FEBRUARY 2017

OLSSON PROJECT NO. 016-1500

PLATTE REPUBLICAN DIVERSION PROJECT FEASIBILITY REVIEW

PREPARED FOR:

PLATTE REPUBLICAN DIVERSION
LOWER REPUBLICAN
NATURAL RESOURCES DISTRICT
AND TRI-BASIN
NATURAL RESOURCES DISTRICT

LOWER REPUBLICAN NATURAL RESOURCES DISTRICT

Tri Basin Natural Resources District

OLSSON® ASSOCIATES

EXECUTIVE SUMMARY

FINDINGS:

Based on the results of this feasibility study, the Platte Republican Diversion Project would be cost-effective. With minimal improvements to the channel, and the existing bridge and culverts along Turkey Creek, diverting unallocated flows of up to 100 cfs from the Platte River basin could provide substantial benefits to the Republican River basin without negatively impacting Turkey Creek.

The water resources of the Platte and Republican Rivers have been extensively developed in part through the construction of many large reservoirs and canal delivery systems. This development has drastically altered the occurrence of surface water in both timing and location within each basin. The proximity of canals on the south side of the Platte River relative to tributaries to the Republican River now presents a golden opportunity.

While the Platte River basin has had incredible flows the past few years, the water supplies remain relatively low in the Republican River basin. This feasibility study looks at diverting excess flows from the Platte River basin into the Republican River via Turkey Creek.

Olsson used a three-step analysis strategy to develop a benefit cost ratio that would indicate the relative feasibility of this project.

1. The first step involved conducting a geomorphologic field analysis, an environmental assessment, and obtaining survey data to use during the analysis.
2. The second step involved creating a surface water hydraulic model for Turkey Creek. This model was used along with the information developed as part of step one to develop a list of improvements that are needed in order to protect or replace existing structures and mitigate against potential erosion that might occur along Turkey Creek under prolonged periods of higher flows resulting from the diversion project.
3. From the list of improvements, a cost of the project was developed for several different alternatives. A benefit cost ratio for the project was developed using information from the previous costs of providing equivalent benefits to streamflow in the Republican River basin by alternative means.

Given the favorable Benefit Cost Ratios, the Platte Republican Diversion project has great potential to provide needed additional flow into the Republican River basin when excess water is available in the Platte River.

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1.0 INTRODUCTION

This report documents the preliminary results of the feasibility review of the Platte Republican Diversion project in Gosper and Furnas counties, Nebraska. The feasibility review was conducted on behalf of the Lower Republican Natural Resources District (LRNRD) and the Tri-Basin Natural Resources District (TBNRD). The purpose of the proposed Platte Republican Diversion project is to divert unallocated flows from the Platte River to the Republican River via Turkey Creek. The purpose of the feasibility review is to determine impacts of diverting these unallocated flows into Turkey Creek, to develop a benefit-cost analysis for the project, and to provide additional guidance on the feasibility of the project.

Turkey Creek is a tributary to the Republican River and generally runs north to south starting approximately 4 miles east of Elwood, Nebraska. It empties into the Republican River between Edison and Oxford, Nebraska. The upper 4 to 5 miles of Turkey Creek runs through canyon areas and many stretches do not have a fully defined bed and bank. This upper section does have a fairly defined stream centerline, but the overall capacity of the creek in this section is less than the capacity of the creek in the middle and lower sections. The upper section of Turkey Creek also includes several farm ponds that currently retain a portion of the flow along Turkey Creek. The middle and lower portions of Turkey Creek have fully defined beds and banks that carry base flow. The primary land use for the adjacent properties to Turkey Creek are either pastures or farmland.

There are times during the year when the Platte River has potential excess flows that are not allocated or appropriated for downstream uses. Currently, these flows continue on down the Platte River past the proposed diversion point.

Excess flows in the Platte River will be used to help augment flows in the Republican River through Turkey Creek with a direct beneficial use to the state of Nebraska's interstate compact obligations, using publicly owned existing infrastructure. Other beneficial uses include groundwater recharge, and potential recreational benefits at Harlan County Lake.

2.0 REVIEW AND ANALYSIS OF EXISTING CONDITIONS OF TURKEY CREEK

2.1 Existing Characteristics

Topographic Summary of the Project Area

Turkey Creek can be divided into three distinct flow reaches based on channel capacity and characteristics.

The uppermost portions of the Turkey Creek watershed lack a defined channel, with runoff occurring through canyons as sheet flow. At approximately 5 miles downstream near Drive 432A, the creek and its tributaries have a fully defined bed and bank with a visible flowline. The eastern branch of Turkey Creek and the main channel of Turkey Creek, the portions of the watershed that will need to transmit the diverted water, can be divided into three distinct flow reaches based on channel capacity. Exhibit A in Appendix A is an overall map of the project reaches.

Upper Section of Project Area.

The upper section consists of the first 3,000 feet of eastern branch of Turkey Creek. It has a fairly steep slope for the entire length, which will generate higher velocities during flow events, significantly increasing the potential for erosion. It has a fairly defined centerline however lacks a channel bed, banks, and cross-sectional area to contain flows. Any runoff generated by rainfall events flows overland as sheet flow through this area. With no defined channel the flow is not contained and the upper section has an existing capacity of zero (0) cubic feet per second (cfs).

Middle Section of Project Area.

The middle section consists of approximately the next 5 miles of eastern branch of Turkey Creek. It has a defined channel, but has a more limited capacity and is generally steeper relative to the lower section. This middle section has a general top of bank capacity of ranging from 100 cfs at the beginning of the section to 650 cfs just north of Drive 432A. The capacity slowly increases as you progress downstream.

Several farms ponds along Turkey Creek in the upper/middle section affect flow downstream.

The remainder of Turkey Creek is referred to as the lower section. This section has a well-defined channel with higher channel capacities. There is a steady base flow during the majority of the year, and this section can handle the majority of larger storm events. The general top-of-bank capacity is 885 cfs for this portion of Turkey Creek.

Lower Section of Project Area.

2.2 Hydrology

A hydrologic analysis was completed along the entire project length to determine the typical flows that have historically occurred in Turkey Creek. It is important to establish the baseline conditions so that these baseline conditions can be considered relative to the conditions that will occur when diverted flows are added to the creek. This will help separate existing erosional conditions from potential new erosion concerns when designing channel improvements.

The project length was separated into different drainage areas to correctly determine typical flows from upstream to downstream along the creek. Exhibit B in the Appendix A shows the drainage areas as they were delineated. Drainage areas 1 and 2 are in the previously defined upper section, drainage areas 3 through 6 are in the middle section, and drainage areas 7 through 25 are in the lower section. The upper section was divided into two areas to more accurately reflect flows in that section. Downstream of the upper section, drainage areas were separated and delineated according to drainage structures or roadway crossings. A separate drainage area was developed for each structure and peak flows were calculated. Below the uppermost drainage area, the peak flows are combined to reflect a total flow in Turkey Creek at that location.

Two different hydrologic methods were utilized to calculate peak flows along Turkey Creek. The method chosen was based on the size of each drainage area being analyzed. The first method, Technical Release 55 (TR-55), is a simplified procedure to calculate storm runoff volume, peak rate of discharge, and hydrographs for small watersheds and was used for drainage areas under 5 square miles. The second method, which involved using selected Regional Regression Equations, was used for the drainage areas greater than 5 square miles.

Because of a flatter slope and larger flow area, the peak flows actually decrease somewhat toward the downstream areas of Turkey Creek. Peak flows for the 2-year, 10-year, 25-year, 50-year, and 100-year events were calculated. Exhibit C in Appendix A shows the peak flows that were calculated for each drainage area and the cumulative flows along Turkey Creek.

2.3 Hydraulics

Next, the hydraulic characteristics of Turkey Creek were modeled using HEC-RAS 4.0. The HEC-RAS program was developed by the Hydrologic Engineering Center and is designed to model one-dimensional steady flow, one and two-dimensional unsteady flow, sediment transport/mobile bed conditions, and water temperature / water quality conditions. Input data for the HEC-RAS model included the hydrologic information discussed above, LiDAR and survey data to represent the channel shape and the topography, and channel and overbank roughness coefficients. The one-dimensional steady flow model was utilized for this project. The current conditions of Turkey Creek were analyzed to establish the existing water surface elevations along the project length. Each existing drainage structure was also analyzed as part of this modeling effort.

2.4 Geomorphology

A geomorphologic analysis was performed along the entire project length. Soil samples, stream measurements, erosion areas, and other pertinent information were collected during the site visit and used during the analysis. The full geomorphology report is included in Appendix B for reference. The general purpose of the geomorphology study was to determine what would be the potential impact of adding the diverted flows into Turkey Creek for an extended length of time. Flow rates of 40 cfs and 100 cfs were both analyzed for their impacts and length of time that the diverted flows could realistically be diverted into Turkey Creek without causing erosion issues. General findings from this analysis conclude that the upper section would require extensive grading to create a defined channel area or installation of a pipe to handle the new flows. Without a newly created channel, either flow amount would have a highly erosive effect on the existing ground creating large areas of erosion.

The middle and lower sections of Turkey Creek have enough existing capacity to handle 40 cfs of flow during certain times of the year. If the diverted flow of 40 cfs is allowed down Turkey Creek during the months of September through April, the existing creek conditions appear to be sufficient to handle the additional flows. If diverted flows of 100 cfs are introduced into Turkey Creek during the same months, the number of continuous days in a row will need to be monitored. Based off existing conditions and capacity it is recommended that a flow of 100 cfs only be diverted into Turkey Creek for a maximum of 5 continuous days before reducing the diversion of excess flows. Longer periods of the diverted flow of 100 cfs would begin to affect the stability of Turkey Creek and could begin to cause sloughing along the banks and headcutting to the existing flowline. Therefore, it is recommended that the diverted flows be stopped for at least 7 days after the 5 days of continuous 100 cfs of flow. The final recommendation for this will be determined during final design.

2.5 Environmental Evaluation

A full wetland delineation was completed along the project reach to determine the extent of existing wetlands. A memo, site map, and wetland map of each drainage structure are included in Appendix C for reference. The location of the existing wetlands will be taken into account during final design. Erosion control measures and proposed grading will be designed to avoid affecting existing wetlands and the creek. If the U.S. Army Corps of Engineers (USACE) requires a Clean Water Act (CWA) Section 404 permit, it is anticipated that a nationwide permit will be obtainable. The Section 404 permit program regulates the construction activities that take place in waters of the U.S. including wetlands.

Existing Condition Information

Generally, the current condition of Turkey Creek is stable and it can handle typical flows that occur each year. However, if a consistent 40 to 100 cfs is going to be introduced into the system, some improvements must be made to allow Turkey Creek to maintain its current integrity.

2.6 Existing Conditions Conclusion

During large storm events in the upper section, the terrain of the large canyon areas allows the water to spread out and continue to flow downstream without causing issues to the surrounding properties. The middle and lower sections of Turkey Creek have enough capacity to handle the 100-year flood event without overtopping the banks. The existing bridges can also handle up to a 100-year storm event without overtopping. In the vicinity of some of the existing drainage structures there is bank erosion. Left unchecked, this erosion could potentially undermine the structures. Table 1, below, lists each of the existing structure and indicates if it is already in need of repairs due to erosion. The recommended actions are listed with the anticipated size of the erosion repair needed. A large erosion repair size is approximately 150 tons of riprap, medium repair is 75 tons of riprap, and small repair is 25 tons of riprap. The cost associated with these repairs are listed in Table 1 and Table 2 below and are not included as part of the project costs because the erosion at these structures will need to be addressed regardless of whether or not the excess flows are diverted into Turkey Creek. All existing structures require some erosion repair be completed. Generally, the current condition of Turkey Creek is stable and it can handle typical flows that occur each year. However, if a consistent 40 to 100 cfs is going to be introduced into the system, some improvements must be made to allow Turkey Creek to maintain its current integrity.

Table 1. Turkey Creek Structures – Current Conditions

Drainage Area Number	Structure	Existing Size	Recommended Actions	Cost
7	County Road 738	36” Culvert	Small Erosion Repair	$2,000
8	Private Drive 432a	1 span - 20’ wide Bridge	Small Erosion Repair	$2,000
9	County Road 737	Triple 9’ x 10’ Box Culverts	Small Erosion Repair	$2,000
10	County Road 735	120” Culvert	Small Erosion Repair	$2,000
11	Field Access	96” Culvert	Small Erosion Repair	$2,000
12	Private Drive 432	72” Culvert	Medium Erosion Repair	$6,000
13	County Road 731	1 span - 85’ wide Bridge	Large Erosion Repair	$12,000
14	County Road 730	1 span - 55’ wide Bridge	Small Erosion Repair	$2,000

15	County Road 728	3 span – 90’ wide Bridge	Medium Erosion Repair	$6,000
16	County Road 727	1 span – 60’ wide Bridge	Small Erosion Repair	$2,000
17	County Road 726	3 span – 100’ wide Bridge	Large Erosion Repair	$12,000
18	County Road 431/725	3 span – 100’ wide Bridge	Medium Erosion Repair	$6,000
None	County Road 431	1 span – 40’ wide Bridge	Large Erosion Repair	$12,000
19	Highway 6	4 span – 190’ wide Bridge	Large Erosion Repair	$12,000
20	County Road 722	1 span – 45’ wide Bridge	Small Erosion Repair	$2,000
21	County Road 721	3 span – 125’ wide Bridge	Large Erosion Repair	$12,000
22	BNSF Bridge	1 span – 55’ wide Bridge	Large Erosion Repair	$12,000
22	Highway 136	3 span – 105’ wide Bridge	Large Erosion Repair	$12,000
23	County Road 720	3 span – 85’ wide Bridge	Medium Erosion Repair	$6,000
24	Field Access	Twin 60” Culverts	Small Erosion Repair	$2,000
25	Field Crossing	36” Culvert	Medium Erosion Repair	$6,000

Table 2 – Turkey Creek Structures - Estimated Costs for Erosion Repair

Construction Item	Quantity	Unit Price	Total Price
Small Erosion Protection	9 Each	$2,000/Each	$18,000
Medium Erosion Protection	5 Each	$6,000/Each	$30,000
Large Erosion Protection	7 Each	$12,000/Each	$84,000
Estimated Total Erosion Repair Costs			**$132,000**

3.0 PROPOSED IMPROVEMENTS

3.1 Overview of Improvements

The geomorphologic analysis was used to help determine whether the existing creek would be able to handle the diverted flows or whether improvements will be needed. The potential areas of concerns observed during the geomorphologic field investigation and analysis were reviewed and focused on during the conceptual design.

The proposed improvements that would be required as part of the Platte Republican Diversion project are separated into two main categories. The first type of improvement includes modifications to the existing creek channel so that it will handle the diverted flows without causing additional erosion. The second type of improvements includes modifications to existing structures including bridges, culverts, and farm ponds so that they will not be impacted by the diverted flows.

Two different diverted flow values (40 cfs and 100 cfs) were analyzed in the HEC-RAS model to determine how the existing channel and proposed improvements in the upper section would handle the diverted flows over an extended period of time.

3.2 Channel Improvements

Because of the significantly greater channel slopes, the initial focus with regard to channel improvements was in the upper section - the first 3,000 feet of the east branch of Turkey Creek. The existing creek cross-section and slope are not equipped to handle the diverted flows without causing erosion along the existing flow path. A new, larger and more defined typical section will need to be established for the upper section to increase capacity and minimize the potential for erosion from the diverted flows. It is also important that the channel slope in the upper section be reduced to decrease the velocity and in turn minimize potential erosion. A series of grade control structures will need to be installed in the upper 3000-foot section to create a more stable slope. Exhibit D in Appendix A shows the proposed profile along Turkey Creek for this section. The proposed grade control structures can be constructed out of riprap, sheet pile or lumber. The proposed grade structures would include a 4-foot drop on the downstream side of the structure to allow a 1 percent slope to be established for the first 3,000 feet of Turkey Creek. A 1 percent slope is stable and would minimize the erosion that otherwise might occur during the introduction of diverted flows.

Another improvement option for the upper section would be to install a new underground polyvinyl chloride (PVC) pipe for the entire 3,000-foot length instead of grading a defined creek channel. The new pipe would need to be in the range of 36-inches diameter to 48-inches diameter in size. The actual pipe size would be determined during final design. A smaller pipe could be utilized with a steeper slope while a larger pipe would be needed with a flatter slope.

The middle section of Turkey Creek (approximately the next 5 miles) has an intermittently defined channel with varying capacity. Some grading would need to be completed along this section to increase the capacity to handle up to a 100 cfs without causing headcutting or incising of the existing creek. Total regrading of Turkey Creek would not be necessary, but rather would consist of widening of the existing channel in some areas to allow the diverted flows to stay within the banks.

The rest of Turkey Creek's cross-section downstream of the first 5 miles currently has sufficient capacity to handle the diverted flows along with the current base flow that Turkey Creek carries, which is approximately 12 cfs. No substantial improvements are anticipated along this stretch. There may be some minor grading that occurs along this section to repair large areas of erosion that have occurred over time. Any minor grading will take place above the ordinary high water mark (OHWM) so as to minimize any impacts to the existing stream and allow a Nationwide Section 404 permit to be obtained if needed.

3.3 Improvements to Existing Structures

The second category of proposed improvements deals with the existing structures and erosion control measures that need to be installed at each drainage structure location. As indicated above, many of the existing drainage structures at the upstream face have erosion issues that need to be addressed regardless of whether the diverted flows are introduced into Turkey Creek. If measures are not taken to control erosion in these areas erosion will continue to expand and may eventually compromise bridge abutments or cause failure along roadway embankments. It is proposed that riprap will be installed at the upstream face to provide protection either at bridge abutments or the inlets of culverts. The cost of these improvements are separate from the estimated project costs.

There are additional improvements to these existing structures that would be recommended in order to accommodate the introduction of diverted flows into the creek. Table 3 and 4 below lists the additional improvements anticipated for each drainage structure for both 40 cfs and 100 cfs starting at the upstream end of the project and continuing downstream along Turkey Creek. The erosion protection improvements are listed as large, medium and small. This refers to the anticipated amounts of riprap that may have to be installed at each location. A large amount is approximately 150 tons of riprap, medium is 75 tons of riprap, and small is 25 tons of riprap. This erosion protection is in addition to the riprap that will need to be placed at the structures due to existing erosion issues. Tables 3 and 4 below list the total number of erosion protection improvements and their associated costs. The additional riprap reflects the protection needed due to the diverted flows into Turkey Creek. A few existing drainage structures will overtop during a flow of 40 cfs or 100 cfs. Currently, it is anticipated that four drainage structures will need to replaced, or upsized or that an additional culvert will need to be added to handle the diverted flows.

Table 3 – Turkey Creek Structures at 40 cfs - Estimated Costs for Erosion Repair

Construction Item	Quantity	Unit Price	Total Price
Small Erosion Protection	2 Each	$2,000/Each	$4,000
Medium Erosion Protection	14 Each	$6,000/Each	$84,000
Large Erosion Protection	5 Each	$12,000/Each	$60,000
Estimated Total Erosion Repair Costs			**$148,000**

Table 4 – Turkey Creek Structures at 100 cfs - Estimated Costs for Erosion Repair

Construction Item	Quantity	Unit Price	Total Price
Small Erosion Protection	2 Each	$2,000/Each	$4,000
Medium Erosion Protection	14 Each	$6,000/Each	$84,000
Large Erosion Protection	5 Each	$12,000/Each	$60,000
Estimated Total Erosion Repair Costs			**$148,000**

The existing farm ponds will also need some improvements to handle the diverted flows. Either new overflow structures or additional pipes will need to be constructed at each farm pond location to allow the diverted flow to travel downstream instead of creating additional ponding areas and erosion along the farm pond embankment. These improvements could also include some riprap or other method of erosion control to protect the existing embankment.

4.0 BENEFIT-COST ANALYSIS

4.1 Overview

A benefit-cost analysis (BCA) was completed for this project to determine the economic feasibility and potential benefit to the TBNRD, LRNRD and the residents of these two natural resources districts. In this analysis, the cost of designing, constructing, and maintaining the project is compared to the potential benefits or cost savings that it may provide by contrasting these costs with the costs of several previous efforts to reduce consumptive use and/or increase streamflows in the Republican River basin.

4.2 Costs of Diversion Project

Based on the recommended described above and the improvements listed in Tables 3-4, estimated construction costs have been generated for the following improvements to Turkey Creek:

1) Additional improvements needed to handle 40 cfs of diverted flows under two options:

    a. Pipe installation in upper section (Table 5)
    b. Grading improvements in upper section (Table 6)
2) Additional improvements need to handle 100 cfs of diverted flows under two options:
    a. Pipe installation in upper section (Table 7)
    b. Grading improvements in upper section (Table 8)

The three major costs for this project are the grading along the creek, pipe installation and erosion control measures. The majority of the grading will be completed in the upper section to create a larger and defined, stable channel. An estimated unit price of $10 per cubic yard (CY) of earthwork was used to develop the cost for grading. If it is determined that the excavated material can be spoiled onsite, then a lower unit price may be realized for this project. Installing a new pipe in the upper section (instead of grading a larger creek section) is also analyzed as part of an estimated project cost. An average cost of $65 per linear foot was used for the pipe for the 40 cfs option and an average cost of $90 per linear foot was used for the pipe for the 100 cfs option. Installing erosion control measures at the upstream face of the existing structures will be the other major project cost. It has been estimated that each structure will have a cost in the range of $2,000 - $12,000, depending on the magnitude of measures required to accommodate the diverted flows. These erosion control measures are in addition to the erosion repair improvements listed in tables 1-2. The grade control structures needed to create a more stable slope in the upper reach of the project have been estimated at $10,000 for each structure. The four existing drainage structures that cross the stream cannot handle the diverted flows without overtopping; the cost of dealing with this issue are estimated at $10,000 per structure for 40 cfs and $15,000 per structure for 100 cfs. Three well-defined field drives in the upper section will each need a culvert crossing installed along with the proposed channel improvements. Those culvert crossings are estimated to be $5,000 each for 40 cfs and $7,500 each for 100 cfs. The last construction cost is associated with the existing farm ponds. The farm pond improvements are estimated to be $7,500 per pond for 40cfs and $10,000 per pond for 100 cfs. The anticipated construction cost of the diversion structure from Canal E-65 into Turkey Creek is also included at a cost of $315,000. All unit prices are based on past construction costs on prior projects and the Nebraska Department of Road's Average Unit Price Summaries.

Table 5 – Estimated Project Costs – Diverting 40 cfs with Pipe Installation in Upper Section

Construction Item	Quantity	Unit Price	Total Price
Mobilization	1 Each	$50,000/Each	$50,000
Pipe Installation	3,000 LF	$65/LF	$195,000
Small Erosion Protection	2 Each	$2,000/Each	$4,000
Medium Erosion Protection	14 Each	$6,000/Each	$84,000
Large Erosion Protection	5 Each	$12,000/Each	$60,000
Grade Control Structures	9 Each	$10,000/Each	$90,000
New Drainage Structures	4 Each	$10,000/Each	$40,000
New Culvert Crossings	3 Each	$5,000/Each	$15,000
Farm Pond Improvements	7 Each	$7,500/Each	$52,500
Contingency (30%)			$175,000
Estimated Total Construction Cost			**$765,500**
Engineering Fees			$235,000
Construction Observation (10% of Construction Cost)			$76,550
Diversion Structure	1 Each	$315,000/Each	$315,000
Estimated Total Project Cost			**$1,392,050**

Table 6 – Estimated Project Costs – Diverting 40 cfs with Grading in Upper Section

Construction Item	Quantity	Unit Price	Total Price
Mobilization	1 Each	$80,000/Each	$80,000
Earthwork	45,000 CY	$10/CY	$450,000
Small Erosion Protection	2 Each	$2,000/Each	$4,000
Medium Erosion Protection	14 Each	$6,000/Each	$84,000
Large Erosion Protection	5 Each	$12,000/Each	$60,000
Grade Control Structures	9 Each	$10,000/Each	$90,000
New Drainage Structures	4 Each	$10,000/Each	$40,000
New Culvert Crossings	3 Each	$5,000/Each	$15,000
Farm Pond Improvements	7 Each	$7,500/Each	$52,500
Contingency (30%)			$260,000
Estimated Total Construction Cost			**$1,135,500**
Engineering Fees			$235,000
Construction Observation (10% of Construction Cost)			$115,000
Diversion Structure	1 Each	$315,000/Each	$315,000
Estimated Total Project Cost			**$1,800,500**

Table 7 – Estimated Project Costs – Diverting 100 cfs with Pipe Installation in Upper Section

Construction Item	Quantity	Unit Price	Total Price
Mobilization	1 Each	$65,000/Each	$65,000
Pipe Installation	3,000 LF	$90/LF	$270,000
Small Erosion Protection	2 Each	$2,000/Each	$4,000
Medium Erosion Protection	14 Each	$6,000/Each	$84,000
Large Erosion Protection	5 Each	$12,000/Each	$60,000
Grade Control Structures	9 Each	$10,000/Each	$90,000
New Drainage Structures	4 Each	$15,000/Each	$60,000
New Culvert Crossings	3 Each	$7,500/Each	$22,500
Farm Pond Improvements	7 Each	$10,000/Each	$70,000
Contingency (30%)			$220,000
Estimated Total Construction Cost			**$945,500**
Engineering Fees			$235,000
Construction Observation (10% of Construction Cost)			$95,000
Diversion Structure	1 Each	$315,000/Each	$315,000
Estimated Total Project Cost			**$1,590,500**

Table 8 – Estimated Project Costs – Diverting 100 cfs with Grading in Upper Section

Construction Item	Quantity	Unit Price	Total Price
Mobilization	1 Each	$85,000/Each	$85,000
Earthwork	45,000 CY	$10/CY	$450,000
Small Erosion Protection	2 Each	$2,000/Each	$4,000
Medium Erosion Protection	14 Each	$6,000/Each	$84,000
Large Erosion Protection	5 Each	$12,000/Each	$60,000
Grade Control Structures	9 Each	$10,000/Each	$90,000
New Drainage Structures	4 Each	$15,000/Each	$60,000
New Culvert Crossings	3 Each	$7,500/Each	$22,500
Farm Pond Improvements	7 Each	$10,000/Each	$70,000
Contingency (30%)			$275,000
Estimated Total Construction Cost			**$1,200,500**
Engineering Fees			$235,000
Construction Observation (10% of Construction Cost)			$120,000
Diversion Structure	1 Each	$315,000/Each	$315,000
Estimated Total Project Cost			**$1,870,500**

The estimated total construction costs are listed below in Table 9 and are based on the preliminary analysis and design. Two costs are given for the 40 cfs option, and two costs are given for the 100 cfs option. All the construction costs currently have a 30 percent contingency fee included in the total and the estimated costs would be refined during final design. Table 9 also lists estimated total project costs when incorporating the estimated cost for final design and construction observation. Project land rights acquisition costs have not been estimated as part of project development costs. The sponsors anticipate acquiring easements from landowners without compensation.

Table 9 – Estimated Project Costs

Project Option	Estimated Construction Cost	Estimated Total Project Cost
40 cfs with Pipe Option	$756,500	$1,392,050
40 cfs with Grading Option	$1,135,500	$1,800,500
100 cfs with Pipe Option	$945,500	$1,590,500
100 cfs with Grading Option	$1,200,500	$1,870,500

4.3 Benefits

The benefits of the project are generally related to improving water supply conditions in the Republican River. Water use is limited in the Republican River basin (Basin) due to the Republican River Compact (Compact). Nebraska is allocated a certain percentage of the Basins water supply, which varies from year to year based on climatic conditions. During many previous dry years, Nebraska has used more than its allocation of water. Excess flows from the Platte River would be used to offset any potential overuse in the future, reducing or eliminating the cost of other management actions that might be needed.

The Nebraska Department of Natural Resources (NeDNR) has studied the potential amounts of water that may be available from the Platte River for this project. This evaluation involved a comparison of the historic Platte River streamflows against all currently existing demands to this water to compute flows in excess of current demands. Other agencies, including the Platte River Recovery Program are evaluating projects that could affect the future occurrence and availability of excess flows in the Platte River. The water that may be available for this project would be water diverted into the Tri-County Supply Canal for use in generating hydropower and which would otherwise be returned to the Platte River at the J2 return. When there are excess flows downstream of the J2 return (as measured at the Overton gage), some of this water can be retained in the canals and delivered for other purposes, such as to supply water to this diversion project. Data from the NeDNR study from the Overton gage for the years 2000 to 2008 were used to estimate the excess flows that may be available to divert into Turkey Creek during a given year and to calculate the actual water the project could provide based on several assumed capacity limitations. These years were chosen because it was a dry period in which Nebraska could have potentially benefited from the diversion of water into the basin by assisting the state with Compact compliance.

Exhibit E in Appendix A is a spreadsheet that shows the total monthly excess flows available in the Platte River basin during 2000 to 2007. It also contains the amount of water that would be able to be diverted into Turkey Creek based on a project capacity of either 40 cfs or 100 cfs. Table 10 below shows the average annual amount of water that would be available to divert from the Platte River basin during these years.

Table 10 – Potential Acre-Feet Available to Divert

Diversion Capacity Amount	Average Potential Amount
No Limit	56,938 acre-feet
40 cfs	5,806 acre-feet
100 cfs	11,431 acre-feet

The total available excess flows during this period average 56,938 acre-feet per year. The second row lists the amount that could be diverted with a 40 cfs limit on the flow rate. The third row lists the amount that could be diverted with a 100 cfs limit on the flow rate. It is anticipated that when excess flows from the Platte River are available, there would be an opportunity to divert them into Turkey Creek throughout the entire length of the year if desired.

Table 11 below contains the same information as in Table 10, but it limits the available excess flows to the non-irrigation season (September through April).

Table 11 – Potential Acre-Feet Available to Divert during September through April

Diversion Capacity Amount	Average Potential Amount
No Limit	53,850 acre-feet
40 cfs	4,885 acre-feet
100 cfs	9,846 acre-feet

The expected lifetime of the project would be 50 years. While it is difficult to know how often the project will be able to provide these average annual benefits, under the conditions from 2000-2007, the project could have provided substantial benefits during four out of eight years. Based on past experience with potential shortfalls in the Republican River basin, water from the project would be beneficial during about four out of every 10 years. Combining these two probabilities yields an estimated average benefit of two out of every 10 years. These values for flow availability will be used in computing a range of benefit-cost ratios below.

4.4 Alternative Costs

There are several metrics available to assess the cost to Nebraska to offset any water use in excess of its allocation that may occur in the future. While Nebraska was ordered by the U.S. Supreme Court to pay Kansas $5.5 million for its over use of approximately 70,000 acre-feet of water during 2005-2006, the Court made it clear that the cost of a future violation would likely be significantly greater, so using this value as a metric would likely undervalue the benefits of a transfer of water into the Basin from the Platte River.

Another available metric would be the costs of previous actions taken by the state and the natural resources districts (NRDs) to reduce consumptive uses of water in an effort to maintain compliance with the Compact. From 2006 to 2008, surface water was leased from irrigation districts in the basin to assist with compliance with the Republican River Compact (Compact). The state and the local NRDs paid $18,722,500, which resulted in a reduction of consumptive use of 51,614 acre-feet, which equates to $362 per acre-feet of water. This value will be used to assign a benefit to the potential volumes of water that could be delivered from this project during future dry years.

Another available metric would be to utilize the cost associated with the Nebraska Cooperative Republican Platte Enhancement (N-CORPE) project for the LRNRD. The N-CORPE project provides construction costs and delivery costs for water which can be related to this project to develop potential benefit. These costs are summarized in Table 12. Based on these costs, and an assumed average annual delivery of 3,750 acre-feet, the annual delivery cost for water from N-CORPE is $272.59 per acre-foot, or $195,000 per year. The annual delivery cost for the surface water option and the N-CORPE option will be used to calculate a range of benefit-cost ratios below.

Table 12 – Computation of Average Annual Delivery Cost for LRNRD for water from N-CORPE

Cost Items	Cost to LRNRD
Capitol Cost (including interest)	$41,360,511.00
Cost per year - 50 years	$827,210.22
Average Annual Capacity	3,750
Annual Cost per AF – capacity	$220.59
Water Delivery Cost	$52.00
Cost per AF	$272.59

4.5 Benefit-Cost Ratio

The average cost per acre-foot for the alternative sources of water evaluated above are next used to calculate a range of benefit-cost ratios for the Platte Republican Diversion project. Table 13 and Table 14 compute the total delivery costs for the project based on the construction costs presented above and an assumed value of $44.35 acre-foot for the water delivery.

Table 13 – Potential Annual Cost – 40 cfs

Cost Items	PRD Project – Pipe Option	PRD Project – Grading Option
Capitol Cost	$1,392,050.00	$1,800,500.00
Cost per year - 50 years	$27,841.00	$36,010.00
Average Annual Supply*	977 acre-feet	977 acre-feet
Annual Capital Cost per AF	$28.50	$36.86
Water Delivery Cost	$44.35	$44.35
Total Cost per AF	$72.85	$81.21

*20% of 4,885 acre-feet from Table 11 to adjust for benefits in 2 out of 10 years

Table 14 – Potential Annual Cost – 100 cfs

Cost Items	PRD Project – Pipe Option	PRD Project – Grading Option
Capitol Cost	$1,590,500.00	$1,870,500.00
Cost per year - 50 years	$31,810.00	$37,410.00
Average Annual Supply*	1,969 acre-feet	1,969 acre-feet
Annual Cost per AF – capacity	$16.16	$19.00
Water Delivery Cost	$44.35	$44.35
Total Cost per AF	$60.51	$63.35

*20% of 9,846 acre-feet from Table 11 to adjust for benefits in 2 out of 10 years

So the annual cost per acre-foot of water delivered by the Platte Diversion Project would range from $60 to $82, depending on the construction option and the ultimate capacity of the project. Table 15 compares this range of values to the range of costs for alternative sources of water.

Table 15 – Benefit Cost Ratios in Comparison to Project Alternative

Design Alternative	Surface water leasing	N-CORPE
40 cfs – pipe	5.0:1	3.7:1
40 cfs – grading	4.5:1	3.4:1
100 cfs – pipe*	6.0:1	4.5:1
100 cfs – grading*	5.7:1	4.3:1

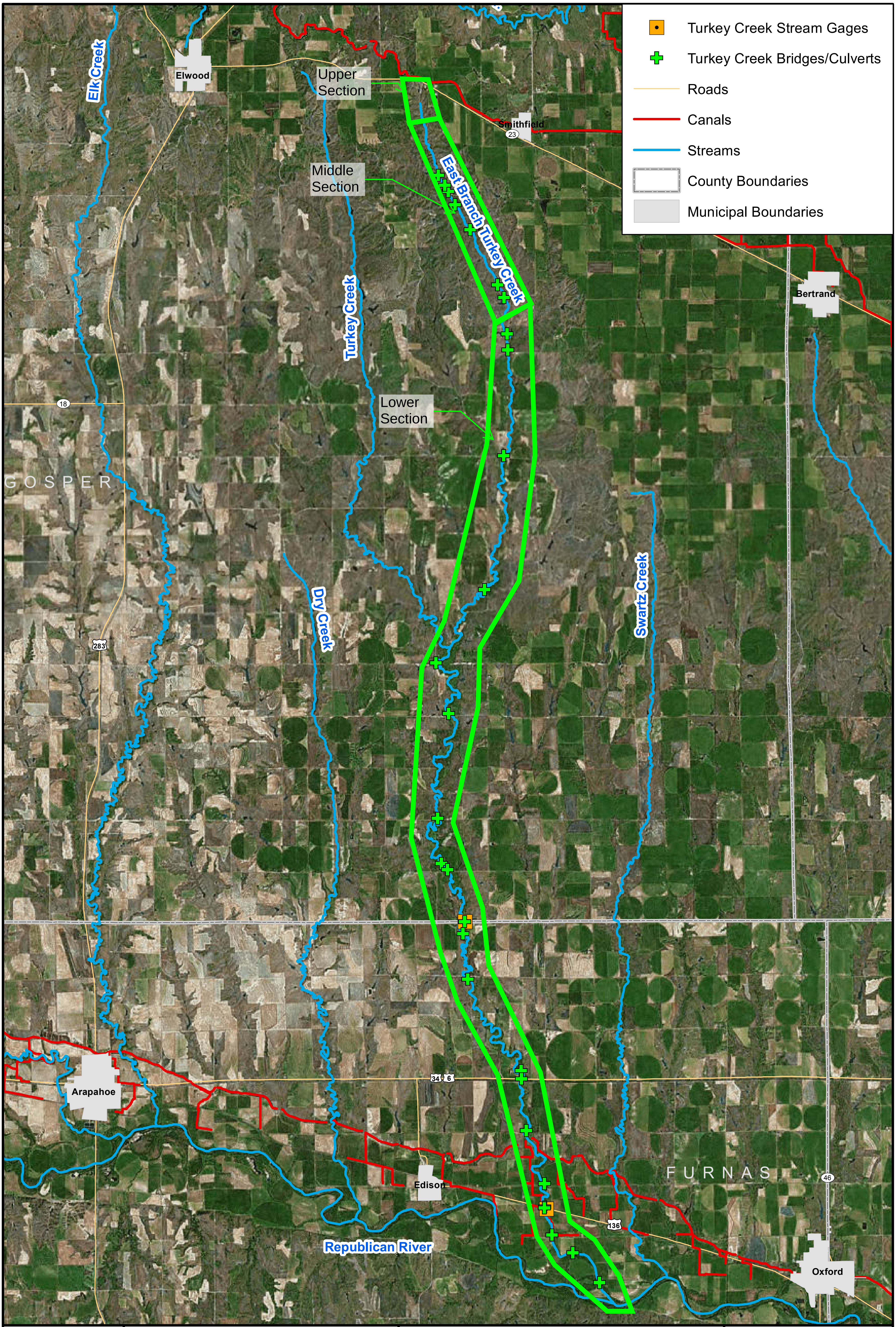
*Benefit-Cost Analysis for 100 cfs option is slightly inflated. In reality the 100 cfs flows can only be diverted into Turkey Creek for 5 days at a time and not for the entire length of time it is available.

In general, the Benefit-cost ratio for the project would appear to fall within the range of 3.4 to 6:1, indicating the diversion project would provide water for streamflow in the Republican River at costs that are significantly lower than other alternative sources. Therefore, the project would be highly feasible.

5.0 SUMMARY AND CONCLUSIONS

Based on the preliminary feasibility analysis completed for the Platte Republican Diversion project, the benefit-cost analysis clearly shows the project would provide a significant benefit over the lifetime of the project given the assumptions made for availability of excess flows from the Platte River. With creek improvements in the upper section and erosion control measures at each drainage structure and farm ponds, Turkey Creek will be able to handle diverted flows up to 100 cfs for the designated periods of time without negatively affecting the surrounding land or causing any significant erosion to the existing creek system.

APPENDIX A – EXHIBITS



PROJECT: 016-1500

DRAWN BY: MKM

DATE: August 17, 2016

0 0.5 1 2 3 Miles

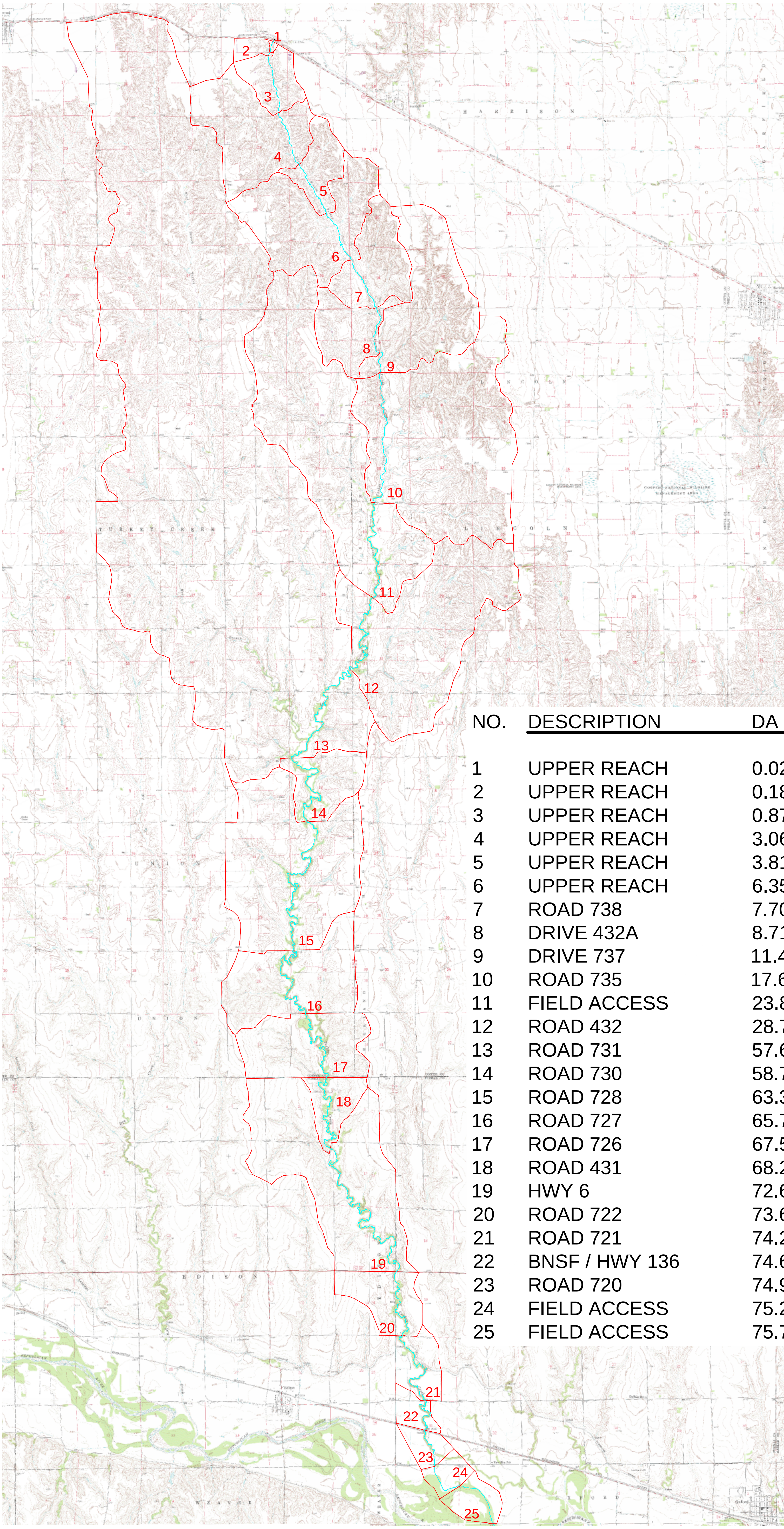
N

Turkey Creek

OLSSON ASSOCIATES

Exhibit A

Sources: NDNR, USGS, US Census Bureau, ESRI



NO.	DESCRIPTION	DA (MI²)
1	UPPER REACH	0.02
2	UPPER REACH	0.18
3	UPPER REACH	0.87
4	UPPER REACH	3.06
5	UPPER REACH	3.81
6	UPPER REACH	6.35
7	ROAD 738	7.70
8	DRIVE 432A	8.71
9	DRIVE 737	11.40
10	ROAD 735	17.68
11	FIELD ACCESS	23.83
12	ROAD 432	28.71
13	ROAD 731	57.69
14	ROAD 730	58.71
15	ROAD 728	63.34
16	ROAD 727	65.70
17	ROAD 726	67.57
18	ROAD 431	68.22
19	HWY 6	72.66
20	ROAD 722	73.64
21	ROAD 721	74.29
22	BNSF / HWY 136	74.60
23	ROAD 720	74.93
24	FIELD ACCESS	75.26
25	FIELD ACCESS	75.72

DWG: C:\Temp\AcPublish_5628\Drainage areas.dwg
DATE: Dec 23, 2016 10:04am
USER: dlightbody
XREFS:

PROJECT NO: 016-1500
DRAWN BY: DSL
DATE: 12/23/16

EAST BRANCH TURKEY CREEK DRAINAGE AREA MAP

OLSSON ASSOCIATES
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Lincoln, NE 68508
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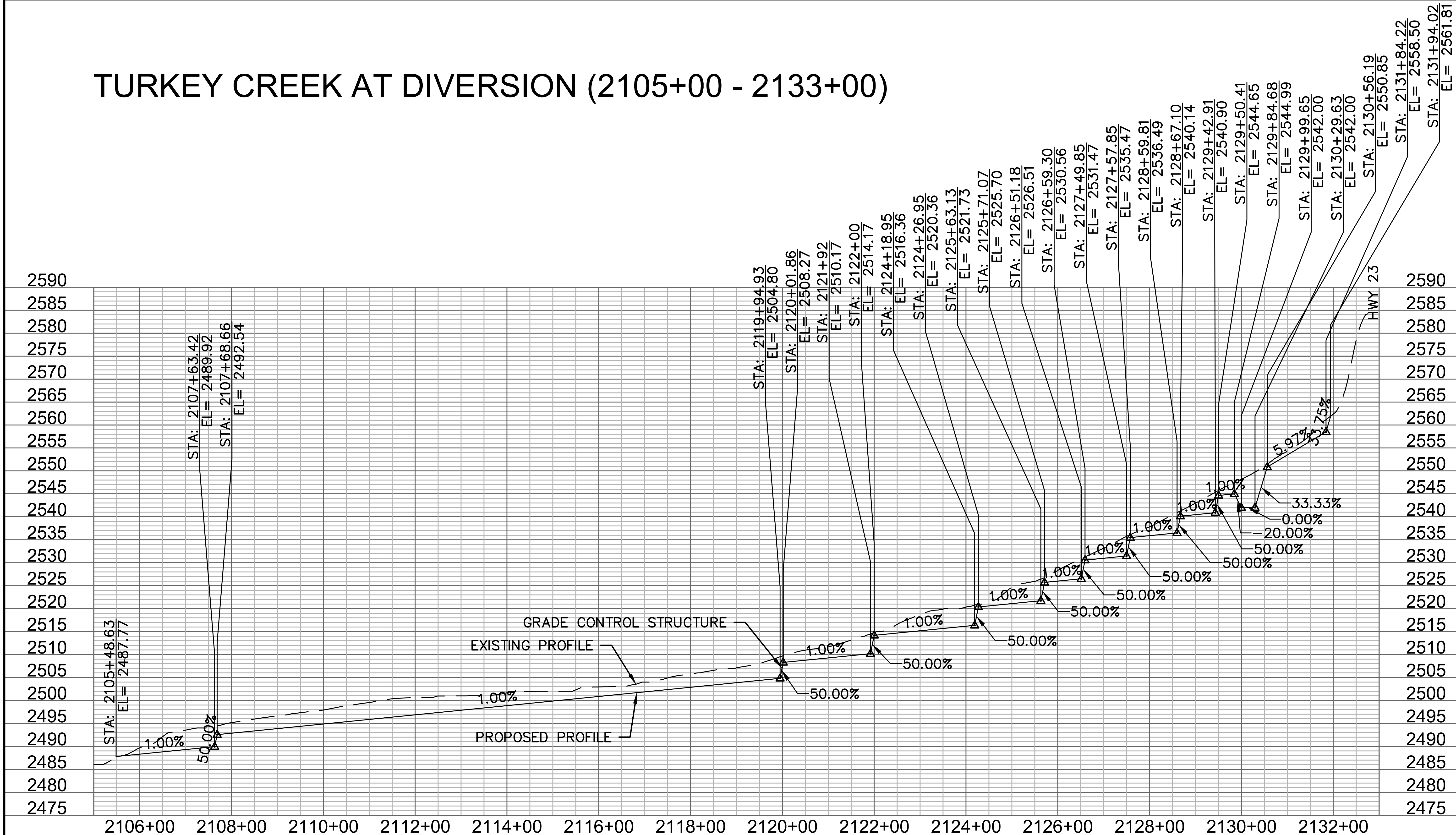
EXHIBIT
B

EXHIBIT C

WRIR 99-4032A Peak-flow equations for the Upper Republican River Region

Drainage Area No.	Desc.	Sta	FL to US XS (ft)	DA Perimiter (mi)	DA (ac)	DA (mi²)	cumulative DA (mi²)	MCS	CR	Q2	Q10	Q25	Q50	Q100	
	point of diversion	213300	0	0	0	0.00	0.00	n/a	n/a	0	0	0	0	0	
1		212400	900	0.59	11.7	0.02	0.02	n/a	n/a	2	9	16	21	28	TR-55
2		211800	600	1.92	105.1	0.16	0.18	n/a	n/a	10	54	96	131	170	
3		207000	4800	3.81	442.8	0.69	0.87	n/a	n/a	30	152	275	373	485	
4		202000	5000	7.7	1399.7	2.19	3.06	n/a	n/a	75	345	617	839	1091	
5		197000	5000	9.63	481.3	0.75	3.81	n/a	n/a	77	332	587	798	1038	
6		192000	5000	11.95	1622.2	2.53	6.35	24.60	1.34	145	486	756	993	1282	Regression
7	US face Rd 738	187339.8	4660.2	13.4	864.3	1.35	7.70	21.43	1.36	134	441	682	892	1148	
8	US face Dr 432a	183058	4281.8	15.7	648.7	1.01	8.71	21.14	1.50	132	425	657	861	1111	
9	US face Dr 737	181052.5	2005.5	17.74	1719.9	2.69	11.40	21.97	1.48	161	531	825	1086	1406	
10	US face Rd 735	168284.8	12767.7	24.58	4022.1	6.28	17.68	19.38	1.65	163	521	807	1063	1377	
11	US face field access	157572	10712.8	26.26	3932.6	6.14	23.83	18.20	1.52	189	614	952	1252	1618	
12	US face Rd 432	146486.9	11085.1	30.15	3123.07	4.88	28.71	17.80	1.59	197	637	988	1301	1683	
13	US face Rd 731	131497	14989.9	39.13	18547.9	28.98	57.69	17.80	1.45	308	1039	1628	2156	2797	
14	US face Rd 730	119744	11753	40.69	653.1	1.02	58.71	17.80	1.50	304	1020	1599	2118	2750	
15	US face Rd 728	99396	20348	44.98	2965.8	4.63	63.34	17.80	1.59	303	1006	1578	2093	2724	
16	US face Rd 727	86092	13304	48.15	1510.4	2.36	65.70	17.80	1.68	298	981	1538	2043	2663	
17	US face Rd 726	75761	10331	50.35	1196.2	1.87	67.57	17.80	1.73	296	969	1519	2019	2635	
18	US face Rd 431	62500	13261	52.3	416.5	0.65	68.22	17.80	1.79	290	944	1481	1969	2572	
19	US face Hwy 6	38182	24318	57.68	2837.8	4.43	72.66	17.80	1.91	286	920	1444	1923	2517	
20	US face Rd 722	30154	8028	59.71	625.7	0.98	73.64	17.80	1.96	282	904	1418	1889	2474	
21	US face Rd 721	20101	10053	62.23	416.8	0.65	74.29	17.80	2.04	276	877	1376	1835	2406	
22	US face BNSF Br	15143	4958	63.72	201.3	0.31	74.60	17.80	2.08	272	862	1352	1803	2366	
23	US face Rd 720	11525	3618	65.01	211.9	0.33	74.93	17.80	2.12	269	850	1333	1778	2334	
24	US face field access	7700	3825	66.37	206.4	0.32	75.26	17.80	2.16	266	837	1313	1752	2301	
25	US face low flow	2977	4723	67.92	300.4	0.47	75.72	17.80	2.20	263	825	1293	1727	2269	

TURKEY CREEK AT DIVERSION (2105+00 - 2133+00)



PROJECT NO: 016-1500	UPPER REACH CHANNEL PROFILE OF TURKEY CREEK	OLSSON ASSOCIATES	601 P Street, Suite 200 P.O. Box 84608 Lincoln, NE 68508 TEL 402.474.6311 FAX 402.474.5160	EXHIBIT
DRAWN BY: DSL				D
DATE: 12/23/2016				

Exhibit E

No capacity limit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total Sept.-Apr.
2000	113,458	118,240	68,988	2,620	-	-	-	-	-	-	11,498	1,394	316,200	316,200
2001	19,034	18,986	15,422	-	879	-	-	-	-	-	889	6,123	61,332	60,453
2002	10,108	14,706	3,570	-	-	-	-	-	-	-	-	69	28,453	28,453
2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	-	411	-	-	-	-	-	-	-	-	-	-	411	411
2005	1,545	-	-	-	48	4,308	-	-	-	-	-	-	5,901	1,545
2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007	-	21,446	1,888	383	1,384	18,042	58	-	-	-	-	-	43,201	23,717
Average	18,018	21,724	11,234	375	289	2,794	7	-	-	-	1,548	948	56,937	53,847

40 cfs capacity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total Sept.-Apr.
2000	2,500	2,500	2,500	2,500	-	-	-	-	-	-	2,500	1,394	13,894	13,894
2001	2,500	2,500	2,500	-	879	-	-	-	-	-	889	2,500	11,767	10,889
2002	2,500	2,500	2,500	-	-	-	-	-	-	-	-	69	7,569	7,569
2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	-	411	-	-	-	-	-	-	-	-	-	-	411	411
2005	1,545	-	-	-	48	2,500	-	-	-	-	-	-	4,093	1,545
2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007	-	2,500	1,888	383	1,384	2,500	58	-	-	-	-	-	8,713	4,771
Average	1,131	1,301	1,174	360	289	625	7	-	-	-	424	495	5,806	4,885

100 cfs capacity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total Sept.-Apr.
2000	6,000	6,000	6,000	2,620	-	-	-	-	-	-	6,000	1,394	28,015	28,015
2001	6,000	6,000	6,000	-	879	-	-	-	-	-	889	6,000	25,767	24,889
2002	6,000	6,000	3,570	-	-	-	-	-	-	-	-	69	15,640	15,640
2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	-	411	-	-	-	-	-	-	-	-	-	-	411	411
2005	1,545	-	-	-	48	4,308	-	-	-	-	-	-	5,901	1,545
2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007	-	6,000	1,888	383	1,384	6,000	58	-	-	-	-	-	15,713	8,271
Average	2,443	3,051	2,182	375	289	1,289	7	-	-	-	861	933	11,431	9,846

APPENDIX B – GEOMORPHOLOGY REPORT

1. Geomorphic Assessment of Turkey Creek

As part of Task 400003 of the Platte Republican Diversion (PRD) Scope of Services, a detailed geomorphic assessment of the entire length of the main stem of Turkey Creek was conducted to determine the impacts of the additional flows to be diverted from the Platte River to the Republican River via the E-65 canal. The diversion point is near the flume on the E-65 canal at the headwaters of Turkey Creek where it intersects SH-23 about 4 miles east of Elwood, Nebraska. The current plan is to continuously divert 40 cfs or 100 cfs into Turkey Creek at its headwaters for an unknown number of days.

There are 2 parts to the geomorphic assessment, 1) a desktop analysis of existing data and information on Turkey Creek and its watershed, and 2) a field reconnaissance of the main stem of the creek to document existing geomorphic conditions of the channel and its valley bottom and evaluate those conditions with regard to the impacts of flows diverted into Turkey Creek.

1.1. Desktop Analysis

Under the desktop analysis, the geology, soils, hydrology, topography, and stream planform characteristics of the creek were documented and analyzed with regard to their influence on the geomorphic characteristics of the creek.

1.1.1. Geology

The geology of the Turkey Creek watershed is one of the principal controls on the topographic development of the watershed. **Figure 1** shows the watershed in relation to nearby towns and test holes drilled in the area as part of the South-Central Nebraska hydrogeology study conducted by the USGS. The upland and tableland areas and exposed valley walls of the watershed are composed of Holocene and late Wisconsin age Peoria Loess, Gilman Canyon Formation, and other loess units overlying Early Pleistocene and Pliocene alluvial silts, sands and gravels. The geologic map compiled by Swinehart et al. (1994) shows the thickness of the loess units along the top of the tablelands and upland areas ranging from about 20 feet (6m) in the southern end of the watershed to more than nearly 40 feet (12m) at the northern end of the watershed. Additional information on the Quaternary loess in the area was obtained from Muhs et al. (2008). Based on descriptions by Hiergesell (1984) of test holes drilled in the area (see Figure 1) around the watershed, the loess and alluvial units overly the Tertiary age Ogallala Formation at a depth of about 80 feet in the southwestern test hole to a depth of about 215 feet in the northern test holes.

The Ogallala Formation is exposed in the basal portion of stream valley walls and shallowly underlies the stream valley floors and appears to daylight within the lower half of the watershed at about the location of the pink line in Figure 1. The pink line is located at the confluence of the west branch of Turkey Creek, but also generally defines a change in the watershed drainage pattern and overall planform of the basin. Upstream, it appears that initiation and development of gullies and tributary valleys along the primary valleys of the upper watershed is much more rapid and extensive, likely as a result of the high runoff and piping characteristics of the loess. This has created a substantial dendritic drainage pattern in the much wider, upper watershed. In the narrower, lower watershed below the dividing line, the drainage pattern is less well developed and the primary drainage valleys are linear running north and south. It is apparent that runoff from the thinner extent of the overlying loess or from areas comprised of or shallowly underlain by the Ogallala Formation is substantially less. This is also indicated by the greater amount of irrigated agricultural land south of the dividing line compared to north of the dividing line where the land is used primarily for grazing, also seen in Figure 1.

The Ogallala Formation overlies the Cretaceous age Pierre Formation at depth and does not daylight anywhere in the watershed. The blue line in Figure 1 defines the north edge of the floodplain and valley wall of the Republican River.

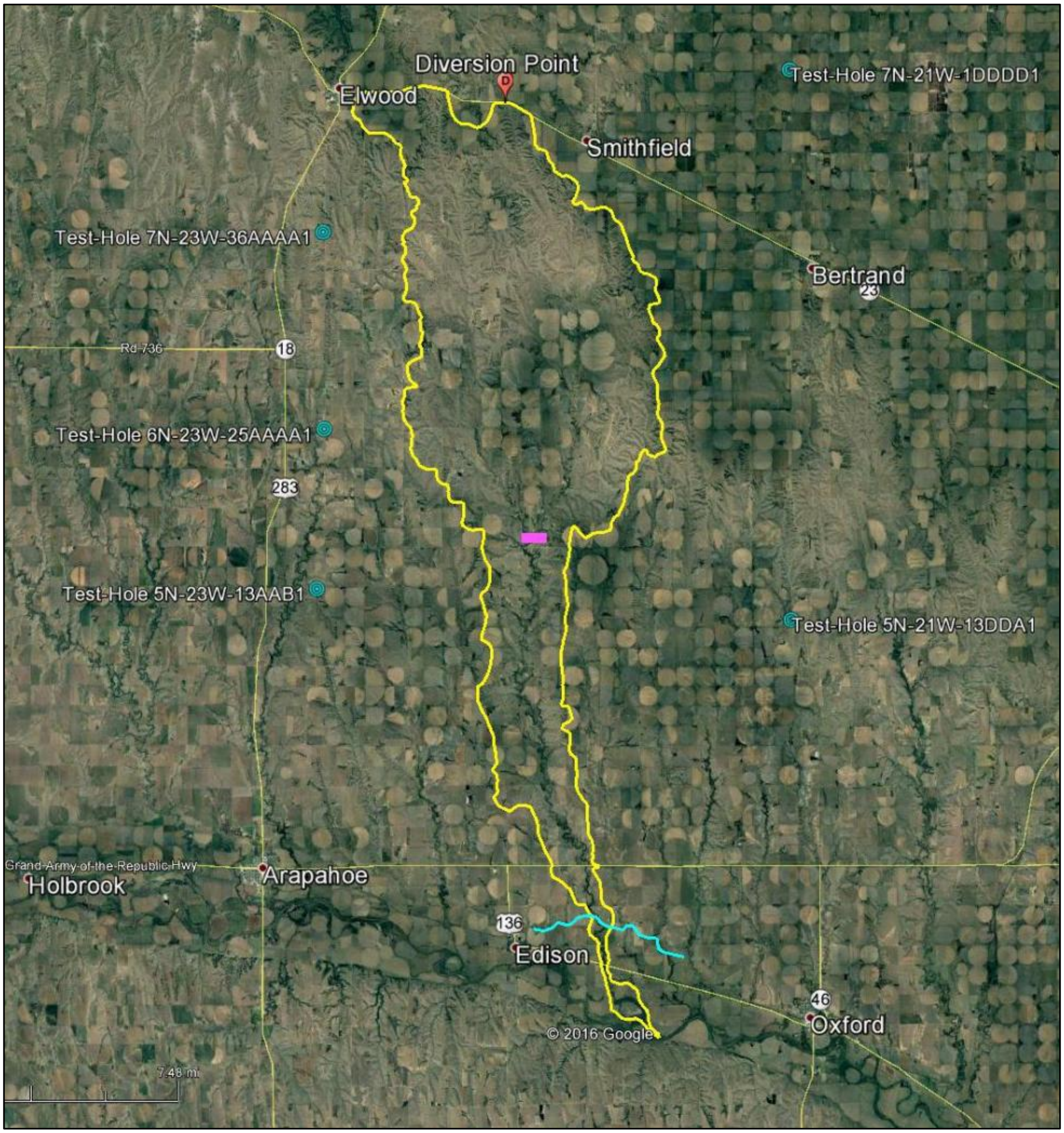


Figure 1. View of Turkey Creek watershed (yellow) and surrounding areas showing locations of test holes and approximate location of daylighting of the Ogallala Formation (pink line) and northern boundary of the Republican River floodplain where it crosses the watershed boundary.

1.1.2. Soils

Soils data and information for the watershed was obtained from the NRCS Web Soil Survey (WSS) website (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm). The soils within the watershed are reflective of the surficial geology of the area with most of the soils developed from the extensive upland and tableland loess deposits. The primary soils are the Holdrege, Coly, and Uly soils, which comprise approximately 28%, 30%, and 22%, respectively, of the soils in the watershed. All three soils are silt loams composed of about 67-68% silt and about 20-23% clay. The soils are generally well drained to moderately well drained with low to high runoff potential depending on location. The soils are fairly susceptible to sheet and rill erosion as indicated by their fairly high erosion factors (RUSLE2 K factor) of 0.37 to 0.49. The estimated maximum average rate of soil erosion (RUSLE2 T factor) of these soils is 5 tons per year. The areas with Holdrege soils are considered prime farmland, whereas the areas containing Coly and Uly soils, which cover more than 50% of the watershed, are not considered prime farmland. South of RD 735, the creek flows along a valley bottom composed of Hobbs silt loam (2% of watershed) derived from stratified silty alluvium produced by Turkey Creek. Upstream of Rd 735, the creek flows along a valley bottom composed of loess derived Uly-Coly soils. **Appendix A** contains the soils data for the watershed.

1.1.3. Hydrology

A cursory analysis was conducted of the stream gage data for Turkey Creek as part of the geomorphic assessment. Daily flow data is available for the Turkey Creek at Edison gage (USGS 06844210) for Water Years 1993 to 2004 and at the Turkey Creek at Furnas gage (Tri-Basin NRD 231700) for Water Years 2006 to the present. Over almost all of the 22 year period of record, the mean daily flow for each year was less than 20 cfs. **Table 1** shows the peak discharge, maximum mean daily flow (MDQ), the number of days with mean daily flows that equaled or exceeded either 40 cfs or 100 cfs (the proposed daily diversion flows), and the number of consecutive days with the mean daily flow equal to or exceeding 40 cfs or 100 cfs for each year.

The capability of the channel to carry the proposed flows of either 40 cfs or 100 cfs for a specific duration is dependent on the capacity of the channel. The capacity of the channel at any given location, if the channel is relatively stable, is often tied to a specific discharge. The channel-forming or channel maintenance discharge is often used to evaluate the capacity of a channel. Researchers have used various discharge levels to represent the channel-forming discharge. One of the most common used is the bankfull discharge. The bankfull discharge is the discharge that fills a stable alluvial channel up to the elevation of the active floodplain (**Figure 2**). In many natural channels, this is the discharge that just fills the cross section without overtopping the banks, hence the term “bankfull.” This discharge is considered to have morphological significance because it represents the breakpoint between the processes of channel formation and floodplain formation and is the discharge at which channel maintenance is the most effective, that is, the discharge at which moving sediment, forming or removing bars, and generally doing work results in the average morphologic characteristics of the channel (Dunne and Leopold 1978). In stable alluvial channels, bankfull discharge corresponds closely with effective discharge and channel forming discharge.

Out of the 22 year period of record 6 years had 10 or more days of mean daily flows (MDQ) ≥40 cfs, but only 2 years had flows ≥40 cfs that lasted more than 4 consecutive days. The wet years of 2007 and 2008 saw 10 and 8 continuous days, respectively, of continuous sustained flows over 40 cfs. Based on this data, the duration of diverted flows equal to or exceeding 40 cfs could potentially have significant impacts on the stability of Turkey Creek given that the creek rarely sees flows in excess of 40 cfs lasting more than 2 or 3 days. However, based on the HEC-RAS modeling and the field assessment conducted for this project, it appears that the channel up to a point about 2.12 miles below the diversion point is capable of containing flows greater than 40 cfs.

Table 1. Hydrologic data for Turkey Creek.

Turkey Creek Edison and Furnas Gages Water Years 1994 to 2016						
Water Year	**Peak Q (cfs)**	**Max MDQ (cfs)**	**#Days ≥40 cfs**	**Consecutive Days ≥40 cfs**	**#Days ≥100cfs**	**Consecutive Days ≥100 cfs**
1994	176	127	5	3	2	2
1995	88	58	2	2	0	0
1996	1,510	707	19	4	7	2
1997	45	33	0	0	0	0
1998	290	125	5	2	2	2
1999	472	266	13	3	5	2
2000	464	187	3	2	2	2
2001	317	189	19	3	2	1
2002	52	32	0	0	0	0
2003	120	63	0	0	0	0
2004	102	60	1	1	0	0
2005	---	---	---	---	---	---
2006	106	71	1	1	0	0
2007	538	278	20	10	13	5
2008	1,470	972	16	8	9	5
2009	126	100	5	3	2	1
2010	296	152	12	4	3	3
2011	1,340	361	7	3	3	2
2012	47	38	0	0	0	0
2013	81	51	1	1	0	0
2014	394	208	5	2	2	1
2015	290	165	4	2	1	1
2016	1,050	324	3	2	1	1

In the 22 years of record, the channel has only seen MDQs in excess of 100 cfs a total of 27 days. Out of that 27 days the channel has only seen 11 times where MDQs greater than 100 cfs lasted 2-3 days, and flows lasting at least 5 days only twice - those were once each in the wet years of 2007 and 2008. Based on the estimated bankfull flows (2-year flow) for cross sections in the HEC-RAS model, it is apparent that most of the channel up to Station 1920+00 is capable of carrying flows over 100 cfs. An examination of the 2009 aerials, it doesn't appear that the high sustained flows in 2007 and 2008 did any evident damage. This suggests that flows of 100 cfs should not be sustained for more than 5 days at a time. However, it is recommended that a monitoring plan be in place once the flows start and implement channel stabilization works for the channel reach between the diversion point and Station 1920+00 since the channel in that stretch doesn't have the capacity to carry the 100 cfs.

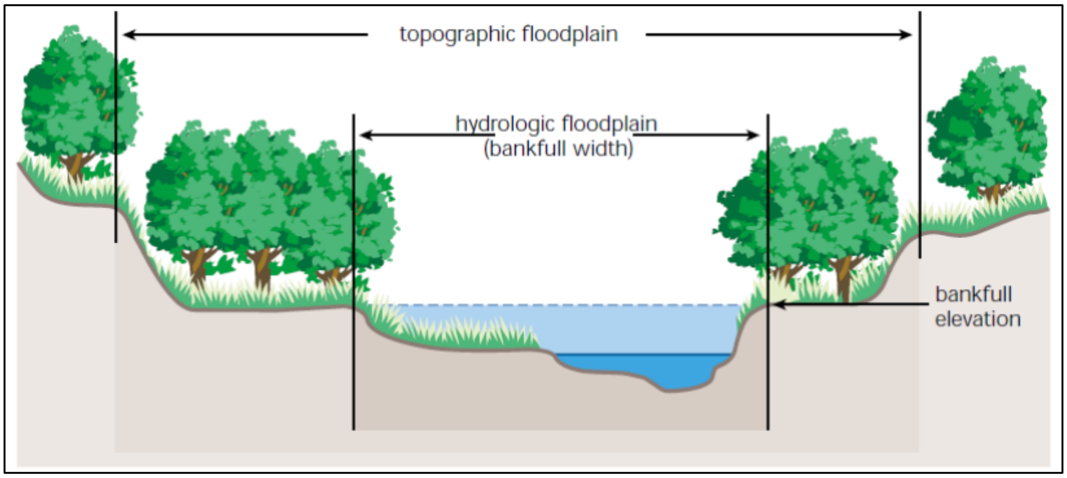


Figure 2. The hydrologic floodplain is defined by bankfull elevation. The topographic floodplain includes the hydrologic floodplain and other lands up to a defined elevation.

The timing of diverted flows could also have an impact on channel stability since the majority of the high mean daily flows and peak flows occur in the summer months when large convective storms produce significant precipitation over the watershed. Therefore, diverting flows into Turkey Creek during the spring when mean daily flows are lower would likely have less of an impact on channel stability than if they were piggy-backed onto the higher summer mean daily flows.

1.1.4. Aerial Photo Analysis

An analysis of historic aerial photos was conducted to determine if there were any major planform and riparian vegetation changes that could have an impact on channel stability. Major planform changes that could be identified include flow diversions, meander bend cutoffs, channel migration, significant bank erosion, and headcut migration or gully progression. Aerial photos from 1968, 1993, 1999, 2003, 2005, 2006, 2009, 2010, 2012, and 2014 were examined. All but the 1968 aerial photos were examined on the Google Earth website. No significant changes in any of the planform characteristics or vegetation were noted over the 46 year period. Some minor land use changes were noted, but these were in upland areas.

1.1.5. Topographic Analysis

General topographic data was obtained from USGS topographic maps covering the watershed. The topographic data combined with planform information was used to evaluate the channel slope and sinuosity of the creek. The primary topographic information obtained from the USGS maps was used to delineate the margins of the creek valley bottom, identify significant changes in topography, delineate the elevations used in the geologic analysis, and identify contour crossings along the creek.

The contour data was used in conjunction with the aerial photos to define the sinuosity of the creek between contour crossings. The sinuosity of the creek is defined by the stream length divided by the valley length between the contour crossings. Highly sinuous reaches are generally less efficient at transporting sediment, but don’t have a significant impact on out of bank flows since those flows will generally pass along the valley floor in a down valley direction. Bankfull flows can result in the erosion of the outer banks of meander bends and, where the upstream and downstream limbs of meander bends are close together, there is the potential for cutoffs across the neck of the bends to occur.

Cutoffs where the length of the channel that is cutoff is short relative to the overland length generally have little impact on the upstream channel. However, cutoffs of large meander bends or cutoffs of multiple meander bends can have can have a significant impact on channel stability upstream since the cutoff results in an over steepening of the channel. An over steepened channel section can induce upstream degradation. **Figure 3** shows the channel sinuosity for reaches between contour crossings where the channel is fairly sinuous. The channel, where it exists, in the uppermost part of the watershed is relatively straight, so sinuosity for that part of the creek is not provided. Figure 2 shows that the creek is highly sinuous over most of its length from where it leaves the Republican River floodplain for about 27 miles upstream. At Mile 30, the sinuosity drops off in the upstream direction, which corresponds with a general steeping of the channel to about Mile 35.4. This also corresponds with the area where the channel starts to change from a well-defined channel with significant base flow to a poorly defined channel with no base flow. This transition starts just below Rd 737 and extends to a point 1.32 miles upstream. This transitional reach is fairly steep, with a gradient of 0.57% as defined by the contours on USGS topo maps.

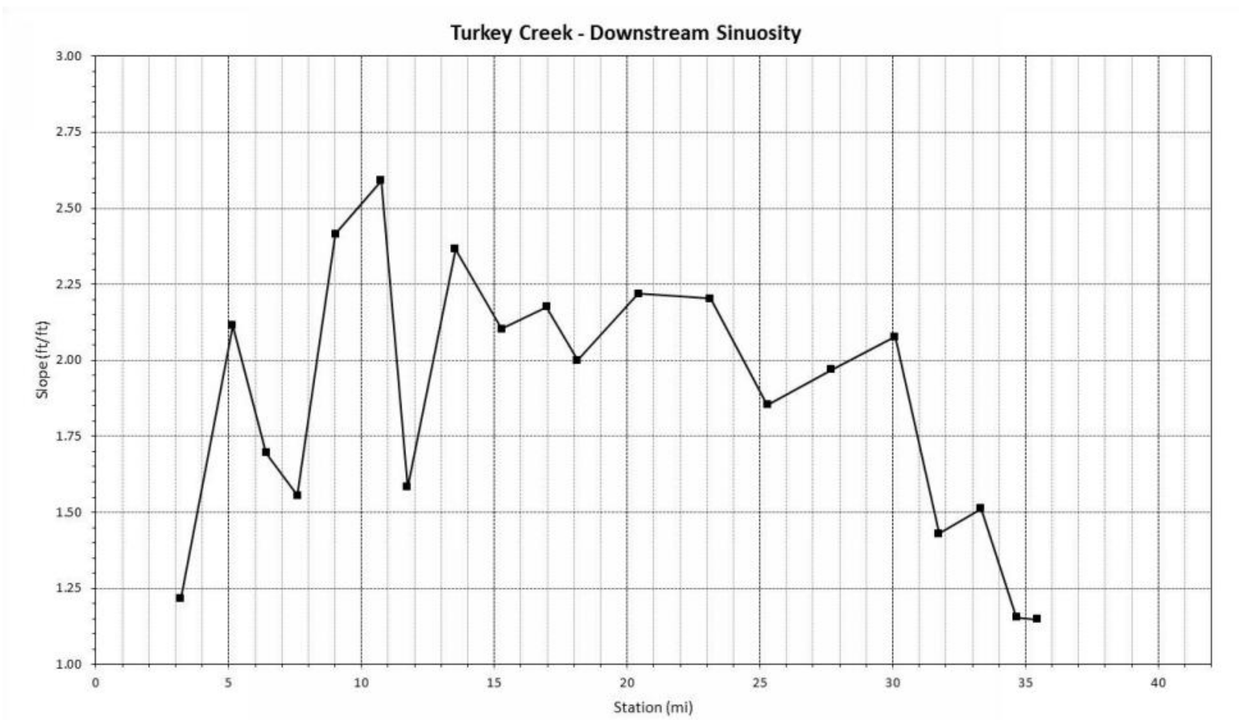


Figure 3. Sinuosity of Turkey Creek.

The contour data was also used to produce a profile of the creek and identify any locations with major profile changes that may be impacted by the augmented flows. **Figure 4** shows the profile of the creek using USGS topographic map contour data. The profile is concave, which is typical of most streams. However, a major convexity in the profile occurs between Mile 35.44 and Mile 37.85. This convexity marks the transition of the channel from well-defined to poorly-defined as described above. Figure 4 also shows the approximate location of where the Ogallala Formation daylights in the valley as described in the geology section above.

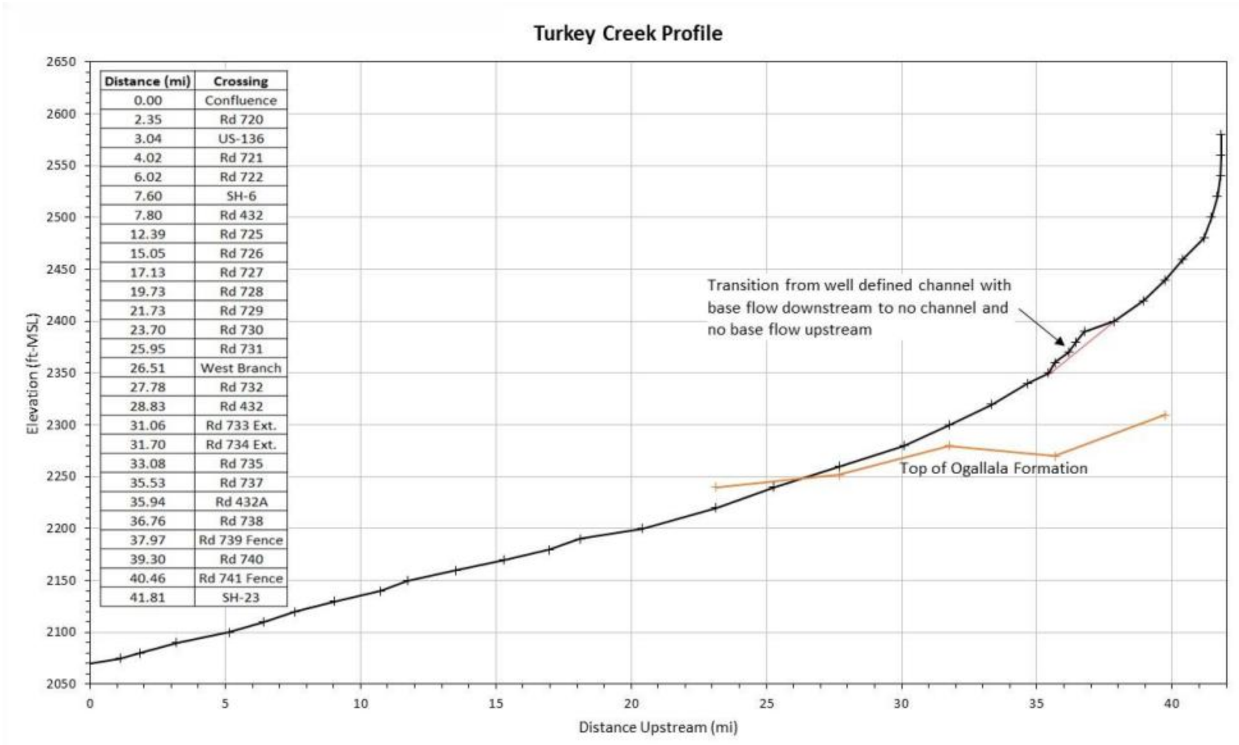


Figure 4. Topographic profile of Turkey Creek from USGS topographic maps.

The gradient of the channel between contours from Mile 0 to Mile 33 ranges generally between 0.1% and 0.2% as shown in **Figure 5**. However, the convexity in the channel profile between Mile 35.44 and Mile 37.85 (see Figure 4) is also defined by steeper channel gradients as high as 0.79%. It is likely that this steeper reach will need to be stabilized prior to the passage of diverted flows into the creek.

1.2. Geomorphic Field Reconnaissance

A geomorphic assessment of the main stem of Turkey Creek was conducted between August 29 and August 31, 2016. The assessment consisted of observing the channel at public access points where direct access to the channel was not granted by landowners or directly accessing the channel where permission was granted. Most observations were made at public access points such as at road crossings or where the creek passed close to a road. In the upper part of the watershed where there were fewer road crossing, but where permission was granted, the creek was accessed by a farm road or by walking into and along the creek. As part of the field reconnaissance, existing conditions and the general geomorphic characteristics of the channels were documented using field notes of observations and georeferenced ground photos. Existing and/or potential problem areas and existing aggradational, degradational, and stable reaches of the mainstem were to be identified and delineated, and significant changes in bed and bank materials along the mainstem were also to be documented.

The geomorphic assessment of the main stem of Turkey Creek is based on observations at specific access points so the following discussion is based on those access points. The reaches described below are defined primarily by geographic features, but some reaches are also defined by geomorphic transitions. The following assessment was supplemented with information from the plan view characteristics of the creek obtained from 2014 Google Earth imagery where there was little of no access. All georeferenced ground photos and the field notes collected during the field reconnaissance are provided in **Appendix B**.

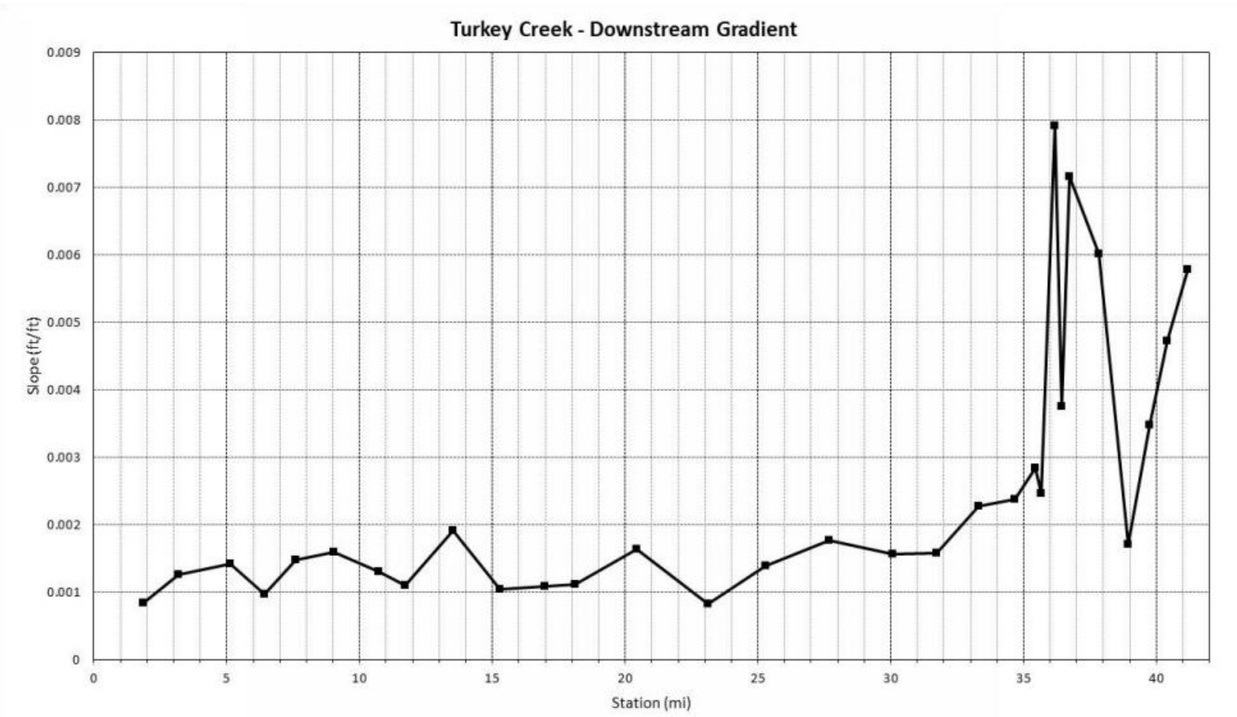


Figure 5. Downstream gradient of Turkey Creek between contour crossings.

1.2.1. Confluence to SH-6 Reach

This reach lies partially within the floodplain of the Republican River. The creek was observed at 9 access points within this reach - at two farm road culvert crossings, at the Rd 720, 721, and 722 bridges, at the SH-6 and US-136 bridges, and at 2 locations (view points) where the creek is in close proximity to the north-south running Rd 432 as shown in **Figure 6**. The riparian corridor along most of this reach is fairly narrow on both banks with farm fields in close proximity to the creek.

A portion of the creek between the confluence and Rd 720 flows along an abandoned meander of the river. The downstream-most farm bridge in this reach consists of a 30-inch corrugated metal pipe (CMP) with a concrete top which acts as an overflow weir during high flows. Although the channel immediately downstream is over widened as a result of scour from the CMP, the approximate channel dimensions upstream and downstream of the culvert are 20-25 ft top width (TW), 15 ft bottom width (BW), and a depth (D) of about 8-10 ft. The channel, both upstream and downstream, is capable of passing the additional flow, but the CMP is not. Although erosion is slow in this reach, saturation slumping does occur.

The next upstream farm bridge consists of a double 48-inch CMP, surrounded by rock fill and capped with a concrete pad. The crossing overtops at high flows since the cap is approximately 1-2 feet below the average floodplain surface. The upstream and downstream channel dimensions are approximately 18-20 ft TW, 15-18 ft BW, and 7-8 ft D. The channel both upstream and downstream is capable of passing the additional flow and the CMPs may be able to pass the additional flow as well. Although erosion is slow in this reach, saturation slumping is evident along both banks.

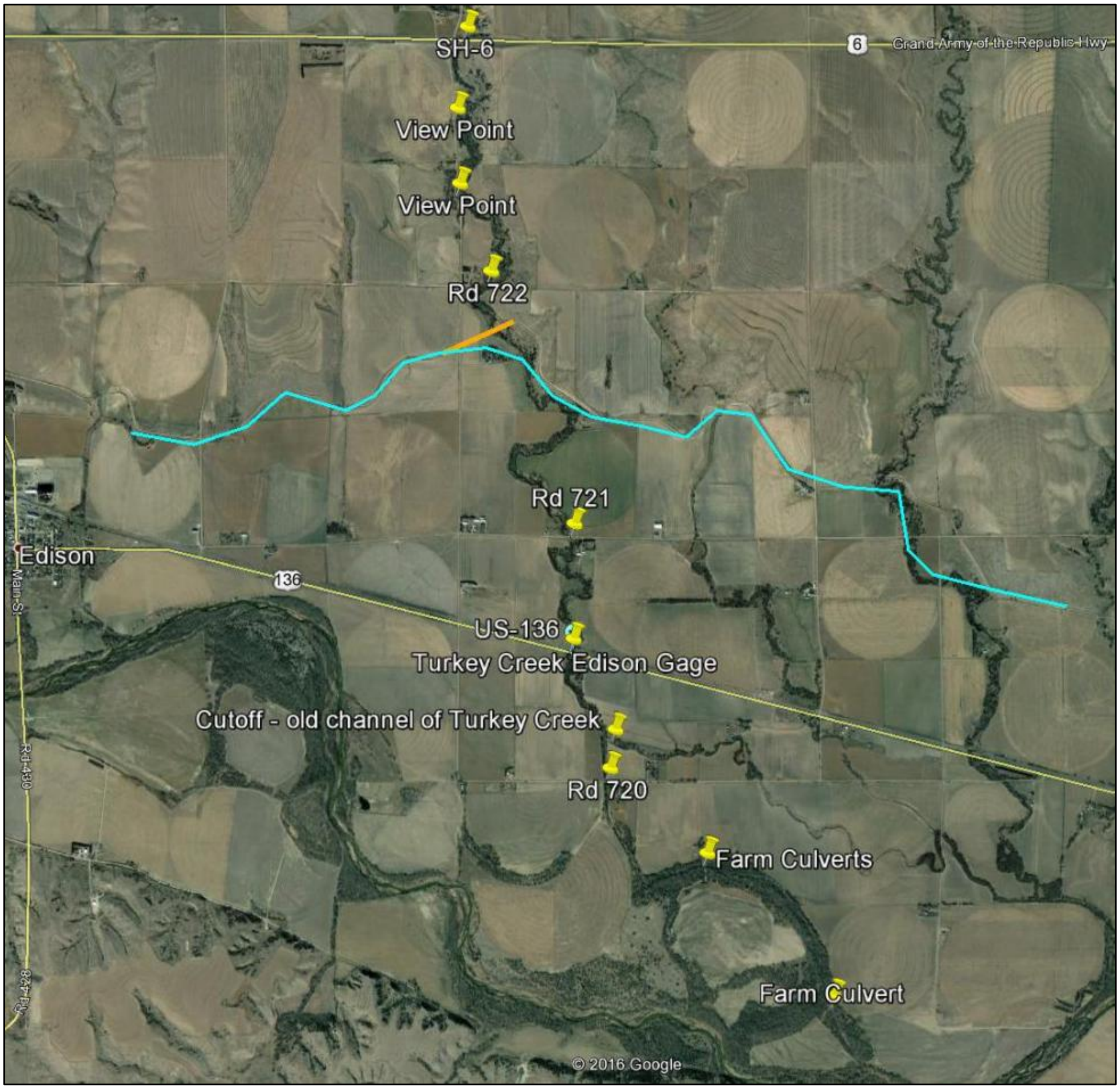


Figure 6. Confluence to SH-6 reach.

Rd 720 crosses a very straight section of the creek. Further upstream at about 1,000 upstream of Rd 720, it appears that the creek was cutoff and diverted into its current straight course upstream and downstream of the Rd 720 bridge at some point in the distant past. This cutoff shortened the creek by almost a mile; however, it appears that the channel has since adjusted to this shortening. This manmade section was constructed sometime in the distant past. Long linear berms on the right descending bank upstream of the bridge and on the left descending bank downstream of the bridge are remnants of the constructed channel. Also, there is an inset floodplain within which the creek is entrenched. The total width of the inset floodplain and channel is about 40-45 ft, with the channel being about 10-12 wide and 8-10 feet deep. Mature trees line the side slopes of the floodplain while younger trees grow along the top bank. It is unclear if the floodplain was excavated as part of the channel construction, but given its symmetry, it is likely that it was constructed as part of the channelization work. **Figure 7** shows the inset floodplain and channel upstream of Rd 720. As seen in the figure, bank erosion does occur in the reach, but it is very slow and the channel has adequate capacity to pass the additional flows.

Figure 7. View looking upstream from Rd 720 bridge.

Upstream of the cutoff and channelization, the creek is much more sinuous. At the US-136 crossing, the channel is deeply entrenched and well confined with a TW of about 30-35 ft, BW of about 20-25 ft, and a D of about 18-20 ft. The banks are near vertical with trees growing along the top of the banks as well as down the face of the banks, indicating that the channel in this reach is quasi-stable. A Bureau of Reclamation Hydromet Station (TCEDNE) is located on the left (east) bank on the downstream side of the bridge. The stream gage at this location was operated by the USGS until 2004. The highway bridge is a 3-span bridge with H-pile bents and spill-through abutments. Some riprap is present on the banks and in the channel below the bridge. A railroad bridge is located about 60 feet upstream. A double stepped concrete structure with about a 2-foot drop spans the channel just downstream of the railroad bridge. It is unknown if this structure is meant to protect the railroad bridge from degradation or if it is an encasement for a utility line. The channel in this area has adequate capacity to pass the additional flows.

The bridge at the Rd 721 crossing appears to be relatively new and consists of 3 spans with 2 wall piers and vertical wall abutments. Although the bridge is skewed to the creek, the abutments and pier walls are aligned with the creek and the floodway. The overbank areas under the bridge are riprapped. Dense vegetation lines the banks of the creek upstream and downstream. The channel upstream and downstream of the bridge is deeply entrenched, but relatively stable except for areas where occasional tree failures create an erodible scallop in the bankline. Discontinuous, low, grassy berms, which are indicative of the relative stability of the reach, line the base of the banks. Approximate channel dimensions upstream and downstream are TW = 30-35 ft, BW = 18-20 ft, and D = 18-20 ft. The channel in this area has adequate capacity to pass the additional flows.

About 1,000 feet south of Rd 722, the creek leaves the Republican River floodplain (blue line in Figure 6) and passes under the Cambridge Canal Siphon (orange line in Figure 5). The Rd 722 bridge is an old steel single span bridge with sediment deposited on the bridge deck from a recent high flow event. However, the creek is deeply entrenched, but stable, with dense vegetation growing along the banks and woody debris in the channel. An occasional depositional berm is present along the toe of the banks as well. There are also gently sloping terraces on both banks with very large mature trees. The terraces are 40 feet or more wide in places. The channel and floodway in this area has adequate capacity to pass the additional flows.

The creek was also observed at two view points upstream of Rd 722 where the creek channel passes close to Rd 432. The appearance of the channel and its dimensions do not change appreciably upstream of Rd 722, but the inset terrace an each bank becomes wider in places where the channel is much more sinuous locally.

1.2.2. SH-6 to Rd 726 Reach

This reach extends from the SH-6 crossing to the Rd 726 crossing as shown in **Figure 8**. This reach is a highly sinuous reach with a riparian corridor that varies in width, the greater widths occurring where the channel is very tortuous. The channel was observed at the SH-6 crossing, the Rd 432 crossing just upstream of SH-6, at a farm bridge just west of Rd 432, and at a view point just north of the Rd 432 crossing in the lower part of the reach, but was not accessible again until the middle part of the reach where the channel passes close to Rd 431 just below the Rd 725 crossing and then the Rd 726 crossing at the upper end of the reach. Within this reach the valley starts to develop side gullies and small tributaries.

The SH-6 bridge is a 3-span bridge having two concrete pier bents with cross beams and spill through abutments covered with concrete panels. The creek flows between the pier bents. The upstream channel appears somewhat smaller than the downstream channel, but the upstream channel has 2 sets of terraces whereas the downstream channel only appears to have one set. The channel dimensions are 8-12 ft BW, 12-15 Ft TW, and 8-10 ft D. In the area immediately upstream of the bridge, the lower inset terrace is about 12-15 ft wide whereas the upper terrace is about 30-40 ft wide and sits about 7-8 ft above the lower terrace. Locally, these terraces suggest at least 2 incisional events in the distant past, based on the ages of the riparian vegetation along the channel. The channel and floodway in this area has adequate capacity to pass the additional flows.

The Rd 432 bridge is a single span steel bridge with concrete vertical wall abutments. Downstream of the Rd 432 crossing, the lower terrace is present and visible, but the upper terrace was not observed. The channel is somewhat wider downstream of the bridge than upstream with dimensions of 18-20 ft BW, 20-25 ft TW, and 12-15 ft D. There is fairly dense vegetation along the channel and lots of woody debris in the channel. The channel capacity upstream of the bridge appears to be less than downstream, but the bridge and channel are still capable of passing the additional flows. Upstream and west of the Rd 432 crossing is a farm road crossing with a 48-inch CMP. It is unlikely this culvert will be able to pass the additional flows.

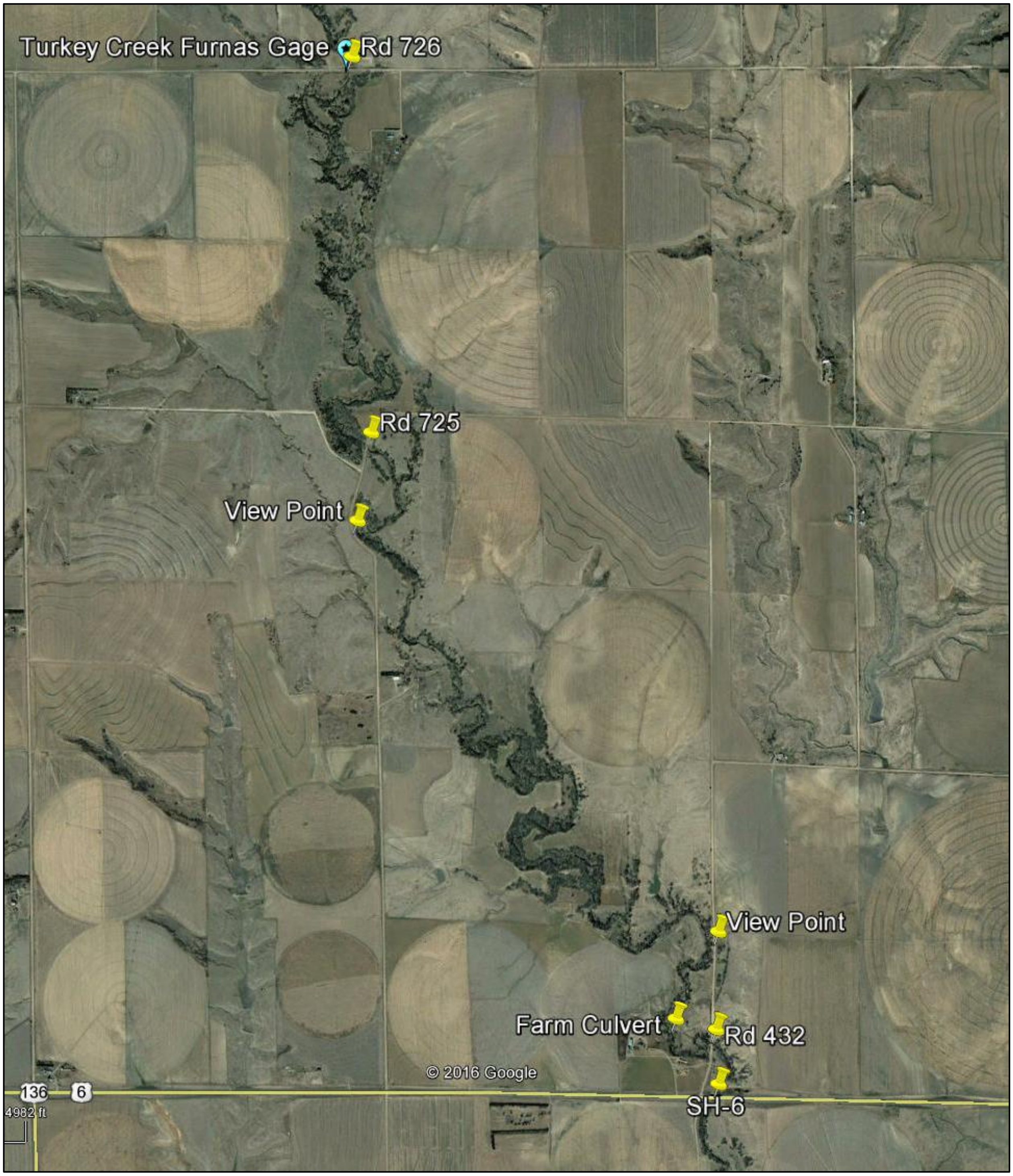


Figure 8. SH-6 to Rd 726 reach.

Between the Rd 432 and Rd 725 crossing, the creek is highly sinuous with very tortuous meanders. At the view point along Rd 431 and at the Rd 725 crossing, the creek is deeply entrenched and has a high terrace along both banks. The Rd 725 bridge, which is skewed to the channel, consists of 3 spans with concrete 2 wall piers that are aligned with the channel and floodway. The creek banks are less vertical and appear relatively stable with young trees along the channel banks. Mature trees are growing along the top of the banks and on the terrace. The approximate channel dimensions are 30-40 ft TW, 8-10 ft BW, and 15-18 ft D. The channel and floodway in this area has adequate capacity to pass the additional flows.

The Rd 726 bridge consists of 3 spans founded on circular pier bents with cross braces and vertical wall abutments. Although the abutments are founded in the overbank areas, roadside drainage and bankline toe erosion are starting to eat away at the ground protecting the abutments. The Nebraska DNR's Turkey Creek at Furnas-Gosper County Line gage (231700) is located on the right (west) bank on the downstream side of the bridge. Roadside drainage has created a large saturation/liquifaction slump in the bankline just below the gage and continued erosion is threatening to destroy or damage the gage (**Figure 9**). The creek at this location is narrower with remnants of past and dormant bank slumps. Grassed berms along the toe appear to be deposits from dormant slumps. Active slumps and bank erosion are apparent in places upstream and downstream of the bridge, especially on the outside of very tight meander bends. The high terrace is well defined on both banks downstream of the bridge where the channel is very sinuous and tortuous, but is not as prominent upstream of the bridge where the channel is less sinuous. The approximate channel dimensions are 18-20 ft TW, 8-10 ft BW, and 18-20 ft D. The channel and floodway in this area has adequate capacity to pass the additional flows.

1.2.3. Rd 726 to Rd 729 Reach

This reach extends from the Rd 726 crossing to the access point at the end of Rd 729 as shown in **Figure 10**. This reach is also a highly sinuous reach with a variable width riparian corridor. The tributary areas with highly dendritic side drainages on both sides of the valley significantly increase in the upstream direction starting in this reach. Several of these tributaries contain small stock ponds.

Between Rd 726 and Rd 727 the channel is still fairly sinuous with short segments of tortuous meandering. Bank erosion and bank failures occur occasionally, especially on the outside of meander bends, and low terraces/benches are also present in many of meander bends as seen in **Figure 11**. Fallen trees that pop out large sections of the banks create many of the erosional scallops and pockets in the banks.

The Rd 727 crossing consists of a small steel bridge with wood planking and vertical concrete abutments. In general, the channel here has less steeply sloping banks (1:1 or 1.5:1), but where bank erosion occurs, there is intermittent, grassed berms of sloughed bank material built up along the toes of vertical eroding banks. Flow in the channel is shallower and the visible bed contains sand. The approximate channel dimensions are 30-40 ft TW, 8-10 ft BW, and 15-18 ft D. Although the bridge is smaller, it and the channel and floodway in this area have adequate capacity to pass the additional flows.

Figure 9. View west showing saturation slump threatening gage at Rd 726.

The Rd 728 bridge is a 3 span concrete bridge with 2 concrete pier bents, vertical abutments, and wingwalls. A substantial amount of woody debris has accumulated under the upstream side of the bridge. The downstream channel is more sinuous and tortuous, but become less so upstream. The downstream channel has a good riparian corridor with matures trees, but that corridor narrows somewhat with less dense riparian vegetation along the banks upstream. The banks of the channel downstream contain old slump scars with mature trees growing at the base of the slump scars. The approximate channel dimensions are 20-25 ft TW, 8-10 ft BW downstream and 6-8 ft BW upstream, and 10-12 ft D. Although the bridge is smaller, it and the channel and floodway in this area appear to have adequate capacity to pass the additional flows.

Rd 729 has no bridge crossing, but comes sufficiently close to the creek to allow for observation of the area. The area is very sinuous with highly tortuous bends. The banks are well vegetated with dormant grassy slumps along the toe of the banks (**Figure 12**). The approximate channel dimensions are 30-35 ft TW, 6-8 ft BW, and 12-15 ft D. The channel and floodway in this area appear to have adequate capacity to pass the additional flows.

Figure 10. Rd 726 to Rd 729 reach.

Figure 11. View of tortuous meander bends in the creek between Rd 726 and Rd 727.


Figure 12. View downstream at Rd 729 access point.

1.2.4. Rd 729 to Rd 432 Reach

This reach extends from the Rd 729 access point to the Rd 432 crossing as shown in **Figure 13**. This reach also includes bridges at the Rd 730 and Rd 731 crossings. The dendritic drainage pattern of the tributaries in this reach is much more pronounced than in the previous reach.

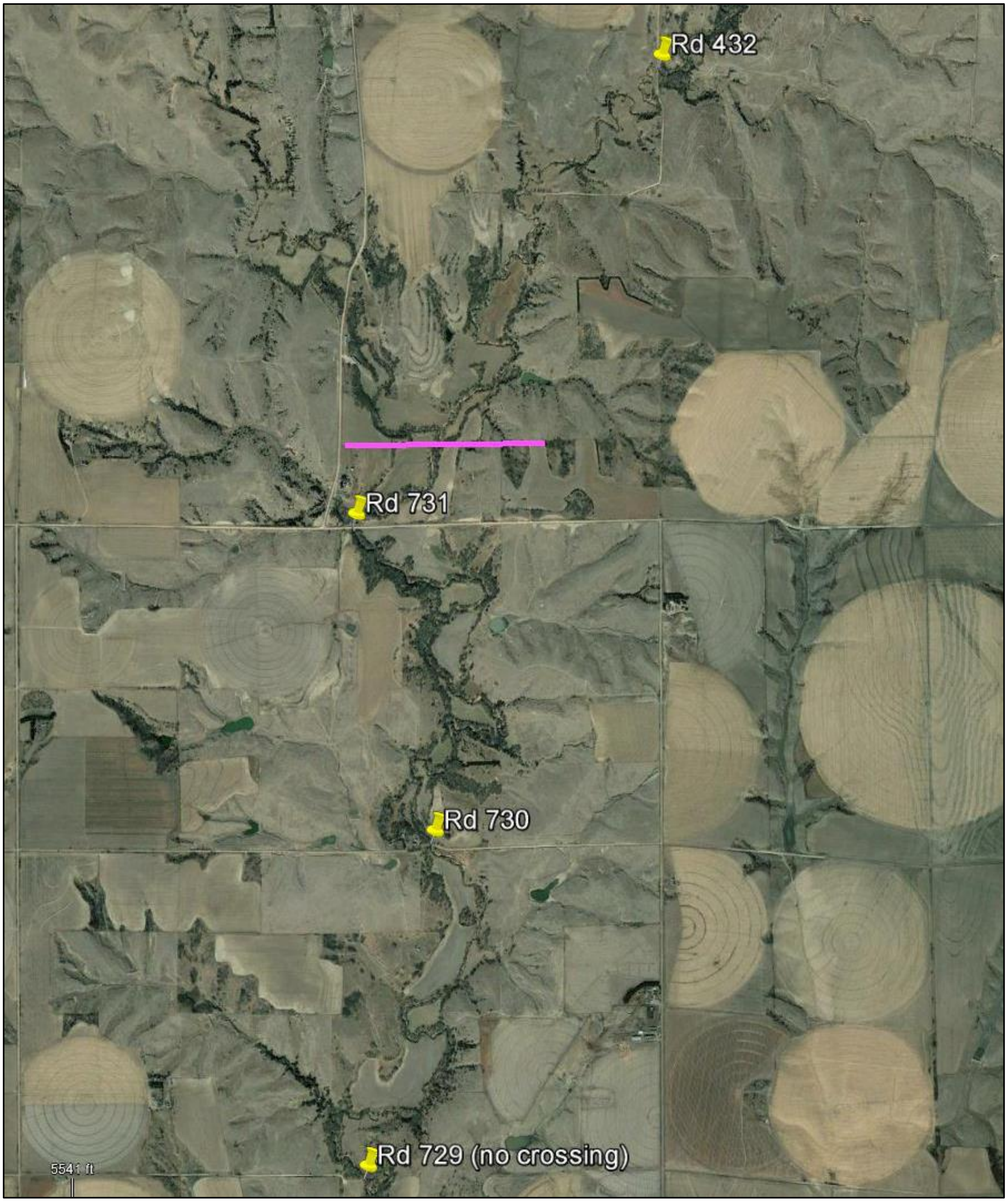


Figure 13. Rd 729 to Rd 732 reach.

This reach is less sinuous than the previous reaches and has a riparian corridor that varies in width. Between Rd 729 and Rd 730, the riparian corridor is fairly narrow in those places where farming practices extend right up to the bankline. Between Rd 730 and Rd 731 the riparian corridor is less encroached upon and generally wider in most places. Upstream of Rd 731, the riparian corridor narrows substantially and the narrowing generally coincides with agricultural practices that extend close to the channel margins. The confluence of the West Branch of Turkey Creek and the daylighting of the Ogallala Formation (pink line in Figure 13) as described above are located just upstream of Rd 731 as well.

There is a single span, steel bridge at the Rd 730 crossing. The size of the channel is similar to that described for Rd 729 access point, but the bottom width is slightly smaller at 8-10 ft. The capacity of the bridge opening is relatively small, but is probably able to pass the additional flows.

The channel between the Rd 730 and Rd 731 crossings is highly sinuous and fairly tortuous in places and has a well-developed riparian corridor of moderate width, especially in the upper half of this segment. The channel also contains low grassy benches along the base of both banks through much of this segment. It is unclear if these benches are erosional or depositional, but given that there is some woody vegetation growing on them would suggest they are slowly depositional in nature and may be representative of an inset floodplain.

The Rd 731 bridge is a concrete 3 span bridge with 2 concrete wall piers and spill through abutments. The abutment slopes and channel under the bridge as well as the banks upstream and downstream are riprapped. A low, narrow, inset floodplain on both sides of the entrenched channel is evident both upstream and downstream of the bridge. Dense vegetation is growing along both banks upstream and downstream. The confluence of a small tributary is present on the right bank just upstream of the bridge. The approximate channel dimensions are 30-35 ft TW, 6-10 ft BW, and 12-15 ft D. The bridge, channel, and floodway in this area appear to have adequate capacity to pass the additional flows.

The sinuosity of the creek between the Rd 731 and Rd 432 crossings decreases somewhat and there are fewer tortuous bends. A low, narrow, inset floodplain on both sides of the entrenched channel is evident over most of this segment. The density and width of the riparian corridor decreases significantly in the upstream direction.

The confluence of the West Branch of Turkey Creek enters on the right bank at about ½ mile upstream of Rd 731. Upstream of the confluence, the main stem of the creek becomes the East Branch. The East Branch between Rd 731 and Rd 432 contains well-developed floodplain benches on both banks. Although the West Branch is tributary to the creek in this segment has a similarly sized upstream contributing area as the East Branch, it doesn't appear to contribute a significant amount of base flow to the main channel. In addition, the East Branch channel upstream of the confluence maintains the same general dimensions as the channel downstream of the confluence, whereas the West Branch channel is only about half the size of the East Branch channel just upstream of the confluence.

The Rd 432 crossing is composed of a 60-inch CMP with a sheet pile headwall and rock riprap at the upstream end. No protection is evident at the downstream end of the culvert. The upstream end is partially blocked by woody debris, which is significantly reducing the capacity of the culvert. Given the potential for large woody material fully blocking the upstream end of the culvert, backwater and overtopping of the roadway here is highly likely. Under current conditions at this crossing, additional flows may exacerbate the potential for roadway overtopping.

1.2.5. Rd 432 to Rd 735 Reach

This reach extends about 4.4 stream miles from the Rd 432 crossing to the Rd 735 crossing (**Figure 14**). Because there was no access to the creek between these crossing, there were no observations of the creek between the crossings. A tributary with a fairly large drainage area intersects the creek on the left bank just upstream of the Rd 432 crossing. A tributary with a smaller drainage area intersects the creek on the left bank at about a mile south of the Rd 735 crossing.

Figure 14. Rd 732 to Rd 735 reach.

The creek immediately upstream and downstream of the Rd 432 crossing is deeply entrenched with well-developed, low, inset floodplain benches. Very little riparian vegetation is present along the channel downstream of the crossing, but there is a dense corridor of riparian vegetation along the creek for about a mile upstream of the crossing. The channel dimensions immediately upstream and downstream of the crossing are 6-8 ft BW, 25-30 ft TW, and 12-15 ft D. Although the channel has the capacity to transport the additional flows, the Rd 432 culvert may not depending on the amount of debris loading.

As seen in Figure 3, the creek starts to steepen somewhat upstream of Mile 30, which is about 1.25 stream miles upstream of the Rd 432 crossing. Based on an examination of the 2014 Google Earth aerial photography, from about halfway upstream to the Rd 735 crossing, the channel bottom and the low, inset, floodplain benches along the channel bottom start to widen. At about 2/3 of a mile below the Rd 735 crossing, the low, inset, floodplain benches and the channel bottom develop into wetlands with an inset low flow channel. **Figure 15** shows the channel and wetland configuration in the area of the Rd 735 crossing. This configuration extends well upstream of the Rd 735 crossing. The low flow channel in this area is only about 3-4 ft wide and about 2-3 ft deep. The widths of the low, inset, floodplain benches and wetlands vary, but the overall channel bottom width is as much as 50+ feet. The amount of riparian vegetation along the channel in this reach drops off significantly and is relatively sparse by the time Rd 735 is reached.

Figure 15. View of the channel and wetlands at the Rd 735 crossing.

The confluence of a right bank tributary with a fairly large drainage area intersects the creek just downstream of the Rd 735 crossing. The Rd 735 crossing is defined by a 96-inch CMP that passes under a high roadway berm (see Figure 15). The culvert has the capacity to transport the additional flows.

1.2.6. Rd 735 to Rd 432A Reach

Like the previous reach, this reach had limited access and was only observed at the road crossings at the upstream and downstream ends (**Figure 16**). This reach includes the Rd 737 crossing near the upstream end. The sinuosity of the reach is fairly low and there is very little riparian vegetation along the channel. The inset floodplain/wetlands are well-developed and continuous upstream of Rd 735 as shown in **Figure 17**.

A tributary with a fairly large drainage area intersects the creek on the left bank about 0.25 miles upstream of the Rd 735 crossing. Another tributary with a fairly large drainage area intersect the channel on the left bank at about 0.8 miles south of the Rd 737 crossing. This confluence also marks a rapid decrease in the inset floodplain/wetlands width in the upstream direction with the wetlands and inset floodplain disappearing by the time the Rd 432A crossing is reached. The Rd 737 crossing also marks the downstream end of the transition to the steep channel reach and profile convexity above Mile 35.4 as shown in Figure 4. Another tributary with a large drainage area also intersects the channel on the right bank about half way between the Rd 737 and Rd 432A crossings.

At the Rd 737 crossing, the crossing is defined by a high roadway berm over three 10-ft by 10-ft concrete box culverts with wingwalls. The channel and inset floodplain/wetlands upstream and downstream of the crossing are small. The floodplain/valley bottom width ranges from approximately 20 to 35 ft with an inset channel/wetlands depth of only about 1 foot as seen in **Figure 18**. As seen in Figure 18, there is very little woody vegetation along the channel upstream of Rd 737.

At the Rd 432A crossing, the wetlands and valley bottom downstream of the crossing have narrowed substantially with the narrowing continuing upstream of the crossing. The Rd 432A crossing consists of a 20-ft wide single span bridge with vertical sheet pile abutment walls and wingwalls. Although there is water under the bridge and in the floodway upstream and downstream of the bridge, the water is stagnant with little to no flow. The valley bottom downstream of the Rd 432A crossing is about 20-25 feet wide with a top width of about 30-40 feet. There is no well-defined channel in the valley bottom. Narrow relict terrace remnants are located on both sides of the valley bottom downstream of the bridge and are about 8-10 feet above the valley bottom.

1.2.7. Rd 432A to Farm Road (Rd 738) Reach

This reach represents the remainder of the steep reach and profile convexity between Mile 35.4 and Mile 37.85 as seen in Figure 4. Observation were made at both ends of the reach as well as along the reach where the channel could be observed from RD 432A. **Figure 19** shows this relatively straight reach of the creek and its associated tributaries. A farm road, which represents an eastward extension of Rd 738, defines the upstream end of this short reach.

Figure 16. Rd 735 to Rd 432A Reach.

Figure 17. View looking upstream at wetlands and small inset channel upstream of the RD 735 crossing.

Figure 18. View looking upstream at narrow wetlands upstream of the RD 737 crossing.

Figure 19. Rd 432A to Farm Road (Rd 738) Reach.

As one progresses upstream of Rd 432A, the valley bottom narrows from about 30 feet to about 20 feet and the amount of wetland flow decreases substantially. Fairly dense riparian vegetation is growing on the valley bottom for about 1,200 feet upstream of Rd 432A (**Figure 20**), at which point upstream base flow and riparian vegetation in the valley bottom disappears. From about that point upstream to the farm road, the valley bottom wetland configuration transitions from a narrow (6-8 ft BW, 30 ft TW), dry channel that is deeply entrenched (10-12 ft) in the valley floor (**Figure 21**) to a very narrow, shallow channel that disappears altogether at a small headcut just downstream of the farm road crossing. Consequently, the capacity of the channel/valley bottom to carry the additional flows decreases upstream and ends just below the farm road.


Figure 20. View looking upstream at 200 feet upstream of the Rd 432A crossing.


Figure 21. View looking up valley at the transition of the creek from a narrow entrenched channel to no well-defined channel just downstream of the farm road crossing.

At the Farm Road (Rd 738) crossing, the crossing is defined by a high road embankment that acts like a dam, impounding water upstream of the embankment, and a 36-inch CMP under the embankment. However, the invert of the CMP is well above the bottom of the upstream pond, so flow does not spill from the ponded area until the invert elevation is reached. If the pond fills rapidly and the culvert is unable to keep up with the inflow, the roadway embankment will overtop. This is also a possibility when additional flows are diverted to the creek in the future.

1.2.8. Farm Road (Rd 738) to View Point (Rd 740) Reach

This reach (**Figure 22**), which is about 2.3 miles long, was only observed at the ends of the reach and at a point 3,100 feet upstream of the Farm Road (Rd 738) because of the lack of access to the reach. Unlike the reaches downstream, this reach has numerous tributaries, many with on-line stock ponds, and a highly dendritic drainage pattern. The mainstem reach is defined by a number of on-line stock ponds ranging in size with low dams and intervening long, well-defined, channel segments. There is little vegetation along the reach and where there are trees, they are generally growing in the bottom of the channel.

Figure 22. Farm Road (Rd 738) to View Point (Rd 740) Reach.

The large pond just upstream of the Farm Road (Rd 738) impounds water for almost a half mile upstream of its dam. This pond has an overflow spillway at the east end, but erosion of the upstream face of the dam threatens the stability of the dam. In addition, any supplemental flows in the future could potentially overwhelm the overflow spillway resulting in overtopping and failure of the dam. **Figure 23** shows the configuration of the dam and spillway.

Figure 23. View of pond, dam, and spillway (yellow line) located 1,500 feet upstream of the Farm Road (Rd 738) crossing.

At about 0.25 and 0.16 miles downstream of the View Point (Rd 740), there are what appear to be 2 smaller dams and ponds which may actually be shallow cattle wallows created by shallow groundwater and surficial ponding of surface runoff. These dams are easily overtopped or flanked.

Where there are well-defined channel segments, the channels may or may not have sufficient capacity to carry the additional flows. But it is also likely that those flows will have a severe impact on those channel segments in the form of significant channel degradation and bank erosion if they are not protected or stabilized prior to the flow diversion.

1.2.9. View Point (Rd 740) to Headwaters Diversion Point Reach

This reach (**Figure 24**) is also about 2.3 miles long and has similar characteristics as the previous reach. There are numerous stock ponds with poorly to well defined, intermittent, intervening channel segments. The longest segment, which is about 0.6 miles long in the upper part of this reach, becomes deeply entrenched moving upstream (**Figures 25** and **26**) and ends at a series of groundwater sapping headcuts in the valley floor (**Figure 27**) about 3,000 feet downstream of the diversion point. The channel is generally "V" shaped, has a variable depth that ranges from 8 to 12 feet, with a top width that varies from 10 to 15 feet and has a 4-5 ft bottom width where there is no gut channel in the bottom. Where there is a gut channel in the bottom, it is usually equi-dimensional with dimensions ranging from about 1 to 2.5 feet wide and about 1 to 2.5 feet deep. At one location where the channel is narrow and deeply entrenched, the local landowner has filled the channel with dead trees to keep cattle from accessing the channel and getting stuck. The headcuts at the upstream end of the entrenched channel segment are about 3 to 4 feet high, but the total drop from the headcuts to a point in the channel about 100 feet downstream is about 10-12 feet. There is no defined channel in the final 3,000 feet below the diversion point.

Figure 24. View Point (Rd 740) to Headwaters Diversion Point Reach.

Figure 25. View down valley showing entrenched channel segment in valley floor about 1 mile downstream of the diversion point.

Figure 26. View downstream showing entrenched channel segment about 1 mile downstream of the diversion point. Note shallow gut channel developing in bottom in foreground.

Figure 27. View of 3-4 ft high headcut at upstream end of entrenched channel section 3,000 feet below diversion point.

1.3. Summary and Recommendations

In general, the creek between its confluence and Rd 432A is stable and its channel and floodway appear to have sufficient capacity to carry the additional diverted flows. However, some crossing structures, such as the CMP at Rd 432, may not have sufficient capacity to carry the additional flows and may need to be replaced.

The primary areas of concern are the reach between Rd 737 and Farm Road (Rd 738), which is the steep reach that creates the convexity in the channel profile seen in Figure 4, and the remaining reaches upstream. The steep reach between Rd 737 and Farm Road (Rd 738) should be further evaluated to determine if the profile anomaly does indeed exist, and if so, what the long term effects of the additional flows on the stability of the channel would be in this reach. If the Rd 737 and Farm Road (Rd 738) reach is significantly steeper, the use of stabilization measures should be considered for the reach.

Upstream of Farm Road (Rd 738), there are several segments with intermittent well-defined channel segments and other segments where the channel is either poorly defined or non-existent. It is recommended that channel sections be designed and constructed where there are reach segments with no or poorly defined channels. Some of these segments may also require bank stabilization. In segments where there is a well-defined entrenched channel, the channel segments should be evaluated for grade control. These deeply entrenched segments may also require bank stabilization of reshaping and grading of the banks to reduce the potential for significant bank erosion and failure. It is also recommended that a channel be designed and constructed in the 3,000-foot un-channeled reach below the diversion point. The constructed channel will likely require grade control and bank stabilization to maintain a stable configuration.

There are also numerous ponds with inadequate dams that are susceptible to failure by overtopping or flanking. The dams should either be removed to prevent the potential impacts of failures on downstream facilities as well as the hazards to life and property, or be redesigned and reconstructed to industry standards with dam surface protection from cattle and wave wash, adequate pond capacity to handle the additional flows, and appropriately sized and protected overflow spillways.

The duration of diverted flows of 40 cfs or 100 cfs could potentially have significant impacts on the stability of Turkey Creek given that the creek rarely sees flows of both 40 cfs and 100 cfs that are sustained for more than 2 or 3 days. However, based on the HEC-RAS modeling and the field assessment conducted for this project, it appears that the channel up to a point about 2.12 miles below the diversion point is capable of containing flows greater than 40 cfs for a sustained period. And based on the estimated bankfull flows (2-year flow) for cross sections in the HEC-RAS model, it is apparent that most of the channel up to about 4 miles below the diversion point is capable of carrying flows over 100 cfs. However, the data and channel morphology suggest that flows of 100 cfs should not be sustained for more than 5 days at a time without a recovery period sufficient to allow the banks to dewater and stabilize, sediment to be deposited, bars to reform, and bankline vegetation to recover. Therefore, it is recommended that the diverted flows be stopped for at least 7 days after the 5 days of continuous 100 cfs of flow. The final recommendation for this will be determined during final design.

Finally, it is recommended that a long-term monitoring plan be established by the LRNRD/TBNRD or in conjunction with local landowners to help identify and address any significant problems along the creek associated with the diversion of additional flows from the E-65 Canal into the creek.

1.4. References

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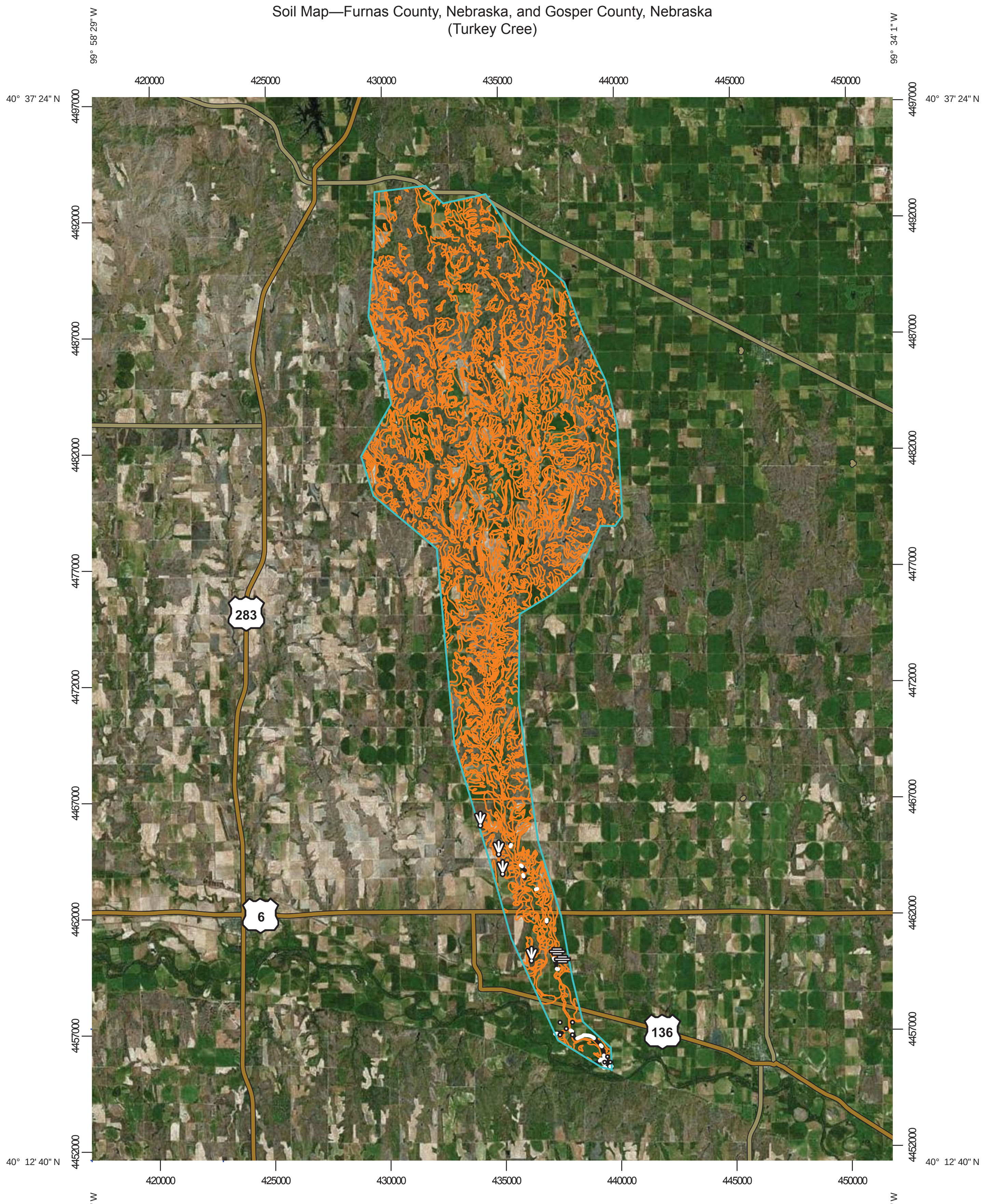
Appendix A: Soils Data

Soil Map—Furnas County, Nebraska, and Gosper County, Nebraska
(Turkey Cree)



Map Scale: 1:223,000 if printed on A portrait (8.5" x 11") sheet.

N

0 3000 6000 12000 18000 Meters

0 10000 20000 40000 60000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84

MAP LEGEND

Area of Interest (AOI)
Area of Interest (AOI)

Soils
Soil Map Unit Polygons
Soil Map Unit Lines
Soil Map Unit Points

Special Point Features
Blowout
Borrow Pit
Clay Spot
Closed Depression
Gravel Pit
Gravelly Spot
Landfill
Lava Flow
Marsh or swamp
Mine or Quarry
Miscellaneous Water
Perennial Water
Rock Outcrop
Saline Spot
Sandy Spot
Severely Eroded Spot
Sinkhole
Slide or Slip
Sodic Spot
Spoil Area
Stony Spot
Very Stony Spot
Wet Spot
Other
Special Line Features

Water Features
Streams and Canals

Transportation
Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background
Aerial Photography

MAP INFORM

The soil surveys that comprise your AO
1:20,000.

Please rely on the bar scale on each ma
measurements.

Source of Map: Natural Resources Co
Web Soil Survey URL:
Coordinate System: Web Mercator (E

Maps from the Web Soil Survey are bas
projection, which preserves direction an
distance and area. A projection that pre
Albers equal-area conic projection, shou
accurate calculations of distance or area

This product is generated from the USD
of the version date(s) listed below.

Soil Survey Area: Furnas County, Neb
Survey Area Data: Version 15, Sep 1,

Soil Survey Area: Gosper County, Neb
Survey Area Data: Version 15, Sep 2,

Your area of interest (AOI) includes mor
area. These survey areas may have bee
scales, with a different land use in mind
different levels of detail. This may result
properties, and interpretations that do n
across soil survey area boundaries.

Soil map units are labeled (as space all
1:50,000 or larger.

Date(s) aerial images were photographe
2003

The orthophoto or other base map on w
compiled and digitized probably differs f
imagery displayed on these maps. As a
shifting of map unit boundaries may be

Map Unit Legend

Furnas County, Nebraska (NE065)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
2347	McCook silt loam, rarely flooded	260.0	0.5%
2355	Inavale soils, occasionally flooded	186.3	0.4%
2360	Munjor fine sandy loam, rarely flooded	10.0	0.0%
2536	Coly silt loam, 30 to 60 percent slopes	21.0	0.0%
2538	Coly silt loam, 6 to 11 percent slopes, eroded	29.5	0.1%
2541	Coly silt loam, 11 to 17 percent slopes, eroded	72.2	0.1%
2548	Coly-Nuckolls silt loams, 11 to 17 percent slopes, eroded	37.3	0.1%
2549	Coly-Nuckolls silt loams, 11 to 30 percent slopes	104.3	0.2%
2557	Coly-Uly silt loams, 3 to 11 percent slopes, eroded	320.4	0.7%
2559	Coly-Uly silt loams, 11 to 30 percent slopes	633.1	1.3%
2673	Holdrege silt loam, 0 to 1 percent slopes, plains and breaks	302.2	0.6%
2674	Holdrege silt loam, 1 to 3 percent slopes, plains and breaks	451.0	0.9%
2675	Holdrege silt loam, 3 to 7 percent slopes, plains and breaks	45.5	0.1%
2676	Holdrege silt loam, 3 to 7 percent slopes, eroded, plains and breaks	161.4	0.3%
2819	Uly silt loam, 3 to 11 percent slopes	202.4	0.4%
3545	Hobbs silt loam, channeled, frequently flooded	397.7	0.8%
3562	Hobbs silt loam, occasionally flooded, cool	39.8	0.1%
3563	Hobbs-McCook silt loams, occasionally flooded	43.8	0.1%
3947	Fillmore silty clay loam, occasionally ponded	3.6	0.0%
4152	Holdrege-Coly silt loams, 3 to 7 percent slopes, eroded	3.8	0.0%

Furnas County, Nebraska (NE065)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
4156	Holdrege-Uly silt loams, 1 to 3 percent slopes	996.6	2.0%
6316	Barney soils, frequently flooded	77.9	0.2%
8470	Gibbon silt loam, occasionally flooded	78.2	0.2%
8593	Wann variant, fine sandy loam, occasionally flooded	35.2	0.1%
8815	Cozad silt loam, 0 to 1 percent slopes	593.7	1.2%
8816	Cozad silt loam, 1 to 3 percent slopes	125.1	0.3%
8817	Cozad silt loam, 3 to 6 percent slopes	51.1	0.1%
8840	Hall silt loam, 0 to 1 percent slopes	198.6	0.4%
8866	Hord silt loam, 0 to 1 percent slopes, warm	472.9	1.0%
8870	Hord silt loam, 1 to 3 percent slopes	14.9	0.0%
8872	Hord silt loam, 3 to 6 percent slopes	12.4	0.0%
9999	Water	13.0	0.0%
Subtotals for Soil Survey Area		**5,995.0**	**12.3%**
Totals for Area of Interest		**48,820.2**	**100.0%**

Gosper County, Nebraska (NE073)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
2538	Coly silt loam, 6 to 11 percent slopes, eroded	1,155.8	2.4%
2541	Coly silt loam, 11 to 17 percent slopes, eroded	1,792.4	3.7%
2559	Coly-Uly silt loams, 11 to 30 percent slopes	148.5	0.3%
2560	Coly-Uly-Hobbs silt loams, 3 to 60 percent slopes	11,151.5	22.8%
2667	Holdrege silt loam, 0 to 1 percent slopes	1,888.3	3.9%
2668	Holdrege silt loam, 1 to 3 percent slopes	826.9	1.7%
2673	Holdrege silt loam, 0 to 1 percent slopes, plains and breaks	244.0	0.5%
2674	Holdrege silt loam, 1 to 3 percent slopes, plains and breaks	4,222.1	8.6%

Gosper County, Nebraska (NE073)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
2675	Holdrege silt loam, 3 to 7 percent slopes, plains and breaks	350.5	0.7%
2820	Uly silt loam, 6 to 11 percent slopes	431.9	0.9%
2823	Uly silt loam, 11 to 17 percent slopes, eroded	2,774.1	5.7%
2830	Uly-Coly silt loams, 11 to 30 percent slopes	10,798.3	22.1%
3545	Hobbs silt loam, channeled, frequently flooded	650.4	1.3%
3562	Hobbs silt loam, occasionally flooded, cool	176.2	0.4%
3715	Cozad silt loam, rarely flooded	92.8	0.2%
3912	Scott silty clay loam, frequently ponded	12.3	0.0%
3952	Fillmore silt loam, frequently ponded	5.4	0.0%
3954	Fillmore silt loam, drained, frequently ponded	23.6	0.0%
4156	Holdrege-Uly silt loams, 1 to 3 percent slopes	1,055.0	2.2%
4157	Holdrege-Uly silt loams, 3 to 7 percent slopes, eroded	3,274.4	6.7%
8816	Cozad silt loam, 1 to 3 percent slopes	91.6	0.2%
8817	Cozad silt loam, 3 to 6 percent slopes	24.6	0.1%
8840	Hall silt loam, 0 to 1 percent slopes	956.5	2.0%
8866	Hord silt loam, 0 to 1 percent slopes, warm	335.5	0.7%
8870	Hord silt loam, 1 to 3 percent slopes	89.7	0.2%
8875	Hord silt loam, wet substratum, 0 to 1 percent slopes	45.3	0.1%
9999	Water	207.6	0.4%
Subtotals for Soil Survey Area		**42,825.3**	**87.7%**
Totals for Area of Interest		**48,820.2**	**100.0%**

RUSLE2 Related Attributes

This report summarizes those soil attributes used by the Revised Universal Soil Loss Equation Version 2 (RUSLE2) for the map units in the selected area. The report includes the map unit symbol, the component name, and the percent of the component in the map unit. Soil property data for each map unit component include the hydrologic soil group, erosion factors Kf for the surface horizon, erosion factor T, and the representative percentage of sand, silt, and clay in the mineral surface horizon. Missing surface data may indicate the presence of an organic surface layer. .

Report—RUSLE2 Related Attributes

Soil properties and interpretations for erosion runoff calculations. The surface mineral horizon properties are displayed. Organic surface horizons are not displayed.

RUSLE2 Related Attributes–Furnas County, Nebraska								
Map symbol and soil name	Pct. of map unit	Slope length (ft)	Hydrologic group	Kf	T factor	Representative value		
						% Sand	% Silt	% Clay
2347—McCook silt loam, rarely flooded								
McCook, rarely flooded	90	197	B	.37	5	18.0	67.0	15.0
2355—Inavale soils, occasionally flooded								
Inavale	99	249	A	.15	5	87.3	6.7	6.0
2360—Munjor fine sandy loam, rarely flooded								
Munjor	99	249	A	.20	4	66.5	20.0	13.5
2536—Coly silt loam, 30 to 60 percent slopes								
Coly	99	39	B	.43	5	11.3	67.7	21.0
2538—Coly silt loam, 6 to 11 percent slopes, eroded								
Coly	100	200	B	.43	5	11.3	67.7	21.0
2541—Coly silt loam, 11 to 17 percent slopes, eroded								
Coly	100	151	B	.43	5	11.3	67.7	21.0
2548—Coly-Nuckolls silt loams, 11 to 17 percent slopes, eroded								
Coly	70	151	B	.43	5	11.3	67.7	21.0
Nuckolls	29	151	C	.37	5	9.4	67.1	23.5

RUSLE2 Related Attributes–Furnas County, Nebraska								
Map symbol and soil name	Pct. of map unit	Slope length (ft)	Hydrologic group	Kf	T factor	Representative value		
						% Sand	% Silt	% Clay
2549—Coly-Nuckolls silt loams, 11 to 30 percent slopes								
Coly	55	79	B	.43	5	11.3	67.7	21.0
Nuckolls	44	79	C	.37	5	9.4	67.1	23.5
2557—Coly-Uly silt loams, 3 to 11 percent slopes, eroded								
Coly	60	141	B	.43	5	14.0	64.0	22.0
Uly	35	141	B	.43	5	14.0	64.0	22.0
2559—Coly-Uly silt loams, 11 to 30 percent slopes								
Coly	45	49	B	.43	5	14.0	64.0	22.0
Uly	40	98	B	.37	5	14.0	64.0	22.0
2673—Holdrege silt loam, 0 to 1 percent slopes, plains and breaks								
Holdrege	96	197	C	.49	5	11.0	67.0	22.0
2674—Holdrege silt loam, 1 to 3 percent slopes, plains and breaks								
Holdrege	94	298	C	.49	5	11.0	67.0	22.0
2675—Holdrege silt loam, 3 to 7 percent slopes, plains and breaks								
Holdrege	94	161	C	.49	5	11.0	67.0	22.0
2676—Holdrege silt loam, 3 to 7 percent slopes, eroded, plains and breaks								
Holdrege, eroded	94	161	C	.43	5	10.0	66.0	24.0
2819—Uly silt loam, 3 to 11 percent slopes								
Uly	85	151	B	.37	5	14.0	64.0	22.0
3545—Hobbs silt loam, channeled, frequently flooded								
Hobbs, channeled, frequently flooded	99	249	B	.37	5	11.3	67.7	21.0
3562—Hobbs silt loam, occasionally flooded, cool								
Hobbs, occasionally flooded, cool	85	197	B	.32	5	11.0	63.0	26.0

RUSLE2 Related Attributes–Furnas County, Nebraska								
Map symbol and soil name	Pct. of map unit	Slope length (ft)	Hydrologic group	Kf	T factor	Representative value		
						% Sand	% Silt	% Clay
3563—Hobbs-McCook silt loams, occasionally flooded								
Hobbs	65	249	B	.37	5	11.3	67.7	21.0
McCook	34	249	B	.37	5	11.3	67.7	21.0
3947—Fillmore silty clay loam, occasionally ponded								
Fillmore	99	249	D	.37	5	20.0	49.0	31.0
4152—Holdrege-Coly silt loams, 3 to 7 percent slopes, eroded								
Holdrege	55	249	C	.37	5	9.4	67.1	23.5
Coly	45	249	B	.43	5	11.3	67.7	21.0
4156—Holdrege-Uly silt loams, 1 to 3 percent slopes								
Holdrege	50	249	C	.37	5	9.4	67.1	23.5
Uly	48	249	B	.37	5	11.2	66.8	22.0
6316—Barney soils, frequently flooded								
Barney	100	249	C/D	.37	2	19.9	52.6	27.5
8470—Gibbon silt loam, occasionally flooded								
Gibbon	99	249	C	.32	5	9.5	68.0	22.5
8593—Wann variant, fine sandy loam, occasionally flooded								
Wann variant	99	249	B	.24	5	63.5	26.5	10.0
8815—Cozad silt loam, 0 to 1 percent slopes								
Cozad	99	249	B	.43	5	11.8	70.2	18.0
8816—Cozad silt loam, 1 to 3 percent slopes								
Cozad	100	249	B	.43	5	11.8	70.2	18.0
8817—Cozad silt loam, 3 to 6 percent slopes								
Cozad	85	180	B	.43	5	27.0	53.0	20.0
8840—Hall silt loam, 0 to 1 percent slopes								
Hall	98	249	C	.37	5	11.3	67.7	21.0
8866—Hord silt loam, 0 to 1 percent slopes, warm								
Hord	85	200	B	.37	5	22.0	58.0	20.0

RUSLE2 Related Attributes–Furnas County, Nebraska								
Map symbol and soil name	Pct. of map unit	Slope length (ft)	Hydrologic group	Kf	T factor	Representative value		
						% Sand	% Silt	% Clay
8870—Hord silt loam, 1 to 3 percent slopes								
Hord	85	298	B	.37	5	22.0	58.0	20.0
8872—Hord silt loam, 3 to 6 percent slopes								
Hord	100	249	B	.32	5	11.2	66.8	22.0

RUSLE2 Related Attributes–Gosper County, Nebraska								
Map symbol and soil name	Pct. of map unit	Slope length (ft)	Hydrologic group	Kf	T factor	Representative value		
						% Sand	% Silt	% Clay
2538—Coly silt loam, 6 to 11 percent slopes, eroded								
Coly	100	200	B	.43	5	11.3	67.7	21.0
2541—Coly silt loam, 11 to 17 percent slopes, eroded								
Coly	100	125	B	.43	5	11.3	67.7	21.0
2559—Coly-Uly silt loams, 11 to 30 percent slopes								
Coly	45	49	B	.43	5	14.0	64.0	22.0
Uly	40	98	B	.37	5	14.0	64.0	22.0
2560—Coly-Uly-Hobbs silt loams, 3 to 60 percent slopes								
Coly	60	39	B	.43	5	11.3	67.7	21.0
Uly	25	125	B	.37	5	17.0	59.0	24.0
Hobbs, frequently flooded	15	249	B	.37	5	11.3	67.7	21.0
2667—Holdrege silt loam, 0 to 1 percent slopes								
Holdrege	90	200	C	.49	5	11.0	67.0	22.0
2668—Holdrege silt loam, 1 to 3 percent slopes								
Holdrege	90	298	C	.49	5	11.0	67.0	22.0
2673—Holdrege silt loam, 0 to 1 percent slopes, plains and breaks								
Holdrege	96	197	C	.49	5	11.0	67.0	22.0
2674—Holdrege silt loam, 1 to 3 percent slopes, plains and breaks								
Holdrege	94	298	C	.49	5	11.0	67.0	22.0

RUSLE2 Related Attributes–Gosper County, Nebraska								
Map symbol and soil name	Pct. of map unit	Slope length (ft)	Hydrologic group	Kf	T factor	Representative value		
						% Sand	% Silt	% Clay
2675—Holdrege silt loam, 3 to 7 percent slopes, plains and breaks								
Holdrege	94	161	C	.49	5	11.0	67.0	22.0
2820—Uly silt loam, 6 to 11 percent slopes								
Uly	85	131	B	.37	5	14.0	64.0	22.0
2823—Uly silt loam, 11 to 17 percent slopes, eroded								
Uly, eroded	85	89	B	.37	5	24.0	51.0	25.0
2830—Uly-Coly silt loams, 11 to 30 percent slopes								
Uly	52	98	B	.37	5	14.0	64.0	22.0
Coly	40	49	B	.43	5	14.0	64.0	22.0
3545—Hobbs silt loam, channeled, frequently flooded								
Hobbs, channeled, frequently flooded	99	249	B	.37	5	11.3	67.7	21.0
3562—Hobbs silt loam, occasionally flooded, cool								
Hobbs, occasionally flooded, cool	85	197	B	.32	5	11.0	63.0	26.0
3715—Cozad silt loam, rarely flooded								
Cozad	100	249	B	.43	5	11.8	70.2	18.0
3912—Scott silty clay loam, frequently ponded								
Scott, frequently ponded	100	249	D	.37	5	20.0	49.0	31.0
3952—Fillmore silt loam, frequently ponded								
Fillmore, frequently ponded	85	249	D	.37	3	8.0	69.0	23.0
3954—Fillmore silt loam, drained, frequently ponded								
Fillmore, drained	98	249	D	.37	3	24.8	52.7	22.5
4156—Holdrege-Uly silt loams, 1 to 3 percent slopes								
Holdrege	50	249	C	.37	5	9.4	67.1	23.5
Uly	48	249	B	.37	5	11.2	66.8	22.0

RUSLE2 Related Attributes–Gosper County, Nebraska								
Map symbol and soil name	Pct. of map unit	Slope length (ft)	Hydrologic group	Kf	T factor	Representative value		
						% Sand	% Silt	% Clay
4157—Holdrege-Uly silt loams, 3 to 7 percent slopes, eroded								
Holdrege	60	249	C	.37	5	9.4	67.1	23.5
Uly	40	249	B	.37	5	11.2	66.8	22.0
8816—Cozad silt loam, 1 to 3 percent slopes								
Cozad	100	249	B	.43	5	11.8	70.2	18.0
8817—Cozad silt loam, 3 to 6 percent slopes								
Cozad	85	180	B	.43	5	27.0	53.0	20.0
8840—Hall silt loam, 0 to 1 percent slopes								
Hall	98	249	C	.37	5	11.3	67.7	21.0
8866—Hord silt loam, 0 to 1 percent slopes, warm								
Hord	85	200	B	.37	5	22.0	58.0	20.0
8870—Hord silt loam, 1 to 3 percent slopes								
Hord	85	298	B	.37	5	22.0	58.0	20.0
8875—Hord silt loam, wet substratum, 0 to 1 percent slopes								
Hord	99	249	C	.37	5	11.3	67.7	21.0

Data Source Information

Soil Survey Area: Furnas County, Nebraska
Survey Area Data: Version 15, Sep 1, 2016

Soil Survey Area: Gosper County, Nebraska
Survey Area Data: Version 15, Sep 2, 2016

Appendix B: Georeferenced Field Photos
Field Notes

Turkey Creek Field Pics

Overview Map

GeoJot+ 2016-08-29 14_42_24.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 14_42_24.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 00.52"
Longitude	W 99° 42' 50.47"
Time Stamp	2:42:25 PM
Date Stamp	8/29/2016
Elevation	2106 ft
Photo Direction	325° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 14_43_25.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 14_43_25.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 00.37"
Longitude	W 99° 42' 50.25"
Time Stamp	2:43:25 PM
Date Stamp	8/29/2016
Elevation	2067 ft
Photo Direction	151° SSE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 14_43_58.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 14_43_58.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 00.64"
Longitude	W 99° 42' 50.32"
Time Stamp	2:43:59 PM
Date Stamp	8/29/2016
Elevation	2011 ft
Photo Direction	287° WNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 14_45_16.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 14_45_16.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 00.07"
Longitude	W 99° 42' 49.82"
Time Stamp	2:45:16 PM
Date Stamp	8/29/2016
Elevation	2001 ft
Photo Direction	315° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 14_46_04.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 14_46_04.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 00.06"
Longitude	W 99° 42' 49.82"
Time Stamp	2:46:04 PM
Date Stamp	8/29/2016
Elevation	2001 ft
Photo Direction	216° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 14_46_22.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 14_46_22.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 14' 59.83"
Longitude	W 99° 42' 49.85"
Time Stamp	2:46:23 PM
Date Stamp	8/29/2016
Elevation	1988 ft
Photo Direction	260° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_16_44.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_16_44.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 16.08"
Longitude	W 99° 44' 02.81"
Time Stamp	3:16:44 PM
Date Stamp	8/29/2016
Elevation	2037 ft
Photo Direction	16° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_17_16.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_17_16.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 15.80"
Longitude	W 99° 44' 02.73"
Time Stamp	3:17:17 PM
Date Stamp	8/29/2016
Elevation	2034 ft
Photo Direction	186° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_17_27.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_17_27.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 15.79"
Longitude	W 99° 44' 02.94"
Time Stamp	3:17:27 PM
Date Stamp	8/29/2016
Elevation	2024 ft
Photo Direction	117° ESE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_18_21.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_18_21.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 15.58"
Longitude	W 99° 44' 02.47"
Time Stamp	3:18:21 PM
Date Stamp	8/29/2016
Elevation	2041 ft
Photo Direction	293° WNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_19_22.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_19_22.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 15.88"
Longitude	W 99° 44' 02.49"
Time Stamp	3:19:22 PM
Date Stamp	8/29/2016
Elevation	2018 ft
Photo Direction	12° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_19_36.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_19_36.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 15.89"
Longitude	W 99° 44' 02.49"
Time Stamp	3:19:37 PM
Date Stamp	8/29/2016
Elevation	2018 ft
Photo Direction	182° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_33_30.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_33_30.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 40.15"
Longitude	W 99° 44' 02.48"
Time Stamp	3:33:31 PM
Date Stamp	8/29/2016
Elevation	2051 ft
Photo Direction	135° SE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_33_54.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_33_54.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 40.45"
Longitude	W 99° 44' 02.79"
Time Stamp	3:33:54 PM
Date Stamp	8/29/2016
Elevation	2047 ft
Photo Direction	310° NW
Make	samsung
Model	SM-P607T

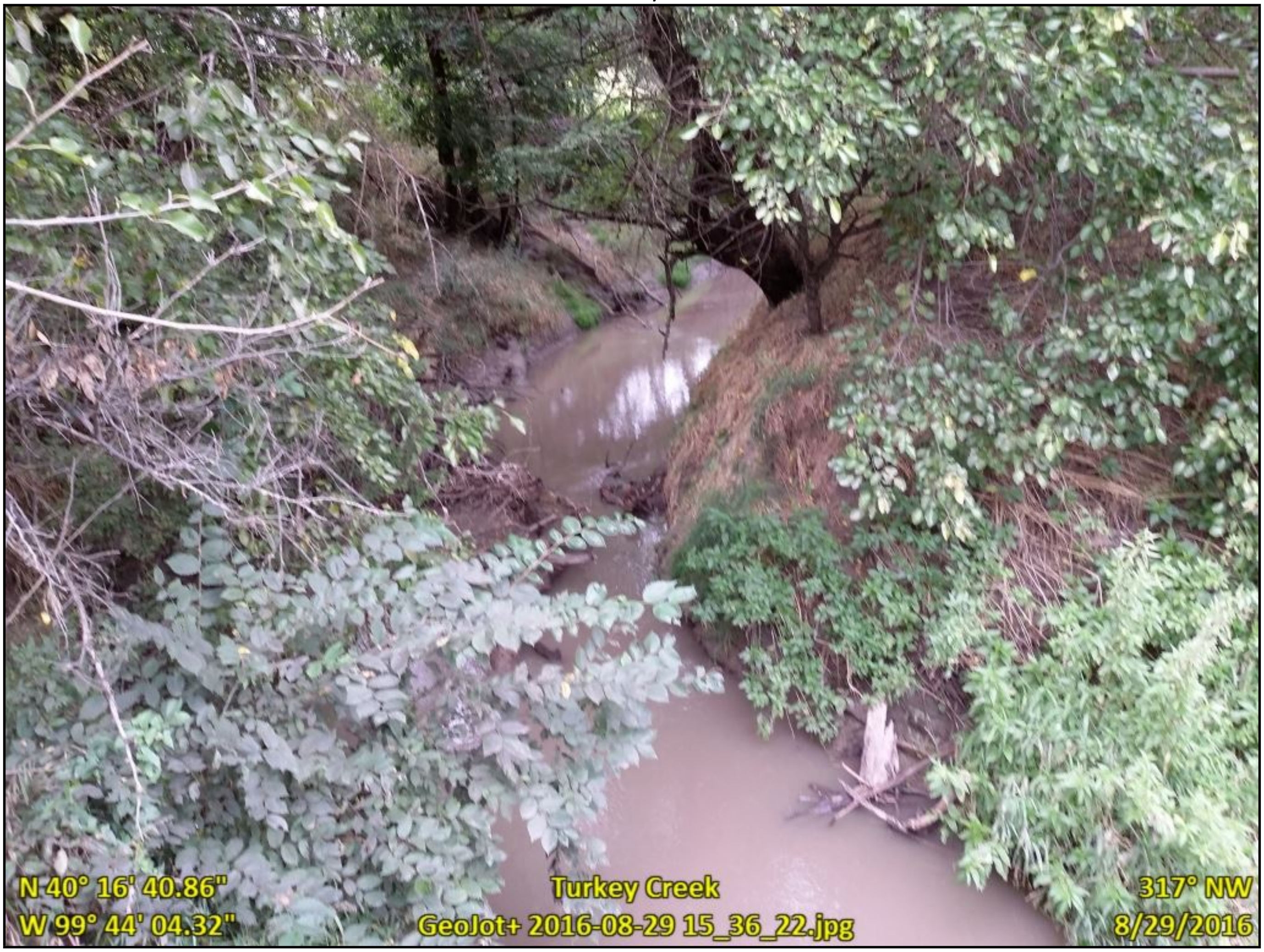
GeoJot+ 2016-08-29 15_35_24.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_35_24.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 40.66"
Longitude	W 99° 44' 03.69"
Time Stamp	3:35:24 PM
Date Stamp	8/29/2016
Elevation	2037 ft
Photo Direction	106° ESE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_36_22.jpg

Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-29 15_36_22.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 40.86"
Longitude	W 99° 44' 04.32"
Time Stamp	3:36:23 PM
Date Stamp	8/29/2016
Elevation	2034 ft
Photo Direction	317° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_36_42.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_36_42.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 40.87"
Longitude	W 99° 44' 04.32"
Time Stamp	3:36:43 PM
Date Stamp	8/29/2016
Elevation	2034 ft
Photo Direction	59° ENE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_38_03.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_38_03.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 40.75"
Longitude	W 99° 44' 03.43"
Time Stamp	3:38:03 PM
Date Stamp	8/29/2016
Elevation	2028 ft
Photo Direction	123° ESE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_38_18.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_38_18.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 39.93"
Longitude	W 99° 44' 03.30"
Time Stamp	3:38:19 PM
Date Stamp	8/29/2016
Elevation	2031 ft
Photo Direction	71° ENE
Make	samsung
Model	SM-P607T

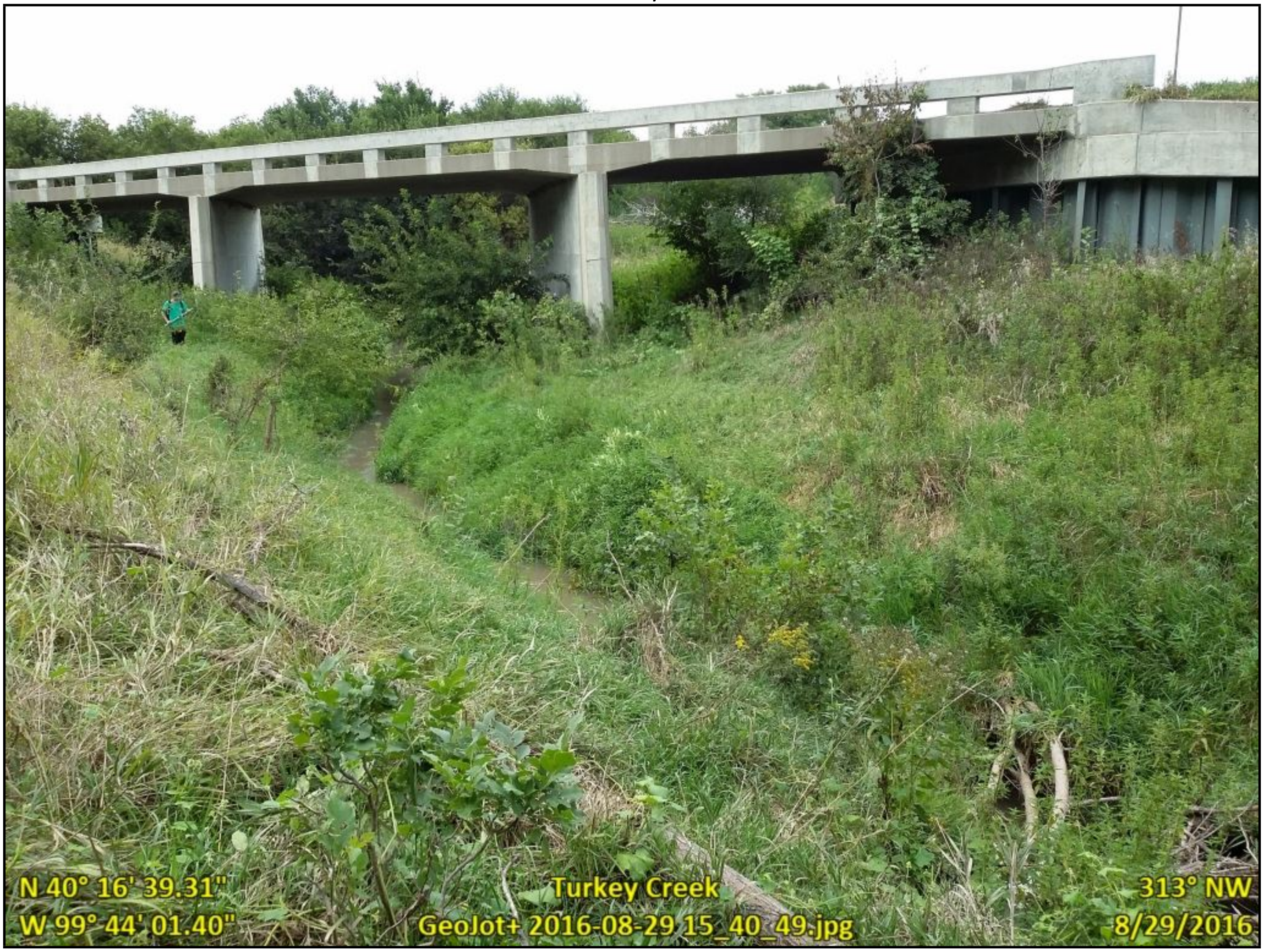
GeoJot+ 2016-08-29 15_39_46.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_39_46.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 39.89"
Longitude	W 99° 44' 03.30"
Time Stamp	3:39:47 PM
Date Stamp	8/29/2016
Elevation	2031 ft
Photo Direction	74° ENE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_40_49.jpg

Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-29 15_40_49.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 39.31"
Longitude	W 99° 44' 01.40"
Time Stamp	3:40:50 PM
Date Stamp	8/29/2016
Elevation	2028 ft
Photo Direction	313° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_41_12.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_41_12.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 39.03"
Longitude	W 99° 44' 01.56"
Time Stamp	3:41:12 PM
Date Stamp	8/29/2016
Elevation	2031 ft
Photo Direction	264° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_41_52.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_41_52.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 39.15"
Longitude	W 99° 44' 01.61"
Time Stamp	3:41:53 PM
Date Stamp	8/29/2016
Elevation	2037 ft
Photo Direction	206° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_42_08.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_42_08.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 38.59"
Longitude	W 99° 44' 01.56"
Time Stamp	3:42:09 PM
Date Stamp	8/29/2016
Elevation	2041 ft
Photo Direction	220° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_42_22.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_42_22.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 16' 38.98"
Longitude	W 99° 44' 01.47"
Time Stamp	3:42:23 PM
Date Stamp	8/29/2016
Elevation	2041 ft
Photo Direction	340° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_58_12.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_58_12.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 48.60"
Longitude	W 99° 43' 52.10"
Time Stamp	3:58:12 PM
Date Stamp	8/29/2016
Elevation	2105 ft
Photo Direction	179° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 15_59_34.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 15_59_34.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 48.72"
Longitude	W 99° 43' 52.81"
Time Stamp	3:59:34 PM
Date Stamp	8/29/2016
Elevation	2094 ft
Photo Direction	9° N
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 16_00_56.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 16_00_56.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 48.61"
Longitude	W 99° 43' 52.86"
Time Stamp	4:00:57 PM
Date Stamp	8/29/2016
Elevation	2091 ft
Photo Direction	170° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 16_01_55.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 16_01_55.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 48.92"
Longitude	W 99° 43' 52.89"
Time Stamp	4:01:56 PM
Date Stamp	8/29/2016
Elevation	2087 ft
Photo Direction	174° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 16_02_38.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 16_02_38.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 49.26"
Longitude	W 99° 43' 52.90"
Time Stamp	4:02:38 PM
Date Stamp	8/29/2016
Elevation	2091 ft
Photo Direction	346° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 16_03_04.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 16_03_04.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 49.62"
Longitude	W 99° 43' 52.89"
Time Stamp	4:03:04 PM
Date Stamp	8/29/2016
Elevation	2089 ft
Photo Direction	173° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-29 16_04_18.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-29 16_04_18.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 48.47"
Longitude	W 99° 43' 52.17"
Time Stamp	4:04:19 PM
Date Stamp	8/29/2016
Elevation	2103 ft
Photo Direction	271° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 07_53_07.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 07_53_07.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 17' 33.69"
Longitude	W 99° 44' 25.99"
Time Stamp	7:53:08 AM
Date Stamp	8/30/2016
Elevation	2120 ft
Photo Direction	182° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 07_53_26.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 07_53_26.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 17' 33.74"
Longitude	W 99° 44' 26.02"
Time Stamp	7:53:26 AM
Date Stamp	8/30/2016
Elevation	2118 ft
Photo Direction	14° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 07_53_57.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 07_53_57.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 17' 33.77"
Longitude	W 99° 44' 25.67"
Time Stamp	7:53:57 AM
Date Stamp	8/30/2016
Elevation	2115 ft
Photo Direction	345° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 07_54_46.jpg

Title:

Attributes	
File Name	GeoJot+ 2016-08-30 07_54_46.jpg
Title	
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 17' 33.77"
Longitude	W 99° 44' 26.27"
Time Stamp	7:54:46 AM
Date Stamp	8/30/2016
Elevation	2115 ft
Photo Direction	95° E
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_09_09.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_09_09.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 17' 51.95"
Longitude	W 99° 44' 34.04"
Time Stamp	8:09:10 AM
Date Stamp	8/30/2016
Elevation	2087 ft
Photo Direction	73° ENE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_09_20.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_09_20.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 17' 51.99"
Longitude	W 99° 44' 34.03"
Time Stamp	8:09:21 AM
Date Stamp	8/30/2016
Elevation	2087 ft
Photo Direction	7° N
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_14_00.jpg
Title: Turkey Creek

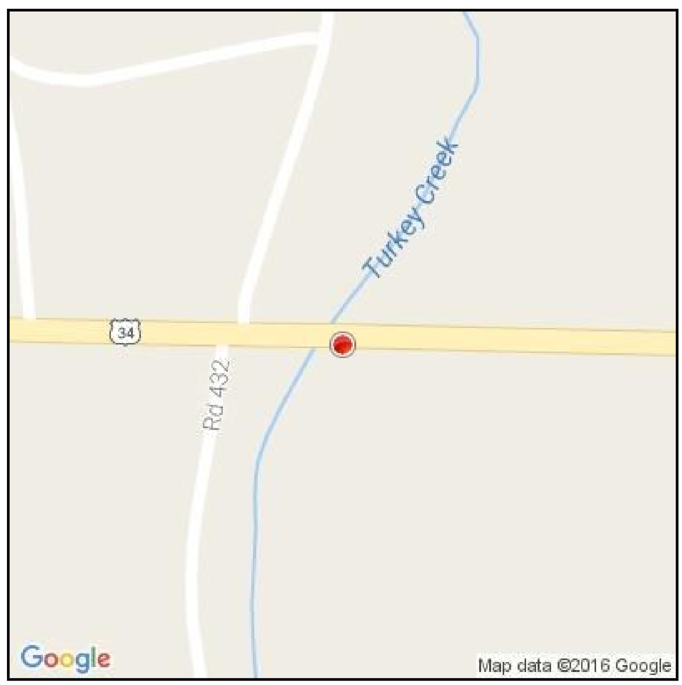
Attributes	
File Name	GeoJot+ 2016-08-30 08_14_00.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 26.72"
Longitude	W 99° 44' 34.65"
Time Stamp	8:14:00 AM
Date Stamp	8/30/2016
Elevation	2087 ft
Photo Direction	110° ESE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_16_32.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_16_32.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 25.41"
Longitude	W 99° 44' 32.43"
Time Stamp	8:16:33 AM
Date Stamp	8/30/2016
Elevation	2100 ft
Photo Direction	225° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_16_51.jpg

Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-30 08_16_51.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 25.46"
Longitude	W 99° 44' 32.57"
Time Stamp	8:16:52 AM
Date Stamp	8/30/2016
Elevation	2096 ft
Photo Direction	192° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_19_00.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_19_00.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 26.21"
Longitude	W 99° 44' 32.70"
Time Stamp	8:19:01 AM
Date Stamp	8/30/2016
Elevation	2064 ft
Photo Direction	134° SE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_19_22.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_19_22.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 26.01"
Longitude	W 99° 44' 32.24"
Time Stamp	8:19:22 AM
Date Stamp	8/30/2016
Elevation	2067 ft
Photo Direction	187° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_20_17.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_20_17.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 26.43"
Longitude	W 99° 44' 31.72"
Time Stamp	8:20:17 AM
Date Stamp	8/30/2016
Elevation	2064 ft
Photo Direction	47° NE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_20_57.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_20_57.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 27.10"
Longitude	W 99° 44' 31.16"
Time Stamp	8:20:57 AM
Date Stamp	8/30/2016
Elevation	2064 ft
Photo Direction	15° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_21_10.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_21_10.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 27.09"
Longitude	W 99° 44' 31.17"
Time Stamp	8:21:10 AM
Date Stamp	8/30/2016
Elevation	2070 ft
Photo Direction	0° N
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_21_40.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_21_40.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 27.64"
Longitude	W 99° 44' 31.04"
Time Stamp	8:21:41 AM
Date Stamp	8/30/2016
Elevation	2057 ft
Photo Direction	50° NE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_22_03.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_22_03.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 27.47"
Longitude	W 99° 44' 31.03"
Time Stamp	8:22:04 AM
Date Stamp	8/30/2016
Elevation	2054 ft
Photo Direction	213° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_40_51.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_40_51.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 33.95"
Longitude	W 99° 44' 32.83"
Time Stamp	8:40:52 AM
Date Stamp	8/30/2016
Elevation	2070 ft
Photo Direction	305° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_41_12.jpg

Title: Turkey Creek

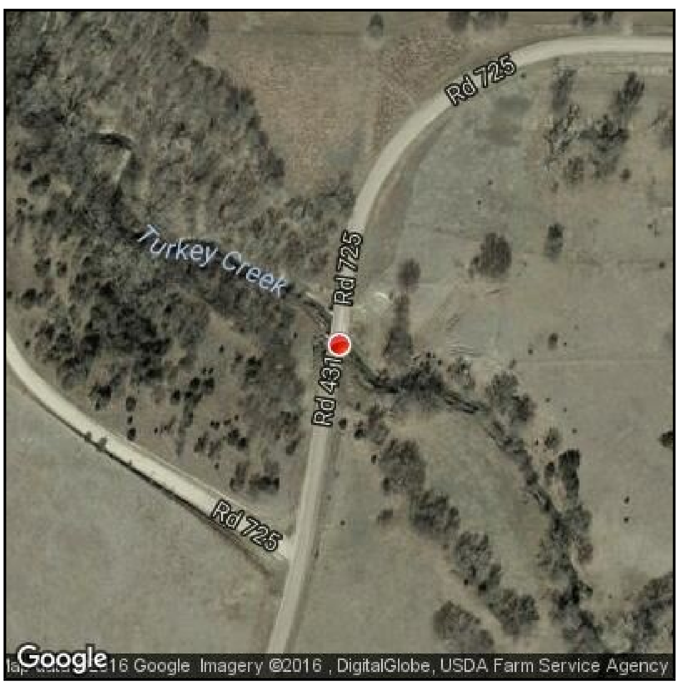
Attributes	
File Name	GeoJot+ 2016-08-30 08_41_12.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 33.97"
Longitude	W 99° 44' 32.73"
Time Stamp	8:41:13 AM
Date Stamp	8/30/2016
Elevation	2073 ft
Photo Direction	118° ESE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 08_41_42.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 08_41_42.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 18' 33.57"
Longitude	W 99° 44' 32.68"
Time Stamp	8:41:43 AM
Date Stamp	8/30/2016
Elevation	2060 ft
Photo Direction	15° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_01_10.jpg
Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-30 09_01_10.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 20' 05.80"
Longitude	W 99° 45' 42.49"
Time Stamp	9:01:10 AM
Date Stamp	8/30/2016
Elevation	2093 ft
Photo Direction	138° SE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_01_39.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_01_39.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 20' 06.21"
Longitude	W 99° 45' 42.74"
Time Stamp	9:01:39 AM
Date Stamp	8/30/2016
Elevation	2096 ft
Photo Direction	326° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_01_59.jpg

Title:

Attributes	
File Name	GeoJot+ 2016-08-30 09_01_59.jpg
Title	
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 20' 06.35"
Longitude	W 99° 45' 42.71"
Time Stamp	9:01:59 AM
Date Stamp	8/30/2016
Elevation	2096 ft
Photo Direction	301° WNW
Make	samsung
Model	SM-P607T

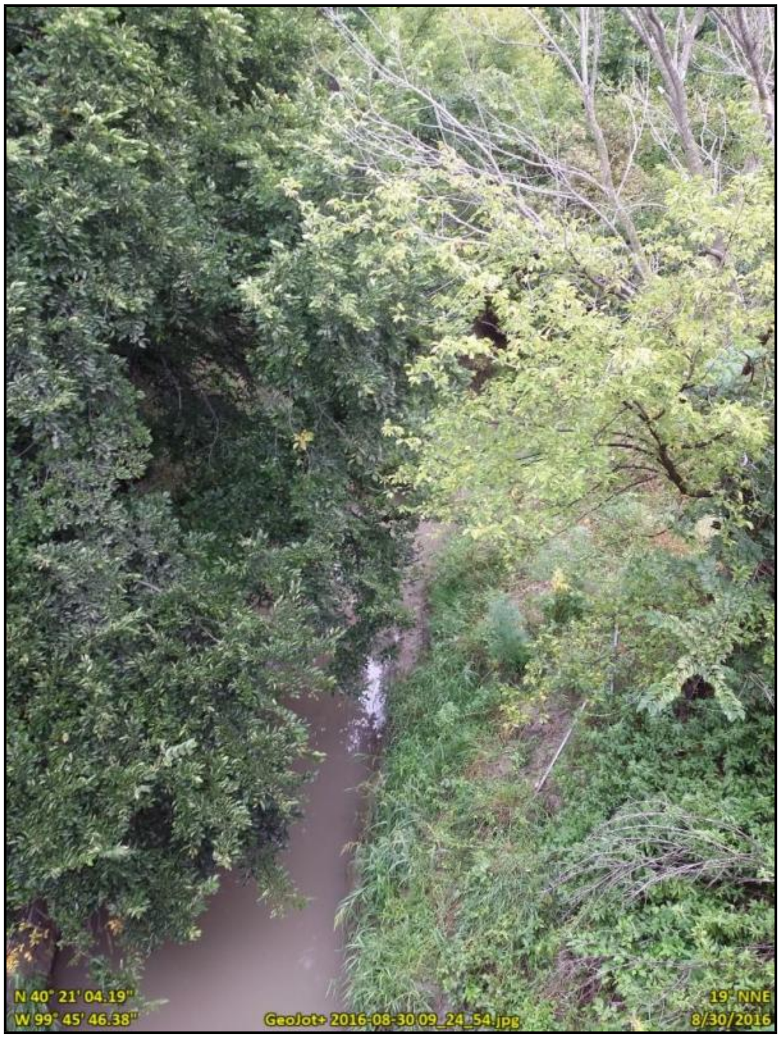
GeoJot+ 2016-08-30 09_03_02.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_03_02.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 20' 06.89"
Longitude	W 99° 45' 42.95"
Time Stamp	9:03:03 AM
Date Stamp	8/30/2016
Elevation	2093 ft
Photo Direction	160° SSE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_24_54.jpg

Title:



Attributes	
File Name	GeoJot+ 2016-08-30 09_24_54.jpg
Title	
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 04.19"
Longitude	W 99° 45' 46.38"
Time Stamp	9:24:55 AM
Date Stamp	8/30/2016
Elevation	2123 ft
Photo Direction	19° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_25_33.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_25_33.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 03.91"
Longitude	W 99° 45' 46.20"
Time Stamp	9:25:33 AM
Date Stamp	8/30/2016
Elevation	2126 ft
Photo Direction	187° S
Make	samsung
Model	SM-P607T


N 40° 21' 03.85"
W 99° 45' 45.59"
Turkey Creek
GeoJot+ 2016-08-30 09_26_18.jpg
269° W
8/30/2016


Turkey Creek
Rd 276
Rd 726
Google
Imagery ©2016 , DigitalGlobe, USDA Farm Service Agency


Turkey Creek
Rd 276
Rd 726
Google
Map data ©2016 Google

Attributes	
File Name	GeoJot+ 2016-08-30 09_26_18.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 03.85"
Longitude	W 99° 45' 45.59"
Time Stamp	9:26:19 AM
Date Stamp	8/30/2016
Elevation	2116 ft
Photo Direction	269° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_27_03.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_27_03.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 03.56"
Longitude	W 99° 45' 45.53"
Time Stamp	9:27:04 AM
Date Stamp	8/30/2016
Elevation	2110 ft
Photo Direction	226° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_27_37.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_27_37.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 03.24"
Longitude	W 99° 45' 45.86"
Time Stamp	9:27:37 AM
Date Stamp	8/30/2016
Elevation	2110 ft
Photo Direction	211° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_28_34.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_28_34.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 02.57"
Longitude	W 99° 45' 46.08"
Time Stamp	9:28:34 AM
Date Stamp	8/30/2016
Elevation	2110 ft
Photo Direction	356° N
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_31_41.jpg

Title:

Attributes	
File Name	GeoJot+ 2016-08-30 09_31_41.jpg
Title	
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 03.60"
Longitude	W 99° 45' 46.01"
Time Stamp	9:31:41 AM
Date Stamp	8/30/2016
Elevation	2106 ft
Photo Direction	276° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_32_52.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_32_52.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 04.36"
Longitude	W 99° 45' 45.86"
Time Stamp	9:32:53 AM
Date Stamp	8/30/2016
Elevation	2106 ft
Photo Direction	242° WSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_43_33.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_43_33.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 03.88"
Longitude	W 99° 45' 46.95"
Time Stamp	9:43:34 AM
Date Stamp	8/30/2016
Elevation	2123 ft
Photo Direction	146° SE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_54_26.jpg

Title:

Attributes	
File Name	GeoJot+ 2016-08-30 09_54_26.jpg
Title	
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 56.18"
Longitude	W 99° 46' 08.78"
Time Stamp	9:54:26 AM
Date Stamp	8/30/2016
Elevation	2136 ft
Photo Direction	352° N
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_54_49.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_54_49.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 56.18"
Longitude	W 99° 46' 08.82"
Time Stamp	9:54:49 AM
Date Stamp	8/30/2016
Elevation	2136 ft
Photo Direction	175° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 09_55_58.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 09_55_58.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 21' 56.01"
Longitude	W 99° 46' 09.30"
Time Stamp	9:55:58 AM
Date Stamp	8/30/2016
Elevation	2126 ft
Photo Direction	70° ENE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 10_15_56.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 10_15_56.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 22' 48.02"
Longitude	W 99° 46' 21.50"
Time Stamp	10:15:56 AM
Date Stamp	8/30/2016
Elevation	2129 ft
Photo Direction	220° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 10_16_17.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 10_16_17.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 22' 48.29"
Longitude	W 99° 46' 21.60"
Time Stamp	10:16:17 AM
Date Stamp	8/30/2016
Elevation	2136 ft
Photo Direction	12° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 10_23_12.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 10_23_12.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 22' 47.99"
Longitude	W 99° 46' 21.10"
Time Stamp	10:23:13 AM
Date Stamp	8/30/2016
Elevation	2142 ft
Photo Direction	287° WNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 10_24_28.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 10_24_28.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 22' 48.37"
Longitude	W 99° 46' 21.29"
Time Stamp	10:24:28 AM
Date Stamp	8/30/2016
Elevation	2142 ft
Photo Direction	270° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 10_46_15.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 10_46_15.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 23' 39.42"
Longitude	W 99° 46' 19.44"
Time Stamp	10:46:16 AM
Date Stamp	8/30/2016
Elevation	2149 ft
Photo Direction	44° NE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 10_46_29.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 10_46_29.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 23' 39.45"
Longitude	W 99° 46' 19.45"
Time Stamp	10:46:30 AM
Date Stamp	8/30/2016
Elevation	2149 ft
Photo Direction	304° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 11_16_01.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 11_16_01.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 24' 33.61"
Longitude	W 99° 46' 06.87"
Time Stamp	11:16:01 AM
Date Stamp	8/30/2016
Elevation	2159 ft
Photo Direction	26° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 11_16_22.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 11_16_22.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 24' 33.51"
Longitude	W 99° 46' 06.73"
Time Stamp	11:16:22 AM
Date Stamp	8/30/2016
Elevation	2159 ft
Photo Direction	187° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 11_17_01.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 11_17_01.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 24' 33.33"
Longitude	W 99° 46' 06.32"
Time Stamp	11:17:02 AM
Date Stamp	8/30/2016
Elevation	2162 ft
Photo Direction	273° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 11_30_52.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 11_30_52.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 25' 24.34"
Longitude	W 99° 46' 23.41"
Time Stamp	11:30:53 AM
Date Stamp	8/30/2016
Elevation	2195 ft
Photo Direction	167° SSE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 11_31_17.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 11_31_17.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 25' 24.67"
Longitude	W 99° 46' 23.50"
Time Stamp	11:31:18 AM
Date Stamp	8/30/2016
Elevation	2201 ft
Photo Direction	21° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 11_31_55.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 11_31_55.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 25' 24.61"
Longitude	W 99° 46' 23.49"
Time Stamp	11:31:56 AM
Date Stamp	8/30/2016
Elevation	2205 ft
Photo Direction	49° NE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 11_33_23.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 11_33_23.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 25' 23.89"
Longitude	W 99° 46' 23.90"
Time Stamp	11:33:23 AM
Date Stamp	8/30/2016
Elevation	2205 ft
Photo Direction	34° NE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 11_34_30.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 11_34_30.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 25' 24.17"
Longitude	W 99° 46' 23.58"
Time Stamp	11:34:30 AM
Date Stamp	8/30/2016
Elevation	2198 ft
Photo Direction	132° SE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 11_34_43.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 11_34_43.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 25' 24.13"
Longitude	W 99° 46' 23.56"
Time Stamp	11:34:43 AM
Date Stamp	8/30/2016
Elevation	2188 ft
Photo Direction	17° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 12_07_59.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 12_07_59.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 26' 38.21"
Longitude	W 99° 45' 18.81"
Time Stamp	12:07:59 PM
Date Stamp	8/30/2016
Elevation	2205 ft
Photo Direction	138° SE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 12_08_57.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 12_08_57.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 26' 38.01"
Longitude	W 99° 45' 18.64"
Time Stamp	12:08:58 PM
Date Stamp	8/30/2016
Elevation	2205 ft
Photo Direction	148° SSE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 12_09_20.jpg
Title: Turkey Creek

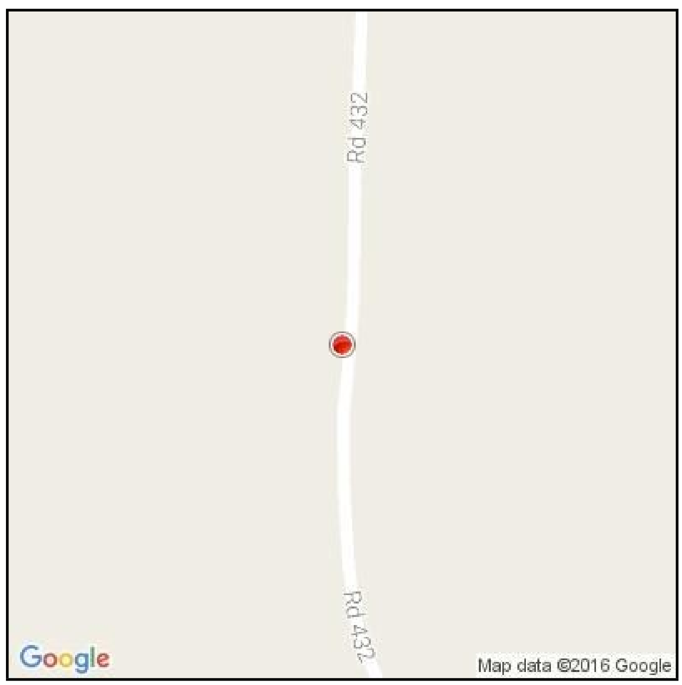
Attributes	
File Name	GeoJot+ 2016-08-30 12_09_20.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 26' 37.92"
Longitude	W 99° 45' 18.60"
Time Stamp	12:09:20 PM
Date Stamp	8/30/2016
Elevation	2198 ft
Photo Direction	325° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 12_11_11.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 12_11_11.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 26' 38.94"
Longitude	W 99° 45' 19.44"
Time Stamp	12:11:12 PM
Date Stamp	8/30/2016
Elevation	2198 ft
Photo Direction	157° SSE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 12_12_02.jpg

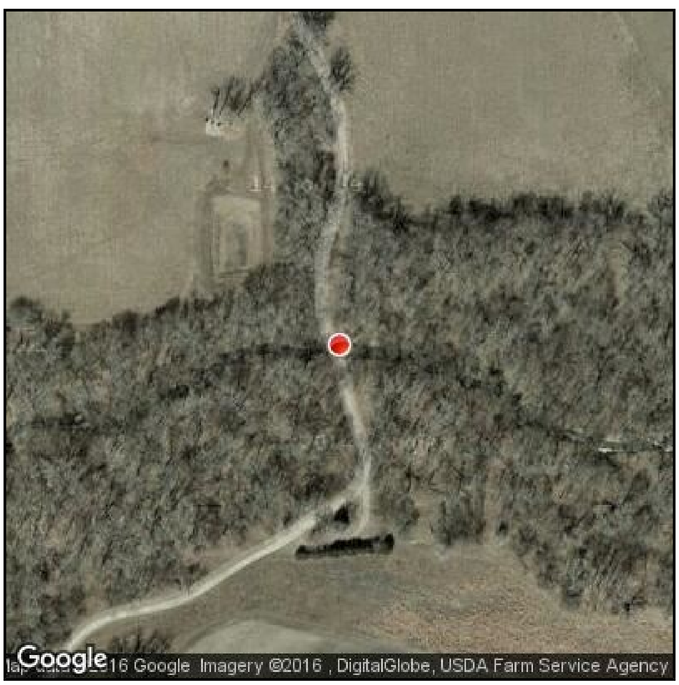
Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-30 12_12_02.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 26' 38.69"
Longitude	W 99° 45' 19.02"
Time Stamp	12:12:02 PM
Date Stamp	8/30/2016
Elevation	2188 ft
Photo Direction	282° WNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 13_14_16.jpg

Title: Turkey Creek



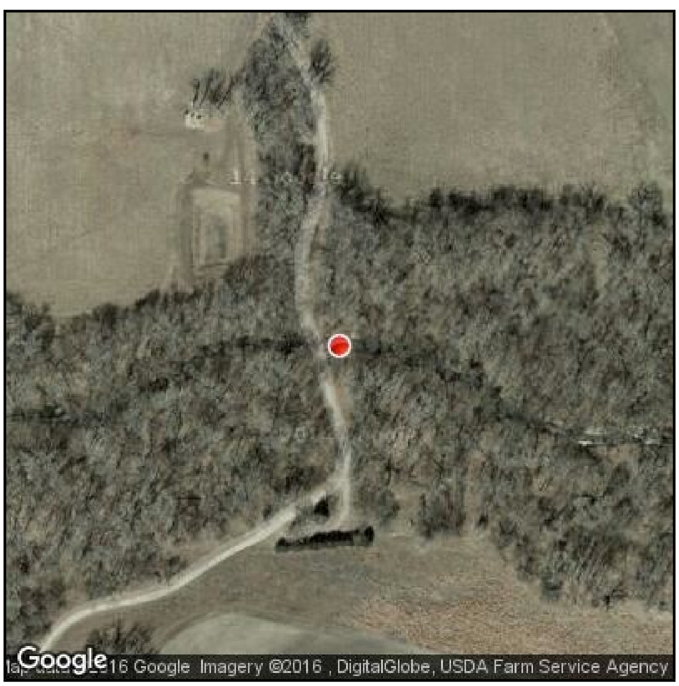
Attributes	
File Name	GeoJot+ 2016-08-30 13_14_16.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 30.72"
Longitude	W 99° 43' 25.57"
Time Stamp	1:14:17 PM
Date Stamp	8/30/2016
Elevation	2001 ft
Photo Direction	89° E
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 13_14_43.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 13_14_43.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 30.68"
Longitude	W 99° 43' 25.76"
Time Stamp	1:14:43 PM
Date Stamp	8/30/2016
Elevation	1995 ft
Photo Direction	270° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 13_15_38.jpg

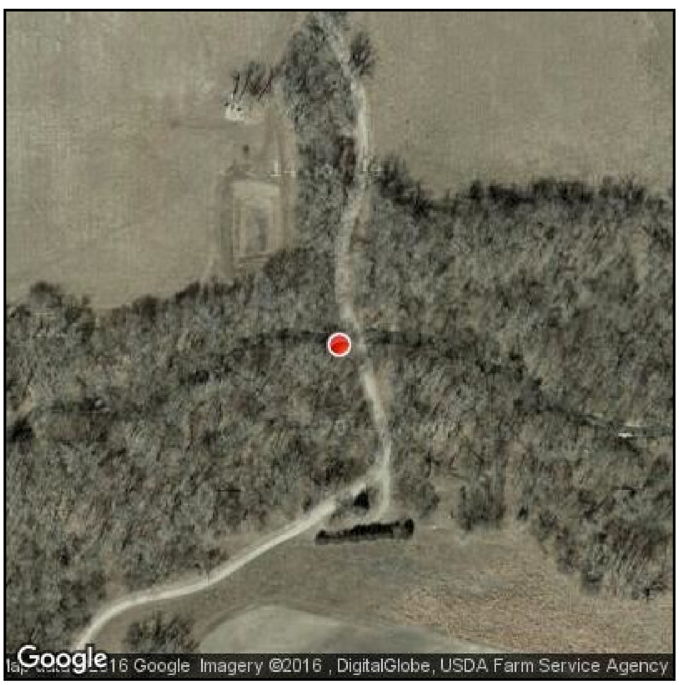
Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-30 13_15_38.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 30.57"
Longitude	W 99° 43' 25.09"
Time Stamp	1:15:38 PM
Date Stamp	8/30/2016
Elevation	1982 ft
Photo Direction	281° WNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 13_16_37.jpg

Title: Turkey Creek



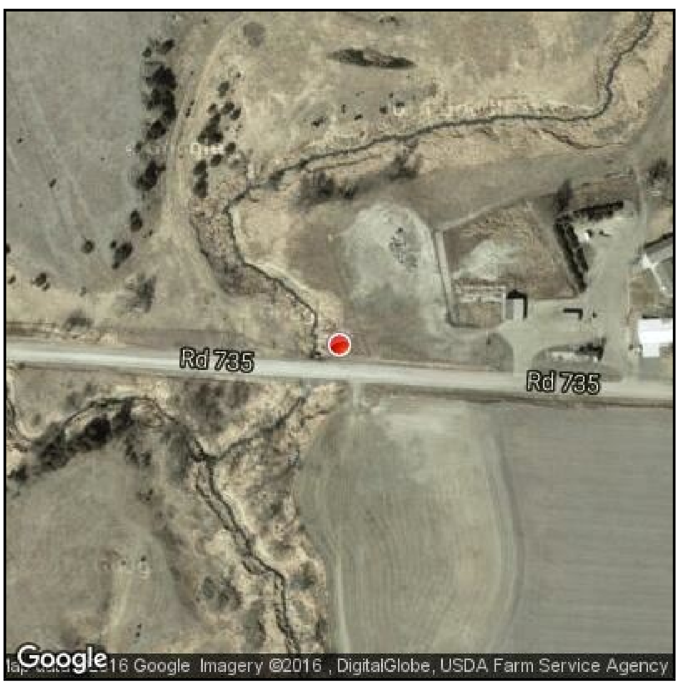
Attributes	
File Name	GeoJot+ 2016-08-30 13_16_37.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 15' 30.46"
Longitude	W 99° 43' 26.05"
Time Stamp	1:16:37 PM
Date Stamp	8/30/2016
Elevation	1988 ft
Photo Direction	36° NE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 14_26_12.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 14_26_12.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 52.66"
Longitude	W 99° 44' 52.97"
Time Stamp	2:26:12 PM
Date Stamp	8/30/2016
Elevation	2247 ft
Photo Direction	349° N
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 14_30_01.jpg

Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-30 14_30_01.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 52.87"
Longitude	W 99° 44' 52.31"
Time Stamp	2:30:02 PM
Date Stamp	8/30/2016
Elevation	2254 ft
Photo Direction	315° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 14_30_35.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 14_30_35.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 52.81"
Longitude	W 99° 44' 52.52"
Time Stamp	2:30:36 PM
Date Stamp	8/30/2016
Elevation	2257 ft
Photo Direction	250° WSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 14_32_13.jpg

Title:

Attributes	
File Name	GeoJot+ 2016-08-30 14_32_13.jpg
Title	
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 51.92"
Longitude	W 99° 44' 53.08"
Time Stamp	2:32:14 PM
Date Stamp	8/30/2016
Elevation	2247 ft
Photo Direction	236° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 14_33_10.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 14_33_10.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 52.17"
Longitude	W 99° 44' 53.08"
Time Stamp	2:33:10 PM
Date Stamp	8/30/2016
Elevation	2251 ft
Photo Direction	206° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 14_58_06.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 14_58_06.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 56.65"
Longitude	W 99° 44' 51.97"
Time Stamp	2:58:07 PM
Date Stamp	8/30/2016
Elevation	2257 ft
Photo Direction	223° SW
Make	samsung
Model	SM-P607T

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 14_58_23.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 56.63"
Longitude	W 99° 44' 51.96"
Time Stamp	2:58:24 PM
Date Stamp	8/30/2016
Elevation	2257 ft
Photo Direction	80° E
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_03_03.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_03_03.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 58.82"
Longitude	W 99° 44' 53.20"
Time Stamp	3:03:03 PM
Date Stamp	8/30/2016
Elevation	2257 ft
Photo Direction	107° ESE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_03_12.jpg

Title: Turkey Creek

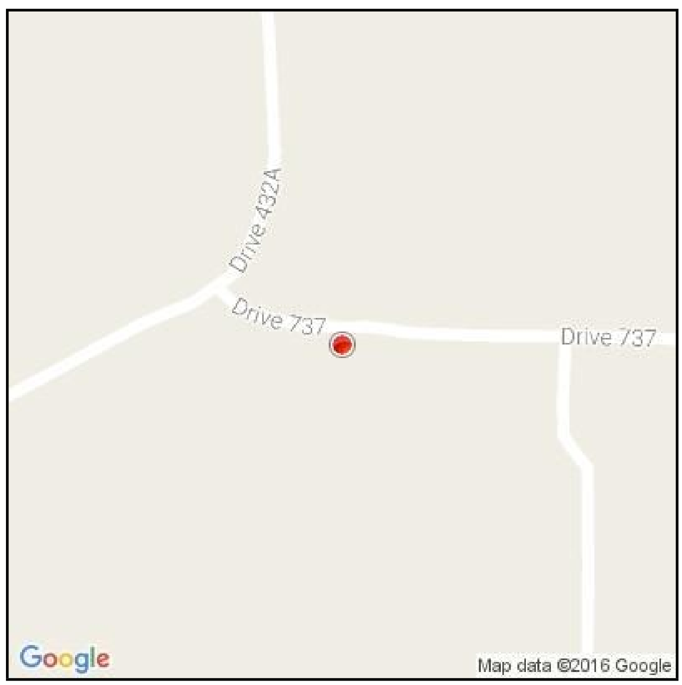
Attributes	
File Name	GeoJot+ 2016-08-30 15_03_12.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 58.78"
Longitude	W 99° 44' 53.24"
Time Stamp	3:03:13 PM
Date Stamp	8/30/2016
Elevation	2254 ft
Photo Direction	152° SSE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_03_22.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_03_22.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 28' 58.78"
Longitude	W 99° 44' 53.32"
Time Stamp	3:03:23 PM
Date Stamp	8/30/2016
Elevation	2251 ft
Photo Direction	208° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_12_10.jpg
Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-30 15_12_10.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 38.65"
Longitude	W 99° 44' 47.23"
Time Stamp	3:12:11 PM
Date Stamp	8/30/2016
Elevation	2293 ft
Photo Direction	182° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_12_58.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_12_58.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 39.10"
Longitude	W 99° 44' 46.35"
Time Stamp	3:12:59 PM
Date Stamp	8/30/2016
Elevation	2297 ft
Photo Direction	288° WNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_13_35.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_13_35.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 39.11"
Longitude	W 99° 44' 47.35"
Time Stamp	3:13:35 PM
Date Stamp	8/30/2016
Elevation	2300 ft
Photo Direction	8° N
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_15_08.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_15_08.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 39.72"
Longitude	W 99° 44' 47.60"
Time Stamp	3:15:08 PM
Date Stamp	8/30/2016
Elevation	2293 ft
Photo Direction	139° SE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_25_20.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_25_20.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 55.25"
Longitude	W 99° 44' 48.05"
Time Stamp	3:25:20 PM
Date Stamp	8/30/2016
Elevation	2300 ft
Photo Direction	89° E
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_26_12.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_26_12.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 55.08"
Longitude	W 99° 44' 47.85"
Time Stamp	3:26:13 PM
Date Stamp	8/30/2016
Elevation	2300 ft
Photo Direction	324° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_26_38.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_26_38.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 54.99"
Longitude	W 99° 44' 47.95"
Time Stamp	3:26:39 PM
Date Stamp	8/30/2016
Elevation	2297 ft
Photo Direction	103° ESE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_27_02.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_27_02.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 55.18"
Longitude	W 99° 44' 48.28"
Time Stamp	3:27:03 PM
Date Stamp	8/30/2016
Elevation	2300 ft
Photo Direction	263° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_27_43.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_27_43.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 55.63"
Longitude	W 99° 44' 48.31"
Time Stamp	3:27:43 PM
Date Stamp	8/30/2016
Elevation	2300 ft
Photo Direction	263° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_29_09.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_29_09.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 55.31"
Longitude	W 99° 44' 48.67"
Time Stamp	3:29:10 PM
Date Stamp	8/30/2016
Elevation	2293 ft
Photo Direction	130° SE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_30_17.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_30_17.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 55.93"
Longitude	W 99° 44' 50.70"
Time Stamp	3:30:17 PM
Date Stamp	8/30/2016
Elevation	2297 ft
Photo Direction	258° WSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_30_38.jpg
Title: Turkey Creek

Attributes	
Tags	
Latitude	N 40° 30' 55.90"
Longitude	W 99° 44' 50.61"
Time Stamp	3:30:39 PM
Date Stamp	8/30/2016
Elevation	2300 ft
Photo Direction	149° SSE
Make	samsung
Model	SM-P607T
File Name	GeoJot+ 2016-08-30 15_30_38.jpg
Title	Turkey Creek
Subject	
Comment	
Description	


N 40° 30' 56.88"
W 99° 44' 51.87"
Turkey Creek
GeoJot+ 2016-08-30 15_31_40.jpg
180° S
8/30/2016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Google
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Drive 432A
Drive 432A
Google
Map data ©2016 Google

Attributes	
File Name	GeoJot+ 2016-08-30 15_31_40.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 56.88"
Longitude	W 99° 44' 51.87"
Time Stamp	3:31:40 PM
Date Stamp	8/30/2016
Elevation	2293 ft
Photo Direction	180° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_32_06.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_32_06.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 56.77"
Longitude	W 99° 44' 51.95"
Time Stamp	3:32:06 PM
Date Stamp	8/30/2016
Elevation	2290 ft
Photo Direction	60° ENE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-30 15_32_28.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-30 15_32_28.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 57.02"
Longitude	W 99° 44' 51.83"
Time Stamp	3:32:29 PM
Date Stamp	8/30/2016
Elevation	2293 ft
Photo Direction	359° N
Make	samsung
Model	SM-P607T

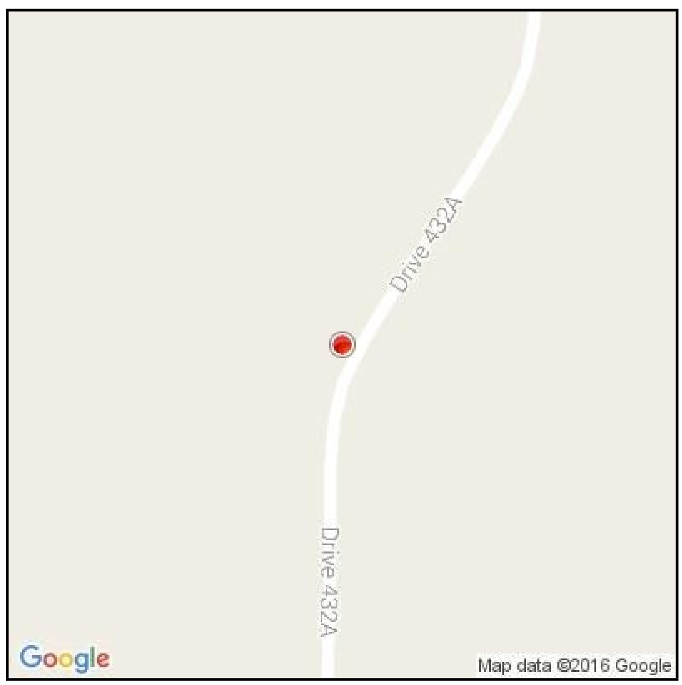
GeoJot+ 2016-08-30 15_32_48.jpg

Title: Turkey Creek

Attributes	
Date Stamp	8/30/2016
Elevation	2290 ft
Photo Direction	250° WSW
Make	samsung
Model	SM-P607T
File Name	GeoJot+ 2016-08-30 15_32_48.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 30' 56.99"
Longitude	W 99° 44' 51.63"
Time Stamp	3:32:49 PM

GeoJot+ 2016-08-31 07_45_42.jpg

Title: Turkey Creek

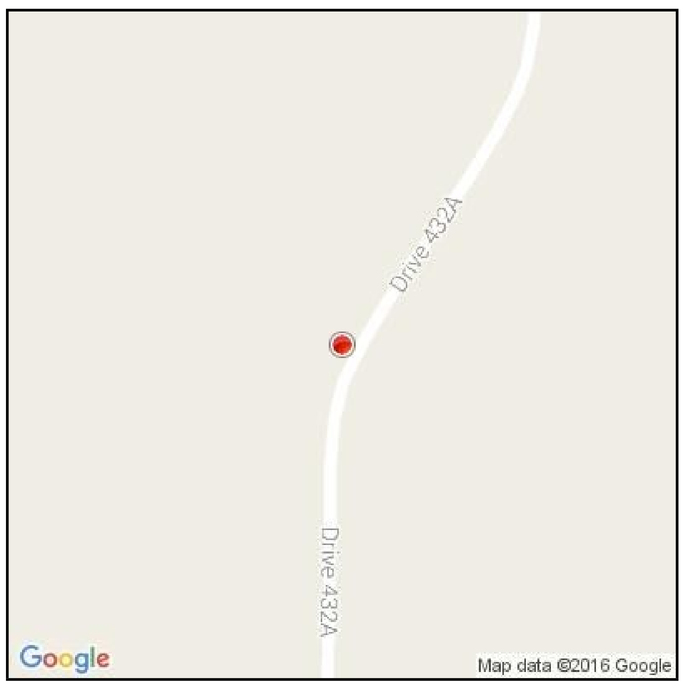


Attributes	
File Name	GeoJot+ 2016-08-31 07_45_42.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 16.77"
Longitude	W 99° 44' 48.23"
Time Stamp	7:45:43 AM
Date Stamp	8/31/2016
Elevation	2409 ft
Photo Direction	308° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 07_45_56.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 07_45_56.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 16.77"
Longitude	W 99° 44' 48.23"
Time Stamp	7:45:56 AM
Date Stamp	8/31/2016
Elevation	2409 ft
Photo Direction	219° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 07_46_05.jpg
Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-31 07_46_05.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 16.77"
Longitude	W 99° 44' 48.23"
Time Stamp	7:46:05 AM
Date Stamp	8/31/2016
Elevation	2409 ft
Photo Direction	10° N
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 07_48_52.jpg
Title: Turkey Creek

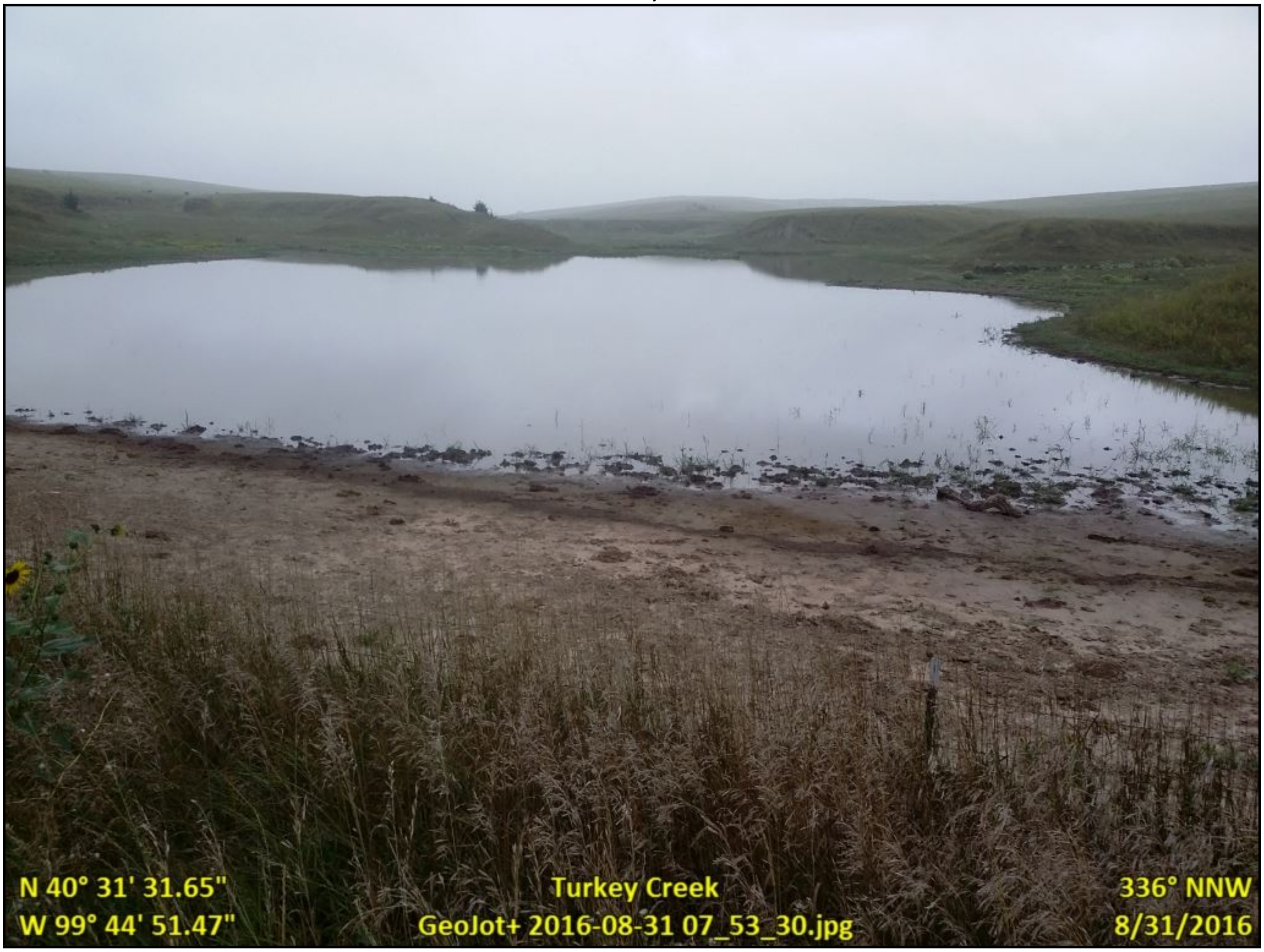
Attributes	
Model	SM-P607T
File Name	GeoJot+ 2016-08-31 07_48_52.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 22.05"
Longitude	W 99° 44' 44.00"
Time Stamp	7:48:53 AM
Date Stamp	8/31/2016
Elevation	2410 ft
Photo Direction	320° NW
Make	samsung

GeoJot+ 2016-08-31 07_53_17.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 07_53_17.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 31.58"
Longitude	W 99° 44' 51.31"
Time Stamp	7:53:17 AM
Date Stamp	8/31/2016
Elevation	2399 ft
Photo Direction	172° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 07_53_30.jpg
Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-31 07_53_30.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 31.65"
Longitude	W 99° 44' 51.47"
Time Stamp	7:53:31 AM
Date Stamp	8/31/2016
Elevation	2401 ft
Photo Direction	336° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 07_53_53.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 07_53_53.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 31.65"
Longitude	W 99° 44' 51.70"
Time Stamp	7:53:54 AM
Date Stamp	8/31/2016
Elevation	2399 ft
Photo Direction	338° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 07_54_48.jpg

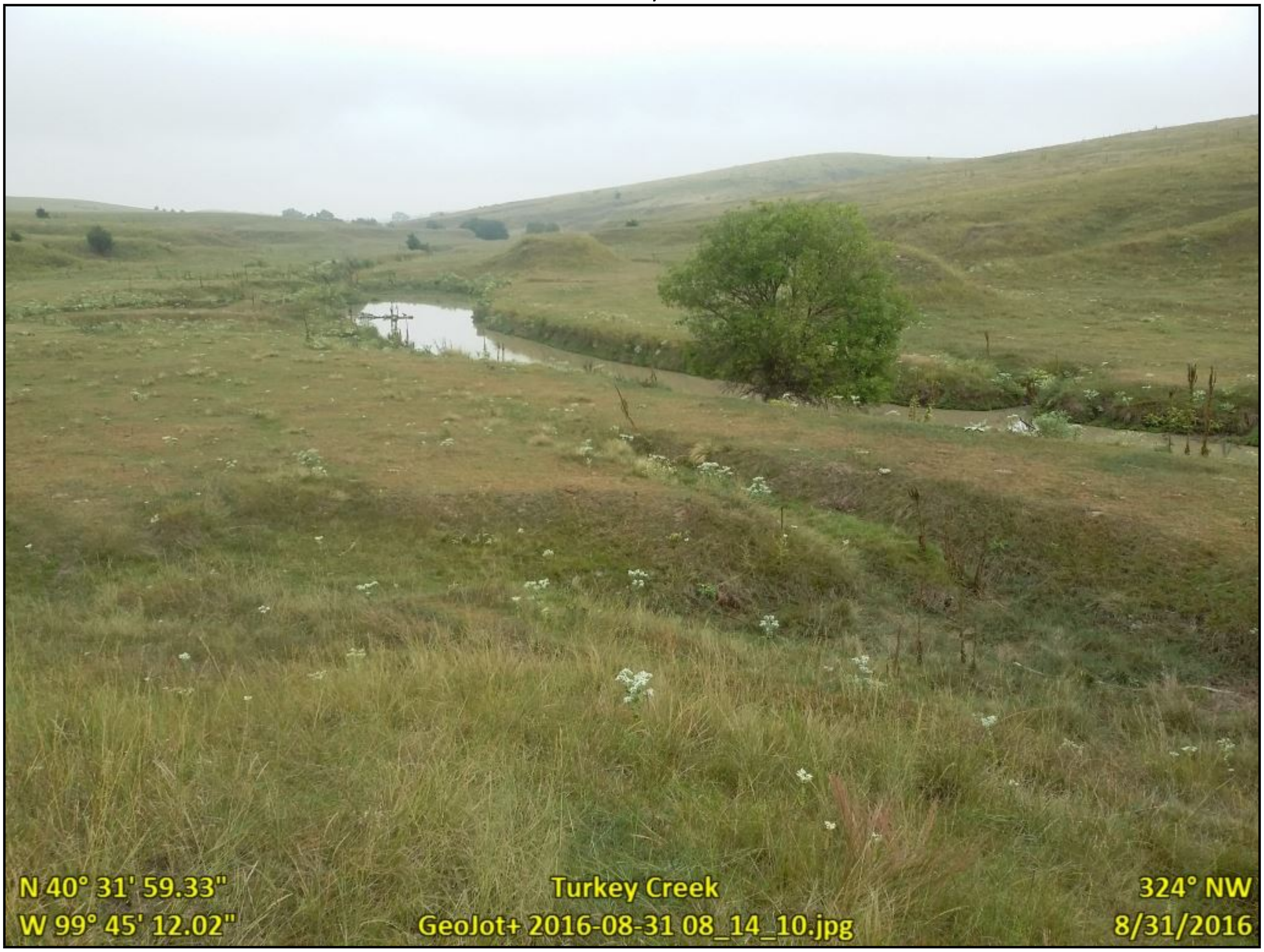
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 07_54_48.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 31.52"
Longitude	W 99° 44' 51.71"
Time Stamp	7:54:48 AM
Date Stamp	8/31/2016
Elevation	2396 ft
Photo Direction	186° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 08_13_58.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 08_13_58.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 59.33"
Longitude	W 99° 45' 12.03"
Time Stamp	8:13:58 AM
Date Stamp	8/31/2016
Elevation	2426 ft
Photo Direction	118° ESE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 08_14_10.jpg
Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-31 08_14_10.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 31' 59.33"
Longitude	W 99° 45' 12.02"
Time Stamp	8:14:10 AM
Date Stamp	8/31/2016
Elevation	2426 ft
Photo Direction	324° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 08_49_12.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 08_49_12.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 33' 16.49"
Longitude	W 99° 46' 04.79"
Time Stamp	8:49:12 AM
Date Stamp	8/31/2016
Elevation	2356 ft
Photo Direction	166° SSE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 08_49_39.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 08_49_39.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 33' 16.73"
Longitude	W 99° 46' 05.53"
Time Stamp	8:49:39 AM
Date Stamp	8/31/2016
Elevation	2362 ft
Photo Direction	28° NNE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 09_33_15.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 09_33_15.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 24.51"
Longitude	W 99° 46' 33.12"
Time Stamp	9:33:15 AM
Date Stamp	8/31/2016
Elevation	2517 ft
Photo Direction	205° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 09_33_37.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 09_33_37.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 24.70"
Longitude	W 99° 46' 33.07"
Time Stamp	9:33:37 AM
Date Stamp	8/31/2016
Elevation	2519 ft
Photo Direction	332° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 09_35_59.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 09_35_59.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 22.83"
Longitude	W 99° 46' 34.59"
Time Stamp	9:35:56 AM
Date Stamp	8/31/2016
Elevation	2474 ft
Photo Direction	316° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 09_36_22.jpg

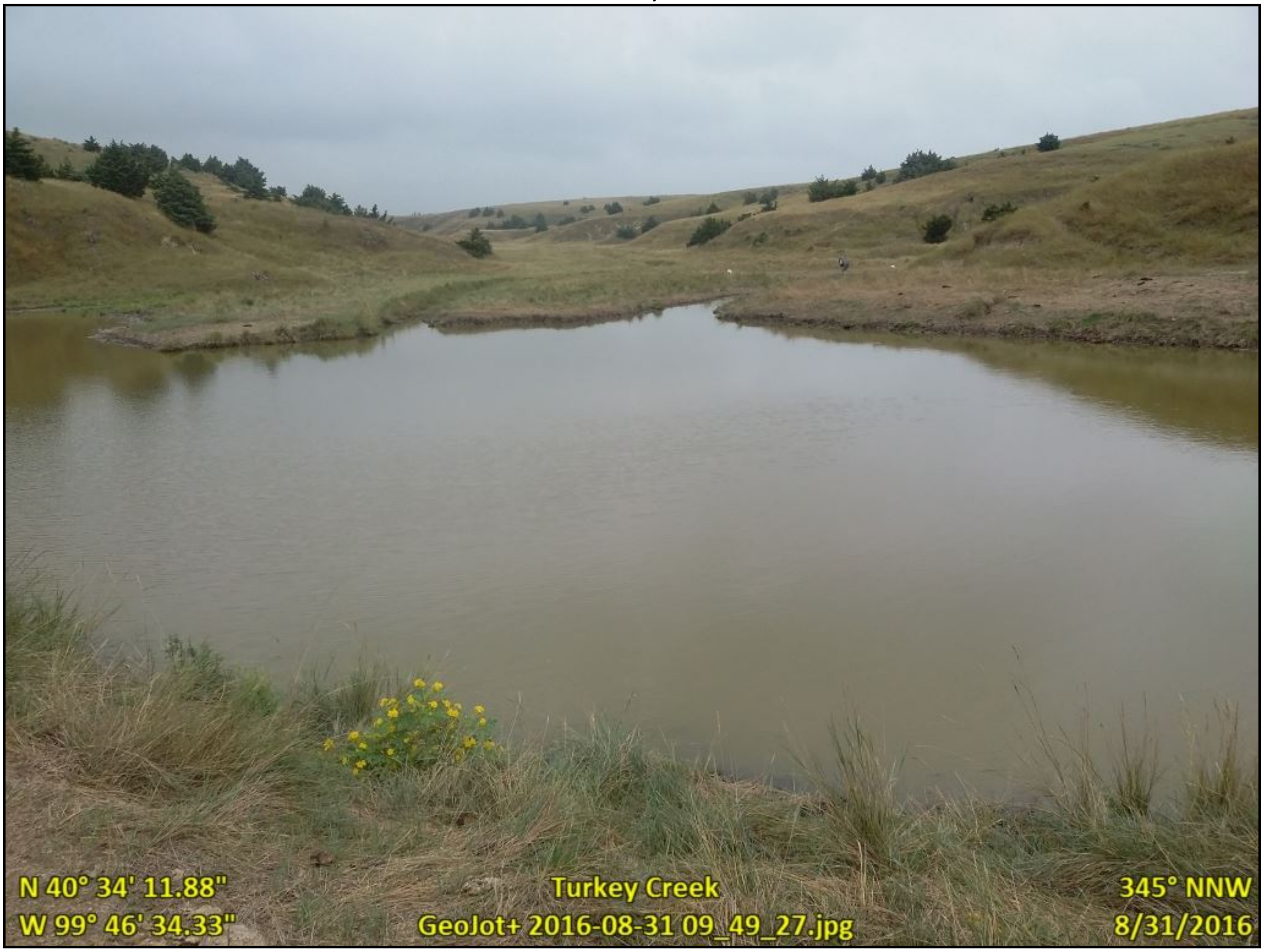
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 09_36_22.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 22.76"
Longitude	W 99° 46' 34.61"
Time Stamp	9:36:23 AM
Date Stamp	8/31/2016
Elevation	2473 ft
Photo Direction	178° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 09_49_09.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 09_49_09.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 11.77"
Longitude	W 99° 46' 34.89"
Time Stamp	9:49:09 AM
Date Stamp	8/31/2016
Elevation	2479 ft
Photo Direction	330° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 09_49_27.jpg
Title: Turkey Creek



Attributes	
File Name	GeoJot+ 2016-08-31 09_49_27.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 11.88"
Longitude	W 99° 46' 34.33"
Time Stamp	9:49:27 AM
Date Stamp	8/31/2016
Elevation	2478 ft
Photo Direction	345° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 09_49_59.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 09_49_59.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 11.77"
Longitude	W 99° 46' 34.89"
Time Stamp	9:50:00 AM
Date Stamp	8/31/2016
Elevation	2478 ft
Photo Direction	188° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_04_30.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_04_30.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 36.39"
Longitude	W 99° 46' 40.03"
Time Stamp	10:04:31 AM
Date Stamp	8/31/2016
Elevation	2485 ft
Photo Direction	336° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_05_30.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_05_30.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 36.39"
Longitude	W 99° 46' 40.02"
Time Stamp	10:05:30 AM
Date Stamp	8/31/2016
Elevation	2485 ft
Photo Direction	198° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_06_13.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_06_13.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 36.40"
Longitude	W 99° 46' 40.02"
Time Stamp	10:06:13 AM
Date Stamp	8/31/2016
Elevation	2484 ft
Photo Direction	82° E
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_12_34.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_12_34.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 38.44"
Longitude	W 99° 46' 40.50"
Time Stamp	10:12:34 AM
Date Stamp	8/31/2016
Elevation	2495 ft
Photo Direction	169° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_13_04.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_13_04.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 38.70"
Longitude	W 99° 46' 40.93"
Time Stamp	10:13:04 AM
Date Stamp	8/31/2016
Elevation	2493 ft
Photo Direction	344° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_13_36.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_13_36.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 39.23"
Longitude	W 99° 46' 40.85"
Time Stamp	10:13:36 AM
Date Stamp	8/31/2016
Elevation	2491 ft
Photo Direction	328° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_14_35.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_14_35.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 40.28"
Longitude	W 99° 46' 40.83"
Time Stamp	10:14:35 AM
Date Stamp	8/31/2016
Elevation	2491 ft
Photo Direction	333° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_18_02.jpg

Title:

Attributes	
File Name	GeoJot+ 2016-08-31 10_18_02.jpg
Title	
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 43.01"
Longitude	W 99° 46' 41.64"
Time Stamp	10:18:02 AM
Date Stamp	8/31/2016
Elevation	2507 ft
Photo Direction	195° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_19_11.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_19_11.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 44.19"
Longitude	W 99° 46' 41.14"
Time Stamp	10:19:12 AM
Date Stamp	8/31/2016
Elevation	2499 ft
Photo Direction	194° SSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_19_30.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_19_30.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 44.19"
Longitude	W 99° 46' 41.14"
Time Stamp	10:19:30 AM
Date Stamp	8/31/2016
Elevation	2499 ft
Photo Direction	341° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_20_18.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_20_18.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 45.25"
Longitude	W 99° 46' 41.29"
Time Stamp	10:20:19 AM
Date Stamp	8/31/2016
Elevation	2503 ft
Photo Direction	234° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_21_07.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_21_07.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 44.95"
Longitude	W 99° 46' 42.35"
Time Stamp	10:21:07 AM
Date Stamp	8/31/2016
Elevation	2502 ft
Photo Direction	228° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_21_21.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_21_21.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 45.09"
Longitude	W 99° 46' 42.51"
Time Stamp	10:21:21 AM
Date Stamp	8/31/2016
Elevation	2501 ft
Photo Direction	162° SSE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_26_34.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_26_34.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 45.49"
Longitude	W 99° 46' 41.53"
Time Stamp	10:26:35 AM
Date Stamp	8/31/2016
Elevation	2497 ft
Photo Direction	336° NNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 10_27_00.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 10_27_00.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 45.36"
Longitude	W 99° 46' 41.25"
Time Stamp	10:27:01 AM
Date Stamp	8/31/2016
Elevation	2497 ft
Photo Direction	239° WSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 11_55_51.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 11_55_51.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 59.98"
Longitude	W 99° 46' 45.17"
Time Stamp	11:55:51 AM
Date Stamp	8/31/2016
Elevation	2532 ft
Photo Direction	309° NW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 11_56_12.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 11_56_12.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 59.97"
Longitude	W 99° 46' 45.25"
Time Stamp	11:56:13 AM
Date Stamp	8/31/2016
Elevation	2531 ft
Photo Direction	284° WNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 11_56_24.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 11_56_24.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 34' 59.93"
Longitude	W 99° 46' 45.25"
Time Stamp	11:56:24 AM
Date Stamp	8/31/2016
Elevation	2531 ft
Photo Direction	185° S
Make	samsung
Model	SM-P607T


N 40° 35' 07.01"
W 99° 46' 49.73"
Turkey Creek
GeoJot+ 2016-08-31 12_05_46.jpg
150° SSE
8/31/2016


23
23
Google
Imagery ©2016 , DigitalGlobe, USDA Farm Service Agency


23
23
Google
Map data ©2016 Google

Attributes	
File Name	GeoJot+ 2016-08-31 12_05_46.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 35' 07.01"
Longitude	W 99° 46' 49.73"
Time Stamp	12:05:46 PM
Date Stamp	8/31/2016
Elevation	2574 ft
Photo Direction	150° SSE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 12_05_58.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 12_05_58.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 35' 07.01"
Longitude	W 99° 46' 49.73"
Time Stamp	12:05:59 PM
Date Stamp	8/31/2016
Elevation	2574 ft
Photo Direction	249° WSW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 12_06_15.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 12_06_15.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 35' 07.01"
Longitude	W 99° 46' 49.72"
Time Stamp	12:06:16 PM
Date Stamp	8/31/2016
Elevation	2574 ft
Photo Direction	302° WNW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 12_16_15.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 12_16_15.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 35' 14.35"
Longitude	W 99° 46' 54.51"
Time Stamp	12:16:15 PM
Date Stamp	8/31/2016
Elevation	2568 ft
Photo Direction	233° SW
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 12_16_32.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 12_16_32.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 35' 14.49"
Longitude	W 99° 46' 54.61"
Time Stamp	12:16:33 PM
Date Stamp	8/31/2016
Elevation	2569 ft
Photo Direction	106° ESE
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 12_17_09.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 12_17_09.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 35' 14.02"
Longitude	W 99° 46' 55.48"
Time Stamp	12:17:10 PM
Date Stamp	8/31/2016
Elevation	2563 ft
Photo Direction	270° W
Make	samsung
Model	SM-P607T

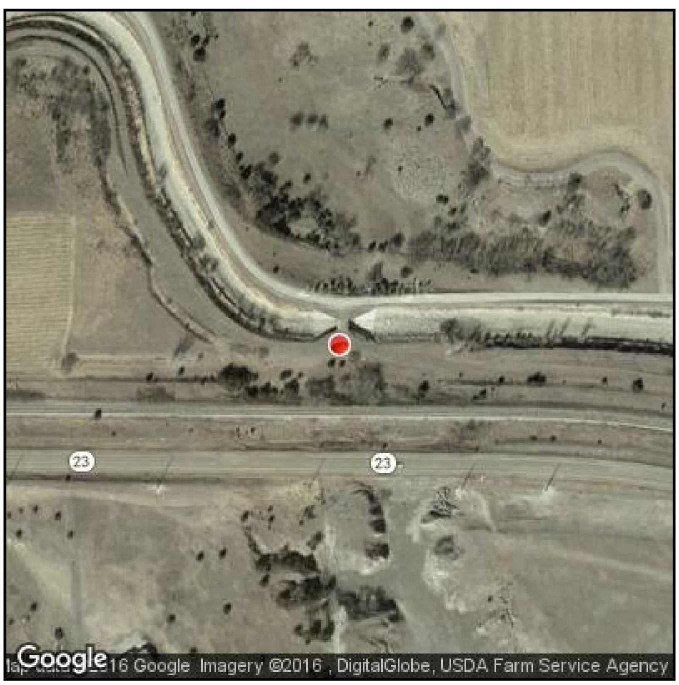
GeoJot+ 2016-08-31 12_17_43.jpg

Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 12_17_43.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 35' 13.45"
Longitude	W 99° 46' 55.50"
Time Stamp	12:17:43 PM
Date Stamp	8/31/2016
Elevation	2565 ft
Photo Direction	184° S
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 12_18_35.jpg

Title: Turkey Creek



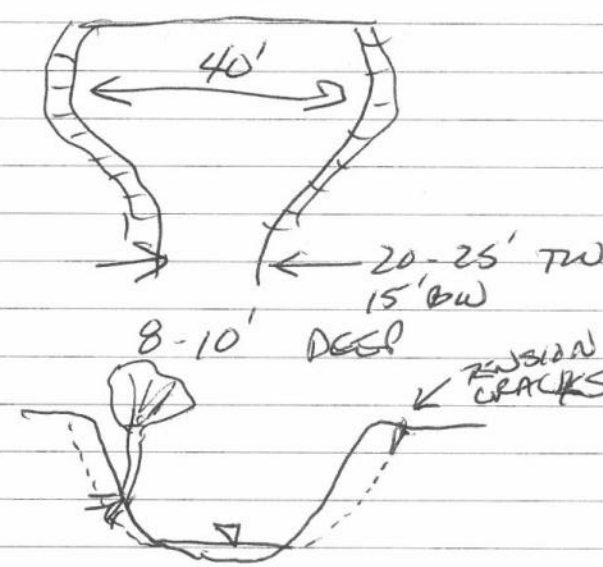
Attributes	
File Name	GeoJot+ 2016-08-31 12_18_35.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 35' 13.69"
Longitude	W 99° 46' 55.42"
Time Stamp	12:18:35 PM
Date Stamp	8/31/2016
Elevation	2572 ft
Photo Direction	264° W
Make	samsung
Model	SM-P607T

GeoJot+ 2016-08-31 12_19_20.jpg
Title: Turkey Creek

Attributes	
File Name	GeoJot+ 2016-08-31 12_19_20.jpg
Title	Turkey Creek
Subject	
Comment	
Description	
Tags	
Latitude	N 40° 35' 14.37"
Longitude	W 99° 46' 55.91"
Time Stamp	12:19:20 PM
Date Stamp	8/31/2016
Elevation	2575 ft
Photo Direction	140° SE
Make	samsung
Model	SM-P607T

ALLEN Mc COY
(308) 991-2033)
CALEB PHARRIS
(308) 627-3338

8/29/2016 TURKEY CREEK
PLATTE - REPUB DIV.
- START @ D/S END NEAR CONFLUENCE ⟹ FARM BRIDGE OVER CREEK (30" CONC. PIPE) W/ CONCRETE HIGH FLOW WEIR
- D/S OF CROSSING HAVE BLOWOUT



- U/S CHANNEL HAS SAME DIMENSIONS AS D/S

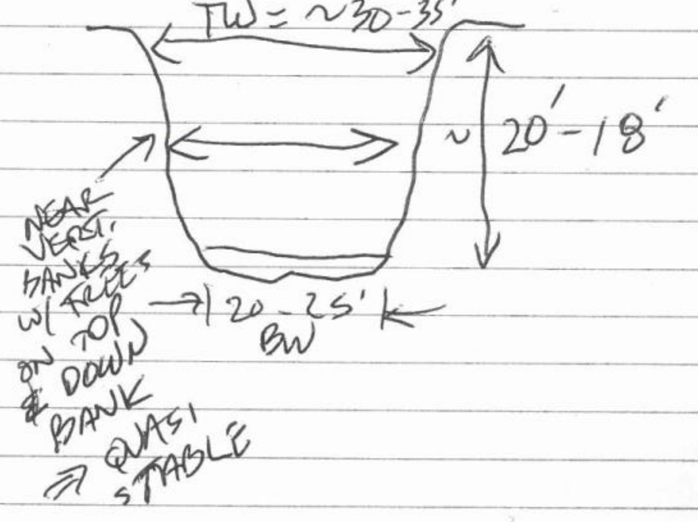
Rite in the Rain.

FURNAS GAGE = 1,050 cfs PEAK ON 5/28/2016

- CREEK U/S FOLLOWS OLD REPUB. R. MEANDER CUTOFF.

TURKEY CK. @ HWY 136 BR.

- 3 SPAN BRIDGE W/ H-PILE BENTS
- HAVE RR BRIDGE U/S
- HAVE CONCRETE DROP ACROSS CHANNEL BETWEEN BRIDGES W/ 2 FT DROP
- CHANNEL IS DEEPLY ENTRENCHED

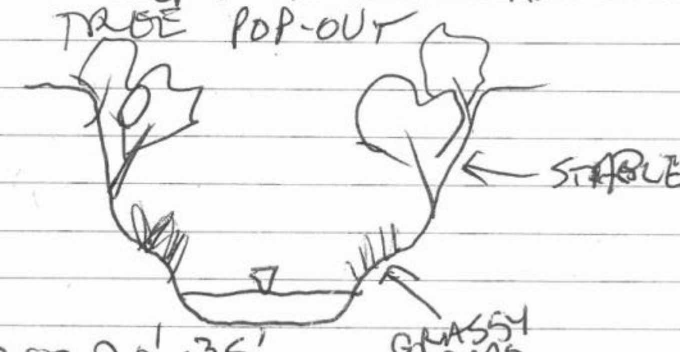


- ALLEN SAYS BRIDGE (GAGE) SAW 1100+ cfs EARLIER THIS SUMMER → ONLY LASTED A DAY, BENT GRASS OVER

RD #721

TURKEY @ NEXT U/S BRIDGE

- BRIDGE PARALLEL TO CHANNEL (& BENTS) BUT SKEWED TO FLOODWAY
- U/S & D/S CHANNEL DEEPLY ENTRENCHED BUT RELATIVELY STABLE EXCEPT FOR OCCASSIONAL TREE POP-OUT

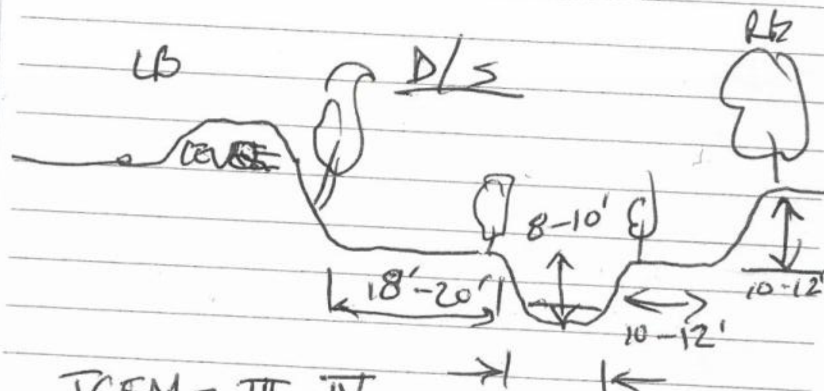


TW ≈ 30'-35'
BW ≈ 18'-20'
DEPTH ≈ 18-20'

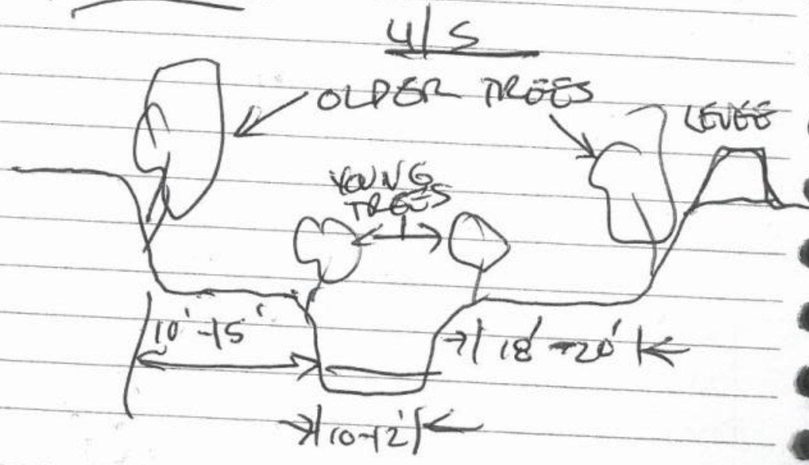
Rite in the Rain.

TURKEY CK @ RD 720 BRIDGE

- LEVEE ON D/S LB AND ON U/S RB.
- SECONDARY INCISION EVENT DOCUMENTED IN CROSS SECTION

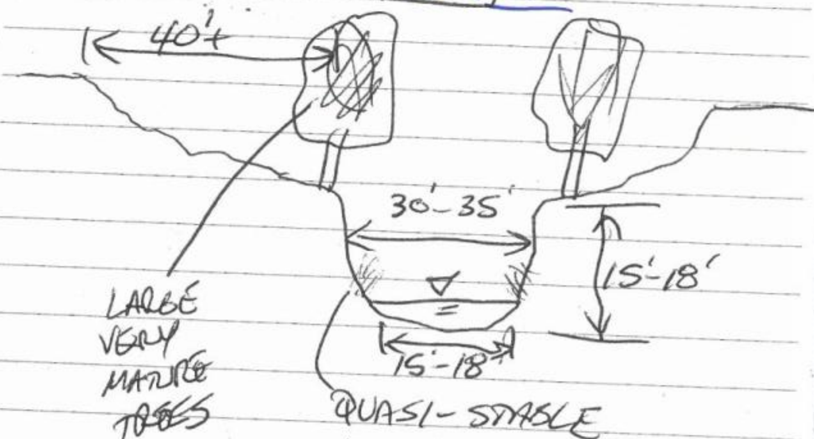


ICEM = III - IV



8/30/2016 - OVERCAST, DRIZZLY

TURKEY @ RD 722

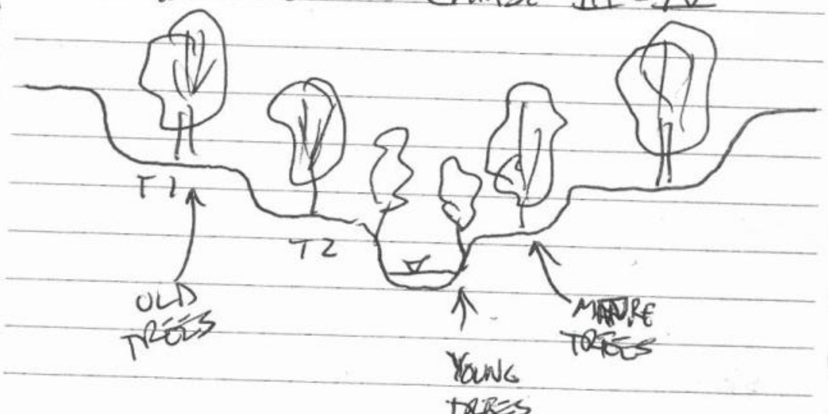


- CHANNEL IS DEEPLY ENTRENCHED BUT STABLE W/ DENSELY VEGETATED BANKS
- BANKS ARE RELATIVELY STEEP BUT HAVE VEG. ON THEM W/ VERY MATURE TREES ON TOP
- OCCAISSIONAL BERM AT TOE OF BANK
- BRIDGE IS OLD BUT PASSES FLOW → HAS SEDIMENT DEPOSITED ON TOP.
- WOODY DEBRIS IN CHANNEL

TURKEY @ HWY 6/34 BRIDGE

- BIG BRIDGE W/ PLENTY OF CAPACITY
- U/S CHANNEL IS SMALLER BUT HAVE 2 SETS OF BENCHES/TERRACES = 2

* INCISION EVENTS (PHASE III-IV

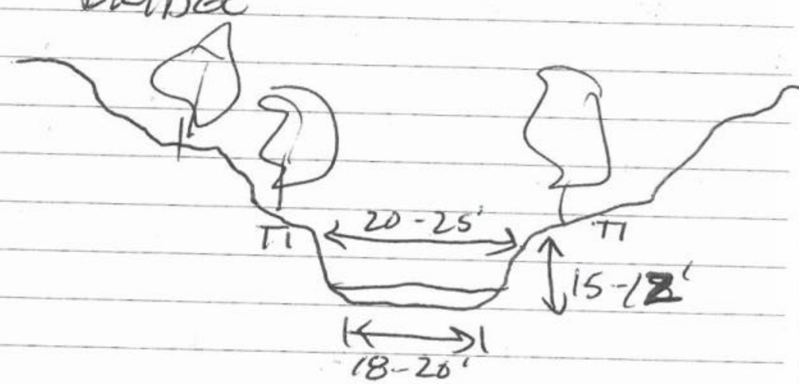


- CHANNEL HAS 8-12' BW, 12[illegible]-15' TW, ~8-10' DEEP
- TERRACES = T2 = 15'-12' WIDE

T1 = 30-40' WIDE

TURKEY @ RD 432 BRIDGE

- HARD TO TELL IF HAVE T2 TERRACE, STILL HAVE T1
- CHANNEL IS WIDER D/S OF BRIDGE

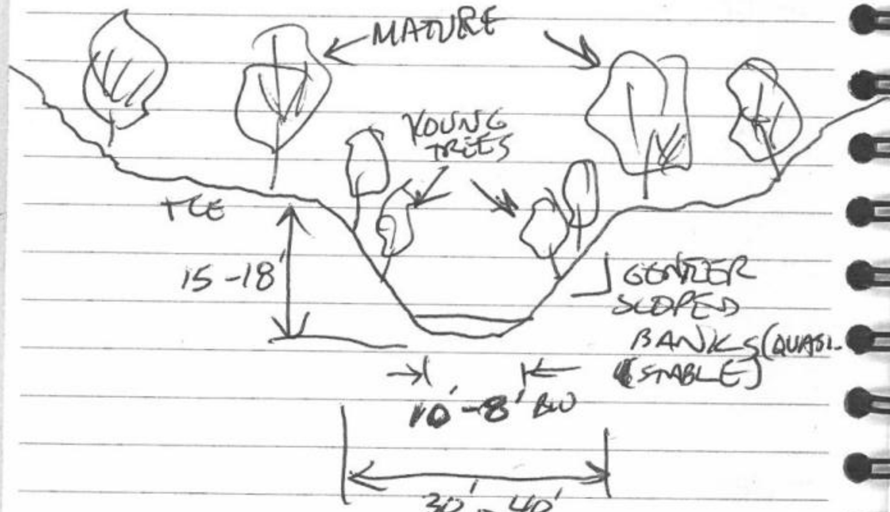


- VERY DENSE VEG., DEBRIS IN CHANNEL
- CAPACITY IS REDUCED COMPARED TO D/S
- REMNANTS (INTERMITTENT) OF T2 U/S? HARD TO TELL

Rite in the Rain.

TURKEY @ RD #431 BRIDGE

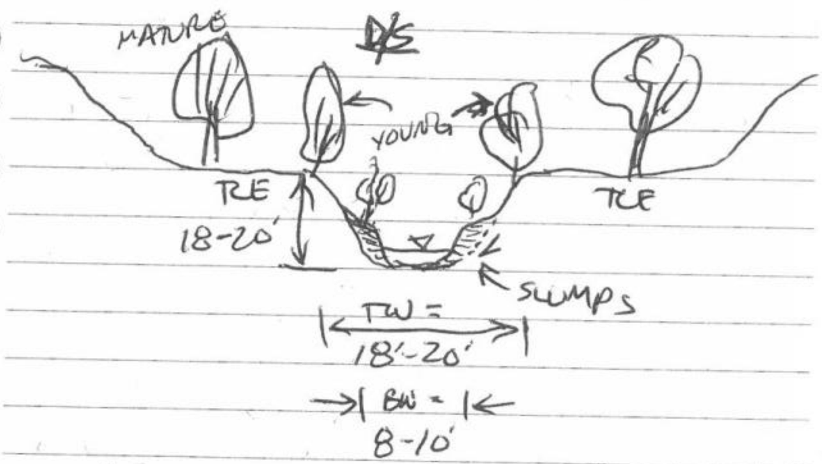
- GETTING INTO HILLS
- CHANNEL IS DEEPLY ENTRENCHED W/ HIGH TCE



- NARROWER BRIDGE CAPACITY BUT STILL HAVE PLENTY

TURKEY @ RD #726 BRIDGE

- CHANNEL IS NARROWER W/ REMNANTS & DORMANT BANK SLUMPS
- HIGH TCE ON BOTH BANK

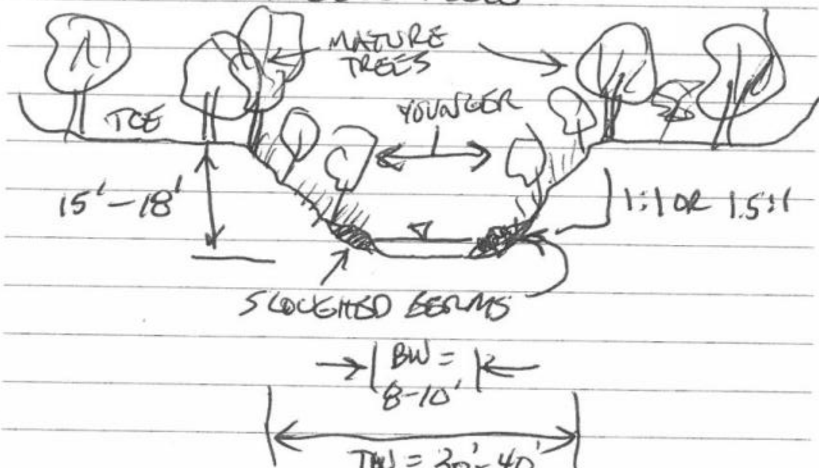


- BERMS AT LOWER BANK APPEAR TO BE DORMANT SLUMPS, OTHER SPOTS ARE ACTIVE
- LIQUIFACTION SLUMP IN RB JUST D/S OF BRIDGE!
- U/S HAVE TERRACES BUT NOT AS PROMINENT
- SMALLER BRIDGE HERE

* GAGE AT THIS BRIDGE

TURKEY @ RD# 727 BRIDGE

- SMALLER BRIDGE & LESS CAPACITY BUT STILL ADEQUATE
- SAND BED CHANNEL, STARTS TO SHALLOW FLOW

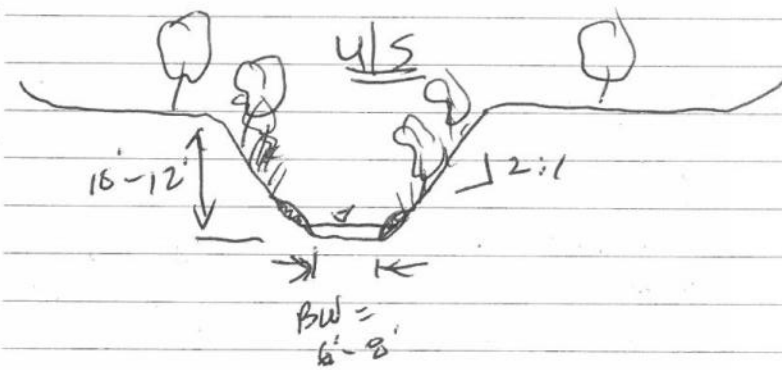


- OCCASSIONAL BANK FAILURES W/ TREES
- VERTICAL FACES IN BANKS IN SOME PLACES

- FLOW IS 2.5–3.0 fps

TURKEY @ RD# 728 BRIDGE

- NARROWER FLOODWAY @ BRIDGE → CAPACITY IS ABOUT THAT OF CHANNEL
- D/S CHANNEL, BANKS ARE WOODED W/ OLD SLUMP SCARS → MATURE TREE GROWING AT BASE OF SLUMP
- U/S CHANNEL & BANKS ARE LESS VEG'ED
- D/S CHANNEL HAS 8'-10' BW
  U/S " " 6-8' BW

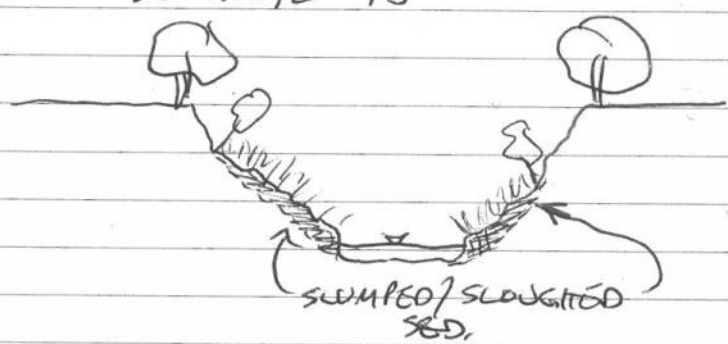


- D/S CHANNEL IS VERY SINUOUS, U/S " " LESS SINUOUS

Rite in the Rain

TURKEY @ END OF RD # 729

- FLOW IS SLOWER → MEANDERING
- WELL VEG'ED BANKS W/ DORMANT SLUMPS
- BW = 6-8'
  TW = 30-35'
  DEPTH = 12'-15'

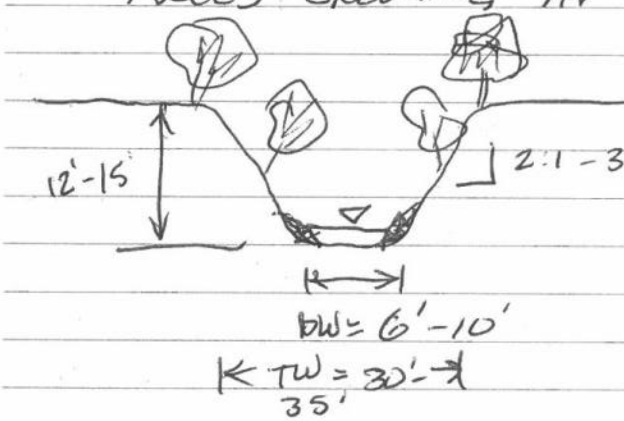


TURKEY @ RD # #730

- SAME AS @ RD # 729 BUT ~~[illegible]~~ SLIGHTLY LARGER BW = ~~[illegible]~~ 8'-10'
- CAPACITY IS DEFINED BY CHANNEL & BRIDGE OPENING

TURKEY @ RD # 731 BRIDGE

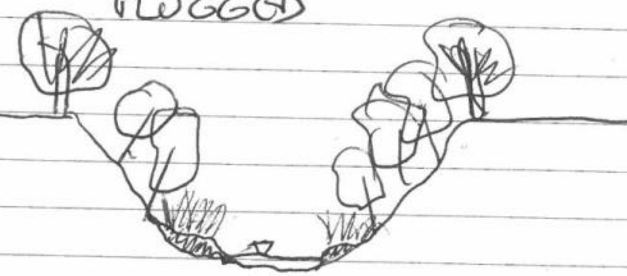
- RIPRAP ON BOTH BANKS U/S & D/S
- CREEK TURNS 90° INTO BRIDGE JUST U/S
- CONFLUENCE OF SMALL CREEK ON RB JUST U/S OF BRIDGE
- HIGH HILLSIDE REMNANT ON RB D/S → SCARP BUT ONLY ERODING SLOWLY, MATURE TREES GROWING AT BASE



- ADEQUATE CAPACITY @ BRIDGE

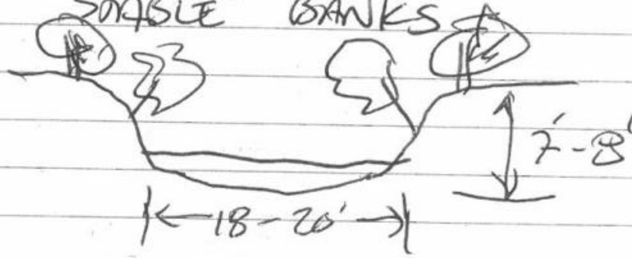
TURKEY @ RD# 432 CULVERT

- CREEK HAS 60" CMP UNDER ROAD
- U/S SIDE OF CULVERT HAS SHEET PILE HEADWALL → CULVERT IS PARTIALLY BLOCKED WITH DEBRIS
- U/S & D/S CHANNEL IS ENTRENCHED
- BW = 6-8'
  TW = 25'-30'
  DEPTH = 12'-15'
- NO CAPACITY HERE, HIGH FLOWS MAY BACK UP & OVER TOP ROAD, ESP. IF CULVERT GETS PLUGGED



DETOUR BACK TO RIVER AREA

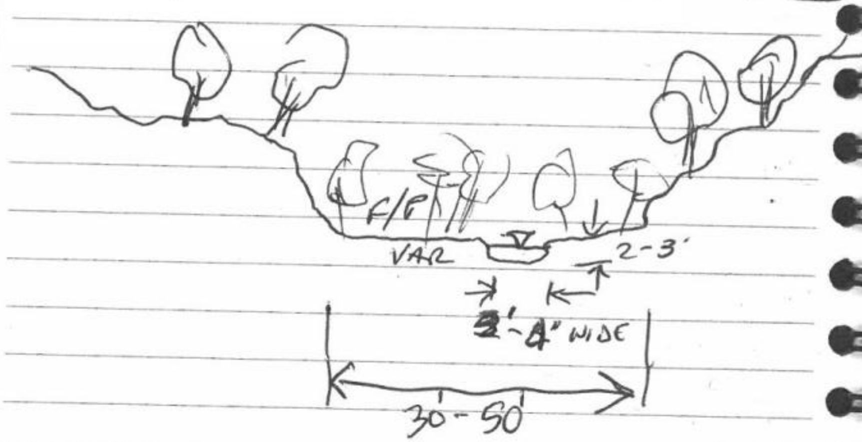
- DOUBLE CMP (48") W/ ROCK FILL & CONCRETE CAP ON ROAD.
- CULVERTS ARE LOW SO HIGHER FLOWS PROBABLY OVERTOP ROAD, ESP. IF CULVERTS GET BLOCKED
- D/S CHANNEL IS 15'-18' WIDE W/ 7-8' DEPTH & STABLE BANKS



- TOP OF ROAD @ CULVERTS IS 1'-2' LOWER THAN F/P SURFACE
- CULVERTS DO NOT HAVE SUFFICIENT CAPACITY

TURKEY @ RD # 735 CULVERT

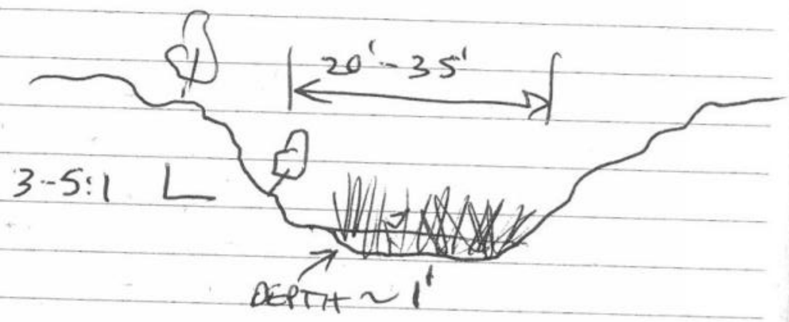
- CULVERT IS 84" OR 96" CMP.
- U/S & D/S CHANNEL ARE SMALL → 3'-4' WIDE 2-3' DEEP W/ LOW INSET BENCHES



- CULVERT MAY HAVE SUFFICIENT CAPACITY DEPENDING ON OTHER FLOWS
- HAVE 2 LARGE TRIBS COME IN 2-3 MILES D/S SO LOSE A LOT OF FLOW UP HERE

TURKEY @ RD # 737 CULVERT

- CROSSING IS 3 X 10' X 10' BOX CULVERTS W/ WINGWALLS
- U/S & D/S CHANNEL IS WETLANDS



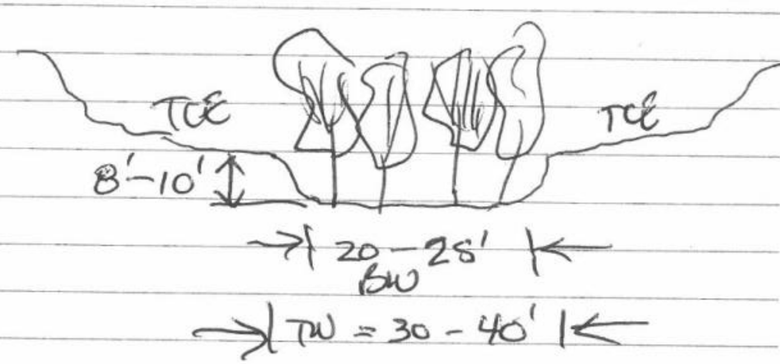
- INTERSPERSED DEAD TREES U/S
- MOD. DENSE LIVE TREES D/S
- ~~U/S~~

Rite in the Rain

TURKEY CRK @ RD 432A

- CROSSING IS SHEET PILE BOX W/ WINGWALLS
- WETLANDS U/S & D/S
- D/S CHANNEL HAS 20-25' BW & 30'-35' TW → 8'-10' DEEP
- U/S SAME UP TO END OF STAGNANT WATER → NOTE LARGE DIAM. DEAD COTTONWOOD IN BOTTOM IN MIDDLE
- U/S TO FARM ROAD LOW WATER X-ING → 30" CMP

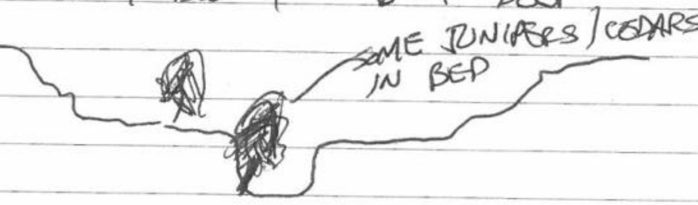
→ U/S & D/S HAVE SAME AGE DENSE TREES GROWING IN BOTTOM OF CHANNEL



8/31 TURKEY CREEK - DAY IS COOL & FOGGY

TURKEY ALONG RD #432

- DEFINED CHANNEL ENTRENCHED IN VALLEY BOTTOM
- LOOKS TO BE 8-10' TW 3-4' BW & ~6-7' DEEP



TURKEY @ RD #738 DAM

- STOCK POND → RD CREATES DAM W/ CULVERT, NO BYPASS → FLOW OVERTOPS TOO
- NO DEFINED CHANNEL D/S FOR ABOUT 75'
- CULVERT IS 36" CMP

Rite in the Rain.

TURKEY @ END OF UNNAMED RD

- CHANNEL IS POORLY DEFINED BUT IS SWALED INTERMITTENTLY
- ~ 15'-18' WIDE, 2-1.5' DEEP IN PLACES WHERE DEFINED
- CLAYEY SILT IN TOP 6"

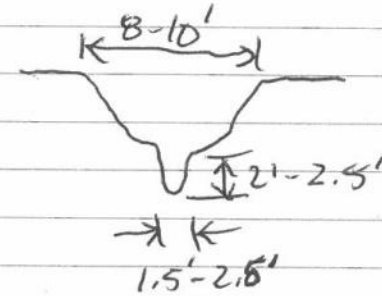
→ REST DOWN TO 1.5' BELOW SURFACE IS MAINLY SILT, NO SAND OR GRAVEL

→ IF CONSTRUCT CHANNEL, MATERIAL IS GOOD FOR CHANNEL BED & BANKS"

- PROBABLY NOT ENOUGH CAPACITY FOR 40 cfs → MAYBE 1/2 TO 3/4 OF THAT

TURKEY CK NEAR U/S END

- PARKED AND WALKED DOWN
- RESERVOIR/POND D/S
- CHANNEL IS PRIMARILY MAINTAINED BY GROUNDWATER SAPPING & CATTLE



* PRETTY FLAT SLOPE THRU HERE

- NOT SUFFICIENT CAPACITY TO CARRY 40 cfs

AT D/S POND & DAM

- HAVE CHANNEL INTO CENTER AT U/S END
- BYPASS AT ~~WEST~~ END OF DAM → POORLY DEFINED CHANNEL D/S
- IF FLOW BYPASSES/FILLS → COULD GET HEADCUT IN BYPASS & DRAINING & FLANKING OF DAM & POND

Rite in the Rain.

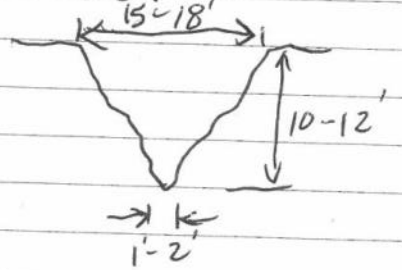
WAYPOINT KZ1 - SHORT 1-ft HIGH KNICK ZONE OVER ~ 10-15'

- LARGE TRIB CONFL. JUST D/S
- CHANNEL D/S IS WIDER & AT BOTTOM → 12'-15' TW 4-5' BW, 7-8' DEEP

→ U/S IS SAME EXCEPT BW → HAVE NARROW GUT CHANNEL

- VERY DEEP (10-12') "V" NOTCH CHANNEL U/S

→ FARMER HAS PUT TREES IN CHANNEL TO KEEP COWS OUT



WAYPOINT GW HC1 & 2

- U/S END OF CHANNEL BIFURCATION (100'-125' D/S) BOTH END IN GW SAPPING HEADCUTS
- HAVE WATER FILLED DEPRESSION JUST U/S
- HEADCUTS HAVE INITIAL 3-4' DROP IN SHORT DISTANCE BUT TOTAL 10'-12' OVER ~100'

UPPER POND BELOW DIV. PT.

- NO DEFINE CHANNEL D/S
- SHALLOW GW CREATES SHORT SEGMENTS
- POND DAM HAS NO OUTLET → WILL OVERTOP & FAIL IF DUMP FLOW INTO IT.

Rite in the Rain.

HALFWAY BETWEEN POND &
DIV. PT.

- HAVE SHORT SECTION OF
  GW SAPPING CHANNEL W/
  HEADCUT @ U/S END →
  NO CHANNEL U/S TO
  DIV. PT.

APPENDIX C – ENVIRONMENTAL REPORTS

MEMO

☐	Overnight
☐	Regular Mail
☐	Hand Delivery
☒	Other: Email

TO:	Travis Figard
FROM:	Caleb Pharris
RE:	Platte River Diversion Wetland Delineation Site Visit
DATE:	2-1-2017
PROJECT #:	016-1500

Introduction

This memo summarizes the findings of a Wetland Delineation site visit conducted along a reach of East Branch Turkey Creek and Turkey Creek in Furnas and Gosper Counties, Nebraska. This summary does not constitute a Wetland Delineation Report which will be required to obtain a Section 404 permit from the U.S. Army Corps of Engineers (Corps) and will be provided when or if any impacts to wetlands or other waters are known. When it is determined that impacts to wetlands and waters will take place a Wetland Delineation Report will be provided for those structures only.

The delineation study area was considered to be a 100-foot buffer from the center of each structure (bridge or culvert) at road crossings for the length of the project. The project begins at the Republican River in Furnas County near Oxford and Edison, Nebraska (Location Map). The project then follows Turkey Creek to the north until it branches off to East Branch Turkey Creek, then follows East Branch Turkey Creek to Lateral E-65, a canal which diverts water from the Platte River for irrigation purposes.

Site Description

There were 20 crossings within the project length. The majority of crossings are associated with county gravel roads in rural areas. The majority of the study areas are located in the right-of-way (ROW) of county roads with portions of the study areas located in pasture land or wooded riparian areas. In three cases the structures were located along highways. At the downstream portion of the project alignment, U.S. Highway 136 (US-136) and U.S. Highway 6 (US-6)/ U.S. Highway 34 (US-34) cross Turkey Creek. At the upstream portion of the project alignment, Nebraska Highway 23 (N-23) crosses East Branch Turkey Creek.

Each crossing was given a Site ID beginning with Site 1 at the downstream end of the project alignment near the Republican River and ending with Site 20 at the upstream end of the project alignment near Lateral E-65.

Summary of Findings

Each site was examined to determine the presence or absence of wetlands and other waters. Summaries of the results of the site visit conducted on August 29 and 30, 2016 are listed below according to the site location. In areas where wetlands and other waters were identified the wetland boundaries or stream channel ordinary high water mark (OHWM) were mapped using a sub-meter accuracy handheld Global Positioning System (GPS) devise. Figures documenting the results of the site visit are attached at the end of this memo

Site 01 – Latitude: 40.250137 Longitude: -99.714006

This bridge is located along an access road over Turkey Creek which allows a farmer to get from one field to another near the Republican River in Furnas County. The channel at this point is perennial and is approximately 4-10 feet wide. The banks of the channel had a mix of hydrophytic (wetland) and non-hydrophytic vegetation present but the dominant species was smooth brome (*Bromus inermis*). No wetlands were present at this site because the banks were incised and unable to hold water for long enough periods of time to support wetland hydrology.

Site 02 – Latitude: 40.258486 Longitude: -99.723808

This bridge is located along an access road over Turkey Creek to Oxford State Wildlife Management Area (WMA) in Furnas County. The channel at this point is perennial and there are approximately 2-foot wide fringe Palustrine Emergent Temporarily Flooded (PEMA) wetlands on the banks of the channel. The channel was approximately 10-15 feet wide.

Site 03 – Latitude: 40.263510 Longitude: -99.731351

This bridge is located along County Road (CR)-720 over Turkey Creek in Furnas County. The channel at this point is perennial and is approximately 8-12 feet wide. There were no wetlands present because the banks of the channel were incised and the dominant vegetation was non-hydrophytic.

Site 04 – Latitude: 40.271092 Longitude: -99.734071

This bridge is located along US-136 over Turkey Creek in Furnas County. The channel at this point is perennial and is approximately 12-14 feet wide. There were no wetlands present because the banks are too steep to hold water for long enough periods of time to support wetland hydrology and the dominant vegetation was non-hydrophytic.

Site 05 – Latitude: 40.277880 Longitude: -99.734066

This bridge is located along CR-721 over Turkey Creek in Furnas County. The channel at this point is perennial and is approximately 4-10 feet wide. There was a mix of hydrophytic and non-hydrophytic vegetation present along the banks. However, the dominant vegetation was non-hydrophytic. The banks of the channel were also too steep to hold water for long enough periods of time to support wetlands.

Site 06 – Latitude: 40.292728 Longitude: -99.740573
This bridge is located along CR-722 over Turkey Creek in Furnas County. The channel at this point is perennial and is approximately 6-8 feet wide. There were no wetlands present at this site because the banks are too steep to hold water for long enough periods of time to support wetlands and the dominant vegetation was non-hydrophytic.

Site 07 – Latitude: 40.30713 Longitude:-99.74255
This bridge is located along US-6/US-34 over Turkey Creek in Furnas County. The channel at this point is perennial and is approximately 5-11 feet wide. There were no wetlands present at this site because the banks were either incised, too steep to hold water for long enough periods of time to support wetland hydrology, or consisted of the bridge abutment and the dominant vegetation was non-hydrophytic.

Site 08 – Latitude: 40.30944 Longitude: -99.742426
This bridge is located along CR-432 over Turkey Creek in Furnas County. The channel at this point is perennial and is approximately 10 feet wide. There is a PEMA fringe wetland on a shelf on the northwest side of the bridge. The wetland extends approximately 70 feet from the bridge abutment until the banks of the channel become too steep to hold water for long enough periods of time to support wetland hydrology and dominant vegetation is non-hydrophytic.

Site 09 – Latitude: 40.335046 Longitude: -99.761829
This bridge is located along CR-431 over Turkey Creek in Furnas County. The channel at this point is perennial and is approximately 8-10 feet wide. There is a PEMA fringe wetland on a shelf on the southwest side of the channel. The wetland extends under the bridge approximately 65 feet to the northwest and 70 feet to the southeast on the southwest bank. Another PEMA fringe wetland is located on the northeast bank of the channel beginning approximately 60 feet northwest from the center of the bridge and extending northwest out of the study area.

Site 10 – Latitude: 40.351132 Longitude: -99.762849
This bridge is located along CR-726/CR-276 over Turkey Creek on the border of Furnas and Gosper Counties. The channel at this point is perennial and is approximately 7 feet wide. There are fringe PEMA wetlands on the east side of the channel but they do not continue under the bridge. The fringe wetlands are 2-8 feet wide and extend to the north and south out of the study area.

Site 11 – Latitude: 40.365623 Longitude: -99.769128
This bridge is located along CR-727 over Turkey Creek in Gosper County. The channel at this point is perennial and is approximately 9-12 feet wide and has fringe PEMA wetlands on the banks. The fringe wetlands on the east side extend to the south approximately 45 feet from the center of the bridge and to the north out of the study area. On the west side the fringe wetlands

are located under the bridge and extend to the south approximately 30 feet from the center of the bridge.

Site 12 – Latitude: 40.380069 Longitude: -99.772678
This bridge is located along CR 728 over Turkey Creek in Gosper County. The channel at this point is perennial and is approximately 8 feet wide. There are fringe wetlands on both sides of the channel which extend to the north and south out of the study area. The fringe wetlands are 2-6 feet wide.

Site 13 – Latitude: 40.409314 Longitude: -99.768561
This bridge is located along CR-730 over Turkey Creek in Gosper County. The channel at this point is perennial and is approximately 5-11 feet wide. There are fringe PEMA wetlands on both banks of the channel which extend to the north and south out of the study area. The fringe wetlands are 2-6 feet wide.

Site 14 – Latitude: 40.423466 Longitude: -99.773158
This bridge is located along CR-731 over Turkey Creek in Gosper County. The channel at this point is perennial and is approximately 10-12 feet wide. There are fringe PEMA wetlands on the banks of the channel. The wetlands do not extend under the bridge. On the north side of the bridge the fringe wetlands extend out of the study area on both sides and are approximately 2-3 feet wide. On the south side the wetlands are located on low lying shelves and are approximately 12-20 feet wide but only extend approximately 71 feet south from the center of the bridge.

Site 15 – Latitude: 40.443988 Longitude: -99.755259
This culvert is located along CR-432 over East Branch Turkey Creek in Gosper County. The channel at this point is intermittent and is approximately 6-12 feet wide. There are fringe PEMA wetlands on the banks of the channel. The wetlands are located on both sides of the channel and are approximately 2-10 feet wide. The fringe wetlands extend to the west and southeast out of the study area.

Site 16 – Latitude: 40.487238 Longitude: -99.748068
This culvert is located along CR-735 over East Branch Turkey Creek in Gosper County. There are PEMA wetlands on both sides of the culvert in depressions and the roadside ditch. The wetlands extend to the north and south out of the study area. A 2-foot wide ephemeral channel is present at the culvert which also extends to the north and south out of the study area.

Site 17 – Latitude: 40.510814 Longitude: -99.746435
This box culvert is located along Drive 737 over East Branch Turkey Creek in Gosper County. There are Palustrine Emergent Temporarily/Seasonally Flooded (PEMA/C) wetlands on both

sides of the culvert. No defined bed and bank or OHWM were observed although the wetlands continue to the north and south out of the study area.

Site 18 – Latitude: 40.51346 Longitude: -99.746703
This bridge is located along Drive 432A over East Branch Turkey Creek in Gosper County. There are PEMA wetlands on both sides of the bridge and discontinuous drainage patterns are present on the upstream side of the bridge, however no defined bed and bank or OHWM were present. The wetlands extend to the east and west out of the study area.

Site 19 – Latitude: 40.525447 Longitude: -99.747708
This culvert is located along CR-738 over East Branch Turkey Creek in Gosper County. There were no wetlands or channel present at this point. CR-738 appears to act as an impoundment and has created a pond on the north side (upstream side) of the road. The pond continues to the north out of the study area.

Site 20 – Latitude: 40.585911 Longitude: -99.777786
This culvert is located along N-23 over East Branch Turkey Creek in Gosper County. There were no wetlands or channel at this point. This area is a valley dominated by non-hydrophytic vegetation.

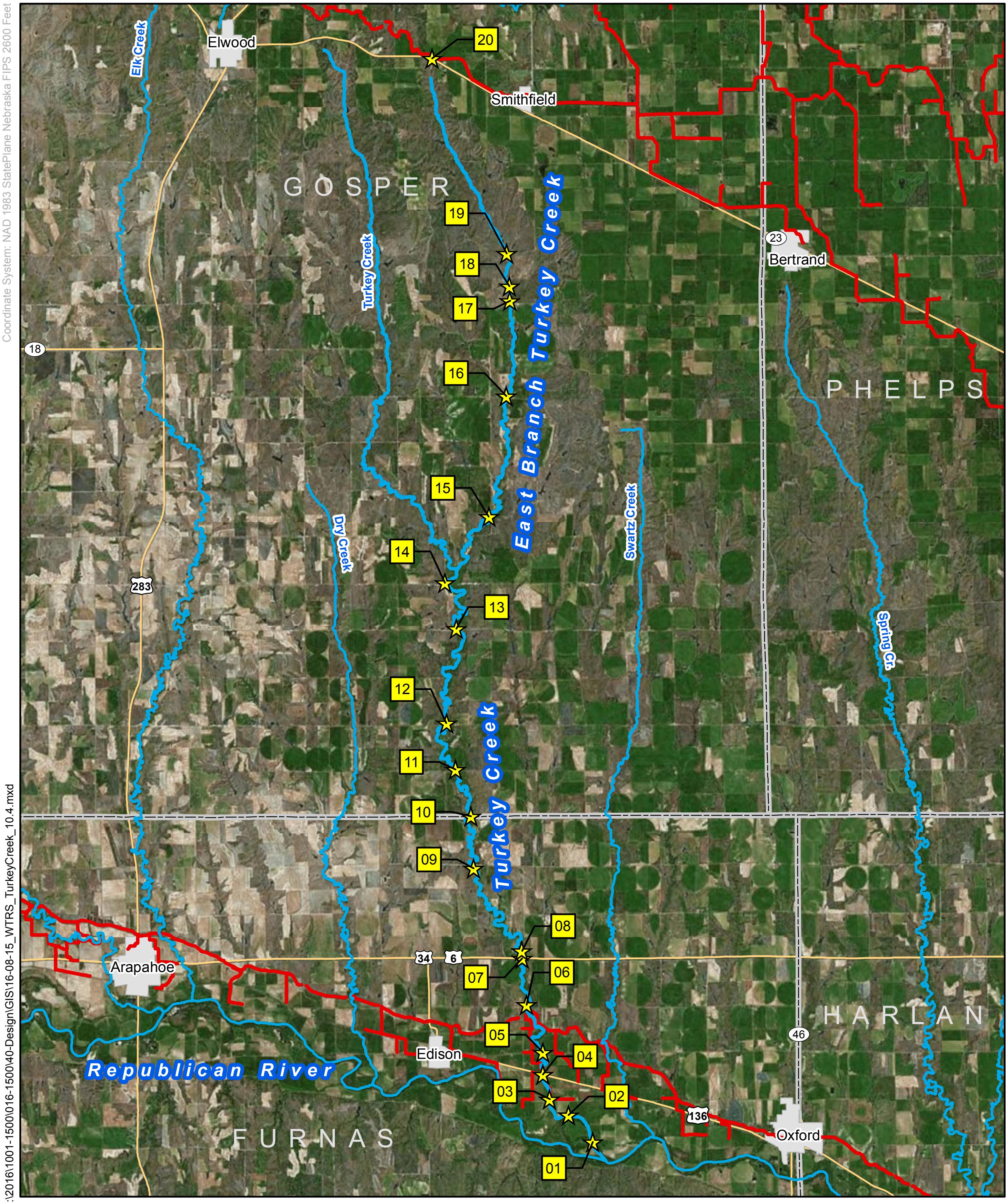
Jurisdictional Determination

Based on the review of existing resources and the site visit, it is likely that all wetlands and stream channels are likely jurisdictional. Although only the Corps can make a determination on whether a feature is jurisdictional or not, it appears that all wetlands and stream channels have a significant nexus, or connection, to the Republican River, a Traditional Navigable Water (TNW) which is a known Waters of the U.S. Therefore, these features would fall under the jurisdiction of the Corps.

The Pond at Site 19 is likely not jurisdictional because there were no wetlands or stream channel on the downstream end of the culvert. Therefore, this feature is likely isolated and would then be a Waters of the State and would fall under the jurisdiction of the Nebraska Department of Environmental Quality (NDEQ).

Permitting Recommendations

If any of these structures need to be replaced or modified, a Wetland Delineation Report will be completed for those structures only. Depending on the amount and type of impacts the permit may be a Nationwide Permit which may or may not require notifying the Corps. If impacts to wetlands exceed 0.5 acre or if impacts to stream channels exceed 300 feet or cause 100 feet of loss or more, an Individual Permit would be required.



Data Source: ESRI World Imagery

N

0 7,600 15,200
Feet

Sites
Streams
Canals

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Site Visit
Location Map

OLSSON ASSOCIATES

Coordinate System: WGS 1984 ARC System Zone 11

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Data Source: ESRI World Imagery

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Feet

OLSSON
ASSOCIATES

Channel

Wetlands

Pond

Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 01

Data Source: ESRI World Imagery

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Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 02

Data Source: ESRI World Imagery

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Feet

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ASSOCIATES

Channel
Wetlands
Pond
Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 03

Coordinate System: WGS 1984 ARC System Zone 11

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Channel
Wetlands
Pond
Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 04

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Data Source: ESRI World Imagery

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Channel
Wetlands
Pond
Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 05

Coordinate System: WGS 1984 ARC System Zone 11

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OLSSON
ASSOCIATES

Channel

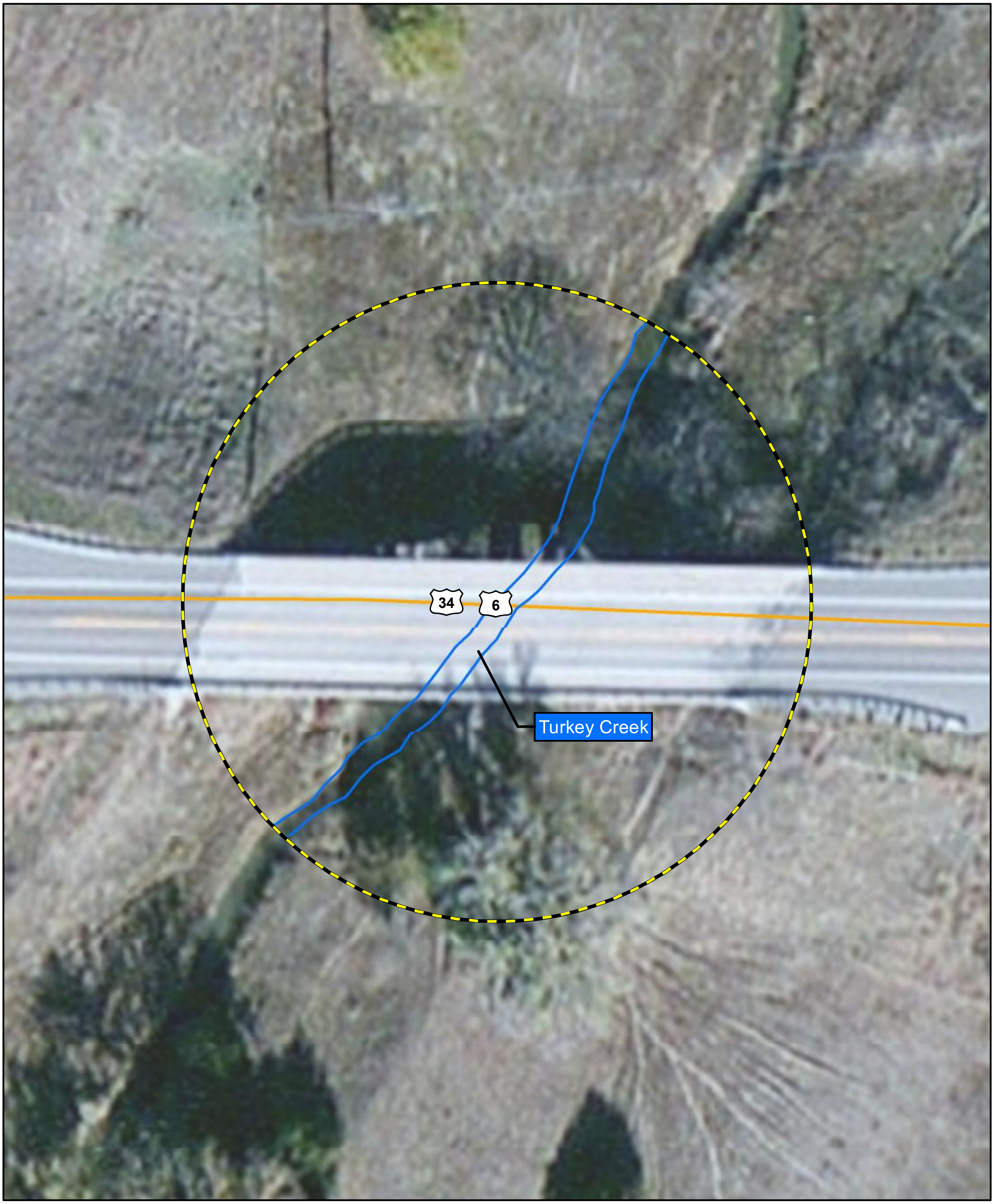
Wetlands

Pond

Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 06

Coordinate System: WGS 1984 ARC System Zone 11



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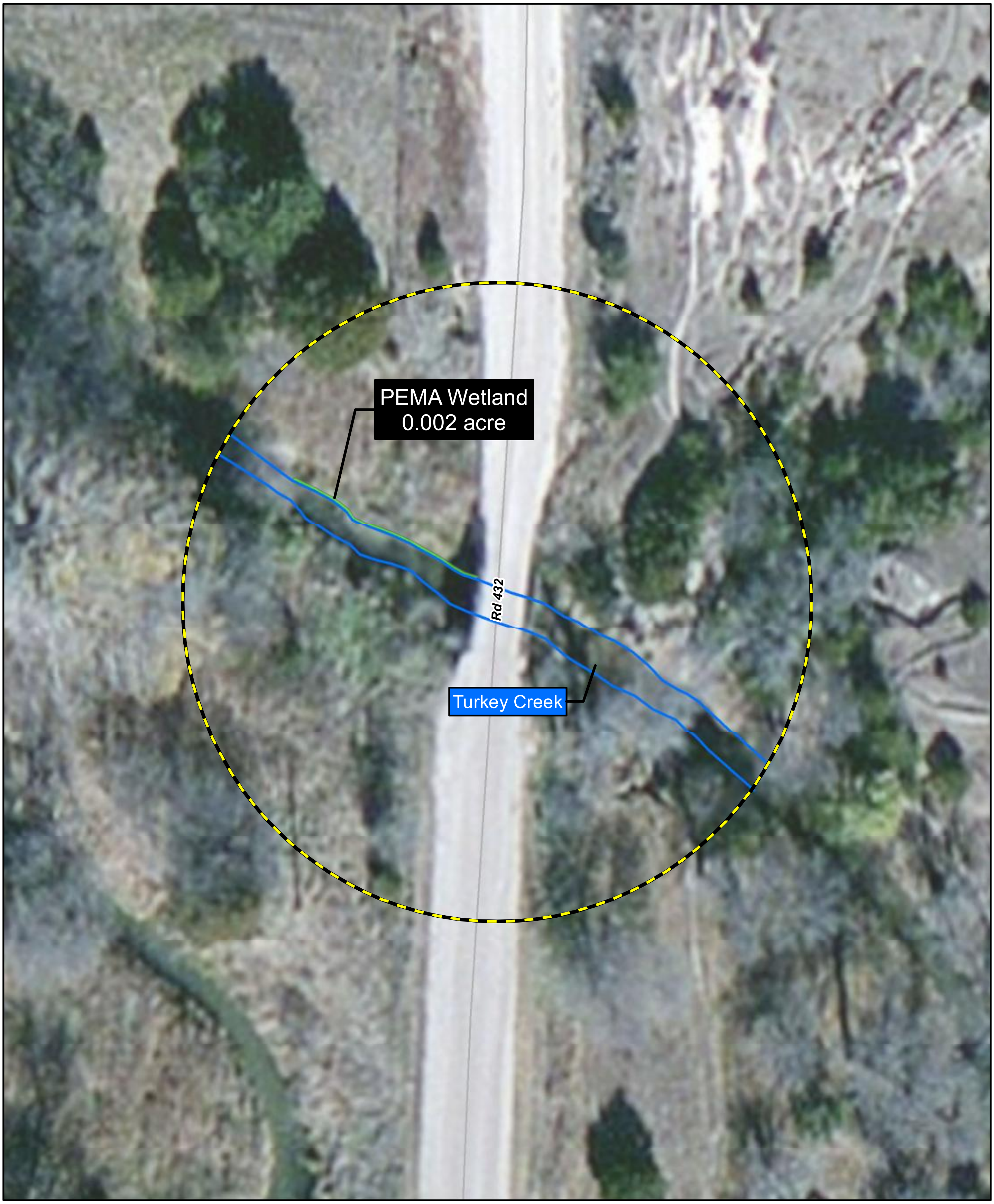
Channel
Wetlands
Pond
Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 07



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Channel

Wetlands

Pond

Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 08

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Coordinate System: WGS 1984 ARC System Zone 11

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Channel

Wetlands

Pond

Study Area

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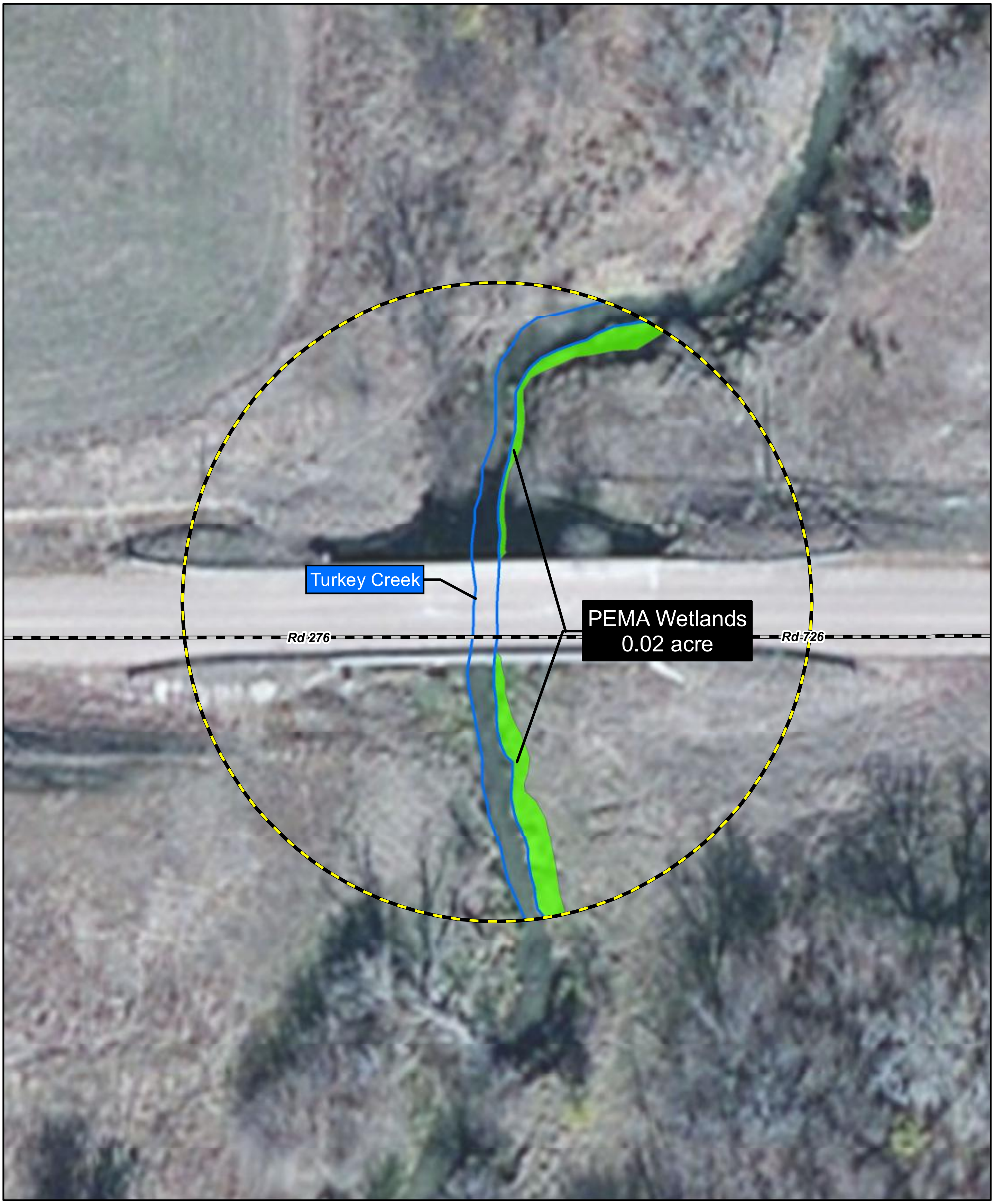
Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 09



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Channel
Wetlands
Pond
Study Area

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Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 10

Coordinate System: WGS 1984 ARC System Zone 11

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Channel
Wetlands
Pond
Study Area

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Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 11

Coordinate System: WGS 1984 ARC System Zone 11

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Channel

Wetlands

Pond

Study Area

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Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 12

Data Source: ESRI World Imagery

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Feet

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Channel
Wetlands
Pond
Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 13

Coordinate System: WGS 1984 ARC System Zone 11

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Feet

Channel

Wetlands

Pond

Study Area

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Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 14

Data Source: ESRI World Imagery

N

0 20 40
Feet

OLSSON ASSOCIATES

Channel
Wetlands
Pond
Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 15

Coordinate System: WGS 1984 ARC System Zone 11

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Feet

OLSSON ASSOCIATES

Channel
Wetlands
Pond
Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 16

Coordinate System: WGS 1984 ARC System Zone 11

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OLSSON ASSOCIATES

Channel

Wetlands

Pond

Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 17

Coordinate System: WGS 1984 ARC System Zone 11

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Feet

OLSSON ASSOCIATES

Channel

Wetlands

Pond

Study Area

Platte River Diversion
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Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 18

Coordinate System: WGS 1984 ARC System Zone 11

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Data Source: ESRI World Imagery

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Feet

Channel

Wetlands

Pond

Study Area

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Platte River Diversion
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Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 19

Coordinate System: WGS 1984 ARC System Zone 11

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Data Source: ESRI World Imagery

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Feet

OLSSON ASSOCIATES

Channel

Wetlands

Pond

Study Area

Platte River Diversion
Wetland Delineation Site Visit
Gosper/Furnas Counties, Nebraska
Delineation Maps
Site 20