

BIA KINLICHEE ROAD IMPROVEMENTS

99% DRAINAGE REPORT

PREPARED FOR:

Bureau of Indian Affairs
Division of Facilities Management
and Construction (DFCM)
1011 Indian School Road NW
Albuquerque, New Mexico 87104



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GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

PROJECT SUMMARY AND LOCATION

The BIA Kinlichee Road Improvements Project includes the paving and drainage upgrades for a portion of Kinlichee Rd (BIA 9252), a gravel road under the jurisdiction of the Bureau of Indian Affairs and located near the town of Ganado, Apache County, Arizona. The project is approximately 2.6 miles in length and limited by BIA N-39 to the North and Arizona State Highway 264 (SR 264) to the South. According to the Arizona Department of Water Resources, the road project and its subbasins are located in the Little Colorado River watershed.

State	Arizona
City	Ganado
County	Apache
Section, Township, Range	Sections 14, 23, 25 & 25; Township 27 N, Range 27 E, Gila-Salt River Meridian

TABLE 1. Location

HYDROLOGY

HYDROLOGIC BACKGROUND

The climate in Ganado is semi-arid, and characterized by low precipitation, low humidity, and extreme variations in temperature. The greatest potential for flooding and erosion is caused by spring and summer thunderstorms. These extreme runoff events are caused by cloudburst type storms that are characterized by short periods of high intensity rainfall.

METHODOLOGY

Drainage criteria and standards follow the BIA School Facilities Design Handbook (BIASFDH). The NRCS Urban Hydrology for Small Watersheds TR-55 method was used to model all runoff. As indicated by the handbook, both the 10 Year-24 hour and 100 Year-24 hour storm events were analyzed.

Rainfall Depth – Obtained from NOAA Atlas 14, Point Precipitation Frequency Estimates (https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=pa).

Storm Event	Rainfall Depth (in)
10 Year, 24-hour	2.06
100 Year, 24-hour	3.19

TABLE 2. Rainfall Depth

Rainfall Distribution – The SCS Type II distribution method was used for both analyzed storm events.

Soils - A soil survey was conducted of the area. The information below is provided by Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at <http://websoilsurvey.nrcs.usda.gov/>. Accessed July 9, 2021.

The contributing watershed consisted predominately of soils classified as Hydraulic Soil Groups A & B. See Appendices for a copy of the soils map.

Curve Number - The SCS Curve Number method was used for the loss calculations in all scenarios. The curve numbers for the watersheds were determined using a weighted average based on soil type, vegetation, and land use. The curve numbers for each subbasin are located in the Appendix.

Time Of Concentration - The total time of concentration was calculated as the summation of the initial overland flow, shallow concentrated flow, and channelized flow. A minimum allowable time of concentration of 5 min was considered per the BIASFDH.

The times of concentration for each basin were calculated using the SCS empirical method. Below is an outline of the formulas used to calculate the times. Individual time calculations are found in the Appendix.

Initial Overland Flow Time:

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where:

T_c = Time of Concentration (hr)

n = Manning's roughness

L_f = Flow Length (ft)

P = 2 yr, 24 hr Rainfall (inches)

S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation:

$$V = 16.1345 * (S_f^{0.5}) \text{ (unpaved surface)}$$

$$T_c = (L_f / V) / (3600 \text{ sec/hr})$$

Where:

T_c = Time of Concentration (hr)

L_f = Flow Length (ft)

V = Velocity (ft/sec)

S_f = Slope (ft/ft)

Channel Flow Equation:

$$V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$$

$$R = A_q / W_p$$

$$T_c = (L_f / V) / (3600 \text{ sec/hr})$$

Where:

T_c = Time of Concentration (hr)

L_f = Flow Length (ft)

R = Hydraulic Radius (ft)

A_q = Flow Area (ft²)

W_p = Wetted Perimeter (ft)

V = Velocity (ft/sec)

S_f = Slope (ft/ft)

n = Manning's roughness

Hydrologic and Hydraulic Modeling Software – The software used to model the project is Autodesk Storm and Sanitary Analysis 2021 (SSA). SSA is a complete hydrologic and hydraulic modeling software. Rainfall intensity, basin area, runoff coefficient and time of concentration data were input into the program to produce the pre and post developed runoff. Hydraflow Express software was used to analyze open channel flow.

HISTORIC DRAINAGE CONDITIONS, BASINS AND SUB-BASINS

There are 3 existing cross culverts at low points in the roadway and 3 approach culverts located at the Kin Dah Lichii Olta' School entrances, and just north of the school. A total of 6 tributary sub-basins outfalling into these culverts were determined (See Historic Drainage Plan Exhibit). Most culverts are full of sediment and require cleaning. There appears to be several locations where surface runoff may cross over the roadway. This is likely due to sediment deposition within the roadside ditches and culverts. There are several roadside ditch outfalls that direct runoff away from the roadway, these will remain and may require cleaning/regrading.

HISTORIC CONDITION ANALYSIS

Subbasin	Area (ac)	Peak Discharge – 10 YR (cfs)	Peak Discharge – 100 YR (cfs)
Subbasin 1	58.65	0.3	6.5
Subbasin 2	1.43	0.01	0.2
Subbasin 3	0.55	0.0	0.1
Subbasin 4	11.60	0.06	1.7
Subbasin 5	3.13	0.02	0.5
Subbasin 6	10.25	0.05	1.5

TABLE 3. Historic Condition Subbasin Analysis Results

PROPOSED DRAINAGE CONDITIONS

Improvement of Kinlichee Road shall not alter the historic subbasins and the location of the existing cross culverts. An additional tributary subbasin on the southern half of the project was delineated after inspecting the overall watershed and the existing road profile (See Proposed Drainage Plan Exhibit). As a result, a fourth low point cross culvert location was proposed.

The proposed roadway section includes graded ditches to convey surface runoff to existing cross culvert locations. Additionally, existing gravel/dirt roads that tie into Kinlichee Road are to be maintained with approaches regraded and corrugated metal pipe (CMP) culverts installed as needed for drainage conveyance.

PROPOSED CONDITION ANALYSIS

Subbasin	Area (ac)	Peak Discharge – 10 YR (cfs)	Peak Discharge – 100 YR (cfs)
Subbasin 7	109.30	0.55	10.7

TABLE 4. Proposed Condition Analysis Results

PROPOSED DRAINAGE FACILITIES

Hydraulic analysis of proposed roadside ditches along with existing and proposed culverts was completed using the Hydraflow Express Extension for Autodesk AutoCAD Civil 3D to ensure their capacity to convey the 100-year, 24-hour storm event runoff. Proposed changes to existing culverts found to be deficient are shown in the project construction plans. See appendices for analysis.

CONCLUSION

By designing the project in accordance with the BIA School Facilities Design Handbook, it is implied that no drainage laws are being violated. The BIASFDH has been followed in the completion of this study and report, and there are no variances to BIA regulations proposed for this project. The proposed improvements provide an effective storm runoff conveyance system for the design storm events analyzed for historic and proposed flows. Historic flows will be captured by graded swales and discharged at historic locations. No downstream or adjacent properties are expected to have adverse effects due to the proposed roadway improvements.

REFERENCES

BIA School Facilities Design Handbook, 2017
NOAA Atlas 14
USDA NRCS Web Soil Survey

APPENDICES

HYDROLOGIC COMPUTATIONS

NOAA Atlas 14 Precipitation Frequency Estimates
Soil Map and Report
SSA TR-55 Analysis Output Data

HYDRAULIC CALCULATIONS

Culvert Capacity Analyses

PLANS AND MAPS

Historic Condition Drainage Map
Proposed Condition Drainage Map
Project Plan and Profiles and Details



NOAA Atlas 14, Volume 1, Version 5
Location name: Ganado, Arizona, USA*
Latitude: 35.7332°, Longitude: -109.4184°
Elevation: 6812.88 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps_&_aerials](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.175 (0.152-0.204)	0.226 (0.196-0.263)	0.304 (0.263-0.354)	0.368 (0.315-0.427)	0.457 (0.388-0.530)	0.529 (0.446-0.613)	0.607 (0.507-0.705)	0.690 (0.570-0.804)	0.809 (0.656-0.947)	0.908 (0.726-1.07)
10-min	0.267 (0.231-0.311)	0.345 (0.298-0.400)	0.463 (0.400-0.538)	0.559 (0.480-0.649)	0.695 (0.590-0.807)	0.805 (0.680-0.934)	0.923 (0.771-1.07)	1.05 (0.868-1.22)	1.23 (0.998-1.44)	1.38 (1.10-1.63)
15-min	0.331 (0.286-0.385)	0.427 (0.369-0.496)	0.574 (0.496-0.667)	0.693 (0.595-0.805)	0.861 (0.732-1.00)	0.998 (0.842-1.16)	1.15 (0.956-1.33)	1.30 (1.08-1.52)	1.53 (1.24-1.79)	1.71 (1.37-2.02)
30-min	0.445 (0.386-0.518)	0.575 (0.497-0.668)	0.773 (0.668-0.898)	0.933 (0.801-1.08)	1.16 (0.986-1.35)	1.34 (1.13-1.56)	1.54 (1.29-1.79)	1.75 (1.45-2.04)	2.06 (1.67-2.41)	2.31 (1.84-2.72)
60-min	0.551 (0.477-0.641)	0.712 (0.615-0.827)	0.957 (0.826-1.11)	1.16 (0.991-1.34)	1.44 (1.22-1.67)	1.66 (1.40-1.93)	1.91 (1.59-2.22)	2.17 (1.79-2.53)	2.54 (2.06-2.98)	2.86 (2.28-3.36)
2-hr	0.655 (0.569-0.756)	0.834 (0.727-0.971)	1.11 (0.963-1.29)	1.34 (1.16-1.55)	1.67 (1.43-1.93)	1.95 (1.65-2.25)	2.25 (1.88-2.59)	2.57 (2.13-2.97)	3.05 (2.47-3.53)	3.44 (2.74-4.00)
3-hr	0.710 (0.625-0.817)	0.901 (0.792-1.04)	1.17 (1.03-1.35)	1.40 (1.22-1.61)	1.73 (1.49-1.98)	2.00 (1.71-2.29)	2.31 (1.95-2.64)	2.63 (2.20-3.02)	3.11 (2.55-3.57)	3.50 (2.82-4.05)
6-hr	0.840 (0.750-0.947)	1.05 (0.938-1.19)	1.33 (1.18-1.50)	1.56 (1.38-1.76)	1.90 (1.66-2.14)	2.17 (1.89-2.45)	2.47 (2.13-2.78)	2.79 (2.38-3.15)	3.24 (2.71-3.67)	3.63 (2.99-4.13)
12-hr	0.992 (0.892-1.11)	1.24 (1.11-1.39)	1.54 (1.38-1.73)	1.79 (1.60-2.00)	2.13 (1.89-2.38)	2.40 (2.12-2.68)	2.68 (2.35-2.99)	2.99 (2.60-3.35)	3.43 (2.94-3.86)	3.82 (3.23-4.31)
24-hr	1.09 (0.984-1.22)	1.38 (1.24-1.54)	1.76 (1.58-1.95)	2.06 (1.84-2.30)	2.49 (2.22-2.77)	2.83 (2.51-3.15)	3.19 (2.81-3.55)	3.56 (3.12-3.96)	4.09 (3.55-4.55)	4.51 (3.88-5.03)
2-day	1.20 (1.09-1.33)	1.51 (1.36-1.67)	1.91 (1.72-2.11)	2.23 (2.01-2.46)	2.67 (2.39-2.95)	3.01 (2.69-3.33)	3.37 (3.00-3.73)	3.74 (3.31-4.14)	4.25 (3.73-4.72)	4.65 (4.05-5.18)
3-day	1.30 (1.18-1.44)	1.63 (1.49-1.80)	2.06 (1.87-2.27)	2.40 (2.17-2.64)	2.86 (2.58-3.15)	3.23 (2.90-3.55)	3.60 (3.22-3.96)	3.98 (3.55-4.39)	4.51 (3.98-4.97)	4.91 (4.31-5.43)
4-day	1.40 (1.28-1.54)	1.76 (1.61-1.93)	2.22 (2.02-2.43)	2.58 (2.35-2.83)	3.06 (2.78-3.36)	3.44 (3.11-3.77)	3.83 (3.45-4.19)	4.23 (3.79-4.63)	4.76 (4.24-5.22)	5.17 (4.57-5.69)
7-day	1.65 (1.50-1.81)	2.06 (1.88-2.27)	2.59 (2.36-2.85)	3.00 (2.73-3.30)	3.55 (3.22-3.91)	3.98 (3.59-4.37)	4.41 (3.96-4.85)	4.85 (4.33-5.33)	5.43 (4.82-5.98)	5.88 (5.18-6.49)
10-day	1.86 (1.70-2.05)	2.34 (2.14-2.57)	2.92 (2.67-3.21)	3.37 (3.07-3.70)	3.97 (3.61-4.35)	4.42 (4.00-4.84)	4.87 (4.40-5.34)	5.32 (4.79-5.84)	5.91 (5.29-6.50)	6.36 (5.66-7.01)
20-day	2.42 (2.21-2.66)	3.04 (2.77-3.34)	3.79 (3.46-4.16)	4.38 (3.99-4.81)	5.16 (4.69-5.65)	5.76 (5.21-6.30)	6.35 (5.73-6.97)	6.95 (6.24-7.63)	7.74 (6.91-8.51)	8.34 (7.40-9.19)
30-day	2.92 (2.66-3.22)	3.67 (3.33-4.05)	4.57 (4.14-5.03)	5.25 (4.75-5.78)	6.15 (5.55-6.76)	6.82 (6.13-7.50)	7.48 (6.70-8.24)	8.13 (7.25-8.96)	8.98 (7.96-9.93)	9.60 (8.48-10.6)
45-day	3.59 (3.26-3.94)	4.51 (4.10-4.96)	5.60 (5.09-6.16)	6.42 (5.82-7.06)	7.47 (6.76-8.21)	8.25 (7.45-9.07)	9.02 (8.12-9.91)	9.76 (8.76-10.7)	10.7 (9.56-11.8)	11.4 (10.1-12.6)
60-day	4.13 (3.76-4.51)	5.18 (4.71-5.67)	6.41 (5.82-7.01)	7.32 (6.63-8.00)	8.47 (7.66-9.25)	9.31 (8.41-10.2)	10.1 (9.12-11.1)	10.9 (9.79-12.0)	11.9 (10.6-13.1)	12.6 (11.2-13.9)

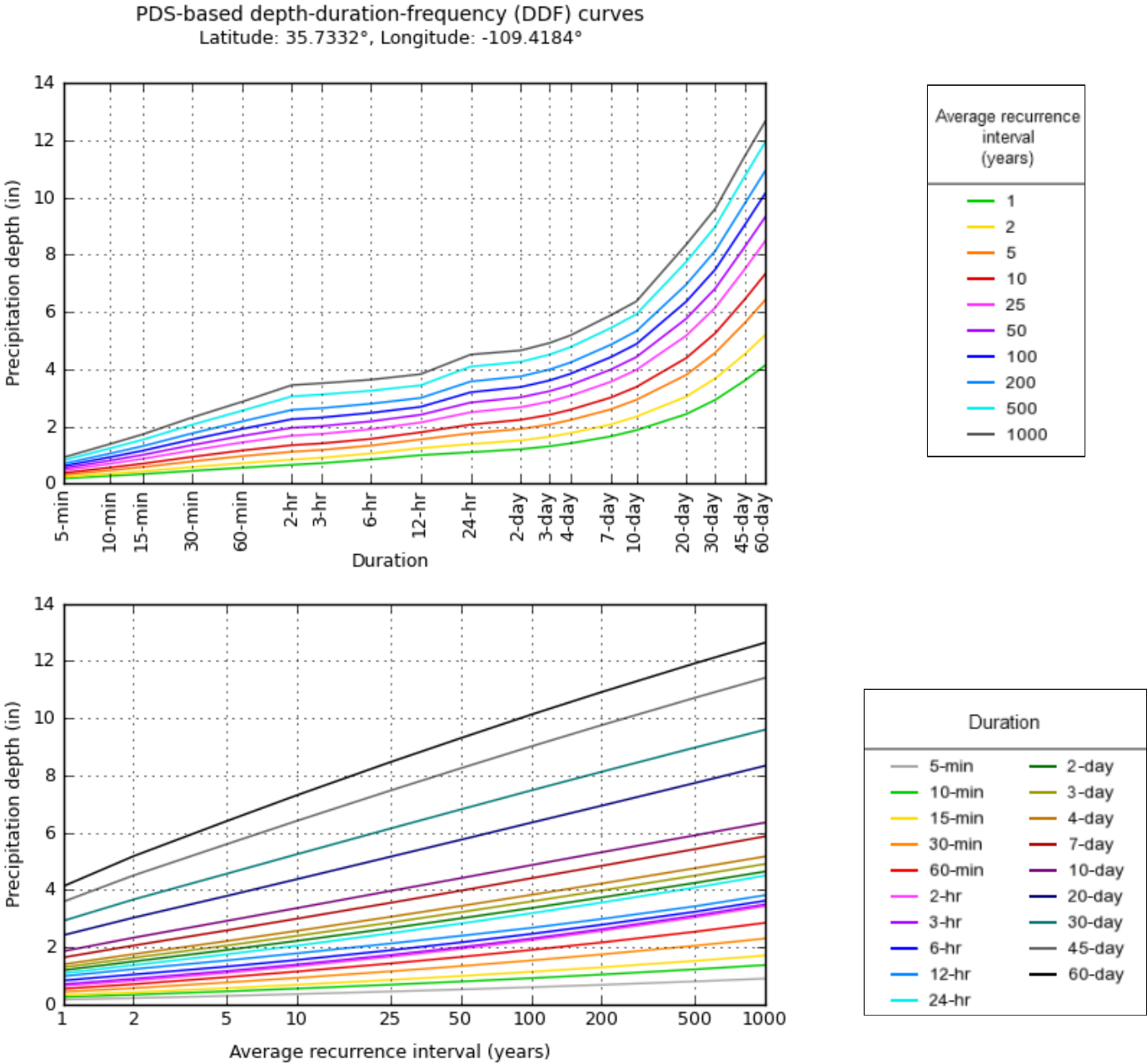
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

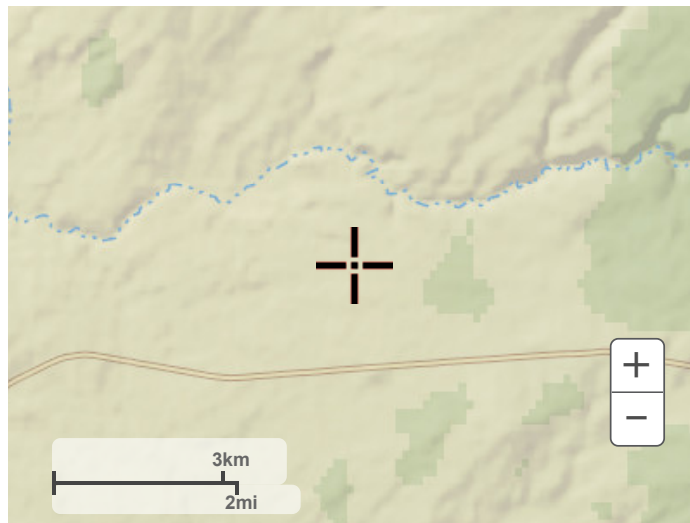
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PF graphical

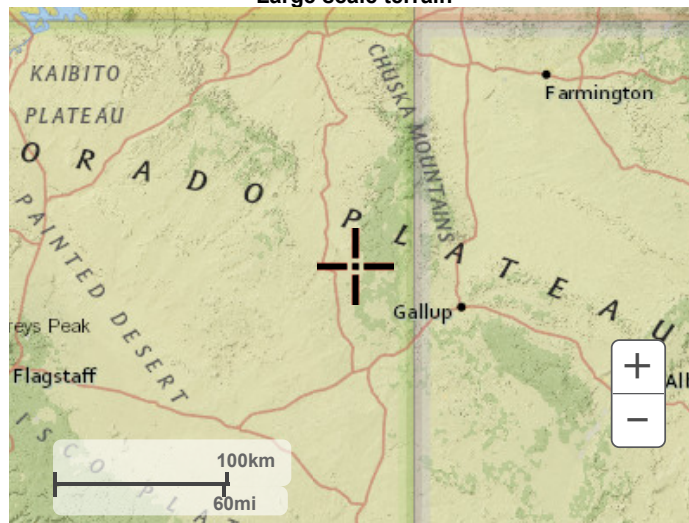


Maps & aerials

Small scale terrain



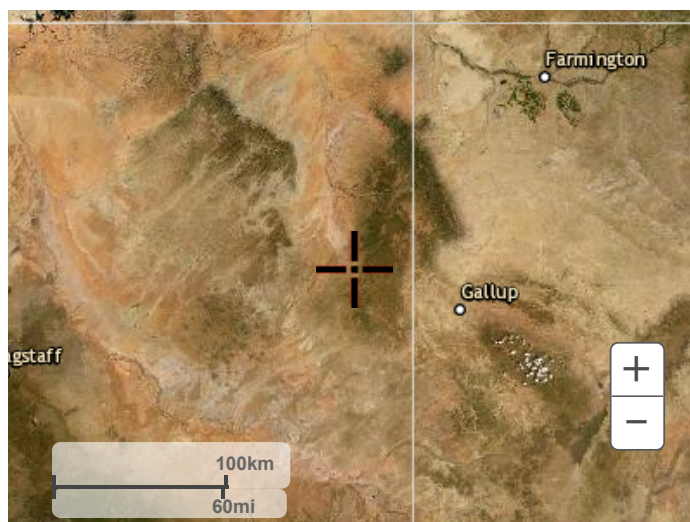
Large scale terrain



Large scale map



Large scale aerial

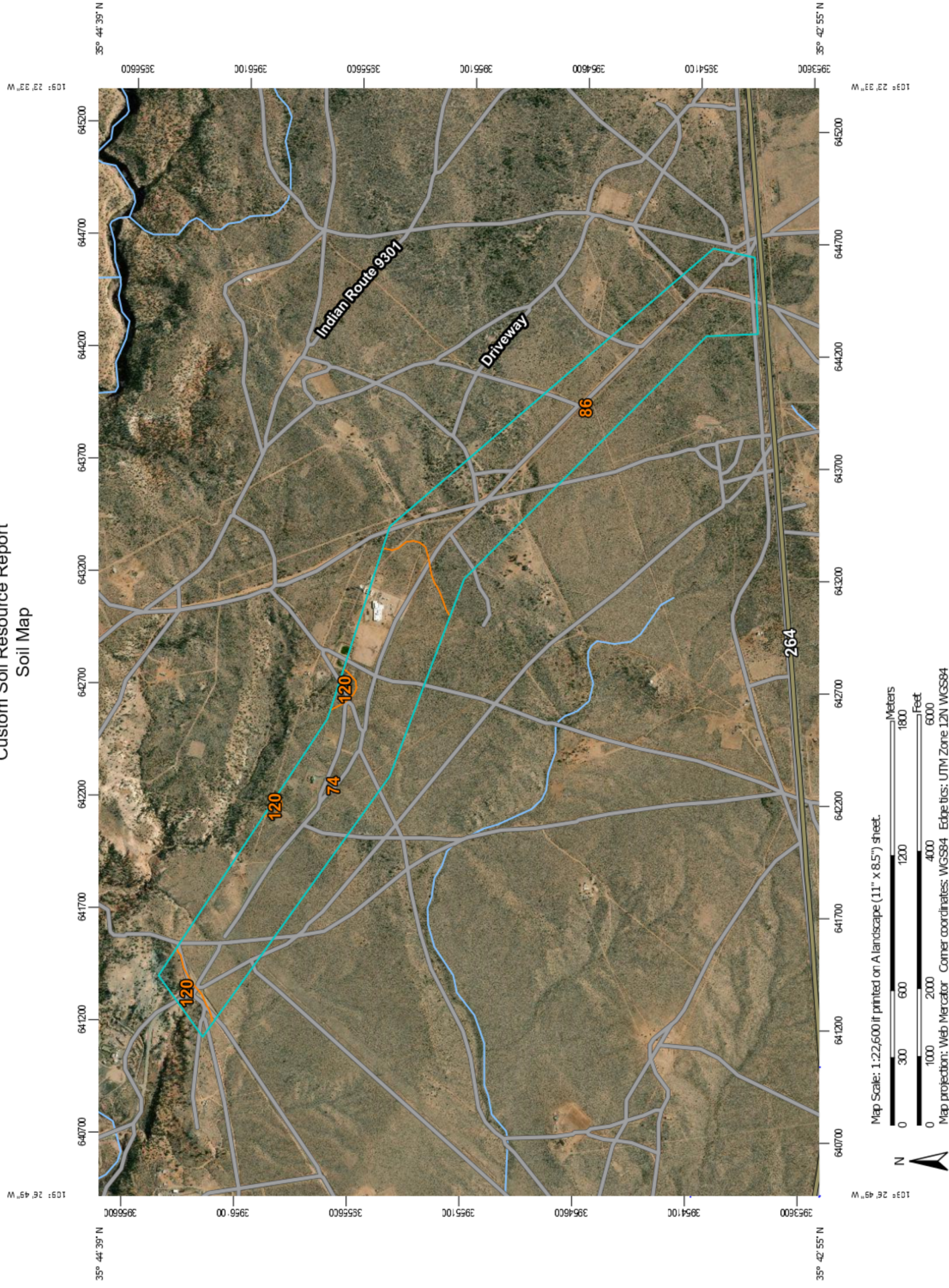


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Custom Soil Resource Report Soil Map



MAP LEGEND



MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Fort Defiance Area, Parts of Apache and Navajo Counties, Arizona and McKinley and San Juan Counties, New Mexico
Survey Area Data: Version 20, Jun 5, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 23, 2014—Nov 2, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
74	Parkelei family, 1 to 8 percent slopes.	184.4	51.0%
86	Plumasano-Parkelei family complex, 1 to 15 percent slopes	164.9	45.6%
120	Toldohn-Vessilla-Rock outcrop complex, 8 to 35 percent slopes	12.3	3.4%
Totals for Area of Interest		361.6	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate

pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Fort Defiance Area, Parts of Apache and Navajo Counties, Arizona and McKinley and San Juan Counties, New Mexico

74—Parkelei family, 1 to 8 percent slopes.

Map Unit Setting

National map unit symbol: 2qsxy
Elevation: 6,500 to 7,500 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 51 degrees F
Frost-free period: 110 to 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Parkelei family and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Parkelei Family

Setting

Landform: Plateaus, mesas
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Eolian deposits and fan and slope alluvium derived from sandstone and shale

Typical profile

A - 0 to 2 inches: sandy loam
BA - 2 to 10 inches: sandy loam
Bt1 - 10 to 24 inches: sandy clay loam
Bt2 - 24 to 38 inches: sandy clay loam
Bk1 - 38 to 50 inches: sandy clay loam
Bk2 - 50 to 71 inches: sandy clay loam
2C - 71 to 80 inches: sand

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6c

Custom Soil Resource Report

Hydrologic Soil Group: B

Ecological site: R035XF605AZ - Loamy Upland 13-17" p.z.

Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 10 percent

Hydric soil rating: No

86—Plumasano-Parkelei family complex, 1 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2qszb

Elevation: 6,800 to 7,400 feet

Mean annual precipitation: 14 to 18 inches

Mean annual air temperature: 48 to 51 degrees F

Frost-free period: 110 to 140 days

Farmland classification: Not prime farmland

Map Unit Composition

Plumasano and similar soils: 40 percent

Parkelei family and similar soils: 35 percent

Minor components: 25 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Plumasano

Setting

Landform: Plateaus

Landform position (two-dimensional): Summit

Landform position (three-dimensional): Crest

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Eolian deposits and fan alluvium derived from sandstone and shale

Typical profile

A - 0 to 2 inches: loamy sand

Bw - 2 to 10 inches: sandy loam

Bk1 - 10 to 28 inches: fine sandy loam

Bk2 - 28 to 52 inches: fine sandy loam

Bk3 - 52 to 80 inches: sandy clay loam

Properties and qualities

Slope: 5 to 15 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 5.95 in/hr)

Custom Soil Resource Report

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: A
Ecological site: F035XF628AZ - Sandy Loam Upland (JUOS, PIED) 13-17" p.z.
Hydric soil rating: No

Description of Parkelei Family

Setting

Landform: Plateaus
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Eolian material and fan alluvium derived from sandstone and shale

Typical profile

A - 0 to 2 inches: fine sandy loam
Bt1 - 2 to 10 inches: sandy clay loam
Bt2 - 10 to 30 inches: sandy clay loam
Btk - 30 to 65 inches: sandy clay loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: B
Ecological site: F035XF625AZ - Loamy Upland (PIED, JUOS) 13-17" p.z. (Provisional)
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 25 percent

Hydric soil rating: No

120—Toldohn-Vessilla-Rock outcrop complex, 8 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2qsxh

Elevation: 6,900 to 7,500 feet

Mean annual precipitation: 14 to 18 inches

Mean annual air temperature: 48 to 51 degrees F

Frost-free period: 110 to 140 days

Farmland classification: Not prime farmland

Map Unit Composition

Toldohn and similar soils: 35 percent

Vessilla and similar soils: 30 percent

Rock outcrop: 20 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Toldohn

Setting

Landform: Hills, ridges

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Slope alluvium derived from sandstone and/or slope alluvium derived from sandstone and shale

Typical profile

A - 0 to 2 inches: clay loam

C1 - 2 to 7 inches: clay

C2 - 7 to 15 inches: clay

Cr - 15 to 60 inches: bedrock

Properties and qualities

Slope: 8 to 35 percent

Depth to restrictive feature: 5 to 20 inches to paralithic bedrock

Drainage class: Well drained

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 0.20 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Custom Soil Resource Report

Frequency of ponding: None

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum: 2.0

Available water capacity: Very low (about 2.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6c

Hydrologic Soil Group: D

Ecological site: F035XF633AZ - Colluvial Slopes 13-17" p.z. (PIED)

Hydric soil rating: No

Description of Vessilla

Setting

Landform: Hills, ridges

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Slope alluvium derived from sandstone

Typical profile

A - 0 to 4 inches: fine sandy loam

C1 - 4 to 9 inches: fine sandy loam

C2 - 9 to 18 inches: channery fine sandy loam

2R - 18 to 28 inches: bedrock

Properties and qualities

Slope: 8 to 20 percent

Depth to restrictive feature: 5 to 20 inches to lithic bedrock

Drainage class: Well drained

Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high
(0.01 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 2 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water capacity: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6c

Hydrologic Soil Group: D

Ecological site: F035XF627AZ - Sandstone Upland (JUOS, PIED) 13-17" p.z.
(Provisional)

Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 15 percent

Hydric soil rating: No

Project Description

File Name 21190_SSA_TR55.SPF

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-55
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On Jul 15, 2021 00:00:00
End Analysis On Jul 16, 2021 00:00:00
Start Reporting On Jul 15, 2021 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:01:00 days hh:mm:ss
Routing Time Step 5 seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	7
Nodes.....	19
<i>Junctions</i>	14
<i>Outfalls</i>	5
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	0
Links.....	14
<i>Channels</i>	7
<i>Pipes</i>	7
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage	Data	Data Source	Rainfall	Rain	State	County	Return	Rainfall	Rainfall
ID	Source	ID	Type	Units				Period	Depth	Distribution
								(years)	(inches)	
1	Time Series	10Yr - 24Hr Storm	Cumulative	inches	Arizona	Apache (Central)	10	2.06	SCS Type II 24-hr	

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ft³)	(cfs)	(days hh:mm:ss)
1	Sub-01	58.65	58.00	2.06	0.05	10219.47	0.29	0 00:52:30
2	Sub-02	1.43	58.00	2.06	0.05	243.74	0.01	0 00:31:20
3	Sub-03	0.55	58.00	2.06	0.05	93.81	0.00	0 00:29:32
4	Sub-04	11.60	58.00	2.06	0.05	2021.56	0.06	0 00:34:49
5	Sub-05	3.13	58.00	2.06	0.05	545.62	0.02	0 00:33:59
6	Sub-06	10.25	58.00	2.06	0.05	1785.69	0.05	0 00:33:09
7	Sub-07	109.30	58.00	2.06	0.05	19043.75	0.55	0 01:04:34

BIA KINLICHEE ROAD IMPROVEMENTS
10-YEAR, 24-HOUR STORM EVENT

Node Summary

SN Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Time of Peak Flooding Occurrence
		(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(days hh:mm)
1 CUL-01-IN	Junction	6723.05	6728.05	6723.05	6728.05	0.00	0.29	6723.21	0 00:00
2 CUL-01-OUT	Junction	6722.74	6727.74	6722.74	6727.74	0.00	0.29	6723.21	0 00:00
3 CULV-02-IN	Junction	6801.36	6806.36	6801.36	6806.36	0.00	0.07	6801.48	0 00:00
4 CULV-02-OUT	Junction	6801.08	6806.08	6801.08	6806.08	0.00	0.07	6801.35	0 00:00
5 CULV-03-IN	Junction	6813.53	6818.53	6813.53	6818.53	0.00	0.06	6813.65	0 00:00
6 CULV-03-OUT	Junction	6812.93	6817.93	6812.93	6817.93	0.00	0.06	6812.97	0 00:00
7 CULV-04-IN	Junction	6818.56	6823.56	6818.56	6823.56	0.00	0.06	6818.67	0 00:00
8 CULV-04-OUT	Junction	6817.81	6822.81	6817.81	6822.81	0.00	0.06	6817.84	0 00:00
9 CULV-05-IN	Junction	6840.90	6845.90	6840.90	6845.90	0.00	0.02	6840.95	0 00:00
10 CULV-05-OUT	Junction	6840.76	6845.76	6840.76	6845.76	0.00	0.02	6840.92	0 00:00
11 CULV-06-IN	Junction	6847.79	6852.79	6847.79	6852.79	0.00	0.05	6847.89	0 00:00
12 CULV-06-OUT	Junction	6847.20	6852.20	6847.20	6852.20	0.00	0.05	6847.44	0 00:00
13 CULV-07-IN	Junction	6864.23	6869.23	6864.23	6869.23	0.00	0.55	6864.40	0 00:00
14 CULV-07-OUT	Junction	6863.37	6868.37	6863.37	6868.37	0.00	0.55	6863.96	0 00:00
15 Out-01	Outfall	6721.74					0.29	6722.20	
16 Out-02	Outfall	6800.08					0.07	6800.35	
17 Out-03	Outfall	6839.76					0.02	6839.91	
18 Out-04	Outfall	6846.20					0.05	6846.44	
19 Out-05	Outfall	6862.37					0.55	6862.95	

BIA KINLICHEE ROAD IMPROVEMENTS
10-YEAR, 24-HOUR STORM EVENT

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Total Depth	Reported Condition
				(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		
1	CULV-01	Pipe	CUL-01-IN	CUL-01-OUT	40.00	6723.05	6722.74	0.7800	36.000	0.0250	0.29	91.60	0.00	0.32	0.31	0.10 Calculated
2	CULV-02	Pipe	CULV-02-IN	CULV-02-OUT	30.00	6801.36	6801.08	0.9300	36.000	0.0250	0.07	33.51	0.00	0.40	0.19	0.06 Calculated
3	CULV-03	Pipe	CULV-03-IN	CULV-03-OUT	40.00	6813.53	6812.93	1.5000	30.000	0.0250	0.06	26.12	0.00	1.45	0.08	0.03 Calculated
4	CULV-04	Pipe	CULV-04-IN	CULV-04-OUT	40.00	6818.56	6817.81	1.8800	30.000	0.0250	0.06	29.21	0.00	1.48	0.07	0.03 Calculated
5	CULV-05	Pipe	CULV-05-IN	CULV-05-OUT	30.00	6840.90	6840.76	0.4700	24.000	0.0250	0.02	8.04	0.00	0.35	0.10	0.05 Calculated
6	CULV-06	Pipe	CULV-06-IN	CULV-06-OUT	30.00	6847.79	6847.20	1.9700	30.000	0.0250	0.05	29.91	0.00	0.55	0.17	0.07 Calculated
7	CULV-07	Pipe	CULV-07-IN	CULV-07-OUT	65.00	6864.23	6863.37	1.3200	36.000	0.0250	0.55	119.68	0.00	0.38	0.38	0.13 Calculated
8	OUTFALL1-LINK	Channel	CUL-01-OUT	Out-01	100.00	6722.74	6721.74	1.0000	60.000	0.0320	0.29	169.73	0.00	1.37	0.46	0.09
9	OUTFALL2-LINK	Channel	CULV-02-OUT	Out-02	100.00	6801.08	6800.08	1.0000	60.000	0.0320	0.07	169.73	0.00	0.96	0.27	0.05
10	OUTFALL3-LINK	Channel	CULV-05-OUT	Out-03	100.00	6840.76	6839.76	1.0000	60.000	0.0320	0.02	169.73	0.00	0.82	0.15	0.03
11	OUTFALL4-LINK	Channel	CULV-06-OUT	Out-04	100.00	6847.20	6846.20	1.0000	60.000	0.0320	0.05	169.73	0.00	0.89	0.24	0.05
12	OUTFALL5-LINK	Channel	CULV-07-OUT	Out-05	100.00	6863.37	6862.37	1.0000	60.000	0.0320	0.55	169.73	0.00	1.60	0.59	0.12
13	SWALE_C3-C2	Channel	CULV-03-OUT	CULV-02-IN	810.00	6812.93	6801.36	1.4300	12.000	0.0250	0.06	29.83	0.00	0.63	0.08	0.08
14	SWALE_C4-C3	Channel	CULV-04-OUT	CULV-03-IN	205.00	6817.81	6813.53	2.0900	12.000	0.0250	0.06	36.07	0.00	0.47	0.07	0.07

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 58.65
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	58.65	B	58.00
Composite Area & Weighted CN	58.65		58.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

BIA KINLICHEE ROAD IMPROVEMENTS
10-YEAR, 24-HOUR STORM EVENT

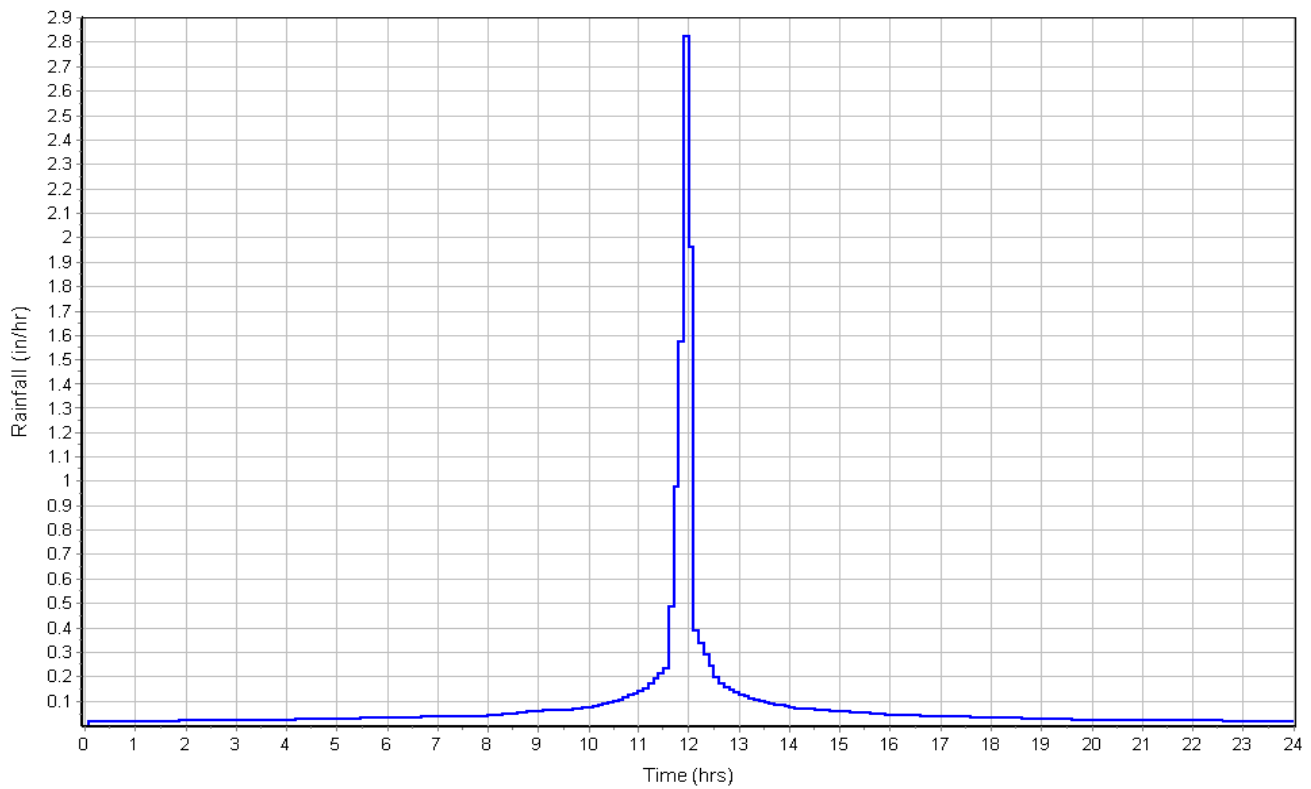
	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00
	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	2800	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	23.57	0.00	0.00
Total TOC (min)	52.51		

Subbasin Runoff Results

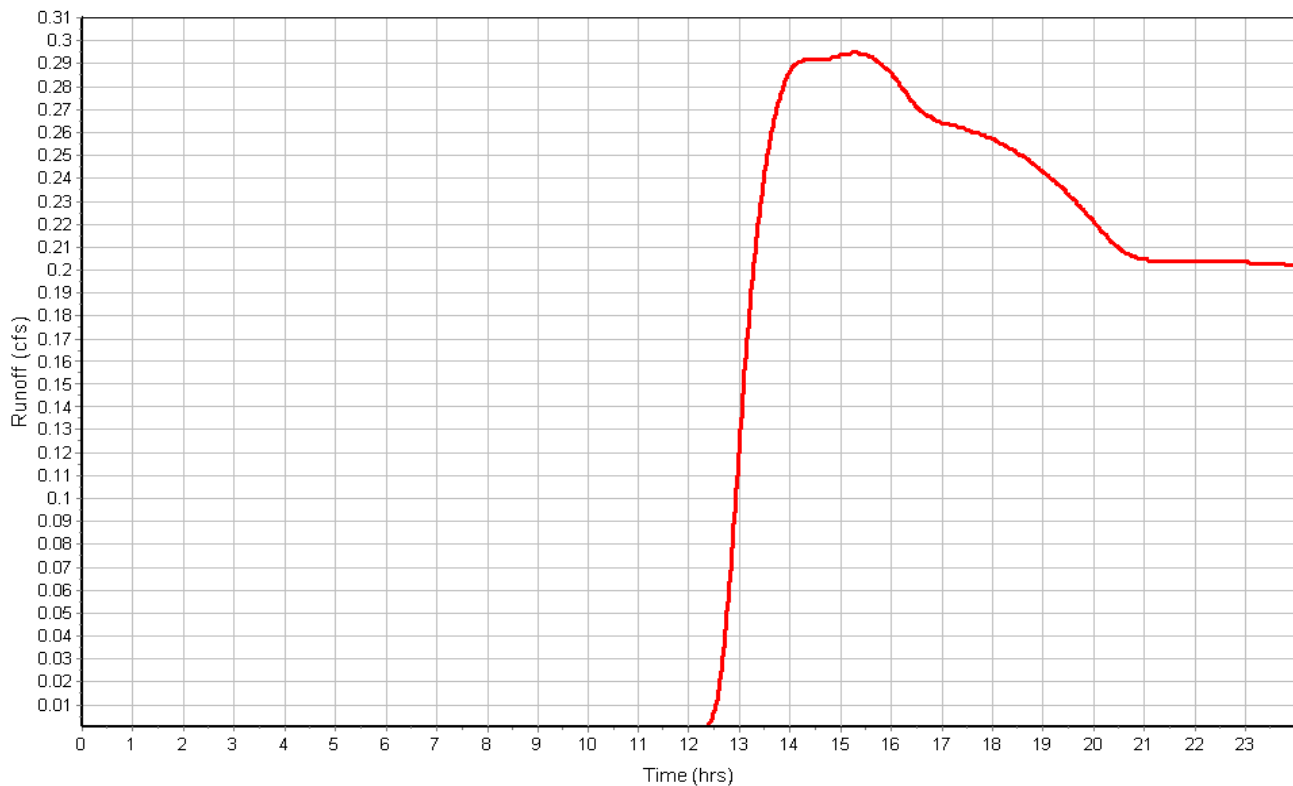
Total Rainfall (in)	2.06
Total Runoff (in)	0.05
Peak Runoff (cfs)	0.29
Weighted Curve Number	58.00
Time of Concentration (days hh:mm:ss)	0 00:52:31

Subbasin : Sub-01

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-02

Input Data

Area (ac) 1.43
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	1.43	B	58.00
Composite Area & Weighted CN	1.43		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

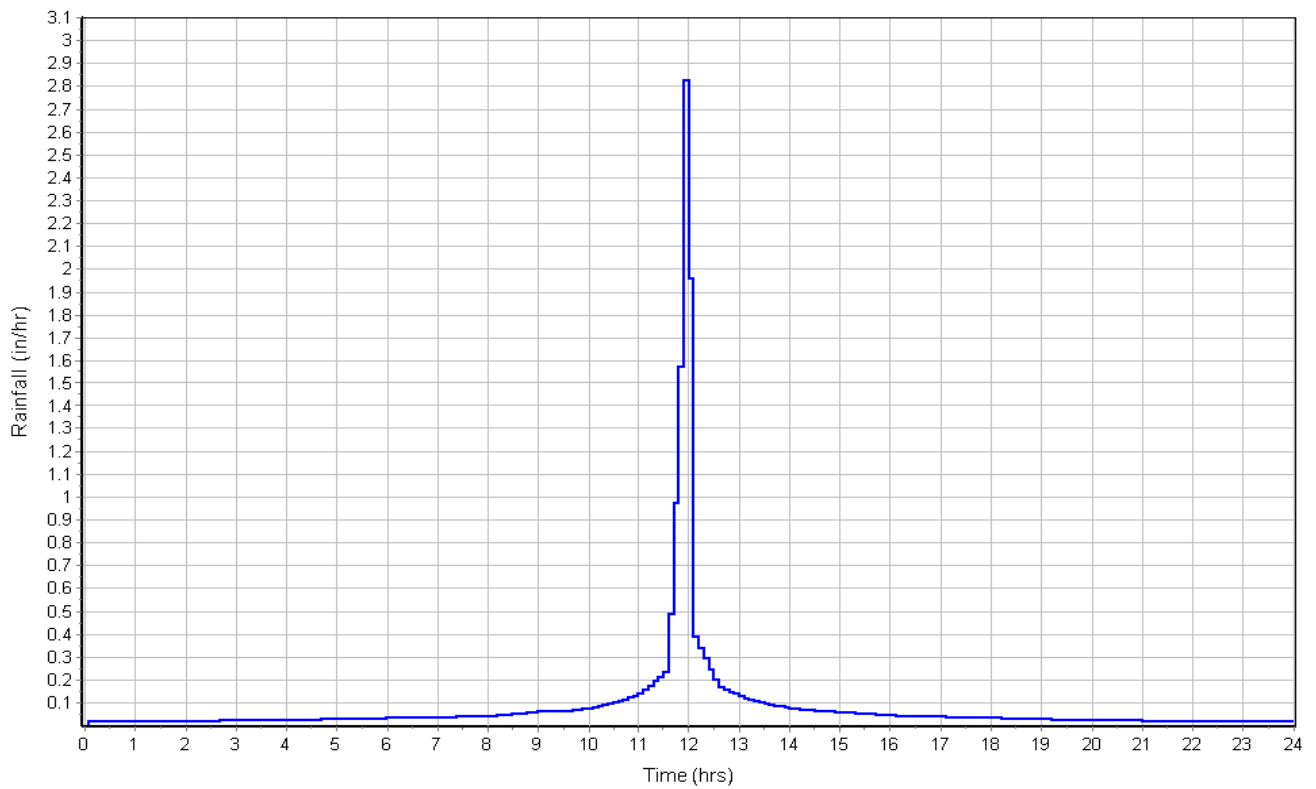
	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.023	0.00	0.00
Flow Length (ft) :	800	0.00	0.00
Channel Slope (%) :	1.5	0.00	0.00
Cross Section Area (ft ²) :	6	0.00	0.00
Wetted Perimeter (ft) :	10.25	0.00	0.00
Velocity (ft/sec) :	5.55	0.00	0.00
Computed Flow Time (min) :	2.40	0.00	0.00
Total TOC (min)	31.34		

Subbasin Runoff Results

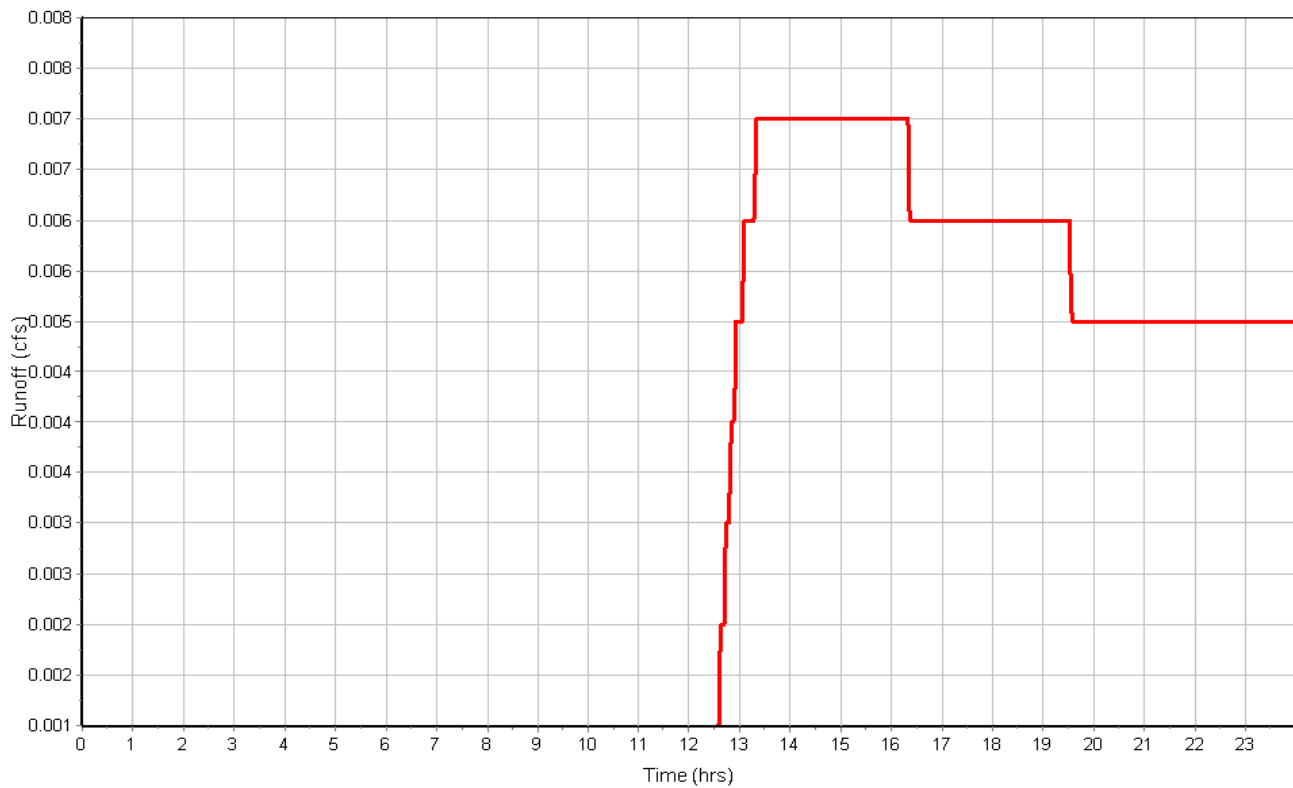
Total Rainfall (in) 2.06
Total Runoff (in) 0.05
Peak Runoff (cfs) 0.01
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:31:20

Subbasin : Sub-02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-03

Input Data

Area (ac) 0.55
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	0.55	B	58.00
Composite Area & Weighted CN	0.55		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

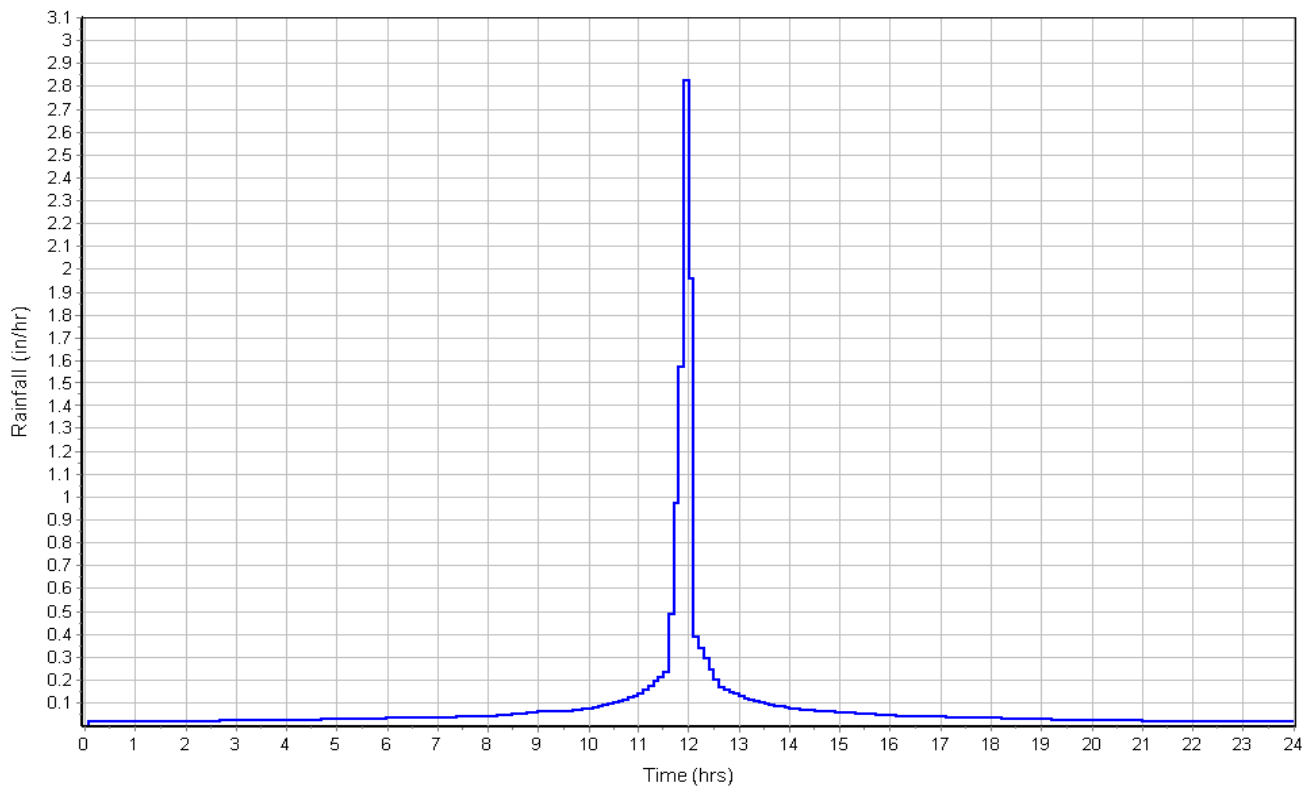
	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.023	0.00	0.00
Flow Length (ft) :	200	0.00	0.00
Channel Slope (%) :	1.5	0.00	0.00
Cross Section Area (ft ²) :	6	0.00	0.00
Wetted Perimeter (ft) :	10.25	0.00	0.00
Velocity (ft/sec) :	5.55	0.00	0.00
Computed Flow Time (min) :	0.60	0.00	0.00
Total TOC (min)29.54			

Subbasin Runoff Results

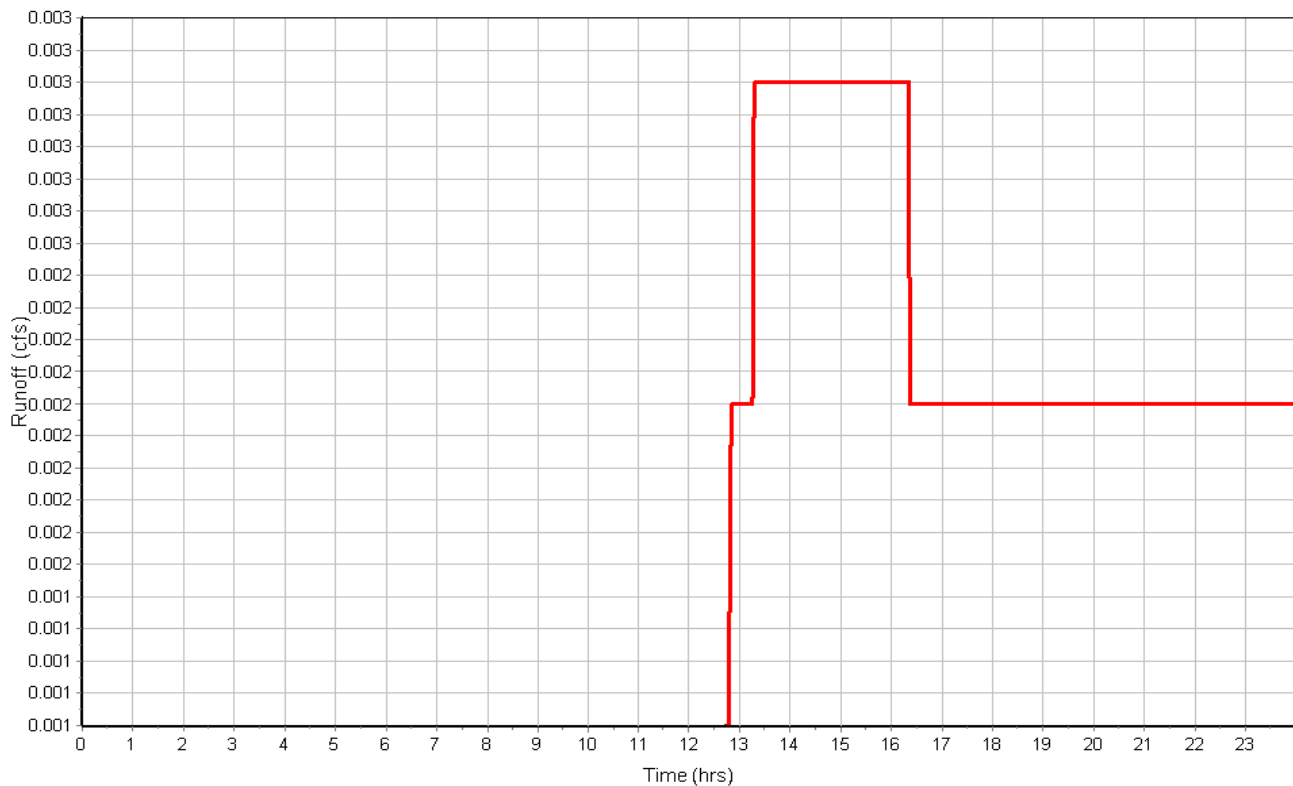
Total Rainfall (in) 2.06
Total Runoff (in) 0.05
Peak Runoff (cfs) 0.00
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:29:32

Subbasin : Sub-03

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-04

Input Data

Area (ac) 11.60
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	11.60	B	58.00
Composite Area & Weighted CN	11.60		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

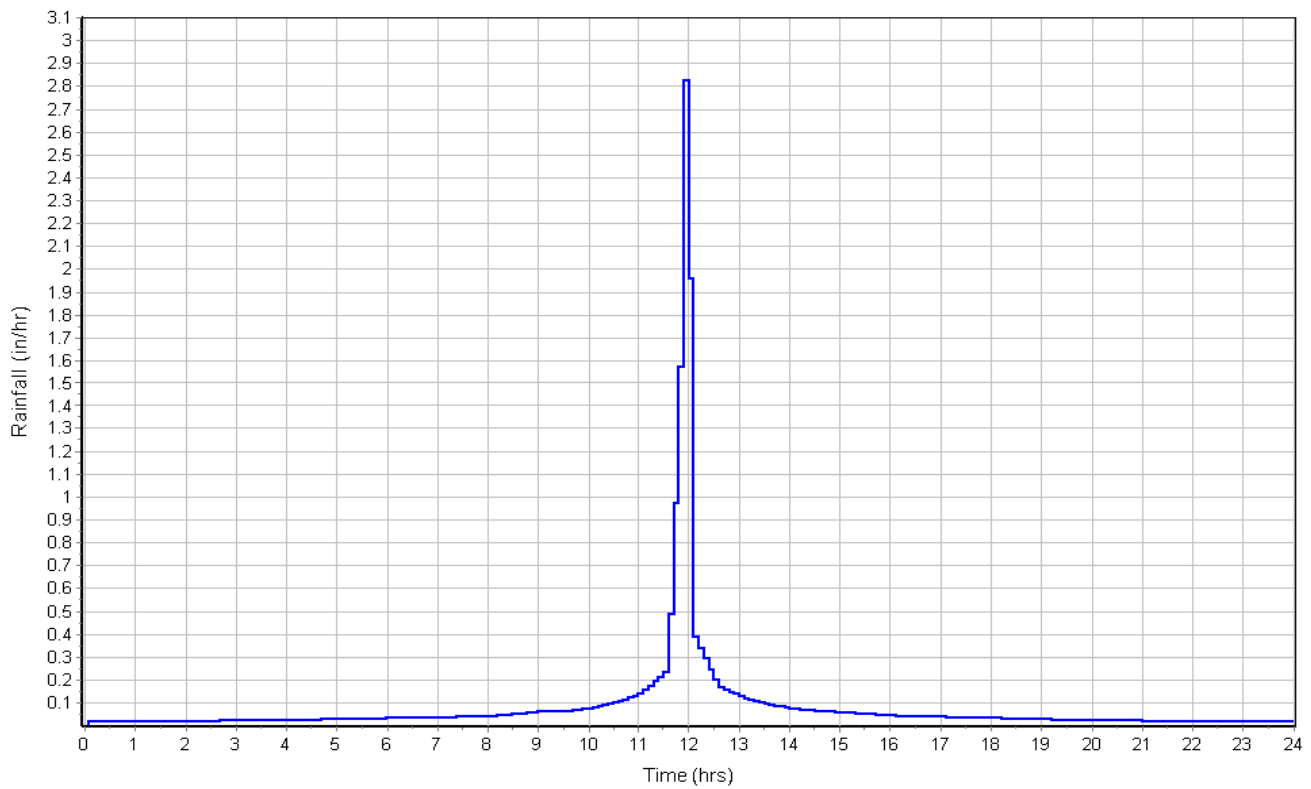
	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	700	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	5.89	0.00	0.00
Total TOC (min)	34.83		

Subbasin Runoff Results

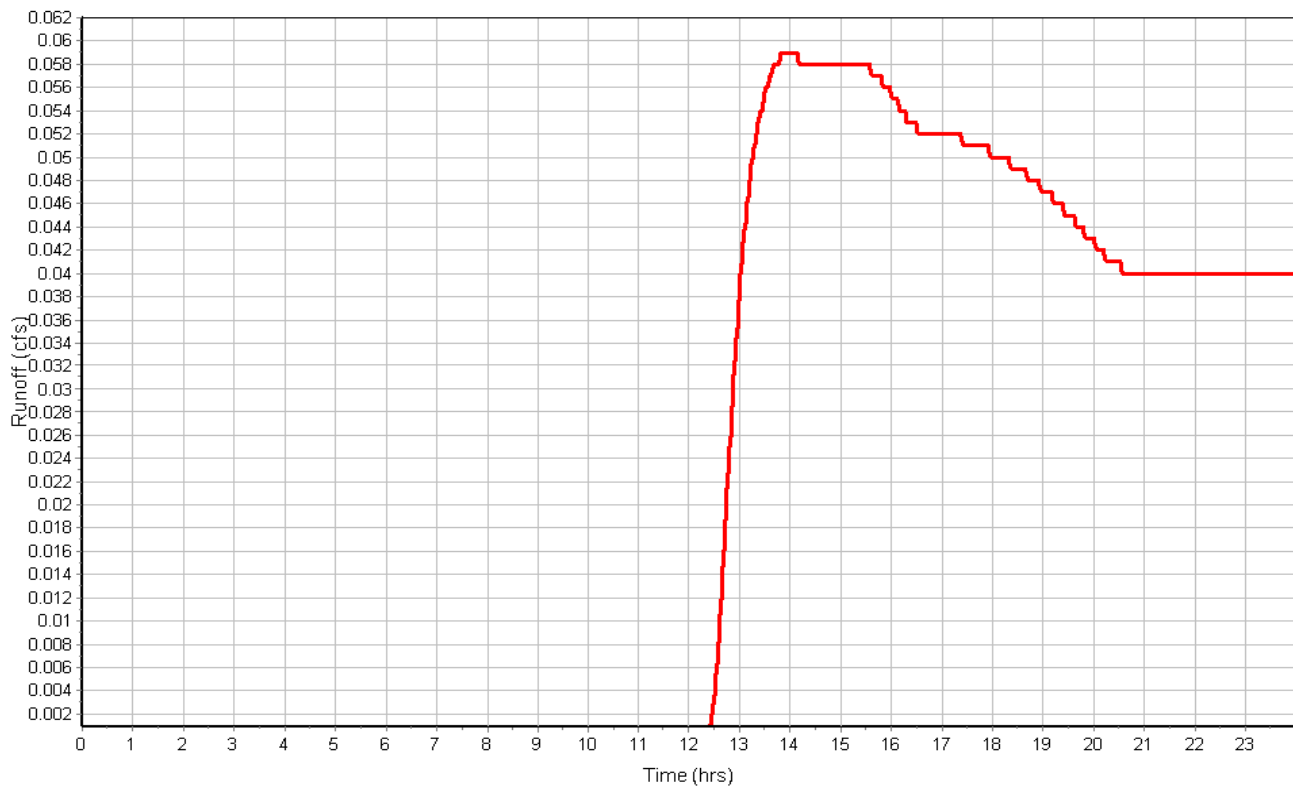
Total Rainfall (in) 2.06
Total Runoff (in) 0.05
Peak Runoff (cfs) 0.06
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:34:50

Subbasin : Sub-04

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-05

Input Data

Area (ac) 3.13
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	3.13	B	58.00
Composite Area & Weighted CN	3.13		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

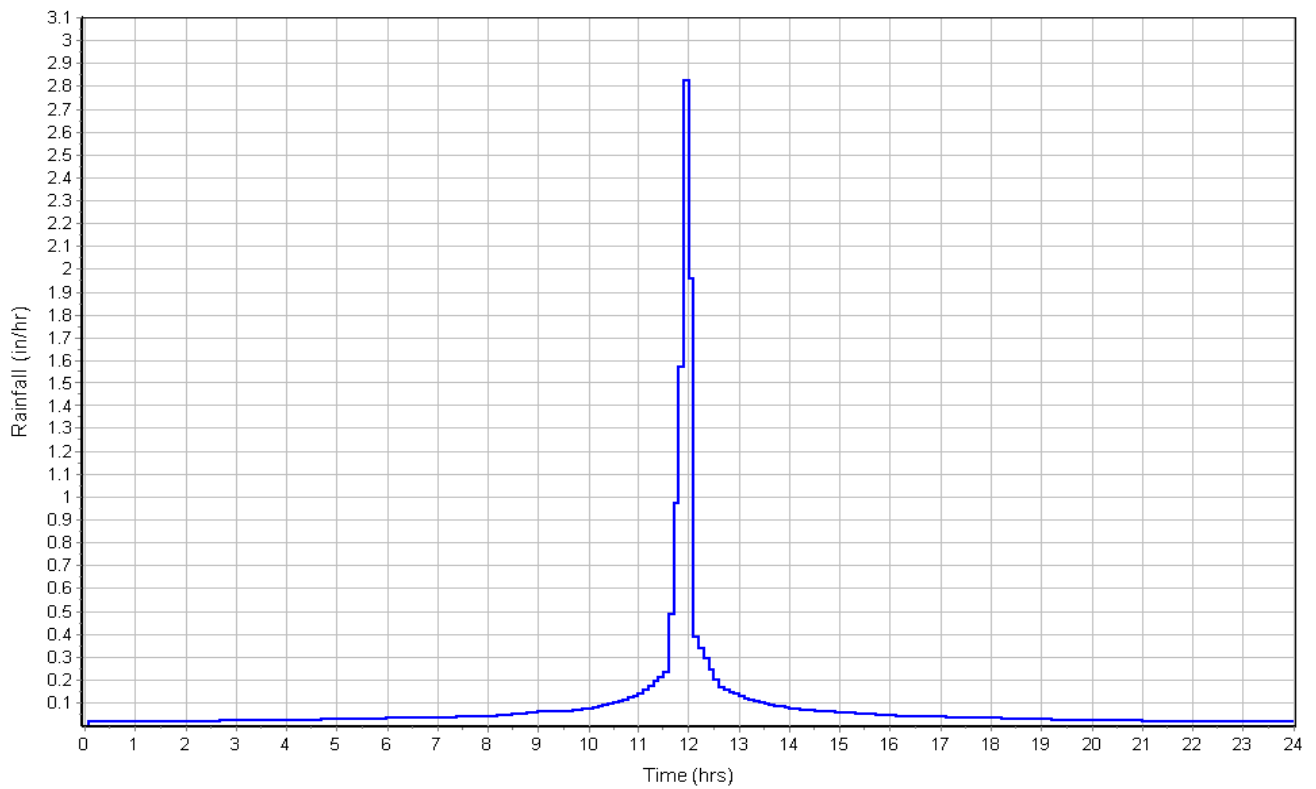
	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	600	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	5.05	0.00	0.00
Total TOC (min)	33.99		

Subbasin Runoff Results

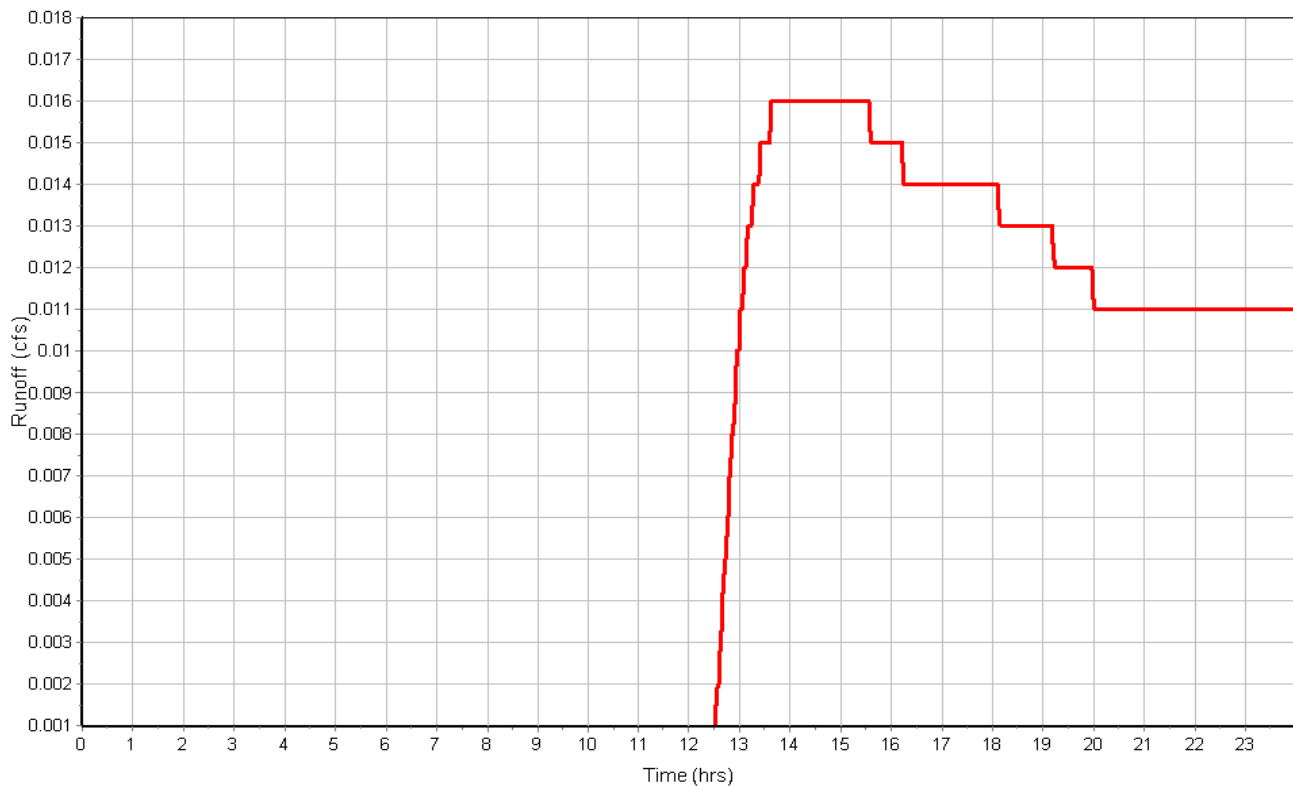
Total Rainfall (in) 2.06
Total Runoff (in) 0.05
Peak Runoff (cfs) 0.02
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:33:59

Subbasin : Sub-05

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-06

Input Data

Area (ac) 10.25
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	10.25	B	58.00
Composite Area & Weighted CN	10.25		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

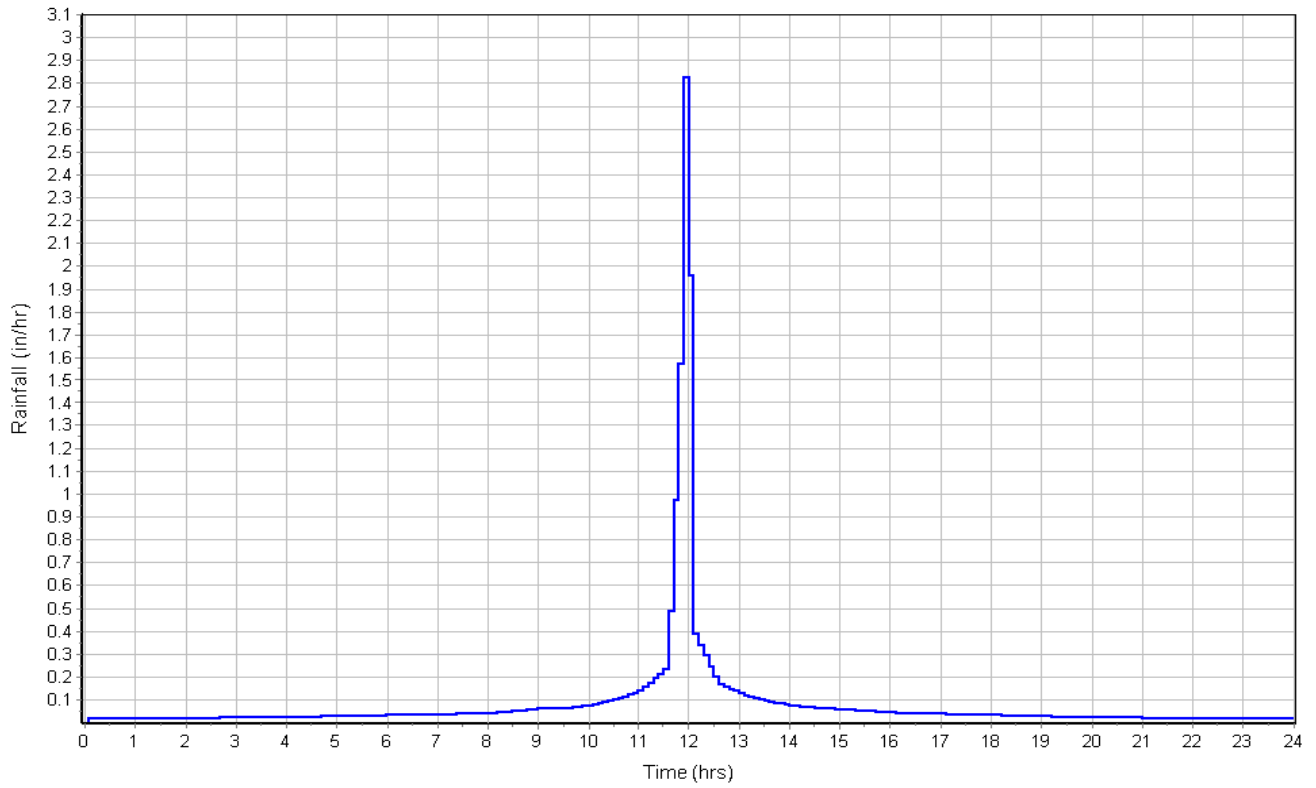
	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	4.21	0.00	0.00
Total TOC (min)	33.15		

Subbasin Runoff Results

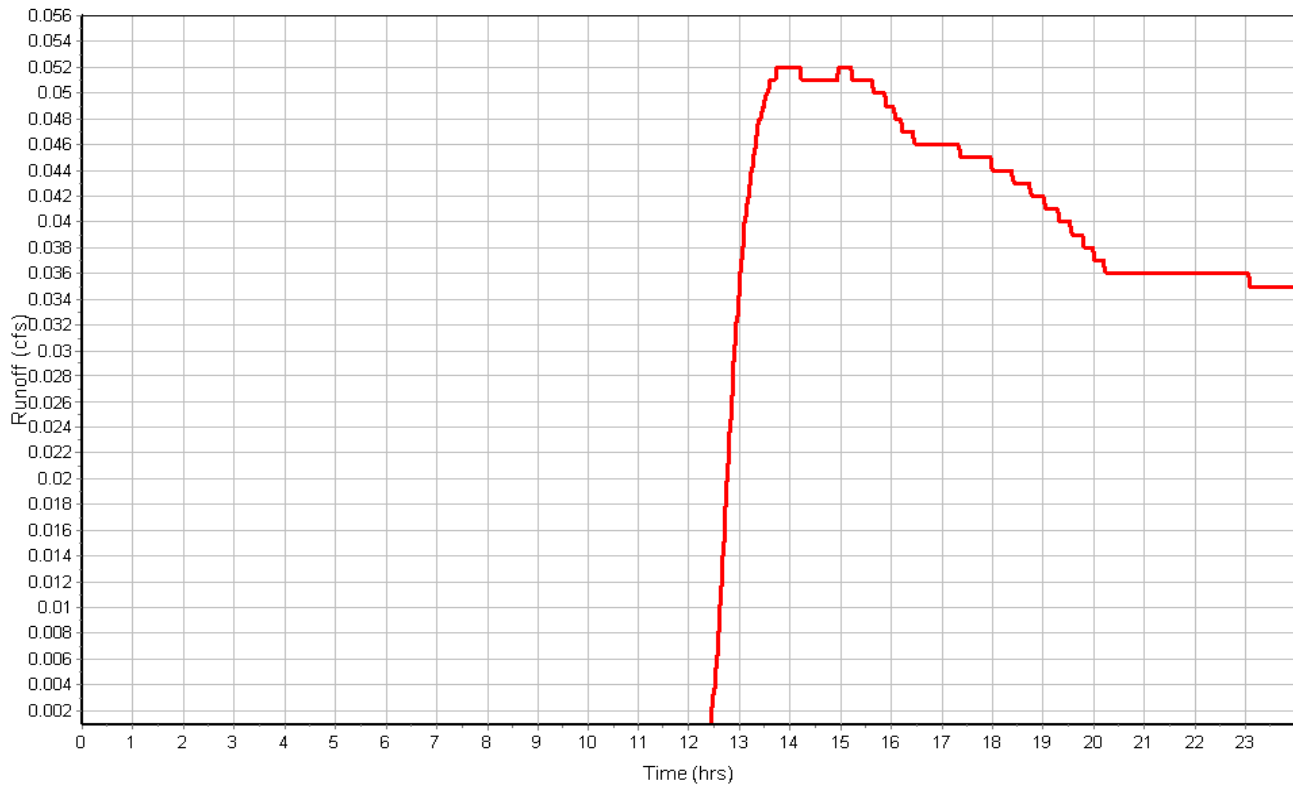
Total Rainfall (in) 2.06
Total Runoff (in) 0.05
Peak Runoff (cfs) 0.05
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:33:09

Subbasin : Sub-06

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-07

Input Data

Area (ac) 109.30
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	109.30	B	58.00
Composite Area & Weighted CN	109.30		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	3200	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	26.94	0.00	0.00

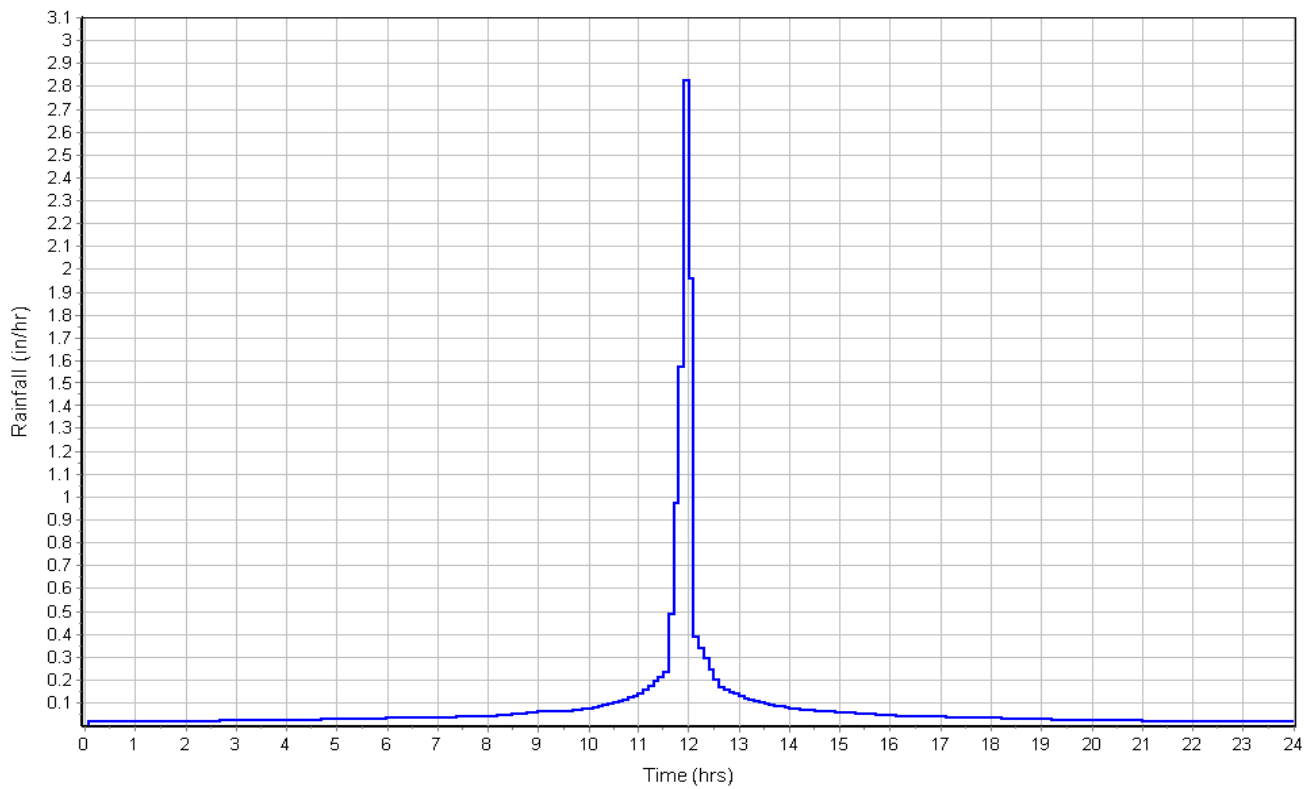
	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.023	0.00	0.00
Flow Length (ft) :	2900	0.00	0.00
Channel Slope (%) :	1.5	0.00	0.00
Cross Section Area (ft²) :	6	0.00	0.00
Wetted Perimeter (ft) :	10.25	0.00	0.00
Velocity (ft/sec) :	5.55	0.00	0.00
Computed Flow Time (min) :	8.71	0.00	0.00
Total TOC (min)	64.58		

Subbasin Runoff Results

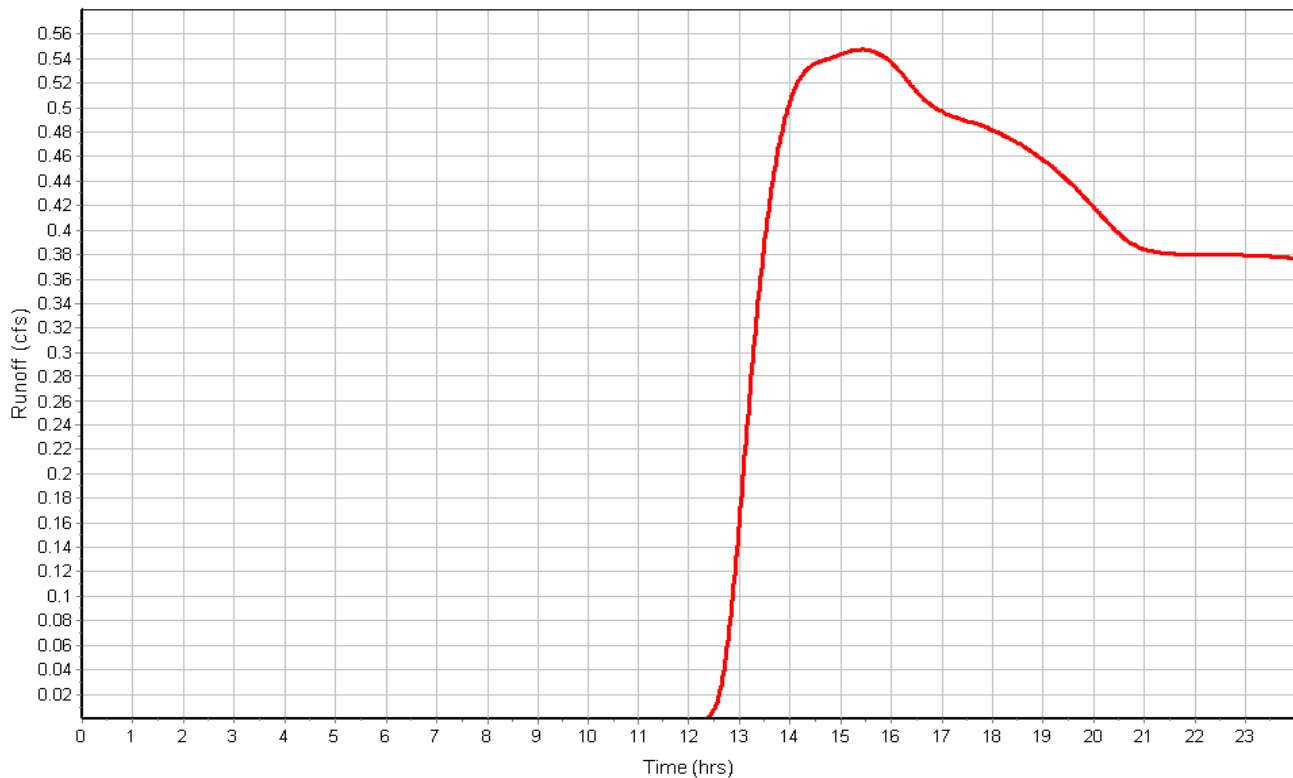
Total Rainfall (in) 2.06
Total Runoff (in) 0.05
Peak Runoff (cfs) 0.55
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 01:04:35

Subbasin : Sub-07

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft ²)
1	CUL-01-IN	6723.05	6728.05	5.00	6723.05	0.00	6728.05	0.00	0.00
2	CUL-01-OUT	6722.74	6727.74	5.00	6722.74	0.00	6727.74	0.00	0.00
3	CULV-02-IN	6801.36	6806.36	5.00	6801.36	0.00	6806.36	0.00	0.00
4	CULV-02-OUT	6801.08	6806.08	5.00	6801.08	0.00	6806.08	0.00	0.00
5	CULV-03-IN	6813.53	6818.53	5.00	6813.53	0.00	6818.53	0.00	0.00
6	CULV-03-OUT	6812.93	6817.93	5.00	6812.93	0.00	6817.93	0.00	0.00
7	CULV-04-IN	6818.56	6823.56	5.00	6818.56	0.00	6823.56	0.00	0.00
8	CULV-04-OUT	6817.81	6822.81	5.00	6817.81	0.00	6822.81	0.00	0.00
9	CULV-05-IN	6840.90	6845.90	5.00	6840.90	0.00	6845.90	0.00	0.00
10	CULV-05-OUT	6840.76	6845.76	5.00	6840.76	0.00	6845.76	0.00	0.00
11	CULV-06-IN	6847.79	6852.79	5.00	6847.79	0.00	6852.79	0.00	0.00
12	CULV-06-OUT	6847.20	6852.20	5.00	6847.20	0.00	6852.20	0.00	0.00
13	CULV-07-IN	6864.23	6869.23	5.00	6864.23	0.00	6869.23	0.00	0.00
14	CULV-07-OUT	6863.37	6868.37	5.00	6863.37	0.00	6868.37	0.00	0.00

BIA KINLICHEE ROAD IMPROVEMENTS
10-YEAR, 24-HOUR STORM EVENT

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 CULV-01-IN	0.29	0.29	6723.21	0.16	0.00	4.84	6723.11	0.06	0 15:20	0 00:00	0.00	0.00
2 CULV-01-OUT	0.29	0.00	6723.21	0.47	0.00	4.53	6722.94	0.20	0 15:20	0 00:00	0.00	0.00
3 CULV-02-IN	0.07	0.01	6801.48	0.12	0.00	4.88	6801.41	0.05	0 15:42	0 00:00	0.00	0.00
4 CULV-02-OUT	0.07	0.00	6801.35	0.27	0.00	4.73	6801.19	0.11	0 15:44	0 00:00	0.00	0.00
5 CULV-03-IN	0.06	0.00	6813.65	0.12	0.00	4.88	6813.58	0.05	0 14:10	0 00:00	0.00	0.00
6 CULV-03-OUT	0.06	0.00	6812.97	0.04	0.00	4.96	6812.95	0.02	0 14:13	0 00:00	0.00	0.00
7 CULV-04-IN	0.06	0.06	6818.67	0.11	0.00	4.89	6818.61	0.05	0 14:06	0 00:00	0.00	0.00
8 CULV-04-OUT	0.06	0.00	6817.84	0.03	0.00	4.97	6817.82	0.01	0 14:08	0 00:00	0.00	0.00
9 CULV-05-IN	0.02	0.02	6840.95	0.05	0.00	4.95	6840.92	0.02	0 14:47	0 00:00	0.00	0.00
10 CULV-05-OUT	0.02	0.00	6840.92	0.16	0.00	4.84	6840.83	0.07	0 15:33	0 00:00	0.00	0.00
11 CULV-06-IN	0.05	0.05	6847.89	0.10	0.00	4.90	6847.83	0.04	0 14:11	0 00:00	0.00	0.00
12 CULV-06-OUT	0.05	0.00	6847.44	0.24	0.00	4.76	6847.31	0.11	0 14:11	0 00:00	0.00	0.00
13 CULV-07-IN	0.55	0.55	6864.40	0.17	0.00	4.83	6864.31	0.08	0 15:27	0 00:00	0.00	0.00
14 CULV-07-OUT	0.55	0.00	6863.96	0.59	0.00	4.41	6863.62	0.25	0 15:28	0 00:00	0.00	0.00

BIA KINLICHEE ROAD IMPROVEMENTS
10-YEAR, 24-HOUR STORM EVENT

Channel Input

SN	Element ID	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Shape	Height	Width	Manning's Roughness	Entrance Losses	Exit/Bend Losses
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(ft)	(ft)			
1	OUTFALL1-LINK	100.00	6722.74	0.00	6721.74	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
2	OUTFALL2-LINK	100.00	6801.08	0.00	6800.08	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
3	OUTFALL3-LINK	100.00	6840.76	0.00	6839.76	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
4	OUTFALL4-LINK	100.00	6847.20	0.00	6846.20	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
5	OUTFALL5-LINK	100.00	6863.37	0.00	6862.37	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
6	SWALE_C3-C2	810.00	6812.93	0.00	6801.36	0.00	11.57	1.4300	Trapezoidal	1.000	10.000	0.0250	0.5000	0.5000
7	SWALE_C4-C3	205.00	6817.81	0.00	6813.53	0.00	4.28	2.0900	Trapezoidal	1.000	10.000	0.0250	0.5000	0.5000

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		
1 OUTFALL1-LINK	0.29	0 15:20	169.73	0.00	1.37	1.22	0.46		
2 OUTFALL2-LINK	0.07	0 15:44	169.73	0.00	0.96	1.74	0.27		
3 OUTFALL3-LINK	0.02	0 15:11	169.73	0.00	0.82	2.03	0.15		
4 OUTFALL4-LINK	0.05	0 14:12	169.73	0.00	0.89	1.87	0.24		
5 OUTFALL5-LINK	0.55	0 15:28	169.73	0.00	1.60	1.04	0.59		
6 SWALE_C3-C2	0.06	0 14:13	29.83	0.00	0.63	21.43	0.08		
7 SWALE_C4-C3	0.06	0 14:09	36.07	0.00	0.47	7.27	0.07		

BIA KINLICHEE ROAD IMPROVEMENTS
10-YEAR, 24-HOUR STORM EVENT

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	No. of Barrels
1	CULV-01	40.00	6723.05	6722.74	0.7800	CIRCULAR	36.000	36.000	0.0250	0.5000	0.5000	3
2	CULV-02	30.00	6801.36	6801.08	0.9300	CIRCULAR	36.000	36.000	0.0250	0.5000	0.5000	1
3	CULV-03	40.00	6813.53	6812.93	1.5000	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	1
4	CULV-04	40.00	6818.56	6817.81	1.8800	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	1
5	CULV-05	30.00	6840.90	6840.76	0.4700	CIRCULAR	24.000	24.000	0.0250	0.5000	0.5000	1
6	CULV-06	30.00	6847.79	6847.20	1.9700	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	1
7	CULV-07	65.00	6864.23	6863.37	1.3200	CIRCULAR	36.000	36.000	0.0250	0.5000	0.5000	3

BIA KINLICHEE ROAD IMPROVEMENTS
10-YEAR, 24-HOUR STORM EVENT

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)	(min)		
1	CULV-01	0.29	0 15:20	91.60	0.00	0.32	2.08	0.31	0.00		Calculated
2	CULV-02	0.07	0 15:43	33.51	0.00	0.40	1.25	0.19	0.00		Calculated
3	CULV-03	0.06	0 14:10	26.12	0.00	1.45	0.46	0.08	0.00		Calculated
4	CULV-04	0.06	0 14:00	29.21	0.00	1.48	0.45	0.07	0.00		Calculated
5	CULV-05	0.02	0 13:53	8.04	0.00	0.35	1.43	0.10	0.00		Calculated
6	CULV-06	0.05	0 13:56	29.91	0.00	0.55	0.91	0.17	0.00		Calculated
7	CULV-07	0.55	0 15:27	119.68	0.00	0.38	2.85	0.38	0.00		Calculated

Project Description

File Name 21190_SSA_TR55.SPF

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method SCS TR-55
Time of Concentration (TOC) Method SCS TR-55
Link Routing Method Hydrodynamic
Enable Overflow Ponding at Nodes YES
Skip Steady State Analysis Time Periods NO

Analysis Options

Start Analysis On Jul 15, 2021 00:00:00
End Analysis On Jul 16, 2021 00:00:00
Start Reporting On Jul 15, 2021 00:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:01:00 days hh:mm:ss
Routing Time Step 5 seconds

Number of Elements

Qty
Rain Gages 1
Subbasins..... 7
Nodes..... 19
 Junctions 14
 Outfalls 5
 Flow Diversions 0
 Inlets 0
 Storage Nodes 0
Links..... 14
 Channels 7
 Pipes 7
 Pumps 0
 Orifices 0
 Weirs 0
 Outlets 0
Pollutants 0
Land Uses 0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	100Yr- 24Hr Storm	Cumulative	inches	Arizona	Apache (Central)	100	3.19	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ft³)	(cfs)	(days hh:mm:ss)
1	Sub-01	58.65	58.00	3.19	0.34	71962.12	6.51	0 00:52:30
2	Sub-02	1.43	58.00	3.19	0.34	1752.84	0.22	0 00:31:20
3	Sub-03	0.55	58.00	3.19	0.34	672.66	0.09	0 00:29:32
4	Sub-04	11.60	58.00	3.19	0.34	14235.15	1.66	0 00:34:49
5	Sub-05	3.13	58.00	3.19	0.34	3842.09	0.46	0 00:33:59
6	Sub-06	10.25	58.00	3.19	0.34	12574.21	1.52	0 00:33:09
7	Sub-07	109.30	58.00	3.19	0.34	134099.76	10.68	0 01:04:34

BIA KINLICHEE ROAD IMPROVEMENTS
100-YEAR, 24-HOUR STORM EVENT

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Time of Peak Flooding Occurrence (days hh:mm)
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	
1	CUL-01-IN	Junction	6723.05	6728.05	6723.05	6728.05	0.00	6.50	6724.27	0 00:00
2	CUL-01-OUT	Junction	6722.74	6727.74	6722.74	6727.74	0.00	6.50	6724.26	0 00:00
3	CULV-02-IN	Junction	6801.36	6806.36	6801.36	6806.36	0.00	1.92	6801.99	0 00:00
4	CULV-02-OUT	Junction	6801.08	6806.08	6801.08	6806.08	0.00	1.57	6801.96	0 00:00
5	CULV-03-IN	Junction	6813.53	6818.53	6813.53	6818.53	0.00	1.75	6814.17	0 00:00
6	CULV-03-OUT	Junction	6812.93	6817.93	6812.93	6817.93	0.00	2.23	6813.18	0 00:00
7	CULV-04-IN	Junction	6818.56	6823.56	6818.56	6823.56	0.00	1.66	6819.20	0 00:00
8	CULV-04-OUT	Junction	6817.81	6822.81	6817.81	6822.81	0.00	1.88	6818.03	0 00:00
9	CULV-05-IN	Junction	6840.90	6845.90	6840.90	6845.90	0.00	0.46	6841.34	0 00:00
10	CULV-05-OUT	Junction	6840.76	6845.76	6840.76	6845.76	0.00	0.46	6841.31	0 00:00
11	CULV-06-IN	Junction	6847.79	6852.79	6847.79	6852.79	0.00	1.51	6848.42	0 00:00
12	CULV-06-OUT	Junction	6847.20	6852.20	6847.20	6852.20	0.00	1.51	6848.07	0 00:00
13	CULV-07-IN	Junction	6864.23	6869.23	6864.23	6869.23	0.00	10.68	6865.24	0 00:00
14	CULV-07-OUT	Junction	6863.37	6868.37	6863.37	6868.37	0.00	10.67	6865.21	0 00:00
15	Out-01	Outfall	6721.74					6.50	6723.21	
16	Out-02	Outfall	6800.08					1.57	6800.94	
17	Out-03	Outfall	6839.76					0.45	6840.30	
18	Out-04	Outfall	6846.20					1.51	6847.05	
19	Out-05	Outfall	6862.37					10.67	6864.14	

BIA KINLICHEE ROAD IMPROVEMENTS
100-YEAR, 24-HOUR STORM EVENT

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Total Depth	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		
1	CULV-01	Pipe	CUL-01-IN	CUL-01-OUT	40.00	6723.05	6722.74	0.7800	36.000	0.0250	6.50	91.60	0.07	0.69	1.37	0.46	Calculated
2	CULV-02	Pipe	CULV-02-IN	CULV-02-OUT	30.00	6801.36	6801.08	0.9300	36.000	0.0250	1.57	33.51	0.05	1.12	0.76	0.25	Calculated
3	CULV-03	Pipe	CULV-03-IN	CULV-03-OUT	40.00	6813.53	6812.93	1.5000	30.000	0.0250	2.23	26.12	0.09	3.96	0.44	0.18	Calculated
4	CULV-04	Pipe	CULV-04-IN	CULV-04-OUT	40.00	6818.56	6817.81	1.8800	30.000	0.0250	1.88	29.21	0.06	3.43	0.43	0.17	Calculated
5	CULV-05	Pipe	CULV-05-IN	CULV-05-OUT	30.00	6840.90	6840.76	0.4700	24.000	0.0250	0.46	8.04	0.06	0.76	0.49	0.25	Calculated
6	CULV-06	Pipe	CULV-06-IN	CULV-06-OUT	30.00	6847.79	6847.20	1.9700	30.000	0.0250	1.51	29.91	0.05	1.22	0.75	0.30	Calculated
7	CULV-07	Pipe	CULV-07-IN	CULV-07-OUT	65.00	6864.23	6863.37	1.3200	36.000	0.0250	10.67	119.68	0.09	1.07	1.43	0.48	Calculated
8	OUTFALL1-LINK	Channel	CUL-01-OUT	Out-01	100.00	6722.74	6721.74	1.0000	60.000	0.0320	6.50	169.73	0.04	2.90	1.50	0.30	
9	OUTFALL2-LINK	Channel	CULV-02-OUT	Out-02	100.00	6801.08	6800.08	1.0000	60.000	0.0320	1.57	169.73	0.01	2.06	0.87	0.17	
10	OUTFALL3-LINK	Channel	CULV-05-OUT	Out-03	100.00	6840.76	6839.76	1.0000	60.000	0.0320	0.45	169.73	0.00	1.53	0.55	0.11	
11	OUTFALL4-LINK	Channel	CULV-06-OUT	Out-04	100.00	6847.20	6846.20	1.0000	60.000	0.0320	1.51	169.73	0.01	2.05	0.86	0.17	
12	OUTFALL5-LINK	Channel	CULV-07-OUT	Out-05	100.00	6863.37	6862.37	1.0000	60.000	0.0320	10.67	169.73	0.06	3.27	1.81	0.36	
13	SWALE_C3-C2	Channel	CULV-03-OUT	CULV-02-IN	810.00	6812.93	6801.36	1.4300	12.000	0.0250	1.72	29.83	0.06	1.57	0.43	0.43	
14	SWALE_C4-C3	Channel	CULV-04-OUT	CULV-03-IN	205.00	6817.81	6813.53	2.0900	12.000	0.0250	1.67	36.07	0.05	1.04	0.43	0.43	

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 58.65
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	58.65	B	58.00
Composite Area & Weighted CN	58.65		58.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T_c = Time of Concentration (hr)
n = Manning's roughness
L_f = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
S_f = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (S_f^{0.5}) (unpaved surface)
V = 20.3282 * (S_f^{0.5}) (paved surface)
V = 15.0 * (S_f^{0.5}) (grassed waterway surface)
V = 10.0 * (S_f^{0.5}) (nearly bare & untilled surface)
V = 9.0 * (S_f^{0.5}) (cultivated straight rows surface)
V = 7.0 * (S_f^{0.5}) (short grass pasture surface)
V = 5.0 * (S_f^{0.5}) (woodland surface)
V = 2.5 * (S_f^{0.5}) (forest w/heavy litter surface)
T_c = (L_f / V) / (3600 sec/hr)

Where:

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n
R = A_q / W_p
T_c = (L_f / V) / (3600 sec/hr)

Where :

T_c = Time of Concentration (hr)
L_f = Flow Length (ft)
R = Hydraulic Radius (ft)
A_q = Flow Area (ft²)
W_p = Wetted Perimeter (ft)
V = Velocity (ft/sec)
S_f = Slope (ft/ft)
n = Manning's roughness

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100-YEAR, 24-HOUR STORM EVENT

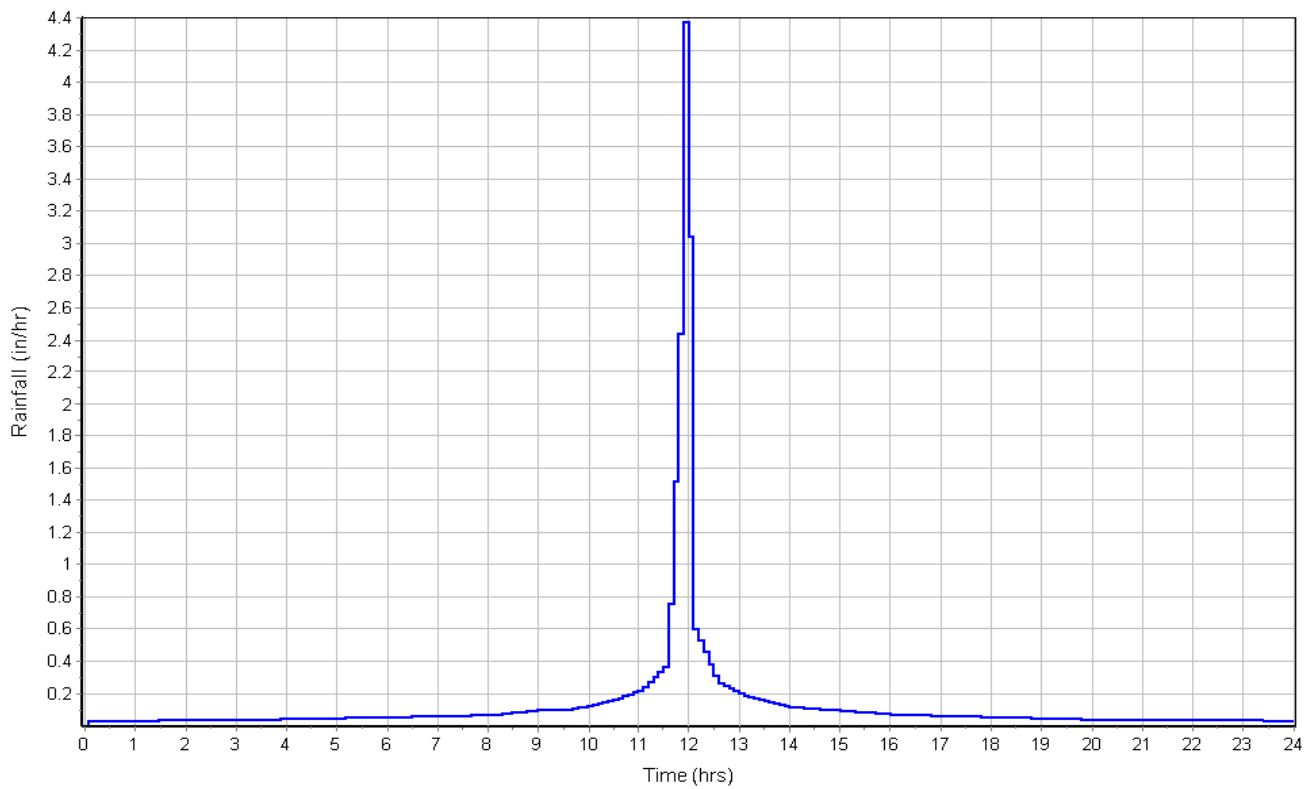
	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00
	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	2800	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	23.57	0.00	0.00
Total TOC (min)	52.51		

Subbasin Runoff Results

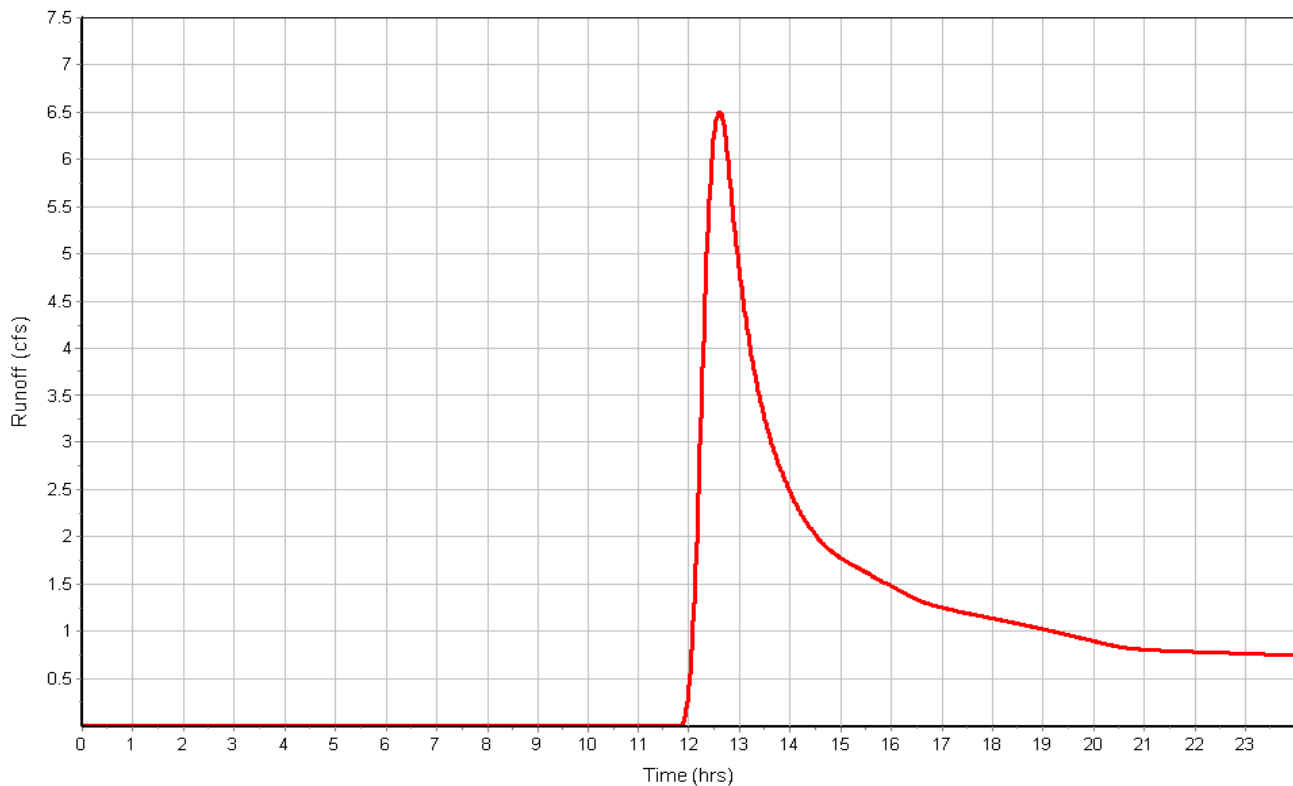
Total Rainfall (in)	3.19
Total Runoff (in)	0.34
Peak Runoff (cfs)	6.51
Weighted Curve Number	58.00
Time of Concentration (days hh:mm:ss)	0 00:52:31

Subbasin : Sub-01

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-02

Input Data

Area (ac) 1.43
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	1.43	B	58.00
Composite Area & Weighted CN	1.43		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

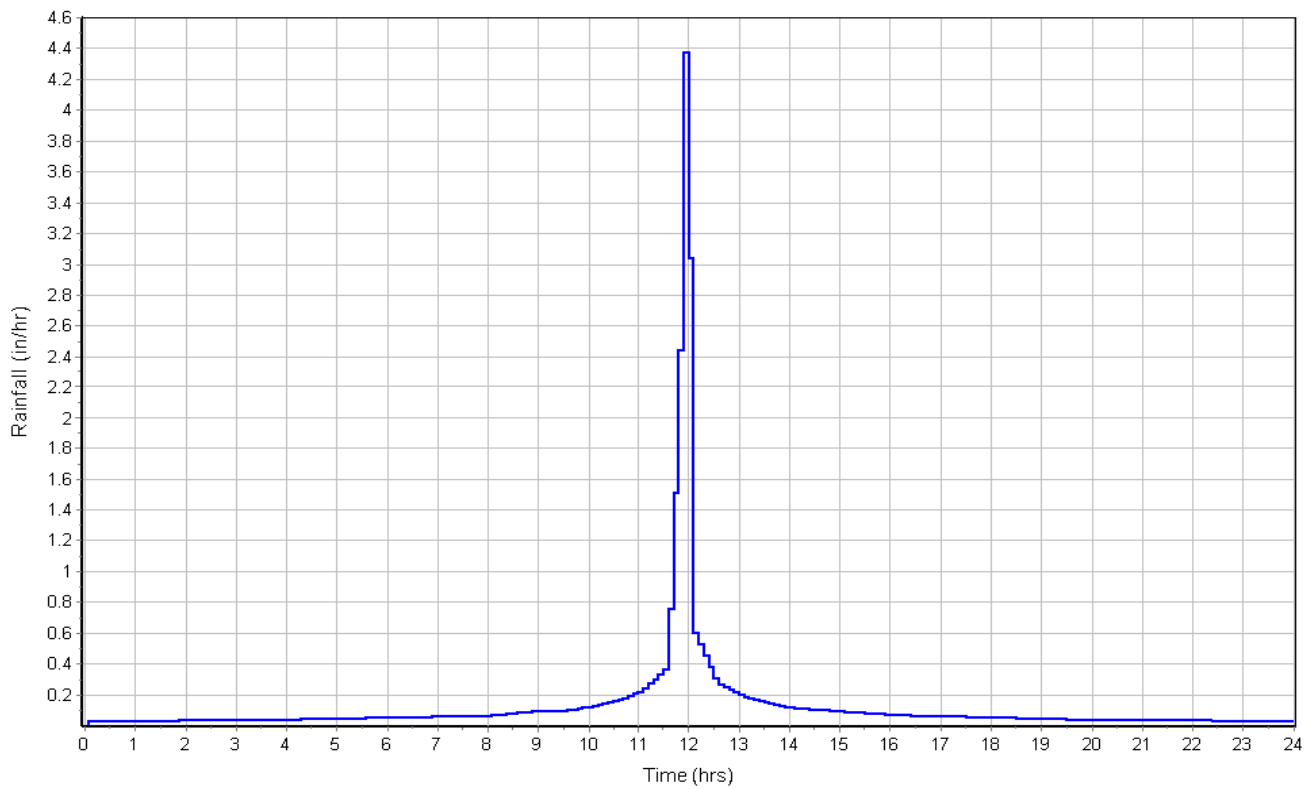
	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.023	0.00	0.00
Flow Length (ft) :	800	0.00	0.00
Channel Slope (%) :	1.5	0.00	0.00
Cross Section Area (ft ²) :	6	0.00	0.00
Wetted Perimeter (ft) :	10.25	0.00	0.00
Velocity (ft/sec) :	5.55	0.00	0.00
Computed Flow Time (min) :	2.40	0.00	0.00
Total TOC (min)	31.34		

Subbasin Runoff Results

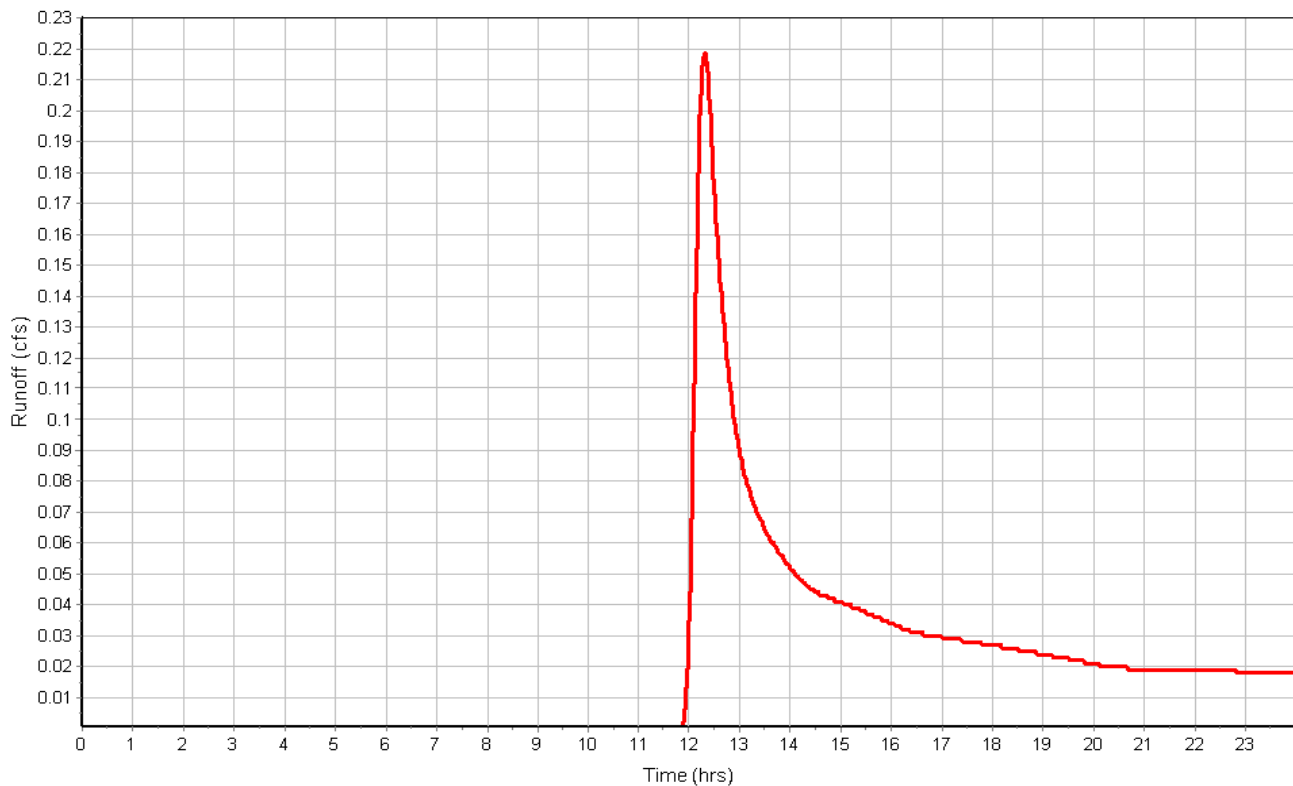
Total Rainfall (in) 3.19
Total Runoff (in) 0.34
Peak Runoff (cfs) 0.22
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:31:20

Subbasin : Sub-02

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-03

Input Data

Area (ac) 0.55
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	0.55	B	58.00
Composite Area & Weighted CN	0.55		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

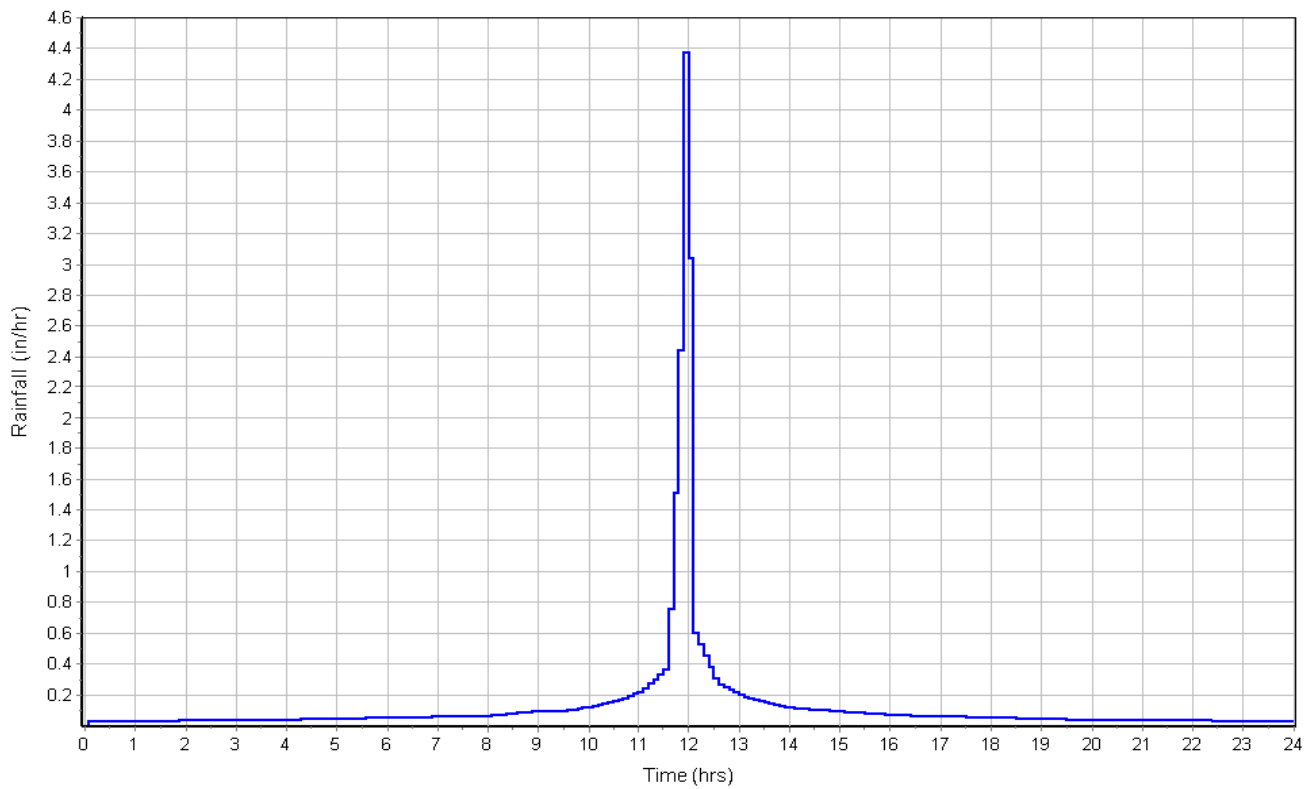
	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.023	0.00	0.00
Flow Length (ft) :	200	0.00	0.00
Channel Slope (%) :	1.5	0.00	0.00
Cross Section Area (ft ²) :	6	0.00	0.00
Wetted Perimeter (ft) :	10.25	0.00	0.00
Velocity (ft/sec) :	5.55	0.00	0.00
Computed Flow Time (min) :	0.60	0.00	0.00
Total TOC (min)	29.54		

Subbasin Runoff Results

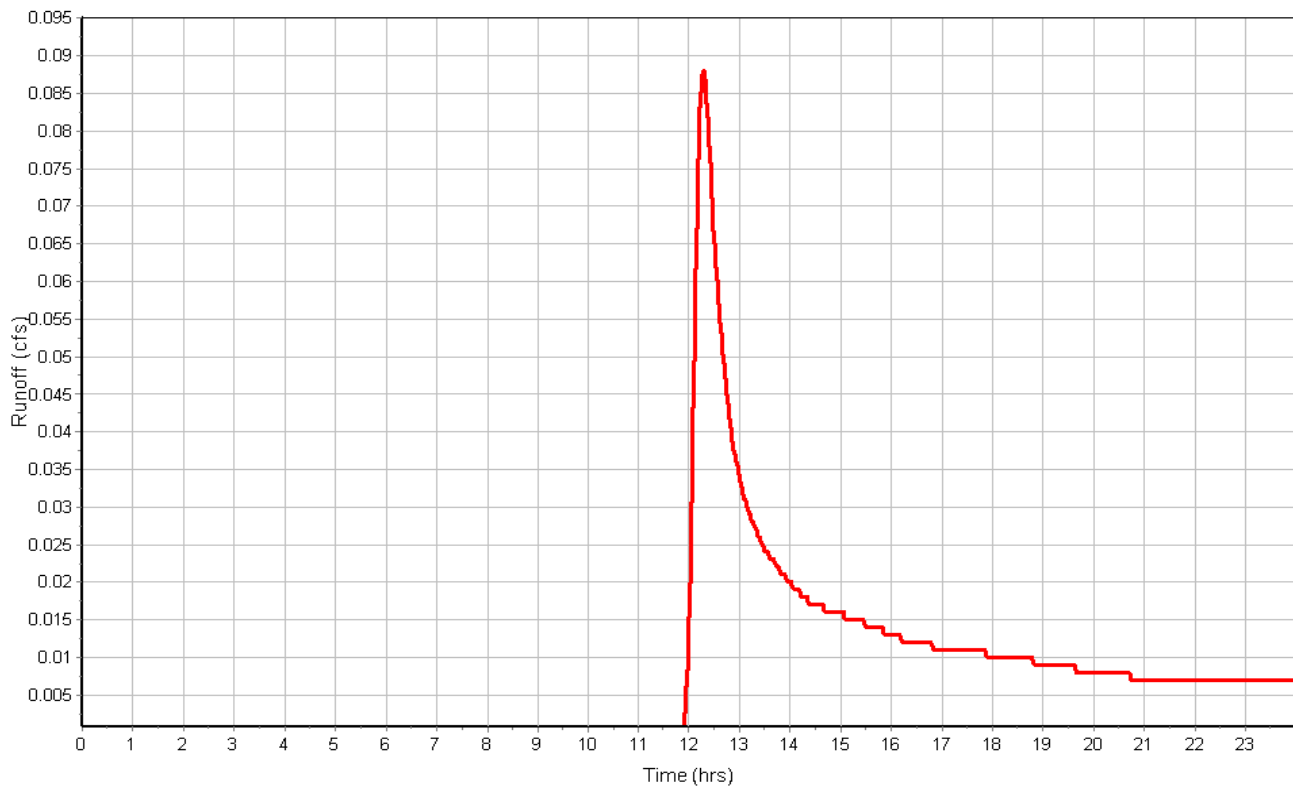
Total Rainfall (in) 3.19
Total Runoff (in) 0.34
Peak Runoff (cfs) 0.09
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:29:32

Subbasin : Sub-03

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-04

Input Data

Area (ac) 11.60
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	11.60	B	58.00
Composite Area & Weighted CN	11.60		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

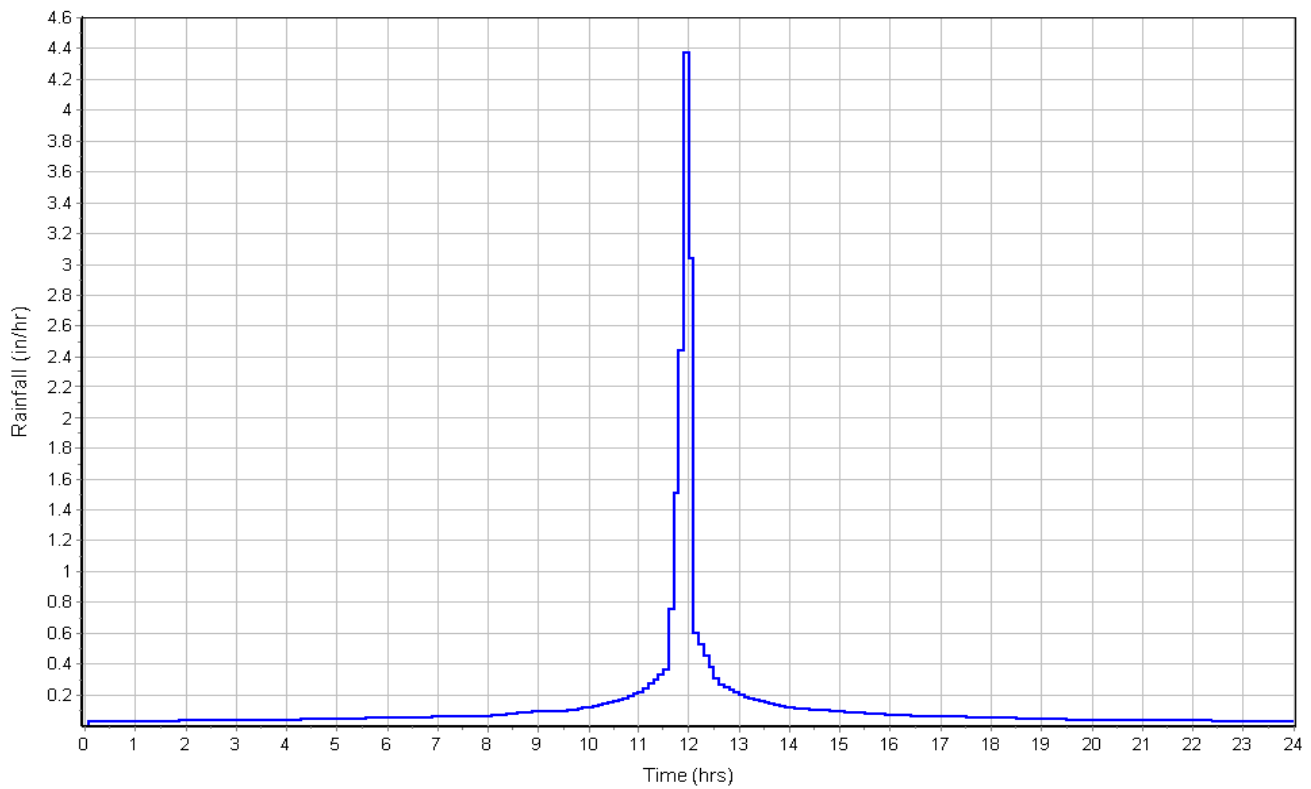
	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	700	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	5.89	0.00	0.00
Total TOC (min)	34.83		

Subbasin Runoff Results

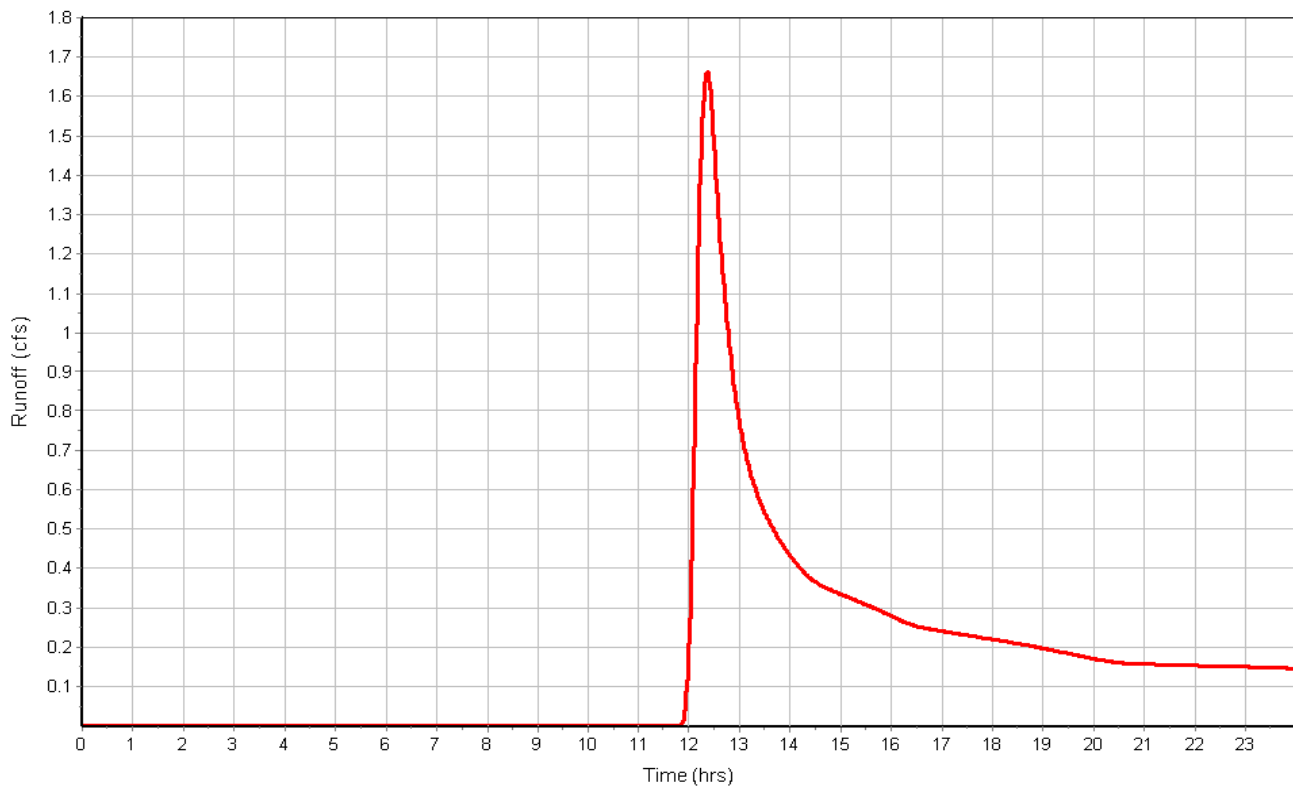
Total Rainfall (in) 3.19
Total Runoff (in) 0.34
Peak Runoff (cfs) 1.66
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:34:50

Subbasin : Sub-04

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-05

Input Data

Area (ac) 3.13
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	3.13	B	58.00
Composite Area & Weighted CN	3.13		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

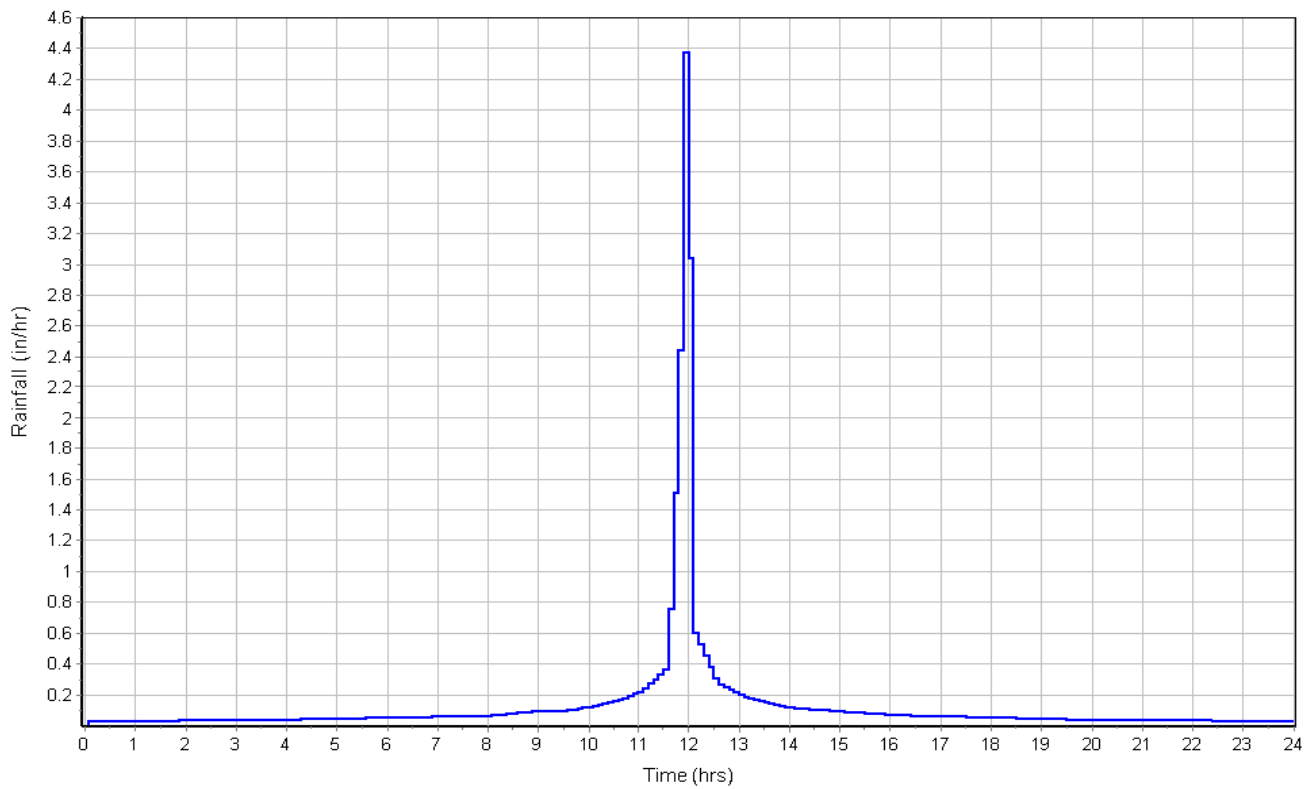
	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	600	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	5.05	0.00	0.00
Total TOC (min)	33.99		

Subbasin Runoff Results

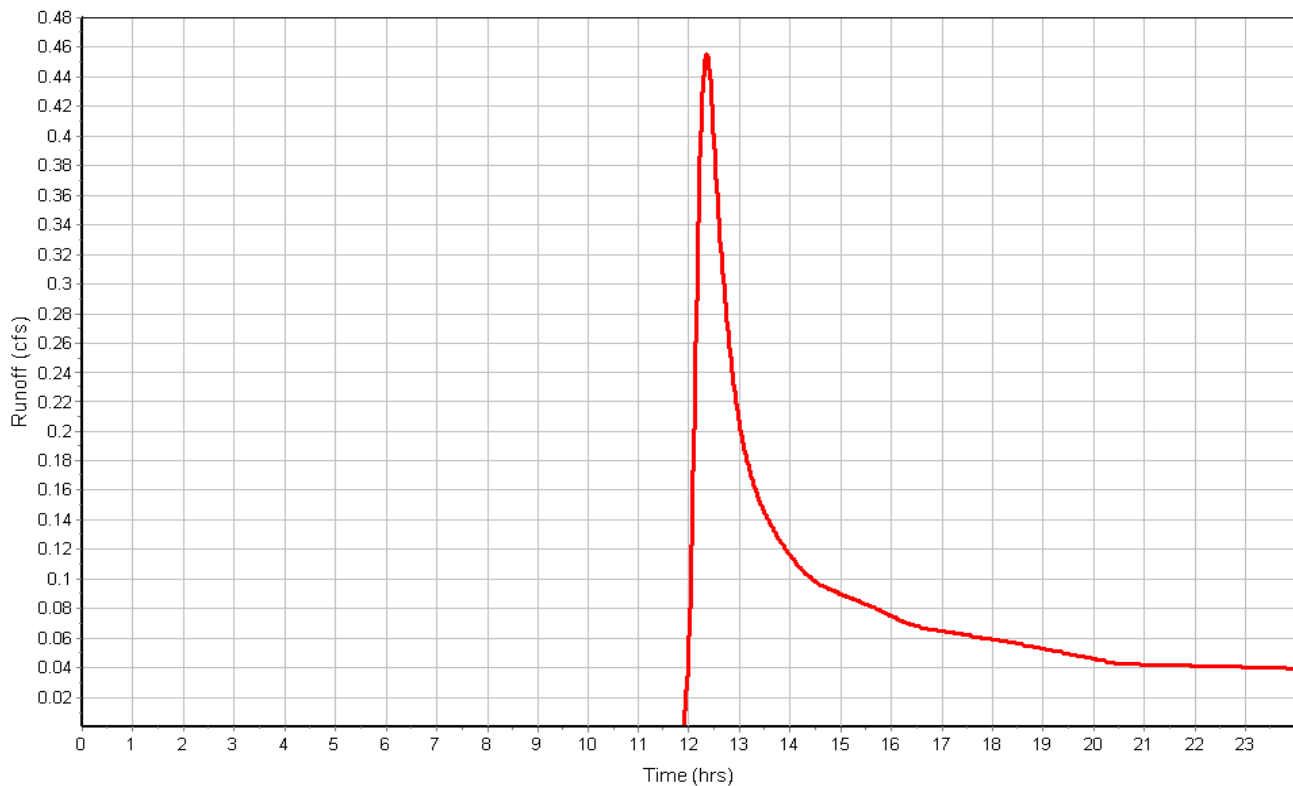
Total Rainfall (in) 3.19
Total Runoff (in) 0.34
Peak Runoff (cfs) 0.46
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:33:59

Subbasin : Sub-05

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-06

Input Data

Area (ac) 10.25
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	10.25	B	58.00
Composite Area & Weighted CN	10.25		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

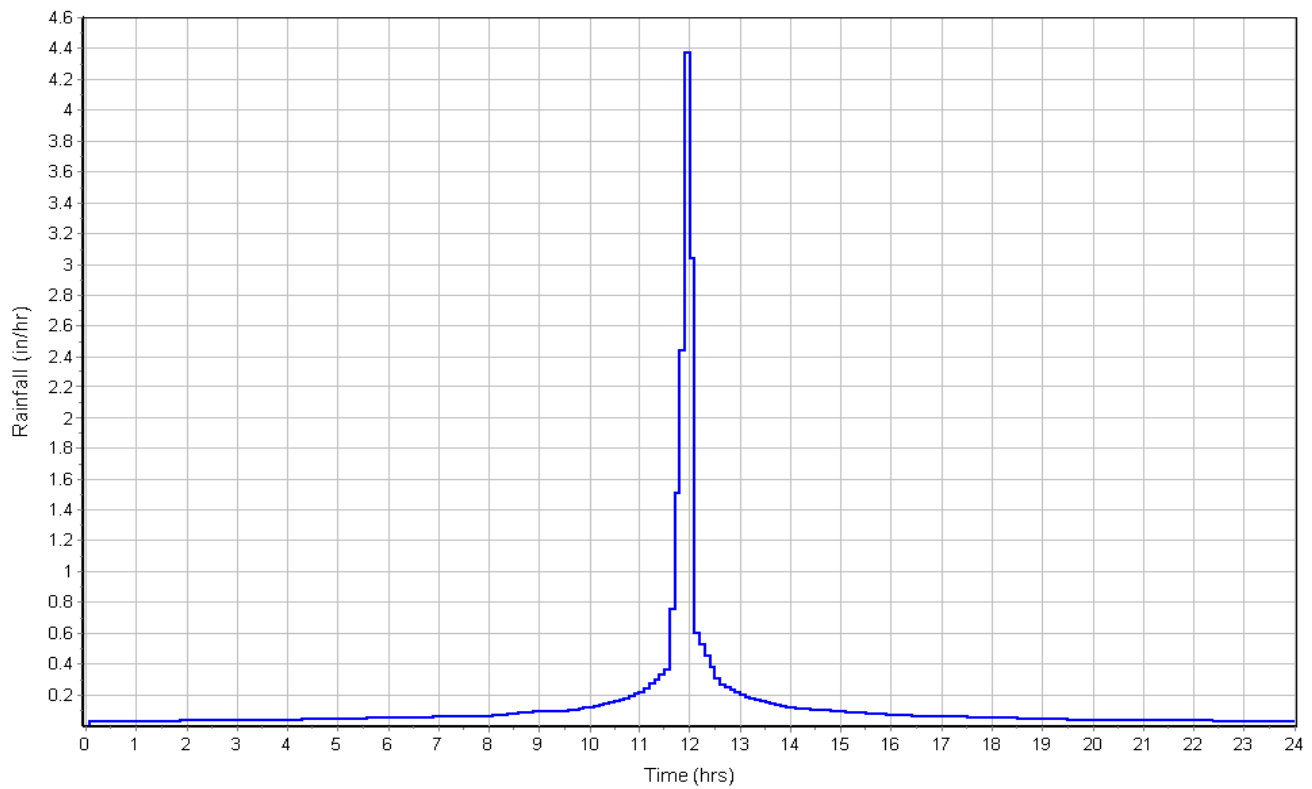
	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	500	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	4.21	0.00	0.00
Total TOC (min)	33.15		

Subbasin Runoff Results

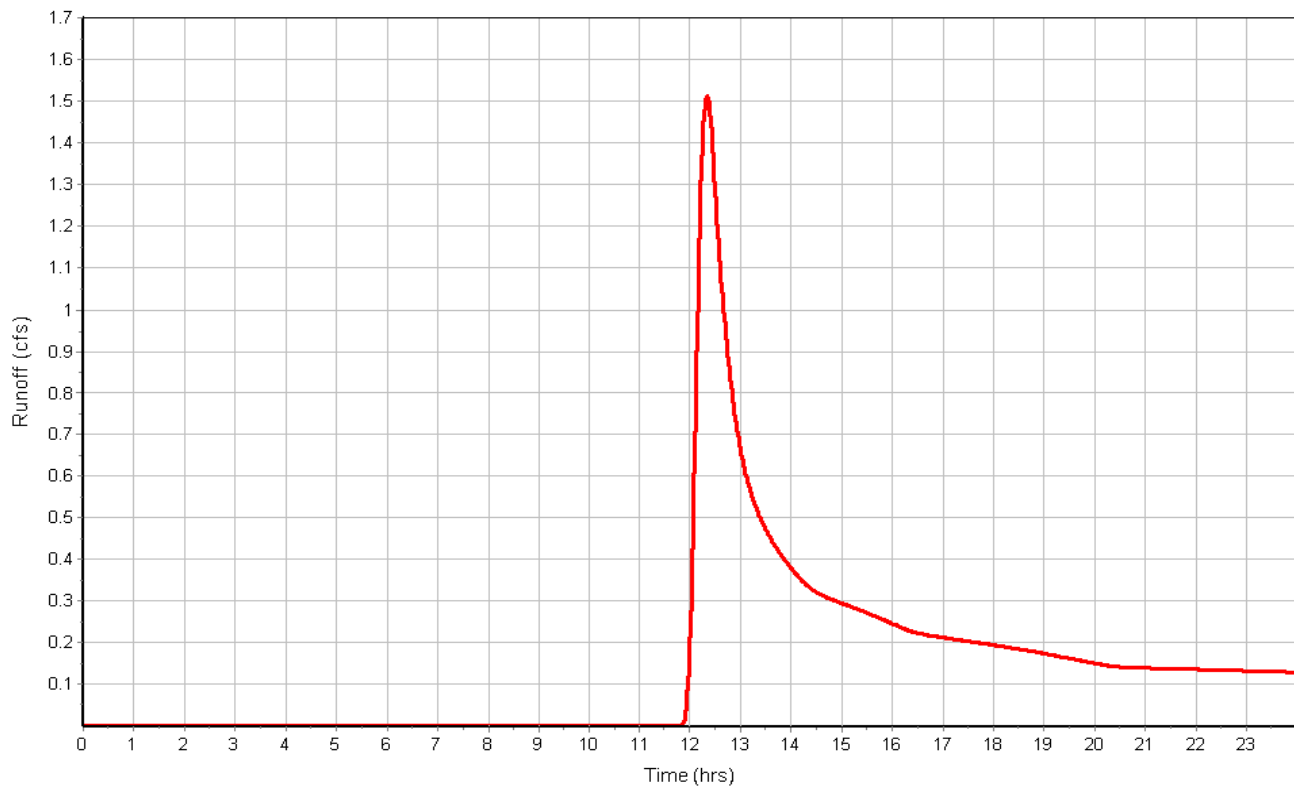
Total Rainfall (in) 3.19
Total Runoff (in) 0.34
Peak Runoff (cfs) 1.52
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 00:33:09

Subbasin : Sub-06

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : Sub-07

Input Data

Area (ac) 109.30
Weighted Curve Number 58.00
Rain Gage ID Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Pinyon & Juniper range, Fair	109.30	B	58.00
Composite Area & Weighted CN	109.30		58.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.40	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	28.94	0.00	0.00

	Subarea A	Subarea B	Subarea C
Shallow Concentrated Flow Computations			
Flow Length (ft) :	3200	0.00	0.00
Slope (%) :	1.5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	26.94	0.00	0.00

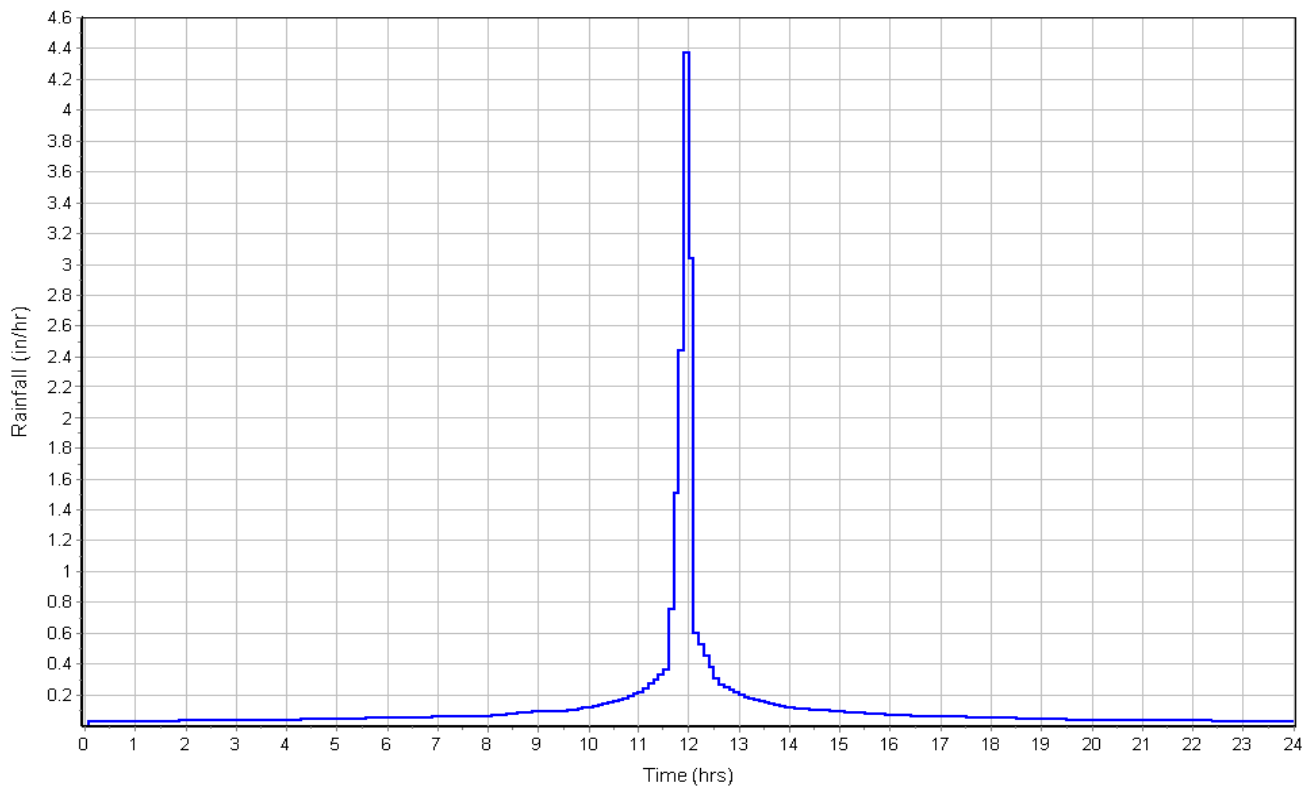
	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	0.023	0.00	0.00
Flow Length (ft) :	2900	0.00	0.00
Channel Slope (%) :	1.5	0.00	0.00
Cross Section Area (ft²) :	6	0.00	0.00
Wetted Perimeter (ft) :	10.25	0.00	0.00
Velocity (ft/sec) :	5.55	0.00	0.00
Computed Flow Time (min) :	8.71	0.00	0.00
Total TOC (min)	64.58		

Subbasin Runoff Results

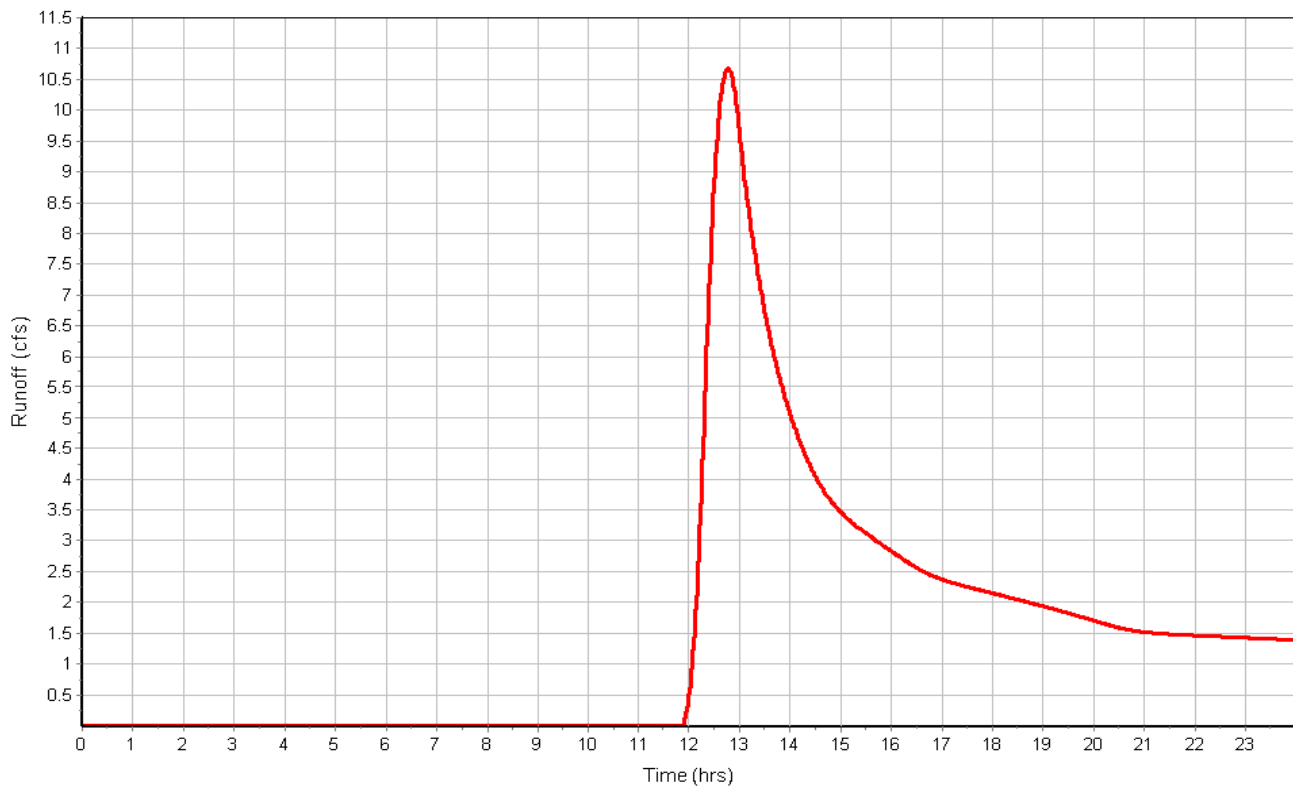
Total Rainfall (in) 3.19
Total Runoff (in) 0.34
Peak Runoff (cfs) 10.68
Weighted Curve Number 58.00
Time of Concentration (days hh:mm:ss) 0 01:04:35

Subbasin : Sub-07

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)
1	CUL-01-IN	6723.05	6728.05	5.00	6723.05	0.00	6728.05	0.00	0.00
2	CUL-01-OUT	6722.74	6727.74	5.00	6722.74	0.00	6727.74	0.00	0.00
3	CULV-02-IN	6801.36	6806.36	5.00	6801.36	0.00	6806.36	0.00	0.00
4	CULV-02-OUT	6801.08	6806.08	5.00	6801.08	0.00	6806.08	0.00	0.00
5	CULV-03-IN	6813.53	6818.53	5.00	6813.53	0.00	6818.53	0.00	0.00
6	CULV-03-OUT	6812.93	6817.93	5.00	6812.93	0.00	6817.93	0.00	0.00
7	CULV-04-IN	6818.56	6823.56	5.00	6818.56	0.00	6823.56	0.00	0.00
8	CULV-04-OUT	6817.81	6822.81	5.00	6817.81	0.00	6822.81	0.00	0.00
9	CULV-05-IN	6840.90	6845.90	5.00	6840.90	0.00	6845.90	0.00	0.00
10	CULV-05-OUT	6840.76	6845.76	5.00	6840.76	0.00	6845.76	0.00	0.00
11	CULV-06-IN	6847.79	6852.79	5.00	6847.79	0.00	6852.79	0.00	0.00
12	CULV-06-OUT	6847.20	6852.20	5.00	6847.20	0.00	6852.20	0.00	0.00
13	CULV-07-IN	6864.23	6869.23	5.00	6864.23	0.00	6869.23	0.00	0.00
14	CULV-07-OUT	6863.37	6868.37	5.00	6863.37	0.00	6868.37	0.00	0.00

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100-YEAR, 24-HOUR STORM EVENT

Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 CULV-01-IN	6.50	6.50	6724.27	1.22	0.00	3.78	6723.32	0.27	0 12:37	0 00:00	0.00	0.00
2 CULV-01-OUT	6.50	0.00	6724.26	1.52	0.00	3.48	6723.17	0.43	0 12:37	0 00:00	0.00	0.00
3 CULV-02-IN	1.92	0.22	6801.99	0.63	0.00	4.37	6801.49	0.13	0 12:39	0 00:00	0.00	0.00
4 CULV-02-OUT	1.57	0.00	6801.96	0.88	0.00	4.12	6801.32	0.24	0 12:39	0 00:00	0.00	0.00
5 CULV-03-IN	1.75	0.09	6814.17	0.64	0.00	4.36	6813.67	0.14	0 12:22	0 00:00	0.00	0.00
6 CULV-03-OUT	2.23	0.00	6813.18	0.25	0.00	4.75	6812.98	0.05	0 12:25	0 00:00	0.00	0.00
7 CULV-04-IN	1.66	1.66	6819.20	0.64	0.00	4.36	6818.69	0.13	0 12:29	0 00:00	0.00	0.00
8 CULV-04-OUT	1.88	0.00	6818.03	0.22	0.00	4.78	6817.85	0.04	0 12:23	0 00:00	0.00	0.00
9 CULV-05-IN	0.46	0.46	6841.34	0.44	0.00	4.56	6840.98	0.08	0 12:22	0 00:00	0.00	0.00
10 CULV-05-OUT	0.46	0.00	6841.31	0.55	0.00	4.45	6840.90	0.14	0 12:22	0 00:00	0.00	0.00
11 CULV-06-IN	1.51	1.51	6848.42	0.63	0.00	4.37	6847.91	0.12	0 12:21	0 00:00	0.00	0.00
12 CULV-06-OUT	1.51	0.00	6848.07	0.87	0.00	4.13	6847.42	0.22	0 12:21	0 00:00	0.00	0.00
13 CULV-07-IN	10.68	10.68	6865.24	1.01	0.00	3.99	6864.46	0.23	0 12:47	0 00:00	0.00	0.00
14 CULV-07-OUT	10.67	0.00	6865.21	1.84	0.00	3.16	6863.91	0.54	0 12:47	0 00:00	0.00	0.00

BIA KINLICHEE ROAD IMPROVEMENTS
100-YEAR, 24-HOUR STORM EVENT

Channel Input

SN Element ID	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Shape	Height	Width	Manning's Roughness	Entrance Losses	Exit/Bend Losses
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(ft)	(ft)			
1 OUTFALL1-LINK	100.00	6722.74	0.00	6721.74	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
2 OUTFALL2-LINK	100.00	6801.08	0.00	6800.08	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
3 OUTFALL3-LINK	100.00	6840.76	0.00	6839.76	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
4 OUTFALL4-LINK	100.00	6847.20	0.00	6846.20	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
5 OUTFALL5-LINK	100.00	6863.37	0.00	6862.37	0.00	1.00	1.0000	Triangular	5.000	10.000	0.0320	0.5000	0.5000
6 SWALE_C3-C2	810.00	6812.93	0.00	6801.36	0.00	11.57	1.4300	Trapezoidal	1.000	10.000	0.0250	0.5000	0.5000
7 SWALE_C4-C3	205.00	6817.81	0.00	6813.53	0.00	4.28	2.0900	Trapezoidal	1.000	10.000	0.0250	0.5000	0.5000

Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		
1 OUTFALL1-LINK	6.50	0 12:37	169.73	0.04	2.90	0.57	1.50		
2 OUTFALL2-LINK	1.57	0 12:39	169.73	0.01	2.06	0.81	0.87		
3 OUTFALL3-LINK	0.45	0 12:22	169.73	0.00	1.53	1.09	0.55		
4 OUTFALL4-LINK	1.51	0 12:21	169.73	0.01	2.05	0.81	0.86		
5 OUTFALL5-LINK	10.67	0 12:47	169.73	0.06	3.27	0.51	1.81		
6 SWALE_C3-C2	1.72	0 12:25	29.83	0.06	1.57	8.60	0.43		
7 SWALE_C4-C3	1.67	0 12:23	36.07	0.05	1.04	3.29	0.43		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	No. of Barrels
1	CULV-01	40.00	6723.05	6722.74	0.7800	CIRCULAR	36.000	36.000	0.0250	0.5000	0.5000	3
2	CULV-02	30.00	6801.36	6801.08	0.9300	CIRCULAR	36.000	36.000	0.0250	0.5000	0.5000	1
3	CULV-03	40.00	6813.53	6812.93	1.5000	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	1
4	CULV-04	40.00	6818.56	6817.81	1.8800	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	1
5	CULV-05	30.00	6840.90	6840.76	0.4700	CIRCULAR	24.000	24.000	0.0250	0.5000	0.5000	1
6	CULV-06	30.00	6847.79	6847.20	1.9700	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	1
7	CULV-07	65.00	6864.23	6863.37	1.3200	CIRCULAR	36.000	36.000	0.0250	0.5000	0.5000	3

BIA KINLICHEE ROAD IMPROVEMENTS
100-YEAR, 24-HOUR STORM EVENT

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)	(min)		
1	CULV-01	6.50	0 12:37	91.60	0.07	0.69	0.97	1.37	0.00		Calculated
2	CULV-02	1.57	0 12:38	33.51	0.05	1.12	0.45	0.76	0.00		Calculated
3	CULV-03	2.23	0 12:22	26.12	0.09	3.96	0.17	0.44	0.00		Calculated
4	CULV-04	1.88	0 12:24	29.21	0.06	3.43	0.19	0.43	0.00		Calculated
5	CULV-05	0.46	0 12:22	8.04	0.06	0.76	0.66	0.49	0.00		Calculated
6	CULV-06	1.51	0 12:21	29.91	0.05	1.22	0.41	0.75	0.00		Calculated
7	CULV-07	10.67	0 12:47	119.68	0.09	1.07	1.01	1.43	0.00		Calculated

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 21 2021

Culvert-01 100-yr 24-hr

Invert Elev Dn (ft) = 6722.74
Pipe Length (ft) = 40.00
Slope (%) = 0.77
Invert Elev Up (ft) = 6723.05
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
n-Value = 0.023
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Mitered to slope (C)
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

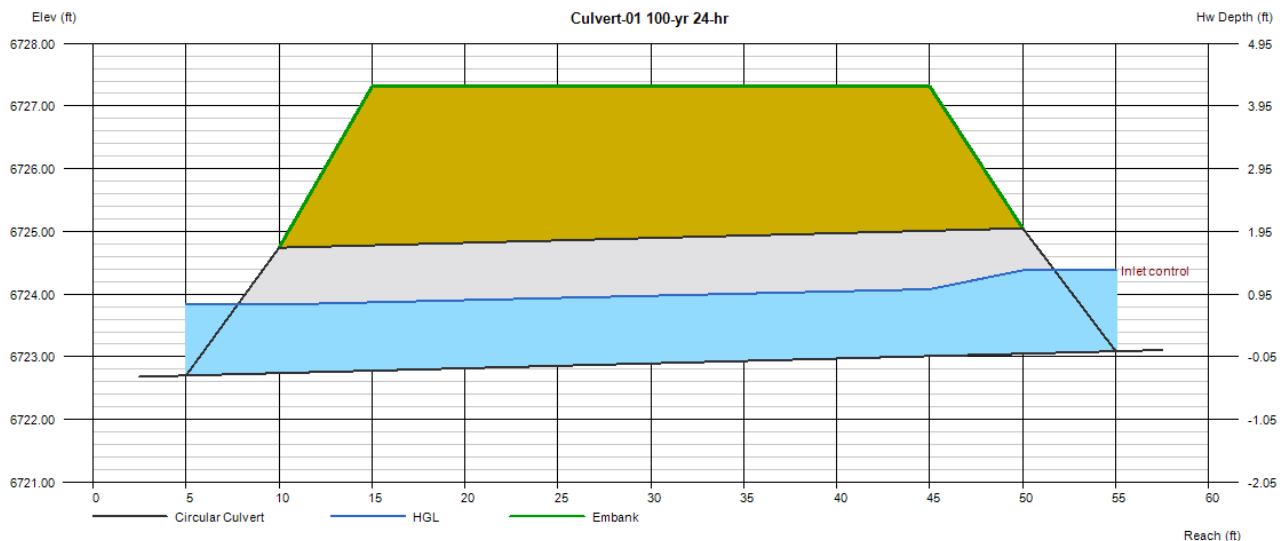
Top Elevation (ft) = 6727.31
Top Width (ft) = 30.00
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 6.51
Qmax (cfs) = 6.51
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 6.51
Qpipe (cfs) = 6.51
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 3.70
Veloc Up (ft/s) = 3.84
HGL Dn (ft) = 6723.83
HGL Up (ft) = 6724.11
Hw Elev (ft) = 6724.38
Hw/D (ft) = 0.67
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 21 2021

Ex. Culvert-02 100-yr 24-hr

Invert Elev Dn (ft) = 6801.08
Pipe Length (ft) = 30.00
Slope (%) = 0.97
Invert Elev Up (ft) = 6801.37
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.023
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Mitered to slope (C)
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

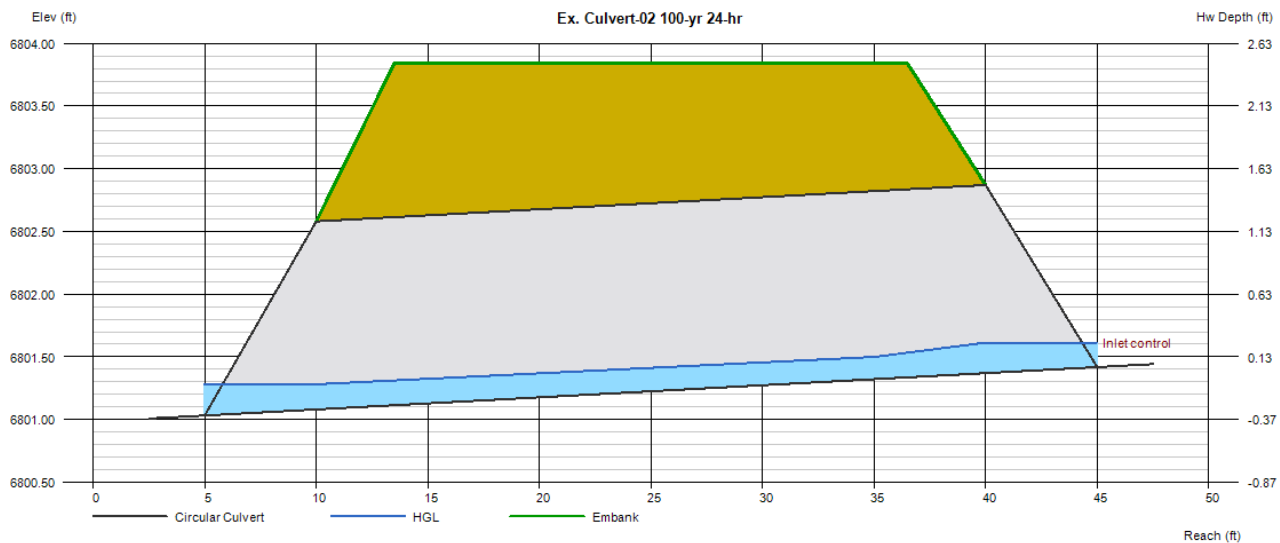
Top Elevation (ft) = 6803.84
Top Width (ft) = 23.00
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 0.22
Qmax (cfs) = 0.22
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 0.22
Qpipe (cfs) = 0.22
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 1.56
Veloc Up (ft/s) = 1.95
HGL Dn (ft) = 6801.28
HGL Up (ft) = 6801.54
Hw Elev (ft) = 6801.61
Hw/D (ft) = 0.16
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 21 2021

Ex. Culvert-03 100-yr 24-hr

Invert Elev Dn (ft) = 6812.93
Pipe Length (ft) = 40.00
Slope (%) = 1.50
Invert Elev Up (ft) = 6813.53
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.023
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Mitered to slope (C)
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

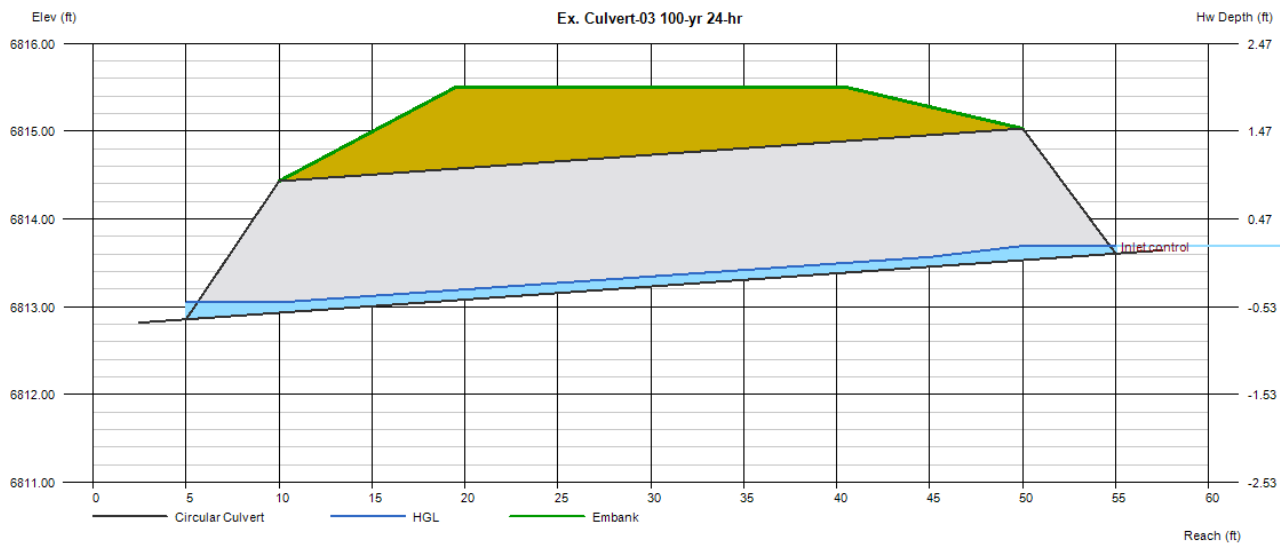
Top Elevation (ft) = 6815.50
Top Width (ft) = 21.00
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 0.09
Qmax (cfs) = 0.09
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 0.09
Qpipe (cfs) = 0.09
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 1.38
Veloc Up (ft/s) = 1.55
HGL Dn (ft) = 6813.05
HGL Up (ft) = 6813.64
Hw Elev (ft) = 6813.69
Hw/D (ft) = 0.11
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 21 2021

Ex. Culvert-04 100-yr 24-hr

Invert Elev Dn (ft) = 6817.81
Pipe Length (ft) = 40.00
Slope (%) = 1.88
Invert Elev Up (ft) = 6818.56
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.023
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Mitered to slope (C)
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

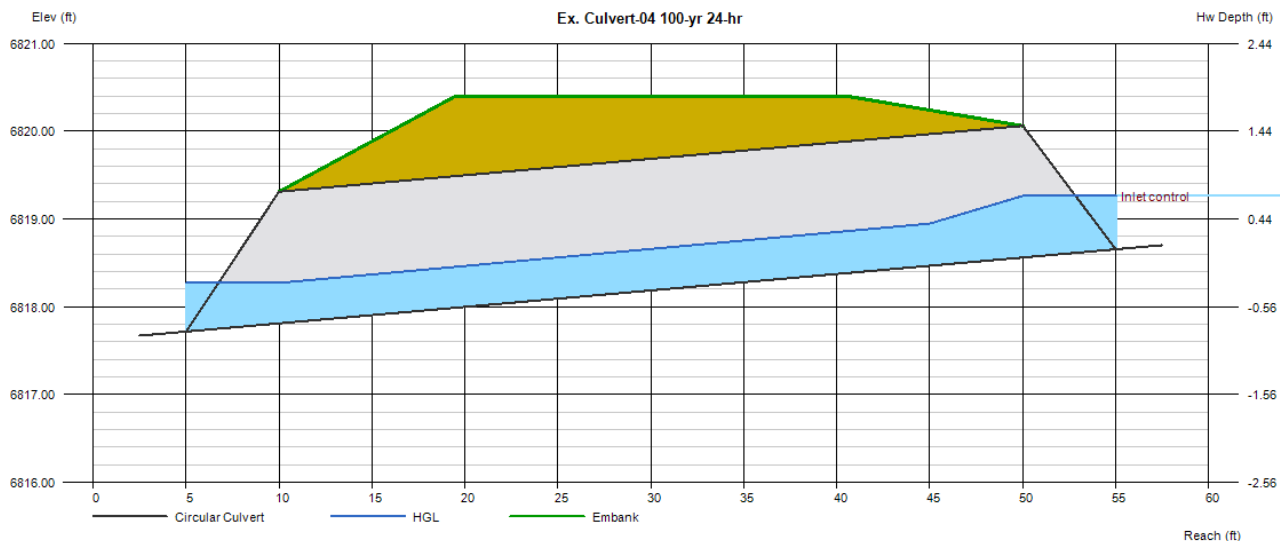
Top Elevation (ft) = 6820.40
Top Width (ft) = 21.00
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 1.66
Qmax (cfs) = 1.66
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 1.66
Qpipe (cfs) = 1.66
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 3.60
Veloc Up (ft/s) = 3.37
HGL Dn (ft) = 6818.27
HGL Up (ft) = 6819.04
Hw Elev (ft) = 6819.26
Hw/D (ft) = 0.47
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 21 2021

Ex. Culvert-05 100-yr 24-hr

Invert Elev Dn (ft) = 6840.76
Pipe Length (ft) = 35.00
Slope (%) = 0.34
Invert Elev Up (ft) = 6840.88
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
n-Value = 0.023
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Mitered to slope (C)
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

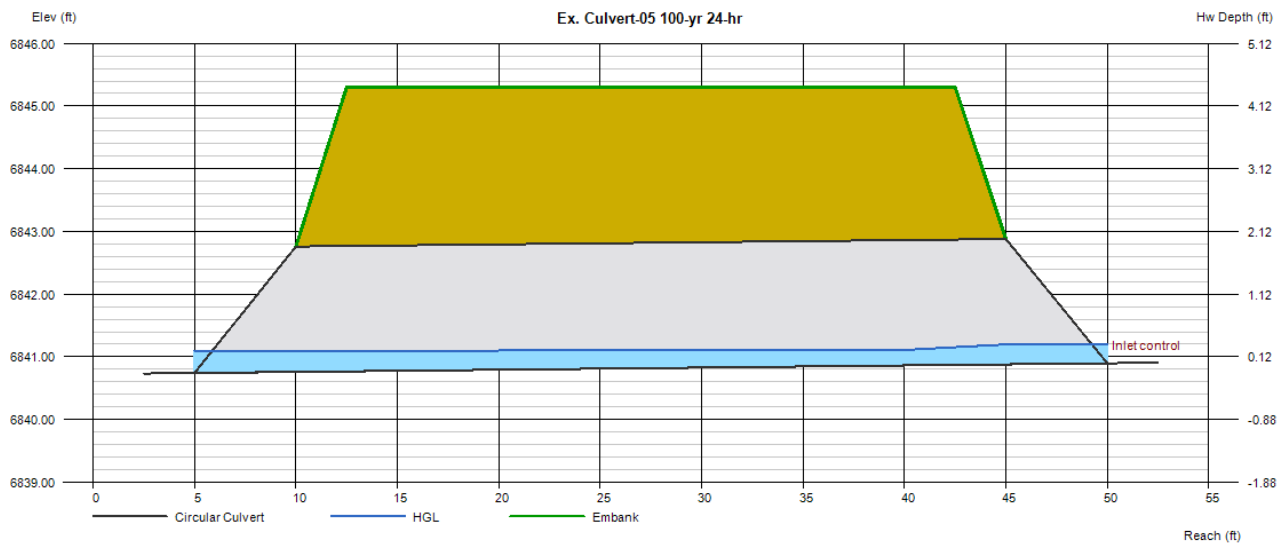
Top Elevation (ft) = 6845.30
Top Width (ft) = 30.00
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 0.46
Qmax (cfs) = 0.46
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 0.46
Qpipe (cfs) = 0.46
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 1.32
Veloc Up (ft/s) = 2.26
HGL Dn (ft) = 6841.10
HGL Up (ft) = 6841.11
Hw Elev (ft) = 6841.20
Hw/D (ft) = 0.16
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 21 2021

Ex. Culvert-06 100-yr 24-hr

Invert Elev Dn (ft) = 6847.20
Pipe Length (ft) = 35.00
Slope (%) = 1.69
Invert Elev Up (ft) = 6847.79
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
n-Value = 0.023
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Mitered to slope (C)
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

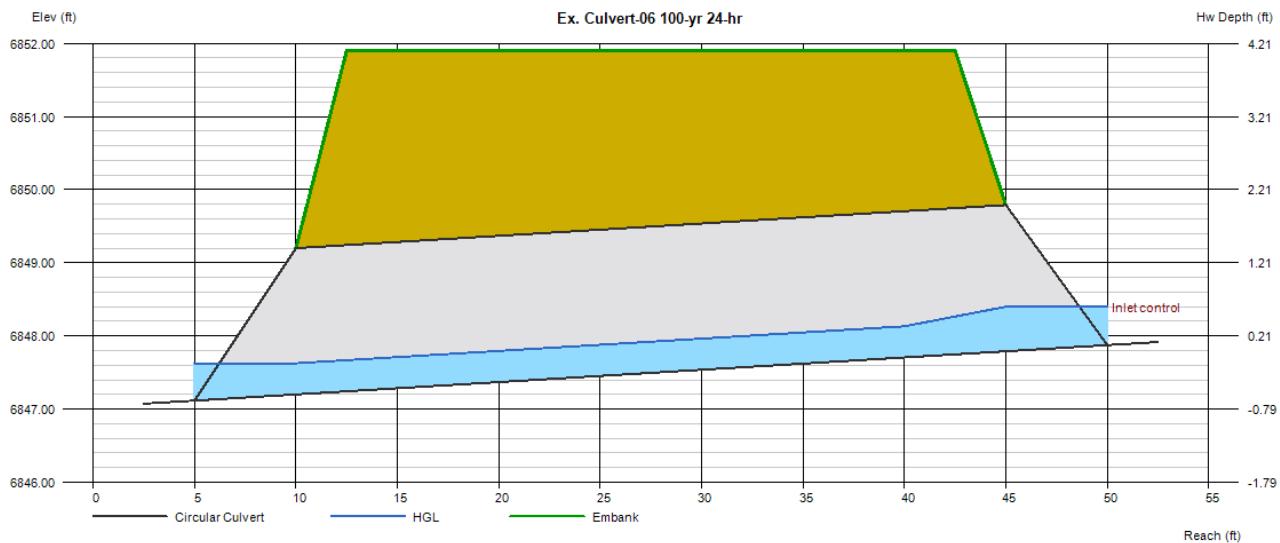
Top Elevation (ft) = 6851.90
Top Width (ft) = 30.00
Crest Width (ft) = 50.00

Calculations

Qmin (cfs) = 1.52
Qmax (cfs) = 1.52
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 1.52
Qpipe (cfs) = 1.52
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 3.10
Veloc Up (ft/s) = 3.11
HGL Dn (ft) = 6847.63
HGL Up (ft) = 6848.22
Hw Elev (ft) = 6848.40
Hw/D (ft) = 0.30
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 21 2021

Culvert-07 100-yr 24-hr

Invert Elev Dn (ft) = 6722.74
Pipe Length (ft) = 40.00
Slope (%) = 0.77
Invert Elev Up (ft) = 6723.05
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
n-Value = 0.023
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Mitered to slope (C)
Coeff. K,M,c,Y,k = 0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

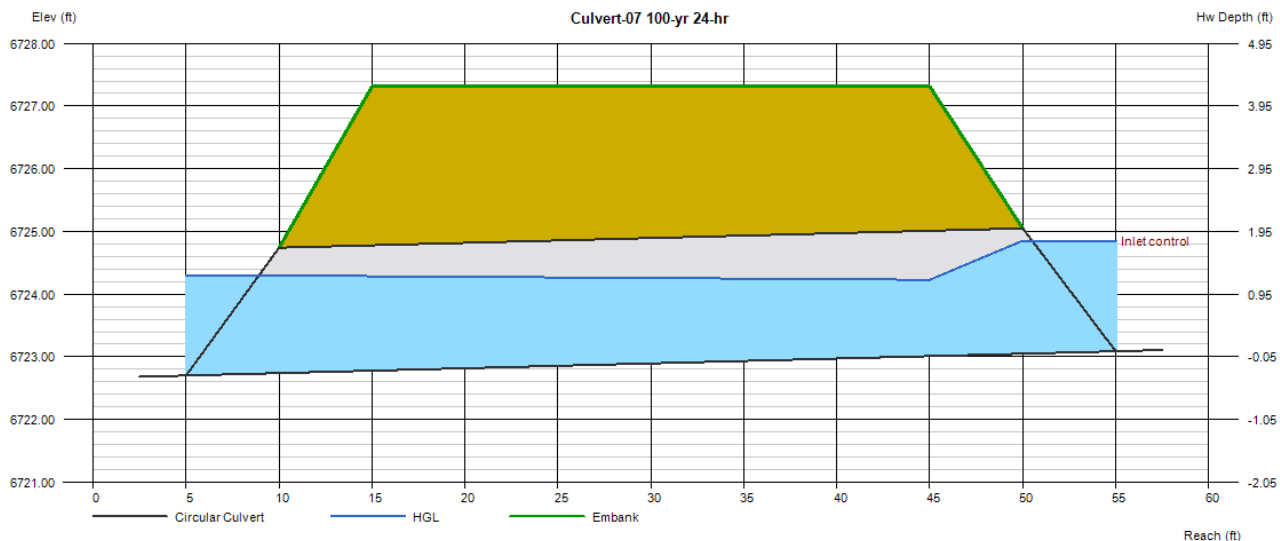
Top Elevation (ft) = 6727.31
Top Width (ft) = 30.00
Crest Width (ft) = 50.00

Calculations

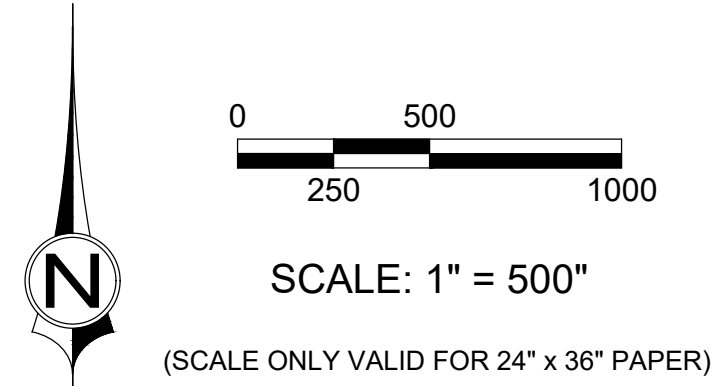
Qmin (cfs) = 10.68
Qmax (cfs) = 10.68
Tailwater Elev (ft) = Normal

Highlighted

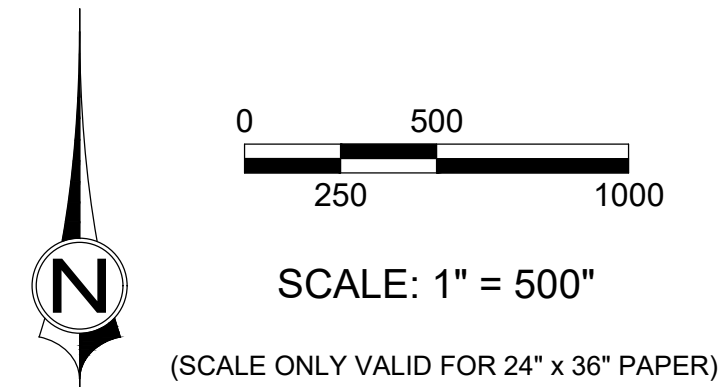
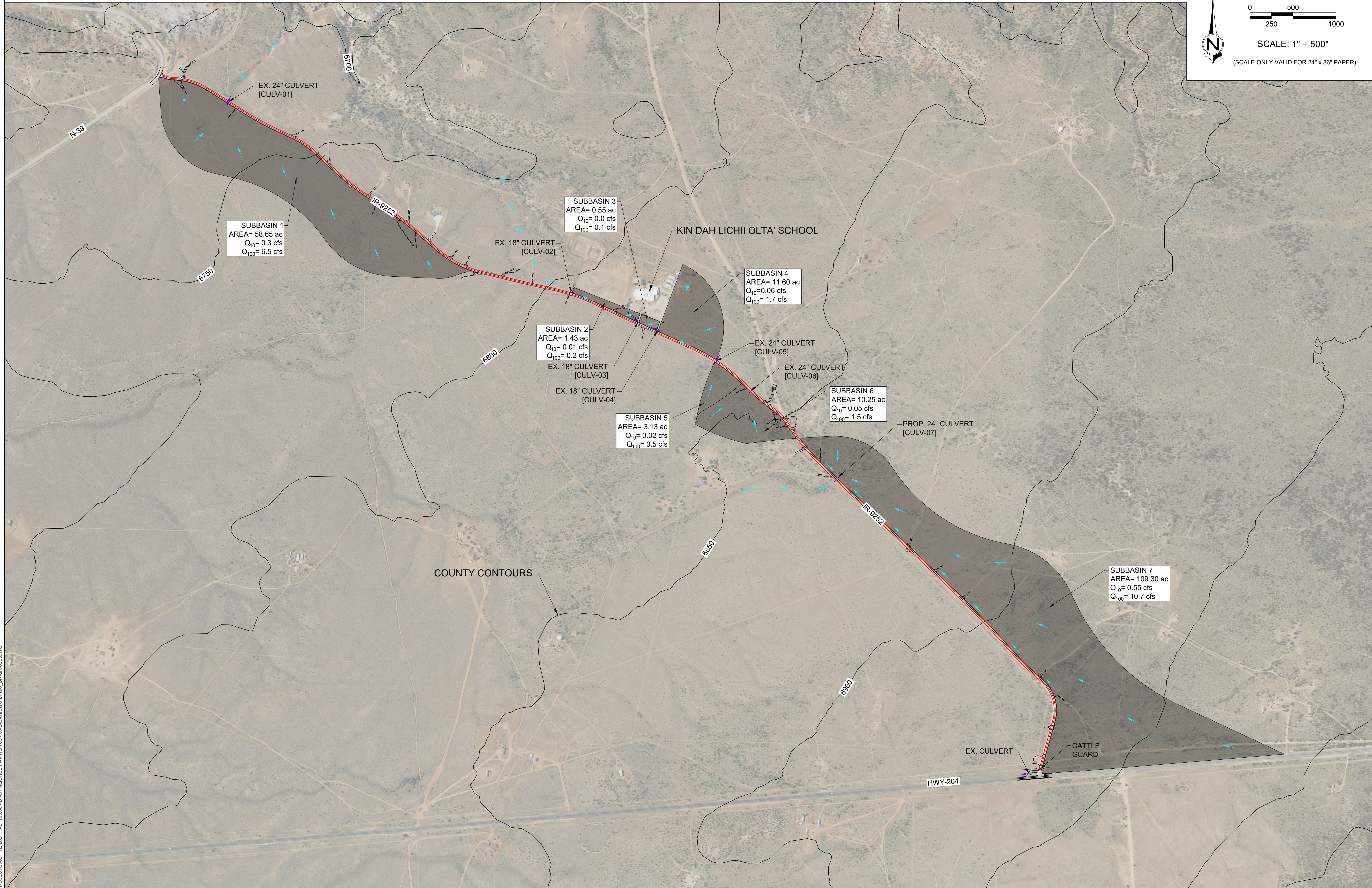
Qtotal (cfs) = 10.68
Qpipe (cfs) = 10.68
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 4.07
Veloc Up (ft/s) = 5.59
HGL Dn (ft) = 6724.30
HGL Up (ft) = 6724.22
Hw Elev (ft) = 6724.85
Hw/D (ft) = 0.90
Flow Regime = Inlet Control



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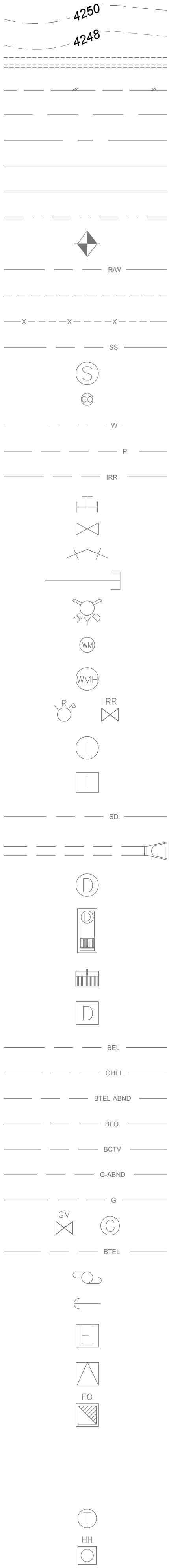
ABBREVIATIONS

ACE	ACRE
AGGR	ARMY CORPS OF ENGINEERS
AGGR	AGGREGATE
ALT.	ALTERNATE
APPR.	APPROXIMATE
AR MH	AIR RELEASE MANHOLE
ARV	AIR RELEASE VALVE
ASSY.	ASSEMBLY
ASTM	AMERICAN SOCIETY FOR TESTING MATERIALS
AVE	AVENUE
BFV	BUTTERFLY VALVE
BH	BORE HOLE
BITUM.	BITUMINOUS
BK	BACK
B.O.	BY OTHERS
BOA	BEGINNING OF ALIGNMENT
BOP	BEGINNING OF PROJECT
BSW	BACK OF SIDEWALK
BVC	BEGIN VERTICAL CURVE
BW	BOTTOM OF WALL
C&G	CURB AND GUTTER
CB	CATCH BASIN
C-C	CENTER TO CENTER
CEL	CONSTRUCTION EASEMENT LINE
CF	CUBIC FEET
CF/S	CUBIC FEET PER SECOND
CI	CAST IRON
CIP	CAST IRON PIPE
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEANOUT
COMM.	COMMUNICATION
CONC.	CONCRETE
CONST.	CONSTRUCTION
CU	COPPER
CY/CU YD	CUBIC YARD
DBL	DOUBLE
DI	DUCTILE IRON
DIA/D	DIAMETER
DIP	DUCTILE IRON PIPE
DR	DRIVE
DRWY	DRIVEWAY
DWG	DRAWING
E.	EAST
EA	EACH
EG	EXISTING GRADE
EP/EOP	EDGE OF PAVEMENT
ELEC.	ELECTRICAL
EL/ELEV.	ELEVATION
ELOH	OVERHEAD ELECTRICAL
EOA	END OF ALIGNMENT
ESMT	EASEMENT
EVC	END VERTICAL CURVE
EX/EXIST.	EXISTING
EXT.	EXTENSION
FEMA	FEDERAL EMERGENCY MANAGEMENT AGENCY
FES	FLARED END SECTION
FG	FINISHED GRADE
FH	FIRE HYDRANT
FIRM	FLOOD INSURANCE RATE MAP
FL	FLOWLINE
FM	FORCE MAIN
FO	FIBER OPTIC
FS	FINISHED SURFACE
FT	FOOT/FEET
GALV.	GALVANIZED
GB	GRADE BREAK
GR	GRATE
GV	GATE VALVE
HDPE	HIGH-DENSITY POLYETHYLENE
HMA	HOT MIX ASPHALT
HOR.	HORIZONTAL
HP	HIGH POINT
HYD.	HYDRANT
IN.	INCH
I.D.	INSIDE DIAMETER
INV.	INVERT
IRR.	IRRIGATION
INS.	INSERT
LEN.	LENGTH
LF	LINEAR FEET
LP	LOW POINT
LT	LEFT
MAX	MAXIMUM
MFG.	MANUFACTURER
MH	MANHOLE
MIN.	MINIMUM
MJ	MECHANICAL JOINT
N.	NORTH
NO.	NUMBER
NTS	NOT TO SCALE
O.C.	ON CENTER
O.D.	OUTSIDE DIAMETER
OH	OVERHEAD
OSHA	OCCUPATION SAFETY AND HEALTH ADMINISTRATION
PC	POINT OF CURVATURE
PCC	POINT OF COMPOUND CURVATURE
PI	POINT OF INTERSECTION
PL	PROPERTY LINE
POLY	POLYETHYLENE
POT.	POTABLE

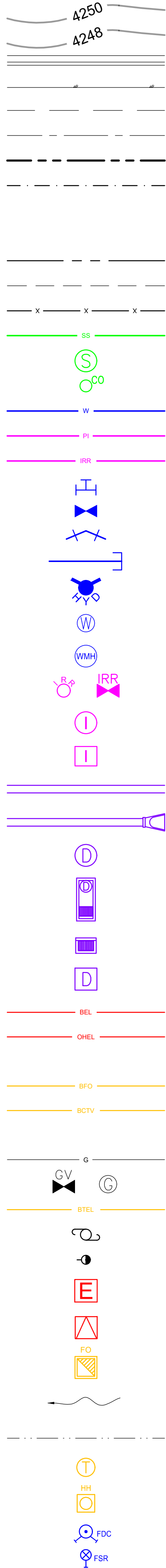
LEGEND

PP	POWER POLE
PRC	POINT OF REVERSE CURVATURE
PRV	PRESSURE REDUCING VALVE
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
PVI	POINT OF VERTICAL INTERSECTION
PUE	PUBLIC UTILITY EASEMENT
RAD/R	RADIUS
RCP	REINFORCED CONCRETE PIPE
REQ'D	REQUIRED
ROW	RIGHT-OF-WAY
RR	RAILROAD
RT	RIGHT
S.	SOUTH
SAN	SANITARY
SCH.	SCHEDULE
SD	STORM DRAIN
SDR	STANDARD DIMENSION RATIO
SF/SQ FT	SQUARE FEET
SHT	SHEET
SIM.	SIMILAR
SS	SANITARY SEWER
ST	STREET
STA	STATION
STD	STANDARD
SW	SIDEWALK
SY/SQ YD	SQUARE YARD
TA	TOP OF ASPHALT
TBC/TC	TOP BACK OF CURB
TBR	TO BE REMOVED
T.O.P.	TOP OF PIPE
TW	TOP OF WALL
TYP.	TYPICAL
VAR.	VARIES
VERT.	VERTICAL
WAT.	WATER
WL	WATER LINE

EXISTING



PROPOSED



LEGEND (cont.)

	EXISTING	PROPOSED	
MAJOR CONTOUR			STREET LIGHT
MINOR CONTOUR			SIGN (SINGLE POLE, 2 OR MORE POLES)
CURB AND GUTTER			MAILBOX
EDGE OF PAVEMENT			ASPHALT PAVEMENT
EDGE OF GRAVEL			CONCRETE FLATWORK
STREET CENTERLINE			UNTREATED BASE COURSE
PROPERTY LINE			LANDSCAPE
LOT LINE			RIP-RAP
SECTION LINE			
SECTION CORNER	XXXX.XX TBC	XXXX.XX TBC	SPOT ELEVATION
RIGHT-OF-WAY LINE			
EASEMENT LINE			
FENCE			
SANITARY SEWER MAIN			
SANITARY SEWER MANHOLE			
SANITARY SEWER CLEAN OUT			
CULINARY WATER LINE			
PRESSURIZED IRRIGATION			
GRAVITY IRRIGATION			
TEE			
GATE VALVE			
BEND (ANGLE NOTED)			
STUB / CAP			
HYDRANT			
WATER METER			
WATER MANHOLE			
SECONDARY WATER SERVICE/VALVE			
GRAVITY IRRIGATION MANHOLE			
GRAVITY IRRIGATION BOX			
STORM DRAIN PIPE			
CULVERT WITH FLARED END SECTION			
STORM DRAIN MANHOLE			
STORM DRAIN COMBO BOX			
STORM DRAIN CURB INLET			
JUNCTION STRUCTURE			
BURIED ELECTRIC LINE			
OVERHEAD ELECTRIC LINE			
ABANDONED COMM. LINE			
BURIED FIBER OPTIC LINE			
BURIED CABLE TV			
ABANDONED GAS LINE			
GAS LINE			
GAS VALVE / GAS METER			
BURIED TELEPHONE			
POWER POLE			
GUY WIRE ANCHOR			
ELECTRICAL EQUIPMENT			
ELECTRICAL TRANSFORMER			
FIBER OPTIC PEDESTAL			
GRADE TO DRAIN			
EXTENTS OF GRADING			
TELEPHONE PEDESTAL			
HANDHOLE BOX			
FIRE DEPARTMENT CONNECTION			
FIRE SPRINKLER RISER			



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GENERAL PROJECT NOTES

1. ALL CONSTRUCTION AND MATERIALS SHALL CONFORM WITH THE CURRENT ADOPTED AND BIA STANDARDS AND SPECIFICATIONS AND WITH ALL OTHER APPLICABLE FEDERAL, STATE AND LOCAL ORDINANCES AND LAWS.
2. THE CONTRACTOR SHALL OBTAIN ALL PERMITS NECESSARY TO COMPLETE THE CONSTRUCTION.
3. THE CONTRACTOR SHALL COORDINATE SITE CONSTRUCTION WITH ALL UTILITY PROVIDERS (POWER, TELEPHONE, GAS, CABLE, ETC.) AND OTHER WHICH MAY BE SPECIFIC TO THE PROJECT.
4. DEVIATION FROM THESE PLANS WITHOUT THE PRIOR WRITTEN CONSENT OF THE ENGINEER MAY CAUSE THE WORK TO BE UNACCEPTABLE.
5. THE CONTRACTOR IS RESPONSIBLE FOR NOTIFICATIONS AND LIAISON WITH UTILITY COMPANIES IN THE PROCESS OF LOCATING, RELOCATION, AND TIE-IN TO UTILITIES. ALSO, THE CONTRACTOR IS RESPONSIBLE FOR NOTIFYING ALL INSPECTORS PRIOR TO BEGINNING SITE CONSTRUCTION.
6. IN THE CASE OF UNFORESEEN CONSTRUCTION COMPLICATIONS OR DISCREPANCIES, THE CONTRACTOR IS TO NOTIFY THE ENGINEER IMMEDIATELY.
7. THE PLANS WERE PREPARED IN ACCORDANCE WITH ESTABLISHED PRACTICES OF CIVIL ENGINEERING DESIGN. THE ENGINEER NOR ITS PERSONNEL CAN OR DO WARRANT THESE PLANS AS CONSTRUCTED EXCEPT WHERE THE ENGINEER INSPECTS AND CONTROLS THE PHYSICAL CONSTRUCTION ON A CONTEMPORARY BASIS AT THE SITE.

CONSTRUCTION SITE SAFETY

1. THE CONTRACTOR IS REQUIRED TO MEET ALL APPLICABLE REGULATIONS CONCERNING PROJECT SAFETY AND ASSUMES FULL RESPONSIBILITY FOR SAFETY ON THE PROJECT.
2. WORKMEN AND THE PUBLIC SHALL BE PROTECTED BY THE CONTRACTOR FROM ANY AND ALL HAZARDS CONNECTED WITH THE CONSTRUCTION WORK.
3. OPEN TRENCHES, MATERIALS, OR EQUIPMENT WITHIN THE WORKING LIMITS ARE TO BE PROTECTED BY THE USE OF ADEQUATE BARRICADES.
4. ALL WORK SHALL BE IN CONFORMANCE WITH CURRENT OSHA REGULATIONS FOR PROJECTS OF THIS TYPE.
5. IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, THE CONTRACTOR SHALL BE SOLELY AND COMPLETELY RESPONSIBLE FOR THE CONDITIONS OF THE JOB SITE, INCLUDING THE SAFETY OF ALL PERSONS AND PROPERTY DURING PERFORMANCE OF THE WORK. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND SHALL NOT BE LIMITED TO NORMAL WORKING HOURS. ANY CONSTRUCTION OBSERVATION BY THE ENGINEER OF THE CONTRACTOR'S WORK IS NOT INTENDED TO INCLUDE THE ADEQUACY OF THE CONTRACTOR'S SAFETY MEASURES EITHER, ON, OR NEAR THE CONSTRUCTION SITE.

TRAFFIC CONTROL AND SIGNAGE

1. THE CONTRACTOR SHALL MAINTAIN INGRESS/EGRESS ACCESS TO INDIVIDUAL PROPERTY OWNERS AT ALL TIMES. THE CONTRACTOR SHALL COORDINATE DETOURS AND ANY TEMPORARY CLOSURES WITH EACH PROPERTY OWNER. THE CONTRACTOR SHALL KEEP DURATION OF ALL CLOSURES AND DETOURS TO A MINIMUM.
2. THE CONTRACTOR SHALL MAINTAIN TEMPORARY DETOUR ROADS UNTIL A DETOUR IS NO LONGER NECESSARY.
3. THE CONTRACTOR SHALL FOLLOW THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) STANDARDS AND GUIDES FOR TRAFFIC CONTROL FOR STREET AND HIGHWAY CONSTRUCTION.
4. THE CONTRACTOR SHALL FOLLOW ADOT STANDARD DRAWINGS WHEN SETTING UP THE TRAFFIC CONTROL DEVICES.

REMOVALS

1. ANY EXISTING STRUCTURES DISTURBED BY CONSTRUCTION NOT EXPLICITLY SHOWN TO BE DISTURBED WITHIN THESE PLANS ARE TO BE RESTORED TO THEIR ORIGINAL LOCATION AND CONDITION. ALL STRUCTURES SUCH AS FENCING, RETAINING WALLS, ETC., IMPACTED BY THE PROPOSED IMPROVEMENTS MAY NOT BE INDICATED.
2. EXCESS EXCAVATED MATERIALS INCLUDING PIPE, STUMPS, ROOTS, SOIL MATERIALS OR ANY OTHER ITEMS THE OWNER DOES NOT WISH TO SALVAGE SHALL BECOME THE CONTRACTOR'S PROPERTY AND SHALL BE REMOVED FROM THE SITE AND DISPOSED OF PROPERLY.

UTILITY NOTES

1. THE LOCATIONS OF UNDERGROUND FACILITIES SHOWN ON THESE PLANS ARE BASED ON FIELD SURVEYS AND LOCAL UTILITY COMPANY RECORDS. IT SHALL BE THE CONTRACTOR'S FULL RESPONSIBILITY TO CONTACT THE VARIOUS UTILITY COMPANIES EITHER DIRECT OR THROUGH BLUE STAKE TO LOCATE THEIR FACILITIES PRIOR TO STARTING CONSTRUCTION.
2. CONTRACTOR TO VERIFY BY POTHOLING BOTH THE VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UTILITIES PRIOR TO INSTALLING ANY NEW LINES. NO ADDITIONAL COMPENSATION SHALL BE PAID TO THE CONTRACTOR FOR DAMAGE AND REPAIR TO THESE FACILITIES CAUSED BY HIS WORK FORCE.
3. CONTRACTOR MUST START AT LOW END OF ALL NEW GRAVITY UTILITY LINES.

GRADING NOTES

1. ALL IMPORTED STRUCTURAL FILL SHALL BE APPROVED BY THE ENGINEER PRIOR TO DELIVERY TO THE SITE. ALL IMPORTED STRUCTURAL FILL SHALL BE PLACED IN 8-INCH LOOSE HORIZONTAL LIFTS AND COMPACTED TO A MINIMUM OF 95 PERCENT OF MAXIMUM DRY DENSITY (ASTM D-1557).
2. THE CONTRACTOR SHALL PROVIDE SUITABLE EQUIPMENT TO CONTROL DUST AND AIR POLLUTION CAUSED BY CONSTRUCTION OPERATIONS. THE CONTRACTOR SHALL ALSO PROVIDE SUITABLE MUD AND DIRT CONTAINMENT TO MAINTAIN THE WORK SITE, ACCESS ROADWAYS AND ADJACENT PROPERTIES IN A CLEAN CONDITION.
3. ALL EXCAVATION AND GRADING SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF UDOT AND THE SPECIFICATIONS AND REQUIREMENTS INCLUDED IN THE BID DOCUMENTS.
4. CONTRACTOR IS RESPONSIBLE FOR ALL ON-SITE INTERIM DRAINAGE DURING CONSTRUCTION.

EROSION CONTROL NOTES

1. THE CONTRACTOR WILL BE REQUIRED TO OBTAIN A AZPDES PERMIT. CONTRACTOR SHALL ABIDE BY ALL REQUIREMENTS OF THE UPDES PERMIT AND SWPPP.
2. AT ALL TIMES DURING CONSTRUCTION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR PREVENTING AND CONTROLLING EROSION DUE TO WIND AND RUNOFF. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR MAINTAINING THE EROSION CONTROL FACILITIES SHOWN.
3. ADDITIONAL EROSION CONTROL MEASURES MAY BE REQUIRED DUE TO UNFORESEEN PROBLEMS OR IF THE PLAN DOES NOT FUNCTION AS INTENDED. ADDITIONAL CONTROL DEVICES MAY BE REQUIRED UPON INSPECTION OF PROPOSED FACILITIES.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ADJUSTING THE EROSION CONTROL MEASURES (SILT FENCES, STRAW BALES, ETC.) DUE TO GRADE CHANGES DURING THE DEVELOPMENT OF THE PROJECT.
5. ALL CONSTRUCTION SHALL BE STABILIZED AT THE END OF EACH WORKING DAY. THIS INCLUDES BACKFILLING OF TRENCHES.
6. ALL MEASURES CONTAINED IN THIS PLAN SHALL BE MAINTAINED IN FULLY FUNCTIONAL CONDITION UNTIL FINAL STABILIZATION OF THE SITE. ALL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE CHECKED BY A QUALIFIED PERSON AT LEAST ONCE EVERY SEVEN CALENDAR DAYS AND WITHIN 24 HOURS OF THE END OF A RAINFALL EVENT. ANY NEEDED CLEANING AND REPAIRS NEED TO BE DONE IMMEDIATELY UPON DISCOVERY. ALL UTILITY LINES SHALL BE CLEANED OF DIRT AND DEBRIS PRIOR TO BEING PUT INTO SERVICE DOWN-GRADE LINES MUST BE PROTECTED FROM WASH-WATER DURING THE CLEANING TO AVOID CONTAMINATION AND COMPROMISING OUTFALL CLEANLINESS.

DUST CONTROL NOTES

TEMPORARY MODIFICATION MEASURES

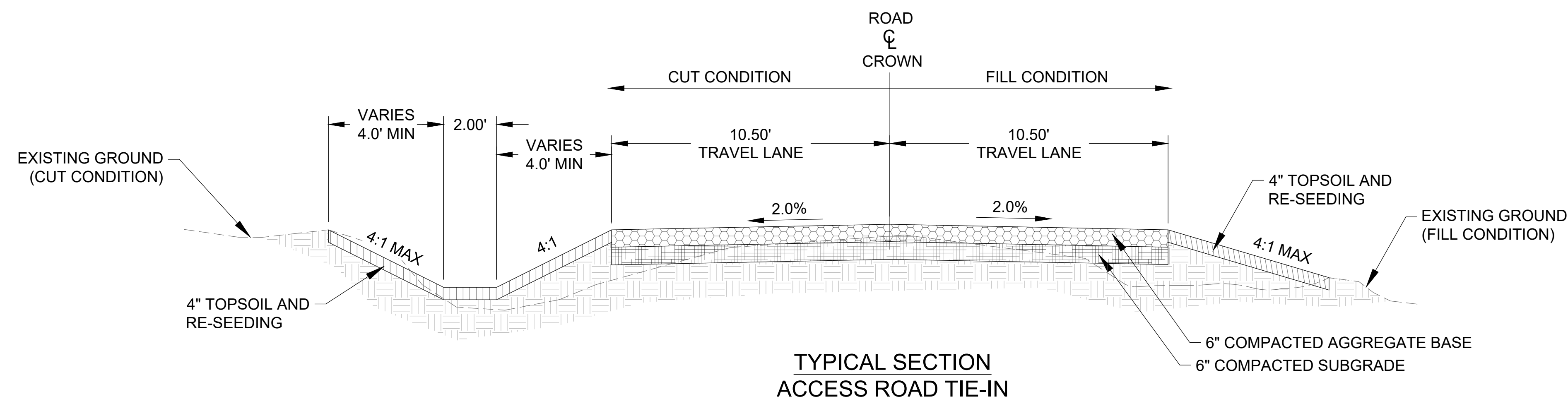
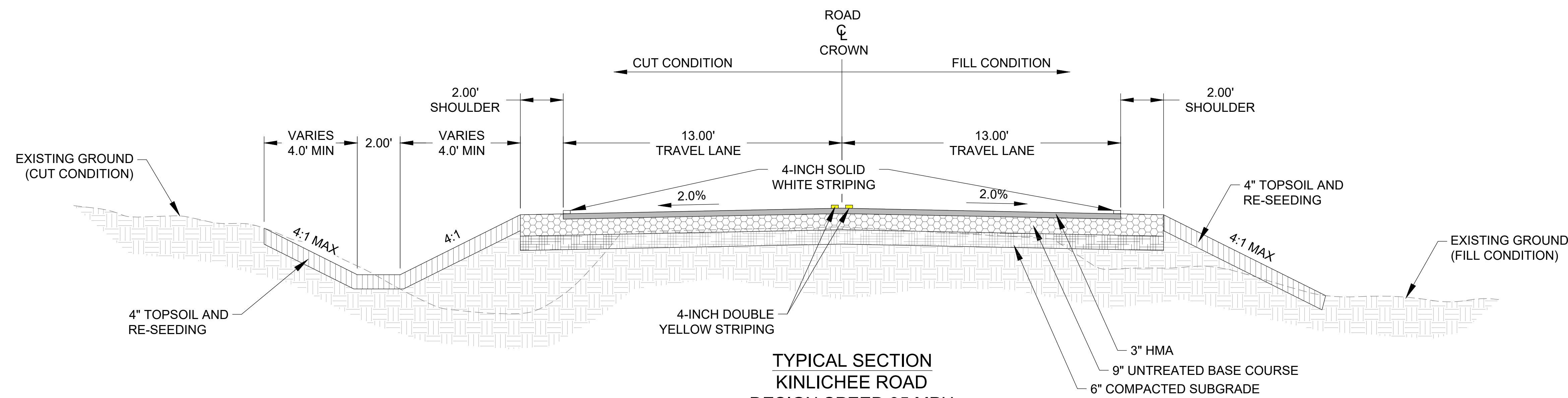
1. BLOWING DUST MUST BE CONTROLLED AT ALL TIMES. INSTALLATION OF A SILT SCREEN AND SITE WATERING SHALL BE USED TO CONTROL DUST. THE USE OF MOTOR OILS AND OTHER PETROLEUM BASED OR TOXIC LIQUIDS FOR DUST SUPPRESSION OPERATIONS IS ABSOLUTELY PROHIBITED.
2. VEGETATIVE COVERINGS: TEMPORARY SEEDING AND MULCHING MAY BE APPLIED TO COVER BARE SOIL AND TO PREVENT WIND EROSION. THE SOIL MUST BE KEPT MOIST TO ESTABLISH COVER.
3. BARRIERS: SOLID BOARD FENCES, SNOW FENCES, BURLAP FENCES, CRATE WALLS, BALES OF HAY, AND SIMILAR MATERIAL CAN BE USED TO CONTROL AIR CURRENTS AND BLOWN SOIL. BARRIERS PLACES AT RIGHT ANGLES TO PREVAILING WIND CURRENTS AT INTERVALS OF ABOUT 15 TIMES THE BARRIER HEIGHT ARE EFFECTIVE IN CONTROLLING WIND EROSION.
4. TILLAGE: THIS PRACTICE ROUGHENS THE SOIL AND BRINGS CLODS TO THE SURFACE. IT IS AN EMERGENCY MEASURE THAT SHOULD BE USED BEFORE WIND EROSION STARTS. PLOWING SHOULD BEGIN ON THE WINDWARD SIDE OF THE SITE USING CHISEL-TYPE PLOWS SPACED ABOUT 12 INCHES APART, SPRING-TOOTH HARROWS, OR SIMILAR PLOWS.

PERMANENT SITE MODIFICATION MEASURES

1. IT IS RECOMMENDED THAT EXISTING TREES AND LARGE SHRUBS BE ALLOWED TO REMAIN IN PLACE TO THE GREATEST EXTENT POSSIBLE DURING SITE GRADING PROCESSES.
2. COARSE GRAVEL OR CRUSHED STONE MAY BE PLACED OVER HIGHLY ERODIBLE SOILS.
3. TOPSOILING: THIS METHOD IS RECOMMENDED WHEN PERMANENT VEGETATION CANNOT BE ESTABLISHED ON A SITE. TOPSOILING IS A PROCESS IN WHICH LESS ERODIBLE MATERIAL IS PLACED ON TOP OF HIGHLY ERODIBLE SOILS.



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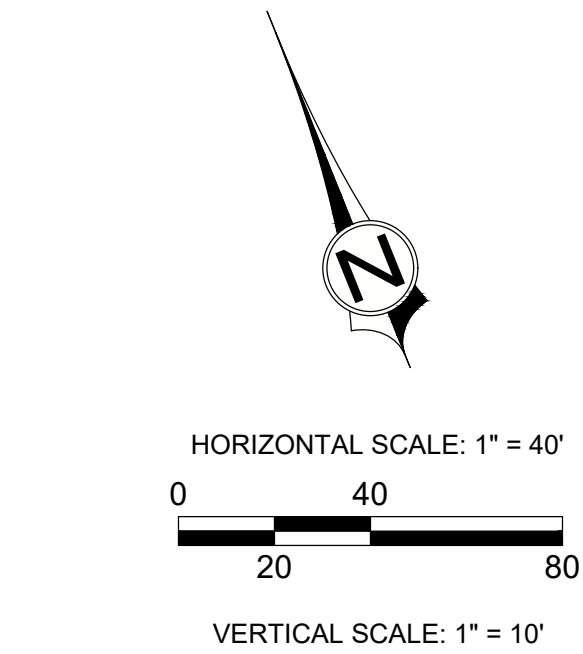
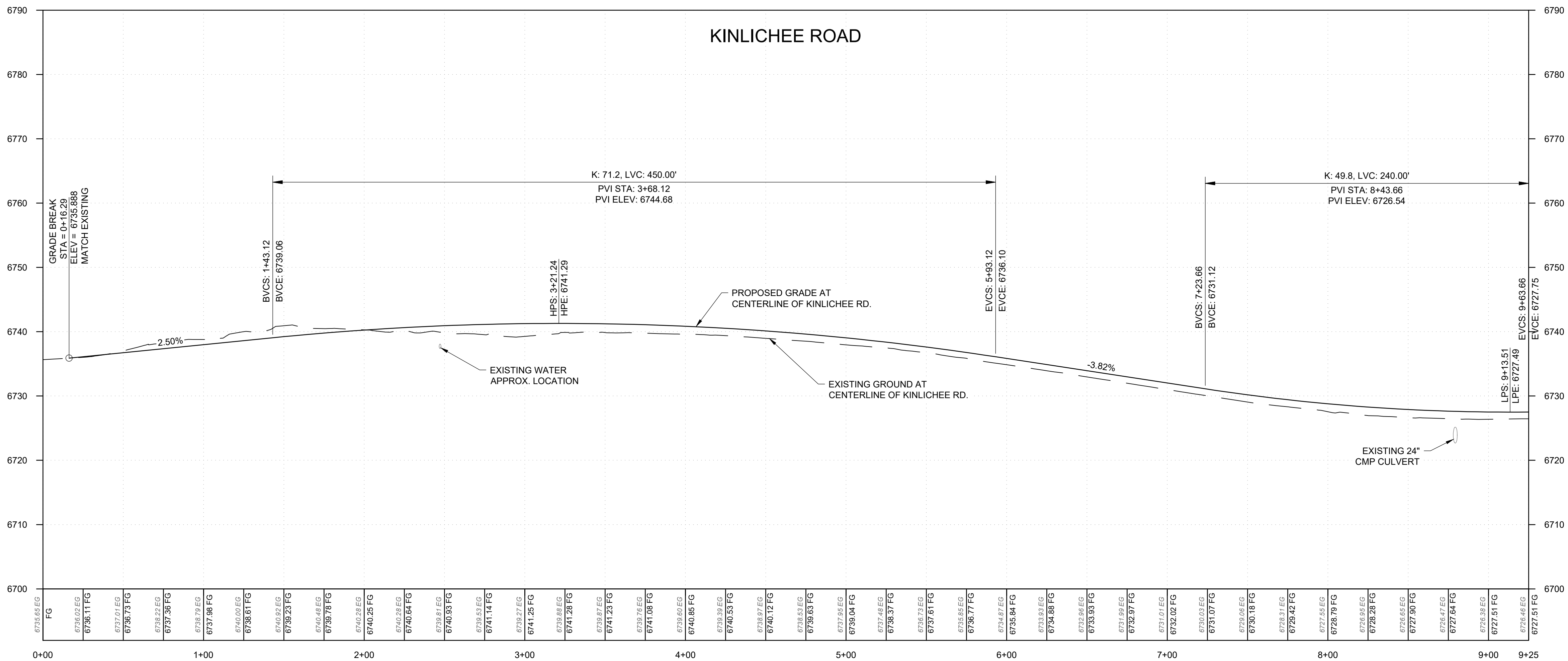
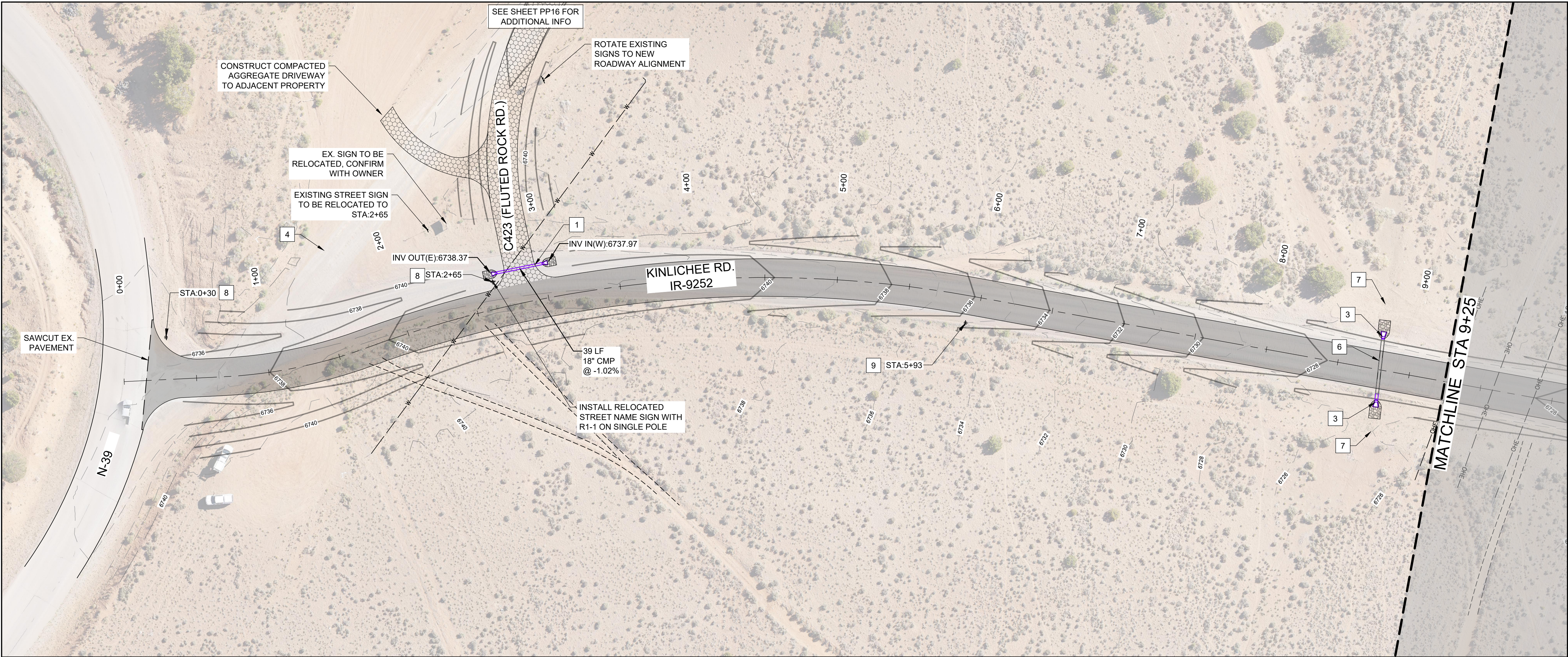
BIA KINLICHEE ROAD IMPROVEMENTS
 GANADO, AZ

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 DATE: SEPTEMBER 2021
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4 OF 23

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LEGEND:

- 3" HMA PAVEMENT SECTION SEE SHEET TS
- 6" COMPACTED AGGREGATE BASE SECTION, SEE SHEET TS

KEYNOTES:

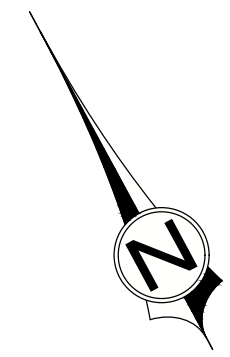
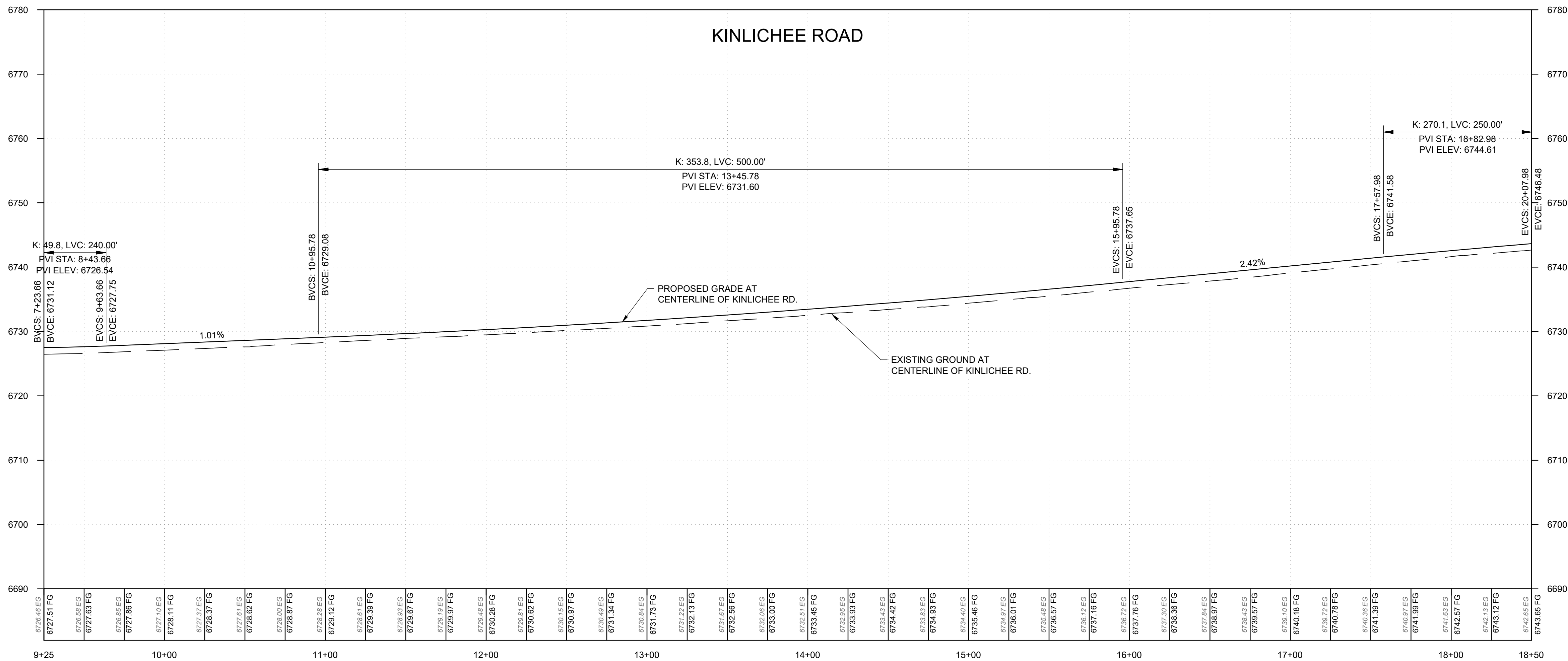
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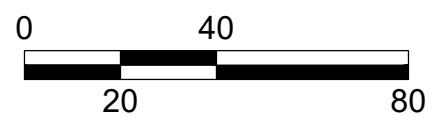
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VERTICAL SCALE: 1" = 10'

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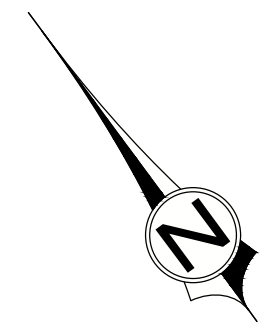
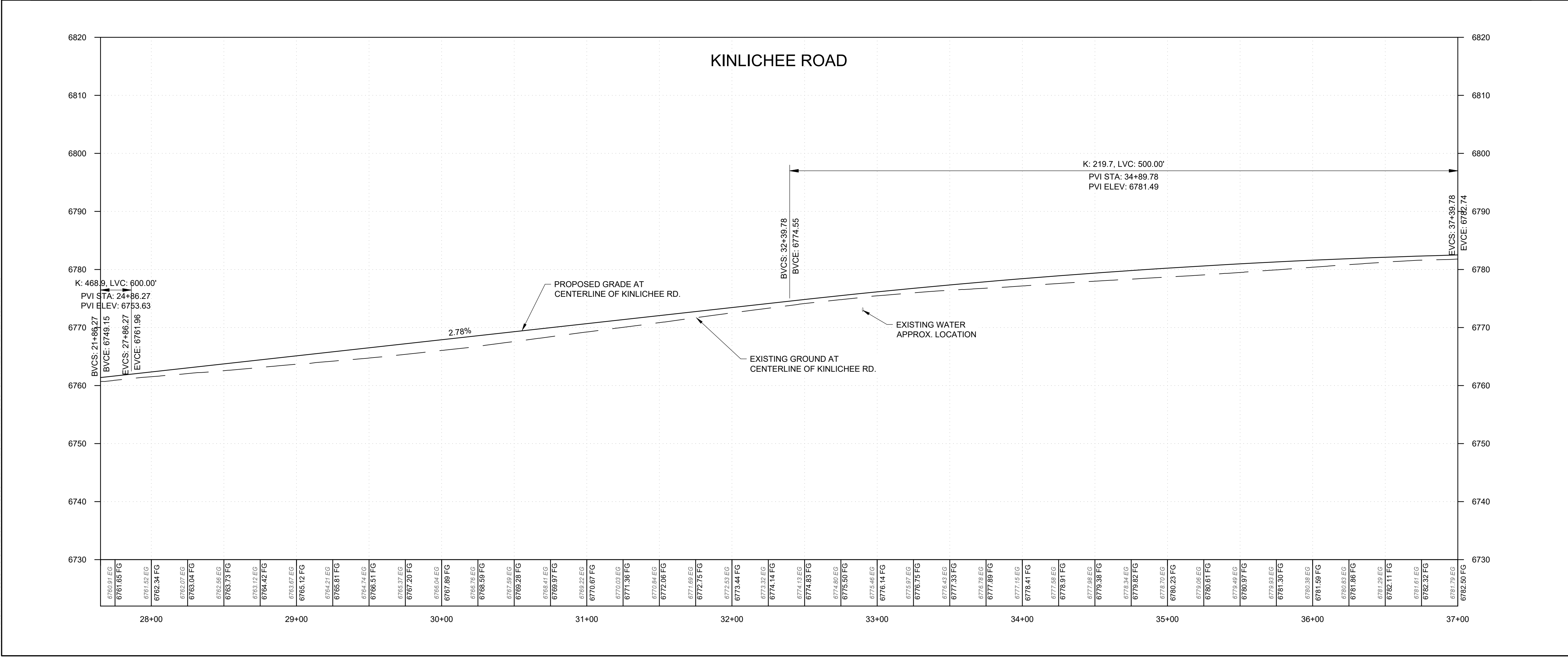
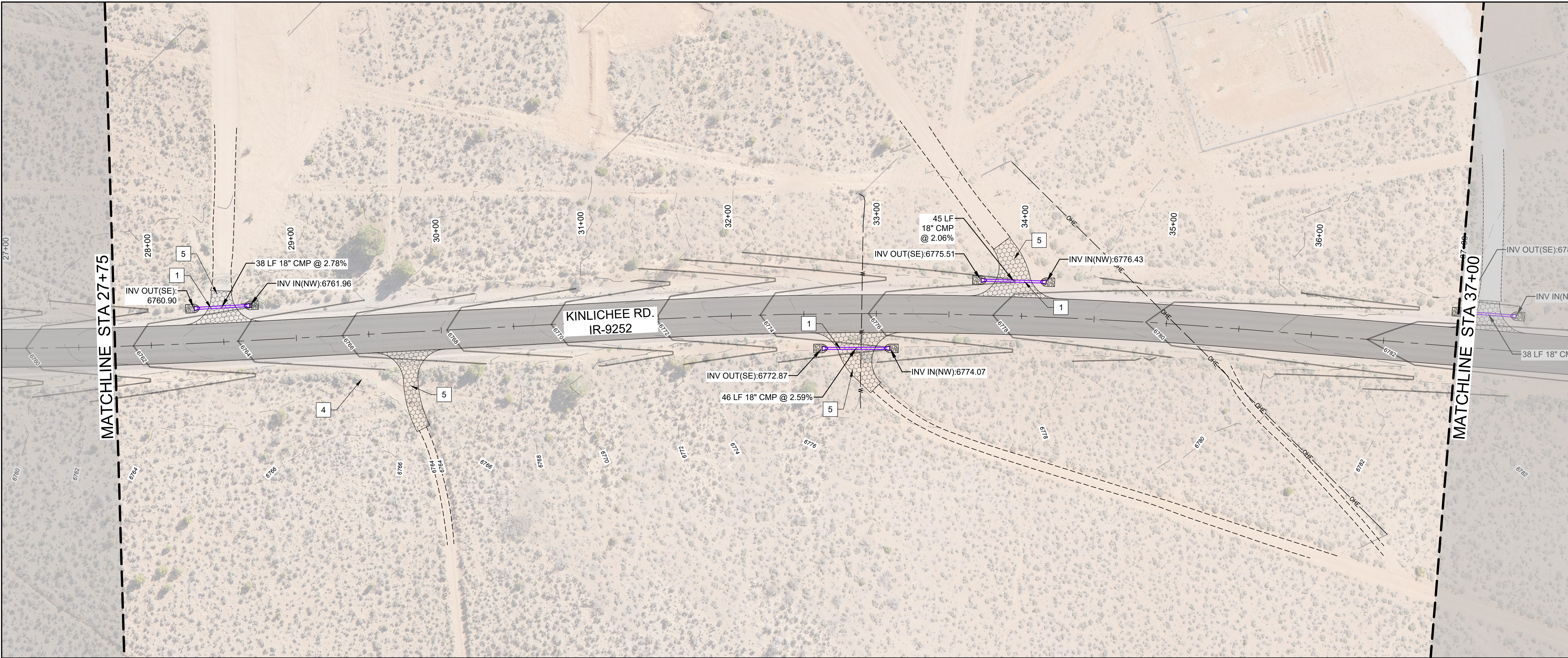
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BIA KINLICHEE ROAD IMPROVEMENTS
CANADO, AZ

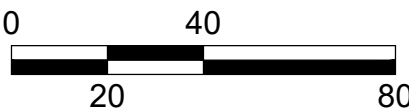
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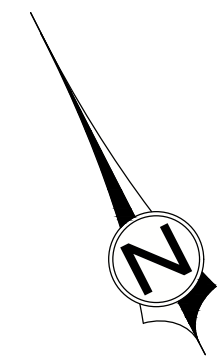
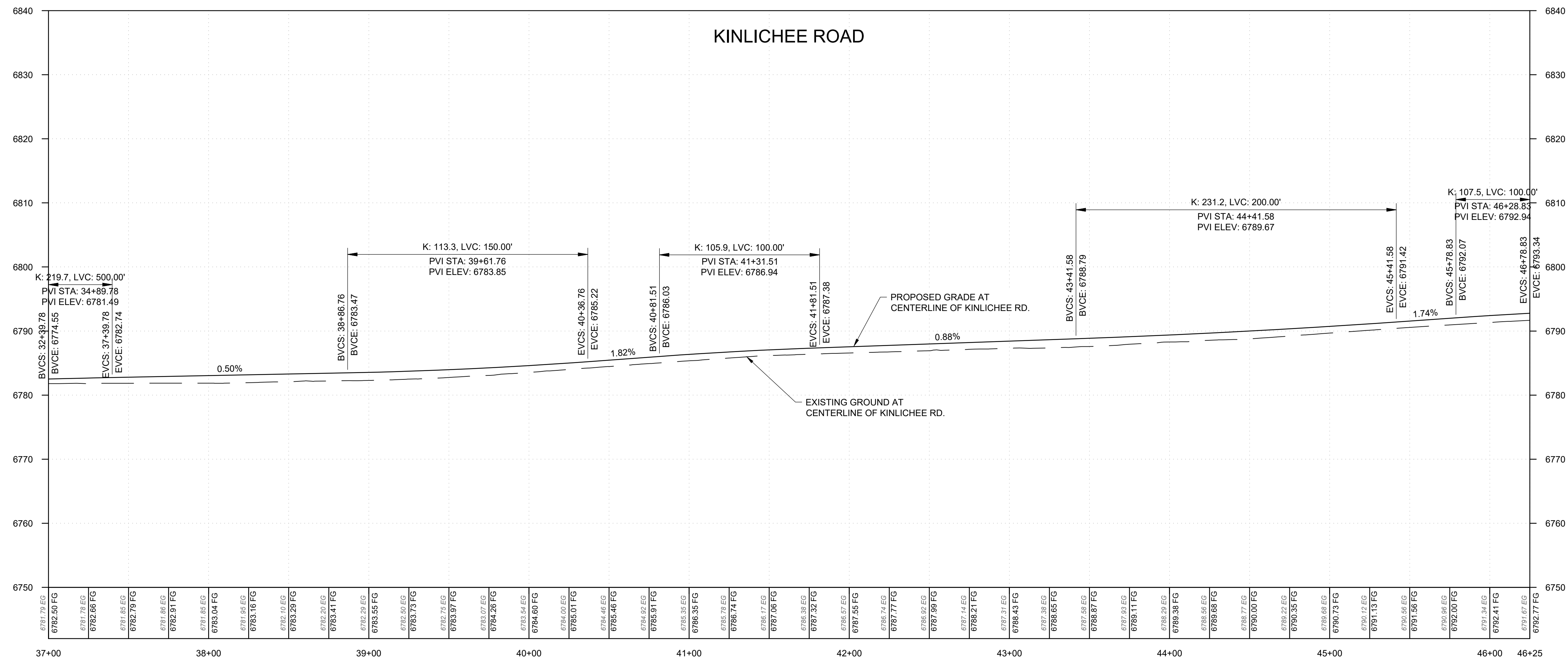
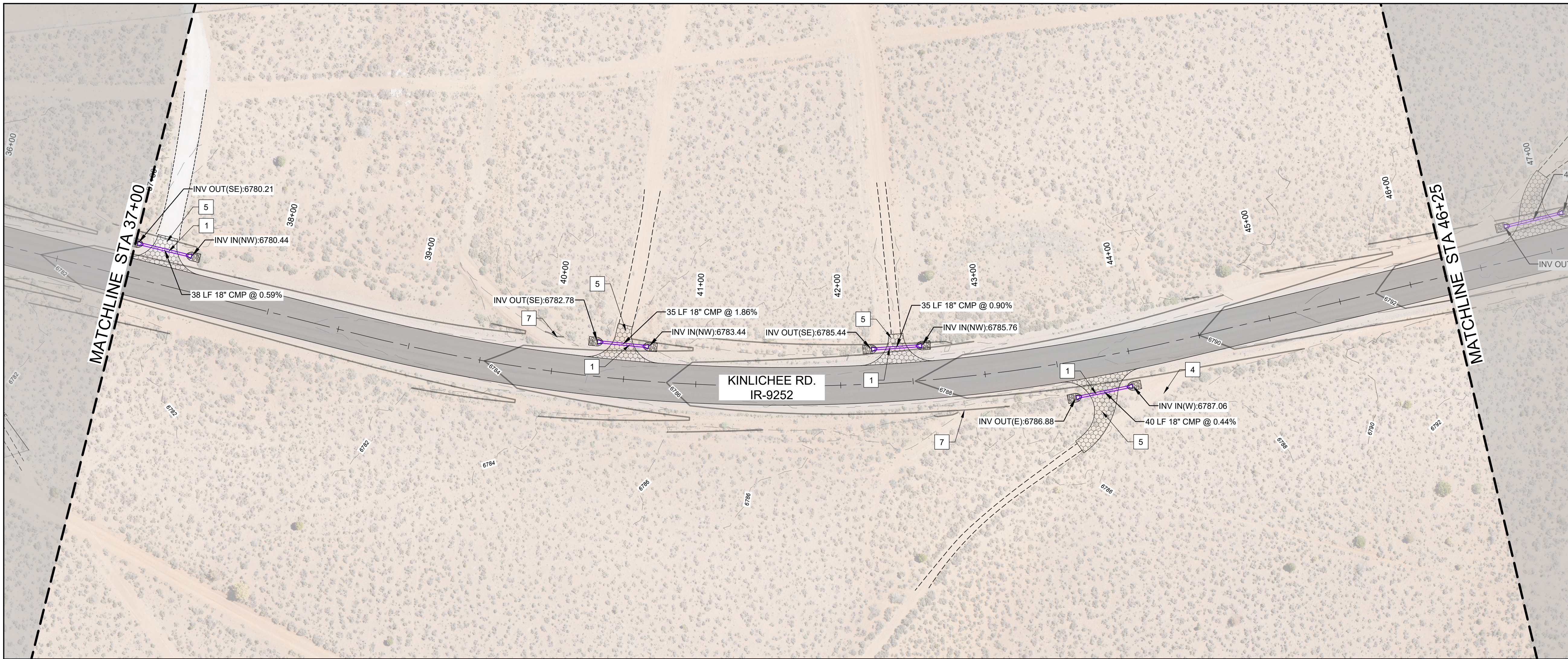
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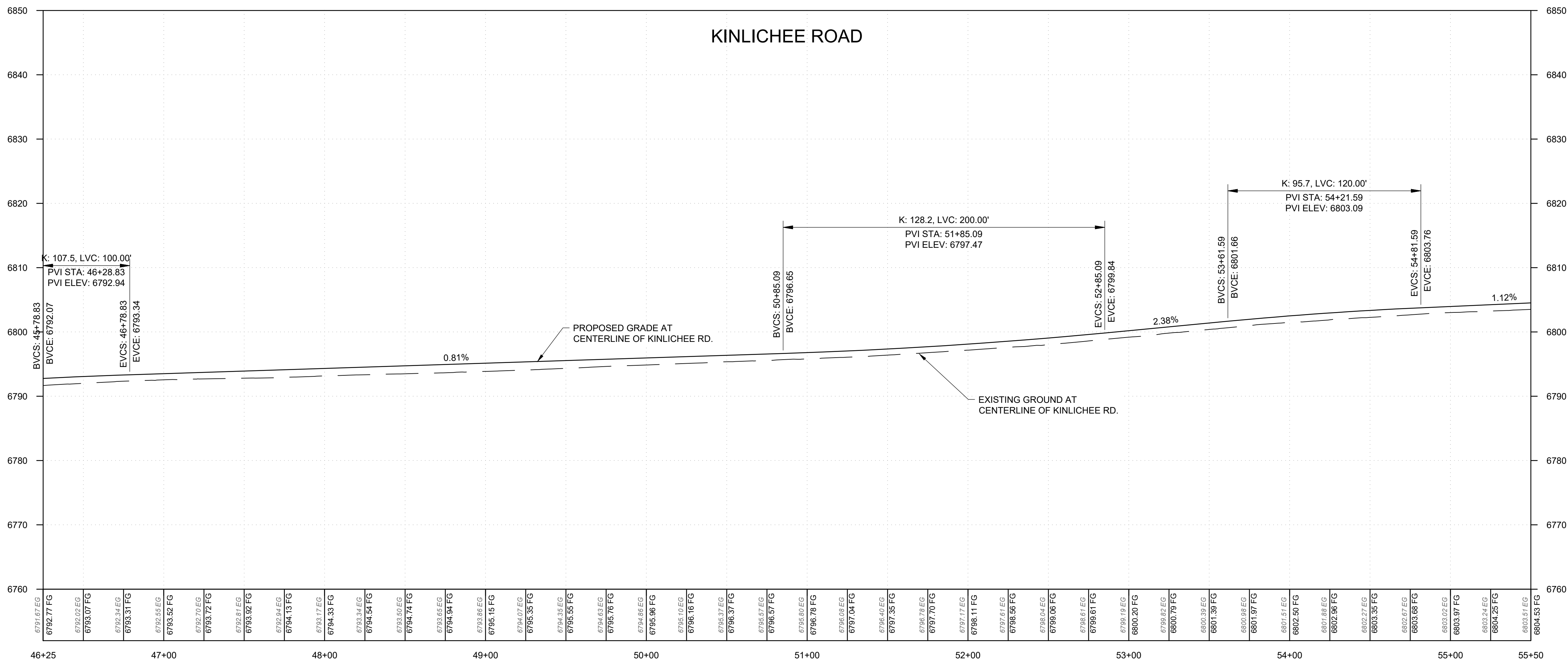
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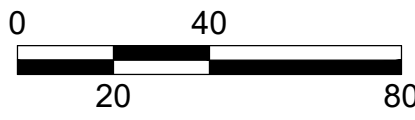
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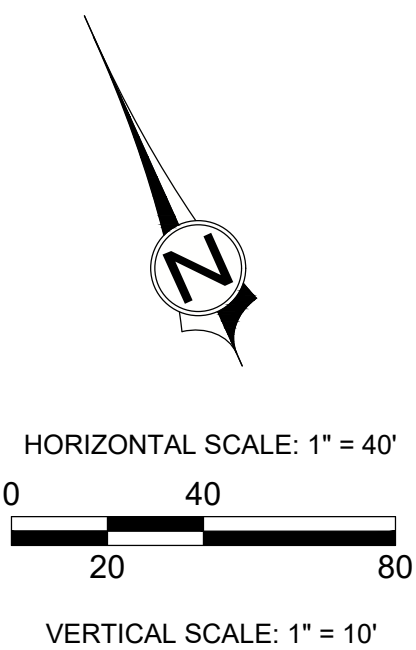
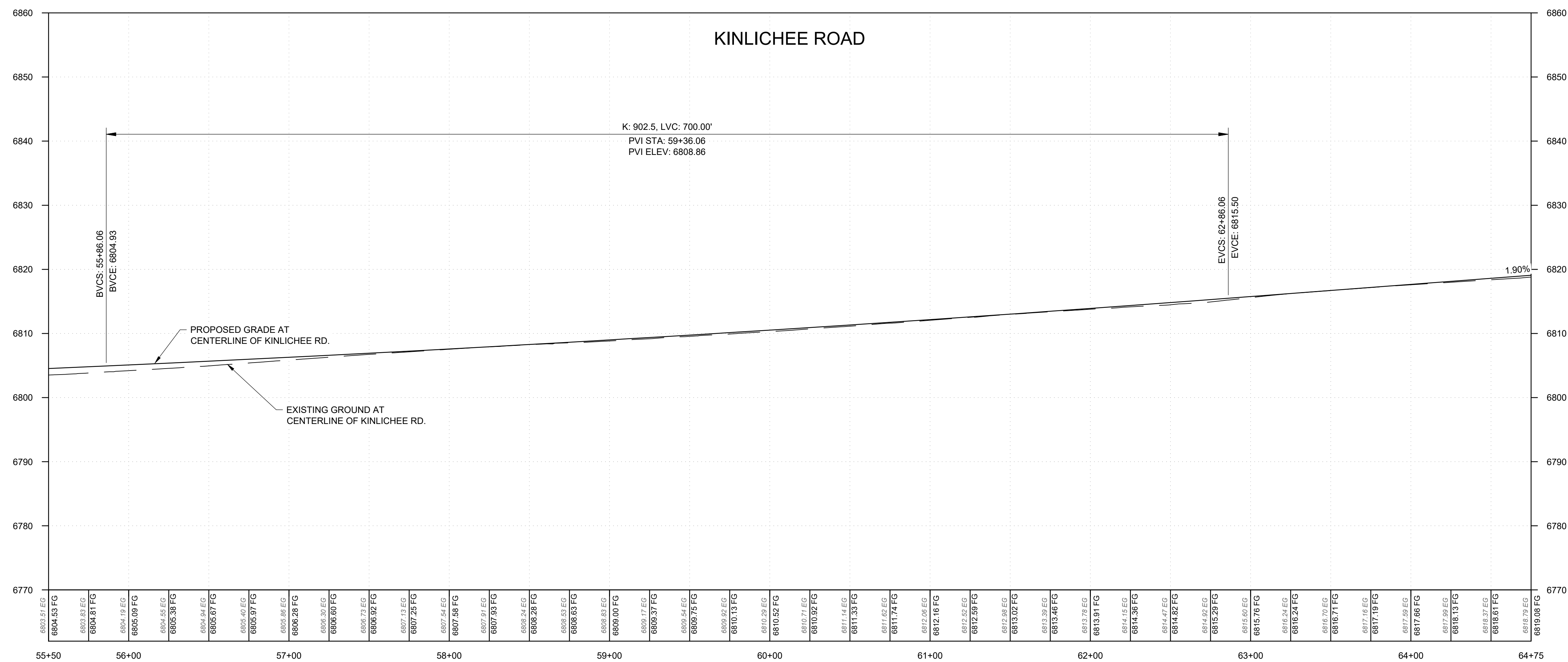
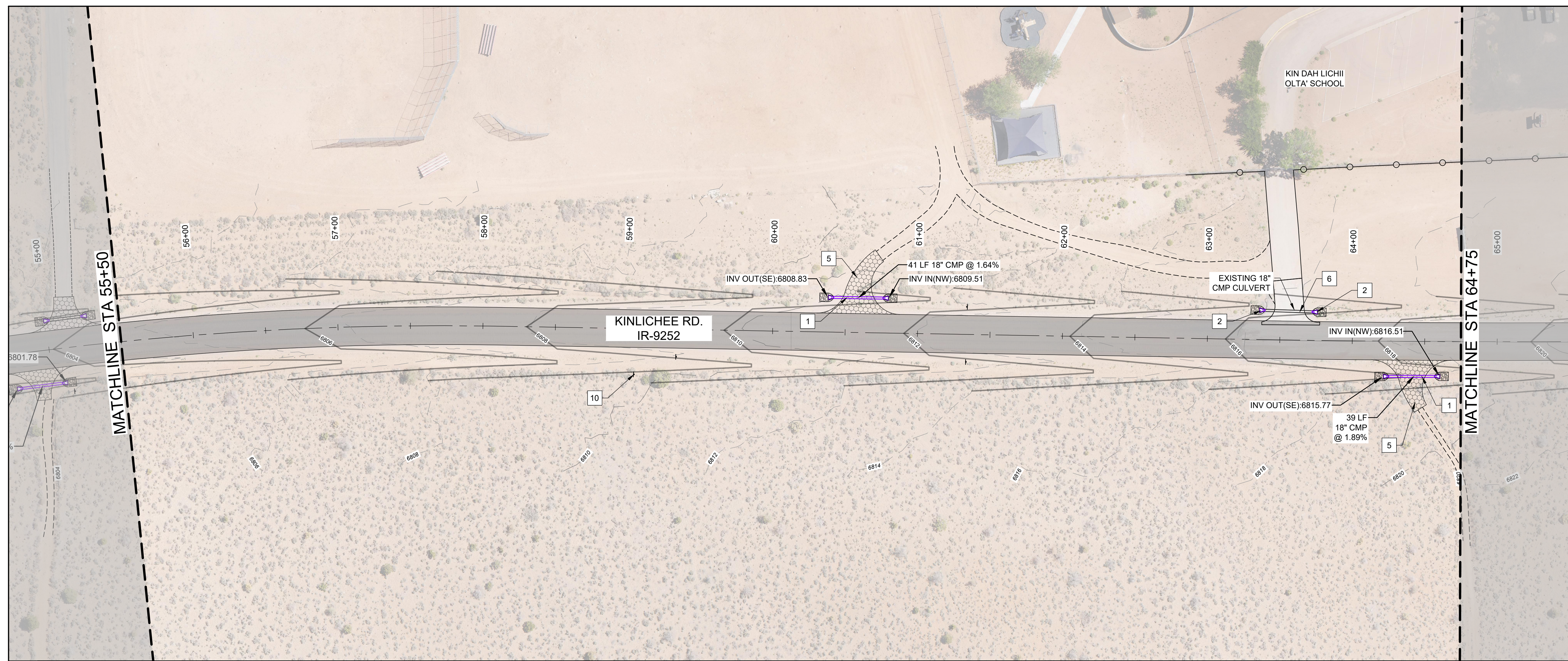
REVISION		DESCRIPTION	BY	DATE
NO.	REVISION			

KINLICHEE RD. PLAN AND PROFILE
STA: 46+25 - 55+00

BIA KINLICHEE ROAD IMPROVEMENTS
GANADO, AZ

PROJ. #: FF 21190
DATE: SEPTEMBER 2021
DESIGN BY: OZ
CHECKED BY: JGJ
SHEET

PP6



LEGEND:

- | | |
|---|---|
|  | 3" HMA PAVEMENT SECTION SEE SHEET TS |
|  | 6" COMPACTED AGGREGATE BASE SECTION, SEE SHEET TS |

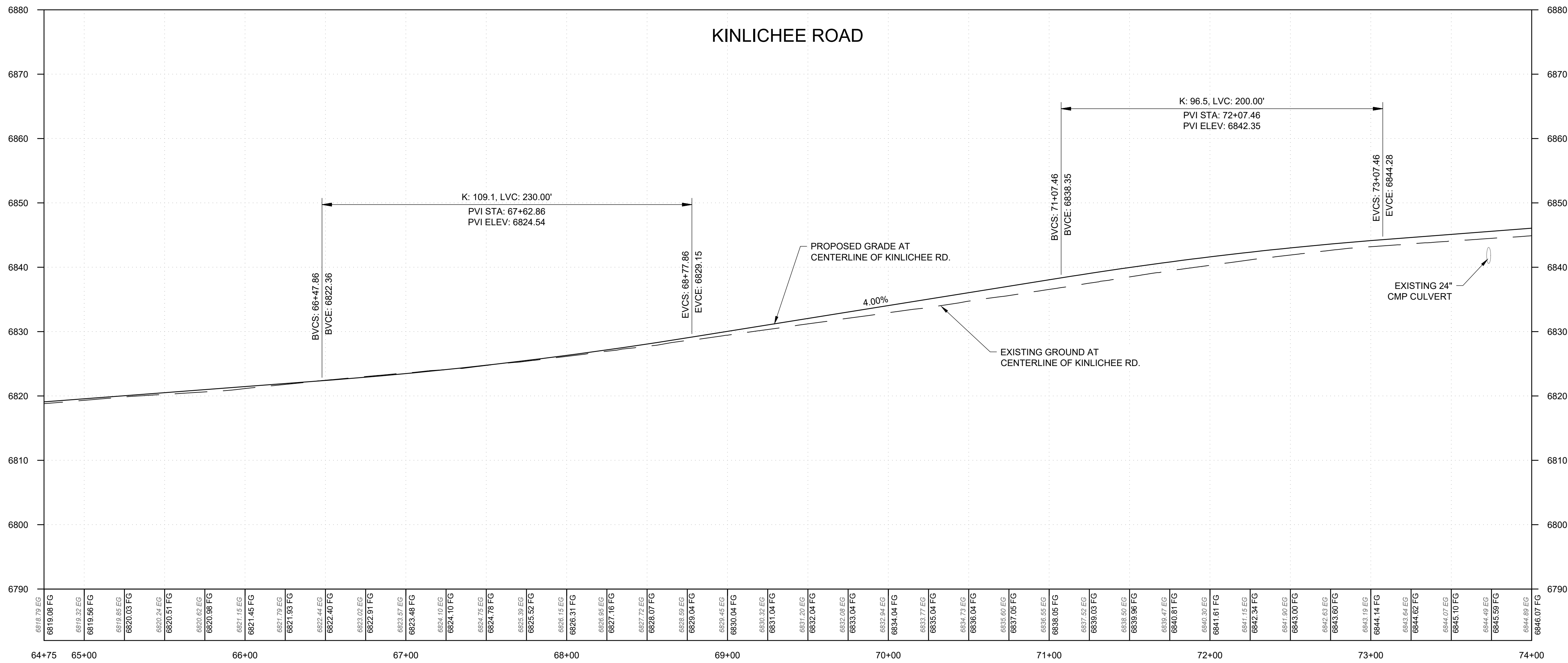
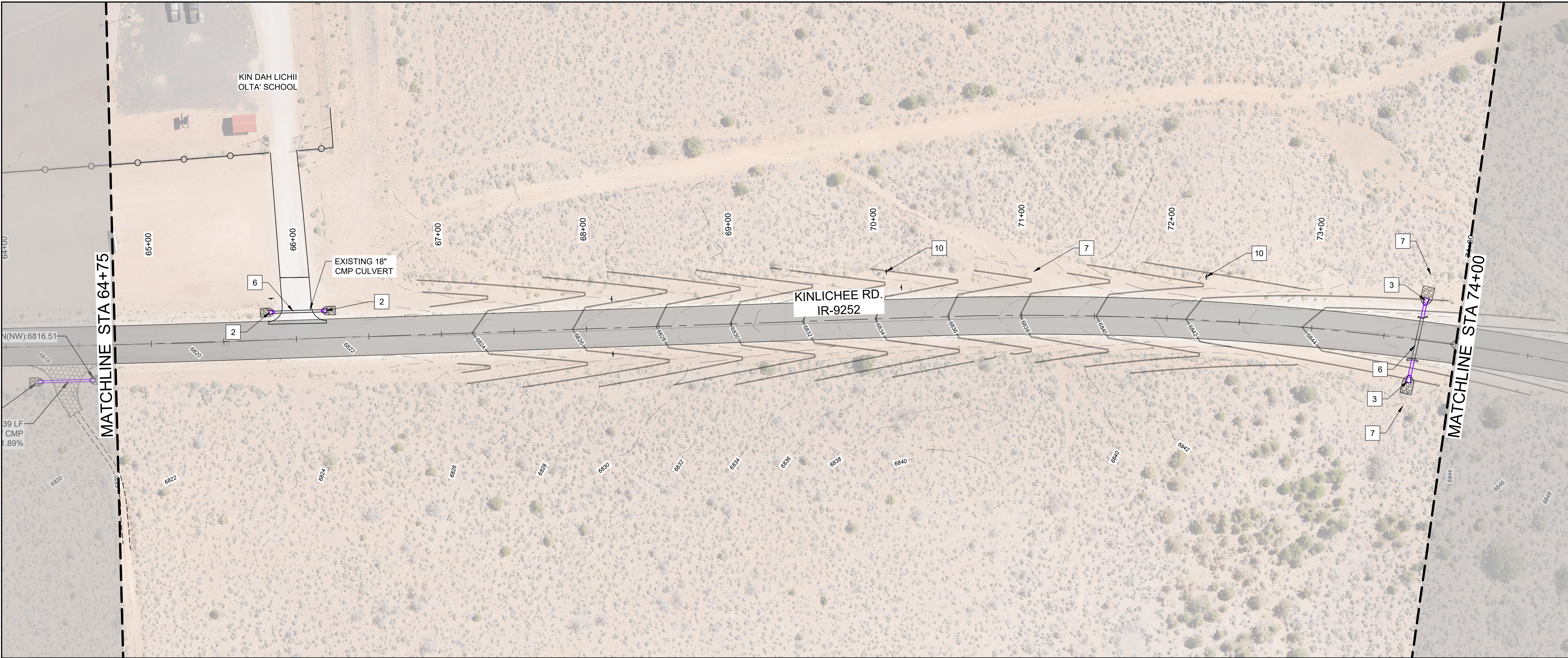
KEYNOTES:

- 1 INSTALL NEW CMP CULVERT WITH (2) FLARED END SECTIONS AND RIP-RAP PADS. SEE DETAIL ON SHEET TS
- 2 INSTALL NEW FLARED END SECTION AND RIP-RAP PAD ON EXISTING CULVERT. SEE DETAIL ON SHEET TS
- 3 INSTALL CMP CULVERT EXTENSION WITH FLARED END SECTION AND RIP-RAP PAD. SEE DETAIL ON SHEET TS
- 4 RESTORE EXISTING ROADWAY TO NATURAL STATE. REMOVE EXISTING GRAVEL SURFACING, REGRADE TO MATCH ADJACENT GRADE. SCARIFY SURFACE 6-INCHES MIN., PLACE TOPSOIL AND RE-SEED WITH NATIVE MIX
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- 9 INSTALL NEW 24"x30" R2-1 30 MPH SPEED LIMIT SIGN WITH POLE PER MUTCD AND ADOT STANDARDS
- 10 REMOVE AND SALVAGE EXISTING SIGN TO OWNER

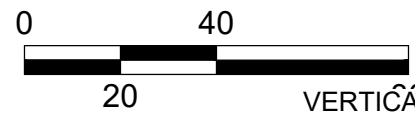


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Call before you dig.

PATH: L:\UTAHPROJECTS\ACTIVE 2021\FX21100.00 - BIA KINLICHEE PAVING\00 - CAD\SHEET FILES\21100 - RPI.DWG



HORIZONTAL SCALE: 1" = 40'



VERTICAL SCALE: 1" = 10'

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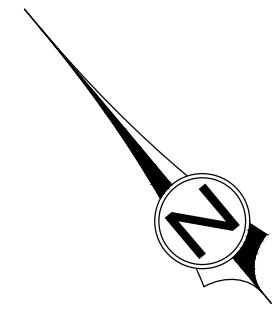
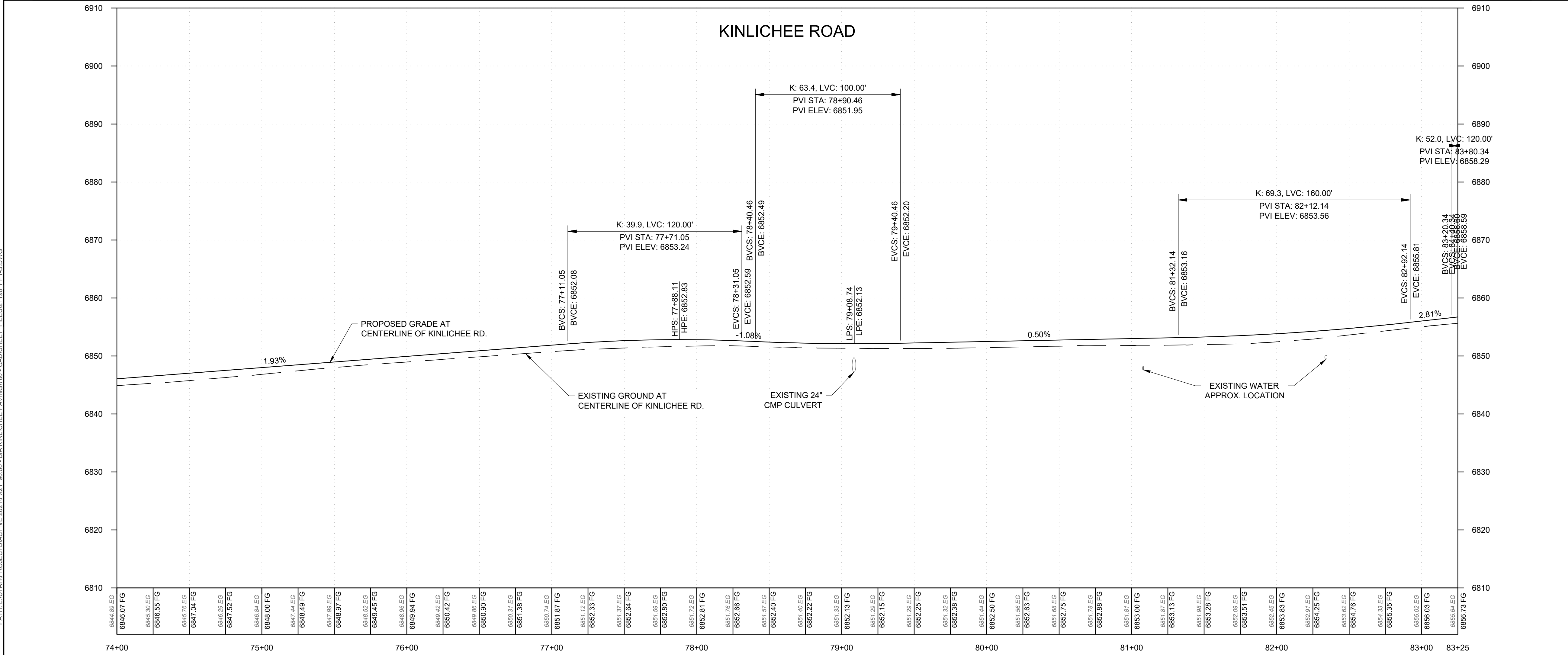
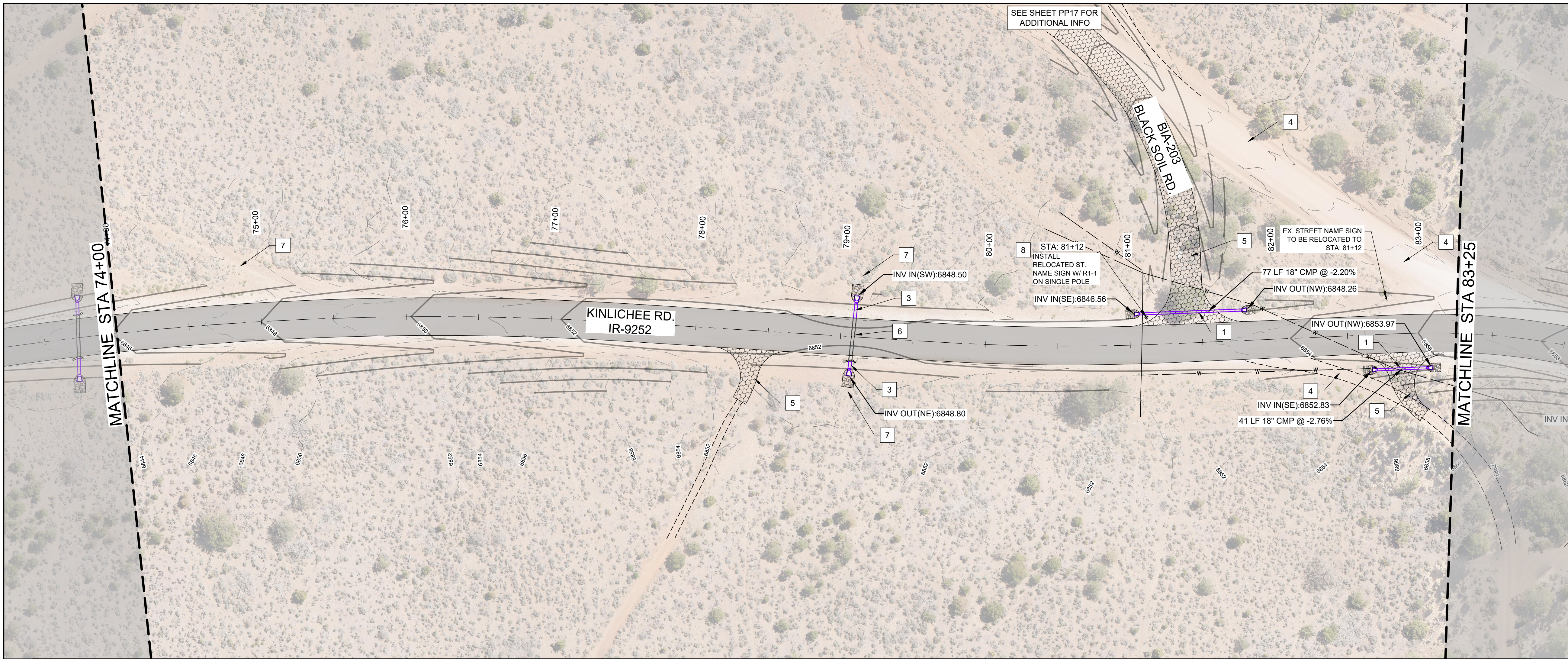
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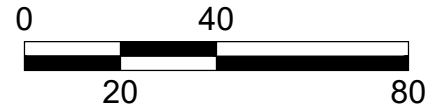
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NO.	REVISION	DESCRIPTION	BY	DATE

PATH: L:\UTAH\PROJECTS\ACTIVE 2021\FF21190.00 - BIA\KINLICHEE PAVING\00 - CAD\SHEET FILES\021190.PP18.DWG



HORIZONTAL SCALE: 1" = 40'



VERTICAL SCALE: 1" = 10'

LEGEND:

- 3" HMA PAVEMENT SECTION SEE SHEET TS
- 6" COMPACTED AGGREGATE BASE SECTION, SEE SHEET TS

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KINLICHEE RD. PLAN AND PROFILE STATION RANGE / OTHER

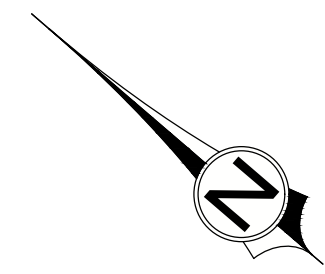
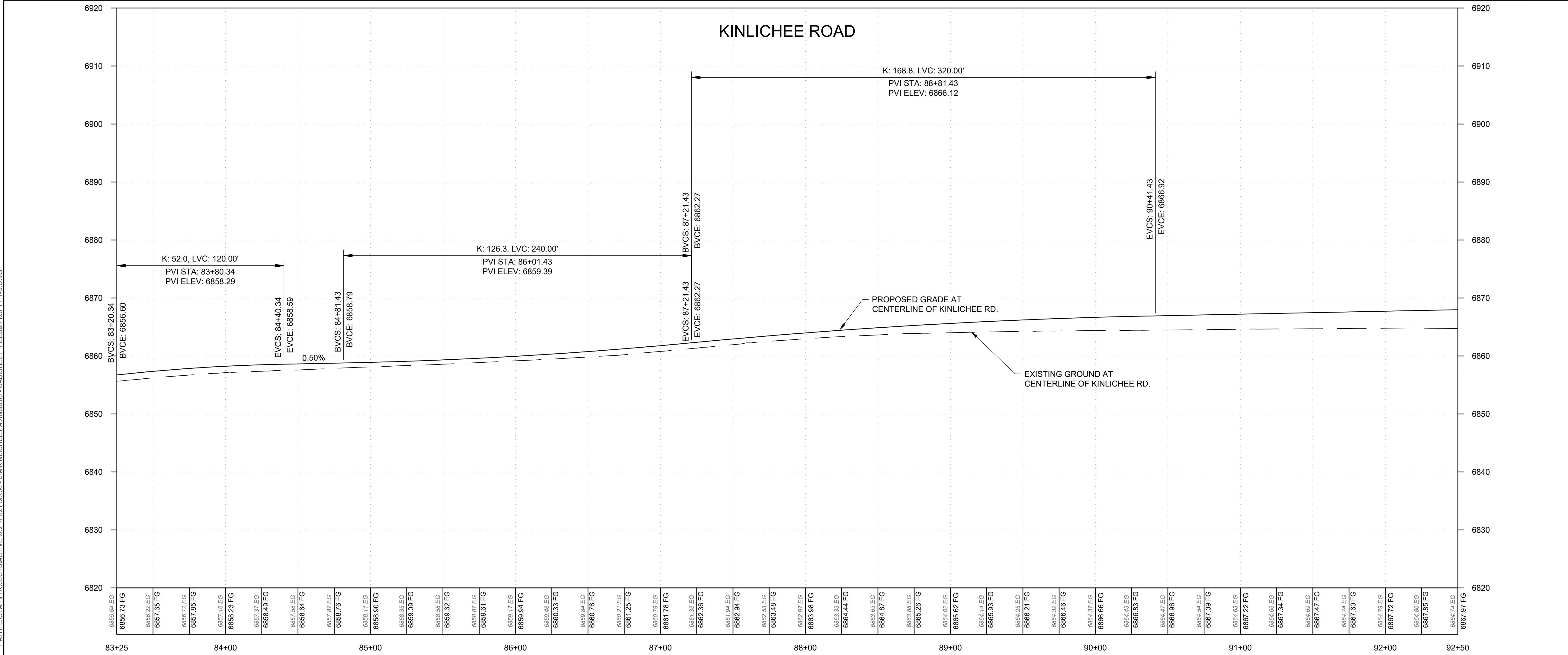
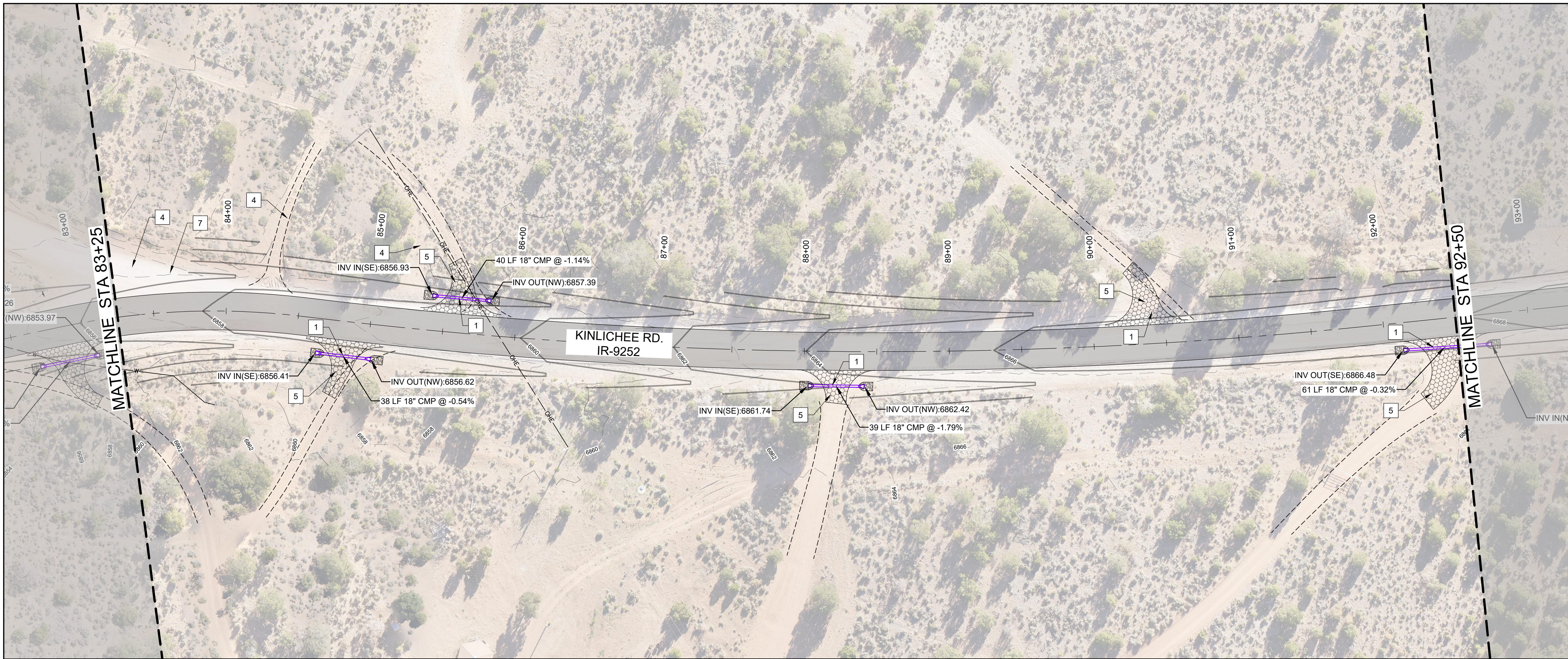
BIA KINLICHEE ROAD IMPROVEMENTS
GANADO, AZ

PROJ. #: FF 21190
DATE: SEPTEMBER 2021
DESIGN BY: OZ
CHECKED BY: JGJ

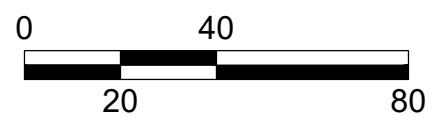
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PP9

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HORIZONTAL SCALE: 1" = 40'



VERTICAL SCALE: 1" = 10'

LEGEND:

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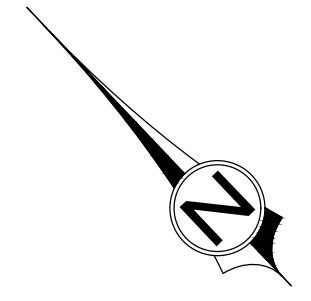
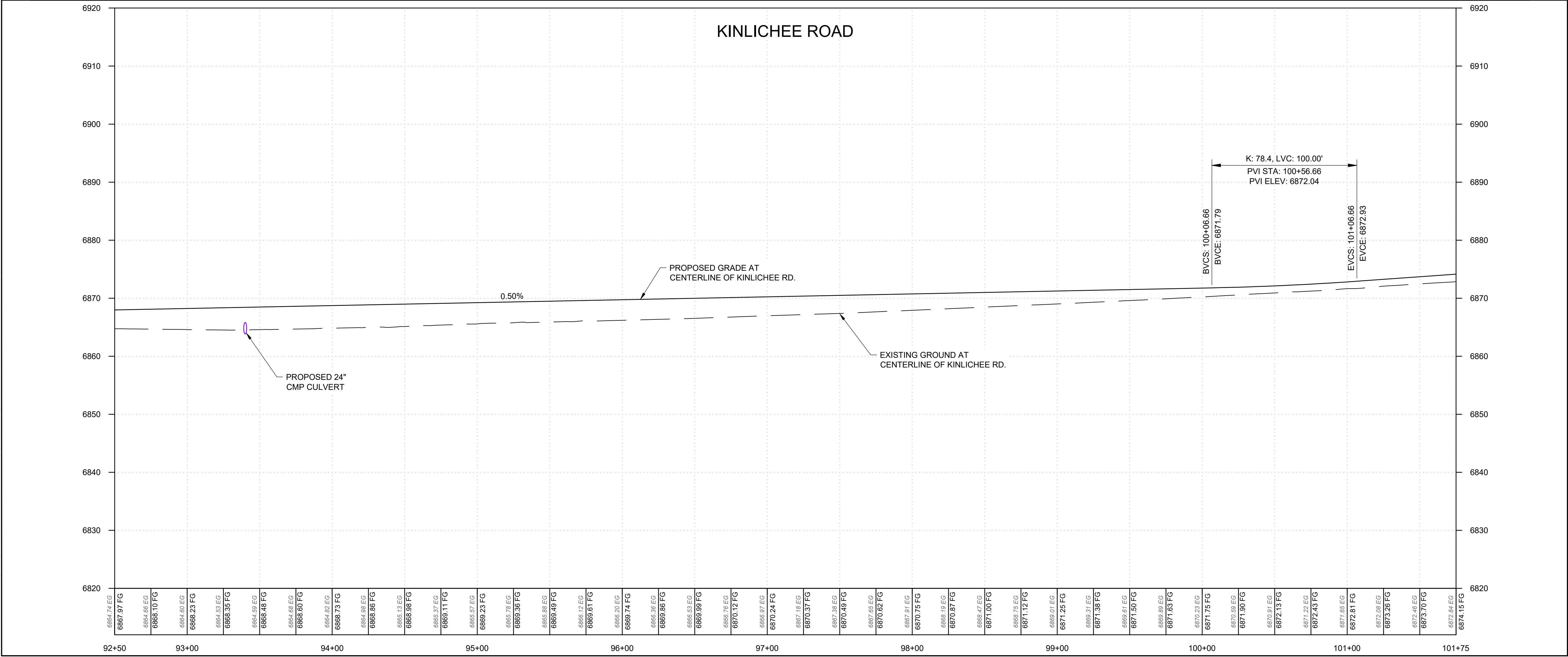
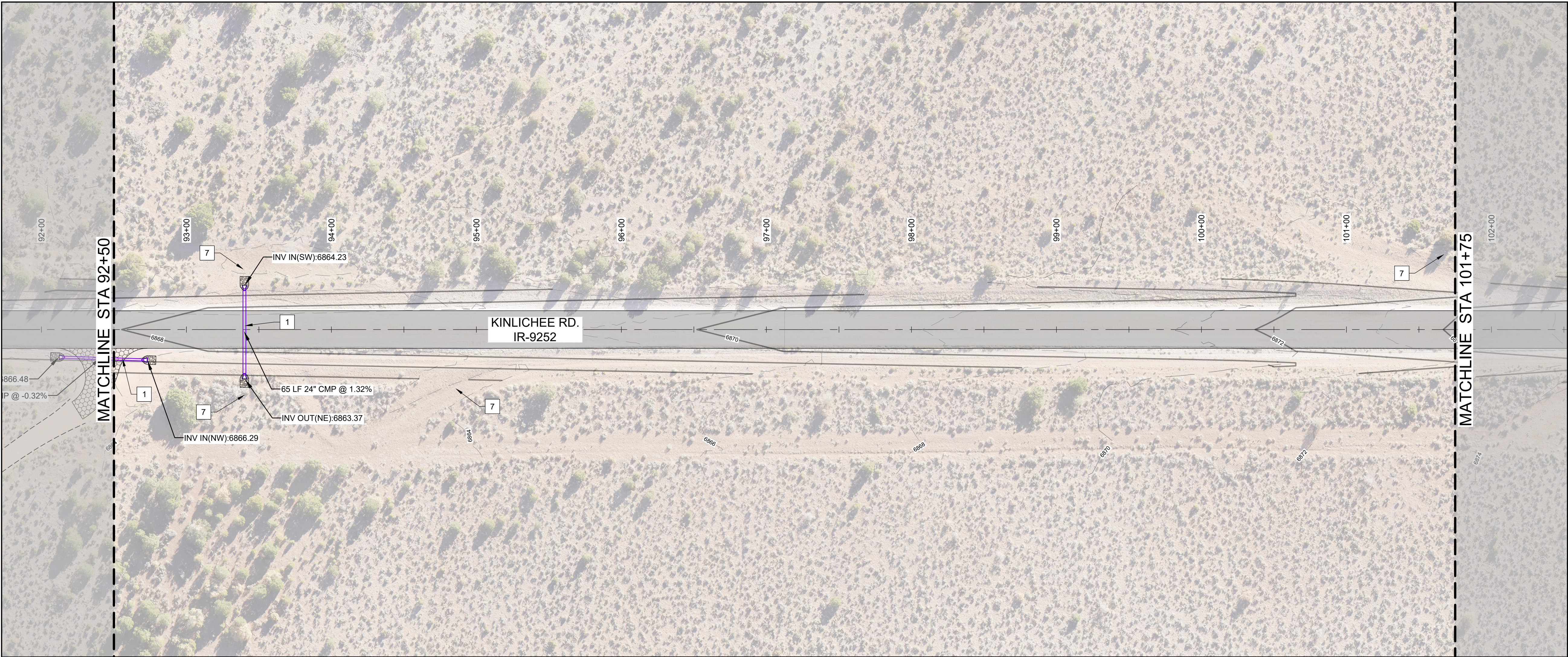
KINLICHEE RD. PLAN AND PROFILE STATION RANGE / OTHER

BIA KINLICHEE ROAD IMPROVEMENTS
CANADO, AZ

PROJ. #: FF 21190
DATE: SEPTEMBER 2021
DESIGN BY: OZ
CHECKED BY: JGJ
SHEET

PP10

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HORIZONTAL SCALE: 1" = 40'
0 20 40 80
VERTICAL SCALE: 1" = 10'

LEGEND:

- 3" HMA PAVEMENT SECTION SEE SHEET TS
- 6" COMPACTED AGGREGATE BASE SECTION, SEE SHEET TS

KEYNOTES:

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**CivilScience**
Engineers | Surveyors | Solutions
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LEHI, UT 84043
801.768.7200

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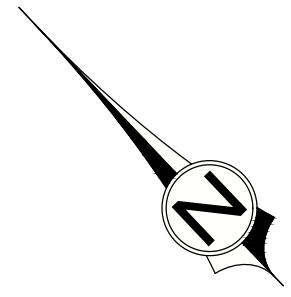
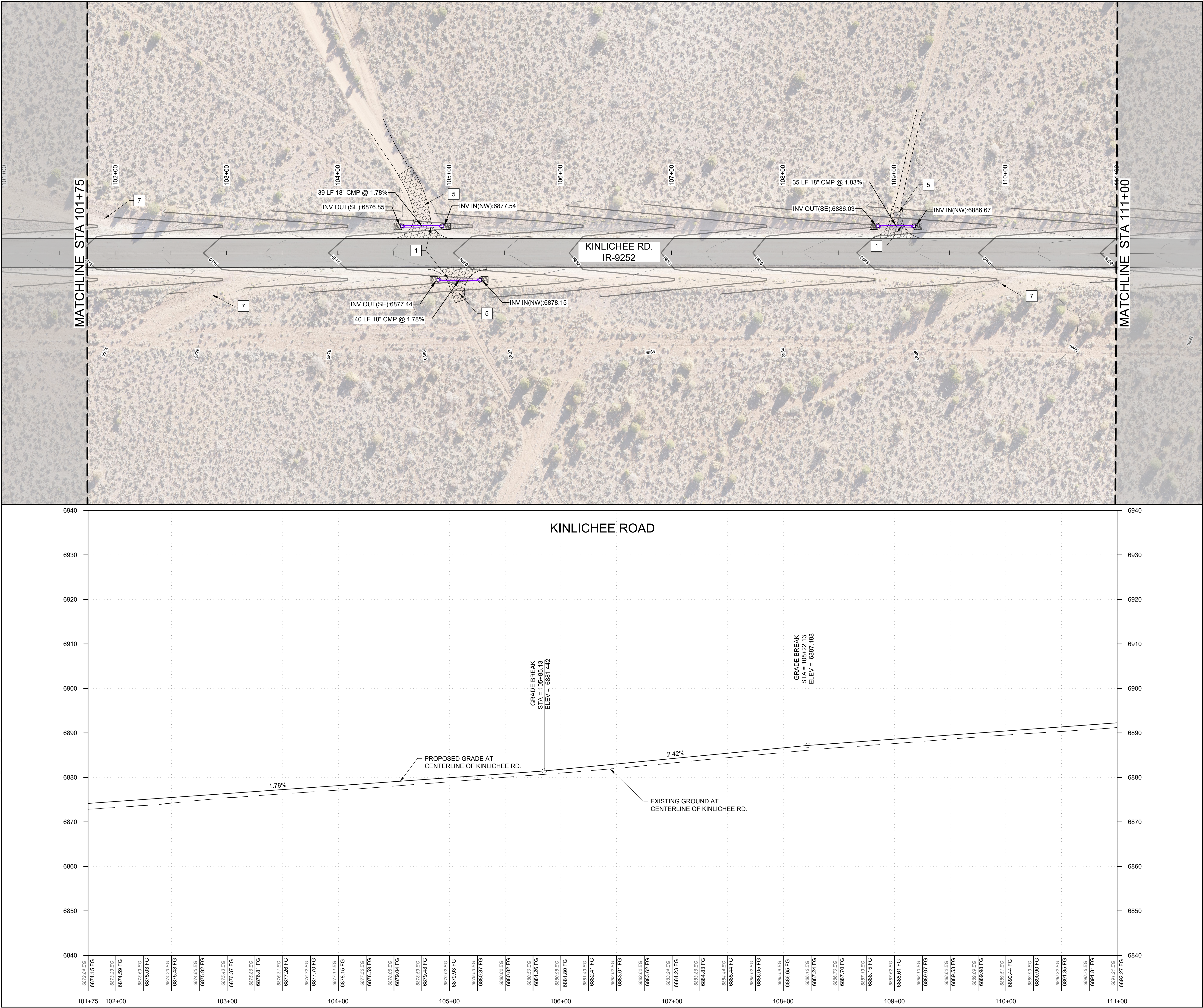
KINLICHEE RD. PLAN AND PROFILE
STATION RANGE / OTHER

BIA KINLICHEE ROAD IMPROVEMENTS
GANADO, AZ

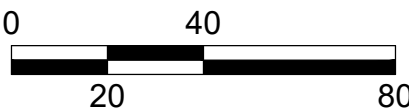
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DESIGN BY: OZ
CHECKED BY: JGJ
SHEET PP11

16 OF 23

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HORIZONTAL SCALE: 1" = 40'



VERTICAL SCALE: 1" = 10'

LEGEND:

- 3" HMA PAVEMENT SECTION SEE SHEET TS
- 6" COMPACTED AGGREGATE BASE SECTION, SEE SHEET TS

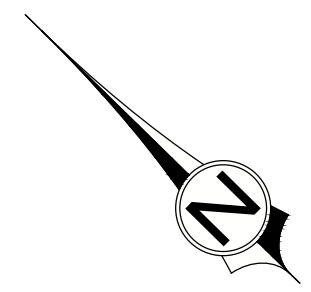
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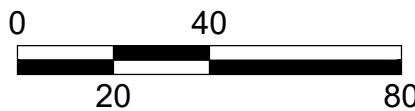


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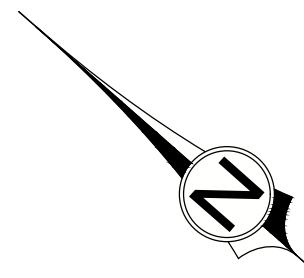
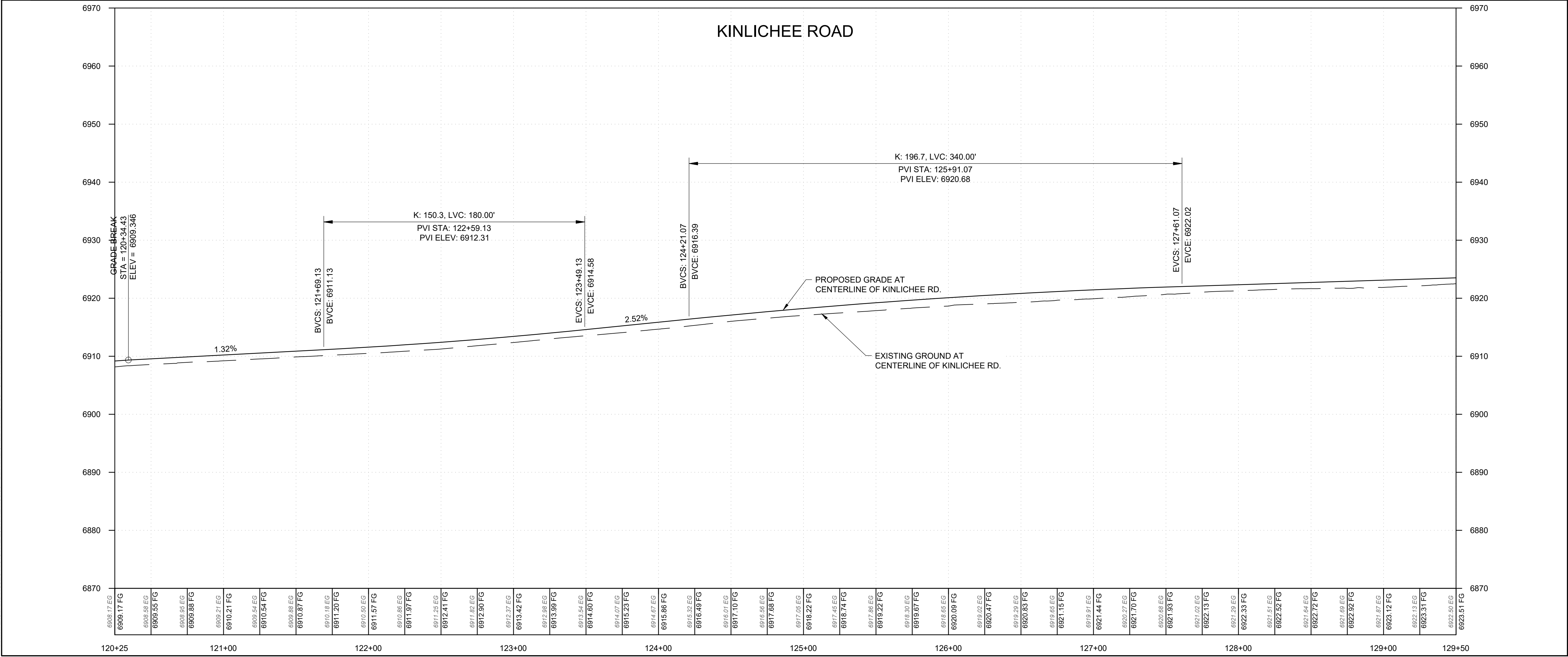
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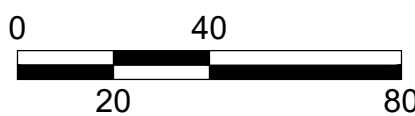
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KINLICHEE RD. PLAN AND PROFILE
STATION RANGE / OTHER
BIA KINLICHEE ROAD IMPROVEMENTS
CANADO, AZ

PATH: L:\UTAH\PROJECTS\ACTIVE 2021\FX21100.00 - BIA KINLICHEE PAVING\000 - CAD\SHEET FILES\21100_RP1-B.DWG



HORIZONTAL SCALE: 1" = 40'



VERTICAL SCALE: 1" = 10'

LEGEND:

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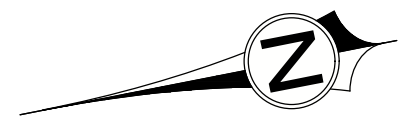
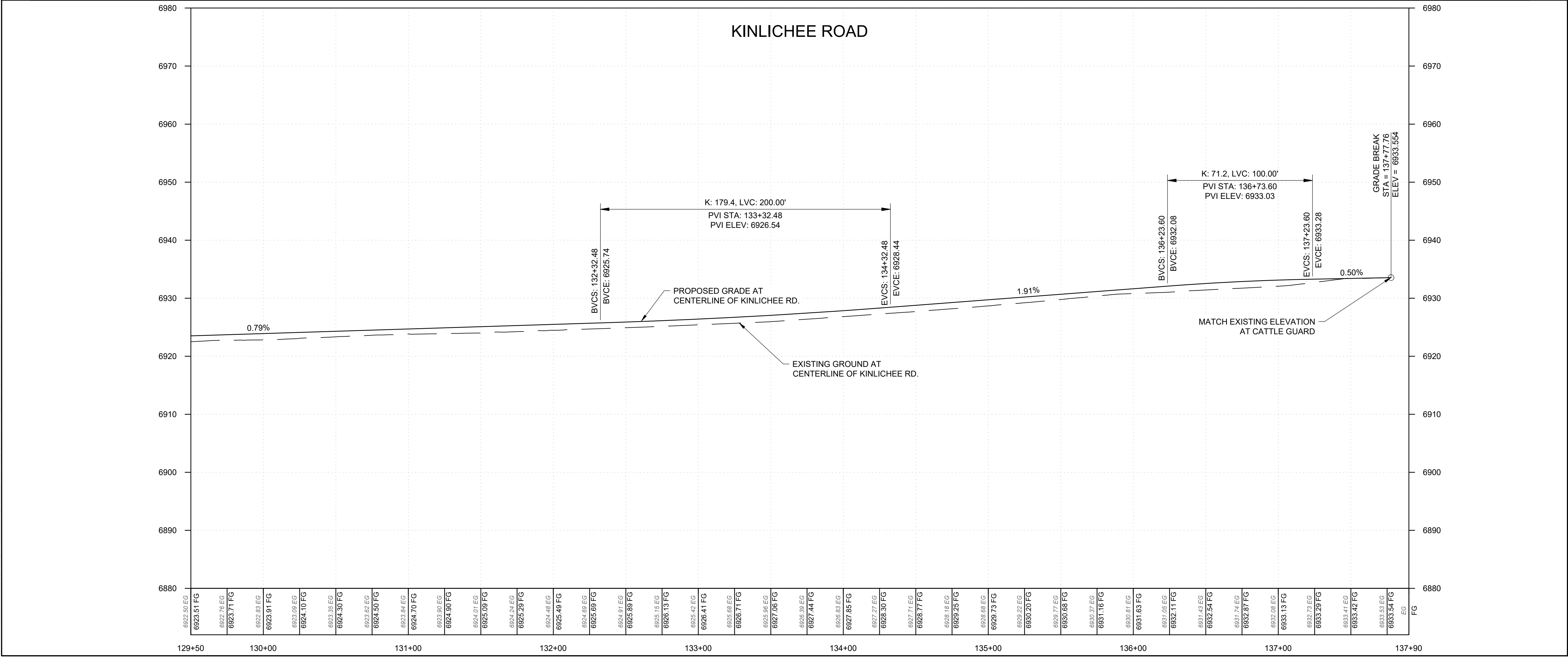
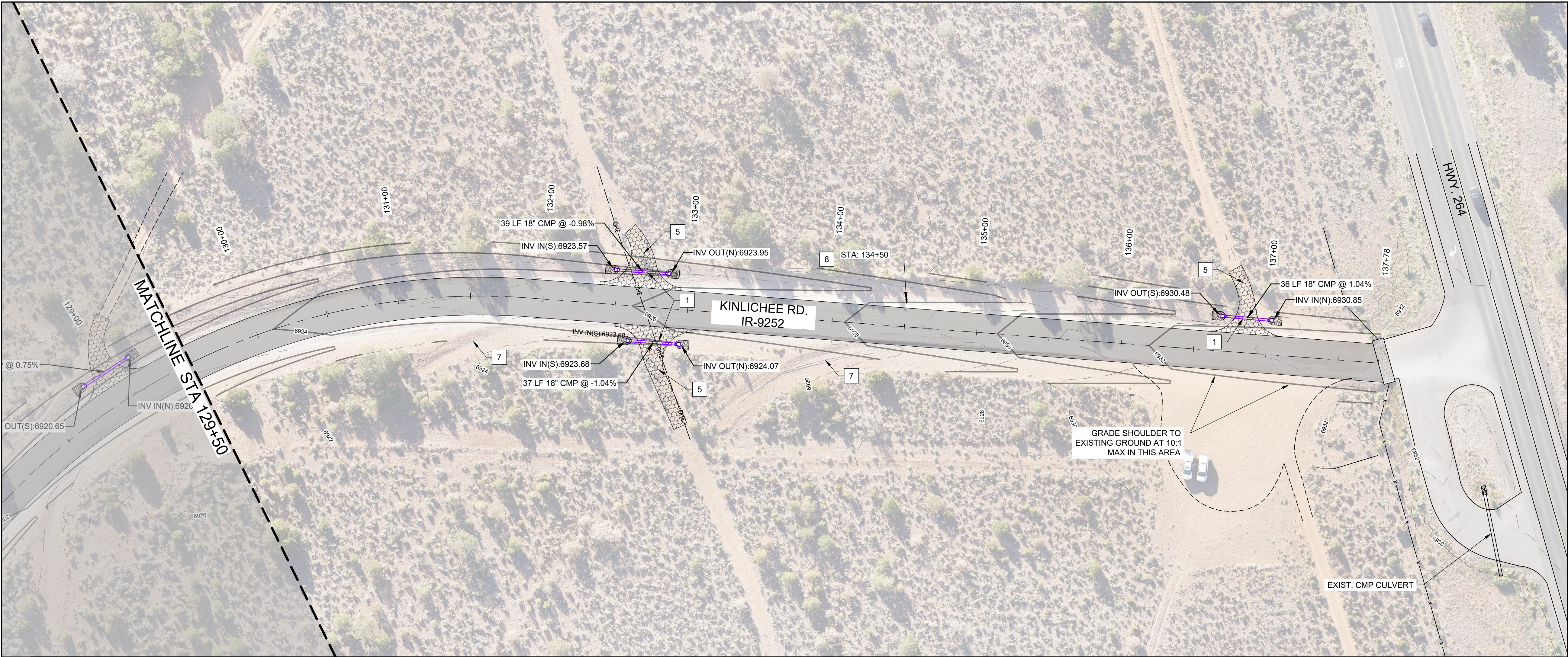
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KINLICHEE RD. PLAN AND PROFILE
STATION RANGE / OTHER
BIA KINLICHEE ROAD IMPROVEMENTS
GANADO, AZ

PROJ. #: FF 21190
DATE: SEPTEMBER 2021
DESIGN BY: OZ
CHECKED BY: JGJ
SHEET

PP14

PATH: L:\UTAHPROJECTS\ACTIVE 2021\FX21100-00-BIA\KINLICHEE PAVING\000 - CAD\SHSHEET FILES\21100-00\PP1-B.DWG



HORIZONTAL SCALE: 1" = 40'
0 20 40 80
VERTICAL SCALE: 1" = 10'

LEGEND:

- 3" HMA PAVEMENT SECTION SEE SHEET TS
- 6" COMPACTED AGGREGATE BASE SECTION, SEE SHEET TS

KEYNOTES:

- INSTALL NEW CMP CULVERT WITH (2) FLARED END SECTIONS AND RIP-RAP PADS. SEE DETAIL ON SHEET TS
- INSTALL NEW FLARED END SECTION AND RIP-RAP PAD ON EXISTING CULVERT. SEE DETAIL ON SHEET TS
- INSTALL CMP CULVERT EXTENSION WITH FLARED END SECTION AND RIP-RAP PAD. SEE DETAIL ON SHEET TS
- RESTORE EXISTING ROADWAY TO NATURAL STATE. REMOVE EXISTING GRAVEL SURFACING, REGRADE TO MATCH ADJACENT GRADE, SCARIFY SURFACE 6-INCHES MIN., PLACE TOPSOIL AND RE-SEED WITH NATIVE MIX
- CONSTRUCT GRAVEL ROADWAY APPROACH 6" THICK COMPACTED AGGREGATE BASE OVER 6" COMPACTED SUBBASE. GRADE SMOOTH TRANSITION TO EXISTING ROADS. TIE IN EXISTING DRAINAGE DITCHES TO NEW DITCHES AND/OR CULVERTS
- CLEAN EXISTING CULVERT TO REMOVE SEDIMENT AND DEBRIS
- GRADE PROPOSED ROADSIDE CHANNEL TO EXISTING DITCH OUTFALL, ENSURE POSITIVE DRAINAGE
- INSTALL NEW 30" R1-1 STOP SIGN WITH POLE PER MUTCD AND ADOT STANDARDS
- INSTALL NEW 24"x30" R2-1 30 MPH SPEED LIMIT SIGN WITH POLE PER MUTCD AND ADOT STANDARDS
- REMOVE AND SALVAGE EXISTING SIGN TO OWNER



KINLICHEE RD. PLAN AND PROFILE
STATION RANGE / OTHER
BIA KINLICHEE ROAD IMPROVEMENTS
GANADO, AZ



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CONSTRUCTION

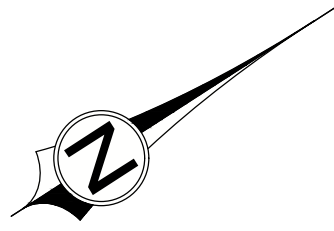
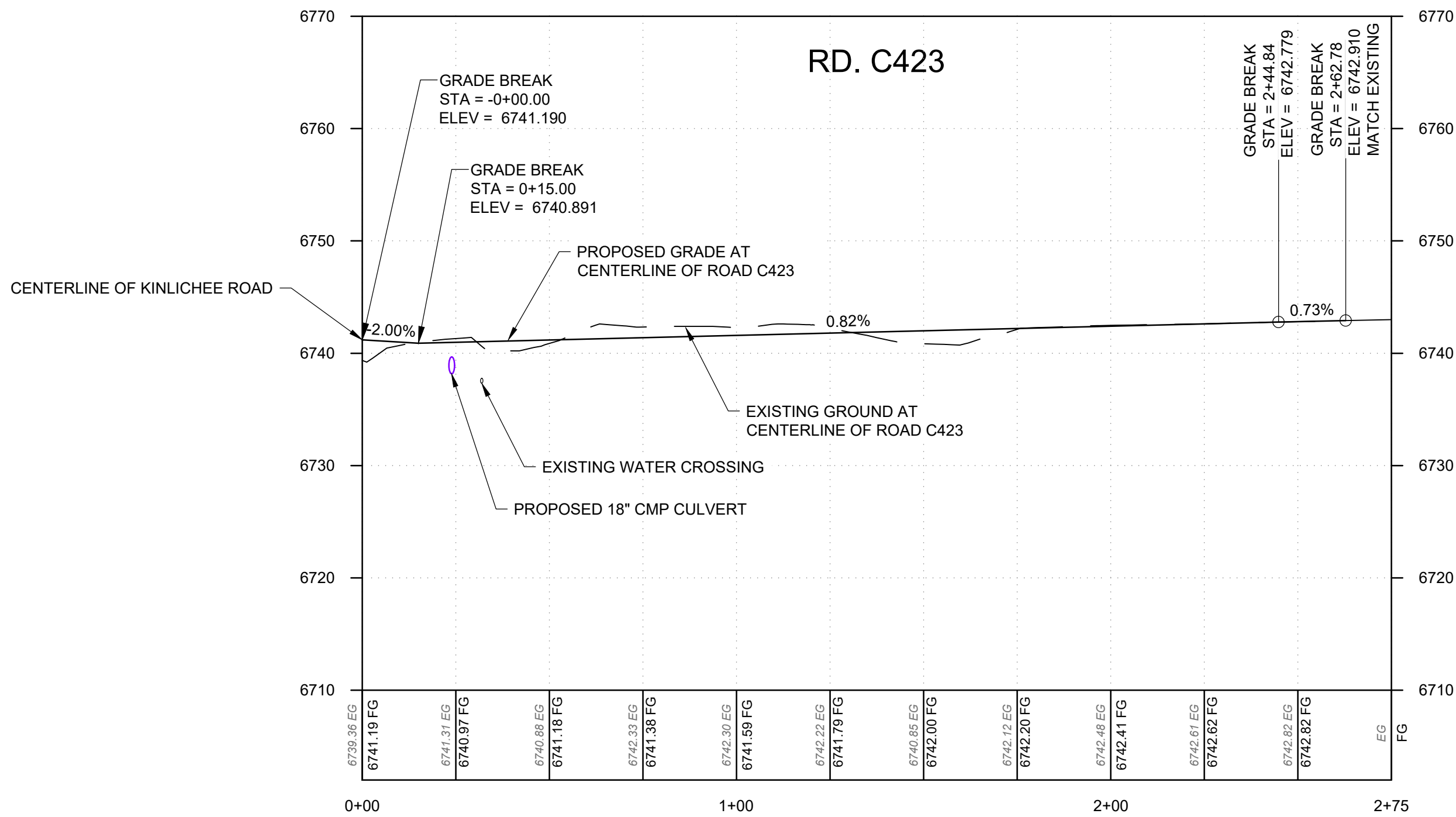
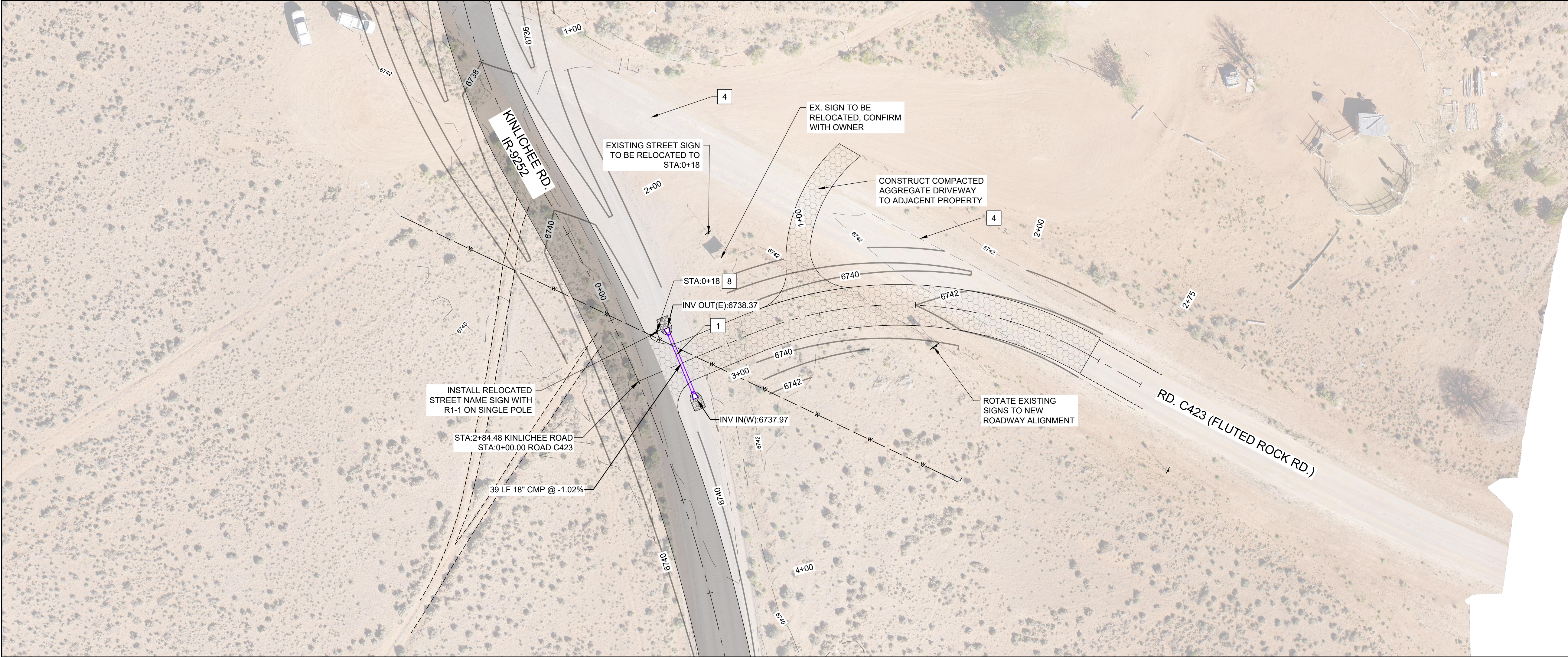
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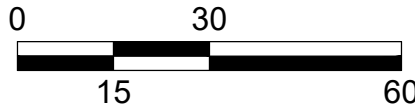
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HORIZONTAL SCALE: 1" = 30'



VERTICAL SCALE: 1" = 10'

LEGEND:

- 3" HMA PAVEMENT SECTION SEE SHEET TS
- 6" COMPACTED AGGREGATE BASE SECTION, SEE SHEET TS

KEYNOTES:

- INSTALL NEW CMP CULVERT WITH (2) FLARED END SECTIONS AND RIP-RAP PADS. SEE DETAIL ON SHEET TS
- INSTALL NEW FLARED END SECTION AND RIP-RAP PAD ON EXISTING CULVERT. SEE DETAIL ON SHEET TS

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CONSTRUCTION

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RD. C423 PLAN AND PROFILE

BIA KINLICHEE ROAD IMPROVEMENTS
GANADO, AZ

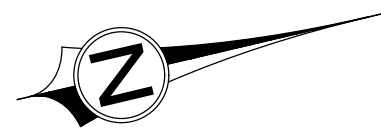
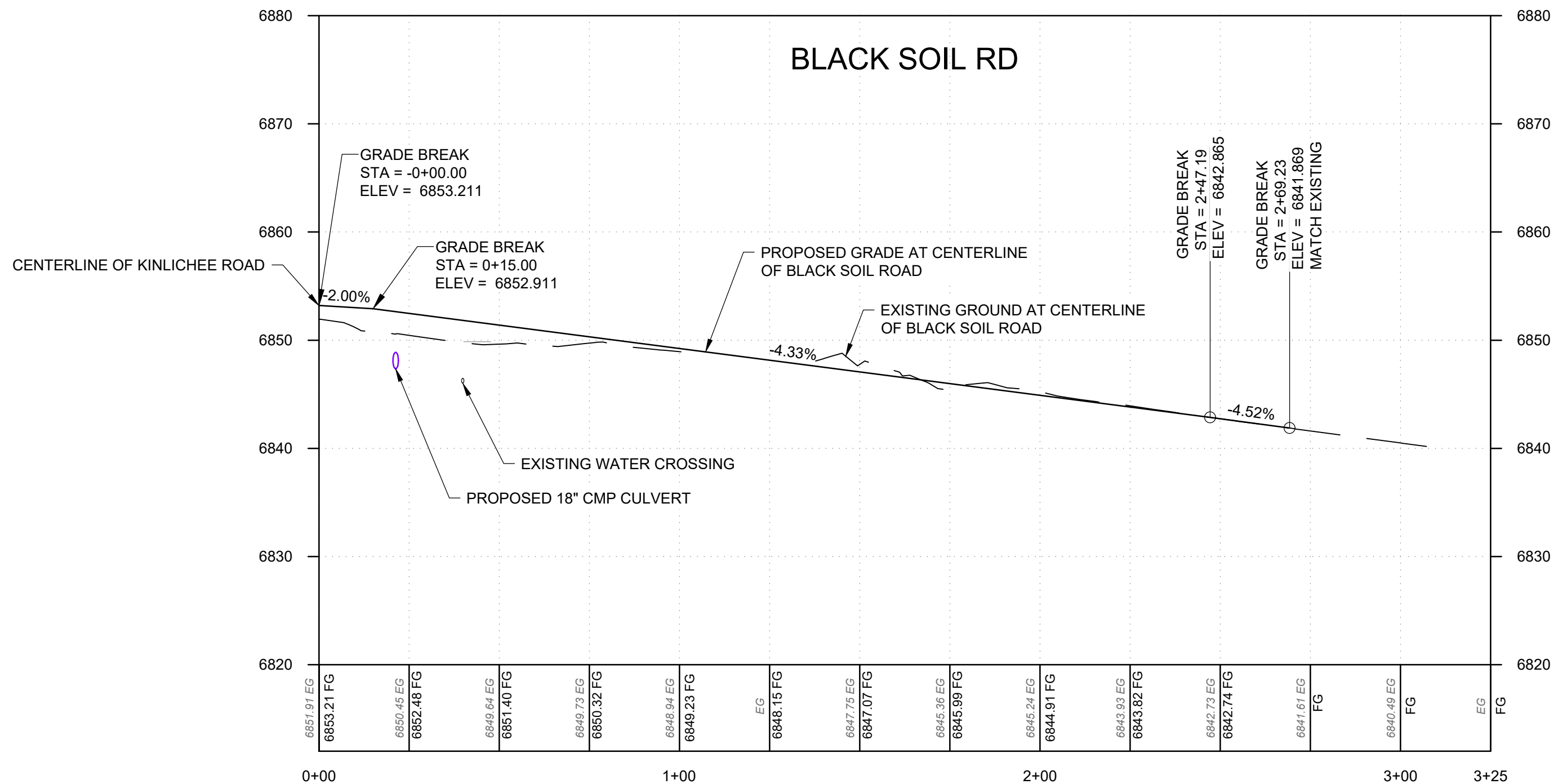
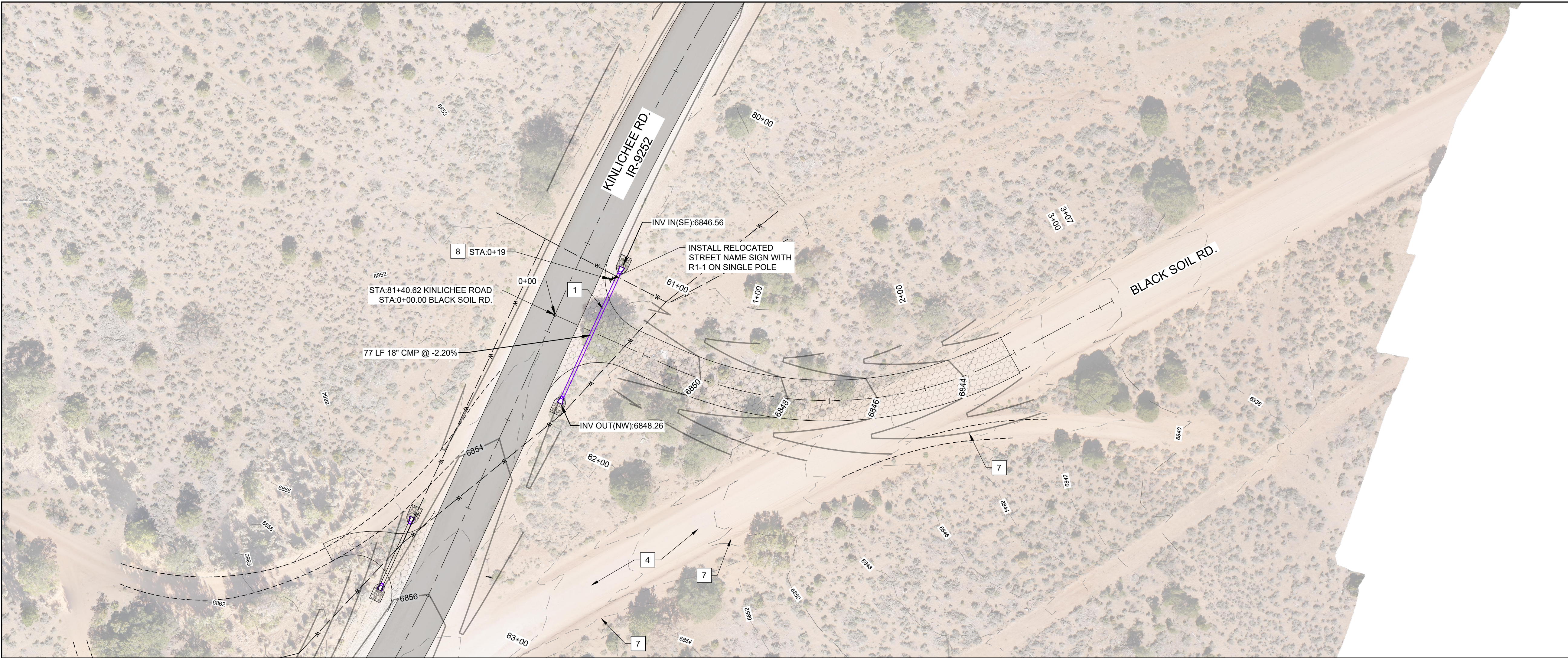


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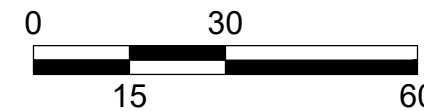
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HORIZONTAL SCALE: 1" = 30'



VERTICAL SCALE: 1" = 10'

LEGEND:

- 3" HMA PAVEMENT SECTION SEE SHEET TS
- 6" COMPACTED AGGREGATE BASE SECTION, SEE SHEET TS

KEYNOTES:

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BLACK SOIL ROAD PLAN AND PROFILE

BIA KINLICHEE ROAD IMPROVEMENTS
GANADO, AZ

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