Preliminary Engineering Report
Puppy Dog Sewer System

for:

City of Minot, North Dakota

Prepared by:

Ulteig Engineers, Inc.

In association with

Ackerman-Estvold Engineering and Management Consulting, Inc.

UEI Project No. 306.124

I hereby certify that this plan, specification, or report 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.

Signature

Thomas J. Welle, PE
Typed or Printed Name

1/12/07
Date

4041
Registration No.

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EXECUTIVE SUMMARY

A. Introduction

The City of Minot and the team of Ulteig Engineers, Inc. and Ackerman-Estvold Engineering have entered into a contractual agreement to conduct a study of the City's Puppy Dog Sanitary Sewer System. The purpose of the study is to develop alternatives and make recommendations for future improvements for this area.

The City of Minot has programmed a project to construct an additional forcemain from the Puppy Dog Pumping Station to the wastewater treatment facility. Additional Puppy dog sewer improvements are planned for 2008, 2009, and 2010 to increase capacity and account for expected development in the First Larson Coulee area.

B. Existing Facilities

The existing sanitary sewer facilities in the Puppy Dog Sewer Service Area consist of the sanitary sewer collection system, sanitary sewer interceptor, and sanitary sewer pumping station and forcemain.

1. Puppy Dog Sanitary Sewer Collection System

The existing collection system is fairly typical of collection systems found in similar cities. It consists of gravity sewer mains from 8 to 10 inches in diameter with associated manholes, cleanouts, and service lines. Exhibit III-1 on Page 9 shows the existing collection system.

2. Puppy Dog Sanitary Sewer Interceptor

The Puppy Dog Pumping Station is fed by a single interceptor line ranging in size from 12" to 21" in diameter. The Interceptor was analyzed in a 2002 study that indicated surcharging and backup occurring during periods of peak flows. Exhibit III-2 on Page 10 shows the existing interceptor.

3. Puppy Dog Sanitary Pumping Station and Forcemain

The Puppy Dog Pumping Station was originally constructed and put into service in the late 1970's. In 1998, the station was replaced with a new structure, pumps, and controls. The pumps were again replaced in 2002.

Flow measurements are recorded weekly utilizing a chart recorder. Based on flow charts, pumped output is approximately 1,200 gpm with one pump and approximately 1,450 gpm with both pumps in operation.

An emergency storage pond for sanitary sewer overflows is located adjacent to the pumping station. The current pond volume is approximately 612,000 gallons, which, at current average day flows, can hold 15 hours of flow.

C. System Characteristics

1. Existing Puppy Dog Sanitary Sewer Service Area

The existing Puppy Dog Sewer Service Area is shown in Exhibit IV-1 on page 14 and consists of 1,740 acres of the South Hill area of Minot. Current average day flows from this area are 691 gallons per minute (gpm). City personnel have indicated that this area and adjacent areas will see the majority of future growth.

2. Population

City planning documents indicate that approximately 78% of the City's future growth will occur in the South Hill area and will become part of the Puppy Dog Sewer Service Area. A planning window of approximately 40 year was selected by City officials along with the identification of several areas that will be served in the near future. These future areas are shown on Exhibit IV-1 on page 14 and include approximately 6,400 acres of developable land.

The existing population for the area is approximately 5,200. Future projections indicate a 2040 population of approximately 36,207. This is based on assuming 2.5 households per acre and a density of 2.27 persons per household.

3. Future Wastewater Flows

Future wastewater flows have been determined for the areas contributing to the Puppy Dog Sewer Service Area. Flows were based on calculating the land area (acres) and multiplying by a flow per acre. The flow used for this study was 950 gallons per acre. This is based on an average of 2.5 residences per acre, 2.27 persons per residence, and 150 gallons per person per day. An additional 100 gallons per acre per day was included for unforeseen development.

Based on the existing flows in the Puppy Dog Sewer Service Area and the future flows from the anticipated contributing areas, the 2040 average daily flow to the Puppy Dog Pumping Station will be 7.02 Million Gallons per Day (MGD) with a peak flow of 17.05 MGD. These future flows were used to size future facilities, including interceptors, pumping stations, forcemains, and wastewater treatment facilities.

D. Hydraulic Model Development

Utilizing SewerCAD modeling software, hydraulic models were developed of the Puppy Dog Pumping Station, Master Pumping Station, and the transfer piping between the aeration basins and stabilization ponds.

Modeling identified pumping station deficiencies when pumping against each other as well as deficiencies of the transfer piping when future flows are applied.

E. System Analysis and Needs Identification

Each system component was analyzed for deficiencies under anticipated future flow conditions. The analysis provided an identification of needed improvements to satisfy future demands. Based on the identified needs, alternatives were developed for each facility.

F. Evaluation of Alternatives

The evaluation of alternatives began with a look at what the effect of doing nothing would be on the City of Minot. Essentially, if nothing is done to improve the facilities in the Puppy Dog Sewer Service Area, development would come to a halt. Therefore, the following alternatives were developed.

1. Puppy Dog Forcemain Improvements

Near-term and long-term forcemain needs were identified. In the near-term, a larger forcemain would increase the output of the Puppy Dog Pumping Station. Several different sizes were considered. This larger forcemain will also be utilized when the Puppy Dog Pumping Station is eventually replaced. Eventually, based on anticipated growth, the flow will exceed the capacity of the new forcemain. Therefore, long-term needs call for additional forcemain capacity.

Alternatives for forcemain discharge at the aerations basins were also identified. Currently, the Puppy Dog Pumping Station has to pump against the Master Pumping Station, which decreases its output. Consideration was given to separate entrances into the aeration basins and to a common influent control structure at the aeration basins. With an influent control structure, the possibility exists for odor. This concern was also addressed.

2. Puppy Dog Pumping Station Improvements

The Puppy Dog Pumping Station is at capacity under existing peak day conditions. Future flows will only exacerbate the current situation. While a larger forcemain will increase the output of the current station, eventually a new station will be needed. The station structure should be designed for the peak flow

for the planning period. Pumps and some of the ancillary equipment can be sized for a 20-year planning period with the intent of upgrading them as flows increase. The existing station will likely be abandoned. City Personnel have indicated that they would like to see the emergency pond expanded at that time.

3. Puppy Dog Interceptor Improvements

The existing Puppy Dog Interceptor is currently at capacity and surcharges at times. It also presents many challenges when looking at replacement or upgrade. It is essentially at the bottom of Puppy Dog Coulee and not very accessible. Therefore, the evaluation of alternatives focused on providing relief to the existing Interceptor while still maintaining its use on a limited basis.

The new First Larson Coulee Interceptor will most likely tie into the Puppy Dog Interceptor at Manhole #34. This Interceptor will consist of pipe ranging in size from 15" to 30" in diameter and will follow the First Larson Coulee. It will be used to tie in current rural subdivisions.

With the current Puppy Dog Interceptor surcharging, the logical point at which to provide relief is at the point where the flow from north of Highway 2/52 joins the flow from south of Highway 2/52. A relief pumping station could take the flow from the southern portion and redirect it to the new First Larson Coulee Interceptor. The northern flow would still utilize the Puppy Dog Interceptor. This would allow for development to continue west of the existing service area while still utilizing the existing Interceptor.

The existing Puppy Dog Interceptor will need to be upgraded from the point where the new First Larson Coulee Interceptor intersects it to the Puppy Dog Pumping Station. Alternatives include installing a larger pipeline alongside the existing pipeline and abandoning it, and utilizing the existing pipeline and installing a parallel line to make up the additional capacity needed. The condition of the existing line is unknown. Therefore, its future viability is in question. An assessment of this pipeline should be conducted, including closed-circuit television (CCTV) inspection. Further evaluation should be conducted at that point.

4. Wastewater Treatment Facility Improvements

The anticipated future flows will most likely cause hydraulic and organic overloading of the existing wastewater treatment facilities. The extent of this overloading is not known at this time and the investigation of the same is beyond the scope of this report.

The current facility plan for the wastewater treatment facilities was completed for a planning period through 2010. An update to that facility plan is needed to

assess the future viability of the current treatment facilities and to make recommendations for future improvements to handle anticipated flows.

G. Recommended Improvements

Due to the magnitude of improvements needed in the PDSSA, it is recommended that the improvements be implemented in a phased approach. This will allow for the following:

- Cost spread out over a number of years
- Ability to adapt to changes in growth patterns and development areas

A map showing the recommended phases is shown in Exhibit VIII-1 on page 35 and consists of the following phased improvements. Detailed descriptions of the phases are included in subsequent sections of this report.

1. Phase I Improvements (2007 Construction)

- New 20" Forcemain to Aeration Basins
- New Influent Control Structure at Aeration Basins

2. Phase II Improvements (2008 Construction)

- First Larson Coulee Interceptor (MH 34 to Hwy 83)
- South Hill Relief Pumping Station
- Televise Puppy Dog Interceptor (MH 34 to Puppy Dog Pumping Station)
- Update Wastewater Treatment Facility Plan

3. Phase III Improvements (2009 Construction)

- New Puppy Dog Pumping Station
- First Larson Coulee Interceptor (Hwy 83 to Crystal Springs)
- Puppy Dog Interceptor Improvements (MH 34 to Puppy Dog Pumping Station)
- Expand Emergency Storage Pond at Puppy Dog Pumping Station

4. Phase IV Improvements (2010 Construction)

- First Larson Coulee Interceptor (Crystal Springs to 30th Street SW)

5. Phase V Construction (Future)

- New Parallel Forcemain to Aeration Basins
- Expansion & Upgrade of Puppy Dog Pumping Station

6. Phase IV Construction (Future)

- Expansion & Upgrade of Wastewater Treatment Facilities

H. Opinion of Cost

The Engineer's Opinion of Estimate Cost for each proposed Phase is shown in Table I-1. Each Cost Opinion includes allowances for total construction costs, engineering, land acquisition (if applicable) and contingencies. Detailed Cost Opinions for each improvement can be found in the Appendix.

Table I.1 – Engineer's Opinions of Estimated Cost

Engineer's Opinion of Estimated Cost			
Estimated Year	**Phase**	**Improvement**	**Total Project Cost**
2007	I	New 20" Forcemain to Aeration Basins	$1,680,400
2007	I	New Influent Control Structure at Aeration Basins	$304,000
		Phase I Total	***$1,984,400***
2008	II	First Larson Coulee Interceptor (MH 34 to Hwy 83)	$3,765,400
2008	II	South Hill Relief Pumping Station	$1,177,300
2008	II	Televise Puppy Dog Interceptor (MH 34 to Puppy Dog Pumping Station	$119,100
2008	II	Update WWTF Facility Plan	$50,000
		Phase II Total	***$5,111,800***
2009	III	New Puppy Dog Pumping Station	$3,824,000
2009	III	First Larson Coulee Interceptor (Hwy 83 to Crystal Springs)	$1,087,900
2009	III	Puppy Dog Interceptor Improvements (MH 34 to New Puppy Dog Pumping Station – Option A	$4,265,600
2009	III	Expand Emergency Storage Pond at Puppy Dog Pumping Station	$345,000
		Phase III Total	***$9,522,500***
2010+	IV	First Larson Coulee Interceptor (Crystal Springs to 30th Street SW)	$458,800
		Phase IV Total	***$458,800***
?	V	New Parallel 20" Forcemain to Aeration Basins	$1,559,900
?	V	Expansion & Upgrade of Puppy Dog Pumping Station	$962,500
		Phase V Total	***$2,522,400***
?	VI	Expansion & Upgrade of Wastewater Treatment Facilities	Undetermined
		Phase VI Total	***Undetermined***
		Total Phases I - V	***$19,599,900***

SECTION II
INTRODUCTION

The City of Minot and the team of Ulteig Engineers and Ackerman-Estvold Engineering entered have into a contractual agreement to conduct a study of the City's Puppy Dog Sanitary Sewer System. The purpose of the study is to develop alternatives and make recommendations for future sanitary collection and conveyance improvements for this area.

The scope of the study includes an evaluation of all existing facilities in the Puppy Dog Sanitary Sewer Service Area (PDSSSA). The existing facilities include the Puppy Dog sanitary sewer collection system, Puppy Dog interceptor, Puppy Dog pumpin station, and Puppy Dog forcemain. A cursory evaluation was also conducted on the existing wastewater treatment facilities (WWTF).

The City of Minot has programmed a project to construct an additional forcemain from the Puppy Dog pumping station to the wastewater treatment facility. Additional Puppy Dog sewer improvements are planned for 2008, 2009, and 2010 to increase capacity and account for expected development in the 1st Larson Coulee area.

The principle elements of the study include:

- A review of the existing sanitary sewer system facilities
- An evaluation of historical trends in wastewater flows
- Projections for future population growth
- Development of a sewer system model of the area
- Analysis of the Puppy Dog Sewer Service Area
- Determination of the 1st Larson Coulee contributing area, related wastewater flows and required pipe sizes
- Determination of 1st Larson Coulee logical break points for the 2008, 2009, and 2010 construction projects from two miles west of Crystal Springs addition to the Puppy Dog pumping station.
- Determination of existing and required future lift station capacity based on future flows
- Determination of required forcemain capacity
- Opinion of Costs for various alternatives
- Recommendations for future facilities in the Puppy Dog Sewer Service Area

SECTION III
EXISTING FACILITIES

This Section describes the existing facilities that currently serve the PDSSSA. These facilities are broken into three general sections as follows:

- Sanitary Sewer Collection System
- Sanitary Sewer Interceptor
- Sanitary Pumping Station and Forcemain

A. Puppy Dog Sanitary Sewer Collection System

The existing collection system of the PDSSSA is fairly typical of collection systems found in cities of similar size and geographical region. The collection system consists of gravity sewer mains from 8 to 10 inches in diameter with associated manholes, cleanouts and service lines. The collection system is shown in Exhibit III-1 on Page 9 and can generally be broken into two distinct areas; North of the 2/52 Bypass and South of the 2/52 Bypass.

The flow from the North portion flows to two points. All flow west of 2nd Street SE, collects at the intersection of 2nd Street SE and 20th Avenue SE. From here it travels through a 12" line to the Puppy Dog Interceptor. The remainder of the North portion collects at 13th Street SE and flows through an 8" line to the Puppy Dog Interceptor. The South portion is collected in the Puppy Dog Interceptor at various points along its route.

B. Puppy Dog Sanitary Sewer Interceptor

The Puppy Dog Pumping Station (PDPS) is fed by a single interceptor line, ranging in size from 12" to 21" in diameter, which runs along Puppy Dog Coulee. It is shown in Exhibit III-2 on Page 10 and consists of approximately 19,000 LF of 12", 3,300 LF of 15", and 4,600 LF of 21".

C. Puppy Dog Sanitary Pumping Station and Forcemain

The PDPS was originally constructed and put on line in the late 1970's. In general, the station serves the South Hill area of Minot. In 1998, the station was replaced with a new structure, pumps and controls. The pumps were again replaced in 2002. The current pumps have 100 hp motors and are rated at 1,150 gallons per minute (gpm) at 185 feet of total dynamic head (TDH), with 14.5 inch diameter impellers. The station, as it exists today, is shown in the picture on Page 11:

EXISTING 12" PUPPY DOG INTERCEPTOR

SANITARY SEWER COLLECTION SYSTEM

N

W E

S

Hwy 2 & 52 Bypass

6th St SE

13th Street SE

16th Street SW

37th Ave SW (Paved)

Hwy 83

CITY OF MINOT EXISTING PUPPY DOG COLLECTION SYSTEM

Ulteig engineers

EXHIBIT III-1

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EXISTING INTERCEPTOR (12"-21" DIA)

EXISTING 12" PVC FORCEMAIN

N

W E

S

12"

12"

15"

21"

12"

12"

EXISTING PUPPY DOG
PUMPING STATION

Hwy 2 & 52
Bypass

30th Street SW (Gravel)

37th Ave SW (Paved)

55th Street SE/Co Rd 12A

46th Street SW (Gravel)

54th Ave SW (Gravel)

54th Ave SE (Paved)

30th Street
SW (Gravel)

66th Ave SW (Gravel)

Hwy 83

Hwy 83

CITY OF MINOT
EXISTING PUPPY DOG INTERCEPTOR & FORCEMAIN

Ulteig engineers

EXHIBIT III-2

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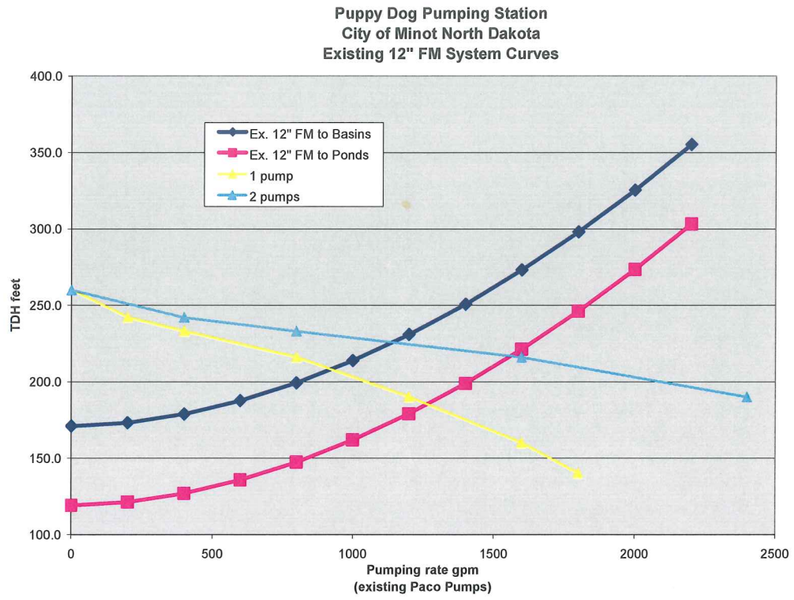
Existing Puppy Dog Pumping Station

The station discharges into a 12" diameter PVC forcemain that is approximately 13,000 lineal feet in length. The forcemain was installed in the 1980's with the original pumping station. In 1990, in conjunction with the aeration basins construction, the forcemain was extended approximately 1700 lineal feet and tied into the new 24" DIP transfer line (north west corner of existing cell #1). Therefore, the station has the ability to pump to either the aeration basins or to the stabilization ponds. City personnel indicated that since installation of the current pumps, the station has pumped exclusively to the stabilization ponds. This is due to the increased pressure in the forcemain when the Master Pumping Station (MPS) is in operation. Output from the PDPS is greater when pumping to the stabilization ponds due to the following conditions:

- Additional static head of 17 feet when pumping to aeration basins
- Additional pressure head of 30 feet created by Master Pump Station when pumping to aerated ponds
- Additional 1,700 feet of forcemain, creating additional friction head, when pumping to aerated ponds

Figure III-1 on Page 12 shows the system head curves for the existing station as well as the curve for the existing 12" forcemain.

Figure III-1 – System Head Curve – Puppy Dog Pumping Station



This figure shows the existing firm pumping capacity of the PDPS as follows:

- One Pump to aeration basins: 920 gpm
- Two Pumps to aeration basins: 1,200 gpm
- One Pump to Ponds: 1,200 gpm
- Two Pumps to Ponds: 1,450 gpm

The curve representing the 12" FM to the basins assumes that the aeration basins are being operated at maximum capacity (elevation 1,670) and that PDPS is working against an additional 32 feet of head created by Master Lift Station. The curve representing the 12" FM to the ponds assumes that the stabilization ponds are operating at maximum capacity (elevation 1,650) and also neglects any head created by the 24" transfer line from the aeration basins.

Flow measurements are recorded weekly utilizing a chart recorder. Based on the flow charts, pumped output is approximately 1,200 gpm with one pump and approximately 1,450 gpm with both pumps running.

An emergency storage pond for sanitary sewer overflows is located adjacent to the PDPS. The pond was originally designed to hold 24 hours of flow. Current pond volume is approximately 612,000 gallons. At current average day flows (691 gpm), the pond can hold approximately 15 hours of flow.

SECTION IV
SYSTEM CHARACTERISTICS

A. Existing Puppy Dog Sanitary Sewer Service Area

The existing PDSSSA is shown in Exhibit IV-1 on Page 14 and consists of approximately 1,741 acres of the South Hill Area of Minot. The area is a mix of residential and commercial with high flows coming from the commercial areas during the weekends.

The PDSSSA can be separated into two sub-areas, which are divided by the US 2/52 Bypass. They will be referred to as the North and South PDSSSA. The North PDSSSA is mostly developed with the only remaining area currently under development. The South PDSSSA has been identified by City Personnel as the area where future growth will occur.

B. Population

1. Existing Service Area

Existing populations for the PDSSSA were derived from the traffic analysis zones (TAZ) developed as part of the Minot Land Use & Transportation Plan completed in November of 2002.

Based on the aforementioned data, the 2000 population for the PDSSSA was 5,219. Table IV-1 on this Page shows a summary of the existing TAZ population data for the 2000 PDSSSA.

Table IV-1 – Existing TAZ Population Data

Puppy Dog Sewer Service Area Existing TAZ Population Data		
Area	**Size (Acres)**	**2000 Population**
TAZ 83	77	1226
TAZ 90	224	420
TAZ 106	320	0
TAZ 108	210	0
TAZ 109	192	0
TAZ 110	160	0
Other Areas	558	3,573
Totals	**1,741**	**5,219**

EXISTING SERVICE AREA
PLANNING AREA
TOTAL SERVICE AREA = 8121 ACRES

N
W E
S

EXISTING SERVICE AREA
1741 ACRES

PLANNING AREA
6380 ACRES

30th Street SW (Gravel)
37th Ave SW (Paved)
Hwy 2 & 52 Bypass
55th Street SE/Co Rd 12A
EAST SIDE ESTATES ADDITION
CHAPARELLE STUDY AREA
CRYSTAL SPRINGS ADDITION
LUCY'S
JOYCE'S
MEADOW BROOK ESTATES
54th Ave SW (Gravel)
54th Ave SE (Paved)
46th Street SW (Gravel)
DALEN ADDITION
MAKEEFF ADDITION
BEAVER CREEK ESTATES
DAKOTA ESTATES ADDITION
WHISPERING PINES ADDITION
66th Ave SW (Gravel)
30th Street SW (Gravel)
16th Street SW
Hwy 83

CITY OF MINOT EXISTING PUPPY DOG SERVICE AREA & FUTURE SERVICE AREA

Ulteig engineers

EXHIBIT IV-1

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2. Future Service Area and Planning Period

Planning documents indicate that approximately 78% of the City's future growth will occur in the south hill area and will become part of the PDSSSA. City officials identified several areas that will be served by the PDSSSA in the future. A planning window of 40 years was selected by City officials. These future areas are shown on Exhibit IV-2 on Page 16 and generally include the following:

- Additional areas west and northeast of the existing PDSSSA.
- First Larson Coulee service area

Populations were estimated on a per acre basis. A breakdown of the areas used for population estimating is shown in Exhibit IV-3 on Page 17. Table IV-2 is a breakdown of the population projected for each of these areas.

Table IV-2 – Population Projections

Puppy Dog Sewer Service Area Population Projections		
Area	**Size (Acres)**	**2040 Population***
1	605	3,433
2	536	3,042
3	54	306
4	47	267
5	462	2,622
6	397	2,253
7	271	1,538
8	454	2,576
9	1158	6,572
10	384	2,179
11	325	1,844
12	263	1,492
13	149	846
14	370	2,100
15	59	335
16	308	1,748
17	136	772
18	78	443
19	324	1,839
Totals	**6,380**	**36,207**
*Based on 2.5 lots/acre, 2.27 persons/lot		

Details regarding flows from these future service areas will be discussed in greater detail in the next section.

EXISTING PUPPY DOG SERVICE AREA

1ST LARSON COULEE STUDY AREA

2-20 YEAR GROWTH AREA

20-40 YEAR GROWTH AREA

OTHER POTENTIAL 1ST LARSON COULEE CONTRIBUTING AREAS

WATER SERVICE PLANNING AREA (WSPA)

N

W E

S

30th Street SW (Gravel)

37th Ave SW (Paved)

Hwy 2 & 52 Bypass

55th Street SE/Co Rd 12A

46th Street SW (Gravel)

54th Ave SW (Gravel)

64th Ave SE (Paved)

30th Street SW (Gravel)

66th Ave SW (Gravel)

Hwy 83

CITY OF MINOT CONTRIBUTING AREAS

Ulteig engineers

EXHIBIT IV-2

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AREAS NOT INCLUDED IN STUDY AREA

AD AVERAGE DAILY FLOW

PD PEAK DAILY FLOW

(8) PLANNING SUB AREA ID NUMBER

N W E S

(1) 605 ACRES AD=.575 MGD PD=1.396 MGD

(2) 536 ACRES AD=.509 MGD PD=1.237 MGD

(3) 54 ACRES AD=.051 MGD PD=.125 MGD

(4) 47 ACRES AD=.045 MGD PD=.109 MGD

(5) 462 ACRES AD=.439 MGD PD=1.067 MGD

(6) 397 ACRES AD=.377 MGD PD=.916 MGD

(7) 271 ACRES AD=.257 MGD PD=.624 MGD

(8) 454 ACRES AD=.431 MGD PD=1.048 MGD

(9) 1158 ACRES AD=1.100 MGD PD=2.673 MGD

(10) 384 ACRES AD=.365 MGD PD=.886 MGD

(11) 325 ACRES AD=.308 MGD PD=.750 MGD

(12) 263 ACRES AD=.250 PD=.601

(13) 149 ACRES AD=.142 PD=.345

(14) 370 ACRES AD=.352 PD=.855

(15) 59 ACRES AD=.056 PD=.136

(16) 308 ACRES AD=.293 MGD PD=.712 MGD

(17) 136 ACRES AD=.129 PD=.313

(18) 78 ACRES AD=.074 MGD PD=.180 MGD

(19) 324 ACRES AD=.308 MGD PD=.763 MGD

Hwy 2 & 52 Bypass

55th Street SE/Co Rd 12A

Hwy 83

Hwy 52

CITY OF MINOT FUTURE SERVICE AREA FLOW PROJECTIONS

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EXHIBIT IV-3

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C. Historical Wastewater Flows

1. Puppy Dog Sanitary Collection System

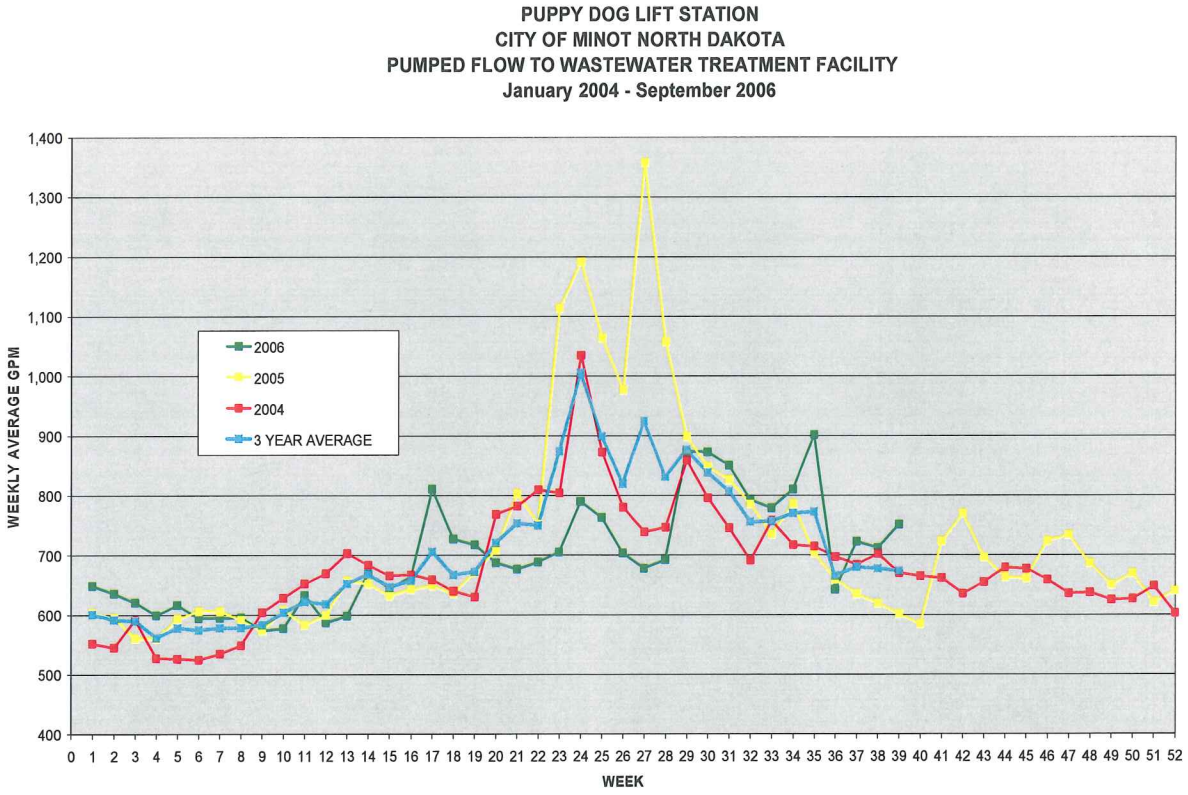
Flows from within the collection system are not recorded by City personnel. Anecdotal evidence provided by City personnel indicates that during periods of peak flow, surcharging and backup occurs in the Puppy Dog interceptor. Due to this condition, an exact measurement of flow cannot be obtained, however, it can be determined that the peak flow from the collection system exceeds the capacity of the interceptor as currently installed.

2. Puppy Dog Pumping Station Records

As stated previously, flow measurements at the PDPS are recorded on a weekly basis from existing chart recorders. Measurement is made based on effluent flows from the station. Influent flow is not recorded.

Historical pumping records from PDPS were obtained from January of 2004 to September of 2006 and are shown in Figure IV-1 below.

Figure IV-1 – PDPS Historical Pumping Data



The average daily flow for this period was 0.995 MGD, or 691 gpm. Maximum average and minimum average daily flows were 1.96 MGD (1,358 gpm) and 0.76 MGD (526 gpm), respectively, for this same time period.

3. Inflow and Infiltration Contribution

No attempt has been made to quantify the amount of inflow and infiltration (I/I) occurring in the PDSSSA. Comparing normal pumping records to those records from periods of precipitation and runoff, it is assumed that I/I is contributing to the overall flow in the PDSSSA. Also, anecdotal evidence provided by City personnel indicates that there have been times when the manholes along the interceptor were submerged due to high water in the Puppy Dog Coulee. Many manholes have been raised in an attempt to minimize this occurrence.

4. Peak Flows and Peaking Factors

As previously stated, due to the capacity of the interceptor as currently installed, an exact measurement of flow could not be determined, including peak flows.

Peaking factors cannot be calculated without peak flows. However, based on average daily flows seen at the PDPS and based on the maximum firm pumping capacity of the PDPS, the calculated peaking factor of the station is approximately 2.10.

D. Future Wastewater Flows

Future wastewater flows have been determined for the areas contributing to the PDSSSA. Flows were based on calculating the land area (acres) contributing to each service area and multiplying it by a flow per acre. Allowances were made for areas which appear to be un-buildable as well as areas within the 100-year flood plain of First Larson Coulee. The flow used for this study was 950 gallons per acre. This is based on an average of 2.5 residences per acre, 2.27 persons per residence, and 150 gallons per person per day. An additional 100 gallons per acre per day was included for unforeseen development.

Based on the existing flows in the PDSSSA and the future flows from the anticipated contributing areas, the 2040 average flow to the PDPS will be 7.02 MGD (4,900 gpm) with a peak flow of 17.05 MGD (11,850 gpm). These future flows will be utilized to size future facilities, including interceptors, pumping stations, forcemains, and wastewater treatment facilities.

1. Existing Puppy Dog Sanitary Sewer Service Area

The existing PDSSSA is shown in Exhibit IV-1 on Page 14. As previously stated, the average daily flow from this area is 691 gpm. It is anticipated that

future flows in the existing PDSSSA will include partial flows from Areas 10 and 11, as shown on Exhibit IV-3 on Page 16. These additional flows will utilize existing collectors within the existing PDSSSA. Future average day flows from these areas are estimated to be 0.67 MGD (470 gpm) and are shown in Table IV-3 below.

Table IV-3 – Future Flows -- Existing Puppy Dog Service Area

Future Flows – Existing Puppy Dog Service Area		
Area Number	**Area (Acres)**	**Average Day Future Flow (gal)**
Existing Area	1,740	995,040*
10	200	190,000
11	100	95,000
18	78	74,100
Total	***2,118***	***1,354,140***
* Indicates Actual Average Day Flow		

It is estimated that 60% of the existing flow occurs south of Highway 2 and the remaining 40% occurs north of Highway 2. The entire future flow from areas 10 and 11 will be south of Highway 2 and the entire flow from area 18 will be north of Highway 2. Therefore, average day future flows for the southern portion of the existing service area will be approximately 0.88 MGD (615 gpm) with a peak flow of 2.15 MGD (1,500 gpm). Average day future flows for the northern portion of the existing service area will be approximately 0.47 MGD (330 gpm) with a peak day of 1.15 MGD (800 gpm).

2. First Larson Coulee Service Area

The First Larson Coulee Service Area (FLCSA) is shown in Exhibit IV-2 on Page 16 and includes the following subdivisions:

- East Side Estates Addition
- Chaparelle Study Area
- Meadow Brook Estates
- Joyce's Addition
- Lucy's Addition
- Dakota Estates Addition
- Whispering Pines Addition
- Dalen Addition
- Makeeff Addition
- Crystal Springs
- Beaver Creek Estates

These areas were identified and analyzed for future connection to the City of Minot in a 2002 report completed by Wold Engineering. Although collector lines for each subdivision were identified in this study, no attempt was made to identify

potential future flows from these subdivisions. Therefore, future flows for this area will be calculated using the area method outlined previously. Table IV-4 below shows future average day flows from each of these areas. The numbered areas correspond to the numbered areas shown in Exhibit IV-3 on Page 17.

Table IV-4 – Future Flows – First Larson Coulee Service Area

Future Flows – First Larson Coulee Service Area		
Area Number	**Area (Acres)**	**Average Day Future Flow (gal)**
7	271	257,450
9	1,158	1,100,100
12	263	249,850
13	149	141,550
17	136	129,200
Total	***1.977***	***1,878,150***

3. Other Potential Contributing Areas

City Personnel have identified other areas adjacent to the existing PDSSSA and the FLCSA that could potentially contribute flow in the future. These areas are shown in Exhibit IV-3 on Page 16 and are generally described as follows:

- 2 - 20 Year Development
- 20 - 40 Year Development
- Other Potential FLCSA Contributing Areas

Table IV-5 below shows future average day flows from each area within the 2 – 20 year development area.

Table IV-5 – Future Flows – 5–20 Year Development Area

Future Flows – 2-20 Year Development Area		
Area Number	**Area (Acres)**	**Average Day Future Flow (gal)**
6	397	377,150
8	454	431,300
11	325	308,750
18	78	74,100
19	282	267,900
Total	***1,536***	***1,459,200***

Table IV-6 on the next page shows future average day flows from each area within the 20 – 40 year development area.

Table IV-6 – Future Flows – 20–40 Year Development Area

Future Flows – 20-40 Year Development Area		
Area Number	**Area (Acres)**	**Average Day Future Flow (gal)**
1	605	574,750
2	536	509,200
3	54	51,300
4	47	44,650
5	462	438,900
10	384	364,800
16	308	292,600
Total	***2,396***	***2,276,200***

Table IV-7 below shows future average day flows from each area within the Other Potential FLCSA Contributing Areas.

Table IV-7 – Future Flows – Other Potential FLCSA Contributing Areas

Future Flows – Other Potential Contributing Areas		
Area Number	**Area (Acres)**	**Average Day Future Flow (gal)**
14	370	351,500
15	59	56,050
Total	***429***	***407,550***

4. Inflow and Infiltration

Advances in construction technologies and methods have allowed inflow to be kept to a minimum when constructing new sewer mains. Therefore, no allowances have been made for inflow. Allowances for infiltration will be made when assigning peaking factors in the next section.

5. Peak Flows and Peaking Factors

Since an exact measurement of the flows from within the PDSSA cannot be obtain due to reasons outlined previously, no record of peak flows exist. Peaking factors are used in conjunction with average daily flows and are intended to cover normal infiltration for systems built with modern construction techniques. The peaking factor can be found using the following formula:

$$\text{Q Peak Hourly / Q Design Average} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

where P is the population in thousands. Based on this formula, the calculated peaking factor, based on a population of 34,362, is 2.43.

SECTION V
HYDRAULIC MODEL DEVELOPMENT

The hydraulic modeling software package SewerCAD was used to analyze the current hydraulic characteristics of the Puppy Dog Pumping Station and Master Pumping Station serving the City of Minot. Current flow conditions including average daily and peak hourly flows were simulated in the model in conjunction with forcemain, wet-well, and pump characteristics to predict resulting hydraulic conditions. This section summarizes the modeling conducted and the results obtained.

A. Puppy Dog Pumping Station

The wet-well of the existing Puppy Dog Pumping Station is 14 feet by 16 feet. The existing Paco pumps convey wastewater through a 12" diameter forcemain. All simulations run in the model assumed ultimate discharge to the stabilization ponds.

Under average day flow conditions, the model indicated the PDPS was able to pump 1,450 gpm with a headloss of 100 ft in the existing forcemain. The worst case scenario of only one pump in service during peak hourly flows was simulated with the current 12" forcemain. During peak flow conditions, the model predicted high water level alarms and wet well flooding. The worst case scenario revealed the current forcemain and single pump combination is unable to service peak flow conditions.

B. Master Pumping Station

Currently, the flow from PDPS bypasses the aeration basins and flows directly to the stabilization ponds. Using current flow conditions, the Master Pumping Station (MPS) was simulated to predict the head associated with pumping the PDPS against the MPS flow. Average daily flow conditions of 3.5 MGD from the MPS were simulated. At the common junction of the MPS and PDPS forcemains, a head of 32.5 feet was predicted. Therefore, if the flow from PDPS is pumped to the aeration basins, the pumps would need to overcome an additional head of 32.5 feet.

C. Puppy Dog Interceptor Surcharging Analysis

A 2001 report to the City of Minot indicated that the Puppy Dog interceptor, as currently installed, is surcharging at several points. Through computational fluid dynamics (CFD), an analysis of the current conditions was completed. The results of the analysis closely matched the results of the 2001 report, verifying that the Puppy Dog interceptor experiences periods of surcharging.

SECTION VI
SYSTEM ANALYSIS AND NEEDS IDENTIFICATION

An analysis was completed of the various system components to identify any deficiencies and needed improvements. During this analysis, several system components were found to be deficient under anticipated future flows.

A. Puppy Dog Sanitary Collection System and Interceptor

As previously stated, the Puppy Dog Interceptor is currently operating at maximum capacity during times of peak flows. Topography will dictate that portions of future growth areas west and southwest of the existing PDSSA will need to be serviced by the existing interceptor. In order for this to occur, additional capacity in the Puppy Dog Interceptor is needed.

B. Puppy Dog Pumping Station and Forcemain

The Puppy Dog Pumping Station is fairly new and in good condition. It does, however, become overwhelmed, hydraulically, at times. Anticipated future flows will continue to tax the pumping station. A new station will eventually be needed. Due to the lengthy planning period and the inherent uncertainties surrounding future planning, phasing of the ultimate build-out of the pumping station is most likely in the best interests of the City of Minot. This will allow for smaller equipment sizing in the short term and the ability to adapt to changes in future growth patterns.

Although the existing forcemain from the Puppy Dog Pumping Station to the wastewater treatment facilities will not have enough capacity to handle future flows, there is little need for ultimate capacity in the near future. As with the Pumping Station, phasing the forcemain to ultimate build-out is most likely in the best interests of the City of Minot. Also, a larger forcemain immediately will allow for an increase in pumping capacity at the pumping station. This will "buy" the station a few years before it is at maximum capacity.

Due to the configuration of the forcemains at the wastewater treatment facilities, the Puppy Dog Pumping Station is not able to pump to the aeration basins very efficiently. Any new forcemain installation should be coupled with a separation of the Puppy Dog and Master forcemains at the aeration basins.

C. Service to First Larson Coulee Rural Subdivisions

As previously stated, several rural subdivisions along the First Larson Coulee will need sanitary sewer service by 2010. We understand it is the intent of the City of Minot to service these areas. This creates the need for a central collector for this area. The previously mentioned 2002 Study by Wold Engineers laid out a plan for an

interceptor laid along the bottom of First Larson Coulee. This alternative is still viable and will be investigated further in subsequent sections of this report.

D. Minot Wastewater Treatment Facility

The wastewater treatment facility receives flows from the Puppy Dog Pumping Station and the Master Pumping Station. Both stations have the ability to pump to either the aeration basins or the stabilization ponds. Currently, the Master Station pumps exclusively to the aeration basins while the Puppy Dog Station pumps exclusively to the Stabilization Ponds. At current average day flows, the Puppy Dog contribution is approximately 1 MGD while the Master contribution is approximately 3.5 MGD.

Over the last few years, the average flow from Master has declined slightly while the average flow from Puppy Dog has remained fairly steady. The Puppy Dog flow is expected to dramatically increase over the next few years to approximately 7 MGD on an average day.

This dramatic increase in flow is expected to impact the wastewater treatment facilities in a substantial way. However, since a detailed evaluation of the wastewater treatment facilities is beyond the scope of this study, speculation as to how great of an impact future flows may have was not evaluated.

It can be noted that the most recent facility plan completed for the wastewater treatment facilities was completed with a planning window of 2010. That document indicated a 2010 average day flow to the aeration basins of approximate 5.5 MGD. Current flows are within 1 MGD of that amount. An update to that facility plan would be appropriate in the near future.

SECTION VII
EVALUATION OF ALTERNATIVES

A. Do Nothing

As previously stated, according to planning officials with the City of Minot, it is anticipated that approximately 78% of the City's future growth will occur in the PDSSSA. This growth will consist of future subdivision and commercial areas as well as several existing subdivisions that have expressed interest in replacing their individual sewage systems and connecting to the City's collection system.

Doing nothing is not an option for the PDSSSA. Based on the 1990 Facility Plan, the 2010 projected flow has already been exceeded by approximately 17%. This area will continue to grow and put pressure on the existing facilities, which are already exceeding their capacities, at times. In order to maintain service for the existing users, facility upgrades must take place. Without improvements, growth in this area is no longer feasible and would have to come to a halt.

B. Puppy Dog Forcemain Improvements

The existing forcemain, as currently installed and operated, allows for a maximum of 1,450 gpm to be pumped to the stabilization ponds. This flow is further reduced when pumping to the aeration basins. In addition, anticipated flows from future contributing areas will be limited due to the size of the existing forcemain. This section identifies near-term and long term improvements to the Puppy Dog Forcemain, as well as improvements needed at the aeration basins to allow unrestricted flow from the PDPS.

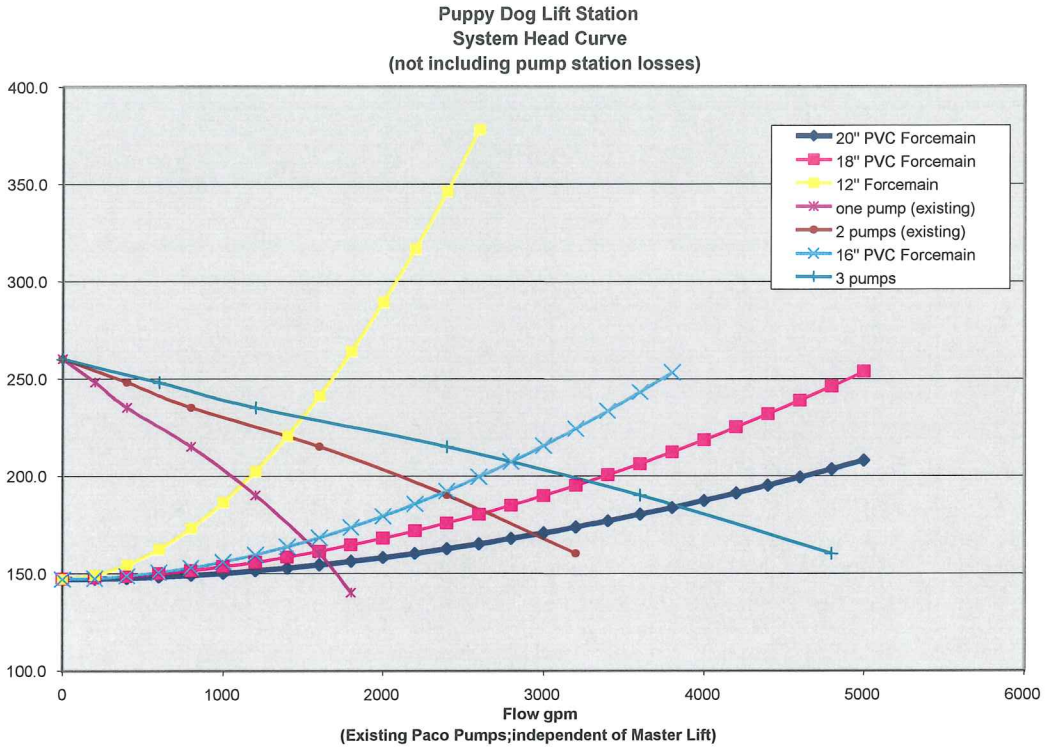
1. Near-term Forcemain Improvements

The purpose of the near-term improvements to the Puppy Dog Forcemain will allow the existing PDPS to pump with an increased capacity. This will essentially buy the City some time to allow for continued development in the PDSSSA. An evaluation of the following forcemain alternatives was conducted.

- Add Third Pump to PDPS
- Dual 12" Forcemains
- 16" Forcemain
- 18" Forcemain
- 20" Forcemain

A comparison of the effect these different forcemain sizes would have on the existing pumps is illustrated in Figure VII-1 on the following page.

Figure VIII-1 – Forcemain Evaluation with Existing PDPS Pumps



As shown, very little increase in flow is achieved by adding a third pump to PDPS with the existing forcemain. Significant increases can be achieved with the installation of a larger forcemain while still utilizing the existing pumps at PDPS. The addition of a parallel 12" forcemain would add approximately 850 gpm of capacity to the station. The station would see an additional capacity of 950 gpm, 1,150 gpm and 1,350 gpm with installation of 16", 18" and 20" forcemains, respectively. These flow rates are assuming that PDPS is pumping independent of the Master Lift Station. Improvements necessary to create this condition are discussed in the next section.

2. Long-term Forcemain Improvements

As additional acres of development are added to the PDSSSA, the need for additional pumping capacity will increase. With additional pumping capacity, limitations within the forcemain discussed under the short-term forcemain improvements will become apparent.

It would not be economical to build additional capacity into the forcemain discussed under the short-term improvements. Therefore, construction of additional forcemain capacity will be looked at in the long-term. Two alternatives were considered for long-term forcemain improvements as follows:

- New 36" Forcemain

- Additional 20" Forcemain

3. Influent Control Structure at Aeration Basins

The proposed influent control structure would be a common discharge point for all forcemains that enter the aeration basins. The most logical place to position a control structure is at the entrance to the aeration basins.

The control structure serves several purposes:

- Allows multiple forcemains to discharge at a common point against gravity only
- Eliminates the need for multiple pump stations to work against each other in a closed loop system, which may reduce the required pump horsepower
- Upflow effect of the structure allows stilling of the wastewater before overflowing the weirs
- Allows the pumped flow to be evenly spit between multiple basins
- Eliminates the need for buried valves to take a basin out of service. Stop logs or downward opening weir gates will be used

Flow from the influent control structure would be by gravity to the aeration basins. Preliminary calculations indicated that in order to handle peak flows, the minimum height of the structure is 10 to 12 feet above the maximum basin water surface elevation. This assumes that the existing 24" diameter basin inlet piping remains. However, it is recommended that this piping be replaced with either a new 36" diameter pipe or a second 24" diameter pipe. This will allow for a shorter structure while still being able to handle peak flows.

A separate entrance for the new forcemain was considered but not evaluated due to the following reasons:

- 10 State Standards recommends the use of multipurpose flow distribution structures to effectively split the hydraulic and organic loads.
- The inlet control structure is less expensive the separate forcemains by approximately $200,000.
- The inlet control structure will provide greater pumping capacity and operational flexibility.

4. Odor Control

We understand that the City is very cognizant regarding potential odors at any of their wastewater facilities. We also realize that the potential exists for odor at an influent control structure.

Biological processes, both aerobic and anaerobic, contribute to odors in a wastewater system. As bacteria convert organic waste into food and energy,

odors are produced along with cell generation. The most identifiable culprit contributing to odors in a wastewater collection system is hydrogen sulfide (H_2S). H_2S is most notable for its rotten egg smell. H_2S is also toxic, corrosive and has the unfortunate effect of numbing a person's sense of smell.

H_2S is formed when dissolved oxygen is depleted in water resulting in anaerobic conditions. In these conditions, microbes reduce naturally occurring sulfates to sulfides which are then released into the atmosphere under turbulent conditions. To effectively prevent the release of H_2S, the USEPA recommends maintaining dissolved hydrogen sulfide (DHS) concentrations at or below 1.0 mg/L.

One of the most common and economic methods for controlling odors in collection system is chemical addition. Several chemicals are available for addition and they typically control odors through one of two methods: oxidation and precipitation.

A comparison of chemical prices was conducted to evaluate the most economic means of treatment using chemical addition. Recommended chemical dosing rate per pound of DHS and treatment costs were established by consulting multiple suppliers.

Table VIII-1 – Chemical Addition Comparison

Chemical	Recommended Dose (lb Fe/lb DHS)	Treatment Cost ($/lb of DHS)
Ferrous Chloride ($FeCl_2$)	8	$2.52
Ferric Chloride ($FeCl_3$)	4	$3.20
Hydrogen Peroxide (H_2O_2)	4	$6.68
Potassium Permanganate ($KMnO_4$)	6	$17.16
Sodium Hypochlorite (NaOCl)	10	$11.60

Based on the chemical comparison shown in the above Table VIII-1, the most economic method for treatment is the use of the metal salt Ferrous Chloride. These prices reflect costs based upon theoretical chemical dosing for treatment of DHS. As the characteristics of wastewater in each collection system are different, further study may be needed to identify appropriate dosing rates specific to the City of Minot.

Another method by which odors can be controlled in collection systems and WWTF processes is through the use of air scrubbers. The three general types of scrubbers include chemical, dry, and biological. Although scrubbers neutralize atmospheric odors, they do nothing to reduce dissolved odors in wastewater; therefore the potential for odors in the collection system remains. However they are very effective at treating airborne odors present and generated by WWTF processes. They are particularly applicable where high concentrations of H_2S gas

are found. Because the cost of scrubbers can be high, process modifications to eliminate odor development should be evaluated before the adoption of scrubbers is suggested.

Based on existing flow conditions, wastewater strength, and forcemain characteristics from the Master Lift Station and the Puppy Dog Lift Station, a theoretical DHS loading prediction was developed. Based on the prediction, the Master Lift Station will produce approximately 108 lbs of DHS per day and the Puppy Dog Lift Station will produce approximately 20 lb of DHS per day. Table VIII-2 below summarizes the costs to effectively treat the predicted DHS to the 1.0 mg/L concentration recommended by the USEPA using $FeCl_2$.

Table VIII-2 – Chemical Treatment Cost

Facility	DHS Loading (lb DHS/Day)	Chemical Cost ($/Year)
Master Pumping Station	108	$99,500
Puppy Dog Pumping Station	20	$18,400
Total	**128**	**$117,900**

The treatment costs included in the above Table VIII-2 only reflect chemical costs and do not take into account capital costs associated with injection equipment. The most logical chemical application point would be at the existing lift stations.

Typical injection stations consist of a chemical container, metering pump, and PVC tubing. The injection line should be positioned below the water surface in the wet well of the lift station. Treatment chemicals can be corrosive and may damage concrete, piping, or pumps if allowed to discharge above the water surface and onto equipment.

Because a detention time of several minutes is required to effectively treat DHS using chemical injection, injection at the inlet control structure is most likely impractical. If treatment of odors at the inlet control structure is desired rather that the use of chemical treatment in the forcemains, a scrubber may be suitable. Because atmospheric H2S is highly dependent on turbulence and tends to be site specific, sizing a scrubber at this time would not be practical as the scrubber would most likely be improperly sized. Once construction of an inlet control structure has been completed, field data measuring H_2S would need to be collected to select and size an appropriate scrubber.

C. Puppy Dog Pumping Station Improvements

1. New Puppy Dog Pumping Station

The existing Puppy Dog Pumping Station will need to be replaced at some point in time. The increased forcemain size will allow for only a few more years of usefulness with the current station. Consideration was given to renovation of the existing station. However, influent piping size and current wetwell sizing limits the viability of the existing station with the anticipated future flows.

Replacement of the existing station appears to be the only solution to meet future demands. The existing site is not large enough for a new station and the existing station must remain in operation during construction. Therefore, a new site is needed. The open field south of the existing station across 37th Avenue is the most practical place to site a new station.

2. Expansion of Puppy Dog Pumping Station

The anticipated 2040 flows to the Puppy Dog Pumping Station require a substantial station. However, construction to meet ultimate flows can be accomplished in stages. The structure for the new station should be designed for ultimate flows, but the pumps and ancillary equipment can be designed for a 20-year life and upgraded. Due to the size of the pumping equipment necessary to meet anticipated 2040 flows, a station with the capability to accept an additional set of pumps should be constructed.

D. Puppy Dog Interceptor Improvements

1. Interceptor through First Larson Coulee

Installation of a new interceptor through First Larson Coulee to collect flows from several rural subdivisions appears to be the only viable alternative to provide sewer service to these areas. According to City Personnel, it is the City's goal to have the interceptor available to the people of the Crystal Springs subdivision by sometime in 2010. Installation of this interceptor will be challenging due to tough construction conditions within the coulee and the remote nature of the construction.

Preliminary sizing of the new interceptor indicates the need for a 15" diameter sewer main west of Crystal Springs. The pipe diameter gradually increases to 30" diameter, which is the size required when tying onto the existing Puppy Dog Interceptor.

2. South Hill Relief Pumping Station

As previously stated, the existing Puppy Dog Interceptor is operating, at times, at maximum capacity. In order for development that will utilize this interceptor to continue, relief must be provided. The most cost-effective way to achieve this is to pump a portion of the flow in the interceptor to the new interceptor through First Larson Coulee.

The most logical point at which to intercept the flow is at the point where the flow from the area north of Highway 2/52 crosses to the south. A station position here will intercept that flow coming from the south side of Highway 2/52. The station will pump the flow south to the top of the hill where it will be able to flow by gravity into the new First Larson Coulee Interceptor.

As stated in Section IV the anticipate 2040 flow utilizing the existing Puppy Dog Interceptor is approximately 0.88 MGD with a peak flow of approximately 2.15 MGD. This will require a relief pumping station capacity of approximately 2,000 gpm.

3. Upgrade of Existing Puppy Dog Interceptor

The upgrade of the existing Puppy Dog Interceptor from Manhole 34 to the Puppy Dog Pumping Station can be accomplished either by replacement of the existing pipeline or by installation of a parallel pipeline to supplement the existing. Either alternative will require a challenging installation due to the rugged terrain and limited access.

The condition of the existing pipeline is not known at this time. Therefore, an analysis of the pipeline condition should be conducted before final selection of a preferred alternative is made. For the purposes of this report, each alternative will be considered.

E. Wastewater Treatment Facility Improvements

1. Aeration Basins

Each aeration basin has a surface area of approximately 8 Acres when full. At a depth of 15 feet, this translates to a working volume of approximately 34 million gallons each. Hydraulically, the basins are limited by their transfer piping to the stabilization ponds. Organically, the basins are limited by the horsepower of the existing blowers and the efficiency of the diffusers.

A more in-depth analysis of the aeration basins is necessary to determine the point where they will be overloaded both hydraulically and organically.

2. **Stabilization Ponds**

After the aeration basins, the wastewater is transferred to the stabilization ponds for further treatment and eventual disposal. The stabilization ponds consist of four ponds and a constructed wetland. As with the aeration basins, a more in-depth analysis is necessary to determine the point where the stabilization ponds will be overloaded.

3. **Transfer Piping**

Wastewater is currently transferred between the aeration basins and the stabilization ponds through approximately 5,500 LF of 24" diameter ductile iron transfer pipe. Based on current installation conditions, the transfer pipe has a full-flow capacity of approximately 11 MGD.

Future capacity needs call for a transfer pipe to handle approximately 17 MGD from Puppy Dog Pumping Station and approximately 8 MGD from Master Pumping Station.

SECTION VIII
RECOMMENDED IMPROVEMENTS

A. General

Due to the magnitude of improvements needed in the PDSSSA, it is recommended that the improvements be implemented in a phased approach. This will allow for the following:

- Cost spread out over a number of years
- Ability to adapt to changes in growth patterns and development areas

The recommended phasing schedule is shown in Exhibit VIII-1 on Page 35 and is outlined in this section.

B. Phase I Improvements (2007 Construction)

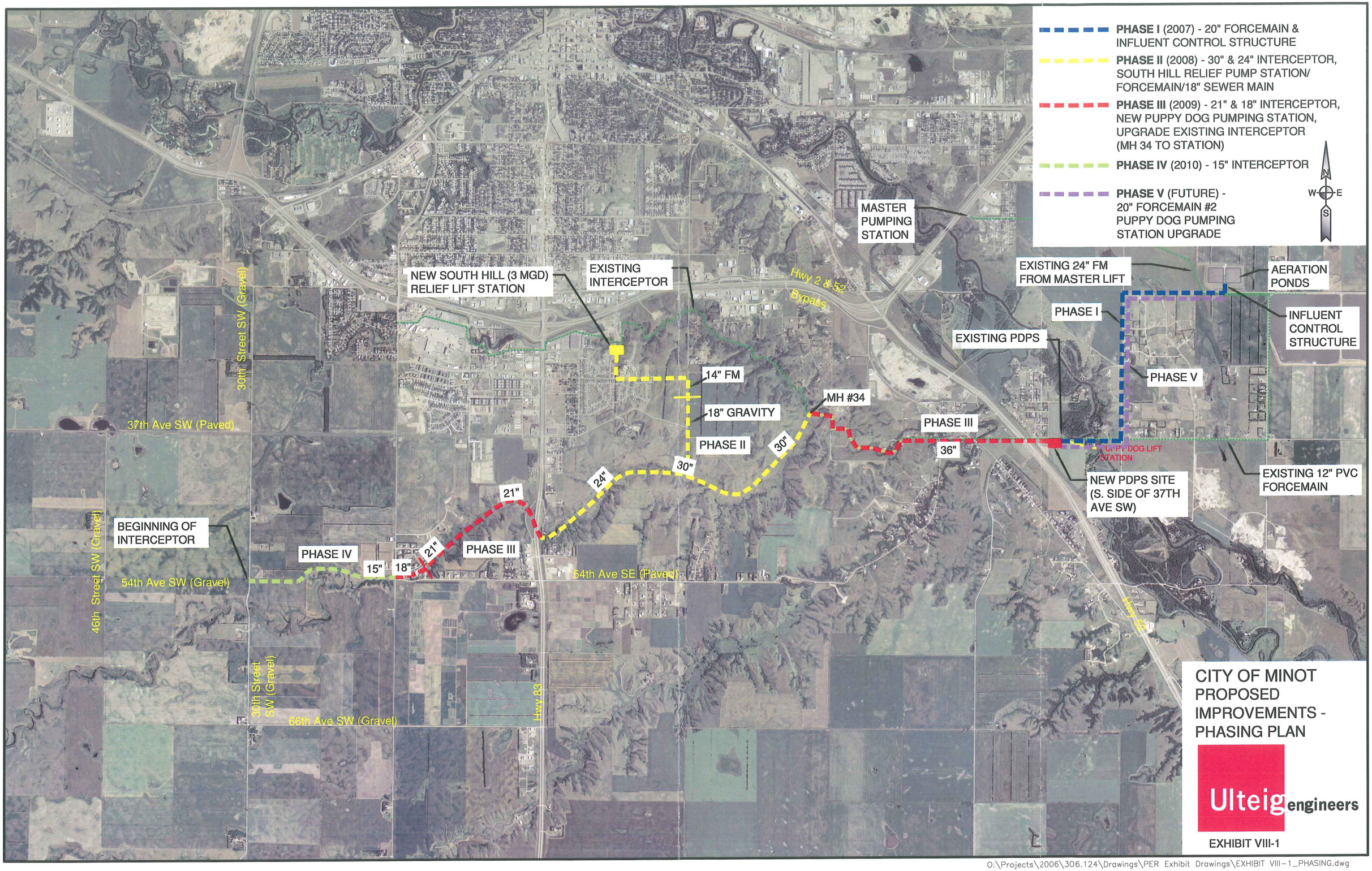
1. New 20" Forcemain to Aeration Basins

A new 20" diameter forcemain from the existing Puppy Dog Pumping Station to the aeration basins is recommended. This will allow for a substantial increase in existing pump output and will extend the life of the existing station. It is estimated that with this new forcemain, between 1,100 and 2,200 new homes will be able to be served with the existing pumping station. The larger number of new homes assumes that a new influent control structure is constructed at the aeration basins.

It is recommended that after connection to the existing station the new 20" forcemain head south across 37th Avenue. Crossing of the Mouse River will be by directional boring and will occur on the south side of an existing farmstead. From there, the forcemain will continue east to the west side of 55th Street SE. It will then continue north on the west side of 55th Street SE to the right-of-way of 20th Avenue SE. The forcemain will continue east in the right-of-way of 20th Avenue Se to the aeration basins. An aerial photograph showing the proposed forcemain route is included as Exhibit VIII-2 on Page 36.

2. New Influent Control Structure at Aeration Basins

To provide for more efficient delivery of wastewater to the aeration basins and for other reasons outlined previously, it is recommend that a new influent control structure be constructed at the aeration basins.



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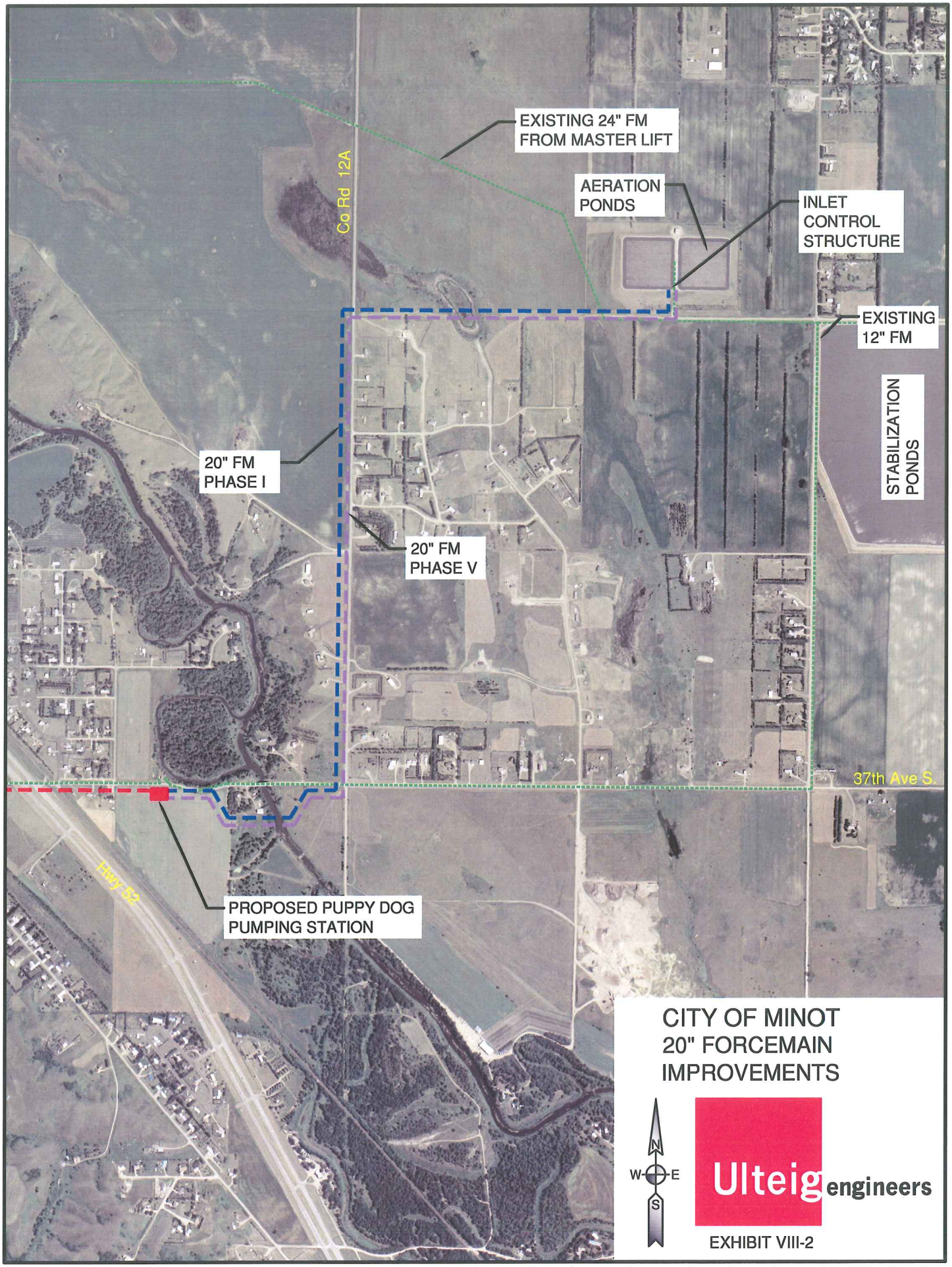

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The new structure would be of cast-in-place concrete construction and would be placed within the dikes of the basins. It would house the termination points for the forcemains from Master Pumping Station and Puppy Dog Pumping Station as well as provision for a future third forcemain. A new large aeration basin inlet pipe would be constructed from the control structure to the existing 24" basins inlet piping.

A schematic drawing showing the proposed influent control structure and associated basin influent piping is shown in Exhibit VIII-3 on Page 38.

C. Phase II Improvements (2008 Construction)

1. First Larson Coulee Interceptor (Existing MH 34 to Highway 83)

This improvement consists of the installation of 24" and 30" diameter sewer interceptor from the existing manhole 34 to just west of Highway 83. The Highway crossing will be accomplished with a steel casing pipe bored underneath the highway. An aerial photograph showing this section of the proposed First Larson Coulee Interceptor is included as Exhibit VIII-4 on Page 39

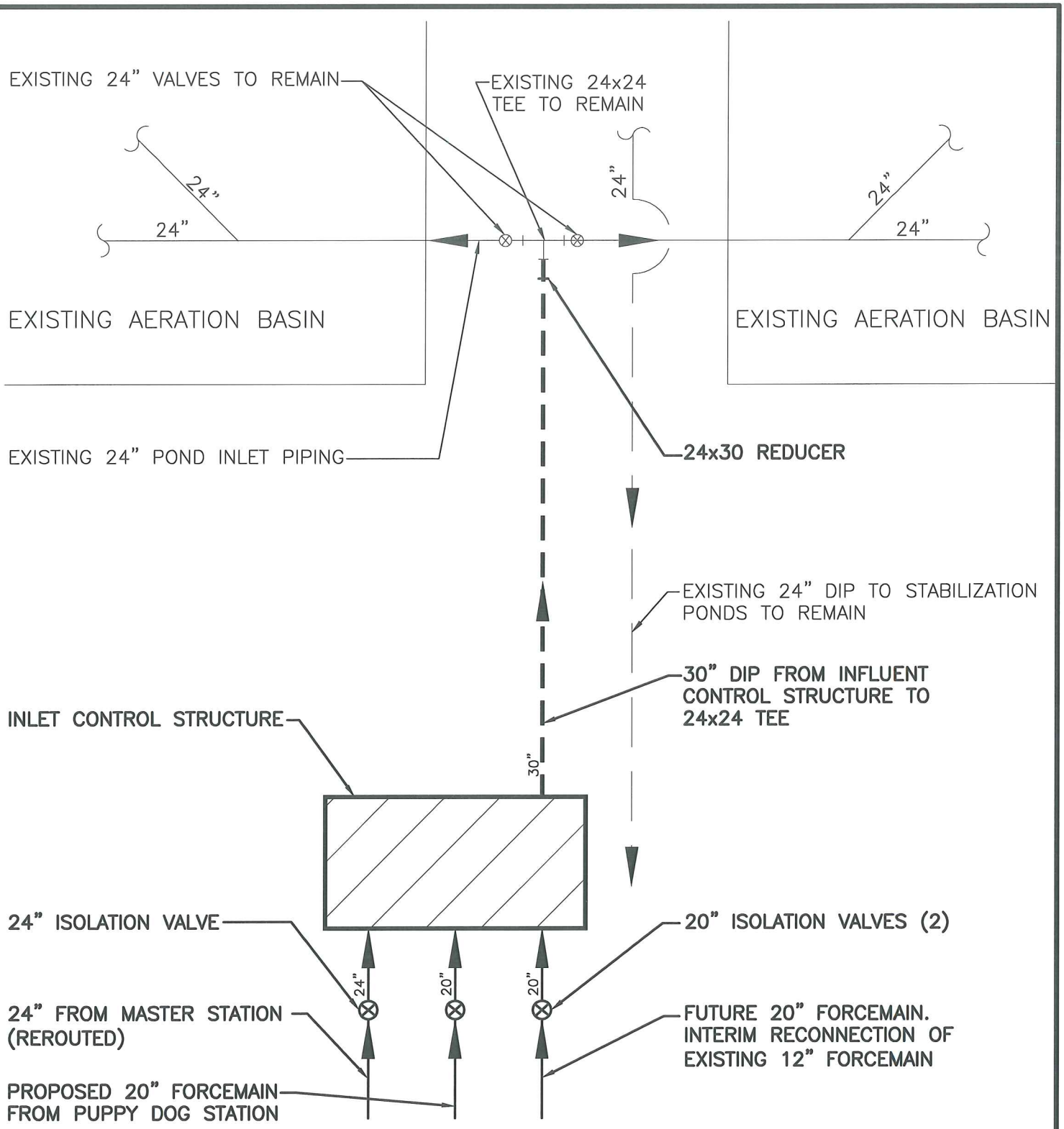
2. South Hill Relief Pumping Station

In order for development west and southwest of the existing PDSSSA to continue, it is recommended that relief be provided for the Puppy Dog Interceptor, which is currently overloaded and is prone to surcharging and backups.

A South Hill Relief Pumping Station located on 6th Street is recommended. This station will be designed for approximately 2,000 gpm and will intersect the flow from the southern portion of the service area. Flow from the northern portion of the service area will continue to utilize the existing interceptor.

Flow from the pumping station will be conveyed through a 14" diameter forcemain along 6th Street and 31st Avenue SE to 13th Street. At some point along 13th Street, the forcemain will discharge into a manhole. The flow will travel by gravity from this point until it reaches the new First Larson Coulee Interceptor.

An aerial photograph showing the proposed pumping station, forcemain, and gravity sewer is included as Exhibit VIII-5 on Page 40. In addition, a schematic drawing and section drawing of the proposed pumping station are included as Exhibits VIII-6 and VIII-7 on Pages 41 and 42, respectively



CITY OF MINOT

INFLUENT CONTROL STRUCTURE

Phase I Improvements

Ulteig engineers

EXHIBIT VIII-3

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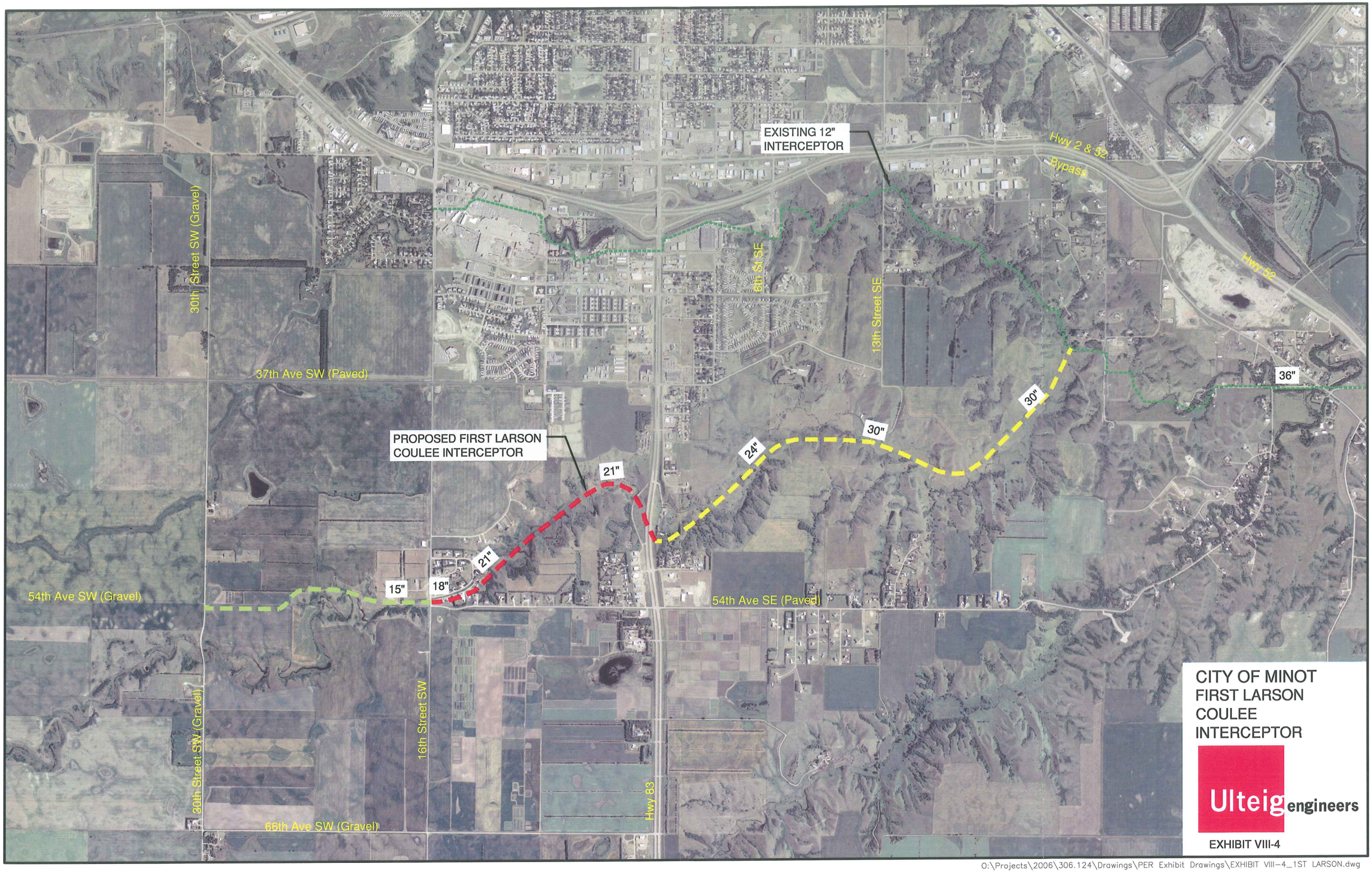

CITY OF MINOT
FIRST LARSON
COULEE
INTERCEPTOR

Ulteig engineers

EXHIBIT VIII-4

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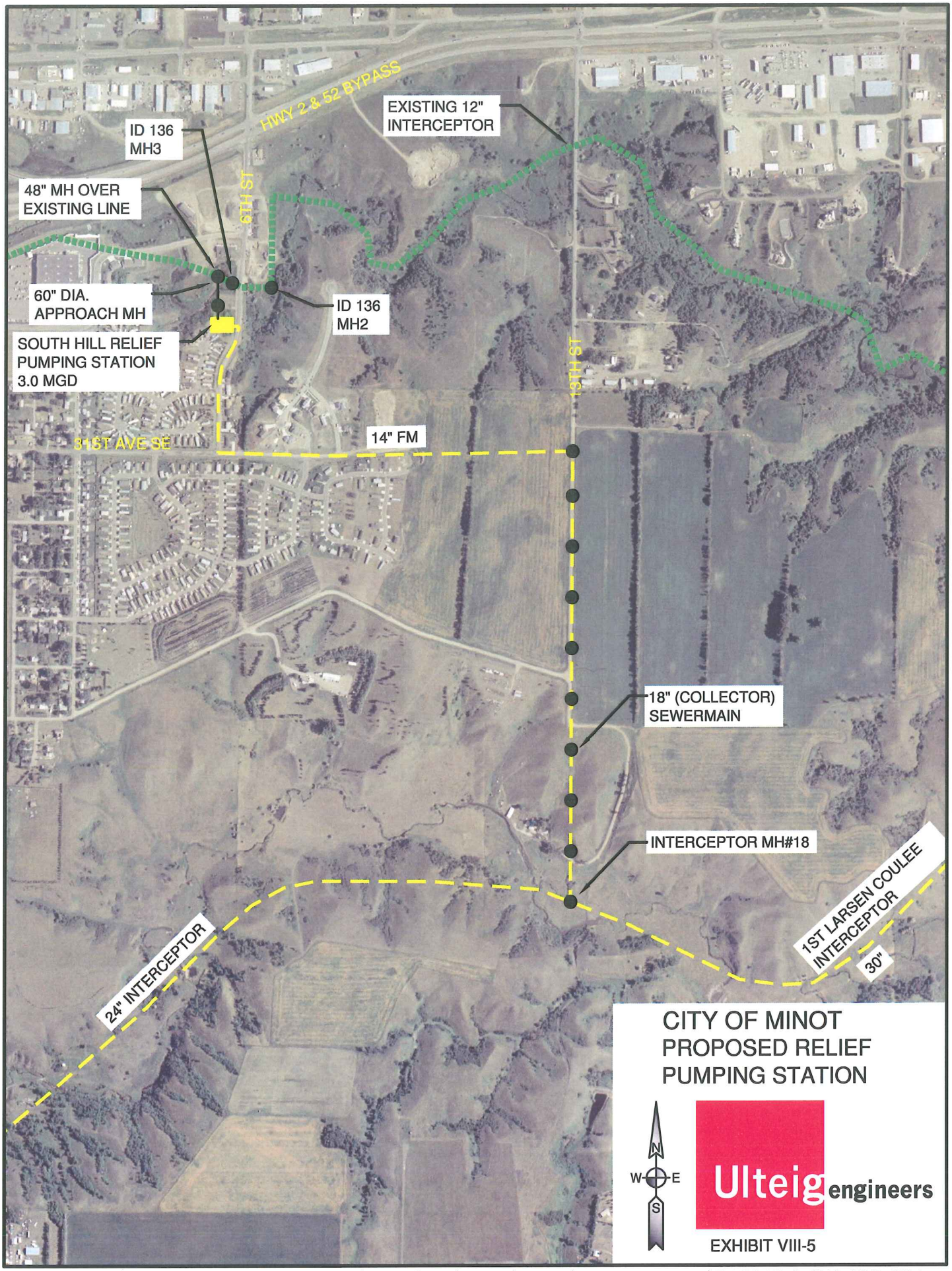

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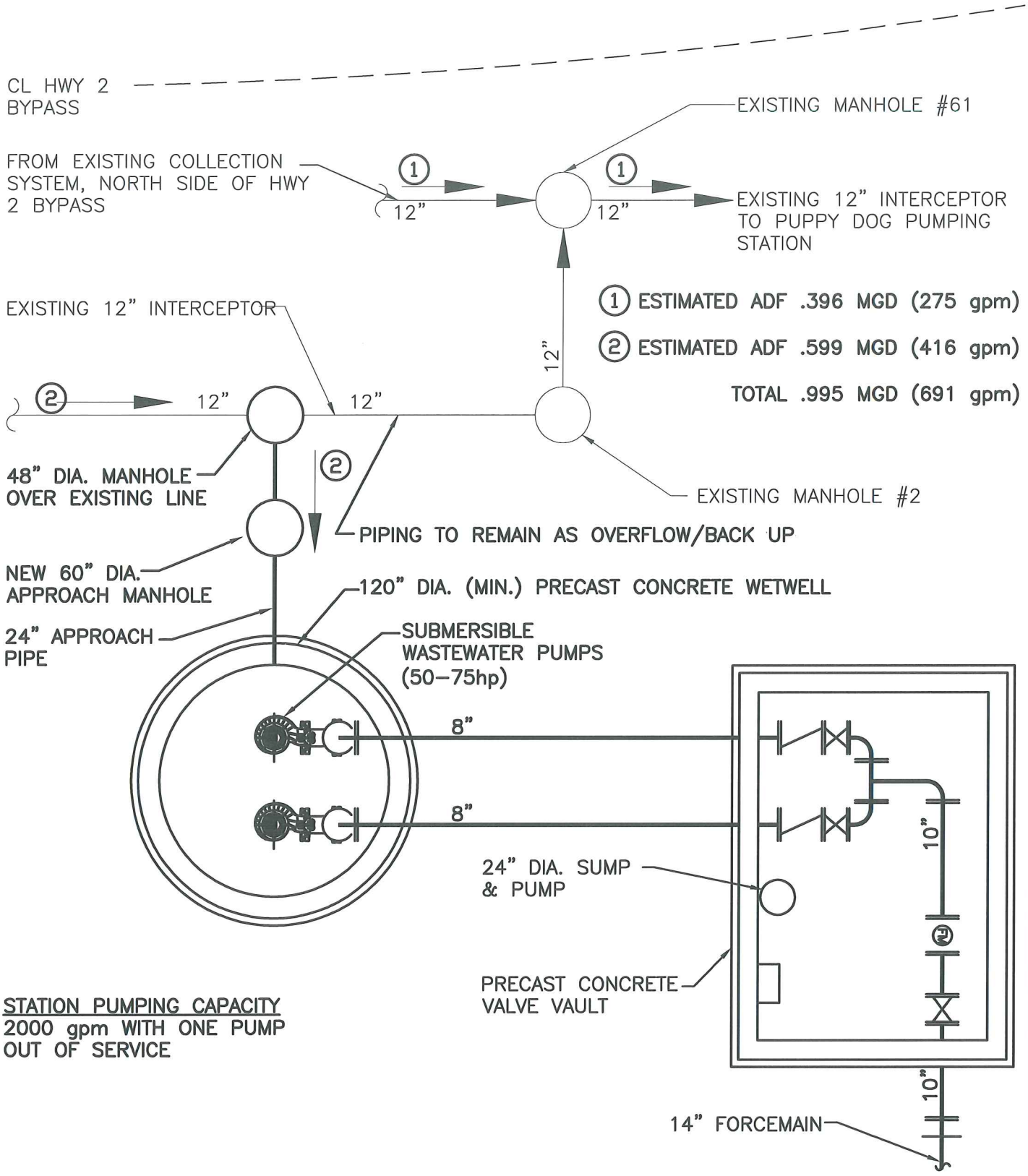

CITY OF MINOT
3 MGD SOUTH HILL RELIEF PUMP STATION
Phase II Improvements

Ulteig engineers

EXHIBIT VIII-6

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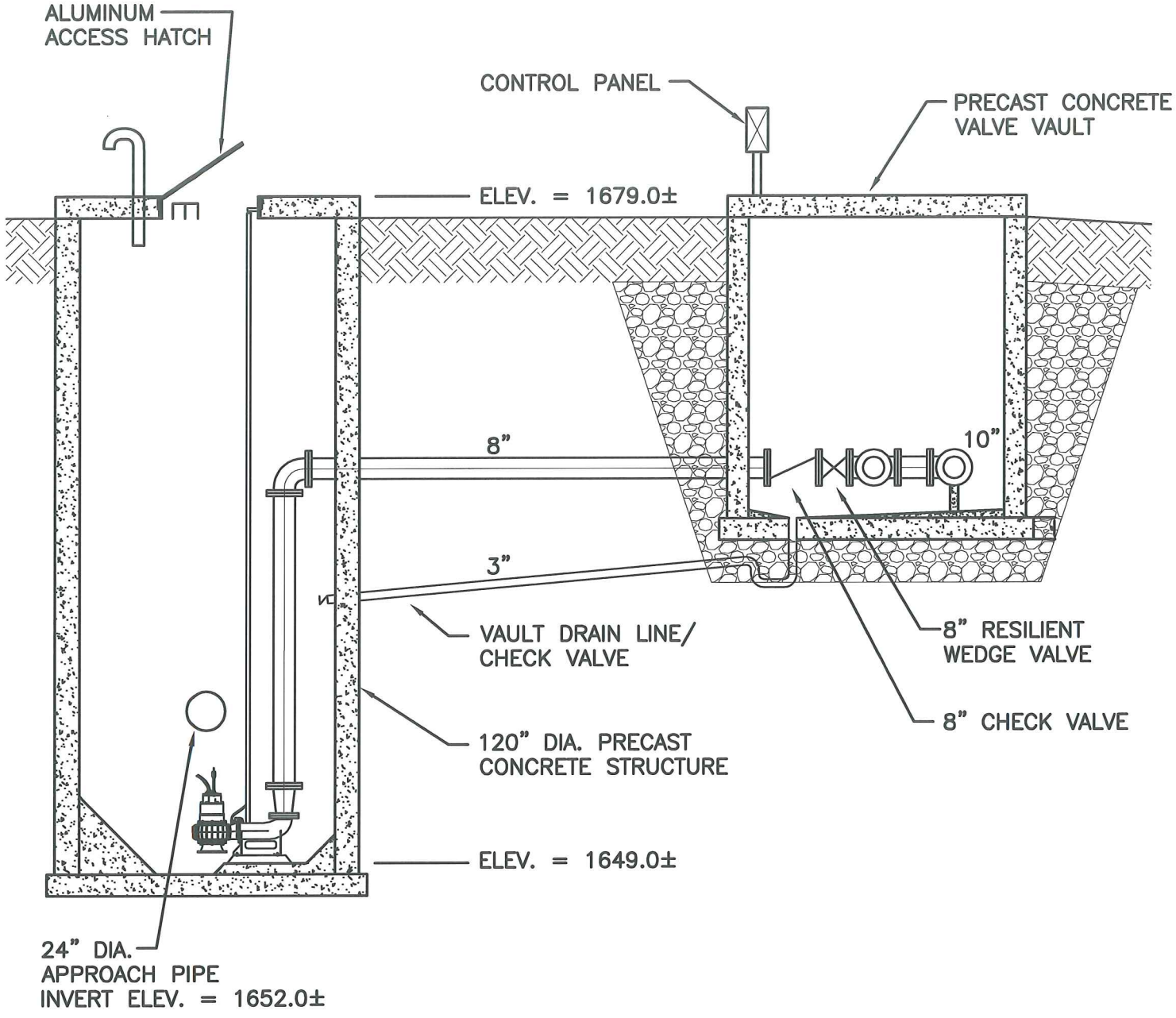

LEGEND

8" CHECK VALVE	
RESILIENT WEDGE VALVE	
MAGNETIC FLOW METER	FM

CITY OF MINOT
3 MGD SOUTH HILL
RELIEF PUMP STATION
Phase II Improvements

Ulteig engineers

EXHIBIT VIII-7

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3. Televise Puppy Dog Interceptor (Existing MH 34 to PDPS)

The Puppy Dog Interceptor from MH 34 to the PDPS consists of 15" and 21" reinforced concrete piping, which was installed in the 1970's. Currently, the condition of this section of piping is unknown. In order to assess to future viability of this pipeline, it is recommended that closed-circuit television (CCTV) inspection be conducted during low flow or shut down. This will allow an analysis to determine whether the pipeline can be utilized in the future in conjunction with a parallel pipeline or whether a 36" diameter replacement pipeline is needed.

4. Update Wastewater Treatment Facility Plan

The current facility plan for the wastewater treatment facilities was completed for a planning period ending in 2010. With the anticipated flows from the future planning area, it is necessary to update the facility plan to reflect changes in development and associated flows to the wastewater facilities. It is recommended that this be done under this phase in order to effectively plan for future necessary improvements at the aeration basins and stabilization ponds.

D. Phase III Improvements (2009 Construction)

1. New Puppy Dog Pumping Station

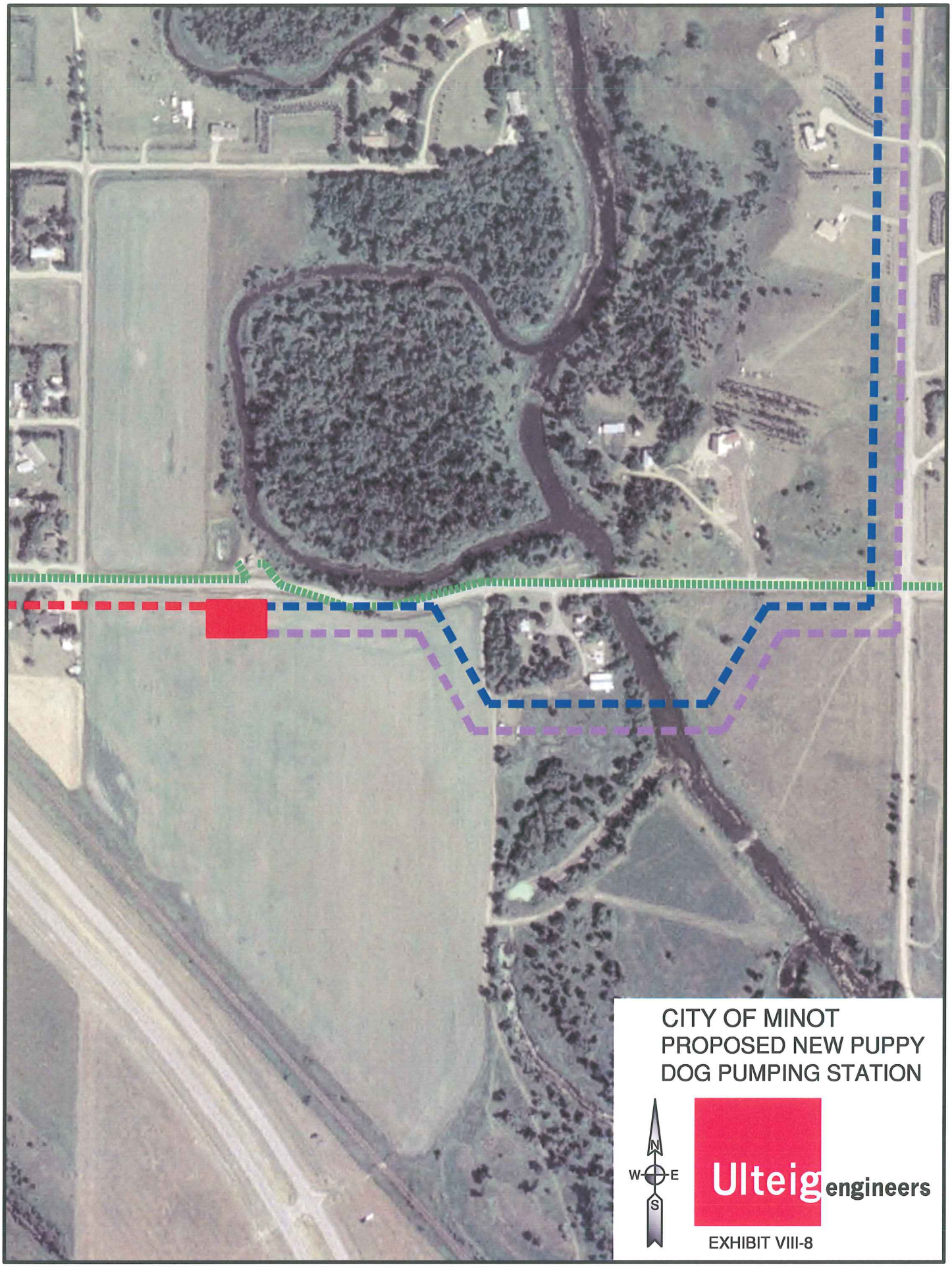
To meet anticipated future demands, it is recommended that a new Puppy Dog Pumping Station be constructed. As previously stated, the existing Puppy Dog Pumping Station, with a new forcemain, should be able to handle between 1,100 and 2,200 additional homes, depending on whether or not a new influent control structure is constructed at the aeration basins. City Personnel should monitor growth and adjust the timing for the new station accordingly.

The structure of the new station will be designed for ultimate flows. The pumping components will be sized for a 20-year design life. Provisions will be made in the new station for future expansion, when needed.

An aerial photograph showing the proposed new Puppy Dog Pumping Station is included as Exhibit VIII-8 on Page 44. In addition, a schematic drawing and section drawing of the proposed pumping station are included as Exhibits VIII-9, VIII-10, and VIII-11 on Pages 45, 46, and 47 respectively

2. First Larson Coulee Interceptor (Highway 83 to Crystal Springs)

This improvement consists of the installation of 18" and 21" diameter sewer interceptor from just west of Highway 83 to the rural subdivision of Crystal Springs. An aerial photograph showing this section of the proposed First Larson Coulee Interceptor is included as Exhibit VIII-4 on Page 39.



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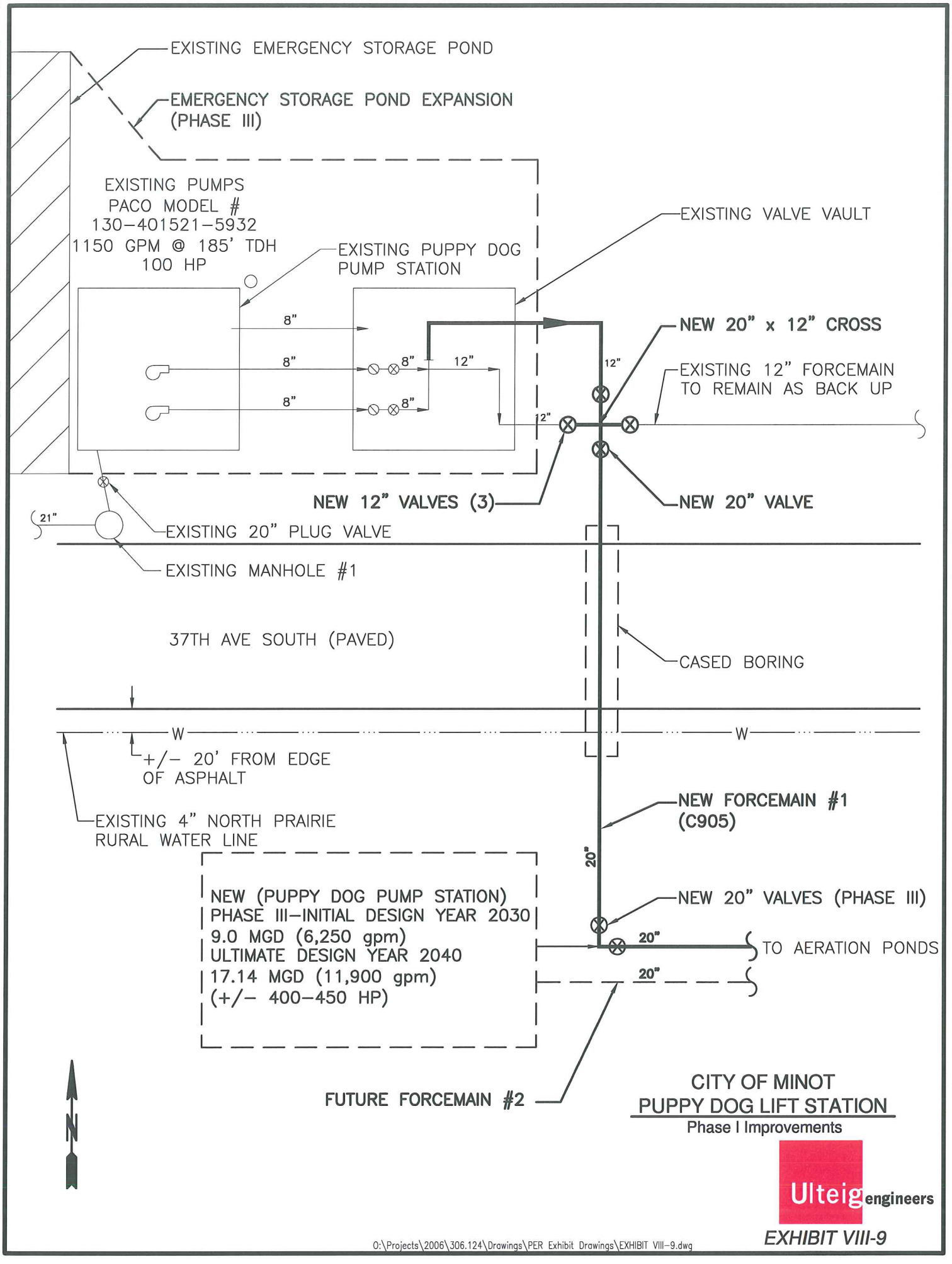
EXISTING EMERGENCY STORAGE POND
EMERGENCY STORAGE POND EXPANSION (PHASE III)
EXISTING PUMPS
PACO MODEL #
130-401521-5932
1150 GPM @ 185' TDH
100 HP
EXISTING PUPPY DOG PUMP STATION
EXISTING VALVE VAULT
8"
8"
8"
8"
8"
12"
12"
12"
NEW 20" x 12" CROSS
EXISTING 12" FORCEMAIN TO REMAIN AS BACK UP
NEW 12" VALVES (3)
NEW 20" VALVE
21"
EXISTING 20" PLUG VALVE
EXISTING MANHOLE #1
37TH AVE SOUTH (PAVED)
CASED BORING
W
W
+/- 20' FROM EDGE OF ASPHALT
EXISTING 4" NORTH PRAIRIE RURAL WATER LINE
NEW FORCEMAIN #1 (C905)
20"
NEW (PUPPY DOG PUMP STATION)
PHASE III-INITIAL DESIGN YEAR 2030
9.0 MGD (6,250 gpm)
ULTIMATE DESIGN YEAR 2040
17.14 MGD (11,900 gpm)
(+/- 400-450 HP)
NEW 20" VALVES (PHASE III)
20"
TO AERATION PONDS
20"
FUTURE FORCEMAIN #2
N
CITY OF MINOT
PUPPY DOG LIFT STATION
Phase I Improvements
Ulteig engineers
EXHIBIT VIII-9
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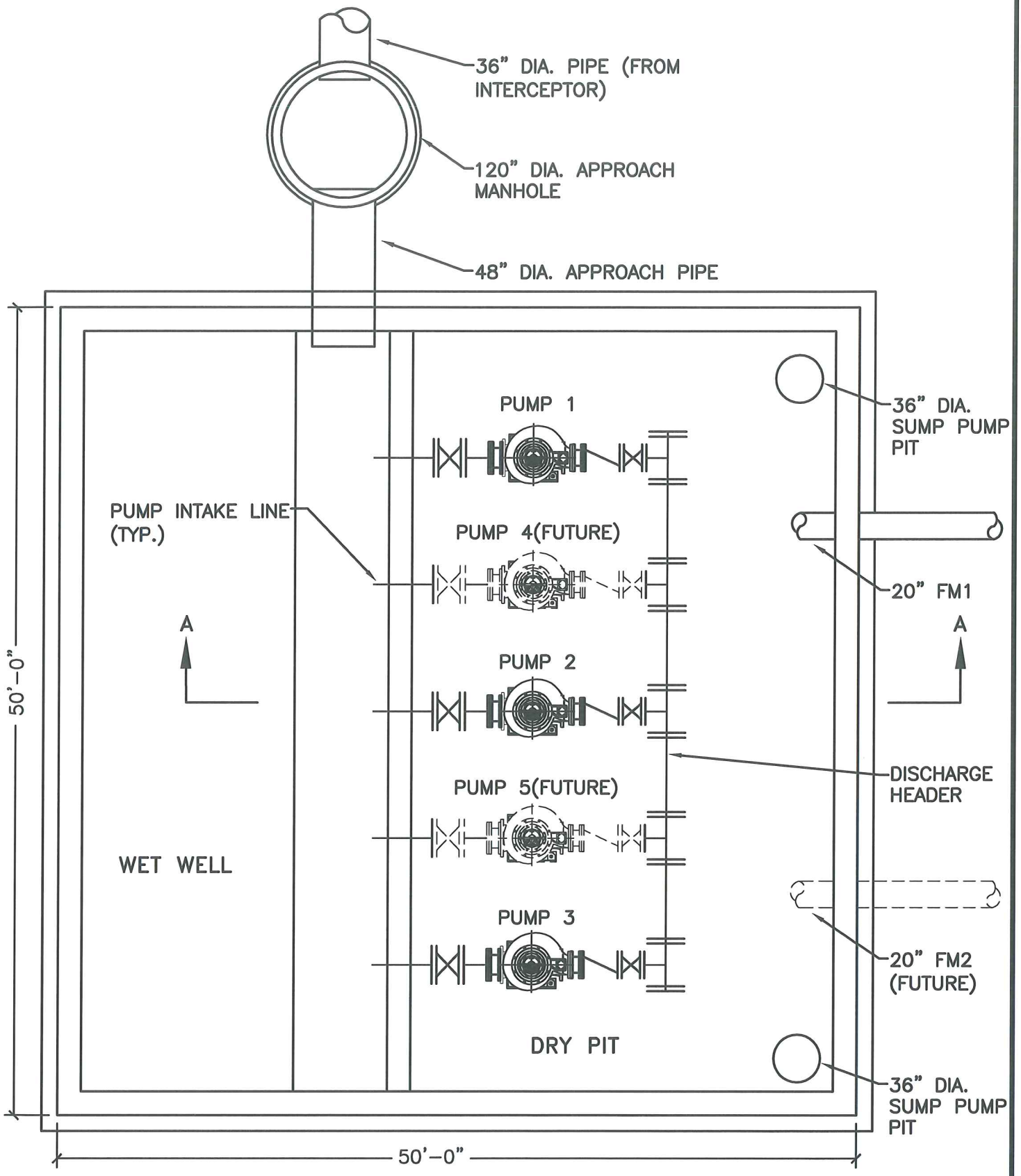

CITY OF MINOT

PUPPY DOG PUMPING STATION

Phase III Improvements

LOWER LEVEL PLAN

Ulteig engineers

EXHIBIT VIII-10

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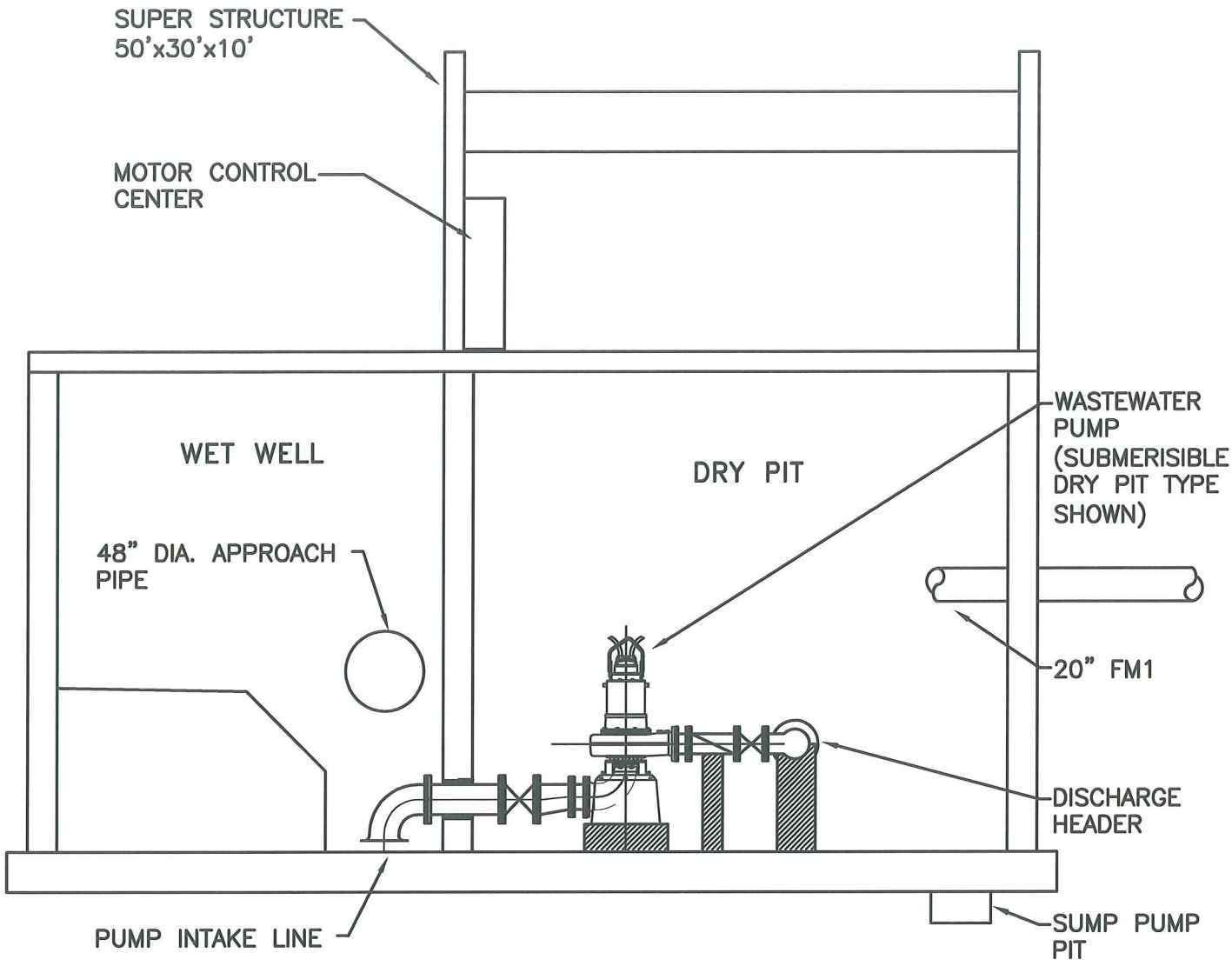

SECTION A–A
(EXHIBIT VIII–10)

CITY OF MINOT
PUPPY DOG PUMPING STATION
Phase III Improvements

Ulteig engineers

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EXHIBIT VIII-11

3. Puppy Dog Interceptor Improvements (MH 34 to new Puppy Dog Pumping Station)

This improvement consists of either the installation of a parallel interceptor intended to supplement the existing interceptor or a new interceptor line intended to act as a stand-alone sewer interceptor. Installation would occur from the existing manhole #34 to the new Puppy Dog Pumping Station. The preferred alternative will not be known until an accurate assessment of the condition of the existing pipeline can be made. An aerial photograph showing this section of the Puppy Dog Coulee Interceptor is included as Exhibit VIII-1 on Page 35.

4. Expand Emergency Storage Pond at Puppy Dog Pumping Station

After the new Puppy Dog Pumping Station is constructed, it is anticipated that the existing station will be demolished. City personnel have indicated that the existing emergency storage pond be expanded in the void left by the station demolition. It is anticipated that the size of the pond could be approximately doubled. Increased capacity in the pond will allow City Personnel a time cushion when reacting to potential pumping station failures and maintenance issues.

E. Phase IV Improvements (2010 Construction)

1. First Larson Coulee Interceptor (Crystal Springs to 30th Street SW)

This improvement consists of the installation of 18" and 21" diameter sewer interceptor from just west of Highway 83 to the rural subdivision of Crystal Springs. An aerial photograph showing this section of the proposed First Larson Coulee Interceptor is included as Exhibit VIII-4 on Page 39.

F. Phase V Improvements (Future)

1. New Parallel 20" Forcemain to Aeration Basins

The new 20" forcemain recommended in Phase I has a capacity of approximately 9 MGD. Once this flow is realized within the service area, an increase in forcemain capacity will be needed. It is recommended that a new 20" forcemain be installed parallel to the 20" forcemain installed under Phase I. The route, which is the same as the first 20" forcemain, is shown in Exhibit VIII-2 on Page 36.

2. Expansion & Upgrade of Puppy Dog Pumping Station

Along with a new parallel forcemain, an expansion and upgrade of the Puppy Dog Pumping Station will be necessary to keep up with increasing demands within the service area.

G. Phase VI Improvements (Future)

1. Expansion & Upgrade of Wastewater Treatment Facilities

As previously stated, it is anticipated that an expansion and upgrade of the wastewater treatment facilities will be needed at some point in the future to effectively treat increased flows. However, an in-depth analysis of the treatment facilities has not been completed to date and is beyond the scope of this report.

At this point it is recommended that the City begin the process of updating their current wastewater treatment facility plan. The current plan was completed through the year 2010.

SECTION IX
OPINION OF PROBABLE COST

The Engineer's Opinion of Estimate Cost for each proposed Phase is shown in Table IX-1. Each Cost Opinion includes allowances for total construction costs, engineering, land acquisition (if applicable) and contingencies. Detailed Cost Opinions for each improvement can be found in the Appendix.

Table IX.1 – Engineer's Opinions of Estimated Cost

Engineer's Opinion of Estimated Cost			
Estimated Year	**Phase**	**Improvement**	**Total Project Cost**
2007	I	New 20" Forcemain to Aeration Basins	$1,680,400
2007	I	New Influent Control Structure at Aeration Basins	$304,000
		Phase I Total	***$1,984,400***
2008	II	First Larson Coulee Interceptor (MH 34 to Hwy 83)	$3,765,400
2008	II	South Hill Relief Pumping Station	$1,177,300
2008	II	Televise Puppy Dog Interceptor (MH 34 to Puppy Dog Pumping Station	$119,100
2008	II	Update WWTF Facility Plan	$50,000
		Phase II Total	***$5,111,800***
2009	III	New Puppy Dog Pumping Station	$3,824,000
2009	III	First Larson Coulee Interceptor (Hwy 83 to Crystal Springs)	$1,087,900
2009	III	Puppy Dog Interceptor Improvements (MH 34 to New Puppy Dog Pumping Station – Option A	$4,265,600
2009	III	Expand Emergency Storage Pond at Puppy Dog Pumping Station	$345,000
		Phase III Total	***$9,522,500***
2010+	IV	First Larson Coulee Interceptor (Crystal Springs to 30th Street SW)	$458,800
		Phase IV Total	***$458,800***
?	V	New Parallel 20" Forcemain to Aeration Basins	$1,559,900
?	V	Expansion & Upgrade of Puppy Dog Pumping Station	$962,500
		Phase V Total	***$2,522,400***
?	VI	Expansion & Upgrade of Wastewater Treatment Facilities	Undetermined
		Phase VI Total	***Undetermined***
		Total Phases I - V	***$19,599,900***

APPENDIX

A. Engineer's Opinions of Estimated Cost

APPENDIX A

Engineer's Opinions of Estimated Cost

Preliminary Opinion of Probable Costs
Phase I
20" Forcemain #1
City of Minot North Dakota
UEI Project # 306.124

20" PVC Forcemain, Existing PDPS to the Aeration Basins

No	Item	Unit	Quantity		Unit Cost		Extended Costs
1	General Conditions (8%)	LS	1	$	98,900.00	$	98,900.00
2	Temporary Pumping Requirements	LS	1	$	20,000.00	$	20,000.00
	Interim connection to existing @ valve vault						
3	Core drill existing wall for 12" DIP	EA	1	$	1,500.00	$	1,500.00
4	12" flanged 90 bend	EA	3	$	800.00	$	2,400.00
6	12" Dia Butterfly Valves	EA	3	$	2,800.00	$	8,400.00
7	20" Dia Butterfly Valve (MJ)	EA	1	$	6,300.00	$	6,300.00
8	20 x 12 MJ Cross	EA	1	$	3,600.00	$	3,600.00
9	20 x 12 MJ Reducer	EA	1	$	1,600.00	$	1,600.00
10	12" DIP Process Piping	LS	1	$	3,000.00	$	3,000.00
	20" PVC Forcemain to Aeration Basins						
11	20" PVC Forcemain	LF	11,000	$	80.00	$	880,000.00
12	36" dia steel casing pipe	LF	240	$	600.00	$	144,000.00
13	20 HDPE forcemain (Boring River Crossing)	LF	200	$	155.00	$	31,000.00
14	20" Ductile Iron MJ Fittings	EA	15	$	1,500.00	$	22,500.00
15	Undeveloped Design Details (10%)					$	112,400.00
					Construction Subtotal	**$**	**1,336,000.00**
	Contingency (5%)					$	67,000.00
					Grand Total Construction Costs	**$**	**1,403,000.00**
	Engineering (13%)					$	182,400.00
	Design/Bidding						
	Construction Administration/Observation						
	Right-of-Way Acquisition					$	25,000.00
	Title Search						
	Survey						
	Negotiation						
	Legal & Administrative (5%)*					$	70,000.00
					Grand Total	**$**	**1,680,400.00**

* Includes Purchase of Right of Way and Easements

Preliminary Opinion of Probable Costs
Phase I
Influent Control Structure
City of Minot North Dakota
UEI Project # 306.124

Aeration Basins Influent Control Structure

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 17,800.00	$ 17,800.00
2	Influent Control Structure (Cast in Place)	LS	1	$ 100,000.00	$ 100,000.00
3	Flow Control Devices	EA	3	$ 7,500.00	$ 22,500.00
4	Basin influent piping	LF	125	$ 500.00	$ 62,500.00
5	Basin influent pipe fittings	EA	3	$ 3,000.00	$ 9,000.00
6	Undeveloped Design Details (15%)				$ 29,000.00
				Construction Subtotal	**$ 240,800.00**
	Contingency (10%)				$ 24,000.00
				Grand Total Construction Costs	**$ 264,800.00**
	Engineering (14.8%)				$ 39,200.00
	Design/Bidding				
	Construction Administration				
				Grand Total	**$ 304,000.00**

Preliminary Opinion of Probable Costs
Phase II
Puppy Dog Coulee Interceptor
City of Minot North Dakota
UEI Project # 306.124

Dec-06

24" Interceptor from New MH #18 to New MH #36 (Just West of HWY 83 R/W)

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 91,000.00	$ 91,000.00
2	Clearing & Grubbing	LS	1	$ 10,000.00	$ 10,000.00
3	24" PVC Sewermain	LF	7200	$ 95.00	$ 684,000.00
4	Highway Boring & Casing	LF	200	$ 850.00	$ 170,000.00
5	New 72" Dia Manholes	EA	5	$ 10,000.00	$ 50,000.00
6	New 60" Dia MH	EA	13	$ 8,000.00	$ 104,000.00
7	Surface Restoration	Acres	12	$ 1,500.00	$ 18,000.00
8	Undeveloped Design Details (10%)				$ 102,000.00
		Schedule A Construction Subtotal			**$ 1,229,000.00**
	Contingency (5%)				$ 61,000.00
		Grand Total Construction Costs			**$ 1,290,000.00**
	Engineering (13%)				$ 167,700.00
	Design/Bidding				
	Construction Administration				
	Right-of-Way Acquisition				$ 20,000.00
	Title Search				
	Survey				
	Negotiation				
	Legal & Administrative (5%)*				$ 65,000.00
			Grand Total		**$ 1,542,700.00**

* Includes Purchase of Right-of-Way and Easements

Preliminary Opinion of Probable Costs
Phase II
First Larson Coulee Interceptor
City of Minot North Dakota
UEI Project # 306.124

Dec-06

30" Interceptor from Ex Mh #34 to New Manhole #18

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 132,000.00	$ 132,000.00
2	Clearing & Grubbing	LS	1	$ 10,000.00	$ 10,000.00
3	Temporary Pumping @ Mh #34	LS	1	$ 4,000.00	$ 4,000.00
4	Remove Ex. MH #34	EA	1	$ 2,000.00	$ 2,000.00
5	Install new 84" Dia MH #34/reconnect existing mains & Stub outs	EA	1	$ 14,000.00	$ 14,000.00
6	30" dia pipe/protective coating	LF	7,200	$ 180.00	$ 1,296,000.00
7	New 72" Dia Manholes	EA	5	$ 10,000.00	$ 50,000.00
8	New 60" Dia MH	EA	13	$ 8,000.00	$ 104,000.00
9	Surface Restoration	Acres	12	$ 1,500.00	$ 18,000.00
10	Undeveloped Design Details (10%)				$ 148,000.00
		Schedule A Construction Subtotal			**$ 1,778,000.00**
	Contingency (5%)				$ 89,000.00
		Grand Total Construction Costs			**$ 1,867,000.00**
	Engineering (13%)				$ 242,700.00
	Design/Bidding				
	Construction Administration				
	Right-of-Way Acquisition				$ 20,000.00
	Title Search				
	Survey				
	Negotiation				
	Legal & Administrative (5%)*				$ 93,000.00
			Grand Total		**$ 2,222,700.00**

* Includes Purchase of Right-of-Way and Easements

Preliminary Opinion of Probable Costs
Phase II
3.0 MGD South Hill Relief Lift Station
City of Minot North Dakota
UEI Project # 306.124
Dec-06

No	Item	Unit	Quantity	Unit Cost	Extended Costs
	Relief Pump Station				
1	General Conditions (8%, all components)	LS	1	$ 69,000.00	$ 69,000.00
2	Clearing & Grubbing	LS	1	$ 5,000.00	$ 5,000.00
3	48" Diameter Sanitary Manholes	EA	1	$ 5,500.00	$ 5,500.00
4	60" Diameter Approach Manhole	EA	1	$ 8,600.00	$ 8,600.00
5	24" Diameter PVC Approach Pipe	LF	100	$ 72.00	$ 7,200.00
6	120" dia precast concrete pump station	EA	1	$ 55,000.00	$ 55,000.00
7	10' x 12' precast Concrete Valve Vault	EA	1	$ 25,000.00	$ 25,000.00
8	Submersible WW Pumps	EA	2	$ 40,000.00	$ 80,000.00
9	10" Pump Discharge pipe & fittings Lines	LS	1	$ 8,500.00	$ 8,500.00
10	10" magnetic flow meter	EA	1	$ 8,000.00	$ 8,000.00
11	10" Check Valves	EA	2	$ 5,500.00	$ 11,000.00
12	10" Isolation Valves	EA	2	$ 2,500.00	$ 5,000.00
13	Surface Restoration & Seeding	LS	1	$ 10,000.00	$ 10,000.00
14	Electricals & Controls	LS	1	$ 68,000.00	$ 68,000.00
15	80 Kw Diesel Generator	EA	1	$ 23,000.00	$ 23,000.00
16	Undeveloped Design Details (10%)				$ 32,000.00
		Pump Station Construction Subtotal			**$ 420,800.00**
	14" Forcemain				
17	14" PVC Forcemain	LF	4,500	$ 42.00	$ 189,000.00
18	Ductile Iron Forcemain Fittings (MJ)	EA	6	$ 500.00	$ 3,000.00
19	Remove Asphalt	SY	6,600	$ 2.00	$ 13,200.00
20	Replace Asphalt	Tons	1,700	$ 50.00	$ 85,000.00
21	Surface Restoration & Seeding	LS	1	$ 5,000.00	$ 5,000.00
22	Undeveloped Design Details (10%)				$ 30,000.00
		12" Forcemain Construction Subtotal			**$ 325,200.00**
	18" Gravity line to 1st Larson Coulee Interceptor				
23	18" PVC Sewermain	LF	1,600	$ 75.00	$ 120,000.00
24	48" Diameter Sanitary Manholes	EA	9	$ 5,500.00	$ 49,500.00
25	Undeveloped Design Details (10%)				$ 17,000.00
			Gravity Line Subtotal		**$ 186,500.00**
			Subtotal Total Construction Costs		$ 932,500.00
	Contingency (5%)				$ 47,000.00
			Grand Total Construction Costs		**$ 979,500.00**
	Engineering (13.25%)				$ 129,800.00
	Design/Bidding				
	Construction Administration				
	Right-of-Way Acquisition				$ 5,000.00
	Title Search				
	Survey				
	Negotiation				
	Legal & Administrative (5%)*				$ 49,000.00
	Pump Station Land Purchase (4 Acres)				$ 14,000.00
			Grand Total		**$ 1,177,300.00**

* Includes Purchase of Right-of-Way and Easements

Preliminary Opinion of Probable Costs
Phase II
Televising Existing Pipeline
City of Minot North Dakota
UEI Project # 306.124

Dec-06

Televising Existing Puppy Dog Interceptor from Manhole #34 to PDPS

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 7,000.00	$ 7,000.00
3	Bypass Pumping	LS	1	$ 30,000.00	$ 30,000.00
4	15" Sewermain Cleaning &Televising	LF	5,900	$ 4.50	$ 26,550.00
5	21" Sewermain Cleaning & Televising	LF	4,500	$ 6.50	$ 29,250.00
				Subtotal	**$ 93,000.00**
	Contingency (10%)				$ 9,000.00
				Total	**$ 102,000.00**
	Engineering (15%)				$ 12,000.00
	Legal & Administrative (5%)				$ 5,100.00
				Grand Total	**$ 119,100.00**

Preliminary Opinion of Probable Costs
Phase III
Puppy Dog Pumping Station
City of Minot North Dakota
UEI Project # 306.124

Dec-06

New Puppy Dog Pumping Station

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 234,600.00	$ 234,600.00
2	Clearing & Grubbing	LS	1	$ 5,000.00	$ 5,000.00
3	48" Diameter approach pipe	LF	30	$ 450.00	$ 13,500.00
4	120" Dia Approach Manhole	EA	1	$ 64,000.00	$ 64,000.00
5	Cast in Place Concrete Wetwell/Drywell	LS	1	$ 1,300,000.00	$ 1,300,000.00
6	Pumping Equipment *	EA	3	$ 145,000.00	$ 435,000.00
7	Process piping/Flowmeters	LS	1	$ 150,000.00	$ 150,000.00
8	Sump Pump	EA	2	$ 4,000.00	$ 8,000.00
9	Superstructure (Precast)	LS	1	$ 200,000.00	$ 200,000.00
10	Site work/Entrance Road	LS	1	$ 50,000.00	$ 50,000.00
11	Demolition of Existing Pump Station	LS	1	$ 20,000.00	$ 20,000.00
12	Motor Control Center	EA	1	$ 40,000.00	$ 40,000.00
13	Control Panel	EA	1	$ 200,000.00	$ 200,000.00
14	SCADA System	LS	1	$ 20,000.00	$ 20,000.00
15	750 KVA Generator Set	EA	1	$ 160,000.00	$ 160,000.00
16	Undeveloped Design Details (10%)				$ 266,600.00
				Construction Subtotal	**$ 3,167,000.00**
	Contingency (5%)				$ 158,000.00
				Grand Total Construction Costs	**$ 3,325,000.00**
	Engineering (12%)				$ 399,000.00
	Design/Bidding				
	Construction Administration				
	Legal & Administrative (3%)				$ 100,000.00
				Grand Total	**$ 3,824,000.00**

* Pumping equipment unit price is based on Fairbanks Morse Pumps,
Dry Pit **Submersible** Pumps
For 3, **Standard**, dry pit pumps, deduct $35,000 ea ($105,000 Total)

* Includes Purchase of Right-of-Way and Easements

Preliminary Opinion of Probable Costs
Phase III
Puppy Dog Coulee Interceptor
City of Minot North Dakota
UEI Project # 306.124

18" & 21" Interceptor from new MH #36 to New MH #54 (HWY 83 to Crystal Springs)

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%, all components)	LS	1	$ 64,900.00	$ 64,900.00
2	Clearing & Grubbing	LS	1	$ 30,000.00	$ 30,000.00
3	21" dia PVC Sewermain	LF	5355	$ 75.00	$ 401,625.00
4	18" dia PVC Sewermain	LF	1270	$ 63.00	$ 80,010.00
5	New 60" Dia MH	EA	5	$ 7,200.00	$ 36,000.00
6	New 48" Dia MH	EA	9	$ 5,500.00	$ 49,500.00
7	Remove Ashphalt Pavement	SY	2850	$ 8.00	$ 22,800.00
8	Replace Asphalt Pavement	TON	960	$ 70.00	$ 67,200.00
9	Surface Restoration	Acres	12	$ 1,500.00	$ 18,000.00
10	Undeveloped Design Details (15%)				$ 105,800.00
			Construction Subtotal		**$ 875,800.00**
	Contingency (5%)				$ 43,800.00
			Grand Total Construction Costs		**$ 920,000.00**
	Engineering (13.25%)				$ 121,900.00
	Design/Bidding				
	Construction Administration				
	Legal & Administrative (5%)*				$ 46,000.00
			Grand Total		**$ 1,087,900.00**

* Includes acquisition of Right of Way and Easements

Preliminary Opinion of Probable Costs
Phase III
Puppy Dog Coulee Interceptor
City of Minot North Dakota
UEI Project # 306.124

Dec-06

New 36" Interceptor from Ex. MH #34 to New PDPS

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%, all components)	LS	1	$ 256,600.00	$ 256,600.00
2	Clearing & Grubbing	LS	1	$ 20,000.00	$ 20,000.00
3	36" Conc Sewermain/liner	LF	10,600	$ 225.00	$ 2,385,000.00
4	48" Dia Steel Casing Pipe (across Hwy 52)	LF	80	$ 500.00	$ 40,000.00
7	New 72" Dia Manholes	EA	30	$ 9,200.00	$ 276,000.00
8	New 84" Dia MH	EA	4	$ 12,600.00	$ 50,400.00
9	Surface Restoration	Acres	12	$ 1,500.00	$ 18,000.00
10	Undeveloped Design Details (15%)				$ 418,400.00
				Construction Subtotal	**$ 3,464,400.00**
	Contingency (5%)				$ 173,200.00
				Grand Total Construction Costs	**$ 3,638,000.00**
	Engineering (12%)				$ 436,600.00
	Design/Bidding				
	Construction Administration				
	Legal & Administrative (5%)				$ 182,000.00
				Grand Total	**$ 4,256,600.00**

* Includes Purchase of Right-of-Way and Easements

Preliminary Opinion of Probable Costs
Phase III
Puppy Dog Coulee Interceptor
City of Minot North Dakota
UEI Project # 306.124

Dec-06

New Parallel 24" dia main ***from Ex. MH #34 to New PDPS***

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 122,800.00	$ 122,800.00
2	Clearing & Grubbing	LS	1	$ 20,000.00	$ 20,000.00
3	24" parallel Sewermain pipe	LF	10,600	$ 95.00	$ 1,007,000.00
4	36" Dia Steel Casing Pipe (across Hwy 52)	LF	80	$ 400.00	$ 32,000.00
7	New 60" Dia MH	EA	30	$ 7,200.00	$ 216,000.00
8	New72" Dia MH	EA	4	$ 9,200.00	$ 36,800.00
9	Surface Restoration	Acres	15	$ 1,500.00	$ 22,500.00
10	Undeveloped Design Details (15%)				$ 200,100.00
				Construction Subtotal	**$ 1,657,000.00**
	Contingency (5%)				$ 82,900.00
				Grand Total Construction Costs	**$ 1,740,000.00**
	Engineering (13%)				$ 226,000.00
	Design/Bidding				
	Construction Administration				
	Legal & Administrative (5%)				$ 83,000.00
				Grand Total	**$ 2,049,000.00**

* Includes Purchase of Right-of-Way and Easements

Preliminary Opinion of Probable Costs
Phase III
PDPS Emergency Storage Pond Expansion
City of Minot North Dakota
UEI Project # 306.124

Dec-06

PDPS Emergency Storage Pond Expansion

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 17,000.00	$ 17,000.00
3	Strip topsoil & Stockpile	LS	1	$ 2,000.00	$ 2,000.00
4	Common Excavation	CY	82,000	$ 2.50	$ 205,000.00
5	Surface Restoration	LS	1	$ 2,000.00	$ 2,000.00
6	Undeveloped design Details (10%)				$ 21,000.00
				Subtotal	**$ 247,000.00**
	Contingency (10%)				$ 25,000.00
				Grand Total Construction Costs	**$ 272,000.00**
	Engineering (14%)				$ 38,000.00
	Legal & Administrative (5%)				$ 35,000.00
				Grand Total	**$ 345,000.00**

Preliminary Opinion of Probable Costs
Phase IV
First Larson Coulee Interceptor
City of Minot North Dakota
UEI Project # 306.124

15" PVC Interceptor from Crystal Springs to 30th Street Sw

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 26,000.00	$ 26,000.00
2	Clearing & Grubbing	LS	1	$ 5,000.00	$ 5,000.00
3	15" dia PVC Sewermain	LF	5,600	$ 36.00	$ 201,600.00
6	New 48" Dia MH	EA	15	$ 5,500.00	$ 82,500.00
9	Surface Restoration	Acres	8	$ 1,500.00	$ 12,000.00
10	Undeveloped Design Details (10%)				$ 30,000.00
				Construction Subtotal	**$ 357,100.00**
	Contingency (5%)				$ 18,000.00
				Grand Total Construction Costs	**$ 375,000.00**
	Engineering (14.6%)				$ 54,800.00
	Design/Bidding				
	Construction Administration				
	Right-of-Way Acquisition				$ 10,000.00
	Title Search				
	Survey				
	Negotiation				
	Legal & Administrative (5%)*				$ 19,000.00
				Grand Total	**$ 458,800.00**

* Includes Purchase of Right-of-Way and Easements

Preliminary Opinion of Probable Costs
Phase V
20" Forcemain #2
City of Minot North Dakota
UEI Project # 306.124

20" PVC Forcemain, New PDPS to the Aeration Basin's Control Structure

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 93,300.00	$ 93,300.00
2	20" Dia Butterfly Valve (MJ)	EA	1	$ 6,300.00	$ 6,300.00
4	20" PVC Forcemain	LF	11,000	$ 80.00	$ 880,000.00
5	36" dia steel casing pipe	LF	160	$ 750.00	$ 120,000.00
6	20 HDPE forcemain (Boring River Crossing)	LF	200	$ 155.00	$ 31,000.00
7	20" Ductile Iron MJ Fittings	EA	15	$ 1,500.00	$ 22,500.00
8	Undeveloped Design Details (10%)				$ 106,000.00
				Construction Subtotal	**$ 1,259,000.00**
	Contingency (5%)				$ 63,000.00
				Grand Total Construction Costs	**$ 1,322,000.00**
	Engineering (13%)				$ 171,900.00
	Design/Bidding				
	Construction Administration/Observation				
	Legal & Administrative (5%)*				$ 66,000.00
				Grand Total	**$ 1,559,900.00**

Preliminary Opinion of Probable Costs
Phase V
Puppy Dog Pumping Station
City of Minot North Dakota
UEI Project # 306.124

Dec-06

Equipment Expansion from 3 pumps to 5 pumps (new equipment only)
(Does not include existing equipment replacement costs)

No	Item	Unit	Quantity	Unit Cost	Extended Costs
1	General Conditions (8%)	LS	1	$ 59,800.00	$ 59,800.00
2	Pumping Equipment *	EA	2	$ 145,000.00	$ 290,000.00
3	Process piping/Flowmeters	LS	1	$ 60,000.00	$ 60,000.00
4	Motor Control Center	EA	1	$ 40,000.00	$ 40,000.00
5	Control Panel	EA	1	$ 130,000.00	$ 130,000.00
7	750 KVA Generator Set	EA	1	$ 160,000.00	$ 160,000.00
8	Undeveloped Design Details (10%)				$ 68,000.00
				Construction Subtotal	**$ 808,000.00**
	Contingency (5%)				$ 40,000.00
				Total Construction Costs	**$ 848,000.00**
	Engineering (13.5%)				$ 114,500.00
	Design/Bidding				
	Construction Administration				
				Grand Total	**$ 962,500.00**

* Pumping equipment unit price is based on Fairbanks Morse Pumps,
Dry Pit **Submersible** Pumps
For 3, **Standard**, dry pit pumps, deduct $35,000 ea ($70,000 Total)