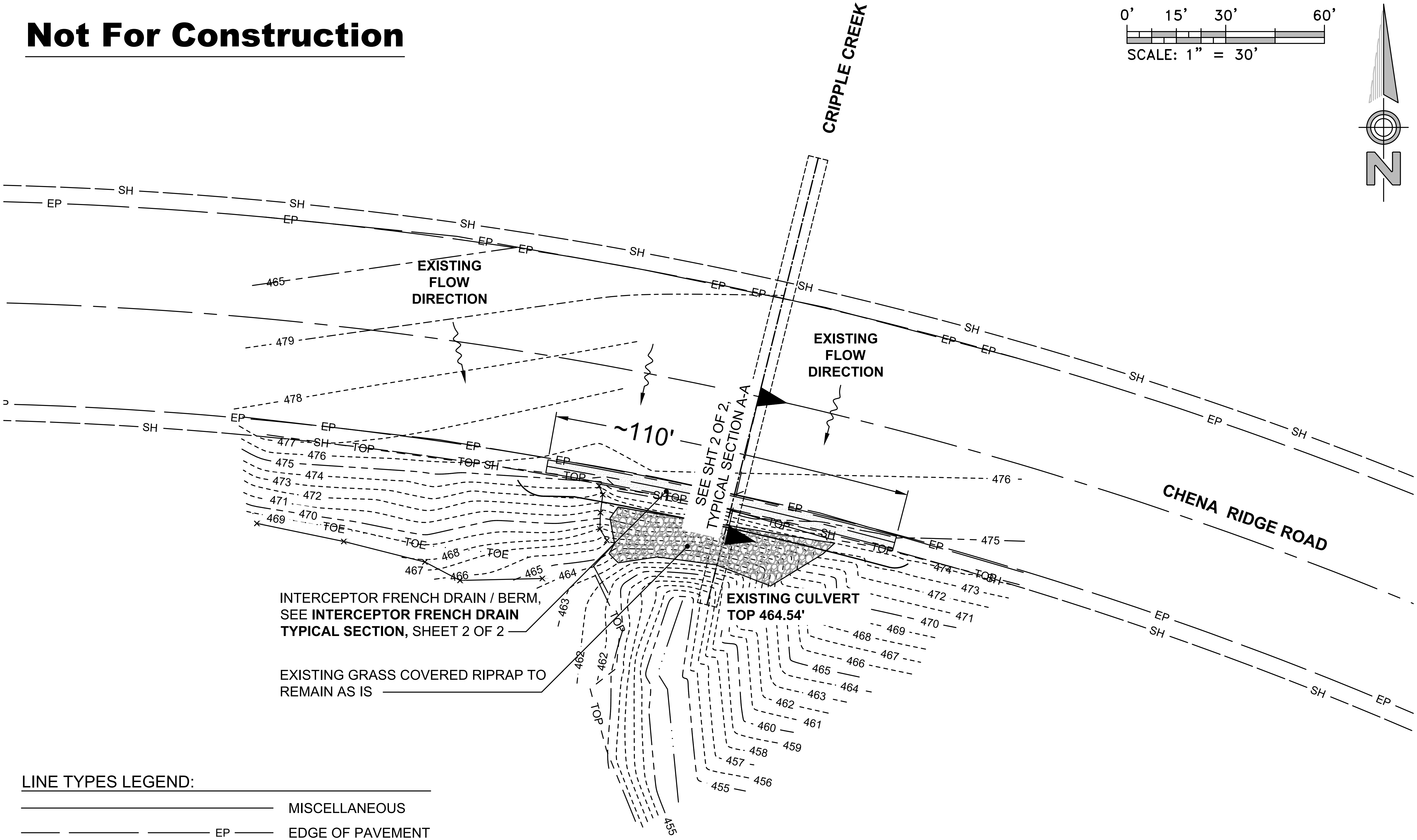
IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

- DETAILS -
DAWSON ROAD & MISTLETOE DRIVE
NORTH POLE, ALASKA

CONCEPT DESIGN DRAWINGS

Chena Ridge Road & Cripple Creek Channel (Site 65)

Not For Construction



LINE TYPES LEGEND:

——————	MISCELLANEOUS
—— —— EP ——	EDGE OF PAVEMENT
—— · · · ——	EDGE OF WATER
—— — ——	CENTERLINE
—— — — ——	PROPERTY LINE / FEATURE REF
—— — — 50 — — ——	MAJOR CONTOUR
- - - - 49 - - - -	MINOR CONTOUR
· · · TOE · · · TOE · · · TOE ·	TOE OF BANK
—— — — TOP — — TOP ——	TOP OF BANK

CHENA RIDGE & CRIPPLE CREEK PROJECT SITE PLAN

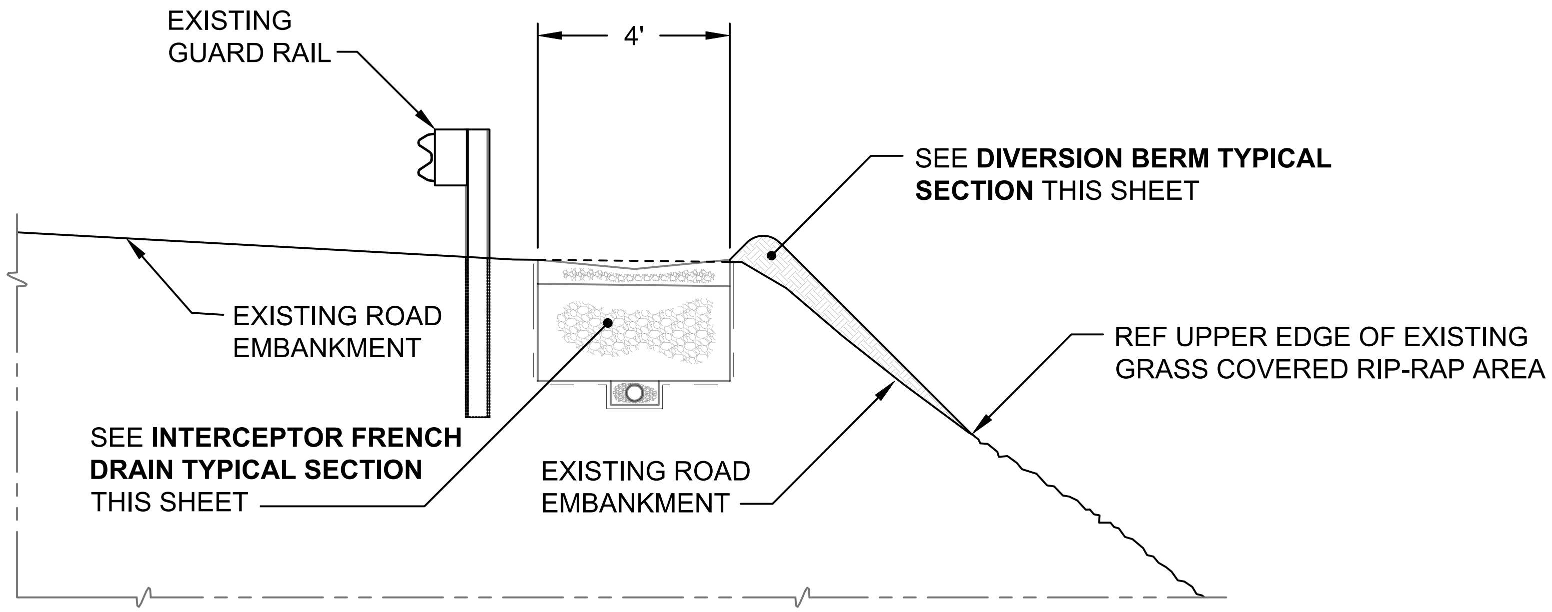
[NOT TO SCALE]

Tanana Valley Watershed Assoc (TVWA)

IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

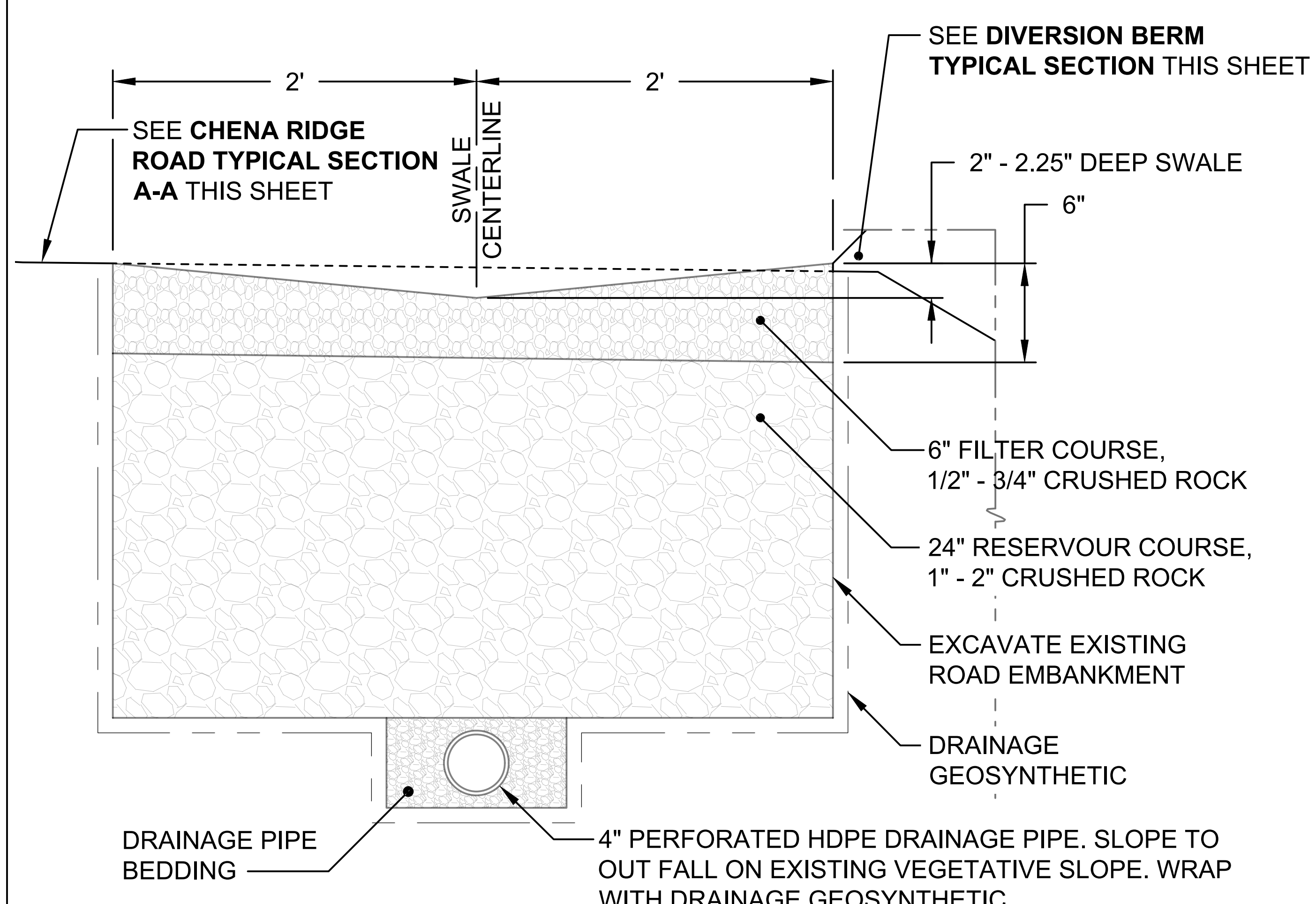
- SITE PLAN -
CHENA RIDGE & CRIPPLE CREEK
FAIRBANKS, ALASKA

Not For Construction



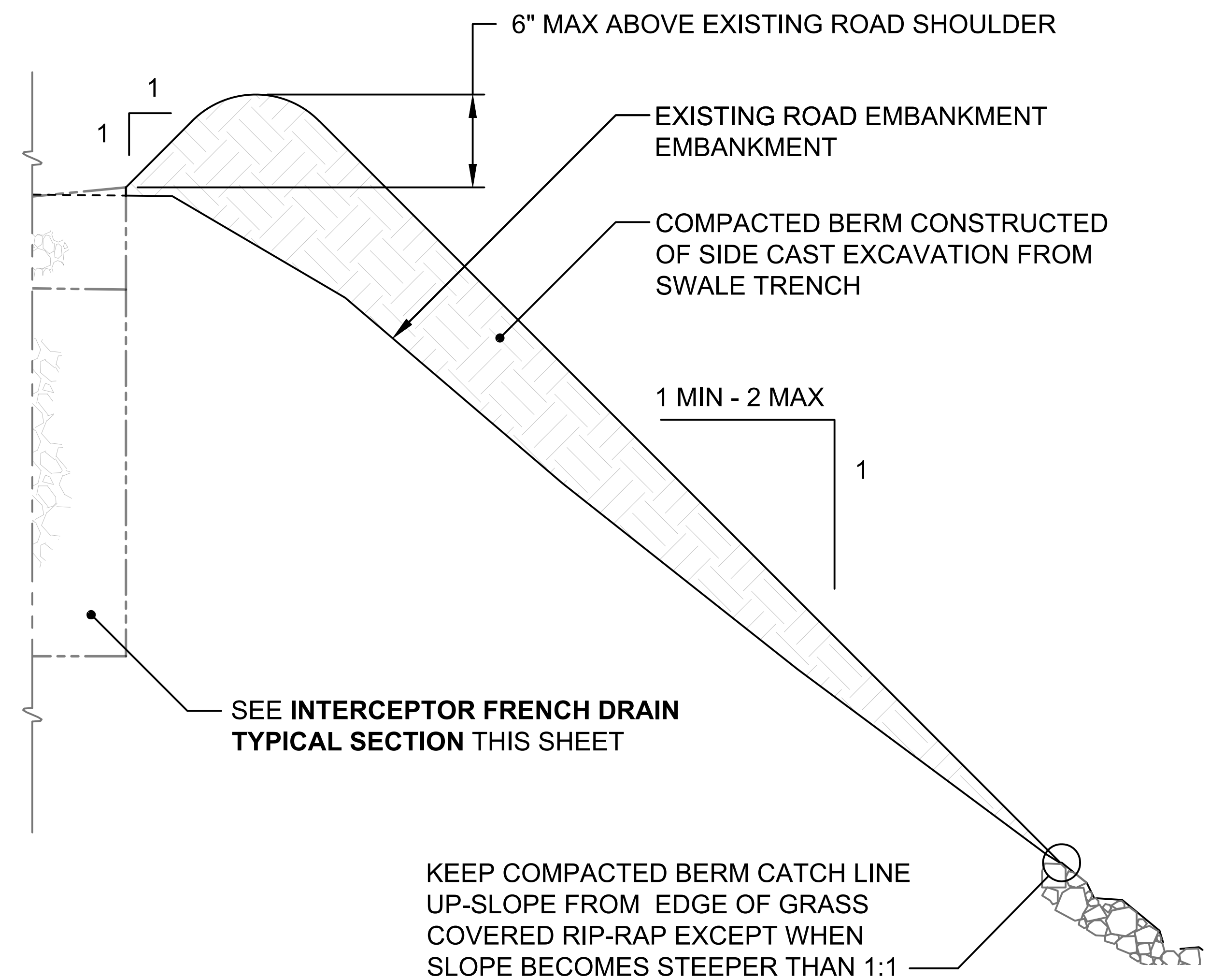
CHENA RIDGE ROAD TYPICAL SECTION A-A

[NOT TO SCALE]



INTERCEPTOR FRENCH DRAIN TYPICAL SECTION

[NOT TO SCALE]



DIVERSION BERM TYPICAL SECTION

[NOT TO SCALE]

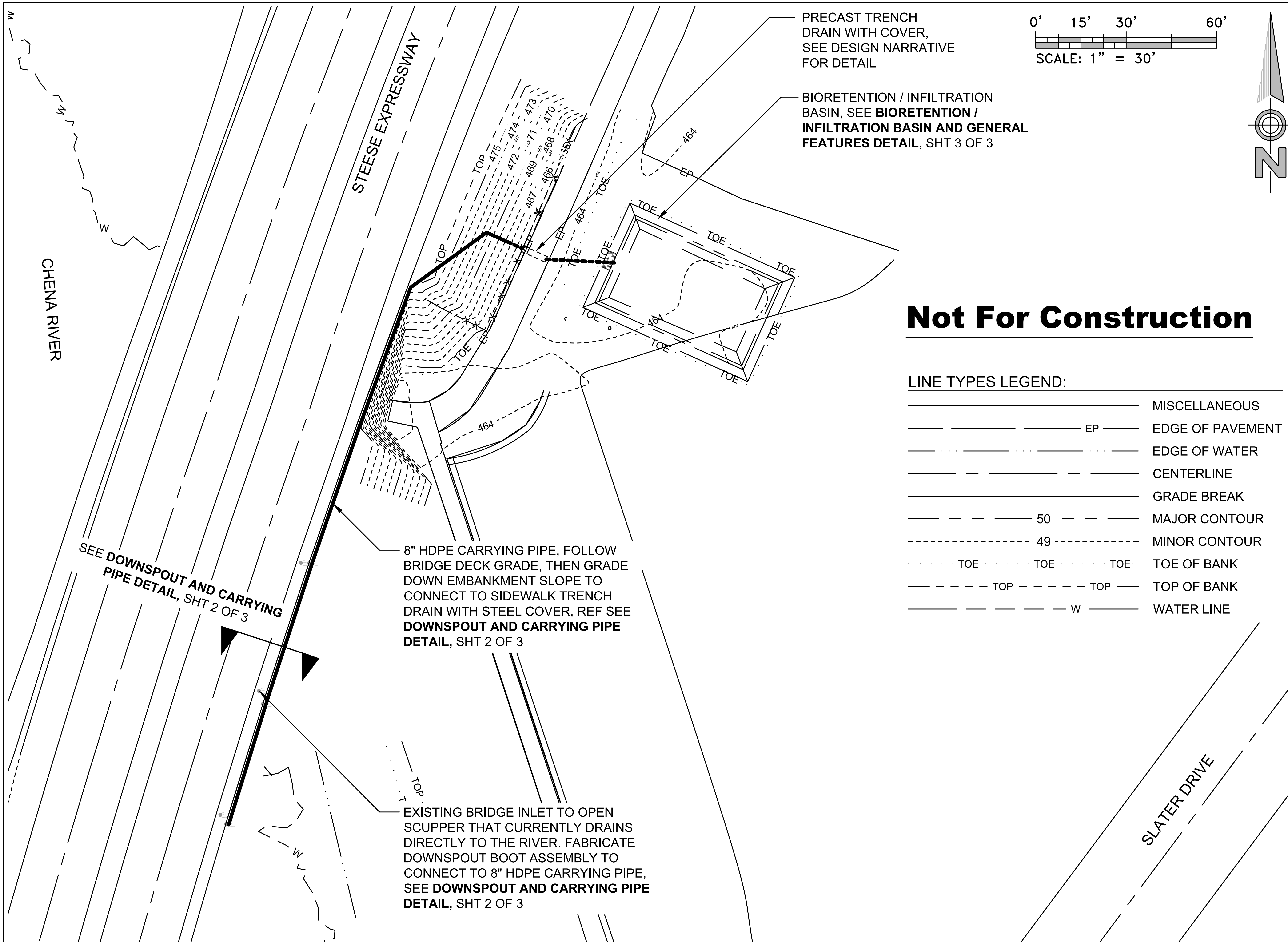
Tanana Valley Watershed Assoc (TVWA)

IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

- TYPICAL SECTIONS -
CHENA RIDGE & CRIPPLE CREEK
FAIRBANKS, ALASKA

CONCEPT DESIGN DRAWINGS

Steese Hwy and Chena River Bridge, Site 59

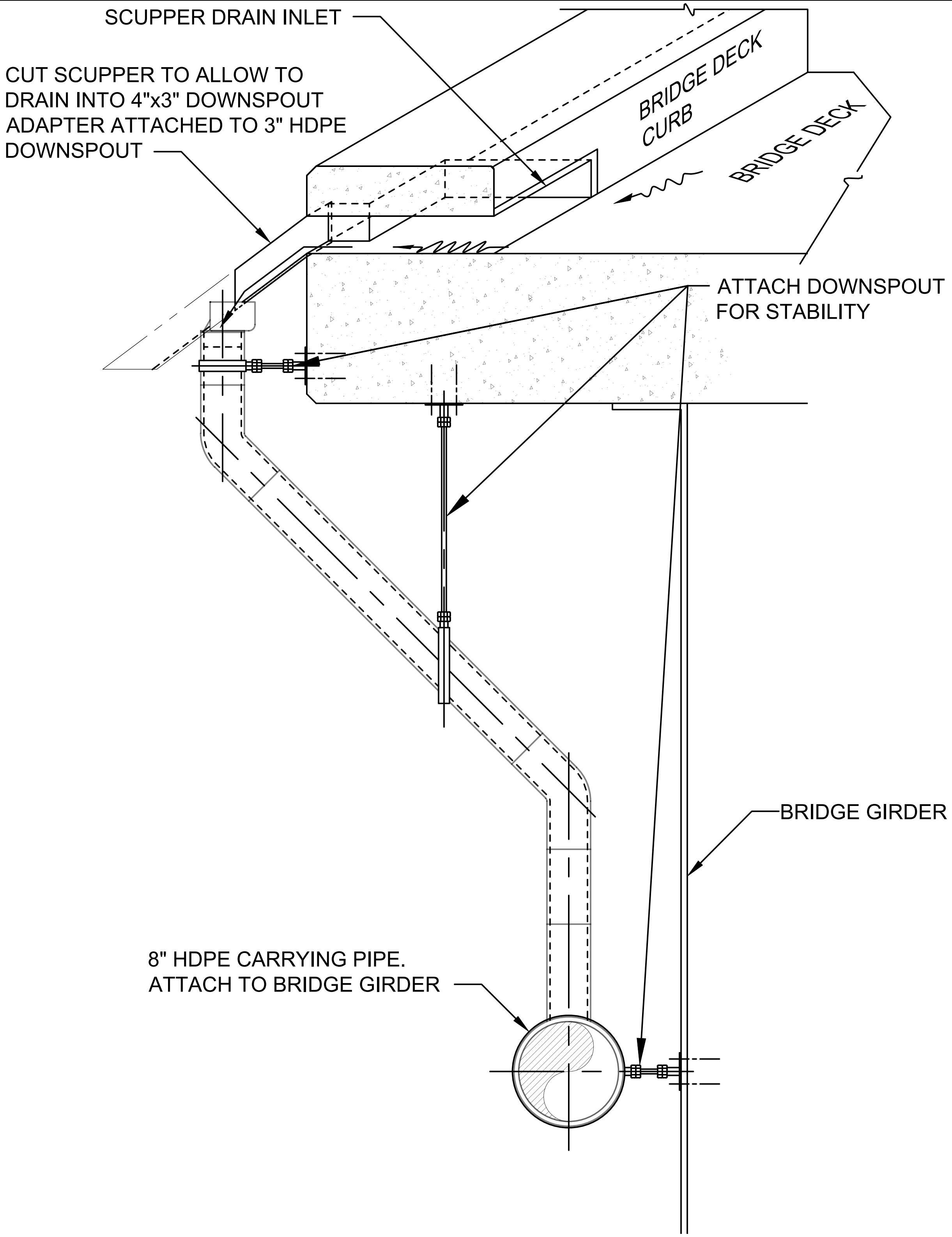


Tanana Valley Watershed Assoc (TVWA)

IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

- SITE PLAN -
STEESE EXPRESSWAY AND CHENA RIVER
FAIRBANKS, ALASKA

1
OF 3 SHEETS



DOWNSPOUT AND CARRYING PIPE DETAIL

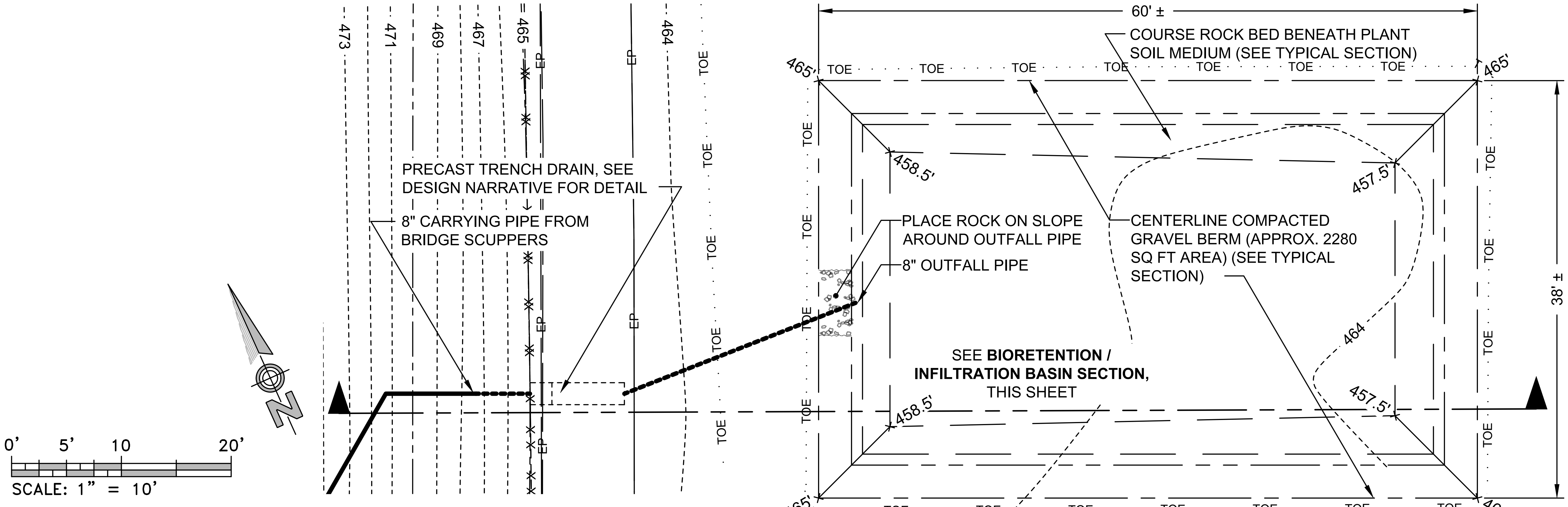
[NOT TO SCALE]

Not For Construction

Tanana Valley Watershed Assoc (TVWA)

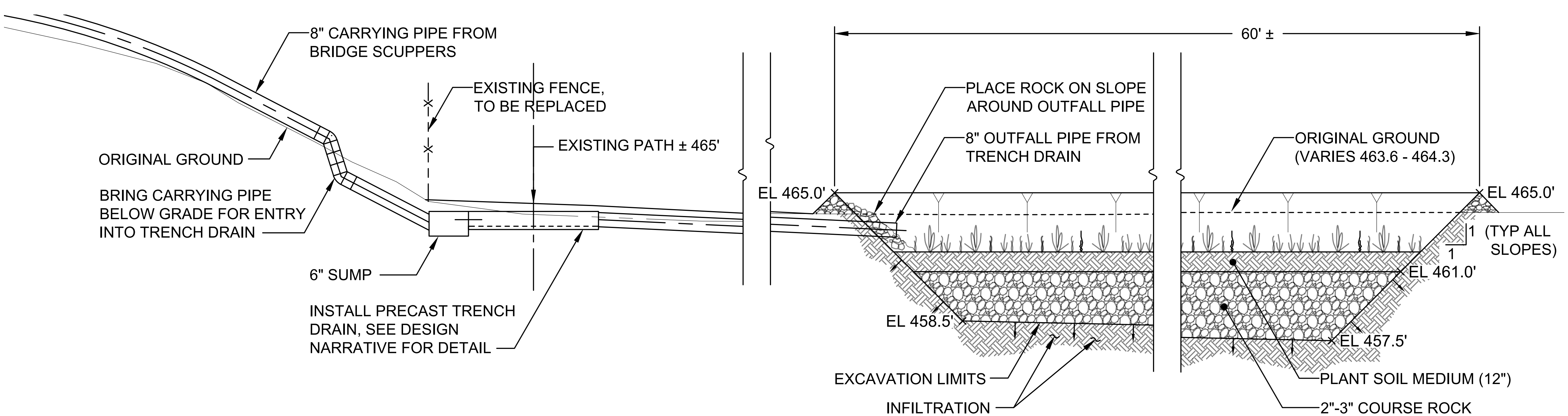
IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

- GENERAL DETAILS -
STEESE EXPRESSWAY AND CHENA RIVER
FAIRBANKS, ALASKA



BIORETENTION / INFILTRATION BASIN AND GENERAL FEATURES DETAIL

[NOT TO SCALE]



BIORETENTION / INFILTRATION BASIN SECTION

[NOT TO SCALE]

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Tanana Valley Watershed Assoc (TVWA)

IDENTIFICATION AND PRIORITIZATION OF GREEN INFRASTRUCTURE NEEDS AT ROAD CROSSINGS OF THE CHENA RIVER AND TRIBUTARIES

- BIORETENTION/INFILTRATION BASINS TYP PLAN & SECTION -
STEESE EXPRESSWAY AND CHENA RIVER
FAIRBANKS, ALASKA