Contents

Appendix D1 Hydrology and Hydraulics 1-1
D1.1 Introduction 1-2
D1.2 Data Collection 1-2
D1.3 Watershed Characteristics and Modeling Approach 1-5
D1.3.1 Watershed Characteristics 1-5
D1.3.2 Modeling Approach 1-5
D1.4 Existing Conditions 1-6
D1.4.1 Hydrologic Modeling 1-6
D1.4.2 Hydraulic Modeling 1-8
D1.5 Alternative Screening 1-14
D1.6 Measure Analyses 1-16
D1.6.1 Restoration or Enhancement of Existing On-Channel Storage 1-16
D1.6.2 New On-Channel Storage 1-17
D1.6.3 Off-Channel Storage 1-18
D1.6.4 Channel Improvements, Berms, and Diversions 1-20
D1.7 References 1-24
D1.8 Figures 1-25
D1.9 Tables 1-36
D1.10 Charts 1-50
D1.11 Proposed Improvement Geometries 1-54

Appendix D2 Aquatic Resources Avoidance, Minimization, and Mitigation 2-57
D2.1 Regulatory Context 2-58
D2.1.1 Section 404 of the Clean Water Act 2-58
D2.1.2 NRCS Policy 2-59
D2.1.3 Regulatory and Policy Crosswalk 2-59
D2.2 Avoidance Alternatives Analysis 2-60
D2.2.1 Spring Creek Watershed Range of Alternatives and Screening 2-60
D2.3 Wetlands and Aquatic Resource Impact Minimization 2-72
D2.3.1 Wetland and Aquatic Resource Impacts 2-72
D2.3.2 Minimization 2-72
D2.4 Mitigation 2-73

Appendix D3 Economics Technical Memorandum 3-75
D3.1 Introduction 3-76
D3.2 Federal Guidelines of National Economic Efficiency Analysis of Flood Mitigation and Groundwater Recharge Measures 3-76
D3.3 Ecosystem Services Evaluated 3-77
D3.3.1 Ability to Characterize, Quantify, and Monetize Services 3-78
D3.3.2 Metrics To Evaluate Services 3-78
D3.3.3 Prioritizing Services 3-78
D3.3.4 Summary 3-79

D3.4 National Economic Efficiency Benefit-Cost Analysis Data and Methodology 3-79
D3.4.1 Project Description 3-80
D3.4.2 Future Without Federal Investment 3-81
D3.4.3 Action Alternatives 3-81
D3.4.4 Benefit Analysis 3-82
D3.4.5 Estimated Costs 3-86
D3.4.6 Comparison of Costs and Benefits and the NEE Plan 3-88
D3.5 Appendix D References 3-88

Appendix D4 Special Status Species Review 4-90
D4.1 Introduction 4-91
D4.2 Fish and Aquatic Species 4-92
D4.3 Terrestrial Wildlife 4-94
D4.4 Special Status Species 4-99
D4.5 Determination of Effects and Conservation Measures 4-104

Figures

Figure D1-1 1-26
Figure D1-2 1-27
Figure D1-3 1-28
Figure D1-4 1-29
Figure D1-5 1-30
Figure D1-6 1-31
Figure D1-7 1-32
Figure D1-8 1-33
Figure D1-9 1-34
Figure D1-10 1-35
Figure D3-1. Ecosystem Services for Flood Damage Reduction 3-78

Tables

Table D1-1. Data Collection Summary 1-2
Table D1-2 1-37
Table D1-3 1-38
Table D1-4. Page 1 of 3 1-39
Table D1-5. Page 2 of 3 1-40
Table D1-6. Page 3 of 3 1-41
Table D1-7. Page 1 of 2 1-42
Table D1-8. Page 2 of 2 1-43
Table D1-9. Page 1 of 4 1-44
Table D1-10. Page 2 of 4 1-45
Table D1-11. Page 3 of 4 1-46
Table D1-12. Page 4 of 4 1-47
Table D1-13 1-48

Table D1-14 1-49
Table D1-15 1-55
Table D1-16 1-56
Table D2-1. Cozad Alternatives Analysis. Project Purpose – Flood Damage Reduction. Project Need – Provide protection from a 10-year precipitation event to minimize the current risk of flooding and reduce flood-related damages to public and private infrastructure Potential Flood Control Alternatives 2-61
Table D2-2. Lexington Alternatives Analysis. Project Purpose – Flood Damage Reduction. Project Need – Provide protection from a 25-year precipitation event to minimize the current risk of flooding and reduce flood-related damages to public and private infrastructure Potential Flood Control Alternatives 2-67
Table D2-3. Spring Creek Delineation Resource Impacts 2-72
Table D3-1. Estimated Average Annual Structural Cost Avoidance Benefits. Spring Creek Watershed, Nebraska (FY 2024 $s, 2.75% Discount Factor). 3-83
Table D3-2. Estimated Average Annual Agricultural Damage Reduction Benefits. Spring Creek Watershed, Nebraska (FY 2024 $s, 2.75% Discount Factor). 3-84
Table D3-3. Estimated Average Annual NEE Damage Reduction Benefits. Spring Creek Watershed, Cozad, Nebraska (FY 2024 $s, 2.75% Discount Factor) 3-85
Table D3-4. Estimated Average Annual NEE Damage Reduction Benefits. Spring Creek Watershed, Lexington NE, Nebraska (FY 2024 $s, 2.75% Discount Factor) 3-85
Table D3-5. Estimated Average Annual NEE Damage Reduction Benefits. Spring Creek Watershed, Lexington SW, Nebraska (FY 2024 $s, 2.75% Discount Factor) 3-86
Table D3-6. Estimated Installed Spring Creek Watershed, Nebraska, (FY 2024 $s, NWPM 506.11) 3-86
Table D3-7. Comparison of NEE Benefits and Costs Spring Creek Watershed, Nebraska (FY 2024 Dollars, 2.75% Discount Factor). 3-88
Table D4-1. Spring Creek Watershed Effect Determination and Conservation Conditions for Tier 1 Fish and Aquatic Species 4-92
Table D4-2. Spring Creek Watershed Effect Determination and Conservation Conditions for Tier 1 Terrestrial Species 4-94
Table D4-3. Spring Creek Watershed Endangered and Threatened Species Review 4-99

Appendix D1 Hydrology and Hydraulics

Hydrology and Hydraulics

To:	CPNRD
From:	HDR
Project:	Spring and Buffalo Creeks Watershed Plan - Environmental Assessment
Date:	Wednesday, May 15, 2024

D1.1 Introduction

Initially, the study area, as presented in the July 2019 application, contained a total of 266,870 acres and encompassed the Spring and Buffalo Creeks Watersheds. After project initialization, the contributing drainage area, identified through 1-meter-resolution LiDAR terrain data and preliminary hydrologic/hydraulic modeling, was analyzed. Based on this analysis, the study area was found to be 354,658 acres, exceeding the Watershed and Flood Prevention Operations program's 250,000-acre limit. The Spring and Buffalo Creeks Watersheds were divided into two separate project areas and analyzed separately. This technical memorandum documents the hydrologic and hydraulic analyses performed prior to the Spring Creek/Buffalo Creek division and therefore contains data in support of watershed plan alternative development for both. The memo documents data collection, watershed characteristics and modeling approach, existing conditions hydrologic and hydraulic modeling, alternative screening, and alternative analyses.

D1.2 Data Collection

Various documents and datasets were collected to support the hydrologic and hydraulic modeling and alternative development. A data collection summary is provided in Table D1-1.

Table D1-1. Data Collection Summary

Category	Data	Source	Notes
Reports and Studies	Flood Insurance Study – Buffalo County, Nebraska, and Incorporated Areas	FEMA 2010	Brief mention of Spring Creek in relation to study of Elm Creek.
Reports and Studies	Flood Insurance Study – Dawson County, Nebraska, and Incorporated Areas	FEMA 2011	Documents a detailed study of Spring Creek from US 30 (downstream) to County Road 431 (upstream). Includes limited discussion of other streams of interest.
Reports and Studies	Watershed Work Plan for Spring Creek Watershed, August 1965	CPNRD 1965	1965 Plan has 11 Flood Retarding Structures (FRS), 33.7 miles of channel improvements and 1.77 miles of dike.

Category	Data	Source	Notes
Reports and Studies	Supplemental Work Plan for Spring Creek Watershed, January 1978	CPNRD 1978	1978 Plan replaced six of the original FRS with one, making a revised total of 6 FRS. Updated plan also reduced the length of channel improvements and dike construction.
Reports and Studies	Buffalo Creek Watershed Feasibility Report, June 1977	Kirkham Michael & Associates 1977	Recommended plan includes structures B-1, B-3, C-5, F-3, F-7, F-6, F-5, 11, 10, 15, 22 and 21.
Reports and Studies	1980 Spring Creek Lower Watershed Project Application and Feasibility Report for Creek Bank and Streambed Stabilization and Flood Control	Schemmer Associates, Inc. 1980	1980 Plan included a levee system, designed to protect Lexington from a 100-year event, and Spring Creek channel improvements to convey the 2-year event. Obtained from City of Lexington.
Reports and Studies	CPNRD Integrated Management Plan (IMP)	CPNRD 2019	Joint Integrated Water Resources Management of Over-appropriated Portions of the Platte River Basin.
Design and As-Built Plans	Buffalo Creek Watershed Dam Drawings (B-1, B-3, C-5, F-1, F-3, F-5, F-7)	CPNRD 2020a	As-builts and design plans (dates vary), received from CPNRD in 2020.
Design and As-Built Plans	Spring Creek Watershed Flood Retarding Structure 19-B Drawings	CPNRD 2020b	As-built plans received from CPNRD in 2020.
Design and As-Built Plans	Spring Creek Watershed Dam Drawings (9-A, 9-B, 11-A, 18-A, 25-A)	NRCS 2020	As-builts and design plans (dates vary), received from NRCS in 2020.
Design and As-Built Plans	NDNR Dam Inspection Reports	NDNR 2020	Used to support hydrologic modeling of FRS spillways.
Design and As-Built Plans	Union Pacific (UP) Right-of-Way Maps, Station Maps, and Condensed Profiles	UP 2021	Used for hydraulic structure locations, types, and dimensions.
Field Reconnaissance	Hydraulic Structure Data	HDR 2021a	Basic dimensions were obtained for accessible structures at key locations. Field reconnaissance in and near Cozad and Lexington was performed on June 28-29, 2021.

Category	Data	Source	Notes
Field Reconnaissance	Hydraulic Structure Data	HDR 2021b	Basic dimensions were obtained for accessible structures at key locations. Field reconnaissance in and near Overton was performed on September 27, 2021.
Hydrology and Hydraulics	2016 National Land Cover Dataset (NLCD)	USGS 2016	Used to develop loss parameters and roughness.
Hydrology and Hydraulics	NOAA Atlas 14 Precipitation Data	NOAA 2020	Used for meteorologic inputs.
Hydrology and Hydraulics	NRCS SSURGO Soils Data	NRCS 2020	Used to develop loss parameters.
Hydrology and Hydraulics	National Hydrographic Dataset	USGS 2020	Streams, canals, floodplains, and stream gages for watershed area.
Hydrology and Hydraulics	NDNR Dam Inventory Application	NDNR 2020	Dam locations and data for Custer, Dawson, and Buffalo Counties
Hydrology and Hydraulics	General Highway Maps	NDOT 2020a	General highway maps for Custer, Dawson, and Buffalo Counties, prepared in 2005, 2016, and 2014, respectively. Used for hydraulic structure locations.
Hydrology and Hydraulics	NebraskaMAP Bridge Dataset	NDOT 2020b	Available hydraulic structure data for structures with >20 ft span for Custer, Dawson, and Buffalo Counties (accessed online).
Hydrology and Hydraulics	Historic Construction Plans and As-Built Drawings	NDOT 2020c	Road improvement plans for multiple segments along US 30, dated between 1985 and 1999.
Hydrology and Hydraulics	Historic Construction Plans and As-Built Drawings	NDOT 2021	Road improvement plans for US 283 between I-80 and Lexington, dated 1991.
Reference Data and Terrain	Aerial Imagery	NAIP 2018	For Custer, Dawson, and Buffalo Counties
Reference Data and Terrain	Combined 2009, 2012, and 2017 1-meter LiDAR Data	NRCS 2020	For Custer and Dawson Counties
Reference Data and Terrain	Combined 2009, 2012, and 2017 1-meter LiDAR Data	CPNRD 2020	For Buffalo and Dawson Counties
Reference Data and Terrain	2019 Parcel Data	gWorks 2021	Parcel Valuation Data

D1.3 Watershed Characteristics and Modeling Approach

This section describes the characteristics of the Spring-Buffalo Creek watershed and the hydrologic and hydraulic modeling approach that was developed based on the watershed characteristics and resultant flow patterns.

D1.3.1 Watershed Characteristics

The Spring-Buffalo Creek watershed is composed of two distinct topographic regions (Figure D1-1). The upstream portion of the watershed is characterized by hilly terrain with moderate to steep slopes. The upstream portion is referred to herein as the highlands. The downstream portion of the watershed is in the Platte River valley and is characterized by generally flat terrain. The downstream portion is referred to herein as the lowlands. The highlands are predominantly herbaceous rangeland. The lowlands are predominantly cultivated crops but also include developed areas in and near Cozad, Lexington, and Overton.

The shallow topographic relief in the lowlands results in complex flow patterns during rainfall-runoff events. In many locations, existing topographic and/or man-made features result in bifurcating flow paths. For example, in some stream reaches overbanking flows are not conveyed in floodplain areas parallel to the stream channel but rather flow overland to the east-southeast. Figure D1-2 shows one location where some Stump Ditch flow overtops the stream bank and is directed to the Spring Creek Subwatershed. Another type of flow split occurs at various US 30 and UP stream and ditch crossings. Some of the US 30 and UP bridges and culverts have limited capacity relative to higher magnitude flood event flows. This results in a portion of the flow being conveyed across the US 30 and UP corridors to the south. Excess flow is conveyed to the east-southeast along the north side of the corridor, crossing natural subbasin boundaries due to the prevailing slopes and the shallow topographic relief.

D1.3.2 Modeling Approach

A modeling approach was formulated considering the disparate characteristics of the highland and lowland areas and the analysis objectives. Traditional hydrologic modeling was performed for the highlands, where the topographic relief allowed for delineation of subbasins and parameter development for defined stream channels. The hydrologic modeling also allowed for the incorporation of flood retarding structures.

In the lowlands, traditional hydrologic modeling was not practical. The shallow topographic relief proved to be extremely problematic with respect to subbasin delineation, and the numerous flow splits could not be modeled in an efficient or accurate manner that would yield meaningful results. Similarly, the complex flow patterns were not conducive to one-dimensional (1D) hydraulic modeling. Based on the characteristics of the lowlands and its runoff patterns, a two-dimensional (2D) hydraulic modeling approach was adopted. Output hydrographs from the hydrologic modeling of the highlands were applied as inflow hydrographs at the upstream boundary of the lowlands, and rainfall excess was applied to the 2D model domain. The

hydrologic and hydraulic models are discussed in greater depth in Section D1.4, and the modeling performed to support alternative analyses is discussed as applicable in Section D1.6.

D1.4 Existing Conditions

Existing conditions hydrologic and hydraulic modeling was performed to assess flood-prone areas and to establish a baseline condition to which the proposed alternatives could be compared.

Prior to initiating hydrologic and hydraulic modeling, it was necessary to perform an initial watershed and subwatershed delineation to define model extents. A combined terrain composed of 2009, 2012, and 2017 LiDAR datasets was prepared. Based on the input datasets, this terrain raster had 1-meter by 1-meter cells. Due to the size of the Spring-Buffalo Creek Watershed – totaling over 550 square miles – it was necessary to resample the terrain to 10-foot by 10-foot cell spacing for the initial delineation which was performed using ArcGIS tools. The initial delineation resulted in reliable subwatershed boundaries in the highlands. In the lowlands, defining subwatershed boundaries required inspection of historic boundaries, USGS topographic mapping, and initial delineation outputs. Additionally, an initial 2D rainfall-excess-on-grid hydraulic model was used to observe flow patterns and inform subwatershed boundaries. The Spring-Buffalo Creek watershed and its subwatersheds are shown in Figure D1-3.

D1.4.1 Hydrologic Modeling

The U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center's Hydrologic Modeling System software, HEC-HMS, was used to perform hydrologic modeling. Version 4.6 was the current version at the time the hydrologic modeling commenced and was used throughout. Hydrologic model input parameter development for the existing conditions model is addressed in the sections below.

Subbasin Delineation

Subbasin delineation for the highlands was performed using ArcGIS 10.7.1 tools and the LiDAR terrain datasets obtained from the NRCS and the CPNRD. As described above, the combined terrain was resampled to a cell size of 10 feet by 10 feet to facilitate the delineation process. The automated workflow used several Spatial Analyst hydrology tools including flow direction, sink, fill, flow accumulation, snap pour point, and watershed.

Subbasin outlets were selected considering stream confluences, flood retarding structures, and roadway embankments, with a target subbasin area of less than 12 square miles. The subbasins are shown in Figure D1-4.

Based on its homogeneity, a single subbasin was modeled for the lowlands to calculate the rainfall excess to be applied to the 2D hydraulic model domain.

Loss Method

The SCS curve number method was used as the loss method for all subbasins. This method considers land use (or land cover) and hydrologic soil groups (HSGs) to determine the initial abstraction and rainfall excess from each subbasin. The 2016 National Landcover Database (NLCD) was used to assess land use characteristics. Land cover is shown in Figure D1-5. The NLCD classifications were correlated to cover descriptions in TR-55 (NRCS 1986).

NRCS SSURGO soils data were used to determine the HSGs. The predominant HSG in the highlands is B. In the lowlands, HSGs B and C are prevalent. HSGs are shown in Figure D1-6. Using TR-55 tables, curve numbers were identified for each land use and soil combination. Composite curve numbers were then calculated for each subbasin. In the highlands, the subbasin curve numbers range from 61 to 73. The curve number calculated for the lowlands is 78. Table D1-2 documents the curve numbers for each of the subbasins.

Transform

The SCS Unit Hydrograph method was selected based on the availability of data to support parameter development. Subbasin lag times were calculated using the SCS lag equation. National Hydrography Dataset (NHD) flowlines were used where available and extended upstream to determine watershed (subbasin) hydraulic lengths. Average watershed slope was calculated using ArcGIS tools, and potential watershed storage, a function of curve number, was also determined. These inputs and the calculated lag times are documented in Table D1-2.

Routing Reaches

The Muskingum Cunge method was selected for reach routing. Cross sections were extracted from the LiDAR terrain using the ArcGIS 3D Analyst tool and were used to identify representative trapezoidal channel parameters for each routing reach. Table D1-3 documents the routing reach parameters.

Reservoir Routing

Design and as-built plans for existing flood retarding structures in the Spring Creek and Buffalo Creek Subwatersheds were provided to HDR by the CPNRD and the NRCS (CPNRD 2020a, CPNRD 2020b, NRCS 2020). Stage-area curves were taken from the reservoir capacity tables in the historic plans. Stage-discharge curves were generated using plan data to perform spreadsheet calculations that account for pipe, riser, port opening, and auxiliary spillway flows. The spreadsheet calculations were performed in a manner that checks for various hydraulic controls through the range of potential stage conditions. The initial condition of each reservoir was assumed to be the normal pool elevation based on the lowest opening (pipe, port, or riser crest). Small diameter (i.e., less than 18-inch diameter) drawdown pipes were assumed to be closed or non-functional. Reservoir routing tables are included in this appendix: stage-area-storage curves are presented in Table D1-4, Table D1-5, and Table D1-6; a principal and auxiliary spillway summary is included as Table D1-7 and Table D1-8; and the resulting elevation-discharge curves are included as Table D1-9, Table D1-10, Table D1-11, and Table D1-12.

Meteorologic Model

For application of precipitation data to the model, the highlands were divided into its three major basins: Stump Ditch, Spring Creek, and Buffalo Creek. The centroid of each of these basins was calculated in ArcGIS, and NOAA Atlas 14 precipitation data for these centroids were obtained and applied to the respective subbasins. The precipitation data are documented in Table D1-13. A frequency storm distribution and a 24-hour storm duration were selected. It is noted that the frequency storm and SCS Type II distributions are similar, but the frequency storm incorporates additional location-specific depth-duration data.

Control Specifications

The hydrologic model runs simulate a 72-hour period with a 5-minute time interval. The 72-hour duration was necessary for consistency with the 2D hydraulic modeling. Due to the size of the watershed and the travel time – particularly across the flat 2D domain – the 72-hour duration was selected to capture peak flows at areas of interest in the lower portion of the watershed.

D1.4.2 Hydraulic Modeling

The USACE Hydrologic Engineering Center's River Analysis System software, HEC-RAS, was used to perform hydraulic modeling. The 2D hydraulic model was initially developed using HEC-RAS 5.0.7, which was the current version at the time of initiation. The model was transitioned to the newer version HEC-RAS 6.0 after its release in May 2021 to capitalize on new hydraulic structure and terrain modification capabilities.

Model Domain

The lowland area of the Spring-Buffalo Watershed was modeled in a single model domain. This modeling approach was based on the shallow topographic relief and existing topographic and/or man-made features that result in bifurcating flow paths. A few examples are provided below:

- The Stump Ditch reach upstream of the Cozad Canal frequently overtops in an area referred to as "Hay-Alfalfa Valley". Flows leaving the stream channel to the left bank side (i.e., east side) are conveyed across County Road 421 and enter the Spring Creek subwatershed.
- Shallow topographic relief exists in the area where highland flows and Lateral Number 20 flows enter the lowlands near the Spring Creek and Buffalo Creek subwatershed boundary. Due to the terrain and the limited channel capacity, overtopping from the Spring Creek subwatershed to the Buffalo Creek subwatershed occurs for some rainfall-runoff events.
- Shallow topographic relief exists along Spring Creek downstream of Lexington. In some locations, flows leaving the stream channel to the left bank side (i.e., the northeast side) are conveyed from the Spring Creek subwatershed to the Elm Creek-Platte River subwatershed.

The shallow topographic relief and the bifurcating flow paths make traditional subbasin delineation impractical. A traditional subbasin approach would result in defined locations to apply peak discharges or inflow hydrographs to a desired set of waterways. Initial modeling

demonstrated that multiple flow sources and flow paths influence flood-prone areas. Identifying locations for flow application would over-simplify the representation of these flow sources and paths. Therefore, a rainfall-excess-on-grid approach was adopted. This approach is described further in the Boundary Conditions section.

The model domain totals 300 square miles (see Figure D1-7). The northern boundary of the model domain follows the following features (described generally from west to east): County Road 771 (from the Spring Creek subwatershed boundary to County Road 418), natural subbasin boundaries (from County Road 418 to Spring Creek), Gothenburg Canal (from Spring Creek to Buffalo Creek), natural subbasin boundaries (from Buffalo Creek to Crooked Creek), and Dawson County Canal (from Crooked Creek to the Buffalo Creek subwatershed boundary). The western boundary of the model domain is consistent with the western boundary of the Spring Creek subwatershed. The southern boundary is the westbound Interstate 80 embankment. North of US 30, the eastern model domain boundary is consistent with the Buffalo Creek subwatershed boundary. The model domain then follows US 30 past the Elm Creek crossing and the Village of Elm Creek before turning to the south and terminating near Birch Road. To include the downstream reach of Buffalo Creek, the model domain includes a portion of Elm Creek; however, Elm Creek flows were not applied to the model domain.

Boundary Conditions

Three types of boundary conditions were applied to the model; these include flow hydrographs, precipitation (in this case, rainfall excess), and normal depth. These three types of boundary conditions are discussed further in the following paragraphs.

Flow Hydrographs

Runoff from the highlands was applied to the 2D model domain through 25 boundary condition lines (see Figure D1-7). Flow hydrographs from corresponding junctions in the HEC-HMS model were applied at each of the 25 locations by referencing the HEC-HMS output DSS file. Due to terrain features (such as canal embankments) and hydraulic structures near some inflow hydrograph locations, most of the boundary condition lines were placed just inside the model domain's upstream boundary to apply the flow to defined conveyance channels.

Precipitation

Spatially varying infiltration was not accommodated by HEC-RAS 5.0.7 tools. Based on the functionality available at the time modeling was initiated, a single subbasin, rainfall-excess-on-grid approach was adopted. The 2D hydraulic model domain is predominantly composed of cultivated crop areas with HSG B and C classifications. Cultivated crop areas account for 86% of the model domain. Considering the model functionality and the generally homogeneous characteristics, the 2D model domain was modeled as a single subbasin in HEC-HMS to calculate rainfall excess for application in the HEC-RAS 5.0.7 model. This approach was retained when the hydraulic model was transitioned to HEC-RAS 6.0.

Normal Depth

As noted previously, the model domain's southern boundary is the westbound Interstate 80 (I-80) embankment. While the model domain extends to this feature, the primary area of hydraulic modeling interest is in and near the municipal areas of Cozad, Lexington, and Overton. Detailed modeling of the I-80 corridor was not imperative, and hydraulic structure data along I-80 was limited. Additionally, it is noted that analysis of the Platte River was outside of the scope which pertains to the Spring-Buffalo Creek Watershed. A simplified approach was therefore adopted. Normal depth boundary conditions were established immediately upstream of 11 I-80 hydraulic structure locations to allow flow to exit the model domain. Additionally, a normal depth boundary condition was applied to the eastern boundary of the model domain near Birch Road, southeast of the Village of Elm Creek. These outflow boundary condition lines are shown in Figure D1-7.

Terrain and Terrain Modifications

A composite terrain was prepared for use in the hydraulic model. Due to the watershed area spanning multiple counties, the most recent LiDAR data varied across the 2D domain. A combination of 2009, 2012, and 2017 LiDAR datasets was used to develop the base terrain. The LiDAR data used has 1-meter cell spacing. Modifications were made to the base terrain as part of the hydraulic structure modeling approach. These modifications are discussed in the Hydraulic Structures section of this memorandum.

2D Flow Area

A nominal cell size of 200 feet by 200 feet was applied to the 2D flow area. As a high resolution subgrid model, HEC-RAS uses the detailed underlying terrain – in this case the 1-meter by 1-meter LiDAR – to develop geometric and hydraulic property tables for cells and cell faces. Breaklines were used to represent hydraulically significant features such as roadway embankments, railroad embankments, and berms adjacent to canals and other waterways. Cell spacing along the breaklines ranged from 40 feet to 200 feet, with spacing repeated adjacent to the breaklines considering nearby features and cell orientation with respect to flow paths. Breaklines were not used at every embankment or berm in the 300-square mile model domain. Rather, the location and application of breaklines was developed considering hydraulic significance and the hydraulic structure modeling approach, which is discussed further in the Hydraulic Structures section.

The land cover layer was created using 2016 NLCD raster data, with a land cover classification assigned to each 30-meter by 30-meter raster cell. Manning's n values for each NLCD classification were established based on the HEC-RAS Hydraulic Reference Manual and regional modeling experience. NLCD classifications and assigned Manning's n values are documented in Table D1-14. Manning's n override polygons were created for major streams and waterways including Stump Ditch, Drainage Ditch No. 4, Spring Creek, Drainage Ditch No. 1, and Buffalo Creek. Using Cowan's procedure and field observations, a Manning's n value of 0.04 was selected for these channels.

Hydraulic Structures

Numerous hydraulic structures exist in the 2D model domain. An approach for modeling these hydraulic structures was developed considering the domain size; modeling objectives; structure locations, sizes, and types; representation of channels in the existing terrain; and data availability. The approach also considered available HEC-RAS 2D model capabilities.

The domain encompasses approximately 300 square miles; modeling of all hydraulic structures was neither practical nor possible given data limitations. Modeling needs and priorities were therefore considered in evaluating and selecting methods for representing hydraulic structures. As documented previously, traditional subbasin delineation was problematic based on the shallow topographic relief and the influence of natural and man-made features resulting in flow splits. Accordingly, some of the model domain is included for the hydrologic purpose of conveying flow to areas of hydraulic modeling interest. A simplified hydraulic structure modeling approach is appropriate and reasonable for areas of the 2D modeling that were relied on for hydrologic purposes, while greater modeling detail is required in areas where a comparison of existing and proposed conditions is required to evaluate flood damage reduction.

Hydraulic structure groups and their modeling approaches are described below. The approaches are general in nature and required evaluation of available data, inspection of hydraulic performance, and engineering judgment. Adjustments to the general approaches were required in some cases to improve model stability. Due to HEC-RAS 5.0.7 functionality limitations, bridges could not be modeled explicitly. However, this limitation was removed with the release of HEC-RAS 6.0, and some bridges that had previously been modeled as culverts were updated.

Group A – Municipal Limits and Nearby Areas

Group A includes the structures within the municipal limits of Cozad, Lexington, and Overton as well as nearby areas affected by evaluated flood control measures. These structures have the greatest influence on flood damage reduction, warranting a more refined modeling approach. Initial data sources for this group included General Highway Maps (NDOT 2020a), the NebraskaMAP Bridge Dataset (NDOT 2020b); historic construction plans and as-built drawings (NDOT 2020c, NDOT 2021); and UP drawings (UP 2021). In June, HDR personnel performed field reconnaissance and took basic hydraulic structure opening measurements along significant conveyance paths in Cozad and Lexington (HDR 2021a). In September, data was similarly collected in Overton (HDR 2021b). Hydraulic structures in Group A are generally modeled as bridges and culverts. A small number of structures for which data was not available were modeled as terrain modification openings as described under Group C. The structures modeled in this manner are located away from primary conveyance paths and therefore convey only local drainage.

While data was available for most Group A structures from one or more of the sources noted, there are limitations to the planning-level modeling. These limitations apply to all hydraulic structure groups. The model terrain is composed of LiDAR datasets. The accuracy of the LiDAR

in channel areas may be limited due to water and/or thick vegetation. To function properly in the 2D hydraulic model, culvert inverts are required to be placed above the minimum terrain elevation of the cells at the entrance and exit points. While some data sources provided invert elevations, the vertical datum was not always known. For other data sources including HDR's field reconnaissance, opening dimensions were measured but elevations were not surveyed. Based on these data limitations, hydraulic structure openings were established relative to the terrain.

Group B – US 30 and UP Corridor

Group B includes hydraulic structures along the US 30 and UP corridor that are outside of the municipal limits and nearby areas (see Group A). Due to the influence of the highway and railroad embankments on flow patterns in the watershed, these hydraulic structures are generally modeled as bridges and culverts. Available data for these structures were obtained from the NebraskaMAP Bridge Dataset (NDOT 2020b); historic construction plans and as-built drawings (NDOT 2020c, NDOT 2021); and UP right-of-way maps, station maps, and condensed profiles (UPRR 2021). UP data was limited, and field reconnaissance on UP right-of-way was not feasible for this watershed planning effort. Therefore, where needed UP structure data (span and rise dimensions, etc.) were estimated based on corresponding upstream US 30 structures.

Group C – Upstream of US 30 and UP Corridor

Hydraulic structure Group C includes those upstream of the US 30 and UP corridor that are not included in Group A. Group C is divided into two parts: structures along major streams and other structures.

In the context of this discussion on hydraulic structures, major streams include Stump Ditch, Spring Creek, and Buffalo Creek. Along the major streams, structures are modeled as bridges, culverts, bare-earth terrain openings, or terrain modification openings. These modeling approaches are outlined below:

- Bridge – Structure modeled as a bridge using available data sources.
- Culvert – Structure modeled as a culvert using available data sources.
- Bare-Earth Terrain Opening – As is often done with LiDAR terrain products, the LiDAR obtained and used for the modeling effort had been post-processed to represent bare-earth terrain. This post-processing generally removes bridge decks, leaving the conveyance channel beneath.
- Terrain Modification Opening – A hydraulic opening is created using terrain modification tools. For this case, the terrain opening width was based on the channel bottom width.

It is noted that sometimes LiDAR post-processing results in flawed terrain beneath a bridge that may partially obstruct conveyance. In these cases, a bare-earth terrain opening can be created using a cross-section or trapezoidal channel approach to terrain modification.

At culvert locations, LiDAR post-processing generally retains roadway (or railroad) embankments, requiring that a culvert or terrain modification opening be used. Because

hydraulic structures in Group C serve a hydrologic function – that is, the primary modeling objective is to convey flow downstream – any of the methods outlined above is adequate. The terrain modification openings are considered conservative with respect to downstream conveyance.

For other structures (i.e., those not along major streams), the hydraulic performance at the structure was evaluated for adequacy. If flow was conveyed downstream at the crossing location, no changes (such as adding a culvert) were made. Situations where this occurs include bare-earth terrain locations and locations where cells encompass both sides of an embankment. If flow was not conveyed downstream at the crossing location, a culvert or terrain modification opening was added.

Group D – Downstream of US 30 and UP Corridor

Hydraulic structure Group D includes those downstream of the US 30 and UP corridor that are not included in Group A. Group D is divided into two parts: structures along major streams and other structures.

Along the major streams (Stump Ditch, Spring Creek, and Buffalo Creek), structures are modeled as bridges, culverts, or bare-earth openings (see Group C discussion above). Terrain modification openings considered to be conservative in upstream areas may be unconservative in downstream areas where potential backwater exists. For this reason, culverts were used in lieu of terrain modification openings in downstream areas. Where necessary, culvert sizes were estimated based on the width of upstream and downstream channels.

For other structures (i.e., those not along major streams), no action was taken. Where conveyance of minor waterways is blocked by embankments, minor ponding occurs before the embankment is overtopped. This condition is acceptable for areas downstream of the US 30 and UP corridor and outside of the major streams.

Model Stability Improvements

Some hydraulic structures were discovered to be causing model instabilities (which is attributed to the fact they were conveying little or no flow). A reevaluation of the hydraulic structures in Groups C and D was completed based on their impact to flow patterns in the municipalities, influence in potential alternative areas, and performance in initial model runs. This resulted in removing some hydraulic structures initially modeled as a part of Groups C and D. Some of these culverts were removed entirely, such as culverts along perched irrigation ditches. These were conveying little to no flow and were causing instabilities in the model runs. Other hydraulic structures in Group C were replaced with terrain modification openings as described in the above sections, as they were experiencing instabilities, but downstream conveyance was required for their hydrologic function.

Model Limitations

The hydraulic modeling was performed to support a comparative analysis of existing conditions and proposed alternatives to support watershed planning objectives. As documented in this

section, the modeling was subject to limitations related to terrain and hydraulic structure data. Model refinement varied based on the watershed planning objectives. The analyses and findings are subject to the limitations of the available data and the scope of work. Additionally, the analyses were limited in terms of event type and frequency. The nature of flooding events is highly variable; events of varying spatial extent and/or greater magnitude can occur. The hydraulic modeling results should not be relied on for any other purpose than what is explicitly stated in this memorandum.

D1.5 Alternative Screening

Based on the alternative screening process, channel conveyance measures (a combination of channel improvements and associated flood protection berms [dikes] and diversion channels) were evaluated for the rural communities of Cozad and Lexington with the objective of reducing flood-related damages to public and private infrastructure. Hydrologic modeling also indicates that at the smaller, more frequent precipitation events, flooding within Lexington occurs routinely in both the northeast and southwest area of the community and is caused by separate and distinct sources. At the smaller, more frequent precipitation events, flooding in the northeast portion of the community is predominately caused by Spring Creek overbanking and runoff restrictions caused by U.S. Highway 30 and UPRR. Flooding in the southwest area of Lexington is caused primarily by Stump Ditch overbanking.

Therefore, channel conveyance alternatives were considered for Cozad, the northeast portion of Lexington (Lexington NE), and the southwest portion of Lexington (Lexington SW). The No Action alternative was also considered.

A determination of the need for hydrology and/or hydraulic analysis was considered for each potential measure for each alternative. The following are the results of the determinations:

- No Action

  Under the no action alternative, no measures would be implemented, and existing flood risks would remain. No further analysis is needed for this alternative.

- Restoration or Enhancement of Existing On-Channel Storage

  In the 1970s and 1980s, flood retarding structures were constructed in the highlands through the PL 566 program. The existing flood retarding structures include:

  Dam Sites 18-A, 19-B, and 25-A located in the Stump Ditch basin of the Spring Creek Subwatershed;

  Dam Sites 9-A, 9-B, and 11-A located in the Spring Creek basin of the Spring Creek Subwatershed; and

  Dam Sites B-1, B-3, C-5, F-1, F-3, F-5, and F-7 located in the Buffalo Creek Subwatershed.

This measure would include restoration and/or enhancement of flood storage capacity of the existing flood retarding structures. This measure was advanced for further analysis for each alternative; see Section D1.6.1.

- New On-Channel Storage

  This measure would include construction of new flood retarding structures. The necessary topographic relief for on-channel storage is only provided in the highlands. This measure was advanced for further analysis for each alternative; see Section D1.6.2.

- Off-Channel Storage

  This measure would include construction of in-channel diversions and weirs to divert flood flows to off-channel storage basins. This measure was identified for the lowlands since the topographic relief is not conducive to a traditional dam embankment tying into high ground. This measure was advanced for further analysis for each alternative; see Section D1.6.3.

- Levee Systems

  This measure would include construction of levees along primary waterways to increase the conveyance system capacity. Compared to berms, levee systems would require more robust design, permitting, and approval (accreditation) processes. For this reason, levee systems were not advanced in the measure screening. Berms were considered in conjunction with channel improvements and diversions as described below.

- Channel Improvements, Berms, and Diversions

  The screening evaluation and initial modeling demonstrated the need to consider channel improvements, berms, and/or diversions in combination. This approach was taken due to limited channel capacities, lack of topographic relief, and multiple flooding sources in some areas. This measure was advanced for further analysis for each alternative; see Section D1.6.4.

- Floodplain Connectivity

  This measure would include construction of grade check structures along stream channels and/or modification of banks to promote use of the floodplain for temporary storage of flood waters. The hydrologic setting limits the potential for enhancement of floodplain connectivity. Floodplains adjacent to streams are poorly defined because the entire lowland area is in the Platte River floodplain. Accordingly, there is limited topographic relief and a lack of natural barriers to inter-subwatershed flow. Efforts to enhance floodplain connectivity would result in diversion of flood flows to other areas. Floodplain connectivity was not advanced in the measure screening.

- Physical Non-Structural Measures

  Physical, non-structural measures include elevation, relocation, buyout/acquisition, and dry and wet flood-proofing. Due to the nature of these measures, hydrologic and hydraulic modeling is not required for their evaluation.

- Non-Physical Non-Structural Measures

  Non-physical, non-structural measures include flood warning systems, land use regulation, zoning, flood insurance, floodplain mapping, evacuation plans, risk communication, and flood emergency preparedness planning. These measures would help communities respond to flood events and may prevent future development in floodplain areas, but they would not meet the purpose of existing flood damage reduction. Accordingly, the non-physical, non-structural measures was not advanced.

- Agricultural Best Management Practices (Conservation Measures)

  Agricultural Best Management Practices (BMPs) include conservation cropping systems, contour farming, diversion, grassed waterways and outlets, and terracing. Implementation is dependent of willingness of landowners and availability of cost-sharing funds. The benefits to the watershed when implementing agricultural BMPs are improved soil conservation, runoff prevention, and improved feeding operations. The purpose of the agricultural BMPs is not to reduce peak flows nor to reduce flooding, which is the objective of this watershed plan as documented in the purpose and need. Therefore, agricultural BMPs were not advanced as a potential measure.

D1.6 Measure Analyses

This section documents the analyses performed for measures that advanced from the initial screening and warranted quantitative evaluation. These measure include:

- Restoration or Enhancement of Existing On-Channel Storage,
- New On-Channel Storage,
- Off-Channel Storage, and
- Channel Improvements, Berms, and Diversions.

Under each of these measures, the analyses are addressed by sub-watershed.

D1.6.1 Restoration or Enhancement of Existing On-Channel Storage

The Spring-Buffalo Creek Watershed has multiple existing flood retarding structures, all located in the highland region of the watershed. Analyses were performed to evaluate whether restoring the flood storage capacities back to their design capacities would result in significant benefit to the watershed. Stage-storage curves for select dam sites, taken from the design drawings and as-built plans provided by CPNRD for dams in the Buffalo Creek Watershed and for Dam Site 19-B in the Spring Creek Watershed (CPNRD 2020a, 2020b), and by the NRCS for other dams in the Spring Creek Watershed (NRCS 2020) were compared to stage-storage curves generated from the most recent LiDAR for dry structures. This comparison shows the amount of flood storage that has been lost due to sedimentation behind the impoundments since their construction.

Spring Creek Subwatershed

Dam Site 19-B, located on Stump Ditch, was selected for evaluation based on its size and high hazard designation. The stage-storage comparison, shown in Chart D1-1, shows that Dam Site 19-B has lost 4% of its flood storage since its construction. The corresponding change in the storage-discharge relationship due to a 4% loss in storage was deemed negligible. Accordingly, restoration of storage capacity would not result in significant benefits downstream.

Buffalo Creek Subwatershed

Dam Sites B-1 and B-3 were selected for evaluation based on their size in comparison to other dams in the watershed. The stage-storage comparisons, shown in Chart D1-2 and Chart D1-3 (Appendix C), show that Dam Sites B-1 and B-3 have lost 5% and 26% of their flood storage since their construction, respectively. The peak outflow sensitivity due to flood storage reduction was analyzed at Dam Site B-3. This sensitivity analysis showed that for the 100-year event the flood storage reduction would result in a 16% increase in peak outflow from Dam Site B-3. However, this increase would be attenuated significantly between the dam and the Overton area. For the 25-year event, the flood storage reduction would result in less than 1% increase in peak outflow from Dam Site B-3. Since the flood damage reduction measures were focused on more frequent events – specifically the 10-year event for the Buffalo Creek Subwatershed – restoring the lost storage capacity at Dam Site B-3 would not result in significant benefits downstream. The change in the storage-discharge relationship at Dam Site B-1 due to a 5% loss in storage was deemed negligible, and restoration of storage capacity would not result in significant benefits downstream.

D1.6.2 New On-Channel Storage

As documented previously, the necessary topographic relief for on-channel storage is only provided in the highlands. Evaluations for the Spring Creek and Buffalo Creek subwatersheds are documented below.

Spring Creek Subwatershed

Existing flood retarding structures regulate a significant portion of the highlands. The Stump Ditch basin highland area is about 56,900 acres. Of this area, 50,400 acres or 89% of the area is regulated by three existing dams. The Spring Creek basin highland area is about 23,500 acres. Of this area, 16,700 acres or 71% of the area is regulated by three existing dams.

To evaluate whether regulating currently unregulated areas would result in flood damage reduction, a HEC-RAS 2D model run was performed for the lowlands. This run had the entirety of the flow contribution from the highlands removed, representing the scenario where all the highlands area is regulated, and spillways are all closed. The results of this model run were compared to the model run representing the existing flow contribution from the highlands (i.e., with existing dams in place and spillways operational). The comparison showed that changes to flood depths and extents were negligible; therefore, this measure was not pursued further. The comparison does not indicate that the existing dams are not effective in reducing downstream

flood damages. Rather, it indicates that adding flood retarding structures to control currently unregulated areas would not be effective. This is attributed to 1) the limited unregulated highland areas, and 2) the size of the unregulated highland areas compared to the size of the corresponding lowland areas.

Buffalo Creek Subwatershed

Existing flood retarding structures regulate a significant portion of the highlands. The Buffalo Creek basin highland area is about 82,200 acres. Of this area, 42,400 acres or 52% of the area is regulated by seven existing dams. The unregulated area within the Buffalo Creek subwatershed is highly dispersed; there is no single, unregulated waterway with a significant contributing drainage area.

To evaluate whether regulating currently unregulated areas would result in flood damage reduction, a HEC-RAS 2D model run was performed for the lowlands in the same manner as described for the Spring Creek subwatershed. The comparison of existing and full regulation conditions showed that changes to flood depths and extents were negligible. Adding flood retarding structures to control currently unregulated areas would not be effective for the same reasons as described for the Spring Creek subwatershed. Even if adding regulation were effective, it would require multiple flood retarding structures, making the measure more difficult and costly.

D1.6.3 Off-Channel Storage

Off-channel storage was considered as an measure. The viability of this measure was evaluated by determining the amount of area that would be required to store the flood volume that would be outside of the banks of the creek during a 10-year or 25-year storm event.

Spring Creek Subwatershed

Cozad Vicinity

The flow capacity of Drainage Ditch No. 4 upstream of Cozad was determined using Bentley's FlowMaster software. The cross section geometry, channel slope, and roughness of Drainage Ditch No. 4 were input to estimate a bankfull flow capacity of approximately 190 cubic feet per second (cfs). Data on the water table during peak storm season was gathered from the NRCS Web Soil Survey (NRCS 2022). This data showed that the depth to water table is greater than 6.5 feet for most of the watershed during the months of April through August, when a significant storm event is most likely to occur. The depth of Drainage Ditch No. 4 in the reach where the off-channel storage would occur is about eight (8) feet. With a 2-foot buffer from the water table, and one (1) foot of freeboard required, a conservative depth of three (3) feet was used as the design depth for the off-channel storage measure. The flow hydrograph at Drainage Ditch No. 4 from the 10-year storm event was extracted from the HEC-RAS model. The volume of flow above 190 cfs was summed, resulting in a storage volume of 1,068 acre-feet. At a depth of three (3) feet, the off-channel storage measure would therefore require a minimum area of 356

acres to adequately store the excess flow. This was deemed too large of an area for this type of storage, and the measure was not pursued further.

Lexington Vicinity

The flow capacity of Spring Creek upstream of Lexington was determined using Bentley's FlowMaster software. The cross section geometry, channel slope, and roughness of Spring Creek were input to estimate a bankfull flow capacity of approximately 376 cfs. The depth of Spring Creek in the reach where the off-channel storage would occur is about 9.5 feet. Data on the water table during peak storm season was gathered from the NRCS Web Soil Survey (NRCS 2022). This data showed that the depth to water table is greater than 6.5 feet for most of the watershed during the months of April through August, when a significant storm event is most likely to occur. With a 2-foot buffer from the water table, and one (1) foot of freeboard required, a conservative depth of 3.5 feet was used as the design depth for the off-channel storage measure. The flow hydrograph at Spring Creek from the 25-year storm event was pulled from the HEC-RAS model. The volume of flow above 376 cfs was summed, resulting in a storage volume of 2,239 acre-feet. At a depth of 3.5 feet, the off-channel storage measure would require a minimum area of 640 acres to store the excess flow. This was deemed too large of an area for this type of storage, and the measure was not pursued further.

The above analysis process was also evaluated at an unnamed ditch in the area south of the intersection of UPRR and County Road 431, prior to its confluence with Drainage Ditch No. 1 to the south. The bankfull flow capacity estimate of the unnamed ditch is approximately 157 cfs. The depth of the unnamed ditch in the reach where the off-channel storage would occur is about five (5) feet. With a 2-foot buffer from the water table, and one (1) foot of freeboard required, a conservative depth of 2.0 feet was used as the design depth for the off-channel storage measure. The flow hydrograph at the unnamed ditch from the 25-year storm event was pulled from the HEC-RAS model. The volume of flow above 157 cfs was summed, resulting in a storage volume of 1,165 acre-feet. At a depth of 2.0 feet, the off-channel storage measure in this location would require a minimum of 582 acres to adequately store the excess flow. This was also deemed too large of an area for this type of storage, and the measure was not pursued further.

Buffalo Creek Subwatershed

The flow capacity of the unnamed swale in the Buffalo Creek right overbank north of Overton was determined using Bentley's FlowMaster software. The cross section geometry, channel slope, and roughness of the unnamed swale were input to estimate the bankfull flow capacity of approximately 72 cfs. The depth of the unnamed swale in the reach where the off-channel storage would occur is about 3.5 ft. Data on the water table during peak storm season was gathered from the NRCS Web Soil Survey (NRCS 2022). This data showed that the depth to water table is greater than 6.5 feet for most of the watershed during the months of April through August, when a significant storm event is most likely to occur. With a 2-foot buffer from the water table, and on1 foot of freeboard required, a conservative depth of 0.5 feet was used as the design depth for the off-channel storage measure. The flow hydrograph at the unnamed

swale from the 10-year storm event was extracted from the HEC-RAS model. The volume of flow above 72 cfs was summed, resulting in a storage volume of 2,545 acre-feet. At a depth of 0.5 feet, the off-channel storage measure would require a minimum area of 5,090 acres to adequately store the excess flow. This was deemed too large of an area for this type of storage, and the measure was not pursued further.

D1.6.4 Channel Improvements, Berms, and Diversions

Channel improvements, berms, and diversions were considered to reduce flooding impacts in populated areas of the watershed.

Spring Creek Subwatershed

Cozad Vicinity Alternative Description

Due to the variety of flooding sources entering Cozad, it would be impractical to try to eliminate or redirect all sources. The primary source of flooding in Cozad was determined to be Drainage Ditch No. 4 and Stump Ditch with its associated flow breakouts further upstream. Channel improvement, berm, and diversion measures were developed in relation to this source. These improvements are shown in Figure D1-8, and channel and berm geometry is documented in Table D1-15 and Table D1-16, respectively. A new berm is proposed a quarter mile north of 24th Street, running from Avenue O to the east to tie into Newell Street. A diversion channel, from the intersection of the existing Drainage Ditch No. 4 alignment and the new berm, would travel east past Newell Street, then turn south and travel along the east side of Newell Street. The improvements would continue this path south, meeting up with the existing Drainage Ditch No. 4 alignment. At 16th Street, a second diversion would carry all flow that exceeds the existing Drainage Ditch No. 4 capacity to the east toward Stump Ditch. The existing Drainage Ditch No. 4 alignment past this second diversion point would not be improved. Stump Ditch, carrying the new diverted flows, would be improved to just north of Dawson County Canal. At this location, low flows would continue through the Cozad Country Club Golf Course and excess flows would be conveyed in a new channel east of the golf course. Channel improvements would cease after the convergence of Stump Ditch and Drainage Ditch No. 4, south of County Road 760. Along the alignment of the channel improvements, hydraulic structures would be replaced to accommodate higher flows.

Cozad Vicinity Analysis and Results

An initial economic evaluation was conducted as part of the alternative development process to assess costs and benefits for a range of rainfall-runoff events. Through this evaluation it was determined that a 10-year storm event was appropriate for improvements in the Cozad vicinity.

Following additional measure development focused on hydraulic performance of the design event, rainfall-runoff modeling of the existing condition and this proposed alternative were performed for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year events. Inundation depth rasters were generated for each event to inform the plan cost-benefit analysis.

Lexington Vicinity Alternative Description

Two sets of improvements are proposed in the Lexington vicinity. The first is primarily along Drainage Ditch No. 1, and the second is along Spring Creek. These improvements are shown in Figure D1-9 and are described further below. Channel and berm geometry is documented in Table D1-15 and Table D1-16, respectively.

The first set of channel improvements would begin on the north side of the intersection of US 30 and County Road 431. The new channel would travel south past US 30 and UP, cross to the east side of County Road 431, and then converge with the existing alignment of Drainage Ditch No. 1. Three new hydraulic structures would be required (US 30, UP, and County Road 431) for this alternative. Other potential routes were considered to avoid new structures at US 30 and UP; however, those routes were unfavorable as they either decreased flood damage reduction benefits (for crossings further to the east) or increased the length and cost of improvements (for crossings further to the west). A raise of County Road 431 from its intersection with US 30 to the north approximately half a mile is required to build the necessary head to drive flows south through the new channel. Drainage Ditch No. 1 would be improved from County Road 431 to its existing confluence with Spring Creek. Structures along this route would require upsizing.

Spring Creek channel improvements would begin at a point three quarters of a mile north of E 13th Street. Improvements would continue along the existing Spring Creek alignment until the improvement's termination at the confluence of Spring Creek and Drainage Ditch No. 1. A berm beginning on the east side of Highway 21, extending east to Spring Creek is proposed. The berm would then continue along the Spring Creek alignment, with a 20-foot bench from the channel, along its right bank to its termination a quarter mile north of County Road 755. Structures along this route would require upsizing.

Lexington Vicinity Analysis and Results

An initial economic evaluation was conducted as part of the alternative development process to assess costs and benefits for a range of rainfall-runoff events. Through this evaluation it was determined that a 25-year storm event was appropriate for improvements in the Lexington vicinity.

Following additional measure development focused on the hydraulic performance of the design event, rainfall-runoff modeling of the existing condition and this proposed alternative were performed for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year events. Inundation depth rasters were generated for each event to inform the plan cost-benefit analysis.

Buffalo Creek Subwatershed

Overton Vicinity Alternative Description

Two sets of improvements are proposed in the Overton vicinity. The first is in the Buffalo Creek right overbank area northeast of the town, and the second is along a ditch on the southwest side of the town. These improvements are shown in Figure D1-10 and are described further below. Channel and berm geometry is documented in Table D1-15 and Table D1-16, respectively.

A new berm is proposed to start at Lincoln Street, half a mile north of 9th Street. This berm would continue east to the existing drainage lateral. It would then continue along the right bank of the drainage lateral alignment to its termination 150 feet north of US 30. A small detention pond is proposed on the west side of the new berm near its termination point to manage runoff in the interior area (i.e., the developed area west of the berm alignment).

Channel improvements are proposed beginning at the drainage structure through US 30 near the Overton High School football field. The channel improvements would be continued along this drainage path, crossing Lincoln Street to the east, UPRR to the south, and continuing southeast with improvements terminating at the leachate ponds southeast of Overton.

Overton Vicinity Analysis and Results

An initial economic evaluation was conducted as part of the alternative development process to assess costs and benefits for a range of rainfall-runoff events. Through this evaluation it was determined that a 10-year storm event was appropriate for improvements in the Overton vicinity.

Following additional measure development focused on the hydraulic performance of the design event, rainfall-runoff modeling of the existing condition and this proposed alternative were performed for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year events. Inundation depth rasters were generated for each event to inform the plan cost-benefit analysis.

D1.7 References

The reader is referred to Table D1-1 for various references and data sources. Additional detail (as needed) and references are noted below.

NRCS

2022 Web Soil Survey – Soil Data Explorer. Dawson County, Nebraska. Accessed Multiple Dates. Web Soil Survey (usda.gov)

D1.8 Figures

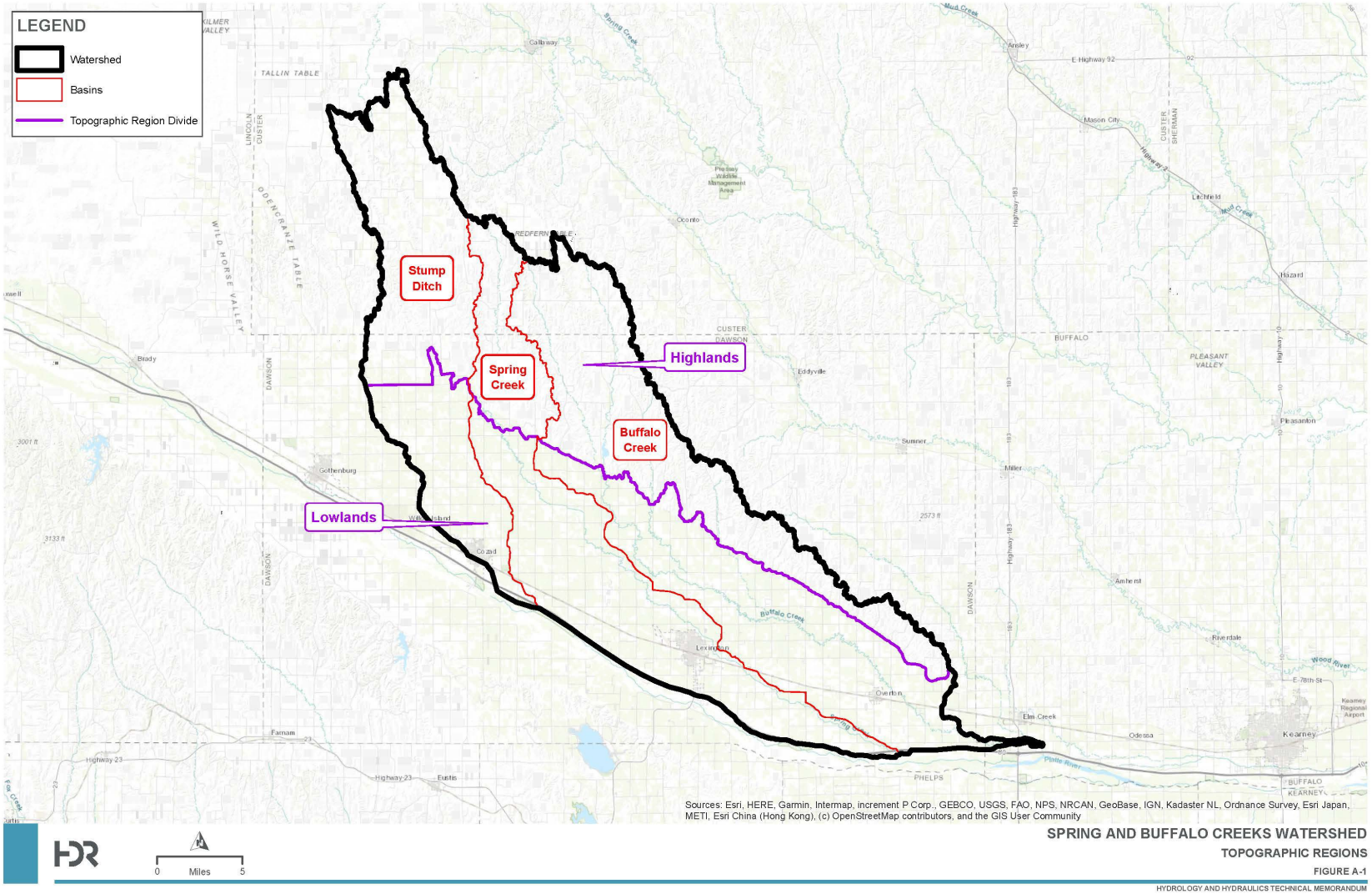

LEGEND
Watershed
Basins
Topographic Region Divide
Stump Ditch
Spring Creek
Buffalo Creek
Highlands
Lowlands
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
0 Miles 5
SPRING AND BUFFALO CREEKS WATERSHED
TOPOGRAPHIC REGIONS
FIGURE A-1
HYDROLOGY AND HYDRAULICS TECHNICAL MEMORANDUM

Figure D1-1

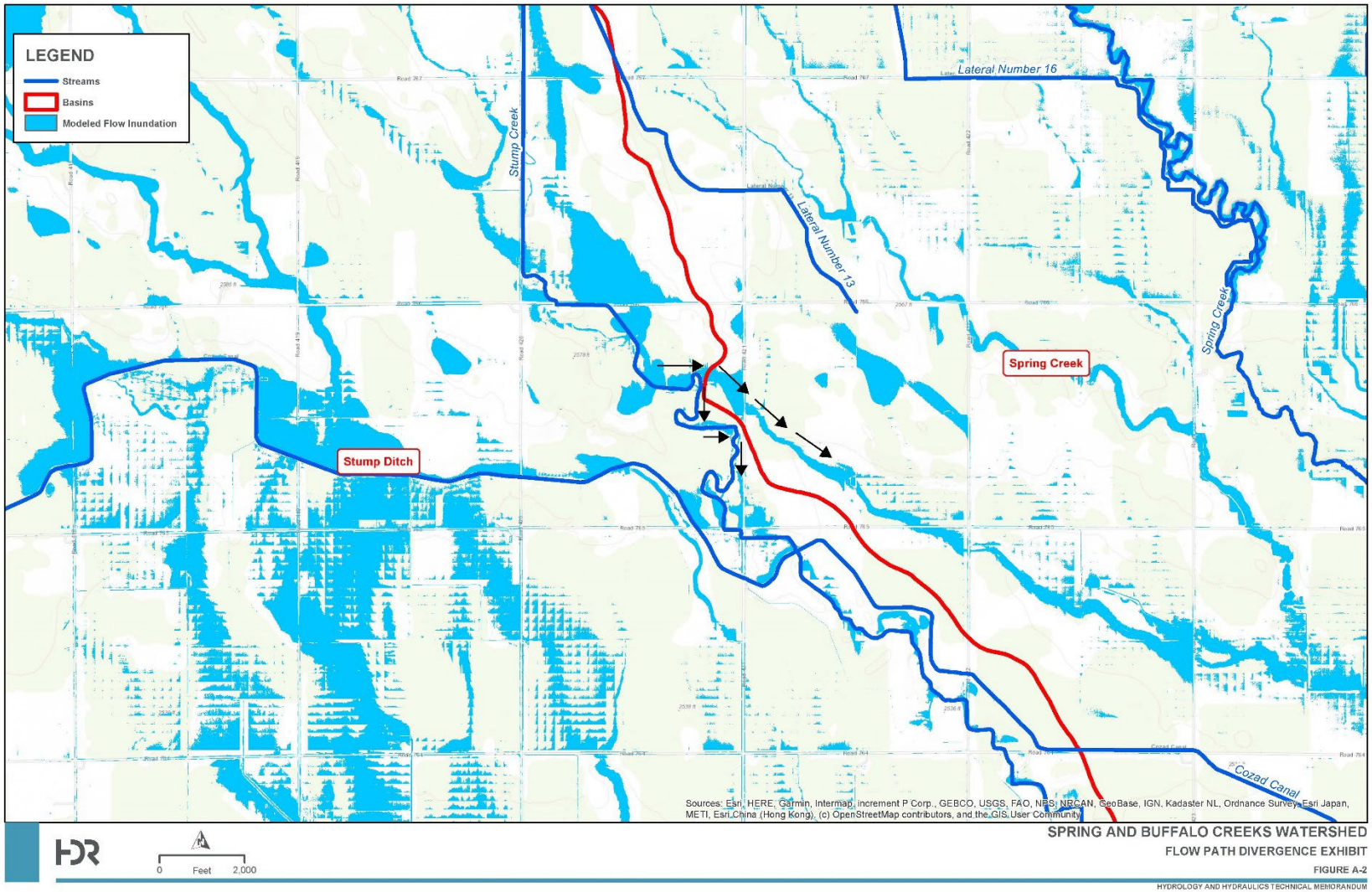

LEGEND
Streams
Basins
Modeled Flow Inundation
Stump Creek
Lateral Number 16
Lateral Number 13
Spring Creek
Spring Creek
Stump Ditch
Cozad Canal
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
HDR
0 Feet 2,000
SPRING AND BUFFALO CREEKS WATERSHED
FLOW PATH DIVERGENCE EXHIBIT
FIGURE A-2
HYDROLOGY AND HYDRAULICS TECHNICAL MEMORANDUM

Figure D1-2

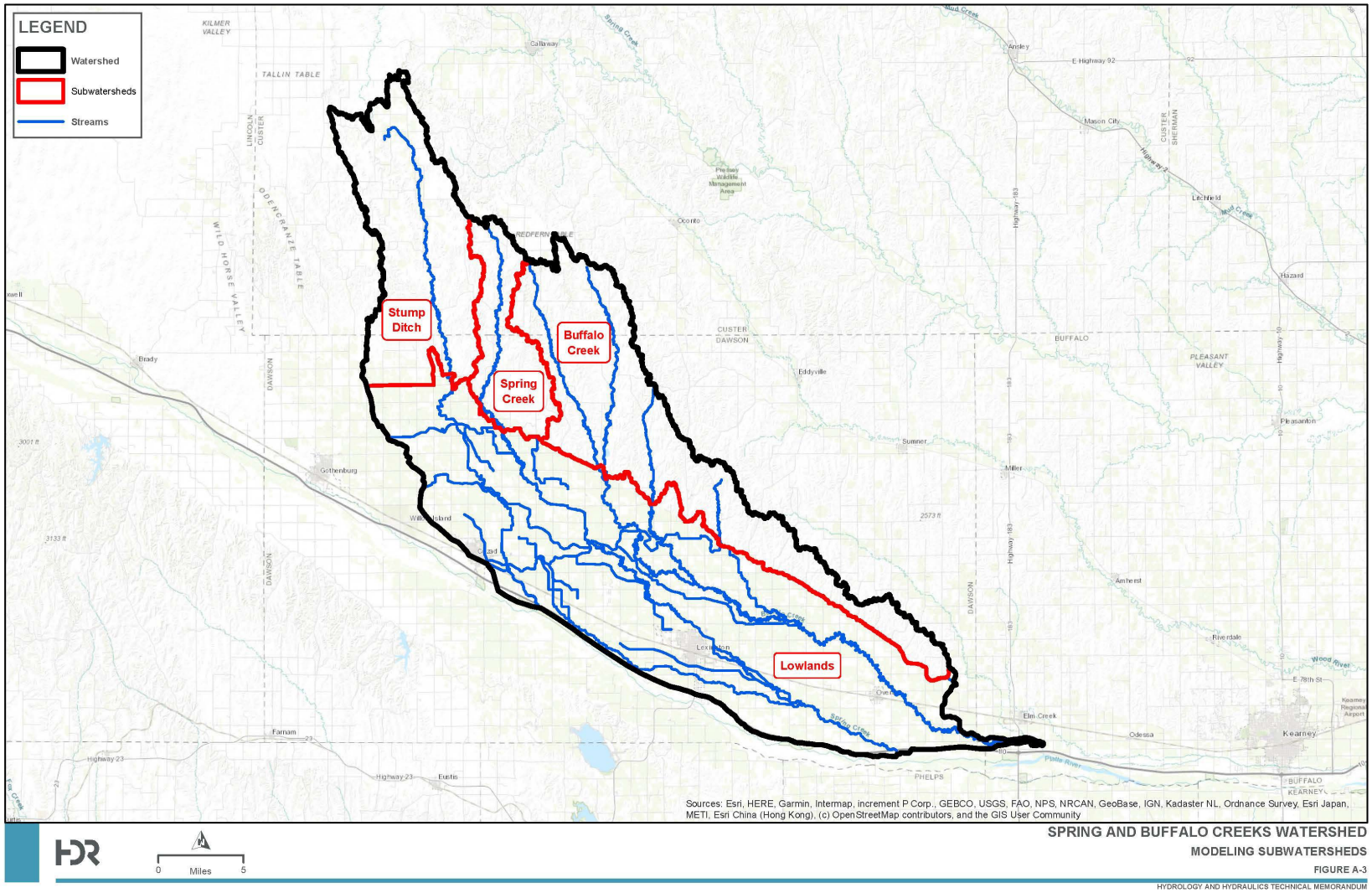

LEGEND
Watershed
Subwatersheds
Streams
Stump Ditch
Buffalo Creek
Spring Creek
Lowlands
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
0 Miles 5
SPRING AND BUFFALO CREEKS WATERSHED
MODELING SUBWATERSHEDS
FIGURE A-3
HYDROLOGY AND HYDRAULICS TECHNICAL MEMORANDUM

Figure D1-3

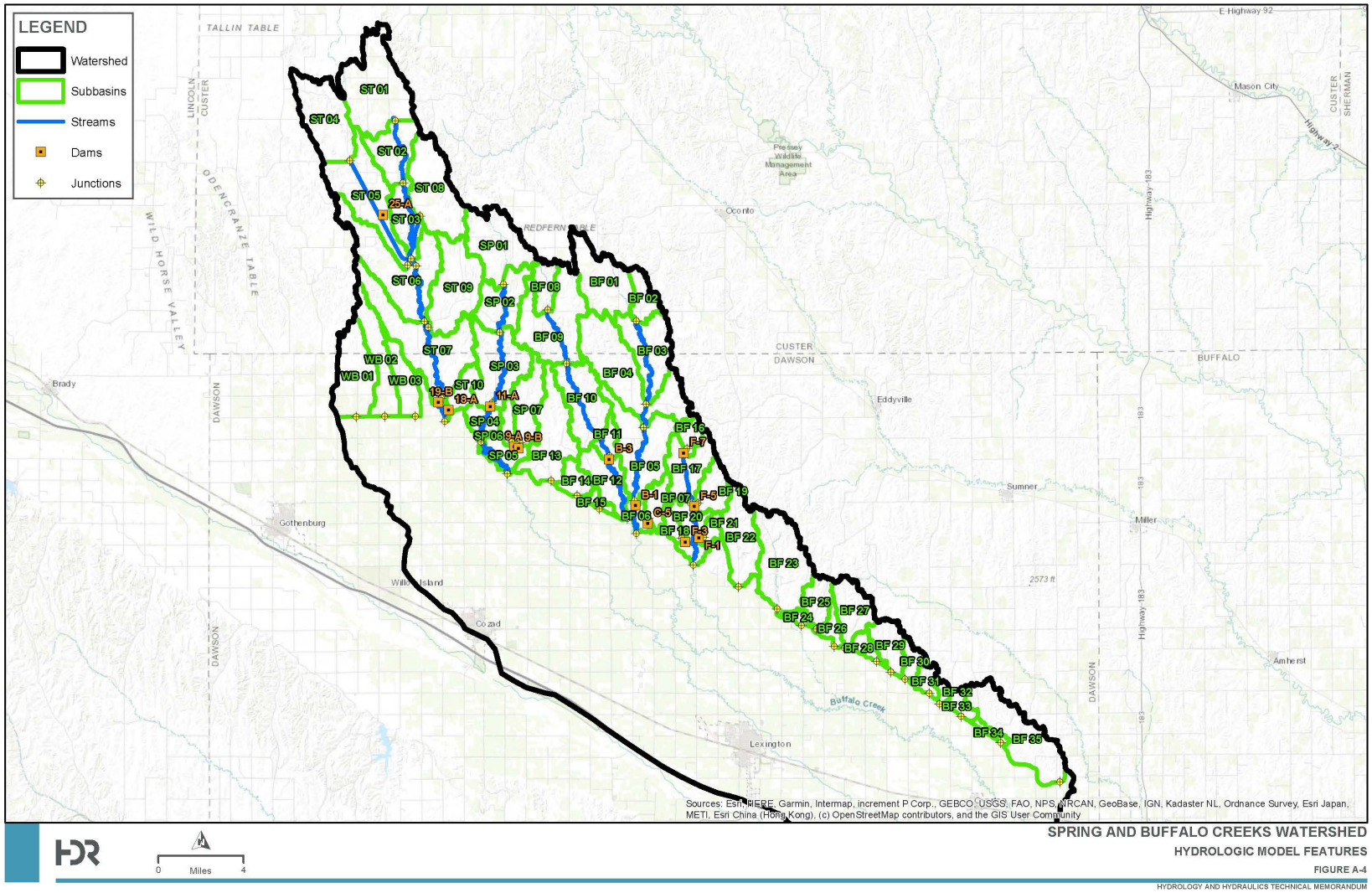

LEGEND
Watershed
Subbasins
Streams
Dams
Junctions
TALLIN TABLE
REDFERN TABLE
WILD HORSE VALLEY
ODENCRANZE TABLE
LINCOLN
CUSTER
DAWSON
CUSTER
DAWSON
BUFFALO
CUSTER
SHERMAN
Brady
Gothenburg
Willow Island
Cozad
Oconto
Eddyville
Sumner
Miller
Lexington
Amherst
Mason City
E Highway 92
Highway 2
Highway 183
Buffalo Creek
2573 ft
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
0
Miles
4
SPRING AND BUFFALO CREEKS WATERSHED
HYDROLOGIC MODEL FEATURES
FIGURE A-4
HYDROLOGY AND HYDRAULICS TECHNICAL MEMORANDUM

Figure D1-4

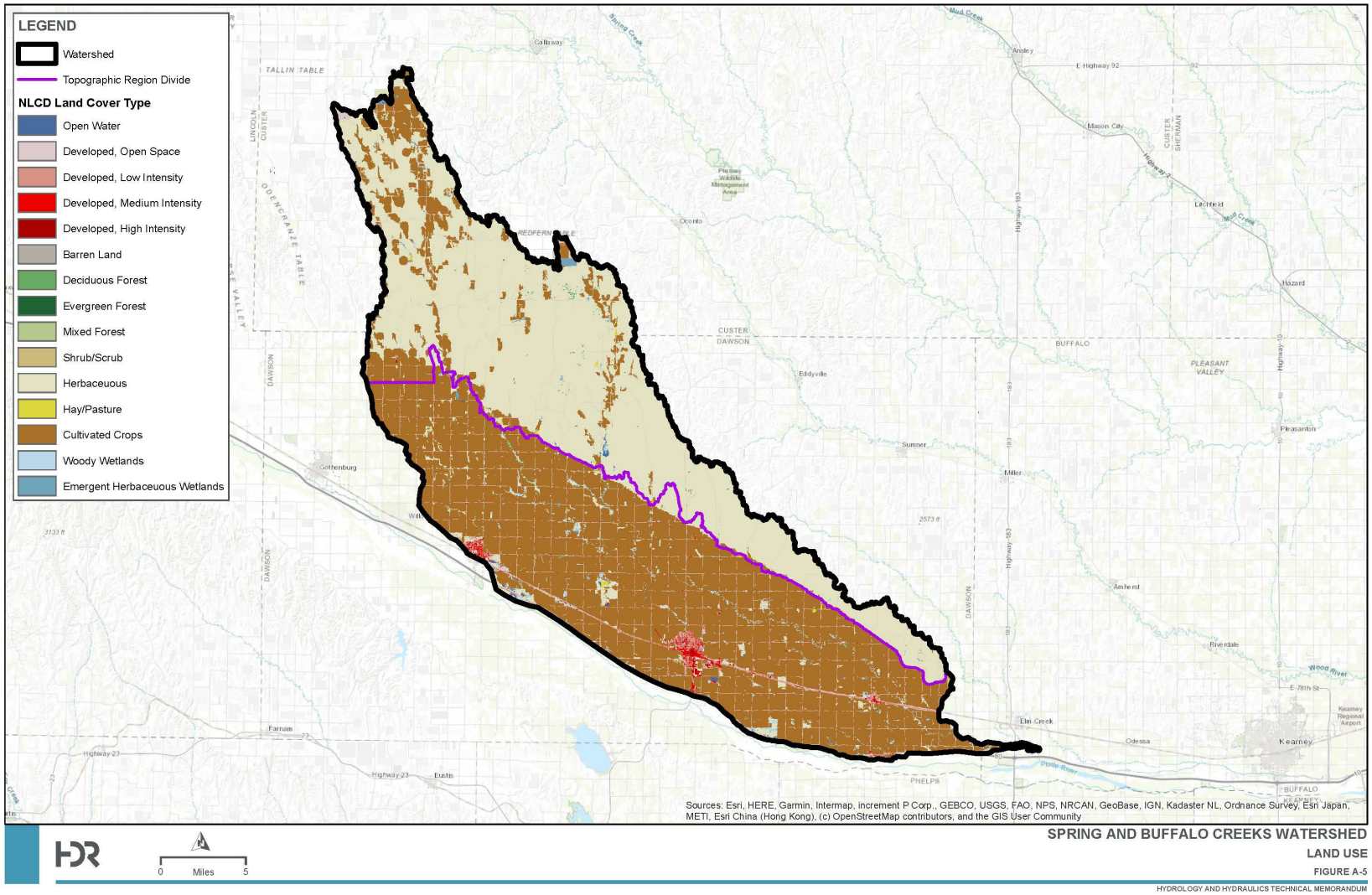

LEGEND
Watershed
Topographic Region Divide
NLCD Land Cover Type
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrub/Scrub
Herbaceuous
Hay/Pasture
Cultivated Crops
Woody Wetlands
Emergent Herbaceuous Wetlands
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
0 Miles 5
SPRING AND BUFFALO CREEKS WATERSHED
LAND USE
FIGURE A-5
HYDROLOGY AND HYDRAULICS TECHNICAL MEMORANDUM

Figure D1-5

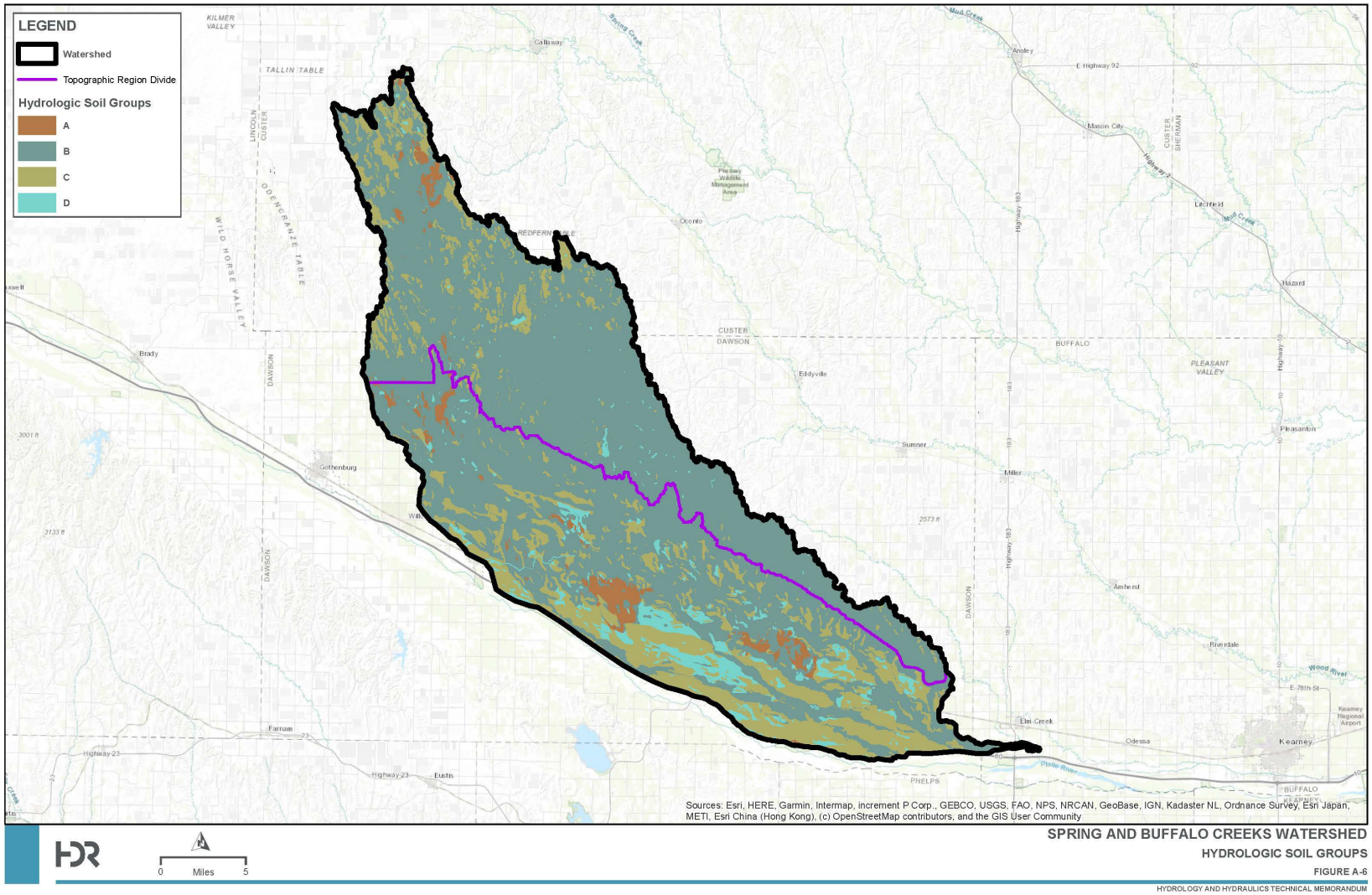

LEGEND
Watershed
Topographic Region Divide
Hydrologic Soil Groups
A
B
C
D
Callaway
Ansley
Mason City
Arcadia
Litchfield
Ocento
Hazard
Brady
Eddyville
Sumner
Miller
Pleasanton
Gothenburg
Amherst
Riverdale
Elm Creek
Odessa
Kearney
Farnam
Eustis
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
0 Miles 5
SPRING AND BUFFALO CREEKS WATERSHED
HYDROLOGIC SOIL GROUPS
FIGURE A-6
HYDROLOGY AND HYDRAULICS TECHNICAL MEMORANDUM

Figure D1-6

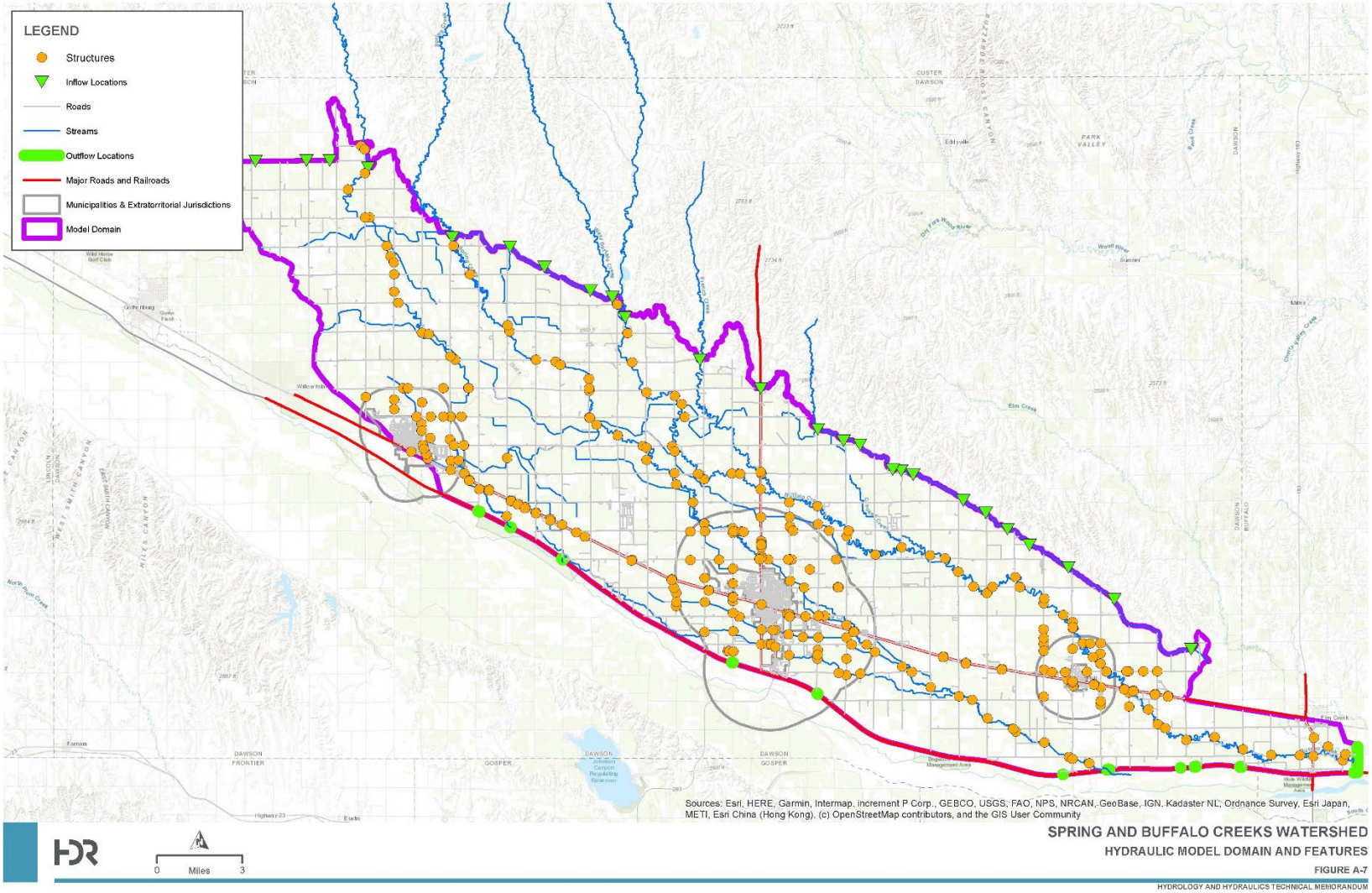

LEGEND
Structures
Inflow Locations
Roads
Streams
Outflow Locations
Major Roads and Railroads
Municipalities & Extraterritorial Jurisdictions
Model Domain
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
0
Miles
3
SPRING AND BUFFALO CREEKS WATERSHED
HYDRAULIC MODEL DOMAIN AND FEATURES
FIGURE A-7
HYDROLOGY AND HYDRAULICS TECHNICAL MEMORANDUM

Figure D1-7

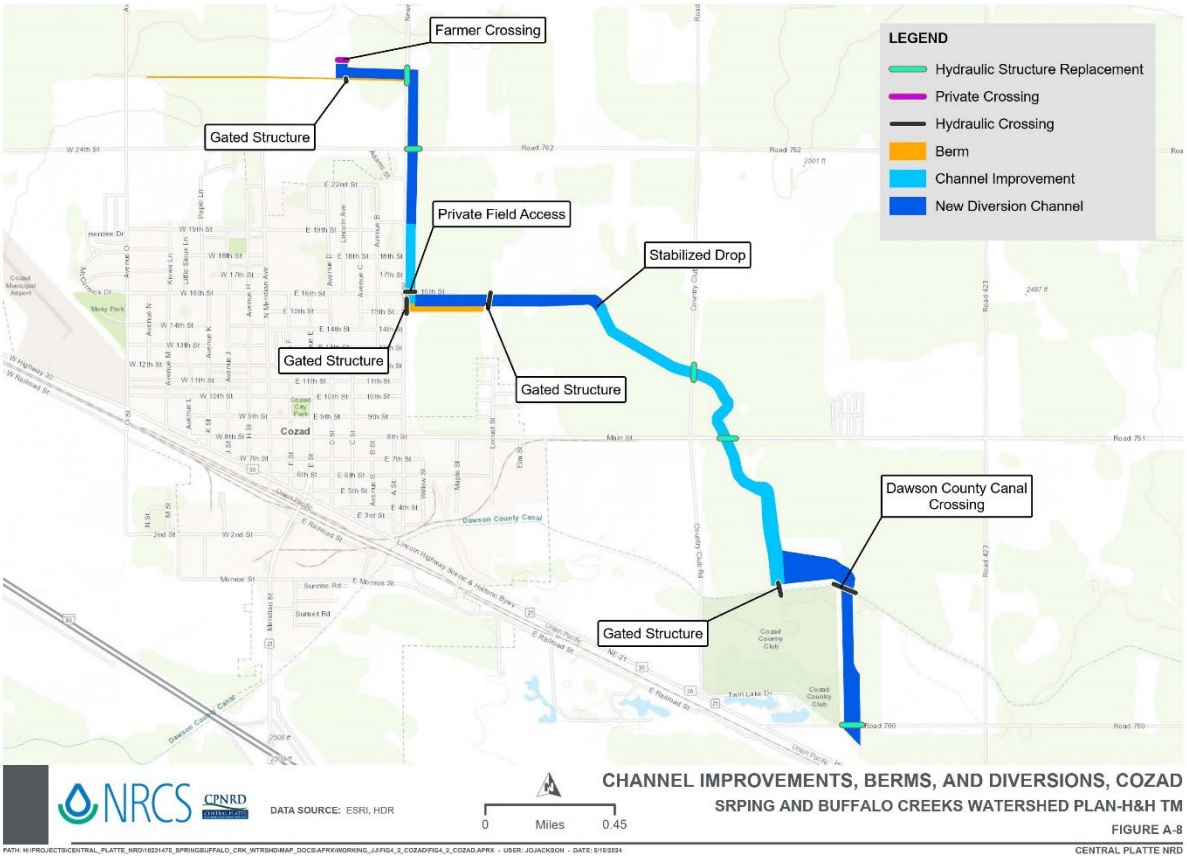

Farmer Crossing
Gated Structure
Private Field Access
Stabilized Drop
Gated Structure
Gated Structure
Dawson County Canal Crossing
Gated Structure
LEGEND
Hydraulic Structure Replacement
Private Crossing
Hydraulic Crossing
Berm
Channel Improvement
New Diversion Channel
Cozad
Dawson County Canal
DATA SOURCE: ESRI, HDR
0
Miles
0.45
CHANNEL IMPROVEMENTS, BERMS, AND DIVERSIONS, COZAD
SRPING AND BUFFALO CREEKS WATERSHED PLAN-H&H TM
FIGURE A-8
CENTRAL PLATTE NRD

Figure D1-8

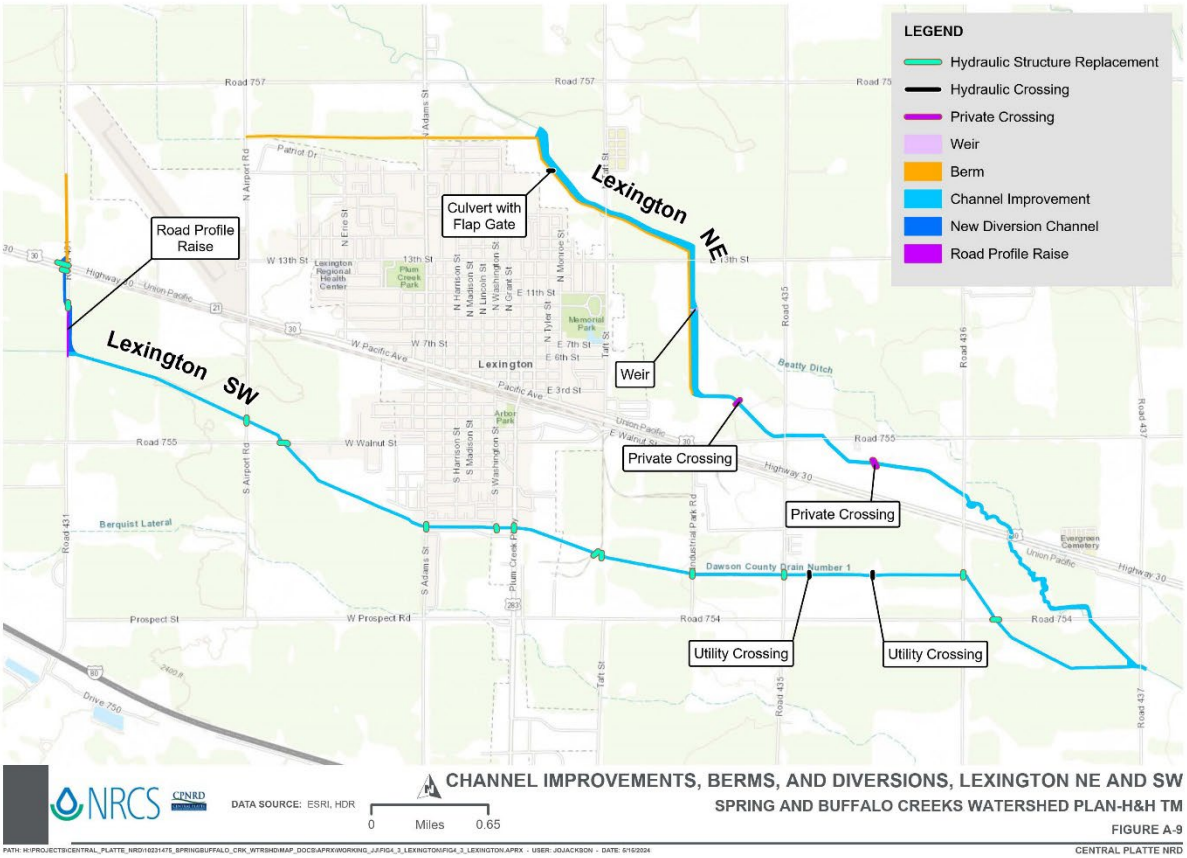

LEGEND
Hydraulic Structure Replacement
Hydraulic Crossing
Private Crossing
Weir
Berm
Channel Improvement
New Diversion Channel
Road Profile Raise
Culvert with Flap Gate
Road Profile Raise
Lexington NE
Lexington SW
Weir
Private Crossing
Private Crossing
Utility Crossing
Utility Crossing
Lexington
Dawson County Drain Number 1
Berquist Lateral
Beatty Ditch
DATA SOURCE: ESRI, HDR
0 Miles 0.65
CHANNEL IMPROVEMENTS, BERMS, AND DIVERSIONS, LEXINGTON NE AND SW
SPRING AND BUFFALO CREEKS WATERSHED PLAN-H&H TM
FIGURE A-9
CENTRAL PLATTE NRD

Figure D1-9

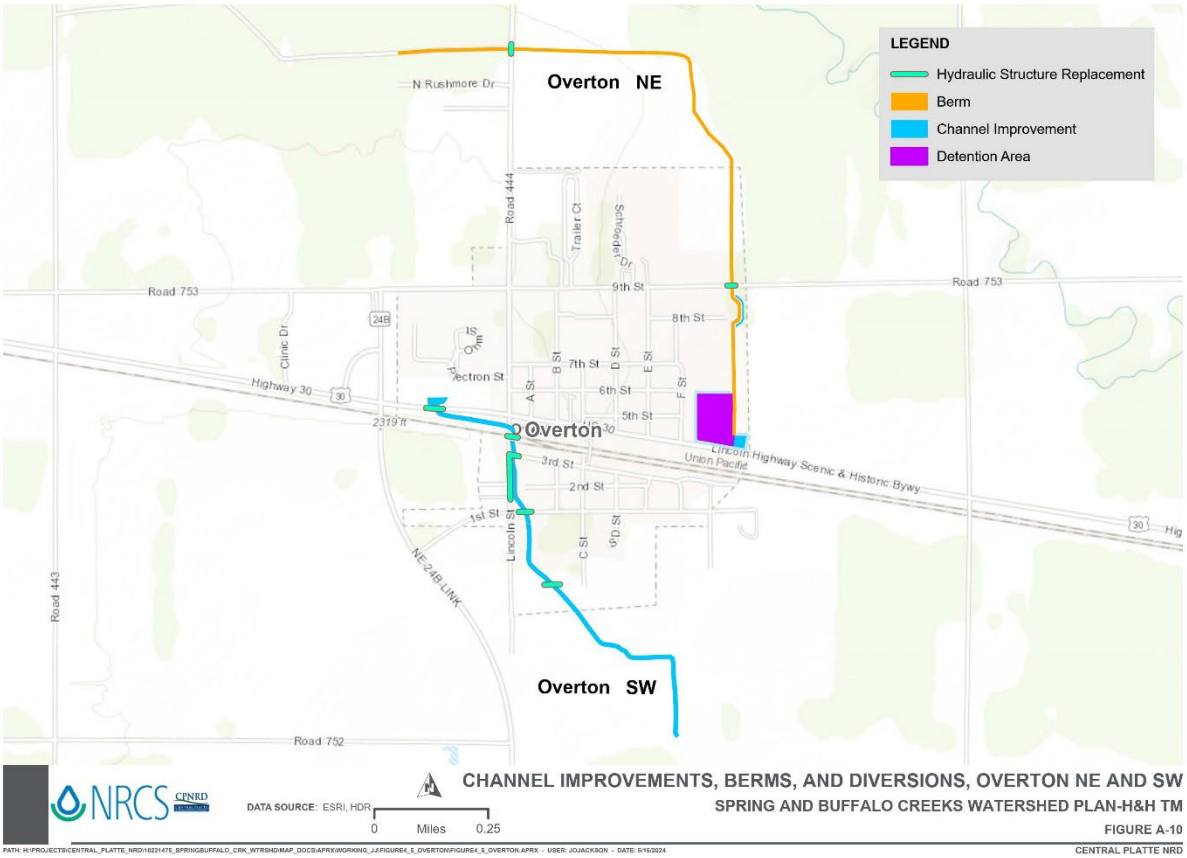

LEGEND
Hydraulic Structure Replacement
Berm
Channel Improvement
Detention Area
Overton NE
Overton SW
Overton
N Rushmore Dr
Road 444
Trailer Ct
Road 753
9th St
8th St
7th St
6th St
5th St
3rd St
2nd St
1st St
Clinic Dr
24B
Highway 30
2319 ft
Pectron St
A St
B St
C St
D St
E St
F St
Lincoln St
Union Pacific
Lincoln Highway Scenic & Historic Bywy
NE-24B-LINK
Road 443
Road 752
NRCS
CPNRD
DATA SOURCE: ESRI, HDR
0
Miles
0.25
CHANNEL IMPROVEMENTS, BERMS, AND DIVERSIONS, OVERTON NE AND SW
SPRING AND BUFFALO CREEKS WATERSHED PLAN-H&H TM
FIGURE A-10
CENTRAL PLATTE NRD

Figure D1-10

D1.9 Tables

Table D1-2

Subbasin	Drainage Area, mi2	Curve Number	Hydraulic Length, ft	Storage, in.	Average Slope, %	Lag Time, min
BF_01	7.1	69	36917.9	4.5	11.6	138.0
BF_02	2.4	65	16948.4	5.4	11.3	83.0
BF_03	6.6	65	34330.9	5.4	10.7	150.0
BF_04	11.6	62	43979.4	6.1	14.0	173.0
BF_05	9.0	64	47115.9	5.6	11.5	192.0
BF_06	1.2	64	14272.2	5.6	11.4	74.0
BF_07	2.2	61	17858.3	6.4	17.8	77.0
BF_08	2.3	63	16746.9	5.9	20.3	65.0
BF_09	10.0	66	38220.4	5.2	13.5	142.0
BF_10	6.8	62	35144.5	6.1	15.0	140.0
BF_11	1.5	63	14838.5	5.9	11.6	78.0
BF_12	4.2	62	34823.1	6.1	14.6	141.0
BF_13	8.0	63	37842.8	5.9	13.2	154.0
BF_14	2.0	62	13153.9	6.1	12.9	69.0
BF_15	0.8	62	6588.7	6.1	11.6	42.0
BF_16	1.5	61	12033.0	6.4	19.6	53.0
BF_17	4.8	62	23770.7	6.1	16.3	98.0
BF_18	3.1	63	28385.6	5.9	12.3	127.0
BF_19	3.0	61	17306.5	6.4	16.8	77.0
BF_20	1.1	62	12733.0	6.1	17.5	57.0
BF_21	1.1	61	10313.6	6.4	16.7	51.0
BF_22	6.0	62	34715.5	6.1	15.4	136.0
BF_23	9.4	62	40683.8	6.1	14.6	159.0
BF_24	0.7	65	5169.9	5.4	9.8	35.0
BF_25	2.7	62	17168.4	6.1	16.2	76.0
BF_26	1.3	65	14225.9	5.4	10.8	74.0
BF_27	4.1	61	25508.0	6.4	15.4	109.0
BF_28	1.3	62	8348.0	6.1	13.1	47.0
BF_29	3.0	62	20402.9	6.1	14.5	92.0
BF_30	1.4	61	14396.2	6.4	15.7	69.0
BF_31	1.3	62	9875.7	6.1	14.4	52.0
BF_32	0.6	62	8637.2	6.1	14.8	46.0
BF_33	1.2	62	7839.2	6.1	14.0	44.0
BF_34	0.6	62	2873.9	6.1	14.0	20.0
BF_35	9.3	63	52566.8	5.9	14.0	195.0
SP_01	7.5	65	26863.8	5.4	14.4	107.0
SP_02	5.2	64	33181.0	5.6	14.0	131.0
SP_03	7.7	63	28932.4	5.9	15.2	116.0
SP_04	2.2	68	23141.7	4.7	8.1	117.0
SP_05	2.4	67	24107.3	4.9	7.4	130.0
SP_06	1.3	62	14308.2	6.1	15.4	67.0
SP_07	4.4	62	29977.5	6.1	16.7	117.0
ST_01	11.0	73	28860.5	3.7	6.9	131.0
ST_02	5.0	66	29420.2	5.2	9.4	138.0
ST_03	3.5	67	30012.7	4.9	10.7	128.0
ST_04	7.9	68	37870.8	4.7	13.7	133.0
ST_05	9.1	67	51375.0	4.9	12.0	186.0
ST_06	11.0	66	50638.3	5.2	12.7	183.0
ST_07	12.3	64	61136.6	5.6	15.0	207.0
ST_08	8.7	65	26876.4	5.4	9.5	131.0
ST_09	8.4	65	38727.8	5.4	13.7	146.0
ST_10	2.2	66	21127.9	5.2	10.7	99.0
WB_01	7.0	72	34381.6	3.9	8.9	137.0
WB_02	5.4	69	54062.4	4.5	10.3	198.0
WB_03	3.3	71	29320.1	4.1	7.5	135.0
SPBF_01	295.5	78	241004.5	2.8	1.8	1216.0

Table D1-3

Reach	Subbasin	Length, ft	Slope, ft/ft	Manning's n	Section Type
ST_R02	ST_02	20,164	0.0031	0.055	Eight Point
ST_R03A	ST_03	25,101	0.0020	0.055	Eight Point
ST_R03B	ST_03	14,492	0.0020	0.055	Eight Point
ST_R05	ST_05	38,707	0.0027	0.055	Eight Point
ST_R06	ST_06	22,995	0.0020	0.055	Eight Point
ST_R07	ST_07	31,185	0.0002	0.055	Eight Point
ST_RDS07	ST_07	6,550	0.0079	0.055	Eight Point
SP_R02	SP_02	20,589	0.0026	0.055	Eight Point
SP_R03	SP_03	27,358	0.0013	0.055	Eight Point
SP_R04	SP_04	17,987	0.0023	0.055	Eight Point
SP_R05	SP_05	23,947	0.0018	0.055	Eight Point
BF_R03	BF_03	29,823	0.0023	0.055	Eight Point
BF_R04	BF_04	7,812	0.0011	0.055	Eight Point
BF_R05	BF_05	29,610	0.0012	0.055	Eight Point
BF_R06	BF_06	10,267	0.0040	0.055	Eight Point
BF_R09	BF_09	18,763	0.0033	0.055	Eight Point
BF_R10	BF_10	27,342	0.0029	0.055	Eight Point
BF_R11	BF_11	7,622	0.0026	0.055	Eight Point
BF_R12	BF_12	24,514	0.0021	0.055	Eight Point
BF_R17	BF_17	14,674	0.0038	0.055	Eight Point
BF_R18	BF_18	24,083	0.0015	0.055	Eight Point

Table D1-4. Page 1 of 3

Dam Site: B-1

Elevation, ft	Area, ac	Volume, ac-ft
2501.0	0.0	0.0
2502.0	0.2	0.1
2506.0	2.2	4.8
2510.0	6.3	16.9
2512.5	10.8	21.3
2514.0	13.5	18.2
2518.0	27.8	82.6
2522.0	44.8	145.2
2526.0	69.2	227.9
2530.0	131.3	400.9
2534.0	190.7	644.0
2536.0	221.0	453.2
2538.0	262.0	452.3
2542.0	324.0	1171.9
2546.0	392.6	1433.1
2550.0	469.2	1723.5
2551.0	489.6	510.1
2554.0	550.9	1530.2

Dam Site: B-3

Elevation, ft	Area, ac	Volume, ac-ft
2550.0	0.0	0.0
2552.0	1.0	5.0
2554.0	2.0	3.0
2556.0	3.0	3.0
2558.0	5.0	19.0
2560.0	9.0	20.0
2562.0	13.0	36.0
2564.0	19.0	44.0
2566.0	27.0	65.0
2568.0	39.0	80.0
2570.0	54.0	126.0
2572.0	74.0	179.0
2573.3	88.0	130.0
2574.0	101.0	104.0
2576.0	127.0	271.0
2578.0	153.0	347.0
2580.0	178.0	378.0
2582.0	204.0	428.0
2583.0	217.0	272.0
2584.0	230.0	240.0
2585.3	239.0	340.0
2586.0	255.0	166.0
2588.0	281.0	524.0
2590.0	308.0	520.0
2592.0	336.0	500.0

Dam Site: C-5

Elevation, ft	Area, ac	Volume, ac-ft
2505.0	0.0	0.0
2506.0	0.0	0.0
2508.0	0.2	0.2
2510.0	0.4	0.6
2512.0	1.3	1.7
2514.0	2.3	3.6
2516.0	4.6	6.9
2518.0	6.9	11.5
2520.0	11.1	18.0
2522.0	15.4	26.5
2522.5	17.1	8.1
2524.0	22.3	29.6
2526.0	29.2	51.5
2528.0	36.5	65.7
2529.0	40.1	38.3
2530.0	43.7	41.9
2532.0	51.3	95.0
2534.0	59.0	110.3

Dam Site: F-1

Elevation, ft	Area, ac	Volume, ac-ft
2495.0	0.0	0.0
2496.0	0.9	0.5
2497.5	3.5	3.3
2498.0	4.3	1.9
2500.0	7.6	11.9
2502.0	11.3	18.9
2502.5	12.2	5.9
2504.0	14.9	20.3
2506.0	16.7	31.6
2508.0	18.5	35.2
2509.1	21.8	22.1
2510.0	24.4	20.8
2512.0	30.3	54.7
2514.0	36.3	66.6

Table D1-5. Page 2 of 3

Dam Site: F-3

Elevation, ft	Area, ac	Volume, ac-ft
2494.0	0.0	0.0
2496.0	1.8	1.8
2498.0	1.8	3.6
2500.0	1.9	3.7
2502.0	4.5	6.4
2504.0	7.1	11.6
2506.0	10.2	17.3
2508.0	13.3	23.5
2510.0	17.3	30.6
2512.0	21.2	38.5
2512.6	22.9	13.2
2514.0	26.9	34.9
2515.6	31.5	46.7
2516.0	32.6	12.8

Dam Site: F-5

Elevation, ft	Area, ac	Volume, ac-ft
2516.0	0.0	0.0
2518.0	2.4	2.4
2520.0	9.0	11.4
2522.0	15.5	24.5
2524.0	22.1	37.6
2526.0	28.6	50.7
2528.0	39.0	67.6
2530.0	49.4	88.4
2532.0	61.0	110.4
2533.0	66.6	63.8
2534.0	72.5	69.6
2536.0	83.5	156.0
2538.0	94.6	178.1

Dam Site: F-7

Elevation, ft	Area, ac	Volume, ac-ft
2555.0	0.0	0.0
2555.8	0.0	0.0
2558.0	0.9	1.3
2560.0	2.4	3.3
2562.0	5.6	8.0
2564.0	9.9	15.5
2566.0	14.7	24.5
2567.0	17.4	16.0
2568.0	20.2	18.8
2570.0	26.3	46.5
2572.0	32.5	58.8
2574.0	39.7	72.2
2574.1	40.0	4.0
2576.0	47.2	82.9
2578.1	55.1	107.4
2580.0	62.3	111.4

Dam Site: 11-A

Elevation, ft	Area, ac	Volume, ac-ft
2622.0	0.0	0.0
2624.0	0.7	0.7
2626.0	1.4	2.1
2628.0	12.4	13.9
2630.0	25.4	37.8
2632.0	40.9	66.3
2634.0	59.6	100.5
2636.0	78.3	137.9
2638.0	103.4	181.7
2640.0	128.5	232.0
2641.0	146.4	137.4
2642.0	164.2	155.3
2643.0	178.1	171.2
2644.0	192.1	185.1
2646.0	238.9	430.9
2647.0	261.2	250.0
2647.5	272.4	133.4
2648.0	283.6	139.0
2650.0	320.2	603.8
2652.0	356.0	676.1
2653.0	376.6	366.2
2653.5	386.9	190.9
2654.0	397.2	196.2
2656.0	446.2	843.4

Table D1-6. Page 3 of 3

Dam Site: 18-A

Elevation, ft	Area, ac	Volume, ac-ft
2632.0	0.0	0.0
2634.0	1.8	1.8
2636.0	8.4	10.2
2637.0	11.0	9.7
2638.0	13.7	12.3
2639.0	16.3	15.0
2640.0	18.9	17.6
2641.0	22.7	20.8
2642.0	26.5	24.6
2643.0	30.4	28.4
2644.0	34.2	32.3
2644.5	36.5	17.7
2645.0	38.8	18.8
2646.0	43.3	41.0
2646.5	45.6	22.2
2647.0	47.9	23.4
2648.0	52.5	50.2
2649.0	57.2	54.8
2650.0	61.9	59.5
2651.0	66.5	64.2

Dam Site: 19-B

Elevation, ft	Area, ac	Volume, ac-ft
2618.2	0.0	0.0
2620.0	0.3	0.3
2622.0	0.6	0.9
2624.0	1.0	1.6
2626.0	2.6	3.6
2628.0	4.3	6.9
2630.0	8.3	12.6
2631.0	10.3	9.3
2632.0	12.3	11.3
2634.0	22.1	34.4
2636.0	31.9	54.0
2638.0	68.9	100.8
2640.0	105.9	174.8
2642.0	145.8	251.7
2644.0	185.7	331.5
2644.2	189.5	37.5
2646.0	224.1	372.2
2648.0	262.5	486.6
2650.0	313.6	576.1
2652.0	364.8	678.4
2654.0	433.6	798.4
2656.0	502.5	936.1
2658.0	572.2	1074.7
2660.0	641.9	1214.1
2662.0	710.7	1352.6
2664.0	779.5	1490.2
2666.0	852.9	1632.4
2668.0	926.3	1779.2
2670.0	999.7	3705.2
2672.0	1073.1	5778.0

Dam Site: 9-A

Elevation, ft	Area, ac	Volume, ac-ft
2586.0	0.0	0.0
2588.0	0.4	0.4
2590.0	1.1	1.5
2591.5	1.7	2.1
2592.0	1.9	0.9
2594.0	3.6	5.5
2596.0	5.3	8.9
2598.0	7.8	13.1
2600.0	10.2	18.0
2600.5	11.1	5.3
2602.0	13.9	18.8
2604.0	17.6	31.2
2606.0	22.0	39.6
2606.5	23.1	11.3
2608.0	26.4	37.1
2610.0	32.0	58.4
2612.0	37.7	69.7
2614.0	44.0	81.7
2616.0	50.3	94.3

Dam Site: 9-B

Elevation, ft	Area, ac	Volume, ac-ft
2581.0	0.0	0.0
2582.0	0.2	0.1
2584.0	0.7	0.9
2586.0	2.8	3.5
2588.0	5.0	7.8
2590.0	9.0	14.0
2592.0	13.0	22.0
2593.0	16.0	14.5
2594.0	19.0	17.5
2596.0	25.1	44.1
2598.0	34.6	59.7
2600.0	44.1	78.7
2602.0	54.7	98.8
2604.0	65.3	120.0
2606.0	74.7	140.0
2606.5	77.1	38.0
2608.0	84.2	120.9
2610.0	94.1	178.3
2612.0	104.0	198.1
2614.0	116.0	220.0

Table D1-7. Page 1 of 2

Principal Spillway - Dam Site	Principal Spillway -	Port - No. Openings	Port - Opening Type	Port - Width or Diameter, ft	Port - Height, ft.	Port - Invert Elev., ft.	Riser - Opening Type	Riser - Length or Diameter, ft.	Riser - Width, ft.	Riser - Crest Elev., ft.	Riser - Cap (Y/N)	Riser - Cap Depth, ft.	Pipe - Manning's n	Pipe - Diameter, ft.	Pipe - Length, ft.	Pipe - U/S Invert Elev., ft.	Pipe - D/S Invert Elev., ft.	Auxiliary Spillway - Width, ft	Auxiliary Spillway - Crest Elev., ft.
B-1	Port A	0	R	--	--	--	R	10.5	3.5	2536.0	N	--	0.0	3.5	224.0	2512.0	2506.0	500.0	2551.0
	Port B	0	C	--		--													
B-3	Port A	0	R	--	--	--	R	9.0	3.0	2573.3	N	--	0.0	3.0	208.0	2553.7	2549.7	300.0	2583.0
	Port B	0	C	--	--	--													
C-5	Port A	0	R	--	--	--	C	2.5	--	2522.5	N	--	0.0	1.5	127.0	2513.1	2506.9	50.0	2529.0
	Port B	0	C	--	--	--													
F-1	Port A	0	R	--	--	--	C	2.5	--	2502.5	N	--	0.0	1.3	92.5	2497.1	2496.0	60.0	2509.1
	Port B	0	C	--	--	--													
F-3	Port A	0	R	--	--	--	C	2.5	--	2506.0	N	--	0.0	1.3	101.6	2498.6	2494.5	60.0	2512.6
	Port B	0	C	--	--	--													
F-5	Port A	0	R	--	--	--	C	2.5	--	2526.0	N	--	0.0	2.0	137.0	2518.6	2515.0	60.0	2533.0
	Port B	0	C	--	--	--													
F-7	Port A	0	R	--	--	--	C	2.5	--	2567.0	N	--	0.0	1.5	119.5	2557.6	2556.0	75.0	2574.1
	Port B	0	C	--	--	--													
18-A	Port A	1	R	1.0	1.0	2641.0	R	6.0	2.0	2644.5	N	--	0.0	1.5	97.1	2636.5	2632.5	40.0	2646.5
	Port B	0	C	--	--	--													
9-A	Port A	2	R	1.0	0.5	2600.5	R	3.5	2.5	2606.5	N	--	0.0	1.5	126.2	2591.5	2588.0	30.0	2608.0
	Port B	0	C	--	--	--													
9-B	Port A	2	R	1.0	1.0	2593.0	R	3.5	2.5	2598.0	N	--	0.0	1.5	176.2	2586.0	2582.0	30.0	2606.5
	Port B	0	C	--	--	--													

Table D1-8. Page 2 of 2

Principal Spillway Dam Site	Pipe 1 Manning's n	Pipe 1 Diameter, ft.	Pipe 1 Length, ft.	Pipe 1 U/S Invert Elev., ft.	Pipe 1 D/S Invert Elev., ft.	Port 1 No. Openings	Port 1 Opening Type	Port 1 Width or Diameter, ft	Port 1 Height, ft.	Port 1 Invert Elev., ft.	Riser 1 Opening Type	Riser 1 Length or Diameter, ft.	Riser 1 Width, ft.	Riser 1 Crest Elev., ft.	Riser 1 Cap (Y/N)	Riser 1 Cap Depth, ft.
11-A	0.013	1.5	20.00	2628.00	2628.00	0	R	--	--	--	R	6.0	2.0	2638.0	N	--
						0	C	--	--	--						
19-B	0.013	2.0	40.00	2632.00	2629.20	1	R	2.00	1.83	2638.20	R	7.5	2.5	2644.2	N	--
						0	C	--	--	--						

Dam Site	Pipe 2 Manning's n	Pipe 2 Diameter, ft.	Pipe 2 Length, ft.	Pipe 2 U/S Invert Elev., ft.	Pipe 2 D/S Invert Elev., ft.	Port 2 No. Openings	Port 2 Opening Type	Port 2 Width or Diameter, ft	Port 2 Height, ft.	Port 2 Invert Elev., ft.	Riser 2 Opening Type	Riser 2 Length or Diameter, ft.	Riser 2 Width, ft.	Riser 2 Crest Elev., ft.	Riser 2 Cap (Y/N)	Riser 2 Cap Depth, ft.
11-A	0.013	1.5	33.50	2628.00	2628.00	1	R	1.83	2.00	2641.00	R	7.5	2.5	2647.5	N	--
						1	R	1.83	2.00	2643.00						
19-B	0.013	2.5	72.85	2629.20	2626.92	0	R	--	--	--	R	15.0	5.0	2656.0	Y	2.5
						0	C	--	--	--						

Dam Site	Pipe 3 Manning's n	Pipe 3 Diameter, ft.	Pipe 3 Length, ft.	Pipe 3 U/S Invert Elev., ft.	Pipe 3 D/S Invert Elev., ft.	Auxiliary Spillway Width, ft	Auxiliary Spillway Crest Elev., ft.
11-A	0.013	2.5	169.00	2627.50	2625.50	400.0	2653.5
19-B	0.013	5.0	243.10	2626.92	2619.00	800.0	2664.0

Table D1-9. Page 1 of 4

Dam Site:	B-1
Elevation, ft	Discharge, cfs
2501.0	0.0
2502.0	0.0
2503.0	0.0
2504.0	0.0
2505.0	0.0
2506.0	0.0
2507.0	0.0
2508.0	0.0
2509.0	0.0
2510.0	0.0
2511.0	0.0
2512.0	0.0
2513.0	0.0
2514.0	0.0
2515.0	0.0
2516.0	0.0
2517.0	0.0
2518.0	0.0
2519.0	0.0
2520.0	0.0
2521.0	0.0
2522.0	0.0
2523.0	0.0
2524.0	0.0
2525.0	0.0
2526.0	0.0
2527.0	0.0
2528.0	0.0
2529.0	0.0
2530.0	0.0
2531.0	0.0
2532.0	0.0
2533.0	0.0
2534.0	0.0
2535.0	0.0
2536.0	0.0
2536.5	28.0
2537.0	80.0
2537.5	147.0
2538.0	226.0
2538.5	249.0
2539.0	251.0
2539.5	253.0
2540.0	255.0
2541.0	259.0
2542.0	263.0
2543.0	267.0
2544.0	271.0
2545.0	275.0
2546.0	279.0
2547.0	283.0
2548.0	287.0
2549.0	290.0
2550.0	294.0
2551.0	297.0
2552.0	1620.0
2553.0	4020.0
2554.0	7140.0
2555.0	10830.0
2556.0	15020.0

Dam Site:	B-3
Elevation, ft	Discharge, cfs
2550.0	0.0
2551.0	0.0
2552.0	0.0
2553.0	0.0
2554.0	0.0
2555.0	0.0
2556.0	0.0
2557.0	0.0
2558.0	0.0
2559.0	0.0
2560.0	0.0
2561.0	0.0
2562.0	0.0
2563.0	0.0
2564.0	0.0
2565.0	0.0
2566.0	0.0
2567.0	0.0
2568.0	0.0
2569.0	0.0
2570.0	0.0
2571.0	0.0
2572.0	0.0
2573.0	0.0
2573.5	6.0
2574.0	40.0
2574.5	90.0
2575.0	152.0
2576.0	159.0
2577.0	162.0
2578.0	165.0
2579.0	169.0
2580.0	172.0
2581.0	175.0
2582.0	178.0
2583.0	181.0
2584.0	973.0
2585.0	2420.0
2586.0	4290.0
2587.0	6500.0
2588.0	9020.0
2589.0	11790.0
2590.0	14810.0
2591.0	18060.0
2592.0	21510.0

Dam Site:	C-5
Elevation, ft	Discharge, cfs
2505.0	0.0
2506.0	0.0
2507.0	0.0
2508.0	0.0
2509.0	0.0
2510.0	0.0
2511.0	0.0
2512.0	0.0
2513.0	0.0
2514.0	0.0
2515.0	0.0
2516.0	0.0
2517.0	0.0
2518.0	0.0
2519.0	0.0
2520.0	0.0
2521.0	0.0
2522.0	0.0
2522.5	0.0
2523.0	9.0
2523.5	18.0
2524.0	18.0
2525.0	19.0
2526.0	20.0
2527.0	20.0
2528.0	21.0
2529.0	21.0
2530.0	153.0
2531.0	394.0
2532.0	706.0
2533.0	1080.0
2534.0	1490.0

Table D1-10. Page 2 of 4

Dam Site: F-1

Elevation, ft	Discharge, cfs
2495.0	0.0
2496.0	0.0
2497.0	0.0
2498.0	0.0
2499.0	0.0
2500.0	0.0
2501.0	0.0
2502.0	0.0
2502.5	0.0
2503.0	8.0
2503.5	8.0
2504.0	9.0
2505.0	9.0
2506.0	10.0
2507.0	10.0
2508.0	11.0
2509.0	11.0
2510.0	147.0
2511.0	426.0
2512.0	792.0

Dam Site: F-3

Elevation, ft	Discharge, cfs
2494.0	0.0
2495.0	0.0
2496.0	0.0
2497.0	0.0
2498.0	0.0
2499.0	0.0
2500.0	0.0
2501.0	0.0
2502.0	0.0
2503.0	0.0
2504.0	0.0
2505.0	0.0
2506.0	0.0
2506.5	9.0
2507.0	11.0
2507.5	11.0
2508.0	11.0
2509.0	12.0
2510.0	12.0
2511.0	13.0
2512.0	13.0
2513.0	53.0
2514.0	275.0
2515.0	601.0
2516.0	1000.0

Dam Site: F-5

Elevation, ft	Discharge, cfs
2516.0	0.0
2517.0	0.0
2518.0	0.0
2519.0	0.0
2520.0	0.0
2521.0	0.0
2522.0	0.0
2523.0	0.0
2524.0	0.0
2525.0	0.0
2526.0	0.0
2526.5	9.0
2527.0	24.0
2527.5	29.0
2528.0	31.0
2529.0	33.0
2530.0	34.0
2531.0	35.0
2532.0	36.0
2533.0	38.0
2534.0	196.0
2535.0	486.0
2536.0	861.0
2537.0	1300.0
2538.0	1810.0

Table D1-11. Page 3 of 4

Dam Site: F-7

Elevation, ft	Discharge, cfs
2555.0	0.0
2556.0	0.0
2557.0	0.0
2558.0	0.0
2559.0	0.0
2560.0	0.0
2561.0	0.0
2562.0	0.0
2563.0	0.0
2564.0	0.0
2565.0	0.0
2566.0	0.0
2567.0	0.0
2567.5	9.0
2568.0	15.0
2568.5	16.0
2569.0	16.0
2570.0	17.0
2571.0	18.0
2572.0	18.0
2573.0	19.0
2574.0	19.0
2575.0	188.0
2576.0	537.0
2577.0	995.0
2578.0	1540.0
2579.0	2160.0

Dam Site: 11-A

Elevation, ft	Discharge, cfs
2622.0	0.0
2623.0	0.0
2624.0	0.0
2625.0	0.0
2626.0	0.0
2627.0	0.0
2628.0	0.0
2628.5	0.0
2629.0	0.0
2629.5	3.0
2630.0	8.0
2630.5	10.0
2631.0	12.0
2631.5	14.0
2632.0	15.0
2632.5	16.0
2633.0	18.0
2633.5	19.0
2634.0	19.0
2634.5	20.0
2635.0	21.0
2635.5	22.0
2636.0	23.0
2636.5	24.0
2637.0	24.0
2637.5	25.0
2638.0	26.0
2638.5	29.0
2639.0	30.0
2639.5	31.0
2640.0	32.0
2640.5	33.0
2641.0	33.0
2641.5	34.0
2642.0	35.0
2642.5	48.0
2643.0	54.0
2643.5	58.0
2644.0	62.0
2644.5	78.0
2645.0	87.0
2645.5	94.0
2646.0	96.0
2646.5	97.0
2647.0	99.0
2647.5	100.0
2648.0	101.0
2649.0	104.0
2650.0	106.0
2651.0	109.0
2652.0	111.0
2653.0	113.0
2654.0	487.0
2655.0	2050.0
2656.0	4280.0
2657.0	7010.0
2658.0	10170.0
2659.0	13700.0
2660.0	17560.0

Dam Site: 18-A

Elevation, ft	Discharge, cfs
2632.0	0.0
2633.0	0.0
2634.0	0.0
2635.0	0.0
2636.0	0.0
2637.0	0.0
2638.0	0.0
2639.0	0.0
2640.0	0.0
2641.0	0.0
2641.5	0.0
2642.0	3.0
2642.5	5.0
2643.0	6.0
2643.5	7.0
2644.0	8.0
2644.5	8.0
2645.0	25.0
2645.5	27.0
2646.0	27.0
2646.5	28.0
2647.0	66.0
2648.0	223.0
2649.0	446.0
2650.0	720.0
2651.0	1040.0

Table D1-12. Page 4 of 4

Dam Site: 19-B

Elevation, ft	Discharge, cfs
2618.2	0.0
2633.0	0.1
2633.2	7.0
2633.7	12.0
2634.2	17.0
2634.7	20.0
2635.2	22.0
2635.7	25.0
2636.2	27.0
2636.7	29.0
2637.2	31.0
2637.7	33.0
2638.2	34.0
2638.7	36.0
2639.2	43.0
2639.7	53.0
2640.2	59.0
2640.7	64.0
2641.2	69.0
2641.7	73.0
2642.2	77.0
2642.7	80.0
2643.2	84.0
2643.7	87.0
2644.2	90.0
2644.7	104.0
2645.2	106.0
2645.7	108.0
2646.2	109.0
2646.7	111.0
2647.2	113.0
2647.7	115.0
2648.2	116.0
2648.7	118.0
2649.2	119.0
2649.7	121.0
2650.2	122.0
2650.7	124.0
2651.2	125.0
2651.7	127.0
2652.2	128.0
2652.7	130.0
2653.2	131.0
2653.7	132.0
2654.2	134.0
2654.7	135.0
2655.2	136.0
2655.7	138.0
2656.2	149.0
2656.7	207.0
2657.2	291.0
2657.7	395.0
2658.7	597.0
2659.7	607.0
2660.7	617.0
2661.7	627.0
2662.7	636.0
2663.7	645.0
2664.7	1890.0
2665.7	5320.0
2666.7	10000.0
2667.7	15650.0
2668.7	22120.0
2669.7	29320.0
2670.7	37190.0
2671.7	45660.0

Dam Site: 9-A

Elevation, ft	Discharge, cfs
2586.0	0.0
2587.0	0.0
2588.0	0.0
2589.0	0.0
2590.0	0.0
2591.0	0.0
2592.0	0.0
2593.0	0.0
2594.0	0.0
2595.0	0.0
2596.0	0.0
2597.0	0.0
2598.0	0.0
2599.0	0.0
2600.0	0.0
2600.5	0.0
2601.0	2.0
2601.5	4.0
2602.0	5.0
2602.5	6.0
2603.0	7.0
2603.5	8.0
2604.0	9.0
2604.5	9.0
2605.0	10.0
2605.5	10.0
2606.0	11.0
2606.5	12.0
2607.0	21.0
2607.5	31.0
2608.0	31.0
2609.0	111.0
2610.0	256.0
2611.0	444.0
2612.0	666.0
2613.0	918.0
2614.0	1200.0

Dam Site: 9-B

Elevation, ft	Discharge, cfs
2581.0	0.0
2582.0	0.0
2583.0	0.0
2584.0	0.0
2585.0	0.0
2586.0	0.0
2587.0	0.0
2588.0	0.0
2589.0	0.0
2590.0	0.0
2591.0	0.0
2592.0	0.0
2593.0	0.0
2593.5	0.0
2594.0	7.0
2594.5	10.0
2595.0	12.0
2595.5	14.0
2596.0	15.0
2596.5	17.0
2597.0	18.0
2597.5	19.0
2598.0	20.0
2598.5	25.0
2599.0	26.0
2599.5	26.0
2600.0	27.0
2601.0	27.0
2602.0	28.0
2603.0	29.0
2604.0	30.0
2605.0	30.0
2606.0	31.0
2607.0	60.0
2608.0	177.0
2609.0	345.0
2610.0	550.0
2611.0	788.0
2612.0	1050.0

Table D1-13

Stump Ditch Basin Precipitation Depths[1]

Duration	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5-min	0.41	0.52	0.61	0.75	0.85	0.96
15-min	0.73	0.93	1.09	1.33	1.52	1.72
60-min	1.28	1.63	1.92	2.34	2.68	3.02
2-hr	1.55	1.96	2.32	2.83	3.23	3.64
3-hr	1.69	2.14	2.53	3.08	3.52	3.97
6-hr	1.94	2.44	2.88	3.50	4.00	4.52
12-hr	2.22	2.77	3.25	3.95	4.51	5.10
24-hr	2.54	3.15	3.69	4.46	5.10	5.76
2-day	2.91	3.61	4.22	5.10	5.80	6.53
4-day	3.37	4.16	4.84	5.81	6.57	7.36
7-day	3.92	4.72	5.41	6.39	7.16	7.96
10-day	4.42	5.24	5.94	6.94	7.73	8.53

Buffalo Creek Basin Precipitation Depths[1]

Duration	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5-min	0.42	0.53	0.62	0.74	0.84	0.95
15-min	0.76	0.94	1.10	1.33	1.51	1.69
60-min	1.35	1.69	1.99	2.40	2.73	3.06
2-hr	1.64	2.06	2.41	2.93	3.34	3.76
3-hr	1.78	2.24	2.64	3.22	3.69	4.17
6-hr	2.04	2.57	3.03	3.71	4.26	4.85
12-hr	2.33	2.91	3.43	4.19	4.81	5.47
24-hr	2.64	3.29	3.86	4.69	5.38	6.09
2-day	3.00	3.73	4.36	5.28	6.02	6.78
4-day	3.47	4.28	4.98	5.97	6.75	7.55
7-day	4.03	4.87	5.57	6.56	7.34	8.14
10-day	4.54	5.40	6.12	7.13	7.93	8.74

Spring Creek Basin Precipitation Depths[1]

Duration	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5-min	0.41	0.52	0.62	0.75	0.85	0.96
15-min	0.74	0.93	1.10	1.33	1.52	1.71
60-min	1.31	1.65	1.95	2.37	2.70	3.04
2-hr	1.58	2.00	2.36	2.87	3.28	3.70
3-hr	1.72	2.18	2.57	3.14	3.59	4.06
6-hr	1.98	2.49	2.93	3.58	4.11	4.67
12-hr	2.26	2.82	3.32	4.05	4.64	5.27
24-hr	2.58	3.21	3.76	4.57	5.23	5.92
2-day	2.95	3.67	4.29	5.20	5.92	6.68
4-day	3.42	4.23	4.93	5.92	6.70	7.51
7-day	3.98	4.81	5.51	6.51	7.29	8.10
10-day	4.49	5.33	6.05	7.06	7.86	8.67

2D Model Domain Precipitation Depths[1]

Duration	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5-min	0.43	0.53	0.62	0.74	0.84	0.94
15-min	0.76	0.95	1.11	1.33	1.50	1.68
60-min	1.36	1.70	2.00	2.42	2.76	3.11
2-hr	1.65	2.07	2.44	2.98	3.41	3.86
3-hr	1.79	2.26	2.67	3.29	3.79	4.31
6-hr	2.04	2.58	3.05	3.77	4.37	5.00
12-hr	2.32	2.90	3.42	4.19	4.84	5.53
24-hr	2.63	3.26	3.81	4.64	5.33	6.05
2-day	2.98	3.69	4.31	5.21	5.94	6.70
4-day	3.43	4.21	4.89	5.85	6.63	7.42
7-day	3.98	4.77	5.45	6.42	7.19	7.99
10-day	4.48	5.30	6.00	7.00	7.79	8.60

Footnote: NOAA Atlas 14 Data taken at centroid of basin.

Table D1-14

NLCD Code	Land Cover Description	Manning's n Value
N/A	Stream Channels	0.040
11	Open Water	0.030
21	Developed, Open Space	0.035
22	Developed, Low Intensity	0.100
23	Developed, Medium Intensity	0.100
24	Developed, High Intensity	0.100
31	Barren Land	0.035
41	Deciduous Forest	0.120
43	Mixed Forest	0.120
52	Shrub/Scrub	0.080
71	Grassland/Herbaceous	0.050
81	Pasture/Hay	0.050
82	Cultivated Crops	0.045
90	Woody Wetlands	0.120
95	Emergent Herbaceous Wetlands	0.120
128	No Data	0.060

D1.10 Charts

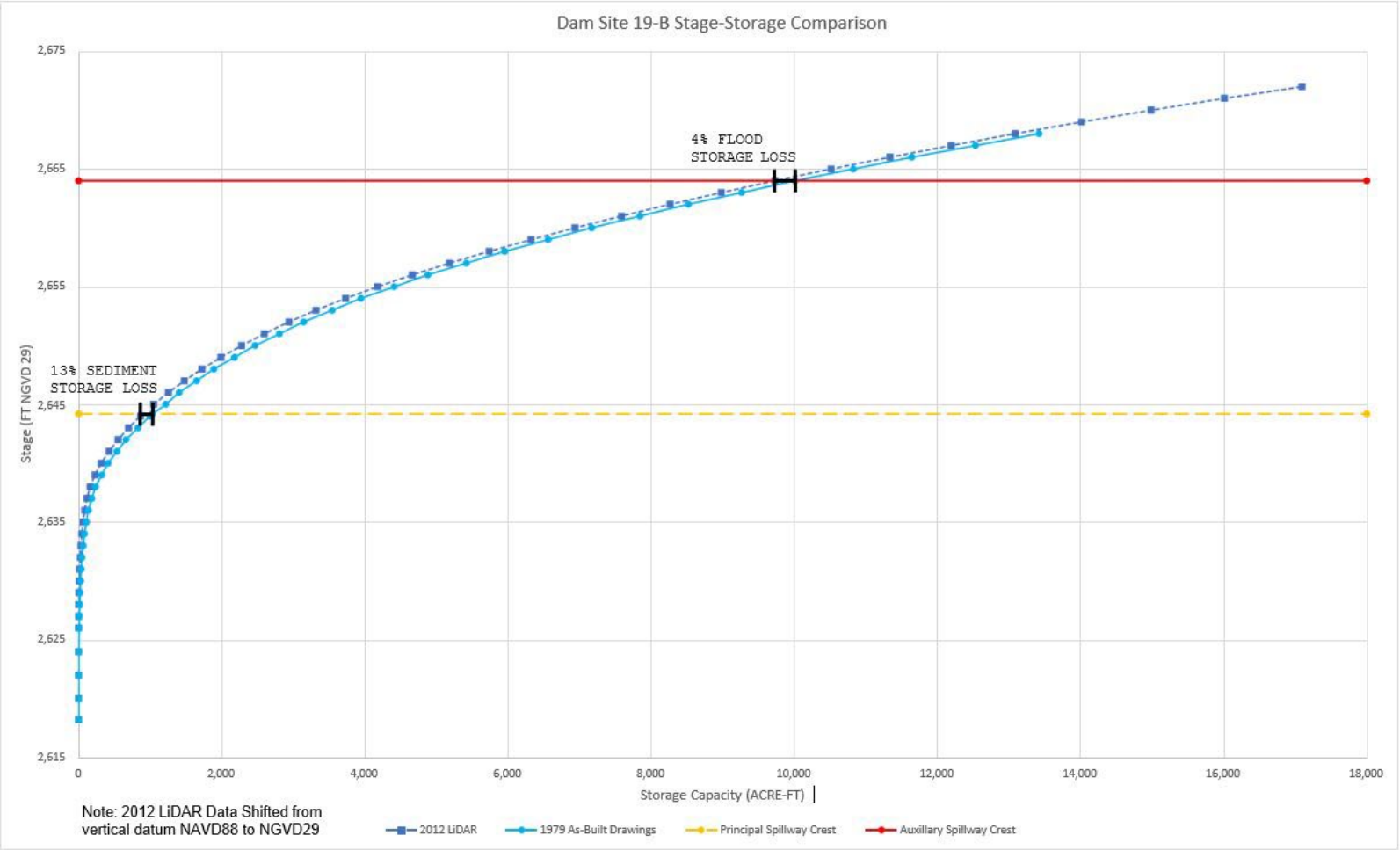

Dam Site 19-B Stage-Storage Comparison
2,675
2,665
2,655
2,645
2,635
2,625
2,615
Stage (FT NGVD 29)
4% FLOOD
STORAGE LOSS
13% SEDIMENT
STORAGE LOSS
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
Storage Capacity (ACRE-FT)
Note: 2012 LiDAR Data Shifted from
vertical datum NAVD88 to NGVD29
2012 LiDAR
1979 As-Built Drawings
Principal Spillway Crest
Auxillary Spillway Crest

Chart D1-1

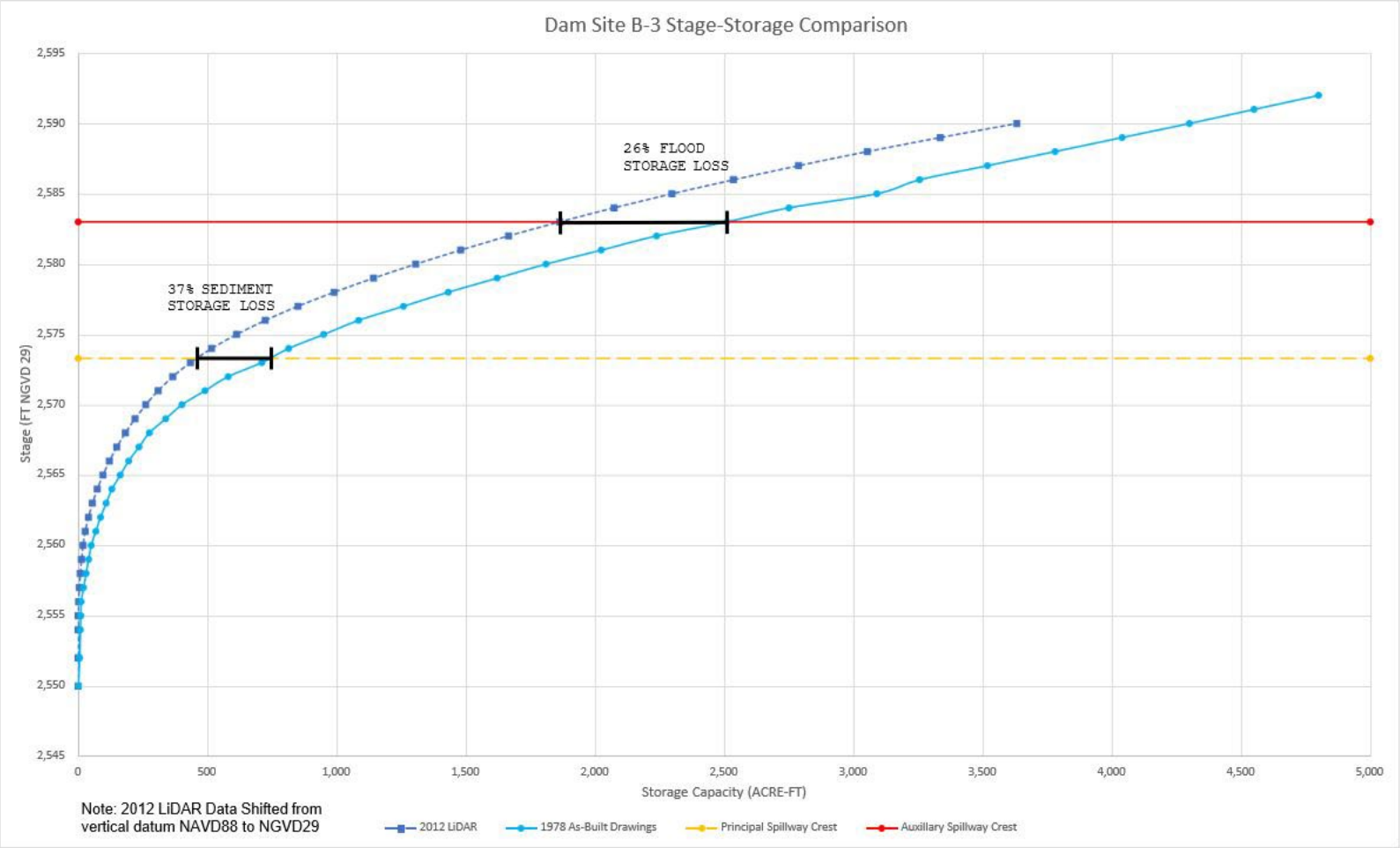

Dam Site B-3 Stage-Storage Comparison
26% FLOOD
STORAGE LOSS
37% SEDIMENT
STORAGE LOSS
Stage (FT NGVD 29)
2,595
2,590
2,585
2,580
2,575
2,570
2,565
2,560
2,555
2,550
2,545
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
Storage Capacity (ACRE-FT)
Note: 2012 LiDAR Data Shifted from
vertical datum NAVD88 to NGVD29
2012 LiDAR
1978 As-Built Drawings
Principal Spillway Crest
Auxillary Spillway Crest

Chart D1-2

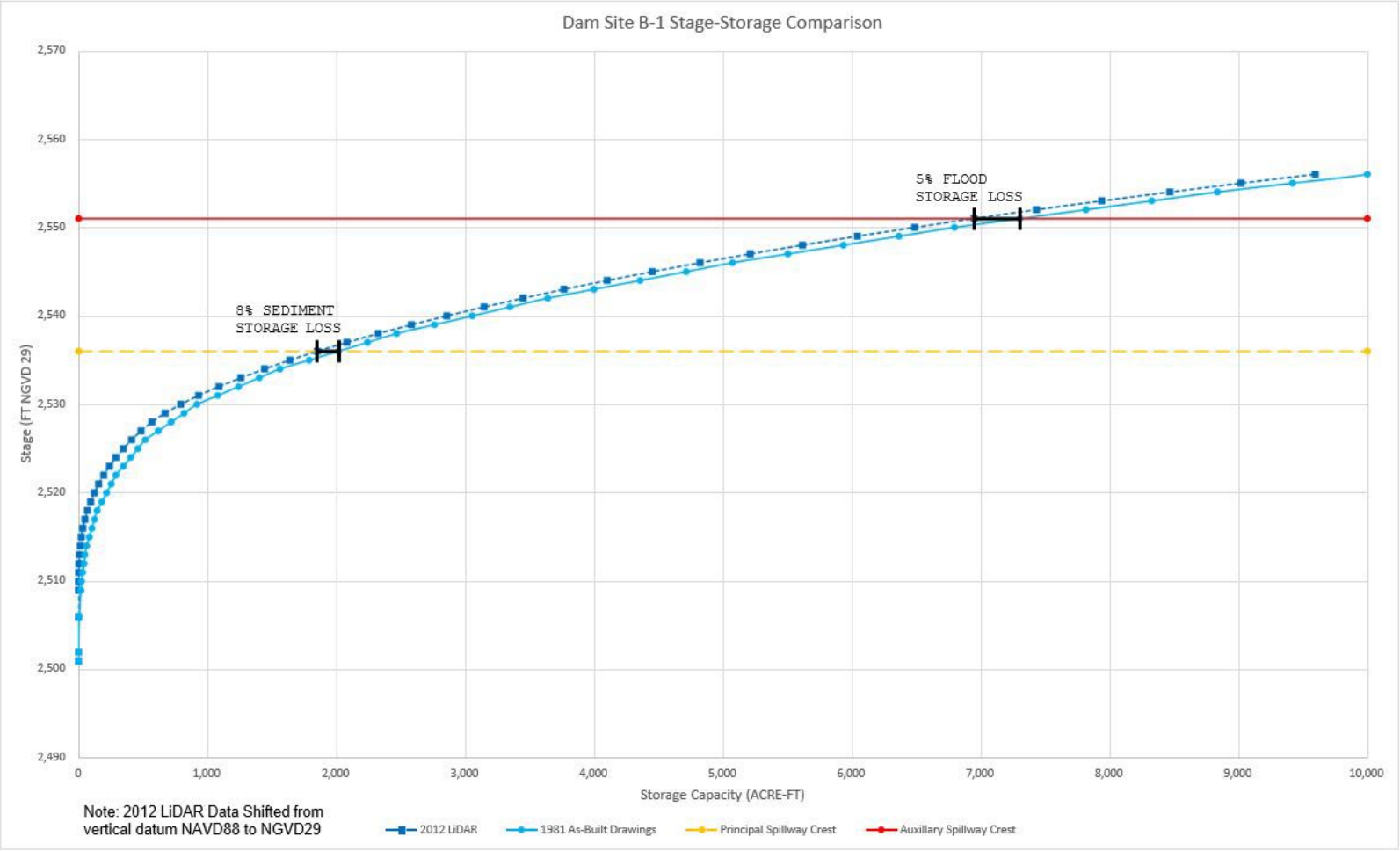

Dam Site B-1 Stage-Storage Comparison
2,570
2,560
2,550
2,540
2,530
2,520
2,510
2,500
2,490
Stage (FT NGVD 29)
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
Storage Capacity (ACRE-FT)
5% FLOOD
STORAGE LOSS
8% SEDIMENT
STORAGE LOSS
Note: 2012 LiDAR Data Shifted from
vertical datum NAVD88 to NGVD29
2012 LiDAR
1981 As-Built Drawings
Principal Spillway Crest
Auxillary Spillway Crest

Chart D1-3

D1.11 Proposed Improvement Geometries

Table D1-15

Measure Description	Improvement Starts	Improvement Ends	Channel Shape	Length	Channel Slope	Top Width	Bottom Width	Nominal Depth	Side Slopes	n value	Flow Area
				(ft)	(ft/ft)	(ft)	(ft)	(ft)	H:V		(sf)
Cozad Section 1	NW of CR 762 and Newell St Intersection	Immediately South of W 16th St	Eight-Point	5220.0	0.001	182.000	28	6.0	3:1	0.040	630
Cozad Section 2 (Diversion)	Immediately South of W 16th St	Confluence with Stump Ditch near Country Club Road	Trapeziodal	3650.0	0.001	123.000	102	3.5	3:1	0.030	394
Cozad Section 3	Confluence with Stump Ditch near Country Club Road	Confluence with DD #4	Eight-Point	7730.0	0.001	201.000	24	4.0	3:1	0.040	488
Lexington NE (Spring Creek)	South of CR 757	Confluence with DD #1	Eight-Point	27530.0	0.001	108.000	20	7.0	3:1	0.040	599
Lexington SE (DD #1)	CR 431 & US 30	DD #1	Eight-Point	2920.0	0.001	92.000	10	7.0	3:1	0.040	465
Lexington SE (DD #1)	DD #1	Confluence with Spring Creek	Eight-Point	33690.0	0.001	92.000	24	7.0	3:1	0.040	563
Overton Interior Drainage	200 ft north of 9th St	200 ft north of US 30	Triangular	2120.0	0.001	6.000	0	1.0	3:1	0.040	3
Overton South	US 30	1/2 mile south of 1st St	Six-Point	5720.0	0.001	54.000	24	2.0	3:1	0.040	69

Table D1-16

Measure Description	Improvement Starts	Improvement Ends	Length	Top Width	Bottom Width	Average Height of Berm	Side Slopes	Prism Area	Approx. Volume of Earth Fill
			(ft)	(ft)	(ft)	(ft)	H:V	(sf)	(cy)
Cozad North Berm	Avenue O	Newell St	4600	10.0	28.000	3	3:1	57.0	9800.0
Lexington Berm	South of CR 757	1/4 mile north of CR 755	18750	20.0	44.000	4	3:1	128.0	88900.0
Overton Berm	1/4 mile west of Lincoln St	200 ft north of US 30	7930	10.0	28.000	3	3:1	57.0	16800.0

Appendix D2 Aquatic Resources Avoidance, Minimization, and Mitigation

Aquatic Resources Avoidance, Minimization, and Mitigation

Project: Spring Creek Watershed Plan – Environmental Assessment

D2.1 Regulatory Context

The purpose of this memorandum is to provide the detail needed to address Section 404 of the Clean Water Act (and specifically the Section 404 (b)(1) Guidelines and 33 CFR Parts 325 and 332) as well as Natural Resource Conservation Service (NRCS) Policy and specifically Executive Order 11990.

D2.1.1 Section 404 of the Clean Water Act

The Federal Water Pollution Control Act of 1972 is today known as the Clean Water Act (CWA). The U.S. Army Corps of Engineers (USACE) and the States administer the various sections of the CWA with the oversight of the Environmental Protection Agency (EPA). Section 404 of the CWA regulates the discharge of dredged or fill material into waters of the U.S. is prohibited unless the action is exempted or is authorized by a permit issue by the Corps or by the State.

In USACE's evaluation of permit applications to discharge dredged or fill material into waters of the U.S. (WOUS), including wetlands, the USACE is required to analyze alternatives to the proposed project that achieve its purpose. USACE conducts this analysis pursuant to two main requirements – the 404(b)(1) Guidelines (Guidelines)[1] and the National Environmental Policy Act (NEPA)[2]. USACE also considers alternatives as part of its public interest review evaluation[3].

USACE must evaluate alternatives that are practicable and reasonable. In accordance with the Guidelines at 40 CFR 230.10(a), a permit cannot be issued if a practicable alternative exists that would have less adverse impact on the aquatic ecosystem (known as the Least Environmentally Damaging Practicable Alternative [LEDPA]), provided that the LEDPA does not have other significant adverse environmental consequences to other natural ecosystem components. Reasonable alternatives must be considered to satisfy NEPA. However, there are no requirements with reasonable alternatives relative to USACE's permit decision similar to the Guidelines. Evaluations to address the Guidelines and NEPA normally satisfy the requirements of the public interest review.

The Guidelines include two rebuttable presumptions for projects with discharges into WOTUS which involve special aquatic sites (defined at 40 CFR 240.40-45 and include wetlands, riffle pool complexes, and other specific aquatic resources), that do not require access to or siting within the special aquatic site(s) to achieve their basic essence (basic project purpose). The first presumption states that alternatives that do not affect special aquatic sites are presumed to be available. The second presumption states that practicable alternatives located in non-special

[1] 40 CFR Part 230
[2] 33 CFR Part 325 Appendix B and 40 CFR 1508
[3] 33 CFR 320.4(a)(2)ii

aquatic sites (e.g., other waters, uplands, etc.) have less adverse impact on the aquatic ecosystem. It is the applicant's responsibility to clearly demonstrate to the USACE that both of these presumptions have been rebutted in order to pass the alternatives portion of the Guidelines.

D2.1.2 NRCS Policy

The NRCS provides guidance for compliance with NEPA as well as other Executive Orders. The National Watershed Program Manual[4] and National Watershed Program Handbook[5] provide the requirements for alternatives formulation. The alternatives formulation process is the basis for selecting combinations of measures to include as alternatives. Any alternative that does not meet the stated purpose and need does not get considered in detail for economic and environmental analysis.

In additional, Executive Order (E.O.) 11990 requires that Federal agencies take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the beneficial functions of wetlands when “providing federally undertaken, financed or assisted construction and improvements.” NRCS policy for implementing the EO can be found at 190-GM, Part 410, Subpart B, Section 410.26 and includes procedures for pre-conversion that includes an evaluation of potential avoidance, minimization, and mitigation.

D2.1.3 Regulatory and Policy Crosswalk

The Guidelines state that practicable is defined as meaning the alternative is available, and capable of being done after taking into consideration cost, existing technology, and/or logistics in light of the overall project purpose(s)[6]. Reasonable is based on consideration of the project purpose as well as technology, economics and common sense[7]. The Guidelines may require more substantive effort to demonstrate compliance compared to NEPA[8], as well as involve limitations relative to how they can be applied to determine practicability. This is further underscored by the rebuttable presumptions previously discussed requiring it be clearly demonstrated by the applicant that the alternatives are not practicable compared to the applicant’s proposed project.

The NWPM states that any alternative that does not meet the stated purpose and need for action does not need to considered in detail. Alternatives that meet the need for action but do not achieve the purposes may be eliminated from detailed study. “[F]or alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated” (40 CFR Section 1502.14(a)). Alternatives that may appear reasonable but clearly become unreasonable because of cost, logistics, existing technology, or environmental reasons must be included in this section and the reasons for elimination discussed.

[4] Title 390-501-M
[5] Title 390-600-H
[6] 40 CFR 230.3(q)
[7] Council on Environmental Quality Guidance 40 Most Asked Questions #2A
[8] 40 CFR 230.10(a)(4)

The purpose of the following analysis is to show the alternatives development and screening relative to reasonable alternatives to be addressed under NEPA and practicable alternative under the Guidelines.

D2.2 Avoidance Alternatives Analysis

This section provides an evaluation of the range of alternatives considered that would potentially avoid impacts to wetlands and aquatic resources for the purpose of compliance with the Guidelines and NRCS policy.

D2.2.1 Spring Creek Watershed Range of Alternatives and Screening

The NRCS Federal project purpose can be related to the basic project purpose under CWA. The Federal (and basic) project purpose is flood damage reduction.

The project purpose (or the applicant's project purpose) is further refined based on the geographic locations of problems occurring in the watershed. An analysis of problems within the watershed identified significant and routine flood damages in the communities of Cozad and Lexington, Nebraska. An analysis of the storm events that cause damage was conducted. This analysis resulted in the following project purposes:

- Provide the community of Cozad, Nebraska protection from a 10-year (10 percent annual exceedance probability in any given year) precipitation event to minimize the current risk of flooding and reduce flood-related damages to public and private infrastructure.

- Provide the community of Lexington, Nebraska protection from a 25-year (4 percent annual exceedance probability event in any given year) precipitation event to minimize the current risk of flooding and reduce flood-related damages to public and private infrastructure.

To address these project purposes, a range of measures were identified and analyzed for their ability to meet the project purpose and to determine their reasonableness and practicability. Measures included the no action alternative, off-site locations (structural and non-structural measures), and on-site measures (consisting of non-structural measures). Table D2-1 and Table D2-2 provides the evaluation of the range of measures and disposition relative to evaluation within the Plan-EA.

Table D2-1. Cozad Measures Analysis. Project Purpose – Flood Damage Reduction. Project Need – Provide protection from a 10-year precipitation event to minimize the current risk of flooding and reduce flood-related damages to public and private infrastructure Potential Flood Control Alternatives

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Alternative (Consideration for More Detail Study or Elimination)
No Action/Future Without Federal Project (considered as a stand-alone alternative)	This alternative is the most likely course of action should the Sponsor not receive federal funding for the project. Under this alternative, no federal assistance would be available and the Sponsor would not pursue further action. While there would be no costs associated with this alternative, flood damages would continue to occur.	NA	NA	NA	NA	NA	Will be carried forward within the environmental screening.
On-Channel Storage	Restoration and/or Enhancement of Existing Floodwater Retarding Structures (FWRS) Restore or enhance the flood storage capacity of three (3) existing FWRS (18-A, 19-B, 25-A) constructed by the Soil Conservation Service (SCS) between 1970 and 1979 as part of the PL566 program and owned by Dawson County and/or City of Lexington. Two (2) structures are classified by NDNR as low hazard, 19-B is classified as high hazard due to potential dam breach damage to the city of Cozad. 56,500 acres of headwater area is located in the highland's region and is part of the Stump Ditch drainage area, with 50,400 acres being controlled by 3 existing FWRS. Eliminating runoff from the highlands area from the hydrologic model decreases the peak flow (Q10, Q25, Q50, and Q100) at the entrance to the Cozad corporate limits.	Analyze flood damage reduction with entire upland area contribution eliminated. If no appreciative damage reduction observed, restoration or enhancement opportunities would not meet purpose and need. If enhancement or restoration is reasonable, determine if additional flood storage area, given the area controlled, would reduce peak flows to meet the project purpose and need. Model runs were made with no inflow from areas currently and potentially contained by FWRS and compared with existing conditions.	Does not meet purpose and need. Flood depth reduction from this measure was negligible; improvements for any recurrence interval would not provide meaningful benefit.	NA	NA	NA	Eliminated due to not meeting purpose and need by not providing a noticeable improvement in storage capacity, and therefore, reduction in peak flows.
On-Channel Storage	Construction of new large FWRS (between 21 and 160 surface water acres) in the highlands area. The necessary topographic relief for on-channel storage is only provided in highlands area. Of the 56,500 acres in the highlands area, 50,400 acres are regulated.	Analyze flood damage reduction with entire upland area contribution eliminated. If no appreciative damage reduction observed, restoration or enhancement opportunities would not meet purpose and need.	Does not meet purpose and need. Flood depth reduction from this measure was negligible; improvements for any recurrence interval would not provide meaningful benefit.	NA	NA	NA	Eliminated due to not meeting purpose and need by not providing a noticeable improvement in storage capacity, and therefore,

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Alternative (Consideration for More Detail Study or Elimination)
		If flow reduction is more than negligible, advance to identifying site locations.					reduction in peak flows.
On-Channel Storage	Construction of new small FWRS (Less than 20 surface water acres)	Analyze flood damage reduction with entire upland area contribution eliminated. If no appreciative damage reduction observed, restoration or enhancement opportunities would not meet purpose and need. If appreciative damages are observed, evaluate the peak flow reduction of removal of flow from all 6,100 acres of uncontrolled portions of the highlands. If peak flow reduction is negligible, no further analysis. If flow reduction is more than negligible, advance to identifying site locations.	Does not meet purpose and need. Flood depth reduction from this measure was negligible; improvements for any recurrence interval would not provide meaningful benefit.	NA	NA	NA	Eliminated due to not meeting purpose and need by not providing a noticeable improvement in storage capacity, and therefore, reduction in peak flows.
Off-Channel Storage	Construction of off-channel storage for peak flow diversion. The lowland area is relatively flat (average slope is 1.80%) and the topographic relief is not conducive to a traditional dam embankment tying into high ground. An in-channel diversion would be constructed to work in conjunction with a side channel weir to divert flood flows to an off-channel storage basin. The lowland area has high groundwater levels (average depth to water is 6.56 feet [average depth for April–August when the likelihood of flooding is highest]); therefore, the maximum excavation depth is 2 feet for a total storage depth of 4.5 feet.	Determine Drainage Ditch No. 4 capacity at top of bank (~190 cfs). Determine the excess volume for a 10-year event that would need to be contained off-channel. Determine if land needs for those volumes are reasonable.	Measure would require off-channel storage of all flow above the existing channel flow capacity (~190 cfs). This would require the storage of approximately 46,538,000 cubic feet of water to store the 10-year event. With only 3 ft of depth available, 0.56 square mile of area is required. Due to shallow relief and high groundwater table, there is a very small vertical range of storage. The storage needed given this area would require an unreasonable amount of land area. However, due to the flat relief upstream of Cozad, flooding occurs over a wide portion of the study area, with flooding originating from Stump Ditch as well as other upstream drainage	NA	NA	NA	Eliminated due to not meeting purpose and need based on inability to capture flood flows over a wide floodplain.

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Alternative (Consideration for More Detail Study or Elimination)
			ditches. Due to the flat topography, locating multiple off-channel storage locations would not result in capturing all the runoff necessary to meet the purpose and need.				
Levee Systems	Restrict flood flows from urbanized area by constructing a levee system that meets USACE standards for participation in federal flood insurance program.	Qualitatively assess functionality of levee implementation relative to cause of flooding. Assess constraints to levee siting and assess logistical and cost considerations.	Measure meets project purpose and need.	Independently, a levee system would be needed along Drainage Ditch No. 4. This would require numerous property takings along the east side of Cozad. Additionally, some level of drainage improvements would also be needed pending levee placement. Interior drainage would also need to be an issue.	Measure would have logistical challenges regarding implementation due to the multiple property takings needed to implement, and incorporation of additional drainage improvements to address additional exterior and interior drainage.	Due to the logistics and extensive property takings, this measure does not effectively or efficiently address the problems or achieve the desired opportunity efficiently.	Eliminated due to reasonableness, inefficiency, and logistics of implementation of a levee system.

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Alternative (Consideration for More Detail Study or Elimination)
Channel Conveyance	Channel conveyance includes a combination of channel improvements and associated flood protection berms and diversion channels, as necessary. Channel improvements – Channel improvements would increase the capacity of the conveyance system through modification of the channel alignment and/or geometry and replace undersized drainage structures to provide protection from a defined flood event. Flood protection berms – Implementation of specific flood protection barriers to provide flood damage reduction for specific areas of interest. Based on hydraulic modeling, identify locations for berms to redirect flows away from flood prone structures. Diversions – Redirect excess flows upstream and construct a diversion around urban area to reduce flows in urban area to no-damage flows. Promote use of existing drainages or drainage ditches to convey excess flood waters.	Model collective channel conveyance measures improvement and provide the reduction in flooding extents and depth for a defined damage storm. Determine the reduction in flooding extents and depth along Drainage Ditch No. 4 and within Cozad as a result of the channel improvements for a defined damage storm (10-year storm event).	Measure meets purpose and need. Model results have shown that a combination of channel conveyance to existing Drainage Ditch No. 4 and natural drainageways, a flood protection berm, and new diversion ditches would result in reductions in flood extent and depths for the 10-year storm event within Cozad.	Yes	Yes	Yes	Carried forward as an measure to evaluate in a more detailed study.
Floodplain Connectivity	The intent of this measure would be to use the historic floodplain for temporary storage of floodwaters. This measure would consist of reconnecting the stream to the historic floodplain by constructing a series of grade check structures along the channel. Note that the stream channel is not deeply incised.	Qualitatively evaluate the available floodplain storage that is currently not connected at 10-year event. Pending availability of storage, estimate the approximate acreage of available floodplain storage and resultant reduction in peak flows.	Temporary flood storage potential is limited due to the hydrologic setting. Floodplains adjacent to individual streams are poorly defined because the entire lowland area is in the Platte River floodplain. Accordingly, there is limited topographic relief and a lack of natural barriers to inter-subwatershed flow. Existing connectivity results in relatively frequent flooding of widespread areas.	NA	NA	NA	Eliminated due to not meeting purpose and need as floodplain areas are already connected at events targeted for flood damage reduction.

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Alternative (Consideration for More Detail Study or Elimination)
Physical Non-Structural Measures	Elevation, relocation/buyout/acquisition, dry and wet flood proofing.	Determine the number of structures within the existing flood prone area. Quantify the total number of structures (structure type not classified) located within the existing floodplain and determine market value for acquisition. Determine the number of acres of land within the existing floodplain and determine market value for acquisition.	Measure meets purpose and need.	Approximately 1,550 structures would require some level of non-structural improvement. Total assessed value of $112,154,137 Acquisition and/or elevation raise and dry/wet proofing is not reasonable at this scale due to the number of properties involved. Voluntary participation at this scale is unlikely and therefore flood cleanup and repair costs would still affect the community in the aftermath of flood events.	Acquisition and/or elevation raise and dry/wet proofing is not logistically practicable at this scale due to the number of properties involved. Voluntary participation at this scale is unlikely and therefore flood cleanup and repair costs would still affect the community in the aftermath of flood events.	Due to the need for voluntary participation at this scale, not complete or effective.	Eliminated due to reasonableness, logistics, lack of completeness, and inefficiency of implementation of measures at the scale necessary to provide a noticeable reduction in flood damage.

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Alternative (Consideration for More Detail Study or Elimination)
Non-Physical Non-Structural Measures	Flood warning systems, land use regulation, zoning, flood insurance, floodplain mapping, evacuation plans, risk communication, flood emergency preparedness plan. https://www.usace.army.mil/Missions/Civil-Works/Project-Planning/nnc/	Qualitative evaluation of the potential to reduce flood damage.	While these measures may prevent future development from flood prone areas and minimize some property damages, the area of damages is already developed. Prohibiting future development would have no effect on existing damages. Evacuation, risk communication, and flood emergency preparedness would benefit life and health risks but would have minimal effect on flood damage reduction.	NA	NA	NA	Eliminated due to not meeting purpose and need for flood damage reduction.
Agricultural BMPs (Conservation Measures)	Full implementation of conservation measures on agricultural lands within the Spring Creek drainage basin. Non-irrigated measures may include conservation cropping systems, contour farming, diversion, grassed waterway or outlet, flat channel terrace, and level terrace. Irrigated measures may include irrigation land leveling, irrigation water management, and drainage field ditch.	Qualitative evaluation of the potential to reduce flood damage.	BMPs could be applied throughout the study area, but their implementation is impeded by willing landowners and availability of funding to cost share. The purpose of the BMPs is not to reduce peak flows or to reduce flooding. They are intended to provide soil conservation, prevent runoff, and to improve feeding operations. Even if BMPs could be applied on all agricultural land in the study area, there would be no reduction in peak flows or the number of flooding events.	NA	NA	NA	Eliminated due to not meeting purpose and need based on inability of affecting peak flows and flood damage reduction.

Table D2-2. Lexington Measures Analysis. Project Purpose – Flood Damage Reduction. Project Need – Provide protection from a 25-year precipitation event to minimize the current risk of flooding and reduce flood-related damages to public and private infrastructure Potential Flood Control Measures

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Measure (Consideration for More Detail Study or Elimination)
No Action/Future Without Federal Project (considered as a standalone alternative)	This alternative is the most likely course of action should the Sponsor not receive federal funding for the project. Under this alternative, no federal assistance would be available, and the Sponsor would not pursue further action. While there would be no costs associated with this alternative, flood damages would continue to occur.	NA	NA	NA	NA	NA	Will be carried forward within the environmental screening.
On-Channel Storage	Restoration and/or Enhancement of Existing FWRS. Restore or enhance the flood storage capacity of three (3) existing FWRS (9-A, 9-B, 11-A) constructed by SCS between 1970 and 1979 as part of the PL566 program and owned by Dawson County and/or City of Lexington. Two (2) structures are classified by NDNR as low hazard, 11-A is classified as significant hazard. 23,500 acres of headwater area is located in the highland's region and is part of the Spring Creek drainage area, with 16,700 acres being controlled by 3 existing FWRS. Eliminating runoff from the highlands area from the hydrologic model decreases the peak flow (Q10, Q25, Q50, and Q100) at the entrance to the Lexington corporate limits.	Analyze flood damage reduction with entire upland area contribution eliminated. If no appreciative damage reduction observed, restoration or enhancement opportunities would not meet purpose and need. If enhancement or restoration is reasonable, determine if additional flood storage area, given the area controlled, would reduce peak flows to meet the project purpose and need. Model runs were made with no inflow from areas currently and potentially contained by FWRS and compared with existing conditions.	Flood depth reduction from this measure was negligible; improvements for any recurrence interval would not provide meaningful benefit.	NA	NA	NA	Eliminated due to not meeting purpose and need by not providing a noticeable improvement in storage capacity, and therefore, reduction in peak flows.
On-Channel Storage	Construction of new large FWRS (Between 21 and 160 surface water acres) in the highlands area. The necessary topographic relief for on-channel storage is only provided in highlands area. Of the 23,500 acres in the highlands area, 16,700 acres are regulated. Only high potential area is located in drainage east of FWRS 9-A. This drainage contributes flow to Spring Creek. The NDNR database shows no jurisdiction dams are located in drainage east of FWRS 9-A.	Analyze flood damage reduction with entire upland area contribution eliminated. If no appreciative damage reduction observed, restoration or enhancement opportunities would not meet purpose and need. If flow reduction is more than negligible, advance to identifying site locations.	Flood depth reduction from this measure was negligible; improvements for any recurrence interval would not provide meaningful benefit.	NA	NA	NA	Eliminated due to not meeting purpose and need by not providing a noticeable improvement in storage capacity, and therefore, reduction in peak flows.

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Measure (Consideration for More Detail Study or Elimination)
On-Channel Storage	Construction of new small FWRS (Less than 20 surface water acres)	Analyze flood damage reduction with entire upland area contribution eliminated. If no appreciative damage reduction observed, restoration or enhancement opportunities would not meet purpose and need. If appreciative damages are observed, evaluate the peak flow reduction of flow removal from all 6,800 acres of uncontrolled portions of the highlands. If peak flow reduction is negligible, no further analysis. If flow reduction is more than negligible, advance to identifying site locations.	Flood depth reduction from this measure was negligible; improvements for any recurrence interval would not provide meaningful benefit.	NA	NA	NA	Eliminated due to not meeting purpose and need by not providing a noticeable improvement in storage capacity, and therefore, reduction in peak flows.
Off-Channel Storage	Construction of off-channel storage for peak flow diversion. The lowland area is relatively flat (average slope is 1.80%), and the topographic relief is not conducive to a traditional dam embankment tying into high ground. An in-channel diversion would be constructed to work in conjunction with a side channel weir to divert flood flows to an off-channel storage basin. The lowland area has high groundwater levels (average depth to water is 6.56 feet [average depth for April–August when the likelihood of flooding is highest]); therefore, the maximum excavation depth is 2 feet for a total storage depth of 4.5 feet.	Determine Spring Creek capacity at top of bank (~375 cfs). Determine the excess volume for a 25-year event that would need to be contained off-channel. Determine if land needs for those volumes are reasonable.	Measure would require off-channel storage of all flow above the existing channel flow capacity (~375 cfs). This would require the storage of approximately 97,528,000 cubic feet of water to store the 10-year event. With only 4.5 ft of depth available, over 0.78 square mile of area is required. Due to shallow relief and high groundwater table, there is a very small vertical range of storage. The storage needed given this area would require an unreasonable amount of land area. The storage needed to provide a 25-year level of protection with this method would result in an even greater area of land being required. However, due to the flat relief upstream of Lexington, flooding occurs over a wide portion of the study area, with flooding originating from Stump Ditch, Spring Creek, drainage ditches, and along US 30 and the Union Pacific Railroad. Due to the flat topography, locating multiple off-channel storage locations would not result in capturing all the runoff necessary to meet the purpose and need.	NA	NA	NA	Eliminated due to not meeting purpose and need based on inability to capture flood flows over a wide floodplain.

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Measure (Consideration for More Detail Study or Elimination)
Levee Systems	Restrict flood flows from urbanized area by construction of a levee system that meets USACE standards for participation in the federal flood insurance program. Area of potential affect is along Spring Creek within Lexington and to Drainage Ditch No. 1.	Qualitatively assess functionality of levee implementation relative to cause of flooding. Assess constraints to levee siting and assess logistical and cost considerations.	Measure meets purpose and need.	Levee systems would be required around Lexington (basically a ring levee) due to the multiple directions from which flooding flows contribute to the flood problems in Lexington. On the south side of Lexington, the potential levee location would affect multiple homes and businesses. Additionally, interior drainage would need to be considered and additional conveyance measures developed.	Measure would have logistical challenges regarding implementation due to the multiple property takings need to develop.	Due to the logistics and extensive property takings, this measure does not effectively or efficiently address the problems or achieve the desired opportunity efficiently.	Eliminated due to reasonableness, inefficiency, and logistics of implementing a levee system.
Channel Conveyance	Channel conveyance includes a combination of channel improvements and associated flood protection berms and diversion channels, as necessary. Channel improvements – Channel improvements would increase the capacity of the conveyance system through modification of the channel alignment and/or geometry and replace undersized drainage structures to provide protection from a defined flood event. Flood protection berms – Implementation of specific flood protection barriers to provide a flood damage reduction for specific areas of interest. Based on hydraulic modeling, identify locations for berms to redirect flows away from flood prone structures. Diversions – Redirect excess flows upstream and construct a diversion around urban area to reduce flows in urban area to no-damage flows. Promote use of existing drainages or drainage ditches to convey excess flood waters.	Model collective channel conveyance measures improvement and provide the reduction in flooding extents and depth for a defined damage storm. Determine the reduction in flooding extents and depth along Spring Creek and within Lexington as a result of the channel improvements for a defined damage storm (25-year storm event).	Model results have shown that a combination of channel conveyance to both Spring Creek and Dawson County Drainage Ditch No. 1 and flood protection berms along Spring Creek and along Road 431 would result in reductions in flood extent and depths for the 25-year storm event within Lexington.	Yes	Yes	Yes	Carried forward as an measure to evaluate in a more detailed study.

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Measure (Consideration for More Detail Study or Elimination)
Floodplain Connectivity	The intent of this measure would be to use the historic floodplain for temporary storage of floodwaters. This measure would consist of reconnecting the stream to the historic floodplain by constructing a series of grade check structures along the channel. Note that the stream channel is not deeply incised.	Qualitatively evaluate the available floodplain storage that is currently not connected at 25-year event. Pending storage availability, estimate the approximate acreage of available floodplain storage and resultant reduction in peak flows.	Temporary flood storage potential is limited due to the hydrologic setting. Floodplains adjacent to individual streams are poorly defined because the entire lowland area is in the Platte River floodplain. Accordingly, there is limited topographic relief and a lack of natural barriers to inter-subwatershed flow. Existing connectivity results in relatively frequent flooding of widespread areas.	NA	NA	NA	Eliminated due to not meeting purpose and need as floodplain areas are already connected at events targeted for flood damage reduction.
Physical Non-Structural Measures	Elevation, relocation, buyout/acquisition, dry/wet flood proofing.	Determine the number of structures within the existing flood prone area. Quantify the total number of structures (structure type not classified) located within the existing floodplain and determine market value for acquisition. Determine the number of acres of land within the existing floodplain and determine market value for acquisition.	Measure meets purpose and need.	Approximately 1,020 structures would require some level of non-structural improvement. Total assessed value of $115,011,850. Acquisition and/or elevation raise and dry/wet proofing is not reasonable at this scale due to the number of properties involved. Voluntary participation at this scale is unlikely and therefore flood cleanup and repair costs would still affect the community in the aftermath of flood events	Acquisition and/or elevation raise and dry/wet proofing is not logistically practicable at this scale due to the number of properties involved. Voluntary participation at this scale is unlikely and therefore flood cleanup and repair costs would still affect the community in the aftermath of flood events.	Due to the need for voluntary participation at this scale, not complete or effective.	Eliminated due to reasonableness, logistics, lack of completeness, and inefficiency of implementation of measures at the scale necessary to provide a noticeable reduction in flood damage.
Non-Physical Non-Structural Measures	Flood warning systems, land use regulation, zoning, flood insurance, floodplain mapping, evacuation plans, risk communication, flood emergency preparedness plan. https://www.usace.army.mil/Missions/Civil-Works/Project-Planning/nnc/	Qualitative evaluation of the potential to reduce flood damage.	These measures may prevent future development from flood prone areas and minimize some property damages; overall, they would be ineffective in reducing flood damages.	NA	NA	NA	Eliminated due to not meeting purpose and need for flood damage reduction.

Measures	Description	Screening Methodology	Screening Results (Purpose and need, reasonableness/practicability) Purpose and Need	Screening Results (Purpose and need, reasonableness/practicability) Reasonableness (NEPA)	Screening Results (Purpose and need, reasonableness/practicability) Practicability (Cost, Logistics, Technology – 404(b)(1) Guidelines)	Screening Results (Purpose and need, reasonableness/practicability) PR&G (Completeness, Effectiveness, Efficiency, Acceptability)	Disposition of Measure (Consideration for More Detail Study or Elimination)
Agricultural BMPs (Conservation Measures)	Full implementation of conservation measures on agricultural lands within the Spring Creek drainage basin. Non-irrigated measures may include conservation cropping systems, contour farming, diversion, grassed waterway or outlet, flat channel terrace, and level terrace. Irrigated measures may include irrigation land leveling, irrigation water management, and drainage field ditch.	Qualitative evaluation of the potential to reduce flood damage.	BMPs could be applied throughout the study area, but their implementation is impeded by willing landowners and availability of funding to cost share. The purpose of the BMPs is not to reduce peak flows or to reduce flooding. Even if BMPs could be applied on all agricultural land in the study area, there would be no reduction in peak flows or in number of flooding events. They are intended to provide soil conservation, prevent runoff, and to improve feeding operations.	NA	NA	NA	Eliminated due to not meeting purpose and need due to the inability to affect peak flows and flood damage reduction as described in the purpose and need.

Measure Screening Summary

The measures analysis did not identify any other alternatives other than the Channel Conveyance Measure that meet the purpose and need or were practicable for either the Cozad or Lexington geographical areas. Therefore, the Channel Conveyance Measure (and therefore developed as an alternative) is, by default, the LEDPA alternative for the Cozad and Lexington geographical areas. Section D2.3 addresses the anticipated impacts to aquatic resources and associated minimization measures considered.

D2.3 Wetlands and Aquatic Resource Impact Minimization

This section describes the anticipated impacts to wetlands and aquatic resources for the Channel.

D2.3.1 Wetland and Aquatic Resource Impacts

Table D2-3 describes the wetland and aquatic resource impacts.

Table D2-3. Spring Creek Delineation Resource Impacts

	Permanent Impact (acres/linear feet)	Temporary Impact Acreage (acres/linear feet)
Cozad	**0.37 acres / 150 linear feet**	**7.48 acres / 2,335 linear feet**
PEMA/C Wetland	0.33[1]	6.75[1]
Ephemeral	--	0.03 acres / 450 linear feet
Intermittent Stream	0.04 acre / 150 linear feet	0.60 acres / 1,885 linear feet
OW	--	0.1
Lexington NE	**0.08 acres / 172 linear feet**	**15.02 acres / 31,513 linear feet**
PEMA/C Wetland	0	2.25
Intermittent Stream	0.01 acres / 22 linear feet	0.07 acres / 263 linear feet
Perennial Stream	0.07 acres / 150 linear feet	12.70 acres / 31,250 linear feet
Lexington SW	**0.07 acre / 183 linear feet**	**14.3 acres / 29,940 linear feet**
PEMA/C Wetland	0.02	8.7
Wetland in Agricultural Setting	<0.01	0.1
Intermittent Stream	0.04 acres/183 linear feet	5.5 acres/29,940 linear feet

D2.3.2 Minimization

Impacts on existing natural resources and cultural resources/historic properties due to the installation of this project were identified in Chapter 5. All adverse impacts were avoided and minimized to the maximum extent practicable.

D2.4 Mitigation

Construction would have temporary, minor, adverse impacts on streams due to construction, vehicle traffic, and excavation. Minor permanent fill would be required where proposed berms intersect waterways/wetlands or for new conveyance structures or weir. While fill would be required in select locations along the existing ditch/waterway, the aquatic resources would be realigned or shifted to the east so there would be no net loss of waterway to the landscape. Furthermore, the waterways would be widened and improved, further serving to enhance the aquatic resources in the study area. Wetland and stream mitigation would be determined during the Clean Water Act 404 permitting process. All temporarily affected resources would be restored after the project. The project would result in permanent, moderate, beneficial impacts on waterways by stabilizing streambanks and decreasing the number of overtopping events by increasing channel capacity.

During construction, site mitigation measures would include erosion and sediment control, dust control, and other practices identified during the design process. Best management practices during construction would be implemented to minimize the mobilization of the sediment into stream systems, including silt fencing, bank stabilization, construction entrances, sediment storage, matting, and grassing/vegetative cover.

Impacts on existing natural resources and cultural resources/historic properties due to the installation of this project were identified in Chapter 5. All adverse impacts were avoided and minimized to the maximum extent practicable. Remaining adverse impacts, while still minor in nature, would be mitigated. In-field surveys, paired with other existing data, were utilized to determine the mitigation needs. Mitigation quantities for each resource would be based on input from NRCS resource specialists and USACE regulatory requirements. Land required for mitigation would be located at or near the project site and would be acquired by the Sponsor for the duration of the project life. All necessary mitigation plans would be developed as part of the design phase, prior to construction.

The project would be permitted with a Clean Water Act Section 404, Nationwide Permit 43: Stormwater Management Facilities. This project complies with the Food Security Act by not making wetland areas easier to farm than they currently are nor does it convert any wetlands to farmland. This project complies with EO 11990 by adequately replacing impacted wetlands with new wetlands, which would result from increasing the channel capacity, creating wetland benches and gentler, stable banks.

The Programmatic Agreement was developed in accordance with 36 CFR 800.4(b)(2) for a phased identification and evaluation of effects to historic properties and will include treatments to resolve adverse effects, should they be determined to occur. As required, NRCS would conduct further consultations with the Section 106 consulting parties to seek ways to avoid, minimize, or mitigate adverse effects on those discoveries. The Sponsor would bear the costs of the mitigation of adverse effects to historic properties under the National Historic Preservation

Act. No costs for such mitigation have been explicitly included in the economic analysis because these costs are as yet undetermined. All mitigation is anticipated to occur on-site.

Appendix D3 Economics Technical Memorandum

Economics Technical Memorandum

Project:	Appendix D Economics
Date:	Wednesday, October 23, 2024

D3.1 Introduction

This economic evaluation includes a discussion of the economics of system improvements and the federal guidelines for the economic evaluation of watershed improvement projects, including the Principles, Requirements, and Guidelines, a discussion of the methodologies and data used in the National Economic Efficiency (NEE) benefit-cost analysis (BCA), and a discussion of the evaluation's results using the Economic Tables (NWPM Part 506, NRCS 2014b).

D3.2 Federal Guidelines of National Economic Efficiency Analysis of Flood Mitigation and Groundwater Recharge Measures

An NEE BCA has been performed to evaluate the benefits of the proposed alternatives. The evaluation identifies damages that would be sustained under the FWOFI condition and estimates the benefits associated with each alternative. This analysis relies on federal water resource project and Natural Resources Conservation Service (NRCS) guidelines for the evaluation of NEE benefits and costs. These guidelines rely primarily on the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies (PR&G) (CEQ, 2014); the NRCS Natural Resources Economics Handbook (NRCS 1998); and the National Watershed Program Manual (NRCS 2014b).

The 2007 Water Resources Development Act directed federal agencies to update the original Principles and Guidelines (P&G) from 1983, which resulted in the creation of the PR&G. The revised purpose of the PR&G is to allow for "maximizing public benefits (of all types) relative to costs, the use of quantified and unquantified information in the tradeoff analysis, flexibility in decision-making to promote localized solutions, ability to rely on the best available science and objectivity, and advance transparency for Federal investments in water resources" (CEQ, 2014).

Further expanding the guidance on benefits, the PR&G state, "Public benefits encompass environmental, economic, and social goals; include monetary and non-monetary effects; and allow for the consideration of both quantified and unquantified measures" (CEQ, 2014).

PR&G guidance recommends projects be evaluated from an ecosystem services perspective. In order to receive federal investment, water projects must strive to "protect and restore the functions of ecosystems and mitigate any unavoidable damage to these natural systems" (CEQ, 2014).

The updated PR&G give equal standing to economic, social, and environmental impacts when selecting the Preferred Alternative. This includes both monetized and non-monetized valuation methods, which allows the analysis to fully articulate the impacts the project provides. The equal standing also allows the project to best meet the federal objective of maximizing public benefits and costs while ensuring the protection of ecosystem services.

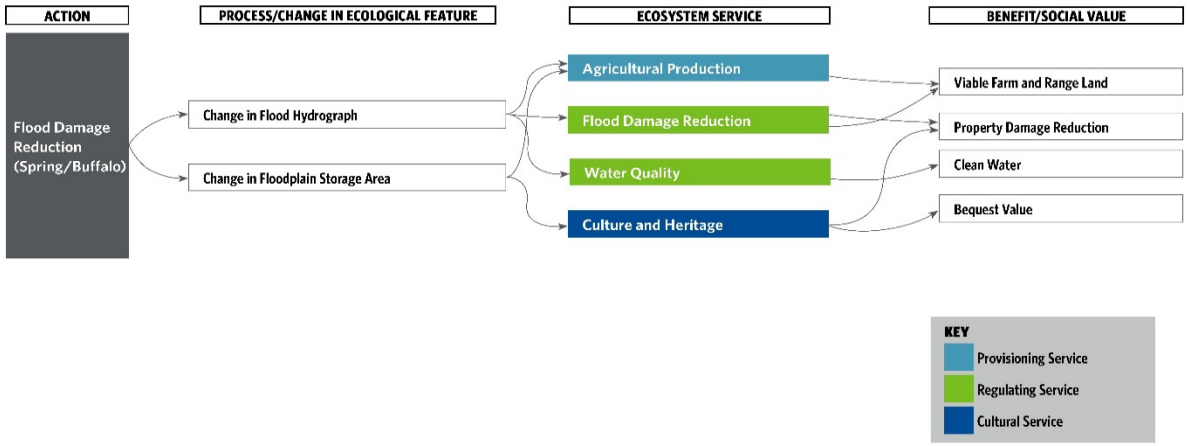
D3.3 Ecosystem Services Evaluated

The resource concerns discussed above include all categories of ecosystem services present within the Spring Creek Watershed. All forms of ecosystem services can be interrupted or otherwise negatively impacted by flooding. Public scoping comments, planning documents, watershed plans from surrounding areas, and discussions with the project sponsor and federal agencies further suggest the project's primary benefits would result from reducing flood damages to buildings and people in Cozad and Lexington as well as reducing damages on agricultural land in the surrounding areas.

Figure D3-1 illustrates how the implementation of a proposed action would create social benefits and costs in the Spring Creek Watershed. The illustration, when used as part of the NEE BCA, describes changes in ecosystem composition all the way through to effects on social outcomes and human well-being. The implementation of a proposed action would change the ecological structure of the watersheds through the construction of channel conveyances, which includes a combination of channel improvements and associated flood protection berms and diversion channels. Channel improvements, including modifying the channel alignment and/or geometry and replacing undersized drainage structures, would increase the conveyance system's capacity and provide protection from a defined flood event.

The described changes would regulate flooding within the Spring Creek Watershed and therefore increase the value of flood damage reduction services. The implementation of a proposed action would reduce the damages to public and private property as well as avoid income and wage losses that could occur from businesses closing and farms being damaged.

Figure D3-1. Ecosystem Services for Flood Damage Reduction



D3.3.1 Ability to Characterize, Quantify, and Monetize Services

The ecosystem services described in Figure D3-1 can be characterized, quantified, and monetized. A modeling approach was formulated that considers the disparate characteristics of the highland and lowland areas and the analysis objectives. Traditional hydrologic modeling was performed for the highlands where the topographic relief allowed for delineation of subbasins and parameter development for defined stream channels. The hydrologic modeling also allowed for the incorporation of flood retarding structures.

In the lowlands, traditional hydrologic modeling was not practical. The shallow topographic relief proved to be extremely problematic with respect to subbasin delineation, and the numerous flow splits could not be modeled in an efficient or accurate manner that would yield meaningful results. Similarly, the complex flow patterns were not conducive to one-dimensional (1D) hydraulic modeling. Based on the characteristics of the lowlands and its runoff patterns, a two-dimensional (2D) hydraulic modeling approach was adopted. Output hydrographs from the highlands hydrologic model were applied as inflow hydrographs at the upstream boundary of the lowlands, and rainfall excess was applied to the 2D model domain.

D3.3.2 Metrics To Evaluate Services

The metrics used to evaluate the change in ecosystem service values under implementation of a proposed action are shown in Figure D3-1. Regulating services are evaluated by quantifying and valuing changes to the square feet of buildings impacted by flooding, lost business revenues and employee income, and the number of agricultural acres impacted by flooding.

D3.3.3 Prioritizing Services

Services were prioritized based on their expected contribution to the project's primary purpose of reducing flood damages in Cozad, Lexington, and the surrounding agricultural areas. As a

result, the regulating services shown in Figure D3-1 were prioritized for analysis. While the primary benefits are from changes to regulating services, the project may result in smaller, secondary changes to other ecosystem services.

D3.3.4 Summary

In summary, the three projects located in the Spring Creek Watershed (Cozad, Lexington Northeast, and Lexington Southwest) would provide a monetized increase in benefit and social value for flood damage reduction for nonagricultural related damages ($2,258,100) and an increased benefit for agricultural related damages ($197,761). Cozad measures have a monetized increase in benefit and social value for both nonagricultural ($1,221,143) and agricultural related damages ($118,618). Lexington Northeast has a monetized increase in nonagricultural related damages ($896,259) and a reduction for agricultural related damages (-$197,859). Lexington Southwest has a monetized increase in nonagricultural related damages ($167,698) and agricultural related damages ($277,002).

D3.4 National Economic Efficiency Benefit-Cost Analysis Data and Methodology

For the completion of the NEE evaluation, a BCA was conducted for the Spring Creek Watershed Plan and Environmental Assessment. This analysis compares a set of alternatives to assist in the selection of the Preferred Alternative. The Project will provide resilience to the community by reducing the damages flooding causes in the watersheds. The benefits and costs of each alternative will be estimated and compared to the existing condition, also referred as the FWOFI. The benefit categories analyzed within this BCA include avoided flood damages to buildings and agriculture.

In July 2019, the Central Platte Natural Resources District (CPNRD) requested assistance from NRCS under the Watershed and Flood Prevention Operations (WFPO) program to develop a watershed plan in the Spring Creek Watershed. The project area contains 354,658 acres within the Spring Creek Watershed. Project alternatives were created for each watershed within the project area. This allows the best set of alternatives to be selected for each watershed. Dividing these watersheds would result in a Spring Creek Subwatershed project area of 196,044 acres and a Buffalo Creek Subwatershed project area of 158,614 acres.

Flooding and related flood damages within the subwatershed project areas are the result of multiple, often inter-related, factors. Heavy rains over a long period overwhelm major drainageways, causing streambank overtopping and damages to property. The topography of the study area is rather flat, limiting the places to which inundation can escape. Infrastructure influences the drainage flows in some areas. Agriculture intensification in the area has removed private water storage and increased soil erosion.

The problems created by flooding include but are not limited to:

- Damages to personal property, including agricultural land, residences, business, and infrastructure
- Damages to public infrastructure, including roadways, bridges, buildings, and utilities
- Increased travel time due to roadway detours during flooding
- Increased risk to human health and public safety
- Loss of services, including water, wastewater, electricity, natural gas, and telecommunications
- Streambank erosion
- Sediment deposits

D3.4.1 Project Description

The NEE evaluation includes identification of the estimated damages associated with the FWOFI and each alternative. To determine the benefits for each alternative, the damages under each alternative were compared against the FWOFI. Estimated benefits and costs are based on full employment with no relative change in prices over the project's life. The analysis estimates the effects of each alternative over a 100-year project life (U.S. Water Resources Council 1983). All economic damages, benefits, and costs use the base fiscal year (FY). Benefits, and costs have been discounted and converted to an annual average, following the FY 2024 federal interest rate of 2.75 percent (OMB Circular A-94, 2023).

The objective of the economic analysis is to determine whether benefits from proposed actions exceed project costs for federally funded projects. The NEE evaluation compares benefits derived from a comparison of the action alternatives against a base condition or No-Action Alternative. The action alternatives consists of several project components (increments) located within two separate subwatersheds of the Spring and Buffalo Creeks. These increments each include a channel conveyance that would add flood protection berms and diversion channels.

In order to ensure "reasonable reality" is captured within this analysis, a set of storm events were analyzed to determine which recurrence intervals to use. These events aim to capture any possible differences in damages between the FWOFI and the proposed actions. For the purposes of flood damage mitigation projects, the most and least frequent events analyzed need to bracket the impacts. This means events that occur more frequently than the analysis will not produce any damages, while events that occur less frequently than the analysis will produce flooding conditions similar for both the FWOFI and all proposed conditions. The other in-between events were selected based on their ability to accurately depict a hypothetical depth damage curve. This means no large jumps for the frequent events, where the system is more volatile. This process included a series of discussions with the project team to ensure accuracy

was maintained. The final recurrence intervals selected were the 5-, 10-, 25-, 50-, and 100-year events.

D3.4.2 Future Without Federal Investment

This alternative represents the project area as it currently stands. Without federal funding, the Sponsor is most likely to select the No-Action Alternative. Though no costs are associated with this alternative, flooding damages would continue to occur.

D3.4.3 Action Alternatives

Channel conveyance includes a combination of channel improvements and associated flood protection berms and diversion channels, as necessary. Channel improvements would increase the capacity of the conveyance system through modification of the channel alignment and/or geometry and replace undersized drainage structures to provide protection from a defined flood event. Flood protection berms include the implementation of specific flood projection barriers to provide a flood damage reduction for specific areas of interest. Based on hydraulic modeling, locations were identified for berms to redirect flows away from flood prone structures. Diversions would redirect excess flows upstream and around the urban area to reduce flows in an urban area to no-damage flows.

Cozad Channel Conveyance

The flood damage reduction alternative for the Cozad area includes a combination of new small earthen flood control berms, new drainage conveyance ditches and diversions, and existing drainage channel conveyance improvements.

Beginning at O Street 0.25 mile north of W 24th Street, an earthen flood control berm would be constructed on the south side of the existing drainage ditch No. 4. The drainage ditch would divert higher flows through a new diversion ditch that extends east to Newell Street. On the west side of Newell Street, the existing roadside ditch would be improved to south of East 16th Street. A new drainage diversion would extend east to an existing drainageway that drains into Stump Ditch west of Country Club Road. The existing drainageway would be improved to north of the Cozad Country Club, at which point a new drainage diversion ditch would be constructed to carry flow around the east border of the Cozad Country Club to the intersection of County Road 760 (see Figure 4-1, Alternative S2, Cozad Channel Conveyance).

Earthen flood control berms are typically 2–5 feet in height with 3:1 side slopes. New drainage diversions/ditches and improved drainageways would typically have a maximum 102-foot bottom width and maximum 201-foot top width.

Lexington Northeast Channel Conveyance

On the north side of Lexington, a small earthen flood control berm would begin on the south side of County Road 757 at North Airport Road. It would continue east to Spring Creek east of state Highway 21. Spring Creek capacity would then be improved to south to County Road 437 (see Figure 4-2, Alternative S2, Lexington Northeast Channel Conveyance).

Earthen flood control berms are typically 2–5 feet in height with 3:1 side slopes. Improved drainageways would typically have a maximum 24-foot bottom width and maximum 108-foot top width.

Lexington Southwest Channel Conveyance

On the south side of Lexington, North Airport Road would be raised from County Road 757 south to its intersection with Union Pacific Railroad. South of US 30, the west South Airport Road ditch capacity would be improved south to Dawson County Drain No. 1 to just north of W. Walnut Street. The capacity of Drain No. 1 would be improved east to the intersection with County Road 437 (see Figure 4-3, Alternative S2, Lexington Southwest Channel Conveyance).

Earthen flood control berms are typically 2–5 feet in height with 3:1 side slopes. Improved drainageways would typically have a maximum 24-foot bottom width and maximum 108-foot top width.

D3.4.4 Benefit Analysis

Economic benefits and impacts were calculated based on the estimated effects of the Proposed Action versus the FWOFI. For the Spring Creek Watershed, the Proposed Action includes a combination of channel improvements and associated flood protection berms and diversion channels, as necessary.

The Project includes two types of benefits: a reduction in damage to structures within city limits and a reduction in agricultural losses. Benefits are calculated by taking the difference in estimated damage between the existing (FWOFI) and proposed alternatives. All economic benefits calculated assume that the improvements are fully developed by 100 years after project completion. The following sections describe the development of these benefits categories.

Avoided Structure Damage

The avoided structure damage benefit represents the physical damage to buildings avoided by implementation of the identified alternatives over the No Action/FWOFI. Hydraulics and hydrology (H&H) model flood impact results for the No Action/FWOFI 100-year floodplain were used to define an inventory of all potential structures that could be affected by flooding. Affected structures were assigned flood depths (above foundation height) for each of the 5 flood events under the No Action/FWOFI and Action Alternatives. These 5 events include the 5-, 10-, 25-, 50-, and 100-year return periods.

Data on each structure was obtained from the Dawson County Assessor. This was used to link the flood depths to translate depth of flooding into monetary estimates of flood-related damage for each flood event. Collected data from the Dawson County Assessor include structure type (residential, non-residential), foundation type, number of stories, structure size (square feet), number of floors, and assessed value. To determine the depreciated replacement value (DRV), the data provided was input to Marshall and Swift's SwiftEstimator.

Depth-damage functions link H&H floodplain depths at each structure with the DRV's in order to estimate the monetary value of physical damage due to each flood event. These functions

identify the percentage of damage to the structure, contents, and inventory for each depth and structure type. Functions for damages to residential structures and contents have been obtained from the U.S. Army Corps of Engineers EGM 04-01 (USACE, 2003). Contents values for all properties are expressed as a percentage of total structure value. Within the USACE depth damage curves, there is a content-to-structure value ratio for each occupancy type. The ratio for residential structures is 100 percent of structure value, whereas for nonresidential structures it varies between 6 and 85 percent depending on the occupancy type. The associated percentage of damage is then multiplied by the DRV in order to determine the estimated damage at each structure. The physical damages to the structure, contents, and inventory are estimated for each building.

For each flood event and alternative, the estimated structure, contents, and inventory damages are then summed. These damage values are then annualized by event using Riemann Sums, more specifically the midpoint method. Using this method estimates the incremental damage between each of the recurrence intervals. The damage curve is modeled as:

$$e^{\left(\frac{\ln(y_{n1})+\ln(y_{n2})}{2}\right)*(x_{n2}-x_{n1})}$$

For this method, the x axis increments are bound by the recurrence intervals used in the project and capped at the 1,000-yr event. That is the x axis increment bounds are 5- to 10-year, 10- to 25-year, 25- to 50-year, 50- to 100-yr, and the 100- to 1,000-year. As damage does not occur until the 5-year event, the 0- to 5-year bounds do not need calculated. The y axis increments are bounded by the total damage per flooding event. For a more in-depth discussion on Riemann sums, see the Khan Academy (Khan Academy, 2024)

The benefit of each alternative is the difference in damage value between the FWOFI and each proposed action. This benefit is summarized by project in Table D3-1 below. The table values represent the average annual benefit to buildings for the With Project condition.

Table D3-1. Estimated Average Annual Structural Cost Avoidance Benefits. Spring Creek Watershed, Nebraska (FY 2024 $s, 2.75% Discount Factor).

Measure	Land Treatment	Average Annual Cost Avoidance Benefit
Cozad	Channel conveyance	$1,613,117
Lexington NE	Channel conveyance	$1,491,745
Lexington SW	Channel conveyance	$164,863
Total		$3,269,725

Avoided Agricultural Damage

The project is primarily in a rural area; therefore, agricultural damages occur frequently without flood mitigation. The project aims to reduce total flood damage with channel improvements and associated flood protection berms and diversion channels. Crop damages are estimated using the areas impacted by flooding for each return period for the FWOFI and Action Alternatives.

The approach implemented here follows a simplified approach, which generates a reasonable order of magnitude measure of impact and is assumed to be sufficient for this assessment of potential economic feasibility.

In this analysis, the H&H data is intersected with CropScape data for the project area to calculate flooded acres of land by crop type. The crops included in the analysis include irrigated and dryland corn. The USDA's National Agricultural Statistics Service (NASS) was used to determine the average acreage, yield, and price received for each crop type. Crop budgets produced by the University of Nebraska's Agricultural Extension was used to determine the cost to produce each crop type. This data was collected and averaged for the years of 2014 through 2021. This information was then entered into the flood damage model. Table D3-1 includes the inputs used for each crop.

Table D3-2: Crop Inputs (Averaged Over 2014-2022, FY 2024 $s)

Crop	% Share	Acreage	Yield	Price Received ($/Yield)	Crop Budget ($/Acre)
Corn, Irrigated	94.41%	178,900	217.10	$4.45	$280.42
Corn, Dryland	5.59%	10,600	126.40	$4.45	$165.49

The model computes the damage for each return period by multiplying the damaged acres with the value per acre, for each crop. That is, within any parcel, the acreage of crops that is inundated is counted as a total loss. While this method is not the most accurate way to estimate crop damage, they are a secondary benefit category and the comparison between the alternatives is what really matters.

These results are then summed to determine the annual damage by Action Alternative. The benefits are then compared with the annualized cost of the alternative. These damages were also annualized using Riemann Sums, as described above. Annual avoided agricultural damage for each project are shown in Table D3-2. The results of channel conveyance reduce agricultural damage for the Cozad project. However, the Lexington Northeast measures result in an increase in damage. This increase is due to the project diverting some of the flows away from the cities.

Table D3-3. Estimated Average Annual Agricultural Damage Reduction Benefits. Spring Creek Watershed, Nebraska (FY 2024 $s, 2.75% Discount Factor).

Measure	Land Treatment	Average Annual Benefit
Cozad	Channel conveyance	$268,858
Lexington NE	Channel conveyance	-$442,889
Lexington SW	Channel conveyance	-$620,043
Total		-$794,074

Summary of Benefits

The summary of the estimated average annual NEE benefits for the Spring Creek Watershed are presented in Table D3-3, D3-4, D3-5. Annualized damage reduction benefits are $3,160,835 for Alternative 2, Cozad Channel Conveyance, $1,450,808 for Alternative 3, Lexington Northeast Channel Conveyance, and $727,258 for Alternative 4, Lexington Southwest Channel Conveyance. The Total Estimated Average Annual Damage Reduction Benefits identified in these tables includes induced flooding damages caused by an alternative. Annualized induced flooding damages are $1,278,860 for Alternative 2, Cozad Channel Conveyance, $401,952 for Alternative 3, Lexington Northeast Channel Conveyance, and $1,182,438 for Lexington Southwest Channel Conveyance. The combined proposed increments would provide $2,475,651 in average annual benefits from avoided structure and agricultural damages.

Table D3-4. Estimated Average Annual NEE Damage Reduction Benefits. Spring Creek Watershed, Cozad, Nebraska (FY 2024 $s, 2.75% Discount Factor)

Land Treatment	Damage Category	Damage reduction benefit, average annual Agriculture Related	Damage reduction benefit, average annual Nonagricultural-Related
Channel conveyance	Avoided Structure Damage	$1,613,117	$0
Channel conveyance	Avoided Agricultural Damage	$268,858	$0
	Total	$1,881,975	$0

Table D3-5. Estimated Average Annual NEE Damage Reduction Benefits. Spring Creek Watershed, Lexington NE, Nebraska (FY 2024 $s, 2.75% Discount Factor)

Land Treatment	Damage Category	Damage reduction benefit, average annual Agriculture Related	Damage reduction benefit, average annual Nonagricultural-Related
Channel conveyance	Avoided Structure Damage	$1,491,745	$0
Channel conveyance	Avoided Agricultural Damage	-$442,889	$0
	Total	$1,048,856	$0

Table D3-6. Estimated Average Annual NEE Damage Reduction Benefits. Spring Creek Watershed, Lexington SW, Nebraska (FY 2024 $s, 2.75% Discount Factor)

Land Treatment	Damage Category	Damage reduction benefit, average annual Agriculture Related	Damage reduction benefit, average annual Nonagricultural-Related
Channel conveyance	Avoided Structure Damage	$164,863	$0
Channel conveyance	Avoided Agricultural Damage	-$620,043	$0
	Total	-$455,180	$0

D3.4.5 Estimated Costs

Project capital, operations, and maintenance (O&M) costs are estimated in 2024 dollars for each project measure (see Table D3-6). Costs for each project measure are included as separate items. The present value costs are compared to present value benefits for each measure. O&M costs for each alternative are assumed to be 0.5 percent of the capital cost and are estimated to include the cost of an eventual replacement of the project measure. The O&M cost estimate is also assumed to account for the difference between current and with-project conditions O&M expenditures. Present value and annualized costs are computed with a 2.75 percent discount rate over 100 years.

Table D3-7. Estimated Installed Spring Creek Watershed, Nebraska, (FY 2024 $s, NWPM 506.11)

Measure and activity	Total
Cozad	
Mobilization/Demobilization	$1,293,925
Clearing/Grubbing	$77,556
Structure Removals	$24,105
Earthwork (Berm Embankment)	$77,032
Earthwork (Excavation)	$3,865,215
Earthwork (Waste/Haul-Off)	$2,968,921
Structures - Culverts	$350,049
Structures - Bridges	$7,599,423
Revetment	$899,438
Erosion Control	$80,910
Rolled Erosion Control Product	$126,631
Seeding	$186,134
Construction Contingency (25%+/-)	$4,387,354
Total Construction Cost	$21,936,693
Right-of-Way - Berm	$90,826
Right-of-Way - Conveyance Improvements	$969,154
Right-of-Way - Legal Fee	$105,998
Total ROW	$1,165,978
Engineering Services - Berm & Conveyance	$2,193,669
Permitting	$1,096,835
Construction Services (5%)	$2,193,669

Measure and activity	Total
Total Project Costs	$28,586,843
Annual Maintenance	$219,367
Lexington NE	
Mobilization/Demobilization	$1,228,736
Clearing/Grubbing	$91,692
Structure Removals	$149,871
Earthwork (Berm Embankment)	$313,367
Earthwork (Excavation)	$1,113,293
Earthwork (Waste/Haul-Off)	$389,246
Structures - Culverts	$12,419,413
Structures - Bridges	$-
Revetment	$287,585
Erosion Control	$76,822
Rolled Erosion Control Product	$375,098
Seeding	$220,091
Structures - Diversion Dam	$157,208
Construction Contingency (25%+/-)	$4,205,622
Total Construction Cost	$21,028,045
Right-of-Way - Berm	$345,938
Right-of-Way - Conveyance Improvements	$903,330
Right-of-Way - Legal Fee	$124,927
Total ROW	$1,374,195
Engineering Services - Berm & Conveyance	$2,102,805
Permitting	$1,051,402
Construction Services (5%)	$2,102,805
Total Project Costs	$27,659,251
Annual Maintenance	$210,280
Lexington SW	
Mobilization/Demobilization	$1,552,269
Clearing/Grubbing	$77,556
Structure Removals	$115,286
Earthwork (Berm Embankment)	$81,355
Earthwork (Excavation)	$1,047,528
Earthwork (Waste/Haul-Off)	$707,854
Structures - Culverts	$15,579,289
Structures - Bridges	$579,573
Revetment	$493,004
Erosion Control	$97,050
Rolled Erosion Control Product	$535,795
Seeding	$186,134
Construction Contingency (25%+/-)	$5,263,211
Total Construction Cost	$26,315,904
Right-of-Way - Berm	$67,518
Right-of-Way - Conveyance Improvements	$989,570
Right-of-Way - Legal Fee	$105,709
Total ROW	$1,162,797
Engineering Services - Berm & Conveyance	$2,631,590
Permitting	$1,315,795
Construction Services (5%)	$2,631,590
Total Project Costs	$34,057,676
Annual Maintenance	$263,159
Total Spring Creek Watershed	**$90,303,771**

D3.4.6 Comparison of Costs and Benefits and the NEE Plan

The NEE evaluation results compare the benefits added by each alternative. These serve as the best estimates of the economic value the Preferred Alternative would provide. Results are presented following NRCS guidelines (NWPM Part 506, NRCS 2014b). Table D3-7 summarizes the average annual NEE benefits and costs for the with-project alternative in the Spring Creek Watershed. As shown in Table D3-7, the Cozad and Lexington NE increments of the proposed actions are economically justified for funding with the PL 83-566.

Table D3-8. Comparison of NEE Benefits and Costs Spring Creek Watershed, Nebraska (FY 2024 Dollars, 2.75% Discount Factor).

Measure	Land Treatment	Total Damage reduction benefit, average annual*	Total Average Annual Cost	NEE Metrics Benefit Cost Ratio	NEE Metrics Net Benefits
Cozad	Channel conveyance	$1,881,975	$1,061,369	1.77	$820,606
Lexington NE	Channel conveyance	$1,048,856	$1,024,961	1.02	$23,895
Lexington SW	Channel conveyance	-$455,180	$1,266,300	-0.36	-$1,721,480
Total		**$2,475,651**	**$3,352,630**	**0.74**	**-$876,979**

D3.5 Appendix D References

CEQ 2014. Council of Environmental Quality. (2014). Updated Principles, Requirements and Guidelines for Water and Land Related Resources Implementation Studies. Washington, D.C. CEQ.

Khan Academy. 2024. Khan Academy. (n.d.). Riemann sums. https://www.khanacademy.org/math/ap-calculus-ab/ab-integration-new/ab-6-2/a/riemann-sums-review

NRCS 1998. Natural Resources Conservation Service (NRCS). (1998). *Natural resource economics handbook.* Washington, D.C. USDA NRCS.

NRCS 2015. Natural Resources Conservation Service (NRCS). (2015). *National watershed program manual* (4th ed., Amend 1). Washington, D.C.: USDA NRCS. Retrieved from https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=36702.

OMB 2023. Circular A-4: Regulatory Analysis. Office of Management and Budget. Retrieved from https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/circulars/A4/a-4.pdf

Reclamation 2017. Colorado River Basin Salinity Control Program, Economic Salinity Damage Model, Unpublished Value.

U.S. Water Resources Council 1983. U.S. Water Resources Council. (1983). *Economic and environmental principles and guidelines for water and related land resources implementation studies.*

USACE 2000. US Army Corps of Engineers (USACE). (2000). *Engineering regulation 1105-2-100, Planning Guidance Notebook*.

USACE 2017. U.S. Army Corps of Engineers (USACE). (2017). *Federal interest rates for Corps of Engineers projects for FY 2017*. Economic Guidance Memorandum 17-01. Retrieved from https://planning.erdc.dren.mil/toolbox/library/EGMs/EGM17-01.pdf.

The White House 2014. Updated Principles, Requirements and Guidelines for Water and Land Related Resources Implementation Studies | The White House (archives.gov).

Appendix D4 Special Status Species Review

Special Status Species Review

To:	Project File
Project:	Spring Creek Watershed Plan – Environmental Assessment
Date:	Friday, August 23, 2024

D4.1 Introduction

This memorandum provides the analysis of the effects of the No Action and Action alternatives on Fish and Aquatic Resources, Terrestrial Resources, and Endangered and Threatened species for the Spring Creek Watershed. For purposes of habitat assessment, the following were used to assess habitat within the Spring Creek Watershed:

- The majority of the study area is within the Mixedgrass Prairie Ecoregion from the Nebraska Legacy Project. The Mixedgrass Prairie contains a variety of native plant communities. Tallgrass prairie species, including big bluestem, Indian grass, switchgrass, and Canada wildrye, tend to dominate in the east and along river floodplains. Short-grass species, including blue grama and buffalo grass, dominate in the western part of the ecoregion. Forbs may include prairie-clovers, alfalfa, deer vetch, leadplant, prairie-coneflower, stiff sunflower, and dotted gayfeather. Most watercourses are lined with riparian forests composed of cottonwood, green ash, hackberry, and eastern red-cedar. Wet meadows and wet prairies along river courses include a variety of plants such as woolly sedge, spike rush, and prairie cordgrass. This ecoregion contains an abundance of wetlands, including playas, which are wind-formed, circular depressions whose underlying clay pan holds water from rainfall and run-off. In the Sandhills Ecoregion, two principal plant community types are found in the ecoregion: dune prairie and valley wetlands. Dune prairies consist of a mixture of sand-adapted grasses, including sand bluestem, prairie sandreed, little bluestem, and hairy grama. Blowouts, wind-excavated depressions in dune tops, are uncommon today because of improved range management that limits the effects of wind on erosion and the decreased frequency of fire. Wet meadows occur in the valleys and support sedges, spikerushes, prairie cordgrass, and switchgrass (Schneider et al. 2011).

- The Central Loess Hills Biologically Unique Landscape (BUL) occupies the loess hills region of central Nebraska, including the northern portion of the study area (Schneider et al. 2011). The landscape consists of rolling to steep loess hills, dissected by the valleys of the Loup River system. The hills are now a mosaic of mixed-grass prairie and cropland. Lack of grazing managed for biological diversity values, exotic plant invasion, and herbicide spraying have degraded the majority of prairies. The flatter tablelands of this landscape contain playa wetlands that are used by whooping cranes and numerous other aquatic birds during migration.

- The Central Platte River BUL includes the Platte River channel and the floodplain from central Dawson County eastward to central Hamilton County. The Central Platte River BUL includes the Platte River channel and the floodplain from central Dawson County eastward to central Hamilton County. The central Platte River is a large, shallow, braided stream. Sandbars and wooded islands are common within the channel. Much of the streambank is also wooded, with cottonwood and eastern red-cedar as dominants. Sand pits are common along the river, many with housing developments. Most of the river floodplain is in cropland, though there are scattered wet meadows in areas. Sand dune grasslands occur on the south side of the river in areas.

Potential presence of species of interest were identified from Lists of Species of Greatest Conservation Need from the Nebraska Natural Legacy Project (Schneider et al. 2018). For this analysis, Tier 1 species were reviewed. Tier 1 species are those that are globally or nationally most at-risk of extinction. Tier 1 species are higher priority, and more research and conservation efforts are focused on these species.

Identification of state and federally-listed endangered and threatened species was developed based on coordination with Nebraska Game and Parks Commission (NGPC) and use of their Conservation and Environmental Review Tool (CERT) and the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) website, there are 12 federally- and state-listed endangered and threatened or candidate species that have the potential to occur in the study area.

D4.2 Fish and Aquatic Species

Table D4-1 provides a list of the fish and aquatic species (mollusks) that are included on the Tier 1 species list within the Mixedgrass Prairie Ecoregion and the effects resulting from Alternative S2 Spring Creek Watershed Channel Conveyance. Unless otherwise noted, there are no effects resulting from Alternative A1, No, Action/Future Without Federal Project. The Analysis has been further refined to include the geographical areas of interest for each alternative.

Table D4-1. Spring Creek Watershed Effect Determination and Conservation Conditions for Tier 1 Fish and Aquatic Species

Common Name	Scientific Name	Habitat	Determination of Effect
Blacknose shiner	*Notropis heterolepis*	Headwater streams, spring fed, clear water, pools, quiet waters	The Project is located outside the NGPC-estimated range of Blacknose shiner, with an apparent absence of headwater, spring- fed aquatic habitat. Therefore, no effect anticipated.

Common Name	Scientific Name	Habitat	Determination of Effect
Finescale dace[1]	*Chrosomus neogaeus*	Headwaters of clear, cool, high-quality streams	While the Project is located immediately adjacent to the NGPC-estimated range of Finescale dace, the dominance of agricultural fields makes possibility of occurrence unlikely. The sites encountered in the project area consist of turbid, low velocity, seasonally intermittent agricultural ditches with a higher thermal range than the preferred cool, headwater stream habitat of this species. Therefore, the Project may affect, but is unlikely to adversely affect Finescale dace.
Flathead chub	*Platygobio gracilis*	Large, turbid rivers with fast currents over gravel or sand substrates	While the Project is located within the NGPC-estimated range of Flathead chub, the dominance of agricultural fields makes possibility of occurrence unlikely. The sites encountered in the project area consist of sluggish, low velocity, seasonally intermittent agricultural ditches with a higher thermal range than the preferred cool, headwater stream habitat of this species. Therefore, the Project may affect, but is unlikely to adversely affect Flathead chub.
Lake sturgeon	*Acipenser fulvescens*	Shallow water, gravel/rocky substrate	The Project is located outside the NGPC-estimated range of Lake sturgeon. Additionally, the habitat characteristics at the project site are inconsistent with the required riverine requirements for Lake Sturgeon. Therefore, no effect anticipated.
Northern redbelly dace[1]	*Chrosomus eos*	Headwater streams, spring fed, clear water, sandhill streams, beaver ponds, undercut banks, meandering streams, small pools	While the Project is located immediately adjacent to the NGPC-estimated range of Northern redbelly dace, the dominance of agricultural fields makes possibility of occurrence unlikely. The sites encountered in the project area consist of turbid, low velocity, seasonally intermittent agricultural ditches with a higher thermal range than the preferred cool, headwater stream habitat of this species. Therefore, the Project may affect, but is unlikely to adversely affect Northern redbelly dace.
Plains minnow	*Hybognathus placitus*	Permanent streams and backwaters with sandy substrate and moderate current	The Project is located within the NGPC-estimated range of Plains minnow. Due to the sites that may possess the temporally permanence correlated with slow to moderate velocity, it is recommended that conservation measures are implemented to avoid impacts to this species.

Common Name	Scientific Name	Habitat	Determination of Effect
Plains topminnow	*Fundulus sciadicus*	Vegetative backwaters and headwaters, shallow parts of rivers and streams	The Project is located within the NGPC-estimated range of Plains topminnow. Due to the few sites that possess vegetated shoreline and substrate, it is recommended that conservation measures are implemented to avoid impacts to this species.
Western silvery minnow	*Hybognathus argyritis*	Backwaters, pools, and slow-moving waters in medium to large rivers	The Project is located within the NGPC-estimated range of Western silvery minnow. Due to the sites that possess the pool-habitat type with slow to moderate velocities, it is recommended that conservation measures are implemented to avoid impacts to this species.
Niobrara ambersnail	*Oxyloma haydeni*	Moist soil by stream	The Project is located outside the NGPC-estimated range of Niobrara ambersnail. Therefore, no effect anticipated.

Source: Schneider et al. 2018.
[1]Also addressed as part of Endangered and Threatened Species

D4.3 Terrestrial Wildlife

Table D4-2 provides a list of the terrestrial species (insects, mammals, and reptiles) that are included on the Tier 1 species list within the Mixedgrass Prairie Ecoregion and the effects resulting from Alternative S2 Spring Creek Watershed Channel Conveyance. Unless otherwise noted, there are no effects resulting from Alternative A1, No, Action/Future Without Federal Project. The Analysis has been further refined to include the geographical areas of interest for each alternative.

Table D4-2. Spring Creek Watershed Effect Determination and Conservation Conditions for Tier 1 Terrestrial Species

Common Name	Scientific Name	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
American burying beetle (ABB)[1]	*Nicrophorus americanus*	Variety of habitats including grassland prairie, forest edge, scrubland, and mesic areas such as wet meadows, streams, and wetlands; carrion availability is a more important component of habitat than a specific type of vegetation	While the Project is located within the NGPC-estimated range of ABB, the dominance of agricultural fields makes possibility of occurrence unlikely. Therefore, the Project may affect, but is unlikely to adversely affect ABB.	The Project is located outside the NGPC-estimated range of ABB. Therefore, no effect anticipated.

Common Name	Scientific Name	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
Fox mayfly	*Cercobrachys fox*	Medium size rivers	No medium size rivers intersect the Project. Therefore, no effect anticipated.	No medium size rivers intersect the Project. Therefore, no effect anticipated.
Ghost tiger beetle	*Cicindela lepida*	Sparsely-vegetated areas with open, sandy soils	No sparsely-vegetated areas with open, sandy soils were identified during the wetland delineation. Therefore, no effect anticipated.	No sparsely-vegetated areas with open, sandy soils were identified during the wetland delineation. Therefore, no effect anticipated
Iowa skipper	*Atrytone arogos iowa*	Tall-grass prairie, mixed-grass prairie along the Niobrara, native prairie with standing grass stems	No prairie habitat identified within the Project area. Therefore, no effect anticipated.	No prairie habitat identified within the Project area. Therefore, no effect anticipated.
Kohler's fritillary	*Boloria selene sabulocollis*	Sandhills and stream valley wet meadows with violets	Project is not located within the Nebraska Sandhills Ecoregion. Delineated waterways consisted of incised channels, with little topographic floodplain connectivity and no wet meadows present. Therefore, no effect anticipated.	Project is not located within the Nebraska Sandhills Ecoregion. Delineated waterways consisted of incised channels, with little topographic floodplain connectivity and no wet meadows present. Therefore, no effect anticipated.
Married underwing	*Catocala nuptialis*	Tall-grass and mixed-grass prairie; larvae feed on lead plant (*Amorpha*)	Although lead plant individuals may be present within the Project area, no prairie habitat was identified within the Project area. Therefore, no effect anticipated.	Although lead plant individuals may be present within the Project area, no prairie habitat was identified within the Project area. Therefore, no effect anticipated.
Monarch[1]	*Danaus plexippus*	Utilizes broad range of habitats but requires select species of milkweeds as larval host plants	Milkweed plant identified during the wetland delineation. Monarch may be present with the Project area.	Milkweed plant identified during the wetland delineation. Monarch may be present with the Project area.
Mottled duskywing	*Erynnis martialis*	Hilly areas with prairie openings, host plant is New Jersey tea (*Ceanothus*)	Project area dominated by agricultural fields and lacks prairie habitat. The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.	Project area dominated by agricultural fields and lacks prairie habitat. The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.

Common Name	Scientific Name	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
Nebraska fritillary	*Boloria selene nebraskensis*	Wet meadows with violets	Wetlands identified during the wetland delineation were associated with concentrated drainageways lacking wet meadow habitat. The Cozad Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.	Wetlands identified during the wetland delineation were associated with concentrated drainageways lacking wet meadow habitat. The Cozad Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.
Ottoe skipper	*Hesperia ottoe*	Tall-grass prairie, rolling/hilly prairie, mixed-grass prairie - feed on bluestems	No prairie habitat identified within the Project area. Therefore, no effect anticipated.	No prairie habitat identified within the Project area. Therefore, no effect anticipated.
Platte River caddisfly	*Ironoquia plattensis*	Sloughs, backwaters, wet meadows	No large floodplains containing sloughs, backwaters or wet meadows are present in the Project area. Therefore, no effect anticipated.	No large floodplains containing sloughs, backwaters or wet meadows are present in the Project area. Therefore, no effect anticipated.
Regal fritillary	*Speyeria idalia*	Tall-grass and mixed-grass prairie with violets, wet meadows	No prairie habitat or wet meadows identified within the Project area. Therefore, no effect anticipated.	No prairie habitat or wet meadows identified within the Project area. Therefore, no effect anticipated.
Smoky-eyed brown	*Lethe eurydice fumosa*	Sedge meadows in Sandhills and along streams and wetlands	Project is not located within the Nebraska Sandhills Ecoregion. Wetland delineation failed to find sedge meadows. Therefore, no effect anticipated.	Project is not located within the Nebraska Sandhills Ecoregion. Wetland delineation failed to find sedge meadows. Therefore, no effect anticipated.
Southern plains bumble bee	*Bombus fraternus*	Prairie grasslands	No prairie habitat identified within the Project area. Therefore, no effect anticipated.	No prairie habitat identified within the Project area. Therefore, no effect anticipated.
Suckley's cuckoo bumble bee	*Bombus suckleyi*	Grasslands, wetlands, woodland openings	Wetlands are present within the Project area. Therefore, species may be present and affected.	Wetlands are present within the Project area. Therefore, species may be present and affected
Two-lined stonefly	*Perlesta golconda*	Medium rivers with sand bottoms	No medium size rivers intersect the Project. Therefore, no effect anticipated.	No medium size rivers intersect the Project. Therefore, no effect anticipated.

Common Name	Scientific Name	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
Two-spotted skipper	*Euphyes bimacula illinois*	Marshes, bogs, wet stream sides, and wet sedge meadows.	Delineated waterways consisted of incised channels, with little topographic floodplain connectivity and no wet meadows present. Therefore, no effect anticipated.	Delineated waterways consisted of incised channels, with little topographic floodplain connectivity and no wet meadows present. Therefore, no effect anticipated.
Whitney underwing	*Catocala whitneyi*	Tall-grass and mixed-grass prairie; larvae feed on lead plant (*Amorpha*)	Although lead plant individuals may be present within the Project area, no prairie habitat was identified within the Project area. Therefore, no effect anticipated.	Although lead plant individuals may be present within the Project area, no prairie habitat was identified within the Project area. Therefore, no effect anticipated.
Bailey's eastern woodrat	*Neotoma floridana baileyi*	Pines and bluffs, woodlands and rocks	Woodland identified within the Project was associated with residential / urban development. No pine bluff habitat present within the Project area. The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.	Woodland identified within the Project was associated with residential / urban development. No pine bluff habitat present within the Project area. The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.
Eastern little brown bat	*Myotis lucifugus lucifugus*	Deciduous woodlands, usually associated with water source	The Project is outside the NGPC-estimated range for the species. Therefore, no effect anticipated.	The Project is outside the NGPC-estimated range for the species. Therefore, no effect anticipated.
Eastern red bat	*Lasiurus borealis*	Deciduous and pine woodlands, usually associated with water source	Woodland identified within the Project was associated with residential / urban development. May provide suitable habbuitat for the species.	There are woodland areas associated with low-density residential development and Spring Creek that may provide suitable habitat for the species.

Common Name	Scientific Name	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
Hoary bat	*Lasiurus cinereus*	Deciduous and pine woodlands, usually associated with water source in arid landscapes	There are areas of dense tree habitat (Cozad Country Club and other residential areas) that may provide suitable habitat for the species.	There are woodland areas associated with low-density residential development and Spring Creek that may provide suitable habitat for the species.
Northern long-eared bat[1]	*Myotis septentrionalis*	Interior of deciduous and coniferous woodlands	There are areas of dense tree habitat (Cozad Country Club and other residential areas) that may provide suitable habitat for the species. .	There are woodland areas associated with low-density residential development and Spring Creek that may provide suitable habitat for the species.
Plains pocket mouse	*Perognathus flavescens perniger*	Sandy-loose soil prairies, loess bluff prairie, loess mixed-grass prairie, northern sand/gravel prairie	The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.	The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.
Plains spotted skunk	*Spilogale putorius interrupta*	Grasslands and old field habitat close to old structures and wooded areas	There is field habitat and old structures / wooded areas that may be used by the species.	There is field habitat and old structures / wooded areas that may be used by the species.
Silver-haired bat	*Lasionycteris noctivagans*	Deciduous and pine woodlands, usually associated with water source	The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.	The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.
Swift fox	*Vulpes velox*	Short-grass prairie, western mixed-grass prairie	The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.	The Project is located outside the NGPC-estimated range of the species. Therefore, no effect anticipated.
Tricolored bat[1]	*Perimyotis subflavus*	Deciduous woodlands	There are areas of dense tree habitat (Cozad Country Club and other residential areas) that may provide suitable habitat for the species.	There are woodland areas associated with low-density residential development and Spring Creek that may provide suitable habitat for the species.
Blanding's turtle	*Emydoidea blandingii*	Requires proximity to water; Sandhills fens, Sandhills freshwater marsh, northern cordgrass wet prairie, small tributaries, Sandhills prairies	While wetlands were identified within the Project area, they lack the specific characteristics favorable to the species.	While wetlands were identified within the Project area, they lack the specific characteristics favorable to the species.

Common Name	Scientific Name	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
		(upland habitat), marshes and oxbows in eastern portion of state.	Therefore, no effect anticipated.	
Red-bellied snake	*Storeria occipitomaculata*	Riverbanks and riparian woodlands, often with dense layers of leaf litter providing shelter and moisture	No rivers or riparian woodlands present within the Project area. The Project is approximately 1.30 miles north of the Platte River. Therefore, no effect anticipated.	No rivers or riparian woodlands present within the Project area. The Project is approximately 2 miles north of the Platte River. Therefore, no effect anticipated.

Source: Schneider et al. 2018.
[1]Also addressed as part of Endangered and Threatened Species

D4.4 Special Status Species

Table D4-3 provides the list of Endangered and Threatened Species for Spring Creek Watershed and resultant effects analysis for Alternative S2 Spring Creek Watershed Channel Conveyance. Unless otherwise noted, there are no effects resulting from Alternative A1, No, Action/Future Without Federal Project. The Analysis has been further refined to include the geographical areas of interest for each alternative. Review and concurrence on the effects analysis from NGPC and USFWS, respectively.

Table D4-3. Spring Creek Watershed Endangered and Threatened Species Review

Common Name	Species Name	Listing	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
American burying beetle (ABB)	*Nicrophorus americanus*	Federal Threatened 4(d) Rule; State Threatened	Variety of habitats including grassland prairie, forest edge, scrubland, and mesic areas such as wet meadows, streams, and wetlands; carrion availability is a more important component of habitat than a specific type of vegetation	While the Project is located within the NGPC-estimated range of ABB, the dominance of agricultural fields makes possibility of occurrence unlikely. Therefore, the Project may affect, but is unlikely to adversely affect ABB.	The Project is located outside the NGPC-estimated range of ABB. Therefore, no effect anticipated.

Common Name	Species Name	Listing	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
Black-footed Ferret	*Mustela nigripes*	Federal Endangered ; State Endangered	Prairie dog towns or complexes 1,000 acres or more in size.	No prairie dog towns present in the Project area. Therefore, no effect anticipated.	No prairie dog towns present in the Project area. Therefore, no effect anticipated.
Eastern black rail	*Laterallus jamaicensis jamaicensis*	Federal Threatened, State Threatened	Dense vegetative cover, freshwater marsh habitats, sedge meadows	Emergent wetland habitat present in the Project area; however, no documented occurrences of the species in close proximity. Therefore, the Project may affect, but is unlikely to adversely affect eastern black rail.	Emergent wetland habitat present in the Project area; however, no documented occurrences of the species in close proximity. Therefore, the Project may affect, but is unlikely to adversely affect eastern black rail.
Eskimo curlew	*Numenius borealis*	Federal Endangered ; State Endangered	Wet meadows, burned over prairies, newly plowed fields.	Agricultural land present in both geographical areas may provide suitable habitat for the species. Therefore, the Project may affect, but is unlikely to adversely affect Eskimo curlew.	Agricultural land present in both geographical areas may provide suitable habitat for the species. Therefore, the Project may affect, but is unlikely to adversely affect Eskimo curlew.
Gray wolf	*Canis lupus*	Federal Endangered ; State Endangered	Wide range of habitats including prairie, mountains, temperate forests, wetlands, tundra, and taiga.	No documented occurrences of the species within proximity to the Project in the last 30 years. Therefore, no effect anticipated.	No documented occurrences of the species within proximity to the Project in the last 30 years. Therefore, no effect anticipated.

Common Name	Species Name	Listing	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
Interior least tern	*Sternula antillarum athalassos*	State Endangered	Present during April 15-August 15 nesting season; un-vegetated or sparsely vegetated sandbars in river channels and sandpits	Project is over 1 mile north of the Platte River. Visual site distance between the Project and the river is inhibited. No effect anticipated.	Project is over 1 mile north of the Platte River. Visual site distance between the Project and the river is inhibited. No effect anticipated.
Monarch	*Danaus plexippus*	Federal Proposed Threatened	Field, roadside area, open area, wet area, or urban garden; milkweed and flowering plants are needed for monarch habitat	Milkweed plant identified during the wetland delineation. Monarch may be present with the Project area.	Milkweed plant identified during the wetland delineation. Monarch may be present with the Project area.
Northern long-eared bat	*Myotis septentrionalis*	Federal Threatened; State Threatened	Roost singly or in colonies underneath bark or in cavities, crevices or hollows of live and dead trees and/or snags (typically ≥ 3 inches dbh); overwinter in hibernacula that include caves and abandoned mines, abandoned railroad tunnels, storm sewer entrances, dry wells, and aqueducts. Project areas are not within any swarming/staging areas, so active season in Nebraska is between April 1 and October 31st	While no woodland areas are present within the Project area there are areas of dense tree habitat (Cozad Country Club and other residential areas) that may provide suitable habitat for the species.	There are woodland areas associated with low-density residential development and Spring Creek that may provide suitable habitat for the species.
Piping plover	*Charadrius melodus*	Federal Threatened; State Threatened	Present during April 15-August 15 nesting season; un-vegetated or sparsely vegetated sandbars in river channels and sandpits	Project is over 1 mile north of the Platte River. Visual site distance between the Project and the river is inhibited. No effect anticipated.	Project is over 1 mile north of the Platte River. Visual site distance between the Project and the river is inhibited. No effect anticipated.

Common Name	Species Name	Listing	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
Rufa red knot	*Calidris canutus rufa*	Federal Threatened; State Threatened	Open mud flats and/or mud and sandy shorelines free of vegetation	Project is over 1 mile north of the Platte River. Visual site distance between the Project and the river is inhibited. No effect anticipated.	Project is over 1 mile north of the Platte River. Visual site distance between the Project and the river is inhibited. No effect anticipated.
Tricolored bat	*Perimyotis subflavus*	Proposed Endangered	Similar habitat needs as northern long-eared bat.	While no woodland areas are present within the Project area there are areas of dense tree habitat (Cozad Country Club and other residential areas) that may provide suitable habitat for the species.	There are woodland areas associated with low-density residential development and Spring Creek that may provide suitable habitat for the species.
Western prairie fringed orchid	*Platanthera praeclara*	Federal Threatened; State Threatened	Native tall or mixed-grass prairies that are associated with wet meadows; high quality prairie	No effect. Watershed not in NGPC range.	

Common Name	Species Name	Listing	Habitat	Determination of Effect Cozad Geographical Area	Determination of Effect Lexington Geographical Area
Whooping crane	*Grus americana*	Federal Endangered ; State Endangered	spring and fall migrant; shallow, sparsely vegetated streams, rivers, and wetlands to feed and roost during their migration; frequently stopover near ponds and lakes; may feed in crop fields or hay meadows that are in close proximity to roosting locations; critical habitat located in southern portion of study area	Project is over 1 mile north of the Platte River. Visual site distance between the Project and the river is inhibited. Whooping crane may use agricultural fields and wetlands/waterways within Project area for foraging.	Project is over 1 mile north of the Platte River. Visual site distance between the Project and the river is inhibited. Whooping crane may use agricultural fields and wetlands/waterways within Project area for foraging.
Whooping crane critical habitat	*Grus americana*	Federal Endangered ; State Endangered	a 3-mile wide, 56-mile-long reach of the Platte River from Lexington to Shelton, Nebraska has been federally listed as critical habitat for whooping cranes	Project is approximately 13 miles west of federally listed critical habitat area. No effect anticipated.	Project is approximately 1.70 miles north of federally listed critical habitat area. No effect anticipated.

D4.5 Determination of Effects and Conservation Measures

The following fish and aquatic species, terrestrial, and special status specials have the potential to occur in Cozad and Lexington geographical area:

- Plains minnow
- Plains topminnow
- Western silvery minnow
- Monarch
- Suckley's cuckoo bumble bee
- Eastern red bat
- Hoary bat
- Northern long-eared bat
- Tri-colored bat
- Plains spotted skunk
- Eskimo curlew
- Whooping crane

The Project is located within the NGPC-estimated range of plains minnow, plains topminnow, and western silvery minnow. Areas of the project possess favorable slow to moderate velocity, vegetated shoreline and substrate, and pool-habitat suitable for the species. The following conservation measures are proposed to mitigate effects on the species:

- Some chemicals which are approved for overwater use may not be acceptable for use in streams with these fish. Guidance documents will be made available.
- Work or projects conducted in stream or river channels may not be allowed during the spawning periods of these fish.
- Bank stabilization may be limited.
- Grazing (as part of a management plan developed with the assistance of a state agency) along streams where these fish occur may be limited or controlled.
- Upland erosion or soil disturbances will need to be designed to avoid and minimize sedimentation of streams where these fish occur.
- Aquatic organism passage will need to be considered for in-stream structures (e.g., culverts, dams, weirs)

With the implementation of the above conservation measures, the project may affect, but is unlikely to adversely affect the three fish species.

Milkweed was observed within the Project area. Therefore, the monarch may be affected. Since monarch is still listed as a federal proposed threatened species for listing, there are no formal conservation measures for implementation. Upon Project completion, it is recommended that seed mixes used to stabilize areas include milkweed species. Therefore, the project may affect, but is unlikely to adversely affect the monarch.

Wetlands are present within the Project area. Therefore, Suckley's cuckoo bumble bee may be present and affected. There are currently no conservation conditions proposed to mitigate effects on the species. Upon project completion, impacted wetland areas would be stabilized and revegetated appropriately. Therefore, the project may affect, but is unlikely to adversely affect Suckley's cuckoo bumble bee.

There is woodland habitat present within the Project area that may provide suitable habitat for eastern red bat, hoary bat, northern long-eared bat, and tri-colored bat. The Project would be modified, to the extent practicable, to avoid tree removal in excess of what is required to implement the Project safely. Tree removal would be limited to that specified in Project plains and contractors would understand clearing limits and how they are marked in the field. Tree removal would occur between November 1 through March 31 to mitigate effects on the species. With the implementation of conservation condition, the Project may affect, but is unlikely to adversely affect eastern red bat, hoary bat, northern long-eared bat, and tri-colored bat.

There is field habitat and old structures/wooded areas in the Project area that may be used by plains spotted skunk. Due to the mobile nature of the species, the skunk would avoid areas of construction and disturbance. The species is also nocturnal, so there would be limited opportunities for interaction during construction. The Project would not convert large tracts of suitable habitat for the species into unsuitable habitat. Upon Project completion, the species would reintegrate into areas previously inhabited. Therefore, the Project may affect, but is unlikely to adversely affect plains spotted skunk.

Agricultural land present in both geographical areas may provide suitable habitat for the Eskimo curlew. There are currently no conservation conditions proposed for the species. Due to the mobile nature of the species, the curlew would avoid areas of construction and disturbance. Upon Project completion, the species would reintegrate into areas previously disturbed. Therefore, the Project may affect, but is unlikely to adversely affect Eskimo curlew.

At its closest point, the Project is approximately 1.30 miles north of the Platte River. Visual site distance between the Project and the river is inhibited. Whooping crane may use agricultural fields and wetlands/waterways within Project area for foraging. To mitigate effects on the species, construction activities would not occur during whooping crane migration periods (March 6 – April 29 and October 9 – November 15) to the extent practicable. If construction activities are required during migration periods, a qualified biologist would conduct surveys according to protocol. If species are present, the Contractor would be ordered to stop work within 0.50 mile of the whooping crane and follow protocol to determine when work can resume. Work can resume when the crane departs the area. Construction activities would be limited to the hours of 10:00 am to 4:00 pm during the migration period, unless morning survey indicates whooping cranes are not present. Post-construction herbaceous species used for re-seeding would be native grass or forbs species and shrubs or woody species reaching no more than 4 feet in height. With the implementation of conservation conditions, the Project may affect, but is unlikely to adversely affect whooping crane.

NEBRASKA GAME PARKS

Environmental Review Report

Project Information

Report Generation Date:	9/19/2024 10:38:04 AM
Project Title:	NRCS / CPNRD - Spring Creek Watershed Planning EA
User Project Number(s):	
System Project ID:	NE-CERT-013246
Project Type:	Development (ex: construction, housing, land development, CSW/ISW Permits, etc.; Does NOT include Mining), New construction outside municipality - previously undisturbed habitat
Project Activities:	None Selected
Project Size:	196,036.58 acres
County(s):	Custer; Dawson
Watershed(s):	Loup; Middle Platte
Watershed(s) HUC 8:	Middle Platte-Buffalo; South Loup
Watershed(s) HUC 12:	102001010607; Central Midway Lake; City of Calloway-Sand Creek; City of Cozad +
Biologically Unique Landscape(s):	Central Loess Hills; Central Platte River
Township/Range and/or Section(s):	008N019W; 008N020W; 009N019W; 009N020W; 009N021W; 009N022W; 010N021W; 010N022W; 010N023W; 010N024W; 011N022W; 011N023W; 011N024W; 012N023W; 012N024W; 012N025W; 013N023W; 013N024W; 014N023W; 014N024W; 014N025W; 015N024W; 015N025W
Latitude/Longitude:	40.963287 / -99.940164

Contact Information

Organization:	HDR
Contact Name:	Emily Schmit
Contact Phone:	402.399.1340
Contact Email:	Emily.Schmit@hdrinc.com
Contact Address:	1917 S 67th Street Omaha NE 68106
Prepared By:	
Submitted On Behalf Of:	NRCS / CPNRD

System Project ID: NE-CERT-013246 Report Generation Date: 9/19/2024 10:38:04 AM

Project Description
NRCS Watershed Planning EA.

The Nebraska Nongame and Endangered Species Conservation Act (NESCA)

The Nebraska Game and Parks Commission (Commission or NGPC) has responsibility for protecting state-listed endangered and threatened species under authority of the Nongame and Endangered Species Conservation Act (NESCA) (Neb. Rev. Stat. § 37-801 to 37-814). Pursuant to §37-807 (3)(c) of NESCA, **all state agencies shall, in consultation with the Commission, ensure projects they authorize (i.e., issue a permit for), fund or carry out** do not jeopardize the continued existence of state-listed endangered or threatened species or result in the destruction or modification of habitat of such species which is determined by the Commission to be critical. If a proposed project may affect state-listed species or designated critical habitat, further consultation with the Commission is required.

Informal consultation pursuant to NESCA can be completed by using the Conservation and Environmental Review Tool (CERT). The CERT analyzes the project type and location, and based on the analysis, provides information about potential impacts to listed species, habitat questions and/or conservation conditions.

- If project proponent agrees to implement conservation conditions, as outlined in the report and applicable to the project type, then this document serves as documentation of consultation with the Commission and the following actions can be taken to move forward with the project:
  - Sign the report in the designated areas, and
  - Upload the signed and dated report into the project within CERT, and
  - Change the edit status to Final from Draft status.
- When these actions are completed, no additional coordination (i.e., contacting the Commission) is required.
- If the report indicates further consultation is required in the Overall Results section on the following page and/or conservation conditions cannot be met, then the following actions must be taken:
  - Project proponent is required to contact and consult with the Commission. Contact information can be found under the Additional Considerations section.

Review the Overall Results section on the following page for further instructions.

Disclaimer

The U.S. Fish and Wildlife Service has responsibility for conservation and management of fish and wildlife resources for the benefit of the American public under the following authorities: 1) Endangered Species Act; 2) Fish and Wildlife Coordination Act; 3) Bald and Golden Eagle Protection Act; and 4) Migratory Bird Treaty Act.

It is recommended that a project start with requesting an Official Species List via the Information for Planning and Consultation (IPaC) Tool, to begin informal consultation with the U.S. Fish & Wildlife Service.

The information generated in a CERT Environmental Review Report DOES NOT satisfy consultation obligations between the lead federal agency and the U.S. Fish and Wildlife Service pursuant to the Endangered Species Act (ESA).

For the purposes of ESA, the information in this report should be considered as technical assistance, and does not serve as the U.S. Fish and Wildlife Service's concurrence letter, even if the user signs and agrees to implement conservation conditions in order to satisfy consultation requirements of NESCA.

Review the Additional Considerations section for further information.

System Project ID: NE-CERT-013246 Report Generation Date: 9/19/2024 10:38:04 AM

Overall Results

The following result is based on a detailed analysis of your project.

- Potential impacts on listed species may occur as a result of this project, further consultation with the Nebraska Game and Parks Commission is required. Please review all the information provided in this document, then sign and date the Certification section. Upload the report under the Edit Details tab using the File Attachments feature and change the Edit Status to Final. Email a copy of your certified (i.e., signed and dated) report with a request for further review to the Commission (ngpc.envreview@nebraska.gov). Attach supporting documentation that may aid in the review such as designs, survey reports, site photos. etc.

Additional Information

Potential impacts on listed species may occur as a result of this project. Further consultation with the Nebraska Game and Parks Commission is required.

Nebraska Game and Parks Commission Property
This project is within or near a property owned and/or managed by the Nebraska Game and Parks Commission (NGPC). Please contact the Nebraska Game and Parks Commission to determine if this project will have impacts on the property.

Certification

I certify that ALL the project information in this report (including project location, project size/configuration, project type, project activities, answers to questions) is true, accurate and complete. If the project type, activities, location, size, or configuration of the project change; if a species listing status is reclassified; if a new species is listed; or if any of the answers to any questions asked in this report change, then this document is no longer valid, and re-consultation with the Nebraska Game and Parks Commission is required.

Applicant/project proponent signature Date

Additional Considerations

Nebraska Game and Parks Commission
Environmental Review Team
2200 North 33 Street
Lincoln, NE 68503
Phone: (402) 471-5423
Email: ngpc.envreview@nebraska.gov

U.S. Fish and Wildlife Service
Nebraska Ecological Services
9325 South Alda Road
Wood River, NE 68883
Phone: (308) 382-6468
Email: nebraskaes@fws.gov

U.S. Army Corps of Engineers
Omaha Regulatory Office
8901 South 154 Street
Omaha, NE 68138
Phone: (402) 896-0896
Email: NE404Reg@usace.army.mil

The following federal laws contribute to the conservation and management of fish and wildlife resources in the United States: Endangered Species Act, Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act, Clean Water Act, and the Fish and Wildlife Coordination Act.

Bald and Golden Eagle Protection Act

The federal Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. 668-668c) provides for the protection of the bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*). Under the Eagle Act, "take" of eagles, their parts, nests or eggs is prohibited. Disturbance resulting in injury to an eagle or a decrease in productivity or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior is a form of "take."

Nebraska Specific Information

Bald eagles use mature, forested riparian areas near rivers, streams, lakes, and wetlands and occur along all the major river systems in Nebraska. The bald eagle southward migration begins as early as October and the wintering period extends from December-March. The golden eagle is found in arid open country with grassland for foraging in western Nebraska and usually near buttes or canyons which serve as nesting sites. Golden eagles are often a permanent resident in the Pine Ridge area of Nebraska. Additionally, many bald and golden eagles nest in Nebraska from mid-February through mid-July. Disturbances within 0.5-miles of an active nest or within line-of-sight of the nest could cause adult eagles to discontinue nest building or to abandon eggs. Both bald and golden eagles frequent river systems in Nebraska during the winter where open water and forested corridors provide feeding, perching, and roosting habitats, respectively. The frequency and duration of eagle use of these habitats in the winter depends upon ice and weather conditions. Human disturbances and loss of wintering habitat can cause undue stress leading to cessation of feeding and failure to meet winter thermoregulatory requirements. These affects can reduce the carrying capacity of preferred wintering habitat and reproductive success for the species.

To comply with the Eagle Act, it is recommended that the project proponent determine if the proposed project would impact bald or golden eagles or their habitats. This can be done by conducting a habitat assessment, surveying nesting habitat for active and inactive nests, and surveying potential winter roosting habitat to determine if it is being used by eagles. The area to be surveyed is dependent on the type of project; however for most projects we recommend surveying the project area and a ½ mile buffer around the project area. If it is determined that either species could be affected by the proposed project, the Commission recommends that the project proponent notify the Nebraska Game and Parks Commission as well as the Nebraska Field Office, U.S. Fish and Wildlife Service for recommendations to avoid "take" of bald and golden eagles.

Migratory Bird Treaty Act and Nebraska Revised Statute §37-540

We recommend the project proponent comply with the Migratory Bird Treaty Act (16 U.S.C. 703-712: Ch. 128 *as amended*) (MBTA). The project proponent should also comply with Nebraska Revised Statute §37-540, which prohibits take and destruction of nests or eggs of protected birds (as defined in Nebraska Revised Statute §37-237.01). Construction activities in grassland, wetland, stream, woodland, and river bank habitats that would result in impacts on birds, their nests or eggs protected under these laws should be avoided. Although the provisions of these laws are applicable year-round, most migratory bird nesting activity in Nebraska occurs during the period of April 1 to July 15. However, some migratory birds are known to nest outside of the aforementioned primary nesting season period. For example, raptors can be expected to nest in woodland habitats during February 1 through July 15, whereas sedge wrens, which occur in some wetland habitats, normally nest from July 15 to September 10. If development in this area

is planned to occur during the primary nesting season or at any other time which may result in impacts to birds, their nests or eggs protected under these laws, we request that the project proponent arrange to have a qualified biologist conduct a field survey of the affected habitats to determine the absence or presence of nesting migratory birds. If a field survey identifies the existence of one or more active bird nests that cannot be avoided by the planned construction activities, the Nebraska Game and Parks Commission and the Nebraska Field Office, U.S. Fish and Wildlife Service should be contacted immediately. For more information on avoiding impacts to migratory birds, their nests and eggs, or to report active bird nests that cannot be avoided by planned construction activities, please contact the U.S. Fish and Wildlife Service and/or the Nebraska Game and Parks Commission (contact information within report). Adherence to these guidelines will help avoid unnecessary impacts on migratory birds.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) requires consultation with the U.S. Fish and Wildlife Service (Service) and the State fish and wildlife agency (i.e., Nebraska Game and Parks Commission) for the purpose of preventing loss of and damage to fish and wildlife resources in the planning, implementation, and operation of federal and federally funded, permitted, or licensed water resource development projects. This statute requires that federal agencies take into consideration the effect that the water related project would have on fish and wildlife resources, to take action to prevent loss or damage to these resources, and to provide for the development and improvement of these resources. The comments in this letter are provided as technical assistance only and are not the document required of the Secretary of the Interior pursuant to Section 2(b) of FWCA on any required federal environmental review or permit. This technical assistance is valid only for the described conditions and will have to be revised if significant environmental changes or changes in the proposed project take place. In order to determine whether the effects to fish and wildlife resources from the proposed project are being considered under FWCA, the lead federal agency must notify the Service in writing of how the comments and recommendations in this technical assistance letter are being considered into the proposed project.

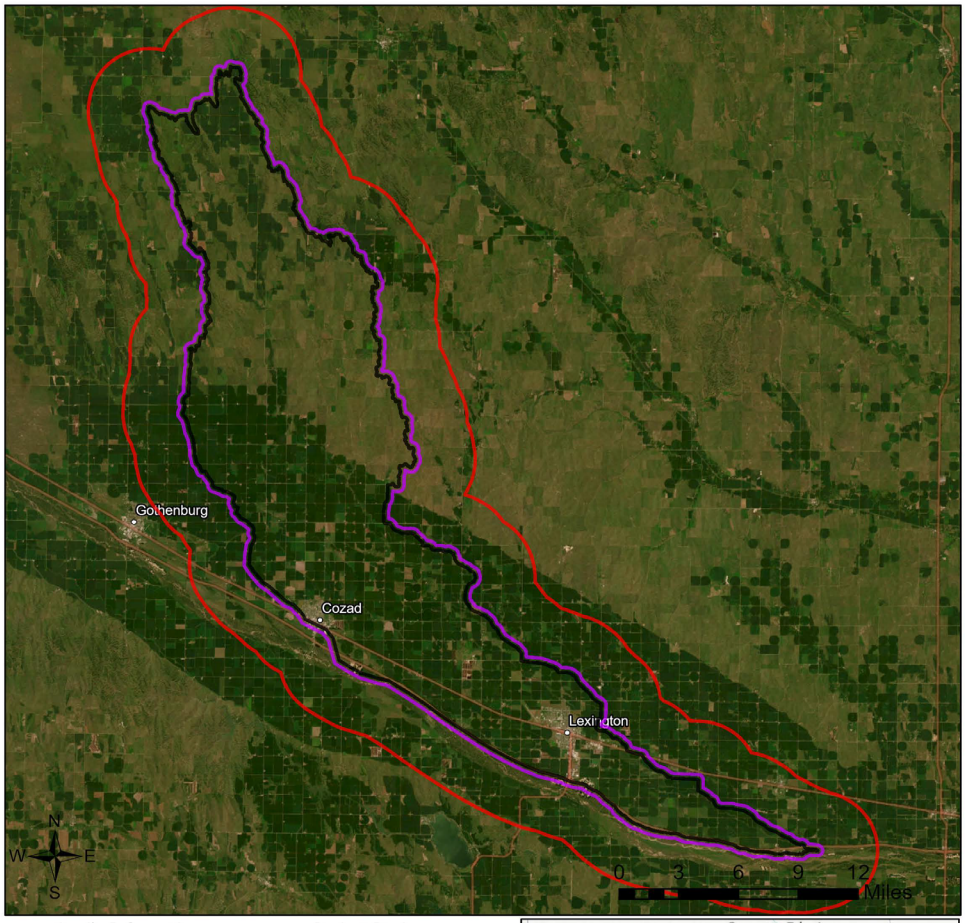
Section 404 of the Clean Water Act

In general, the Nebraska Game and Parks Commission and the U.S. Fish and Wildlife Service have concerns for impacts to wetlands, streams and riparian habitats. We recommend that impacts to wetlands, streams, and associated riparian corridors be avoided and minimized, and that any unavoidable impacts to these habitats be mitigated. If any fill materials will be placed into waterways or wetlands, the U.S. Army Corps of Engineers Regulatory Office in Omaha should be contacted to determine if a 404 permit is needed.

System Project ID: NE-CERT-013246 Report Generation Date: 9/19/2024 10:38:04 AM

NRCS / CPNRD - Spring Creek Watershed Planning EA

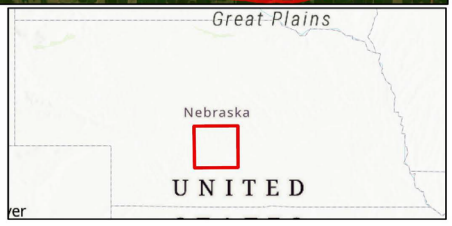
Aerial Image Basemap With Locator Map



3-mile Information Buffer Boundary

Project Review Boundary

Project Boundary



Project Size (acres): 196,036.58

Lat/Long (DD): 40.9633 / -99.9402

County(s): Custer; Dawson

BUL(s): Central Loess Hills; Central Platte River

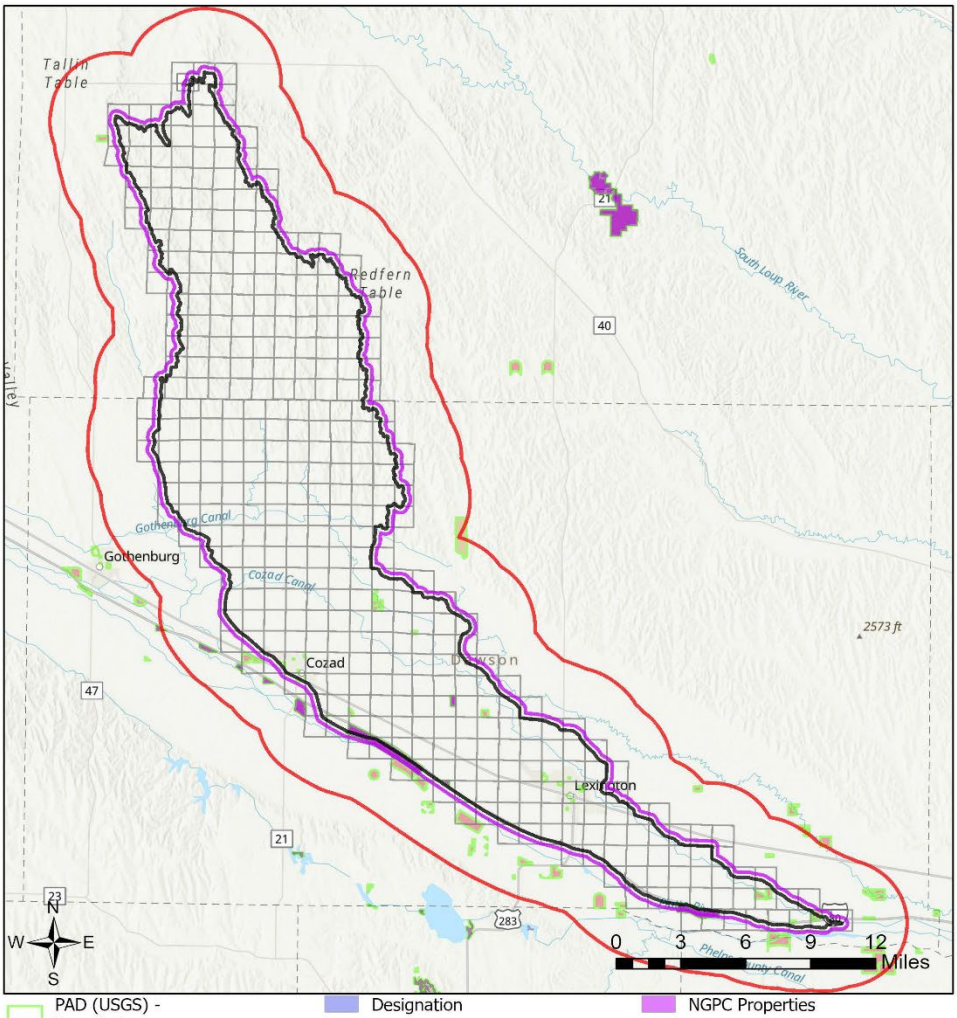
Township/Range/Section(s): T08R19WS05; T08R19WS06; T08R20WS01; T08R20WS02; T08R20WS03 +

Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS
Nebraska Game & Parks Commission, Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, USFWS
Earthstar Geographics

System Project ID: NE-CERT-013246 Report Generation Date: 9/19/2024 10:38:04 AM

NRCS / CPNRD - Spring Creek Watershed Planning EA

Topographic Basemap With Sections and Protected Areas



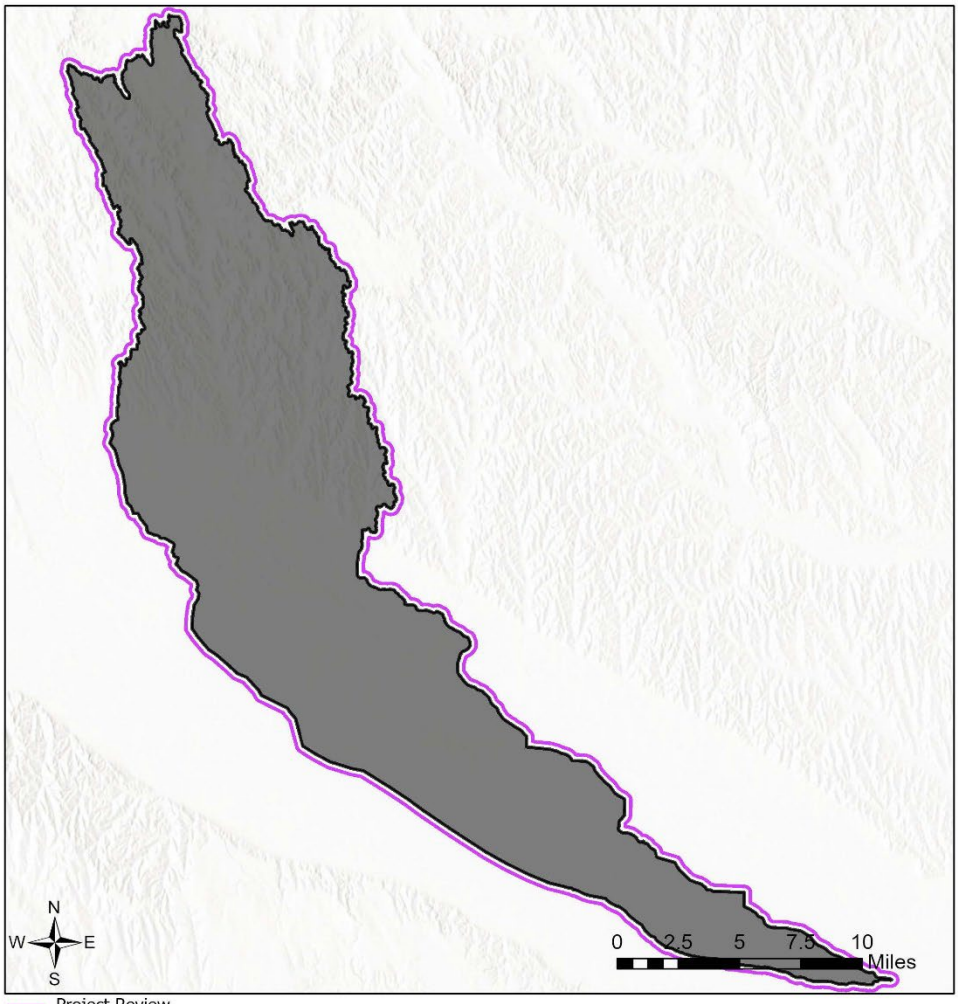
- PAD (USGS) - boundaries
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- National Park Service
- Bureau of Reclamation
- Designation
- Regional Agency
- State (NGPC)
- Other State
- NGO or Private
- Other (City, Unknown)
- NGPC Properties
- Sections
- 3-mile Information Buffer Boundary
- Project Review Boundary
- Project Boundary

Nebraska Game & Parks Commission, Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, USFWS Esri, CGIAR, USGS

System Project ID: NE-CERT-013246 Report Generation Date: 9/19/2024 10:38:04 AM

NRCS / CPNRD - Spring Creek Watershed Planning EA

Web Map As Submitted By User



Esri, CGIAR, USGS

System Project ID: NE-CERT-013246 Report Generation Date: 9/19/2024 10:38:04 AM

Table 1
Protected Areas in Immediate Vicinity of Project (project review area)

Area Name	Owner/Manager	Information Source
Arbor Park & Skate Park	City Land	USGS Protected Areas Database
Bellamy Ballpark	City Land	USGS Protected Areas Database
Bittern's Call WMA	Nebraska Game and Parks Commission	NGPC
Bittern's Call Wildlife Management Area	State Fish and Wildlife	USGS Protected Areas Database
Centennial Park	City Land	USGS Protected Areas Database
Central Platte North Natural Resource District Easement # 11	Private	USGS Protected Areas Database
Central Platte North Natural Resource District Easement # 19	Private	USGS Protected Areas Database
Central Platte North Natural Resource District Easement # 21	Private	USGS Protected Areas Database
Central Platte North Natural Resource District Easement # 26	Private	USGS Protected Areas Database
Central Platte North Natural Resource District Easement # 5	Private	USGS Protected Areas Database
Central Platte North Natural Resource District Easement # 6	Private	USGS Protected Areas Database
Cozad City Park	City Land	USGS Protected Areas Database
Darr Strip WMA	Nebraska Game and Parks Commission	NGPC
Darr Strip Wildlife Management Area	State Fish and Wildlife	USGS Protected Areas Database
Darr WMA	Nebraska Game and Parks Commission	NGPC
Darr Wildlife Management Area	State Fish and Wildlife	USGS Protected Areas Database
Dogwood WMA	Nebraska Game and Parks Commission	NGPC
Dogwood Wildlife Management Area	State Fish and Wildlife	USGS Protected Areas Database
East Cozad Wildlife Management Area	State Fish and Wildlife	USGS Protected Areas Database
East Darr Wildlife Management Area	State Fish and Wildlife	USGS Protected Areas Database
Family Aquatic Center	City Land	USGS Protected Areas Database
Kirk Patrick Memorial Park	City Land	USGS Protected Areas Database
Muny Park	City Land	USGS Protected Areas Database
Oak Park	City Land	USGS Protected Areas Database

System Project ID: NE-CERT-013246 Report Generation Date: 9/19/2024 10:38:04 AM

Table 1
Protected Areas in Immediate Vicinity of Project (project review area)

Area Name	Owner/Manager	Information Source
Optimist Recreation Complex	City Land	USGS Protected Areas Database
Overton Wildlife Management Area	State Fish and Wildlife	USGS Protected Areas Database
Pioneer Park	City Land	USGS Protected Areas Database
Plum Creek Park	City Land	USGS Protected Areas Database
Unknown Park	City Land	USGS Protected Areas Database
Water Tower Park	City Land	USGS Protected Areas Database
Wetlands Reserve Program (WRP), Dawson, NE	Private	USGS Protected Areas Database

Table 2
Documented Occurrences in Immediate Vicinity of Project (project review area):
Natural communities and selected special areas

Name	Other Information	SRank	GRank
Whooping Crane Designated Critical Habitat	Whooping Crane Designated Critical Habitat		
Central Loess Hills Biologically Unique Landscape	Link to BUL document		
Central Platte River Biologically Unique Landscape	Link to BUL document		
Large Intact Block of Habitat for At-risk Species			

Table 3
Regional Documented Occurrences of Species within 1 Mile of Project Review Area:
Tier 1 and 2 at-risk species and additional S1-S3 plants

Scientific Name	Common Name	USFWS	State	SGCN	SRank	GRank	Taxonomic Group
Charadrius melodus	Piping Plover	T	T	Tier 1	S2	G3	Vertebrate Animal - Birds
Cygnus buccinator	Trumpeter Swan			Tier 2	S2	G4	Vertebrate Animal - Birds
Fundulus sciadicus	Plains Topminnow			Tier 1	S3	G4	Vertebrate Animal - Fishes
Grus americana	Whooping Crane	E	E	Tier 1	S1	G1	Vertebrate Animal - Birds
Haliaeetus leucocephalus	Bald Eagle			Tier 2	S3	G5	Vertebrate Animal - Birds
Hybognathus placitus	Plains Minnow			Tier 1	S2	G4	Vertebrate Animal - Fishes
Nicrophorus americanus	American Burying Beetle	T	E	Tier 1	S3?	G3	Invertebrate Animal - Beetles
Penstemon haydenii	Blowout Penstemon	E	E	Tier 1	S1	G1G2	Vascular Plant - Dicots
Recurvirostra americana	American Avocet			Tier 2	S3	G5	Vertebrate Animal - Birds

System Project ID: NE-CERT-013246 Report Generation Date: 9/19/2024 10:38:04 AM

Table 3
Regional Documented Occurrences of Species within 1 Mile of Project Review Area:
Tier 1 and 2 at-risk species and additional S1-S3 plants

Scientific Name	Common Name	USFWS	State	SGCN	SRank	GRank	Taxonomic Group
Speyeria idalia	Regal Fritillary			Tier 1	S3	G3?	Invertebrate Animal - Butterflies and Skippers
Sternula antillarum athalassos	Interior Least Tern		E	Tier 1	S2	G4T3Q	Vertebrate Animal - Birds
Storeria occipitomaculata	Redbelly Snake		NC	Tier 1	S2	G5	Vertebrate Animal - Reptiles
Tantilla nigriceps	Plains Blackhead Snake		NC	Tier 2	S1	G5	Vertebrate Animal - Reptiles

Table 4
Potential Occurrences in Immediate Vicinity of Project (project review area):
Special status species (Tier 1 at-risk species and Bald and Golden Eagle), based on models or range maps

Scientific Name	Common Name	Data Type	USFWS	State	SGCN	SRank	GRank	Taxonomic Group
Argynnis idalia	Regal Fritillary	Range			Tier 1	S3	G3?	
Asio flammeus	Short-eared Owl	Range			Tier 1	S2	G5	
Athene cunicularia	Burrowing Owl	Range			Tier 1	S2	G4	
Atrytone arogos iowa	Iowa Skipper	Range			Tier 1	S1	G2G3T2T3	
Boloria myrina nebraskensis	Nebraska Fritillary	Range			Tier 1	SNR	G5?T3T4	
Boloria myrina sabulocollis	Kohler's Fritillary	Range			Tier 1	S1S2	G5?T3	
Calidris subruficollis	Buff-breasted Sandpiper	Range			Tier 1	S2N	G4	
Catocala nuptialis	Married Underwing	Range			Tier 1	SNR	G3	
Catocala whitneyi	Whitney Underwing	Range			Tier 1	S1	G2G3	
Charadrius melodus	Piping Plover	Model	T	T	Tier 1	S2	G3	
Cicindela limbata limbata	Sandy Tiger Beetle	Range			Tier 1	S4	G5T3T4	
Coccyzus erythropthalmus	Black-billed Cuckoo	Range			Tier 1	S3	G5	
Dalea cylindriceps	Large-spike Prairie-clover	Range			Tier 1	S2	G3	
Danaus plexippus	Monarch	Range			Tier 1	S2	G4	
Ellipsoptera lepida	Ghost Tiger Beetle	Range			Tier 1	S2	G3	
Emydoidea blandingii	Blanding's Turtle	Range			Tier 1	S4	G4	
Euphyes bimacula illinois	Two-spotted Skipper	Range			Tier 1	S3	G4T1T2	

System Project ID: NE-CERT-013246 Report Generation Date: 9/19/2024 10:38:04 AM

Table 4
Potential Occurrences in Immediate Vicinity of Project (project review area):
Special status species (Tier 1 at-risk species and Bald and Golden Eagle), based on models or range maps

Scientific Name	Common Name	Data Type	USFWS	State	SGCN	SRank	GRank	Taxonomic Group
Fundulus sciadicus	Plains Topminnow	Range			Tier 1	S3	G4	
Grus americana	Whooping Crane	Range	E	E	Tier 1	S1	G1	
Haliaeetus leucocephalus	Bald Eagle	Range			Tier 2	S3	G5	
Hesperia ottoe	Ottoe Skipper	Range			Tier 1	S2	G3	
Hybognathus argyritis	Western Silvery Minnow	Range			Tier 1	S2	G4	
Hybognathus placitus	Plains Minnow	Range			Tier 1	S2	G4	
Lanius ludovicianus	Loggerhead Shrike	Range			Tier 1	S3	G4	
Lasiurus borealis	Eastern Red Bat	Range			Tier 1	S3	G3G4	
Lasiurus cinereus	Hoary Bat	Range			Tier 1	S3	G3G4	
Lethe eurydice fumosus	Smoky-eyed Brown	Range			Tier 1	S3	G5T3T4	
Myotis septentrionalis	Northern Long-eared Myotis	Range	E	E	Tier 1	S1S2	G2G3	
Nicrophorus americanus	American Burying Beetle	Range	T	T	Tier 1	S3	G3	
Oxyloma haydeni	Niobrara Ambersnail	Range			Tier 1	SNR	G3	
Perimyotis subflavus	Tricolored Bat	Range			Tier 1	S3	G3G4	
Sternula antillarum athalassos	Interior Least Tern	Model	E	E	Tier 1	S2	G4T3Q	
Storeria occipitomaculata	Redbelly Snake	Range			Tier 1	S2	G5	

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Nebraska Ecological Services Field Office
9325 B South Alda Rd., Ste B
Wood River, NE 68883-9565
Phone: (308) 382-6468 Fax: (308) 384-8835

In Reply Refer To: 09/19/2024 15:28:45 UTC
Project Code: 2024-0146535
Project Name: NRCS CPNRD - Spring Creek Watershed EA

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).
New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website (https://ipac.ecosphere.fws.gov/) at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.
The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.
A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.
If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: https://www.fws.gov/media/endangered-species-consultation-handbook or at our Nebraska Field Office webpage (https://www.fws.gov/office/nebraska-ecological-services/project-planning-and-review-under-endangered-species-act).
We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Project Consultation Code in the header of this letter (i.e., YEAR-XXXXXXX) with any request for consultation or correspondence about your project that you submit to our office.

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Act, there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts and permitting see https://www.fws.gov/program/migratory-bird-permit
The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.
In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit:

https://www.federalregister.gov/documents/2012/10/03/2012-24433/migratory-bird-conservation-executive-order-13186

Platte River System: The Platte River, its tributaries, and associated wetland habitats are resources of national importance. Due to the cumulative effect of many water depletion projects

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

in the Platte River basin, the Service considers any direct or indirect depletion of flows from the Platte River system to be significant and will continue to further deteriorate the already stressed habitat conditions. Federal agencies must consult with the Service under section 7 of the ESA for projects in Nebraska that may lead to water depletions or have the potential to impact water quality in the Platte River system, because these actions my affect threatened and endangered species inhabiting the downstream reaches of these river systems. The federally listed species that could be impacted from Platte River water depletions include the federally endangered Whooping Crane (Grus americana), and Pallid Sturgeon (Scaphirhynchus albus); the threatened Piping Plover (Charadrius melodus) and Western Prairie Fringed Orchid (Platanthera praeclara). In general, depletions include evaporative losses and/or consumptive use of surface or groundwater within the affected basin, often characterized as diversions minus return flows. Project elements that could be associated with depletions include, but are not limited to: borrow sites, ponds, lakes, and reservoirs (e.g., for detention, recreating, irrigation, storage, stock watering, municipal storage, and power generation); hydrostatic testing of pipelines; wells; dust abatement; diversion structures; and water treatment facilities. For more information on consultation requirements for the Platte River species, please visit https://fws.gov/partner/platte-river-recovery-implementation-program

Nebraska Nongame and Endangered Species Conservation Act: Federally listed species protected under the Endangered Species Act are also state-listed under the Nebraska statute, the Nebraska Nongame and Endangered Species Conservation Act. There may be state-listed species affected by the proposed project that are not federally listed. To determine if the proposed project may affect state-listed species, the Service recommends that the project proponent contact the Nebraska Game and Parks Commission (NGPC) Planning and Program Division located at 2200 North 33rd Street Lincoln, Nebraska 68503-0370. For more information and to request an environmental review from the NGPC, visit their Environmental Review website at http://outdoornebraska.gov/environmentalreview/ for instructions and contact information.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Bald & Golden Eagles
- Migratory Birds
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

Nebraska Ecological Services Field Office
9325 B South Alda Rd., Ste B
Wood River, NE 68883-9565
(308) 382-6468

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

PROJECT SUMMARY

Project Code: 2024-0146535
Project Name: NRCS CPNRD - Spring Creek Watershed EA
Project Type: Flooding
Project Description: NRCS Watershed EA
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@40.97969945,-99.99650034313714,14z



Counties: Custer and Dawson counties, Nebraska

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

ENDANGERED SPECIES ACT SPECIES

There is a total of 7 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

BIRDS

NAME	STATUS
Piping Plover *Charadrius melodus* Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Whooping Crane *Grus americana* Population: Wherever found, except where listed as an experimental population There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/758	Endangered

FISHES

NAME	STATUS
Pallid Sturgeon *Scaphirhynchus albus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7162	Endangered

INSECTS

NAME	STATUS
American Burying Beetle *Nicrophorus americanus* Population: Wherever found, except where listed as an experimental population No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/66	Threatened
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate
Western Regal Fritillary *Argynnis idalia occidentalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/12017	Proposed Threatened

FLOWERING PLANTS

NAME	STATUS
Western Prairie Fringed Orchid *Platanthera praeclara* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1669	Threatened

CRITICAL HABITATS

There is 1 critical habitat wholly or partially within your project area under this office's jurisdiction.

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

NAME	STATUS
Whooping Crane *Grus americana* https://ecos.fws.gov/ecp/species/758#crithab	Final

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

BALD & GOLDEN EAGLES

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act[1] and the Migratory Bird Treaty Act[2].

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats[3], should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

There are likely bald eagles present in your project area. For additional information on bald eagles, refer to Bald Eagle Nesting and Sensitivity to Human Activity

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Oct 15 to Jul 31

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

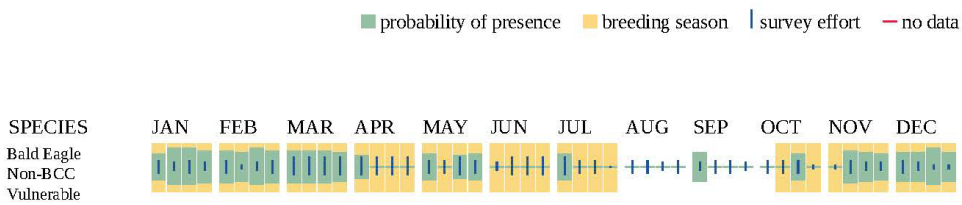
Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

MIGRATORY BIRDS

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats[3] should follow appropriate regulations and consider implementing appropriate conservation measures, as described in the links below. Specifically, please review the "Supplemental Information on Migratory Birds and Eagles".

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the PROBABILITY OF PRESENCE SUMMARY below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Oct 15 to Jul 31
Black Tern *Chlidonias niger surinamenisis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3093	Breeds May 15 to Aug 20
Bobolink *Dolichonyx oryzivorus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9454	Breeds May 20 to Jul 31
Chimney Swift *Chaetura pelagica* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9406	Breeds Mar 15 to Aug 25
Lark Bunting *Calamospiza melanocorys* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9451	Breeds May 10 to Aug 15

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

NAME	BREEDING SEASON
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Long-eared Owl *asio otus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
Pectoral Sandpiper *Calidris melanotos* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9561	Breeds elsewhere
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9398	Breeds May 10 to Sep 10
Western Grebe *aechmophorus occidentalis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/6743	Breeds Jun 1 to Aug 31
Whimbrel *Numenius phaeopus hudsonicus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/11991	Breeds elsewhere
Willet *Tringa semipalmata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10669	Breeds Apr 20 to Aug 5

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

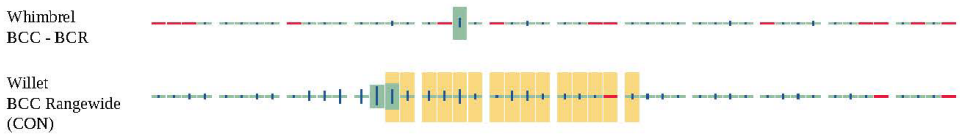
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.



Project code: 2024-0146535 09/19/2024 15:28:45 UTC



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

WETLAND INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE VISIT HTTPS://WWW.FWS.GOV/WETLANDS/DATA/MAPPER.HTML OR CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

Project code: 2024-0146535 09/19/2024 15:28:45 UTC

IPAC USER CONTACT INFORMATION

Agency: Central Platte Natural Resources District
Name: Emily Schmit
Address: 1917 South 67th Street
City: Omaha
State: NE
Zip: 68106
Email emily.schmit@hdrinc.com
Phone: 4023991340

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Natural Resources Conservation Service