



FARGO-MOORHEAD AREA DIVERSION
PROJECT SOCIO ECONOMICS
TECHNICAL REPORT IN SUPPORT OF
MINNESOTA EIS

Final Report -
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1 EXECUTIVE SUMMARY

1.1 PURPOSE AND INTRODUCTION

The Minnesota Department of Natural Resources (MNDNR) is preparing a State Environmental Impact Statement (EIS) for the Fargo-Moorhead Diversion Project necessary to meet Minnesota Rules part 4410.2300. As a requirement of these rules, the MNDNR is required to assess the social and economic factors as they relate to the Project and project alternatives. The purpose of this technical memorandum (TM) is to document and describe data gathered as well as provide analysis of the data so the socioeconomic effects can be disclosed in the EIS socio economic impact analysis (SEIA).

The scope of the SEIA is to quantitatively evaluate the costs of the Project (including mitigation) as well as the flood damage reduction benefits arising from operation of the Project (including mitigation). Social impacts, such as property buyouts, are described in monetary terms where possible and are qualitatively described where the impact is not quantifiable.

The study area in this SEIA includes four counties: Cass and Richland County, ND; and Clay and Wilkin County, MN, Figure 1. The study area is focused on impacts within the Metropolitan Area that includes the cities of Fargo, ND and Moorhead, MN, which will directly benefit from the diversion project; and the areas containing the diversion project features and the areas impacted by the project features. The project features include: upstream embankments and upstream staging areas, diversion channel, and diversion outlet. The project area begins south of the metro area near Hickson, ND and extends north along the Red River ending at Georgetown, MN after the confluence with the Buffalo River.

In this TM, three (3) alternative conditions are evaluated. They include a without Project and two with Project conditions. They are described as:

- Alternative 1: Base No Action Alternative
- Alternative 2: Proposed Project Alternative
- Alternative 3: Northern Alignment Alternative

1.2 AFFECTED ENVIRONMENT

The Base No Action Alternative is the baseline for the analysis with a base year of 2012.

The major socio economic indicators included are: demographics, employment and income, housing, and fiscal resources. These economic indicators present the FM Metro Study area as an area that is resilient to economic hardship and a promising area for future growth. Population in the metro area has been steadily increasing. Cass County, ND and Clay County, MN have demonstrated growth from 1980 to 2010 with the average consistently above the state and national averages. This growth has been centered primarily in the FM Metro Area. Meanwhile, the surrounding communities and counties have experienced consistent decline. The population located in the area is well educated compared to national and state

averages. Data also shows a relative abundance of affordable housing available to support economic growth.

Unemployment in the area is consistently below the national average, even remaining low through the recession of 2008 and the historic 2009 flood; indicating the economy is resistant to economic hardship. Per capita and median household income has shown increases larger than national averages over the period. Growth in employment has typically been in service related sectors with retail trade and other services in the two counties experiencing the largest growth.

The FM Metro Study also supports a much larger area, including northwest Minnesota and eastern North Dakota, providing health care, agricultural support, post-secondary education, financial, and retail shopping, as well serving as a major transportation hub. The impacts to this broader area were not analyzed for this socio-economic evaluation.

1.3 METHODOLOGY

Impacts of the alternatives were evaluated in the SEIA using flood risk assessment methodologies. The FM SEIA flood risk analysis was carried out using a combination of economic frameworks, including physical flood damage models and economic impact models. The physical flood damage model provides measures of direct impacts, which are referred to as impacts to capital stock (buildings, contents, and vehicles). The results of the physical flood damage models were used to estimate indirect effects, which are referred to as the loss of building function. Impacts to loss of building function may include costs associated with relocating businesses and residents to temporary facilities; and losses of income earned from sales (economic output). Cost estimates of actions are combined with economic impact models to evaluate the indirect regional benefits to employment and income patterns.

1.4 SUMMARY OF FINDINGS

Table 1 summarizes the benefits and impacts for the two project alternatives – the Proposed Alternative (Alternative 2) and the Northern Alignment Alternative (Alternative 3) - compared to the Base No Action Alternative (Alternative 1). For example, both alternatives reduce Average Annual Damages by \$41M over the Base No Action Alternative. The Average Annual Damages are calculated using a combination of likelihood of occurrence and consequence of occurrence; thus, more frequent, lower impact events are weighed more heavily in the 50-year analysis period due to their higher chance of occurrence. However, both the project alternatives are designed to protect the FM Metro Area against large events – certified protection for up to a 100-year event and significant protection for up to a 500-year event for an indefinite period of time (much greater than 50 years). The damage reductions for the 100-year and 500-year events are \$1.4 Billion and \$3.4 Billion, respectively.


Flood Insurance premiums constitute a significant cost for residents in the FM Metro area under the Base No Action Alternative. The National Flood Insurance Program Floodsmart.gov website indicates the average flood insurance policy costs about \$650 per year however; these costs are significantly higher for

properties in high risk areas and for properties with basements below the base flood elevation. Both Alternatives 2 and 3 will remove over 17,000 structures from being required to pay flood insurance policy costs. Using the average policy cost referenced above, this would result in an annual savings of \$11M.

Table 1: Summary of Economic Impacts in the FM Metro Area for the Proposed Project (Alt. 2) and the Northern Alignment Alternative (Alt.3) Compared to the Base No Action Alternative (Alt. 1)

Impact	Alternative Condition	
	Proposed (Alt. 2)	Northern (Alt. 3)
Impacts to Capital Stock		
Average Annual Damages Reduced ¹	-\$41 Million	-\$41 Million
Flood Insurance		
Protected Structures at 1-percent-annual-chance	17,714	17,646
Building Loss of Function		
Average Annual Disruption Costs Reduced	-\$3 Million	-\$3 Million
Average Annual Flood Related Relocation Costs Reduced	-\$47 Million	-\$46 Million
Average Annual Business Losses Reduced		
Output	-\$1,354 Million	-\$1,284 Million
Employment	-14,715 Jobs	-14,081 Jobs
Labor Income	-\$491 Million	-\$463 Million
Gross Regional Product	-\$777 Million	-\$737 Million
Total State and Local Tax	-\$100 Million	-\$96 Million
Construction Impacts		
Direct Construction Investment	\$1,789 Million	\$1,791 Million
Total Sales Gained	\$3,021 Million	\$3,100 Million
Total Job Creation	20,744 Jobs	22,049 Jobs
Total Income	\$1,219 Million	\$1,295 Million
Total Value Added	\$1,548 Million	\$1,645 Million
Total Taxes	\$106 Million	\$113 Million
Annual Operations and Maintenance Impacts		
Total Sales	\$5 Million	\$5 Million
Total Job Creation	37 Jobs	37 Jobs
Total Income	\$2 Million	\$2 Million
Total Value Added	\$3 Million	\$3 Million
Total Taxes	>\$1 Million	>\$1 Million

Overall Alternatives 2 and 3 have nearly equivalent benefits and impacts throughout the FM Metro area. Importantly, both alternatives provide the same amount of flood protection for the FM Metro Area. However, there are two socio-economic differences between Alternative 2, the Proposed Project, and



Alternative 3, the Northern Alignment Alternative – number of residences and businesses that require relocation, and overall cost.

The project alternatives will have different impacts on properties in the staging area and along the southern embankment alignment. While both would have impacts from operations of the staging area, the Northern Alignment Alternative would move the southern embankment of the Proposed Project north approximately 1.5 miles. Moving the embankment alignment north creates impacts to 68 additional structures north of the Proposed Project Alternative embankment alignment. These incremental structure impacts are highlighted in Figure ES 1 and Figure ES 2, which also show the structure impacts for the Base No Action Alternative for comparison. In addition to the 79 residences that would have to be relocated for the Northern Alignment Alternative compared to the Proposed Project, St Benedicts, a historic church and cemetery would also be impacted. The additional impacts to residences and businesses increase the cost of the Northern Alignment Alternative over the Proposed Alternative by \$56M.

Figure ES 1: Staging Area Residential Structure Impacts

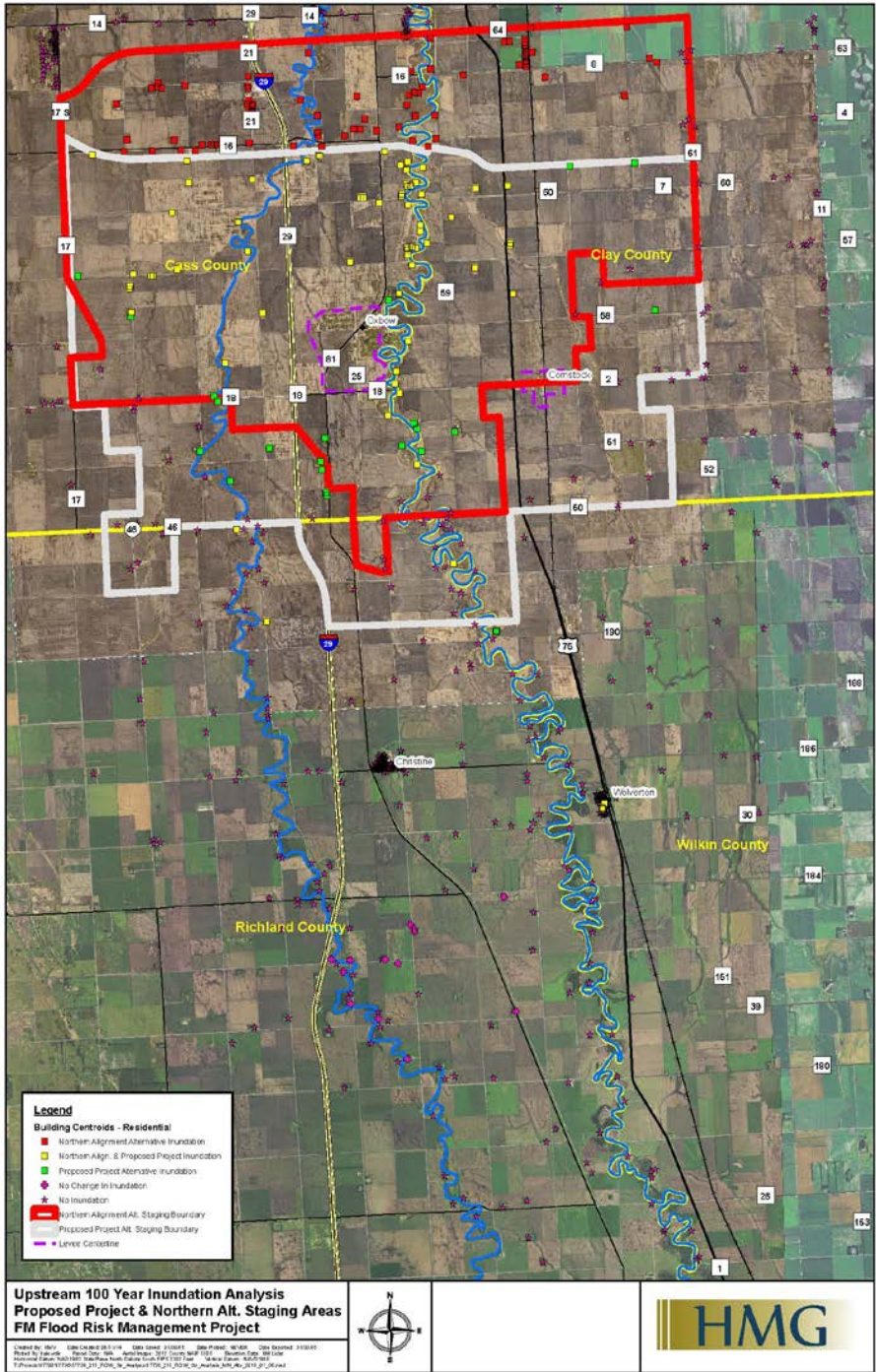
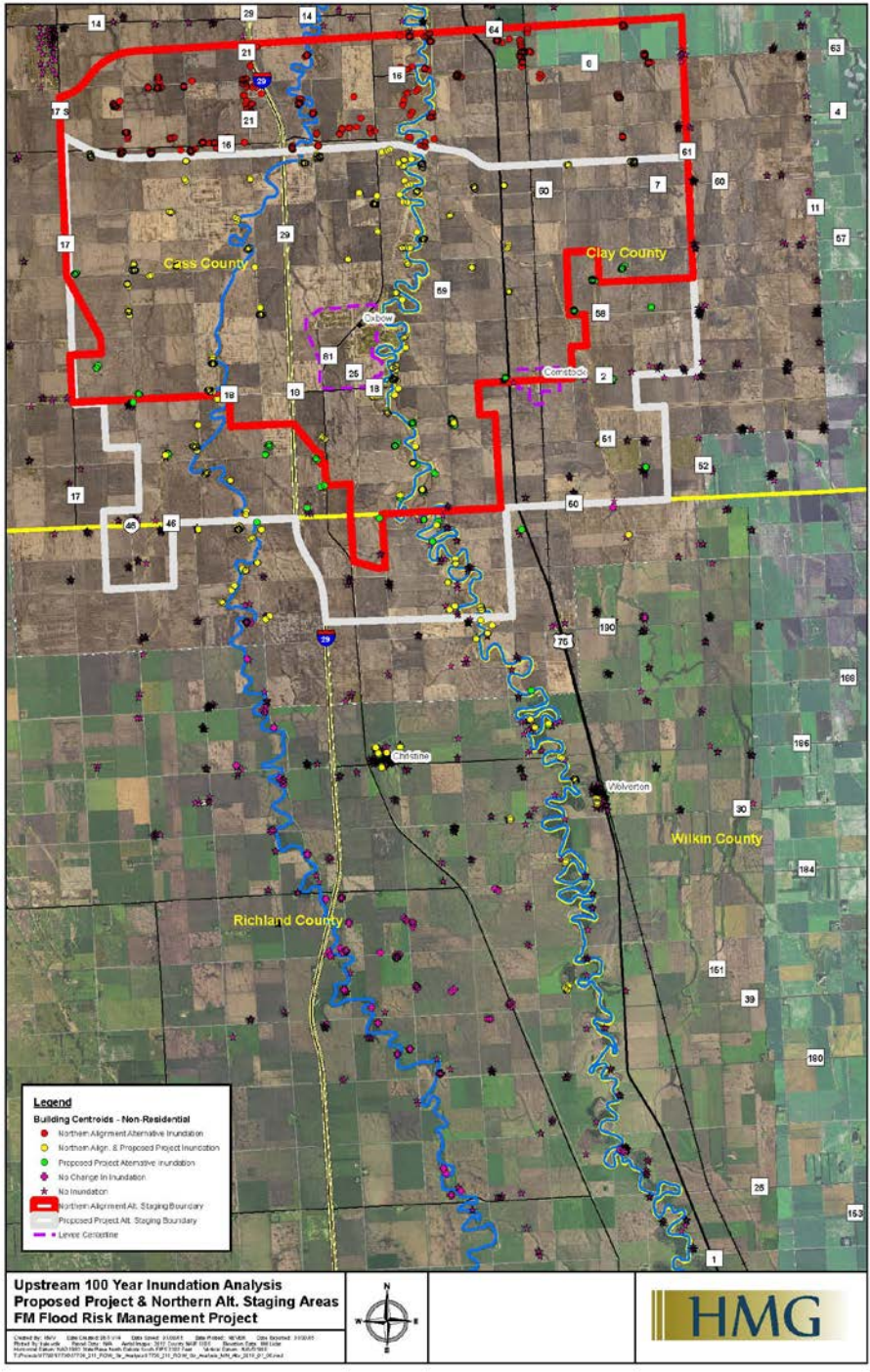


Figure ES 2: Staging Area Non-residential Structure Impacts



Both Alternatives 2 and 3 require the construction of a ring levee to protect the communities of Oxbow, Hickson, and Bakke. Alternative 2 would require the construction of a ring levee to protect the community of Comstock, while Alternative 3 would not. Both alternatives would require protection of, or raising of, the Comstock sewage treatment lagoons.

The overall cost of the impacts is presented in Table 2.

Table 2: Summary of Property Impacts between the Proposed Project Alternative (Alternative 2) and Northern Alignment Alternative (Alternative 3) – Number and Cost of Residential, Non-Residential & Commercial Structures

Type of Property	Proposed Alternative		Northern Alignment Alternative	
	Fee Title	Easement	Fee Title	Easement
Diversion and Embankment Footprint				
Acres	717	62	453	44
Non-Residential	11		7	
Residential	3		5	
Total Cost (Millions)	\$5.41	\$0.07	\$4.20	\$0.05
Upstream Staging Area				
Acres	25,842	6,413	28,356	4,997
Non-Residential	434	162	677	94
Residential	71	20	132	20
Total Cost (Millions)	\$151.52	\$9.00	\$210.91	\$6.39

2 PURPOSE AND INTRODUCTION

The Minnesota Department of Natural Resources (MNDNR) is preparing a State Environmental Impact Statement (EIS) for the Fargo-Moorhead Diversion Project necessary to meet Minnesota Rules part 4410.2300. As a requirement of these rules, the MNDNR is required to assess the social and economic factors as they relate to the Project and project alternatives and address public comments received regarding the socioeconomic effects of the Project. More specifically, implementing flood risk management alternatives could have varying impacts on social and economic resources in the communities in the study area. These impacts must be documented as part of the EIS process. This technical memorandum (TM) has been prepared to address these requirements. The purpose of this TM is to document and describe data gathered as well as provide analysis of the data so the socioeconomic effects can be disclosed in the EIS socio economic impact analysis (SEIA).

The study area considered in this SEIA includes four counties: Cass and Richland County, ND; and Clay and Wilkin County, MN. The study area is focused on impacts within the Metropolitan Area that includes the cities of Fargo, ND and Moorhead, MN which will directly benefit from the diversion project; and the

areas containing the diversion project features and the areas impacted by the project features. The project features include: upstream tieback embankments and upstream staging areas; diversion channel, and extends to the diversion outlet. The project area begins south of the metro area near Hickson, ND and extends north along the Red River ending at Georgetown, MN after the confluence with the Buffalo River.

The scope of the SEIA is to quantitatively evaluate the costs of the Project (including mitigation) as well as the flood damage reduction benefits arising from operation of the Project (including mitigation). Social impacts such as property buyouts are described in monetary terms where possible in the cost and are qualitatively disclosed where the impact is not quantifiable. In this TM, three (3) alternative conditions are evaluated. They include a without project and two with project conditions. They are described as:

- Alternative 1: Base No Action Alternative
- Alternative 2: Proposed Project Alternative
- Alternative 3: Northern Alignment Alternative

Additional detail about the Proposed Project and Northern Alignment Alternatives, including alignment information, costs and structure impacts are contained in Appendix A of this report.

2.1 ALTERNATIVE 1: BASE NO ACTION ALTERNATIVE

The Base No Action Alternative as defined by the MNDNR in the No Action Alternatives Section for the Fargo-Moorhead EIS. The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded permanent projects such as levee construction (i.e., structural measures) and property buyouts (i.e., non-structural measures). The Base No Action Alternative used for the socioeconomic analysis assumes the flood protection measures tie into high ground at a flood stage of approximately 39.5 feet and assumes no emergency measures will be implemented to fill in gaps between the permanent projects. Given this, the flood protection measures provide protection during more frequent flood events, such as the 10-percent annual chance (10-year) and 4-percent annual chance (25 year) flood events; however, water passes around these measures in many locations for larger flood events leaving the Metropolitan Area vulnerable to flooding.

The Base No Action Alternative for this analysis differs from the No Action Alternative used for the U.S. Army Corps of Engineers (COE) for the July, 2011 Final Environmental Impact Statement (FEIS) for the Fargo-Moorhead Metropolitan Area Flood Risk Reduction Project. The No Action Alternative for the FEIS included the 4th Street levee system in Fargo, but no other permanent or emergency flood protection measures since they were not funded or completed at the time of the analysis.

2.2 ALTERNATIVE 2: PROPOSED PROJECT ALTERNATIVE

As proposed, the Project would create a 30-mile long diversion channel on the North Dakota side of the Metropolitan Area with an upstream floodwater staging area. There would be a 6-mile long connecting channel between the Red River and the diversion inlet control structure. When operated, the Project would divert a portion of the Red River and Wild Rice River flow upstream of the Metropolitan Area,

intercept flow at the Sheyenne, Maple, Lower Rush and Rush Rivers, and discharge it to the Red River downstream of the Metropolitan Area. Aqueduct structures on the Sheyenne and Maple Rivers will convey a portion of the flow from these tributaries through the metropolitan area. Operation of the Project would occur when it becomes known that a stage of 35.0 feet would be exceeded at the U.S. Geological Survey (USGS) gage in Fargo (the Fargo gage). At this stage, the flow through Fargo would be approximately 17,000 cfs. A flow of 17,000 cfs at the Fargo gage is approximately a 10 percent chance or 10-year flood event. Operation begins by partially closing the gates at the Red River and Wild Rice River hydraulic control structures. Once the gates on the Red River and Wild Rice River are partially closed, water would begin to inundate the upstream staging area. The gates on the Diversion channel inlet would be operated to control water levels in the staging area and control downstream impacts.

The Proposed Alternative would significantly reduce flood damages and flood risk in the Metropolitan Area, but would not completely eliminate flood risk. The Proposed Alternative would reduce flood stages on the Red River in the cities of Fargo and Moorhead and would also reduce stages on the Wild Rice, Sheyenne, Maple, Rush and Lower Rush Rivers between the Red River and the diversion channel. With the Proposed Alternative operational, the stage from a 1-percent chance flood event on the Red River would be reduced from approximately 42.1 feet (assuming emergency levees confine the flow) to 35.0 feet at the Fargo gage.

2.3 ALTERNATIVE 3: NORTHERN ALIGNMENT ALTERNATIVE

The Northern Alignment Alternative is a modified version of the proposed project and would move the southern embankment of the proposed project north approximately 1.5 miles. The rest of the proposed project features would remain the same.

The NAA would provide the same reduction in flood stages on the Red River in the cities of Fargo and Moorhead and would also reduce stages on the Wild Rice, Sheyenne, Maple, Rush and Lower Rush Rivers between the Red River and the diversion channel as the Proposed Project Alternative. With the NAA operational, the stage from a 1-percent chance flood event on the Red River would be reduced from approximately 42.1 feet (assuming emergency levees confine the flow) to 35.0 feet at the Fargo gage.

The following sections of this TM provide a description of the affected environment, methods used to assess impacts of alternatives, and findings of impacts for the No Action, and Future with Project conditions.

3 AFFECTED ENVIRONMENT

This section describes the existing and future conditions of the study area. The without project condition is the 2012 baseline for the analysis. This section presents an overview of the major socio economic trends including: demographics, employment and income, housing, and fiscal resources. Primary data sources for the analysis include: 1980, 1990, 2000, and 2010 census data; American Community Survey (ACS); Bureau of Labor Statistics (BLS); Bureau of Economic Analysis (BEA).

3.1 DESCRIPTION OF EXISTING SOCIO ECONOMIC CONDITIONS

3.1.1 POPULATION

As reported in Table 3, the 2010 census reports the population of the Fargo Moorhead Study Area (Clay and Cass Counties) is approximately 209,000. Cass County, ND has demonstrated historically high average growth from 1980 to 2010 with the average consistently above the state and national averages. The county growth has been centered around the high average growth in the City of Fargo. Clay County, MN and the City of Moorhead have not had the same high growth until the more recent period of 2000 to 2010. Conversely, the surrounding communities and counties have experienced consistent decline over the same periods.

Table 3: Historical Population Trends: National, State, County, and City

Location	1980	1990	Percent Change 1980-1990	2000	Percent Change 1990-2000	2010	Percent Change 2000-2010
United States	231,103,121	253,498,149	9.7%	281,421,906	11.0%	308,745,538	9.7%
Minnesota	4,075,970	4,375,099	7.3%	4,919,479	12.4%	5,303,925	7.8%
Clay County, MN	49,327	50,422	2.2%	51,229	1.6%	58,999	15.2%
Moorhead, MN	29,998	32,295	7.7%	32,177	-0.4%	38,065	18.3%
Wilkin County, MN	8,454	7,516	-11.1%	7,138	-5.0%	6,576	-7.9%
North Dakota	652,717	638,800	-2.1%	642,200	0.5%	672,591	4.7%
Cass County, ND	88,247	102,874	16.6%	123,138	19.7%	149,778	21.6%
Fargo, ND	61,383	74,111	20.7%	90,599	22.2%	105,549	16.5%
Richland County, ND	19,207	18,148	-5.5%	17,998	-0.8%	16,321	-9.3%

Source: US Census Bureau, American Fact Finder.

Note: 1980 and 1990 data for each location obtained from Decennial Census, US Census Bureau

Approximately two-thirds of the population in the four county study area (143,000 persons) is located in Fargo, ND; and Moorhead, MN. The remaining 88,000 persons reside outside of the two cities (44,000 in Cass County, ND; 21,000 in Clay County, MN; 16,000 Richland County, ND; and 6,600 Wilkin County, MN).

According to the Census Bureau, for the population 18 and over, approximately 41-44% of the population in the study area has some college or an associate's degree (Table 4). The study area has a lower incidence of population without any high school diploma or equivalent than the national and respective state averages (5-6%) in the metro area counties. In Richland and Wilkin Counties the incidence of population without any high school diploma or equivalent is between the national and state averages.

Table 4: Highest Educational Attainment 2010-2012

Location	Population 18 and Over	Less than High School graduate	High School graduate (includes equivalency)	Some college or associate's degree	Bachelor's degree or higher
United States	237,706,206	14%	28%	31%	26%
Minnesota	4,067,888	8%	27%	35%	30%
Clay County, MN	45,972	6%	29%	41%	25%
Moorhead, MN	30,818	6%	25%	44%	26%
Wilkin County, MN	4,985	11%	29%	44%	15%
North Dakota	534,217	9%	27%	40%	25%
Cass County, ND	119,948	5%	20%	42%	33%
Fargo, ND	87,205	6%	19%	42%	33%
Richland County, ND	12,813	10%	27%	46%	18%

Source: US Census Bureau, American Fact Finder.

3.1.2 HOUSING

There are two measures of housing relevant to flood risk; first total housing provides an estimate of the stock of residential buildings in the study area. The second measure is the number of available housing units, which indicates the relative availability of housing for residents to use for temporary relocations during flooding or for permanent relocations due to project construction. As Table 5 shows, the majority of the housing units are located in the FM Metro Area.

Table 5: Total Housing Units

Location	2000	2010	2000-2010 Percent Change
United States	115,904,641	131,704,730	14%
Minnesota	2,065,946	2,347,201	14%
Clay County, MN	19,476	23,959	23%
Wilkin County, MN	3,105	3,078	-1%
Moorhead City, MN	12,180	15,274	25%
North Dakota	289,677	317,498	10%
Cass County, ND	53,790	67,938	26%
Richland County, ND	7,575	7,503	-1%
Fargo City, ND	41,200	49,956	21%

Source: US Census Bureau, American Fact Finder

According to the Census American Fact Finder, available housing has been on the rise in the study area outpacing the national and state averages between 2000 and 2010 (Table 6). The 2010 median values for available housing in Cass County, ND are nearly 25% higher than the state average while still below the national average. Meanwhile in Clay County, MN available housing is priced below the Minnesota state average.

Table 6: Available Housing Units

Location	2000	2010	2000-2010 Percent Change	2010 Median	
				\$ Value	\$ Monthly Rent
United States	10,424,540	14,988,438	44%	\$187,500	\$850
Minnesota	170,819	259,974	52%	\$202,700	\$762
Clay County, MN	1,076	1,680	56%	\$154,900	\$636
Moorhead, MN	520	970	87%	\$153,500	\$662
Wilkin County, MN	353	388	10%	\$102,800	\$496
North Dakota	32,525	36,306	12%	\$117,200	\$567
Cass County, ND	2,475	4,039	63%	\$151,300	\$611
Fargo, ND	1,932	3,165	64%	\$149,400	\$606
Richland County, ND	690	852	23%	\$93,400	\$454

Source: US Census Bureau, American Fact Finder

3.1.3 EMPLOYMENT AND INCOME

According to the Greater Fargo-Moorhead Economic Development Corporation (GFMEDC) Website (2014):

- #1 ranked city in US News & World Report for finding a job, January 2012;
- #3 ranked place in the Eighth Annual Farmers Insurance Study for most secure places to live in the U.S., December 2011;
- #5 ranked best place to live in America by Moving.Com

Employment trends in the study area are positive for Minnesota and North Dakota (including: Moorhead, and Clay County and Wilkin Counties) with a decline shown in Fargo as indicated by the data presented below (Table 7). All counties in the study area have unemployment well below the national average.

Table 7: Civilian Labor Force Estimates – 2010-2012

Location	2010	2012	2010	2012	2010	2012	2010	2012
	Labor Force		Employment		Unemployment		Unemployment Rate (%)	
United States*	153,889	154,975	139,064	142,469	14,825	12,506	9.6	8.1
Minnesota	2,938,795	2,954,950	2,721,194	2,789,861	217,601	165,089	7.4	5.6
Clay County, MN	33,883	35,115	32,009	33,427	1,874	1,688	5.5	4.8
Moorhead, MN	21,967	22,880	20,871	21,906	1,096	974	5	4.3
Wilkin County, MN	3,815	3,783	3,606	3,605	209	178	5.5	4.7
North Dakota	378,342	397,892	364,053	385,718	14,289	12,174	3.8	3.1
Cass County, ND	89,319	89,968	86,177	87,344	3,142	2,624	3.5	2.9
Fargo, ND	62,743	63,019	60,528	61,183	2,215	1,836	3.5	2.9
Richland County, ND	9,068	8,554	8,720	8,242	348	312	3.8	3.6

**Numbers in Thousands*

Source: US Bureau of Labor Statistics, Local Area Unemployment Statistics, <http://www.bls.gov/lau>, Downloaded April 27, 2015.

Table 8 below presents additional information on historical unemployment trends in the study area. In both counties and the Cities of Fargo and Moorhead, unemployment has remained well below the national average. Unemployment rose slightly during the recession period from 2008-2010, but has been declining since.

Table 8: Unemployment Rate (%): National, State, County, and City (2002-2012)

Location	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
United States	5.8	6.0	5.5	5.1	4.6	4.6	5.8	9.3	9.6	8.9	8.1
Minnesota	4.5	4.9	4.6	4.2	4.1	4.7	5.4	8.0	7.4	6.5	5.6
Clay County, MN	3.6	3.6	3.6	3.5	3.3	3.5	3.7	5.0	4.8	5.1	4.2
Moorhead, MN	3.0	3.1	3.2	3.0	2.8	3.0	3.1	4.2	4.2	4.4	3.7
Wilkin County, MN	3.9	3.9	3.8	3.8	3.8	3.9	4.4	5.6	4.8	4.8	4.1
North Dakota	3.5	3.6	3.5	3.4	3.2	3.1	3.1	4.1	3.8	3.4	3.0
Cass County, ND	2.7	2.9	2.7	2.7	2.5	2.6	2.7	4.1	3.8	3.5	3.3
Fargo, ND	2.8	3.0	2.8	2.7	2.5	2.6	2.7	4.2	3.8	3.5	3.2
Richland County, ND	3.4	3.6	3.4	3.4	3.4	3.3	3.8	5.1	4.1	4.0	3.7

Source: US Bureau of Labor Statistics, Local Area Unemployment Statistics, <http://www.bls.gov/lau>, Downloaded March 12, 2014.

In Table 9, historical employment has favored the sectors: service related, retail trade, and other services in the two counties.

Table 9: Population and Employment for Clay County, MN and Cass County, ND (Standard Industrial Classification-based)

Characteristic	Historical – Clay County		Historical – Cass County	
	1990	2000	1990	2000
Population	50,422	51,229	102,874	123,138
Total full-time and part-time employment	22,070	24,859	74,263	101,976
Non-services related	4,039	(D)	10,683	(D)
Farm	1,521	1,184	1,509	1,250
Agricultural services, forestry, fishing	226	(D)	344	(D)
Mining	16	(D)	58	(D)
Construction	1,094	1,401	3,956	6,232
Manufacturing	1,182	1,047	4,816	7,473
Service related	13,528	16,130	53,265	74,622
Transportation & public utilities	775	915	4,653	5,718
Wholesale trade	697	945	6,540	7,923
Retail trade	4,498	4,741	13,124	18,615
Finance, insurance & real estate	1,228	1,387	6,874	9,296
Services	6,330	8,142	22,074	33,070
Government	4,503	4,808	10,315	11,546

Source: US Bureau of Economic Analysis, *Employment by Industry by Place of Work*
Notes: (D) – Data subject to non-disclosure.

Personal income per-capita, a measure of income that is typically used to compare the wealth of the population of an area, is presented below in Table 10. In 2012, the national average was \$43,700 per person per year. Personal income per capita in Clay County, MN was below both the state (18%) and national (12%) averages. Cass and Richland County, ND were below the state average but above the national average. The Fargo-Moorhead metro area was also above the national but slightly below both state averages. However, per-capita income has been on the rise in the study area with growth outpacing the state and national averages.

Table 10: Personal Income Per-Capita (In-Dollars)

Location	2007	2008	2009	2010	2011	2012	2007-2012 Percent Change
United States	\$39,804	\$40,873	\$39,357	\$40,163	\$42,298	\$43,735	9.9%
Minnesota	\$41,588	\$43,068	\$41,202	\$42,616	\$45,135	\$46,925	12.8%
Clay County, MN	\$31,842	\$34,083	\$33,219	\$34,563	\$36,595	\$38,549	21.1%
Wilkin County, MN	\$33,858	\$41,661	\$35,612	\$41,699	\$43,529	\$52,343	54.6%
North Dakota	\$36,127	\$40,880	\$40,005	\$43,232	\$47,218	\$54,871	51.9%
Cass County, ND	\$38,387	\$42,336	\$40,888	\$42,805	\$46,311	\$49,402	28.7%
Richland County, ND	\$32,321	\$39,512	\$34,369	\$41,042	\$43,727	\$53,553	65.6%

Source: US Bureau of Economic Analysis, National, State, and Regional Data

Note: Data for Fargo and Moorhead collected at the Metropolitan Statistical Area (MSA) level.

Another measure of wealth is median household income (MHI) as reported by the Census Bureau (Table 11 below). MHI in the study area is below the national average during the two periods. However, between 2000 and 2010 MHI demonstrated strong growth with increases between 19 and 34% (US average 19%, Minnesota 18%, and North Dakota 41%).

Table 11: Median Household Income (2000 & 2010)

Location	Median Household Income	
	2000	2010
United States	\$41,994	\$50,046
Minnesota	\$47,111	\$55,422
Clay County, MN	\$37,889	\$48,395
Moorhead City, MN	\$34,781	\$44,683
Wilkin County, MN	\$38,093	\$48,611
North Dakota	\$34,604	\$48,878
Cass County, ND	\$38,147	\$50,932
Fargo City, ND	\$35,510	\$42,144
Richland County, ND	\$36,098	\$48,821

Source: US Census Bureau, Small Area Estimates Branch, Internet Release Date: November 2011

The industry breakdown for earnings by place of work is shown below in Table 12. The earnings by place of work indicate that in Clay County, agriculture and government services are the largest sectors by income even though they are not the highest for number employed. In Cass County, ND Government is also a source of high earnings for the study area along with Health Care, Wholesale Trade, Manufacturing, and Construction.

Table 12: Components of Personal Income, \$Millions (2012)

2012 NAICS Industry	Location							
	United States	Minnesota	Clay County, MN	Wilkin County, MN	North Dakota	Cass County, ND	Richland County, ND	Fargo-Moorhead, MN-ND
Total earnings (by place of work)	9,821,404.0	190,045.9	1,121.4	204.9	31,093.4	6,918.1	656.5	8,039.5
Farming	99,786.0	7,143.3	149.2	93.2	4,306.6	338.4	254.2	487.6
Forestry, fishing, and related activities	27,819.0	457.3	(D)	(D)	120.8	(D)	(D)	(D)
Mining	168,326.0	901.4	(D)	(D)	2,790.9	(D)	(D)	(D)
Utilities	79,326.0	1,660.3	(D)	(D)	420.6	16.9	(D)	16.9 (E)
Construction	517,367.0	8,954.4	61.5	3.5	2,541.0	500.5	33.4	562.0
Manufacturing	972,055.0	24,415.6	66.9	0.5	1,504.9	570.9	112.4	637.8
Wholesale trade	502,780.0	12,163.5	72.4	15.9	2,053.5	583.7	28.9	656.1
Retail trade	586,086.0	9,902.9	79.6	5.4	1,709.4	470.8	23.5	550.4
Transportation and warehousing	332,747.0	5,824.0	(D)	(D)	1,835.8	251.1	(D)	(D)
Information	313,717.0	4,990.3	8.4	(D)	485.9	275.8	3.4	284.2
Finance and insurance	690,829.0	16,065.9	24.4	(D)	1,151.9	515.4	9.7	539.7
Real estate and rental and leasing	181,390.0	3,244.0	6.8	(D)	616.8	260.5	2.9	267.3
Professional, scientific, and technical services	974,178.0	14,915.3	34.3	1.3	1,226.9	445.8	13.7	480.1
Management of companies and enterprises	257,268.0	9,780.2	28.6	0.0	398.0	218.5	(D)	247.1
Administrative and waste management services	392,535.0	5,830.9	11.2	(D)	558.2	207.3	(D)	218.6
Educational services	164,466.0	2,752.9	(D)	0.9	119.6	24.5	(D)	(D)
Health care and social assistance	1,075,222.0	23,163.1	(D)	21.7	2,977.4	933.6	(D)	933.6 (E)
Arts, entertainment, and recreation	105,335.0	1,927.7	4.1	0.1	89.6	31.7	0.8	35.8
Accommodation and food services	306,546.0	4,469.9	30.1	2.0	737.9	210.2	6.8	240.3
Other services, except public administration	355,685.0	6,187.9	48.1	15.6	823.9	198.2	12.7	246.3
Government and government enterprises	1,717,941.0	25,166.7	244.2	20.3	4,623.8	850.4	93.8	1,094.6

Source: US Bureau of Economic Analysis

Notes: (D) – Data subject to non-disclosure but the estimates for these items are included in total.

(E) – The estimate shown here constitutes the major portion of the true estimate.

3.1.4 FISCAL RESOURCES

Fiscal resources or tax collections are a measure of the local government's ability to provide services. The two main sources of taxes typically considered include property and sales taxes. Property and sales taxes typically provide stable revenue sources for general government operations. Below, Table 13 and Table 14 show the effective tax rates for property and sales taxes in the study area.

Table 13: Annual Property Taxes Levied, 2012

Location	Total Valuation	Property Taxes Levied	Effective Tax Rates
Clay County, MN	\$57,679,963	\$26,155,639	45.669%
Moorhead City, MN	54,581,000	552,345	1.01%
Wilkin County, MN	\$22,656,951	\$7,215,925	31.868%
Cass County, ND	\$548,947,150	\$220,000,000	40.08%
Fargo City, ND	\$360,271,576	\$19,099,001	5.30%
Richland County, ND	\$70,194,419	\$21,593,751	30.762%

Sources: Property Tax Statistics, Cass County, ND County Assessors Office Valuation Reports

Table 14: Sales and Use Tax Rates and Revenues, 2011

Location	Sales Tax	Sales Tax Revenue
Minnesota	6.88%	\$4,556,451,905
Clay County, MN		\$27,395,204*
Wilkin County, MN		\$1,602,301*
North Dakota	5.00%	\$829,381,509*
Cass County, ND		\$141,088,424
Richland County, MN		\$6,715,912

Sources: Sales Tax Statistics, Minnesota Department of Revenue; North Dakota Sales and Use Tax Statistical Report

3.1.5 OTHER ECONOMIC EFFECTS

Other economic effects considered but not quantified in this report include flood related losses for agriculture producers, and impacts to transportation networks. *It is anticipated that agricultural land in the upstream staging area could continue to be farmed for both the Proposed Project and NAA Alternatives. However this land would be more susceptible to flooding with the operation of the staging area. If flooding occurs prior to the growing season there may not be any impact to agricultural production.*

Due to growing season restrictions, final planting dates for crops range between end of May for corn, to early June for soybeans and flax. Farmers would have until this time for stored water to clear and for land to dry enough for planting to occur. If stored water is still present and/or the land has not dried prior to these timeframes, crop plantings would be prohibited resulting in agricultural losses and/or limited production. It should be noted that current project design for both the Proposed Project and NAA

Alternatives pass 17,000 cfs through the flood damage reduction area (RS35') before the Diversion will be operated. As a result of this, the Project would not have operated during the summer based on a review of historic flood events.

The COE provided an evaluation of impacts to transportation systems in the Fargo-Moorhead Feasibility Study Economics Appendix. The transportation analysis looked at impacts from the historic flood in 2009. The transportation study looked at impacts to vehicle traffic, rail systems, and air travel. The evaluation found significant impacts to transportation networks with the 2009 event, which equates to approximately a 2-percent annual chance (50-year) flood event. In particular, roadway impacts included:

- Submerging of roadways from overland and riverine flooding from the Red, Wild Rice, Sheyenne, Maple, Rush, and Lower Rush Rivers;
- Roadway used for temporary levees;
- Central travel corridors repurposed to sand bag distribution routes; and
- Congestion increased with emergency responders.

The COE found that transportation impacts increase for flood fighting activities with a 50-year event and above due to increased flood fighting activities. Furthermore, transportation impacts increase significantly from local reroutes with the 100-year and 500-year events as flood inundation limits and duration increase.

The transportation study found that air and rail traffic are unaffected until a 100 year event. Under current conditions the railroads crossing the Red River at Fargo must be shut down to build dikes across the rail embankment during the 100-year event and above, which shuts down the rail traffic through the Fargo-Moorhead Metro Area and impacts the operation of the rail yard in Fargo and rail yard in Dilworth. According to the North Dakota State Freight Plan, produced by NDDOT dated May 2014 in 2012 127 trains per day passed through Fargo-Moorhead.

3.1.6 SUMMARY

According to the GFMEDC Website (2014):

“Fargo Moorhead is a metropolitan area with a vibrant population of roughly 215,000 and almost 30,000 college students. The Fargo Moorhead community is known for steady growth, a highly- trained workforce, business friendly environment, outstanding quality of life and reasonable costs of living and doing business.”

The data presented above describes the FM Metro Area as an area that matches this description with consistent socio economic growth. Population in the metro area has been steadily increasing. Economic indicators of income and employment have outpaced state and national trends. Unemployment in the area is consistently below the national average, even remaining low through the recession of 2008 and the historic 2009 flood, indicating the economy is resistant to economic hardship. The expected continuation of trends in the study area makes it a promising area for future growth.

4 MODELING AND METHODOLOGY

The following section describes the methods and models that are used to evaluate the impacts of the alternatives.

4.1 SOCIO ECONOMIC METHODOLOGY

Impacts of the alternatives are evaluated in the SEIA using flood risk assessment methodologies. Flood risk is a function of flood impacts or consequences and the likelihood of those impacts occurring. The likelihood is measured by the return period of a flood. Flood impacts are divided into direct and indirect impacts. Direct impacts describe harm that results from the immediate physical contact of water to people, infrastructure and the environment. Examples include damages to buildings, building contents and other assets. Indirect impacts are those caused by the disruption of the physical and economic links in the region as well as the costs associated with the emergency response to a flood. For example, businesses losses because of interruption of normal activities, or costs associated with traffic disruption when roads are impassable. Furthermore, the effect of a flood on the environment, human or community well-being, or the loss of life are difficult to quantify, and are therefore considered to be intangible impacts, whereas, the tangible dollar losses from a damaged building or ruined inventory in a warehouse are more easily calculated.¹

The FM SEIA flood risk analysis was carried out using a combination of economic frameworks including physical flood damage models and economic impact models. The physical flood damage model provides measures of direct impacts referred to here as impacts to capital stock (buildings, contents, and vehicles). The results of the physical flood damage models were used to estimate indirect effects, which are referred to as loss of building function. Finally cost estimates of actions are combined with economic impact models to evaluate the indirect regional benefits to employment and income patterns. The combined sets of impacts and models used to evaluate them are shown below in Table 15. The model frameworks are discussed in more detail in the following sections.

¹ Intangible impacts are typically not quantified. They may be discussed qualitatively where information is available. For example, it is difficult to assign monetary values to loss of life with flooding. As such qualitative discussions may be framed with number of lives lost in historical floods.

Table 15: Model Frameworks for FM Socio Economic Analysis

Model	Model Framework	Impacts Evaluated	Model Outputs
Direct Impacts of Flood Risk			
HAZUS	GIS	Impacts to capital stock	Physical Flood Damages, (\$'s)
Basement Flooding Model	MS Excel	Impacts to capital stock	Physical Flood Damages, (\$'s)
Indirect Impacts of Flood Risk			
Business Loss Model	MS Excel	Direct effects of building function due to flooding	Relocations Costs (\$:s) Output Impact (\$'s)
Input-Output	IMPLAN	Secondary effects of building function due to flooding	Economic Output, Employment, Income, Tax Generation
Construction, and Operation and Maintenance Impacts			
Input-Output	IMPLAN	Direct and Secondary effects of project construction	Economic Output, Employment, Income, Tax Generation

4.1.1 IMPACTS TO CAPITAL STOCK

The HAZUS model is designed to be a flexible model and comes with prepackaged default datasets and it also includes functionality for the user to add customized area specific data (both engineering and economic). This model flexibility allows the user to conduct analysis with multiple levels of detail depending on data availability as presented below in Table 16. Drawing on this flexibility, the FM Diversion SEIA is structured to incorporate level 2 and 3 analyses.

Table 16: HAZUS Modeling Level of Effort

HAZUS Level of Analysis	Data Inputs	Application to the Project	H&H Inputs	Economic Inputs
1	Default hazard inventory and damage information	NA	NA	NA
2	Combinations of local and default hazard, building, and damage data	Outside City Reach (Staging Areas, and Diversion Channel)	Depth Grids (10, 25, 50, 100, 500-yr)	NA – Used Default Data
3	Input detailed engineering and user supplied structure and damage information	In-Town Reach (Fargo and Moorhead Cities)	Depth Grids (10, 25, 50, 100, 500-yr)	COE Structure Inventory and DDFs

The In-Town reach of the study area (comprised primarily of Fargo and Moorhead cities as shown in Figure 1) is modeled as a level 3 analysis. This reach of the model utilizes existing information available from the US Army Corps of Engineers Environmental Impact Statement completed in July 2011. The EIS and feasibility study used the HEC-Flood Damage Assessment (FDA) model to evaluate flood risk reduction benefits. To run the FDA model, the COE developed a detailed inventory of structures (residential, commercial, industrial, public, and agricultural) for Fargo and Moorhead and also developed new depth

damage functions (DDF).² The COE structure inventory and DDF was modified to work with the HAZUS model and combined with depth grids for the In-Town reach.³

The remaining areas, referred to as the Outside City Reach, which include the Staging area and Diversion Channel, are evaluated as a level 2 analysis at the census tract level with aggregation to the county level. The flood depth grids for the project are run through HAZUS utilizing the base HAZUS data. The Outside City Reach results are broken down by county.

Before utilizing the COE structure inventory in the HAZUS model, the inventory information was updated from 2009 to 2013 dollars. To do this, the structure inventory was overlaid with current assessor data in ARCGIS and the structure valuations were updated to current assessed values (market values). In order to adjust to Depreciated Replacement Value, necessary for the damage analysis, adjustment factors developed by the COE in their Economics Technical Appendix for residential and non-residential properties were applied.⁴

As noted in the COE EIS, a characteristic of the Fargo Moorhead study area is the potential for basement flooding through sewer backups of sanitary sewer lines. In this condition, homes that may not be flooded directly by flood waters may be indirectly flooded as a result of water backing up through sewer lines. While the HEC-FDA model is capable of modeling this aspect of the area, HAZUS is not due to its reliance on GIS depth grids and lack of inputs for structure elevation information beyond foundation heights. Simply put, HAZUS is not aware of linkages between structures from connecting sewer basins. A second flood damage model was developed to evaluate this set of damages.

The model was created in Microsoft Excel with a subset of the structure inventory, and the low entry elevations, and depth damage curves from the HEC-FDA model.⁵ To complete the basement flooding

² Depth damage functions calculate structure and content damage as a function of structure value.

³ Due to non-disclosure requirements for very large commercial properties the COE was required to remove several properties from the HEC-FDA inventory before providing the model. These properties accounted for approximately 20 million in damages in the COE damage estimate.

⁴ These factors were estimated by the Corps of Engineers based on a comparison of a sample of assessed values from the structure inventory to estimates of depreciate replacement value from Marshal and Swift cost estimating.

⁵ This analysis only used a subset of the residential properties based on input from the COE. The subset included residential properties with basements in Fargo, North Dakota for which beginning damage stages exceeded foundation height. Those properties

(footnote continued)

analysis, structures needed to be matched with a maximum water surface elevation for the sewer basin. To accomplish this:

1. Flooding depths were assigned at each structure location in ArcGIS. Structures were matched with sewer basins;
2. The maximum water surface elevations were determined for each sewer basin for the 10- to 500-yr return periods based on the depth of flooding at each structure in the corresponding basin.
3. The maximum basin water surface elevation was then assigned back to each structure.

Depth damage curves were then applied in the basement flooding analysis following a similar process as HAZUS to estimate structure damages. The results were combined with the HAZUS estimates to give the full value of damage estimates.


Table 17: Count of Structures per Model

Structure Type	HAZUS In-Town		Sewer Backup Flooding In-Town	
	Count of Structures	Value of Structures	Count of Structures	Value of Structures
Agricultural	171	21,700	NA	
Residential	20,982	3,491,100	20,903	3,759,100
Commercial/Industrial	6,207	4,943,800	NA	
Public	547	1,574,200	NA	
Total	27,907	10,030,800	20,903	3,759,100

Flood depth grids for the 10-percent (10-year), 4-percent (25-year), 2-percent (50-year), 1-percent (100-year), and 0.2-percent (500-year) annual chance flood events were prepared for the HAZUS model. The analysis includes runs of the HAZUS model for the Base No Action Alternative and two with project conditions. Depth grids are required for each project condition and return period.

4.1.2 LOSS OF BUILDING FUNCTION

were indicated to be the set of structures the COE reviewed in its own basement flooding analysis. We are expanding this analysis to include structures in Moorhead, Minnesota and West Fargo, North Dakota and this information will be included in the next draft of this report.



Damage to buildings can also cause regional economic losses through the loss of functionality. The impacts may include expenses associated with relocating businesses and residents to temporary facilities; and losses of income earned from sales (economic output). These costs are dependent on the duration of flooding and the amount of time to restore the building to functional capacity. The HAZUS model contains information necessary to estimate the impacts including:

- Depth-Duration curves which associate depth of flooding with a duration of loss of building function;
- Assumptions for building square footage;
- Estimates of costs of temporary rental space by building type;
- Estimates of disruption of service by building type;
- Estimates of output by building type; and
- Estimates of buildings which will be recovered post flood (recapture) by building type.

An MS Excel model was created to link the structure inventory flood depths and this information. Values from the HAZUS model were updated to current dollar using the consumer price index.⁶ The methods for each category of loss of function are discussed below.

Relocation expenses are disruption costs that include the cost to transfer inventory, and the rental costs of temporary space. Relocation costs are estimated by combining average square footage for each building class, disruption costs for each occupancy type in dollars per square foot, rental costs for each occupancy type in dollars per square foot per day, and length of disruption for each occupancy type as a function of flood depth (Table 18 below).

⁶ HAZUS values were in base year 2006.

Table 18: Relocation Cost Assumptions (\$'s 2014)

Occupancy	Occupancy Description	Average Square Footage	Rental Costs (\$/SqFt/Day)	Disruption Costs (\$/SqFt)
es1	Single Family Dwellings	1,600	\$0.02	\$0.96
res2	Mobile Homes	1,063	\$0.02	\$0.96
res3a	Multi-Family Dwellings; Duplex	3,000	\$0.02	\$0.96
res3b	Multi-Family Dwellings	3,000	\$0.02	\$0.96
res3c	Multi-Family Dwellings; 5-9 units	8,000	\$0.02	\$0.96
res3d	Multi-Family Dwellings; 10-19 units	12,000	\$0.02	\$0.96
res3e	Multi-Family Dwellings; 20-49 units	40,000	\$0.02	\$0.96
res3f	Multi-Family Dwellings; 50+ units	60,000	\$0.02	\$0.96
res4	Temporary Lodging	135,000	\$0.08	\$0.96
res5	Institutional Dorms	25,000	\$0.01	\$0.96
res6	Nursing Homes	25,000	\$0.04	\$0.96
COM1	Retail Trade	110,000	\$0.05	\$1.28
COM2	Wholes Trade	30,000	\$0.02	\$1.11
COM3	Personal and Repair Services	10,000	\$0.06	\$1.11
COM4	Professional/Technical/Business	80,000	\$0.06	\$1.11
COM5	Banks	4,100	\$0.07	\$1.11
COM6	Hospital	55,000	\$0.06	\$1.59
COM7	Medical Office/Clinics	7,000	\$0.06	\$1.59
COM8	Entertainment and Recreation	5,000	\$0.07	\$0.00
COM9	Theaters	12,000	\$0.07	\$0.00
COM10	Parking	145,000	\$0.01	\$0.00
ind1	Heavy Industrial	30,000	\$0.01	\$0.00
ind2	Light Industrial	30,000	\$0.01	\$1.11
ind3	Food/Drug/Chemicals	45,000	\$0.01	\$1.11
ind4	Metals/Minerals	45,000	\$0.01	\$1.11
ind5	High Technology	45,000	\$0.01	\$1.11
ind6	Construction	30,000	\$0.00	\$1.11
agr1	Agriculture	30,000	\$0.02	\$0.80
rel1	Religious Organizations	17,000	\$0.04	\$1.11
gov1	General Services	11,000	\$0.06	\$1.11
gov2	Emergency Response	11,000	\$0.06	\$1.11
edu1	Schools/Libraries	130,000	\$0.04	\$1.11
edu2	Colleges/Universities	50,000	\$0.06	\$1.11

Source: HAZUS default data

Loss of sales includes output for each building class (Table 19 below), output per day per square foot, length of disruption for each occupancy type as a function of flood depth, with an adjustment for output recapture post flood.



Table 19: Output Impact Assumptions (\$'s 2014)

Occupancy	Occupancy Description	Output/Sales (\$/SqFt/Day)	Output Recapture
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res1	Single Family Dwellings	\$0.00	0%
res2	Mobile Homes	\$0.00	0%
res3a	Multi-Family Dwellings; Duplex	\$0.00	0%
res3b	Multi-Family Dwellings	\$0.00	0%
res3c	Multi-Family Dwellings; 5-9 units	\$0.00	0%
res3d	Multi-Family Dwellings; 10-19 units	\$0.00	0%
res3e	Multi-Family Dwellings; 20-49 units	\$0.00	0%
res3f	Multi-Family Dwellings; 50+ units	\$0.00	0%
res4	Temporary Lodging	\$0.61	60%
res5	Institutional Dorms	\$0.00	0%
res6	Nursing Homes	\$1.01	60%
COM1	Retail Trade	\$0.53	87%
COM2	Wholes Trade	\$0.68	87%
COM3	Personal and Repair Services	\$0.81	51%
COM4	Professional/Technical/Business	\$1.17	90%
COM5	Banks	\$3.82	90%
COM6	Hospital	\$1.01	60%
COM7	Medical Office/Clinics	\$2.02	60%
COM8	Entertainment and Recreation	\$1.27	60%
COM9	Theaters	\$1.21	60%
COM10	Parking	\$0.00	60%
ind1	Heavy Industrial	\$2.04	98%
ind2	Light Industrial	\$2.04	98%
ind3	Food/Drug/Chemicals	\$2.72	98%
ind4	Metals/Minerals	\$2.16	98%
ind5	High Technology	\$4.08	98%
ind6	Construction	\$2.02	95%
agr1	Agriculture	\$1.01	75%
rel1	Religious Organizations	\$2.02	60%
gov1	General Services	\$0.81	80%
gov2	Emergency Response	\$0.93	0%
edu1	Schools/Libraries	\$3.90	60%

edu2	Colleges/Universities	\$5.93	60%
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Source: HAZUS default data

In addition lost sales are linked to Implan sectors to estimate regional economic effects.⁷ IMPLAN is a widely used computer simulation tool that employs input-output techniques to measure the regional impacts of each Proposed Alternative.⁸ IMPLAN uses proprietary datasets based on the Bureau of Economic Analysis (BEA) National Income and Product Accounts (NIPA) datasets. Datasets are available down to the county and state levels. The model generates regional multipliers based on construction and operations spending of each alternative. The multipliers are affected by the size of the study area, the time period of the datasets being used in the model, and the level of economic activity being evaluated. Key metrics evaluated include gross regional product⁹, income and employment, and taxes.¹⁰

4.1.3 CONSTRUCTION; AND OPERATIONS AND MAINTENANCE

The Implan® model is also used to evaluate the impacts of Construction and O&M activities.

Cost estimates were combined with multipliers to estimate the direct and indirect impacts to output, employment and income, gross regional product, and tax generation. The construction impacts are assumed to occur over an 8 year construction period with O&M occurring every year following construction.

⁷ Minnesota Implan Group Inc. (MIG), Software and Data, www.implan.com

⁸ Input-output models create an accounting framework for a regional economy which describing flows of outputs to and from industries and institutions. In the models, economics sectors can: purchase outputs of other sectors, sell to other sectors, sell outside the local economy, and buy outside the local economy. This accounting framework allows the user to predict how a change in the level of economic activity will affect the local economy.

⁹ Gross regional product also known as value added is analogous to Gross Domestic Product. It is the market value of all final goods and services produced in the region for a given time period.

¹⁰ This part of the analysis does not account for market readjustments as in a computable general equilibrium model (CGE) or the effects of reconstruction on other business sectors such as construction related activity.

5 ENVIRONMENTAL CONSEQUENCES

5.1 BASE NO ACTION ALTERNATIVE:

Alternative 1 is the Base No Action Alternative. The Base No Action Alternative is the baseline against which the with-project condition is compared to estimate the damage reduction. Under the economic analysis, the damages from the suite of five (5) return periods are converted to an average annual damage (AAD). The analysis period and discount rate used to compare damages and benefits to costs will be 50 years and 3.5 percent respectively.

5.1.1 IMPACTS TO CAPITAL STOCK

The following tables and Figures 2-11 display the estimated damages for the without project/ No Action condition. The computed average annual damages for the Fargo Moorhead study area are approximately \$51 million (Table 20). The majority (92%) of those damages are to residential, commercial, and industrial properties and their contents.



Return Period	10-year	25-year	50-year	100-year	500-year	Average Annual Damage
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Table 20: Base No Action Alternative Estimated Damages to Buildings and Contents; and Vehicles (\$ Millions)

Damages - North Dakota						
Fargo						
Buildings and Contents	\$28	\$156	\$720	\$1,322	\$3,952	\$46
Vehicles	\$10	\$15	\$43	\$64	\$188	\$3
<i>Total Fargo</i>	\$38	\$170	\$763	\$1,386	\$4,140	\$48
Remaining Cass County						
Buildings and Contents	\$0	\$1	\$1	\$1	\$2	\$0
Vehicles	\$1	\$1	\$2	\$2	\$3	\$0
<i>Total Remaining Cass County</i>	\$1	\$2	\$3	\$3	\$5	\$0
Richland County						
Buildings and Contents	\$0	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$1	\$1	\$0
<i>Total Richland County</i>	\$0	\$0	\$0	\$1	\$1	\$0
Total North Dakota	\$39	\$172	\$766	\$1,390	\$4,146	\$48
Damages - Minnesota						
Moorhead						
Buildings and Contents	\$0	\$2	\$14	\$29	\$66	\$1
Vehicles	\$6	\$7	\$9	\$11	\$15	\$1
<i>Total Moorhead</i>	\$7	\$10	\$24	\$40	\$81	\$2
Remaining Clay County						
Buildings and Contents	\$2	\$2	\$2	\$2	\$3	\$0
Vehicles	\$1	\$1	\$1	\$1	\$2	\$0
<i>Total Remaining Clay County</i>	\$3	\$3	\$3	\$3	\$5	\$0
Wilkin County						
Buildings and Contents	\$0	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$0	\$1	\$0
<i>Total Wilkin County</i>	\$0	\$0	\$0	\$0	\$1	\$0
Total Minnesota	\$10	\$13	\$27	\$43	\$87	\$2
Total Damages						
Buildings and Contents	\$31	\$161	\$739	\$1,355	\$4,024	\$47
Vehicles	\$18	\$25	\$55	\$79	\$208	\$4
Total	\$50	\$187	\$794	\$1,434	\$4,232	\$51

As the tables show, appreciable damage begins with the 10 year event and increases significantly at the 50 year event and above. The breakdown of the average annual damages by area, In-town (Fargo and Moorhead) and the remaining portions of Cass and Clay Counties along with Richland and Wilkin Counties provide a comparison of the tradeoffs between realized benefits within the metro area and impacts to properties in the staging area and along the diversion channel. Under the Base No Action Alternative condition, nearly all of the flood damages (99%) are located in the FM Metro area. The largest damages (96%) are in the Fargo, ND Reach (\$48 million) and 3% of the total damages (\$2 million) are in Moorhead, MN (In Town Moorhead Reach).

Finally, the damages estimated here (\$51 million) vary from the COE 2011 study, which computed existing conditions damages of \$194 million with HEC-FDA.¹¹ Differences between the models make a comparison of results difficult. Notable reasons for the difference in damage estimates are:


- Inclusion of funded and recently constructed levees in the Base No Action Alternative
- Updated hydraulics
- Conversion of model frameworks from HEC-FDA to HAZUS.

Also as noted above, due to non-disclosure requirements the COE was required to remove several properties from the HEC-FDA inventory before providing the model. These properties accounted for approximately \$20 million in damages in the COE damage estimate. These damages are not accounted for in this analysis.

5.1.2 FLOOD INSURANCE

Flood Insurance premiums constitute a significant cost for residents in the Fargo-Moorhead Metropolitan area under the Base No Action Alternative. Flood insurance costs are not taken into account in the

¹¹ “The socioeconomic analysis incorporates new and updated economic and hydraulic information in addition to what was incorporated into economic models developed for the FFREIS. Therefore, the EIS model outputs are not a side-by-side comparison of economic model outputs developed for the FFREIS and will not be comparable to model outputs that were presented in the FFREIS or model outputs that would result from applying the model platform used for the FFREIS.”



traditional federal benefit to cost analysis because premiums are a proxy for the value of flood risk. Including flood premiums is thus double counting the value of flood risk reduction in a traditional benefit cost analysis. However, flood Insurance premiums constitute a significant cost savings for residents in the Fargo-Moorhead Metropolitan area under the Base No Action Alternative. These costs will increase as the Biggert Waters Flood Insurance Reform Act of 2012 and subsequent 2014 Homeowner Flood Insurance Affordability Act (HFIAA) are implemented.

The National Flood Insurance Program Floodsmart.gov website indicates the average flood insurance policy costs about \$650 per year. These costs are significantly higher for properties in high risk areas and significantly higher for properties with basements below the base flood elevation. For example, a policy that includes \$250,000 in coverage for the structure and \$150,000 in coverage for contents has a premium of \$1,958 per year (\$1,191 for structure only) and this cost is expected to increase 10%-18% per year as the HFIAA is implemented.

Table 21**Error! Reference source not found.** summarizes the estimated number of structures impacted by the Base No Action Alternative (Alternative 1) for the 1-percent annual chance flood event for the area inside the Proposed Project Alternative alignment. The structures are from the HAZUS level 3 coverage and are broken down by jurisdiction as well as type of structure.

Table 21: Structures currently impacted by flooding within Proposed Project Alternative protected area at 1-percent-annual-chance flood by jurisdiction

Jurisdiction	Base No Action (Alt. 1)
Briarwood	16
Brooktree Park	12
Cass	562
Clay	65
Fargo	15766
Frontier	49
Harwood	45
Horace	37
Moorhead	616
North River	22
Oakport	42
Prairie Rose	27
Reile's Acres	33
West Fargo	1
Total	17293

5.1.3 LOSS OF BUILDING FUNCTION

Average annual direct and indirect impacts from loss of building function are summarized below in Table 22. Relocation costs were estimated using values presented in Table 18. The Base No Action Alternative would maintain the flood related relocation costs. The estimated average annual existing relocation costs are approximately \$55 million.

Table 22: Base No Action Alternative Summary of Average Annual Impacts from Loss of Building Function (\$ Millions)

Description	Direct Impact	Indirect Impact	Induced Impact	Total Impact
North Dakota Business Losses				
Disruption Costs	\$3			\$3
Relocation Costs	\$53			\$53
Business Losses				
Output	\$980	\$266	\$266	\$1,512
Employment	9,202	3,018	3,562	15,782
Labor Income	\$350	\$101	\$96	\$548
Gross Regional Product	\$547	\$157	\$163	\$866
Total State and Local Tax	\$110	NA	NA	\$110
Minnesota Business Losses				
Disruption Costs	\$1			\$1
Relocation Costs	\$2			\$2
Business Losses				
Output	\$33	\$6	\$4	\$43
Employment	299	46	35	380
Labor Income	\$11	\$2	\$1	\$14
Gross Regional Product	\$17	\$3	\$2	\$23
Total State and Local Tax	\$4	NA	NA	\$4
Total Business Losses				
Disruption Costs	\$4			\$4
Relocation Costs	\$55			\$55
Business Losses				
Output	\$1,013	\$272	\$270	\$1,555
Employment	9501	3064	3597	16162
Labor Income	\$361	\$103	\$97	\$562
Gross Regional Product	\$564	\$160	\$165	\$889
Total State and Local Tax	\$114	NA	NA	114

Impacts to business losses were estimated using inputs presented in Table 19 with the direct impacts to output run through the Implan model. The Implan model provided estimated indirect impacts to output;

direct and indirect impacts to employment, labor income, and value added; and impacts to taxes. Existing conditions flooding generated an average annual direct loss of \$1,013 million in business output. During flooding approximately 9,500 jobs are impacted with average income losses of \$48,000 per employee. When combined with the indirect and induced impacts, flooding generates over \$1.6 billion in business output losses and affects nearly 16,000 jobs. Additionally, business activity losses (economic output and employment) reduce overall tax collections by approximately \$114 million.

5.1.4 CONSTRUCTION; AND OPERATIONS AND MAINTENANCE

This alternative would not have any impacts from new construction or O&M activities.

5.1.5 OTHER ECONOMIC EFFECTS

Under the Base No Action Alternative, existing conditions would be maintained. As noted in Section 3.1.5, the evaluation found significant impacts to transportation networks with larger events (50 year and above). The COE found that transportation impacts increase for flood fighting activities with a 50 year event and above due to increased flood fighting activities. Furthermore transportation impacts increase from local reroutes with the 100 and 500 year events as flood inundation limits and duration increase. Air and rail traffic are affected at the 100 year event and above. Railroads crossing the Red River at Fargo must be shut down to build dikes across the rail embankment during the 100-year event and above which shuts down the rail traffic through the Fargo-Moorhead Metro Area and impacts the operation of the rail yard in Fargo and rail yard in Dilworth. The COE estimated average annual damages for the Base No Action Alternative condition of \$3.7 billion (2009 \$'s).


5.2 WITH PROJECT CONDITIONS

The with project conditions are evaluated in this section. The with project conditions consider the implementation of flood risk reduction plans under both the Proposed (Alternative 2) and Northern Alignment (Alternatives 3) alternatives. Results for the alternative conditions analysis are compared against the Base No Action Alternative.

5.2.1 IMPACTS TO CAPITAL STOCK

The following tables summarize the estimated damages and damage reductions for Alternative 2 and Alternative 3 Project condition. Figures 2-12 compare the floodplain for the Alternatives for the 10-, 4-, 2-, 1- and 0.2-percent annual chance flood events. Table 23 and Table 24 below present the residual damages under the project conditions for Alternative 2 and Alternative 3 respectively.

Table 25 (which follows) provides a comparison of the reduction of average annual damages for the Proposed Project conditions.



Overall Alternatives 2 and 3 have nearly equivalent benefits and impacts throughout the FM Metro area. Under Alternative 2 and 3 the computed average annual damages for the Fargo Moorhead study area are approximately \$10 million (Table 24 and Table 25 below). Under the alternative conditions damages in Fargo and Moorhead are reduced by 84% and 38% respectively from the Base No Action Alternative condition. Damages in the surrounding areas increase by approximately 4% (increase of \$40,000 in average annual damages); however the damages in the surrounding areas remain less than 1% of the overall total damage estimate.

Table 23: Alternative 2 - Estimated Residual Damages to Buildings and Contents; and Vehicles (\$ Millions)

Return Period	10-year	25-year	50-year	100-year	500-year	Average Annual Damage
Damages - North Dakota						
Fargo						
Buildings and Contents	\$25	\$41	\$44	\$48	\$801	\$7
Vehicles	\$9	\$11	\$11	\$11	\$46	\$1
<i>Total Fargo</i>	\$35	\$51	\$54	\$59	\$847	\$8
Remaining Cass County						
Buildings and Contents	\$0	\$1	\$1	\$1	\$2	\$0
Vehicles	\$1	\$1	\$2	\$2	\$3	\$0
<i>Total Remaining Cass County</i>	\$1	\$2	\$3	\$3	\$5	\$0
Richland County						
Buildings and Contents	\$0	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$1	\$1	\$0
<i>Total Richland County</i>	\$0	\$0	\$0	\$1	\$1	\$0
Total North Dakota	\$36	\$53	\$57	\$63	\$853	\$8
Damages – Minnesota						
Moorhead						
Buildings and Contents	\$0	\$3	\$4	\$4	\$24	\$0
Vehicles	\$6	\$7	\$7	\$7	\$10	\$1
<i>Total Moorhead</i>	\$7	\$10	\$11	\$12	\$34	\$1
Remaining Clay County						
Buildings and Contents	\$2	\$2	\$2	\$2	\$3	\$0
Vehicles	\$1	\$1	\$1	\$1	\$2	\$0
<i>Total Remaining Clay County</i>	\$3	\$3	\$3	\$3	\$5	\$0
Wilkin County						
Buildings and Contents	\$0	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$0	\$1	\$0
<i>Total Wilkin County</i>	\$0	\$0	\$0	\$0	\$1	\$0
Total Minnesota	\$10	\$13	\$14	\$15	\$40	\$1
Total Damages						
Buildings and Contents	\$29	\$47	\$52	\$57	\$830	\$7
Vehicles	\$18	\$21	\$22	\$22	\$63	\$2
Total	\$47	\$68	\$74	\$79	\$893	\$9



Return Period	10-year	25-year	50-year	100-year	500-year	Average
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Table 24: Alternative 3 – Estimated Residual Damages to Buildings and Contents; and Vehicles (\$ Millions)

						Annual Damage
Damages - North Dakota						
Fargo						
Buildings and Contents	\$25	\$41	\$44	\$48	\$802	\$7
Vehicles	\$9	\$11	\$11	\$11	\$46	\$1
<i>Total Fargo</i>	\$35	\$51	\$54	\$59	\$848	\$8
Remaining Cass County						
Buildings and Contents	\$0	\$1	\$1	\$1	\$2	\$0
Vehicles	\$1	\$1	\$2	\$2	\$3	\$0
<i>Total Remaining Cass County</i>	\$1	\$2	\$3	\$3	\$5	\$0
Richland County						
Buildings and Contents	\$0	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$1	\$1	\$0
<i>Total Richland County</i>	\$0	\$0	\$0	\$1	\$1	\$0
Total North Dakota	\$36	\$53	\$57	\$63	\$854	\$8
Damages – Minnesota						
Moorhead						
Buildings and Contents	\$0	\$3	\$4	\$4	\$24	\$0
Vehicles	\$6	\$7	\$7	\$7	\$10	\$1
<i>Total Moorhead</i>	\$7	\$10	\$11	\$12	\$34	\$1
Remaining Clay County						
Buildings and Contents	\$2	\$2	\$2	\$2	\$3	\$0
Vehicles	\$1	\$1	\$1	\$1	\$2	\$0
<i>Total Remaining Clay County</i>	\$3	\$3	\$3	\$3	\$5	\$0
Wilkin County						
Buildings and Contents	\$0	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$0	\$1	\$0
<i>Total Wilkin County</i>	\$0	\$0	\$0	\$0	\$1	\$0
Total Minnesota	\$10	\$13	\$14	\$15	\$40	\$1
Total Damages						
Buildings and Contents	\$29	\$47	\$52	\$57	\$831	\$7
Vehicles	\$18	\$21	\$22	\$22	\$63	\$2
Total	\$47	\$68	\$74	\$79	\$894	\$9

Both alternative 2 and 3 provide significant damage reduction between the 10- and 100- year events. The 500 year event is reduced by seventy-seven percent but continues to show large flood damages.

Table 25: Comparison of Average Annual Damage Reduction (\$ Millions)

	Base No Action Alternative (Alt. 1)	Proposed (Alt. 2)		Northern (Alt. 3)	
	Damages	Residual Damage	Reduction	Residual Damage	Reduction
Damages - North Dakota					
Fargo					
Buildings and Contents	\$46	\$7	\$39	\$7	\$39
Vehicles	\$3	\$1	\$2	\$1	\$2
<i>Total Fargo</i>	\$48	\$8	\$40	\$8	\$40
Remaining Cass County					
Buildings and Contents	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$0	\$0
<i>Total Remaining Cass County</i>	\$0	\$0	\$0	\$0	\$0
Richland County					
Buildings and Contents	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$0	\$0
<i>Total Richland County</i>	\$0	\$0	\$0	\$0	\$0
Total North Dakota	\$48	\$8	\$40	\$8	\$40
Damages – Minnesota					
Moorhead					
Buildings and Contents	\$1	\$0	\$1	\$0	\$1
Vehicles	\$1	\$1	\$0	\$1	\$0
<i>Total Fargo</i>	\$2	\$1	\$1	\$1	\$1
Remaining Clay County					
Buildings and Contents	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$0	\$0
<i>Total Remaining Clay County</i>	\$0	\$0	\$0	\$0	\$0
Wilkin County					
Buildings and Contents	\$0	\$0	\$0	\$0	\$0
Vehicles	\$0	\$0	\$0	\$0	\$0
<i>Total Wilkin County</i>	\$0	\$0	\$0	\$0	\$0
Total Minnesota	\$2	\$1	\$1	\$1	\$1
Total					
Buildings and Contents	\$47	\$7	\$39	\$7	\$39
Vehicles	\$4	\$2	\$2	\$2	\$2
Total	\$51	\$9	\$41	\$9	\$41

A review of the HAZUS model indicates both alternatives will have equivalent impacts to the northern parts of Richland and Wilkin Counties. Furthermore, increased flood depths result in an increase in expected damages to properties already at risk result. The overall net impact to Richland and Wilkin Counties is \$187 and \$532 in average annual damages respectively.

5.2.2 FLOOD INSURANCE

As noted under the Base No Action Alternative, flood Insurance premiums constitute a significant cost for residents in the Fargo-Moorhead Metropolitan area under the Base No Action Alternative. Table 26 presents the estimated number of structures subject to flood insurance for the area protected by the Proposed Project Alternative under the Base No Action Alternative, Proposed, and Northern conditions. For comparison the number of structures impacted by flood insurance under the Base No Action Alternative condition is shown. Results are for the 1-percent annual chance flood event. The structures are from the HAZUS level 3 coverage and are broken down by jurisdiction as well as type of structure.

Table 26: Impacted structures within the project boundary protected area at 1-percent-annual-chance flood by jurisdiction and by alternative

Jurisdiction	Base No Action Alternative (Alt. 1)	Proposed (Alt. 2)	Northern (Alt. 3)
Briarwood	16	1	1
Brooktree Park	12	6	6
Cass	562	208	208
Clay	65	43	43
Fargo	15766	489	490
Frontier	49	0	0
Harwood	45	3	3
Horace	37	1	1
Moorhead	616	11	11
North River	22	10	10
Oakport	42	0	0
Prairie Rose	27	0	0
Reile's Acres	33	0	0
West Fargo	1	0	0
Total	17293	772	773

5.2.4 LOSS OF BUILDING FUNCTION

In addition to reducing physical losses to capital stock in the floodplain, Alternative 2 and 3 would reduce average annual business function losses discussed with the Base No Action Alternative condition. Relocation costs, business losses, and tax impacts were estimated for the alternatives and compared to the Base No Action Alternative from Table 2222. The results are summarized below in Table 27. Average annual relocation costs for Alternative 2 are \$8 million and \$9 million for Alternative 3 with an overall reduction of \$45 million and \$44 million respectively in average annual flood related relocation costs.

Table 27: Alternative 2 –Summary of Annual Impacts from Loss of Building Function (\$ Millions)

Description	Total Base No Action Alternative	Proposed (Alt. 2)			Northern (Alt. 3)		
		Direct Impact	Total Impact	Reduction over Base No Action Alternative	Direct Impact	Total Impact	Reduction over Base No Action Alternative
North Dakota Business Losses							
Disruption Costs	\$3	\$1	\$1	\$2	\$1	\$1	\$2
Relocation Costs	\$53	\$8	\$8	\$45	\$9	\$9	\$44
Business Losses							
Output	\$1,512	\$119	\$183	\$1,329	\$154	\$239	\$1,273
Employment(in jobs)	15782	825	1298	14484	1121	1756	14026
Labor Income	\$548	\$41	\$65	\$483	\$56	\$88	\$460
Value Added	\$866	\$65	\$103	\$764	\$84	\$136	\$731
Total State and Local Tax	\$110	\$12	\$12	\$98	\$15	\$15	\$95
Minnesota Business Losses							
Disruption Costs	\$1	\$0	\$0	\$1	\$0	\$0	\$1
Relocation Costs	\$2	\$0	\$0	\$2	\$0	\$0	\$2
Business Losses							
Output	\$43	\$14	\$18	\$25	\$24	\$32	\$11
Employment(in jobs)	380	117	149	230	260	325	55
Labor Income	\$14	\$5	\$6	\$8	\$9	\$11	\$3
Gross Regional Product	\$23	\$7	\$10	\$13	\$13	\$17	\$6
Total State and Local Tax	\$4	\$2	\$2	\$2	\$2	\$2	\$1
Total Business Losses							
Disruption Costs	\$4	\$1	\$1	\$3	\$1	\$1	\$3
Relocation Costs	\$55	\$8	\$8	\$47	\$9	\$9	\$46
Business Losses							
Output	\$1,555	\$133	\$200	\$1,354	\$178	\$271	\$1,284
Employment (in jobs)	16162	942	1448	14715	1381	2081	14081
Labor Income	\$562	\$46	\$71	\$491	\$65	\$99	\$463
Gross Regional Product	\$889	\$72	\$113	\$777	\$97	\$153	\$737
Total State and Local Tax	\$113	\$14	\$14	\$100	\$17	\$17	\$96

For Alternative 2, the project would reduce losses to direct output by \$880 million (residual business output losses of \$133 million). Including indirect and induced business losses, the project would save \$1,354 million in lost economic output and 14,715 jobs with combined labor income of \$491 million. Alternative 3 would have a smaller impact on business losses. Direct business losses are reduced by \$742 million (residual business losses of \$178 million). With Indirect and induced business losses, the Alternative 3 would save \$1,284 million in lost economic output and 14,081 jobs with combined labor income of \$463 million. Alternative 2 would reduce flood related tax impacts by approximately \$100. Alternative 3 would reduce flood related tax impacts by approximately \$96 million (\$4 million less than Alternative 2).

5.2.5 CONSTRUCTION; AND OPERATIONS AND MAINTENANCE

The project would provide the following increases in economic activity from expenditures during construction and annual operations and maintenance (O&M) (Table 28). Total impacts from construction spending are \$3.0 billion and \$3.1 billion for Alternatives 2 and 3 respectively. Construction impacts would be spread over 8 years.

Table 28: Summary of Economic Impacts from Construction; and Operations and Maintenance (\$ Millions)

Description	Proposed (Alt. 2)		Northern (Alt. 3)	
	Direct Impact	Total Impact	Direct Impact	Total Impact
Total Construction Impacts				
Output	\$1,790	\$3,021	\$1,791	\$3,100
Employment (in jobs)	11333	20744	12045	22049
Labor Income	\$778	\$1,219	\$827	\$1,295
Gross Regional Product	\$820	\$1,548	\$872	\$1,645
Total State and Local Tax	\$106	\$106	\$113	\$113
Annual Operations and Maintenance Impacts				
Output	\$3	\$5	\$3	\$5
Employment (in jobs)	20	37	20	37
Labor Income	\$1	\$2	\$1	\$2
Gross Regional Product	\$1	\$3	\$1	\$3
Total State and Local Tax	>\$1	>\$1	>\$1	>\$1

Following construction, both alternatives would continue to have positive impacts on the economy through annual O&M activities. The estimated annual O&M for Alternatives 2 and 3 is \$3 million. O&M would support an additional \$5 million in regional sales activity. O&M would generate approximately 20 jobs with average incomes of \$70,000 per employee. Annual spending, employment, and indirect and induced effects would generate \$190,000 in new tax revenues per year following construction.

5.2.6 STRUCTURE IMPACTS AND RELOCATIONS

Additional interest is placed on how the differing alignments of the alternatives will affect areas surrounding Fargo and Moorhead which includes the staging area and the diversion channel. Under the Base No Action Alternative, these areas account for 1% of the overall damage estimate (approximately Average Annual \$600,000). While both would have impacts from operations of the staging area, the Northern Alignment Alternative would move the southern embankment of the proposed project north approximately 1.5 miles. Moving the alignment North creates impacts to additional structures north of the Proposed Project Alternative embankment alignment. These incremental structure impacts are highlighted in Figure 13 and Figure 14, which also show the structure impacts for the Base No Action Alternative for comparison.

Figure 13: Staging Area Residential Structure Impacts

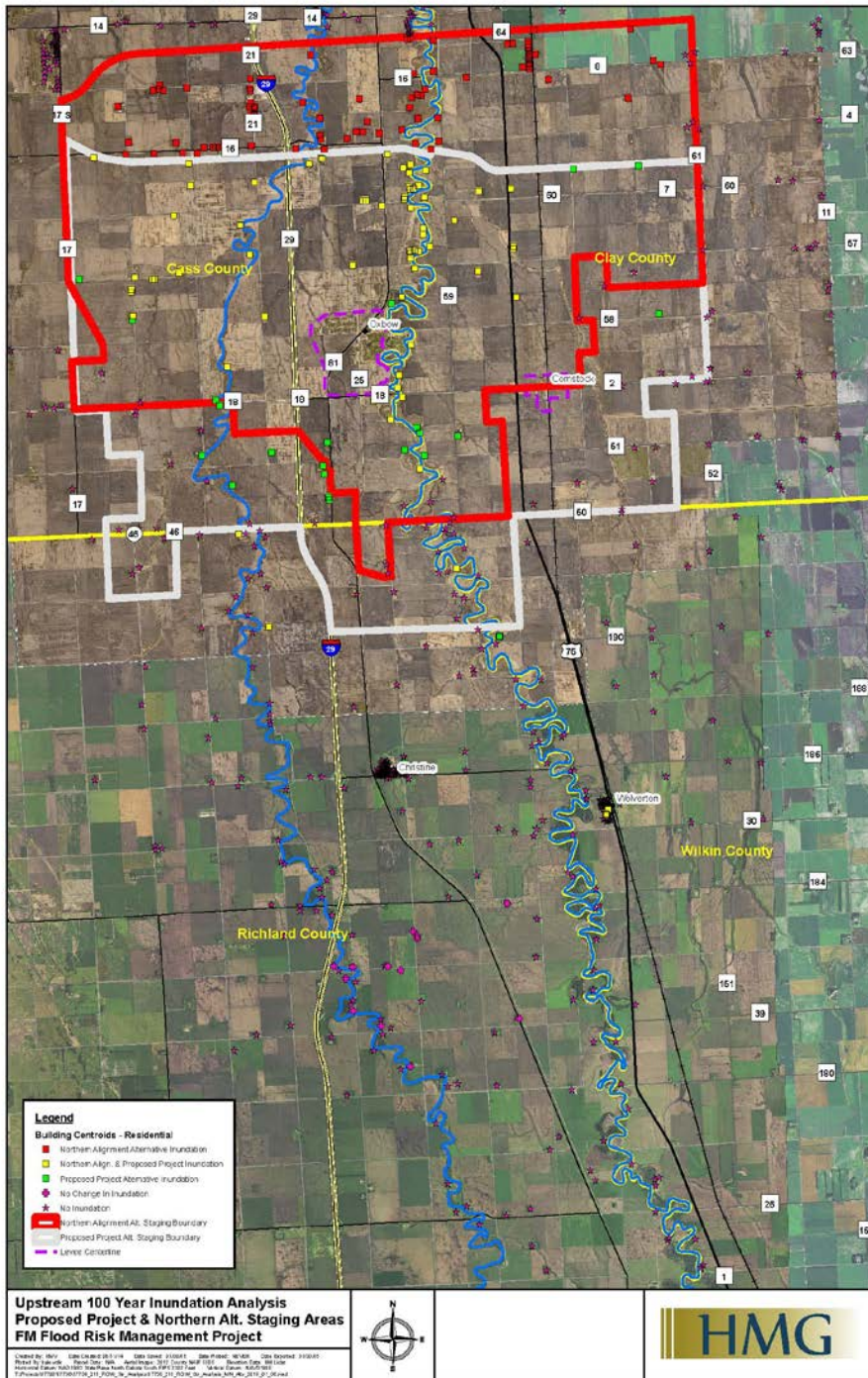


Figure 14: Staging Area Non-residential Structure Impacts

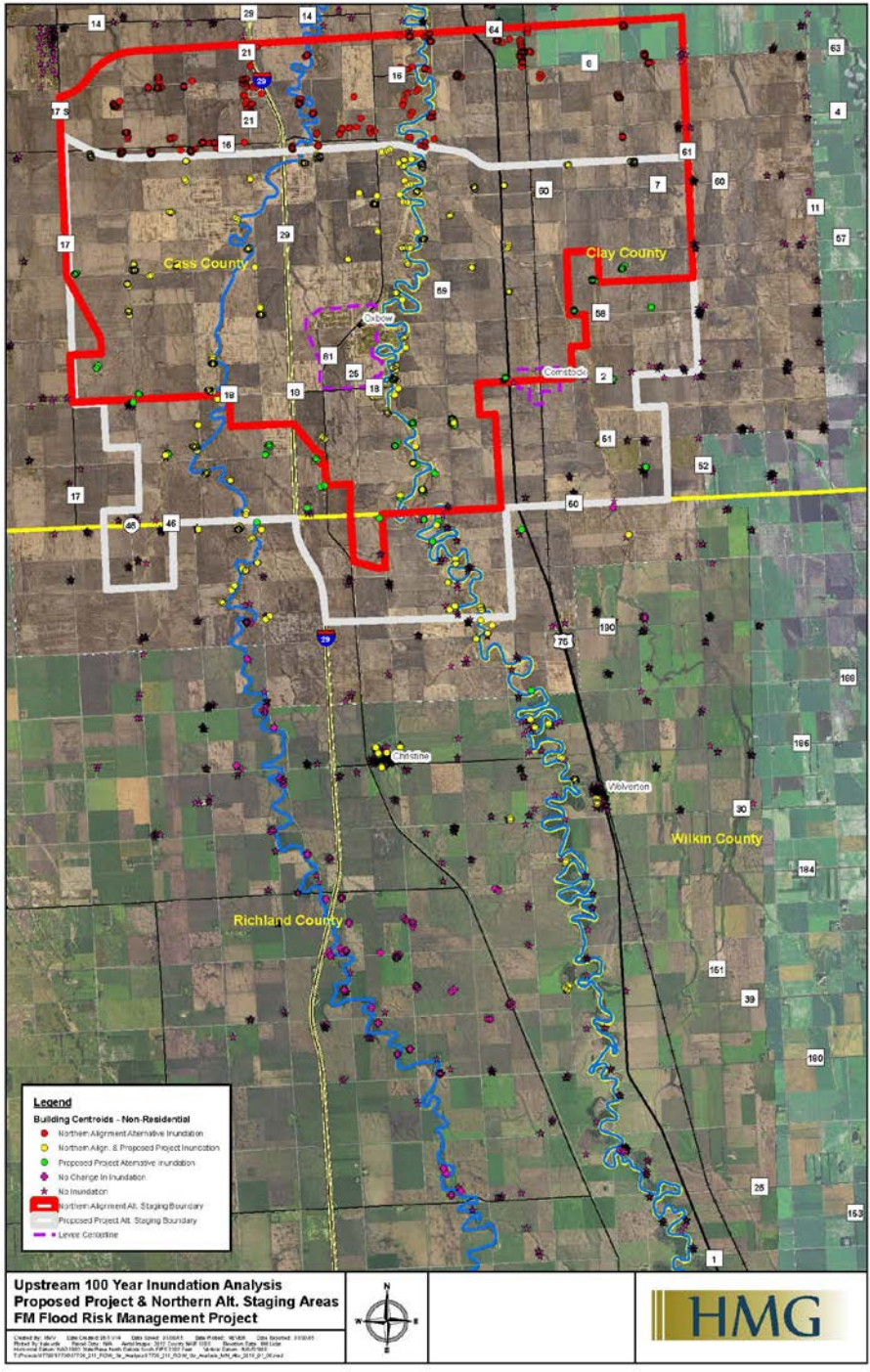


Table 29 presents the incremental structure impacts for the Northern Alignment Alternative. It shows the structures which would need to be relocated as well as the number of those structures which are currently flooded with the Base No Action Alternative. A detailed review indicates that moving the alignment of the staging area north with the NAA places will impact 90 residential (vs. 29 for Base No Action Alternative), 378 non-residential (vs. 224 for Base No Action Alternative) and 34 commercial (vs. 26 for Base No Action Alternative) structures, including the St. Benedict community area previously removed from flooding with the Proposed Alternative. The structures include residences, commercial, and one historic church and cemetery.

Table 29: Summary of Staging Area Property Impacts between the Northern Alignment and Base No Action Condition - Number of Residential, Non-Residential & Commercial Structures

Alternative	Diversion (Footprint)	Upstream Storage Area - 3' or More	Upstream Storage Area - Less Than 3'	Total
Northern Alt. Residential	5	79	6	90
Northern Alt. Non-Residential	7	351	20	378
Northern Alt. Commercial	0	34	0	34
Base No Action Residential	0	0	29	29
Base No Action Non-Residential	0	12	214	224
Base No Action Commercial	0	4	22	26

Table 30: Summary of Staging Area Property Acquisition and Relocation Costs between the Proposed Project Alternative and Northern Alignment Alternative

Type of Property	Type of Fee	Proposed Alternative		Northern Alignment Alternative	
		# of Acres/Structures Impacted	Total Cost (\$ Millions)	# of Acres/Structures Impacted	Total Cost (\$ Millions)
Diversion Footprint					
Fee Acres	Fee Title	717	3.01	453	1.90
Permanent Easement Acres	Easement	62	0.07	44	0.05
Non-Residential	Fee Title	11	1.65	7	1.05
Non-Residential	Easement				
Residential	Fee Title	3	0.75	5	1.25
Residential	Easement				
Total			5.48		4.25
Upstream Staging Area					
Fee Acres ¹	Fee Title	25,842	73.36	28,356	83.79
Permanent Easement Acres ²	Easement	6,413	6.09	4,997	4.75
Non-Residential ³	Fee Title	434	60.76	677	94.78
Non-Residential ⁴	Easement	162	2.27	94	1.32
Residential ³	Fee Title	71	17.40	132	32.34
Residential ⁴	Easement	20	0.32	20	0.32
Total			160.20		217.30

Notes: ¹ 46% of acres with an inundation depth 3' or Greater & 50% of acres with inundation depth 1'-3' and 54% of acres with an inundation depth 3' or Greater & 50% of acres with inundation depth 1'-3'

² Inundation depth 0'-1' & 50% of acres with inundation depth 1'-3'

³ Inundation depth 3' or Greater & 50% of structures with inundation depth 1'-3'

⁴ Inundation depth 0'-1' & 50% of structures with inundation depth 1'-3'

Both with project alternatives would have impacts south of Cass and Clay counties. A ring levee to protect the communities of Oxbow, Hickson, and the Bakke Subdivision (OHB) is needed for both project alternatives, Table 31. A ring levee to protect the community of Comstock is needed for the Proposed Project Alternative, but not the Northern Alignment. Relocation or raising the sewage lagoons for the city of Comstock is needed for both alternatives. Appendix A provides detail on the costs and impacts for the Proposed Project and Northern Alignment Alternatives.

Table 31: Number of Residential Structures Inundated by Location

Location	Proposed Alternative (Alt. 2)	Northern Alignment Alternative (Alt 3.)
Oxbow	95	94
Bakke Subdivision	59	59
Hickson	16	16
Christine	0	0
Comstock	26	0

5.2.7 OTHER ECONOMIC EFFECTS

Under the project conditions, both Alternative 2 and 3 would reduce impacts to transportation networks up to the 100 year event. Impacts to air and rail would be reduced. Road closures noted under existing conditions would be reduced in the FM Metro area. The project would generate transportation impacts from closures to roadways and bridges in the staging and diversion areas. Even with the additional impacts the COE estimated that the project would generate significant savings to transportation networks. Under the project conditions, flooding would create \$333 million (2009\$'s) in average annual transportation impacts for a savings of \$3.3 billion over the Base No Action Alternative condition.


SUMMARY OF FINDINGS

The impacts for the Base No Action Alternative and the project alternative conditions are summarized below in Table 32. Overall Alternatives 2 and 3 have nearly equivalent benefits and impacts throughout the FM Metro area.

Table 32: Summary of Project Impacts

Impact	Alternative Condition	
	Proposed (Alt. 2)	Northern (Alt. 3)
Impacts to Capital Stock		
Average Annual Damages Reduced ¹	-\$41 Million	-\$41 Million
Flood Insurance		
Protected Structures at 1-percent-annual-chance	17,714	17,646
Building Loss of Function		
Average Annual Disruption Costs Reduced	-\$3 Million	-\$3 Million
Average Annual Flood Related Relocation Costs Reduced	-\$47 Million	-\$46 Million
Average Annual Business Losses Reduced		
Output	-\$1,354 Million	-\$1,284 Million
Employment	-14,715 Jobs	-14,081 Jobs
Labor Income	-\$491 Million	-\$463 Million
Gross Regional Product	-\$777 Million	-\$737 Million
Total State and Local Tax	-\$100 Million	-\$96 Million
Total Construction Impacts		
Direct Construction Investment	\$1,789 Million	\$1,791 Million
Total Sales Gained	\$3,021 Million	\$3,100 Million
Total Job Creation	20,744 Jobs	22,049 Jobs
Total Income	\$1,219 Million	\$1,295 Million
Total Value Added	\$1,548 Million	\$1,645 Million
Total Taxes	\$106 Million	\$113 Million
Annual Operations and Maintenance Impacts		
Total Sales	\$5 Million	\$5 Million
Total Job Creation	37 Jobs	37 Jobs
Total Income	\$2 Million	\$2 Million
Total Value Added	\$3 Million	\$3 Million
Total Taxes	>\$1 Million	>\$1 Million

There are two differences between Alternative 2, the Proposed Project, and Alternative 3, the Northern Alignment Alternative: number of residences and businesses that require relocation; and overall cost. In comparison to Alternative 2, Alternative 3 will impact an additional 90 residential (vs. 29 for Base No Action Alternative), 378 non-residential (vs. 224 for Base No Action Alternative), and 34 commercial (vs. 26 for Base No Action Alternative) structures, including a historic church and cemetery in St. Benedict. These properties support approximately \$4,500 in average annual benefits with the proposed alignment; with the NAA they add to the total project cost through relocation costs. The additional impacts to



residences and businesses increase the cost of the Northern Alignment Alternative over the Proposed Alternative by \$56M.

Alternative 2, The Proposed Alternative has an estimated construction cost of \$1.7 billion; Alternative 3, The Northern Alignment Alternative has a higher construction cost of \$1.8 billion as a result of additional property buyouts, for a difference of approximately \$100 million (6%) in the construction cost between the two plans. Alternative 2 would require the construction of a ring levee to protect the community of Comstock, while Alternative 3 would not.

Both alternatives have the following structure impacts in Richland and Wilkin counties:

- Number of residential structures impacted at the 100-yr return period inundation area: Richland 2, Wilkin 0
- Estimated average annual damages: Richland \$187, and Wilkin \$532.

Finally, flood insurance poses an additional cost to property owners in the FM Metro Area. In comparison to the Proposed Alternative, the Northern Alignment Alternative will result in fewer buyouts of properties due to the placement of the staging area. As such the Proposed Alternative could generate higher benefits to property owners holding flood insurance.

APPENDIX A

FINAL TECHNICAL MEMORANDUM

OPINION OF PROBABLE CONSTRUCTION COST TO SUPPORT MN/DNR EIS NORTHERN ALIGNMENT EVALUATION

January 9, 2015

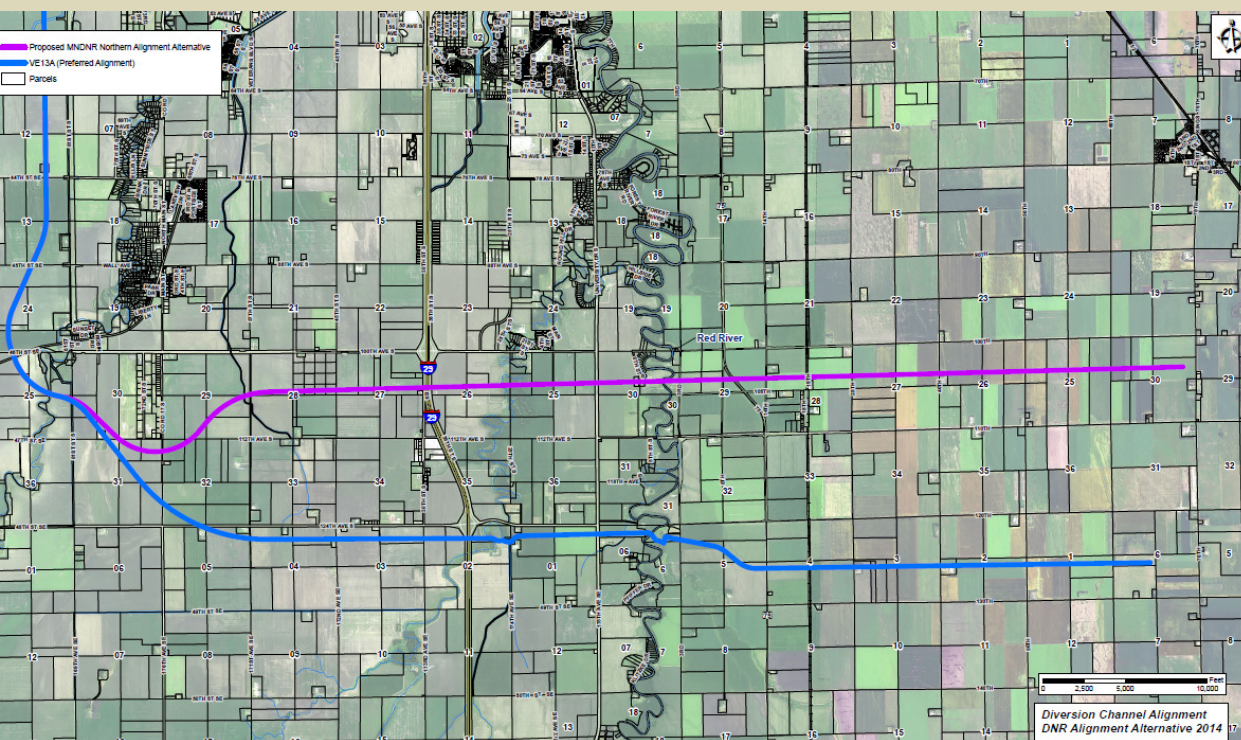


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Exhibits

- Exhibit A – Lands and Damages Opinion of Cost Detailed Breakdown***
- Exhibit B – Northern Alignment Alternative Opinion of Cost***
- Exhibit C – Hydrology and Hydraulics Summary of Alternatives***

EXECUTIVE SUMMARY

This study summarizes estimated construction costs for the MnDNR conceptual Northern Alignment Alternative. To facilitate comparison of the estimated costs for conceptual alignments developed to date, the methodology utilized to develop this opinion of cost closely follows that presented in the *Final Technical Memorandum, FM Diversion Post-Feasibility Southern Alignment Analysis (PFSAA): VE-13, North of Wild Rice River, South of Oxbow, Report for the U.S. Army Corps of Engineers (USACE) and the Local Sponsors, Final dated October 10, 2012*. A map depicting the Northern Alignment and the Proposed Project Alternative alignment is presented in **Figure 1** attached. The estimated construction costs for the Northern Alignment Alternative are summarized in **Table 0.1** below.

Table 0.1: Northern Alignment Alternative Opinion of Construction Cost Summary

Item Description	Project Cost (2010 dollars) ^{1 2 3 4 5 6 7 8 9}
1 Lands and Damages	351,000,000
2 Relocations	149,000,000
6 Fish and Wildlife Facilities	61,000,000
8 Roads, Railroads and Bridges	59,000,000
9 Channels and Canals	784,000,000
11 Levees and Floodwalls	163,000,000
14 Recreation Facilities	29,000,000
30 Planning, Engineering and Design (PED)	187,000,000
31 Construction Management (CM)	87,000,000
Total	1,870,000,000

¹ Costs are rounded to the nearest \$1 million.

² 2010 US Dollars (\$) construction costs; escalation is not included (estimate is not fully funded).

³ Methodology similar to PFSAA phase except where feature designs differ as stated in this report.

⁴ Contingency included. Contingency is an allowance for costs that will be in the Project Cost and are not included in the Contract Cost. Does not account for changed conditions either in the final design or during construction.

⁵ Changes to 2010 material, labor, equipment or fuel opinion of cost are not reflected in the project costs presented above.

⁶ Limited design work completed (<5%). Based on screening-level project definition. This screening-level (Class 5, <5% design completion per ASTM E 2516-06 and USACE EI 01D010 [9/1/97]) cost estimate is based on screening-level designs, alignments, quantities, and unit prices. Costs will change with completion of further design. A construction schedule is not available at this time. The estimated accuracy range for the total project cost as the project is defined is -50% to +100%.

⁷ Quantities based on design work completed.

⁸ Unit prices based on information available at this time from comparable projects and MII work analysis.

⁹ Limited soil boring and field investigation information available.

The estimated construction costs for the Northern Alignment Alternative and the Proposed Alignment Alternative are summarized in **Table 0.2** below. The alternative alignments presented in the October 10, 2012 PFSAA report investigated realignment of features eastward of diversion alignment Station 1514+00 at the Sheyenne River Aqueduct crossing. The assessment of the Northern Alignment Alternative similarly investigates alternative conceptual features upstream of the Sheyenne River Aqueduct crossing.

Recent anecdotal evidence provided by officials in the Fargo-Moorhead region indicates that construction costs have shown some volatility and generally risen this year. The costs presented in **Table 0.2** below are presented in 2010 dollars for comparison to the PFSAA study alignment alternative cost estimates. Infrastructure bundles from the October 10, 2012 PFSAA are included in the estimated costs shown in **Table 0.2** below.

Table 0.2: Northern Alignment Alternative and Proposed Project Alternative Comparative Cost Summary

Alignment Description	Project Cost (2010 dollars)
	1 2 3 4 5 6 7 8 9 10 11
Northern Alignment Alternative	1,870,000,000
Proposed Alignment Alternative ¹¹	1,789,000,000

¹ Costs are rounded to the nearest \$1 million.

² 2010 US Dollars (\$) construction costs; escalation is not included (estimate is not fully funded).

³ Methodology similar to PFSAA phase except where feature designs differ as stated in this report.

⁴ Contingency included. Contingency is an allowance for costs that will be in the Project Cost and are not included in the Contract Cost. Does not account for changed conditions either in the final design or during construction.

⁵ Changes to 2010 material, labor, equipment or fuel opinion of cost are not reflected in the project costs presented above.

⁶ Limited design work completed (<5%). Based on screening-level project definition. This screening-level (Class 5, <5% design completion per ASTM E 2516-06 and USACE EI 01D010 [9/1/97]) cost estimate is based on screening-level designs, alignments, quantities, and unit prices. Costs will change with completion of further design. A construction schedule is not available at this time. The estimated accuracy range for the total project cost as the project is defined is -50% to +100%.

⁷ Quantities based on design work completed.

⁸ Unit prices based on information available at this time from comparable projects and MII work analysis.

⁹ Limited soil boring and field investigation information available.

¹⁰ Infrastructure bundles from the October 10, 2012 PFSAA are included in the estimated costs.

¹¹ VE13A Project cost values referenced from FM Diversion Post-Feasibility Southern Alignment Analysis: VE-13, North of Wild Rice River, South of Oxbow dated Final - October 10, 2012 Exhibit H1. Lands and easement costs follow USACE methodology from the PFSAA as applied to structure datasets updated since the PFSAA.

1 BACKGROUND AND OVERVIEW

The Fargo-Moorhead Area Diversion (FM Diversion) Project was developed by the U.S. Army Corps of Engineers (USACE) to provide flood risk reduction for the Fargo-Moorhead area and is presented in the Integrated Final Feasibility Report and the Final Environmental Impact Statement (FR/FEIS) dated July 2011. Readers unfamiliar with the project should reference these documents for additional detail about the project. The project consists of a 20,000 cfs diversion channel with upstream staging and storage, and was referred to as the Locally Preferred Plan (LPP, aka North Dakota Diversion) in the FR/FEIS. This plan was also known as the Federally Recommended Plan (FRP).

An October 10, 2012 study, referred to as the Post-Feasibility Southern Alignment Analysis (PFSAA) evaluated and compared four alternative alignments to the FRP that have the potential to increase project value by further optimizing the project functionality for the estimated cost and impacts.

The four base alternative alignments evaluated in the comparative PFSAA study are listed below.

1. VE-13, Option A (VE13A), (Proposed Alignment Alternative)
2. VE-13, Option C (VE13C)
3. South of Oxbow (OXBOW)
4. North of Wild Rice River (NWRR)

The PFSAA investigations resulted in the VE13A Alignment being selected as the Proposed Project Alternative, which is referred to as the Proposed Project Alternative for this report. At the time of writing this report, the Minnesota DNR is investigating an additional conceptual alignment named the Northern Alignment Alternative as part of the State of Minnesota Environmental Impact Statement (MNEIS). A map showing comparison of the Proposed Alignment Alternative and the Northern Alignment Alternative is presented in **Figure 1** attached. Hydraulic modeling (Phase 7.0 EA unsteady HEC-RAS) results prepared for the MNEIS for the 10, 4, 2, 1 and 0.2-percent chance flood events are summarized in **Exhibit 3** attached. These model results include the Base No Action Alternative, Proposed Project Alternative and Northern Alignment Alternative.

1.1 PURPOSE AND INTENDED USE OF THE ESTIMATE

The purpose of this study is to present an opinion of probable construction cost for the Northern Alignment Alternative for use in the MN EIS and by HMG in development of socio-economic model(s) for alternatives being considered as part of the MN EIS. The estimated construction costs presented in this study are intended to be comparative to construction cost estimates prepared for alignments to date.

This opinion of probable cost was developed using a conceptual Northern Alignment Alternative definition provided by MnDNR. The opinion of cost is based on information from other FM Diversion project alternatives and the consulting team's experience and qualifications. The opinion of cost represents the team's best judgment as experienced and qualified professionals familiar with the project, based on project-related information available at this time, available cost information from other project alternatives and a screening level design for the Northern

Alignment Alternative. The opinion of probable cost will change as more information becomes available and the level of design detail is advanced. In addition, since the team has no control over the cost of labor, materials, equipment, or services furnished by others, or over the contractor's methods of determining prices, or over competitive bidding or market conditions, it can be expected that proposals, bids, or actual construction costs will vary from this opinion of probable cost. If a more accurate opinion of probable cost is desired, a more detailed study including more detailed project definition, field investigations, design and micrositing of the Northern Alignment Alternative would be necessary.

1.2 DESCRIPTION OF ALTERNATIVES

This study includes one alignment alternative named the Northern Alignment.

1.2.1 NORTHERN ALIGNMENT

The Northern Alignment Alternative is a conceptual alignment alternative developed during preparation of the MN EIS. In general, the Northern Alignment Alternative is identical to the Proposed Project Alternative downstream of the Sheyenne River Aqueduct site. Upstream of the Sheyenne River Aqueduct, the Northern Alignment Alternative runs roughly parallel to the Proposed Project Alternative offset within roughly two miles north of the Proposed Project Alternative. For a map depicting the Northern Alignment Alternative see **Figure 1** attached.

Assumptions related to staging elevation are consistent with the PFSAA methodology. The assumed top-of-dam for the Northern Alignment Alternative assumes a top of embankment elevation 927.1 feet based on the 103k cfs event peak water surface elevation plus a minimum of 4 feet of freeboard or the Probable Maximum Flood (PMF) flood event peak water surface elevation plus 3 feet of freeboard. Further analysis of freeboard requirements will occur during final design. This staging elevation is based on the unsteady HEC-RAS Phase 6 hydrologic and hydraulic modeling results. The hydrology utilized in the Phase 6 analysis is the same hydrology that was developed by the USACE for the FR/FEIS. The Phase 6 unsteady HEC-RAS models consist of existing condition and FRP models based on the FR/FEIS design.

The Northern Alignment Alternative is conceptual at this time and was developed by MnDNR. Assumptions and surrogate cost data are necessary to complete an opinion of cost because no field investigations, micrositing or feasibility geotechnical, structural, environmental or civil analysis has been performed to date for this alignment. Where these assumptions are necessary, estimated costs developed for the PFSAA VE13 Option C Alignment Alternative are used as surrogate in a subset of categorical and item costs for the Northern Alignment Alternative. The following methodology section of this technical memorandum summarizes for what features and cost categories newly estimated construction costs or surrogate costs were utilized.

2 METHODOLOGY

The methodology used to develop this opinion of cost is summarized in this section. In general, the assumptions used to develop the Northern Alignment Alternative opinion of cost are consistent with the methodology utilized in the 2011 FR/FEIS and the 2012 Post Feasibility Southern Alignment Analysis (PFSAA) with appropriate updates as noted. This is intended for comparative purposes. It is acknowledged that some assumptions, such as the use of 2010 dollars and feasibility construction schedule, are not revised and updated for project context in 2014.

For a more detailed description of assumptions, background, work analysis, unit costs and other cost estimate methodology please refer to the following two previously completed report documents:

- *Final Technical Memorandum, FM Diversion Post-Feasibility Southern Alignment Analysis (PFSAA): VE-13, North of Wild Rice River, South of Oxbow, Report for the U.S. Army Corps of Engineers (USACE) and the Local Sponsors, Final dated October 10, 2012 (HMG, LLC);*
- *FEIS Feasibility Study Phase 4 Appendix G Cost Estimates, Final dated February 28, 2011 (HMG, LLC);*

Cost estimates for planning purposes are prepared in accordance with the following USACE guidance:

- ER 1100-2-1150 Engineering and Design for Civil Works Projects
- ER 1105-2-100 Planning Guidance Notebook
- ER 1110-1-1300 Cost Engineering Policy and General Requirements
- ER 1110-2-1302 Civil Works Cost Engineering
- ETL 1110-2-573 Construction Cost Estimating Guide for Civil Works
- EM 1110-2-1304 Civil Works Construction Cost Index System (CWCCIS)
- Direct communications with USACE

2.1 COST ESTIMATE METHODOLOGY AND ASSUMPTIONS

Project Title:	Final Technical Memorandum, Opinion of Probable Construction Cost to Support MN/DNR EIS Northern Alignment Evaluation
	[This estimate is based on methodology presented in <i>Final Technical Memorandum, FM Diversion Post-Feasibility Southern Alignment Analysis (PFSAA): VE-13, North of Wild Rice River, South of Oxbow, Report for the U.S. Army Corps of Engineers (USACE) and the Local Sponsors, Final dated October 10, 2012</i> (HMG, LLC). This estimate is also based on methodology presented in the feasibility study <i>Phase 4 Appendix G dated February 28, 2011</i> . (HMG, LLC)]
Project Location:	Cass County, ND and Clay County, MN
Software:	MCACES cost estimating software MII, version 3.01 (MII) and MS-Excel
Work Breakdown:	Civil Works Breakdown Structure (as coordinated with USACE during FEIS preparation)
Costbook:	2008 Cost Book for MII (English units) for USACE Phase 4 LPP TPCS dated April 2011
Measurements:	English
Currency:	August 2010 US Dollars (\$); temporal escalation excluded (to be performed by USACE if necessary)
Quantities:	Estimated quantity calculations are performed by Houston-Moore Group (HMG) for the Northern Alignment Alternative. Lands and Damages quantities were compiled by HMG using USACE methodology from the PFSAA study in coordination w/ USACE staff. Surrogate costs from the PFSAA study are assumed where necessary to complete definition of the Northern Alignment Alternative opinion of cost.
Schedule:	The schedule assumed in these estimates is the \$200 million per year funding scenario breakdown, as developed by HDR Engineering, Inc. in the report titled <i>DRAFT – Project Phasing and Project Scheduling, dated June 11, 2010</i> .
Estimator:	This feasibility construction cost estimate was compiled by Houston-Moore Group (HMG). Lands and Damages costs were compiled by HMG using USACE methodology from the PFSAA study in coordination w/ USACE staff.

2.1.1 ESTIMATE TYPE AND ANTICIPATED ACCURACY RANGE

The anticipated cost for each alternative is based on screening level design. The opinion of cost should be considered a screening-level, order-of-magnitude estimate that generally corresponds to a Class 4 estimate based on standards established by the Association for the Advancement of Cost Engineering (AACE) and American Society

for Testing and Materials (ASTM) and as set forth in ASTM E 2516-06 Standard Classification for Cost Estimate Classification System as outlined in Engineer Regulation ER 1110-2-1302. A Class 4 cost estimate is characterized by limited project definition (less than 5%), wide-scale use of parametric models (i.e. making extensive use of order-of-magnitude costs from similar projects or proposals) to calculate estimated costs, and a relatively high uncertainty. The estimated cost of each alternative is a point estimate within a range of possible costs for the alternative. The selected accuracy range for these point estimates is -50% to +100%.

This estimate is based on an alignment from others with limited project definition. Project definition for the Northern Alignment Alternative to date does not include field investigations, feasibility designs or micrositing of features.

2.1.2 CONSTRUCTION CRITICAL PATH AND SCHEDULE ASSUMPTIONS.

Schedule assumptions are generally consistent with assumptions made during PFSAA and April 2011 Phase 4 FRP feasibility cost estimate work. Cost estimates presented in the FRP TPCS, PFSAA and this tech memo do not incorporate any construction schedule and critical path work performed since April of 2011. Construction sequence work was not performed for individual alignment alternatives.

2.1.3 DIRECT COST ASSUMPTIONS (CONSTRUCTION COSTS)

Direct cost assumptions are those used in the PFSAA cost estimates and are generally consistent with assumptions made during April 2011 Phase 4 FRP feasibility cost estimate work. Unit costs presented are based on information obtained during 2010 and 2011 cost estimate development phases. Direct costs are those associated with quantity takeoffs, unit costs, wage rates and taxes. Using the unit costs from the previous cost work implies that the underlying assumptions developed in the MII cost model are also applicable in this Northern Alignment Alternative evaluation. For a summary of contractor/vendor quotes and detailed discussion of the Phase 4 MII cost model and unit costs developed for feasibility and the PFSAA work, refer to the *FEIS Feasibility Study Phase 4 Appendix G Cost Estimates, Final dated February 28, 2011* (HMG, LLC).

2.1.4 INDIRECT COST ASSUMPTIONS (CONTRACTOR COSTS)

Indirect cost assumptions (contractor costs) are those used in the PFSAA cost estimates and are generally consistent with assumptions made during April 2011 Phase 4 FRP feasibility cost estimate work. The cost estimates presented in the SDEIS assume a single Prime Broker Contractor oversees Subcontractors that perform the work. This contractor scenario is assumed for very large contracts (in excess of \$200M). Indirect costs are those associated with contractor Job-Office-Overhead (JOOH), contractor Home-Office-Overhead (HOOH), Mobilization/Demobilization, contractor Profit, Bonding and subcontractor costs/markups. Using the unit costs from the previous cost work implies that the underlying assumptions developed in the Phase 4 MII cost model are also applicable in this Northern Alignment Alternative evaluation. For a detailed discussion of the MII cost model and unit costs developed for feasibility and the PFSAA work, refer to the *FEIS Feasibility Study Phase 4 Appendix G Cost Estimates, Final dated February 28, 2011* (HMG, LLC).

2.1.5 CATEGORICAL COST ASSUMPTIONS

Categorical cost assumptions for the Northern Alignment are generally consistent with assumptions made during the PFSAA and the April 2011 Phase 4 FRP feasibility cost estimate work with appropriate updates as noted.

01 Lands and Damages (e.g. easements, right-of-way acquisition)

- The methodology for estimating Lands and Damages quantities, unit costs and estimated easement, acquisition and impact costs was developed by USACE for the staging boundary as defined by USACE.
- Lands and Easements costs for the Northern Alignment Alternative were compiled by HMG using USACE methodology from the PFSAA study and in coordination with USACE staff and an assumed staging boundary as defined by USACE.
- Costs for Lands and Damages were estimated on the basis of quantities specific to the Northern Alignment Alternative. Quantities were estimated using GIS and a summary is presented in **Figure 2** attached.
- Lands and Damages estimated costs assume construction of an OHB ring levee for both the Proposed Project Alternative and the Northern Alignment Alternative.
- Lands and Damages estimated costs assume construction of a Comstock ring levee for the Proposed Project Alternative, but not for the Northern Alignment Alternative due to shift in staging pool.
- The following tables summarize the quantity takeoffs used to develop estimated Lands and Damages costs for the Northern Alignment Alternative and show comparison to quantities estimated for the Proposed Alignment Alternative.

Table 2.1 Lands and Easements: Acreage Comparison Summary: Northern Alignment Alternative

Alternative	Depth	Cass County	Richland County	Clay County	Wilkin County	Total
Northern Alignment Alt.	0 to 1 foot (acres)	840	18	1,451	0	2,309
Northern Alignment Alt.	1 to 3 feet (acres)	2,363	27	2,986	0	5,376
Northern Alignment Alt.	3 feet or more (acres)	16,356	37	9,275	0	25,668
Northern Alignment Alt.	Total (acres)	19,559	82	13,712	0	33,353

Table 2.2 Lands and Easements: Acreage Comparison Summary: Proposed Project Alternative

Alternative	Depth	Cass County	Richland County	Clay County	Wilkin County	Total
Proposed Project Alt.	0 to 1 foot (acres)	718	418	2,100	436	3,672
Proposed Project Alt.	1 to 3 feet (acres)	2,524	241	2,681	36	5,482
Proposed Project Alt.	3 feet or more (acres)	14,240	397	8,241	224	23,102
Proposed Project Alt.	Total (acres)	17,482	1,056	13,022	695	32,255

- Lands and Easements costs for the Proposed Project Alternative were compiled by HMG using USACE methodology from the PFSAA study and in coordination with USACE staff. The estimate assumed a staging boundary as defined by USACE and used a structure inventory dataset updated since the PFSAA. The structure inventory resulted in changes to structure counts and cost for this category.

Table 2.2 (cont'd Alternate Table Format) Lands and Easements: Acreage Comparison Summary: Proposed Project Alternative

Proposed Project Alternative (PPA)						Northern Alignment Alternative (NAA)					Comparison (PPA – NAA)				
Alt.	Inund. Depth (feet)	Cass Co.	Richland Co.	Clay Co.	Wilken Co.	Alt.	Cass Co.	Richland Co.	Clay Co.	Wilken Co.	Alt.	Cass Co.	Richland Co.	Clay Co.	Wilken Co.
PPA	0 to 1'	718	418	2,100	436	NAA	840	18	1,451	0	PPA-NAA	-122	400	649	436
PPA	1 to 3'	2,524	241	2,681	36	NAA	2,363	27	2,986	0	PPA-NAA	161	214	-305	36
PPA	Greater Than 3'	14,240	397	8,241	224	NAA	16,356	37	9,275	0	PPA-NAA	-2,116	360	-1,034	224
Totals	Totals	17,482	1,056	13,022	696	Totals	19,559	82	13,712	0	PPA-NAA	-2,077	974	-690	696

Table 2.3 Property Impact, Number of Residential and Non-Residential Structures: Northern Alignment Alternative

Alternative	Diversion (Footprint Extent)	Upstream Storage Area 3 Feet or More Inundation	Upstream Storage Area Less than 3 Feet Inundation	Total
Northern Alignment Alt. Residential	5	120	32	157
<i>Breakdown of Existing Conditions for Impacted "Northern Alignment Residential" Properties</i>				
<i>Ex. Conditions, No Inundation</i>	4	68	30	102
<i>Ex. Conditions, Less Than 3'</i>	1	50	2	53
<i>Ex. Conditions, 3' or More</i>	0	2	0	2
Northern Alignment Alt. Non-Residential	7	615	156	778
<i>Breakdown of Existing Conditions for Impacted "Northern Alignment Non-Residential" Properties</i>				
<i>Ex. Conditions, No Inundation</i>	2	174	118	294
<i>Ex. Conditions, Less Than 3'</i>	5	411	38	454
<i>Ex. Conditions, 3' or More</i>	0	30	0	30
Northern Alignment Alt. Total	12	735	188	935

Note: this table excludes properties within Oxbow-Hickson-Bakke & Comstock ring levees not impacted.

Table 2.4 Property Impact, Number of Residential and Non-Residential Structures: Proposed Project Alternative

Alternative	Diversion (Footprint Extent)	Upstream Storage Area 3 Feet or More Inundation	Upstream Storage Area Less than 3 Feet Inundation	Total
Proposed Project Alt. Residential	3	63	28	94
<i>Breakdown of Existing Conditions for Impacted "Proposed Alignment Residential" Properties</i>				
<i>Ex. Conditions, No Inundation</i>	2	36	27	65
<i>Ex. Conditions, Less Than 3'</i>	1	25	1	27
<i>Ex. Conditions, 3' or More</i>	0	2	0	2
Proposed Project Alt. Non- Residential	11	363	233	607
<i>Breakdown of Existing Conditions for Impacted "Proposed Alignment Non-Residential" Properties</i>				
<i>Ex. Conditions, No Inundation</i>	2	116	200	318
<i>Ex. Conditions, Less Than 3'</i>	9	228	33	270
<i>Ex. Conditions, 3' or More</i>	0	19	0	19
Proposed Project Alt. Total	14	426	261	701

Note: this table excludes properties within Oxbow-Hickson-Bakke & Comstock ring levees not impacted.

Table 2.5 Property Impact, Number of Residential Structures Inundated in Storage Area by Location (Staging Boundary as Defined by USACE)

Location	Northern Alignment Alternative	Proposed Alignment Alternative
Richland County ¹	0	1
Wilkin County ¹	0	0
Cass County ¹	109	68
Clay County ¹	43	22
Total	152	91
Oxbow ²	94	95
Bakke Subdivision ²	59	59
Hickson ²	16	16
Christine ²	0	0
Comstock ²	0	26

¹ Structure count includes all residential structures within county, excluding those within communities and impacted by the diversion footprint.

² Communities not included in County Count; impact if no ring levee protection.

A contingency of 25% was assumed for Lands and Damages.

For a detailed breakdown of quantities and unit costs related to Lands and Damages see **Exhibit A** attached.

02 Relocations

- The estimated costs for Utility Relocations for the Northern Alignment Alternative are the PFSAA VE13 Option C costs, used as a surrogate in lieu of itemizing new quantities for this cost category for the Northern Alignment Alternative. Detailed evaluation of utility conflicts and utility relocations has not been performed for the Northern Alignment Alternative.
- The estimated costs for Roadway Bridges & Local Road Construction for the Northern Alignment Alternative are the PFSAA VE13 Option C costs, used as a surrogate in lieu of itemizing new quantities for this cost category. This cost category includes pavement section for road raises for I-29. Note that transportation feature costs were estimated for the Northern Alignment Alternative, but are presented in a different cost category.
- The estimated costs for Road Raises up and over the dam embankment for the Northern Alignment Alternative are based on quantities estimated by HMG. The road raises estimated for the Northern Alignment Alternative include: I-29, Highway 75, one Railroad and misc. lower volume local roadways.
- The difference in cost between Alternatives for 48th St SE, the \$3 million listed in the structures table is for the bridge over the diversion channel. However, with the Northern alignment this bridge will no longer be needed and only "up and over" costs were factored into the northern alignment. Current design work investigating combining CR16 and CR17 roadway bridges may make this issue irrelevant. The OPC assumption is consistent w/ PFSAA methodology.

06 Fish and Wildlife Facilities

- The estimated costs for Fish and Wildlife Facilities for the Northern Alignment are the PFSAA VE13 Option C costs, used as a surrogate in lieu of itemizing new quantities for this cost category for the Northern Alignment Alternative. The Northern Alignment Alternative does not appear to require a different work scope for these features than VE13 Option C.

08 Roads, Railroads and Bridges

- The estimated costs for Roads, Railroads and Bridges in the Northern Alignment opinion of cost are the PFSAA VE13 Option C costs, used as a surrogate in lieu of itemizing new quantities for this cost category for the Northern Alignment Alternative. The Northern Alignment Alternative does not appear to require a different work scope for railroad bridges than VE13 Option C.

09 Channels & Canals

- For the Sheyenne River Aqueduct and features downstream of it, the estimated costs for Channels and Canals for the Northern Alignment Alternative are the PFSAA VE13 Option C costs, used as a surrogate in lieu of itemizing new quantities for this cost category for the Northern Alignment Alternative. This includes diversion channel reaches and hydraulic structures. The Northern Alignment Alternative does not appear to require a different work scope for these features than VE13 Option C.
- For features upstream of the Sheyenne River Aqueduct (commencing eastward from diversion centerline station 1514+00), estimated costs for the dam and connecting channel earthwork and ROW are based on conceptual civil grading quantities estimated based on the Northern Alignment Alternative. These quantities assume stripping/salvaging 12 inches of topsoil across the grading extents, a shrink factor of 0.85 ECY/BCY for dam embankments, and the same assumed proportions of Type 1, 2, 3 and 4 earthwork as presented for the corresponding features in the Proposed Project Alternative.
- The assumed permanent right-of-way is 30 feet offset from features. The assumed temporary right-of-way is 15 feet offset beyond the extent of the permanent right-of-way.
- The length of alignment between the Sheyenne River Aqueduct and the Inlet Weir is longer for the Northern Alignment Alternative (8,000 LF) than it is for Proposed Project Alternative (7,700 LF). See **Figure 1**.
- Reach 7 and 8 connecting channel costs are prorated based on a reach length of 5.1 miles (from the Inlet to the Red River of the North) and a unit project cost of \$960/LF, similar to the PFSAA cost estimates.
- The Control Structure on Red River is estimated based on the Proposed Project Alternative project cost, prorated at \$1,766,000/VLF to adjust for structure height, excludes \$5.2 million fish passage structures and is rounded to the nearest million dollars. The fish passage system cost from PFSAA VE13 Option C is used as a surrogate for this cost at the Northern Alignment Alternative. The estimated cost of civil site work at this structure is unchanged from the Proposed Project Alternative as micrositing work has not been performed for the Northern Alignment.
- The Control Structure on Wild Rice River is estimated based on the Proposed Project Alternative project cost, prorated at \$466,000/VLF to adjust for structure height, excludes \$4.3 million fish passage structures and is rounded to the nearest million dollars. The fish passage system cost from PFSAA VE13 Option C is used as a surrogate for this cost at the Northern Alignment Alternative. The estimated cost of civil site

work at this structure is unchanged from the Proposed Project Alternative as micrositing work has not been performed for the Northern Alignment.

- The East Weir at Connecting Channel is excluded from the Northern Alignment opinion of cost.
- The estimated cost of the Diversion Inlet Weir from PFSAA VE13 Option C is used as a surrogate for this cost at the Northern Alignment Alternative. The estimated cost for gates on the inlet weir is \$21 million and is based on the Final Technical Memorandum - FM Diversion Post-Feasibility Summary Report, referred to as the “bundles” report. The estimated cost of civil site work at this structure is unchanged from the Proposed Project Alternative as micrositing work has not been performed for the Northern Alignment Alternative.

11 Levees & Floodwalls

- The costs for four segments of dam embankment (CSAH17, INLET-WRR, WRR-RRN, RRN-MN) are estimated for the Northern Alignment Alternative based on excavation, embankment, topsoil and ROW quantity takeoffs developed by HMG, LLC using Civil3D grading models and unit costs from the PFSAA. These quantities assume stripping/salvaging 12 inches of topsoil across the grading extents assume a shrink factor of 0.85 ECY/BCY for dam embankments, and the same assumed proportions of Type 1, 2, 3 and 4 earthwork as presented for the corresponding features in the PFSAA VE13 Option C.
- The assumed top of dam elevation is 927.1. For comparison, the top of dam assumed for VE13 Option C from the PFSAA was 927.3. The pool elevation difference is due to the effect of shifting the Northern Alignment northward of the VE13 Option C Alignment. The assumed dam cross section is 15' top width, 4H:1V side slopes because dam height less than 20 feet. 5H:1V side slopes on the upstream side were not used because no significant reaches of dam exceeded 20 foot height for the Northern Alignment Alternative.
- The estimated costs for Road Raise for Levees in the Northern Alignment opinion of cost are the PFSAA VE13C costs, used as a surrogate in lieu of itemizing new quantities for this cost category for the Northern Alignment.
- The estimated \$29 million cost of the additional in-town levees from PFSAA VE13 Option C is used as a surrogate for this cost at the Northern Alignment Alternative. It is acknowledged that this estimated cost differs from more recent cost information developed for these features. However, for the purposes of this estimate is included to complete a comparative estimate of the Northern Alignment Alternative and the Proposed Alignment Alternative.
- The estimated costs for both the Proposed Project Alternative and the Northern Alignment Alternative includes estimated \$65 million construction cost for a OHB ring levee as referenced in Table 1 Oxbow, Hickson, and Bakke Area Levee Alternatives, page C-4, Appendix C - Oxbow/Hickson/Bakke Ring Levee.
- The estimated costs for the Proposed Project Alternative includes estimated \$4 million construction cost for a Comstock ring levee, as estimated by Houston Engineering / HMG. The Comstock ring levee costs are not included for the Northern Alignment Alternative.

14 Recreation Facilities (e.g. multi-purpose trails, soft trails, trail river crossing(s), trailhead facilities, parking lots, interpretive signage, landscaping other than site restoration)

- The estimated costs for Recreation Facilities in the Northern Alignment opinion of cost are the PFSAA VE13C costs, used as a surrogate in lieu of itemizing new quantities for this cost category for the Northern

Alignment.

30 Planning, Engineering and Design (PED)

- Where project-wide costs are presented, PED is estimated as 15% of construction costs. This assumption is consistent with Phase 4 April 2011 FRP. PED was recalculated based on the compilation of Northern Alignment estimated construction costs.

31 Construction Management (CM)

- Where project-wide costs are presented, CM is estimated as 7% of construction costs. This assumption is consistent with Phase 4 April 2011 FRP. CM was recalculated based on the compilation of Northern Alignment estimated construction costs.

Estimated time-value-of-money escalation costs are not included in the estimated costs presented in the PFSAA for the alignment alternatives.

Contingency generated by USACE cost risk analysis is included in the estimated costs presented in the PFSAA for the alignment alternatives. A contingency of 26% was assumed for construction features. This assumption is consistent with Phase 4 April 2011 FRP.

3 OPINION OF PROBABLE CONSTRUCTION COST

The opinion of cost for the Northern Alignment is summarized below.

3.1 OPINION OF PROBABLE CONSTRUCTION COST

A summary of estimated land acquisition costs for the Northern Alignment is summarized in **Table 3.1** below:

Table 3.1 Lands and Easements: Opinion of Cost Comparison Summary for ROW and Easements

Cost Category*	Proposed Project Alternative	Northern Alignment
Upstream Staging Area (\$)	234 million	295 million
East Alignment from Sheyenne Aqueduct to Inlet Weir (\$)	2 million	9 million
Sheyenne Aqueduct to Outlet to Red River of the North (\$)	29 million	29 million
Mitigation Area Easements	18 million	18 million
Total Land Cost (\$)	283 million	351 million

*For additional breakdown, see **Exhibit B**.

A comparison of estimated construction costs for the Northern Alignment Alternative and the Proposed Project Alternative is presented in **Table 3.2** below:

Table 3.2: Northern Alignment Alternative Opinion of Construction Cost Summary

Item Description	Proposed Project Alternative Project Cost (2010 dollars) <small>1 2 3 4 5 6 7 8 9 10 11</small>	Northern Alignment Alternative Project Cost (2010 dollars) <small>1 2 3 4 5 6 7 8 9 10</small>
1 Lands and Damages	283,000,000	351,000,000
2 Relocations	153,000,000	149,000,000
6 Fish and Wildlife Facilities	61,000,000	61,000,000
8 Roads, Railroads and Bridges	59,000,000	59,000,000
9 Channels and Canals	771,000,000	784,000,000
11 Levees and Floodwalls	162,000,000	163,000,000
14 Recreation Facilities	29,000,000	29,000,000
30 Planning, Engineering and Design (PED)	185,000,000	187,000,000
31 Construction Management (CM)	86,000,000	87,000,000
Total	1,789,000,000	1,870,000,000

¹ Costs are rounded to the nearest \$1 million.
² 2010 US Dollars (\$) construction costs; escalation is not included (estimate is not fully funded).
³ Methodology similar to PFSAA phase except where feature designs differ as stated in this report.
⁴ Contingency included. Contingency is an allowance for costs that will be in the Project Cost and are not included in the Contract Cost. Does not account for changed conditions either in the final design or during construction.
⁵ Changes to 2010 material, labor, equipment or fuel opinion of cost are not reflected in the project costs presented above.
⁶ Limited design work completed (<5%). Based on screening-level project definition. This screening-level (Class 5, <5% design completion per ASTM E 2516-06 and USACE EI 01D010 [9/1/97]) cost estimate is based on screening-level designs, alignments, quantities, and unit prices. Costs will change with completion of further design. A construction schedule is not available at this time. The estimated accuracy range for the total project cost as the project is defined is -50% to +100%.
⁷ Quantities based on design work completed.
⁸ Unit prices based on information available at this time from comparable projects.
⁹ Limited soil boring and field investigation information available.
¹⁰ Infrastructure bundles from the October 10, 2012 PFSAA are included in the estimated costs
¹¹ VE13A Project cost values referenced from FM Diversion Post-Feasibility Southern Alignment Analysis: VE-13, North of Wild Rice River, South of Oxbow dated Final - October 10, 2012 Exhibit H1. Updates included as noted in tech memo text.

A rough breakdown of costs by socio-economic modeling category is presented in **Table 3.3** below. The pro-rated percentages of Labor, Equipment and Materials are assumed based on the April 2011 Phase 4 LPP TPCS MII file provided by USACE applied to the compiled Northern Alignment Alternative opinion of cost. The Northern Alignment Alternative opinion of cost was developed outside of MII software.

Table 3.3: Northern Alignment Alternative Opinion of Construction Cost Economic Breakdown

Item Description	Northern Alignment Alternative Project Cost (2010 dollars) ^{1 2 3 4 5 6 7}
Labor	357,000,000
Equipment	328,000,000
Materials	350,000,000
Lands and Damages	351,000,000
Relocations	149,000,000
Fish & Wildlife Facilities	61,000,000
Planning, Engineering and Design (PED)	187,000,000
Construction Management (CM)	87,000,000
Total	1,870,000,000

¹ 2010 US Dollars (\$) construction costs; escalation is not included (estimate is not fully funded)

² Methodology similar to PFSAA phase except where feature designs differ.

³ Labor is assumed 34% of construction cost based on Phase 4 LPP MII file.

⁴ Equipment is assumed 32% of construction cost based on Phase 4 LPP MII file.

⁵ Materials is assumed 34% of construction cost based on Phase 4 LPP MII file.

⁶ PED is assumed 15% of construction cost.

⁷ CM is assumed 7% of construction cost.

For a detailed breakdown of estimated costs for each alternative see **Exhibit B** attached.

4 CONCLUSIONS

The opinion of cost for the Northern Alignment Alternative is \$81 million more than the opinion of cost developed for the Proposed Project Alternative as shown in Project Cost values referenced from the FM Diversion Post-Feasibility Southern Alignment Analysis: VE-13, North of Wild Rice River, South of Oxbow dated Final - October 10, 2012 Exhibit H1. Of this difference, an estimated \$68 million is due to changes to Lands and Damages costs associated with the dam and staging area.

5 CERTIFICATION

The preliminary analysis and conclusions provided are based on the limited data and project definition available at the time of this analysis. Using generally accepted engineering methods and practices, analyses have been performed using reasonable effort to characterize the site and proposed alternatives.

Certification:

I hereby certify that this memorandum was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of North Dakota.



Gregg Thielman, HMG, LLC

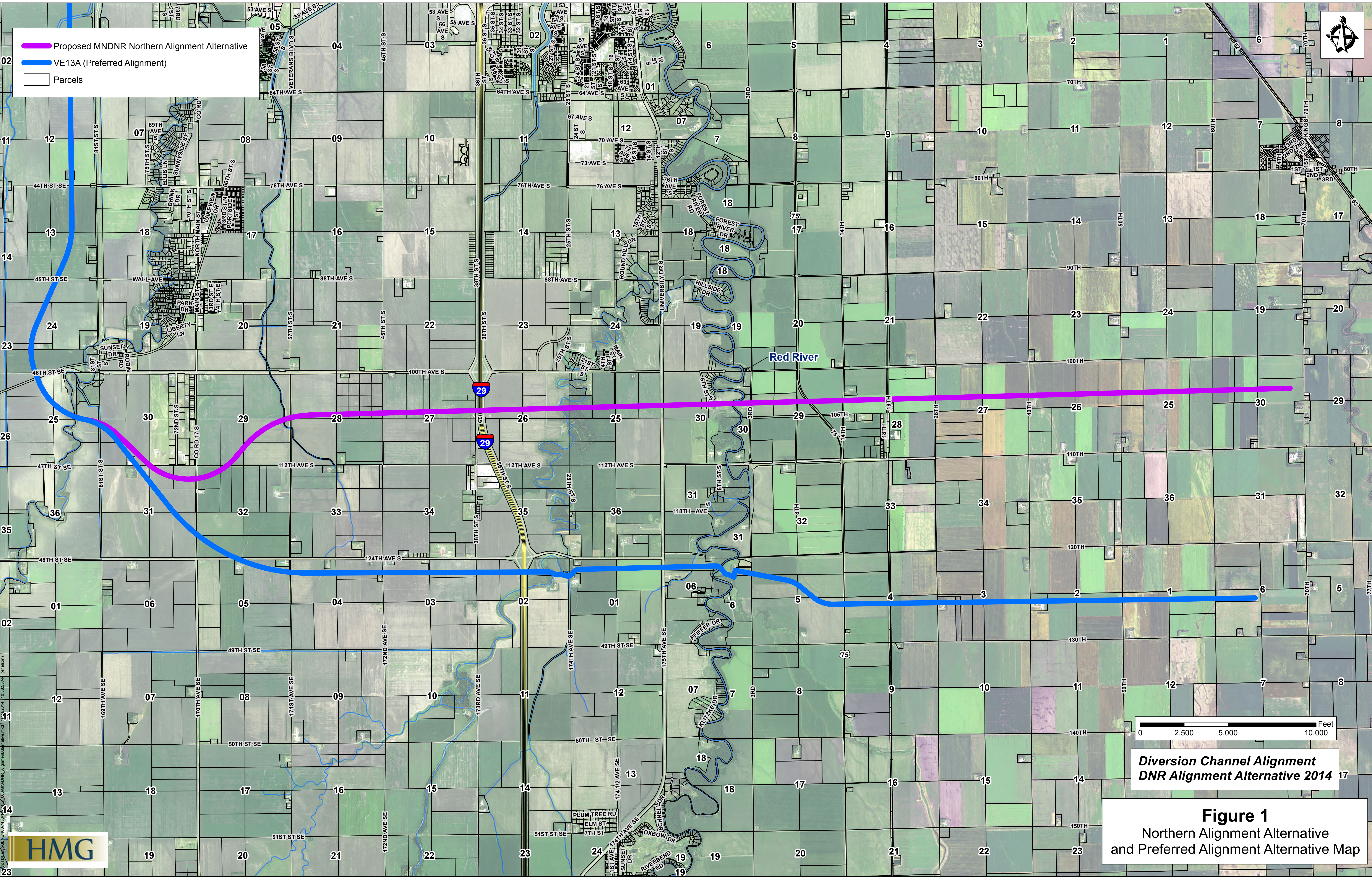
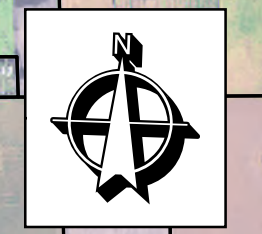
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Matt Metzger, HMG, LLC

PE #: 9064

— Proposed MNDNR Northern Alignment Alternative
— VE13A (Preferred Alignment)
 □ Parcels



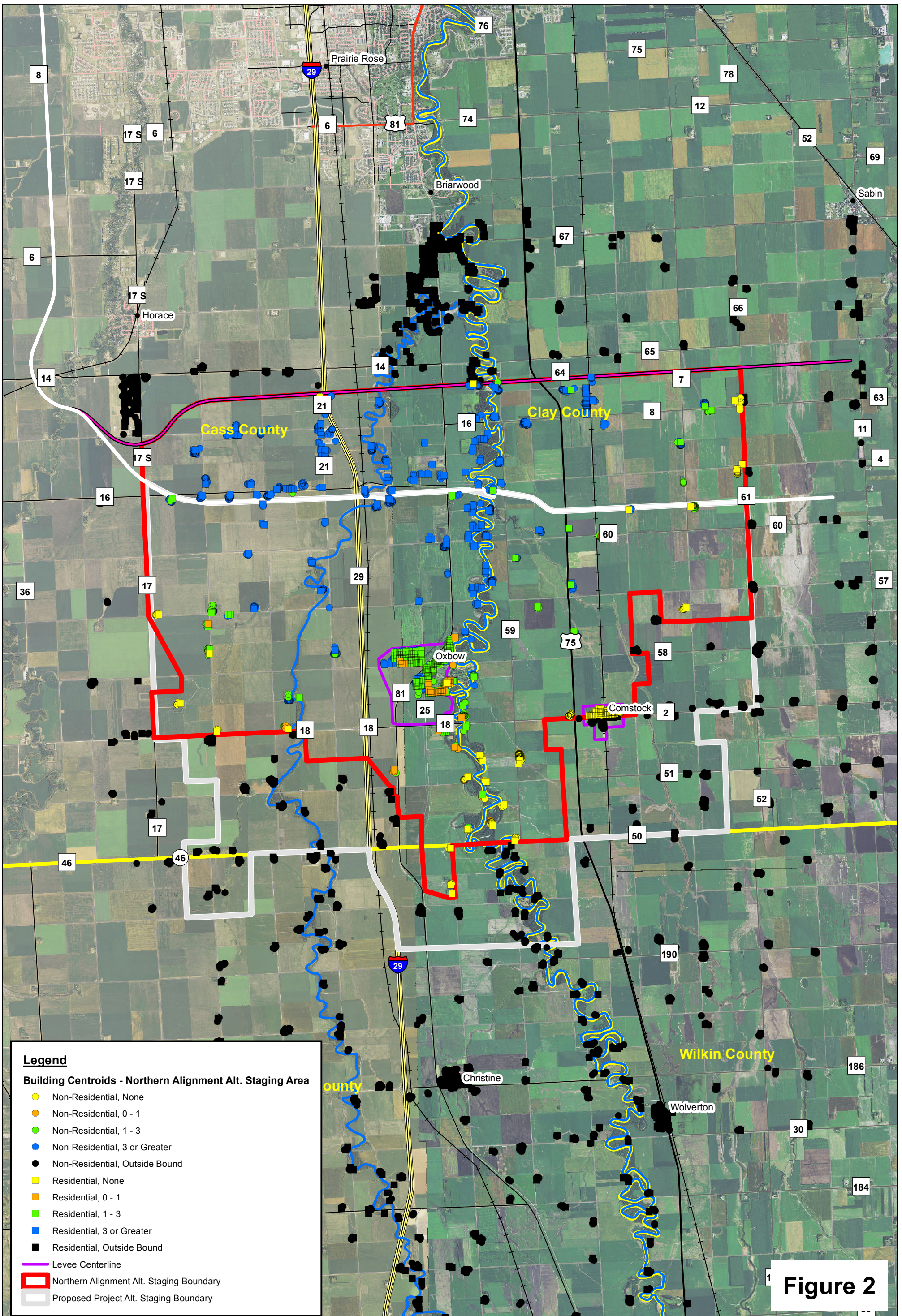
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**Diversion Channel Alignment
DNR Alignment Alternative 2014**

Figure 1
Northern Alignment Alternative
and Preferred Alignment Alternative Map

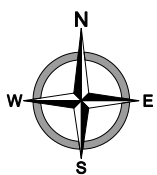


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1 **Figure 2**

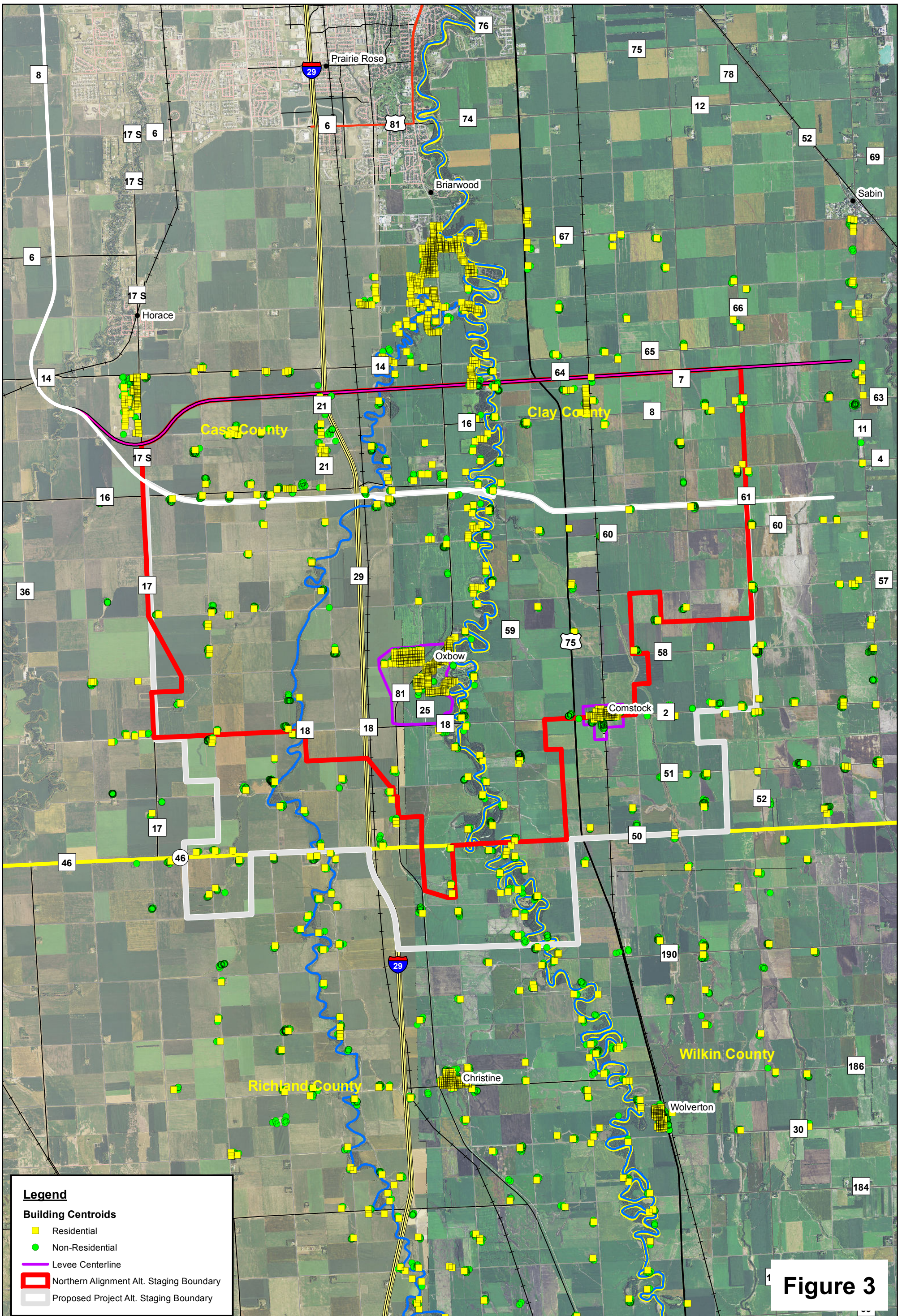
**Upstream 100 Year Inundation Analysis
Proposed Project & Northern Alt. Staging Areas
FM Flood Risk Management Project**



Northern Alignment Alternative
and Staging Area Map



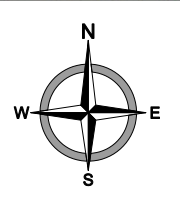
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1 **Figure 3**

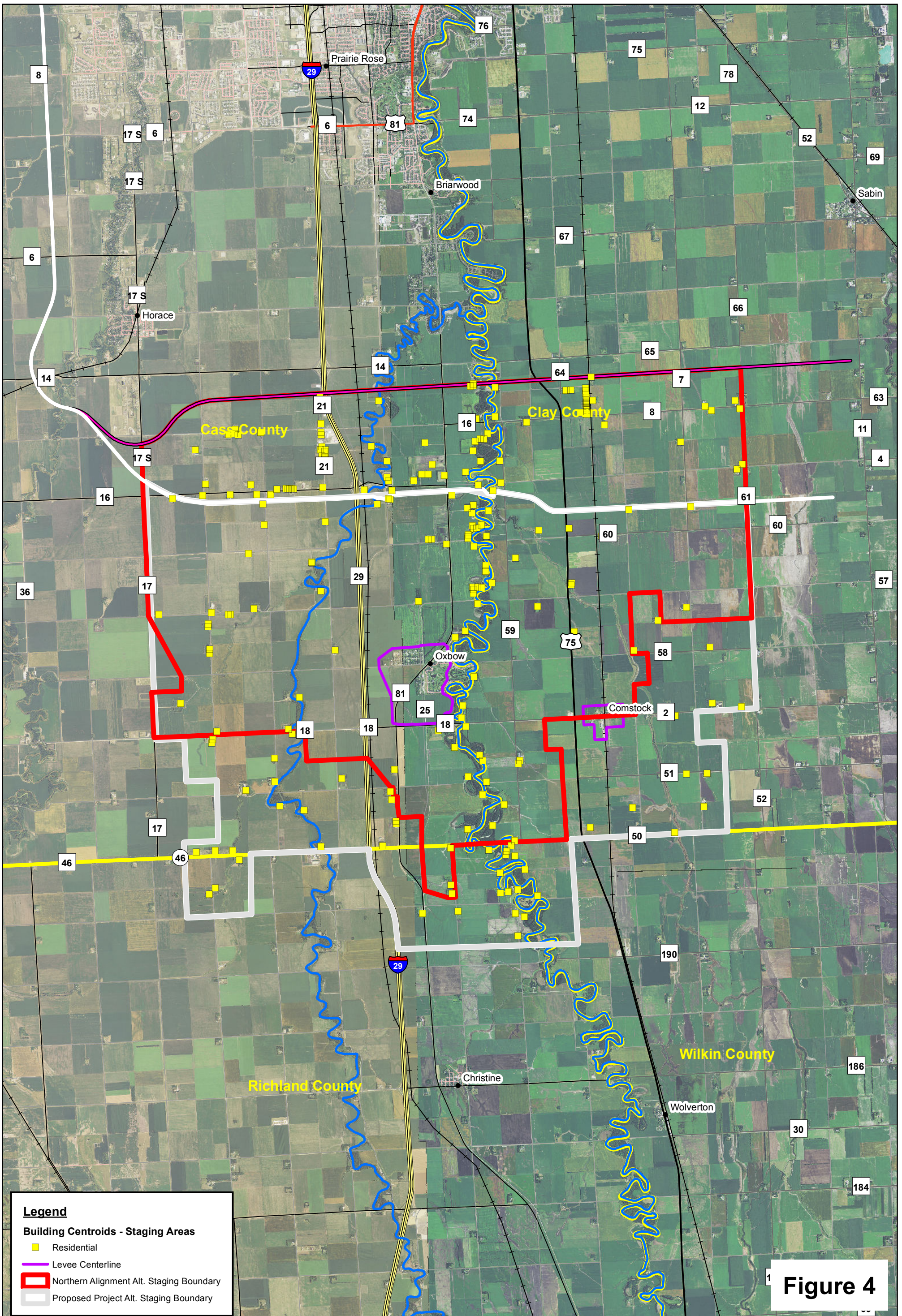
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FM Flood Risk Management Project**

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Structures
Residential & Non-Residential

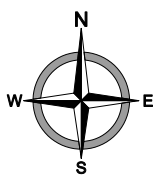




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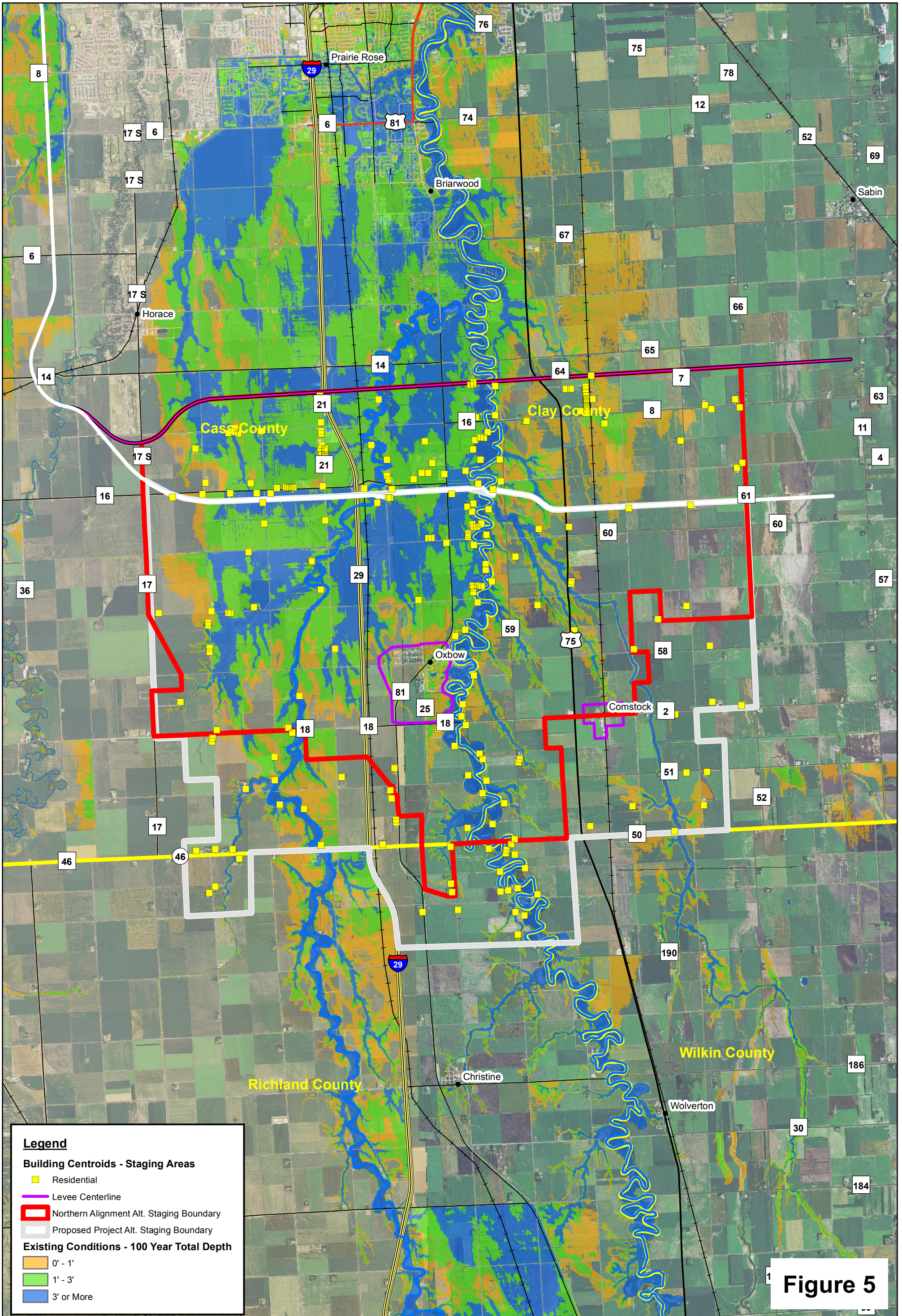
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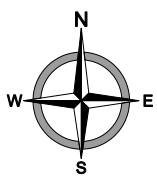
Proposed & Northern Alternative
Staging Area Structures
Residential





1 **Figure 5**

**Upstream 100 Year Inundation Analysis
Proposed Project & Northern Alt. Staging Areas
FM Flood Risk Management Project**



Proposed & Northern Alternative
Existing Conditions
Staging Area Structures
Residential



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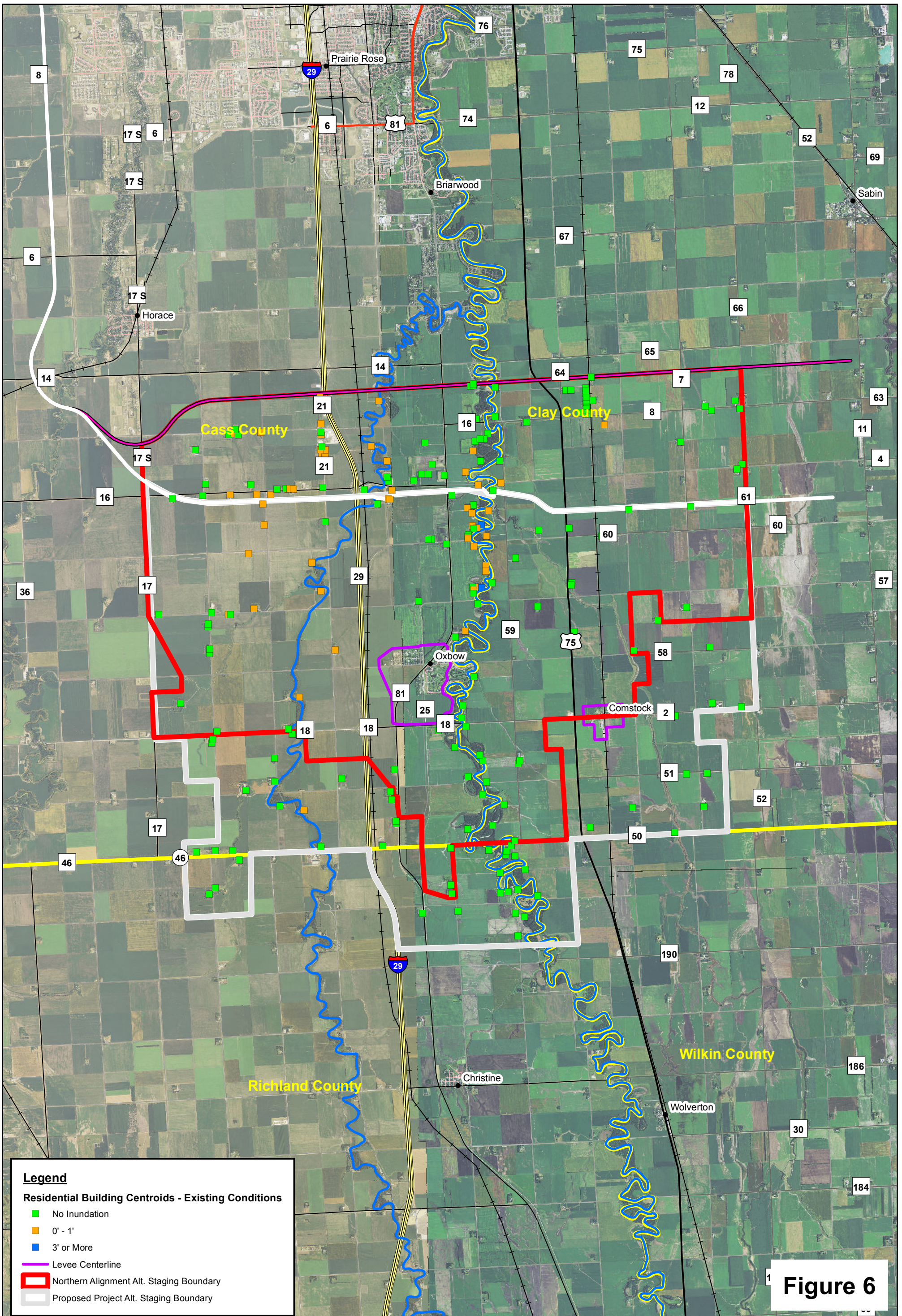
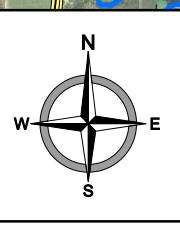


Figure 6

**Upstream 100 Year Inundation Analysis
Proposed Project & Northern Alt. Staging Areas
FM Flood Risk Management Project**

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Proposed & Northern Alternative
Existing Conditions
Staging Area Structures
Residential



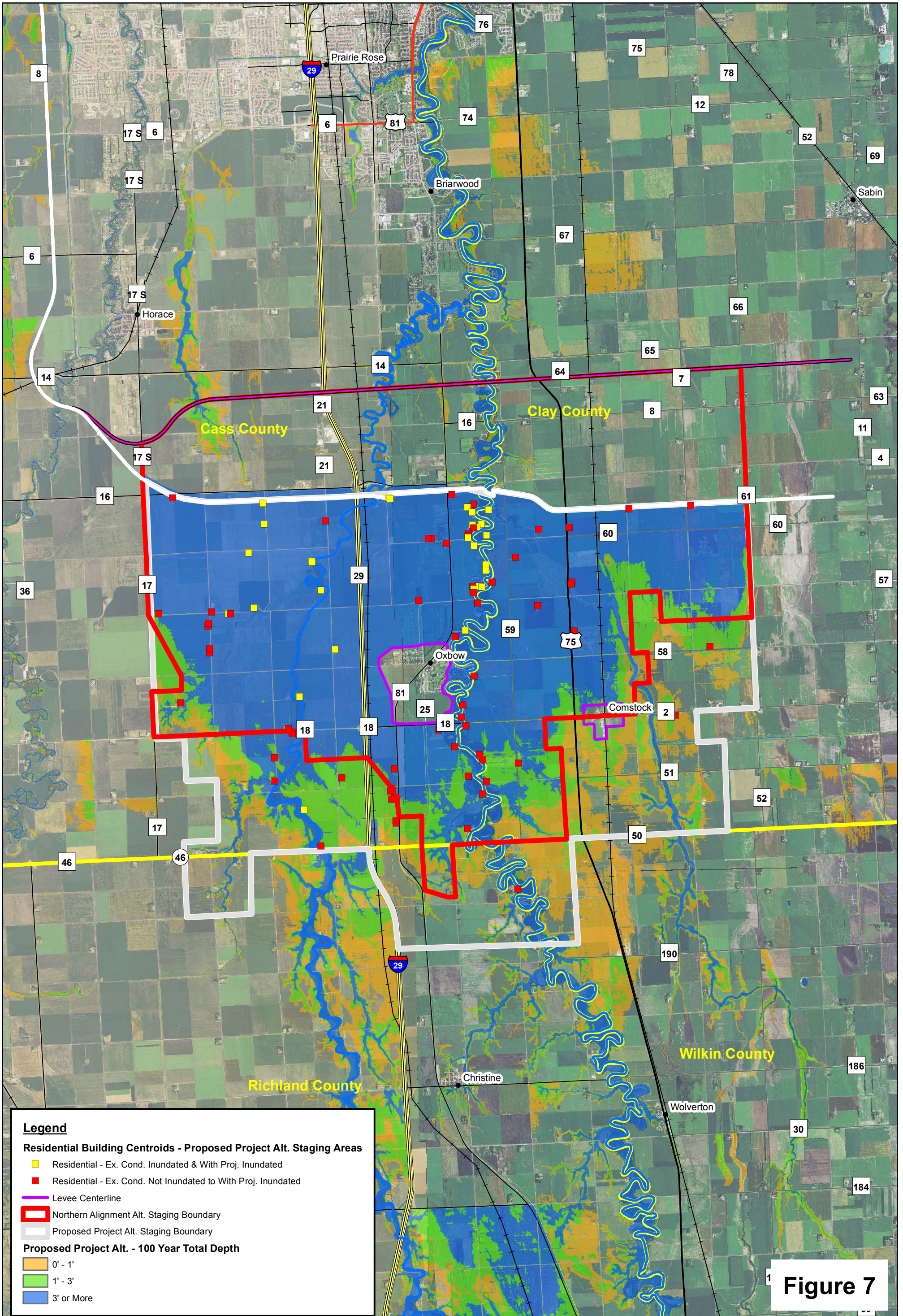
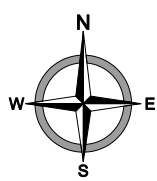


Figure 7

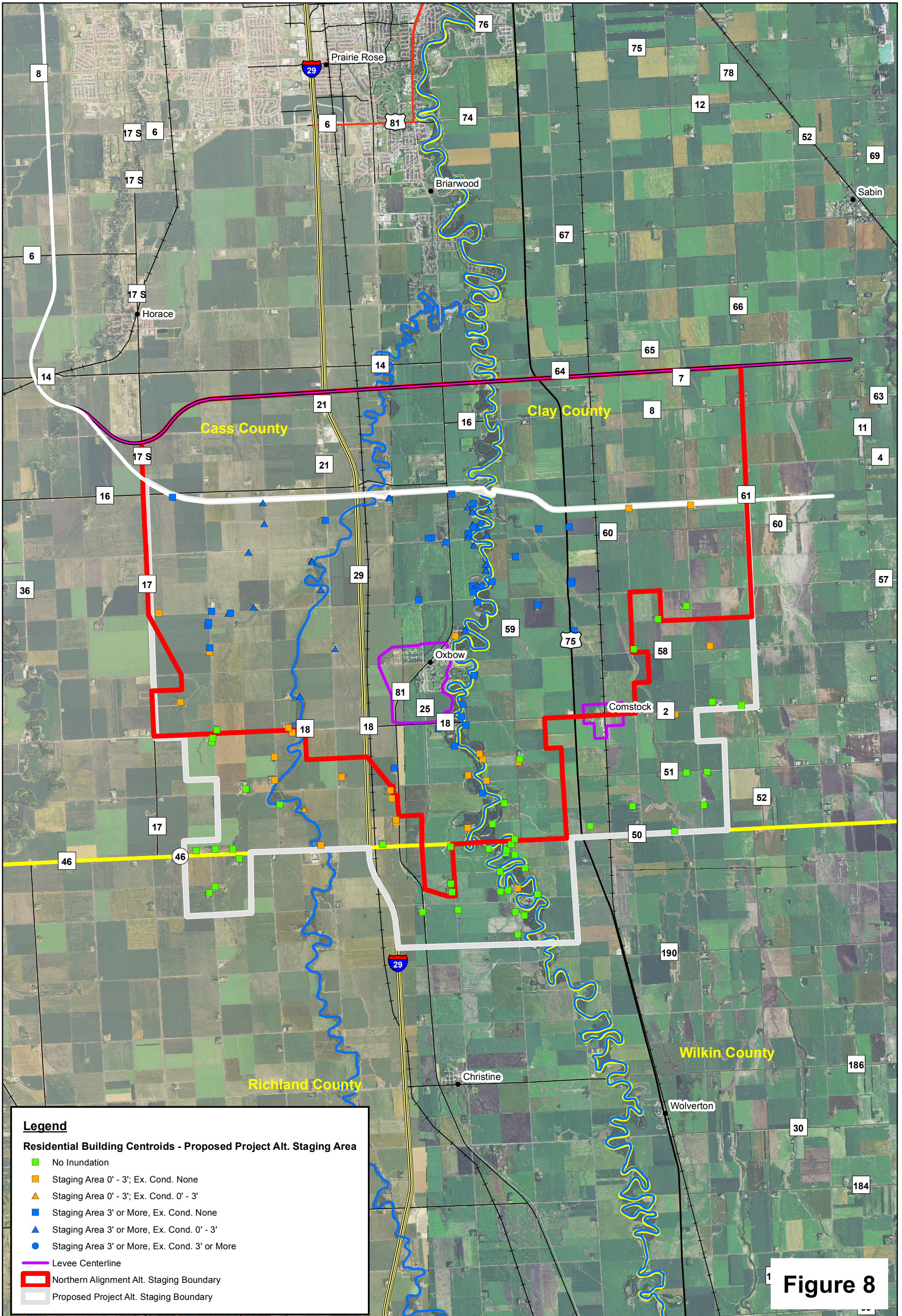
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FM Flood Risk Management Project**

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Proposed Project Alternative
Staging Area Structures
Residential

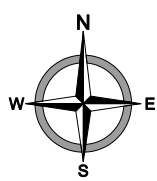




1 **Figure 8**

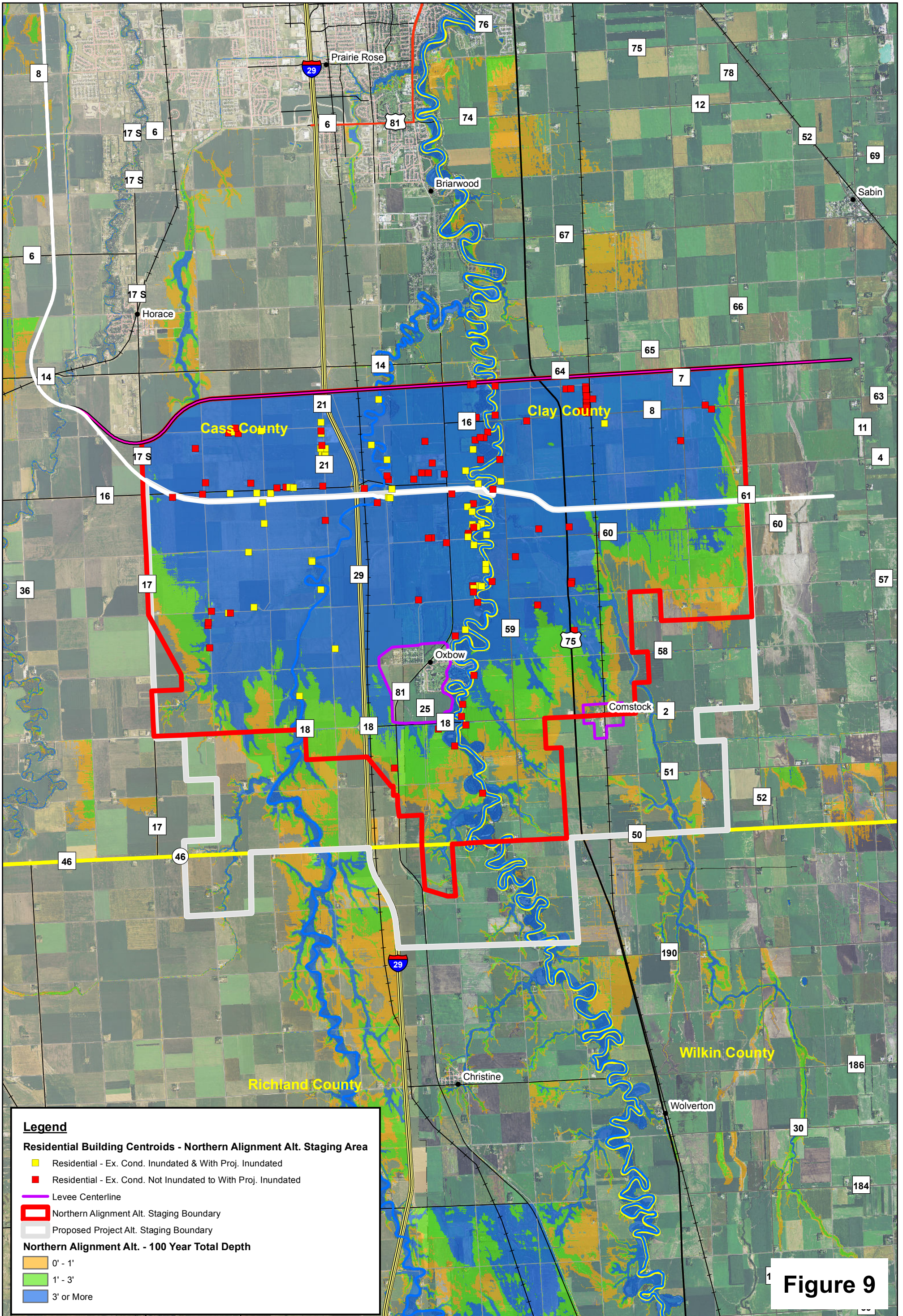
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FM Flood Risk Management Project**

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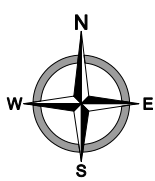
Proposed Project Alternative
Staging Area Structures
Residential





1 **Figure 9**

**Upstream 100 Year Inundation Analysis
Proposed Project & Northern Alt. Staging Areas
FM Flood Risk Management Project**



Northern Alignment Alternative
Staging Area Structures
Residential



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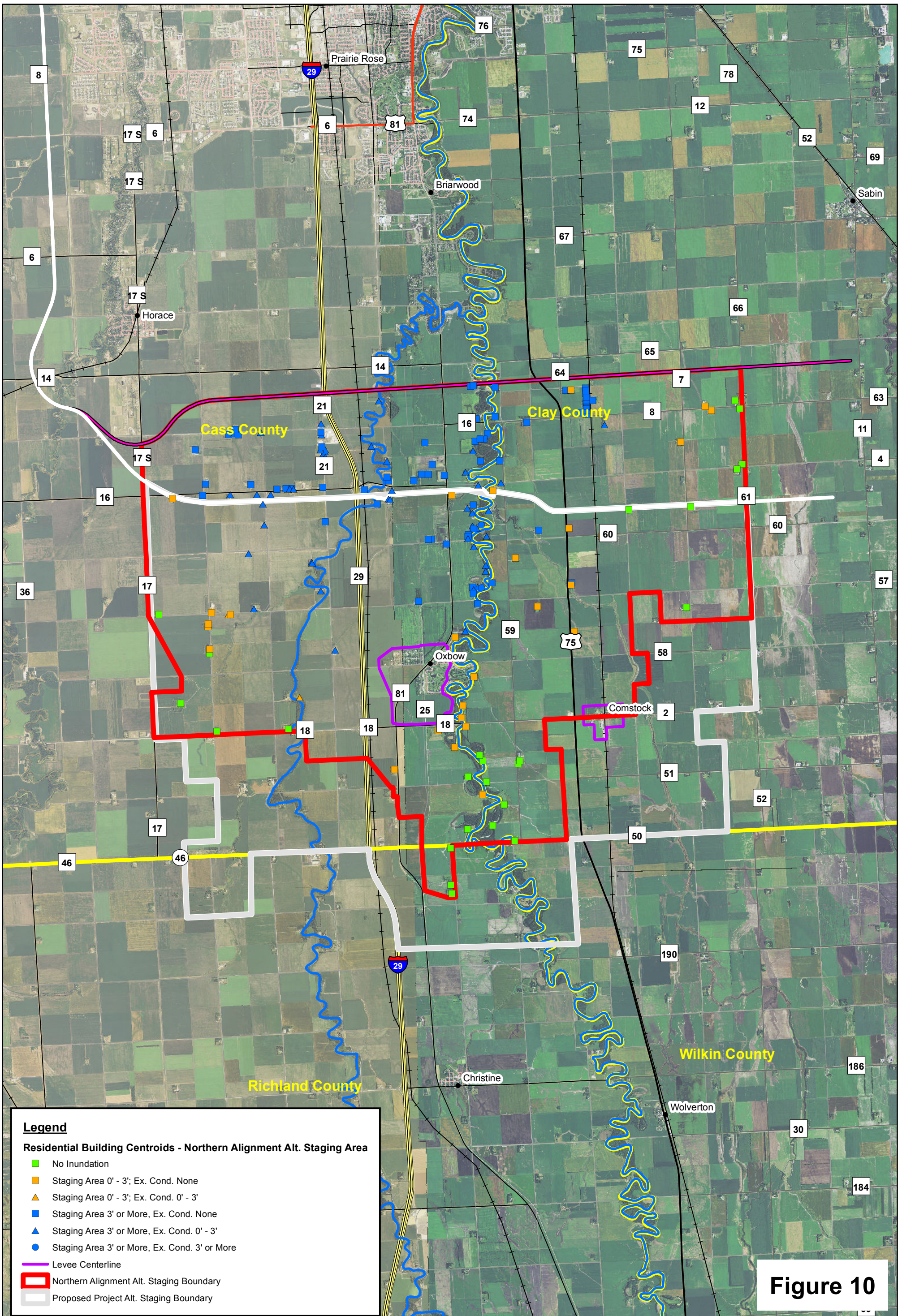


Figure 10

Legend

Residential Building Centroids - Northern Alignment Alt. Staging Area

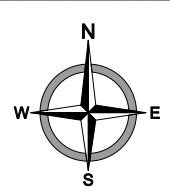
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- ▲ Staging Area 0' - 3'; Ex. Cond. 0' - 3'
- Staging Area 3' or More, Ex. Cond. None
- ▲ Staging Area 3' or More, Ex. Cond. 0' - 3'
- Staging Area 3' or More, Ex. Cond. 3' or More

— Levee Centerline

▭ Northern Alignment Alt. Staging Boundary

▭ Proposed Project Alt. Staging Boundary

**Upstream 100 Year Inundation Analysis
Proposed Project & Northern Alt. Staging Areas
FM Flood Risk Management Project**



Northern Alignment Alternative
Staging Area Structures
Residential



Created By: KMV Date Created: 06/11/14 Date Saved: 11/24/14 Date Plotted: NEVER Date Exported: 11/24/14
 Plotted By: kyle.volk Parcel Date: N/A Aerial Image: 2012 County NAIP SIDS Elevation Data: IW1 Lidar
 Horizontal Datum: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet Vertical Datum: NAVD1988
 T:\Projects\177001\17738\17738_211_ROW_Str_Analysis\17738_211_ROW_Str_Analysis_2014_09_18_Final.mxd

EXHIBIT A – LANDS AND DAMAGES OPINION OF COST DETAILED BREAKDOWN

Northern Alternative Scenario

Calculations for Sheyenne Structure Site to Inlet Weir								
Type of property	Value/acre or site	Number of acres/sites	Type of fee	Approx. # of sites		Total costs	Admin costs NFS	Admin Cost COE
Fee Acres	\$4,200.00	196	Fee	9.8		\$823,200.00	\$784,000.00	\$13,239.80
Perm Ease Acres	\$1,050.00	8	Easement	0.4		\$8,400.00	\$1,600.00	\$314.80
Non-Residential	\$150,000.00	0	fee			\$0.00	\$0.00	\$0.00
Non-Residential	\$15,000.00		Easement			\$0.00	\$0.00	\$0.00
Residential	\$250,000.00	0	Fee			\$0.00	\$0.00	\$0.00
Residential	\$20,000.00		Easement			\$0.00	\$0.00	\$0.00
						\$831,600.00	\$785,600.00	\$13,554.60
								\$1,630,754.60

Calculations for Inlet Weir U/S								
Type of property	Value/acre or site	Number of acres/sites	Type of fee	Approx. # of sites		Total costs	Admin costs NFS	Admin Cost COE
Fee Acres	\$4,200.00	453	Fee	22.65		\$1,902,600.00	\$1,812,000.00	\$30,600.15
Perm Ease Acres	\$1,050.00	44	Easement	2.2		\$46,200.00	\$8,800.00	\$1,731.40
Non-Residential	\$150,000.00	7	fee			\$1,050,000.00	\$49,000.00	\$4,809.00
Non-Residential	\$15,000.00		Easement			\$0.00	\$0.00	\$0.00
Residential	\$250,000.00	5	Fee			\$1,250,000.00	\$40,000.00	\$3,435.00
Residential	\$20,000.00		Easement			\$0.00	\$0.00	\$0.00
						\$4,248,800.00	\$1,909,800.00	\$40,575.55
								\$6,199,175.55

Calculations for Upstream Impacted areas								
Type of property	Value/acre or site	Number of acres/sites	Type of fee	Approx. # of sites		Total costs	Admin costs NFS	Admin Cost COE
Upstream Acres ⁽¹⁾	\$3,900.00	13,044	Fee	652.188		\$50,870,664.00	\$4,565,316.00	\$448,053.16
Upstream Acres ⁽²⁾	\$2,150.00	15,312	Fee	765.612		\$32,921,316.00	\$5,359,284.00	\$525,975.44
Upstream Acres ⁽³⁾	\$950.00	4,997	Easement	249.85		\$4,747,150.00	\$999,400.00	\$171,646.95
Non-Residential ⁽⁴⁾	\$140,000.00	677	fee			\$94,780,000.00	\$4,739,000.00	\$465,099.00
Non-Residential ⁽⁵⁾	\$14,000.00	94	Easement			\$1,316,000.00	\$80,000.00	\$64,578.00
Residential ⁽⁴⁾	\$245,000.00	132	Fee			\$32,340,000.00	\$1,056,000.00	\$90,684.00
Residential ⁽⁵⁾	\$16,000.00	20	Easement			\$320,000.00	\$80,000.00	\$13,740.00
						\$217,295,130.00	\$16,879,000.00	\$1,779,776.55
								\$235,953,906.55

Notes

- (1) 46% of acres with an inundation depth 3' or Greater & 50% of acres with inundation depth 1'-3'
- (2) 54% of acres with an inundation depth 3' or Greater & 50% of acres with inundation depth 1'-3'
- (3) Inundation depth 0'-1' & 50% of acres with inundation depth 1'-3'
- (4) Inundation depth 3' or Greater & 50% of structures with inundation depth 1'-3'
- (5) Inundation depth 0'-1' & 50% of structures with inundation depth 1'-3'

Sheyenne Structure Site to Inlet Weir			
	Federal Costs	NFS Costs	TOTAL
Lands/Damages	-	\$831,600.00	\$831,600.00
RE Administrative Costs	\$13,554.60	\$785,600.00	\$799,154.60
Total	\$13,554.60	\$1,617,200.00	\$1,630,754.60
Contingencies (25%)	\$3,388.65	\$404,300.00	\$407,688.65
Total	\$16,943.25	\$2,021,500.00	\$2,038,443.25
Inlet Weir U/S			
	Federal Costs	NFS Costs	TOTAL
Lands/Damages	-	\$4,248,800.00	\$4,248,800.00
RE Administrative Costs	\$40,575.55	\$1,909,800.00	\$1,950,375.55
Total	\$40,575.55	\$6,158,600.00	\$6,199,175.55
Contingencies (25%)	\$10,143.89	\$1,539,650.00	\$1,549,793.89
Total	\$50,719.44	\$7,698,250.00	\$7,748,969.44
UPSTREAM IMPACTED AREA			
	Federal Costs	NFS Costs	TOTAL
Lands/Damages	-	\$217,295,130.00	\$217,295,130.00
RE Administrative Costs	\$1,779,776.55	\$16,879,000.00	\$18,658,776.55
Total	\$1,779,776.55	\$234,174,130.00	\$235,953,906.55
Contingencies (25%)	\$444,944.14	\$58,543,532.50	\$58,988,476.64
Total	\$2,224,720.69	\$292,717,662.50	\$294,942,383.19

Exhibit A

**Lands and Damages
Opinion of Cost Breakdown**

Proposed Alignment Alternative

Calculations for Sheyenne Structure Site to Inlet Weir								
Type of property	Value/acre or site	Number of acres/sites	Type of fee	Approx. # of sites		Total costs	Admin costs NFS	Admin Cost COE
Fee Acres	\$4,200.00	170	Fee	8.5		\$714,000.00	\$680,000.00	\$11,483.50
Perm Ease Acres	\$1,050.00	5	Easement	0.3		\$5,250.00	\$1,000.00	\$196.75
Non-Residential	\$150,000.00	0	fee			\$0.00	\$0.00	\$0.00
Non-Residential	\$15,000.00		Easement			\$0.00	\$0.00	\$0.00
Residential	\$250,000.00	0	Fee			\$0.00	\$0.00	\$0.00
Residential	\$20,000.00		Easement			\$0.00	\$0.00	\$0.00
						\$719,250.00	\$681,000.00	\$11,680.25
								\$1,411,930.25

Calculations for Inlet Weir U/S								
Type of property	Value/acre or site	Number of acres/sites	Type of fee	Approx. # of sites		Total costs	Admin costs NFS	Admin Cost COE
Fee Acres	\$4,200.00	717	Fee	35.9		\$3,011,400.00	\$2,868,000.00	\$48,433.35
Perm Ease Acres	\$1,050.00	62	Easement	3.1		\$65,100.00	\$12,400.00	\$2,439.70
Non-Residential	\$150,000.00	11	fee			\$1,650,000.00	\$77,000.00	\$7,557.00
Non-Residential	\$15,000.00		Easement			\$0.00	\$0.00	\$0.00
Residential	\$250,000.00	3	Fee			\$750,000.00	\$24,000.00	\$2,061.00
Residential	\$20,000.00		Easement			\$0.00	\$0.00	\$0.00
						\$5,476,500.00	\$2,981,400.00	\$60,491.05
								\$8,518,391.05

Calculations for Upstream Impacted areas								
Type of property	Value/acre or site	Number of acres/sites	Type of fee	Approx. # of sites		Total costs	Admin costs NFS	Admin Cost COE
Upstream Acres ⁽¹⁾	\$3,900.00	11,887	Fee	594.4		\$46,359,300.00	\$4,160,450.00	\$408,318.45
Upstream Acres ⁽²⁾	\$2,150.00	13,955	Fee	697.8		\$30,003,250.00	\$4,884,250.00	\$479,354.25
Upstream Acres ⁽³⁾	\$950.00	6,413	Easement	320.6		\$6,091,944.26	\$1,282,514.58	\$220,271.88
Non-Residential ⁽⁴⁾	\$140,000.00	434	Easement			\$60,760,000.00	\$3,038,000.00	\$298,158.00
Non-Residential ⁽⁵⁾	\$14,000.00	162	Easement			\$2,268,000.00	\$80,000.00	\$111,294.00
Residential ⁽⁴⁾	\$245,000.00	71	Fee			\$17,395,000.00	\$568,000.00	\$48,777.00
Residential ⁽⁵⁾	\$16,000.00	20	Easement			\$320,000.00	\$80,000.00	\$13,740.00
						\$163,197,494.26	\$14,093,214.58	\$1,579,913.58
								\$178,870,622.43

Notes

- (1) 46% of acres with an inundation depth 3' or Greater & 50% of acres with inundation depth 1'-3'
- (2) 54% of acres with an inundation depth 3' or Greater & 50% of acres with inundation depth 1'-3'
- (3) Inundation depth 0'-1' & 50% of acres with inundation depth 1'-3'
- (4) Inundation depth 3' or Greater & 50% of structures with inundation depth 1'-3'
- (5) Inundation depth 0'-1' & 50% of structures with inundation depth 1'-3'

Sheyenne Structure Site to Inlet Weir			
	Federal Costs	NFS Costs	TOTAL
Lands/Damages	-	\$719,250.00	\$719,250.00
RE Administrative Costs	\$11,680.25	\$681,000.00	\$692,680.25
Total	\$11,680.25	\$1,400,250.00	\$1,411,930.25
Contingencies (25%)	\$2,920.06	\$350,062.50	\$352,982.56
Total	\$14,600.31	\$1,750,312.50	\$1,764,912.81
Inlet Weir U/S			
	Federal Costs	NFS Costs	TOTAL
Lands/Damages	-	\$5,476,500.00	\$5,476,500.00
RE Administrative Costs	\$60,491.05	\$2,981,400.00	\$3,041,891.05
Total	\$60,491.05	\$8,457,900.00	\$8,518,391.05
Contingencies (25%)	\$15,122.76	\$2,114,475.00	\$2,129,597.76
Total	\$75,613.81	\$10,572,375.00	\$10,647,988.81
UPSTREAM IMPACTED AREA			
	Federal Costs	NFS Costs	TOTAL
Lands/Damages	-	\$163,197,494.26	\$163,197,494.26
RE Administrative Costs	\$1,579,913.58	\$14,093,214.58	\$15,673,128.16
Total	\$1,579,913.58	\$177,290,708.85	\$178,870,622.43
Contingencies (25%)	\$394,978.39	\$44,322,677.21	\$44,717,655.61
Total	\$1,974,891.97	\$221,613,386.06	\$223,588,278.03

Exhibit A

**Lands and Damages
Opinion of Cost Breakdown**

EXHIBIT B – NORTHERN ALIGNMENT ALTERNATIVE OPINION OF COST

Exhibit B

MN EIS Northern Alignment OPC Summary

January 9, 2015

Technical Memorandum

Opinion of Probable Construction Cost to Support MN/DNR EIS Northern Alignment Evaluation
 Fargo-Moorhead Metro Flood Risk Management Project

Notes: Opinion of cost below includes contingency

WBS Feature Code	Description	Proposed Alt. VE13A w/ Updates Project Cost		Northern Alignment Alt. Alignment by Mn DNR Project Cost		Notes
1	LANDS & DAMAGES					
	ROW and Easements - Diversion Channel (D/S of Sta. 1514+00 at Sheyenne River Hydraulic Structure Site)	Revised (USACE & MEI)	29,051,500	Assume Same Cost as Preferred Alternative	29,051,500	2,3,4,5,6
	ROW and Easements - Diversion Channel (U/S of Sta. 1514+00 from Sheyenne Structure Site to Inlet Weir)	Revised (USACE & MEI); updated structure dataset	1,764,912	Revised (USACE & MEI)	2,038,443	2,3,4,5,6
	ROW and Easements - Levee Embankments and Connecting Channel (From Inlet Weir U/S)	Revised (USACE & MEI); updated structure dataset	10,647,988	Not Broken Down Separately	N/A	
	ROW and Easements - Upstream Storage Area (U/S of Inlet Weir)	Revised (USACE & MEI); updated structure dataset	223,558,278	Not Broken Down Separately	N/A	
	ROW and Easements - Upstream Levees and Connecting Channel (U/S of inlet weir, not including staging area)	N/A	N/A	Revised (USACE & MEI)	7,748,969	2,3,4,5,6
	ROW and Easements - Upstream Storage Area, Levees and Connecting Channel (U/S of Inlet Weir)	N/A	N/A	Revised (USACE & MEI)	294,942,383	2,3,4,5,6
	MITIGATION AREA EASEMENTS					
	Acquisition of Aquatic Mitigation Easements	No Change From Phase 4 FRP	10,155,600	No Change From Phase 4 FRP	10,155,600	1
	Acquisition of Wetlands Impacts Mitigation Easements	No Change From Phase 4 FRP	6,287,400	No Change From Phase 4 FRP	6,287,400	1
Acquisition of Riparian Forest Footprint Mitigation Easement	No Change From Phase 4 FRP	1,253,700	No Change From Phase 4 FRP	1,253,700	1	
2	RELOCATIONS					
	UTILITY RELOCATIONS					
	Electric Power	No Change From Phase 4 FRP	9,921,400	No Change From Phase 4 FRP	9,921,400	1
	Natural Gas Pipeline	No Change From Phase 4 FRP	997,600	No Change From Phase 4 FRP	997,600	1
	Petroleum Pipelines	No Change From Phase 4 FRP	1,016,000	No Change From Phase 4 FRP	1,016,000	1
	Fiber Optic Lines	No Change From Phase 4 FRP	5,376,400	No Change From Phase 4 FRP	5,376,400	1
	Water Utilities	No Change From Phase 4 FRP	2,313,000	No Change From Phase 4 FRP	2,313,000	1
	Sanitary Sewer	No Change From Phase 4 FRP	369,400	No Change From Phase 4 FRP	369,400	1
	ROADWAY BRIDGES, ROAD RAISES RAISES & LOCAL ROAD CONSTRUCTION					
	173rd Avenue SE 1	No Change From Phase 4 FRP	3,628,800	No Change From Phase 4 FRP	3,628,800	1
	25th Street SE	No Change From Phase 4 FRP	3,654,000	No Change From Phase 4 FRP	3,654,000	1
	County Hwy 81 (North)	No Change From Phase 4 FRP	4,233,600	No Change From Phase 4 FRP	4,233,600	1
	Interstate 29 (NB-North)	No Change From Phase 4 FRP	4,699,800	No Change From Phase 4 FRP	4,699,800	1
	Interstate 29 (SB-North)	No Change From Phase 4 FRP	4,687,200	No Change From Phase 4 FRP	4,687,200	1
	28th Street SE	No Change From Phase 4 FRP	3,578,400	No Change From Phase 4 FRP	3,578,400	1
	31st Street SE	No Change From Phase 4 FRP	3,641,400	No Change From Phase 4 FRP	3,641,400	1
	33rd Street SE	No Change From Phase 4 FRP	4,485,600	No Change From Phase 4 FRP	4,485,600	1
	36th Street SE	No Change From Phase 4 FRP	4,170,600	No Change From Phase 4 FRP	4,170,600	1
	Interstate 94 (WB)	No Change From Phase 4 FRP	4,649,400	No Change From Phase 4 FRP	4,649,400	1
	Interstate 94 (EB)	No Change From Phase 4 FRP	4,649,400	No Change From Phase 4 FRP	4,649,400	1

Exhibit B

MN EIS Northern Alignment OPC Summary

January 9, 2015

Technical Memorandum

Opinion of Probable Construction Cost to Support MN/DNR EIS Northern Alignment Evaluation
 Fargo-Moorhead Metro Flood Risk Management Project

Notes: Opinion of cost below includes contingency

WBS Feature Code	Description	Proposed Alt. VE13A w/ Updates Project Cost	Northern Alignment Alt. Alignment by Mn DNR Project Cost	Notes
	41st Street SE	No Change From Phase 4 FRP 4,447,800	No Change From Phase 4 FRP 4,447,800	1
	44th Street SE	No Change From Phase 4 FRP 3,792,600	No Change From Phase 4 FRP 3,792,600	1
	46th Street SE	No Change From Phase 4 FRP 4,132,800	No Change From Phase 4 FRP 4,132,800	1
	170th Avenue SE	No Change From Phase 4 FRP 3,465,000	No Change From Phase 4 FRP 3,465,000	1
	48th Street SE	Revised 3,805,200	Feature Eliminated 0	
	52nd St. SE	N/A N/A	N/A N/A	
	Interstate 29 (SB-South)	No Change From Phase 4 FRP 4,599,000	No Change From Phase 4 FRP 4,599,000	1
	Interstate 29 (NB-South)	No Change From Phase 4 FRP 4,611,600	No Change From Phase 4 FRP 4,611,600	1
	County Hwy 81 (South)	No Change from PFSAA 3,225,600	No Change from PFSAA 3,225,600	1
	ROAD RAISES			
	Road Raise for I-29	Revised 42,632,100	Revised 42,585,480	2,3,4,5,6
	Road Raise for Hwy 75 over Tie-back Levee	Revised 6,332,760	Revised 5,769,540	2,3,4,5,6
	Road Raise - Rail Road over Tie-back Levee	Revised 3,331,440	Revised 2,926,980	2,3,4,5,6
	Road Raise - Highway 81	N/A N/A	N/A N/A	1
	Road Raise - County Road 16	New Item 1,501,920	N/A N/A	1
	Road Raise - Highway 46	N/A N/A	N/A N/A	1
	General	New Item 331,380	New Item 315,000	
	LOCAL ROAD CONSTRUCTION			
	Local Road Construction	N/A 1,175,200	N/A 2,576,700	2,3,4,5,6
6	FISH AND WILDLIFE FACILITIES			
	Aquatic Impacts Mitigation	No Change From Phase 4 FRP 3,172,900	No Change From Phase 4 FRP 3,172,900	1
	Fish Bypass Channel Optimization - Red River & Wild Rice River	No Change From Phase 4 FRP 31,941,000	No Change From Phase 4 FRP 31,941,000	1
	Wetland Impacts Mitigation	No Change From Phase 4 FRP 17,290,400	No Change From Phase 4 FRP 17,290,400	1
	Riparian Forest Impacts Mitigation	No Change From Phase 4 FRP 2,896,100	No Change From Phase 4 FRP 2,896,100	1
	Adaptive Management	No Change From Phase 4 FRP 5,254,200	No Change From Phase 4 FRP 5,254,200	1
8	ROADS, RAILROADS AND BRIDGES			
	Railroad Bridges	No Change From Phase 4 FRP 58,586,800	No Change From Phase 4 FRP 58,586,800	1
9	CHANNELS AND CANALS			
	Reach 1 - 2012	No Change From Phase 4 FRP 1,633,400	No Change From Phase 4 FRP 1,633,400	1
	Reach 2 - 2013	No Change From Phase 4 FRP 4,854,100	No Change From Phase 4 FRP 4,854,100	1
	Reach 3 - 2014	No Change From Phase 4 FRP 35,768,200	No Change From Phase 4 FRP 35,768,200	1
	Reach 4 - 2015	No Change From Phase 4 FRP 123,448,700	No Change From Phase 4 FRP 123,448,700	1
	Reach 5 - 2016	No Change From Phase 4 FRP 28,860,600	No Change From Phase 4 FRP 28,860,600	1
	Reach 6 - 2017 Downstream of Sta. 1514+00 (Sheyenne)	No Change From Phase 4 FRP 173,558,300	No Change From Phase 4 FRP 173,558,300	1
	Reach6 - 2017 Upstream of Sta. 1514+00 (Sheyenne) to Inlet Weir	Revised Alignment 33,856,907	Revise Alignment 34,856,233	
	Reach 7 - 2018	Feature Eliminated N/A	Feature Eliminated N/A	1
	Reach 8 - 2019	Feature Eliminated N/A	Feature Eliminated N/A	1

Exhibit B

MN EIS Northern Alignment OPC Summary

January 9, 2015

Technical Memorandum

Opinion of Probable Construction Cost to Support MN/DNR EIS Northern Alignment Evaluation
 Fargo-Moorhead Metro Flood Risk Management Project

Notes: Opinion of cost below includes contingency

WBS Feature Code	Description	Proposed Alt. VE13A w/ Updates Project Cost	Northern Alignment Alt. Alignment by Mn DNR Project Cost	Notes
	Reach 7 and 8 Revised	New Item 25,051,088	New Item 25,728,000	2,3,4,5,6
	Control Structure on Red River	Revised 54,899,000	Revised 59,000,000	2,3,4,5,6
	Control Structure on Red River - Fish Passage Ramp	DEDUCTION DUE TO ALTERNATE MITIGATION -7,603,470	DEDUCTION DUE TO ALTERNATE MITIGATION -5,185,417	2,3,4,5,6
	Hydraulic Structure at Wolverton Creek	Feature Eliminated N/A	Feature Eliminated N/A	1
	Hydraulic Structure at Wild Rice River	Revised 41,961,000	Revised 45,700,000	2,3,4,5,6
	Hydraulic Structure at Wild Rice River Fish Passage Ramp	DEDUCTION DUE TO ALTERNATE MITIGATION -6,291,243	DEDUCTION DUE TO ALTERNATE MITIGATION -4,290,504	2,3,4,5,6
	Hydraulic Structure - East Weir (at Connecting Channel)	No Change From Phase 4 FRP 271,800	No Change From Phase 4 FRP 271,800	1
	Hydraulic Structure - Inlet Weir to Diversion	Revised 13,776,000	Revised 13,478,000	2,3,4,5,6
	Hydraulic Structure - Inlet Weir to Diversion Gates	21,000,000	21,000,000	2,3,4,5,6
	Hydraulic Structures at Sheyenne River	No Change From Phase 4 FRP 64,015,300	No Change From Phase 4 FRP 64,015,300	1
	Hydraulic Structure - Drain 14 - Large Drain Structure	No Change From Phase 4 FRP 10,556,500	No Change From Phase 4 FRP 10,556,500	1
	Hydraulic Structures at Maple River	No Change From Phase 4 FRP 57,707,500	No Change From Phase 4 FRP 57,707,500	1
	Hydraulic Structures at Lower Rush River	No Change From Phase 4 FRP 22,357,000	No Change From Phase 4 FRP 22,357,000	1
	Hydraulic Structures at Rush River	No Change From Phase 4 FRP 22,314,300	No Change From Phase 4 FRP 22,314,300	1
	Small Drain Structures (2)	No Change From Phase 4 FRP 320,500	No Change From Phase 4 FRP 320,500	1
	Large Drain Structure (1)	No Change From Phase 4 FRP 563,700	No Change From Phase 4 FRP 563,700	1
	Side Channel Inlets 1x72" (19)	No Change From Phase 4 FRP 10,650,900	No Change From Phase 4 FRP 10,650,900	1
	Side Channel Inlets 2x72" (7)	No Change From Phase 4 FRP 7,134,500	No Change From Phase 4 FRP 7,134,500	1
	Outlet to Red River	No Change From Phase 4 FRP 28,607,600	No Change From Phase 4 FRP 28,607,600	1
	Diversion Channel Landscape Plantings	No Change From Phase 4 FRP 1,383,500	No Change From Phase 4 FRP 1,383,500	1
11	LEVEES AND FLOODWALLS			
	Tie-Back Levee - TBL East 2B (Constructed in MN)	Deleted and Replace w/ New Reach N/A	Deleted and Replace w/ New Reach N/A	1
	Tie-Back Levee - TBL Cass 17 (Constructed in ND)	Deleted and Replace w/ New Reach N/A	Deleted and Replace w/ New Reach N/A	1
	Levee - Connecting Channel - Reach 2018 (ND-23, 26)	Deleted and Replace w/ New Reach N/A	Deleted and Replace w/ New Reach N/A	1
	Levee - Connecting Channel - Reach 2019 (ND-25)	Deleted and Replace w/ New Reach N/A	Deleted and Replace w/ New Reach N/A	1

Exhibit B

MN EIS Northern Alignment OPC Summary

January 9, 2015

Technical Memorandum

Opinion of Probable Construction Cost to Support MN/DNR EIS Northern Alignment Evaluation
 Fargo-Moorhead Metro Flood Risk Management Project

Notes: Opinion of cost below includes contingency

WBS Feature Code	Description	Proposed Alt. VE13A w/ Updates Project Cost	Northern Alignment Alt. Alignment by Mn DNR Project Cost	Notes
	Embankment - CSAH17	Revised Section, Alignment and Productivity 4,000,000	Revised Section, Alignment and Productivity 2,700,000	2,3,4,5,6
	Embankment - INLET-WRR	Revised Section, Alignment and Productivity 23,900,000	Revised Section, Alignment and Productivity 26,500,000	2,3,4,5,6
	Embankment - WRR-RRN	Revised Section, Alignment and Productivity 7,700,000	Revised Section, Alignment and Productivity 10,900,000	2,3,4,5,6
	Embankment - RRN-MN	Revised Section, Alignment and Productivity 27,100,000	Revised Section, Alignment and Productivity 27,600,000	2,3,4,5,6
	Road Raise for Levees	Revised 1,343,916	Revised 1,603,980	2,3,4,5,6
	OHB Ring Levee	New Item since PFSAA 65,000,000	New Item since PFSAA 65,000,000	2,3,4,5,6
	Comstock Ring Levee	New Item since PFSAA 4,000,000	Feature Not Included N/A	2,3,4,5,6
	Increase Flows Through Town (35' Flood Stage, Add'l Levees)	PFSAA Bundles Report 29,000,000	PFSAA Bundles Report 29,000,000	2,3,4,5,6
14	RECREATION FACILITIES			
	Recreation Facilities	No Change From Phase 4 FRP 29,010,700	No Change From Phase 4 FRP 29,010,700	2,3,4,5,6
30	PLANNING, ENGINEERING & DESIGN (PED)			
	PED	Use 15% (Ph4) 185,146,215	Use 15% (Ph4) 186,640,334	2,3,4,5,6
31	CONSTRUCTION MANAGEMENT (CM)			
	CM	Use 7% (Ph4) 86,401,567	Use 7% (Ph4) 87,098,822	2,3,4,5,6
	Total	\$ 1,789,000,000	\$ 1,870,000,000	2,3,4,5,6
		Proposed Alt. VE13A w/ Updates	NORTHERN ALIGNMENT	

¹ Categorical cost carried forward from FRP and not revised, as directed by USACE.

² Unknown Quantities

³ Limited Design Work Completed

⁴ Unknown Unit Prices

⁵ Alignment Not Final

⁶ Limited Field Investigations, Borings Available

**EXHIBIT C – HYDROLOGY AND HYDRAULICS SUMMARY OF ALIGNMENT
ALTERNATIVES**

10 - Percent Chance Event (10-year)						
Alternative	Cass/Richland County Line Elevation (ft)	Oxbow Elevation (ft)	Staging Elevation (ft)	Fargo Gage Elevation (ft)	Thompson Elevation (ft)	Diversion Inlet Flow (cfs)
	RS 2582760	RS 2552977	RS 2531315	RS 2388223	RS 1667877	RS 157365
Base No Action Alternative	912.26	909.97	908.73	897.7 (34.96)	837.62	-----
Proposed Project Alternative	912.22	910.06	908.84	897.53 (34.79)	837.73	0
Northern Alignment Alternative	912.22	910.05	908.83	897.56 (34.82)	837.75	0

4 - Percent Chance Event (25-year)						
Alternative	Cass/Richland County Line Elevation (ft)	Oxbow Elevation (ft)	Staging Elevation (ft)	Fargo Gage Elevation (ft)	Thompson Elevation (ft)	Diversion Inlet Flow (cfs)
	RS 2582760	RS 2552977	RS 2531315	RS 2388223	RS 1667877	RS 157365
Base No Action Alternative	916.14	913.63	912.30	901.17 (38.43)	843.26	-----
Proposed Project Alternative	920.45	919.73	919.57	897.83 (35.09)	843.26	9,000
Northern Alignment Alternative	918.60	917.37	916.93	897.87 (35.13)	843.27	9,000

2 - Percent Chance Event (50-year)						
Alternative	Cass/Richland County Line Elevation (ft)	Oxbow Elevation (ft)	Staging Elevation (ft)	Fargo Gage Elevation (ft)	Thompson Elevation (ft)	Diversion Inlet Flow (cfs)
	RS 2582760	RS 2552977	RS 2531315	RS 2388223	RS 1667877	RS 157365
Base No Action Alternative	918.36	915.55	914.05	902.59 (39.85)	845.51	-----
Proposed Project Alternative	922.06	921.60	921.52	897.78 (35.04)	845.74	20,000
Northern Alignment Alternative	919.98	918.94	918.67	897.82 (35.08)	845.76	20,000

1 - Percent Chance Event (100-year)						
Alternative	Cass/Richland County Line Elevation (ft)	Oxbow Elevation (ft)	Staging Elevation (ft)	Fargo Gage Elevation (ft)	Thompson Elevation (ft)	Diversion Inlet Flow (cfs)
	RS 2582760	RS 2552977	RS 2531315	RS 2388223	RS 1667877	RS 157365
Base No Action Alternative	919.68	916.46	914.76	903.42 (40.68)	847.82	-----
Proposed Project Alternative	922.67	922.29	922.22	897.77 (35.03)	848.03	20,000
Northern Alignment Alternative	920.62	919.57	919.35	897.79 (35.05)	848.01	20,000

0.2 - Percent Chance Event (500-year)						
Alternative	Cass/Richland County Line Elevation (ft)	Oxbow Elevation (ft)	Staging Elevation (ft)	Fargo Gage Elevation (ft)	Thompson Elevation (ft)	Diversion Inlet Flow (cfs)
	RS 2582760	RS 2552977	RS 2531315	RS 2388223	RS 1667877	RS 157365
Base No Action Alternative	923.13	918.26	915.95	904.96 (42.22)	851.43	-----
Proposed Project Alternative	923.68	922.41	922.24	902.7 (39.96)	851.56	20,000
Northern Alignment Alternative	923.29	920.07	919.23	902.72 (39.98)	851.58	20,000

All of the Alternatives include "No Action" flood protection through the Flood Damage Reduction Area