MINOT REGIONAL SANITARY SEWER STUDY

(M00-120)

REGISTERED PROFESSIONAL ENGINEER
P.E. 3221
NORTH DAKOTA

I HEREBY CERTIFY THAT THIS REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED ENGINEER UNDER THE LAWS OF THE STATE OF NORTH DAKOTA.

DATE: 8-17-02 REG. NO. 3221

Wold Engineering, P.C.
720 Western Avenue
Minot, ND 58701

Ackerman Surveying & Assoc.
6008 Highway 2 East
Minot, ND 58701

Houston Engineering, Inc.
2505 N. University Drive
Fargo, ND 58105

Table of Contents

INTRODUCTION

The city of Minot Planning Commission has been discussing the issue of rural lots and sewer systems for several years. The issue came to a head on August 23, 1999 (Attachment 1). The Planning Commission decided that a technical committee should be set up to address rural sanitary sewer issues. This technical committee met through the fall of 1999 and on into January and February of 2000. Prior to the setting up of the technical committee, rural lots outside of the Minot city limits but within the two mile zoning jurisdiction were required to be of a minimum lot size of two acres. These rural lots were also required to have a septic system permit from the First District Health Unit (Attachment 2). Typically, the First District Health Unit would only require "percolation" tests on high wastewater generators. The typical rural sewer septic system, when built, would be inspected by the First District Health Unit and approved if constructed properly (Attachment 3). The technical committee, during its study and meetings, found that the existing process of review for rural sanitary sewer septic systems was not working.

The technical committee looked at ways for treating wastewater generated by rural homes and businesses. Currently, the method for treating wastewater on rural lots is through the use of a septic tank and drainfield or through the use of a Nodak (mound system) (Attachment 4 and 5). A chamber type drain tile system is also being used (Attachment 6). There are new methods that are in use in states outside of North Dakota for treating wastewater. These treatment systems are actually variations of package wastewater treatment plants intended to require low maintenance and intended to treat the wastewater flow. This treated wastewater flow can then be discharged into receiving waters or can be used for irrigation for yards, golf courses or farm land (Attachments 7 and 8). These package treatment systems currently have not been approved for use in North Dakota. Once the package treatment systems are approved by the North Dakota Health Department they will become an attractive alternative for treating wastewater for rural subdivisions that are a considerable distance from a public sanitary sewer system. Centralized sanitary sewer lagoon systems are also being used for high wastewater generators and for larger rural subdivisions.

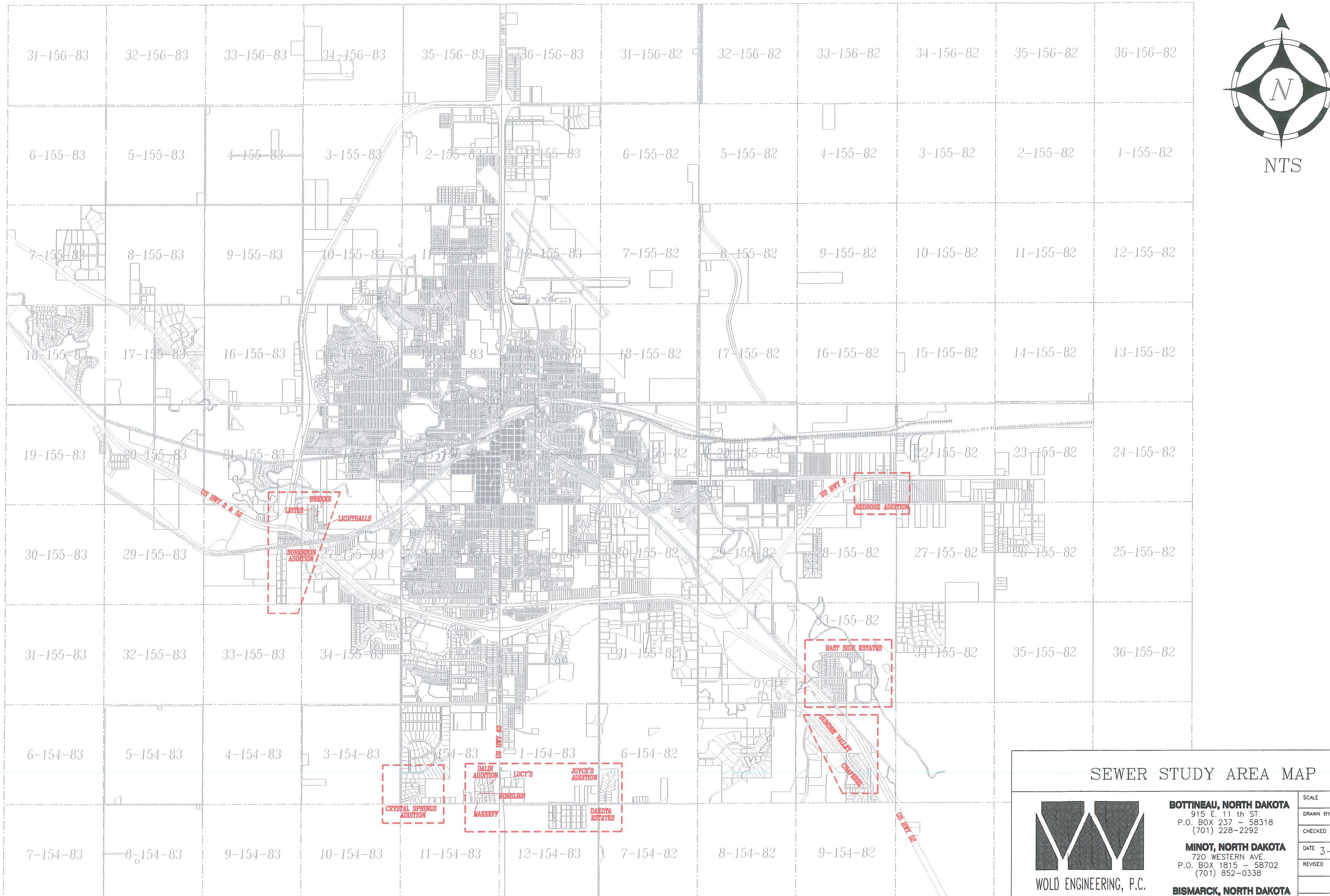
On February 14, 2000, the Planning Commission met to address the findings of the technical committee concerning rural lots and septic systems (Attachment 9). Attachments 10 and 11 provide the results and actions taken by the Planning Commission concerning rural sanitary sewer treatment systems.

In October of 2000 the city of Minot solicited proposals for an engineer to prepare a regional sanitary sewer study. The Wold Engineering, P.C. team was selected to complete that study.

During the contract negotiations phase the following areas were identified for study:

1. Dakota Estates – 2 1/2 acre lots
2. Crystal Springs – approximately 1 acre lots
3. Lucy's Amusement Park/Mobile Home Park – approximately 2 acres
4. Joyce's Subdivision – approximately 1 acre lots
5. Nedrose Addition – approximately 1/3 acre lots
6. Eastside Estates – approximate 1/2 acre lots
7. Brekke Subdivision – approximately 1/4 acre lots
8. Sorenson's Addition – approximately 1/4 acre lots
9. Dalen Addition – approximately 2/3 acre lots
10. Chaparrel and area next to it

These areas are shown on the following map of the Minot area. It was also determined by the city that they would provide recommended changes to the currently used on-site sewage disposal code and would prepare a Sundre Aquifer Protection Plan.



SEWER STUDY AREA MAP

WOLD ENGINEERING, P.C.

CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS

BOTTINEAU, NORTH DAKOTA
915 E. 11 th ST.
P.O. BOX 237 – 58318
(701) 228-2292

MINOT, NORTH DAKOTA
720 WESTERN AVE.
P.O. BOX 1815 – 58702
(701) 852-0338

BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 – 58502
(701) 258-9227

SCALE	NTS
DRAWN BY	CAB
CHECKED BY	JJM
DATE	3-01-02
REVISED	
DRAWING NO.	M00-120

PLANNING COMMISSION
Regular Session
August 23, 1999
7:00 P.M.
City Council Chambers
City Hall
AGENDA

1. Public hearing on a request by James Ommen, Clifford Movchan and Manor Care Health Services to vacate a portion of 7th Avenue SW located approximately 100 feet west of Beacon Street.

2. Public hearing on a request by Phil and Lisa Johnson, Shane and Brenda Goettle, Donald and Julie DeCamp, Eldred and Maxine Ames and Thelma Rasmuson to vacate the alley west of 8th Street NW and south of 1st Avenue NW.

3. Public hearing on a request by the Canadian Pacific Railway for a special use to install a communications tower and building on a portion of unplatted SW¼ of the SW¼, Section 19-155-82. This property is located on the northeast side of Valley Street and approximately 500 feet southeast of 8th Avenue SE.

4. Public hearing on a request by Century 21 Action Realtors to subdivide Lot 36, less the south 9 feet, Highland Acres 3rd Addition into 2 lots. This property is located at the southwest corner of the intersection of 21st Avenue NW at Skyline Drive.

5. Rural Lots/Septic Systems Issue - Discussion and Recommendation.

6. Possible Joint City/County Planner Issue - Discussion.

7. City Council Storm Sewer Action, Development Fee, List of Projects - Information.

8. Minor Subdivision Approval - Information.

Date: August 6, 1999

TO: Planning Commission

FROM: Robert R. Amptman, City Engineer RA

RE: Agenda Item No. 5 - Rural Lots/Septic Systems Issue.

I. Background

For the past several years, Minot and much of the state have received above-average precipitation. Weather experts predict that this "wet cycle" will likely continue for several more years. This has resulted in high ground water levels and saturated soils. In rural areas, the availability of water distribution from rural water districts has resulted in more water use and consequently, more wastewater generation.

Within and just beyond the City's 2-mile jurisdiction, there are hundreds of lots developed with homes and businesses that use septic tanks and drain fields for on-site sewage disposal. There are numerous more lots that are vacant which could be developed in a similar manner. These rural lots vary in size from 20,000 square feet to 5 acres. Ages of septic systems, soil types and topography vary from lot to lot and from subdivision to subdivision. All of the foregoing factors have contributed to the problem of on-site sewage system failures, and this problem is wide-spread. Because of this problem, the City Council has requested a recommendation from the Planning Commission on a policy regarding development with the use of on-site sewage disposal. Attached as EXHIBIT 1 is an excerpt from the July 6, 1999 City Council meeting regarding this issue.

II. Extent of the Problem

Based upon information provided by the First District Health Unit, there are or have been documented septic system failures in the following areas or subdivisions (See attached EXHIBITS 2-5):

1. Dakota Estates
2. Crystal Springs
3. Minot Mobile Estates
4. Lucy's Amusement Park/Mobile Home Park
5. Joyce's Subdivision
6. Sunnyslope Addition
7. Nedrose Addition
8. Eastside Estates

9. Tierracita Vallejo
10. Hacienda Hills
11. Brekke Subdivision
12. Sorenson's Addition
13. Dalen Addition
14. Meadowbrook Estates
15. Battleground Addition
16. NDAD Bingorama
17. Little Ponderosa

The exhibits show other potential problem areas as well. Many of the failures have been repairable where the lots are large enough to install new drain fields. However, there are numerous lots in the first four (4) areas on the preceding list which are beyond repair resulting in severe failure. In some cases, sewage has surfaced the ground and is flowing in roadside ditches. The Health Unit and the Ward County Water Resource District Board are working on correcting these severe problem areas.

The Health Unit has the authority to require the capping of drain fields that have failed and making the property owners have their tanks pumped out periodically by a licensed septic hauler. In some of these areas, connection to a municipal sewer system is the only solution. It is safe to say that there is the potential for public health and welfare problems resulting from this matter.

I have contacted the other three major cities in the state regarding their policies regarding rural development. Grand Forks requires a minimum lot size of 5 acres when septic tanks are used. Bismarck requires lot sizes ranging from 40,000 to 85,000 square feet, depending on soil types. Fargo does not permit the use of on-site sewage disposal systems.

III. Possible Policies

Well, now what do we do? The following are possible policies or actions related to the septic tank problem.

A. Do Nothing. This option is no policy change whatsoever. This is probably not acceptable considering the facts.

B. Require Sanitary Sewer Connection. In this case, new rural developments within 1/8 mile of the city limits would be required to connect to the city's sanitary sewer collection system. A distance different from 1/8 mile may be considered. This would be an expensive policy.

C. Require Small Package Treatment Systems. There are small systems on the market. However, the State Health Department, has not yet been willing to approve such systems.

D. Permit No Further Rural Subdivisions. This is a form of moratorium likely to be challenged through legal channels. But, it would help solve the problem in the long term.

E. Require Sanitary Sewer Connection - All New Developments. This would force development to be more compact and near the city limits and existing sewers. This item and item D above are essentially the same.

F. Increase Minimum Lot Size: Documented failures have occurred on practically all lot sizes up to 4 and 5 acres. The large lot sizes do, however, offer the area necessary for repairs and new drain fields.

G. "Grandfather" Existing Platted Lots.

H. Declare a Moratorium On Existing Undeveloped Lots. This would likely face a legal challenge.

IV. Recommendation

"This is a fine mess you've gotten us into, Ollie!" - a famous quote from Laurel and Hardy. This may be how the Commission feels about this issue. There are no easy answers. However, I believe it is better to solve a problem in small steps, even one this complicated. As a beginning, I suggest the following:

A. Require sanitary sewer connection and annexation of any new development, any portion of which is within 600 feet of the city limits.

B. Grandfather the existing platted lots with respect to sewage disposal methods and require soil permeability tests on all undeveloped lots before building permits are issued.

C. Require, where septic tanks are to be used, a new minimum lot size of 5 acres on all new plats beyond 600 feet from the city limits.

D. Work with the State Health Department to get approval of a "package treatment system" which can be used with a sewer system for rural developments.

Attachments

Excerpt of the Minutes of the July 6, 1999, Regular City Council Meeting

SUBDIVISION APPROVAL - RIDGEDALE ACRES 3RD ADDITION

Alderman Podrygula moved that the City review its policy of annexing property with septic tanks into the City of Minot and that the subdivision request be held until the review is completed. He expressed concern with annexation without a requirement for City sanitary sewer system hookup, necessitating installation of septic tanks. Motion seconded by Alderman Snyder.

Art Ekblad, Planning Commission Chairman, reported that the Planning Commission has been looking at this area and that he would like to establish a committee to study the issue without stopping the annexation of this property.

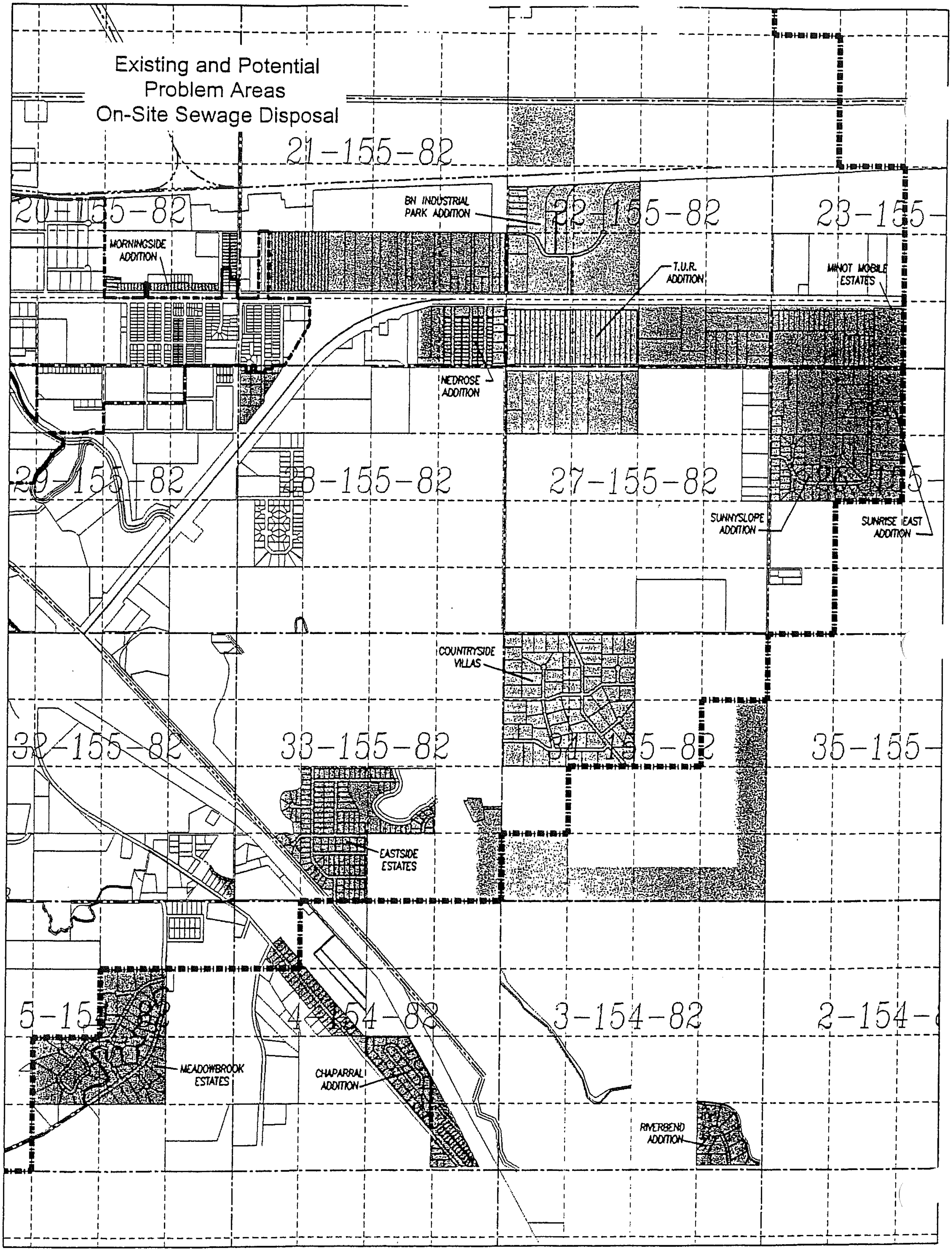
The City Engineer commented that there were many septic tank problems in the rural areas surrounding Minot and that adjustments to the City's policy may need to be considered. He stated that he would like to work with First District Health Unit to prepare a report on this issue for the Planning Commission within the next 2 months.

Following discussion, Alderman Podrygula moved to amend the prior motion to provide approval of the subdivision of a portion of unplatted NE¼, Section 1-155-83, into ten lots to be called Ridgedale Acres 3rd Addition, subject to the condition that soils percolation tests be submitted for approval to the City Engineer and First District Health Unit prior to the issuance of septic tank and building permits and, in addition, subject to the condition that, before any additional developments with septic tanks are annexed into the City of Minot, the Planning Commission present a recommendation to the City Council regarding a policy on this issue. Motion seconded by Alderman Snyder and carried unanimously.

Whereupon the original motion, as amended, that the City Council approve the subdivision of a portion of unplatted NE¼, Section 1-155-83, into ten lots to be called Ridgedale Acres 3rd Addition, subject to the condition that soils percolation tests be submitted for approval to the City Engineer and First District Health Unit prior to the issuance of septic tank and building permits and, in addition, subject to the condition that, before any additional developments with septic tanks are annexed into the City of Minot, the Planning Commission present a recommendation to the City Council regarding a policy on this issue, carried by the following roll call vote: ayes: Bertsch, Butz, Christianson, Collins-Roggenbuck, Frey, Hatlelid, Krabseth, Kuhn, Leigh, Podrygula, Snyder, Zimbelman. nays: none.

C: File
City Engineer
Petitioner

EXHIBIT 1



Existing and Potential
Problem Areas
On-Site Sewage Disposal
21-155-82
20-155-82
22-155-82
23-155-
BN INDUSTRIAL
PARK ADDITION
MORNINGSIDE
ADDITION
T.U.R.
ADDITION
MINOT MOBILE
ESTATES
NEDROSE
ADDITION
29-155-82
28-155-82
27-155-82
26-155-
SUNNYSLOPE
ADDITION
SUNRISE EAST
ADDITION
COUNTRYSIDE
VILLAS
32-155-82
33-155-82
34-155-82
35-155-
EASTSIDE
ESTATES
5-154-82
4-154-82
3-154-82
2-154-
MEADOWBROOK
ESTATES
CHAPARRAL
ADDITION
RIVERBEND
ADDITION

EXHIBIT 2

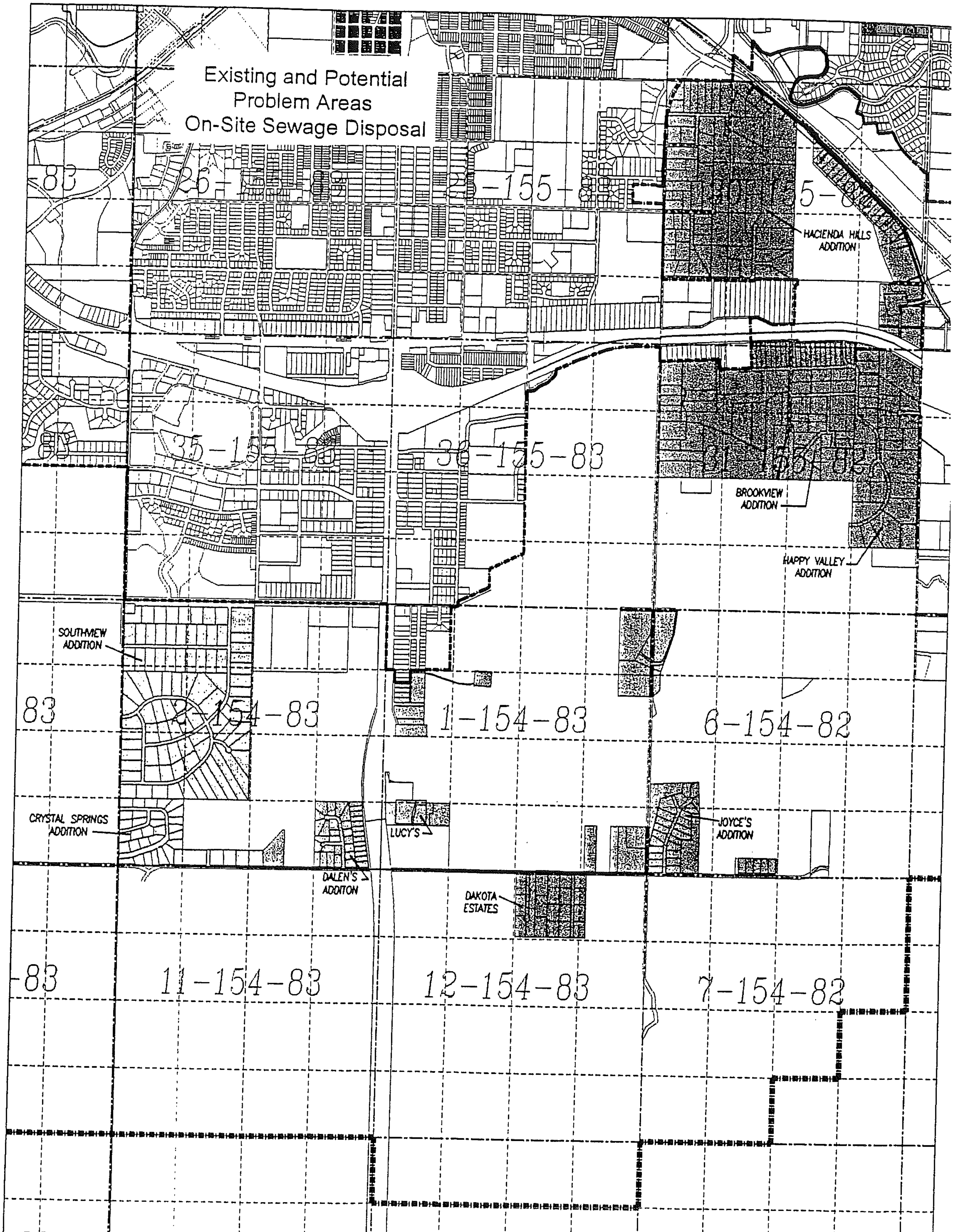
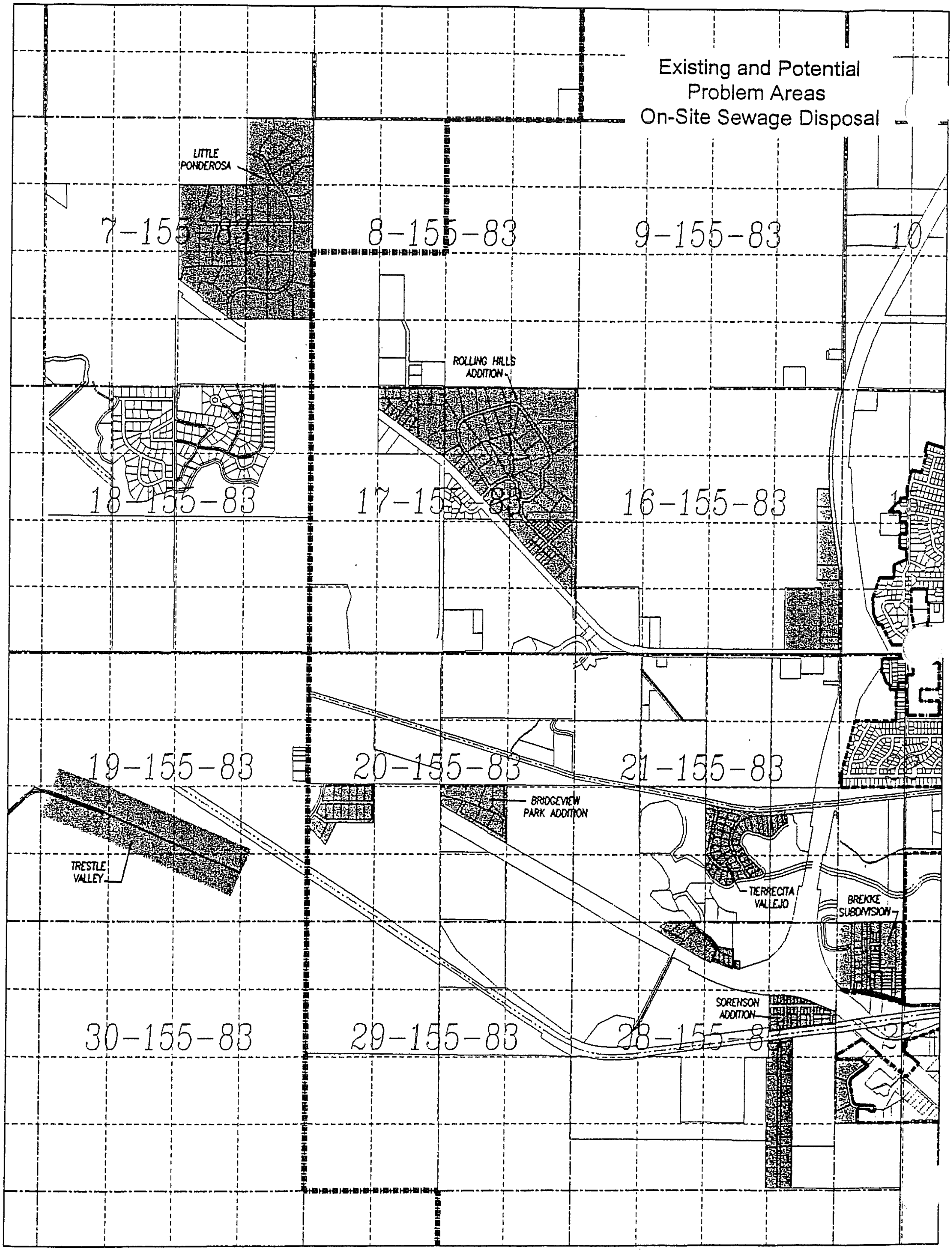

Existing and Potential
Problem Areas
On-Site Sewage Disposal
26-155-83
25-155-83
HACIENDA HILLS ADDITION
35-155-83
36-155-83
BROOKVIEW ADDITION
HAPPY VALLEY ADDITION
SOUTHVIEW ADDITION
2-154-83
1-154-83
6-154-82
CRYSTAL SPRINGS ADDITION
LUCY'S
JOYCE'S ADDITION
DALEN'S ADDITON
DAKOTA ESTATES
11-154-83
12-154-83
7-154-82

EXHIBIT 3



Existing and Potential
Problem Areas
On-Site Sewage Disposal
LITTLE PONDEROSA
7-155-83
8-155-83
9-155-83
ROLLING HILLS ADDITION
18-155-83
17-155-83
16-155-83
19-155-83
20-155-83
21-155-83
BRIDGEVIEW PARK ADDITION
TRESTLE VALLEY
TIERRECITA VALLEJO
BREKKE SUBDIVISION
SORENSON ADDITION
30-155-83
29-155-83
28-155-83

EXHIBIT 4

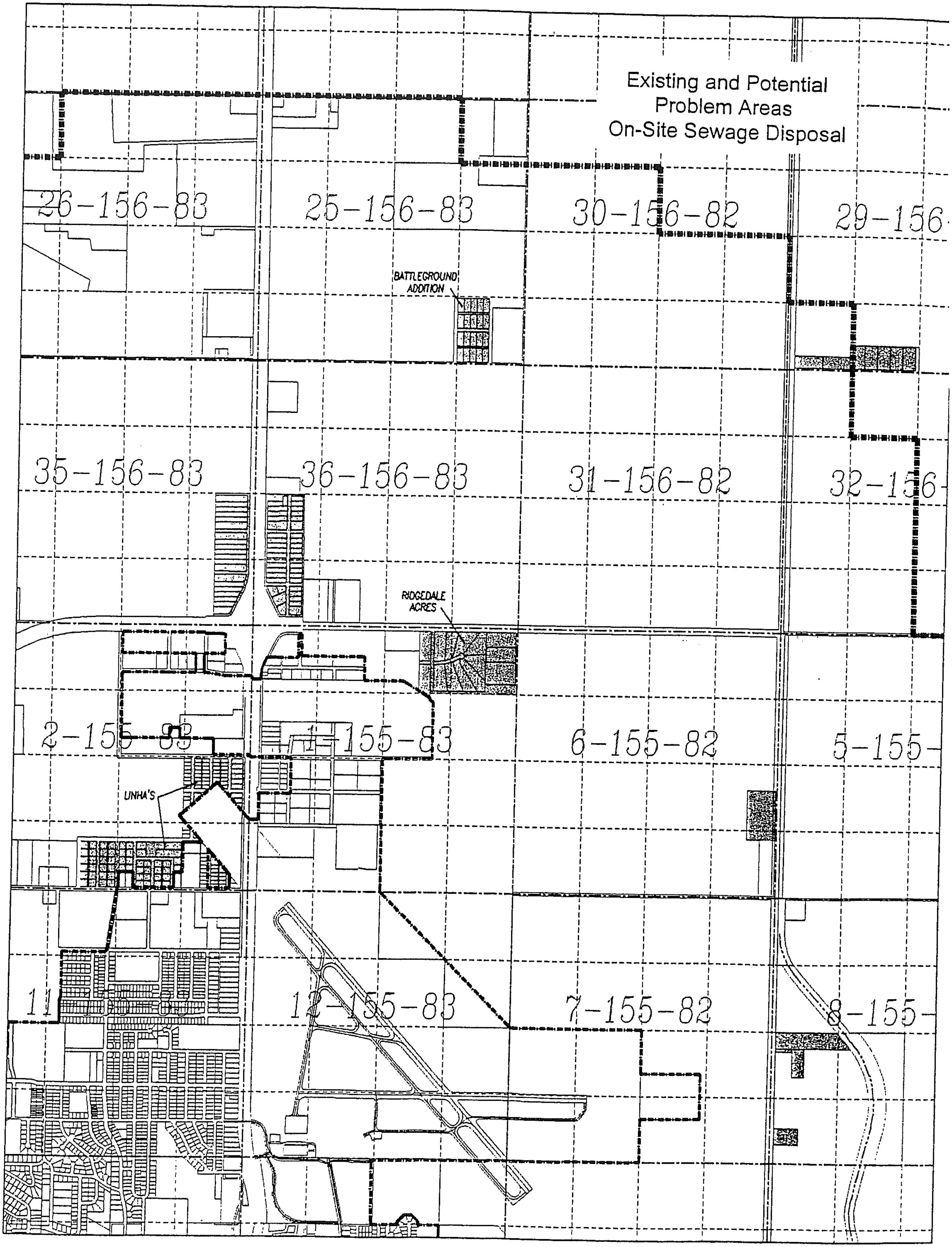

Existing and Potential
Problem Areas
On-Site Sewage Disposal
26-156-83
25-156-83
30-156-82
29-156
BATTLEGROUND ADDITION
35-156-83
36-156-83
31-156-82
32-156
RIDGEDALE ACRES
2-155-83
1-155-83
6-155-82
5-155
UNHA'S
11-155-83
12-155-83
7-155-82
8-155

EXHIBIT 5

ORDINANCE NO. 3608 - AMEND CITY OF MINOT CODE OF ORDINANCES - ENACT SECTION 31-152(b) - ESTABLISH STORM SEWER DEVELOPMENT FEE - SECOND READING

Alderman Anderson moved that the City Council place Ordinance No. 3608 on second reading to enact Section 31-152(b) of the City of Minot Code of Ordinances pertaining to the establishment of a storm sewer development fee. Motion seconded by Alderman Bertsch.

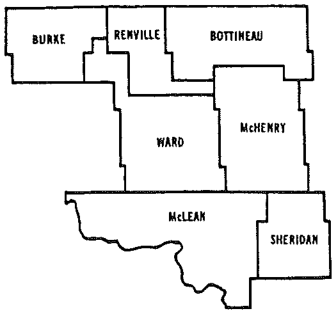
David Schmitke of 508 10th Street NE spoke in opposition to the establishment of a storm sewer development fee. Alan Westereng of 905 11th Avenue NE requested clarification on how the storm sewer development fee would be administered. Earl Allen of 914 18th Street NW spoke in opposition to the storm sewer development fee.

Discussion continued with aldermen expressing their opposition or support of the storm sewer development fee.

Alderman Christianson commented that the ordinance would be reviewed every 5 years to determine its effectiveness and the need for continuation.

Whereupon the above motion by Alderman Anderson, seconded by Alderman Bertsch, carried by the following roll call vote: ayes: Anderson, Bertsch, Christianson, Collins-Roggenbuck, Hatlelid, Krabseth, Podrygula, Zimbelman. nays: Butz, Frey, Kuhn. Leigh, Snyder.

Alderman Anderson moved that the City Council pass Ordinance No. 3608 on second reading. Motion seconded by Alderman Bertsch, carried by the following roll call vote: ayes: Anderson, Bertsch, Christianson, Collins-Roggenbuck, Hatlelid, Krabseth, Podrygula, Zimbelman. nays: Butz, Frey, Kuhn, Leigh, Snyder.



First District Health Unit

801 - 11th AVENUE SW – PHONE 701/852-1376 – FAX 701/852-5043

MAILING ADDRESS:
PO BOX 1268
MINOT, ND 58702

COUNTY OFFICES

Bottineau County
Public Health Nurse
Courthouse
Bottineau, ND 58318
228-3101

Burke County
Public Health Nurse
Courthouse
P.O. Box 326
Bowbells, ND 58721
377-2316

McHenry County
Public Health Nurse
Memorial Building
P.O. Box 517
Towner, ND 58788
537-5732

McLean County
Public Health Nurse
Courthouse
Washburn, ND 58577
462-8541

Renville County
Public Health Nurse
Courthouse
Mohall, ND 58761
756-6383

Sheridan County
Public Health Nurse
Courthouse
P.O. Box 415
McClusky, ND 58463
363-2506

DATE: January 25, 1999

TO: City & County Planning Commission
Ward County Water Resource Board

FROM: Chris Helgesen, EHP C.H.
Chief, Environmental Health Division
First District Health Unit

SUBJECT: Existing and potential sewer disposal problems of the two and four mile area of Minot, ND

A. Problem areas presently include:

1. ***Dalin Addition/Crystal Springs area*** - These areas currently have problems with private sewer disposal due to several factors. These factors include high water tables, improper placement of drainage ditches and smallish sized lots.
2. ***Country Acres Mobile Home Park*** - This area poses sewer disposal problems, due to a lack of space for drainfield repair, since they have been repaired numerous times in recent years. Also, excessive water use will continually pose concerns for years to come.
3. ***Minot Mobile Estates/Sunnyslope Area*** - These areas also have high water table and in the case of Minot Mobile Estates, very limited alternatives for drainfield repair. The Sunnyslope area has high water table and as more lots are being utilized, increased saturated conditions will then get worse.
4. ***Sorenson Addition*** - This area has high water table problems in conjunction with very small lots. Any repairs or addition to drainfields will be difficult, if not impossible.
5. ***Behms Truck Stop Area*** - This poses a special problem due to the increased biological factors of sewage that originates from restaurants and c-stores. It is very difficult to operate and maintain drainfields in situations like this - location next to river.
6. ***Eastside Estates*** - Problems have arisen due to the fact that many vacant lots are 1/2 - 3/4 acre. Landowners then want to install a private sewer system due to a grandfather clause, but continued approvals will cause problems in the future.

7. ***Tierracita Vallejo*** - This area poses problems due to high water table, small lots and the proximity to river loops.
8. ***Country Club Heights*** - The past few years it has been noted that there have been increased failures with septic systems. This is due to several factors, such as tight soils, high water tables, and newer, larger homes, possibly using more water than usual.
9. ***Little Ponderosa & Rolling Hills*** - Pose similar problems. The contour of the land constitutes design problems and the soil percolation seems to be slower.
10. ***Brekke Addition*** - This area has high water table and small lots. This makes for poor sewage treatment and any possible repairs to drainfields are difficult, if not impossible.
11. ***Happy Valley*** -This area has larger, newer homes, with possibly more water use appliances. The contour of the land, with steep slopes, causes possible design and installation problems.
12. ***Joyce Addition*** - This area has special problems due to seasonal high water table.
13. ***Dakota Estates*** - This area has high water table, newer, larger homes, and several drainfield failures have been noted in the past few years.
14. ***Meadowbrook Addition*** - This area has seasonal high water table areas and its proximity to river areas and coulees poses surface water contamination problems.
15. ***Pasta Mill & Elevator*** - Septic system failures have been noted here due to the fact that many commercial/industrial sites have increased waste use plus the biological strength of sewage is greater than single family dwellings. This system is presently failing.
16. ***Countryside Villas*** - This area was planned and developed in a very high water table where surface water has been within one foot of the surface. Sewers in this area will have a high failure rate due to water table problems. Storm water problems could also be severe.
17. ***Chapperell Addition*** - This area has small lots. Any repairs to drainfields are difficult and in time could be impossible.
18. ***Sundre Valley*** - This area has had drainfield problems as the soil varies considerably--tight soil, gravel soil, etc. There is also a high water table.

B. Potential future problem areas are the Hacienda Hills and Southview Addition, due to saturation of both sewage water & storm waters that happen due to paving or concrete streets and driveways, soil conditions will eventually become impermeable.

The above named areas pose special, individual problems which may include:

1. Lots that are insufficient size.
2. Poor soil conditions.
3. Adjacent rivers, streams, etc.
4. Steep slopes which causes special problems for design.
5. Storm water problems.

Proposed Improvements:

The obvious way to alleviate present and potential problems with sewage disposal is to properly abandon septic tanks in individual lots and hook to a municipal sewer system.

If this cannot be done, private sewage disposal systems pose these problems in these aforementioned areas.

1. Future subdivisions will have to be platted with enough acreage to accommodate installations and potential repairs/extensions and planning for placement of community sewer lines.
2. Easements or replatting of existing lots will have to take place to ensure large enough lot sizes.
   Special design and installation of drainfields will have to take place for areas of high water table and impermeable soils.
   Individual lots with steep slopes also cause special problems for contractors.

Conclusion:

This office strongly encourages and recommends that existing subdivisions and future subdivisions hook to municipal sewerage systems due to existing failures and problems that will arise.

City and County Planning Commissions need to have a plan in place that will contain specifications of the size of the lots, and location of dwellings for easiest private sewage disposal installation/repair, or placement of sewer lines for hookup to a municipal sewer system. Also, storm water runoff must be planned for to ensure excess saturation doesn't take place on drainfields, or that excessive ponding doesn't occur.

Sec. 28-31. Sewage Disposal Plans Required:

If the premises to be subdivided will not immediately have access to the municipal sewage system, no final subdivision design can be approved by the Commission unless it is accompanied by a report from the inspector in charge of health and sanitation, which report will indicate an approval or disapproval of the petitioner's plan for sewage disposal. Specifically this report will comment on the following items:

(1) Type of system/systems proposed to be utilized;

(2) Soils testing and borings constructed by the petitioner;

(3) Lot size;

(4) Lot width and depth;

(5) Topography, including slope of the land;

(6) Relationship to sources of drinking water, including wells and aquifers; and

(7) Proposed location of the systems on individual lots, when individual sewage disposal systems are to be used.

Sec. 28-32. Drainage Plan Required.

(a) As part of the application for approval of his subdivision design the applicant who seeks plat approval shall submit a drainage study and/or plan to include:

(1) On-site storm management facilities necessary to drain the subdivision.

(2) Inclusion of stormwater detention/retention methods available to reduce the runoff impact on his or other properties.

(3) Statement of impacts, if any, on other properties within the same drainage basin or sub-basin as the proposed subdivision.

(4) Drainage calculations using accepted engineering standards and formulas to substantiate the drainage plan and impacts.

(5) A recommendation from a registered civil engineer in the State of North Dakota as to the storm drainage management method to be used.

(6) A schedule of implementation of the storm water management project or projects necessitated by the subdivision, and a statement of the financing method intended to be used.

(7) A preliminary grading plan showing how each lot will be graded relative to potential drainage impact on adjacent lots.

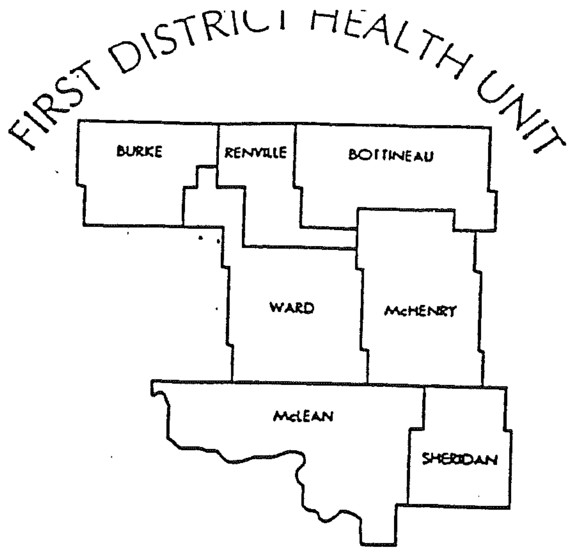
(8) If proposed stormwater detention/retention facilities are to be operated and maintained by the City, the applicant shall deed the land necessary for the facilities to the City and provide a dedicated and improved access road to the facilities from a public street. The nature of access road improvements shall be determined on a case by case basis.

(b) The City Engineer may waive any or all of the requirements in subsection (a) if in his sole opinion, the proposed subdivision by nature of its size, topography, or location, will have little or no impact with respect to stormwater runoff.

(c) If the necessary storm water improvements will require funding by the subdivider, such funding must be guaranteed before the subdivision plat is recorded. Such guarantee can be a bond, letter of credit, special escrow account, or other method acceptable to the City Council.

Sec. 28-33 -- 28-39. Reserved.

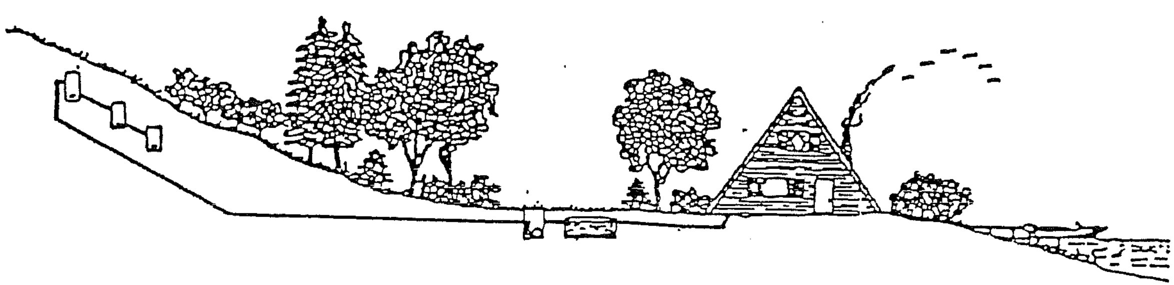
ATTACHMENT NO. 3



INDIVIDUAL SEWAGE TREATMENT SYSTEM REQUIREMENTS

REGULATION #10

Adopted: June 16, 1960
Revised: June 7, 1978
Revised: May 16, 1996



INDIVIDUAL SEWAGE TREATMENT SYSTEMS
First District Health Unit: Regulation #10

SECTION PAGE

Intent

These regulations written in accordance with the authority granted to the Board of Health in the North Dakota Century Code, Section 23-05 and 23-14, hereby provide the minimum standards and criteria for design, location, installation, use, and maintenance of individual sewage treatment systems. The purpose is to protect the health, safety, and welfare of the residents of the First District Health Unit. The regulations will apply to all counties served by the First District Health Unit and will be enforced by said entity.

General Provisions.

1. All sewage treatment systems shall be constructed, added to, or altered in accordance with this regulation. When a public or noncommunity

sewerage system is deemed available to a premise used for human occupancy if such premise is within two hundred feet, the First District Health Unit shall require that sewage be discharged into that system.

2. Nothing contained in these regulations will be construed to prevent the First District Health Unit from requiring compliance with higher requirements than those contained herein where such higher requirements are essential to maintain a safe and sanitary conditions.

3. No individual sewage treatment system will be installed during wet conditions or conditions by which the soil would become smeared during construction.

4. Where public sewage treatment systems are not available and construction of an individual sewage treatment system is contemplated for a building of human occupancy, use, addition to, or alteration of any existing sewage treatment system, the master plumber or sewer and water contractor, or septic system installer, previous to beginning any construction shall make application to the First District Health Unit for a written permit to make the desired installation. An onsite inspection is required prior to permit approval. A plans approval is valid for twelve (12) months from date of issuance.

5. "Sewage treatment" under this section means all private methods of collecting and disposing of domestic sewage including septic tanks, approved privies, chemical toilets, and any others.

6. All domestic sewage shall be disposed of by an approved method of collection and treatment. Domestic sewage shall not be disposed of in any manner that will cause pollution of the ground surface, ground water, bathing area, lake, pond, watercourse, any crevice, sink hole, or other opening either natural or artificial in a rock formation.

7. Where water under pressure is not available, all human body wastes shall be disposed of by disposing them in approved privies, chemical toilets, or such other installations acceptable to the First District Health Unit.

8. Water-carried sewage from bathrooms, kitchens, laundry fixtures, and other household plumbing shall pass through a septic tank prior to its discharge into the soil. Where underground disposal for treatment is not feasible, consideration will be given to special methods of collection and disposal.

9. The building contractor, owner, plumbing contractor, or disposal system installer are jointly responsible for compliance with this regulation.

10. Abandoned disposal systems, septic tanks, pumping and other chambers, and seepage beds shall be disconnected from the buildings. The tanks and chambers shall be pumped out and filled with earth. **The First District Health Unit must be notified to approve abandonment procedures.**

11. No property shall be improved in excess of its capacity to properly absorb sewage effluent in the quantities and by the means provided in this regulation.

12. The minimum lot size in which a private treatment system may be installed is one (1) acre, except where zoning requires more. If platted prior to 1978, the situation will be evaluated on an individual basis.

13. "Continuing education" under this regulation means a structured, professionally presented curriculum dealing with onsite sewage treatment systems sanctioned by the First District Health Unit.

14. "Installer" under this regulation means an individual or contractor that engages in the construction of onsite sewage treatment systems.

15. "Mottled soil" under this regulation means soil from a soil boring which is marked with contrasting colors is considered to be mottled.

16. A "chamber or pump chamber" under this regulation means a watertight receptacle for receiving effluent from the septic tank which will be used for placement of an effluent grade pump to distribute that effluent to the treatment area.

17. "NDCC" means the North Dakota Century Code.

18. Malfunctioning individual sewage treatment systems are a menace to the health and general welfare of the public and are hereby declared a nuisance; and are subject to the requirements specified under NDCC Section 23-05-04 and Section 23-05-12.

19. Any person who violates, or refuses to comply with any provision of these regulations is guilty of a Class B Misdemeanor which can result in a maximum penalty of 30 days in jail and/or a $500.00 fine (NDCC Section 23-05-12).

Installation: Excavator and Installer requirements.

1. Individuals or business contractors shall be required by the First District Health Unit to have or obtain a license or permit to install individual onsite sewage treatment systems as described in this regulation.

2. Installers of septic systems must obtain suitable continuing education every year which pertains to onsite septic system installation. Reciprocity for training in other jurisdictions can be made on an individual basis by the First District Health Unit.

3. The installer of a treatment system must contact the First District Health Unit two (2) days prior to backfill and filter cover for final approval. If upon inspection it is found that any construction does not meet regulations or is different from the approved plans or any other violation, an order will be given to rectify the condition. A compliance inspection will be completed for final approval.

Design of Individual Sewage Systems.

1. **Design.** The design of the individual sewage treatment system must take into consideration location with respect to wells or other sources of water supply, topography, water table, soil characteristics, area available, and maximum occupancy of the building. **Sewage treatment fields must have a minimum of two (2) lines.**

2. **Type of system.** The type of system to be installed shall be determined on the basis of location, soil permeability, and ground water elevation.

3. **Sanitary sewage.** The system shall be designed to receive all sanitary sewage, including laundry waste, from the building. Drainage from footings or roof shall not enter the system.

4. **Discharge.** The system shall consist of a septic tank discharging into a sewage treatment field approved by the First District Health Unit.

5. **Ground Water.** No individual sewage treatment system can be installed where ground water may collect above the sewage treatment system causing a flooded condition. The minimum separation distance from the bottom of the treatment area to the mottled soil must equal or exceed three (3) feet.

6. **Alternate design.** Where soil conditions or lot sizes are such that neither of the systems mentioned can be expected to operate satisfactorily, approval of an alternate design shall be secured from the First District Health Unit.

7. **Sewage flow.** Design criteria for sewage flow according to the type of establishment is indicated in the following table.

Type of Establishment	Gallons Per Person Per Day (unless otherwise noted)
Airports (per passenger)	5
Apartments-multiple family (per resident)	60
Assembly halls (per seat)	2
Bars (per seat)	5
Bathhouses and swimming pools	10
Bowling alleys (per lane)	75
CAMPS:	
Campground with central comfort stations	35
With flush toilets, no showers	25
Construction camps (semipermanent)	50
Day camps (no meals served)	15
Resort camps (night and day)--limited plumbing	50
Luxury camps	100
Churches (per sanctuary seat)	5
Churches with kitchens (per sanctuary seats)	7
Cottages and small dwellings and seasonal occupancy	50
Country clubs (per member present)	25
Dwellings:	
Boardinghouses	50
-- additional for nonresident boarders	10
Luxury residences and estates	150
Multiple family dwellings (apartments)	60
Roominghouses	40
Single family dwellings	75
Factories (gallons per person, per shift, exclusive of industrial wastes)	35
Hospitals (per bed space)	250
Hotels (per guest)	50
Institutions other than hospitals (per bed space)	100
Laundries, self service (gallons per machine)	500
Mobile home parks (per space)	250
Motels (per bed space)	50
Picnic parks (sanitary waste only)	5
Picnic parks with bathhouses, showers, and flush toilets	10
Restaurants : toilet and kitchen wastes (per patron)	10
Restaurants : kitchen wastes (per meal served)	3
Restaurants : additional for bars and cocktail lounges	2
Schools:	

Boarding.. 75
Day, without gyms, cafeterias, or showers................................ 15
Day, with gym, cafeterias, and showers.. 25
Day, with cafeterias, but without gyms or showers..................... 20

Service stations (per vehicle served)... 10

Theaters:

Movie (per auditorium seat).. 5
Drive-in (per car space).. 5

Travel trailer parks:

without individual water & sewer hookups (per space).............. 50
with individual water & sewer hookups (per space)................. 100

Workers:

Construction (semipermanent camps).. 50
Day, School and offices (per shift)... 15

Location of Individual Sewage System.

1. The following table provides for the minimum distances that shall be observed in locating the various components of the treatment system.

	Well	Distribution Device	Treatment Area	Property Lines	Building
Building Sewer	100'	----------	----------	----------	----------
Septic Tank	100'	5'	10'	10'	10'
Distribution Device	100'	----------	----------	10'	20'
Treatment Area	100'	5'	----------	10'	10'
Well	----------	100'	100'	----------	----------
Water line (pressure)	----------	10'	10'	----------	----------
Water line (suction)	----------	100'	100'	----------	----------
Surface water Bodies	----------	100'	100'	----------	----------

2. All proposed sites for individual sewage treatment systems must be evaluated as to :

   a. Depth to the highest known or calculated ground water table or bedrock;

   b. Soil conditions, properties, and permeability;

c. Slope;

d. The existence of lowlands, local surface depressions, and rock outcrops;

e. All legal setback requirements from existing and proposed buildings, property lines, sewage tanks, soil treatment systems, water supply wells, buried water pipes and utility lines, the ordinary high water mark of lakes, rivers, streams, flowages, and the location of all soil treatment systems and water supply wells on adjoining lots to the proposed soil treatment system, sewage tank, and water supply well; and

f. Surface water flooding probability.

3. Privies, septic tanks, and underground treatment systems shall not be within two hundred (200) feet measured horizontally from the high water level in the reservoir or the banks of tributary streams when situated less than three thousand (3000) feet upstream from potable water intake structures. Sewage treatment facilities situated beyond three thousand (3000) feet upstream from intake structures shall be located no less than one hundred (100) feet measured horizontally from the high water level in the reservoir or the banks of the tributary streams.

Percolation Tests.

Where percolation tests are required, they must be made by a licensed soil testing company approved by the First District Health Unit. Results are to be given to First District Health Unit and the homeowner prior to design of system.

Soil Borings.

Where soil borings are required, they must be made as follows:

1. Each boring or excavation must be made to a depth at least three feet deeper than the bottom of the proposed system or until bedrock or a water table is encountered, whichever is less.

2. A soil texture description must be recorded by depth and notations made where texture changes occur.

3. Particular effort must be made to determine the highest known water table by recording the first occurrence of mottling observed in the hole, or if mottling is not encountered, the open holes in clay or loam soils must be

observed after standing undisturbed a minimum of sixteen hours, and depth to standing water, if present, must be measured.

Septic Tanks.

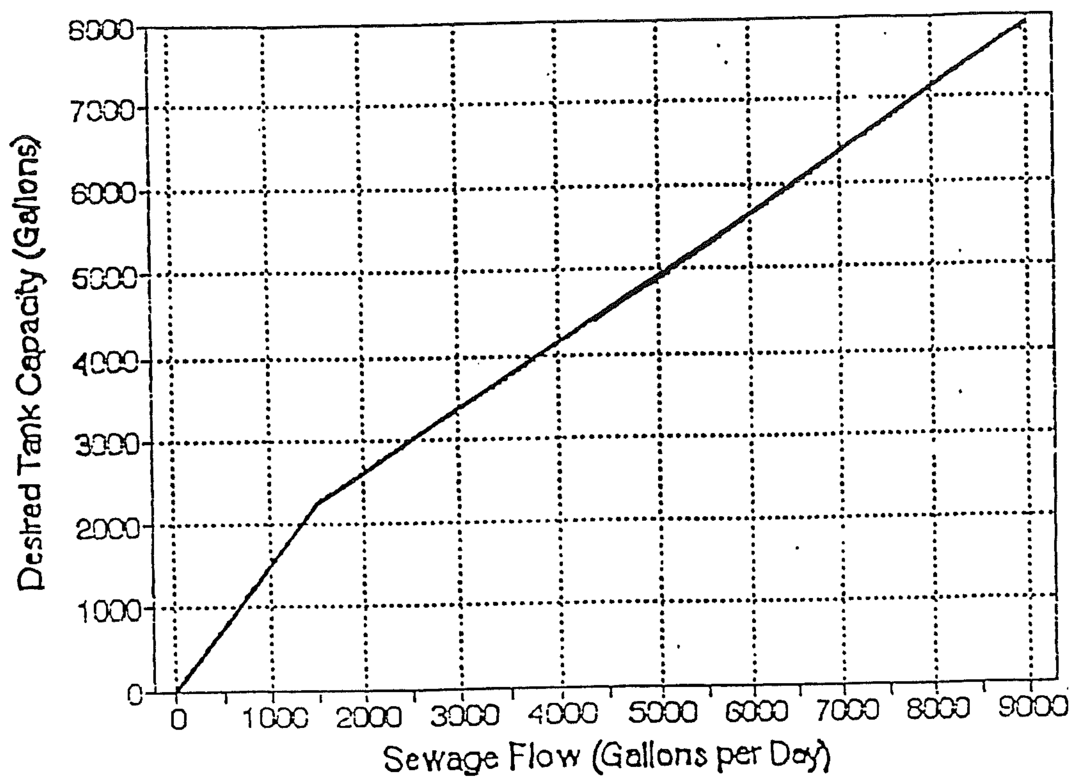
1. **Liquid Capacity.** The liquid capacity of all septic tanks shall conform to the following tables determined by the number of bedrooms or apartment units in dwelling occupancies and the occupant load or the number of plumbing fixture units as determined from the table, whichever is greater in other building occupancies.

CAPACITY OF SEPTIC TANKS*

Single family dwellings-number of bedrooms	Multiple dwelling units or apartments-one bedroom each	Other uses; maximum fixture units served	Minimum septic tank working capacity in gallons
1-3		20	1000
4	2 units	25	1200
5 or 6	3	33	1500
7 or 8	4	45	2000
	5	55	2250
	6	60	2500
	7	70	2750
	8	80	3000
	9	90	3250
	10	100	3500

Extra bedroom, 150 gallons each.
Extra dwelling units over 10, 250 gallons each.
Extra fixture units over 100, 25 gallons per fixture unit.

Septic Tank Capacity



RESTAURANTS:	To provide cooling of dishwasher wastes for grease coagulation, provide twice the capacity shown on graph.
LAUNDROMATS:	To provide cooling of wastewater for suds and grease flotation, provide at least twice the capacity shown on graph.
SLAUGHTER-HOUSES:	Do not allow blood to enter the system. Collect the blood separately and sell to renderer. To provide sufficient time to stabilize the remaining high strength waste, twice the capacity shown on graph is required.
DAIRIES:	Septic tanks and drainfields will not treat milk or whey wastes.

2. **Septic tank construction.** Septic tanks must be constructed of durable materials not subject to excessive corrosion or decay and must be water tight. Each such tank must be structurally designed to withstand all anticipated earth or other loads and must be installed level and on a solid bed. All tanks regardless of material or method of construction must conform to the following criteria:

a. The liquid depth of any septic tank or compartment shall be not less than thirty-six inches, nor more than six and one-half feet. No tank may have an inside horizontal dimension less than twenty-four inches.

b. The space in the tank between the liquid surface and the top of the inlet and outlet baffles must be not less than twenty percent of the total required liquid capacity, except that in horizontal cylindrical tanks this space must be not less than fifteen percent of the total required liquid capacity.

c. There must be at least one inch between the underside of the top of the tank and the highest point of the inlet and outlet devices. The inlet invert must be not less than three inches above the outlet invert.

d. Baffles must be integrally cast with the tank, affixed with a permanent waterproof adhesive or affixed with stainless steel connectors, top and bottom, and be constructed of acid-resistant concrete, acid resistant fiberglass or plastic.

e. The inlet baffle must extend at least six inches, but not more than twenty percent of the total liquid depth below the liquid surface and at least one inch above the crown of the inlet sewer.

f. The outlet baffle and the baffles between compartments must extend below the liquid surface a distance equal to forty percent of the liquid depth, except that the penetration of the indicated baffles or sanitary tees for horizontal cylindrical tanks must be thirty-five percent of the total liquid depth. They also must extend above the liquid surface. In no case may they extend less than six inches above the liquid surface.

g. Inlet baffles must be no less than six inches or no more than twelve inches measured from the end of the inlet pipe to the nearest point on the baffle. Outlet baffles must be six inches measured from beginning of the outlet pipe to the nearest point on the baffle.

Sanitary tees used as baffles must be at least four inches in diameter.

h. The inlet and outlet must be located opposite each other along the axis of maximum dimension. The horizontal distance between the nearest points of the inlet and outlet devices must be at least four feet.

i. There may be one or more manholes. Manholes must be at least eighteen inches in diameter, and located within six feet of all walls of the tank. The manhole must extend through the cover to a point within twelve inches but no closer than six inches below finished grade. The manhole cover must be corrosion resistant, rated three hundred-pound load bearing, and covered with at least six inches of earth. When in the opinion of the First District Health Unit the manhole is permitted above finish grade, it must be safely secured by chain or other method approved by the First District Health Unit.

j. There must be an inspection pipe of at least four inches in diameter or a manhole over both the inlet and outlet devices. The inspection pipe must extend through the cover and be capped flush or above finished grade. A downward projection of the centerline of the inspection pipe must directly in line with the centerline of the inlet or outlet device.

3. **Multiple tanks.**

a. Where more than one tank is used to obtain the required liquid volume, the tanks must be connected in series.

b. No more than four tanks in series can be used to obtain the required liquid volume.

c. The first tank must be no smaller than any subsequent tanks in series.

4. **Depth of septic tank.** Where septic tanks are installed above frostline, precautions must be taken to prevent the septic tank from freezing.

5. **Service limited.** No septic tank shall serve more than one property.

6. **Disposal of effluent.** The effluent from all septic tanks shall be disposed of underground in a sewage treatment field or an approved alternative system.

Distribution Box.

1. **Use.** A distribution box may be used when more than one line of absorption field or more than one seepage bed is used.

2. **Connection.** Each lateral line shall be connected separately to the distribution box and shall not be subdivided.

3. **Invert level.** The inlet invert shall be at least one inch above the invert of the outlets. The size of the distribution box shall be sufficient to accommodate the number of lateral lines.

4. **Watertight.** The distribution box shall be of watertight construction arranged to receive the septic tank effluent sewer and with an outlet or connecting line serving each trench or seepage bed.

5. **Inspection.** The sides of the box should extend to within a short distance of the ground surface to permit inspection, and shall have a concrete marker at grade.

Absorption Trenches.

1. **Design.** Absorption trenches shall be designed and constructed on the basis of the percolation test results or other soil dated. The minimum trench bottom area required is 400 sq.ft. The bottom of the trench shall be dug so it is level throughout its length. The maximum depth to the bottom of absorption trenches may not exceed forty-eight inches. The trench bottom must be at least 36 inches above the mottled soil condition indicating a water table or from standing water in the borehole.

2. **Filter material.** The filter material shall cover the four-inch diameter pipe to a depth of two inches measured from the crown of the pipe and extend the full width of the trench and shall be not less than 18 inches deep beneath the bottom of the four-inch diameter pipe. The filter material may be washed rock or crushed stone ranging in size from one inch to three inches. The filter material shall be covered by hay, straw, or approved filter fabric, as the laying of the pipe proceeds. Approved graveless systems may be used in lieu of rockfill providing an equivalent surface area of soil is utilized.

3. **Spacing.** Trenches must have a minimum spacing of undisturbed earth of six feet for eighteen-inch to twenty-four-inch trench widths, and nine feet for trenches up to thirty-six inches wide.

4. **Absorption field.** The size and requirements for absorption fields shall conform to those given in the following table:

Recommended Absorption Trench Area

Percolation Rate Minutes/Inch	Soil Classification	Depth of Rock Blow Distribution Pipe 18"	24"
	-Trench bottom area loading rate, gal/ft².[2]/day		
.1 to 5	Sand	1.80	2.10
6 to 15	Sandy loam	1.20	1.40
16 to 30	Loam	0.90	1.05
31 to 45	Silt loam	0.76	0.89
46 to 60	Clay loam	0.68	0.79
	-Square feet of trench bottom/bedroom[1]		
.1 to 5		85	70
6 to 15		125	110
16 to 30		165	145
31 to 45		200	170
46 to 60		220	190

[1]Based on sewage volume of 150/GPD/Bedroom

[2]Bed systems must be 1.5 times the size of an equivalent trench system

5. **Absorption lines.**

a. Gravity distribution. Absorption lines shall be constructed of four-inch pipe.

b. Pressure distribution. Absorption lines must be constructed of one and one-half-inch to two-inch rigid plastic pipe with one-fourth-inch holes drilled in the bottom of the pipes. the number of perforations and spacing of perforations for different diameter pipes for pressure distribution laterals must not exceed ten percent of the average pressure head on the perforations. The pipe and connections must be able to withstand a pressure of at least forty pounds per square inch. The perforated laterals should be attached to a two-inch manifold pipe and should have the ends capped. The laterals should be spaced no further than forty inches on center and no further than twenty inches from the edge of the rock. Pipe must be installed level and capped at ends. The manifold must be supported and backfilled by hand.

6. **Grade.** The absorption trench bottom must be level.

Absorption Beds

The square footage of sewage treatment beds must be 1.5 times the square footage of trench systems or 600 square feet minimum. Other minimum requirements such as rock, piping material, cover material, etc. are the same as mentioned in this regulation. Absorption beds must be level.

Piping Material.

All piping from building drain to sewage treatment system shall be four inches or larger service schedule 40 acrylonitrile-butadiene-styrene or polyvinyl chloride plastic pipe, type PSP PVC sewer pipe SDR 35, and fittings A.S.T.M. D3033 or D3034.

Pumps and Pump Systems.

This section pertains to pumps installed after the septic tank.

1. **Pumping chambers.**

   a. The pumping chambers must be watertight and constructed of corrosion-resistant material.

   b. The working capacity of the pumping chamber must equal one-fourth of the daily sewage flow. Total capacity of the pumping chamber must equal or exceed daily sewage flow.

   c. The desired pump cycling frequency is four times per day.

   d. A secure cover must be provided that is either bolted on or heavy enough to prevent unauthorized entry.

   e. An external electrical outlet must be provided for connection to the pump and control switches. Openings for wiring into the pump chamber must be sealed.

   f. No electrical splices or connections shall be located in the pump chamber or riser.

2. **Pumps.**

a. Effluent lift pumps must be cast bronze, cast iron, or plastic construction and must be designed for handling septic tank effluent. Pedestal sump pumps with an open motor are not allowed.

b. Set the pump on a pedestal on the bottom of the pump chamber to minimize grit and solids entering the impeller.

c. The pump must have maximum lift capability at least five feet greater than the actual elevation, plus pipe friction loss. A pump to a sewage mound shall deliver seven and five-tenths gallons per minute for each one hundred square feet of rock area.

d. Outlet piping must be one and one-fourth inches in diameter or greater. The pipe must be laid below frostline or uniformly graded to drain back to the pump chamber. Volume of drain back should not exceed ten percent of the working capacity of the pump chamber. If piping is set to drain back, any check valves on the pump could be removed and a one-fourth-inch drainhole drilled on the low point of the outlet pipe. Piping connection to the pump must be with a union or quick disconnect coupling near the top of the pump chamber.

3. Pump controls.

a. On-off switching for sewage pumps must be sealed mercury float switches or of a type approved by the First District Health Unit.

b. Electrical connections must not be made in the pump chamber or pump chamber riser.

Alternative Systems.

1. **Mounds.** Mounds may be constructed on soils having a percolation rate faster than one hundred twenty minutes per inch. For soils slower than one hundred twenty minutes per inch, the system must be moved to more amenable soil.

a. Location. Mounds may not be located on site of greater than twelve percent slope. For moderately permeable soils, the First District Health Unit may approve construction on slopes over six percent. Mounds may not be built in areas where water may pond.

b. Design. The basal sand area of the mound must be sized on the basis of eighty-three hundredths gallons per square foot per day.

The basal sand may be twelve inches to twenty-four inches deep and must extend at least five feet beyond the rock filter material in all directions. The rock layer may be twelve inches to twenty-four inches deep, and may not exceed ten feet in width. Only pressure distribution may be used in the mound, so piping shall be one and one-half-inch to two-inch diameter rigid ABS or PVC. One and one-fourth-inch hole must be drilled every thirty-six inches and the ends of the lateral must be capped. A one-quarter inch hole shall be drilled in the top of the cap to serve as a siphon break. Laterals shall be spaced no further than forty inches on center and no further than twenty inches from the edge of the filter rock. Surface water must be diverted by a berm located uphill from the base of the mound.

c. Specifications. Sand must be uniformly graded, with no more than fifteen percent fines. Filter rock must be one inch to three inches in diameter, washed or screened to less than ten percent fines.

A jar test should be used to determine sand suitability. In a one quart jar, place two inches of the sand. Add water to three-fourths level, cap, shake, and set aside to settle. If a layer of silt is present on top which is more than one-eighth inch thick, the sand is not suitable for mound construction.

d. Construction.

(1) Scarify the area with backhoe teeth or a cultivator. Do not remove topsoil. Bring outlet pipe from pump up into the center of the mound area.

(2) Lay sand on scarified area. Do not compact the soil with machinery tires. Level sand to desired depth.

(3) Lay filter rock down the center of the sand layer. Level.

(4) Connect piping to manifold and lay pipe on rock. Cover pipe with rock and level by hand. Holes must be on bottom of the pipe.

(5) Lay sand up to the top of the rock on all sides, sloping sand away at a three to one or four to one slope.

(6) Cover rock with red rosin paper, straw, hay, or filter fabric.

(7) Backfill entire mound to a three to one or four to one grade.. Downhill side of mound on slopes must be backfilled at a four to one or longer grade. Cover mound with topsoil.

(8) Seed grass over mound. Trees and shrubs may be planted on the toe and up the sides of the mound, but do not plant shrubs or trees on top. If vegetation is not established before winter, cover mound with hay or straw to prevent freezing.

2. **Alternative design.** Alternative designs for construction of sewage treatment systems complying with the intent of this code may be submitted to the First District Health Unit for approval.

3. **Holding Tanks.**

(1.) Holding tanks may be allowed only as replacements for existing non-conforming systems or on existing parcels or lots as of the date of the enactment of these regulations and only where it can conclusively be shown that a standard system cannot be feasibly installed.

(2.) A holding tank shall be constructed of the same materials and by the same procedures as those specified for watertight septic tanks.

(3.) The tank shall be protected against flotation by weight of tank, earth anchors, or shallow bury depths.

(4.) The minimum capacity of a holding tank for a dwelling is 1000 gallons or 400 gallons times the number of bedrooms, which ever is greater.

(5.) For permanent structures other than dwellings, the capacity shall be at least 5 times the daily flow rate.

(6.) Holding tanks shall be located in an area that is readily accessible for pumping under all weather conditions and where accidental spillage will not create a nuisance.

(7.) A contract for disposal and treatment of the sewage wastes shall be maintained by the owner with a pumper, municipality, agency or firm established for that purpose.

Sand Filters. Repealed effective September 1, 1990.

Chemical Toilets.

1. Chemical toilets shall consists of a toilet seat connected by a metal hopper to a metal tank containing chemicals, usually sodium hydroxide. All connections to the toilet seat and the tank shall be watertight.

2. A supply of the chemical shall be available in a closed container for periodic additions to the toilet.

Privies.

1. All requests for permission to erect and use privies shall be approved by the First District Health Unit.

2. General specifications for the design and construction of a privy. A privy pit must be constructed by providing a watertight structure in the pit. The watertight structure shall provide a minimum capacity of 1000 gallons. A privy building shall be placed over the structure. The floor of this building shall be of concrete with the privy seat of suitable material which is easily cleaned and serviceable. A vent located adjacent to the seat shall extend from the vault to a point above the roof of the building. The seat shall be provided with a cover which shall be self-closing.

   All openings in the building shall be screened to prevent the entrance of flies. The building shall be so constructed so as to prevent the entrance of vermin to the vault. The privy door shall be self-closing.

3. Removable cans. When removable cans are used in a privy, they shall be placed in watertight vaults and provision made for removing the seat so the cans can be moved for disposal of the contents in a manner acceptable to the First District Health Unit. The privy building shall comply with the above specifications for a pit privy building.

Septic Tank Pumpers.

1. Every person engaged in the business of removing and disposing of the solid and liquid contents of private sewage treatment systems shall obtain an annual license from The State Department of Health.

2. All solid and liquid contents of chemical toilets, septic tanks, pump chambers, and watertight pits for septic tank effluent shall be removed, when necessary, and disposed of in conformance with subsections 3 through 9.

3. Every pumper shall obtain a license to engage in such operations as specified in the appropriate rules of the State Department of Health, Chapter 33-21-01.

4. A metal license tag with the number of the license issued shall be posted in a conspicuous place on the left side of the servicing unit.

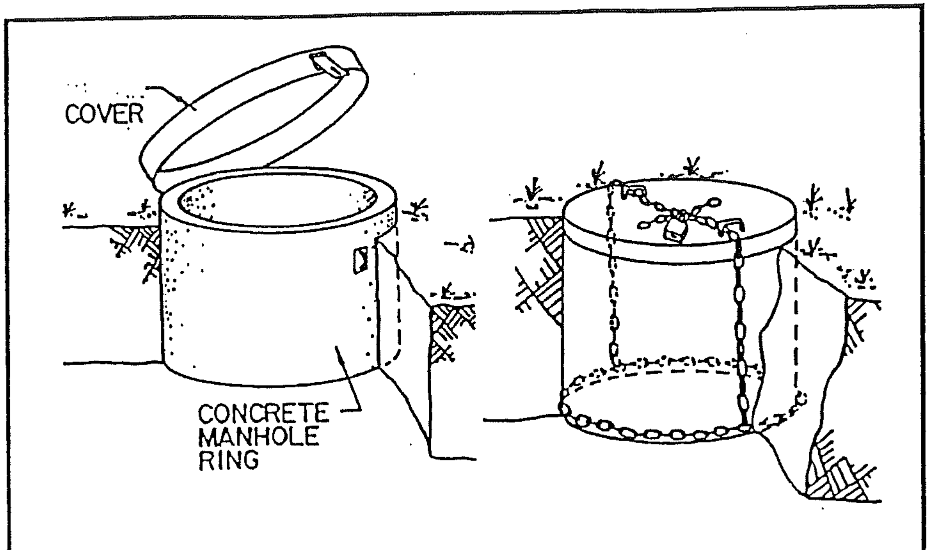
5. Every vehicle used for pumping purposes shall be equipped with a watertight tank so that there will be no spillage on private premises or on highways or roads.

6. All portable receptacles used for transporting liquid or solid waste shall be watertight, equipped with tight-fitting lids, and shall be cleaned daily.

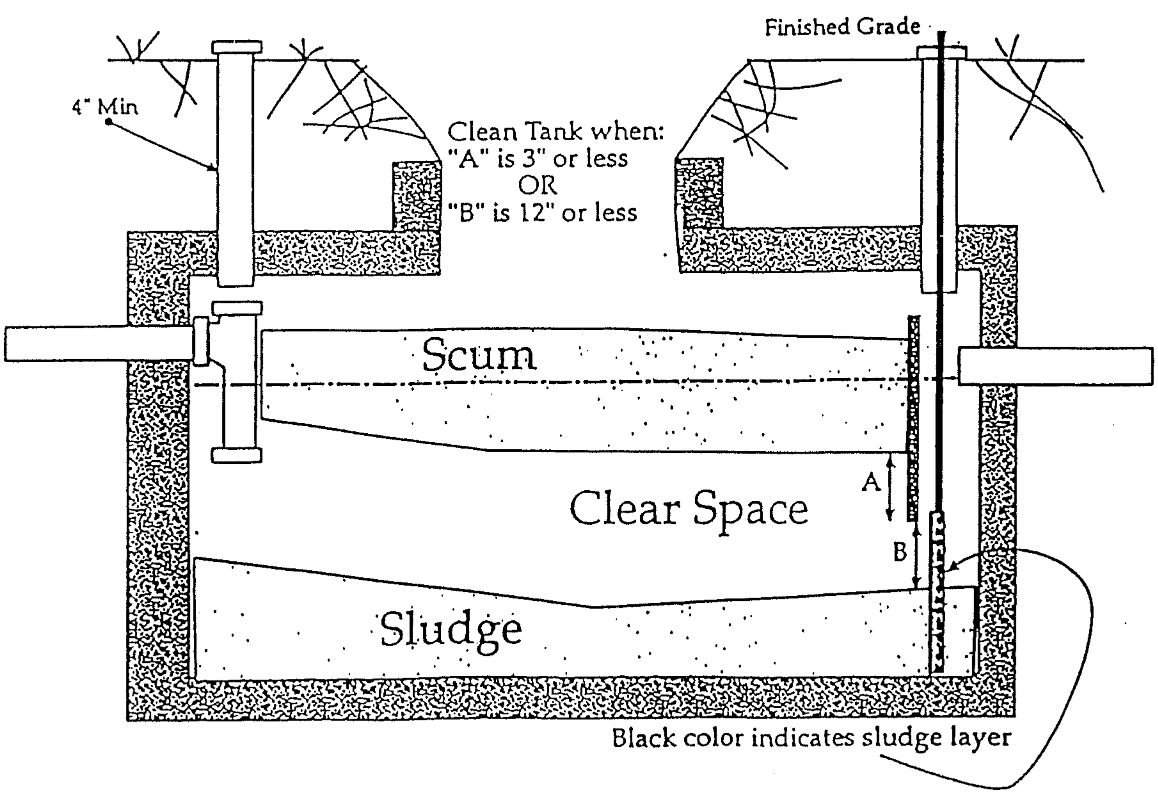
7. All pumps and hose lines shall be maintained so as to prevent leakage.

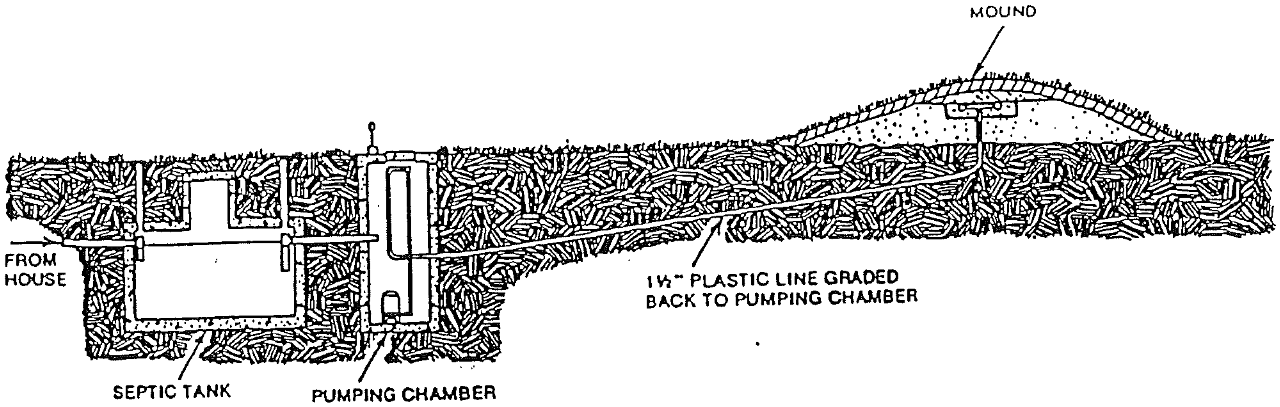
8. All waste material shall be disposed of in such a place and in such a manner as will not constitute a nuisance or a menace to public health.

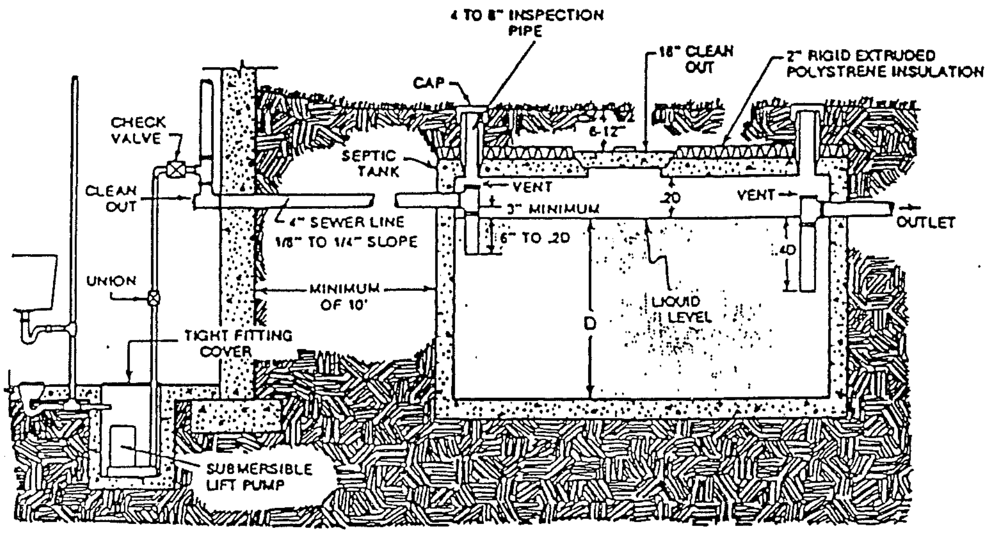
9. Waste material collected by a pumper shall not be discharged into ditches, watercourses, lakes, ponds, tidewater, or at any point where it can pollute any water supply, bathing area, or shellfish growing area. It shall not be deposited on the surface of the ground within one thousand feet of any residence or public road.

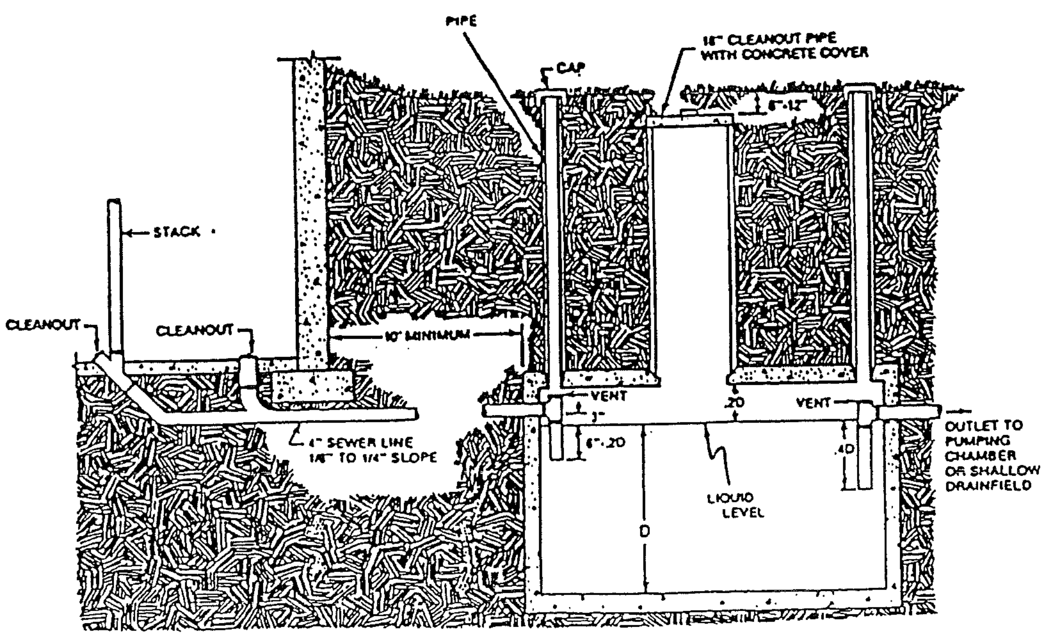


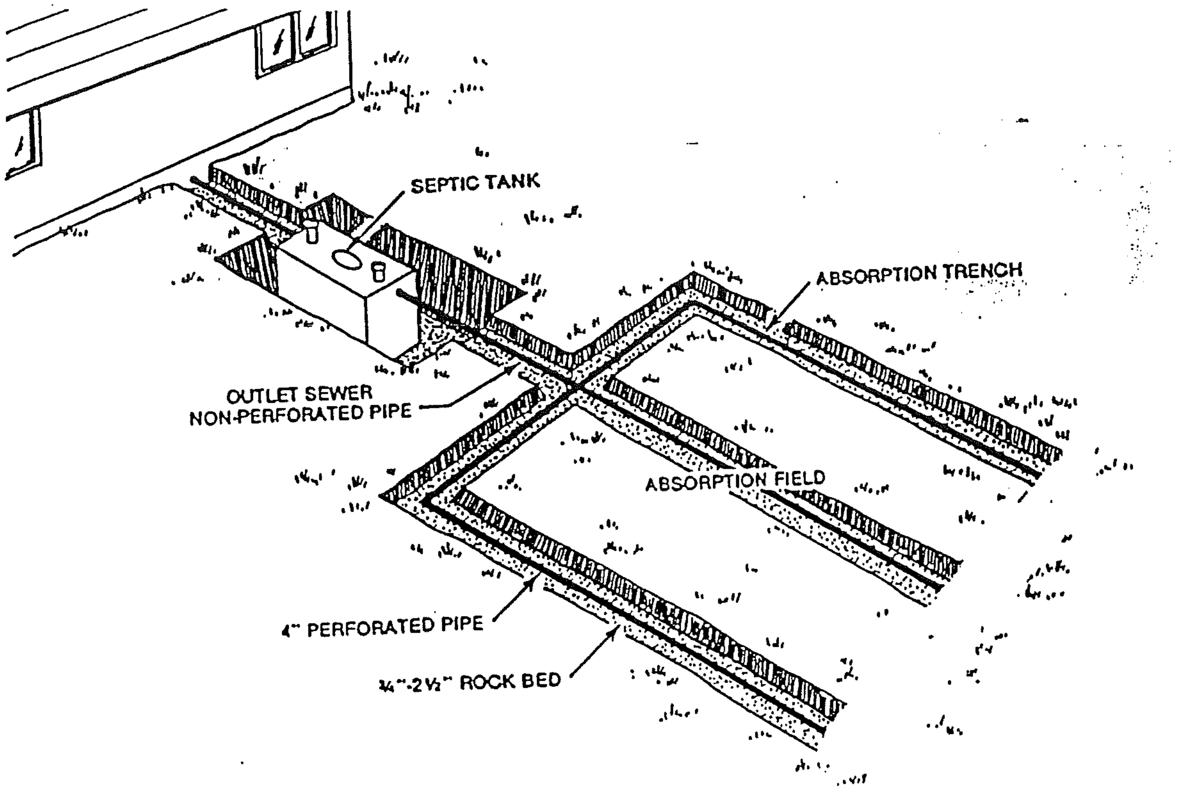
METHODS OF SECURING MANHOLE COVER TO PREVENT UNAUTHORIZED ENTRY

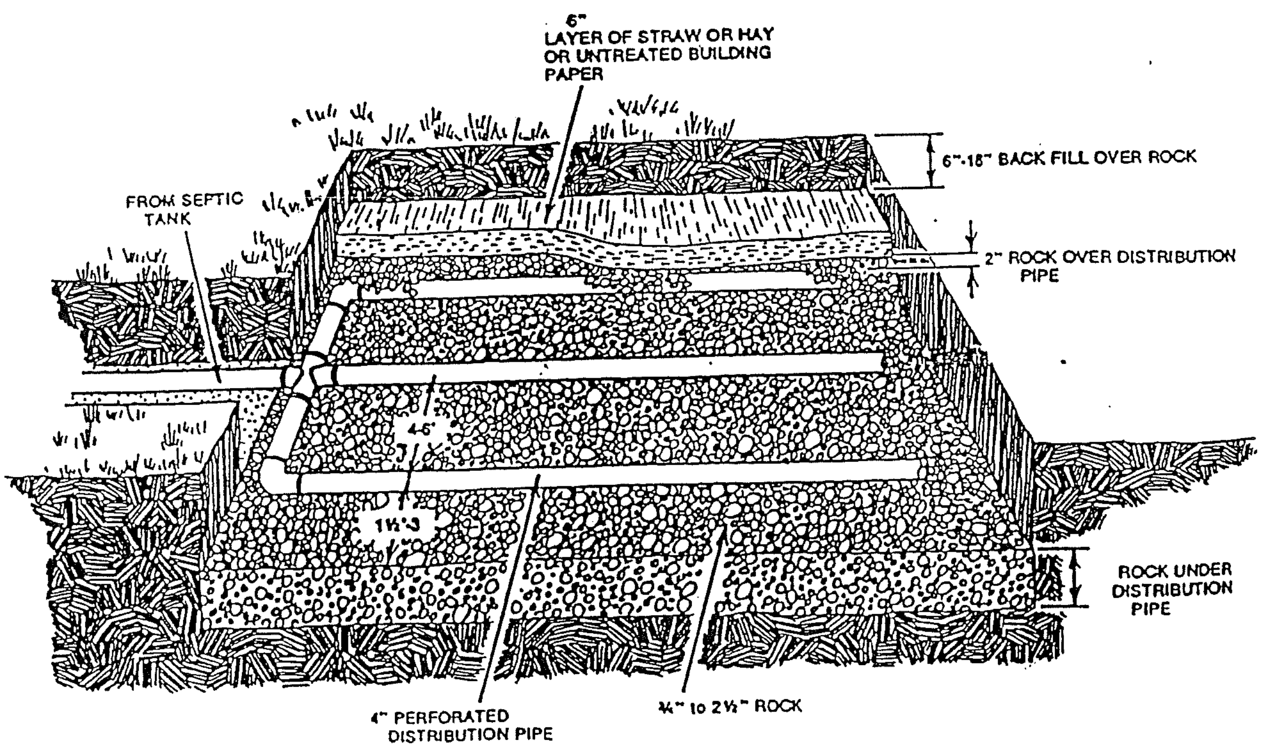


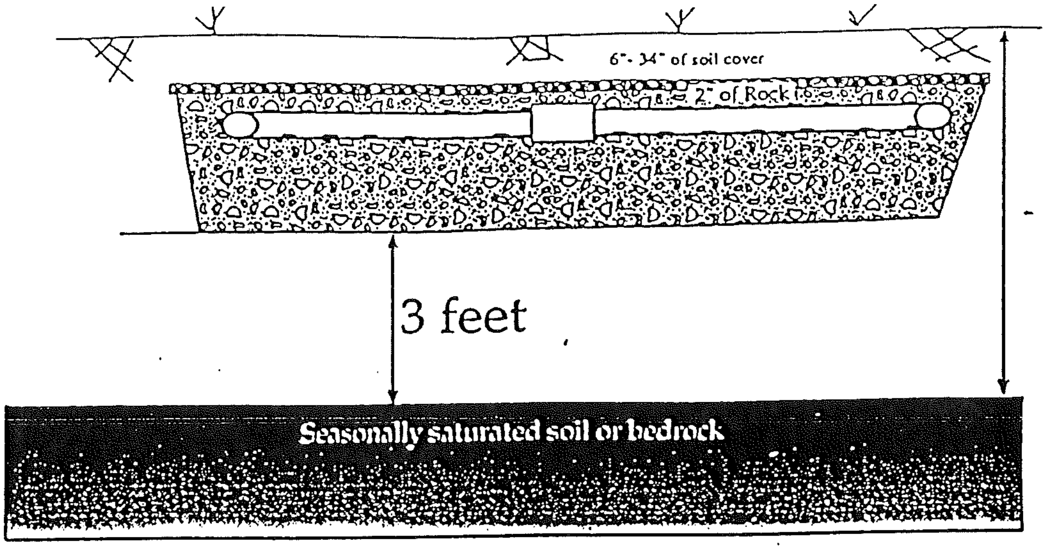

MOUND
FROM HOUSE
1½" PLASTIC LINE GRADED BACK TO PUMPING CHAMBER
SEPTIC TANK
PUMPING CHAMBER

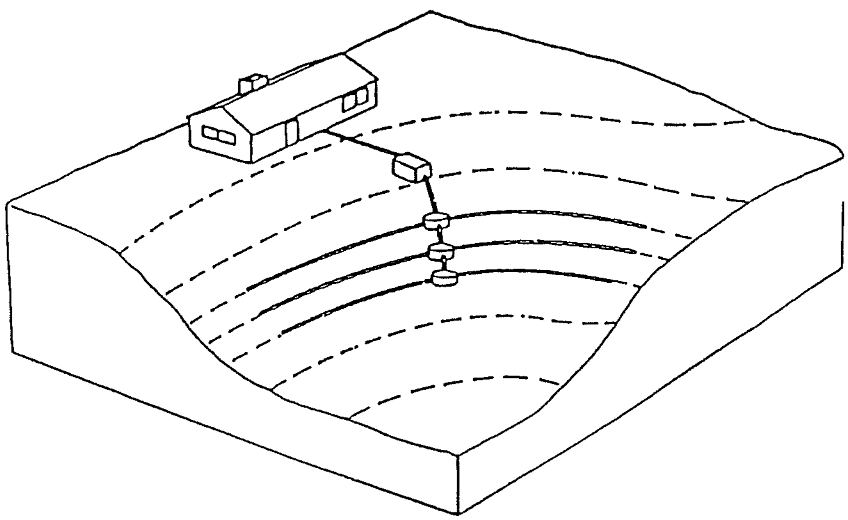

4 TO 8" INSPECTION PIPE
CAP
18" CLEAN OUT
2" RIGID EXTRUDED POLYSTRENE INSULATION
6-12"
CHECK VALVE
CLEAN OUT
SEPTIC TANK
VENT
.2D
VENT
3" MINIMUM
OUTLET
4" SEWER LINE 1/8" TO 1/4" SLOPE
6" TO .2D
.4D
UNION
MINIMUM OF 10'
LIQUID LEVEL
D
TIGHT FITTING COVER
SUBMERSIBLE LIFT PUMP


PIPE
18" CLEANOUT PIPE WITH CONCRETE COVER
CAP
6"-12"
STACK
CLEANOUT
CLEANOUT
10' MINIMUM
VENT
.2D
VENT
3"
6"-.2D
.4D
OUTLET TO PUMPING CHAMBER OR SHALLOW DRAINFIELD
4" SEWER LINE 1/8" TO 1/4" SLOPE
LIQUID LEVEL
D

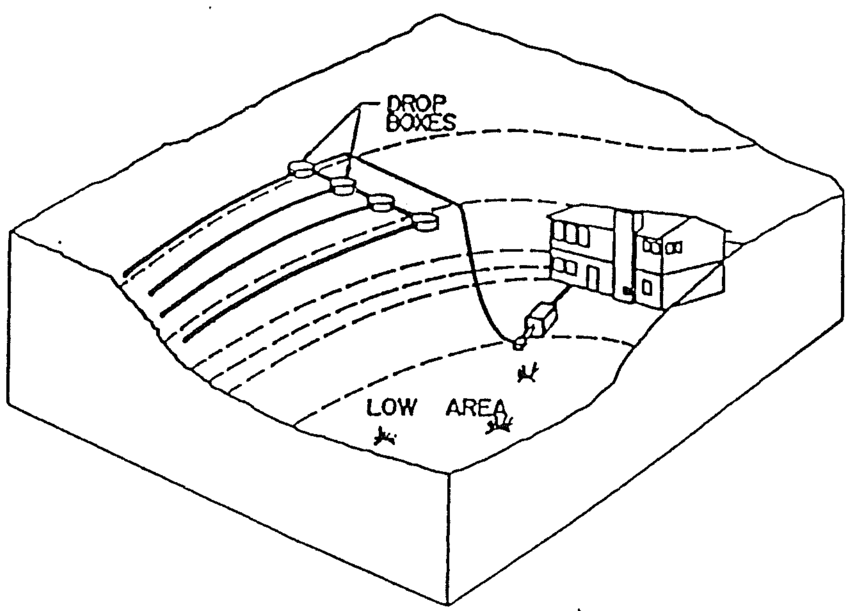

SEPTIC TANK
ABSORPTION TRENCH
OUTLET SEWER
NON-PERFORATED PIPE
ABSORPTION FIELD
4" PERFORATED PIPE
¾"-2½" ROCK BED


6"
LAYER OF STRAW OR HAY
OR UNTREATED BUILDING
PAPER
6"-18" BACK FILL OVER ROCK
FROM SEPTIC
TANK
2" ROCK OVER DISTRIBUTION
PIPE
4-6'
1½'-3'
ROCK UNDER
DISTRIBUTION
PIPE
4" PERFORATED
DISTRIBUTION PIPE
¾" to 2½" ROCK





DROP BOX DISTRIBUTION SYSTEM



PUMP SEPTIC TANK EFFLUENT TO AN AREA WITH SUITABLE SOIL

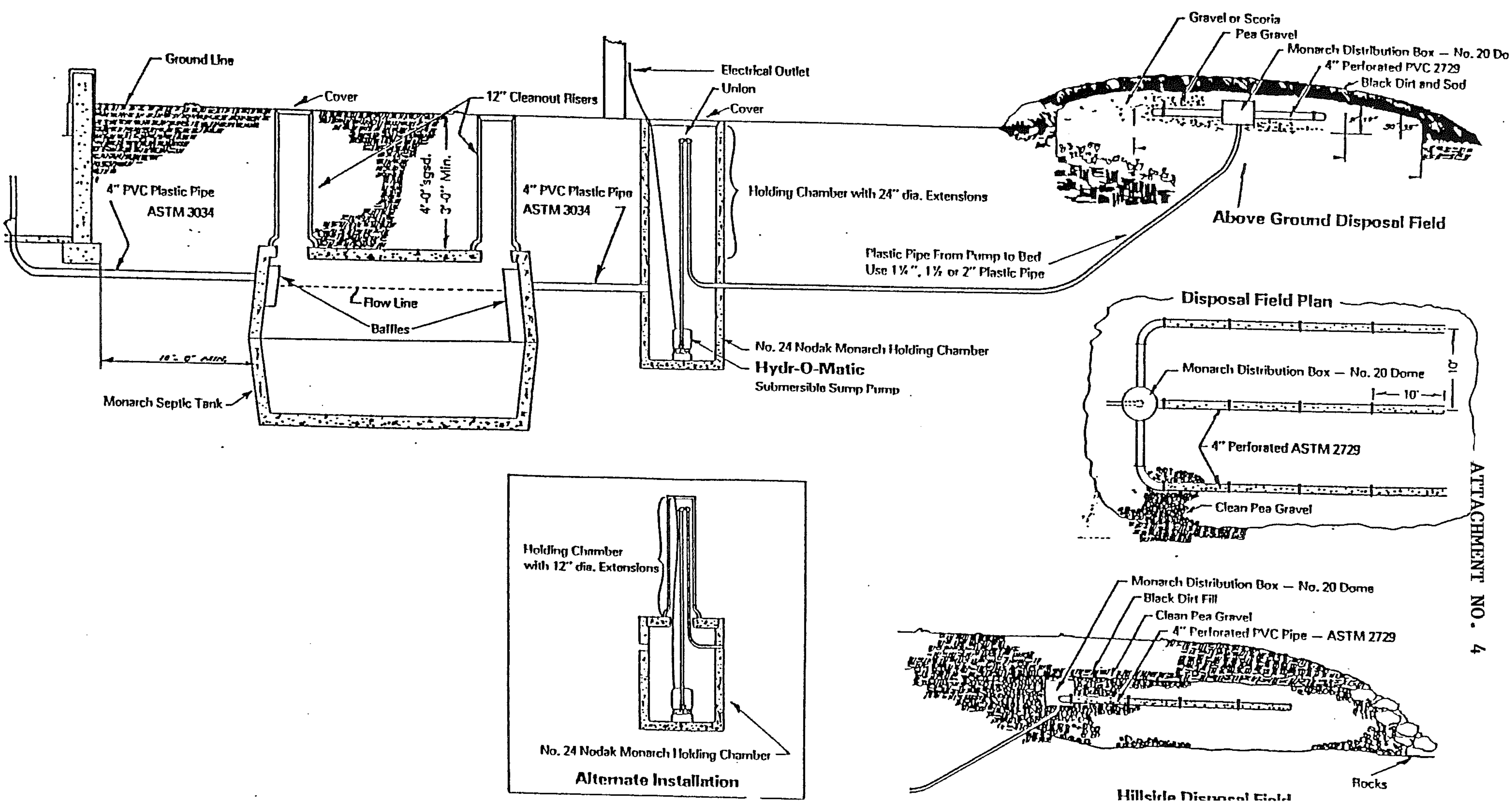
ATTACHMENT NO. 4

Monarch PRODUCTS COMPANY

1300 - 15th STREET NORTHWEST
PHONE 701/852-0307
MINOT, NORTH DAKOTA 58701

300 MANDAN AVENUE
PHONE 701/663-6481
MANDAN, NORTH DAKOTA 58554

NODAK SEWAGE SYSTEM — By MONARCH PRODUCTS CO.



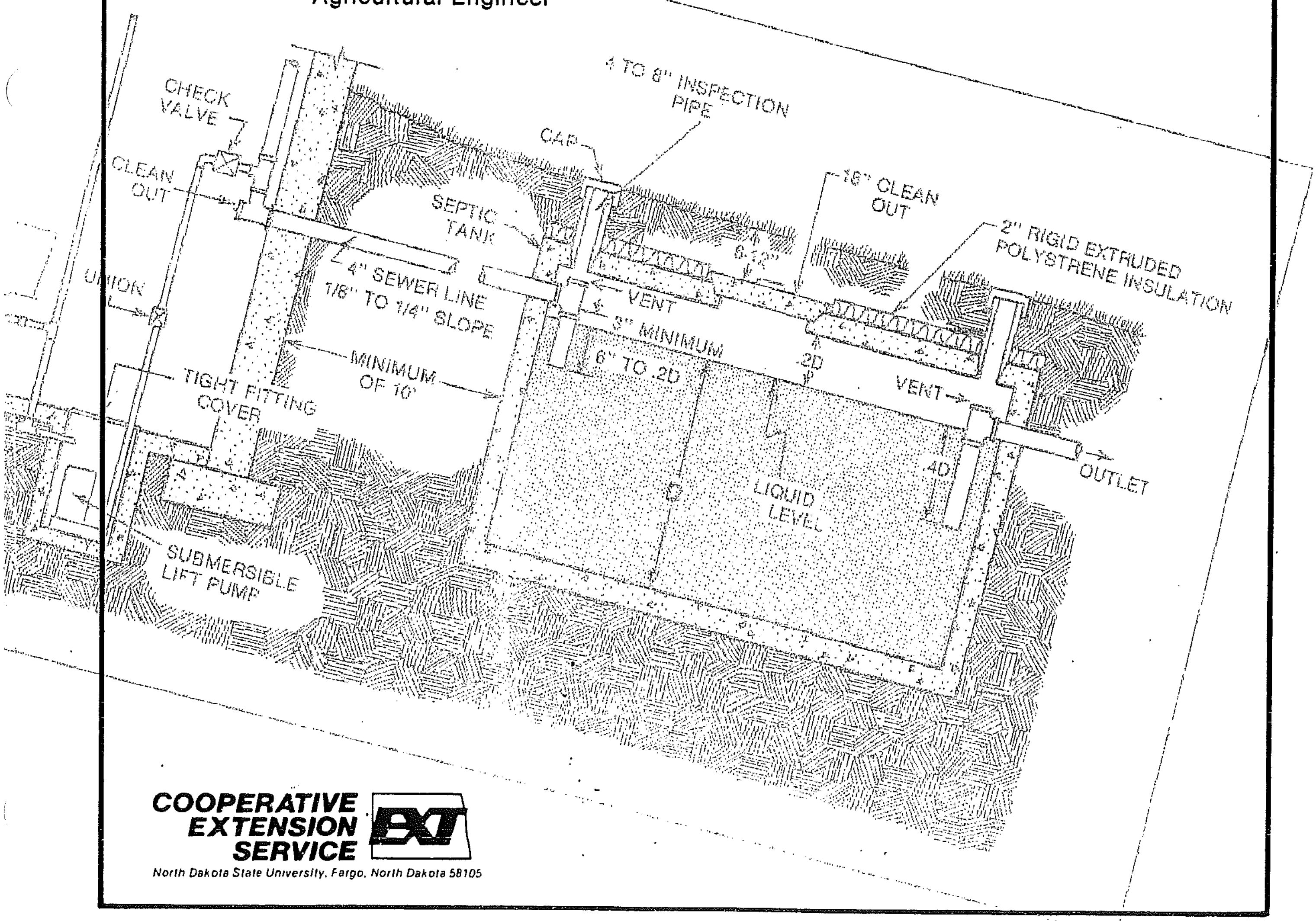
ATTACHMENT NO. 5

AE-892

MARCH 1986

Individual Home Sewage Treatment Systems

Darnell Lundstrom
Agricultural Engineer



COOPERATIVE EXTENSION SERVICE
North Dakota State University, Fargo, North Dakota 58105

Reviewed and Reprinted 1991

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This publication contains information on the design, installation and maintenance of individual sewage treatment systems. An individual sewage tem both treats and disposes of septic wastes. perly installed systems will function for many years with a minimum of maintenance and upkeep.

Home sewage enters the septic tank, which separates solids from the liquids. Solids are held in the septic tank and liquids are conveyed to the final disposal unit. Organic solids retained in the tank are broken down by micro-organisms to liquids, gases and solids. Gases are vented off through the house vent stack. Solids are composed of both scum, which is lighter than water and accumulates on top of the liquid, and sludge, which is heavier than water and sinks to the bottom of the tank. Solids accumulating in the septic tank must periodically be removed by pumping.

Five parts of a sewage disposal system are: (1) house plumbing, (2) sewer line from house to septic tank, (3) septic tank, (4) septic tank outlet sewer, and (5) final disposal unit, which may be a soil absorption unit or a lagoon.

In some areas a permit is required before constructing a new sewage system or repairing an existing system. In these areas you must meet the local codes and requirements. For information check with your local zoning adminstrator, nitarian or health department.

Whether you need a permit or not, good practice demands that the location of individual sewage system components meet certain requirements. For example, keep the septic tank and soil absorption unit at least 50 feet away from any private well. Generally accepted safe distances are shown in Table 1.

When the sewage treatment system is installed, always make a map of the installation. Measure and record distances from the septic tank, septic tank cleanout and soil absorption system to aboveground features such as buildings, fence corners or large trees. Then after the area has grassed over, you can still find the system.

HOUSE PLUMBING FOR SEWAGE

The house plumbing drainage system, Figure 1, includes waste pipes, vent pipes and traps. Waste pipes carry wastewater along with the solid wastes. Vent pipes are provided in drainage systems to carry away gases from all parts of the system and to prevent traps from siphoning. Traps are to prevent sewer gas from entering the house through the drain pipes.

A 3 or 4-inch vertical pipe serves as a main stack to carry wastes from a building. Since the septic tank and traps are vented through the main stack, the stack must be continued through the roof. In cold weather, frost forms on the inside of the stack where it goes through the attic and out the roof. This section of stack should be at least 4 inches in diameter to help prevent frost from closing it off.

A water trap must be installed in the drain pipe between each fixture and the main stack. A trap is formed by a bend in the pipe which is kept filled with water to prevent gases from coming into the house through the fixtures. Vent pipes are installed for each trap and are connected to the main stack. A full flow of waste water in the drain pipes will form a vacuum in the traps that may empty them if the vent is not provided. Wind pressure may cause gas to be forced through the trap. Proper venting will prevent this problem. Gas from a septic tank has a bad odor, may cause serious illness and can be explosive.

Table 1. Location of Sewage Disposal System Components.

Type of System	Distance: Priv. Well or Water Suction Line Feet	Water Supply (Pressure Line) Feet	Lake or Stream Feet	Dwelling Feet	Property Line Feet
Building Sewer	50	10	—	—	—
Septic Tank	50	30	100	10	10
Distribution Box	50	30	100	20	10
Absorption Field	50	30	100	20	10

Adequate cleanouts are necessary in the stack so the plumbing and sewer line can be serviced and cleaned. One cleanout should be installed at the base of the stack and a second at the point where the sewer line leaves the house. One cleanout may be enough if the stack is near the point where the house sewer leaves the building.

Cast iron and copper have been used for stacks and drain systems but approved ABS and PVC plastic pipe is now being placed in most new installations. Use only cast iron or approved plastic pipe underground and under concrete floors.

Avoid direct copper to iron pipe connections since pin-hole leaks may develop in the iron. Use insulated connectors between copper and iron pipe to reduce this corrosion.

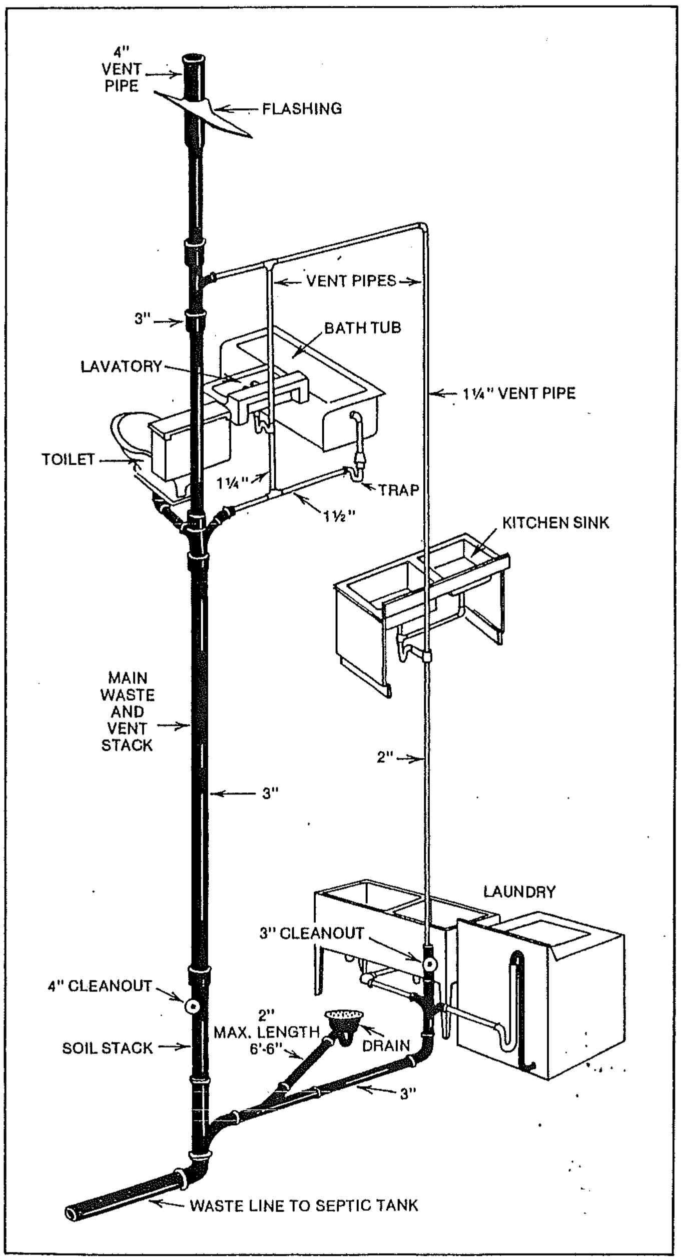


Figure 1. Housing Plumbing Includes - Waste and Vent Pipes and Plumbing Fixtures.

The house sewer should have a slope of at least 1 inch per 8 feet of distance (1.0 percent). For house sewer lines longer than 50 feet, the sewer pipe should not slope more than 1 inch in 4 feet (2.0 percent). On too flat a grade, the liquid will slow down, allowing the solids to settle out in the sewer pipe. On too steep a grade, the liquids will flow away from the solids.

Installations should meet the North Dakota State Plumbing Code. Following this code insures that a plumbing system will be safe and operate properly.

The sewer line from the house to the septic tank may be plastic sewer pipe with glued joints or cast iron with stainless steel clamps or leaded joints. Joints must be watertight and rootproof.

The house discharge sewer is 4-inch (minimum) diameter pipe. Where the sewer line is laid above the frostline, the line must be laid on a uniform slope with no high or low spots.

Don't make sharp bends in the house sewer system. When 45 or 90 degree bends are necessary, use long sweep (long radius) elbows to allow a plumber's snake to got through the sewer line. If long sweep elbows are not available, use several 22½ degree elbows.

NEVER, UNDER ANY CIRCUMSTANCES, ALLOW BASEMENT FOOTING DRAINS TO DRAIN INTO THE HOUSE SEWAGE SYSTEM. Under wet conditions this water will overload the house sewage system. This will cause the water and sewage to back up into the house. Run basement footing drain water to a sump. Install a sump pump and pump the water out away from where the sewage system is located.

SEPTIC TANKS

Solids separate from the liquid as the sewage flows slowly through the septic tank. Some solids settle to the bottom of the tank, and others float in the scum layer at the top (Figure 2). Bacterial action partially decomposes the solids.

The material in the septic tank separates into three distinct layers:

1. A top layer of scum
2. A middle liquid zone
3. A bottom layer of sludge

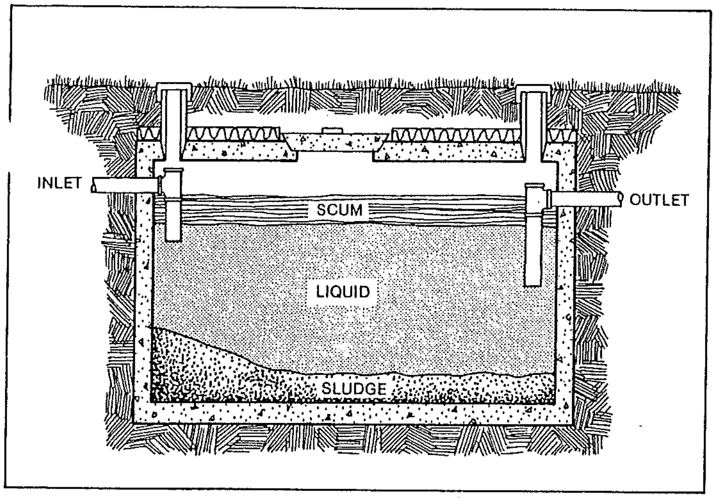


Figure 2. Sludge builds up in the bottom of a septic tank and scum floats at the top.

The scum layer consists primarily of cooking fats and oils, soap scum and products of decomposition which are lighter than water. The greatest amount of bacterial action occurs in the sludge layer, which consists of solids heavier than water.

Sewage liquid discharged from a septic tank is called effluent. Effluent from a properly maintained septic tank is slightly cloudy and contains fine ıspended solids, bacteria and nutrients. Septic .ank effluent **MUST NOT BE DISCHARGED DIRECTLY TO THE GROUND SURFACE OR INTO SURFACE WATERS.** The effluent must be discharged to a properly designed and constructed soil treatment system or lagoon.

Run all sewage wastes from the laundry, bath, kitchen and toilet into the septic tank. Do not let wash water and other similar wastes bypass the septic tank. Soapy or greasy water sent directly into the soil treatment unit will quickly plug the soil pores and ruin the soil system.

SEPTIC TANK LOCATION AND INSTALLATION

Locate the septic tank at least 10 feet away from the house. Locate the tank straight out from the point where the sewer line leaves the house. The tank must be accessible for cleaning, so locate the nk within 40 feet of a driveway or other acceptable route so a tank truck can drive close enough to pump the tank without driving over the drainfield. Locate the septic tank out of high vehicle traffic areas because excessive loads might damage the tank. Compacted soils are also more apt to freeze. Never locate septic tanks under sidewalls or patios where the tank is inaccessible for pumping.

A sewage treatment system works best and can be more easily maintained if the soil treatment area is near the ground surface. Shallow treatment areas and tanks provide easy access to the system. The septic tank depth depends on house plumbing and whether gravity flow from basement fixtures and the floor drain is provided. If no toilet is in the basement, but a basement utility drain is needed, consider installing a sump pump to allow a shallow septic tank installation (Figure 3). Use a solids handling sewage lift pump if a toilet is installed in the basement. Install the pump in a sump below the basement floor level and pipe all basement waste to the sump.

A septic tank may also be installed lower than the basement floor level providing a high water table is not present (Figure 4). If suitable slope is not present, a lift station must be installed at the outlet side of the septic tank so the drainfield can be installed at a shallower depth.

Usually enough heat is provided by water draining from the house and by the bacterial action in the septic tank to keep the septic tank from freezing even when located above frostline. When the top of a septic tank is installed within 18 inches of the ground surface, covering the top of the tank with 2 inches of rigid extruded polystrene insulation board will help retain heat within the septic tank. Whenever the system is built above frostline, it is very important to lay all sewer pipe at a uniform grade without high or low spots. The final disposal field should be large enough to readily absorb water so water will not stand in the lines and freeze.

SEPTIC TANK CONSTRUCTION

Septic tanks must be of watertight construction and built from corrosion and decay resistant materials. Precast reinforced concrete tanks are the most common. However, tanks may also be constructed of poured-in-place concrete or built from concrete blocks with the cores filled with concrete and reinforced. Seal the inside of concrete block tanks with two coats of concrete plaster. Fiberglass and polyethylene septic tanks are also available. They must be installed carefully according to manufacturer's instructions so they will withstand soil and water pressure.

Septic tanks should be designed for a liquid level of not less than 3 nor more than 6½ feet. The

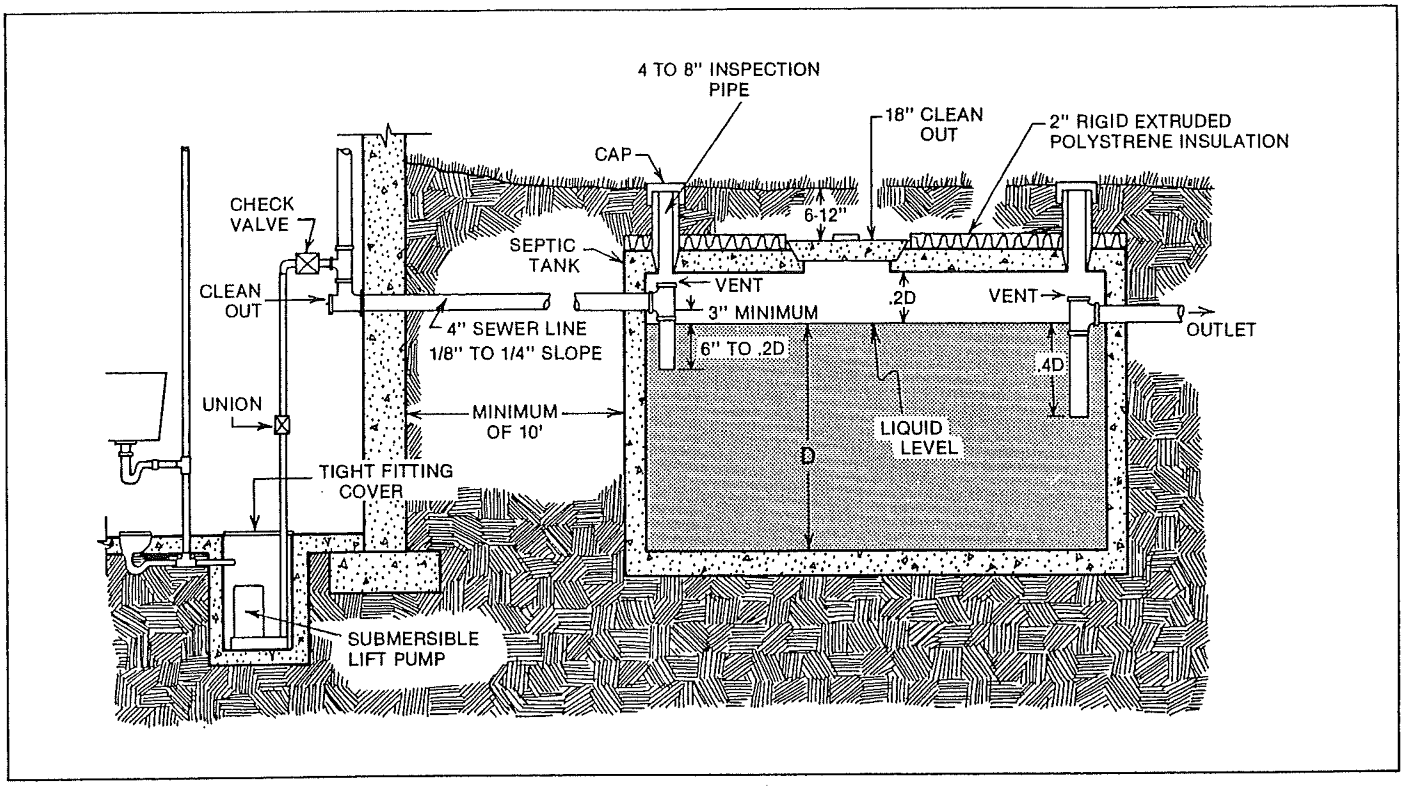


Figure 3. Shallow Septic Tank Installation.

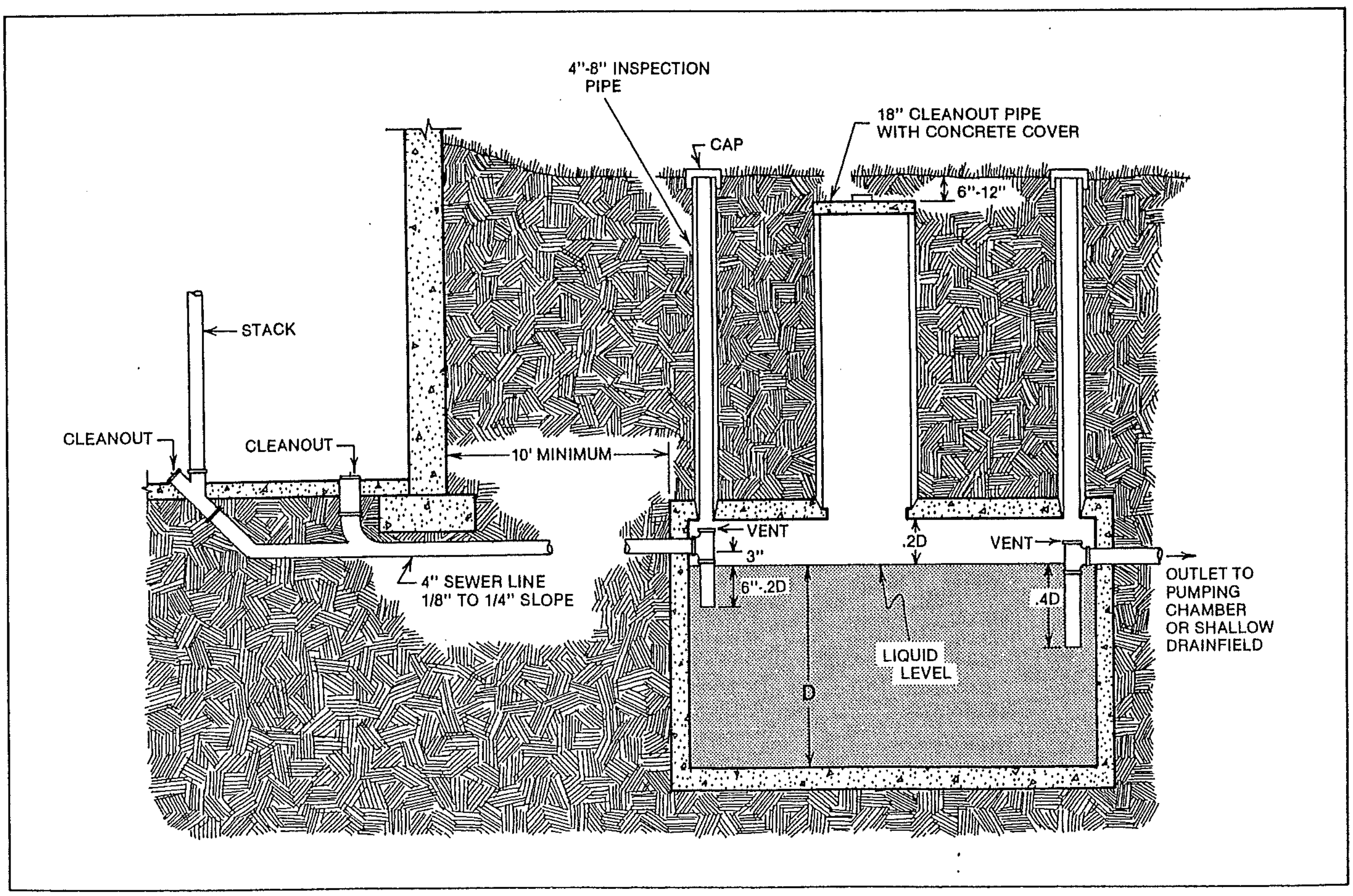


Figure 4. Deep Septic Tank Installation. Suitable Where a Basement Toilet is Desired and a High Water Table is not Present.

horizontal distance between the inlet and outlet of rectangular tanks should be about three times the width of the tank. Incoming solids will settle out in this distance and not flow out to the absorption field. Circular tanks should have at least a 5-foot inside diameter.

The liquid level of the septic tank is determined by the elevation of the outlet. Make the outlet at least 3 inches below the inlet. Room must be left above the septic tank liquid level for scum accumulation. Allow a minimum of 20 percent of tank's liquid level as free board between the liquid level and the roof of the septic tank.

INLET AND OUTLET BAFFLES

Inlet and outlet baffles are critical parts of a correctly installed septic tank. The inlet baffle directs incoming sewage into the liquid zone of the septic tank. The outlet baffle allows sewage effluent to flow out of the liquid zone, retaining the scum in the tank.

Baffles may be constructed as an integral part of the septic tank or fastened to the tank after construction. Plastic sanitary tees are often used in lieu of baffles.

Baffles must be durable and corrosion proof. Durable concrete, fiberglass or plastic are excellent materials. Never use steel baffles as they will corrode quickly. If baffles are bolted in place, use only stainless steel bolts.

Baffles must have proper submergence. The inlet baffle submergence should be from 6 inches to 20 percent of the liquid depth. The outlet baffle submergence should be 40 percent of the liquid depth.

The top of the baffles must be open and extend no closer than 1 inch to the top of the tank. This is required for movement of gases out of the tank.

CLEANING SEPTIC TANKS

Access must be available for inspection and periodic cleanout of septic tanks. One manhole at least 18 inches in diameter must be located on the top of the tank. This manhole should have at least 6 inches but not more than 12 inches of earth covering. If the top of the tank is more than 12 inches below ground level, extensions must be attached to the top of the tank to bring the cover within 12 inches of the ground surface. A minimum of 6 inches of earth should cover the manhole cover to prevent accidental entry.

In addition, at least one 4, 6, or 8-inch diameter inspection port must be installed on the tank top. Two inspection ports are recommended; one over the inlet baffle and one over the outlet baffle. This allows for inspection of the baffles. It also allows for easy inspection of the inlet and outlet if plugging occurs. The inspection ports must have a pipe installed which extends to or above the ground level. Cap the pipes to prevent gas from escaping and children from dropping things into the tank.

Septic tanks must be cleaned regularly to remove the accumulated solids. For most homes a three-year cleaning interval is satisfactory. However, if the home has an in-sink garbage disposal installed, the cleaning interval usually needs to be shorter. One to two years is recommended as garbage disposals increase the solids loading of a septic tank. The System Maintenance Section of this bulletin describes a method to measure the sludge and scum thickness in a septic tank.

SEPTIC TANK SIZING

Septic tanks must be sized according to liquid capacity, NOT total capacity. The liquid capacity of a septic tank is the capacity below the tank outlet. Determine the liquid capacity in cubic feet and multiply by 7.5 to find the capacity in gallons. See Table 2 for recommended septic tank liquid capacities.

Table 2. Recommended septic tank liquid capacities.

Number of bedrooms	Minimum liquid capacity, gallons*
3 or less	1,000
4	1,250
5	1,500

*Liquid capacity is the tank volume below the outlet. An additional internal volume equal to 20 percent of the liquid capacity is needed for floating scum storage.

SEPTIC TANK OUTLET SEWER

The outlet sewer from the septic tank carries sewage effluent from the septic tank to the soil absorption unit or pumping chamber. The outlet sewer must be water tight and at least 4-inch diameter pipe. Lay the pipe at a minimum grade of 1/8 inch per foot. There is no maximum grade for the outlet sewer pipe since the pipe carries only liquids. The outlet sewer pipe must be laid to grade with no low spots where effluent can collect and freeze.

PUMPING STATIONS

Pumping stations, Figure 5, are required where the septic tank effluent must be pumped to the soil absorption unit. Pumping is required with a deep septic tank installation and shallow absorption trench or when the absorption trench is located at a higher elevation than the septic tank. The use of a mound as a final soil absorption system will required a pumping station.

The pumping station tank must be water tight. If not, ground water may seep into the tank and the excess water will easily overload the final dispoal unit. The pumping station tank should have a working capacity (capacity between the pump-on and pump-off levels) of about 1/4 the daily sewage volume for the house. A three bedroom house has a design volume of 450 gallons per day (GPD) so the pumping tank should have a working volume of about 110 gallons.

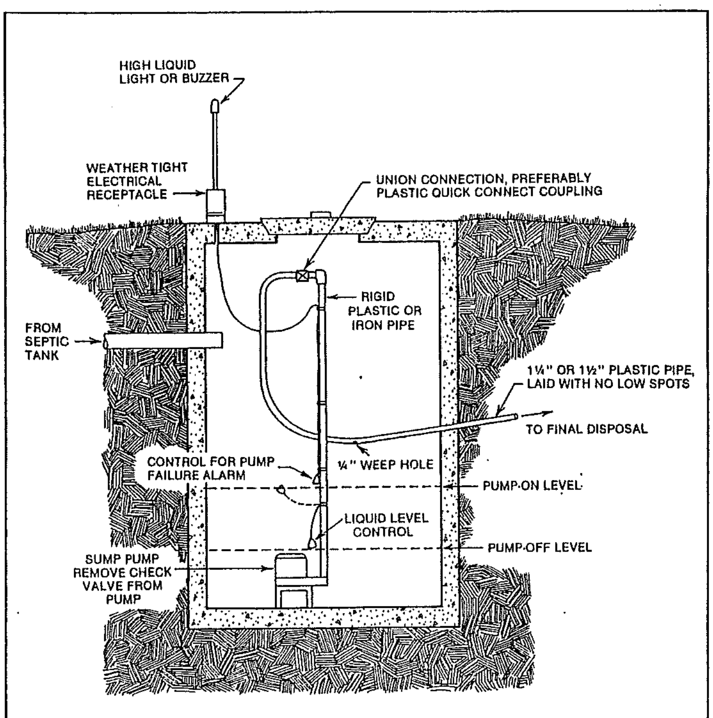


Figure 5. Septic Tank Effluent Pumping Chamber.

The total capacity of the pumping station tank will be considerably larger than the tank's working capacity. Set the pump on a concrete block or pedestal in the tank bottom so grit from the tank bottom is not drawn into the pump. Pump controls often have a limited range between the on and off setting. Ranges of 12 inches to 30 inches are common.

The following table gives some capacities of circular tanks in gallons per foot of depth.

Inside diameter in inches	Gallons per foot of depth
30	36
36	53
42	72
48	94
60	147

The capacity of rectangular tanks in gallons per foot of depth can be calculated by multiplying length in feet by width in feet by 7.5.

Some reserve capacity in the pumping tank must be available in case of pump failure. A reasonable reserve capacity is one day's estimated sewage flow.

Pumping station tanks may be of precast concrete or fiberglass construction. Concrete culvert sections may also be used if the bottom is well sealed with a cast-in-place concrete floor and the joints between culvert sections are sealed. Flotation may be a problem with fiberglass tanks under high water table conditions. Under this condition, the tank must be anchored to prevent upward movement.

A secure manhole cover must be located on the top of the pumping tank. The cover must be of concrete or steel and bolted in place or heavy enough to prevent children from moving the cover.

PUMPS

Sewage lift pumps must be durable and of corrosion resistant construction. Cast bronze submersible pumps or cast iron pumps with stainless steel screws may be utilized. Plastic is also a suitable material if the pump is properly designed and constructed for use with sewage. Pedestal sump pumps with an open motor are not suitable.

A pump's capacity in gallons per hour is not usually a limiting factor in pump selection when pumping to absorption trenches or a bed. However, the maximum lift capability of the pump may be a limiting factor. Always determine the total lift that will be required from the bottom of the pump tank to the absorption field. Select a pump with a maximum lift capability at least 5 feet higher than this elevation difference. Run 1¼ inch or larger diameter flexible plastic pipe from the pumping station to the soil absorption field. The plastic pipe must be buried below frostline or graded uniformly back to the pumping chamber so drainage occurs. Low spots in shallow buried pipe will freeze.

When choosing a pump for use with a **sewage mound**, size the pump for a delivery of about 7.5 GPM per 100 square feet of rock bed area. This will require a 27 GPM pump for a mound serving a three-bedroom house. The pump must have this capacity at the required pressure head. The required head will be the elevation difference in feet between the bottom of the pump tank and the mound plus friction loss in the pipe plus 5 feet. For mound systems, a minimum size of 1½ inch diameter plastic pipe should be used. With a pumping rate of 27 GPM, the friction loss in the pipe will be about 5 feet of head loss per 100 lineal feet of pipe. For example, if a pump was chosen to pump from a pumping tank to a mound for a three-bedroom house where the mound was 8 feet above the elevation of the tank bottom and 200 feet away, the pump would have a required head of 8 feet (for elevation difference) + 10 feet (for friction loss) + 5 feet = 23 feet. A pump would be chosen which can deliver 27 GPM at 23 feet of head.

Install the pump with a union or quick disconnect coupling near the top of the pumping chamber. This makes installation and removal of the pump easier. Do not install a check valve in the outlet pipe from the pumping station. If the pump has a built-in check valve, remove the check valve. Loop the outlet pipe with a ¼ inch weep hole drilled at the low point of the loop. The weep hole must be drilled so the pipe can drain back to the pumping tank.

PUMP CONTROLS

A control is necessary to start and stop the pump. Use a control external from the pump. Pressure diaphragm switches built into the pump do not stand up well under sewage pumping chamber conditions.

Pump controls are usually either of the mercury level control or adjustable weight type (Figure 6).

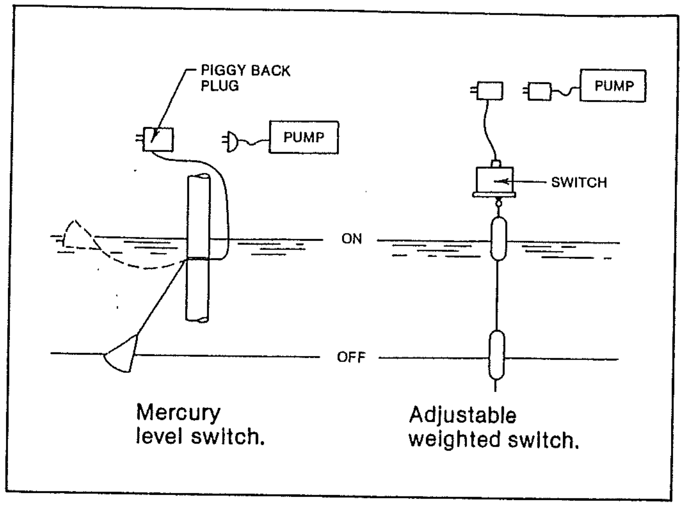


Figure 6. Pump Controls. All Electrical Connections are Outside the Tank.

Mercury level controls have a mercury switch sealed in a bulb. The start and stop locations are determined by the level where the control cord is attached and the length of cord between the attachment point and the mercury bulb. Adjustable weight switches use two weights on a cable hanging down into the pump chamber. The location of the two weights on the cable determine the start and stop locations.

Do not install electrical outlets inside the pumping tank. Mercury level and adjustable weight controls commonly use piggyback plugs where the control cord plugs into an electrical outlet and the pump electrical cord plugs piggyback into the control cord plug. A weatherproof box located outside the pumping tank makes a good location for an electrical outlet to serve the pump. Any electrical connections within the pumping tank must be soldered and have water tight connections.

Install another control on an electrical circuit separate from the pump and connected to an above ground light or buzzer to warn of pump failure. This may also be a mercury level control set 3 to 6 inches higher than the pump start level of the pump control.

PERCOLATION TESTS

Percolation tests are made to help determine the ability of a soil to absorb effluent. The rate of water drop in a test hole determines the percolation rate. A fast drop indicates a high percolation rate while a slow drop indicates slow percolation. Soils which have slower percolation rates need larger soil absorption areas to treat a give quantity of effluent.

Prior to running a percolation test, make soil borings to determine the soil texture (amount of sand, silt and clay) in the possible locations for the soil absorption unit. Then choose the location with better characteristics. Generally, soils having higher sand contents are better choices for the absorption field area.

The following steps outline the procedure used in running a percolation test. Figure 7 shows a percolation test hole.

1. Dig and prepare the test hole. Dig a 6-inch to 8-inch diameter hole to the depth of the proposed disposal system. Roughen the sides and bottom of the holes with a knife or nails driven into a board to counteract the sealing action of the spade or auger. Clean out the loose dirt in the bottom of the hole. Place 2 inches of coarse gravel in the hole.

2. Carefully pour at least 12 inches of water into the hole. Add water through a hose connected to a funnel. The bottom of the hose should be right at the top of the rock to prevent washing of the soil in the test hole. Washing will loosen fine materials and seal the hole.

   Keep water in the hole for four hours, preferably overnight. Refill if necessary to keep the water at the 12-inch level. In clay soils, water must be kept in the hole long enough, at least 12 hours, for soil swelling to take place before measuring the percolation rate.

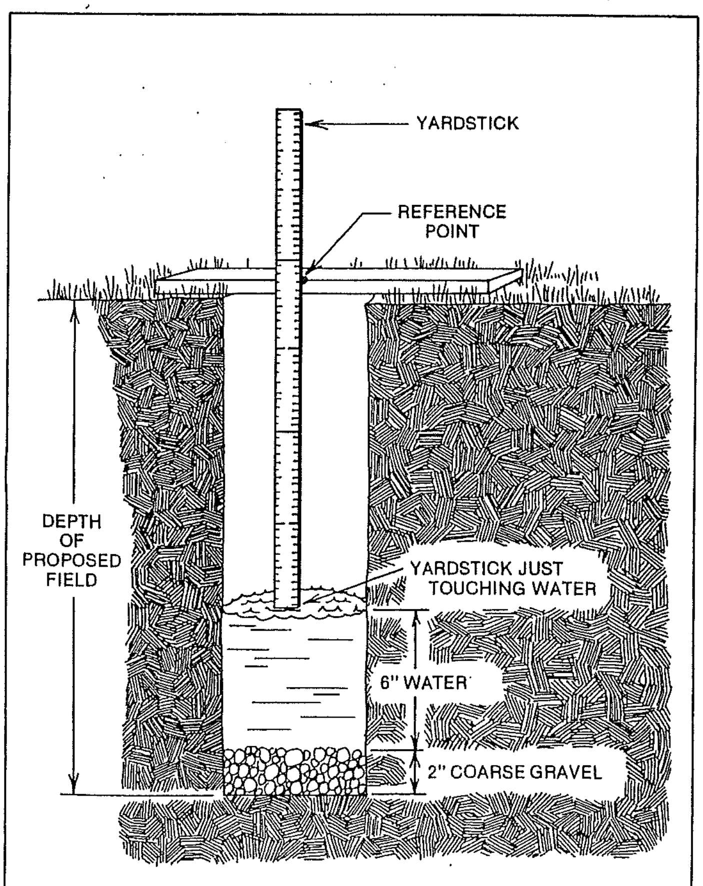


Figure 7. Percolation Test Hole.

3. Make the percolation test. Adjust the water level to 6 inches over the gravel layer. Measure the water level from a fixed point every 30 minutes or as often as required and calculate percolation rate in MPI (minutes per inch). Refill the hole as required. Continue taking readings until three percolation rates vary by no more than 10 percent.

   The percolation rate is calculated by dividing the time interval in minutes by the water level drop in inches. Calculate the percolation rate for each reading. Use the slowest value for each test hole to get the average percolation rate for designing the soil absorption field.

   Example:

   Hole 1: $\dfrac{\text{32 minutes}}{\text{1 1/8 inch drop}} = 28.4$ MPI

   Hole 2: $\dfrac{\text{34 minutes}}{\text{7/8 inch drop}} = 38.9$ MPI

   Average $\dfrac{38.9 + 28.4}{2} = 33.7$ MPI

ABSORPTION TRENCHES

Absorption trenches are the most common and most effective soil absorption system. Use absorption trenches in preference to absorption beds or mounds if possible. Trenches are most suitable for soils having percolation rates of 60 MPI and less. Trenches may be used on 61 to 90 MPI intake rate soils, providing a high water table does not exist and adequate trench length is used. For soils with percolation rates of 61 to 90 MPI, increase trench area by 25 percent over the area required for a soil with a 60 MPI percolation rate.

Size absorption trench systems based on a percolation test. The trench bottom area required is shown in Table 3. Be sure to construct at least this amount of absorption trench. Many homeowners and installers feel this is more trench than they require and install less trench to save money. This usually ends up being false economy. The system fails within a number of years and then additional work

Table 3. Recommended absorption trench area.

Percolation rate min/in.	Depth of Rock below distribution pipe 6"	12"	18"	24"
	–Trench bottom area loading rate, gal/ft²/day–			
1 to 5	1.2	1.5	1.80	2.1
6 to 15	0.8	1.0	1.20	1.4
16 to 30	0.6	0.75	0.90	1.05
31 to 45	0.5	0.63	0.76	0.89
46 to 60	0.45	0.57	0.68	0.79
	–Square feet of trench bottom/bedroom*–			
1 to 5	125	100	85	70
6 to 15	190	150	125	110
16 to 30	250	200	165	145
31 to 45	300	240	200	170
46 to 60	330	265	220	190

*Based on sewage volume of 150 GPD/Bedroom

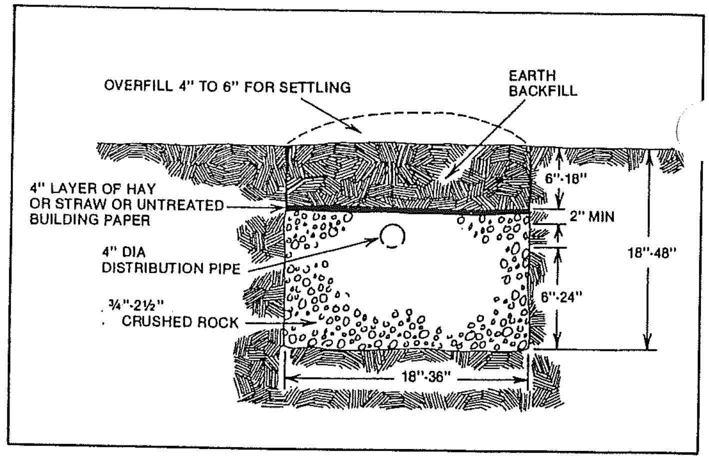


Figure 8. Cross Section of Absorption Trench.

must be done to upgrade the system. Recommendations for trench bottom area are based on a long life treatment system, not a temporary solution.

Trenches may be constructed 18 inches to 36 inches wide with 12 to 30 inches of crushed rock. Use ¾ to 2½-inch diameter rock. With 6 to 18 inches of soil cover over the rock, trenches will be 18 inches to 48 inches deep. The cross section of an absorption trench is shown in Figure 8. The distribution pipe is set with about 2 inches of crushed rock over the pipe. The rock under the distribution pipe distributes effluent over the trench bottom and sidewalls, allowing the liquid to infiltrate into the soil. Four-inch diameter PVC sewer pipe with ½-inch diameter or larger holes placed 12 inches apart or closer is used for distribution pipe. Place the holes downward. When using pipe with a double row of holes, place the pipe with the holes downward in a 5 o'clock and 7 o'clock position. Cover the rock with a 4 to 6-inch layer of hay or straw or untreated building paper to keep the backfill dirt from sifting down into the crushed rock. Backfill the trenches with earth. Overfill the trenches with 4 to 6 inches of backfill material to allow for settling. Trench construction is shown in Figures 9, 10 and 11.

Construct each trench floor level. Trenches must be excavated to follow the contour of the ground rather than being dug in straight lines. Constructing the trench bottom level allows effluent to spread evenly. Set the distribution pipe at a slight slope, 1 inch or 2 inches per 100 feet, toward the end of the trench. The top of the rock covering the pipe must be level throughout the length of the trench.

The maximum length of any one trench should not be more than 100 feet from the distribution point. A trench can then be 200 feet long if the sewage effluent is delivered to the center of the run.

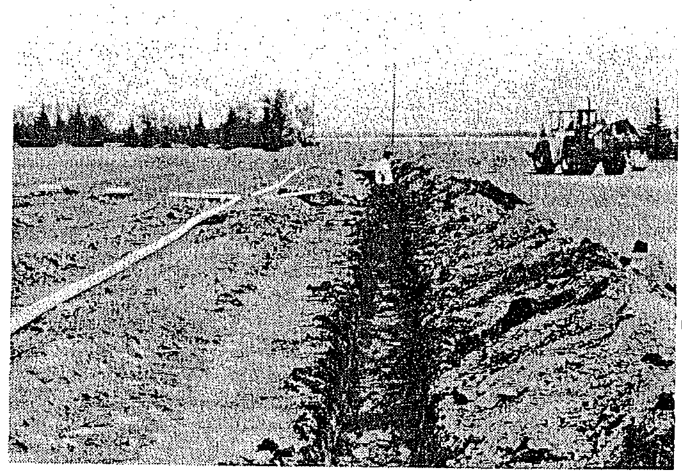


Figure 9. Shallow Absorption Trench After Digging and Before Placing the Rock. The Trench Floor Must be Level Along it's Entire Length.

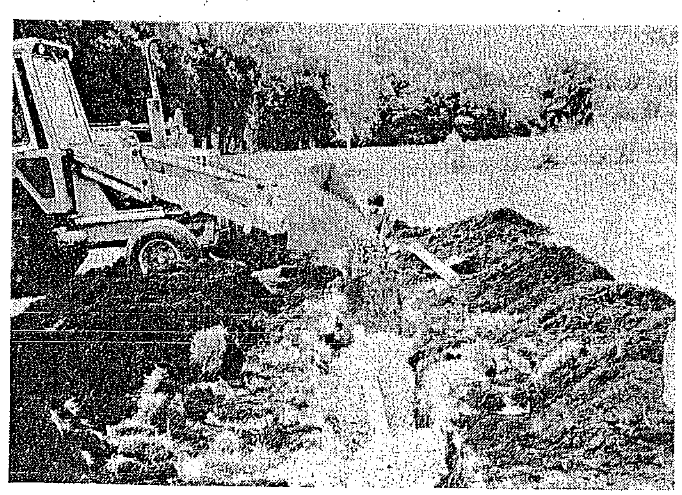


Figure 10. Placing Rock in Trenches With a Front End Loader. The Distribution Pipe is Being Set to Grade.

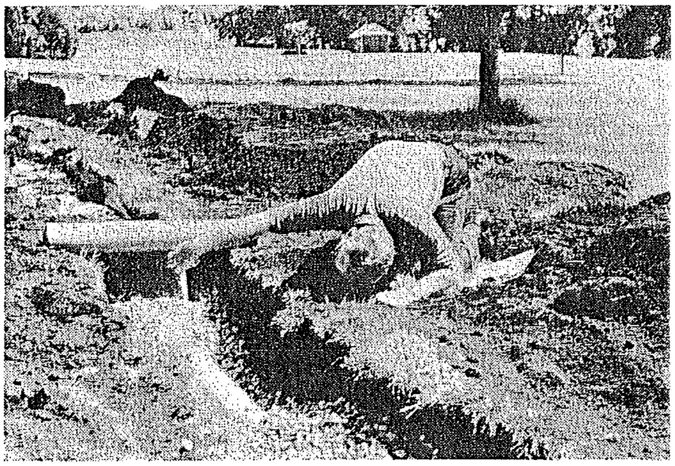


Figure 11. A Local Sanitarian Checking the Depth of Earth Cover Over the Rock. Note the Untreated Building Paper over the Rock and the Distribution Pipe with 1 to 2 Inches of Rock Cover.

TRENCH CONSTRUCTION

Trenches must be constructed with a backhoe. Do not allow any wheel tracks in the trench since the compaction will seal the surface, greatly reducing the effectiveness of the absorption trench.

Never construct trenches in loam or clay loam soils under wet conditions. If work is done in wet soil, the soil will compact and smear, sealing the trench and resulting in failure. If the soil can be rolled into a thread 1/8 inch in diameter without breaking the soil is too wet. If the soil is dry enough for construction, it will crumble when you try to roll it into a thread. Check the soil wetness at the depth the trench will be constructed.

EFFLUENT DISTRIBUTION

Three methods of effluent distribution may be used with absorption trenches. They are drop boxes, distribution boxes and closed loop distribution.

Drop Boxes, Figures 12, 13 and 14, are the preferred method of effluent distribution and may be used on near-level or sloping terrain. Drop boxes are commonly constructed of concrete or other durable, corrosion-proof material with an inlet, outlets to the absorption trenches served by the drop box, and an outlet to the next trench. The inlet is set highest. The outlet to the trenches being served is set lowest. Drop boxes allow a trench to be fully utilized before any effluent goes to the next trench. This is necessary where absorption trench systems are installed on a hillside. Without drop boxes, the effluent could all go to the lower trenches and the system could fail without any effluent ever getting to the higher trenches. Drop boxes also have an advantage in that the outlet to a trench can be blocked off allowing that trench to rest.

Distribution Boxes, Figure 15, are used on relatively level terrain. Distribution boxes are normally constructed from concrete or other durable, corrosion-proof material with an inlet from the septic tank and

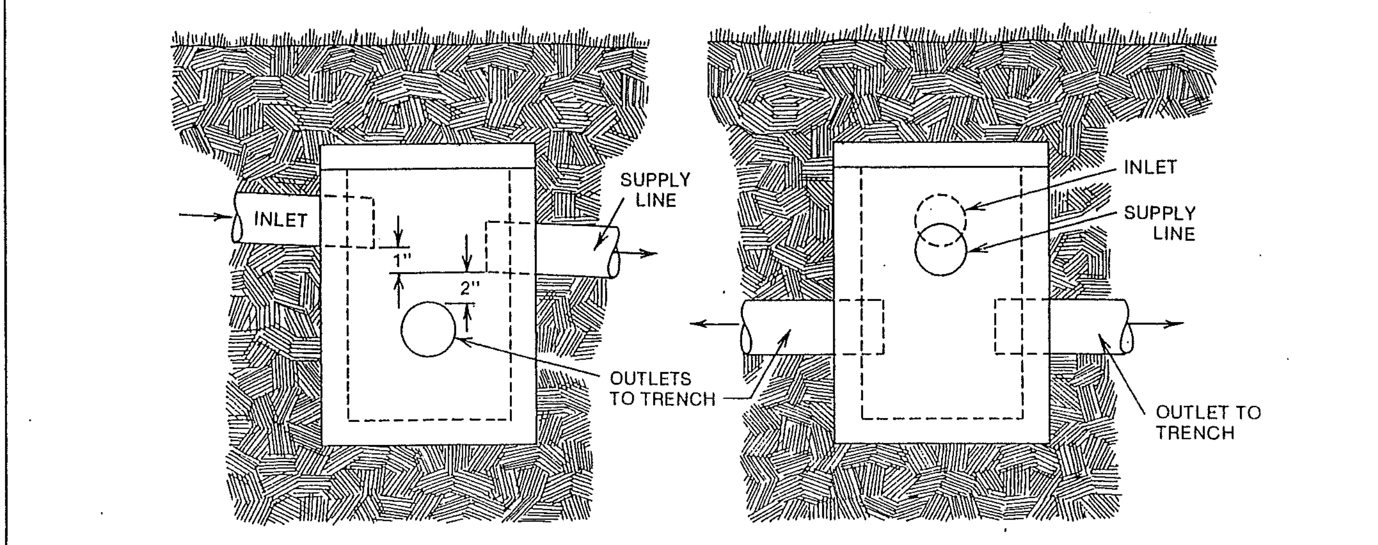


Figure 12. Drop Box Pipe Locations.

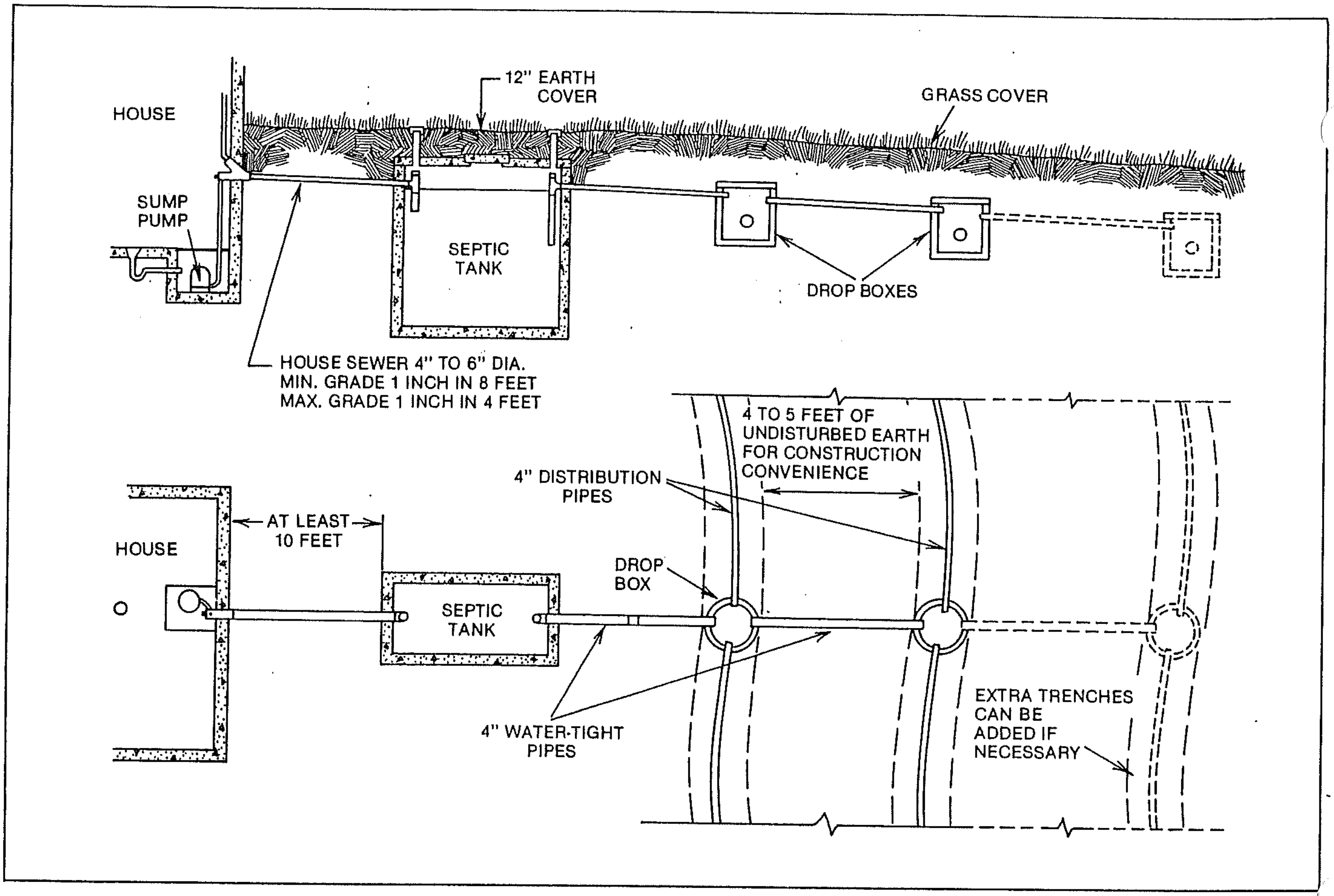


Figure 13. Drop Boxes Used For Effluent Distribution.

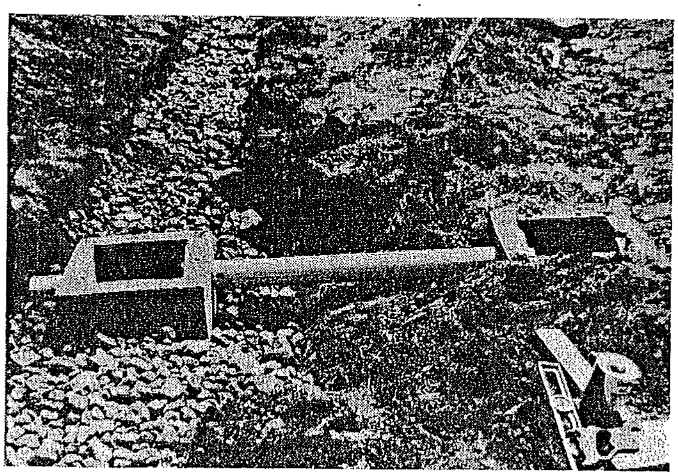


Figure 14. Drop Boxes Used to Distribute Effluent to Trenches. The Right Trench has Been Backfilled. The Left Trench is Ready to Have Straw or Untreated Building Paper Spread Over the Rock.

outlets to each of the absorption trenches. All of the outlets from the distribution box are set at the same elevation. However, in practice, it is virtually impossible to keep all outlets at the same elevation. The trench served by the lowest outlet will then receive the greatest amount of effluent. For this reason, distribution boxes may only be used where the elevation of the lowest trench is high enough to back effluent up to the distribution box without surface seepage occurring. Distribution boxes have an advantage over the closed loop system since the top of the distribution box may be opened and the effluent level inspected. One trench line may also be blocked off so a trench can be rested.

Closed Loop Distribution, Figure 16, is suitable only for level installations. In a closed loop system all the trenches are connected both at the beginning and at the ends of the trenches; solid sewer pipe is run to the absorption field area. Within the absorption field area, perforated pipe is used for distribution in the trenches. The floor of all the trenches are constructed at the same elevation when closed loop distribution is used.

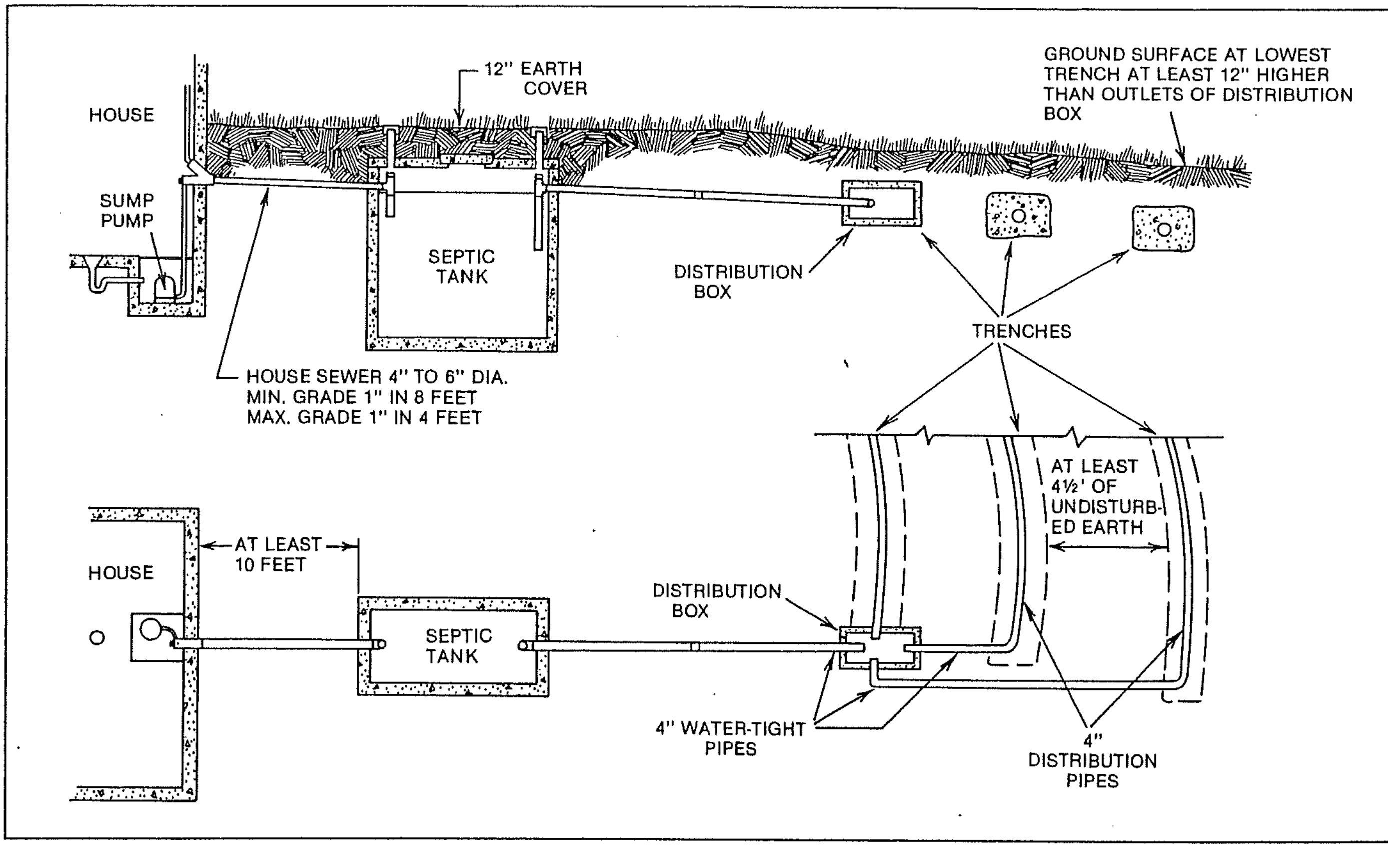


Figure 15. Distribution Box Used for Effluent Distribution.

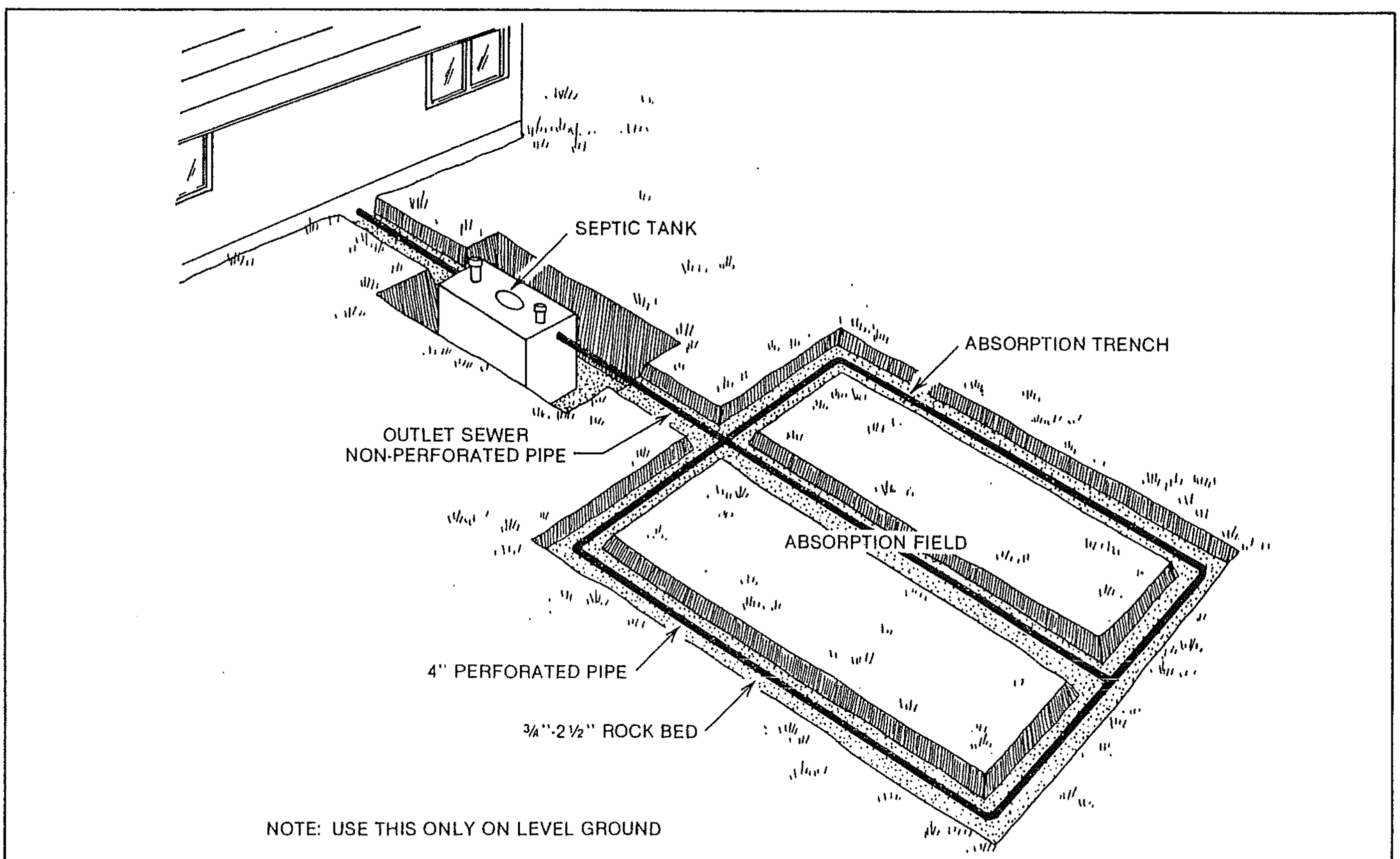


Figure 16. Closed Loop Distribution System.

ABSORPTION BEDS

Absorption beds, Figure 17, are wider than absorption trenches and utilize more than one distribution pipe. They cannot be used in locations having slopes greater than 6 percent. Absorption beds are not as effective as absorption trenches having the same bottom area because the absorption bed will have less sidewall area for percolation compared to a trench system. Therefore, about 25 percent more bottom area is required than for trenches. Absorption beds can be constructed on smaller sites and consequently are used. Percolation tests are used to size absorption beds (see Table 4).

The bottom of the absorption bed must be level in all directions. Excavate the bed with a backhoe. Do not allow any equipment to be driven on the bottom of the bed.

Distribution pipe within beds is normally 4-inch diameter perforated pipe. Place the distribution pipes level, 4 to 6 feet apart and 1½ to 3 feet from the edge of the bed. The pipes are normally joined at the ends to form a continuous loop.

Place a minimum of 6 inches of rock under the distribution pipe and a minimum of 2 inches of rock over the distribution pipe. Use ¾ to 2½-inch diameter rock, cover the rock with a 4 to 6-inch layer of hay, straw or untreated building paper. Backfill the bed with 6 to 18 inches of topsoil. Crown the backfill so the bed will shed water.

Table 4. Recommended absorption bed area.

Percolation rate (min/in.)	Loading rate gal/ft²/day	Treatment area per bedroom* square feet
1 to 5	1.0	150
6 to 15	0.65	230
16 to 30	0.50	300
31 to 45	0.40	375
46 to 60	0.35	430

*Based on 150 GPD/bedroom loading rate

SEWAGE MOUNDS

Sewage mounds are designed for locations having very slowly permeable soils and/or high water tables. A sewage mound is an elevated rock absorption bed

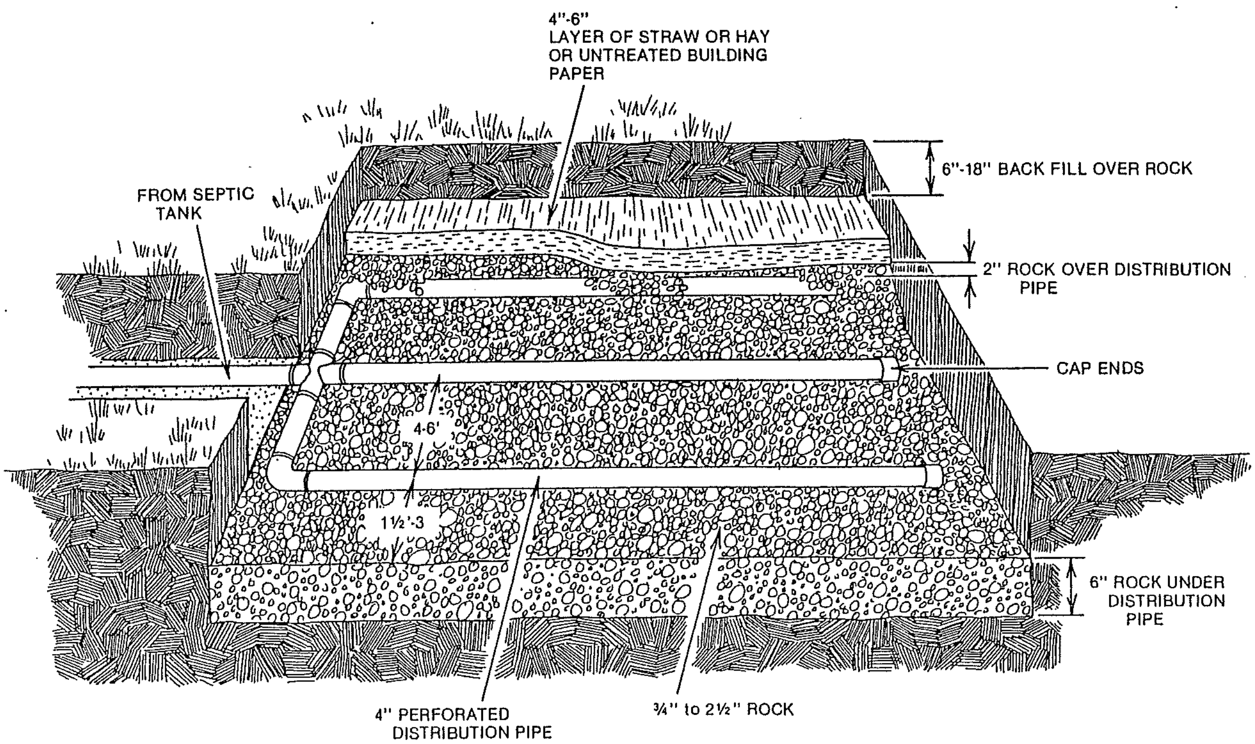


Figure 17. Absorption Bed Construction.

with sand fill over the existing ground (Figure 18). A mound takes advantage of the higher permeability of surface soils compared to subsurface soils. In low permeability soils the total basal area must be large enough to allow percolation of effluent into the soil surface. In high water table conditions the elevated bed allows effluent treatment to take place before the effluent contacts the soil water table.

Sewage mounds date from the first "Nodak" mounds designed at North Dakota State University by J. Clayton Russell and Richard Witz in 1947. The design of mounds has evolved as more information on mound operations has become available. Present mound design accounts for higher water usage and different construction techniques than many earlier designs.

The septic tank effluent in a mound system discharges to a pumping chamber. The pump discharges effluent to the mound through 1½-inch diameter or larger plastic pipe (Figure 19). The pumping chamber should be large enough and the pump controls set so doses equal to about one-fourth of

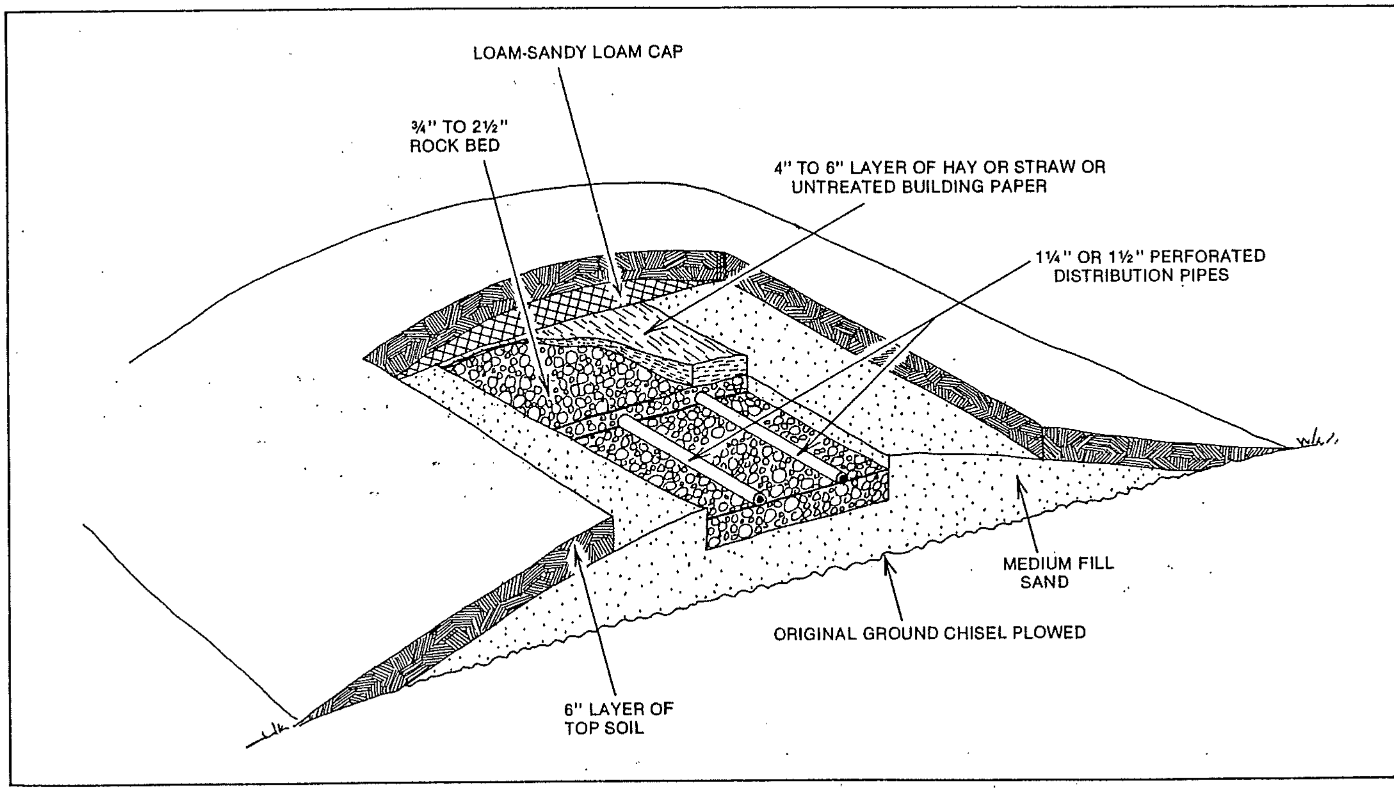


Figure 18. Construction Features of a Sewage Mound.

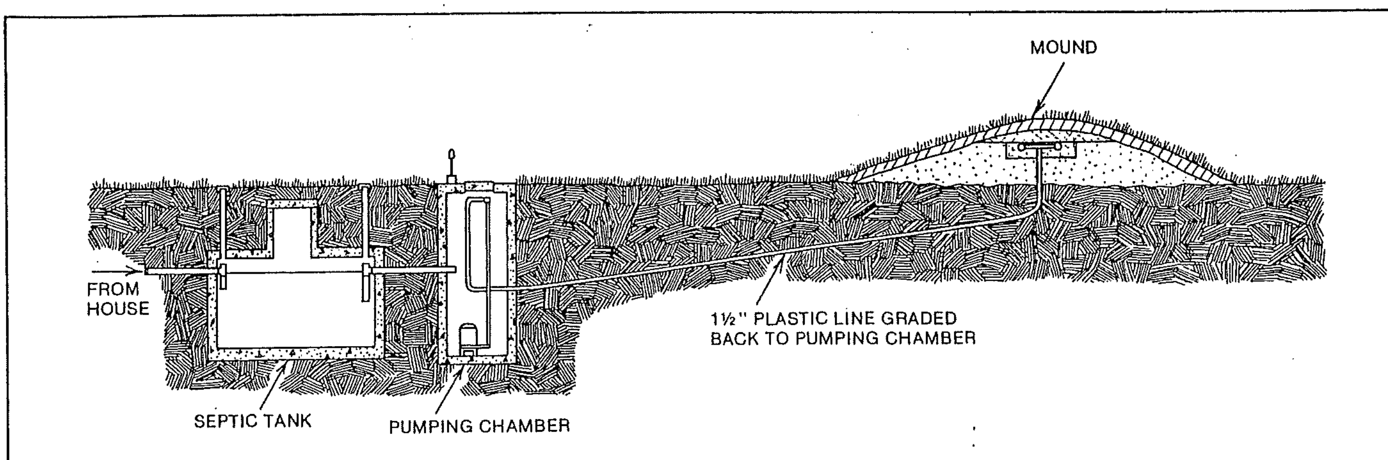


Figure 19. Septic Tank, Pumping Chamber and Mound.

the daily house design sewage volume are discharged to the mound when the pump starts. A three-bedroom house has a design load of 450 GPD so the pump should discharge about 110 gallons per dose.

Mounds should always be designed with a pressure distribution system for effluent distribution in the rock absorption bed (Figure 20). A pressure distribution system evenly distributes the effluent through the entire absorption bed area. This helps prevent overloading in any one spot within the bed.

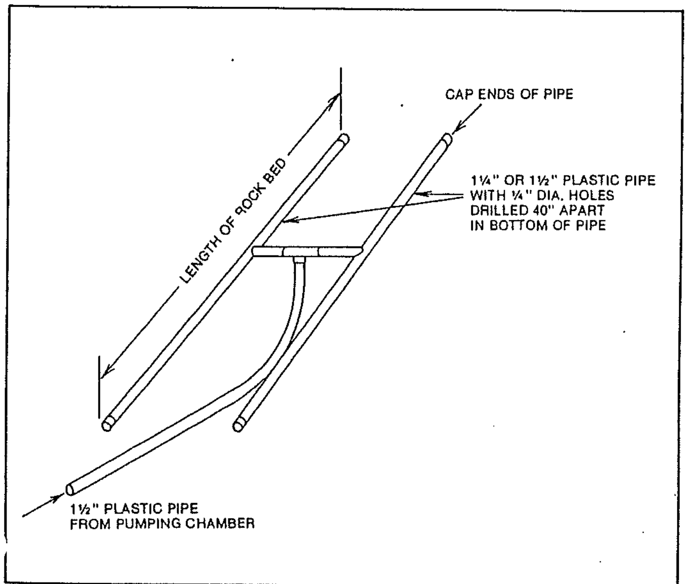


Figure 20. Pressure Distribution System Using Two Parallel Distribution Lines.

The pressure distribution system will be a system of three parallel 1¼-inch diameter or larger plastic pipes for a 7 to 10-foot wide rock bed or two parallel 1¼-inch or larger plastic pipes for a 6-foot or narrower rock bed. Drill a ¼-inch diameter hole in the bottom of the pipes every 40 inches. Cap the ends of the pipe. Manifold the pipes together at the center of the rock bed. The effluent pipe coming from the pumping station will connect to the manifold. The manifold pipe and effluent pipe must be designed so they will drain, either through a ¼-inch diameter weep hole or by draining back to the pumping station.

MOUND SIZING

The rock absorption bed should be sized on the basis of the intake rate of medium sand. Use a loading rate of 1.2 gallons per day per square foot to find the bottom area of the absorption bed. For a three-bedroom house having a design capacity of 450 GPD, the absorption bed area is 450 gal/day $\div$ 1.2 gal/day/ft^2 = 375 ft^2. For soils with low permeability, keep the rock absorption bed width at 4 to 6 feet. For our three-bedroom home example, the rock absorption bed will then be 375 ft^2 $\div$ 6 = 63 ft. long with a 6-foot-wide bed.

The second sizing criteria for mound construction is the basal area or contact area of the fill sand with the existing soil. For slowly permeable clay and clay-loam soils, a loading rate of from .20 to .25 gallons per day per square foot is usually satisfactory. Using the three-bedroom home example, the contact area between the fill sand and the existing ground should be between 450 GPD $\div$ .20 GPD/ft^2 = 2,250 ft^2 and 450 GPD $\div$ .25 GPD/ft^2 = 1,800 ft^2. Figure 21 shows a mound for a three-bedroom home. The fill sand-original soil contact area for this mound located on level ground is 2,150 square feet.

Figure 22 is of a mound built on a slope. Note that when constructed on a slope only the sand soil contact area under and downslope from the rock absorption bed can be considered. Under sloping soil conditions the ends and upslope protion of the mound receive very little effluent.

MOUND CONSTRUCTION

Construct mounds to follow the contour of the existing ground. Never place a mound in a low area where water will accumulate. Mounds can be constructed to complement your landscaping design. Shrubs at the base of the mound will use water and help trap snow (Figure 23).

The first step in mound construction is to mow grass or vegetative cover to a maximum 2-inch height and remove the cuttings. Then dig in the effluent line from the pumping station. The line must be installed below frost level or sloped uniformly back to the pumping chamber so it drains after the pump shuts off. The excavated trench must be backfilled and the soil firmly compacted to prevent effluent from flowing along the pipe.

Ground preparation comes next. The ground must be ripped or scarified by a chisel plow, scarifier or the teeth from the backhoe bucket. Once the surface is prepared, no wheel traffic can be allowed in the

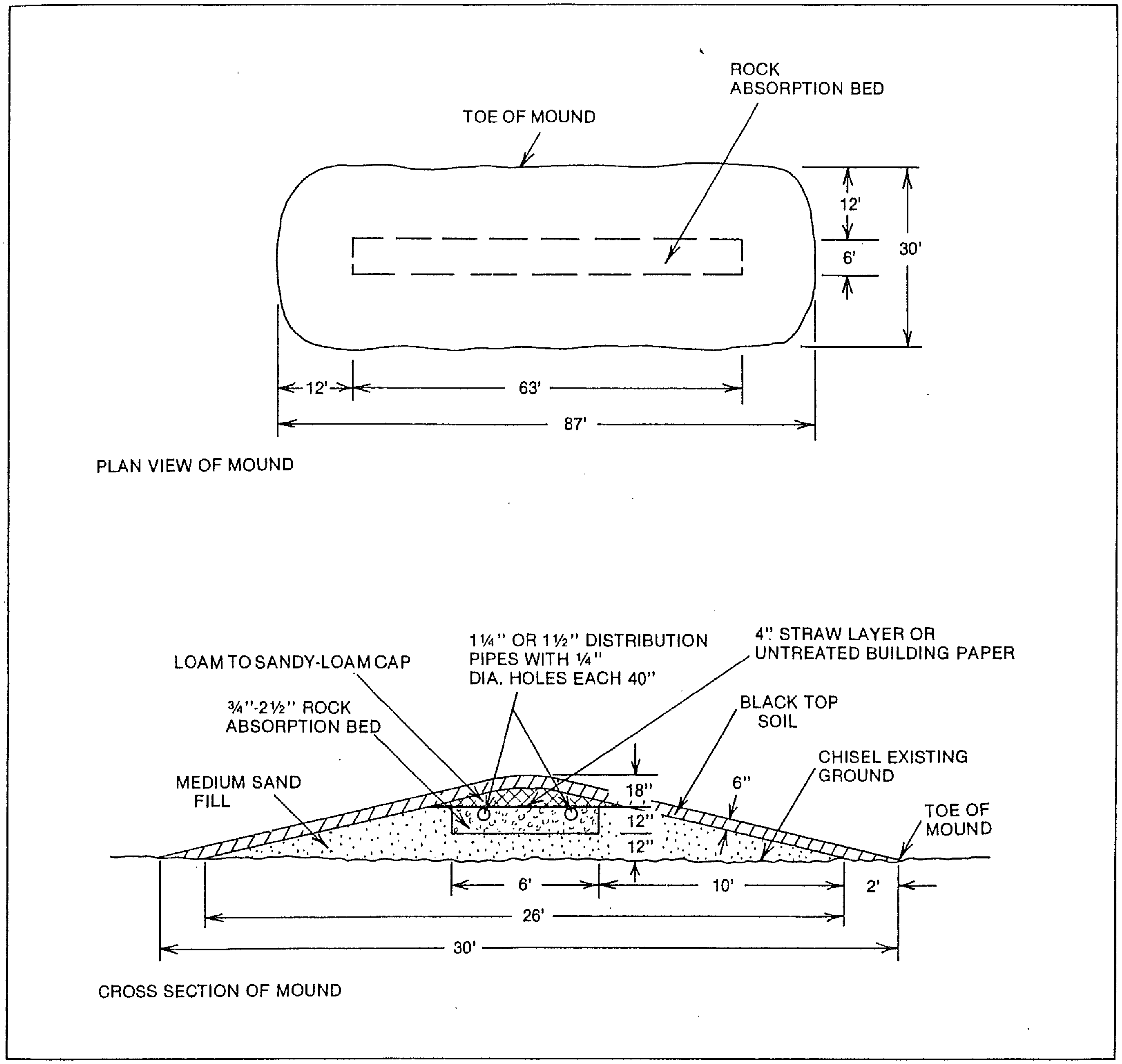


Figure 21. Sewage Mound on Flat Terrain Sized For a Three Bedroom House, Built on a Clay-Loam to Clay Soils.

area. Wheel traffic will seal the soil. Do not work in wet soil conditions. Working in wet soil will compact, smear and seal the soil.

Place the fill sand. The fill sand should be a medium texture sand. The sand need not be screened or washed, but select it with care to be sure **that there are not more than 10 percent fines.** To test, put 2½ inches of sand in a quart jar and add water until about three-fourths full. Cover and shake to mix the sand and water. Let the mixture stand for an hour and measure the silt and clay accumulation on top of the sand. If the depth is ¼ inch or less, the sand is clean enough for use in the mound.

Pit run varies widely, even from the same area of a pit. If in doubt, select a coarser fill.

Shape the sand with a front end loader or blade. Small crawlers work much better than wheel tractors as wheel tractors compact the fill and are difficult to maneuver in the fill. Do not allow the tracks to run

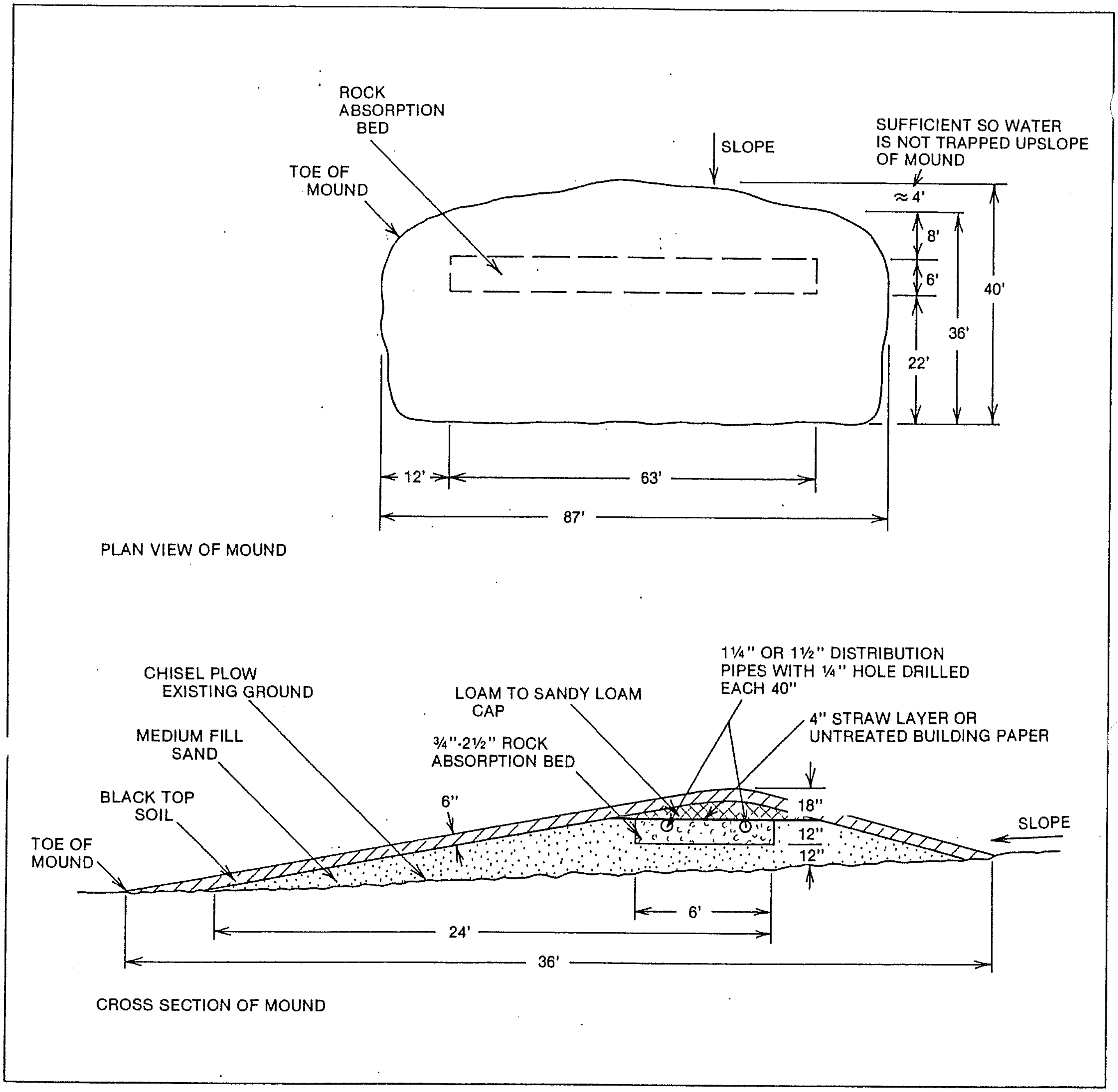


Figure 22. Sewage Mound on Sloping Terrain, Maxiumum %. Slope, Sized for a Three Bedroom Home, Built on Clay-Loam to Clay Soils.

directly on the earth. Keep at least 6 inches of fill sand under the tracks while building the mound. After forming with the tractor blade, level and do the final shaping by hand. Keep the absorption bed floor level the total length of the bed.

Place 6 inches of ¾-inch to 2½-inch diameter rock in the bottom of the absorption bed and level. Place the pressure distribution system on the rock. Connect the distribution system at the center of the mound with a manifold and tee the manifold into the effluent pipe coming from the pumping station. Cap the ends of the pipe. Make sure the manifold and effluent pipe will drain. Place 2 inches of rock over the distribution pipe.

Place a 4 to 6-inch layer of hay or straw or untreated building paper over the top of the rock, then

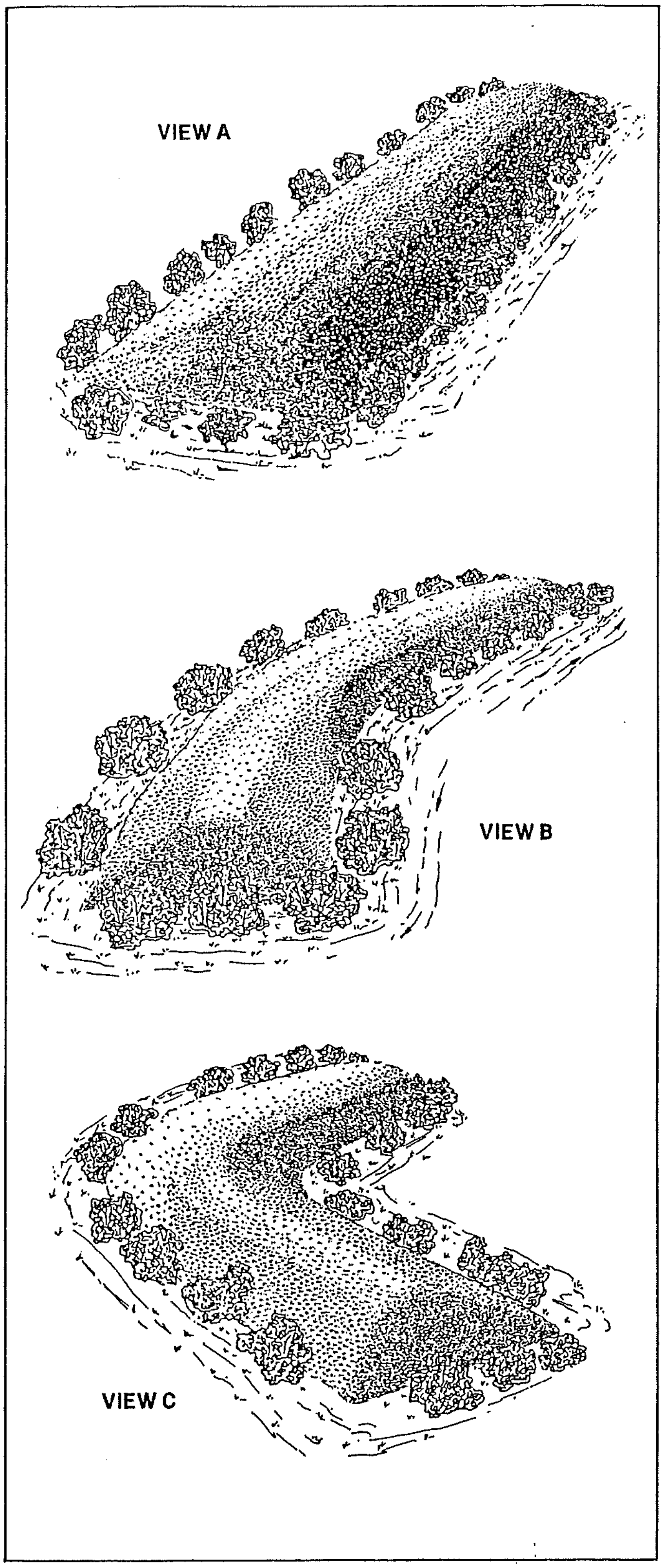


Figure 23. Three Mound Shapes That Can Be Utilized to Fit Landscape Requirements: View A, Rectangular Mound on Uniform Slope; View B, Contour Mound for Hillside; View C, Right Angle Mound or Lot Corner Location. Diversions Must be Constructed Upslope of the Mound to Divert Surface Runoff Water. (Univ. of MN Ext. Bulletin 304)

cap the mound with a loam or loamy sand soil. Make the cap 12 inches high at the center of the bed and 6 inches high at the edge of the bed. Taper the cap down the sides of the mound.

Last, place 6 inches of good topsoil over the entire mound. Plant grass over the entire mound. Water tolerant shrubs may be planted around the base and up the sideslope of the mound if desired.

LAGOONS

Small lagoons (Figure 24) have been used for final disposal on some farms. Construct a lagoon only in high clay content soils which will seal the lagoon bottom.

The lagoon surface area should be sized at about 500 square feet per person. A lagoon serving a four-person household would then have a surface area of about 2,000 square feet. The lagoon should have a depth of 3 feet with a minimum free board of 2 feet. Shape the sides of the lagoon to a 3:1 slope. A 2,000 square foot lagoon with 3 feet working depth and 3:1 side slopes would have a 50-foot diameter at its working depth and a 62-foot diameter at the top of the dike. The lagoon may also be square or rectangular. A 2,000-square foot square lagoon would be 45 feet square at its working depth and 57 feet square at the top of the dike.

A lagoon must be fenced to exclude children and animals. The lagoon must also be maintained to keep animals from burrowing in the sides of the lagoon.

HOLDING TANKS

For a resident on a small lot with no suitable soil treatment area it may be necessary to discharge sewage into a holding tank from which the sewage is pumped and transported to a disposal area. Holding tanks (Figure 25) are not very desirable but may be the only viable solution for some existing situations. Sewage hauling costs are high. Minimize the cost by conserving water.

Install a watertight tank. Size the tank for at least 400 gallons per bedroom with a 1,000 gallon minimum.

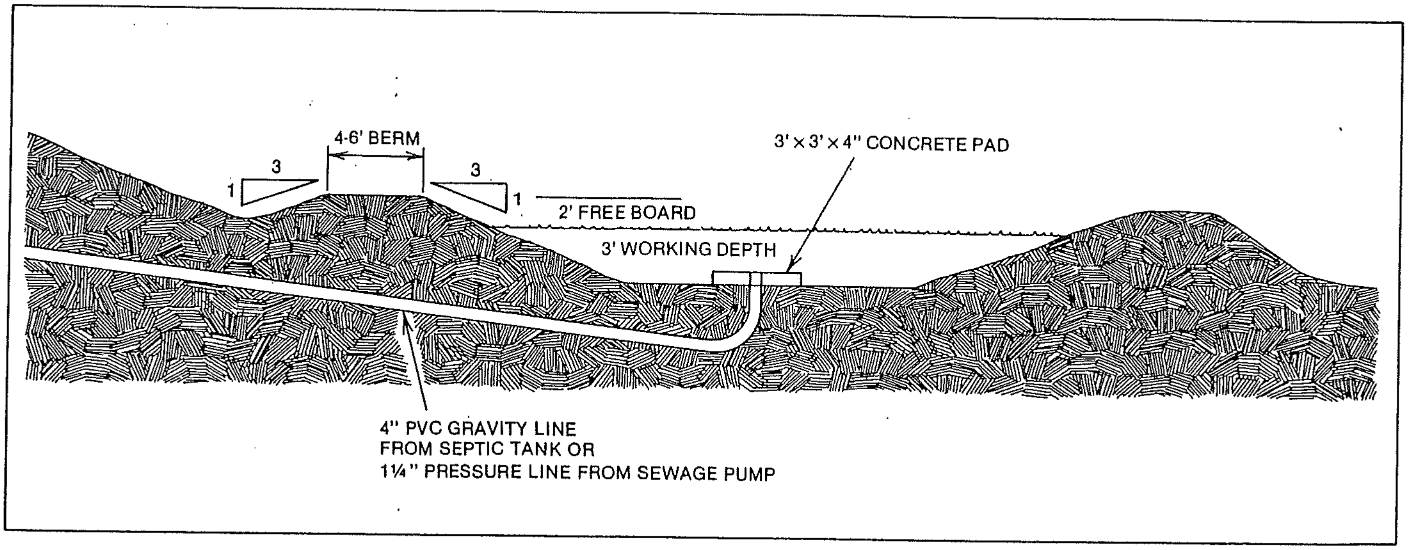


Figure 24. Cross Section of Small Farm Lagoon.

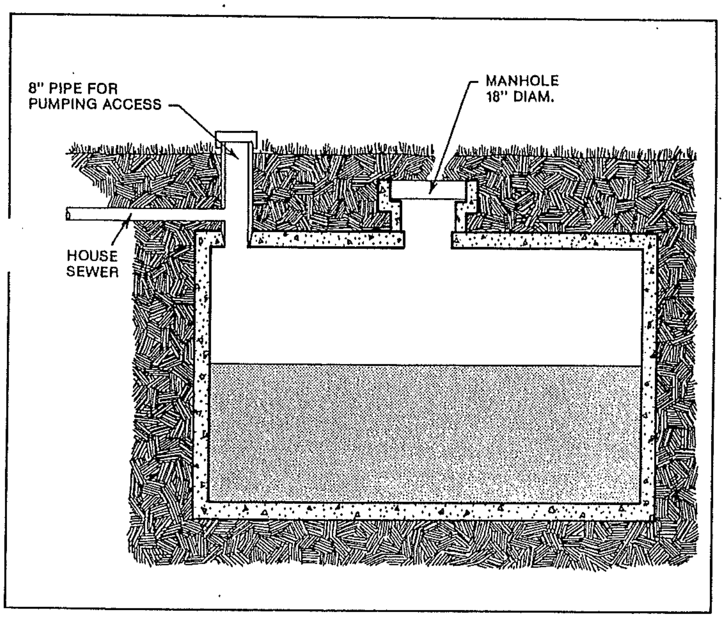


Figure 25. Holding Tank.

Locate the holding tank so it is accessible to a pump truck under all weather conditions and where accidental spills during pumping will not create a nuisance. Place the tank on firm settled soil capable of bearing the weight of a full tank. Protect the tank against flotation under high water table conditions with earth anchors if necessary. It is usually best to keep the tank above the water table and to pump sewage from the house if necessary.

Install a water meter in your water system beyond the pressure tank and outside sillcocks to record all liquid wastes flowing into the holding tank.

SYSTEM MAINTENANCE

Even the best designed and constructed system will fail unless proper maintenance is performed. The major maintenance is the periodic removal of solids from the septic tank. If solids are not removed they will continue to build up and be conveyed to the absorption system. Sewage solids in the absorption system will eventually clog the soil and cause system failure. A soil absorption system clogged with solids must usually be abandoned and a new field constructed.

Most properly sized septic tanks need cleaning about every three years. However, the actual time will depend on the quantity of solids entering the tank. To determine when to have the septic tank cleaned, the scum and sludge layer may be measured. To measure the scum layer, attach a hinged flap to the bottom of a 2 x 2 as shown in Figure 26. Measure the distance from the top of the scum layer to the bottom. If the scum layer is thicker than 12 inches, have the septic tank cleaned. Also measure the sludge layer in the bottom of the tank. Wrap 3 feet of white terry cloth or toweling around a 2 x 2 and push to the bottom of the tank. Turn slowly two or three revolutions, let sit for a minute, then slowly and carefully withdraw the 2 x 2. Sludge thickness can be determined by where the black particles cling to the rough cloth. If the sludge is thicker than one-third of the tank's liquid depth, have the tank cleaned.

Cleaning a septic tank is more than just pumping out the liquids. The solids must also be removed. Cleaning a septic tank is best left to a professional with the correct equipment. Some of the liquid is normally pumped from the tank, then discharged back in to break up and mix the scum and sludge

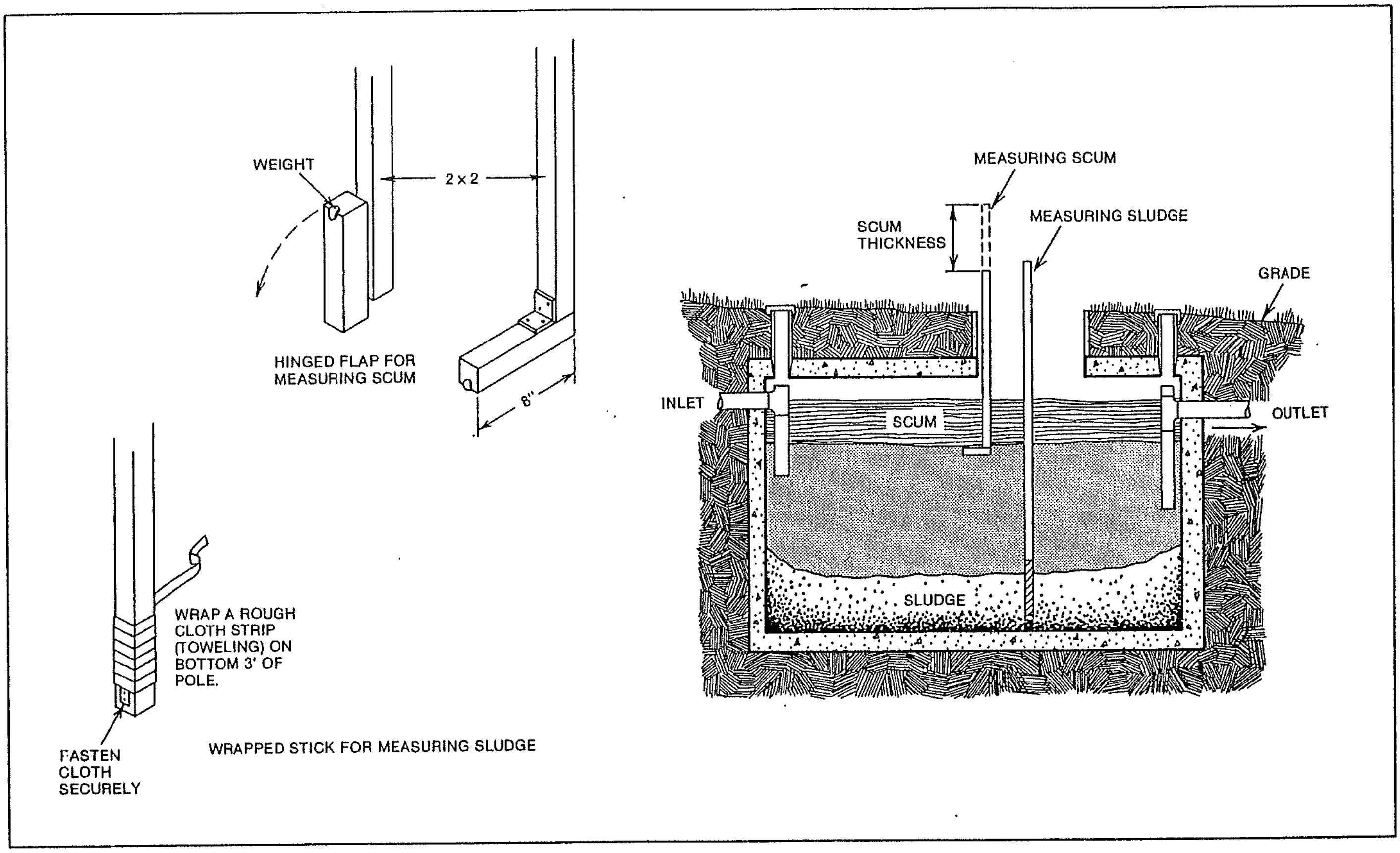


Figure 26. Checking Sludge and Scum Level.

with the liquid. After thoroughly mixing the liquids and solids, the tank is pumped.

Absorption fields require very little maintenance. However, resting a field is beneficial. When allowed to rest for six months to a year, the field will dry out and the soil pore spaces reopen. An absorption field will regain much of its original absorption capacity after resting. Individual trenches with absorption trench systems can be rested by blocking off the entrance to a trench within a drop box or distribution box.

TROUBLESHOOTING SYSTEMS

When a sewage system backs up, first check to see if the inlet pipe or outlet pipe from the septic tank is plugged. If it is, unplug the line. If the lines are open and sewage backs up or liquid runs out into the yard area, the system is probably too small. The most common problem is not sufficient absorption area to absorb the liquid.

An absorption system which is too small must either have the system enlarged or water consumption reduced. If the absorption system is enlarged, do not abandon the old system. Make use of what capacity it has and add additional absorption area.

Problems with system overloading may also result from excessive water. Check these possible problems.

1. Leaky faucets and toilets. These may not look like much water, but running 24 hours per day can add considerably to the liquid load. Fix leaks.
2. Water from house footings drain tile. Drain tile water should empty to a separate sump, never to the septic system. Drain tile water can quickly overload the absorption system.
3. Leaky septic tanks or pumping chambers. In high water table soils, ground water will seep into septic tanks and/or pumping chambers unless they are tightly sealed. This also can quickly overload the absorption field.

If the inlet or outlet lines to the septic tank plug, several things may be the cause. Potential problems include:

1. The inlet pipe is too flat or has a low spot. Either will cause solids to accumulate.

2. Solids such as diapers or sanitary napkins being flushed down toilets. Never dispose of these in an individual system. Plugging will result.
3. The septic tank has excess solids buildup. Solids are backing into either the inlet or outlet pipe.
4. Inlet or outlet baffles have been displaced. Inspect to determine if the baffles are in place and replace if they are missing.

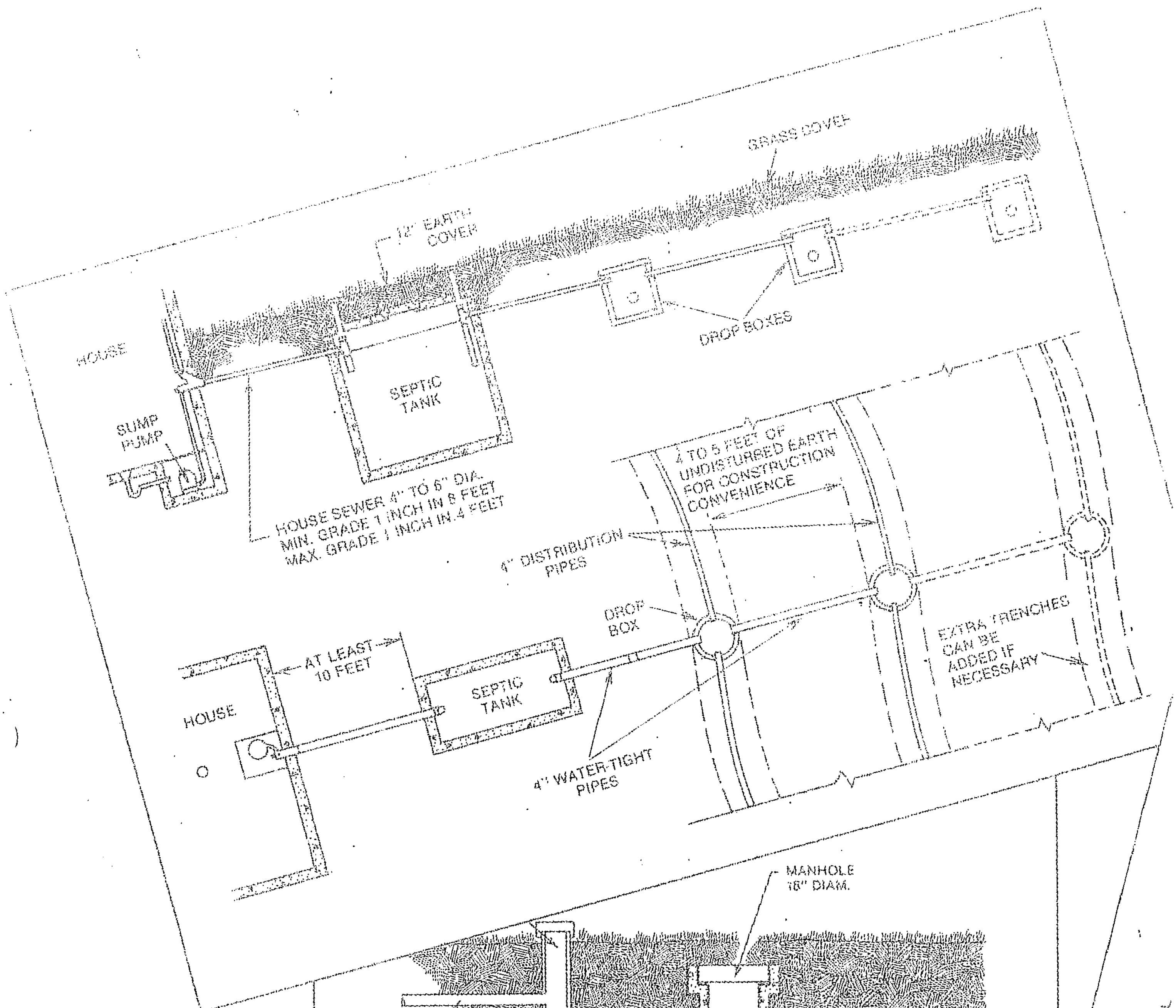
REGULATIONS FROM NORTH DAKOTA STATE HEALTH DEPARTMENT GOVERNING SEWAGE DISPOSAL SYSTEMS

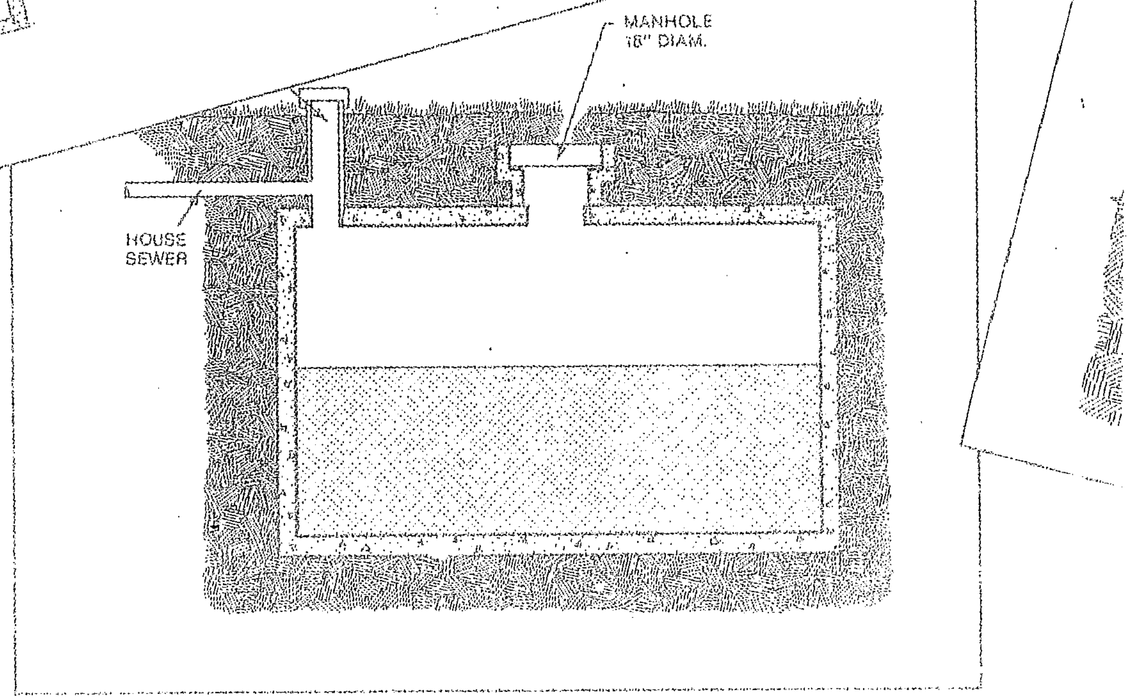
SUBJECT: Sewage and Waste Disposal Facilities for Resort Homes, Cabins, Business Enterprises, Campgrounds, etc., in Shoreline Areas Adjacent to Recreational Reservoirs and Lakes.

FROM: North Dakota State Department of Health Division of Water Supply and Pollution Control.

The following policies are in effect in regard to sewage and waste disposal systems serving the above locations. These policies have been promulgated to protect the public health, abate nuisances and odor conditions, to control pollution and to abate the problem of nutrients from sewage and waste sources entering the water of recreational reservoirs and lakes.

1. All privies, cesspools, septic tanks, and drain fields and other waste disposal facilities must be located 100 feet or more back from the high water level of recreational reservoirs and lakes. Drain fields shall be adequate to handle all liquid wastes.
2. There shall be no pumping or discharge of liquid waste from the septic tank or the drainage field or other waste disposal facilities to the reservoir or lake waters.
3. There shall be no pumping or discharge of liquid waste from the septic tank or drainage field or other waste disposal facilities to ground surface in inhabited areas or to ground areas within 100 feet of the water shoreline or to any area from which such pumping drains into the lake or reservoir.
4. Sludge solids from septic tanks or solids from other waste facilities must be disposed of in remote areas away from habitation and in such a manner that no water pollution problems are crested.
5. The recommended reservoir or lake shore lot size for individual homes or cabins which will be served by private water and sewage disposal facilities should be 20,000 square feet minimum. Water and sewage disposal facilities should be located and constructed so they will not endanger the facilities of adjacent residents.
6. All garbage, refuse, rubbish and unwanted materials should be disposed of in an approved disposal facility. These materials shall not be disposed of in or adjacent to the waters of recreational reservoirs and lakes.





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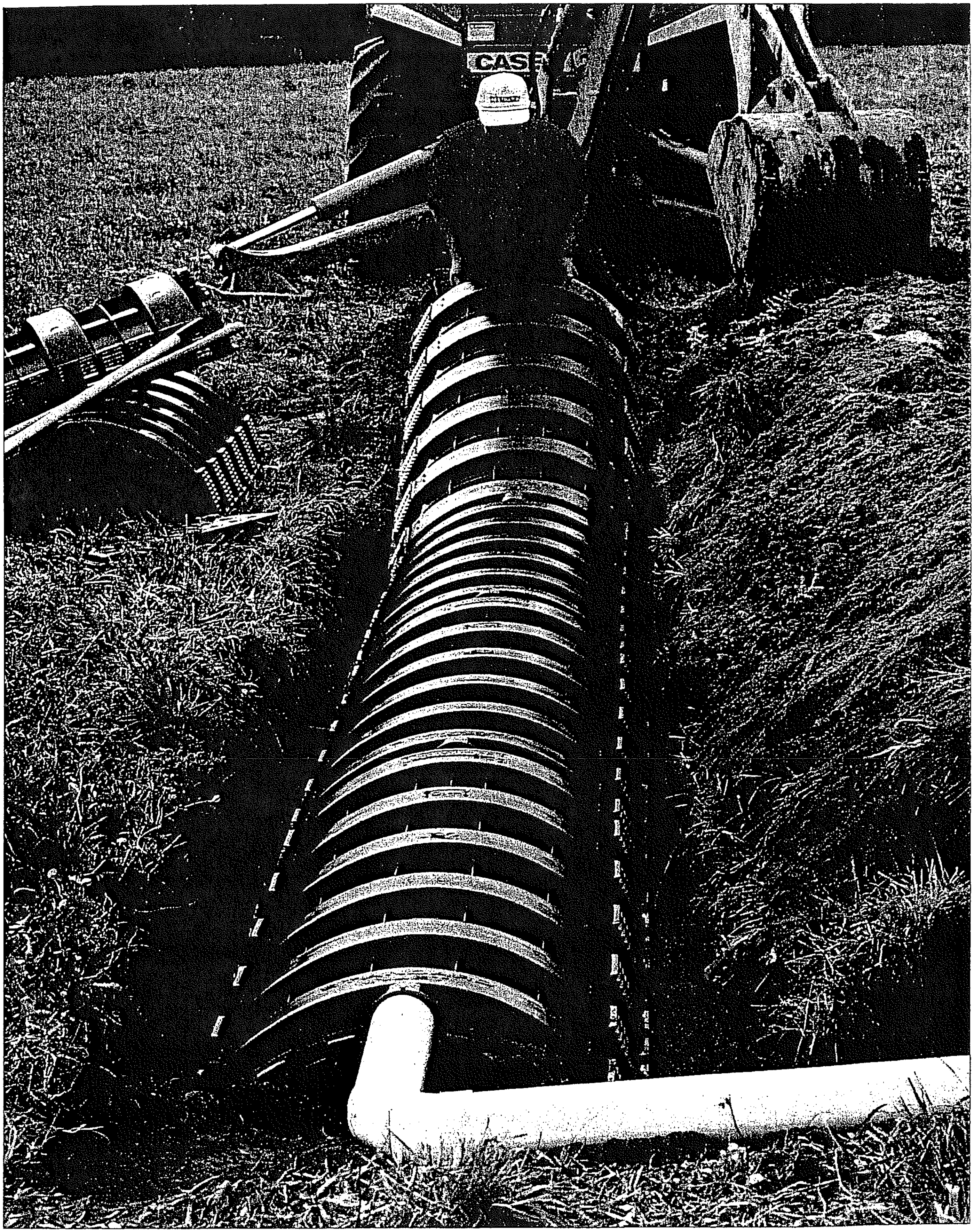
1M-10-91

ATTACHMENT NO. 6

The Infiltrator Chamber System For Septic Leachfields.

INFILTRATOR® SYSTEMS INC

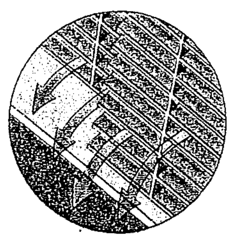


Original Standard and High Capacity Infiltrator chambers provide up to twice the infiltrative capacity of stone and pipe systems.

The Infiltrator Chamber System is a direct replacement for old-fashioned stone and pipe leachfields installed in 3-foot wide trenches. Infiltrator chambers sit directly on the trench bottom. The patented interlocks add strength and latch the chambers together quickly, end to end, so installation takes less than half the time of a labor-intensive stone and pipe job. It's that simple.

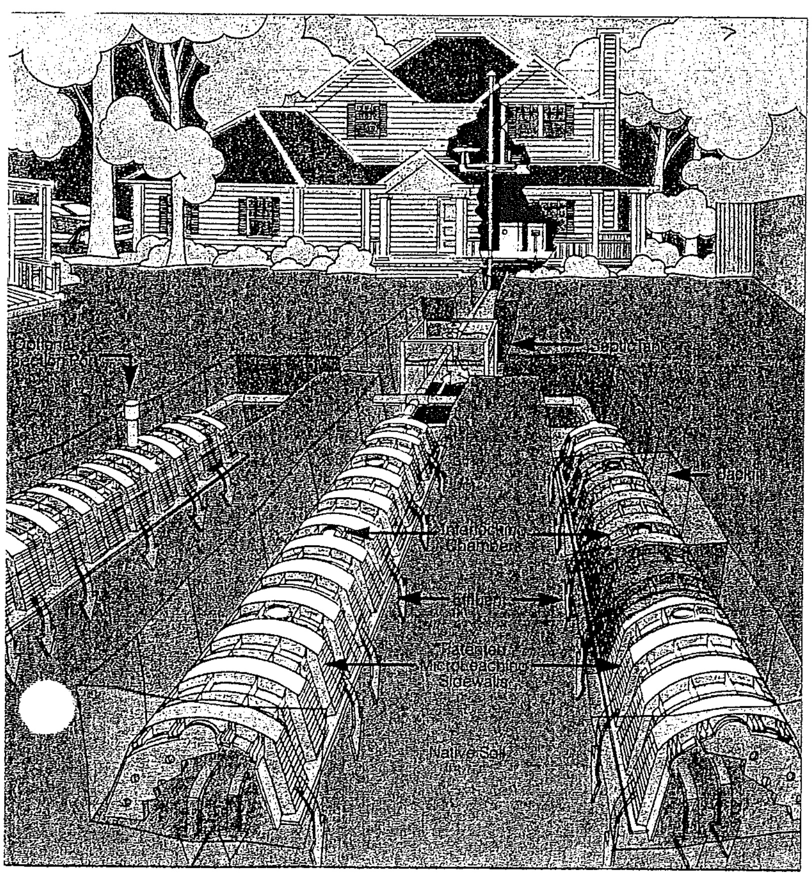
Infiltrator chambers may be used for any application that is suitable for stone and pipe. However, by offering greater infiltrative capacity per linear foot, chamber systems can require as little as half the space as conventional systems.*

Patented MicroLeaching™ sidewall.
The Infiltrator chamber has an engineered, louvered sidewall that allows effluent to pass laterally into the soil. The angled louvers prevent backfill intrusion into the chamber while 1/4" slots allow lateral leaching.



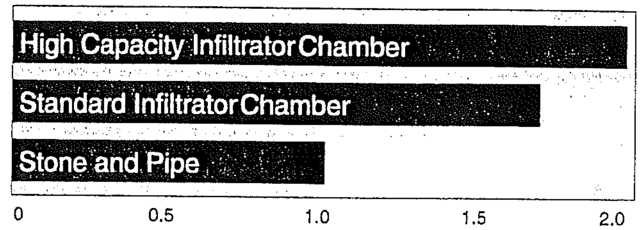
MicroLeaching sidewall

* Subject to state and local regulations.



Open chamber bottom boosts infiltration.
The chamber bottom is completely open, promoting effluent infiltration into the soil with 100% efficiency. The open-bottom area, in combination with the MicroLeaching sidewall, provides maximum infiltrative capacity for long-term, trouble-free service.

LTAR (Long-Term Acceptance Rate).



This graph demonstrates the dramatic efficiency improvement in LTAR of Infiltrator chambers over stone and pipe trenches. The LTAR is a measure of the long-term ability of the system to pass effluent into the soil. For example, the High Capacity Infiltrator chamber infiltrates up to twice the effluent of a same-size stone and pipe trench. This efficiency is recognized by many state and local jurisdictions, who in turn may allow up to 50% shorter trenches.

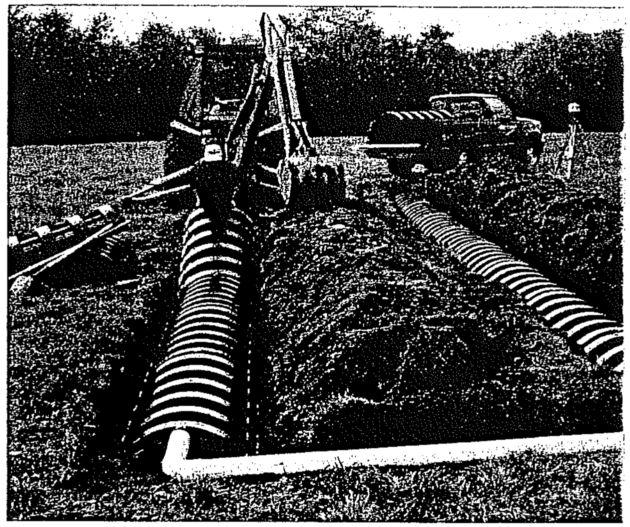
High-density polyethylene construction.
Infiltrator chambers are molded of high-density PolyTuff™ polyethylene. This proprietary blend, including recycled resins, is formulated for optimum strength and chemical resistance. The chambers are impervious to wastewater constituents and stabilized to resist ultraviolet light. Infiltrator chambers are manufactured using an exclusive patented process to assure consistent high quality. These combined factors make Infiltrator chambers the toughest, most reliable chamber in the industry.

AASHTO H-10 and H-20 load ratings.
Infiltrator chambers have been structurally tested by a registered professional engineer. Both Standard and High Capacity chambers are available with AASHTO ratings of H-10 (16,000 lb/axle with 12" of compacted cover) or H-20 (32,000 lb/axle with 18" of compacted cover).

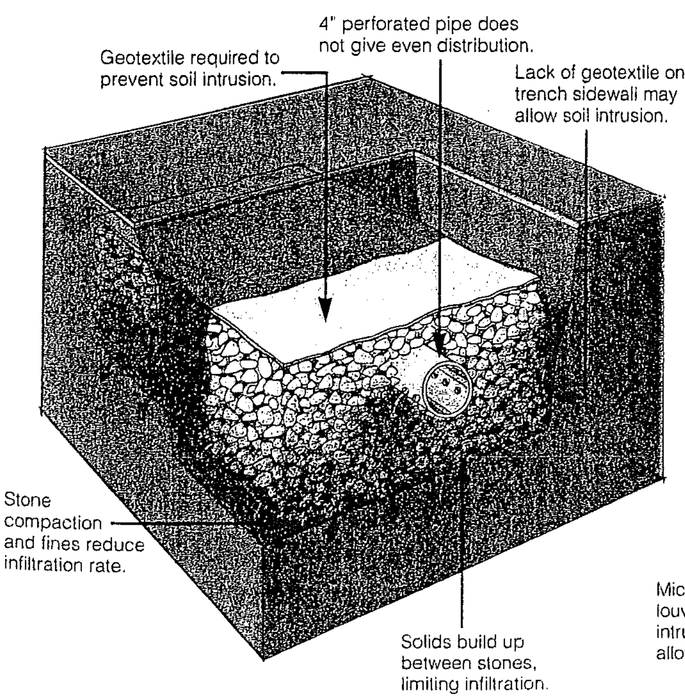
Nominal chamber specifications.

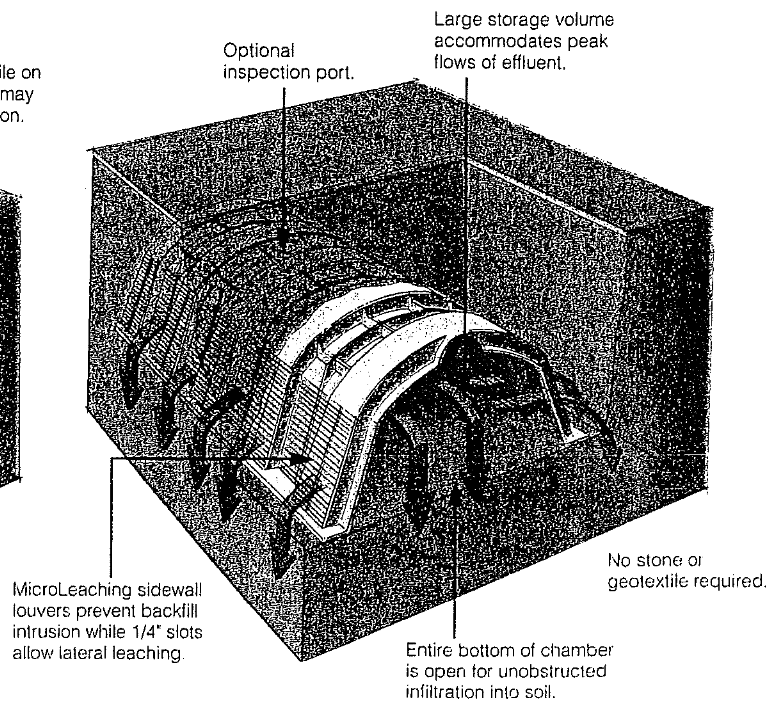
	Standard	High Capacity
Size (W x L x H)	34" x 75" x 12"	34" x 75" x 16"
Weight	25 lb	31 lb
Capacity	77 gal (10.3 ft^3)	122 gal (16.3 ft^3)

Compare the installation and operating advantages.



Conventional stone and pipe system	Infiltrator Chamber System
• Labor-intensive, lengthy installation.	• Easy assembly and installation by two people.
• Dump truck needed for stone delivery.	• Only a backhoe and pickup truck are required.
• Stone hauling adds expense and time, increases soil compaction.	• Lightweight chambers can be delivered in one pickup truck load and hand-carried into position.
• Stone in trench reduces Long-Term Acceptance Rate by more than 50%.	• Entire trench bottom is open for effluent infiltration with 100% efficiency.
• Heavy traffic across yard and spilled stone mean there is more site repair needed after installation.	• There is less regrading, tree damage, and landscape repair involved, and no stone cleanup.
• System lacks easy inspection and monitoring of leachfield without digging up the yard.	• Inspection port is available for easy access to leachfield with no site disruption.
• Geotextile required on top of stone.	• Solid-topped chambers need no geotextile.
• Overall increased cost.	• Overall lower cost.



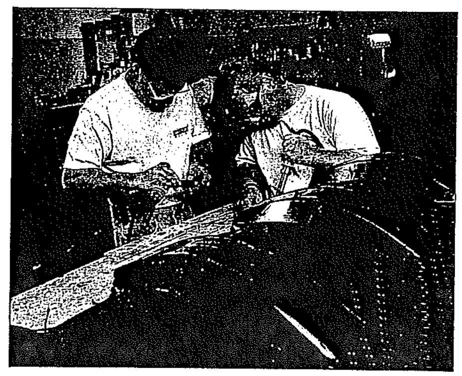


Infiltrator Systems Inc., the industry leader in septic and stormwater chamber system technology.

Over 7.5 million chambers already in service.
In just ten years, the innovative leaching chambers of Infiltrator Systems have drastically changed the technology of on-site septic and stormwater disposal. Already, 7.5 million chambers have been installed in 47 states, Canada, and abroad, forming over 140 million square feet of chamber systems with a success rate of 99.5%. And, we're expanding at the rate of 10,000 new systems a month.

Environmentally concerned company.
Infiltrator Systems devotes over $500,000 a year to research and development, creating new products that operate more and more efficiently and conserve natural resources. Besides using recycled resins, Infiltrator Systems' products take better care of the environment by avoiding the mining, crushing, grading, washing, and hauling of stone, as well as the environmental impact and site disruption that stone causes. That's one of our "greener" ideas for septic and stormwater disposal that just makes sense.

Infiltrator stormwater management.
Besides our septic chamber systems, Infiltrator Systems is on the leading edge of the emerging stormwater management field. The subsurface Maximizer™ Chamber System replaces ponds, large diameter pipe and stone, vaults, and dry wells. With unmatched strength, virtually 100% void volume, and convenient cleanout capabilities, the Maximizer Chamber System gives designers better solutions for retention and detention applications.



Call 1-800-221-4436 for a free copy of the septic installation instructions and video.

Distributed By:

INFILTRATOR®
SYSTEMS INC

Leading the way in septic and stormwater chamber systems℠

4 Business Park Road, P.O. Box 768
Old Saybrook, CT 06475
800-221-4436 860-388-6639 FAX 860-388-6810

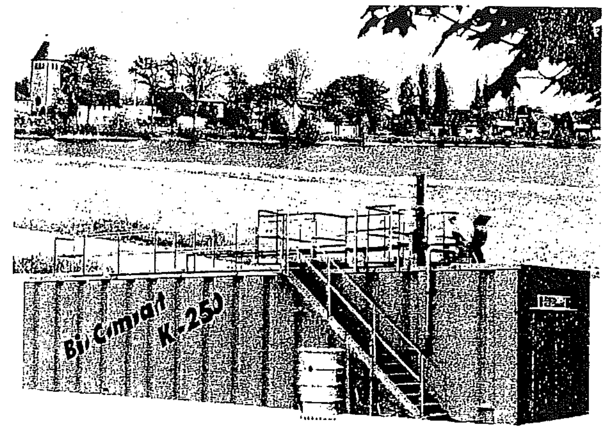
bdt BioDigestor Technologies, Inc.

BioCompact™

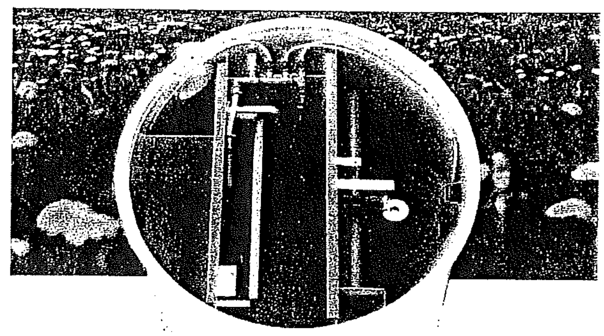
Function

BioCompact™ is a complete biological sewage treatment unit that is actually a down-sized version of the activated sludge process in advanced municipal treatment plants. Unlike septic tanks, the sewage undergoes a complete treatment cycle. The BioCompact™ discharge complies with the strict German regulations (DIN 4261, Sec. 2, Small Waste Water Treatment Plants).

BioCompact™ units are installed in countries with strict enforcement of environmental laws such as Germany, Great Britain, Denmark, and Finland. BioCompact™ units can be found world wide – in countries like China, Russia, Poland, Mexico, Argentina, and on ships. The BioCompact™ S Series is approved for use on ships by agencies such as the U.S. Coast Guard.



BioCompact™ Type K250



BioCompact™ A Series

The smaller BioCompact™ units (A Series) serve as few as four people or up to 100 people and are mainly used in remote areas where a central sewage treatment system is impractical. Since the units are highly standardized, larger BioCompact™ units (K250 or S Series) can serve up to 1,000 people or more. They can be assembled as an array of units serving any number of people.

Maintenance

The BioCompact™ units are designed for simple maintenance. The units operate under an automatic control system with a single indicator light enabling quick observation of the status of the unit at any time. Any bulky matter deposited in the unit can be easily removed through the top access hatch. Sludge concentration in the tank should be checked once a month. In the event sludge concentration exceeds 600 ml/l, the excess can be recycled for additional treatment by opening an air valve.

Performance

BioCompact™ units have been in residential and commercial use since the late 1970's. A test by German authorities on two of the earliest BioCompact™ installations have confirmed the continuous efficiency of the operation and the durability of the system. One of the early installations has been monitored by German authorities over one year (from July 1979 through June 1980) resulting in the confirmation that the efficiency of operation is constantly around 98% removal of the load (BOD and COD) in residential waste water.

Applications

The BioCompact™ waste water treatment plants provide a cost effective and environmentally sound solution of the waste water problem for townships, small communities, resorts, lakeside properties and new urban development. BioCompact™ is easy and quick to install, and easy to operate and maintain. Unlike the conventional septic tanks or mound systems, BioCompact™ is a true waste water treatment (activated sludge process) similar to large waste water treatment plants. BioCompact™ is not designed for the handling of hazardous waste or of any effluent other than waste water resulting from human settlements. BioCompact™ is not designed for handling solid waste, like solid food, rubber and plastic, motor oil, etc.

ATTACHMENT NO. 8

Cromaglass®

WASTEWATER TREATMENT SYSTEMS

A Leader In Wastewater Technology Since 1965.

Cromaglass Wastewater Treatment Systems

DESIGNED as a continuously fed activated sludge process with clarifiers that are operated on a batch basis.

All ***Cromaglass*** treatment systems operate on identical principles: Turbulent aeration of incoming wastes and batch treatment of bio-mass in separate aeration and quiescent settling chamber.

DISCHARGED effluent is an odorless liquid, almost clear in color, with a reduction in BOD and Suspended Solids over 90%. Even higher efficiencies can be achieved if required.

DENITRIFICATION is now mandated in many areas and ***Cromaglass Systems*** are capable of Denitrification with the addition of an anoxic cycle following aeration.

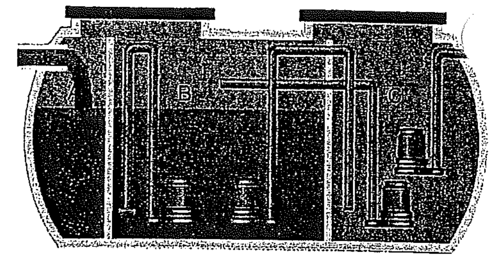
Per-batch cycling is 120-240 minutes. Optimum quality standards are maintained even at peak intake levels because of batch-transfer and batch-reserve functions.

Proven effluent quality is attested to by independent laboratory research and testing. National standards such as established by the National Sanitation Foundation and Federal EPA have been surpassed. Effluent quality is accepted for RECYCLE use with irrigation and toilet flushing.

TYPICAL CYCLE

<u>FILL; AERATION</u>

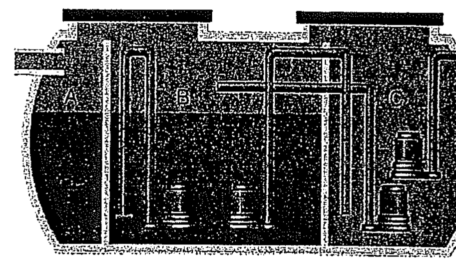
Flow enters the Solids Retention Section (A) which is separated by non-corrosive screen. Inorganic solids are retained behind the screen. Organic solids are broken by turbulence created with mixed liquor being forced through screen by submersible aeration pumps. This eliminates the need for mechanical comminution.



<u>AERATION</u>

Liquid and small organic solids pass through the screen into the continuing Aeration Section (B). Air and mixing are provided by submersible pumps with venturi aspirators that receive air through pipe intake from the atmosphere.

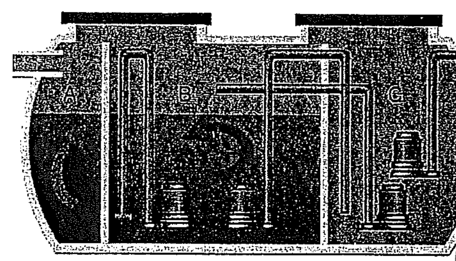
2



<u>DENITRIFICATION</u> (OPTIONAL)

Provided by an anoxic period during the regular treatment cycle. ***Cromaglass*** units create anoxic conditions by closing the air intakes of the aeration pumps with electric valves. This stops aeration, but the system continues mixing.

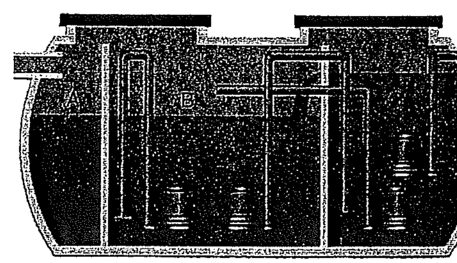
3



<u>TRANSFER/SETTLE</u>

Treated mixed liquor is transferred by pumping to the Clarification Section (C). The transfer period overfills the Clarifier with the excess spilling through overflow weirs back into the main Aeration Section. Transfer ceases and Clarifier (C) is isolated – solids separation occurs under quiescent conditions.

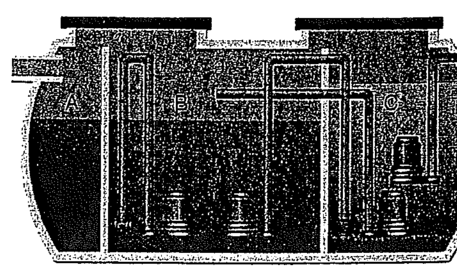
4



<u>DISCHARGE</u>

After settling, effluent is pumped out of the Clarifier (C) for discharge. Return sludge is from the bottom of the Clarifier (C) back into the main Aeration Section (B) using a submersible pump, or sludge can be wasted to a Sludge Processing Tank.

5

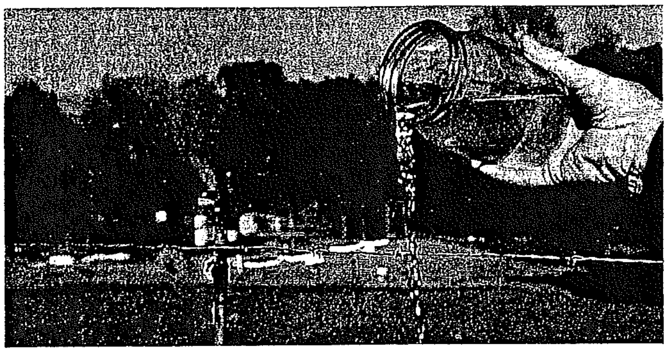


Cromaglass® BENEFITS

- Thoroughly Tested
- Modular Construction
- Easily Expanded
- Lightweight
- No Offensive Noise or Odors
- Easily Installed
- Positive Discharge
- "Flow Thru" Eliminated
- Accepts Overload
- Automatic Controls
- Monitoring 24 Hours
- Noncorrosive

PROVEN QUALITY

Assurance of treatment quality has been accomplished through independent laboratory research and testing supported by sampling from installed systems (results available upon request). National Standards as established by Federal EPA and the National Sanitation Foundation have been surpassed. Effluent quality with over 90-95% reduction of BOD and Suspended Solids enables ***Cromaglass*** to be designed where other methods are not acceptable. Recycled effluent is currently being used for landscape irrigation and as a toilet flushing medium.



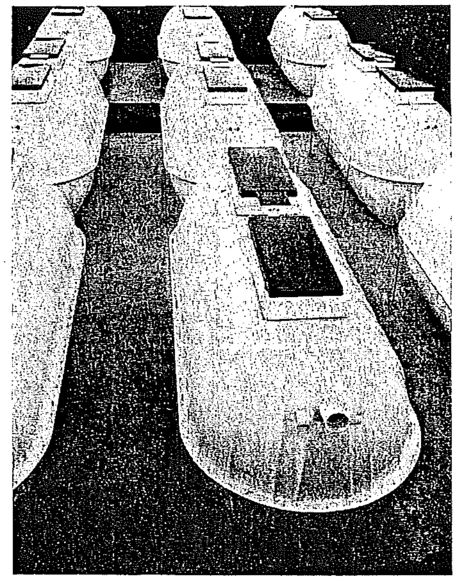
Effluent Sample from Model CA-120 Showing Surface Discharge by Irrigation System.

COST-EFFECTIVE SMALL COMMUNITY SYSTEMS

Treatment of wastewater in small communities and schools located beyond a municipal system presents a challenge to consulting engineers. ***Cromaglass Systems*** offer a cost-effective alternative solution. Many of these professionals have turned to the ***Cromaglass Batch Treat Process***, an alternative and innovative technology assessed favorably by Federal EPA to be used where conventional sewerage systems are unavailable or not cost effective. This modular concept design has proven less costly and more environmentally sound than other sewerage installations. Several schools as well as small community projects have specified ***Cromaglass***.

REDUCED DRAIN FIELD SIZE AND SURFACE DISCHARGE CAPABILITIES

Because of the clear, odorless quality and high treatment standards of ***Cromaglass Systems***, drain field size can be reduced substantially from that required for conventional systems. With optional disinfection added, these systems are permitted for surface discharge under conditions normally unsuitable for subsurface disposal.



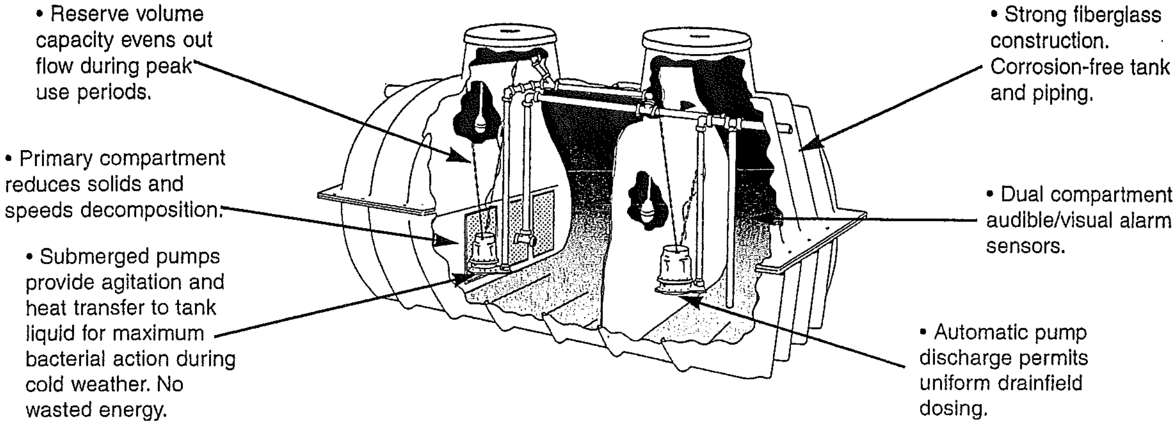
All tanks in place ready for backfill. Note concrete pads and stainless steel tie-down rods.

ADEQUATE OVERLOAD RESERVE

Batch Processing is capable of high treatment even under a wide range of flows as found in growing communities. Also with varying organic loadings of commercial, school and institutional use, excellent effluent standards are maintained. This feature is an integral part of the system to cover temporary emergencies or upsets.

DESIGN FEATURES

Models CA5 • CA12 • CA15

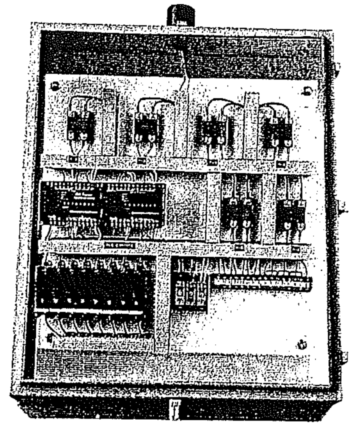


NOISE AND ODORS CONTROLLED

Attractive tank modules with locked maintenance hatchways enable ***Cromaglass Systems*** to be installed without odors or noise associated with other types of open sewage treatment plants, when operated properly. Tanks can be installed below ground close to buildings being served – saving unneeded pipe and/or pump expense.

BY-PASS NOT POSSIBLE

Cromaglass Systems are designed to make by-pass and intertank contamination impossible. When operated properly, no bio-mass can transfer from one section to another except through the programmed pumping system. All sludge collected in the settling chamber is automatically returned to the aeration section for further aeration and breakdown. This results in low sludge accumulation. Most residual sludge that collects is made up of biological ash and insoluble particles. Sludge can also be wasted to a Sludge Processing Tank.

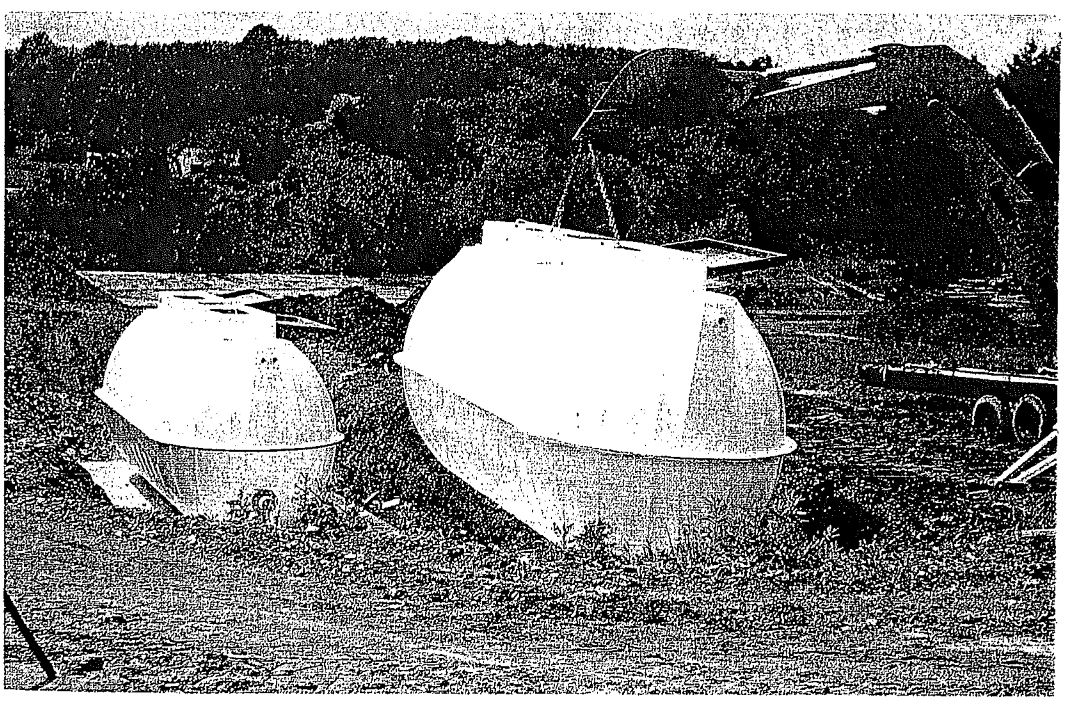


MAXIMUM OPERATIONAL FLEXIBILITY PROVIDED BY PLC CONTROLS

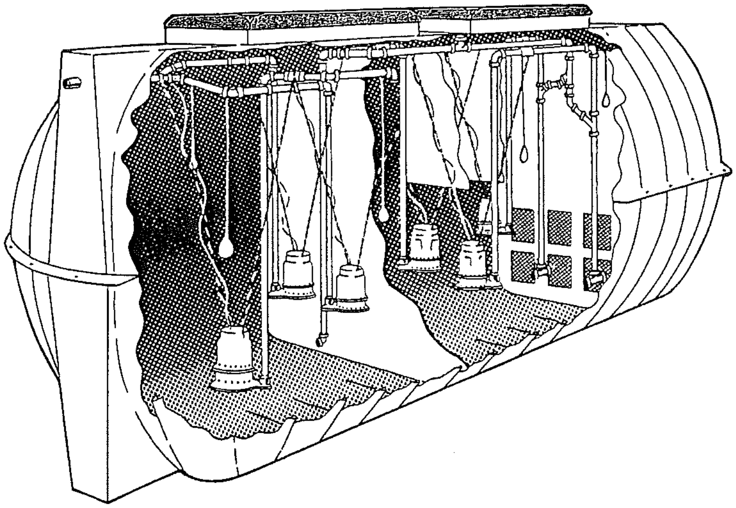
State-of-the-Art PLC controls will respond to the inputs from level sensors and probes in the tanks. The PLC automatically adjusts treatment parameters in response to changes sensed in the influent. It can store a permanent record of all operational functions, which provides information on each function of each cycle for whatever time reference desired. Such information can indicate if service or maintenence is needed, and the operator can then schedule it before a failure occurs.

STRONG, LIGHTWEIGHT, and REUSABLE

Corrosion-proof vessel construction of strong, lightweight fiberglass. Covers and locking hatches are also of fiberglass. Tanks are constructed to withstand pressure involved when installed at acceptable depths below ground. Being light in weight means expensive cranes are not required, saving installation costs. Because ***Cromaglass Systems*** are completely integrated, compact and transportable, they can be reused, relocated and/or resold when changing circumstances warrant.



Lightweight fiberglass modules being off loaded and set in place in the excavation/ concrete pad. This is typically done by backhoe used to excavate the site.



Cromaglass Wastewater Treatment Systems are essentially Sequencing Batch Reactors (SBR) as opposed to conventional continuous flow activated sludge systems. Treatment is by timed sequences within a single vessel. Continuous flow systems require several vessels, using a larger land area and higher installation costs.

Because time functions can easily be changed, an SBR provides custom treatment dependent on varying hydraulic and biological loading up to the designed capacity of the system.

Cromaglass Systems can be installed in modules, meaning a lower initial investment. The system can start with one independent module designed to treat the initial loading.

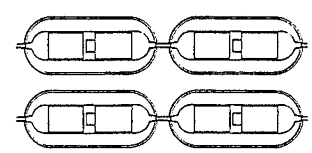
As development grows, additional modules can be added as needed.

Modules can be added at the initial site, or if more economical, a new treatment site can be used.

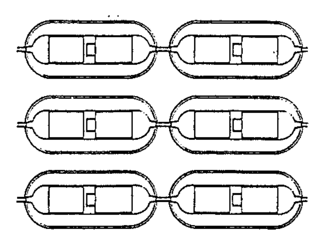
Because a batch system requires less land area, it can be placed in multiple locations – saving additional piping/pumping cost.

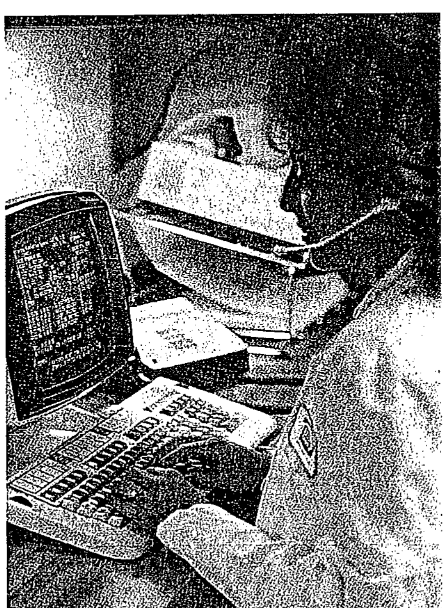
PHASE 1

PHASE 2



PHASE 3





CROMAWATCH

Cromaglass has introduced one of the industry's first central station monitoring wastewater treatment systems.

With the use of a unique combination of telecommunication computers, word processors, and dedicated people, the Plant Operator, ***Cromaglass***, and the Servicing Distributor are all notified if a treatment unit should malfunction.

The microprocessor is built into the ***Cromaglass System***. This 24-hour monitor will relay over an "800" telephone line to the control center computer the reason for an alarm. An on-duty operator will then call to report a ***CromaWatch*** activity. This will assure prompt response to a malfunction.

SPECIFICATIONS

POWER:
115v/230v - Single Phase.
230v/460v - 3 Phase available.

CONTROL PANEL:
Nema 1 enclosure standard.
Nema 3R, 4, 7 and 12 available.

ALARM:
Red light mounted on panel plus Audible alarm.
Remote monitor to phone preset numbers in case of alarm.

CONSTRUCTION MATERIALS:
Tank - Fiberglass.
Comminution Chamber - Fiberglass and noncorrosive screen.
Piping and Fittings - Schedule 40 PVC - NSF approved.
Metal Fittings - Stainless steel.

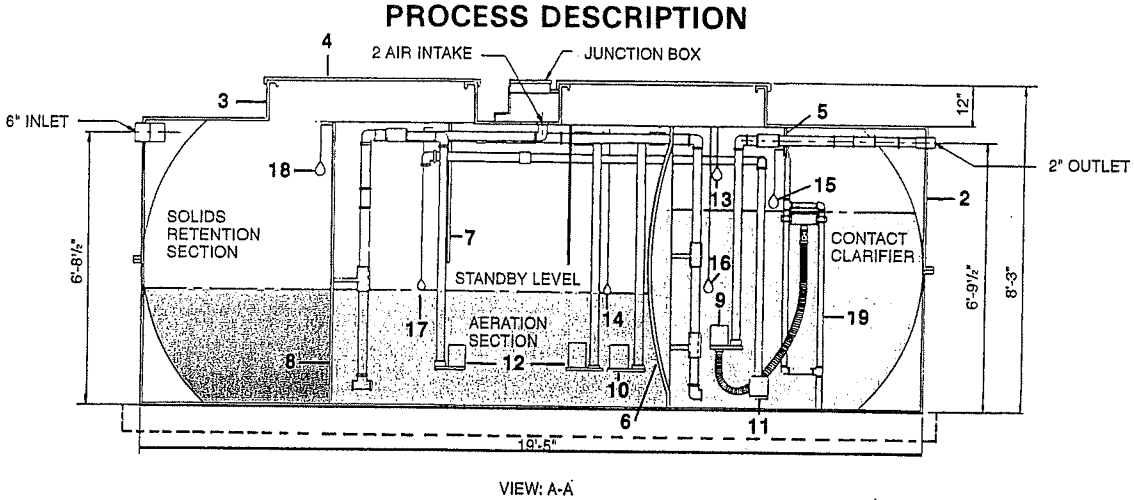
PUMPS	TOTAL HEAD - FEET (METERS)					AMPERAGE	
MODEL	5 (1.52)	10 (3.05)	15 (4.57)	20 (6.10)	25 (7.62)	MAX. RUN AMPS.	LOCKED ROTOR AMPS.
	CAPACITY - G.P.M. (L/MIN.)						
¼ H.P. DISCHARGE	30 (114)	26 (98)	20 (76)	12 (45)		10	15.6
⅓ H.P. WE0311M	100 (379)	80 (303)	60 (227)	36 (136)	3 (11)	9.4	32.2
½ H.P. WS0511A	140 (530)	107 (405)	74 (280)	41 (155)	7 (26)	13	34.9

ADDITIONAL SYSTEM SPECIFICATIONS

MODEL	LENGTH	WIDTH	HEIGHT	SHIPPING WEIGHT LBS. (KG.)	24 HR. MAXIMUM CAPACITY GALS (METER³)	DISCHARGE VOLUME GALS (METER³)	DISCHG PER DAY	TANK VOLUME GALS (M³)	AERATION CAPABILITY #O₂/24 HR.	ORGANIC LOADING MAX. BOD₅ PER 24 HRS.	ELECTRICAL CONSUMPTION KWH/24 HRS.	TOTAL AMPS. REQUIRED 12v/230v
CA-5	7'11" (2.4m)	5'7" (1.7m)	5'7" (1.7m)	704 (319)	500 (1.9)	85 (.32)	6	923 (3.5)	4.0	1.25 lbs.	8.0	15a-120v
CA-12	11'3" (3.4m)	5'7" (1.7m)	5'7" (1.7m)	1020 (463)	1200 (4.5)	200 (.76)	6	1358 (5.1)	4.4	2.44	8.0	15a-120v
CA-15	11'3" (3.4m)	5'7" (1.7m)	5'7" (1.7m)	1020 (463)	1500 (5.7)	260 (.98)	6	1358 (5.1)	6.67	3.7	10.0	15a-120v
CA-25	14'10" (4.5m)	6'10" (2.1m)	6'10" (2.1m)	1720 (780)	2500 (9.5)	420 (1.6)	6	2910 (11.0)	13.7	6.2	21.0	30a-120v
CA-30	14'10" (4.5m)	6'10" (2.1m)	6'10" (2.1m)	2070 (939)	3000 (11.4)	400 (1.51)	8	2910 (11.0)	23.5	7.5	22/30*	60a-230v
CA-50	19'5" (5.9m)	7'4" (2.2m)	8'3" (2.5m)	2684 (1217)	5000 (18.9)	625 (2.37)	8	4950 (18.7)	23.5	15.0	22/30*	60a-230v
CA-60	19'5" (5.9m)	7'4" (2.2m)	8'3" (2.5m)	2684 (1217)	6000 (22.7)	625 (2.37)	10	4950 (18.7)	23.5	15.0	22/30*	60a-230v
CA-100	42'10" (13.1m)	7'4" (2.2m)	8'3" (2.5m)	4885 (2216)	10,000 (37.9)	1000 (3.79)	10	9186 (34.8)	43.7	24.3	52/64*	100a-230v
CA-120	42'10" (13.1m)	7'4" (2.2m)	8'3" (2.5m)	4885 (2216)	12,000 (45.4)	1000 (3.79)	12	9186 (34.8)	43.7	24.3	52/64*	100a-230v

* Dependent on biological and hydraulic loading.

PROCESS DESCRIPTION



VIEW: A-A

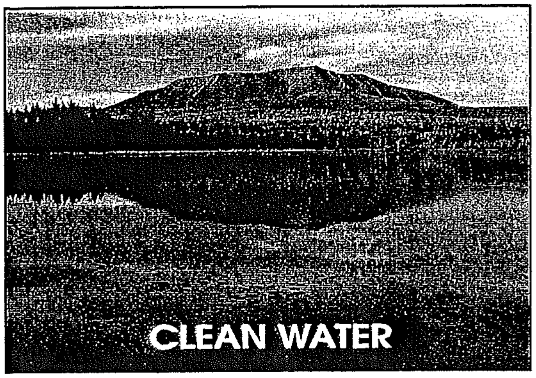
1	Aerobic Wastewater Treatment Plant Model CA-50	11	Sludge Return Pump
2	Tank Model CA-50	12	Aeration Pump P1 & P2
3	Manhole	13	Float - Sludge Return F1
4	Cover	14	Float - Discharge F1
5	Baffle	15	Float - Discharge Alarm
6	Concave Baffle	16	Float - Discharge Shut Off
7	Support Baffle	17	Float - Dual Aeration
8	Screen Baffle	18	Float - High Water Alarm
9	Discharge Pumps - Duplex	19	Floating Discharge Assembly
10	Transfer Pump		

CROMAGLASS Corporation
P.O. Box 3215, 2902 North Reach Road
Williamsport, PA 17701
Phone: (717) 326-3396
Fax: (717) 326-6426

Represented By:

THE Cromaglass® DIGEST

Vol. 11 No. 1 ADVANCED RESEARCH FOR POLLUTION CONTROL DECEMBER 1996



WASTEWATER RECLAMATION MEANS POLLUTION ABATEMENT

With many communities throughout the world approaching or reaching the limits of their available water supplies, water reclamation and reuse has become an attractive option for conserving and extending these supplies. Water reuse may also present communities an opportunity for pollution abatement when it replaces effluent discharge to sensitive surface waters.

The U.S. Environmental Protection Agency, in recognition of the importance of water reuse, has published a manual titled "Guidelines for Water Reuse." Much of the salient information is reported in this newsletter.

Water reclamation and nonpotable reuse only require conventional water and wastewater treatment technology that is widely practiced and readily available in countries throughout the world. Furthermore, because properly implemented nonpotable reuse does not entail significant health risks, it has generally been accepted and endorsed by the public in the urban and agricultural areas where it has been introduced.

GUIDELINES FOR REUSE

Water reclamation for nonpotable reuse has been adopted in the United States and elsewhere without the benefit of national or international guidelines or standards. However, in recent years, many states in the U.S. have adopted standards or guidelines, and the World Health Organization (WHO) has published guidelines for reuse for agricultural irrigation.

Standards are not proposed by the U.S. Environmental Protection Agency (EPA) or the U.S. Agency for International Development (AID). In the U.S., water reclamation and reuse standards are the responsibility of state agencies. The purpose of EPA's manual is to present guidelines for authorities in areas where standards do not exist.

SOURCE SUBSTITUTION

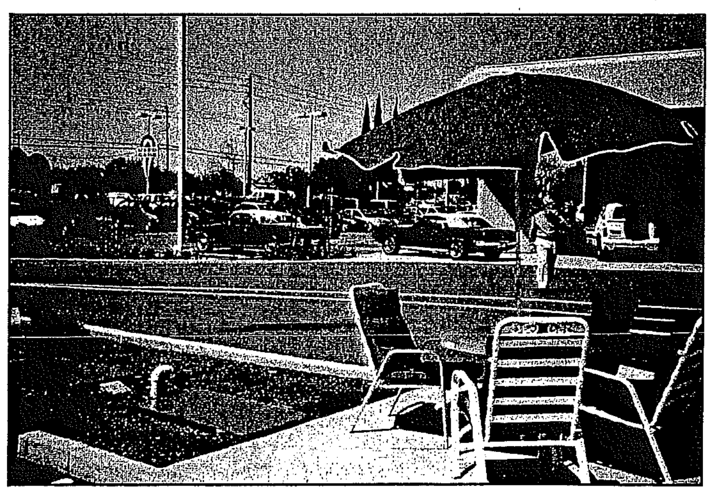
The use of reclaimed water for nonpotable purposes offers the potential for exploiting a "new" resource that can be substituted for existing sources. By "source substitution" – an increased population can be served from an existing potable water source.

Many urban residential, commercial, and industrial uses can be satisfied with water of less than potable water quality: irrigation of lawns, parks, roadway borders and medians; industrial processing; toilet and urinal flushing; construction; cleansing and maintenance, including vehicle washing; scenic waters and fountains; and environmental and recreational purposes.

POLLUTION ABATEMENT

While the need for additional water supply has indeed been the impetus for numerous water reclamation and reuse programs in arid and semi-arid areas, many programs in the U.S. are initiated in response to rigorous and costly requirements for effluent discharge to surface waters, particularly the removal of nitrogen and phosphorus. By eliminating effluent discharges for all or even a portion of the year through water reuse, the need for costly advanced wastewater treatment processes may be reduced or avoided. For most nonpotable reuse applications,

Continued on Page 2



AMERICAN CHEVROLET – Auto dealership in Modesto, CA demonstrates positioning of ***Cromaglass Batch Treat System*** *next to eating facilities and front of building – no problems with odors or visual contact.*

POLLUTION ABATEMENT *Continued from Page 1*

nutrient removal is unnecessary and actually contraindicated for irrigation.

- Naturally, a water reuse program can easily serve both water conservation and pollution abatement purposes.

TREATMENT AND WATER QUALITY CONSIDERATIONS

The overriding consideration in developing a reuse system is that the quality of the reclaimed water be appropriate for its intended use.

TREATMENT FACILITY RELIABILITY

The most common parameters for which water quality limits are imposed are biochemical oxygen demand (BOD), total suspended solids (TSS), and total or fecal coliform counts. Fecal coliform counts are generally used as indicators to determine the degree of disinfection. A limit on turbidity is usually specified to monitor the performance of the treatment facility's reliability – proof that high quality can be maintained. This was accomplished on ***Cromaglass*** recycle/reuse systems through tests of the Ben Franklin Research Program using internationally accepted standards for recycle and reuse of wastewater.

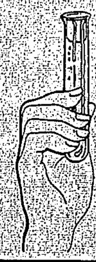
Dr. Melvin C. Zimmerman, the administrator, and his staff reviewed with NSF the protocol to be followed, including inspection of the test site and analytical laboratories. Mr. Michael Gerardi consulted on the project as a wastewater biologist.

Overall, the Ben Franklin Technology Center's evaluation covered a period from September 19, 1995 through May 14, 1996, or eight months.

Cumulative statistics over the program length (through three seasonal changes) provided data results with a mean of 2.84 mg/L BOD_5 and 2.48 mg/L total suspended solids – and total residual coliforms toxicity "neither acutely nor chronically toxic (to the ceriodaphnia dubia or the fathead minnow)."*

**This test universally utilized to determine toxicity to humans.*

In general, most states with regulations require a minimum of secondary or biological treatment followed by disinfection prior to restricted urban reus[e]



CUMULATIVE STATISTICS
09/19/95 - 05/14/96
FINAL EFFLUENT AFTER FILTRATION AND DISINFECTION

BOD_5	2.84 mg/L	97.87% reduction
TSS	2.48 mg/L	98.65% reduction
Fecal Coliforms – Too few to measure		

Where specified by regulation, generally limits on BOD range from 5 mg/L to 30 mg/L, limits on TSS vary from 5 mg/L to 90 mg/L. For those states that do not specify limitations on BOD or TSS, a percent reduction of contaminant removal is usually established.

Average fecal coliform limits for those states that limit fecal coliforms range from non-detectable to 1,000/100 mL, with some states allowing higher single sample fecal coliform limits.

Where water reuse regulations have been developed by many states these regulations vary considerable from state to state. Some states, such as Arizona, California, Florida, and Texas, have developed regulations that strongly encourage water reuse as a water resources conservation strategy. These states have developed comprehensive regulations specifyin[g] water quality requirements, treatment processes, [a]nd both for the full spectrum of reuse applications. The objective in these states is to derive the maximum resource benefits of the reclaimed water while protecting the environment and public health. Some states have developed water reuse regulations with the primary intent of providing a disposal alternative to discharge to surface waters, also considering the management of reclaimed water as a resource.

The following excerpt is from the Pennsylvania Department of Environmental Protection Internet Website:

Pennsylvania Environmental Technology Investment through the Ben Franklin Technology Centers

Cromaglass Corporation manufactures a variety of models of wastewater treatment systems which are designed as Sequencing Batch Reactors (SBR). This allows all incoming wastes to be treated by timed sequences within a single vessel as opposed to the conventional continuous flow activated sludge systems which require several treatment vessels. ***Cromaglass*** is currently marketing a recycle/reuse system which is approved for use where other methods are not acceptable. This is possible due to the ability of the system to reduce BOD and Suspended Solids over 96%, producing an effluent which can be used for landscape irrigation and as a toilet flushing medium. This technology provides a solution for failed septic systems and also allows development of land where conventional septic systems cannot be used.

PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

JOCKEY

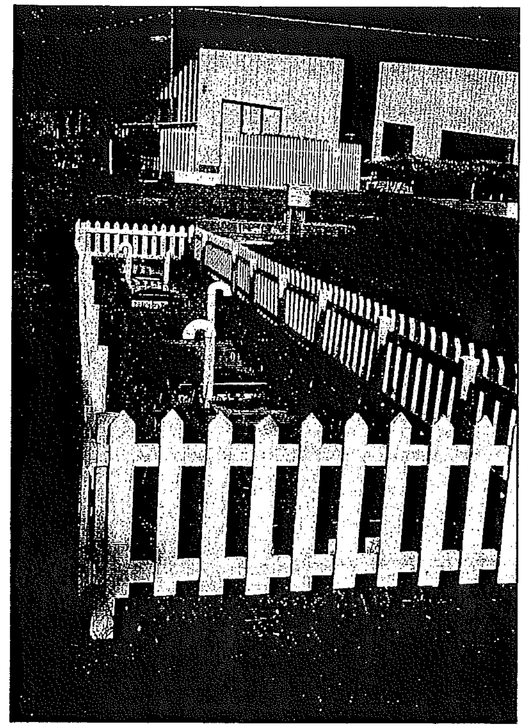
As a world leader in manufacturing clothing apparel Jockey has constructed plants in developing countries, one of which is Jamaica. With increasing awareness of pollution control, management and its consulting engineers turned to the ***Cromaglass*** area distributor, Harper & O'Callaghan of Montego Bay, for their wastewater treatment needs.

Since plant facilities are located near the ocean shoreline and protection of the delicate reef biology is necessary, a wastewater treatment system with high quality effluent discharge capability was required. Several ***Cromaglass*** systems were in use nearby that demonstrated these values – thus it was not difficult to provide the design needed for this Jockey site.

Due to the periodic heavy flows encountered on this type of production facility a Batch Process System was of significance, and ***Cromaglass*** has that design capability.

Two 12,000 GPD modules were installed with controls that enable modification of aeration and other biological parameters, to respond to changes in flow strength and hydraulic loading.

Treated effluent flows to an artificial pond where it is stored and used for irrigation of vegetation on the premises.



One of two 12,000 gallon batch treat systems serving the Jockey plant and offices.

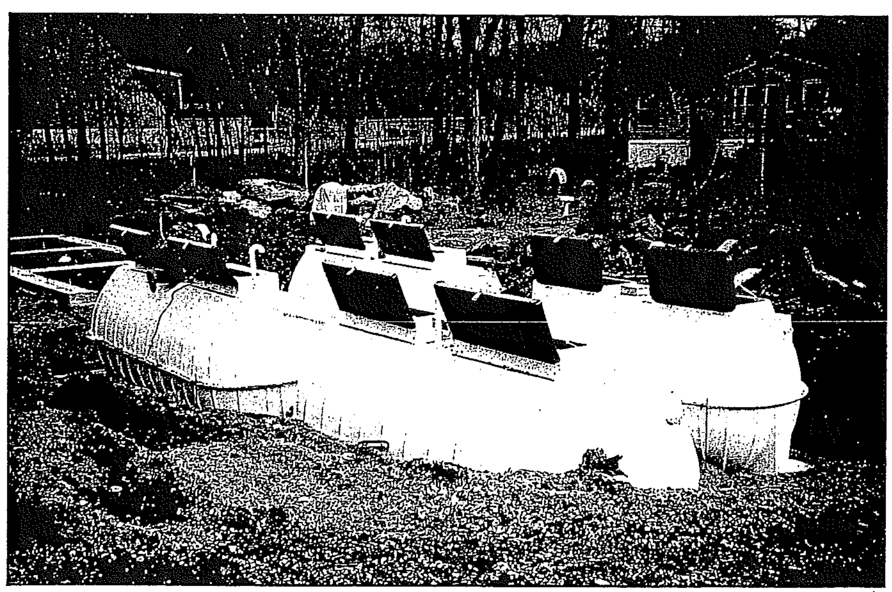
MOBILE HOME PARK SEPTIC PROBLEM

Green Top Mobile Home Park of Sellersville, PA owned by George Roeder, faced a situation which has burdened others in his business – what to do if municipal type sewerage is unavailable, your septic tanks malfunction, and the State Pollution Control Agency threatens penalties.

The problem with the old septic tanks has been poor biological treatment, and the inability of existing soils to absorb the septic water, which surfaced creating odors and water pollution.

In response, Mr. Roeder turned to the consulting engineering firm of Daniel R. Hendricks and its associate, Paul Dietz, P.E. Engineer Dietz knew ***Cromaglass*** from other projects, and expected high quality treatment acceptable to PA DEP for discharge to a nearby stream.

Their solution was the design for modular 12,000 GPD and 6,000 GPD systems treating the flow from the mobile homes located in the park.



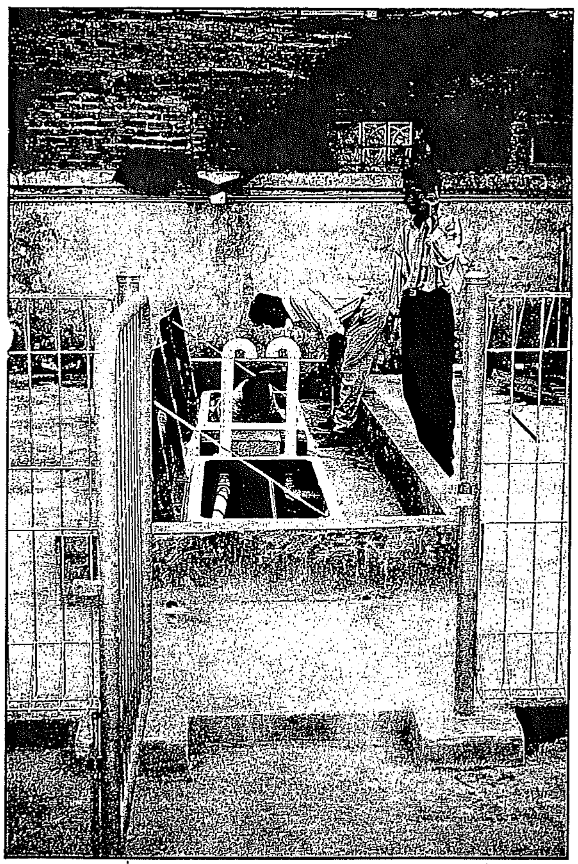
GREEN TOP MOBILE HOME PARK
1 - Model CA-120 (12,000 gal.)
1 - Model CA-60 (6,000 gal.)
1 - 3,000 gal. Chlorine Contact Tank
1 - 5,000 gal. Sludge Wasting Tank
Built-in-place gravity flow sand filters.
(left background)

FEDERAL GOVERNMENT – U.S. EMBASSIES

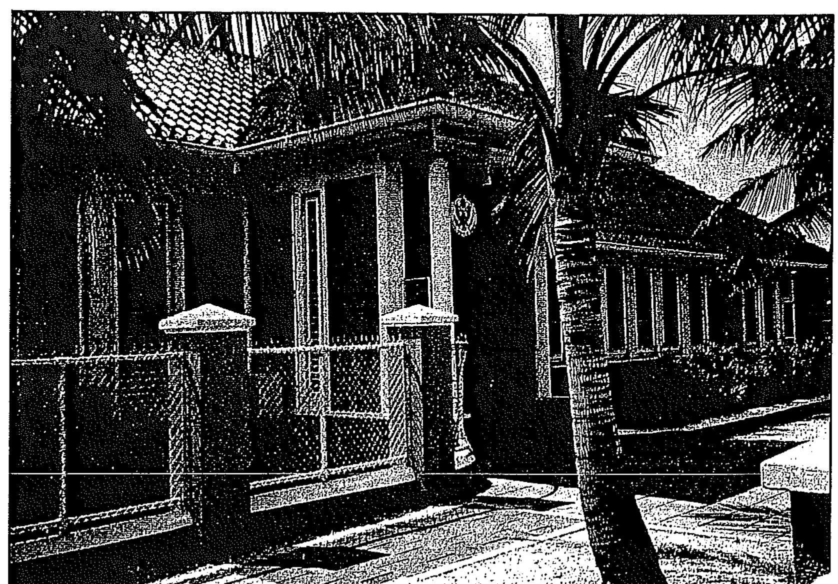
Having its wastewater treatment systems used throughout the world has been very important to ***Cromaglass***, but none more gratifying than those for U.S. Embassies in foreign countries.

One of these was for the Consulate in Curacao, capital of the Netherlands Antilles. Water Treatment International, a ***Cromaglass*** Representative, owned and managed by Gert Rusch of Curacao, sold and installed a ***Cromaglass Batch Treat System*** for connection to the U.S. Consular facilities. Treated effluent is used for irrigation of plantings and flowers in the very arid location.

More recent has been the purchase of a 3000 GPD Batch Treat System for the U.S. Embassy in Jakarta, Indonesia by the U.S. State Department. This system was installed by the Embassy contractor, P. T. Karya Titan of Jakarta, who provided details for all purchasing and shipping from the factory in the U.S. to the site.



Final inspection and startup of Model CA-30 by contractor. (U.S./Indonesian Embassy)



U.S. Consulate in Curacao, Netherlands Antilles served by ***Cromaglass Batch Treat System.***

CGD1296

Cromaglass Corporation

P.O. Box 3215 • Williamsport, PA 17701 • Phone (717) 326-3396 • FAX (717) 326-6426

DATE: March 2, 2000

TO: Mayor and City Council

FROM: Art Ekblad, Chairman Planning Commission

RE: Recommendation/February 14, 2000 Special Planning Commission Meeting

On February 14, 2000 the Planning Commission met in special session. The following recommendations are the results of that meeting:

1. That the City adopt the following policies pertaining to subdivisions and developments around the City of Minot.
   a. That any subdivision application include an engineering study to determine the most feasible and economical method of providing sewage treatment and disposal.
   b. That the City, County and First District Health Unit enter into a joint powers agreement to:
      1. Develop and adopt a properly engineered code to govern the design, installation and operation of on-site sewage disposal systems. (The present requirements for on-site systems are not sufficient to handle present day water usage provided by Rural Water Systems.)
      2. Provide sufficient construction inspection on disposal systems to assure compliance with the new code.
      3. Provide adequate inspection and enforcement of Community Health Regulations to correct the problems caused by presently failing or failed on-site systems. (It is felt that this recommendation combined with b. above, will require additional full time help or a contract with a private firm.)
   c. That existing, platted lots that are vacant and previously approved masterplanned lots be "grandfathered" with respect to lot size, but must comply with Item b. above.
   d. That City staff be directed to work with County, Water Resources Board and Health Unit staff to define, estimate the cost and determine proposed cost sharing for a study on a proposed regional sanitary sewer system.
   e. That the City Council ask the First District Health Unit and Ward County not to permit any new septic tank systems within 1000 feet of the Sundre well field property (Bison Plant).
   f. That the City Council direct that a Sundre Aquifer protection plan be prepared and implemented.
2. That the City develop a new code to govern septic systems.
3. That meetings with the County and First District Health Unit be scheduled to develop the codes and adopt the codes as soon as possible.
4. That the City of Minot not issue septic system construction permits until the new code is adopted.

The Planning Commission also discussed the issue of lot sizes at this meeting. A motion was passed by the Planning Commission to postpone the consideration of the increased lot size until the code regulating the development and use of septic systems in the two-mile jurisdiction has been completed. At that time the Planning Commission will consider the issue of increasing the lot sizes of individual lots.

DATE: February 11, 2000

TO: Rural Lot Study Ad Hoc Committee

FROM: Alan M. Walter, Director of Public Works

RE: Fargo Area Land Development Practices

I visited with the City Engineer of Fargo, Mark Bittner, concerning Fargo's policies for rural development within their growth area. Fargo has jurisdiction over four miles outside the Fargo city limits for zoning, platting etc. This compares with Minot's two-mile extraterritorial jurisdiction. Mark raised several issues that are of interest and possibly of use to us.

First of all, Fargo issues came up because of the mention at the last meeting that there were wastewater systems being used in the Fargo area that were non-conventional. That is, they were not septic tanks and drain fields or NoDak systems. In talking with Mark we find that is not true. He knows of one non-conventional design being used in the Minnesota Lakes area. But to his knowledge there are none in the Fargo area.

Now for the policies Fargo has adopted, for the extraterritorial jurisdiction. First, if a development is within a fifteen-year growth area of Fargo they cannot install a septic tank with a drain field. They are required to install a holding tank and have that pumped or to hook up to either a rural sewer system or the City sewer system. Second, if the planned development is far enough away that it is not feasible to hook up to either one of sewer systems, then the development has to have an engineering study done on the land to see how large the drainage system has to be for the sewer system. Based upon that design the residential lots are platted large enough so that two sewer systems can be placed on each lot. Mark figures that by doing this the housing development will be good for forty to fifty years.

A rural water system can be built in the jurisdictional area of Fargo by the Water Resource District. The WRD takes on the responsibility of having the system designed. A special assessment district is then created so that the sewer system can be paid for. That sewer system connects to the City sewer system at some point. The Fargo area also has some developments that are within reach of the City sewer system and can connect to the system on their own. They have one development north of Fargo that has a lift station and three miles of sanitary sewer force main.

Fargo is also struggling with the same problems we are struggling with as far as the rural subdivisions. They have developed to the south and have reached a development that was platted twenty years ago with two-acre lots. They are now looking at how the utilities can be developed into this area because of the astronomical utility costs associated with these large lots. Fargo is also looking at the size of lots and the effect they have on these rural subdivisions. They are wondering how far out these rural subdivisions will be forced based on the requirements placed on them.

One further note: The township immediately south of Moorhead on the east side of the Red River has taken it upon themselves to develop a sewer system to take care of the rural subdivision south of Moorhead. That rural system connects to the sewer system in Moorhead. This was done to eliminate the same kind of problems we are facing in the Minot area.

dm

Public Works Department

Amendment to Sewage Treatment and Disposal for rural development recommendations:

That the sewage treatment and disposal for rural developments recommendations be amended by adding section 6 and 7 as follows:

6. That the City Council ask the First District Health Unit and Ward County not to permit any new septic tank systems within 1000 feet of the Sundre well field property (Bison Plant).
7. That the City Council direct that a Sundre Aquifer protection plan be prepared and implemented.

MOTION FOR ADOPTION OF RURAL SEWAGE RECOMMENDATIONS:

That the Planning Commission recommend Council adoption of its' sewage treatment and disposal for rural development recommendations, as amended, with the following provisions:

1. That the City begin development of the new code to govern septic systems immediately and that the meetings with the County and Health Unit be scheduled so that an area-wide code can be adopted as soon as possible.
2. That the City of Minot not issue new septic system construction permits until the new code is adopted.

Minutes from Planning Commission Special Meeting
February 14, 2000
7:00 PM
City Council Chambers

Members Present: Dammen, Hight, Hoffart, Kleven, Lokken, Price, Schempp, Schmidt, Semrau, Seymour, Volk, Wetzler, Ekblad

Others Present: PW Director, Gaylen Narum, Roger Kluck, Claire Watne, Laverne Mikkelson, Gaylen Schmidt, Clay Burns, Gary Kramlich, Neil Leigh, Mayor Erickson, Stephen Podrygula, Earl Allen, John Coughlin

The Planning Commission considered the recommendations from the Ad Hoc Committee on policies regarding sewage disposal in rural areas. The recommendation included five items. A copy of that recommendation is attached.

There was much discussion from the Planning Commission and others that attended the meeting. The first recommendation was to increase the lot size requirement from two to four acres. Another item discussed was including an engineering study to determine the most feasible and economical way of providing sewage treatment for a lot. These items were discussed by Claire and Matt Watne, Earl Allen, Laverne Mikkelson, as well as the Planning Commission. Other items discussed included soil types, sewer systems being constructed large enough, cost of the land and a number of other items pertaining to the size of the lot.

The Commission also received a report from the Director of Public Works concerning the same issues in the Fargo area. A copy of that is attached. Following further discussion a number of motions were made.

Commissioner Seymour moved, seconded by Commissioner Schempp to close the hearing on the rural lot sewage issue. Following a roll call vote, motion carried.

Commissioner Schempp moved to include Items #6 and #7 (from a prepared handout) in addition to the five recommendations from the Ad Hoc Committee; motion was seconded by Commissioner Kleven. Item #6 asks the City Council to request that the First District Health Unit and Ward County not permit any new septic systems within 1000 feet of the Sundre well field property (Bison Plant). Item #7 recommends that the City Council direct that a Sundre Aquifer protection plan be prepared and implemented. Motion passed unanimously on a roll call vote.

Motion made by Commissioner Schempp, seconded by Commissioner Price to include the following recommendations:

1. The City begin development of the new code to govern septic systems immediately and that the meetings with the County and Health Unit be scheduled so that an area-wide code can be adopted as soon as possible.
2. That the City of Minot not issue new septic system construction permits until the new code is adopted. The motion passed unanimously on a roll call vote.

Commissioner Wetzler moved, Commissioner Lokken seconded that Items #2 through #7 be approved and passed on to the City Council (these items are included in the agenda for the public hearing, Items #1 through #5 and Items #6 and #7 from motion number two). The motion carried unanimously on a roll call vote.

Commissioner Kleven moved, Commissioner Semrau seconded a motion to table recommendation #1 (that the minimum lot size for on-site sewage disposal systems be increased from two to four acres and that new plats be designed for future division into smaller lots if feasible). The motion failed on a roll call vote.

Commissioner Schempp moved, Commissioner Dammen seconded that the Planning Commission postpone consideration of Item #1 until the code required in Item 3A be adopted. That motioned passed on a 10-3 vote.

Following further discussion the Commissioners agreed that the issue of lot sizes would come back to the Planning Commission once the code has been adopted by the City, County and the First District Health Unit. They would then reconsider the lot size issue and make recommendation to Council based on that meeting.

The meeting adjourned.

MEETING RESUME

Rural Lot Sewage Issue
Ad Hoc Committee
April 11, 2000

SUMMARY OF ACTION

MEMBERS PRESENT: Dammen, Schempp, Kleven

MEMBERS ABSENT: None

OTHERS PRESENT: Aldermen Butz and Leigh, Chris Helgeson, Maurice Foley, Gailen Narum, Bob Amptman, Roger Kluck, Sally Pufall.

Alderman Butz suggested the 100% surcharge should be eliminated. The history of the City Council action was reviewed. Apparently, a complaint to Alderman Anderson resulted in the Council referring the issue to the City administration for further study. Kleven stated these issues are now in limbo, no matter what the ad hoc committee does. Alderman Leigh suggested we wait until after City Council elections to take action. Chris Helgeson stated he was having some problems in denying septic tank permits and needs directions. Kleven suggested the Planning Commission continue requiring the engineering studies in new plats. This was agreed upon by consensus. Schempp stated that the Health Unit must still issue permits if systems are well designed. Leigh questioned this in existing problem areas. Kluck suggested that the Nedrose area sewer proposal, which needs to go to the City Council, could coincide with some of the recommendations being again presented by the Planning Commission. Schempp suggested 3 steps: 1. Separate the recommendations, 2. meet with the City Council Public Works Committee to discuss the problems, or 3. wait until after the Council elections. Kleven suggested number 2 to get some action sooner on the recommendations. After further discussion, Schempp suggested meeting with selected aldermen instead of the Public Works Committee. Schempp suggested that some of the recommendations could be acted on now including Recommendations No. 1.a,b,d,e and f, and No. 3. We would either meet first with City administration on this or with Mayor, Council officers and the two standing committee chairmen. The latter option was approved and Alderman Leigh will contact the Mayor to start the process. The City Engineer stated he would inform the City Manager. Regarding a new code for septic tanks, the State Health Department should be contacted. Regarding Recommendation No. 1.a, this could be presented next commission meeting.

RECEIVED APR 17 2000

DATE: April 13, 2000

TO: Bob Schempp
Jack Kleven
Dave Dammen

FROM: Robert R. Amptman, City Engineer RA

RE: Rural Lot Sewage Issue Ad Hoc Committee - Next Meeting.

The ad hoc committee will meet again on April 25, 2000 at 7:30 a.m. (breakfast) at the Greenhouse Café. The Mayor, City Council President, Vice President and two standing Council Committee Chairmen have been invited to attend.

RRA:pa

c: Alderman Butz
Alan Walter
Rolly Ackerman
Roger Kluck
Chris Helgeson
Alderman Podrygula
John Coughlin
Sally Pufall
Gailen Narum
Fire Marshal

Planning Commission recommendations on area sewage policies.

1a Engineering study on sewage treatment alternatives for new subdivisions.
The planning commission adopted this policy last night--it would help if the City Council followed suit.

1b Joint powers agreement between City, County and First District Health Unit to cover an enforceable and modern on-site sewage code including proper inspection before, during and after installation.
The City Attorney could begin a draft now.

1c Grandfather vacant platted lots, but make them comply with new code,
Compliance would need to wait until a new code is drafted and adopted,

1d Determine cost and extent of a regional sewage system in cooperation with the County and Water Resource Board.
This work could begin now.

1e Ask Ward County and Health Unit not to approve any new systems within 1000 feet of Minots main Water Supply (The Sundre Aquifer)
This action should certainly happen NOW,

1f. Prepare Sundre Aquifer Protection Plan to prevent pollution of our underground water.
Why would we wait to begin this work?

2 Develop new code to govern septic systems.
This will take some time--perhaps a few months. But, the first step would be to contact the State Health Dept for recommendations. Has this been done?

3. Meetings with County and Health Unit to develop codes and adopt them.
Preminary meetings to reach a degree of understanding and direction should be held as soon as possible--particularly between elected representatives.

4. Don't issue septic system construction permits until new code is adopted,
This obviously can't be adopted because prompt action was not taken on the recommdation.

In short, much can be done now to begin to solve the Public Health problem that we are told exists. Or, the City Council can wait until next construction season --as has been suggested. If you wait, you will still be waiting and raw sewage will still be flowing well into many "next construction seasons"

Zoning & Proposed Growth Area Analysis

Background

Recently the City of Minot published a City of Minot Land Use and Transportation Plan that addressed US 2/52 Bypass Improvement Options, Alternates on the West Entrance to the Highway 83 Bypass, along with Short Term, Mid Range and Long Range Planning 15+ years for Urban Roads in the Greater Minot Area.

Traffic Influences Planning

The Plan also addressed Gateways into the City, Town Centers, Greenways, Public Parks and Recreation.

The purpose of this analysis is to get a local perspective concerning land use projections based on development in and around the Greater Minot Area since the early 1970's.

Traffic Patterns

Traffic Patterns have always dictated development in Minot.

Development primary starts with Traffic Patterns which is followed by Commercial Development, Commercial Services, Public Areas such as Parks and Schools, Multifamily and Residential Neighborhoods.

If your Traffic Pattern Changes, so will Development

General

This analysis does not distinguish between similar types of property and is generally listed as Commercial, Industrial, Residential & Agricultural and Agricultural & Public within the Two-Mile Limit of the City of Minot.

The purpose is to get some perception of possible growth areas and address the issue of expansion and the type of Sanitary Sewer Systems needed to take care of this Growth.

Starts with Commercial Expansion

Area from South Broadway West - North & South of 37th Ave SW

Areas adjoining US Highway 2 & 52 - East & West of 54th St NW

Areas at the Intersection of Country Club Road and 54th St NW

Areas adjoining US Highway 83 Bypass West and North of 4th Ave NW to Highway 83 North

Areas adjoining US Highway 83 North - North of County Road 10A to present day 2 Mile Limit

Areas adjoining County Road 12 East of County Road 19

Areas adjoining US 2 Bypass East - From West of 13th St SE to East of 55th Street SE

Industrial Expansion

Area South of and adjoining US 2 & 52 East of 54th St NW

Commercial - Industrial Expansion

Area East of County Road 19 - South to Burdick Expressway & East along US Highway 2

Residential - Agricultural

Areas South of 37th Ave SW East of 54th St NW to US Highway 83 South

Areas North of 37th Ave SW between 16th St SW & 54th St NW

Areas North of US Highway 2 & 52 - West of US Highway 83 Bypass to North & West of the present day 2 mile limit boundary

Residential - Agricultural Continued

Area between 4th Ave NW and 46th Ave NW - East of US Highway 83 Bypass West

Area North of 46th Ave NW and West of Highway 83 North to the present day 2 Mile Limit

Area North of County Road 10A and East of US Highway 83 North to the present day 2 Mile Limit

Area South and Adjoining County Road 10A - West of County Road 19

Area West and Adjoining County Road 19 - South of County Road 10A

** Recommending effort to keep area adjoining Airport Agricultural or Industrial or Commercial Type Services

Area East of County Road 19 and North of County Road 12 to present day 2 Mile Limit

Areas East of US Highway 83 North to US Highway 2 East - South and East to present day 2 Mile Limit

Summary

Future Traffic Patterns in the Long Range Planning Report for a East Bypass - the extension of 55th St SE North to the Intersection of County Road 10 A would add to the Commercial/Industrial Land Use Plan.

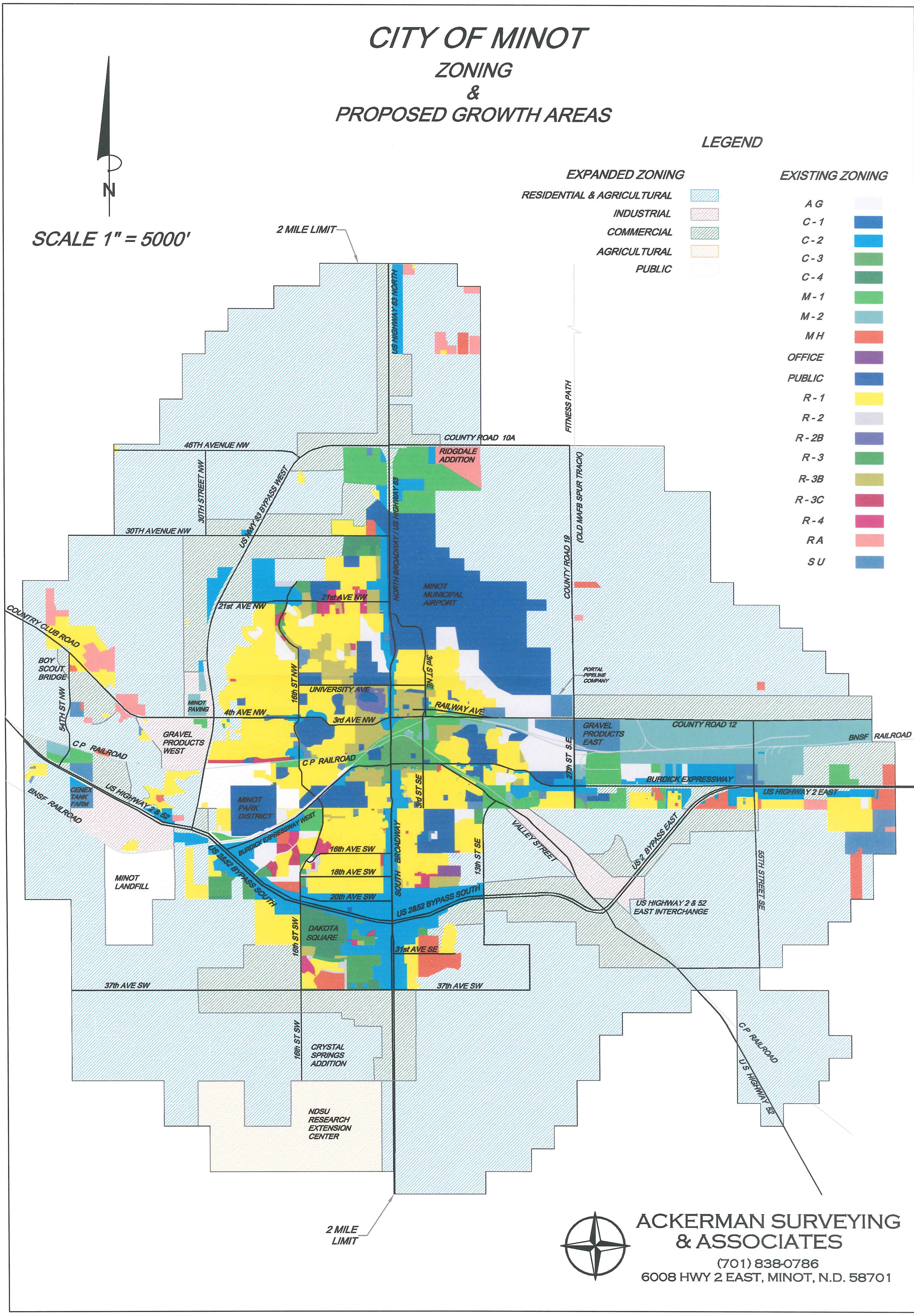
There is an advantage with this planning in being the immediate proximity to the Sanitary Sewer put in on 55th St NE - North to County Road 12 - (Minot Milling Company)

Future Industrial Expansion in this area could be immediate without a long distance to Sanitary Sewer

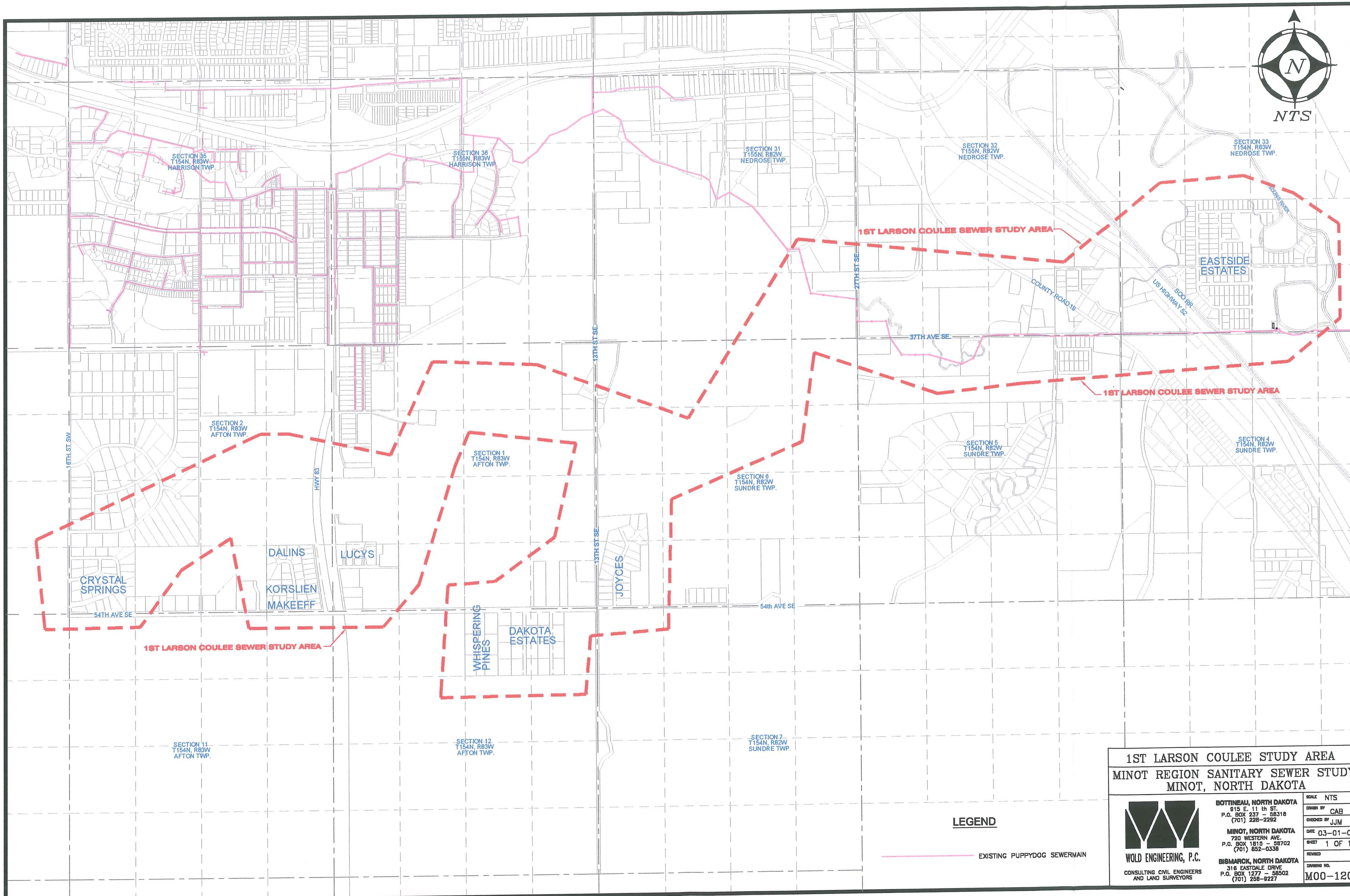
Other Commercial, Industrial, Residential Areas that are being considered are addressed in this report.

CITY OF MINOT

ZONING & PROPOSED GROWTH AREAS



ACKERMAN SURVEYING & ASSOCIATES
(701) 838-0786
6008 HWY 2 EAST, MINOT, N.D. 58701



N
NTS
SECTION 35 T154N, R83W HARRISON TWP.
SECTION 36 T155N, R83W HARRISON TWP.
SECTION 31 T155N, R82W NEDROSE TWP.
SECTION 32 T155N, R82W NEDROSE TWP.
SECTION 33 T154N, R83W NEDROSE TWP.
1ST LARSON COULEE SEWER STUDY AREA
EASTSIDE ESTATES
27TH ST SE
COUNTY ROAD 19
US HIGHWAY 52
SOO RR
37TH AVE SE
13TH ST SE
1ST LARSON COULEE SEWER STUDY AREA
SECTION 2 T154N, R83W AFTON TWP.
SECTION 1 T154N, R83W AFTON TWP.
SECTION 6 T154N, R82W SUNDRE TWP.
SECTION 5 T154N, R82W SUNDRE TWP.
SECTION 4 T154N, R82W SUNDRE TWP.
16TH ST SW
HWY 83
DALINS
LUCYS
CRYSTAL SPRINGS
KORSLIEN
MAKEEFF
JOYCES
54TH AVE SE
54th AVE SE
WHISPERING PINES
DAKOTA ESTATES
1ST LARSON COULEE SEWER STUDY AREA
SECTION 11 T154N, R83W AFTON TWP.
SECTION 12 T154N, R83W AFTON TWP.
SECTION 7 T154N, R82W SUNDRE TWP.
LEGEND
EXISTING PUPPYDOG SEWERMAIN
1ST LARSON COULEE STUDY AREA
MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA
WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS
BOTTINEAU, NORTH DAKOTA
915 E. 11 th ST.
P.O. BOX 237 - 58318
(701) 228-2292
MINOT, NORTH DAKOTA
720 WESTERN AVE.
P.O. BOX 1815 - 58702
(701) 852-0338
BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 - 58502
(701) 258-9227
SCALE NTS
DRAWN BY CAB
CHECKED BY JJM
DATE 03-01-02
SHEET 1 OF 1
REVISED
DRAWING NO.
M00-120

FIRST LARSON COULEE STUDY AREA

I. The First Larson Coulee Study Area is depicted in the following Map:

The First Larson Coulee Study area encompasses an analysis of the following subdivisions for a sanitary sewer system to correct failing septic tank/drainfield systems:

Eastside Estates
Joyce's Subdivision
Dakota Estates
Whispering Pines
Lucy's Amusement Park/Mobile Home Park
Dalen Addition
Korslien Addition
Makeeff Addition
Crystal Springs

Our analysis of this study area looked at the present platted subdivisions and rural outlots within the study area and future growth areas. This study area lends itself to a centralized sewer system. The subject study area developments either adjoin an existing sewer system or lie on the First Larson Coulee borders. We looked at sewage lagoons or a package treatment system for each subdivision and found that these options were too costly on a subdivision by subdivision basis.

II. Appendix A provides our analysis of a gravity sewer system for the subject area. A centralized gravity system provides ease of construction and low maintenance. This type of system is economically feasible because it connects many subdivisions at one time and allows for future connections as new areas develop within the study area.

This is especially true with the platted lots north of Crystal Springs. There is a quarter of land that is platted but has not had very much building. Most of these lots drain towards First Larson Coulee and a gravity sanitary sewer system could easily be tied to the proposed collection system. This proposed system can also cover potentially developable land northwest of Crystal Springs.

The first subdivision for study in this area is Eastside Estates. The proposed Eastside Estates System is depicted in Appendix A, Page 2 of 5. Eastside Estates is adjacent to the existing Puppy Dog sewer main system. The following is our analysis of costs for this sewer main collection system.

ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
EASTSIDE ESTATES GRAVITY SEWER SYSTEM
(Appendix A, Page 2 of 5)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	8" Sanitary Sewer Main	12,000	LF	25.00	$ 300.000.00
2.	Manholes	38	EA	3,000.00	114,000.00
3.	Remove & Replace Aggregate Base	6,300	TON	10.00	63,000.00
4.	Cl. 13 Aggregate Base (new)	3,000	TON	12.00	36,000.00
5.	Sewer Services	159	EA	1,000.00	159,000.00
6.	Right of Way Restoration	1	LS	25,000.00	25,000.00
7.	Connect to Existing Sewer	1	LS	1,500.00	1,500.00
	TOTAL Construction				$ 698,500.00
	Contingency 10%				69,850.00
	Engineering 12%				83,820.00
	Administration & Financing 16%				111,760.00
	TOTAL				$963,930.00

July 15, 2002

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The key to the connection to sanitary sewer of the existing subdivisions along the First Larson Coulee is a gravity sewer system. This sewer system would be a minimum of 18 inches in size and able to handle the expected waste flows. This line would run along the slope above the bottom of First Larson Coulee and would permit the connection of sewer lines off of adjoining subdivisions. This gravity sewer main would have water tight manholes to prevent infiltration of surface water into this proposed system. This system is depicted in Appendix A, Sheets 3, 4, & 5. The cost analysis for this plan is shown on the following page.

ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
FIRST LARSON COULEE GRAVITY SEWER COLLECTION SYSTEM
(Appendix A, Page 3, 4, & 5)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	18" Sanitary Sewer Main	20,800	LF	50.00	$1,040,000.00
2.	Manholes	54	EA	3,000.00	162,000.00
3.	Right of Way Restoration	1	LS	40,000.00	40,000.00
4.	Bore Highway	400	LF	150.00	60,000.00
5.	Remove & Replace Asphalt	100	LF	40.00	4,000.00
6.	Right of Way Acquisition (30')	15	AC	2,000.00	30,000.00
7.	Connect to Existing Sewer	1	LS	1,500.00	1,500.00
	TOTAL Construction				$1,337,500.00
	Contingency 10%				133,750.00
	Engineering 12%				160,500.00
	Administration & Financing 16%				214,000.00
	TOTAL				$1,845,750.00

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The next section of costs for the First Larson Coulee gravity system encompasses individual subdivisions that were included specifically in the proposal study area. Individual systems cost analysis for Joyce's Subdivision; Dakota Estates and Whispering Pines; Lucy's Amusement Park/Mobile Home Park; Dalen, Korslien, & Makeeff Additions; and Crystal Springs area are contained in the following pages. These area systems are also graphically depicted in Appendix A, Sheets 3, 4, & 5.

ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
JOYCE'S SUBDIVISION GRAVITY SEWER SYSTEM
(Appendix A, Page 3 & 4)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	12" Sanitary Sewer Main	2,200	LF	35.00	$ 77,000.00
2.	8" Sanitary Sewer Main	2,000	LF	25.00	50,000.00
3.	Manholes	11	EA	3,000.00	33,000.00
4.	Sewer Services	24	EA	1,000.00	24,000.00
5.	Remove & Replace Aggregate Base	1,100	TON	10.00	11,000.00
6.	Cl. 13 Aggregate Base (new)	500	TON	12.00	6,000.00
7.	Right of Way Restoration	1	LS	5,000.00	5,000.00
8.	Right of Way Acquisition (30')	2	AC	2,000.00	4,000.00
	TOTAL Construction				$ 210,000.00
	Contingency 10%				21,000.00
	Engineering 12%				25,200.00
	Administration & Financing 16%				33,600.00
	TOTAL				$ 289,800.00

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ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
DAKOTA ESTATES & WHISPERING PINES GRAVITY SEWER SYSTEM
(Appendix A, Pages 3 & 4)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	12" Sanitary Sewer Main	4,725	LF	35.00	$ 165,375.00
2.	8" Sanitary Sewer Main	4,400	LF	25.00	110,000.00
3.	Manholes	25	EA	3,000.00	75,000.00
4.	Sewer Services	35	EA	1,000.00	35,000.00
5.	Remove & Replace Aggregate Base	3,100	TON	10.00	31,000.00
6.	Cl. 13 Aggregate Base (new)	1,000	TON	12.00	12,000.00
7.	Right of Way Restoration	1	LS	10,000.00	10,000.00
8.	Remove & Replace Hot Bituminous Pavement	1,900	LF	40.00	76,000.00
9.	Right of Way Acquisition	2	AC	2,000.00	4,000.00
	TOTAL Construction				$ 518,375.00
	Contingency 10%				51,837.50
	Engineering 12%				62,205.00
	Administration & Financing 16%				82,940.00
	TOTAL				$ 715,357.50

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ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
LUCY'S AMUSEMENT PARK/MOBILE HOME PARK GRAVITY SEWER SYSTEM
(Appendix A, Page 5)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	12" Sanitary Sewer Main	1,300	LF	35.00	$ 45,500.00
2.	8" Sanitary Sewer Main	340	LF	25.00	8,500.00
3.	Manholes	5	EA	3,000.00	15,000.00
4.	Sewer Services	1	EA	5,000.00	5,000.00
5.	Right of Way Restoration	1	LS	5,000.00	5,000.00
6.	Right of Way Acquisition (30')	1	AC	2,000.00	2,000.00
	TOTAL Construction				$ 81,000.00
	Contingency 10%				8,100.00
	Engineering 12%				9,720.00
	Administration & Financing 16%				12,960.00
	TOTAL				$ 111,780.00

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ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
DALEN, KORSLIEN & MAKEEFF AREA ADDITIONS GRAVITY SEWER SYSTEM
(Appendix A, Page 5)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	12" Sanitary Sewer Main	2,380	LF	25.00	$ 83,300.00
2.	8" Sanitary Sewer Main	1,990	LF	25,00	49,750.00
3.	Manholes	14	EA	3,000.00	42,000.00
4.	Sewer Services	34	EA	1,000.00	34,000.00
5.	Remove & Replace Aggregate Base	1,000	TON	10.00	10,000.00
6.	Cl. 13 Aggregate Base (new)	300	TON	12.00	3,600.00
7.	Right of Way Restoration	1	LS	7,500.00	7,500.00
8	Right of Way Acquisition (30')	1	AC	2,000.00	2,000.00
	TOTAL Construction				$ 232,150.00
	Contingency 10%				23,215.00
	Engineering 12%				27,858.00
	Administration & Financing 16%				37,144.00
	TOTAL				$ 320,367.00

July 15, 2002

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ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
CRYSTAL SPRINGS AREA ADDITIONS GRAVITY SEWER SYSTEM
(Appendix A, Page 5)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	8" Sanitary Sewer Main	2,470	LF	25.00	$ 61,750.00
2.	Manholes	8	EA	3,000.00	24,000.00
3.	Sewer Services	30	EA	1,000.00	30,000.00
4.	Remove & Replace Hot Bituminous Pavement	2,470	LF	40.00	98,800.00
5.	Right of Way Restoration	1	LS	7,500.00	7,500.00
	TOTAL Construction				$ 222,050.00
	Contingency 10%				22,205.00
	Engineering 12%				26,646.00
	Administration & Financing 16%				35,528.00
	TOTAL				$ 306,429.00

July 15, 2002

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III. Appendix B analyzes possible route options for constructing sewer systems for this study area using a combination of gravity sewer collection systems and force main sewer systems. This option would allow individual subdivisions or clusters of subdivisions to be tied to city sewer without having to build a complete gravity sewer main through the First Larson Coulee area. These cluster subdivision areas are shown pictorially in Appendix B and the costs for each cluster system is analyzed in the following pages. Any parts of the gravity system that could potentially be affected by surface water would have sealed manholes.

ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
JOYCE'S SUBDIVISION, DAKOTA ESTATES & WHISPERING PINES
GRAVITY & FORCE MAIN SEWER SYSTEM
(Appendix B, Pages 2 & 3)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	Lift Station	1	LS	250,000.00	$250,000.00
2.	Force Main	5,600	LF	25.00	140,000.00
3.	12" Sanitary Sewer Main	6,925	LF	35.00	242,375.00
4.	8" Sanitary Sewer Main	6,400	LF	25.00	160,000.00
5.	Manholes	36	EA	3,000.00	108,000.00
6.	Sewer Services	59	EA	1,000.00	59,000.00
7.	Remove & Replace Aggregate Base	4,200	TON	10.00	42,000.00
8.	Cl. 13 Aggregate Base	1,500	TON	12.00	18,000.00
9.	Right of Way Restoration	1	LS	15,000.00	15,000.00
10.	Right of Way Acquisition	10	AC	2,000.00	20,000.00
11.	Remove & Replace Hot Bituminous Pavement	1,900	LF	40.00	76,000.00
12.	Connect to Existing Sewer	1	LS	1,500.00	1,500.00
	TOTAL Construction				$1,131,875.00
	Contingency 10%				113,187.50
	Engineering 12%				135,825.00
	Administration & Financing 16%				181,100.00
	TOTAL				$1,561,987.50

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ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
LUCY'S AMUSEMENT PARK/MOBILE HOME PARK; DALEN, KORSLIEN, & MAKEEFF AREA ADDITIONS; AND CRYSTAL SPRINGS AREA ADDITIONS
GRAVITY & FORCE MAIN SEWER SYSTEM
(Appendix B, Page 4)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	Lift Station	1	LS	250,000.00	$250,000.00
2.	Force Main	3,000	LF	25.00	75,000.00
3.	Connect to Existing Sewer	1	EA	1,500.00	1,500.00
4.	18" Sanitary Sewer Main	7,125	LF	50.00	356,250.00
5.	12" Sanitary Sewer Main	3,680	LF	35.00	128,800.00
6.	8" Sanitary Sewer Main	4,800	LF	25.00	120,000.00
7.	Manholes	47	EA	3,000.00	141,000.00
8.	Sewer Services	64	EA	1,000.00	64,000.00
9.	Sewer Services	1	EA	5,000.00	5,000.00
10.	Remove & Replace Hot Bituminous Pavement	2,570	LF	40.00	102,800.00
11.	Remove & Replace Aggregate Base	1,000	TON	10.00	10,000.00
12.	Cl. 13 Aggregate Base (new)	300	TON	12.00	3,600.00
13.	Right of Way Restoration	1	LS	35,000.00	35,000.00
14.	Right of Way Acquisition (30')	7	AC	2,000.00	14,000.00
15.	Bore Highway	400	LF	150.00	60,000.00
	TOTAL Construction				$1,366,950.00
	Contingency 10%				136,695.00
	Engineering 12%				164,034.00
	Administration & Financing 16%				218,712.00
	TOTAL				$1,886,391.00

July 15, 2002

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IV. Appendix C analyzes possible route options for constructing sewer systems for this area using a combination of gravity sewer collection systems and force main sewer systems. This option is unique in that there would not be any gravity lines in the bottom of the coulee. This option would connect housing areas with gravity sanitary sewer systems that drain into centralized lift stations. This option is outlined in Appendix C. The following is the cost analysis for this option.

ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
FIRST LARSON COULEE LOCALIZED SYSTEM
JOYCE'S SUBDIVISION, DAKOTA ESTATES & WHISPERING PINES
GRAVITY & FORCE MAIN SEWER SYSTEM
(Appendix C, Pages 2 & 3)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	Lift Station	1	LS	250,000.00	$ 250,000.00
2.	Force Main	2,450	LF	25.00	61,250.00
3.	12" Sanitary Sewer Main	6,595	LF	35.00	230,825.00
4.	8" Sanitary Sewer Main	7,335	LF	25.00	183,375.00
5.	Manholes	46	EA	3,000.00	138,000.00
6.	Sewer Services	68	EA	1,000.00	68,000.00
7.	Remove & Replace Aggregate Base	4,200	TON	10.00	42,000.00
8.	Cl. 13 Aggregate Base	1,500	TON	12.00	18,000.00
9.	Right of Way Restoration	1	LS	15,000.00	15,000.00
10.	Right of Way Acquisition	10	AC	2,000.00	20,000.00
11.	Remove & Replace Hot Bituminous Pavement	4,125	LF	40.00	165,000.00
12.	Connect to Existing Sewer	1	LS	1,500.00	1,500.00
	TOTAL Construction				$1,192,950.00
	Contingency 10%				119,295.00
	Engineering 12%				143,154.00
	Administration & Financing 16%				190,872.00
	TOTAL				$ 1,646.271.00

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ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
FIRST LARSON COULEE LOCALIZED SYSTEM AND
CRYSTAL SPRINGS AREA ADDITIONS
GRAVITY & FORCE MAIN SEWER SYSTEM
(Appendix C, Page 4)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	Lift Station	1	LS	250,000.00	$250,000.00
2.	Force Main	6,600	LF	25.00	165,000.00
3.	Connect to Existing Sewer	1	EA	1,500.00	1,500.00
4.	12" Sanitary Sewer Main	550	LF	35.00	19,250.00
5.	8" Sanitary Sewer Main	3,100	LF	25.00	78,750.00
6.	Manholes	13	EA	3,000.00	39,000.00
7.	Sewer Services	30	EA	1,000.00	30,000.00
9.	Remove & Replace Hot Bituminous Pavement	2,200	LF	40.00	88,000.00
10.	Right of Way Restoration	1	LS	35,000.00	35,000.00
11.	Right of Way Acquisition (30')	2	AC	2,000.00	4,000.00
	TOTAL Construction				1,066,750.00
	Contingency 10%				106,675.00
	Engineering 12%				128,010.00
	Administration & Financing 16%				170,680.00
	TOTAL				$1,472,115.00

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ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
FIRST LARSON COULEE LOCALIZED SYSTEM
LUCY'S AMUSEMENT PARK/MOBILE HOME PARK;
DALEN, KORSLIEN, & AKEEFF AREA ADDITIONS;
GRAVITY & FORCE MAIN SEWER SYSTEM
(Appendix C, Page 4)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	Lift Station	1	LS	250,000.00	$250,000.00
2.	Force Main	3,000	LF	25.00	75,000.00
3.	Connect to Existing Sewer	1	EA	1,500.00	1,500.00
4.	12" Sanitary Sewer Main	1,750	LF	35.00	61,250.00
5.	8" Sanitary Sewer Main	3,650	LF	25.00	91,250.00
6.	Manholes	17	EA	3,000.00	51,000.00
7.	Sewer Services	39	EA	1,000.00	39,000.00
9.	Sewer Service	1	EA	5,000.00	5,000.00
10.	Remove & Replace Hot Bituminous Pavement	1,600	LF	40.00	64,000.00
11.	Remove & Replace Aggregate Base	600	TON	10.00	6,000.00
12.	Right of Way Restoration	1	LS	35,000.00	35,000.00
13.	Right of Way Acquisition (30')	2	AC	2,000.00	4,000.00
14.	Bore Highway	400	LF	150.00	60,000.00
	TOTAL Construction				743,000.00
	Contingency 10%				74,300.00
	Engineering 12%				89,160.00
	Administration & Financing 16%				118,880.00
	TOTAL				$ 1,025,340.00

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The following table summarizes Options 1 and 3, shown in Appendix A, B, and C of the First Larson Coulee study area:

Gravity Sewer System, Option 1 – Appendix A

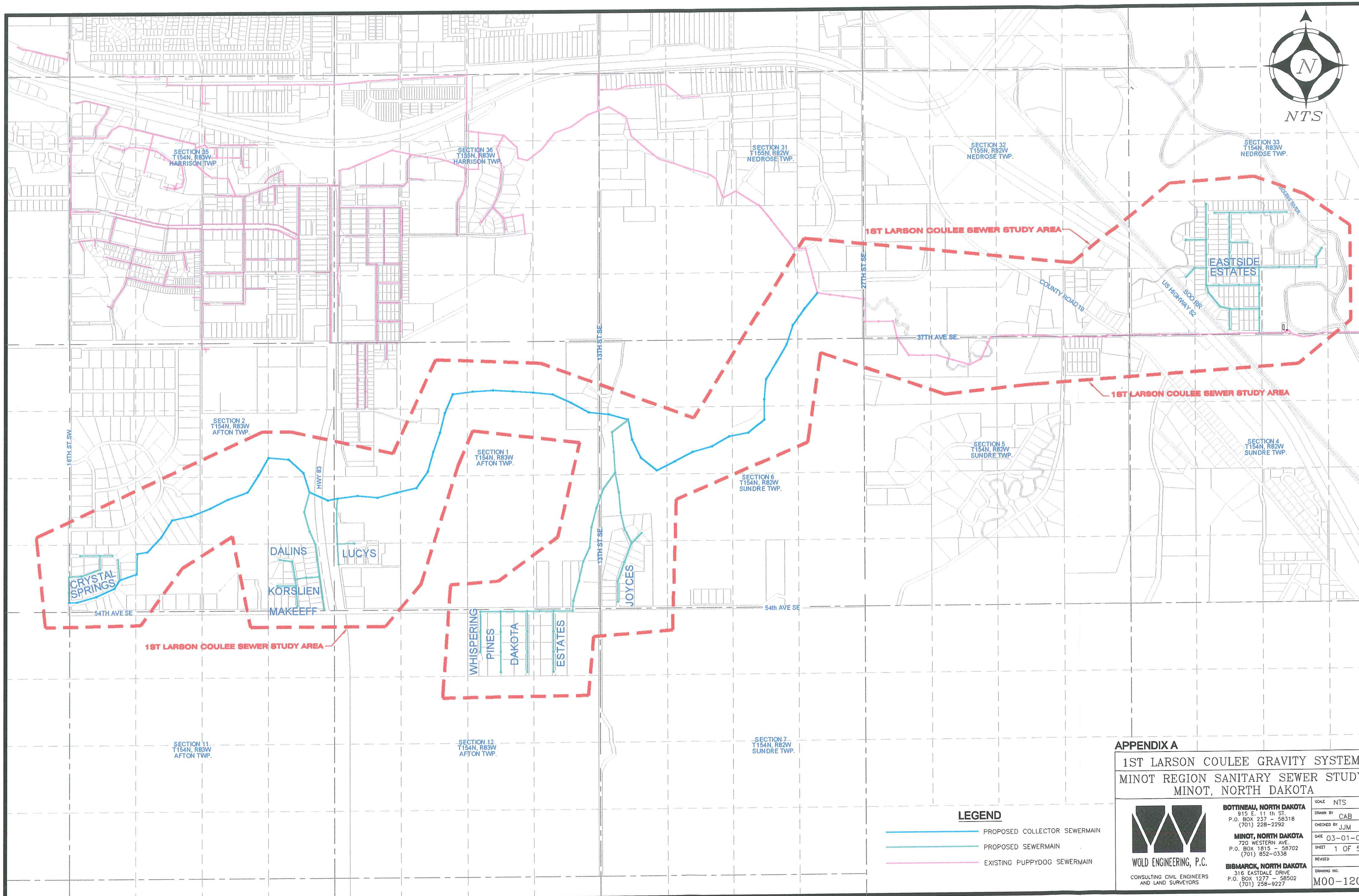
Eastside Estates Gravity System	$ 963,930.00
1st Larson Coulee Collection System (Gravity)	$ 1,845,750.00
Joyce's Subdivision, Dakota Estates & Whispering Pines	$ 1,005,157.50
Lucy's Amusement Park/Mobile Home Park	$ 111,780.00
Dalen, Korslien, & Makeeff Area	$ 320,367.00
Crystal Springs Area	$ 306,429.00
TOTAL	$ 4,553,413.50

Force Main/Gravity Sewer System, Option 2 – Appendix B

Eastside Estates Gravity System	$ 963,930.00
Joyce's Subdivision/Dakota Estates & Whispering Pines (Force Main/Gravity System)	$ 1,561,987.50
Lucy's Amusement Park/Mobile Home Park; Dalen, Korslien, & Makeeff Area Addition; and Crystal Springs Area Additions (Force Main/Gravity System)	$ 1,886,391.00
TOTAL	$ 4,412,308.50

Force Main/Gravity Sewer System Hybrid Option 3 Appendix C

Eastside Estates Gravity System	$ 963,930.00
Joyce's Subdivision, Dakota Estates & Whispering Pines (Gravity & Force Main System)	$ 1,646,271.00
First Larson Coulee Localized System (Gravity & Force Main System)	$ 1,472,115.00
Lucy's Amusement Park/Mobile Home Park; Dalen, Korslien, and Makeeff Area Additions (Gravity & Force Main System)	$ 1,025,340.00
TOTAL	$ 5,107,656.00



NTS
SECTION 35 T154N, R83W HARRISON TWP.
SECTION 36 T155N, R83W HARRISON TWP.
SECTION 31 T155N, R82W NEDROSE TWP.
SECTION 32 T155N, R82W NEDROSE TWP.
SECTION 33 T154N, R83W NEDROSE TWP.
1ST LARSON COULEE SEWER STUDY AREA
EASTSIDE ESTATES
COUNTY ROAD 19
US HIGHWAY 52
SOO RR
27TH ST SE
37TH AVE SE
13TH ST SE
SECTION 2 T154N, R83W AFTON TWP.
SECTION 1 T154N, R83W AFTON TWP.
SECTION 6 T154N, R82W SUNDRE TWP.
SECTION 5 T154N, R82W SUNDRE TWP.
SECTION 4 T154N, R82W SUNDRE TWP.
16TH ST SW
HWY 83
DALINS
LUCYS
CRYSTAL SPRINGS
KORSLIEN
MAKEEFF
54TH AVE SE
54th AVE SE
JOYCES
WHISPERING PINES
DAKOTA ESTATES
SECTION 11 T154N, R83W AFTON TWP.
SECTION 12 T154N, R83W AFTON TWP.
SECTION 7 T154N, R82W SUNDRE TWP.
LEGEND
PROPOSED COLLECTOR SEWERMAIN
PROPOSED SEWERMAIN
EXISTING PUPPYDOG SEWERMAIN
APPENDIX A
1ST LARSON COULEE GRAVITY SYSTEM
MINOT REGION SANITARY SEWER STUDY
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P.O. BOX 1277 – 58502
(701) 258-9227
SCALE NTS
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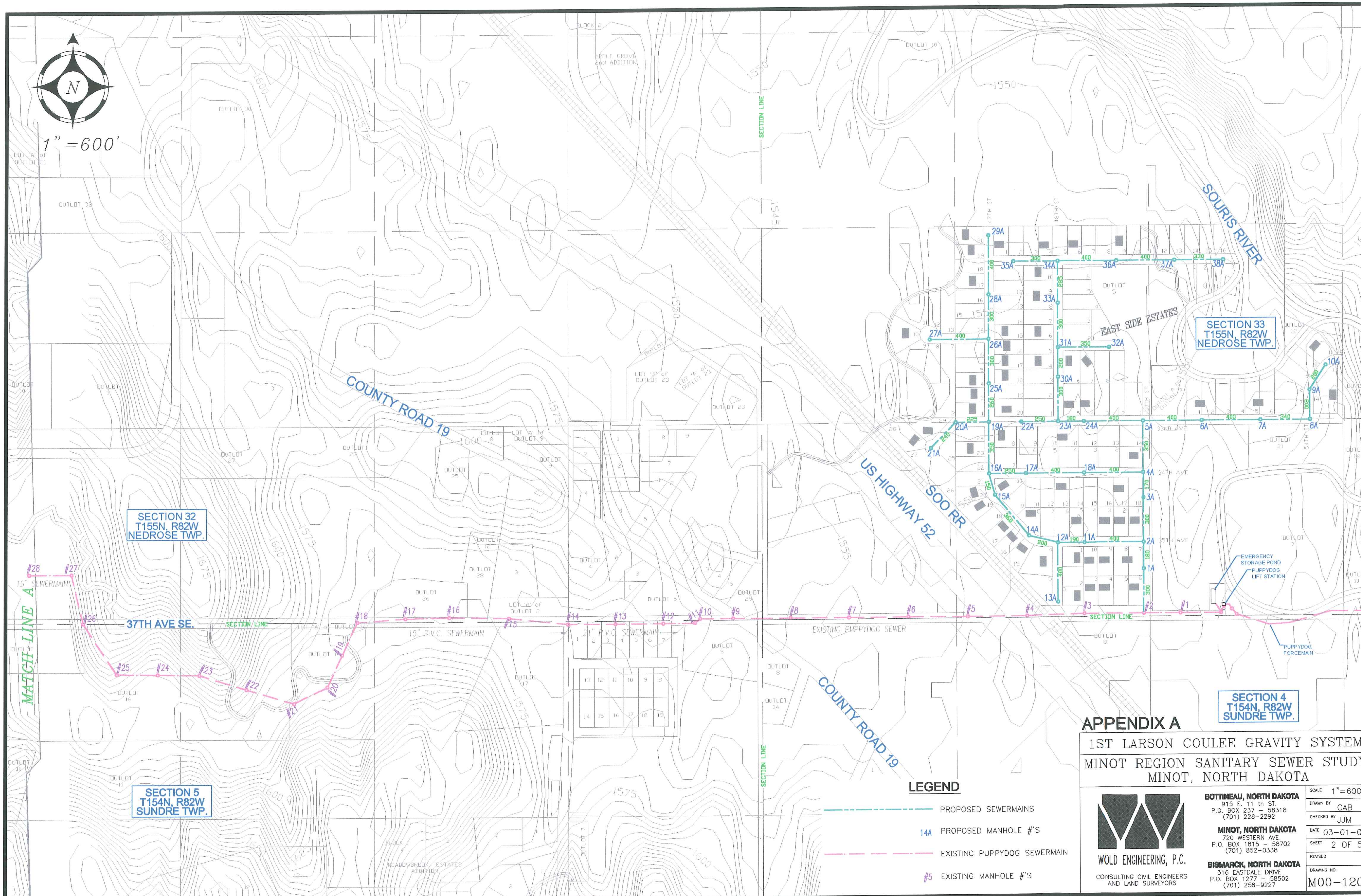
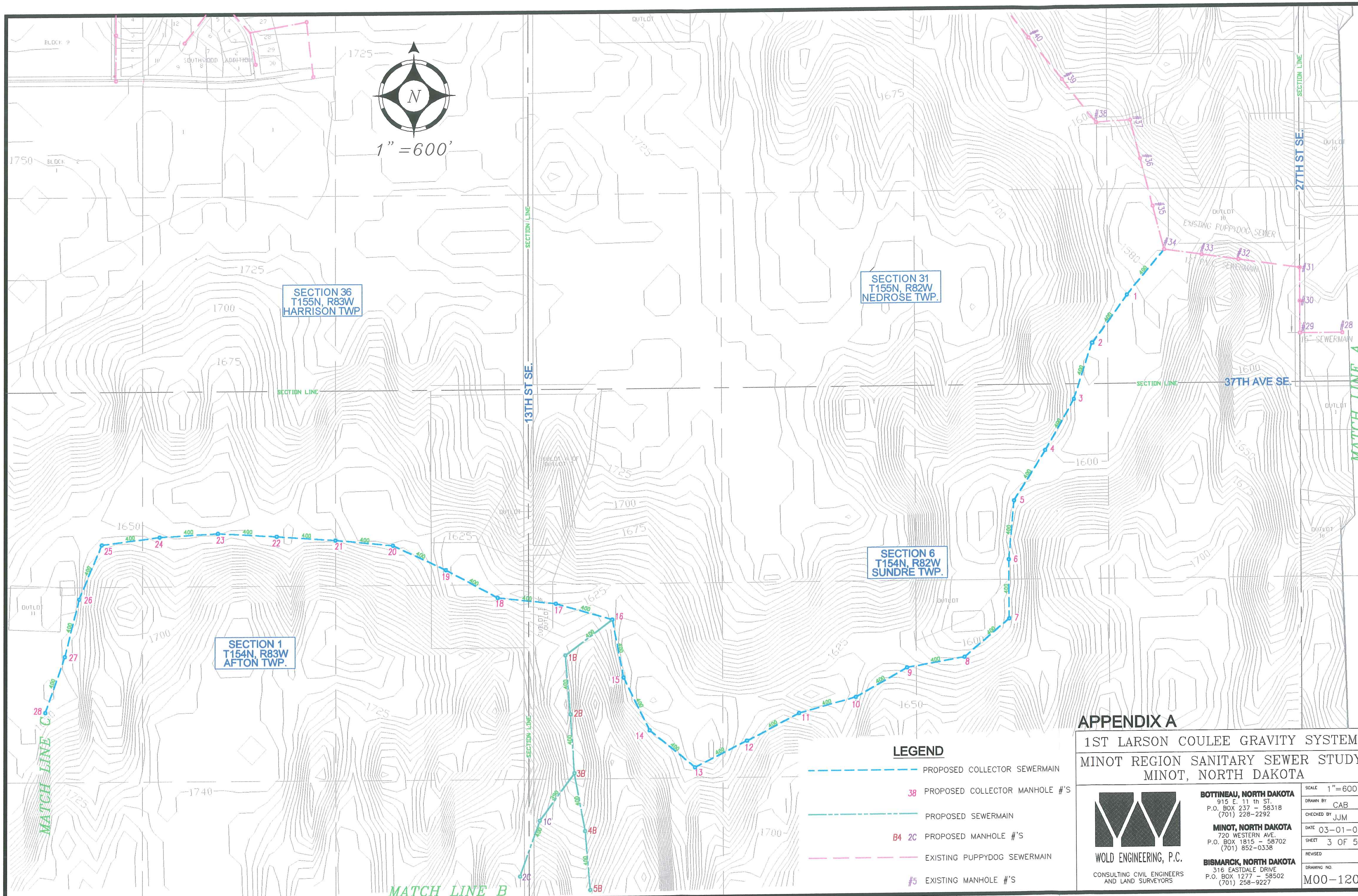
CHECKED BY JJM
DATE 03-01-02
SHEET 1 OF 5
DRAWING NO. M00-120



APPENDIX A
1ST LARSON COULEE GRAVITY SYSTEM
MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA
WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS
BOTTINEAU, NORTH DAKOTA
915 E. 11 th ST.
P.O. BOX 237 - 58318
(701) 228-2292
MINOT, NORTH DAKOTA
720 WESTERN AVE.
P.O. BOX 1815 - 58702
(701) 852-0338
BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 - 58502
(701) 258-9227
SCALE 1"=600'
DRAWN BY CAB
CHECKED BY JJM
DATE 03-01-02
SHEET 2 OF 5
REVISED
DRAWING NO. M00-120
LEGEND
PROPOSED SEWERMAINS
14A PROPOSED MANHOLE #'S
EXISTING PUPPYDOG SEWERMAIN
#5 EXISTING MANHOLE #'S
1"=600'
N
SECTION 32 T155N, R82W NEDROSE TWP.
SECTION 33 T155N, R82W NEDROSE TWP.
SECTION 4 T154N, R82W SUNDRE TWP.
SECTION 5 T154N, R82W SUNDRE TWP.
MATCH LINE A
COUNTY ROAD 19
US HIGHWAY 52
SOO RR
SOURIS RIVER
EAST SIDE ESTATES
37TH AVE SE.
SECTION LINE
15" SEWERMAIN
15" P.V.C. SEWERMAIN
21" P.V.C. SEWERMAIN
EXISTING PUPPYDOG SEWER
EMERGENCY STORAGE POND
PUPPYDOG LIFT STATION
PUPPYDOG FORCEMAIN


N
1" =600'
SECTION 36
T155N, R83W
HARRISON TWP
SECTION 31
T155N, R82W
NEDROSE TWP.
SECTION 6
T154N, R82W
SUNDRE TWP.
SECTION 1
T154N, R83W
AFTON TWP.
13TH ST SE.
27TH ST SE.
37TH AVE SE.
SECTION LINE
EXISTING PUPPYDOG SEWER
MATCH LINE A
MATCH LINE B
MATCH LINE C
LEGEND
PROPOSED COLLECTOR SEWERMAIN
38 PROPOSED COLLECTOR MANHOLE #'S
PROPOSED SEWERMAIN
B4 2C PROPOSED MANHOLE #'S
EXISTING PUPPYDOG SEWERMAIN
#5 EXISTING MANHOLE #'S
APPENDIX A
1ST LARSON COULEE GRAVITY SYSTEM
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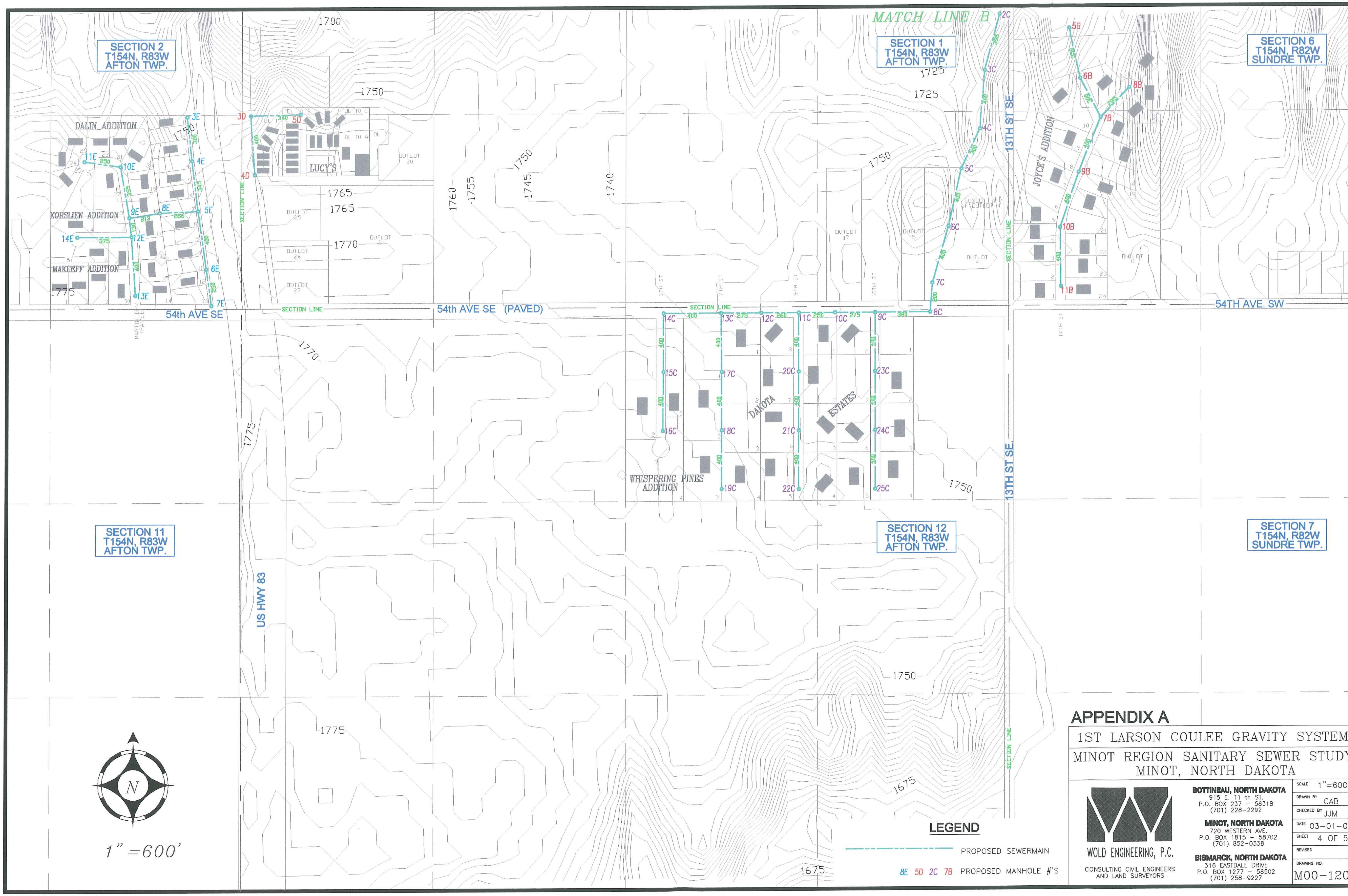
(701) 258-9227
SCALE 1"=600'
DRAWN BY CAB
CHECKED BY JJM
DATE 03-01-02
SHEET 3 OF 5
REVISED
DRAWING NO. M00-120



MATCH LINE B
SECTION 2 T154N, R83W AFTON TWP.
SECTION 1 T154N, R83W AFTON TWP.
SECTION 6 T154N, R82W SUNDRE TWP.
SECTION 11 T154N, R83W AFTON TWP.
SECTION 12 T154N, R83W AFTON TWP.
SECTION 7 T154N, R82W SUNDRE TWP.
DALIN ADDITION
KORSLIEN ADDITION
MAKEEFF ADDITION
LUCY'S
JOYCE'S ADDITION
DAKOTA ESTATES
WHISPERING PINES ADDITION
54th AVE SE
54th AVE SE (PAVED)
54TH AVE. SW
13TH ST SE.
US HWY 83
SECTION LINE
1700
1725
1740
1745
1750
1755
1760
1765
1770
1775
1675
1" =600'
LEGEND
PROPOSED SEWERMAIN
8E 5D 2C 7B PROPOSED MANHOLE #'S
APPENDIX A
1ST LARSON COULEE GRAVITY SYSTEM
MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA
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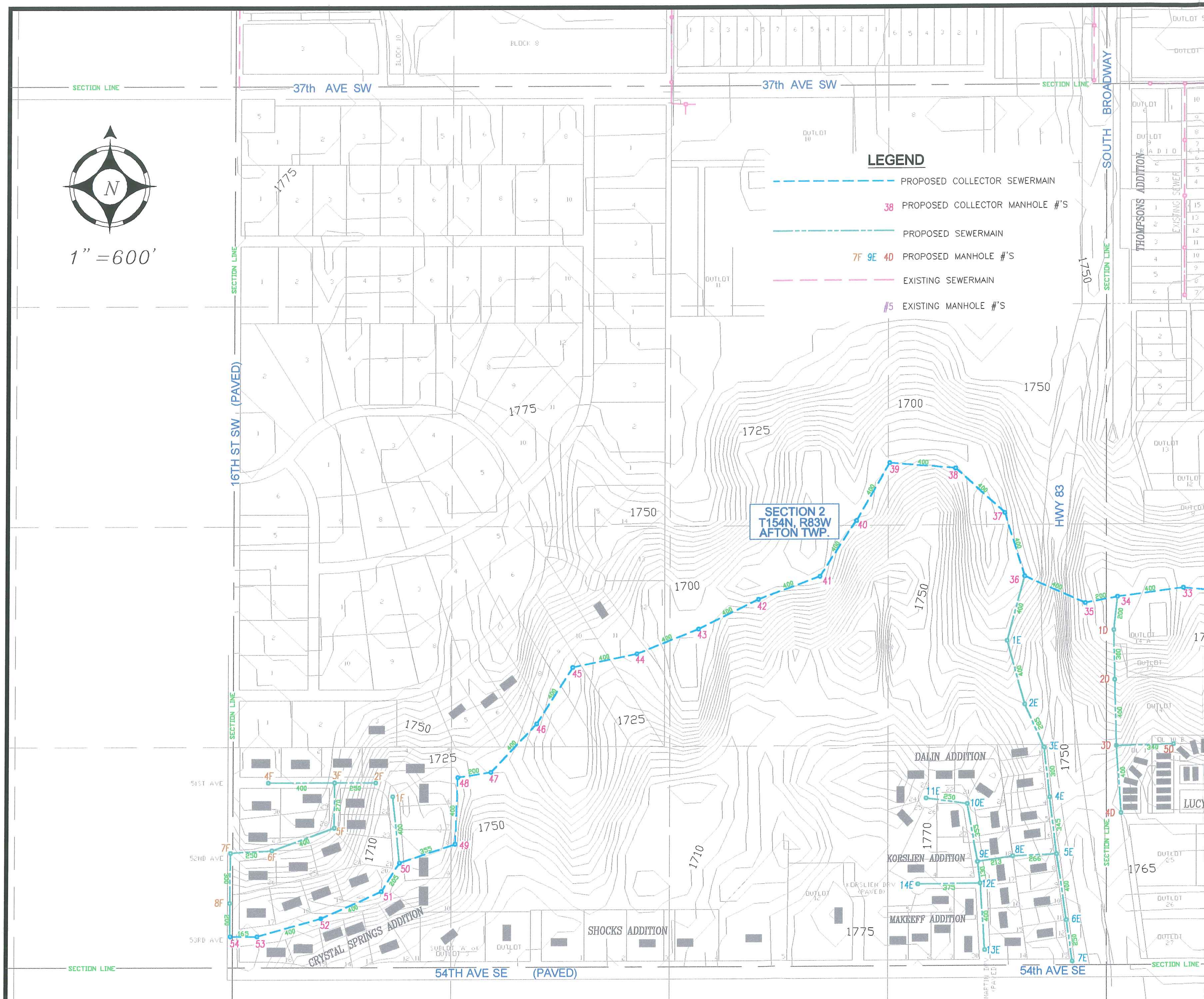
316 EASTDALE DRIVE
P.O. BOX 1277 – 58502
(701) 258-9227
SCALE 1"=600'
DRAWN BY CAB
CHECKED BY JJM
DATE 03-01-02
SHEET 4 OF 5
REVISED
DRAWING NO. M00-120



APPENDIX A

1ST LARSON COULEE GRAVITY SYSTEM

MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA

WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS

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BISMARCK, NORTH DAKOTA
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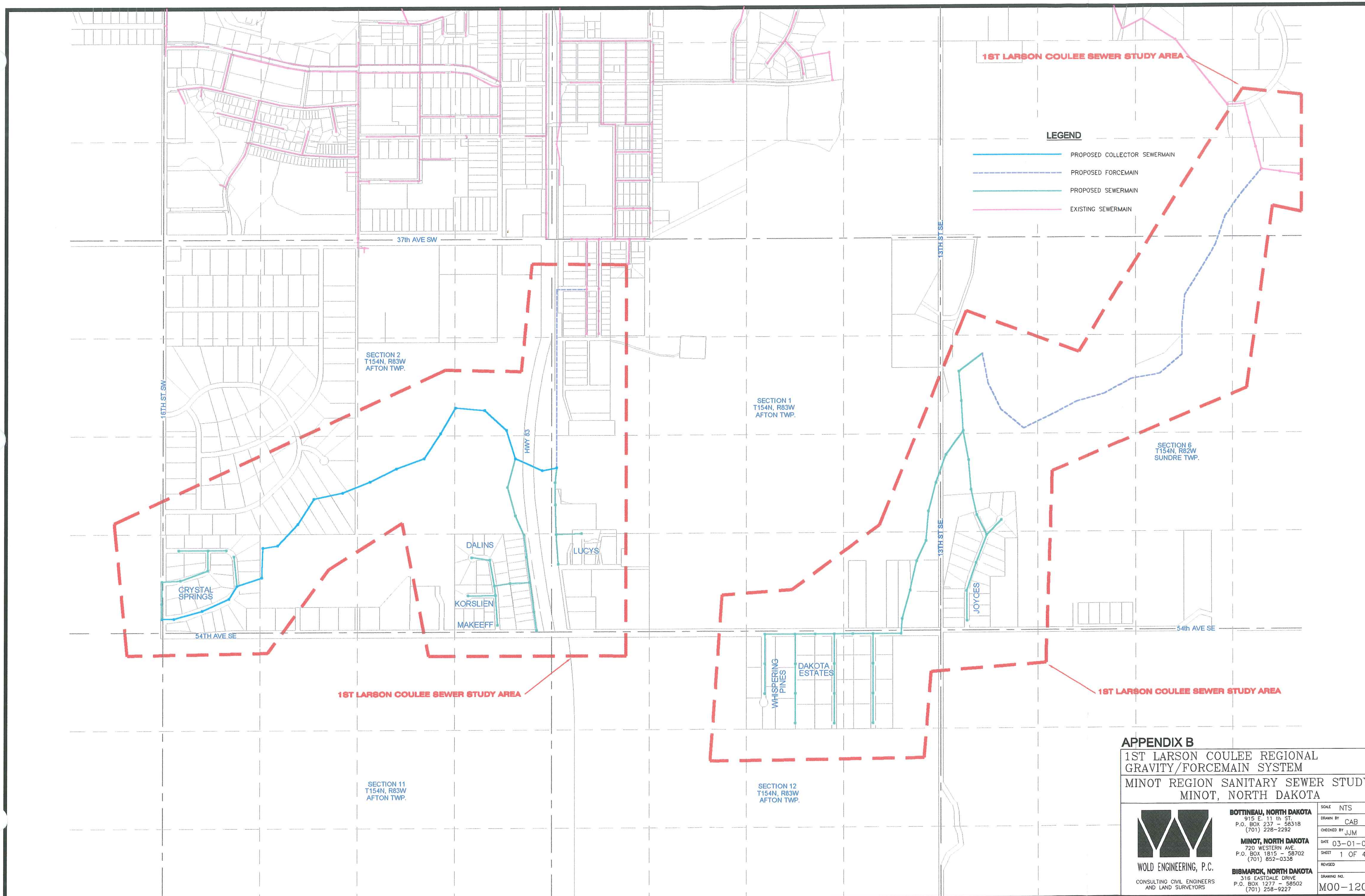
P.O. BOX 1277 - 58502
(701) 258-9227

SCALE	1"=600'
DRAWN BY	CAB
CHECKED BY	JJM
DATE	03-01-02
SHEET	5 OF 5
REVISED	
DRAWING NO.	M00-120



APPENDIX B
1ST LARSON COULEE REGIONAL GRAVITY/FORCEMAIN SYSTEM
MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA
LEGEND
PROPOSED COLLECTOR SEWERMAIN
PROPOSED FORCEMAIN
PROPOSED SEWERMAIN
EXISTING SEWERMAIN
1ST LARSON COULEE SEWER STUDY AREA
1ST LARSON COULEE SEWER STUDY AREA
1ST LARSON COULEE SEWER STUDY AREA
37th AVE SW
54TH AVE SE
54th AVE SE
16TH ST SW
13TH ST SE
13TH ST SE
HWY 83
SECTION 2 T154N, R83W AFTON TWP.
SECTION 1 T154N, R83W AFTON TWP.
SECTION 6 T154N, R82W SUNDRE TWP.
SECTION 11 T154N, R83W AFTON TWP.
SECTION 12 T154N, R83W AFTON TWP.
CRYSTAL SPRINGS
DALINS
KORSLIEN
MAKEEFF
LUCYS
JOYCES
WHISPERING PINES
DAKOTA ESTATES
WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS
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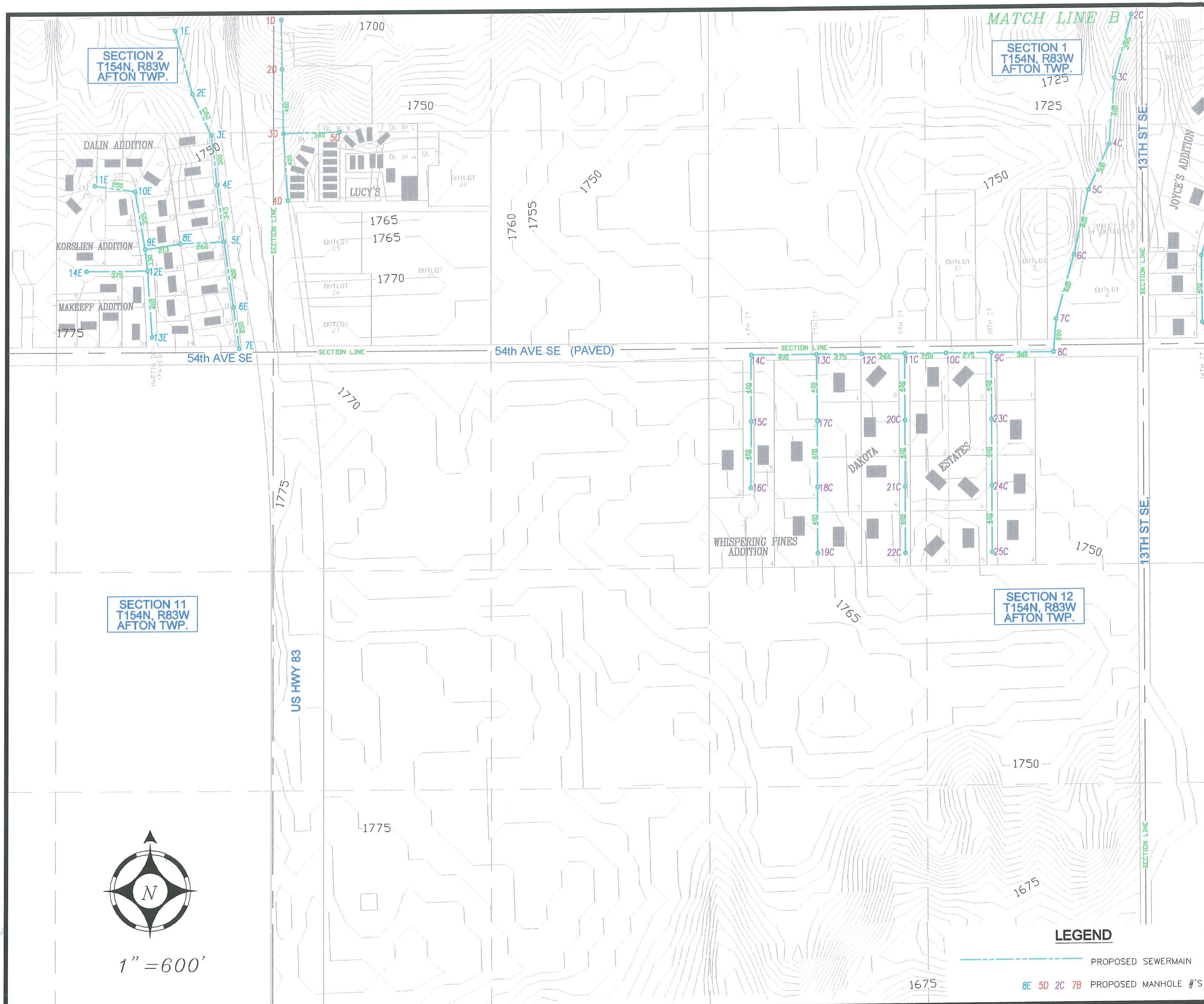
(701) 852-0338
BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 – 58502
(701) 258-9227
SCALE NTS
DRAWN BY CAB
CHECKED BY JJM
DATE 03-01-02
SHEET 1 OF 4
REVISED
DRAWING NO.
M00-120



APPENDIX B

1ST LARSON COULEE REGIONAL
GRAVITY/FORCEMAIN SYSTEM

MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA

WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS

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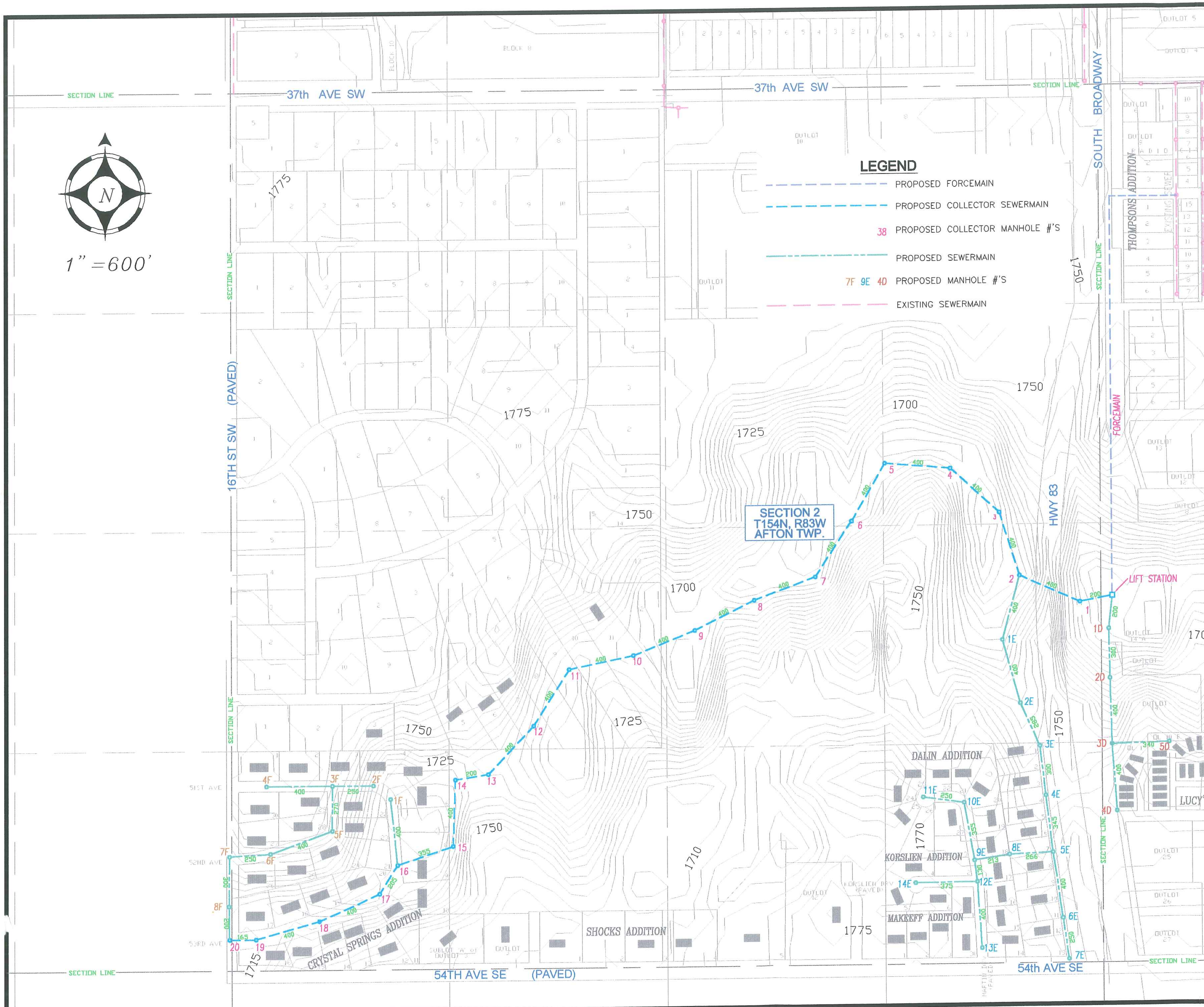
MINOT, NORTH DAKOTA
720 WESTERN AVE.
P.O. BOX 1815 – 58702
(701) 852-0338

BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 – 58502
(701) 258-9227

SCALE	1"=600'
DRAWN BY	CAB
CHECKED BY	JJM
DATE	03-01-02
SHEET	3 OF 4
REVISED	
DRAWING NO.	M00-120



APPENDIX B

1ST LARSON COULEE REGIONAL GRAVITY/FORCEMAIN SYSTEM

MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA

WOLD ENGINEERING, P.C.
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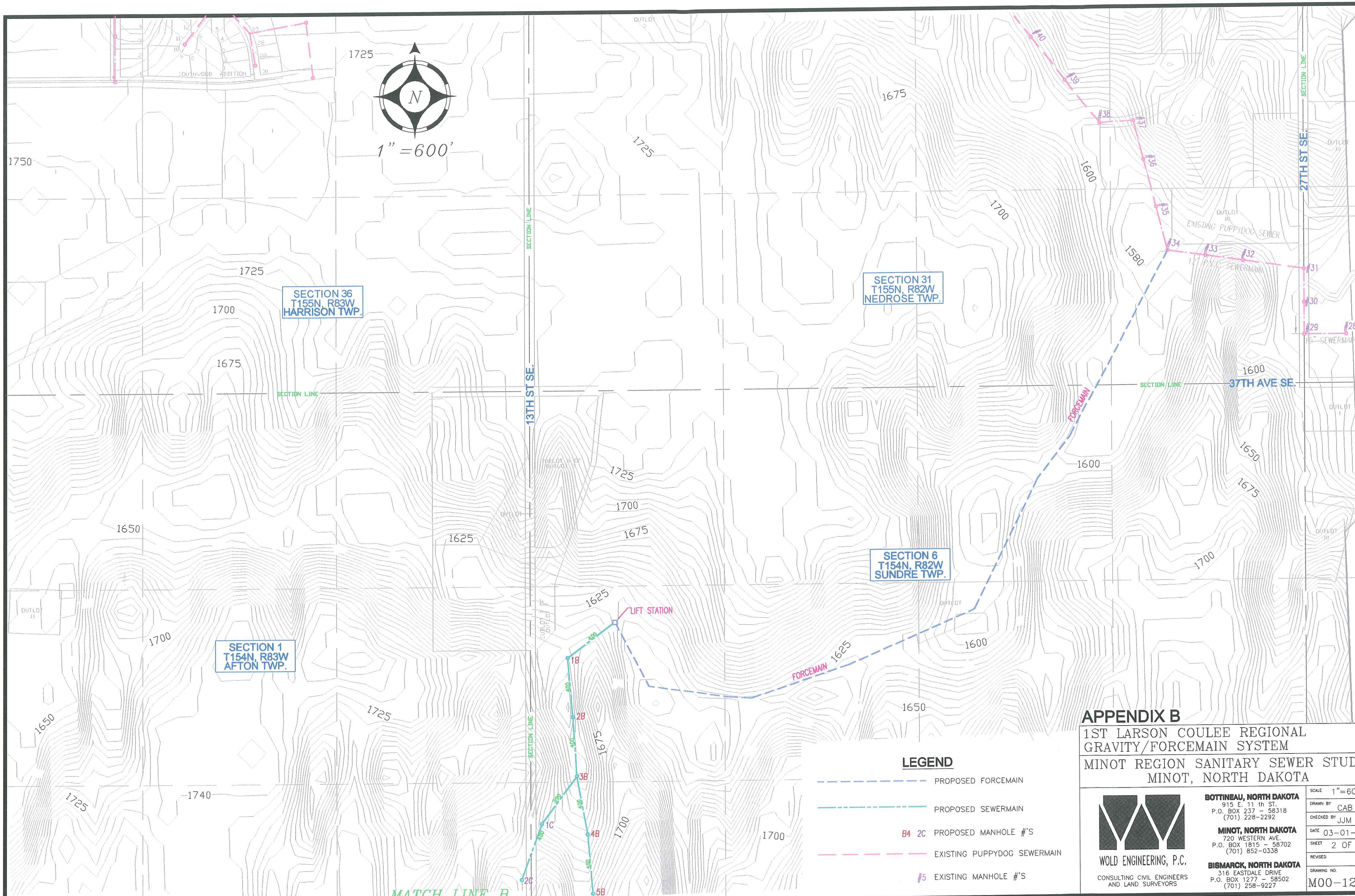
BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 - 58502
(701) 258-9227

SCALE	1"=600'
DRAWN BY	CAB
CHECKED BY	JJM
DATE	03-01-02
SHEET	4 OF 4
REVISED	
DRAWING NO.	M00-120



APPENDIX B

1ST LARSON COULEE REGIONAL GRAVITY/FORCEMAIN SYSTEM

MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA

WOLD ENGINEERING, P.C.
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BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 - 58502
(701) 258-9227

SCALE	1"=600'
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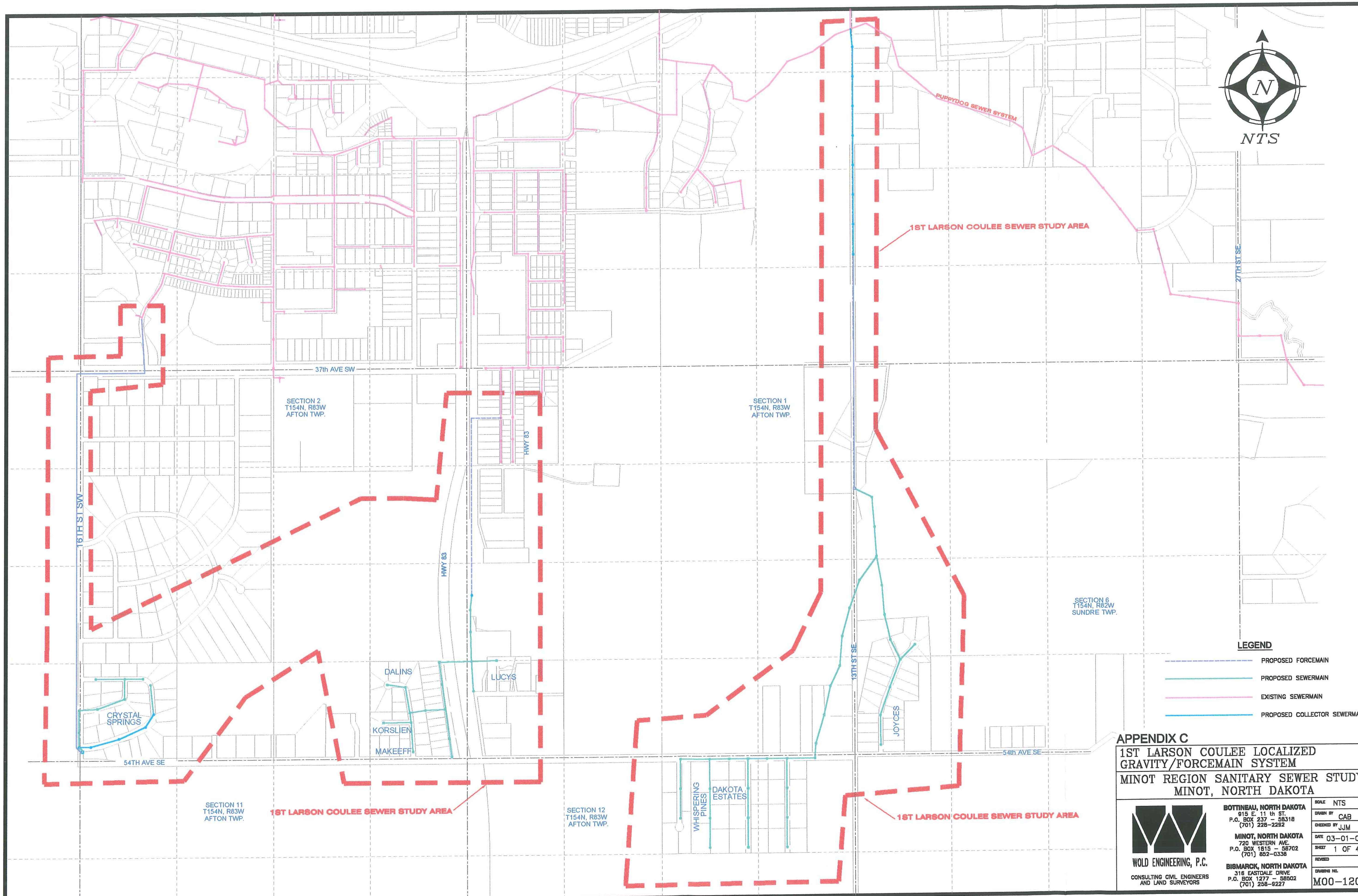
N
NTS
PUPPYDOG SEWER SYSTEM
1ST LARSON COULEE SEWER STUDY AREA
27TH ST SE
37th AVE SW
SECTION 2
T154N, R83W
AFTON TWP.
SECTION 1
T154N, R83W
AFTON TWP.
HWY 83
16TH ST SW
HWY 83
SECTION 6
T154N, R82W
SUNDRE TWP.
13TH ST SE
LEGEND
PROPOSED FORCEMAIN
PROPOSED SEWERMAIN
EXISTING SEWERMAIN
PROPOSED COLLECTOR SEWERMAIN
DALINS
LUCYS
CRYSTAL
SPRINGS
KORSLIEN
MAKEEFF
JOYCES
54th AVE SE
54TH AVE SE
WHISPERING
PINES
DAKOTA
ESTATES
SECTION 11
T154N, R83W
AFTON TWP.
1ST LARSON COULEE SEWER STUDY AREA
SECTION 12
T154N, R83W
AFTON TWP.
1ST LARSON COULEE SEWER STUDY AREA
APPENDIX C
1ST LARSON COULEE LOCALIZED
GRAVITY/FORCEMAIN SYSTEM
MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA
WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS
AND LAND SURVEYORS
BOTTINEAU, NORTH DAKOTA
915 E. 11 th ST.
P.O. BOX 237 – 58318
(701) 228-2292
MINOT, NORTH DAKOTA
720 WESTERN AVE.
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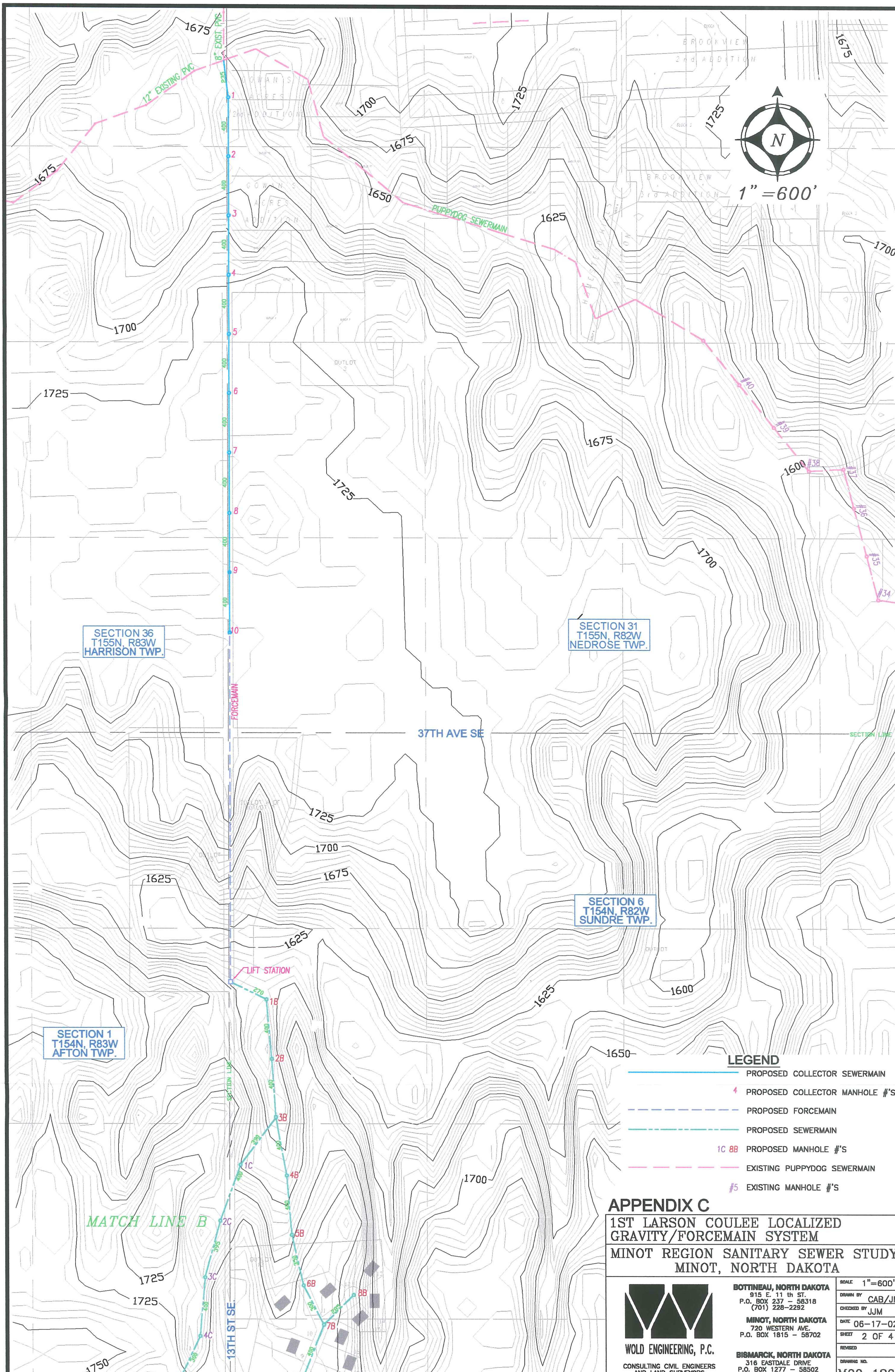
(701) 852-0338
BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 – 58502
(701) 258-9227
SCALE NTS
DRAWN BY CAB
CHECKED BY JJM
DATE 03-01-02
SHEET 1 OF 4
REVISED
DRAWING NO.
M00-120



LEGEND

- PROPOSED COLLECTOR SEWERMAIN
- 4 PROPOSED COLLECTOR MANHOLE #'S
- PROPOSED FORCEMAIN
- PROPOSED SEWERMAIN
- 1C 8B PROPOSED MANHOLE #'S
- EXISTING PUPPYDOG SEWERMAIN
- #5 EXISTING MANHOLE #'S

APPENDIX C

1ST LARSON COULEE LOCALIZED GRAVITY/FORCEMAIN SYSTEM

MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA

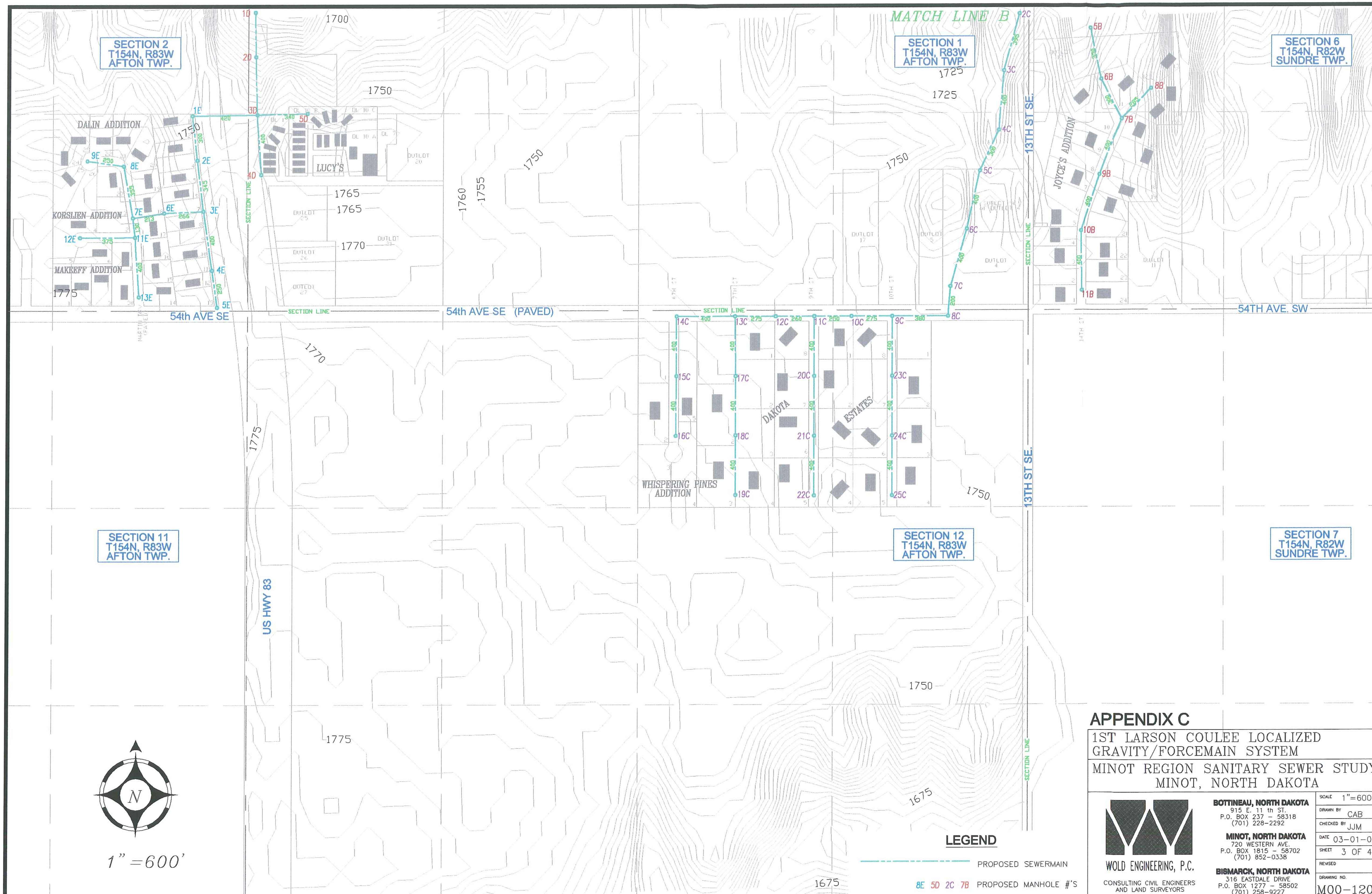
WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS

BOTTINEAU, NORTH DAKOTA
915 E. 11 th ST.
P.O. BOX 237 – 58318
(701) 228–2292

MINOT, NORTH DAKOTA
720 WESTERN AVE.
P.O. BOX 1815 – 58702

BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 – 58502
(701) 258–9227

SCALE	1"=600'
DRAWN BY	CAB/JM
CHECKED BY	JJM
DATE	06-17-02
SHEET	2 OF 4
REVISED	
DRAWING NO.	M00-120



APPENDIX C

1ST LARSON COULEE LOCALIZED GRAVITY/FORCEMAIN SYSTEM

MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA

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BISMARCK, NORTH DAKOTA
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P.O. BOX 1277 – 58502
(701) 258-9227

SCALE	1"=600'
DRAWN BY	CAB
CHECKED BY	JJM
DATE	03-01-02
SHEET	3 OF 4
REVISED	
DRAWING NO.	M00-120

APPENDIX C

1ST LARSON COULEE LOCALIZED GRAVITY/FORCEMAIN SYSTEM

MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA

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SCALE	1"=600'
DRAWN BY	CAB
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DATE	03-01-02
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REVISED	
DRAWING NO.	M00-120

CHAPARELLE STUDY AREA

The Chaparelle Study Area includes the Chaparelle Addition, Sundre Valley, and County Road 19 Additions northwest of Sundre Valley Addition to 37^{th} Avenue SE.

The Chaparelle study area for Option 1 is shown in Appendix A and Option 2 is shown in Appendix B.

I. The Chaparelle Study Area for Option 1 encompasses an analysis of the following subdivisions for sanitary sewer systems:

Chaparelle Addition

Sundre Valley Addition

County Road 19 Homes Northwest of Sundre Valley Addition to 37th Ave SE

Our analysis of this study area looked at the present platted subdivisions and rural outlots within the study area. We also sized the gravity system on County Road 19 and the lift station in the Chaparelle Addition to permit future growth for this option. Future growth is limited by the coulees and steep valley hillsides. We looked at the possibility of a package treatment system or a conventional sewage lagoon system. These options were discounted because the study area immediately adjoins the Puppy Dog sewer system.

Appendix A provides our analysis of the sewer system for the Option 1 study area. A centralized gravity sewer system combined with a lift station and force main due to the topography will serve these areas very well.

The following is our analysis of costs for this Option 1 sewer system.

ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
CHAPARELLE STUDY AREA
GRAVITY/FORCE MAIN SEWER SYSTEM
(Appendix A)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	Lift Station	1	LS	150,000.00	$ 150,000.00
2.	18" Sanitary Sewer Main	1,600	LF	50.00	80,000.00
3.	15" Sanitary Sewer Main	1,825	LF	40.00	73,000.00
4.	12" Sanitary Sewer Main	1,600	LF	35.00	56,000.00
5.	8" Sanitary Sewer Main	3,490	LF	25.00	87,250.00
6.	Manholes	26	EA	3,000.00	78,000.00
7.	Sewer Services	83	EA	1,000.00	83,000.00
8.	Force Main	3,500	LF	25.00	87,500.00
9.	Remove & Replace Aggregate Base	1,800	TON	10.00	18,000.00
10.	Cl. 13 Aggregate Base	600	TON	12.00	7,200.00
11	Right of Way Restoration	1	LS	25,000.00	25,000.00
12.	Right of Way Acquisition	2	AC	2,000.00	4,000.00
13.	Remove & Replace Hot Bituminous Pavement	5,400	LF	40.00	216,000.00
14.	Connect to Existing Sewer	1	LS	1,000.00	1,000.00
	TOTAL Construction				965,950.00
	Contingency 10%				96,595.00
	Engineering 12%				115,914.00
	Administration & Financing 16%				154,552.00
	TOTAL				$1,333,011.00

July 15, 2002

Roger E. Kluck, P.E.

Wold Engineering, P.C.
720 Western Avenue
Minot, ND 58701

Since the Engineer 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, his opinion of probable Project cost and Construction Costs provided herein are made on the basis of his experience and qualifications and represent his best judgement as an experienced and qualified professional engineer, familiar with the construction industry. The Engineer cannot and does not guarantee nor warranty, expressed or implied, that proposals, bid, or actual Project or Construction Costs will not vary from opinions of probable cost prepared by him.

II. The Chaparelle Study Area for Option 2 is shown in Appendix B.

This option uses a force main and lift station from the Chaparelle area to tie directly into the Puppy Dog lift station. The remainder of the project is the same as in Option 1. The following is the cost analysis for this option.

ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
CHAPARELLE STUDY AREA
GRAVITY/FORCE MAIN SEWER SYSTEM
(Appendix B)

	Description	Quantity	Unit	Unit Price	Subtotal
1.	Lift Station	1	LS	150,000.00	$ 150,000.00
2.	12" Sanitary Sewer Main	6,225	LF	35.00	217,875.00
3.	8" Sanitary Sewer Main	2,290	LF	25.00	57,250.00
4.	Manholes	26	EA	3,000.00	78,000.00
5.	Sewer Services	83	EA	1,000.00	83,000.00
6.	Force Main	4,800	LF	25.00	120,000.00
7.	Remove & Replace Aggregate Base	1,800	TON	10.00	18,000.00
8.	Cl. 13 Aggregate Base	600	TON	12.00	7,200.00
9	Right of Way Restoration	1	LS	25,000.00	25,000.00
10.	Right of Way Acquisition	2	AC	2,000.00	4,000.00
11.	Remove & Replace Hot Bituminous Pavement	5,400	LF	40.00	216,000.00
12.	Connect to Existing Sewer	1	LS	1,000.00	1,000.00
13.	Highway Bore	200	LF	900.00	20,000.00
14.	Railroad Bore	50	LF	100.00	5,000.00
15.	Connect to Lift Station	1	LS	5,000.00	5,000.00
	TOTAL Construction				$ 1,07,325.00
	Contingency 10%				100,732.50
	Engineering 12%				120,879.00
	Administration & Financing 16%				161,172.00
	TOTAL				$ 1,390,108.50

July 15, 2002

Roger E. Kluck, P.E.

Wold Engineering, P.C.
720 Western Avenue
Minot, ND 58701

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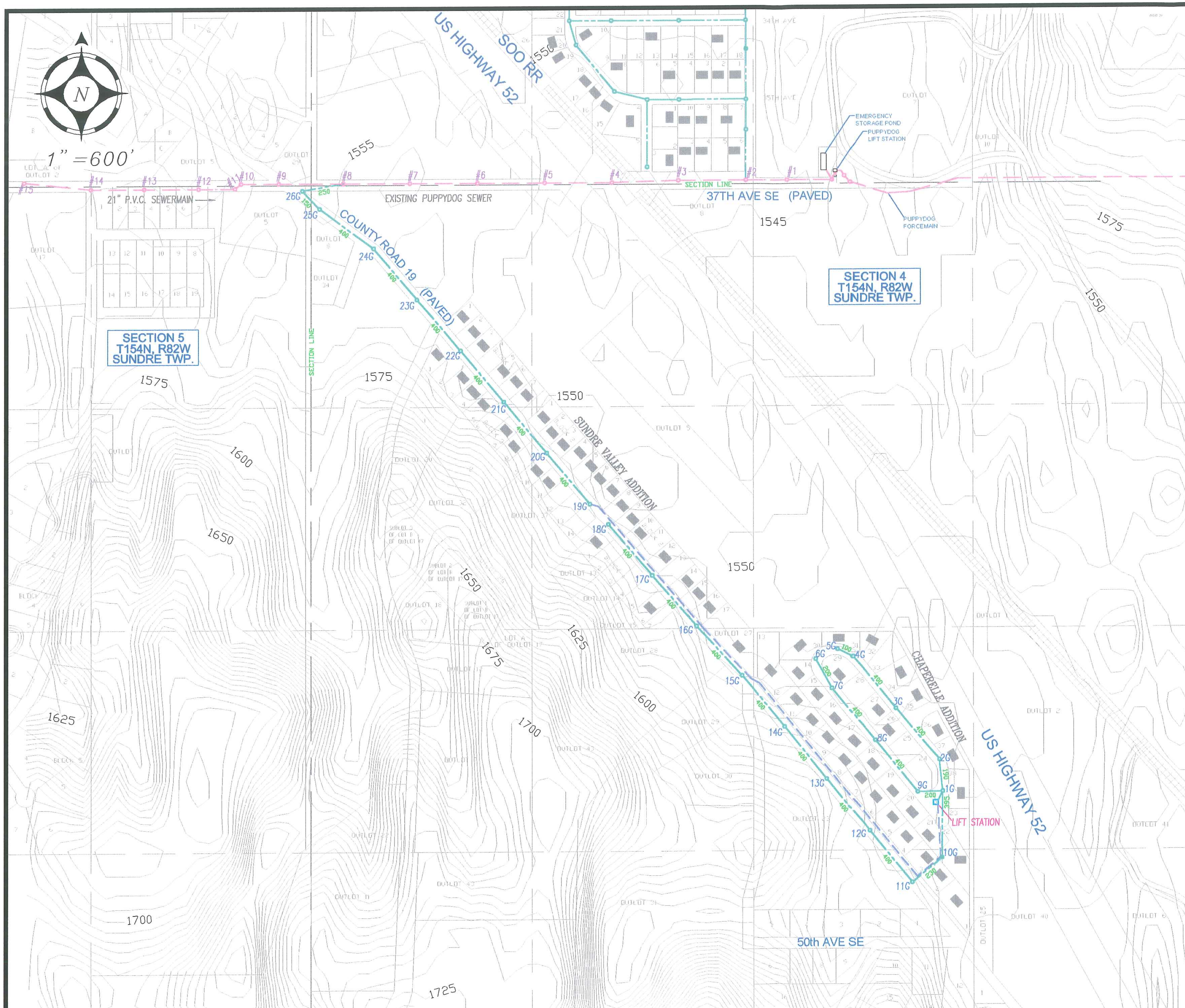
The following table summarized Options 1 & 2

<u>Gravity/Force Main sewer System Option 1</u>	
Chaparelle Study Area	$ 1,333,011.00
<u>Gravity/Force Main Sewer System Option 2</u>	
Chaparelle Study Area	$ 1,390,108.50



LEGEND

- PROPOSED FORCEMAIN
- PROPOSED SEWERMAIN
- 1A 2G PROPOSED MANHOLE #'S
- EXISTING PUPPYDOG SEWERMAIN
- #5 EXISTING MANHOLE #'S

APPENDIX A

CHAPERELLE AREA STUDY

MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA

WOLD ENGINEERING, P.C.
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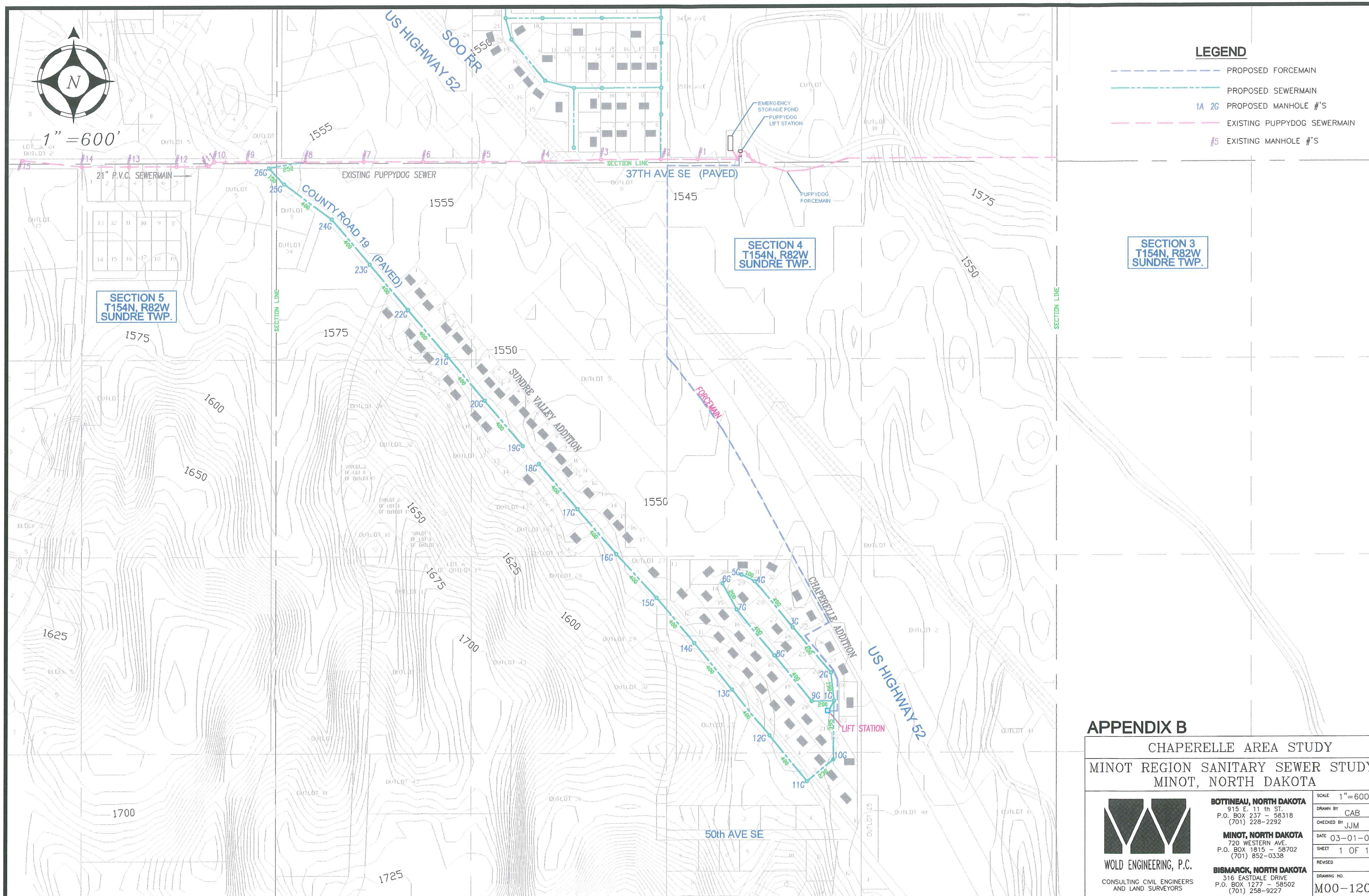
P.O. BOX 1277 – 58502
(701) 258-9227

SCALE	1"=600'
DRAWN BY	CAB
CHECKED BY	JJM
DATE	03-01-02
SHEET	1 OF 1
REVISED	
DRAWING NO.	M00-120

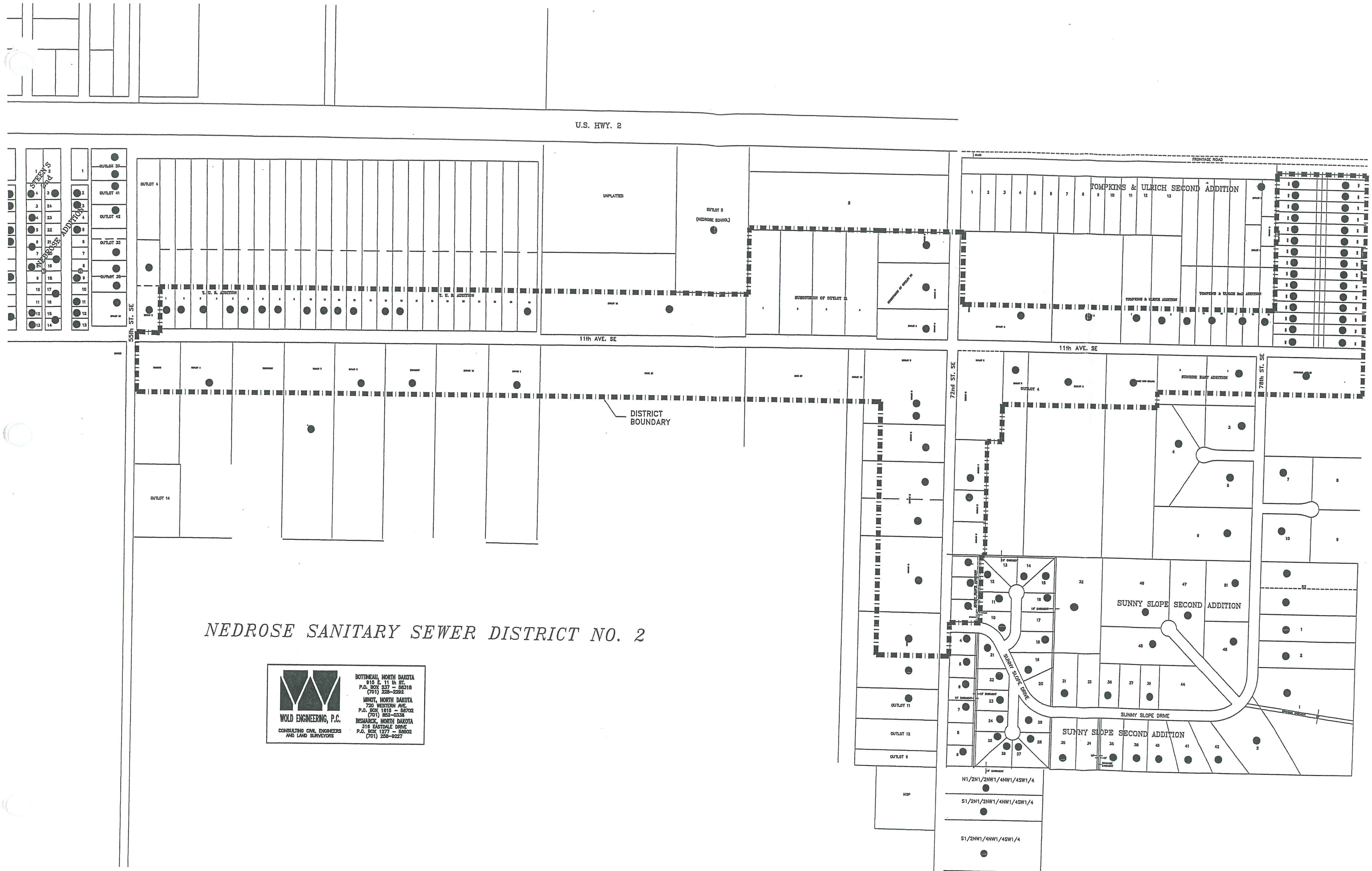


N
1" =600'
LEGEND
PROPOSED FORCEMAIN
PROPOSED SEWERMAIN
1A 2G PROPOSED MANHOLE #'S
EXISTING PUPPYDOG SEWERMAIN
#5 EXISTING MANHOLE #'S
US HIGHWAY 52
SOO RR
21" P.V.C. SEWERMAIN
EXISTING PUPPYDOG SEWER
SECTION LINE
37TH AVE SE (PAVED)
EMERGENCY STORAGE POND
PUPPYDOG LIFT STATION
PUPPYDOG FORCEMAIN
COUNTY ROAD 19 (PAVED)
SECTION 5 T154N, R82W SUNDRE TWP.
SECTION 4 T154N, R82W SUNDRE TWP.
SECTION 3 T154N, R82W SUNDRE TWP.
SUNDRE VALLEY ADDITION
FORCEMAIN
CHAPERELLE ADDITION
LIFT STATION
50th AVE SE
APPENDIX B
CHAPERELLE AREA STUDY
MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA
WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS
BOTTINEAU, NORTH DAKOTA
915 E. 11 th ST.
P.O. BOX 237 - 58318
(701) 228-2292
MINOT, NORTH DAKOTA
720 WESTERN AVE.
P.O. BOX 1815 - 58702
(701) 852-0338
BISMARCK, NORTH DAKOTA
316 EASTDALE DRIVE
P.O. BOX 1277 - 58502
(701) 258-9227
SCALE 1"=600'
DRAWN BY CAB
CHECKED BY JJM
DATE 03-01-02
SHEET 1 OF 1
REVISED
DRAWING NO. M00-120

NEDROSE ADDITION STUDY AREA

The Nedrose Addition study area is shown in Appendix A:

The Nedrose Addition study area encompasses three streets south of Highway 2. These streets area 52nd, 53rd, and 54th Street Southeast. These three sewer lines that are shown connect to an existing sewer line in 11th Avenue that was installed as part of the Minot Mill Economic Development project. The Minot Mill sewer main was installed in part using a Federal EDA Grant. Additionally, the Nedrose School area is served by a sanitary sewer main that was completed in 2001. This project is depicted on the following page:


U.S. HWY. 2
NEDROSE SANITARY SEWER DISTRICT NO. 2
DISTRICT BOUNDARY
11th AVE. SE
55th ST. SE
72nd ST. SE
78th ST. SE
STEN'S 2nd
NEDROSE ADDITION
UNPLATTED
OUTLOT 4
OUTLOT 14
OUTLOT 11
OUTLOT 12
FRONTAGE ROAD
TOMPKINS & ULRICH SECOND ADDITION
SUNNY SLOPE SECOND ADDITION
SUNNY SLOPE DRIVE
N1/2N1/2NW1/4NW1/4SW1/4
S1/2N1/2NW1/4NW1/4SW1/4
S1/2NW1/4NW1/4SW1/4
WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS
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915 E. 11 th ST.
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(701) 228-2292
MINOT, NORTH DAKOTA
720 WESTERN AVE.
P.O. BOX 1918 – 58702
(701) 852-0338
BISMARCK, NORTH DAKOTA
318 EASTDALE DRIVE
P.O. BOX 1277 – 58502
(701) 258-9227

The Nedrose Sanitary Sewer District No. 2 was funded through the State Revolving Fund low interest loan fund. The Ward County Water Resource District was the sponsoring agency for this project. The project was also underwritten in part by the Water Resource District setting the cost per initial hookup at $5,600.00. Assessments were set at a 20 year payoff.

Currently there are 77 existing lots. There are potentially five (5) more lots that could be platted. The total potential lots is 82.

Appendix A provides our analysis of the sewer system for this study area. A centralized gravity sewer system was planned for this area when the Minot Mill Sanitary Sewer Main project was built. The following is our analysis of costs for this sewer system.

ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
NEDROSE ADDITION STUDY AREA GRAVITY SEWER SYSTEM

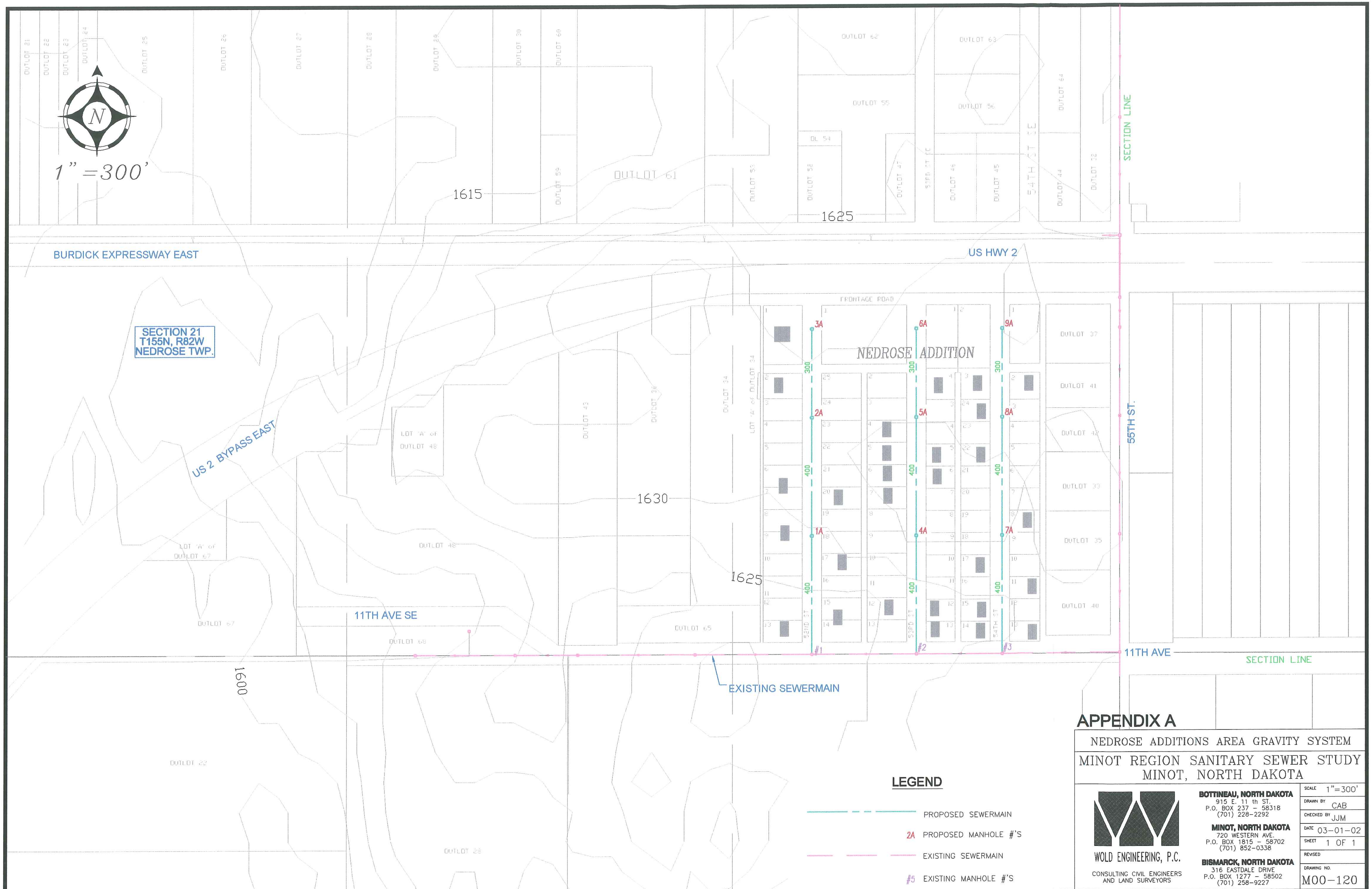
	Description	Quantity	Unit	Unit Price	Subtotal
1.	8" Sanitary Sewer Main	3,300	LF	25.00	$ 82,500.00
2.	Manholes	9	EA	3,000.00	27,000.00
3.	Sewer Services (potential)	77	EA	1,000.00	77,000.00
4.	Remove & Replace Aggregate Base	1,900	TON	10.00	19,000.00
5.	Cl. 13 Aggregate Base	500	TON	12.00	6,000.00
6.	Remove & Replace Hot Bituminous Pavement	1,125	LF	40.00	45,000.00
7.	Connect to Existing Sewer	3	EA	1,000.00	3,000.00
8.	Right of Way Restoration	1	LS	7,500.00	7,500.00
	TOTAL Construction				$ 267,000.00
	Contingency 10%				26,700.00
	Engineering 12%				32,040.00
	Administration & Financing 16%				42,720.00
	TOTAL				$ 368,460.00

July 15, 2002

Roger E. Kluck, P.E.

Wold Engineering, P.C.
720 Western Avenue
Minot, ND 58701

Since the Engineer 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, his opinion of probable Project cost and Construction Costs provided herein are made on the basis of his experience and qualifications and represent his best judgement as an experienced and qualified professional engineer, familiar with the construction industry. The Engineer cannot and does not guarantee nor warranty, expressed or implied, that proposals, bid, or actual Project or Construction Costs will not vary from opinions of probable cost prepared by him.



N
1" = 300'
BURDICK EXPRESSWAY EAST
US HWY 2
SECTION LINE
SECTION 21
T155N, R82W
NEDROSE TWP.
US 2 BYPASS EAST
NEDROSE ADDITION
FRONTAGE ROAD
55TH ST.
11TH AVE SE
11TH AVE
EXISTING SEWERMAIN
1615
1625
1630
1600
OUTLOT 61
3A
2A
1A
6A
5A
4A
9A
8A
7A
#1
#2
#3
300
400
APPENDIX A
NEDROSE ADDITIONS AREA GRAVITY SYSTEM
MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA
LEGEND
PROPOSED SEWERMAIN
2A PROPOSED MANHOLE #'S
EXISTING SEWERMAIN
#5 EXISTING MANHOLE #'S
WOLD ENGINEERING, P.C.
CONSULTING CIVIL ENGINEERS
AND LAND SURVEYORS
BOTTINEAU, NORTH DAKOTA
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SCALE 1"=300'
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DATE 03-01-02
SHEET 1 OF 1
REVISED
DRAWING NO. M00-120

LIGHTHALLS, BREKKE, LEITE'S , SORENSON'S & BEHM TRUCKSTOP STUDY AREA

The Lighthalls, Brekke, Leite's, Sorenson's and Behm Truckstop study area is shown in Appendix A:

The study area encompasses the following additions on the west edge of Minot:

Lighthalls Subdivision Brekke Subdivision Leite's Subdivision	43 existing/46 potential
Sorenson's Additions, South of Bypass	48 existing/8 potential
Behm's Truckstop Area	13 existing/32 potential
Future Development West of Sorenson's	94 potential
TOTAL	284 lots

This number is the combined total of current and potential lots for development. The map currently shown 104 lots platted.

Currently a housing development is in the planning stages on 27th St. SW, north of Lighthall's Subdivision. These potential hookups are included in the cost opinion. This development plans to go forward in 2002 if the right funding mix can be worked out.

A centralized lagoon system or package treatment system was looked at for this area. These options were not feasible because both systems would have to be built in the flood plain. These systems would also have been costly to maintain. The collection system shown in Appendix A was the most cost appropriate solution for these development areas. The following is our analysis of costs for this sewer main collection system:

ENGINEER'S PRELIMINARY OPINION OF PROBABLE COST
LIGHTHALL'S, BREKKE,LEITE'S, SORENSON'S,
& BEHMS TRUCKSTOP AREA STUDY AREA
GRAVITY/FORCE MAIN SANITARY SEWER SYSTEM

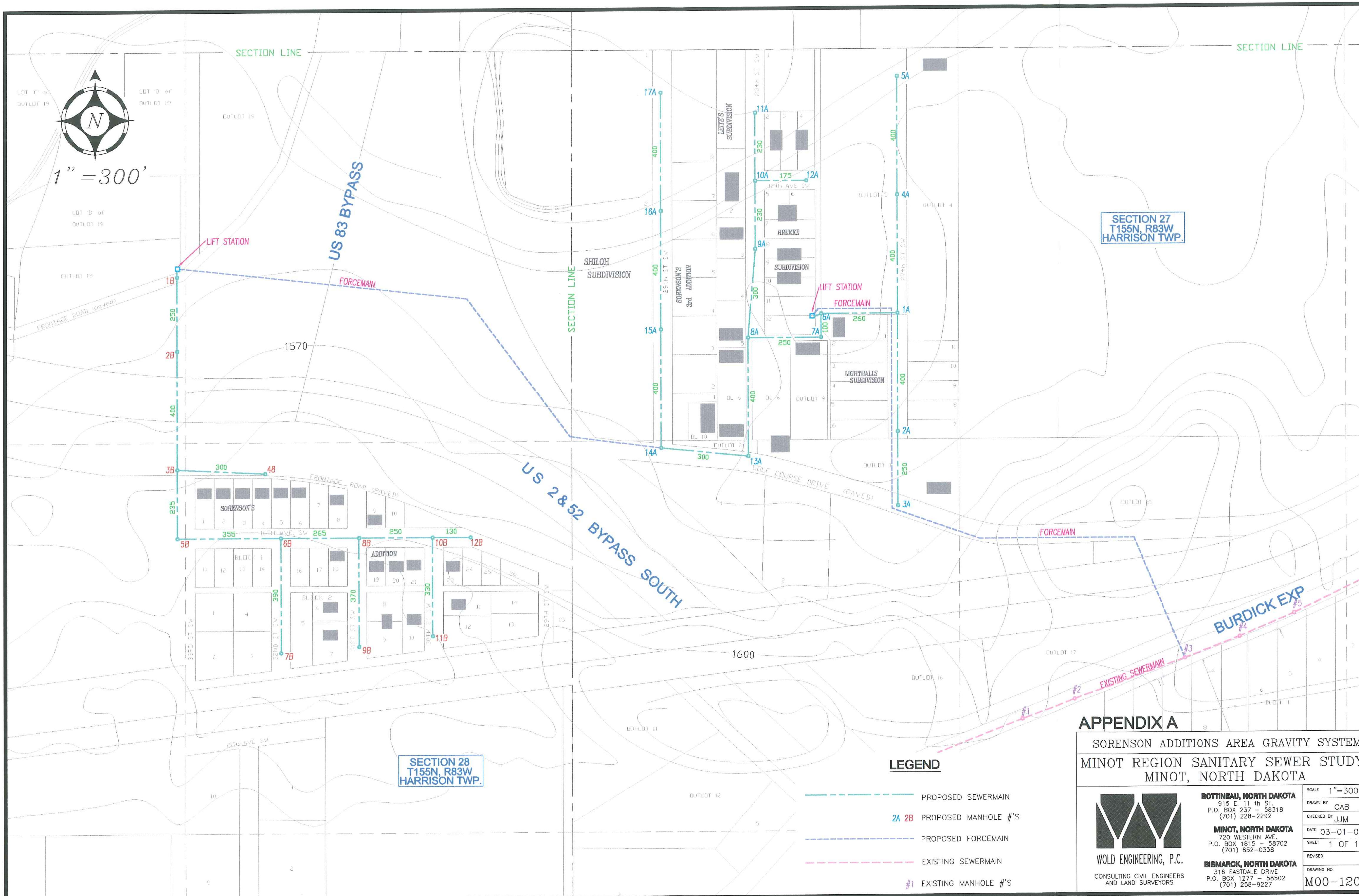
	Description	Quantity	Unit	Unit Price	Subtotal
1.	8" Sanitary Sewer Main	4,635	LF	25.00	$ 115,875.00
2.	Manholes	29	EA	3,000.00	87,000.00
3.	Connect to Existing Sewer	1	EA	1,000.00	1,000.00
4.	Sewer Services (potential)	104	EA	1,000.00	104,000.00
5.	Force Main	4,150	LF	20.00	83,000.00
6.	Lift Station	2	EA	100,000.00	200,000.00
7.	Bore Highway (gravity)	200	LF	150.00	30,000.00
8.	Bore Highway & Railroad (Force Main)	450	LF	150.00	67,500.00
9.	Remove & Replace Aggregate Base	3,300	TON	10.00	33,000.00
10.	Cl. 13 Aggregate Base	900	TON	12.00	10,800.00
11	Right of Way Restoration	1	LS	10,000.00	10,000.00
12.	Right of Way Acquisition (30')	1	AC	2,000.00	2,000.00
13.	Remove & Replace Hot Bituminous Pavement	700	LF	40.00	28,000.00
	TOTAL Construction				$ 772,175.00
	Contingency 10%				77,217.50
	Engineering 12%				92,661.00
	Administration & Financing 16%				123,548.00
	TOTAL				$ 1,065,601.50

July 17, 2002

Roger E. Kluck, P.E.

Wold Engineering, P.C.
720 Western Avenue
Minot, ND 58701

Since the Engineer 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, his opinion of probable Project cost and Construction Costs provided herein are made on the basis of his experience and qualifications and represent his best judgement as an experienced and qualified professional engineer, familiar with the construction industry. The Engineer cannot and does not guarantee nor warranty, expressed or implied, that proposals, bid, or actual Project or Construction Costs will not vary from opinions of probable cost prepared by him.



APPENDIX A
SORENSON ADDITIONS AREA GRAVITY SYSTEM
MINOT REGION SANITARY SEWER STUDY
MINOT, NORTH DAKOTA
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REVISED
DRAWING NO. M00-120
LEGEND
PROPOSED SEWERMAIN
2A 2B PROPOSED MANHOLE #'S
PROPOSED FORCEMAIN
EXISTING SEWERMAIN
#1 EXISTING MANHOLE #'S
1" =300'
N
SECTION LINE
SECTION 27
T155N, R83W
HARRISON TWP.
SECTION 28
T155N, R83W
HARRISON TWP.
US 83 BYPASS
US 2&52 BYPASS SOUTH
BURDICK EXP
LIFT STATION
FORCEMAIN
EXISTING SEWERMAIN
SHILOH SUBDIVISION
SORENSON'S 3rd ADDITION
LEITE'S SUBDIVISION
BREKKE SUBDIVISION
LIGHTHALLS SUBDIVISION
SORENSON'S ADDITION
FRONTAGE ROAD (PAVED)
GOLF COURSE DRIVE (PAVED)
1570
1600

SUMMARY AND RECOMMENDATION

The basis of this study and report was to analyze potential growth areas for the city of Minot, to analyze and study areas experiencing failures in private sanitary sewer systems, and to analyze the capacity of the existing Puppy Dog sanitary sewer system. The growth areas have been analyzed and described in Tab 3.

Tabs 4 – 7 analyze the areas experiencing private sanitary sewer system failures. The opinions of probable cost are summarized in the following table:

<u>First Larson Coulee Gravity Sewer System - Option 1 Appendix A</u>

Eastside Estates	$ 963,930.00	
First Larson Coulee Collection System	1,845,750.00	
Joyce's Subdivision, Dakota Estates & Whispering Pines	1,005,157.50	
Lucy's Amusement Park/Mobile Home Park	111,780.00	
Dalen, Korslien, & Makeeff Area	320,367.00	
Crystal Springs Area Additions	306,429.00	
		$ 4,553,413.50

<u>First Larson Coulee Gravity/Force Main Sewer System - Option 2 Appendix B</u>

Eastside Estates	$ 963,930.00	
Joyce's Subdivision/Dakota Estates & Whispering Pines	1,561,987.50	
Lucy's Amusement Park/Mobile Home Park; Dalen, Korslien, & Makeeff Area Additions; and Crystal Springs Area Additions	1,886,391.00	
		$ 4,412,308.50

<u>First Larson Coulee Force Main/Gravity Sewer System Hybrid - Option 3 Appendix C</u>

Eastside Estates Gravity System	$ 963,930.00	
Joyce's Subdivision, Dakota Estates & Whispering Pines (Gravity & Force Main System)	1,646,271.00	
First Larson Coulee Localized System, & Crystal Springs Area (Gravity & Force Main System)	1,472,115.00	
Lucy's Amusement Park/Mobile Home Park; Dalen, Korslien, and Makeeff Area Additions (Gravity & Force Main System)	1,025,340.00	
		$ 5,107,656.00

Revised 11-18-02

Chaparelle Study Area, Option 1	$ 1,333,011.00
Chaparelle Study Area, Option 2	$ 1,390,108.50
Nedrose Addition	$ 368,460.00
Lighthall's, Brekke, Leite's, Sorenson's & Behm's Truckstop Area Additions	$ 1,065,601.50

LOT ANALYSIS OF EXISTING, POTENTIAL ALONG ROUTE, AND EXTERIOR POTENTIAL LOT CONNECTIONS

First Larson Coulee Gravity Sewer System, Option 1, Appendix A

Eastside Estates	
Existing Lots	159
Potential Lots Along Route	33
Exterior Potential Lots in Growth Areas	46
	238 Lots
Joyce's Subdivision, Dakota Estates & Whispering Pines	
Existing Lots	59
Potential Lots Along Route	14
Exterior Potential Lots in Growth Areas	370
	443 Lots
Lucy's Amusement Park/Mobile Home Park	
Existing Lots	6
Potential Lots Along Route	0
Exterior Potential Lots in Growth Areas	83
	89 Lots
Dalen, Korslien & Makeeff Area	
Existing Lots	34
Potential Lots Along Route	0
Exterior Potential Lots in Growth Areas	9
	43 Lots
Crystal Springs Area Additions	
Existing Lots	30
Potential Lots Along Route	3
Exterior Potential Lots in Growth Areas	481
	514 Lots
TOTAL	1,327 Lots

Revised 11-18-02

First Larson Coulee Gravity/Force Main Sewer System, Option 1, Appendix B

Eastside Estates	
Existing Lots	159
Potential Lots Along Route	33
Exterior Potential Lots in Growth Areas	46
	238 Lots
Joyce's Subdivision/Dakota Estates & Whispering Pines	
Existing Lots	59
Potential Lots Along Route	14
Exterior Potential Lots in Growth Areas	370
	443 Lots
Lucy's Amusement Park/Mobile Home Park; Dalen, Korslien & Makeeff Area Additions; & Crystal Springs Area Additions	
Existing Lots	64
Potential Lots Along Route	4
Exterior Potential Lots in Growth Areas	578
	646 Lots
TOTAL	1,327 Lots

First Larson Coulee Force Main/Gravity Sewer System Hybrid, Option C, Appendix C

Eastside Estates	
Existing Lots	159
Potential Lots Along Route	33
Exterior Potential Lots in Growth Areas	46
	238 Lots
Joyce's Subdivision, Dakota Estates & Whispering Pines	
Existing Lots	68
Potential Lots Along Route	64
Exterior Potential Lots in Growth Areas	418
	550 Lots
First Larson Coulee Localized System & Crystal Springs Area Additions	
Existing Lots	30
Potential Lots Along Route	3
Exterior Potential Lots in Growth Areas	481
	514 Lots
Lucy's Amusement Park/Mobile Home Park; Dalen, Korslien & Makeeff Area Additions	
Existing Lots	39
Potential Lots Along Route	0
Exterior Potential Lots in Growth Areas	92
	131 Lots
TOTAL	1,433 Lots

Chaparelle Study Area, Option 1 or 2	
Existing Lots	83
Potential Lots Along Route	23
Exterior Potential Lots in Growth Areas	165
TOTAL	271 Lots

Nedrose Addition	
Existing Lots	77
Potential Lots Along Route	0
Exterior Potential Lots in Growth Areas	5
TOTAL	82 Lots

Lighthalls, Brekke, Leite's	
Existing Lots	43
Potential Lots	46
Total	89 Lots
Sorenson's Addition	
Existing Lots	48
Potential Lots	8
Total	56 Lots
Area West of Sorenson's Addition	
Potential Lots	94 Lots
Behm's Truckstop Area	
Existing Lots	13
Potential Lots	32
Total	45 Lots
TOTAL	284 Lots

COST PER LOT SUMMARY TABLE

Analysis based upon current platted lots to be connected, potential lots along route, and potential growth area lots to share in initial system cost.

First Larson Coulee Gravity Sewer System, Option 1, Appendix A

Eastside Estates, Gravity Sewer System, Appendix A	$963,930.00 = 238 Lots	$4,100.00/Lot
First Larson Coulee Collection System (CHARGED TO ALL LOTS) This option except Eastside Estates	$1,845,750.00 = 1,089 Lots	$1,700.00/Lot
Joyce's Subdivision, Dakota Estates & Whispering Pines Gravity Sewer System, Appendix A	$1,005,175.50 = 443 Lots	$2,269.00/Lot
Lucy's Amusement Park/Mobile Home Park Gravity Sewer System, Appendix A	$111,780.00 = 89 Lots	$1,300.00/Lot
Dalen, Korslien & Makeeff Area Additions, Gravity Sewer System, Appendix A	$320,367.00 = 43 Lots	$7,500.00/Lot
Crystal Springs Area Additions, Gravity Sewer System, Appendix A	$306,429.00 = 514 Lots	$600.00/Lot
Complete Appendix A System, First Larson Coulee (except Eastside Estates)	$3,589,501.50 = 1,089 Lots	$3,296.00/Lot

First Larson Coulee Gravity Sewer System, Option 2, Appendix B

Eastside Estates	$963,930.00 / 238 Lots =	$4,100.00/Lot
Joyce's Subdivision, Dakota Estates & Whispering Pines, Gravity & Force Main Sewer System, Appendix B	$1,561,987.50 / 443 Lots =	$3,600.00/Lot
Lucy's Amusement Park/Mobile Home Park; Dalen, Korslien & Makeeff Aarea Additions; & Crystal Springs Area Addition, Gravity & Force Main Sewer System, Appendix B	$1,886,391.00 / 646 Lots =	$3,000.00/Lot
Complete Appendix B System First Larson Coulee (except Eastside Estates)	$3,448,378.50 / 1,089 Lots =	$3,167.00/Lot

Revised 11-18-02

First Larson Coulee Gravity Sewer System, Option 3, Appendix C

Eastside Estates	$963,930.00 = 238 Lots	$4,100.00/Lot
First Larson Coulee Localized System, Joyce's Subdivision, Dakota Estates & Whispering Pines, Gravity & Force Main Sewer System, Appendix C	$1,646,271.00 = 550 Lots	$3,000.00/Lot
First Larson Coulee Localized System & Crystal Springs Area Additions, Gravity & Force Main Sewer System	$1,472,115.00 = 514 Lots	$2,900.00/Lot
First Larson Coulee, Lucy's Amusement Park/Mobile Home Park; Dalen, Korslien & Makeeff Area Additions, Gravity & Force Main Sewer System	$1,025,340.00 = 131 Lots	$7,900.00/Lot
Complete Appendix C System First Larson Coulee (except Eastside Estates)	$4,143,726.00 = 1,089 Lots	$3,805.00/Lot

Revised 11-18-02

Chaparelle Study Area, Option 1	$1,333,011.00 = 271 Lots	$5,000.00/Lot
Chaparelle Study Area, Option 2	$1,390,108.50 = 271 Lots	$5,200.00/Lot
Nedrose Addition	$368,460.00 = 82 Lots	$4,500.00/Lot
Lighthall's, Brekke, Leite's, Sorenson's & Behms Truckstop Area Additions	$1,078,021.50 = 284 Lots	$3,800.00/Lot

Tab 10 provides the Houston Engineering report on the Puppy Dog Coulee collection and pumping system.

During the study period, we reviewed other options for sanitary sewage treatment. Currently, there are four primary options other than conventional sanitary sewer collection systems. These options are:

1. Septic tank and drainfield
2. Nodak or mound system
3. Cromaglass Package Wastewater treatment systems or Biodigester technologies treatment package systems
4. Sewage lagoon

Options 1, 2, and 4 are currently being used in North Dakota and Option 3 is currently being used in neighboring states. Option 1 and 2 are being used in the outlined failure areas. These types of individual treatment systems can easily be overloaded by high water usage. These individual treatment systems are also susceptible to high ground water. Option 3 is very attractive for new subdivisions that are a substantial distance from public sewers. This option is currently used in conjunction with a treated water lagoon for irrigating golf courses and public areas in masterplanned neighborhoods such as ski resorts in Montana. Unfortunately, package treatment systems have not been approved for use in North Dakota. Approximately two years ago, we proposed to use a package treatment plant for a masterplanned subdivision north of Bismarck. The State Health Department agreed to study the issue but would not permit a package treatment plant. We ended up using septic tanks and drainfields on large lots. Option 4 has proven itself in North Dakota. However, this option requires considerable maintenance and is unappealing to close neighbors due to the smell.

CONCLUSION

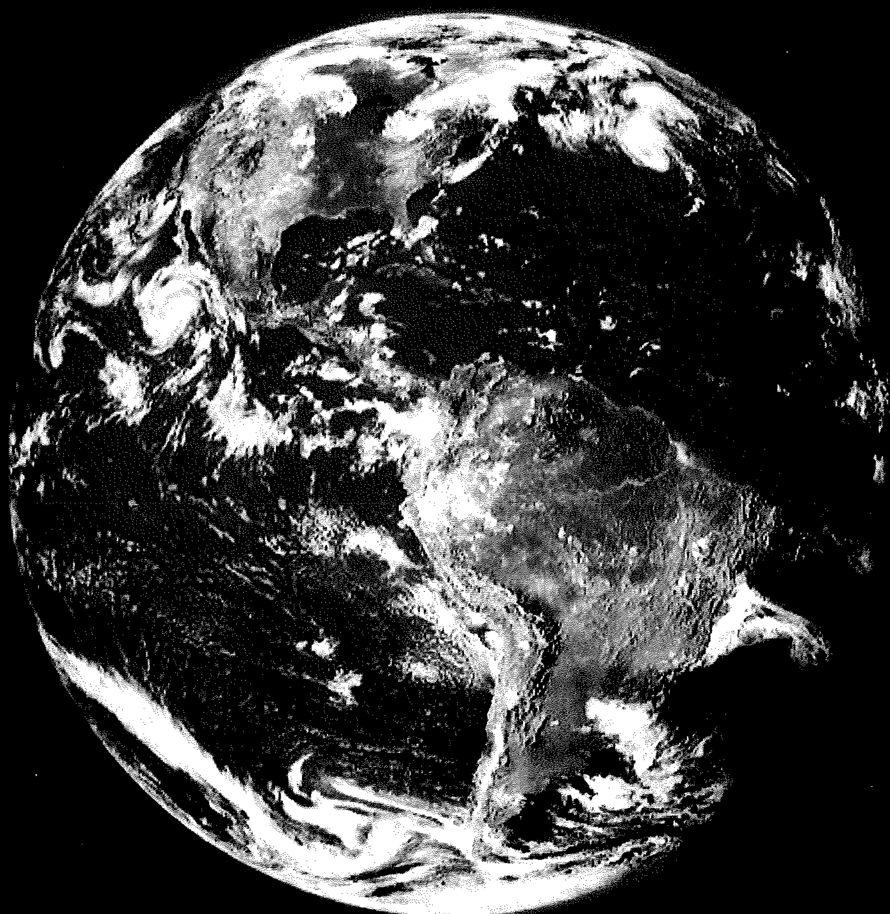
It is our recommendation that new rural subdivisions and all rural lot platting or replatting should include a report certified by a registered professional engineer that covers the following points or issues:

1. Include an area map showing the proposed subdivision/lots showing the proximity to public sanitary sewer using Minot's GIS mapping system.
2. Include a current topographic map of the proposed area.
3. Include a soils report and percolation tests if private sewer systems are being proposed and include system sizing recommendations.
4. Include a preliminary layout of the present/future central sewer collection system so that the homes will be built with the intent of connecting to a central system in the future.
5. Include a recommendation for lot size based upon Item 3.
6. Identify if the proposed development is within 1000 feet of the Sundre Aquifer.
7. Identify in the report that the project will adhere to the new septic tank code if adopted.

The City of Minot should include the Ward County Water Resource District in the approval process for all subdivision/plats outside of the Minot city limits but within Minot's 2-mile planning jurisdiction. This approval is to assure that the Clean Water Act requirements are being adhered to on all rural plats.

We would recommend that the city and county work jointly to pursue funding to begin building the sanitary sewer systems identified in the report in First Larson Coulee. When the First Larson Coulee system is built, the city will need to look at increasing the size of the Puppy Dog sewer system from its connection with the First Larson Coulee system to the Puppy Dog lift station. We would also recommend that the city encourage the North Dakota Health Department to research and approve the use of package treatment plants for rural subdivisions.

Geodetic Control Network for the City of Minot, North Dakota



Prepared by:

Ackerman Surveying & Associates
6008 Hwy 2 East
Minot, North Dakota

TABLE OF CONTENTS

INTRODUCTION / AIM

A high quality, consistent control network is paramount in any survey or geographic information system. In 2001, Ackerman Surveying & Associates, Inc. began the development of a geodetic survey control network that encompasses the majority of the land area within a 25-mile radius of the City of Minot. This report outlines the methods and practices used in establishing such a control network. The adjusted and calibrated final coordinates of the existing and newly installed geodetic control points are also documented within.

Following the recovery of nearly 80 original monuments placed by the United States Coast & Geodetic Survey, the U.S. Geological Survey, and the National Geodetic Survey, measurements were made using both static and kinematic Global Positioning System (GPS) methods. The goal was to maintain a network that had adequate redundancy to ensure accuracy. This was achieved through the use of three dual-frequency Trimble GPS antennas, allowing three distinct baselines to be measured simultaneously with respect to one another.

Horizontal Control

In the development of the horizontal network, four "sub-networks" were created. This was done to reduce the necessary occupation time and to increase the redundancy of the network through measurements to stations common to two or more sub-networks.

The first sub-network (Transport-Base) included two separate phases. The earliest phase included the following stations: Transport, Burlington 2, Burl, Gam, Mayo, Great, M-221, A-276, Surrey, Sou'East, Larson, Harrison, Gassinapp, Minot Reset and G-217. The results of the baseline measurements to Minot Reset were inconclusive due to the station's environment, and as such, were discarded. The second phase of the sub-network included the following additional stations: Twin Buttes, Norwich, Wolseth, Yellow, North 3, Des Lacs, Lacs and Coulee. Solutions from the first sub-network were used for the development of the three subsequent sub-networks.

The second sub-network (Gam-Base) established the positions of the following additional stations: Rising, Sour, Ensign 2, Glenburn, Brace and Fox. In addition, baseline checks were made to North 3, Wolseth, Yellow and Mayo.

The third sub-network (Twin Buttes-Base) established new geodetic positions for the following stations: Ward, Corn 2, Saron 2, Rice, Ramon, Sage, Irwin, Lone, Zion, Butter Reset, Two Hills, Place 2, and Fron. Baseline checks were made to Sou'East, Larson, Burlington 2, Des Lacs, Lacs, Coulee, Gassinapp and Harrison.

The fourth and final subnetwork (Norwich-Base) established the postitions of the following additional stations: Sincoe, Susan, Logan, Coline and Wich 3. This sub-network included redundant baselines to Mayo, Surrey, Rising and Great.

All of the baselines in the network were processed using Transport as a basis. The coordinates published by the National Geodetic Survey were used as the starting point for the station. The solutions generated from the first sub-network were then used to produce baseline solutions for the sub-networks that would follow.

Each sub-network was adjusted slightly (<.015') to account for human, instrumental, and eccentric errors due to measuring, leveling, centering, etc. After the sub-networks were shifted, the coordinate solutions for the stations were obtained.

After the positions were established, the network was adjusted globally to more accurately depict the spatial positions of the individual stations. The adjustment was performed as follows:

First order horizontal stations were assigned a weighing factor of 1; second order stations 1/2; third order stations 1/3. The deviations of each station from the published coordinates were then multiplied by their appropriate factor. The sum of the weighed deviations divided by the sum of the weighing factors represented the global network adjustment. In total, the global network adjustment (horizontal shift) was under 8 centimeters.

At the request of the City of Minot, additional geodetic stations were established within a close vicinity of the city center. These stations (ACKERMAN 1 – ACKERMAN 5) were installed according to National Geodetic Survey guidelines. A detail drawing of an installed monument can be seen in Appendix -C-.

The positions of these stations were established using the calibrated coordinates of the original network. The base station of the survey was set at ACKERMAN 4, a centrally located point in the Minot network, and baselines were measured to the surrounding control points. These points included both existing, calibrated control and the newly established monuments. A calibration was performed following field measurements and the published coordinates are shown within.

Vertical Control

After the static surveying was completed on the horizontal network, kinematic GPS procedures were used to measure baselines extending from Transport to the remaining NGS & USCGS benchmarks within the project vicinity.

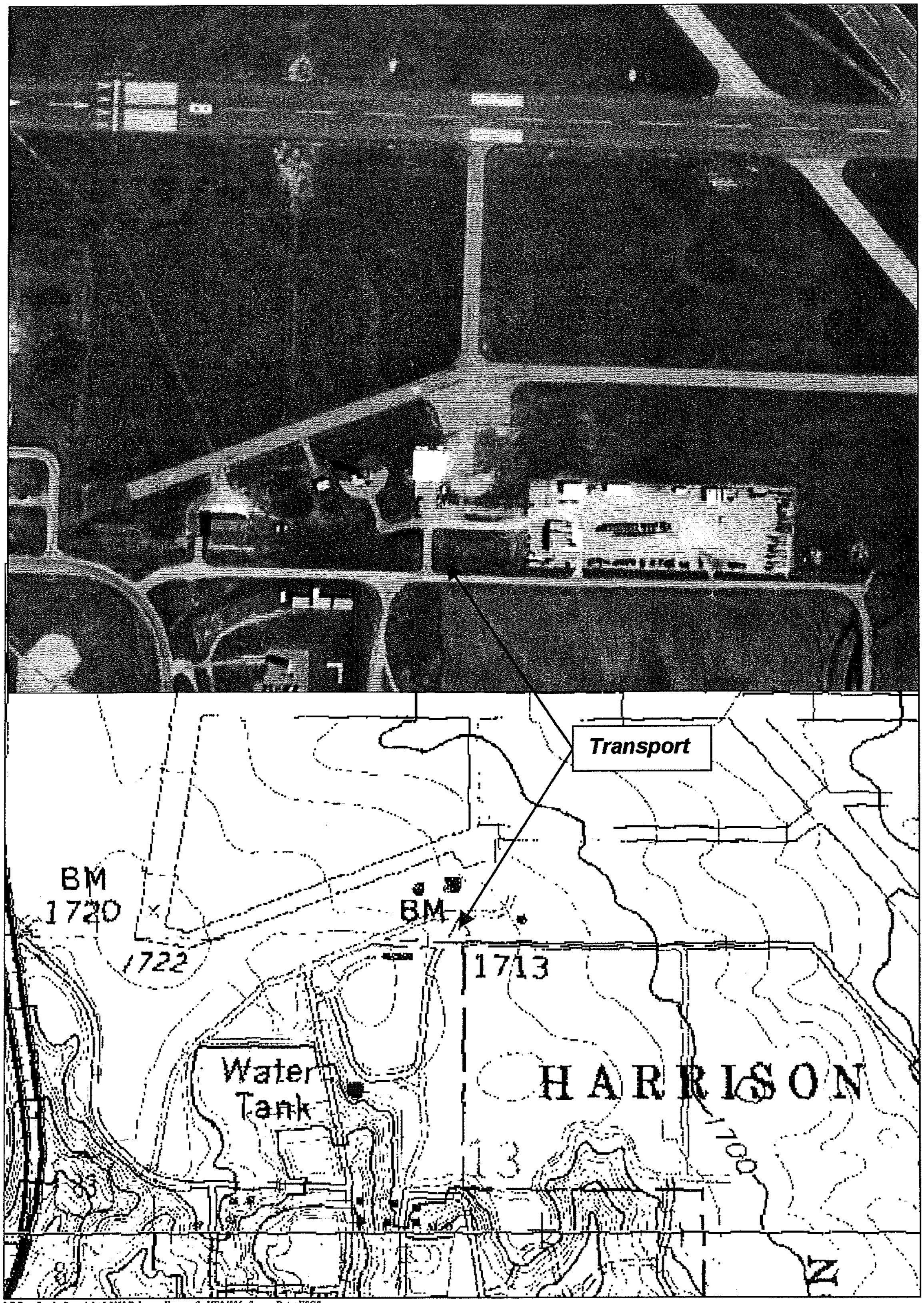
The kinematic solutions were calibrated using those coordinates obtained from the horizontal control network. The elevations published in this report are relative to the City of Minot datum of NGVD 1929.

Those existing benchmarks whose environments were unfavorable for GPS operations (ie. vertical caps in columns or walls) were offset using differential leveling techniques. The offset to the station was then measured and the elevation of the benchmark back-computed accordingly.

HORIZONTAL SURVEY CONTROL NETWORK


HORIZONTAL CONTROL NETWORK
LEGEND
PREVIOUSLY OCCUPIED BASELINES
CITY OF MINOT CONTROL SURVEY BASELINES
SCALE:
1" = 4000'
GASSINARP
HARRISON
SURREY
RMAN SURVEYING
& ASSOCIATES
(701) 838-0786
HWY 2 EAST, MINOT, N.D. 58701

HORIZONTAL CONTROL DATA SHEETS



 148 ft Scale: 1 : 6,400 Detail: 14-0 Datum: WGS84

GEODETIC CONTROL MONUMENT

Station No: 100 ***Station Designation: Transport***

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	*Longitude*	*Ellipsoid Height (sft)*
N 48°15'16.26735"	W 101°17'06.68310"	1646.012

State Plane Coordinates

US Survey Feet

Northing (sft)	*Easting (sft)*	*Elevation (sft)*
458584.162	1777221.600	1713.163

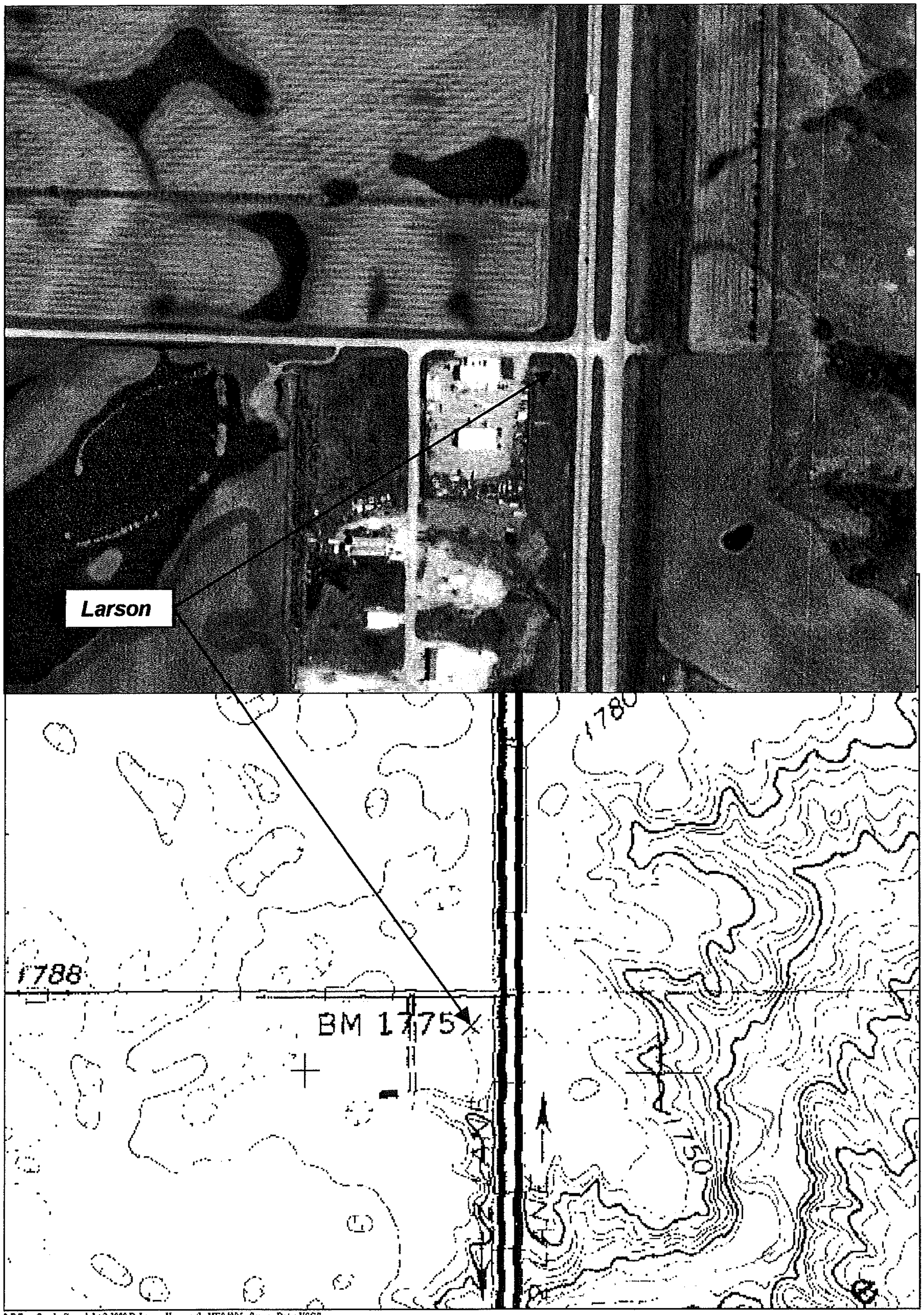
International Feet

Northing (ift)	*Easting (ift)*	*Elevation (ift)*
458585.079	1777225.154	1713.166

Metric

Northing (m)	*Easting (m)*	*Elevation (m)*
139776.732	541698.227	552.173

A detailed station along with original coordinates derived by the National Geodetic Survey and directions to reach the station can be found in Appendix B.



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME04096 Source Data: USGS 148 ft Scale: 1 : 6,400 Detail: 14-0 Datum: WGS84

GEODETIC CONTROL MONUMENT

Station No: 101 **Station Designation: Larson**

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°10'03.61870"	W 101°17'46.00419"	1708.415

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
426932.499	1774233.322	1775.112

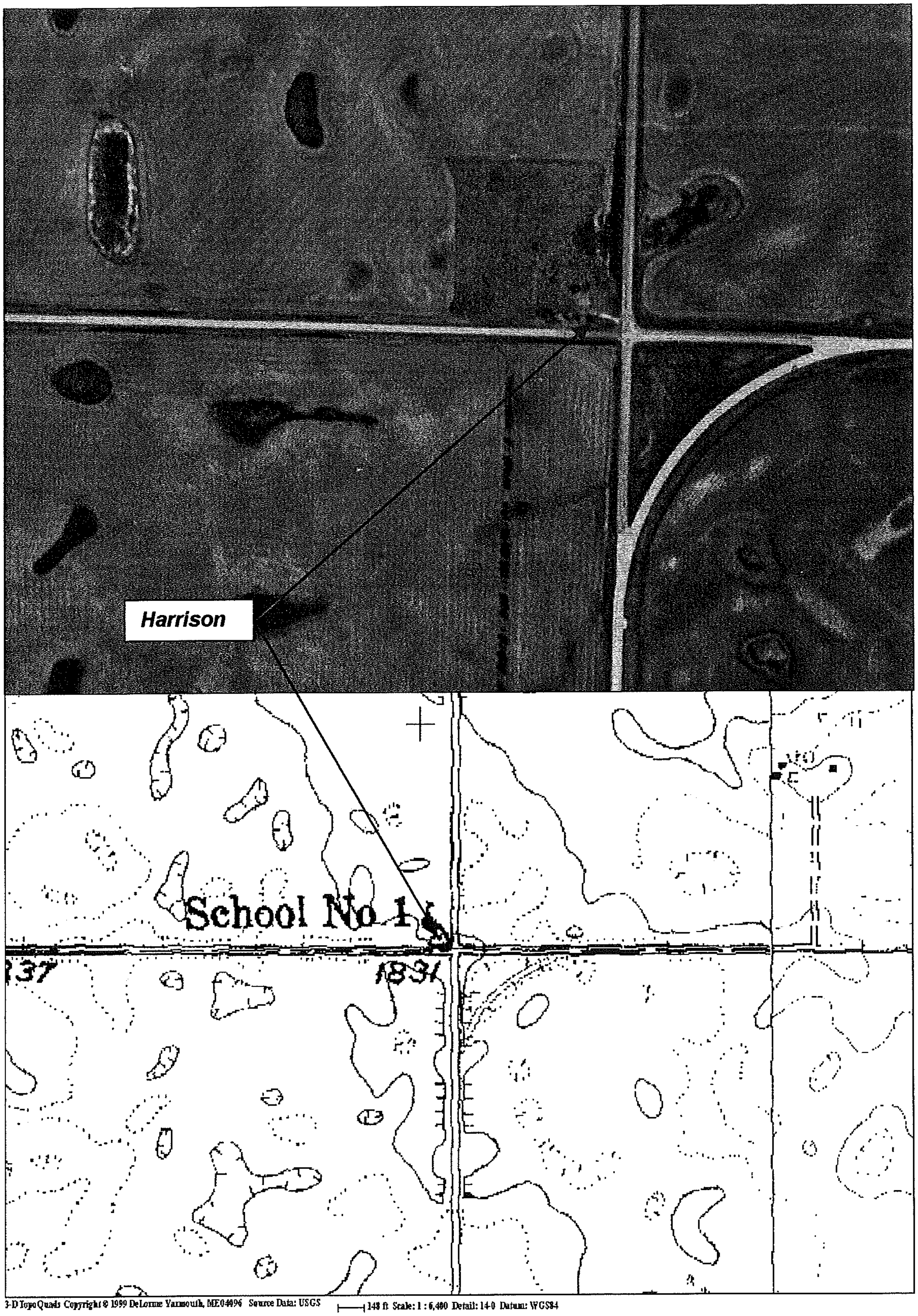
International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
426933.353	1774236.870	1775.116

Metric

Northing (m)	Easting (m)	Elevation (m)
130129.286	540787.398	541.055

A detailed station along with original coordinates derived by the National Geodetic Survey and directions to reach the station can be found in Appendix B.


Harrison
School No 1
1837
1831
3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME04096 Source Data: USGS
148 ft Scale: 1 : 6,400 Detail: 14-0 Datum: WGS84

GEODETIC CONTROL MONUMENT

Station No: 102 **Station Designation: Harrison**

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°11'48.68570"	W 101°22'58.68008"	1764.801

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
437809.262	1753162.147	1830.871

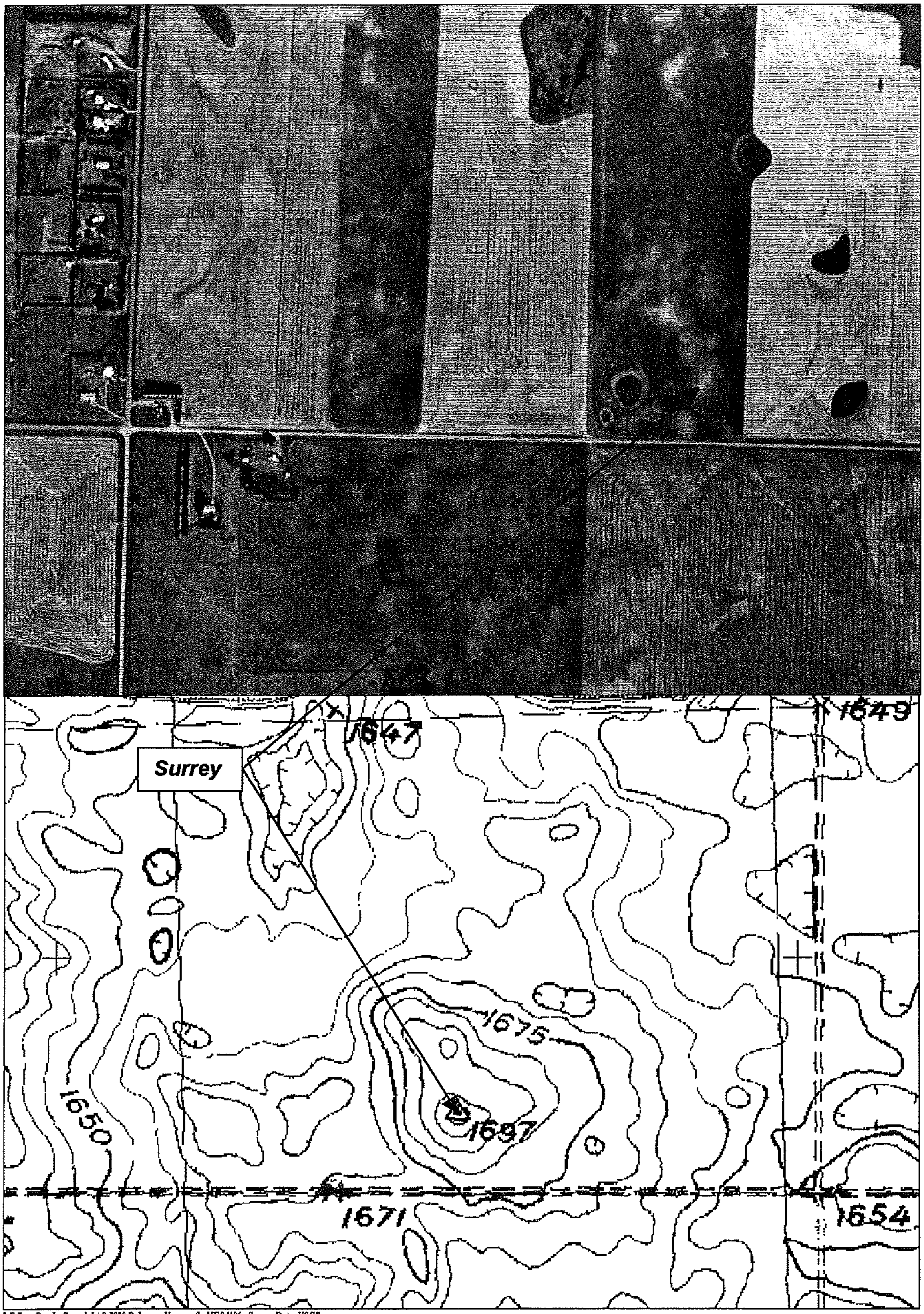
International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
437810.138	1753165.653	1830.875

Metric

Northing (m)	Easting (m)	Elevation (m)
133444.530	534364.891	558.051

A detailed station along with original coordinates derived by the National Geodetic Survey and directions to reach the station can be found in Appendix B.



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME04096 Source Data: USGS
148 ft Scale: 1 : 6,400 Detail: 14-0 Datum: WGS84

GEODETIC CONTROL MONUMENT

Station No: 103 **Station Designation: Surrey**

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°11'51.83434"	W 101°10'27.71053"	1624.934

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
437613.810	1804037.439	1692.600

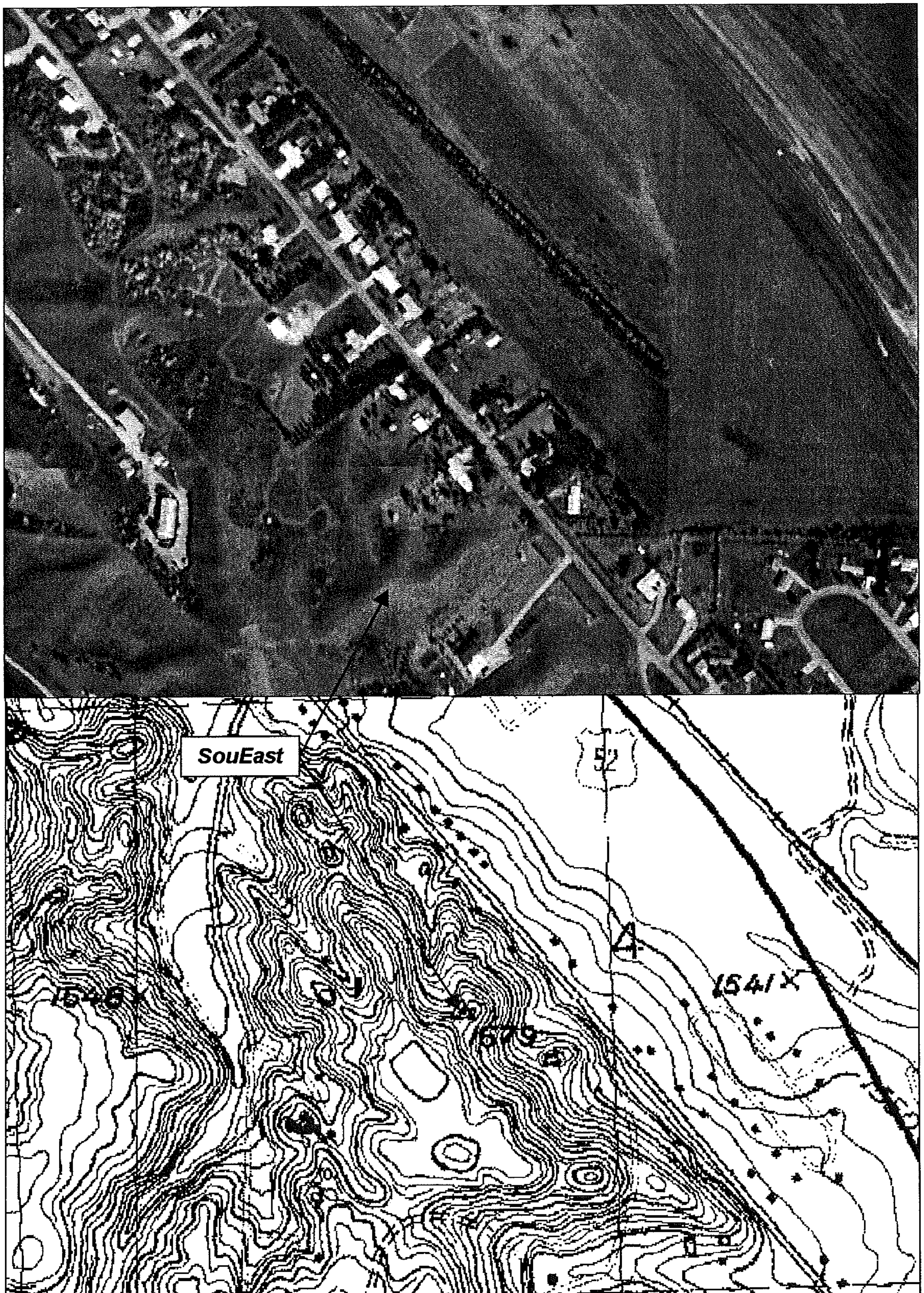
International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
437614.685	1804041.047	1692.603

Metric

Northing (m)	Easting (m)	Elevation (m)
133384.956	549871.711	515.906

A detailed station along with original coordinates derived by the National Geodetic Survey and directions to reach the station can be found in Appendix B.



 148 ft Scale: 1 : 6,400 Detail: 14-0 Datum: WGS84

GEODETIC CONTROL MONUMENT

Station No: 104
Station Designation: SouEast

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°11'20.37532"	W 101°13'25.52020"	1610.499

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
434535.584	1791962.299	1677.835

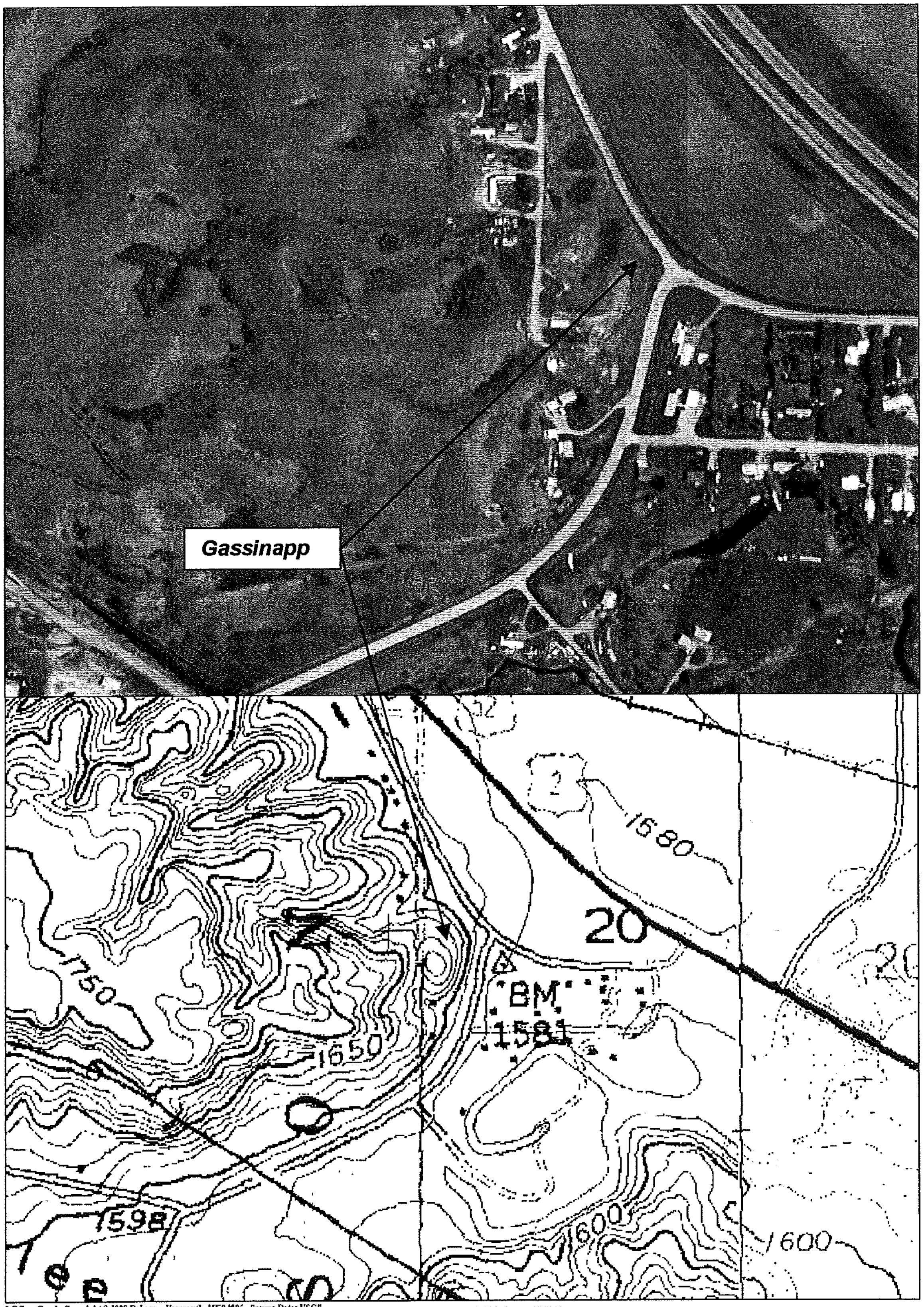
International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
434536.453	1791965.883	1677.838

Metric

Northing (m)	Easting (m)	Elevation (m)
132446.711	546191.201	511.405

A detailed station along with original coordinates derived by the National Geodetic Survey and directions to reach the station can be found in Appendix B.



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GEODETIC CONTROL MONUMENT

Station No: 105

Station Designation: Gassinapp

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°14'00.39965"	W 101°22'54.08838"	1541.477

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
451151.404	1753626.024	1607.774

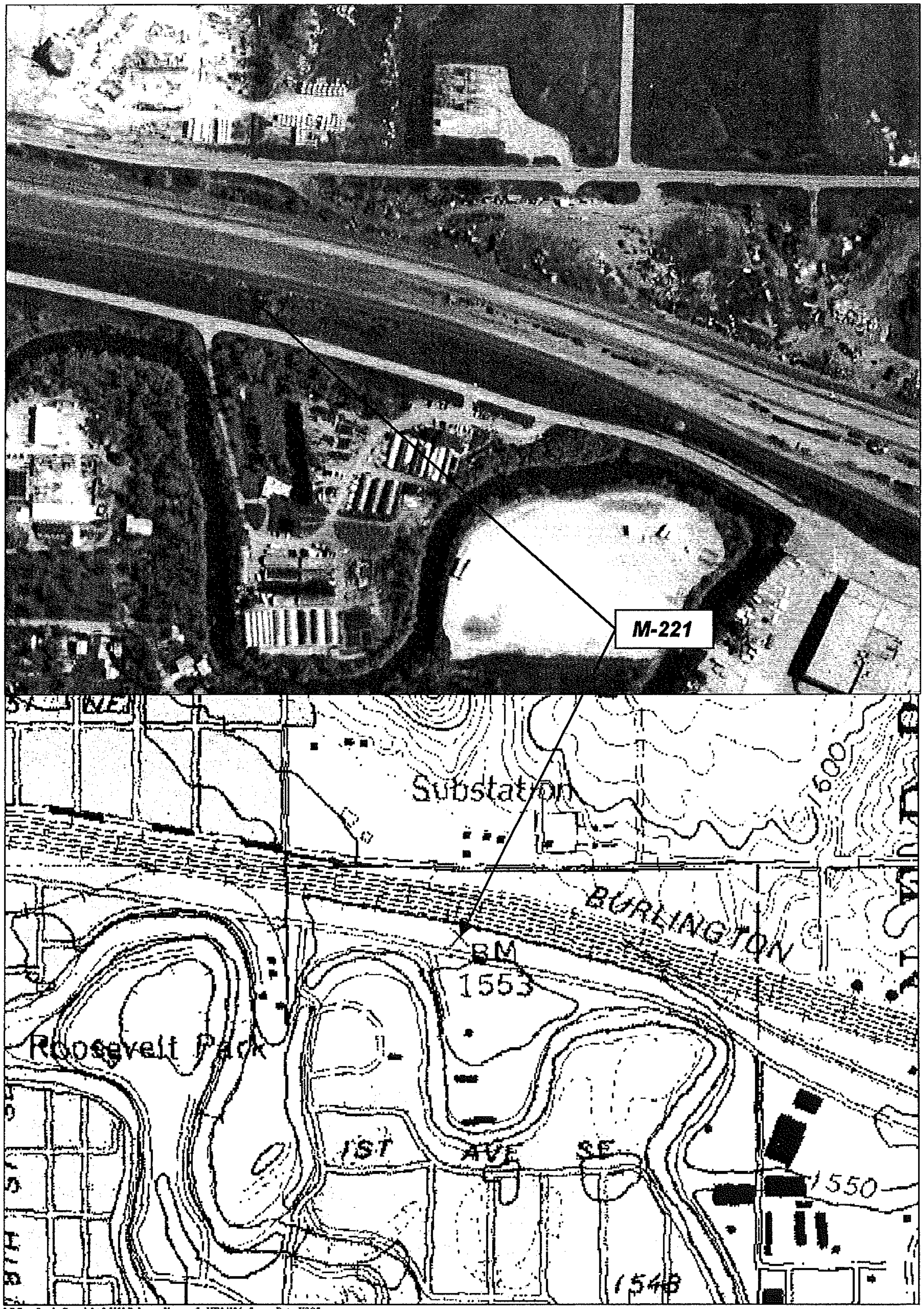
International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
451152.306	1753629.531	1607.777

Metric

Northing (m)	Easting (m)	Elevation (m)
137511.223	534506.281	490.050

A detailed station along with original coordinates derived by the National Geodetic Survey and directions to reach the station can be found in Appendix B.



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GEODETIC CONTROL MONUMENT

Station No: 106 **Station Designation: M-221**

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°14'20.09791"	W 101°16'13.26788"	1485.992

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
452856.243	1780779.080	1552.715

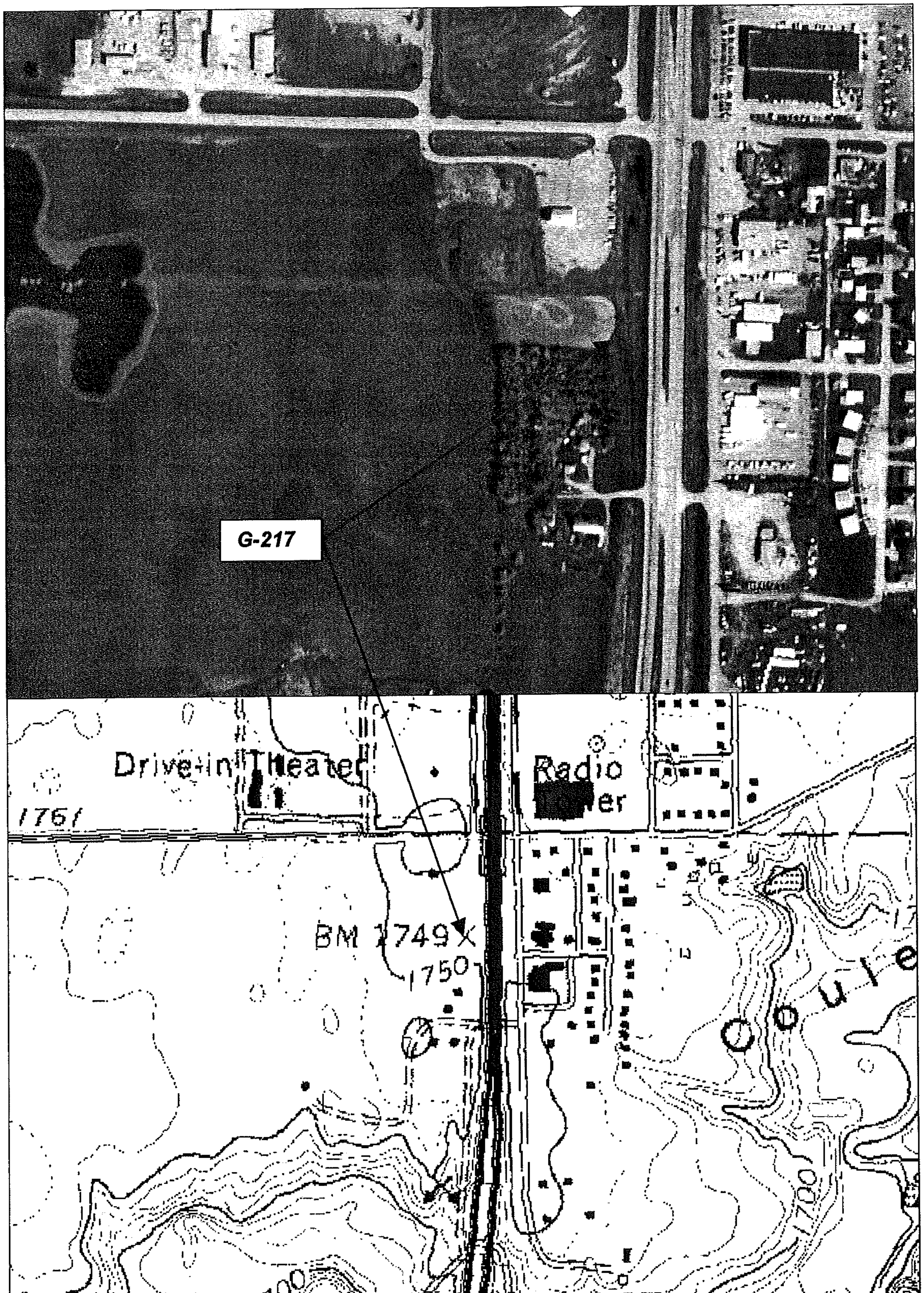
International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
452857.149	1780782.642	1552.718

Metric

Northing (m)	Easting (m)	Elevation (m)
138030.859	542782.549	473.268

A detailed station along with original coordinates derived by the National Geodetic Survey and directions to reach the station can be found in Appendix B.



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GEODETIC CONTROL MONUMENT

Station No: 107

Station Designation: G-217

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°11'41.64296"	W 101°17'47.79692"	1682.766

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
436865.957	1774214.572	1749.148

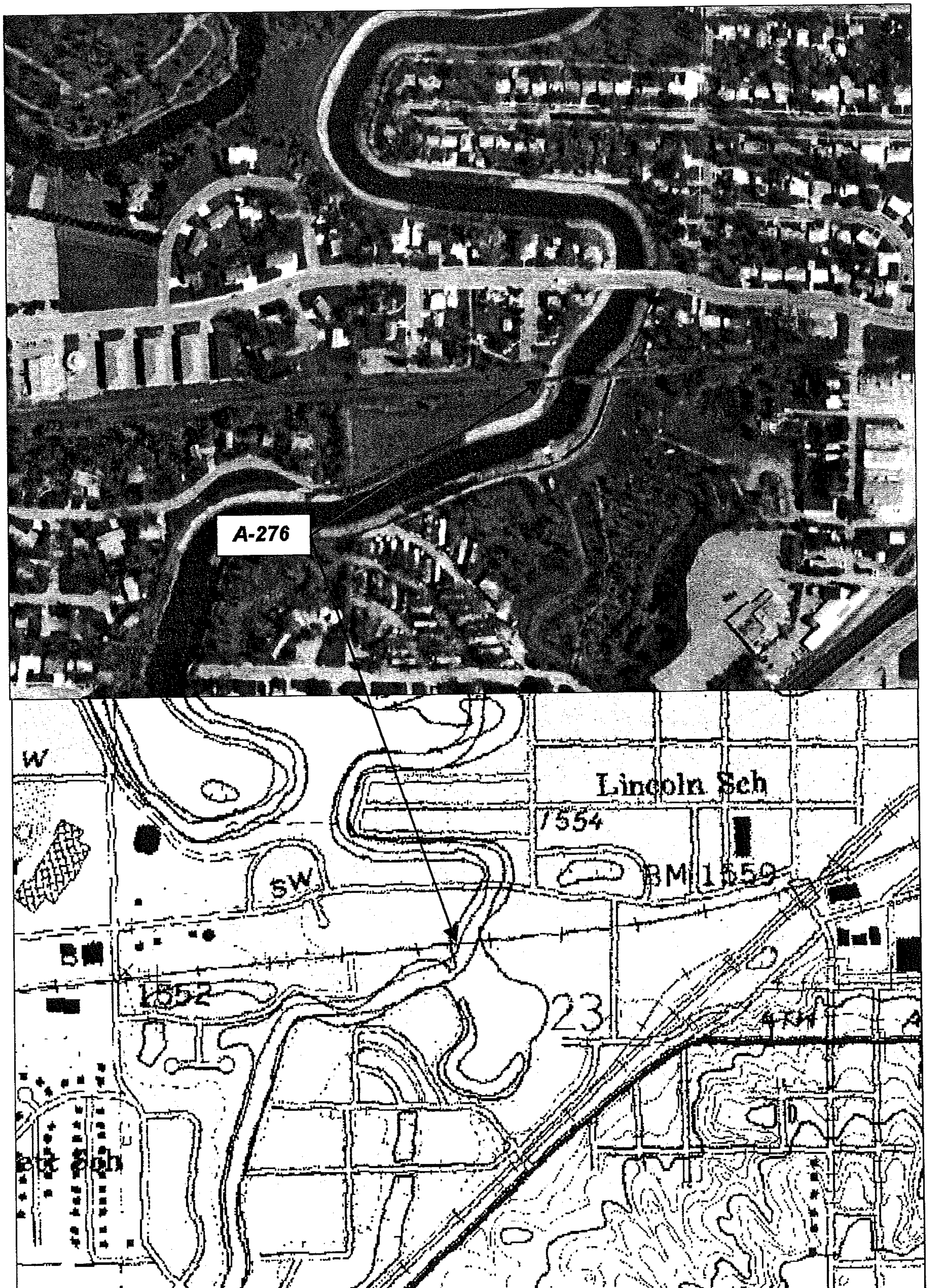
International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
436866.831	1774218.120	1749.151

Metric

Northing (m)	Easting (m)	Elevation (m)
133157.010	540781.683	533.141

A detailed station along with original coordinates derived by the National Geodetic Survey and directions to reach the station can be found in Appendix B.



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GEODETIC CONTROL MONUMENT

Station No: 108

Station Designation: A-276

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°14'02.04742"	W 101°18'35.86360"	1492.640

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
451126.332	1771107.964	1559.070

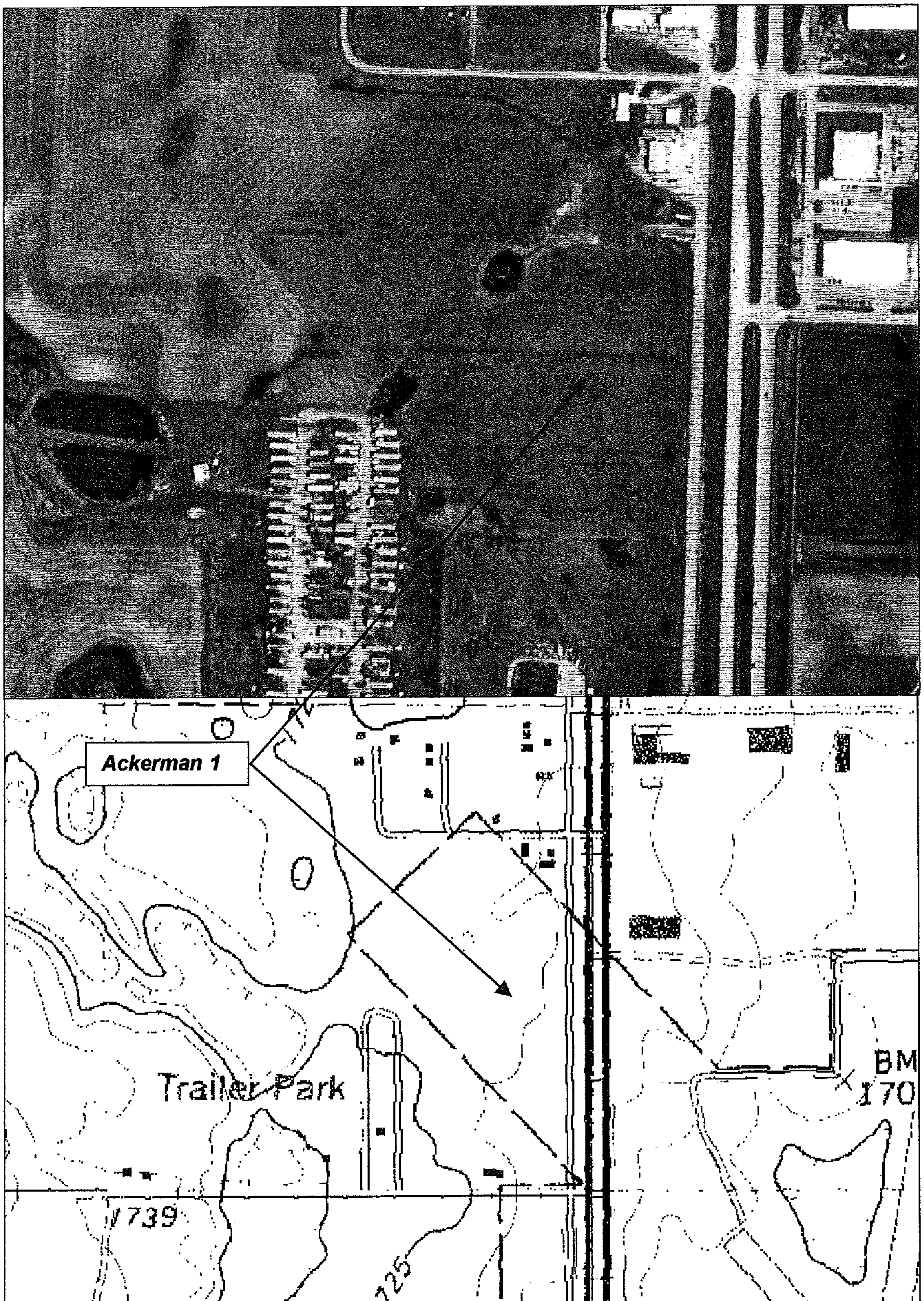
International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
451127.234	1771111.506	1559.073

Metric

Northing (m)	Easting (m)	Elevation (m)
137503.581	539834.787	475.205

A detailed station along with original coordinates derived by the National Geodetic Survey and directions to reach the station can be found in Appendix B.



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GEODETIC CONTROL MONUMENT

Station No: 200

Station Designation: Ackerman 1

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°16'17.70098"	W 101°17'51.69230"	1655.782

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
464840.273	1774240.479	1722.915

International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
464841.203	1774244.027	1722.918

Metric

Northing (m)	Easting (m)	Elevation (m)
141683.599	540789.579	525.145

Directions to Reach the Station

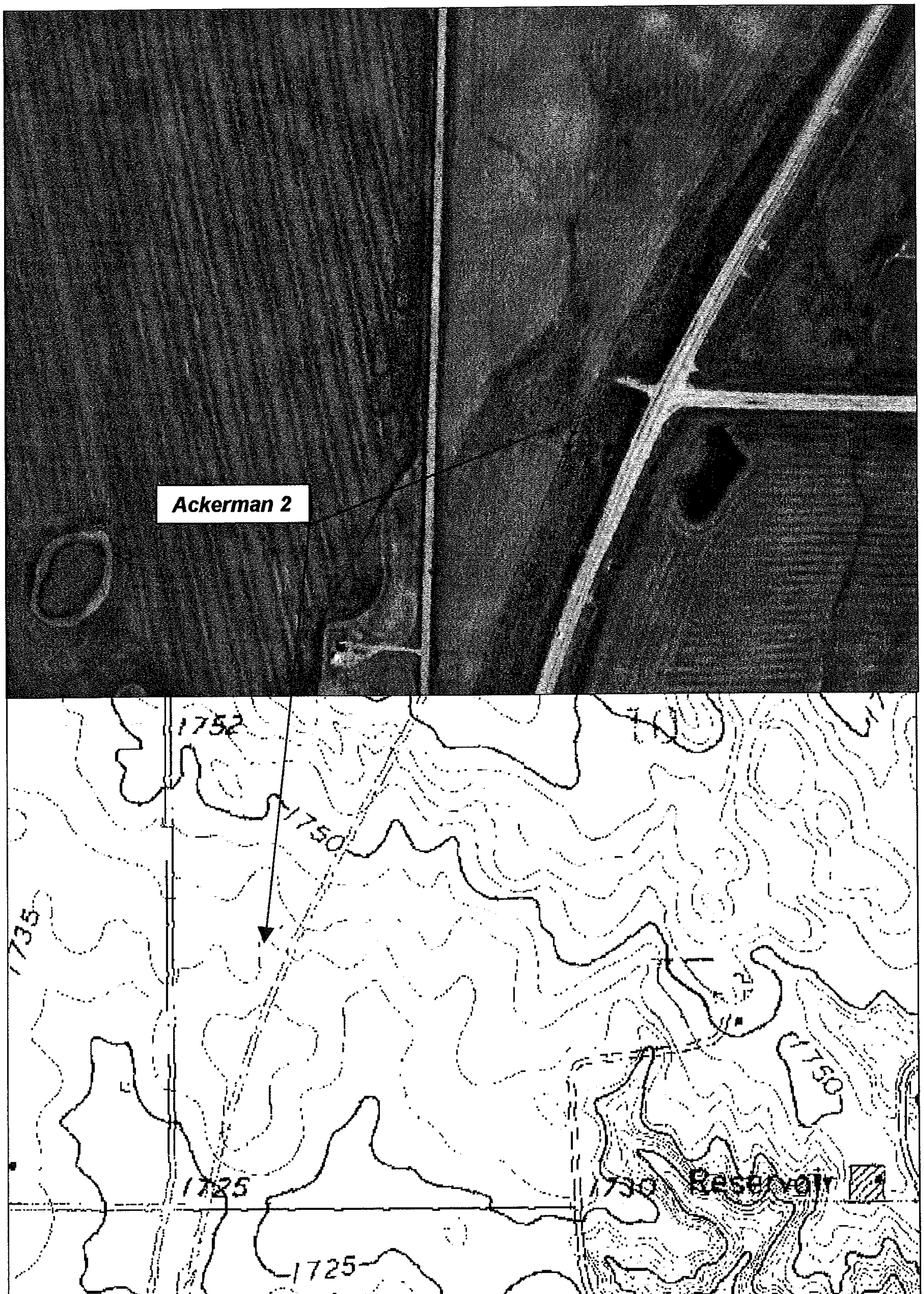
The station is located on land dedicated to the glide path of the Minot International Airport in north Minot.

Commence at the intersection of Broadway (US Highway 83) and Burdick Expressway in Minot. Travel north along Broadway for a distance of 2.53 miles to a T-intersection and a road leading west. Travel west 200 feet (0.04 miles) to a gravel frontage road. Travel north along the frontage road 990 feet (0.19 miles) to the station on the left.

The station is located inside of a standard cover, depicted in Appendix C, and stamped ACKERMAN 1. The station is 312 feet west of a gravel frontage road, 95.0 feet southwest of the projected centerline of the main runway at Minot International Airport, 43.5 feet west-northwest of a telecommunications pedestal, and 2.2 feet northeast of a Carsonite witness post.

The station is a standard 9/16" rod driven 32 feet to refusal.

Additional photographs and descriptions of the station and its surroundings are located in Appendix A.



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GEODETIC CONTROL MONUMENT

Station No: 201 **Station Designation: Ackerman 2**

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°15'30.45344"	W 101°20'14.55099"	1668.815

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
460155.516	1764524.914	1735.593

International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
460156.437	1764528.443	1735.596

Metric

Northing (m)	Easting (m)	Elevation (m)
140255.682	537828.269	529.010

Directions to Reach the Station

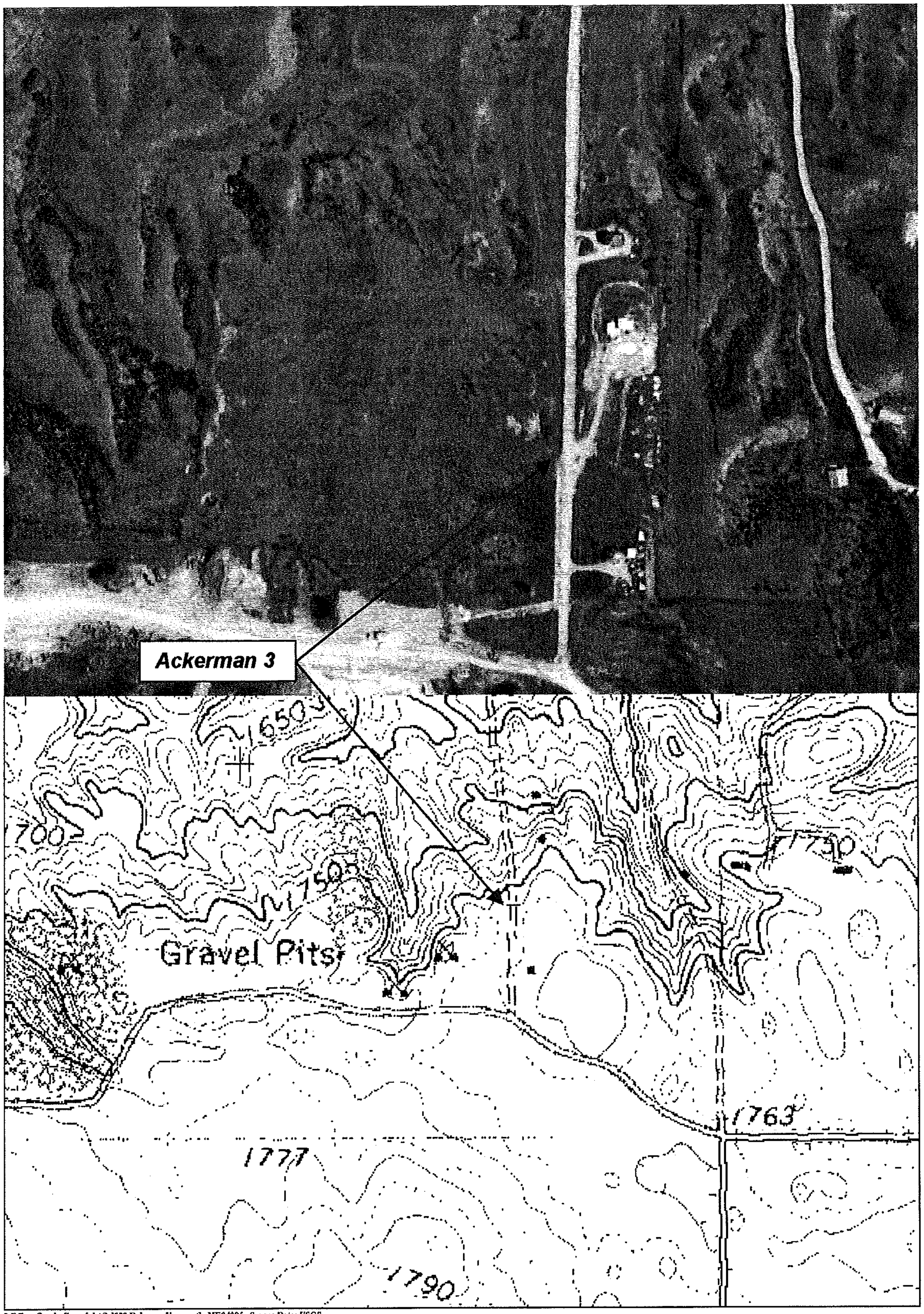
The station is located in the highway right-of-way on the west side of the US Highway 83 Bypass near the highway's intersection with 21st Avenue Northwest in Minot.

Commence at the intersection of Broadway (US Highway 83) and Burdick Expressway in Minot. Travel west then southwest along Burdick Expressway for a distance of 2.10 miles to the intersection with the US Highway 2 & 52 Bypass. Travel west along the 2 & 52 Bypass for a distance of 0.45 miles to the intersection with the US Highway 83 Bypass. Travel north along the US Highway 83 Bypass for a distance of 2.53miles to a T-intersection with 21st Avenue to the east and an approach and the station to the west. The station is located inside of a standard cover, depicted in Appendix C, and stamped ACKERMAN 2.

The station is 182.3 feet west of the centerline-centerline intersection of 21st Avenue Northwest and the US Highway 83 Bypass, 38 feet south of the centerline of an approach, 32.3 feet southwest of the south end of an 18" corrugated metal pipe running under the approach, 15.0 feet southeast of the end of a fence on the south side of the approach, and 2.0 feet northeast of a Carsonite witness post.

The station is a standard 9/16" rod driven 24 feet to refusal.

Additional photographs and descriptions of the station and its surroundings are located in Appendix A.



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GEODETIC CONTROL MONUMENT

Station No: 202 **Station Designation: Ackerman 3**

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°12'52.11923"	W 101°20'38.50119"	1698.716

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
444130.087	1762728.555	1765.234

International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
444130.975	1762732.080	1765.237

Metric

Northing (m)	Easting (m)	Elevation (m)
135371.121	537280.738	538.044

Directions to Reach the Station

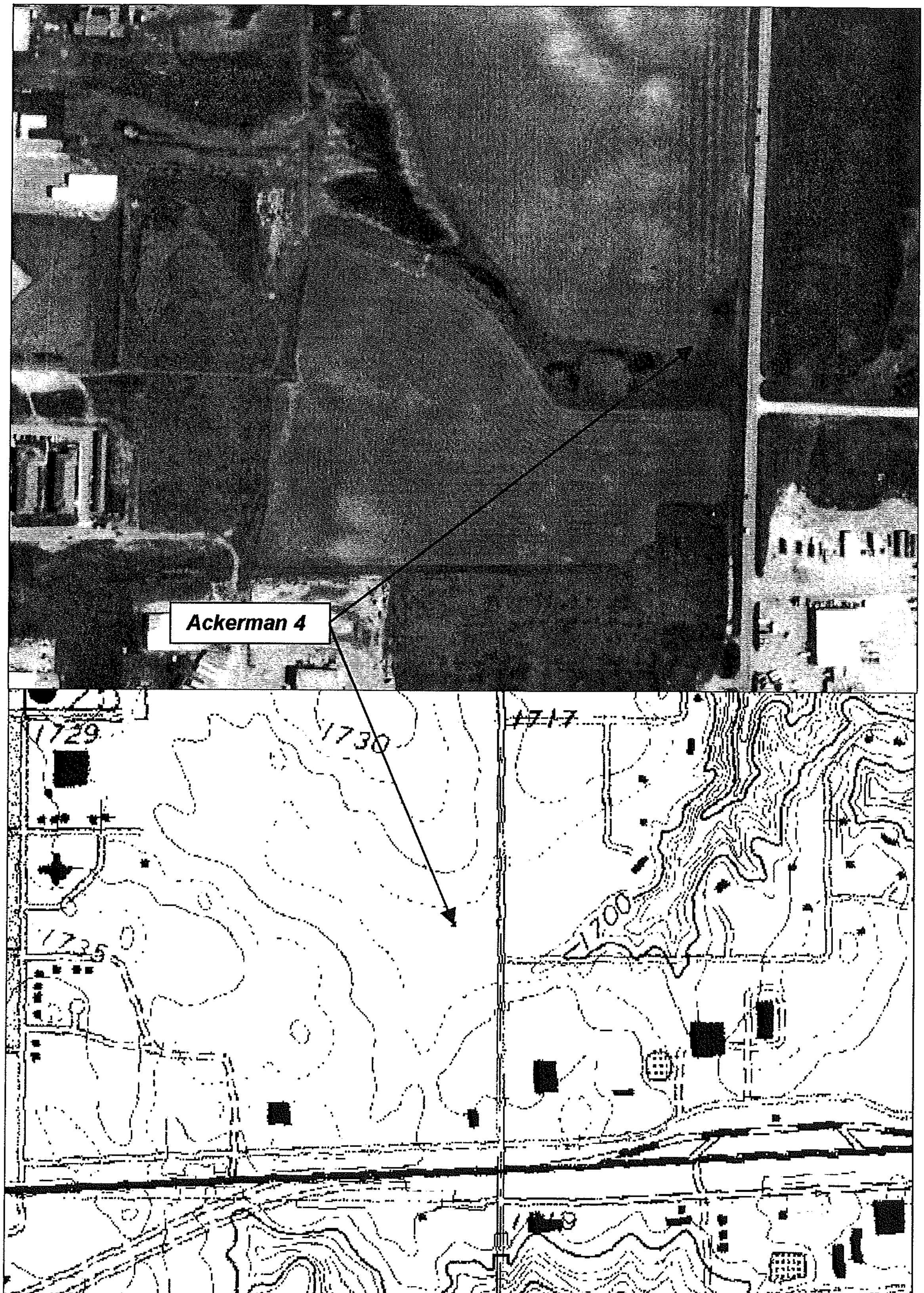
The station is located near the Minot City Landfill on a high point northeast of the landfill site.

Commence at the intersection of Broadway (US Highway 83) and Burdick Expressway in Minot. Travel west then southwest along Burdick Expressway for a distance of 2.10 miles to the intersection with the US Highway 2 & 52 Bypass. Travel west along the 2 & 52 Bypass for a distance of 0.45 miles to the intersection with the US Highway 83 Bypass. Travel south 250 feet to an intersection with a frontage road. Travel west along the frontage road for a distance of 300 feet (0.05 miles) to a T-intersection and a road leading south. Travel south along the gravel road 0.52 miles to the station on the right. The station is located inside of a standard cover, depicted in Appendix C, and stamped ACKERMAN 3.

The station is 50 feet west of the centerline of a gravel road, 2.3 feet south of an east-west fence line. 10.6 feet west of a north-south fence line, 138.5 feet east-northeast of power pole #43 in a row of poles running north and south, and 2.8 feet northeast of a Carsonite witness post.

The station is a standard 9/16" rod driven 60 feet to refusal.

Additional photographs and descriptions of the station and its surroundings are located in Appendix A.



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GEODETIC CONTROL MONUMENT

Station No: 203 **Station Designation: Ackerman 4**

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°12'54.20915"	W 101°16'31.21541"	1645.379

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
444165.743	1779476.626	1712.441

International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
444166.632	1779480.185	1712.444

Metric

Northing (m)	Easting (m)	Elevation (m)
135381.989	542385.560	521.953

Directions to Reach the Station

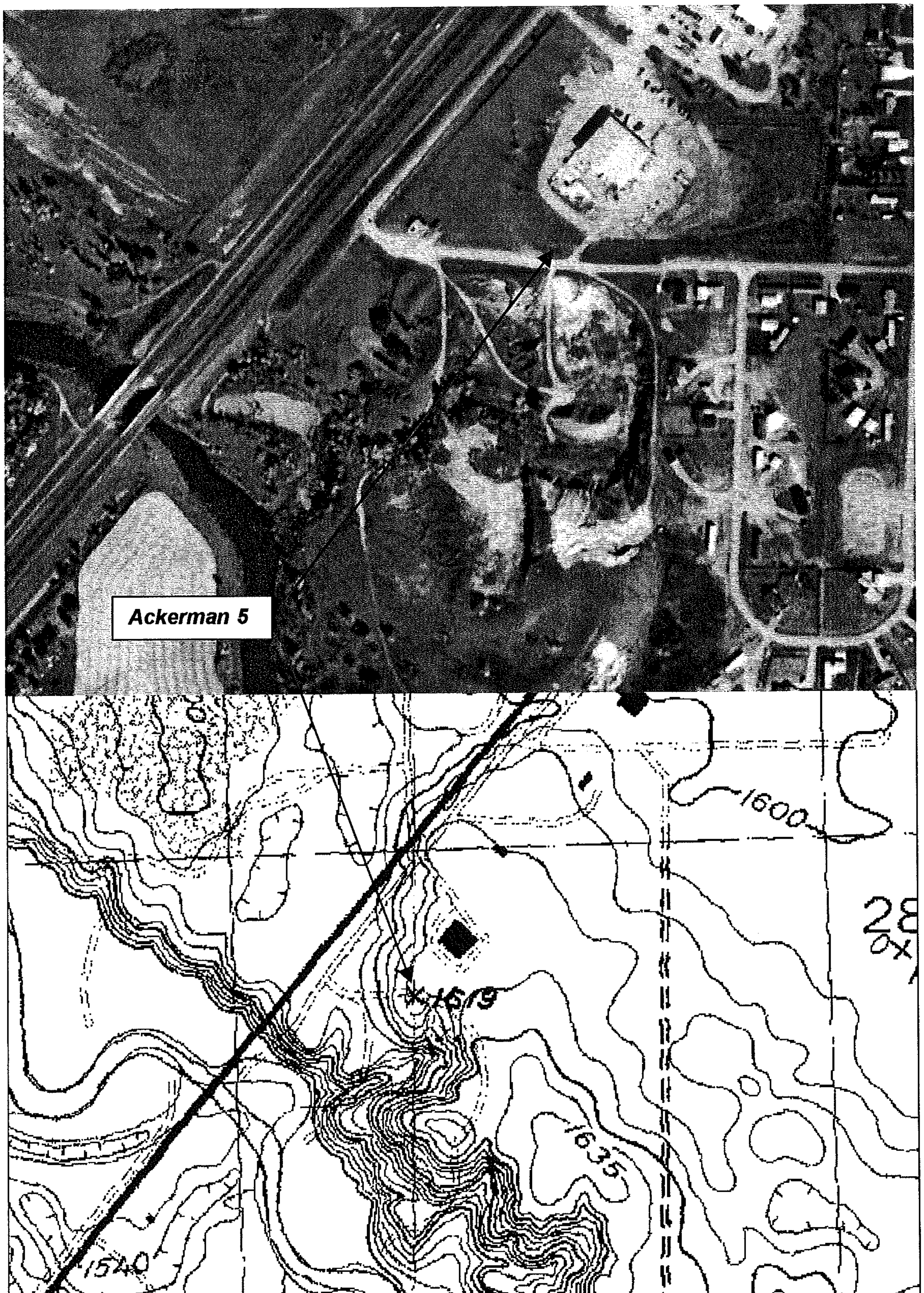
The station is located on the northwest corner of a parcel of land dedicated to a detention pond south of Edgewood Addition in southeast Minot.

Commence at the intersection of Broadway (US Highway 83) and Burdick Expressway in Minot. Travel south along Broadway, a distance of 1.51 miles to the intersection of Broadway and 20th Avenue Southwest. Travel east along 20th Avenue, a distance of 1.00 miles to the intersection of 20th Avenue Southeast and 13th Street Southeast. Travel north along 13th Street Southeast, a distance of 0.21 miles to an intersection and the station on the northwest corner of the detention pond. The station is located inside of a standard cover, depicted in Appendix C, and stamped ACKERMAN 4.

The station is 235.0 feet west of the centerline of 13th Street Southwest, 16.3 feet west of a corner of a chain link fence, 12.8 feet north of a corner of the same fence, and 2.3 feet southeast of a Carsonite witness post.

The station is a standard 9/16" rod driven 28 feet to refusal.

Additional photographs and descriptions of the station and its surroundings are located in Appendix A.



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GEODETIC CONTROL MONUMENT

Station No: 204 **Station Designation: Ackerman 5**

Datum Information

Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	NGVD 1929
Geoid Model:	GEOID99 (Conus)

Geodetic Position

Latitude	Longitude	Ellipsoid Height (sft)
N 48°13'06.36898"	W 101°13'52.15180"	1550.933

State Plane Coordinates

US Survey Feet

Northing (sft)	Easting (sft)	Elevation (sft)
445292.465	1790259.910	1618.307

International Feet

Northing (ift)	Easting (ift)	Elevation (ift)
445293.356	1790263.490	1618.310

Metric

Northing (m)	Easting (m)	Elevation (m)
135725.415	545672.312	493.261

Directions to Reach the Station

The station is located in the right of way on the north side of a gravel road on the south side of Butler Machinery in southeast Minot.

Commence at the intersection of Broadway (US Highway 83) and Burdick Expressway in Minot. Travel south along Broadway, a distance of 1.71 miles to the intersection of Broadway and the US Highway 2 & 52 Bypass. Travel along the eastbound loop-ramp. From the intersection of the eastbound highway travel lane and Broadway, travel east along the US Highway 2 & 52 Bypass, a distance of 2.40 miles to the intersection of US Highway 52 and the US Highway 2 Bypass. Travel east along the US Highway 2 Bypass, a distance of 1.11 miles to an intersection. Turn right at the intersection and travel 95 feet to a frontage road. Travel southwest along the frontage road, a distance of 0.22 miles to a T-intersection. Travel east along a gravel road, a distance of 0.11 miles to the top of a hill and the station on the left. The station is located inside of a standard cover, depicted in Appendix C, and stamped ACKERMAN 5.

The station is 28.0 feet north of the centerline of a gravel road, 96.0 feet west of the centerline of a recycled asphalt approach, 64.1 feet north of a ¼ corner stone, and 2.3 feet southeast of a Carsonite witness post.

The station is a standard 9/16" rod driven 44 feet to refusal.

Additional photographs and descriptions of the station and its surroundings are located in Appendix A.

VERTICAL SURVEY CONTROL NETWORK


VERTICAL CONTROL NETWORK
LEGEND
PREVIOUSLY OCCUPIED BASELINES
CITY OF MINOT VERTICAL CONTROL SURVEY BASELINES
SCALE: 1" = 4000'
F-276
S-335
GASSINAPP
D-276
V-463
S-2
HARRISON
SURREY
RMAN SURVEYING
ASSOCIATES
(701) 838-0786
HWY 2 EAST, MINOT, N.D. 58701

VERTICAL SURVEY CONTROL DATA

Datum Information

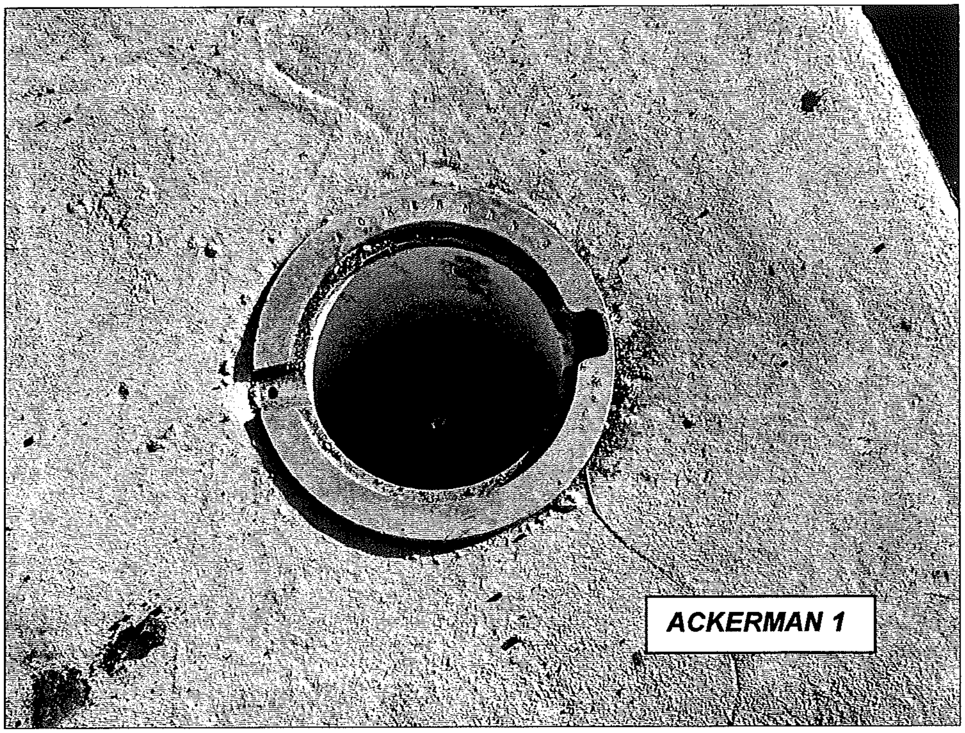
Project Datum:	NAD 1983 (Conus)
Horizontal Coordinate System:	US State Plane 1983
Horizontal Coordinate Zone:	North Dakota North – 3301
Vertical Datum:	**NGVD 1929**
Geoid Model:	GEOID99 (Conus)
Units:	U.S. Survey Feet (1m = 39.37in)

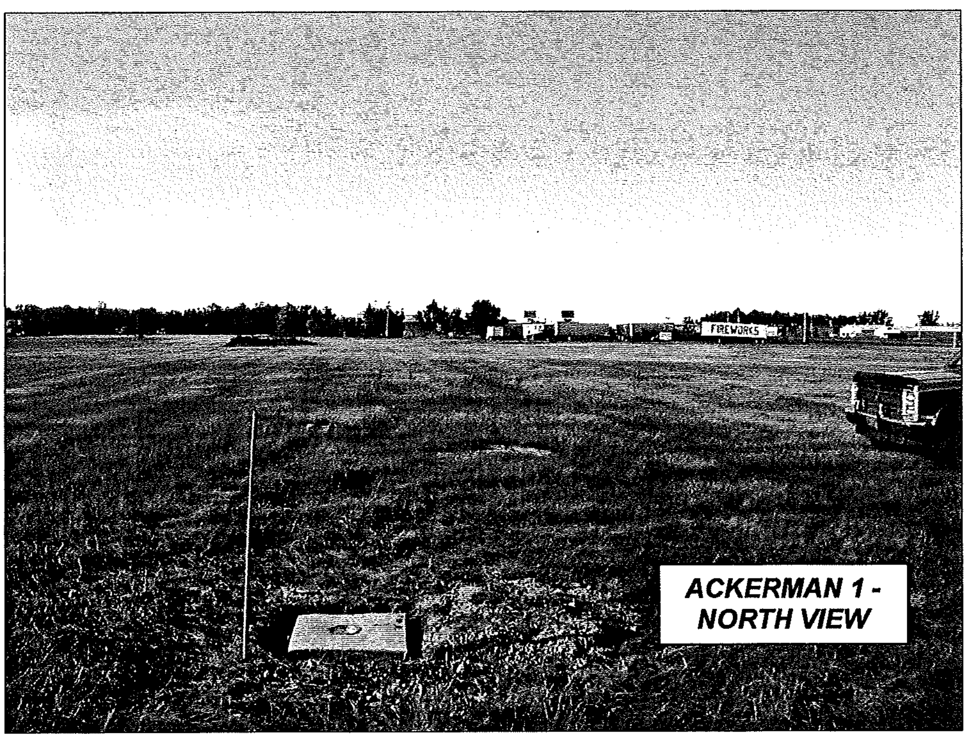
Station Designation	*Northing (sft)*	*Easting (sft)*	*Elevation (sft)*
A-276	451126.332	1771107.964	**1559.070**
C-276	450454.735	1763909.038	**1560.763**
D-276	451471.168	1757403.244	**1568.517**
F-276	456140.326	1749724.530	**1583.955**
G-217	436865.957	1774214.572	**1749.148**
Gassinapp	451151.404	1753626.024	**1607.774**
H-4	452234.133	1775283.580	**1563.709**
Harrison	437809.262	1753162.147	**1830.871**
K-13 Reset	432299.746	1774125.307	**1769.182**
L-232	458665.800	1774884.878	**1719.346**
Larson	426932.499	1774233.322	**1775.112**
M-221	452856.243	1780779.080	**1552.715**
Minot Reset	448288.335	1777837.106	**1733.475**
N-221	N/A	N/A	**1555.701**
N-472	N/A	N/A	**1551.201**
S-221	445841.783	1761811.266	**1628.253**
S-335	453470.445	1759764.795	**1568.247**
S-463	N/A	N/A	**1562.120**
Sou'East	434535.584	1791962.299	**1677.835**
Surrey	437613.810	1804037.439	**1692.600**
T-463	449006.864	1769707.071	**1546.067**
Transport	458584.162	1777221.600	**1713.163**
U-467	441355.922	1774453.600	**1730.479**
V-463	449498.949	1757151.406	**1570.395**
V-467	448733.822	1774525.308	**1675.261**

The horizontal positions of stations other than those documented previously were established using kinematic GPS techniques. Station coordinates annotated "N/A" were unable to be determined due to environmental conditions of the station. Station descriptions, including superseded control and directions to reach the station, are located in Appendix -B-.

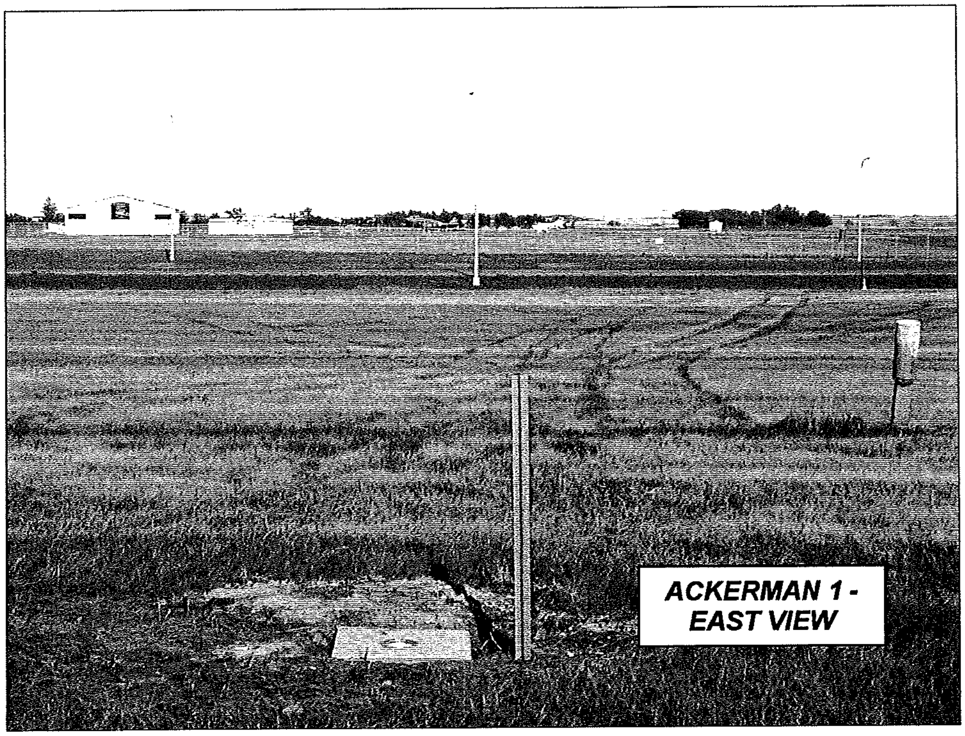
Appendix -A-

Additional Station Descriptions

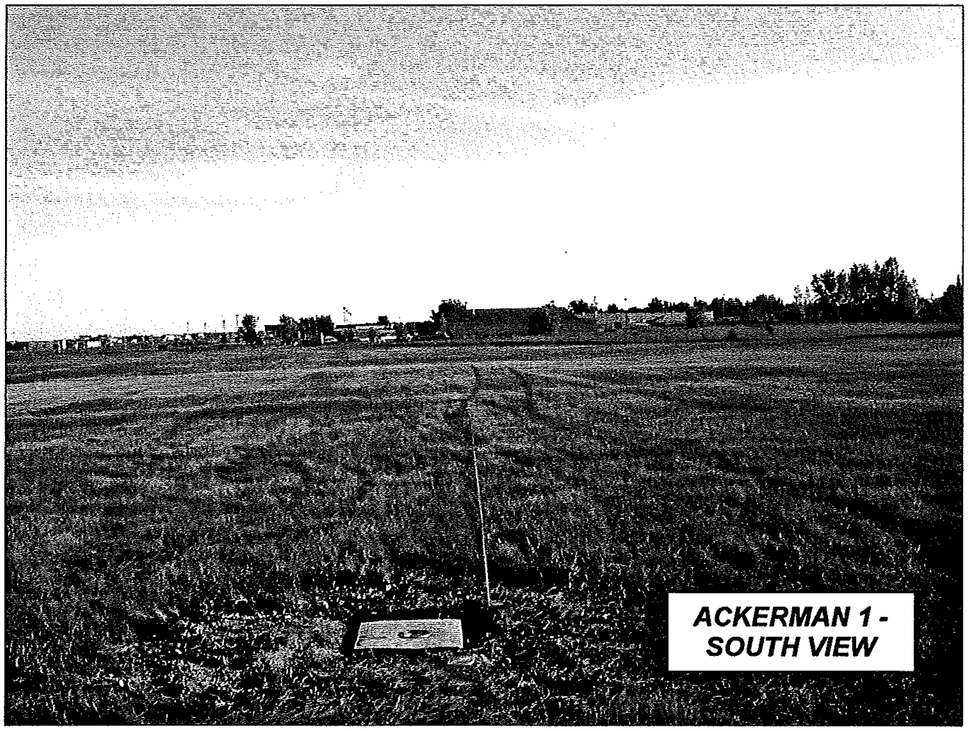

ACKERMAN 1

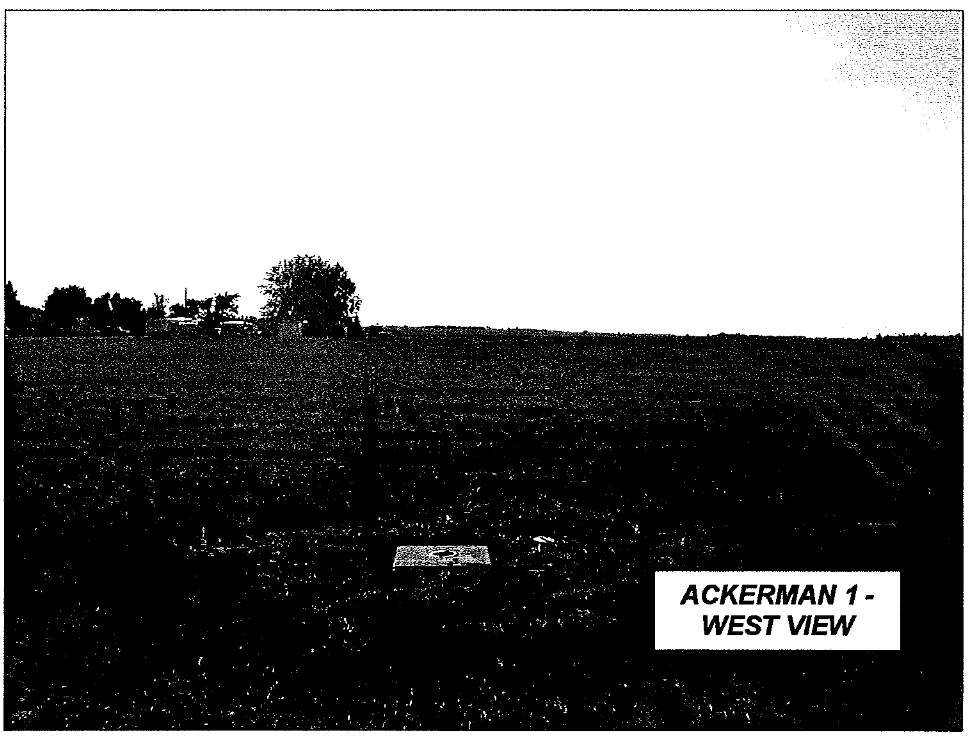


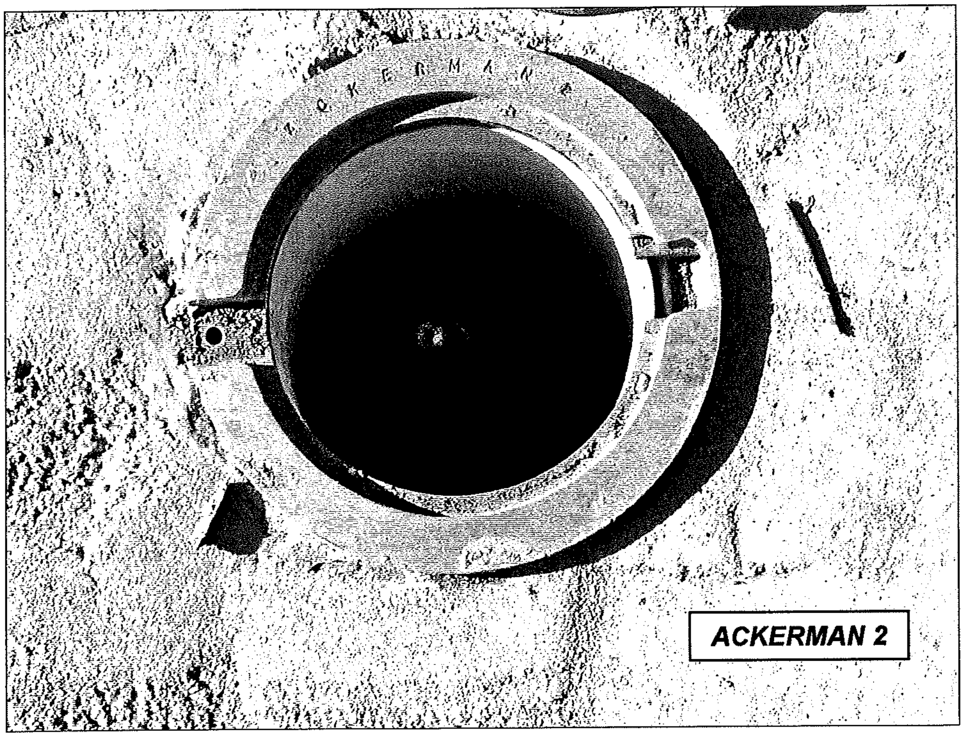
ACKERMAN 1 - NORTH VIEW

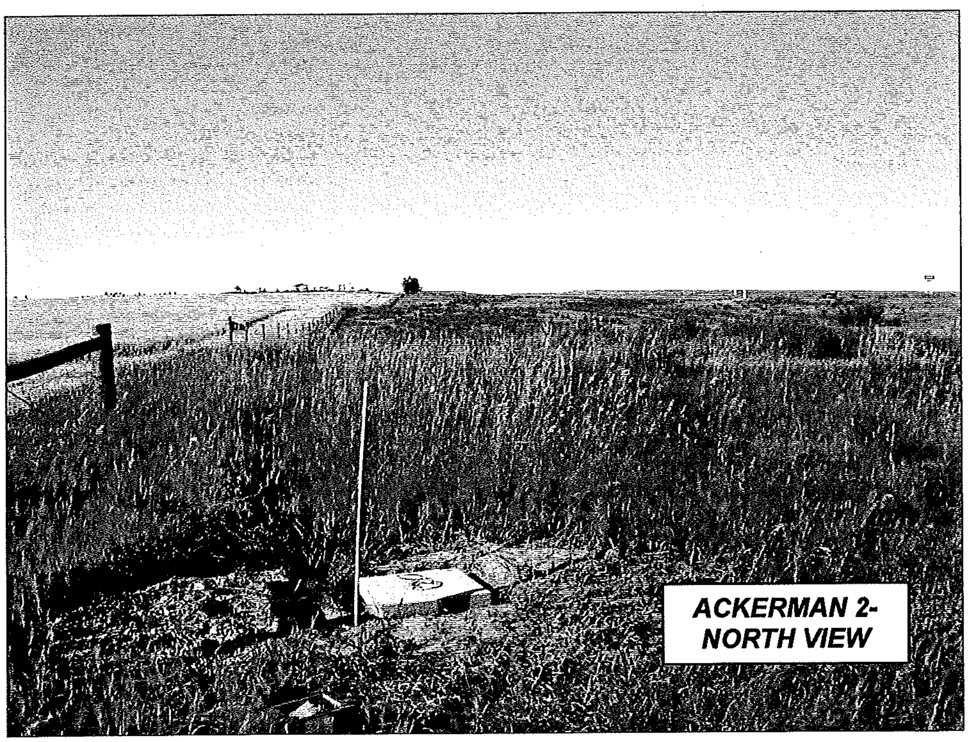

ACKERMAN 1 -
EAST VIEW

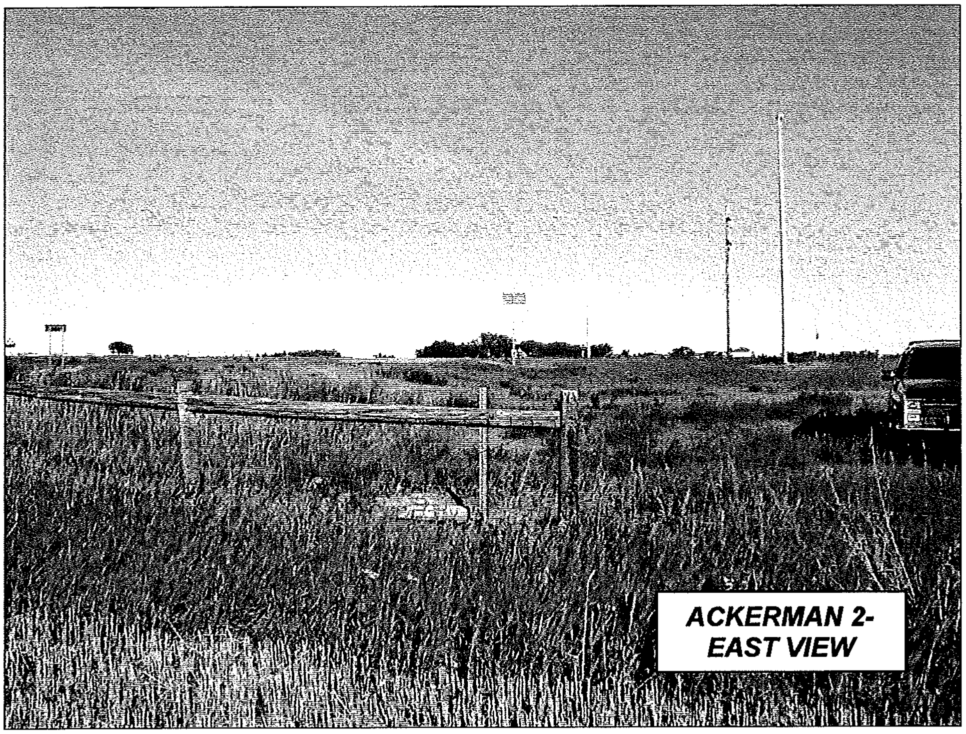

ACKERMAN 1 -
SOUTHEAST VIEW

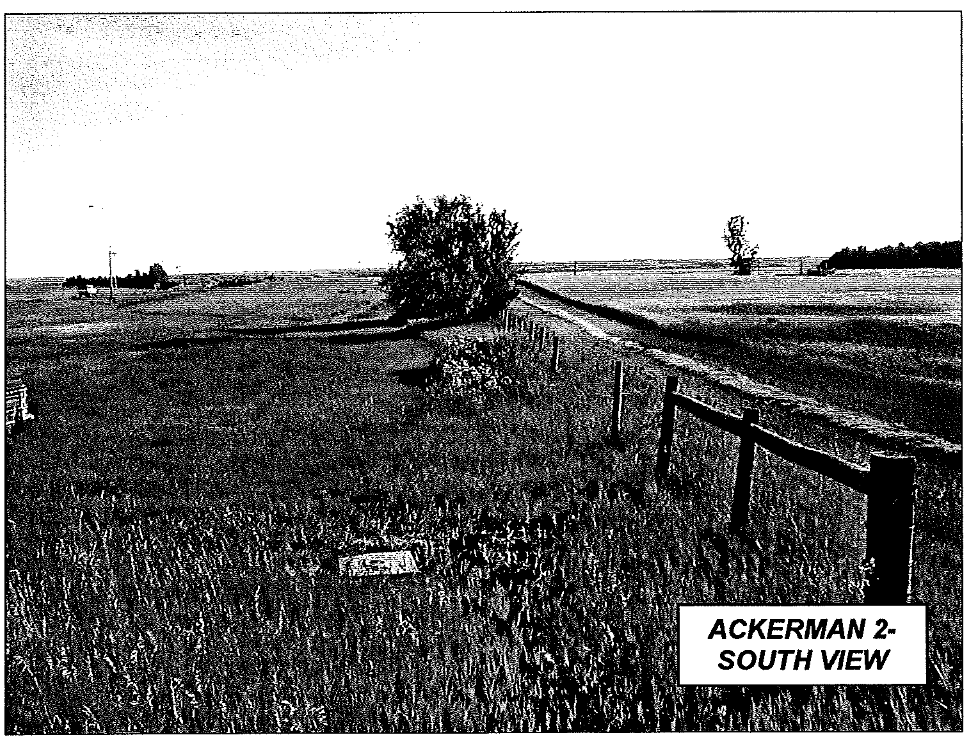

ACKERMAN 1 -
SOUTH VIEW

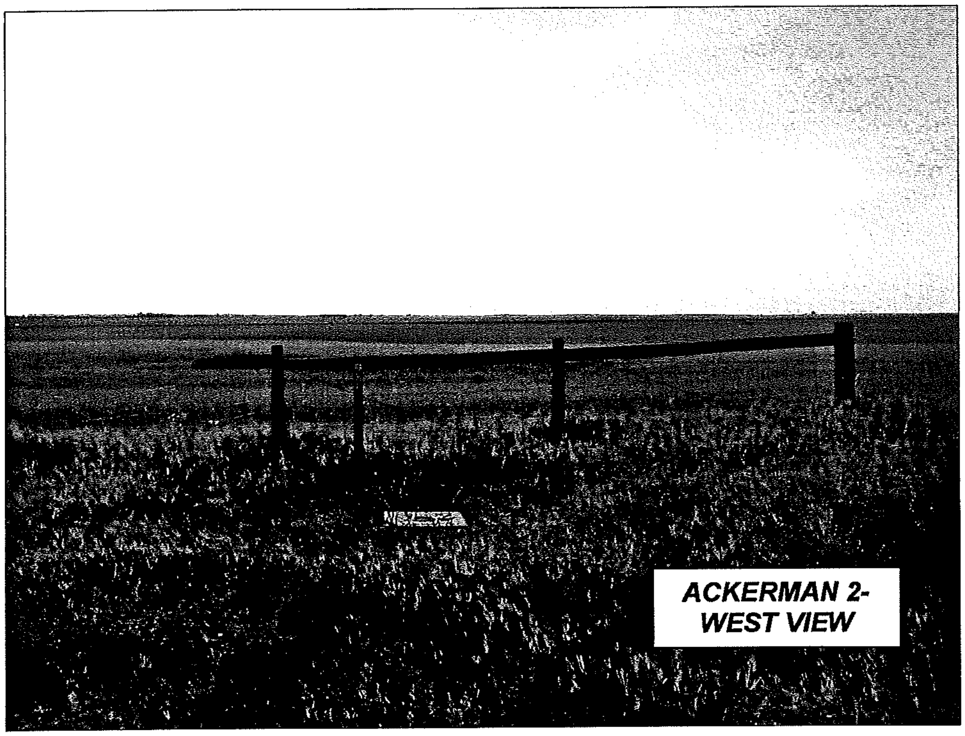

ACKERMAN 1 -
WEST VIEW

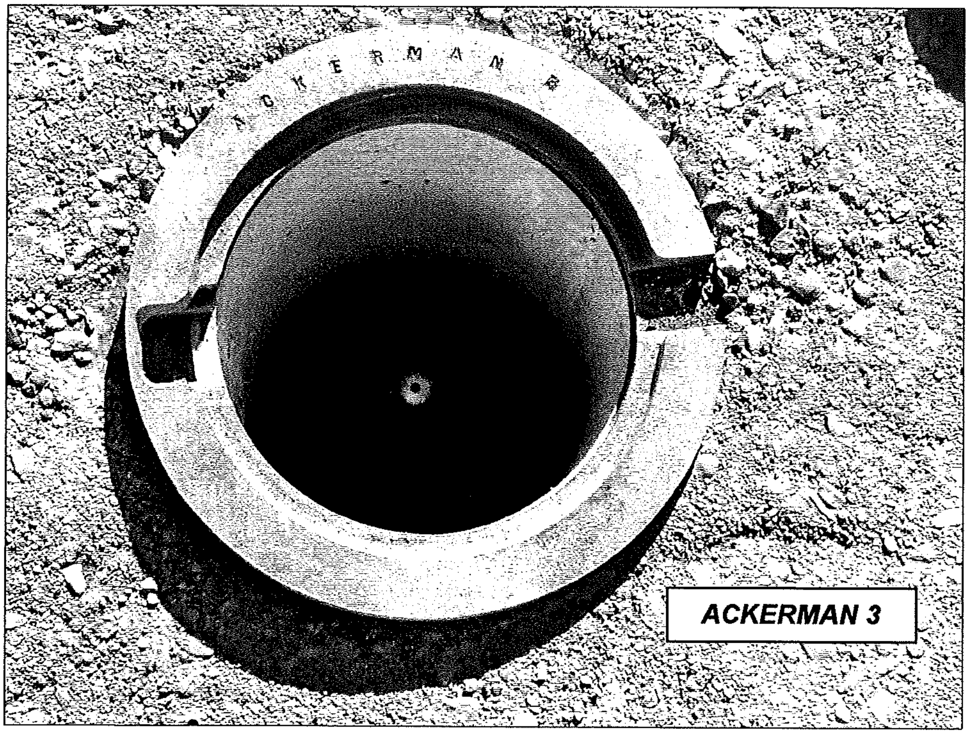

ACKERMAN 2


ACKERMAN 2-
NORTH VIEW

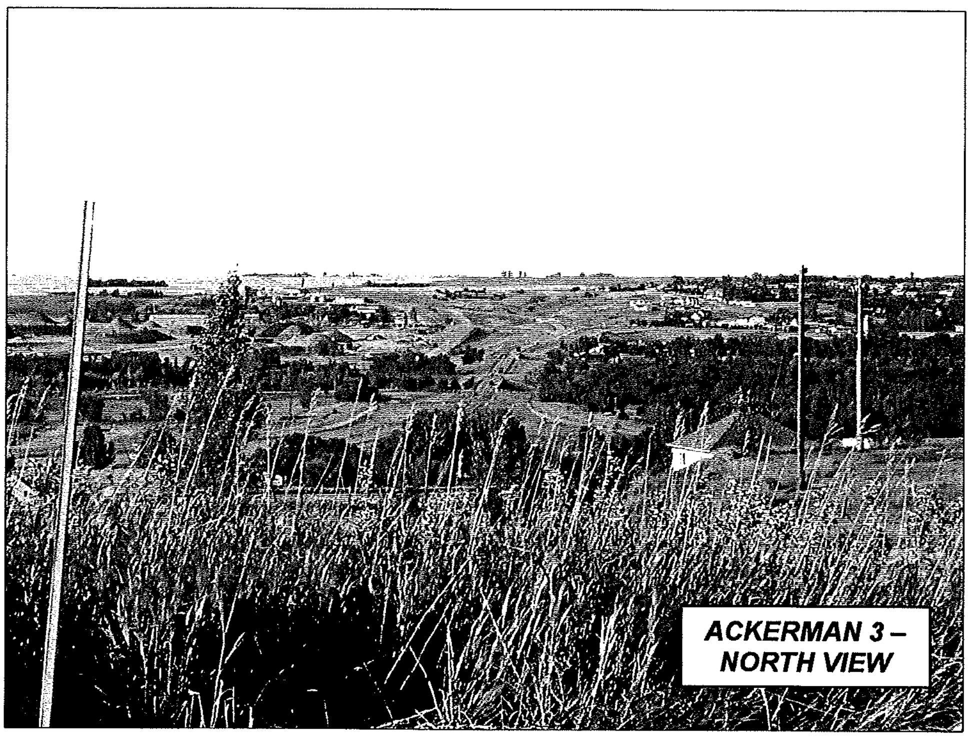

ACKERMAN 2-
EAST VIEW


ACKERMAN 2-
SOUTH VIEW

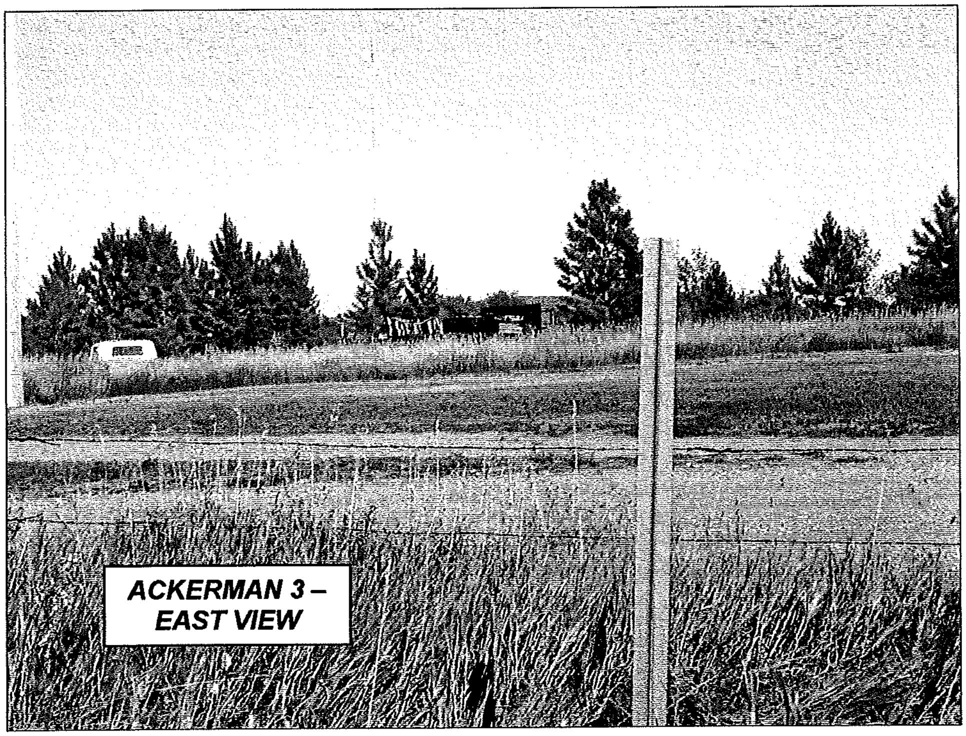

ACKERMAN 2-
WEST VIEW



ACKERMAN 3

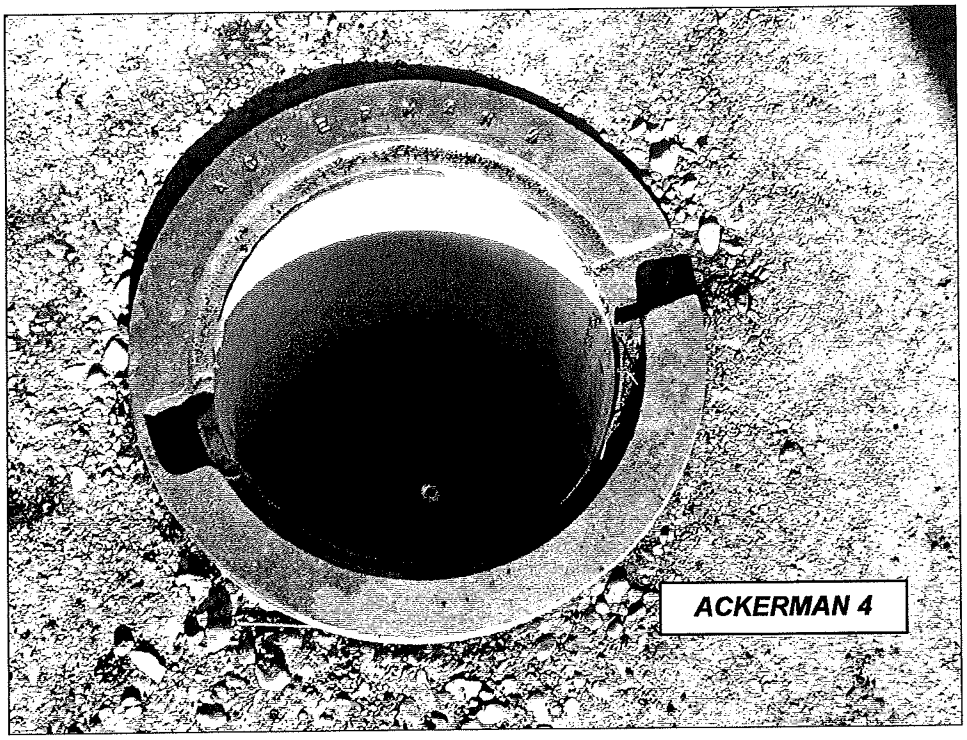


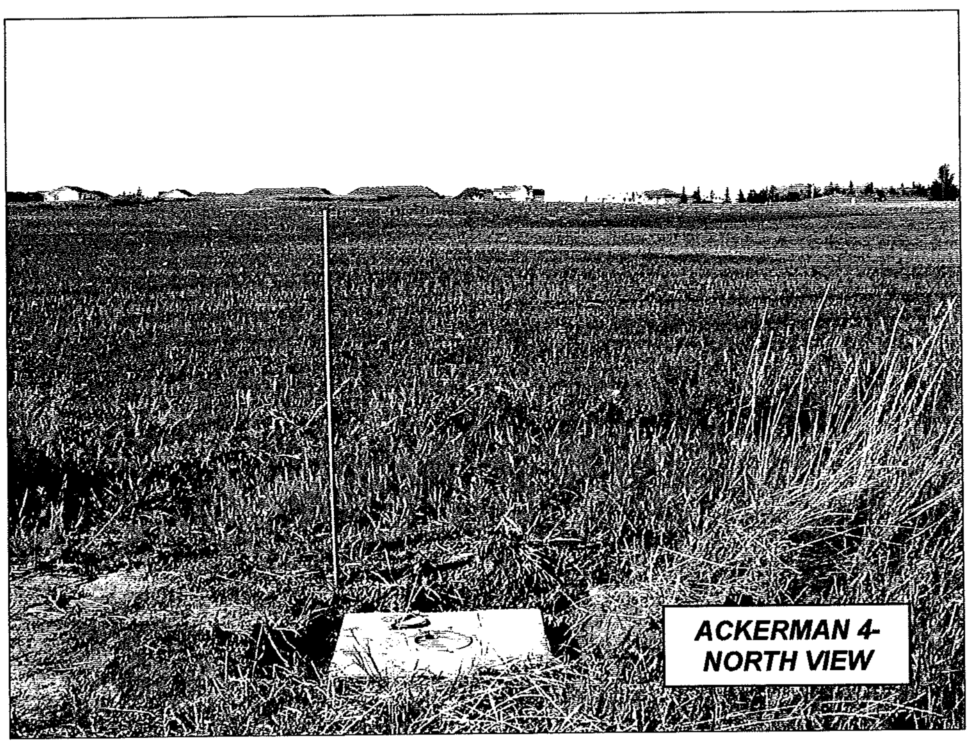
ACKERMAN 3 – NORTH VIEW

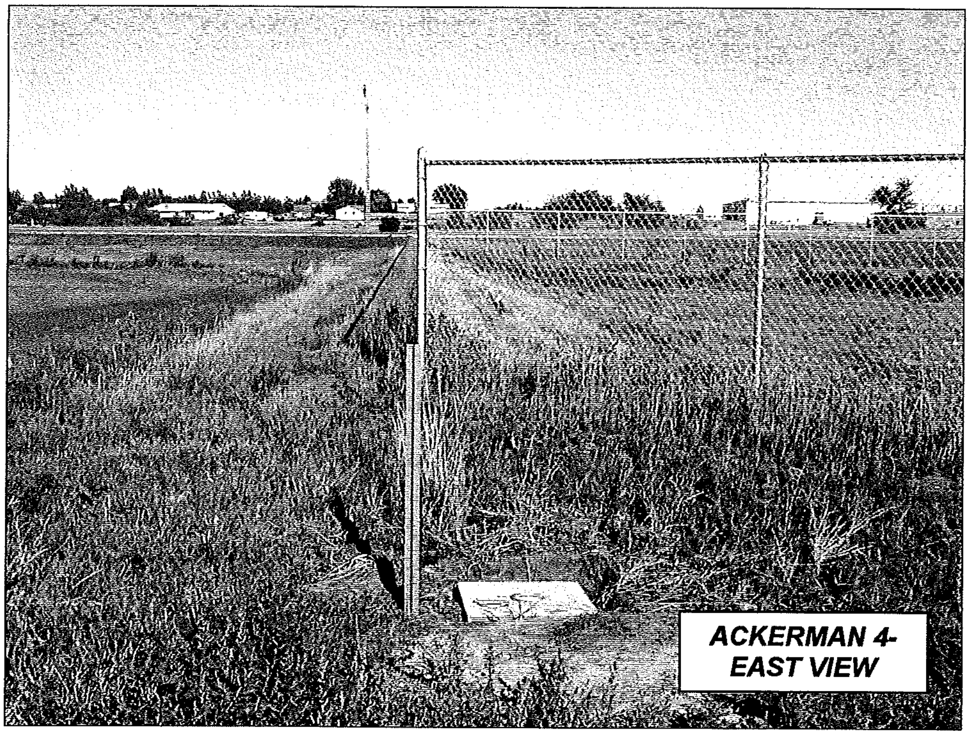

ACKERMAN 3 –
EAST VIEW

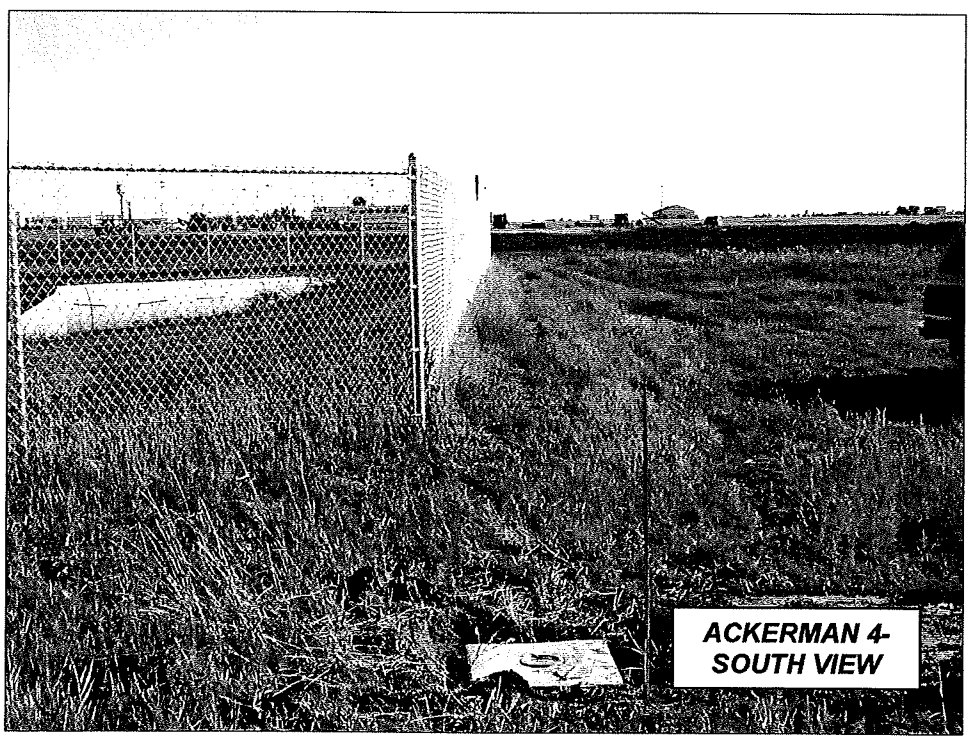

ACKERMAN 3 –
SOUTH VIEW

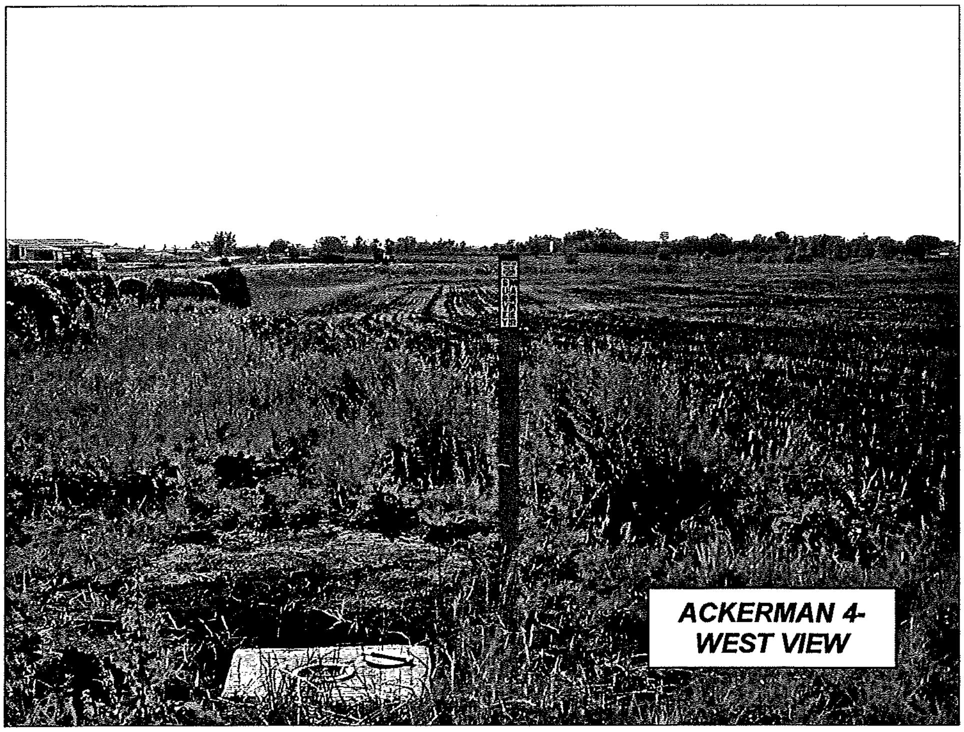

ACKERMAN 3 –
WEST VIEW

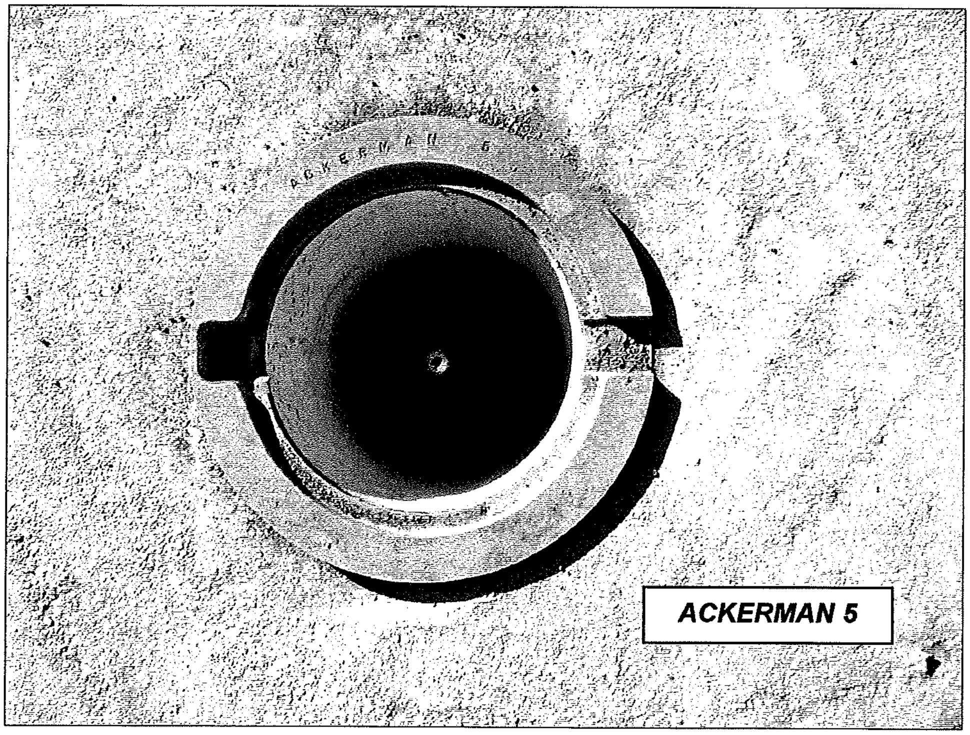

ACKERMAN 4


ACKERMAN 4-
NORTH VIEW

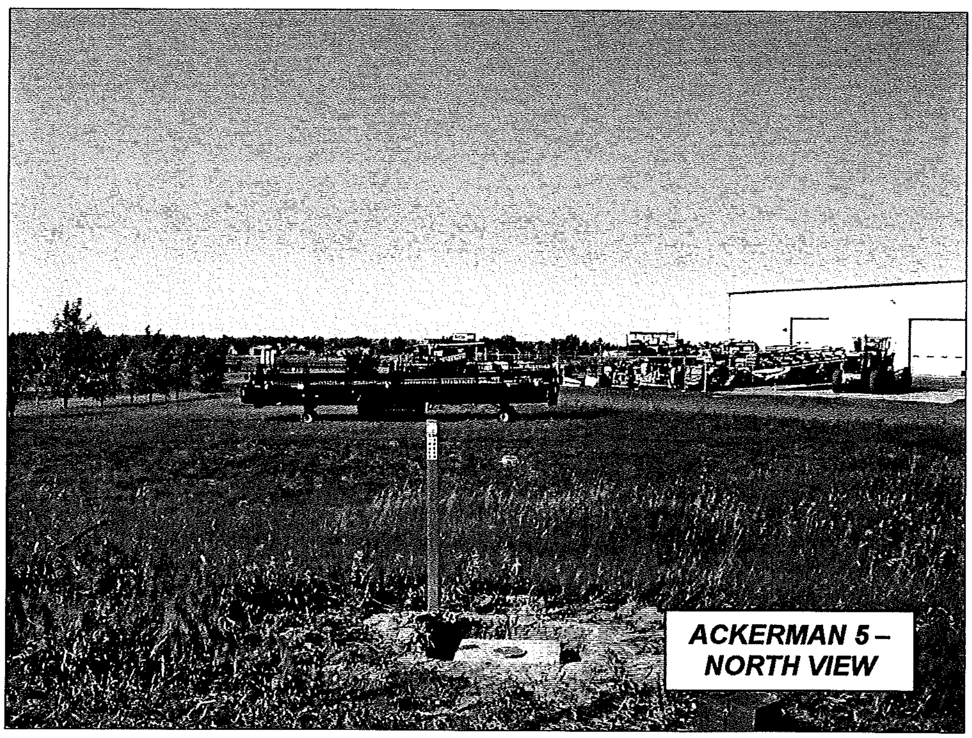

ACKERMAN 4-
EAST VIEW


ACKERMAN 4-
SOUTH VIEW

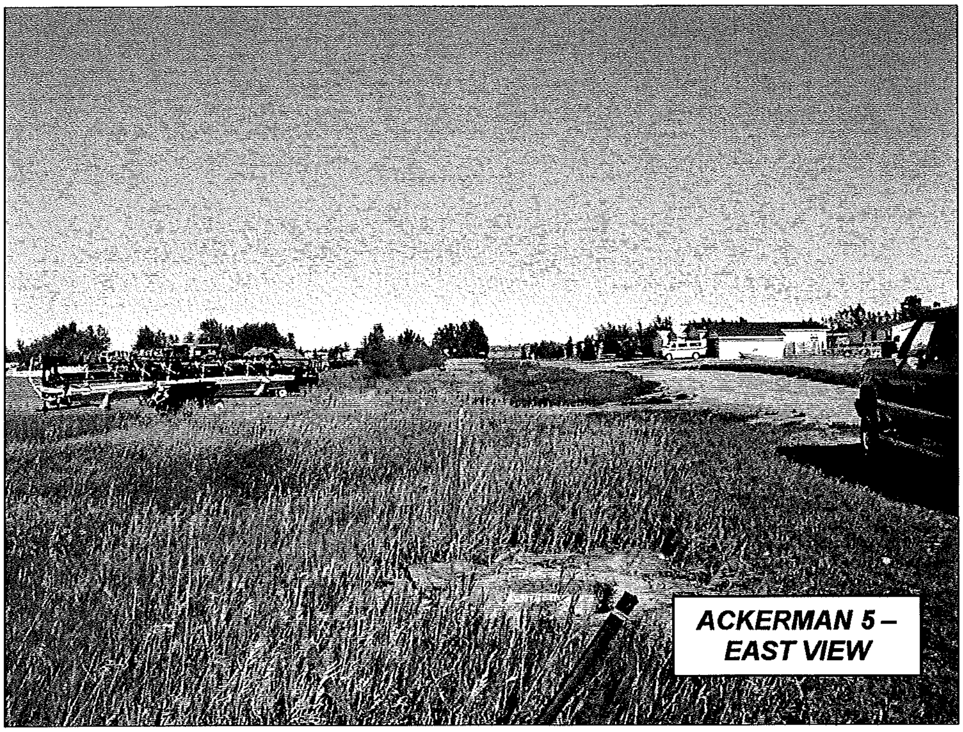

ACKERMAN 4-
WEST VIEW



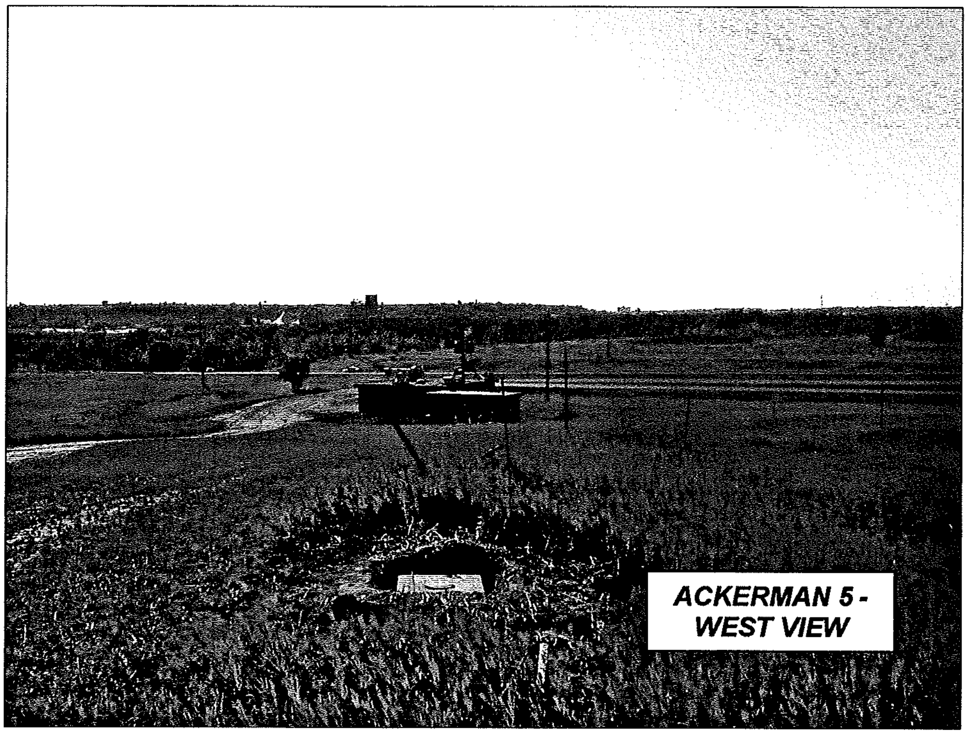
ACKERMAN 5



ACKERMAN 5 – NORTH VIEW


ACKERMAN 5 –
EAST VIEW


ACKERMAN 5 –
SOUTH VIEW


ACKERMAN 5 -
WEST VIEW

Appendix -B-

NGS Data Sheets

(Listed Alphabetically by Station Name)

The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

```
DATABASE = Sybase ,PROGRAM = datasheet, VERSION = 6.64
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
 TF0893 ***********************************************************************
 TF0893  DESIGNATION -  A 276
 TF0893  PID         -  TF0893
 TF0893  STATE/COUNTY-  ND/WARD
 TF0893  USGS QUAD   -  MINOT (1979)
 TF0893
 TF0893                         *CURRENT SURVEY CONTROL
 TF0893  ___________________________________________________________________
 TF0893* NAD 83(1986)-  48 14 02.     (N)    101 18 35.     (W)    SCALED
 TF0893* NAVD 88     -       475.723  (meters)     1560.77  (feet)  ADJUSTED
 TF0893  ___________________________________________________________________
 TF0893  GEOID HEIGHT-        -20.25  (meters)                      GEOID99
 TF0893  DYNAMIC HT  -        475.801 (meters)     1561.02  (feet)  COMP
 TF0893  MODELED GRAV-     980,759.4  (mgal)                        NAVD 88
 TF0893
 TF0893  VERT ORDER  -  FIRST     CLASS II
 TF0893
 TF0893.The horizontal coordinates were scaled from a topographic map and have
 TF0893.an estimated accuracy of +/- 6 seconds.
 TF0893
 TF0893.The orthometric height was determined by differential leveling
 TF0893.and adjusted by the National Geodetic Survey in June 1991.
 TF0893
 TF0893.The geoid height was determined by GEOID99.
 TF0893
 TF0893.The dynamic height is computed by dividing the NAVD 88
 TF0893.geopotential number by the normal gravity value computed on the
 TF0893.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 TF0893.degrees latitude (g = 980.6199 gals.).
 TF0893
 TF0893.The modeled gravity was interpolated from observed gravity values.
 TF0893
 TF0893;                     North         East     Units  Estimated Accuracy
 TF0893;SPC ND N     -    137,500.      539,850.     MT   (+/- 180 meters Scaled)
 TF0893
 TF0893                        SUPERSEDED SURVEY CONTROL
 TF0893
 TF0893  NGVD 29     -        475.353  (m)          1559.55   (f) ADJ UNCH    1 2
 TF0893
 TF0893.Superseded values are not recommended for survey control.
 TF0893.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 TF0893.See file dsdata.txt to determine how the superseded data were derived.
 TF0893
 TF0893_MARKER: DB = BENCH MARK DISK
 TF0893_SETTING: 36 = ABUTMENT
 TF0893_STAMPING: A 276 1963
 TF0893_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
 TF0893
 TF0893  HISTORY     - Date     Condition        Report By
 TF0893  HISTORY     - 1963     MONUMENTED       CGS
 TF0893  HISTORY     - 1981     MARK NOT FOUND   NGS
```

```
TF0893
TF0893                          STATION DESCRIPTION
TF0893
TF0893'DESCRIBED BY COAST AND GEODETIC SURVEY 1963
TF0893'0.75 MI W FROM MINOT.
TF0893'0.75 MILE WEST ALONG THE SOO LINE RAILROAD FROM THE STATION AT MINOT,
TF0893'0.5 MILE WEST OF THE GREAT NORTHERN RAILWAY STATION, AT THE WEST END
TF0893'OF RAILROAD BRIDGE 469.66, 5 1/2 FEET NORTH OF THE NORTH RAIL, ABOUT 6
TF0893'INCHES BELOW THE LEVEL OF THE TRACKS, AND SET IN THE TOP OF THE NORTH
TF0893'END OF THE WEST CONCRETE ABUTMENT OF THE BRIDGE.
TF0893
TF0893                          STATION RECOVERY (1981)
TF0893
TF0893'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1981
TF0893'MARK NOT FOUND.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF0895 ***********************************************************************
TF0895  DESIGNATION -  C 276
TF0895  PID         -  TF0895
TF0895  STATE/COUNTY-  ND/WARD
TF0895  USGS QUAD   -  MINOT (1979)
TF0895
TF0895                         *CURRENT SURVEY CONTROL
TF0895  ___________________________________________________________________
TF0895* NAD 83(1986)-  48 13 54.      (N)    101 20 22.     (W)     SCALED
TF0895* NAVD 88     -       476.152   (meters)    1562.18   (feet)  ADJUSTED
TF0895  ___________________________________________________________________
TF0895  GEOID HEIGHT-        -20.18   (meters)                      GEOID99
TF0895  DYNAMIC HT  -       476.229   (meters)     1562.43  (feet)  COMP
TF0895  MODELED GRAV-    980,758.5    (mgal)                        NAVD 88
TF0895
TF0895  VERT ORDER  -  FIRST     CLASS II
TF0895
TF0895.The horizontal coordinates were scaled from a topographic map and have
TF0895.an estimated accuracy of +/- 6 seconds.
TF0895
TF0895.The orthometric height was determined by differential leveling
TF0895.and adjusted by the National Geodetic Survey in June 1991.
TF0895
TF0895.The geoid height was determined by GEOID99.
TF0895
TF0895.The dynamic height is computed by dividing the NAVD 88
TF0895.geopotential number by the normal gravity value computed on the
TF0895.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF0895.degrees latitude (g = 980.6199 gals.).
TF0895
TF0895.The modeled gravity was interpolated from observed gravity values.
TF0895
TF0895;                    North         East     Units  Estimated Accuracy
TF0895;SPC ND N     -   137,280.      537,640.      MT   (+/- 180 meters Scaled)
TF0895
TF0895                        SUPERSEDED SURVEY CONTROL
TF0895
TF0895  NGVD 29     -       475.780   (m)         1560.95   (f) ADJ UNCH    1 2
TF0895
TF0895.Superseded values are not recommended for survey control.
TF0895.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF0895.See file dsdata.txt to determine how the superseded data were derived.
TF0895
TF0895_MARKER: DB = BENCH MARK DISK
```

```
TF0895_SETTING: 46 = COPPER-CLAD STEEL ROD W/O SLEEVE (10 FT.+)
TF0895_STAMPING: C 276 1963
TF0895_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
TF0895
TF0895  HISTORY     - Date     Condition        Report By
TF0895  HISTORY     - 1963     MONUMENTED       CGS
TF0895
TF0895                         STATION DESCRIPTION
TF0895
TF0895'DESCRIBED BY COAST AND GEODETIC SURVEY 1963
TF0895'2.15 MI W FROM MINOT.
TF0895'2.15 MILES WEST ALONG THE SOO LINE RAILROAD FROM THE STATION AT MINOT,
TF0895'72 FEET SOUTHWEST OF THE CENTER OF A CROSSING OF THE RAILROAD AND A
TF0895'ROAD CROSSING, 2 POLES WEST OF MILE POST 471, 51 1/2 FEET SOUTH OF THE
TF0895'SOUTH RAIL, 42 FEET WEST OF THE CENTER LINE OF A GRAVELED ROAD, 5 FEET
TF0895'SOUTH OF A FENCE CORNER, 1 FOOT EAST OF A FENCE, 1.5 FEET NORTHWEST OF
TF0895'A METAL WITNESS POST, ABOUT LEVEL WITH THE TRACKS, AND ON THE TOP OF A
TF0895'5/8-INCH COPPER COATED ROD THAT IS DRIVEN TO A DEPTH OF 16 FEET AND
TF0895'ENCASED IN A 6-INCH TILE WHICH PROJECTS 5 INCHES.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF0897 ***********************************************************************
TF0897  DESIGNATION -  D 276
TF0897  PID         -  TF0897
TF0897  STATE/COUNTY-  ND/WARD
TF0897  USGS QUAD   -  MINOT (1979)
TF0897
TF0897                         *CURRENT SURVEY CONTROL
TF0897  ___________________________________________________________________
TF0897* NAD 83(1986)-  48 14 04.      (N)     101 21 57.      (W)     SCALED
TF0897* NAVD 88     -       478.468   (meters)    1569.77     (feet)  ADJUSTED
TF0897  ___________________________________________________________________
TF0897  GEOID HEIGHT-          -20.11  (meters)                       GEOID99
TF0897  DYNAMIC HT  -         478.546  (meters)    1570.03    (feet)  COMP
TF0897  MODELED GRAV-     980,759.4    (mgal)                         NAVD 88
TF0897
TF0897  VERT ORDER  -  FIRST     CLASS II
TF0897
TF0897.The horizontal coordinates were scaled from a topographic map and have
TF0897.an estimated accuracy of +/- 6 seconds.
TF0897
TF0897.The orthometric height was determined by differential leveling
TF0897.and adjusted by the National Geodetic Survey in June 1991.
TF0897.WARNING-Repeat measurements at this control monument indicate possible
TF0897.vertical movement.
TF0897
TF0897.The geoid height was determined by GEOID99.
TF0897
TF0897.The dynamic height is computed by dividing the NAVD 88
TF0897.geopotential number by the normal gravity value computed on the
TF0897.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF0897.degrees latitude (g = 980.6199 gals.).
TF0897
TF0897.The modeled gravity was interpolated from observed gravity values.
TF0897
TF0897;                    North          East     Units  Estimated Accuracy
TF0897;SPC ND N     -   137,610.       535,690.      MT   (+/- 180 meters Scaled)
TF0897
TF0897                        SUPERSEDED SURVEY CONTROL
TF0897
TF0897  NGVD 29     -       478.109  (m)          1568.60    (f) ADJ UNCH     1 2
```

```
TF0897
TF0897.Superseded values are not recommended for survey control.
TF0897.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF0897.See file dsdata.txt to determine how the superseded data were derived.
TF0897
TF0897_MARKER: DB = BENCH MARK DISK
TF0897_SETTING: 36 = ABUTMENT
TF0897_STAMPING: D 276 1963
TF0897_MARK LOGO: CGS
TF0897_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
TF0897
TF0897  HISTORY     - Date     Condition        Report By
TF0897  HISTORY     - 1963     MONUMENTED       CGS
TF0897  HISTORY     - 1981     GOOD             NGS
TF0897
TF0897                          STATION DESCRIPTION
TF0897
TF0897'DESCRIBED BY COAST AND GEODETIC SURVEY 1963
TF0897'3.4 MI W FROM MINOT.
TF0897'3.4 MILES WEST ALONG THE SOO LINE RAILROAD FROM THE STATION AT MINOT,
TF0897'OR 4.4 MILES SOUTHEAST ALONG THE SOO LINE RAILROAD FROM THE STATION AT
TF0897'BURLINGTON, 9 1/2 POLES WEST OF MILE POST 472, 114 FEET WEST OF THE
TF0897'CENTER OF A CROSSING OF THE RAILROAD AND A PRIVATE ROAD, 6 FEET NORTH
TF0897'OF THE NORTH RAIL, ABOUT 6 INCHES BELOW THE LEVEL OF THE TRACKS, AND
TF0897'SET IN THE TOP OF THE NORTH END OF THE EAST CONCRETE ABUTMENT OF
TF0897'BRIDGE 472 A.
TF0897
TF0897                          STATION RECOVERY (1981)
TF0897
TF0897'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1981
TF0897'RECOVERED IN GOOD CONDITION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF0899 ***********************************************************************
TF0899  DESIGNATION -  F 276
TF0899  PID         -  TF0899
TF0899  STATE/COUNTY-  ND/WARD
TF0899  USGS QUAD   -  MINOT NW (1979)
TF0899
TF0899                         *CURRENT SURVEY CONTROL
TF0899  ___________________________________________________________________
TF0899* NAD 83(1986)-  48 14 50.     (N)    101 23 48.     (W)     SCALED
TF0899* NAVD 88     -       483.185  (meters)     1585.25  (feet)  ADJUSTED
TF0899  ___________________________________________________________________
TF0899  GEOID HEIGHT-         -20.05  (meters)                     GEOID99
TF0899  DYNAMIC HT  -        483.266 (meters)     1585.52  (feet)  COMP
TF0899  MODELED GRAV-    980,763.6   (mgal)                        NAVD 88
TF0899
TF0899  VERT ORDER  -  FIRST     CLASS II
TF0899
TF0899.The horizontal coordinates were scaled from a topographic map and have
TF0899.an estimated accuracy of +/- 6 seconds.
TF0899
TF0899.The orthometric height was determined by differential leveling
TF0899.and adjusted by the National Geodetic Survey in June 1991.
TF0899
TF0899.The geoid height was determined by GEOID99.
TF0899
TF0899.The dynamic height is computed by dividing the NAVD 88
TF0899.geopotential number by the normal gravity value computed on the
TF0899.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
```

```
TF0899.degrees latitude (g = 980.6199 gals.).
TF0899
TF0899.The modeled gravity was interpolated from observed gravity values.
TF0899
TF0899;                    North        East    Units  Estimated Accuracy
TF0899;SPC ND N     -   139,060.     533,410.     MT  (+/- 180 meters Scaled)
TF0899
TF0899                           SUPERSEDED SURVEY CONTROL
TF0899
TF0899  NGVD 29    -        482.815  (m)         1584.04   (f) ADJ UNCH    1 2
TF0899
TF0899.Superseded values are not recommended for survey control.
TF0899.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF0899.See file dsdata.txt to determine how the superseded data were derived.
TF0899
TF0899_MARKER: DB = BENCH MARK DISK
TF0899_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF0899_STAMPING: F 276 1963
TF0899_MARK LOGO: CGS
TF0899_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
TF0899+STABILITY: SURFACE MOTION
TF0899
TF0899  HISTORY     - Date     Condition        Report By
TF0899  HISTORY     - 1963     MONUMENTED       CGS
TF0899  HISTORY     - 1981     GOOD             NGS
TF0899
TF0899                           STATION DESCRIPTION
TF0899
TF0899'DESCRIBED BY COAST AND GEODETIC SURVEY 1963
TF0899'2.45 MI SE FROM BURLINGTON.
TF0899'2.45 MILES SOUTHEAST ALONG THE SOO LINE RAILROAD FROM THE STATION AT
TF0899'BURLINGTON, 2 TELEPHONE POLES NORTHWEST OF MILE POST 474, 280 FEET
TF0899'SOUTHWEST OF AND ACROSS U.S. HIGHWAY 52 FROM THE SOUTHWEST RAIL OF THE
TF0899'TRACK, 178 1/2 FEET SOUTHWEST OF THE CENTER LINE OF U.S. HIGHWAY 52,
TF0899'76 FEET NORTHWEST OF THE CENTER LINE OF A GRAVELED ROAD, 12 FEET
TF0899'SOUTHEAST OF A POWER POLE, 2 FEET NORTHEAST OF A FENCE, 2.0 FEET WEST
TF0899'OF A METAL WITNESS POST, ABOUT LEVEL WITH THE RAILS AND HIGHWAY, AND
TF0899'SET IN THE TOP OF A CONCRETE POST PROJECTING 5 INCHES.
TF0899
TF0899                           STATION RECOVERY (1981)
TF0899
TF0899'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1981
TF0899'RECOVERED IN GOOD CONDITION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF1068 ***********************************************************************
TF1068  DESIGNATION -  G 217
TF1068  PID        -   TF1068
TF1068  STATE/COUNTY-  ND/WARD
TF1068  USGS QUAD   -  MINOT (1979)
TF1068
TF1068                         *CURRENT SURVEY CONTROL
TF1068  ___________________________________________________________________
TF1068* NAD 83(1986)-  48 11 41.     (N)     101 17 46.      (W)     SCALED
TF1068* NAVD 88     -       533.515  (meters)     1750.37    (feet)  ADJUSTED
TF1068  ___________________________________________________________________
TF1068  GEOID HEIGHT-         -20.23  (meters)                       GEOID99
TF1068  DYNAMIC HT  -        533.601  (meters)     1750.66   (feet)  COMP
TF1068  MODELED GRAV-    980,754.1    (mgal)                         NAVD 88
TF1068
TF1068  VERT ORDER  -  FIRST     CLASS II
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TF1068
TF1068.The horizontal coordinates were scaled from a topographic map and have
TF1068.an estimated accuracy of +/- 6 seconds.
TF1068
TF1068.The orthometric height was determined by differential leveling
TF1068.and adjusted by the National Geodetic Survey in June 1991.
TF1068.WARNING-Repeat measurements at this control monument indicate possible
TF1068.vertical movement.
TF1068
TF1068.The geoid height was determined by GEOID99.
TF1068
TF1068.The dynamic height is computed by dividing the NAVD 88
TF1068.geopotential number by the normal gravity value computed on the
TF1068.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF1068.degrees latitude (g = 980.6199 gals.).
TF1068
TF1068.The modeled gravity was interpolated from observed gravity values.
TF1068
TF1068;                    North         East     Units  Estimated Accuracy
TF1068;SPC ND N      -   133,140.     540,820.      MT  (+/- 180 meters Scaled)
TF1068
TF1068                          SUPERSEDED SURVEY CONTROL
TF1068
TF1068  NGVD 29      -      533.167  (m)         1749.23    (f) ADJ UNCH    1 2
TF1068
TF1068.Superseded values are not recommended for survey control.
TF1068.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF1068.See file dsdata.txt to determine how the superseded data were derived.
TF1068
TF1068_MARKER: DB = BENCH MARK DISK
TF1068_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF1068_STAMPING: G 217 1962
TF1068_MARK LOGO: CGS
TF1068_PROJECTION: PROJECTING 10 CENTIMETERS
TF1068_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
TF1068+STABILITY: SURFACE MOTION
TF1068
TF1068  HISTORY     - Date     Condition        Report By
TF1068  HISTORY     - 1962     MONUMENTED       CGS
TF1068  HISTORY     - 1982     GOOD             NGS
TF1068
TF1068                          STATION DESCRIPTION
TF1068
TF1068'DESCRIBED BY COAST AND GEODETIC SURVEY 1962
TF1068'2.5 MI S FROM MINOT.
TF1068'2.5 MILE SOUTH ALONG U.S. HIGHWAY 83 FROM THE POST OFFICE AT MINOT,
TF1068'ABOUT 0.1 MILE SOUTH OF A GRADED ROAD INTERSECTION, AT THE SOUTHEAST
TF1068'CORNER OF A FIELD, 134 FEET WEST OF THE CENTERLINE OF THE WEST LANE OF
TF1068'A FOUR LANE HIGHWAY, 2 FEET NORTHEAST OF A POWER POLE, 1 FOOT EAST OF
TF1068'A FENCE LINE, 2 FEET SOUTH OF A WITNESS POST, ABOUT 4 FEET BELOW THE
TF1068'HIGHWAY, A CONCRETE POST WHICH PROJECTS 0.5 OF A FOOT.
TF1068
TF1068                          STATION RECOVERY (1982)
TF1068
TF1068'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1982
TF1068'RECOVERED IN GOOD CONDITION.  NEW DESCRIPTION FOLLOWS.
TF1068'4.0 KM (2.5 MI) SOUTHERLY ALONG U. S. HIGHWAY 83 FROM THE POST OFFICE
TF1068'IN MINOT, 38.1 METERS (125.0 FT) WEST OF THE CENTERLINE OF THE SOUTH
TF1068'BOUND LANES OF THE HIGHWAY, 26.1 METERS (85.6 FT) WEST OF MILEPOST 198
TF1068'AND 15.3 METERS (50.2 FT) NORTH OF THE SOUTHEAST CORNER OF A
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TF1068'CULTIVATED FIELD.
TF1068'THE MARK IS 0.6 METERS  S FROM A WITNESS POST.
TF1068'THE MARK IS ABOVE LEVEL WITH THE HIGHWAY.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF1839 ***********************************************************************
TF1839  DESIGNATION -  GASSINAPP
TF1839  PID         -  TF1839
TF1839  STATE/COUNTY-  ND/WARD
TF1839  USGS QUAD   -  MINOT NW (1979)
TF1839
TF1839                         *CURRENT SURVEY CONTROL
TF1839  ___________________________________________________________________
TF1839* NAD 83(1996)-  48 14 00.39826(N)    101 22 54.09196(W)     ADJUSTED
TF1839* NAVD 88     -       490.431  (meters)     1609.02    (feet)  ADJUSTED
TF1839  ___________________________________________________________________
TF1839  LAPLACE CORR-          -8.33  (seconds)                      DEFLEC99
TF1839  GEOID HEIGHT-         -20.07  (meters)                       GEOID99
TF1839  DYNAMIC HT  -         490.512 (meters)     1609.29   (feet)  COMP
TF1839  MODELED GRAV-     980,760.1   (mgal)                         NAVD 88
TF1839
TF1839  HORZ ORDER  -  SECOND
TF1839  VERT ORDER  -  FIRST     CLASS II
TF1839
TF1839.The horizontal coordinates were established by classical geodetic methods
TF1839.and adjusted by the National Geodetic Survey in January 1998.
TF1839
TF1839.The orthometric height was determined by differential leveling
TF1839.and adjusted by the National Geodetic Survey in June 1991.
TF1839
TF1839.The Laplace correction was computed from DEFLEC99 derived deflections.
TF1839
TF1839.The geoid height was determined by GEOID99.
TF1839
TF1839.The dynamic height is computed by dividing the NAVD 88
TF1839.geopotential number by the normal gravity value computed on the
TF1839.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF1839.degrees latitude (g = 980.6199 gals.).
TF1839
TF1839.The modeled gravity was interpolated from observed gravity values.
TF1839
TF1839;                        North         East     Units   Scale     Converg.
TF1839;SPC ND N     -   137,511.181   534,506.207   MT  0.99993920 -0 39 21.9
TF1839;UTM  14      - 5,344,989.468   323,145.154   MT  0.99998432 -1 46 36.8
TF1839
TF1839:                Primary Azimuth Mark                        Grid Az
TF1839:SPC ND N     -  MINOT MUNICIPAL TANK                        096 59 01.2
TF1839:UTM  14      -  MINOT MUNICIPAL TANK                        098 06 16.1
TF1839
TF1839|---------------------------------------------------------------------|
TF1839| PID    Reference Object                     Distance      Geod. Az  |
TF1839|                                                           dddmmss.s |
TF1839| TF1840 GASSINAPP RM 1                                     06306     |
TF1839| TF2153 MINOT MILLER MILLING CO TANK       APPROX. 7.0 KM 0875347.8 |
TF1839| TF2155 MINOT ST LEOS CATH CH SPIRE        APPROX. 6.7 KM 0895225.9 |
TF1839| TF2152 MINOT MUNICIPAL TANK               APPROX. 7.0 KM 0961939.3 |
TF1839| CQ7655 GASSINAPP AZ MK                                    1010953.7 |
TF1839| TF2173 PTS 80                              91.470 METERS 13508     |
TF1839| TF1841 GASSINAPP RM 2                                     16844     |
TF1839|---------------------------------------------------------------------|
TF1839
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TF1839                        SUPERSEDED SURVEY CONTROL
TF1839
TF1839  NAD 83(1986)-  48 14 00.39800(N)    101 22 54.08960(W) AD(        ) 2
TF1839  NAD 27      -  48 14 00.35940(N)    101 22 52.48720(W) AD(        ) 2
TF1839
TF1839.Superseded values are not recommended for survey control.
TF1839.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF1839.See file dsdata.txt to determine how the superseded data were derived.
TF1839
TF1839_MARKER: DS = TRIANGULATION STATION DISK
TF1839_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF1839_STAMPING: GASSINAPP 1946
TF1839_MARK LOGO: CGS
TF1839_PROJECTION: PROJECTING 20 CENTIMETERS
TF1839_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
TF1839+STABILITY: SURFACE MOTION
TF1839
TF1839  HISTORY     - Date     Condition        Report By
TF1839  HISTORY     - 1946     MONUMENTED       CGS
TF1839  HISTORY     - 1954     GOOD             CGS
TF1839  HISTORY     - 1981     GOOD             NGS
TF1839  HISTORY     - 1981     GOOD             NGS
TF1839
TF1839                        STATION DESCRIPTION
TF1839
TF1839'DESCRIBED BY COAST AND GEODETIC SURVEY 1946 (RAM)
TF1839'THE STATION IS LOCATED ABOUT 4.5 MILES WEST OF MINOT ALONG
TF1839'THE SOUTH SIDE OF U.S. HIGHWAY NO. 2.  IT IS IN THE FORK OF THE
TF1839'HIGHWAY TO THE NORTHWEST AND THE GRADED ROAD TO THE SOUTH
TF1839'UP GASSINAP COULEE WHICH IS CROSSED BY A HIGH STEEL BRIDGE
TF1839'OF THE GREAT NORTHERN RAILROAD 0.4 MILE SOUTH.  IT IS ON THE
TF1839'FIRST GRASSY BENCH ABOVE THE HIGHWAY, 147 FEET WEST OF THE
TF1839'INTERSECTION OF THE HIGHWAY AND THE GRAVEL ROAD, 85 FEET
TF1839'SOUTHWEST OF THE APPROXIMATE CENTER LINE OF THE HIGHWAY, AND
TF1839'11 FEET SOUTHEAST OF A WITNESS POST.  THE MARK PROJECTS ABOUT
TF1839'6 INCHES AND THE DISK IS STAMPED GASSINAPP 1946.
TF1839'
TF1839'REFERENCE MARK NO. 1 IS 25.49 FEET NORTHEAST OF THE STATION
TF1839'AND 60 FEET SOUTHWEST OF THE APPROXIMATE CENTER LINE OF THE
TF1839'HIGHWAY.  THE MARK PROJECTS ABOUT 1 INCH AND THE DISK IS STAMPED
TF1839'GASSINAPP NO 1 1946.
TF1839'
TF1839'REFERENCE MARK NO. 2 IS 31.84 FEET SOUTH OF THE STATION AND
TF1839'150 FEET WEST OF THE INTERSECTION OF THE HIGHWAY AND THE GRAVEL
TF1839'ROAD.  THE MARK PROJECTS ABOUT 4 INCHES AND THE DISK IS STAMPED
TF1839'GASSINAPP NO 2 1946.
TF1839'
TF1839'THE AZIMUTH MARK IS APPROXIMATELY 0.4 MILE EAST-SOUTHEAST OF
TF1839'THE STATION, 33 FEET SOUTH OF THE APPROXIMATE CENTER LINE OF
TF1839'THE HIGHWAY, 8 FEET WEST-NORTHWEST OF A WITNESS POST AND 1
TF1839'FOOT NORTH OF A FENCE LINE.  THE MARK PROJECTS ABOUT 1 INCH
TF1839'AND THE DISK IS STAMPED GASSINAPP 1946.
TF1839'
TF1839'TO REACH THE STATION FROM MINOT AT THE JUNCTION OF U.S. HIGHWAYS
TF1839'2, 83, AND 52, GO WEST ON NO. 2 FOR 4.1 MILES TO THE AZIMUTH
TF1839'MARK ON THE LEFT AS DESCRIBED.  CONTINUE 0.4 MILE TO A ROAD
TF1839'FORK ON THE LEFT.  FOLLOW THE HIGHWAY TO THE RIGHT ABOUT
TF1839'100 YARDS THEN TURN BACK TO THE LEFT AND GO UP ON THE FIRST
TF1839'BENCH ABOVE THE HIGHWAY CUT AND THE STATION AS DESCRIBED.
TF1839'
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TF1839'*U.S.G.S., P.T. STA. NO. 80, 1925, IS ABOUT 100 YARDS SOUTHEAST,
TF1839'5 PACES SOUTH OF A MC QUAY-NORRIS SIGN AND 29 PACES EAST FROM
TF1839'THE FENCE CORNER.
TF1839'
TF1839'*COPIED FROM RECONNAISSANCE DESCRIPTION.
TF1839'
TF1839'HEIGHT OF LIGHT ABOVE STATION MARK 1 METERS.
TF1839
TF1839                          STATION RECOVERY (1954)
TF1839
TF1839'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1954 (LWQ)
TF1839'THE STATION AND REFERENCE MARKS WERE RECOVERED AS DESCRIBED
TF1839'IN GOOD CONDITION.  THE AZIMUTH MARK WAS NOT RECOVERED.  A
TF1839'SEARCH OF ABOUT 1/2 HOUR WAS MADE AND THERE DID NOT APPEAR
TF1839'TO BE ANY CHANGES AT THE SITE, BUT IT WAS NOT FOUND.
TF1839
TF1839                          STATION RECOVERY (1981)
TF1839
TF1839'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1981
TF1839'7.5 KM (4.65 MI) WEST FROM MINOT.
TF1839'3.7 KM (2.3 MI) SOUTHWESTERLY ALONG THE BURLINGTON NORTHERN RAILROAD
TF1839'FROM THE RAILROAD STATION IN MINOT, THENCE 3.4 KM (2.1 MI) WESTERLY
TF1839'ALONG U.S. HIGHWAY 2, THENCE 0.4 KM (0.25 MI) WESTERLY ALONG A PAVED
TF1839'ROAD, AT THE JUNCTION OF COUNTY ROAD 17 LEADING SOUTH UNDER A LARGE
TF1839'RAILROAD TRESSEL, ON TOP OF THE FIRST GRASSY BENCH SOUTH OF THE PAVED
TF1839'ROAD, 44.8 METERS (147.0 FT) WEST OF THE CENTER OF THE INTERSECTION
TF1839'AND 26.5 METERS (86.9 FT) SOUTHWEST OF THE CENTER OF THE ROAD.
TF1839'THE MARK IS 6.0 M ABOVE THE HIGHWAY.
TF1839
TF1839                          STATION RECOVERY (1981)
TF1839
TF1839'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1981
TF1839'RECOVERED IN GOOD CONDITION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF0926 ***********************************************************************
TF0926  DESIGNATION -  H 4
TF0926  PID         -  TF0926
TF0926  STATE/COUNTY-  ND/WARD
TF0926  USGS QUAD   -  MINOT (1979)
TF0926
TF0926                         *CURRENT SURVEY CONTROL
TF0926  ___________________________________________________________________
TF0926* NAD 83(1986)-  48 14 14.     (N)    101 17 33.     (W)     SCALED
TF0926* NAVD 88     -       477.037  (meters)    1565.08   (feet)  ADJUSTED
TF0926  ___________________________________________________________________
TF0926  GEOID HEIGHT-        -20.29  (meters)                      GEOID99
TF0926  DYNAMIC HT  -       477.115  (meters)    1565.33   (feet)  COMP
TF0926  MODELED GRAV-    980,760.6   (mgal)                        NAVD 88
TF0926
TF0926  VERT ORDER  -  FIRST     CLASS II
TF0926
TF0926.The horizontal coordinates were scaled from a topographic map and have
TF0926.an estimated accuracy of +/- 6 seconds.
TF0926
TF0926.The orthometric height was determined by differential leveling
TF0926.and adjusted by the National Geodetic Survey in June 1991.
TF0926.WARNING-Repeat measurements at this control monument indicate possible
TF0926.vertical movement.
TF0926
TF0926.The geoid height was determined by GEOID99.
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TF0926
TF0926.The dynamic height is computed by dividing the NAVD 88
TF0926.geopotential number by the normal gravity value computed on the
TF0926.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF0926.degrees latitude (g = 980.6199 gals.).
TF0926
TF0926.The modeled gravity was interpolated from observed gravity values.
TF0926
TF0926;                    North         East     Units  Estimated Accuracy
TF0926;SPC ND N     -   137,860.     541,140.      MT   (+/- 180 meters Scaled)
TF0926
TF0926                       SUPERSEDED SURVEY CONTROL
TF0926
TF0926  NGVD 29     -      476.670  (m)         1563.87    (f) ADJ UNCH    1 2
TF0926
TF0926.Superseded values are not recommended for survey control.
TF0926.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF0926.See file dsdata.txt to determine how the superseded data were derived.
TF0926
TF0926_MARKER: Z = SEE DESCRIPTION
TF0926_SETTING: 30 = STEPS
TF0926_MARK LOGO: CGS
TF0926_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
TF0926
TF0926  HISTORY     - Date     Condition        Report By
TF0926  HISTORY     - UNK      MONUMENTED       SOORR
TF0926  HISTORY     - 1962     GOOD             NGS
TF0926  HISTORY     - 1981     GOOD             NGS
TF0926  HISTORY     - 1982     GOOD             NGS
TF0926
TF0926                       STATION DESCRIPTION
TF0926
TF0926'DESCRIBED BY NATIONAL GEODETIC SURVEY 1962
TF0926'IN MINOT.
TF0926'0.2 MILE EAST ALONG THE MINNEAPOLIS, ST. PAUL AND SAULT STE. MARIE
TF0926'RAILROAD FROM THE GREAT NORTHERN RAILROAD STATION AT MINOT, AT THE
TF0926'CROSSING OF NORTH MAIN STREET, AT THE EAST EDGE OF THE SIDEWALK ALONG
TF0926'THE EAST SIDE OF MAIN STREET AND ACROSS MAIN STREET FROM THE
TF0926'MINNEAPOLIS, ST. PAUL AND SAULT STE. MARIE RAILROAD STATION, 5.1 FEET
TF0926'NORTH OF THE NORTHWEST CORNER OF THE MAIN RADIO AND RECORD SHOP, AT
TF0926'THE TOP OF THE STEPS LEADING TO THE BASEMENT OF THE BUILDING, 29.1
TF0926'FEET SOUTH OF THE SOUTH RAIL, A 2-INCH STEEL POST, AND ABOUT 2 INCHES
TF0926'ABOVE THE LEVEL OF THE SIDEWALK.  NOTE-- THE MINNEAPOLIS, ST. PAUL AND
TF0926'SAULT STE. MARIE RAILROAD IS NOW THE SOO LINE RAILROAD.
TF0926
TF0926                       STATION RECOVERY (1981)
TF0926
TF0926'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1981
TF0926'RECOVERED IN GOOD CONDITION. THE DESCRIPTION IS ADEQUATE WITH
TF0926'THE EXCEPTION THAT THE MAIN RADIO AND RECORD SHOP IS NOW THE S.D.
TF0926'KIVLEY JEWELRY STORE.
TF0926
TF0926                       STATION RECOVERY (1982)
TF0926
TF0926'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1982
TF0926'RECOVERED THIS DATE, NOTE, THE MAIN RADIO AND RECORD SHOP IS NOW S.D.
TF0926'KIVLEY JEWELRY STORE.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF2171 ***********************************************************************
TF2171  DESIGNATION -  HARRISON
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TF2171  PID          -  TF2171
TF2171  STATE/COUNTY-  ND/WARD
TF2171  USGS QUAD    -  MINOT NW (1979)
TF2171
TF2171                         *CURRENT SURVEY CONTROL
TF2171  ___________________________________________________________________
TF2171* NAD 83(1996)-  48 11 48.68483(N)     101 22 58.68061(W)     ADJUSTED
TF2171* NAVD 88     -       558.22    (+/-2cm)     1831.4     (feet)  VERTCON
TF2171  ___________________________________________________________________
TF2171  LAPLACE CORR-            -8.50  (seconds)                      DEFLEC99
TF2171  GEOID HEIGHT-           -20.01  (meters)                       GEOID99
TF2171
TF2171  HORZ ORDER  -  FIRST
TF2171  VERT ORDER  -  THIRD ? (See Below)
TF2171
TF2171.The horizontal coordinates were established by classical geodetic methods
TF2171.and adjusted by the National Geodetic Survey in January 1998.
TF2171
TF2171.The NAVD 88 height was computed by applying the VERTCON shift value to
TF2171.the NGVD 29 height (displayed under SUPERSEDED SURVEY CONTROL.)
TF2171.The vertical order pertains to the superseded datum.
TF2171
TF2171.The Laplace correction was computed from DEFLEC99 derived deflections.
TF2171
TF2171.The geoid height was determined by GEOID99.
TF2171
TF2171;                    North         East     Units   Scale      Converg.
TF2171;SPC ND N     -   133,444.503   534,364.880   MT  0.99993775 -0 39 25.4
TF2171;UTM  14      - 5,340,926.142   322,924.335   MT  0.99998528 -1 46 36.5
TF2171
TF2171:                 Primary Azimuth Mark                     Grid Az
TF2171:SPC ND N     -  HARRISON AZ MK                            093 04 28.6
TF2171:UTM  14      -  HARRISON AZ MK                            094 11 39.7
TF2171
TF2171|---------------------------------------------------------------------|
TF2171| PID    Reference Object                     Distance      Geod. Az  |
TF2171|                                                           dddmmss.s |
TF2171| CQ7779 HARRISON RM 1                         22.592 METERS 02608     |
TF2171| TF2152 MINOT MUNICIPAL TANK                APPROX. 7.8 KM 0645753.2 |
TF2171| CQ7778 HARRISON AZ MK                                     0922503.2 |
TF2171| TF2162 SARON LUTHERAN CHURCH SPIRE         APPROX.12.4 KM 1565916.7 |
TF2171| TF2172 GETESMANE SK EVAN LUTH CHURCH       APPROX. 5.7 KM 2134637.6 |
TF2171| CQ7780 HARRISON RM 2                         22.717 METERS 26505     |
TF2171|---------------------------------------------------------------------|
TF2171
TF2171                          SUPERSEDED SURVEY CONTROL
TF2171
TF2171  NAD 83(1986)-  48 11 48.68469(N)     101 22 58.67835(W) AD(       ) 1
TF2171  NAD 27      -  48 11 48.64500(N)     101 22 57.08900(W) AD(       ) 1
TF2171  NGVD 29     -       557.84    (m)        1830.2     (f) LEVELING    3
TF2171
TF2171.Superseded values are not recommended for survey control.
TF2171.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF2171.See file dsdata.txt to determine how the superseded data were derived.
TF2171
TF2171_MARKER: DS = TRIANGULATION STATION DISK
TF2171_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF2171
TF2171  HISTORY      - Date      Condition        Report By
TF2171  HISTORY      - 1946      MONUMENTED       CGS
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TF2171
TF2171                          STATION DESCRIPTION
TF2171
TF2171'DESCRIBED BY COAST AND GEODETIC SURVEY 1946 (RAM)
TF2171'THE STATION IS LOCATED IN THE SOUTHEAST CORNER OF THE HARRISON
TF2171'SCHOOL YARD, 83 FEET SOUTHEAST OF THE SOUTHEAST CORNER OF THE
TF2171'STUCCO SCHOOL, 89 FEET NORTHWEST OF CROSSROADS, 78 FEET WEST
TF2171'OF THE CENTERLINE OF ROAD, 40 FEET NORTH OF THE CENTERLINE OF
TF2171'ROAD, 11 FEET NORTHEAST OF WITNESS POST AND 8 FEET NORTH OF
TF2171'FENCE.  THE MARK PROJECTS 1 INCH AND THE DISK IS STAMPED
TF2171'HARRISON 1946.
TF2171'
TF2171'REFERENCE MARK NO. 1 IS 74.12 FEET NORTH-NORTHEAST OF THE
TF2171'STATION, 72 FEET EAST OF THE SOUTHEAST CORNER OF SCHOOL, 46
TF2171'FEET WEST OF THE CENTERLINE OF ROAD AND 1 FOOT WEST OF FENCE.
TF2171'THE MARK PROJECTS 1 INCH AND THE DISK IS STAMPED HARRISON NO
TF2171'1 1946.
TF2171'
TF2171'REFERENCE MARK NO. 2 IS 74.53 FEET WEST OF THE STATION, 80
TF2171'FEET SOUTH OF THE SOUTHWEST CORNER OF THE SCHOOL, 35 FEET
TF2171'NORTH OF THE CENTERLINE OF ROAD AND 2 FEET NORTH OF FENCE.
TF2171'THE MARK PROJECTS 1 INCH AND THE DISK IS STAMPED HARRISON
TF2171'NO 2 1946.
TF2171'
TF2171'THE AZIMUTH MARK IS 0.45 MILE EAST OF THE STATION, 42 FEET
TF2171'SOUTH OF THE CENTERLINE OF ROAD, 5 FEET WEST OF WITNESS POST AND
TF2171'2 FEET NORTH OF FENCE.  THE MARK PROJECTS 1 INCH AND THE DISK
TF2171'IS STAMPED HARRISON 1946.
TF2171'
TF2171'TO REACH THE STATION FROM THE JUNCTION OF U.S. HIGHWAYS 83,
TF2171'52 AND 2 IN THE WEST PART OF MINOT, GO SOUTH ON U.S. HIGHWAY
TF2171'83 FOR 2.6 MILES TO CROSSROADS.  TURN RIGHT AND GO WEST 4.0
TF2171'MILES TO CROSSROADS, SCHOOL AND THE STATION.
TF2171'
TF2171'TO REACH THE AZIMUTH MARK FROM THE STATION, DRIVE EAST 0.45
TF2171'MILE TO THE AZIMUTH MARK ON THE RIGHT.
TF2171'
TF2171'HEIGHT OF LIGHT ABOVE STATION MARK 23 METERS.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF1067 ***********************************************************************
TF1067  DESIGNATION -  K 13 RESET
TF1067  PID         -  TF1067
TF1067  STATE/COUNTY-  ND/WARD
TF1067  USGS QUAD   -  MINOT (1979)
TF1067
TF1067                         *CURRENT SURVEY CONTROL
TF1067  ___________________________________________________________________
TF1067* NAD 83(1986)-  48 10 57.     (N)     101 17 46.      (W)     SCALED
TF1067* NAVD 88     -       539.631  (meters)     1770.44    (feet)  ADJUSTED
TF1067  ___________________________________________________________________
TF1067  GEOID HEIGHT-         -20.22  (meters)                        GEOID99
TF1067  DYNAMIC HT  -        539.716 (meters)     1770.72    (feet)  COMP
TF1067  MODELED GRAV-    980,752.0   (mgal)                           NAVD 88
TF1067
TF1067  VERT ORDER  -  FIRST     CLASS II
TF1067
TF1067.The horizontal coordinates were scaled from a topographic map and have
TF1067.an estimated accuracy of +/- 6 seconds.
TF1067
TF1067.The orthometric height was determined by differential leveling
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TF1067.and adjusted by the National Geodetic Survey in June 1991.
TF1067
TF1067.The geoid height was determined by GEOID99.
TF1067
TF1067.The dynamic height is computed by dividing the NAVD 88
TF1067.geopotential number by the normal gravity value computed on the
TF1067.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF1067.degrees latitude (g = 980.6199 gals.).
TF1067
TF1067.The modeled gravity was interpolated from observed gravity values.
TF1067
TF1067;                    North         East     Units  Estimated Accuracy
TF1067;SPC ND N     -    131,780.      540,810.     MT   (+/- 180 meters Scaled)
TF1067
TF1067                          SUPERSEDED SURVEY CONTROL
TF1067
TF1067.No superseded survey control is available for this station.
TF1067
TF1067_MARKER: DB = BENCH MARK DISK
TF1067_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF1067_STAMPING: K 13 RESET 1964
TF1067_MARK LOGO: CGS
TF1067_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
TF1067+STABILITY: SURFACE MOTION
TF1067
TF1067  HISTORY      - Date     Condition         Report By
TF1067  HISTORY      - 1964     MONUMENTED        CGS
TF1067  HISTORY      - 1982     GOOD              NGS
TF1067
TF1067                          STATION DESCRIPTION
TF1067
TF1067'DESCRIBED BY COAST AND GEODETIC SURVEY 1964
TF1067'3.4 MI S FROM MINOT.
TF1067'ABOUT 3.4 MILES SOUTH ALONG U.S. HIGHWAY 83 FROM THE POST OFFICE AT
TF1067'MINOT, WARD COUNTY, IN THE NORTHWEST ANGLE OF CROSSROADS, ABOUT 200
TF1067'FEET WEST OF THE CENTERLINE OF DUAL HIGHWAY, 33 FEET NORTH OF THE
TF1067'CENTERLINE OF THE EAST-WEST ROAD, 2 FEET EAST OF A TELEPHONE POLE AND
TF1067'2 FEET NORTH OF A METAL WITNESS POST.  SET IN THE TOP OF A CONCRETE
TF1067'POST PROJECTING ABOUT 3 INCHES.
TF1067
TF1067                          STATION RECOVERY (1982)
TF1067
TF1067'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1982
TF1067'RECOVERED IN GOOD CONDITION.  THE DESCRIPTION IS ADEQUATE EXCEPT ADD
TF1067'0.2 KM (0.1 MI) NORTH OF MILEPOST 197, DELETE 2 FT EAST OF A TELEPHONE
TF1067'POLE.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF0931 ***********************************************************************
TF0931  DESIGNATION -  L 232
TF0931  PID         -  TF0931
TF0931  STATE/COUNTY-  ND/WARD
TF0931  USGS QUAD   -  BURLINGTON SE (1979)
TF0931
TF0931                         *CURRENT SURVEY CONTROL
TF0931  ___________________________________________________________________
TF0931* NAD 83(1986)-  48 15 16.     (N)    101 17 40.     (W)    SCALED
TF0931* NAVD 88     -       524.472  (meters)    1720.71   (feet)  ADJUSTED
TF0931  ___________________________________________________________________
TF0931  GEOID HEIGHT-          -20.30  (meters)                    GEOID99
TF0931  DYNAMIC HT  -          524.561 (meters)    1721.00  (feet) COMP
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TF0931  MODELED GRAV-     980,762.8    (mgal)                         NAVD 88
TF0931
TF0931  VERT ORDER   -   FIRST      CLASS II
TF0931
TF0931.This mark is at Minot Airport (MOT)
TF0931
TF0931.The horizontal coordinates were scaled from a topographic map and have
TF0931.an estimated accuracy of +/- 6 seconds.
TF0931
TF0931.The orthometric height was determined by differential leveling
TF0931.and adjusted by the National Geodetic Survey in June 1991.
TF0931
TF0931.The geoid height was determined by GEOID99.
TF0931
TF0931.The dynamic height is computed by dividing the NAVD 88
TF0931.geopotential number by the normal gravity value computed on the
TF0931.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF0931.degrees latitude (g = 980.6199 gals.).
TF0931
TF0931.The modeled gravity was interpolated from observed gravity values.
TF0931
TF0931;                       North         East     Units  Estimated Accuracy
TF0931;SPC ND N      -    139,780.      541,010.      MT   (+/- 180 meters Scaled)
TF0931
TF0931                         SUPERSEDED SURVEY CONTROL
TF0931
TF0931  NGVD 29      -        524.105   (m)          1719.50    (f) ADJ UNCH     1 2
TF0931
TF0931.Superseded values are not recommended for survey control.
TF0931.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF0931.See file dsdata.txt to determine how the superseded data were derived.
TF0931
TF0931_MARKER: DB = BENCH MARK DISK
TF0931_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF0931_STAMPING: L 232 1962
TF0931_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
TF0931+STABILITY: SURFACE MOTION
TF0931
TF0931  HISTORY      - Date      Condition         Report By
TF0931  HISTORY      - 1962      MONUMENTED        CGS
TF0931  HISTORY      - 1968      GOOD              NGS
TF0931  HISTORY      - 1978      GOOD              LOCENG
TF0931
TF0931                         STATION DESCRIPTION
TF0931
TF0931'DESCRIBED BY COAST AND GEODETIC SURVEY 1962
TF0931'0.9 MI N FROM MINOT.
TF0931'0.9 MILE NORTH ALONG U.S. HIGHWAY 83 FROM THE FIRST LUTHERAN CHURCH AT
TF0931'MINOT, AT THE SOUTHWEST CORNER OF THE PORT O MINOT AIRPORT, AT THE
TF0931'JUNCTION OF A GRAVELED ROAD LEADING SOUTHEAST AND AROUND THE SOUTH
TF0931'SIDE OF THE AIRPORT, 131.5 FEET EAST OF THE CENTERLINE OF THE EAST
TF0931'LANE OF THE HIGHWAY, 100.5 FEET NORTH OF THE CENTERLINE OF THE
TF0931'GRAVELED ROAD, 41.0 FEET NORTHEAST OF A HIGHWAY RIGHT-OF-WAY POST, 2.5
TF0931'FEET SOUTH OF THE EAST-WEST AIRPORT FENCE, 1.6 FEET WEST OF A METAL
TF0931'WITNESS POST, ABOUT 10 FEET ABOVE THE LEVEL OF THE HIGHWAY, AND SET IN
TF0931'THE TOP OF A CONCRETE POST PROJECTING 6 INCHES.
TF0931
TF0931                         STATION RECOVERY (1968)
TF0931
TF0931'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1968
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TF0931'RECOVERED IN GOOD CONDITION.
TF0931
TF0931                          STATION RECOVERY (1978)
TF0931
TF0931'RECOVERY NOTE BY LOCAL ENGINEER (INDIVIDUAL OR FIRM) 1978
TF0931'RECOVERED IN GOOD CONDITION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF1803 ***********************************************************************
TF1803  DESIGNATION -  LARSON
TF1803  PID         -  TF1803
TF1803  STATE/COUNTY-  ND/WARD
TF1803  USGS QUAD   -  MINOT (1979)
TF1803
TF1803                         *CURRENT SURVEY CONTROL
TF1803  ___________________________________________________________________
TF1803* NAD 83(1996)-  48 10 03.61873(N)    101 17 46.00553(W)    ADJUSTED
TF1803* NAVD 88     -       541.433  (meters)     1776.35   (feet)  ADJUSTED
TF1803  ___________________________________________________________________
TF1803  LAPLACE CORR-           -8.06  (seconds)                    DEFLEC99
TF1803  GEOID HEIGHT-          -20.20  (meters)                     GEOID99
TF1803  DYNAMIC HT  -          541.517 (meters)     1776.63  (feet) COMP
TF1803  MODELED GRAV-      980,749.4   (mgal)                       NAVD 88
TF1803
TF1803  HORZ ORDER  -  FIRST
TF1803  VERT ORDER  -  FIRST     CLASS II
TF1803
TF1803.The horizontal coordinates were established by classical geodetic methods
TF1803.and adjusted by the National Geodetic Survey in January 1998.
TF1803
TF1803.The orthometric height was determined by differential leveling
TF1803.and adjusted by the National Geodetic Survey in June 1991.
TF1803
TF1803.The Laplace correction was computed from DEFLEC99 derived deflections.
TF1803
TF1803.The geoid height was determined by GEOID99.
TF1803
TF1803.The dynamic height is computed by dividing the NAVD 88
TF1803.geopotential number by the normal gravity value computed on the
TF1803.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF1803.degrees latitude (g = 980.6199 gals.).
TF1803
TF1803.The modeled gravity was interpolated from observed gravity values.
TF1803
TF1803;                    North        East      Units   Scale      Converg.
TF1803;SPC ND N     -   130,129.287   540,787.370   MT  0.99993689 -0 35 32.7
TF1803;UTM  14      - 5,337,485.983   329,281.059   MT  0.99995812 -1 42 40.5
TF1803
TF1803:               Primary Azimuth Mark                     Grid Az
TF1803:SPC ND N     - LARSON AZ MK RESET                       271 00 06.5
TF1803:UTM  14      - LARSON AZ MK RESET                       272 07 14.3
TF1803
TF1803|---------------------------------------------------------------------|
TF1803| PID    Reference Object                     Distance      Geod. Az  |
TF1803|                                                           dddmmss.s |
TF1803| CQ7975 LARSON AZ MK                                       0015415.0 |
TF1803| TF2152 MINOT MUNICIPAL TANK                APPROX. 6.6 KM 0051659.1 |
TF1803| TF1804 LARSON RM 1                          27.338 METERS 17855     |
TF1803| TF2162 SARON LUTHERAN CHURCH SPIRE         APPROX. 8.3 KM 1911813.2 |
TF1803| TF1065 H 217 RESET                          38.252 METERS 20858     |
TF1803| TF2172 GETESMANE SK EVAN LUTH CHURCH       APPROX. 9.8 KM 2610115.8 |
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TF1803| TF1805 LARSON RM 2                           32.370 METERS 26801      |
TF1803| TF1802 LARSON AZ MK RESET                                  2702433.8 |
TF1803|----------------------------------------------------------------------|
TF1803
TF1803                          SUPERSEDED SURVEY CONTROL
TF1803
TF1803  NAD 83(1986)-  48 10 03.61875(N)    101 17 46.00338(W) AD(        ) 1
TF1803  NAD 27      -  48 10 03.57800(N)    101 17 44.41700(W) AD(        ) 1
TF1803
TF1803.Superseded values are not recommended for survey control.
TF1803.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF1803.See file dsdata.txt to determine how the superseded data were derived.
TF1803
TF1803_MARKER: DS = TRIANGULATION STATION DISK
TF1803_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF1803_STAMPING: LARSON 1946
TF1803_MARK LOGO: CGS
TF1803_PROJECTION: FLUSH
TF1803_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
TF1803+STABILITY: SURFACE MOTION
TF1803
TF1803  HISTORY     - Date     Condition        Report By
TF1803  HISTORY     - 1946     MONUMENTED       CGS
TF1803  HISTORY     - 1954     MARK NOT FOUND   CGS
TF1803  HISTORY     - 1964     GOOD             CGS
TF1803  HISTORY     - 1982     GOOD             NGS
TF1803  HISTORY     - 1982     GOOD             NGS
TF1803
TF1803                          STATION DESCRIPTION
TF1803
TF1803'DESCRIBED BY COAST AND GEODETIC SURVEY 1946 (RAM)
TF1803'THE STATION IS LOCATED ON THE NORTH SIDE OF LARSON COULEE
TF1803'ABOUT 5 MILES SOUTH OF MINOT, 50 FEET WEST OF THE CENTERLINE
TF1803'OF U.S. HIGHWAY 83, 53 FEET SOUTH OF THE CENTERLINE OF GRAVEL
TF1803'ROAD, 14 FEET EAST-NORTHEAST OF FENCE CORNER AND 7 FEET WEST
TF1803'OF WITNESS POST.  THE MARK PROJECTS 1 INCH AND THE DISK IS
TF1803'STAMPED LARSON 1946.
TF1803'
TF1803'REFERENCE MARK NO. 1 IS 89.69 FEET SOUTH OF THE STATION, 54
TF1803'FEET WEST OF THE CENTERLINE OF U.S. HIGHWAY 83 AND 1 FOOT
TF1803'EAST OF FENCE.  THE MARK PROJECTS 1 INCH AND THE DISK IS
TF1803'STAMPED LARSON NO 1 1946.
TF1803'
TF1803'REFERENCE MARK NO. 2 IS 106.20 FEET WEST OF THE STATION, 58
TF1803'FEET SOUTH OF THE CENTERLINE OF GRADED ROAD AND 2 FEET NORTH
TF1803'OF FENCE.  THE MARK PROJECTS 1 INCH AND THE DISK IS STAMPED
TF1803'LARSON NO 2 1946.
TF1803'
TF1803'THE AZIMUTH MARK IS 0.5 MILE NORTH OF THE STATION, 55 FEET
TF1803'EAST OF THE CENTERLINE OF U.S. HIGHWAY 83, 17 FEET SOUTH
TF1803'OF CENTERLINE OF DRIVEWAY, 7 FEET SOUTH OF FENCE CORNER AND
TF1803'6 FEET NORTH OF WITNESS POST.  THE MARK PROJECTS 2 INCHES
TF1803'AND THE DISK IS STAMPED LARSON 1946.
TF1803'
TF1803'TO REACH THE STATION FROM THE JUNCTION OF U.S. HIGHWAYS 83,
TF1803'52 AND 2 IN THE WEST PART OF MINOT, GO SOUTH ON U.S. HIGHWAY
TF1803'83 FOR 4.5 MILES TO CROSSROADS AND THE STATION IN THE SOUTHWEST
TF1803'CORNER OF THE INTERSECTION.
TF1803'
TF1803'TO REACH THE AZIMUTH MARK FROM THE STATION, DRIVE NORTH ON
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TF1803'U.S. HIGHWAY 83 FOR 0.5 MILE TO THE AZIMUTH MARK ON THE RIGHT.
TF1803'
TF1803'HEIGHT OF LIGHT ABOVE STATION MARK 23 METERS.
TF1803
TF1803 STATION RECOVERY (1954)
TF1803
TF1803'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1954 (LWQ)
TF1803'A SEARCH OF ABOUT 1/2 HOUR WAS MADE FOR THE STATION AND REFERENCE
TF1803'MARKS BUT THEY WERE NOT FOUND. THE AZIMUTH MARK WAS RECOVERED
TF1803'IN GOOD CONDITION AS DESCRIBED. U.S. HWY 83 HAS BEEN WIDENED
TF1803'AND DITCHED AT THE SITE AND IT IS BELEIVED THAT THE STATION
TF1803'AND REFERENCE MARKS HAVE BEEN DESTROYED.
TF1803
TF1803 STATION RECOVERY (1964)
TF1803
TF1803'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1964 (WGT)
TF1803'STATION RECOVERED AND ALL MARKS FOUND IN GOOD CONDITION.
TF1803'THE AZIMUTH MARK WAS IN THE WAY OF HIGHWAY CONSTRUCTION SO A
TF1803'NEW MARK WAS SET. THE ORIGINAL AZIMUTH MARK WAS NOT VISABLE
TF1803'FROM THE GROUND AT THE STATION SO THE NEW MARK WAS RESET
TF1803'TO WEST OF THE STATION.
TF1803'
TF1803'THE STATION IS ON THE NORTH SIDE OF LARSON COULEE AND ABOUT
TF1803'5 MILES SOUTH OF MINOT. THE HIGHWAY IS BEING MOVED TO THE
TF1803'EAST NEAR THE STATION AND THE STATION MARK IS NEAR THE EDGE
TF1803'OF THE WEST RIGHT OF WAY. A METAL WITNESS POST WAS SET ABOUT
TF1803'1 FOOT NORTH OF THE STATION MARK.
TF1803'
TF1803'R.M. NO. 1 IS ALSO AT THE WEST EDGE OF THE NEW RIGHT OF WAY
TF1803'OF HIGHWAY. AN IRON POST WAS DRIVEN IN THE GROUND ABOUT 1
TF1803'FOOT SOUTH OF THIS MARK.
TF1803'
TF1803'BENCH MARK H 217 RESET 1964 IS SOUTHWEST OF THE STATION,
TF1803'ABOUT 200 FEET WEST OF THE CENTER OF DUAL HIGHWAY, ABOUT
TF1803'160 FEET SOUTH OF CENTERLINE OF EAST-WEST ROAD, 3 FEET NORTHEAST
TF1803'OF A TELEPHONE POLE AND 2 FEET SOUTH OF A METAL WITNESS POST.
TF1803'
TF1803'R.M. NO. 2 IS IN THE PASTURE TO THE WEST OF THE STATION AND
TF1803'IS ABOUT 58 FEET SOUTH OF CENTERLINE OF EAST-WEST ROAD.
TF1803'
TF1803'THE AZIMUTH MARK IS ABOUT 0.3 MILE WEST OF THE STATION, 40
TF1803'FEET SOUTH OF THE CENTERLINE OF EAST-WEST ROAD, 2.5 FEET WEST
TF1803'OF A METAL WITNESS POST AND 1 FOOT NORTH OF A FENCE. MARK
TF1803'PROJECTS 3 INCHES AND DISK IS STAMPED LARSON 1946 RESET 1964.
TF1803'
TF1803'TO REACH THE STATION FROM MINOT, FROM THE JUNCTION OF U.S.
TF1803'HIGHWAY 83 AND U.S. 52 BYPASS ABOUT 1.5 MILE SOUTH OF CENTER
TF1803'OF TOWN, GO SOUTH ON U.S. 83 FOR 3.0 MILES TO A SIDE ROAD
TF1803'RIGHT AND STATION IN SOUTHWEST ANGLE OF INTERSECTION.
TF1803
TF1803 STATION RECOVERY (1982)
TF1803
TF1803'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1982
TF1803'7.1 KM (4.4 MI) SOUTH FROM MINOT.
TF1803'7.1 KM (4.4 MI) SOUTHERLY ALONG U. S. HIGHWAY 83 FROM THE POST OFFICE
TF1803'IN MINOT, 38.3 METERS (125.7 FT) NORTHEAST OF BENCH MARK H 217 RESET
TF1803'1964, 32.4 METERS (106.3 FT) EAST OF REFERENCE MARK 2, 30.5 METERS
TF1803'(100.1 FT) WEST OF THE CENTERLINE OF THE SOUTH BOUND LANES OF THE
TF1803'HIGHWAY, 27.3 METERS (89.6 FT) NORTH OF REFERENCE MARK 1 AND 16.2
TF1803'METERS (53.1 FT) SOUTH OF THE CENTER OF A GRAVELED ROAD LEADING WEST.

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TF1803'THE MARK IS 0.3 METERS  N FROM A WITNESS POST.
TF1803'THE MARK IS ABOVE LEVEL WITH THE HIGHWAY.
TF1803
TF1803                        STATION RECOVERY (1982)
TF1803
TF1803'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1982
TF1803'RECOVERED IN GOOD CONDITION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
 TF0924 ***********************************************************************
 TF0924  DESIGNATION -  M 221
 TF0924  PID         -  TF0924
 TF0924  STATE/COUNTY-  ND/WARD
 TF0924  USGS QUAD   -  MINOT (1979)
 TF0924
 TF0924                        *CURRENT SURVEY CONTROL
 TF0924  ___________________________________________________________________
 TF0924* NAD 83(1986)-  48 14 19.     (N)     101 16 16.     (W)     SCALED
 TF0924* NAVD 88     -       473.687  (meters)     1554.09   (feet)  ADJUSTED
 TF0924  ___________________________________________________________________
 TF0924  GEOID HEIGHT-         -20.34  (meters)                      GEOID99
 TF0924  DYNAMIC HT  -         473.765 (meters)    1554.34   (feet)  COMP
 TF0924  MODELED GRAV-      980,762.0   (mgal)                       NAVD 88
 TF0924
 TF0924  VERT ORDER  -  FIRST     CLASS II
 TF0924
 TF0924.The horizontal coordinates were scaled from a topographic map and have
 TF0924.an estimated accuracy of +/- 6 seconds.
 TF0924
 TF0924.The orthometric height was determined by differential leveling
 TF0924.and adjusted by the National Geodetic Survey in June 1991.
 TF0924.WARNING-Repeat measurements at this control monument indicate possible
 TF0924.vertical movement.
 TF0924
 TF0924.The geoid height was determined by GEOID99.
 TF0924
 TF0924.The dynamic height is computed by dividing the NAVD 88
 TF0924.geopotential number by the normal gravity value computed on the
 TF0924.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 TF0924.degrees latitude (g = 980.6199 gals.).
 TF0924
 TF0924.The modeled gravity was interpolated from observed gravity values.
 TF0924
 TF0924;                    North         East     Units  Estimated Accuracy
 TF0924;SPC ND N      -   138,000.      542,730.     MT   (+/- 180 meters Scaled)
 TF0924
 TF0924                        SUPERSEDED SURVEY CONTROL
 TF0924
 TF0924  NGVD 29      -       473.358   (m)          1553.01   (f) ADJ UNCH    1 2
 TF0924
 TF0924.Superseded values are not recommended for survey control.
 TF0924.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 TF0924.See file dsdata.txt to determine how the superseded data were derived.
 TF0924
 TF0924_MARKER: DB = BENCH MARK DISK
 TF0924_SETTING: 30 = CULVERT
 TF0924_STAMPING: M 221 1962
 TF0924_MARK LOGO: CGS
 TF0924_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
 TF0924
 TF0924  HISTORY     - Date     Condition        Report By
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TF0924  HISTORY     - 1962     MONUMENTED        CGS
TF0924  HISTORY     - 1982     GOOD              NGS
TF0924
TF0924                          STATION DESCRIPTION
TF0924
TF0924'DESCRIBED BY COAST AND GEODETIC SURVEY 1962
TF0924'1.2 MI E FROM MINOT.
TF0924'1.2 MILES EAST ALONG THE GREAT NORTHERN RAILROAD FROM THE STATION AT
TF0924'MINOT, ABOUT 0.2 MILE OR 8 POLES EAST OF MILEPOST 202, SET IN THE TOP
TF0924'OF THE WEST END OF THE SOUTH HEADWALL OF A 20-FOOT CONCRETE CULVERT,
TF0924'28 FEET SOUTH OF THE SOUTH RAIL OF THE MAIN TRACK, 1.2 FEET EAST OF
TF0924'THE WEST END OF THE HEADWALL, AND ABOUT 8 FEET BELOW THE LEVEL OF THE
TF0924'TRACK.
TF0924
TF0924                          STATION RECOVERY (1982)
TF0924
TF0924'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1982
TF0924'RECOVERED IN GOOD CONDITION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF1799 ***********************************************************************
TF1799  DESIGNATION -  MINOT RESET
TF1799  PID         -  TF1799
TF1799  STATE/COUNTY-  ND/WARD
TF1799  USGS QUAD   -  MINOT (1979)
TF1799
TF1799                         *CURRENT SURVEY CONTROL
TF1799  ___________________________________________________________________
TF1799* NAD 83(1996)-  48 13 34.72912(N)    101 16 56.04367(W)     ADJUSTED
TF1799* NAVD 88     -        528.753  (meters)    1734.75   (feet) ADJUSTED
TF1799  ___________________________________________________________________
TF1799  LAPLACE CORR-          -6.70  (seconds)                    DEFLEC99
TF1799  GEOID HEIGHT-         -20.30  (meters)                     GEOID99
TF1799  DYNAMIC HT  -         528.840 (meters)    1735.04   (feet) COMP
TF1799  MODELED GRAV-     980,759.5   (mgal)                       NAVD 88
TF1799
TF1799  HORZ ORDER  -  FIRST
TF1799  VERT ORDER  -  FIRST     CLASS II
TF1799
TF1799.The horizontal coordinates were established by classical geodetic methods
TF1799.and adjusted by the National Geodetic Survey in January 1998.
TF1799
TF1799.The orthometric height was determined by differential leveling
TF1799.and adjusted by the National Geodetic Survey in June 1991.
TF1799
TF1799.The Laplace correction was computed from DEFLEC99 derived deflections.
TF1799
TF1799.The geoid height was determined by GEOID99.
TF1799
TF1799.The dynamic height is computed by dividing the NAVD 88
TF1799.geopotential number by the normal gravity value computed on the
TF1799.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF1799.degrees latitude (g = 980.6199 gals.).
TF1799
TF1799.The modeled gravity was interpolated from observed gravity values.
TF1799
TF1799;                    North         East     Units  Scale      Converg.
TF1799;SPC ND N     -   136,638.588   541,885.803   MT  0.99993889 -0 34 55.5
TF1799;UTM  14      - 5,343,972.693   330,506.492   MT  0.99995299 -1 42 08.8
TF1799
TF1799:                Primary Azimuth Mark                    Grid Az
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TF1799:SPC ND N     -  MINOT INTL AIRPORT BEACON                  356 33 34.0
TF1799:UTM  14      -  MINOT INTL AIRPORT BEACON                  357 40 47.3
TF1799
TF1799|---------------------------------------------------------------------|
TF1799| PID    Reference Object                     Distance      Geod. Az  |
TF1799|                                                           dddmmss.s |
TF1799| TF1800 MINOT RM 3                           33.040 METERS 06526     |
TF1799| TF2145 SURREY PUBLIC SCHOOL FLAGPOLE       APPROX.11.3 KM 0840122.1 |
TF1799| CS9194 MINOT AZ MK                                        0890805.4 |
TF1799| TF2146 MINOT USCAA RADIO RANGE STATION     APPROX. 4.0 KM 0984046.6 |
TF1799| TF2148 MINOT KLPM RADIO TRANSM TOWER       APPROX. 3.5 KM 1200004.2 |
TF1799| CS9195 MINOT RM 1                           32.376 METERS 15128     |
TF1799| TF2164 SOUTH PRAIRIE TV STA KXMC MAST      APPROX.20.1 KM 1925637.0 |
TF1799| CS9196 MINOT RM 2                           41.157 METERS 22548     |
TF1799| TF2156 MINOT SOUTH MUNICIPAL TANK          APPROX. 1.8 KM 2413642.6 |
TF1799| TF2157 MINOT MEYER BROADCST MICRO MST      APPROX. 3.0 KM 2454806.2 |
TF1799| TF2152 MINOT MUNICIPAL TANK                426.963 METERS 2721303.2 |
TF1799| TF2155 MINOT ST LEOS CATH CH SPIRE         APPROX. 1.1 KM 3184201.0 |
TF1799| TF2186 MINOT NORTH MUNICIPAL TANK          APPROX. 4.9 KM 3270254.3 |
TF1799| TF2154 MONOT FIRST LUTHERAN CHURCH SPIRE   APPROX. 1.9 KM 3292607.2 |
TF1799| TF2153 MINOT MILLER MILLING CO TANK        APPROX. 1.1 KM 3391831.1 |
TF1799| TF2191 MINOT INTL AIRPORT BEACON           APPROX. 3.1 KM 3555838.5 |
TF1799|---------------------------------------------------------------------|
TF1799
TF1799                         SUPERSEDED SURVEY CONTROL
TF1799
TF1799  NAD 83(1986)-  48 13 34.72903(N)    101 16 56.04173(W) AD(       ) 1
TF1799  NAD 27      -  48 13 34.69290(N)    101 16 54.45720(W) AD(       ) 1
TF1799
TF1799.Superseded values are not recommended for survey control.
TF1799.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF1799.See file dsdata.txt to determine how the superseded data were derived.
TF1799
TF1799_MARKER: DS = TRIANGULATION STATION DISK
TF1799_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF1799_STAMPING: MINOT 1934 1967
TF1799_MARK LOGO: CGS
TF1799_PROJECTION: FLUSH
TF1799_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
TF1799+STABILITY: SURFACE MOTION
TF1799
TF1799  HISTORY     - Date     Condition        Report By
TF1799  HISTORY     - 1934     MONUMENTED       CGS
TF1799  HISTORY     - 1938     GOOD             CGS
TF1799  HISTORY     - 1946     GOOD             CGS
TF1799  HISTORY     - 1954     GOOD             CGS
TF1799  HISTORY     - 1957     GOOD             CGS
TF1799  HISTORY     - 1963     GOOD             CGS
TF1799  HISTORY     - 1967     SEE DESCRIPTION  CGS
TF1799  HISTORY     - 1968     GOOD             CGS
TF1799  HISTORY     - 1982     GOOD             NGS
TF1799
TF1799                         STATION DESCRIPTION
TF1799
TF1799'DESCRIBED BY COAST AND GEODETIC SURVEY 1934 (WRP)
TF1799'STATION IS ON HIGH BLUFFS AT SOUTH EDGE OF MINOT AND OVERLOOKS
TF1799'THE CITY AND THE MOUSE RIVER VALLEY.  STATION IS LOCATED NEAR
TF1799'A SMALL FRAME TWO-STORY HOUSE HAVING A CONCRETE BASE AND BEARING
TF1799'THE NUMBER 700-10TH AVE. SE., AND IS SOUTH-SOUTHEAST OF IT.
TF1799'THE STATION IS 147 FEET FROM THE SOUTHEAST CORNER AND 154 FEET
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TF1799'FROM THE NORTHEAST CORNER.  IT IS ALSO 321 FEET FROM THE
TF1799'NORTHWEST CORNER OF A SMALL HOUSE HAVING NO NUMBER THAT IS
TF1799'EAST-SOUTHEAST OF STATION.
TF1799'
TF1799'STATION MAY BE REACHED BY LEAVING WARD COUNTY COURTHOUSE AND
TF1799'GOING SOUTH ON 4TH STREET SE. TO TOP OF HILL AND INTERSECTION
TF1799'OF THIS STREET AND 11TH AVE.  AT THIS POINT, BY ROSEHILL CEMETERY,
TF1799'TURN EAST AND GO 0.1 MILE, LEAVE 11TH AVE. AND GO NORTH 0.1
TF1799'MILE TO HIGH GROUND ON EDGE OF BLUFF AND STATION.
TF1799'
TF1799'SURFACE, UNDERGROUND, REFERENCE AND AZIMUTH MARKS ARE STANDARD
TF1799'BRONZE DISKS SET IN CONCRETE.
TF1799'
TF1799'REFERENCE MARK NO. 1 IS EAST-SOUTHEAST OF THE STATION.  REFERENCE
TF1799'MARK NO. 2 IS SOUTH OF THE STATION.  DISTANCE BETWEEN REFERENCE
TF1799'MARKS (HORIZONTAL MEASUREMENT) 147.30 FEET.
TF1799'
TF1799'AZIMUTH MARK IS EAST OF STATION, ON SAME BLUFF ON WHICH STATION
TF1799'IS LOCATED.  A TEN-FOOT STAND WILL CLEAR ALL LINES.
TF1799
TF1799                         STATION RECOVERY (1938)
TF1799
TF1799'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1938 (CDM)
TF1799'THE STATION AND ALL MARKS WERE RECOVERED AS DESCRIBED IN 1934
TF1799'AND THE MARKS ARE IN GOOD CONDITION.  REFERENCE MARK NO. 2 IS
TF1799'SOUTHWEST OF THE STATION AND NOT SOUTH AS DESCRIBED IN 1934.
TF1799
TF1799                         STATION RECOVERY (1946)
TF1799
TF1799'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1946 (RAM)
TF1799'THE STATION WAS RECOVERED AS DESCRIBED IN 1934 AND ALL MARKS
TF1799'WERE FOUND IN GOOD CONDITION.  A NEW DESCRIPTION FOLLOWS.
TF1799'
TF1799'THE STATION IS LOCATED ON A HIGH BLUFF ON THE SOUTHERN EDGE
TF1799'OF THE CITY OF MINOT, 0.15 MILE NORTHEAST OF THE ROSEHILL
TF1799'CEMETERY AND 0.15 MILE EAST OF THE MINOT MUNICIPAL WATER TANK.
TF1799'THE MARK PROJECTS 6 INCHES AND THE DISK IS STAMPED MINOT 1934.
TF1799'
TF1799'SURFACE, UNDERGROUND, REFERENCE MARKS AND AZIMUTH MARK ARE A
TF1799'STANDARD BRONZE DISK SET IN CONCRETE.
TF1799'
TF1799'REFERENCE MARK NO. 1 IS 32.376 METERS (106.22 FEET) EAST-SOUTHEAST
TF1799'OF THE STATION.  IT IS ABOUT 9 FEET LOWER IN ELEVATION THAN THE
TF1799'STATION MARK.  THE MARK PROJECTS 2 INCHES AND THE DISK IS
TF1799'STAMPED MINOT NO 1 1934.
TF1799'
TF1799'REFERENCE MARK NO. 2 IS 41.185 METERS (135.12 FEET) SOUTH-SOUTHWEST
TF1799'OF THE STATION.  IT IS ABOUT 15 FEET LOWER IN ELEVATION THAN
TF1799'THE STATION MARK.  THE MARK PROJECTS 2 INCHES AND THE DISK IS
TF1799'STAMPED MINOT NO 2 1934.
TF1799'
TF1799'THE AZIMUTH MARK IS 0.15 MILE (AIRLINE) EAST OF THE STATION
TF1799'AND ON THE FIRST BLUFF EAST OF THE STATION.  IT IS 4 FEET WEST
TF1799'OF A NORTH-SOUTH FENCE LINE.  THE MARK PROJECTS 4 INCHES AND
TF1799'THE DISK IS STAMPED MINOT AZIMUTH 1934.
TF1799'
TF1799'TO REACH THE STATION FROM THE SOUTHEAST CORNER OF THE WARD
TF1799'COUNTY COURTHOUSE, GO SOUTH ON FOURTH STREET TO THE MAIN
TF1799'ENTRANCE OF THE ROSEHILL CEMETERY, TURN LEFT ON ELEVENTH STREET
TF1799'AND GO EAST 0.1 MILE, THENCE LEFT ON GRAVELED ROAD FOR 0.1 MILE
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TF1799'TO THE SUMMIT OF BLUFF AND STATION AS DESCRIBED.
TF1799'
TF1799'TO REACH THE AZIMUTH MARK FROM THE STATION, GO SOUTH 0.1 MILE
TF1799'ON GRAVELED ROAD TO CROSSROAD, THENCE LEFT FOR 0.1 MILE TO
TF1799'WHERE MAIN ROAD TURNS LEFT. CONTINUE ON EAST ON TRACK ROAD FOR
TF1799'0.05 MILE, THENCE LEFT ALONG THE WEST SIDE OF A NORTH-SOUTH
TF1799'FENCE LINE FOR 0.05 MILE TO THE MARK ON THE RIGHT AS DESCRIBED.
TF1799'
TF1799'OBSERVATIONS MADE FROM A 10 FOOT WOOD STAND.
TF1799'
TF1799'HEIGHT OF LIGHT ABOVE STATION MARK - 22 METERS.
TF1799
TF1799 STATION RECOVERY (1954)
TF1799
TF1799'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1954 (LWQ)
TF1799'THE STATION, REFERENCE MARK NO. 2 AND THE AZIMUTH MARK WERE
TF1799'RECOVERED IN GOOD CONDITION. REFERENCE MARK NO. 1 WAS NOT FOUND.
TF1799'THE STREET HAS BEEN GRADED AND IT IS BELIEVED THAT THE MARK
TF1799'WAS DESTROYED.
TF1799'
TF1799'DESCRIPTION IS ADEQUATE.
TF1799
TF1799 STATION RECOVERY (1957)
TF1799
TF1799'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1957 (HJS)
TF1799'STATION RECOVERED AS DESCRIBED AND STATION AND REFERENCE MARKS
TF1799'FOUND IN GOOD CONDITION. ABOUT 2 FEET OF ONE SIDE OF THE
TF1799'AZIMUTH MARK IS EXPOSED BUT IT WAS NOT MOVED AS IT IS NO LONGER
TF1799'VISABLE FROM THE GROUND. THE AREA AROUND THE STATION IS BEING
TF1799'DEVELOPED AND NEW HOUSES ARE BEING ERECTED AND IT WOULD BE
TF1799'DIFFICULT TO FIND A SUITABLE SITE FOR AN AZIMUTH MARK. THE
TF1799'MINOT MUNICIPAL WATER TANK IS VISABLE FROM THE GROUND AT THE
TF1799'STATION AND CAN BE USED FOR AN AZIMUTH.
TF1799'
TF1799'R.M. NO. 1 IS EAST-SOUTHEAST OF THE STATION AND R.M. NO. 2 IS
TF1799'SOUTHWEST OF STATION IN SOUTHWEST ANGLE OF STREET INTERSECTION.
TF1799'
TF1799'THE STATION MARK IS IN THE FRONT YARD OF A RESIDENCE AND IS
TF1799'NEAR A CLOTHES LINE POLE.
TF1799'
TF1799'THE DESCRIPTION TO REACH FROM THE COURT HOUSE IS ADEQUATE.
TF1799
TF1799 STATION RECOVERY (1963)
TF1799
TF1799'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1963 (DJF)
TF1799'THE STATION MARK AND REFERENCE MARK NUMBER 2 WERE RECOVERED
TF1799'UNDISTURBED AND IN GOOD CONDITION. REFERENCE MARK NUMBER 1
TF1799'HAS BEEN DESTROYED AND A NEW REFERENCE MARK NUMBER 3 WAS SET.
TF1799'THE AZIMUTH MARK WAS NOT RECOVERED. BUILDINGS AND HOMES NOW
TF1799'SURROUND THE STATION BUT THE BEACON AT THE MUNICIPAL AIRPORT
TF1799'IS VISIBLE FROM THE GROUND SO IT MAY BE USED FOR AN AZIMUTH.
TF1799'A COMPLETE DESCRIPTION FOLLOWS--
TF1799'
TF1799'THE STATION IS LOCATED IN THE SOUTHEAST PART OF THE CITY OF MINOT,
TF1799'ON A LOW HILL BEHIND A WHITE HOUSE WITH A RED ROOF, NUMBER 702
TF1799'10TH AVENUE S.E.
TF1799'
TF1799'TO REACH THE STATION FROM THE FRONT OF THE WARD COUNTY COURTHOUSE
TF1799'ON 3RD STREET IN MINOT GO SOUTH 0.6 MILE TO 11TH AVENUE S.E.
TF1799'TURN LEFT AND GO EAST 0.3 MILE TO A GRAVELED SIDE STREET ON

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TF1799'THE LEFT (7TH STREET S.E.).  TURN LEFT AND GO NORTH 1/2 BLOCK
TF1799'THEN RIGHT TO TOP OF SMALL HILL AND STATION.
TF1799'
TF1799'THE STATION MARK IS A STANDARD DISK STAMPED MINOT 1934 SET IN
TF1799'THE TOP OF A 12-INCH-SQUARE CONCRETE MONUMENT PROJECTING 4
TF1799'INCHES ABOVE GROUND.  IT IS 52.9 FEET SOUTHEAST OF THE SOUTHEAST
TF1799'CORNER OF A WHITE HOUSE, AND 1.3 FEET NORTHEAST OF A METAL
TF1799'WITNESS POST WITH SIGN.
TF1799'
TF1799'REFERENCE MARK NUMBER TWO IS A STANDARD DISK STAMPED MINOT NO 2
TF1799'1934 SET IN THE TOP OF A 12-INCH-SQUARE CONCRETE MONUMENT
TF1799'PROJECTING 2 INCHES ABOVE GROUND.  IT IS 41.1 FEET WEST OF A
TF1799'FIRE HYDRANT, AND 5 FEET LOWER THAN STATION ELEVATION.
TF1799'
TF1799'REFERENCE MARK NUMBER THREE IS A STANDARD DISK STAMPED MINOT
TF1799'NO 3 1934 SET IN THE TOP OF A 12-INCH CONCRETE CYLINDER SET
TF1799'FLUSH WITH THE SURFACE OF THE GROUND.  IT IS 92.6 FEET SOUTH
TF1799'OF THE CENTER OF 10TH AVENUE, 2.8 FEET WEST OF THE BASE OF A
TF1799'POWERLINE POLE, AND 4 FEET LOWER THAN STATION ELEVATION.
TF1799
TF1799                        STATION RECOVERY (1967)
TF1799
TF1799'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1967 (LFS)
TF1799'STATION RECOVERED AND STATION AND REFERENCE MARKS FOUND IN
TF1799'GOOD CONDITION.  A REQUEST WAS RECEIVED TO MOVE THE STATION
TF1799'MARK OUT OF THE YARD.  THE LAND OWNER WAS CONTACTED AND HE
TF1799'AGREED TO PERMIT THE MARK TO BE LOWERED VERTICALLY.  THE SURFACE
TF1799'AND UNDERGROUND MARKS WERE LOWERED VERTICALLY AND THE DISKS
TF1799'WERE RESTAMPED MINOT 1934 1967.  AT THE TIME OF RECOVERY THE
TF1799'YARD HAD BEEN LANDSCAPED AND THE SURFACE MARK WAS FOUND TO BE
TF1799'PROJECTING ABOUT 18 INCHES.  IT WAS LOWERED TO A POSITION
TF1799'ABOUT FLUSH WITH THE SURFACE OF THE GROUND.
TF1799'
TF1799'TO REACH THE STATION FROM THE FRONT OF THE WARD COUNTY COURT
TF1799'HOUSE IN MINOT GO SOUTH ON 3RD STREET FOR 0.5 MILE TO INTERSECTION
TF1799'WITH 11TH AVENUE SE, TURN LEFT AND GO EAST FOR 0.3 MILE TO
TF1799'INTERSECTION WITH 7TH STREET SE, TURN LEFT AND GO NORTH FOR
TF1799'ABOUT 3/4 BLOCK TO THE STATION IN THE BACK YARD OF A HOUSE
TF1799'ON RIGHT.
TF1799'
TF1799'THE STATION MARK IS 75 FEET EAST OF THE CENTERLINE OF 7TH
TF1799'STREET, 52.9 FEET SOUTH-SOUTHEAST OF THE SOUTHEAST CORNER OF
TF1799'THE HOUSE AT 702 10TH AVENUE AND 23.7 FEET SOUTH-SOUTHWEST OF
TF1799'THE SOUTHWEST CORNER OF A HOUSE THAT WAS UNDER CONSTRUCTION
TF1799'AT THE TIME THE STATION WAS RECOVERED.  MARK IS ABOUT FLUSH
TF1799'WITH THE GROUND.
TF1799'
TF1799'R.M. NO. 2 IS AT THE SOUTHWEST INTERSECTION OF TWO STREETS TO
TF1799'SOUTHWEST OF STATION AND IS 41 FEET WEST OF A FIRE HYDRANT.
TF1799'THE MARK IS FLUSH AND THE DISK IS STAMPED MINOT NO 2 1934.
TF1799'
TF1799'R.M. NO. 3 IS 68.5 FEET EAST-NORTHEAST OF THE SOUTHEAST CORNER
TF1799'OF A NEW HOUSE, 92.5 FEET SOUTH OF THE CENTERLINE OF 10TH AVENUE
TF1799'AND 2.8 FEET WEST OF A POWERLINE POLE.  THE MARK IS FLUSH AND
TF1799'THE DISK IS STAMPED MINOT NO 3 1934.
TF1799'
TF1799'THE AZIMUTH MARK WAS NOT RECOVERED BUT IT WOULD NOT BE VISIBLE
TF1799'FROM THE GROUND AT THE STATION.  THERE WAS NO SUITABLE PLACE
TF1799'TO ESTABLISH A NEW AZIMUTH MARK.
TF1799'
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TF1799'AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN--AT MINOT
TF1799
TF1799                          STATION RECOVERY (1968)
TF1799
TF1799'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1968 (DLW)
TF1799'STATION WAS RECOVERED AS DESCRIBED IN HORIZONTAL CONTROL DATA
TF1799'SUPPLIMENT DATED JULY 1961.  DESCRIPTION
TF1799'IS ADEQUATE.
TF1799'
TF1799'AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN--1/2 MILE
TF1799'SOUTH EAST OF DOWNTOWN MINOT
TF1799
TF1799                          STATION RECOVERY (1982)
TF1799
TF1799'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1982
TF1799'IN MINOT.
TF1799'IN MINOT, AT 702 10TH AVENUE SOUTHEAST, 25.8 METERS (84.6 FT) NORTH OF
TF1799'THE CENTER OF AN ALLEY, 22.1 METERS (72.5 FT) EAST OF THE CENTER OF
TF1799'7TH STREET SOUTHEAST, 3.4 METERS (11.2 FT) EAST OF THE SOUTHEAST
TF1799'CORNER OF A DOUBLE GARAGE, 0.7 METER (2.3 FT) WEST OF A FENCE AND 0.5
TF1799'METER (1.6 FT) NORTH OF A UTILITY POLE.
TF1799'THE MARK IS 1.5 M ABOVE THE STREET.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF0925 ***********************************************************************
TF0925  DESIGNATION -  N 221
TF0925  PID         -  TF0925
TF0925  STATE/COUNTY-  ND/WARD
TF0925  USGS QUAD   -  MINOT (1979)
TF0925
TF0925                         *CURRENT SURVEY CONTROL
TF0925  ___________________________________________________________________
TF0925* NAD 83(1986)-  48 14 16.     (N)    101 17 18.     (W)     SCALED
TF0925* NAVD 88     -       474.591  (meters)    1557.05   (feet)  ADJUSTED
TF0925  ___________________________________________________________________
TF0925  GEOID HEIGHT-          -20.30  (meters)                    GEOID99
TF0925  DYNAMIC HT  -          474.669 (meters)    1557.31  (feet) COMP
TF0925  MODELED GRAV-      980,760.9   (mgal)                      NAVD 88
TF0925
TF0925  VERT ORDER  -  FIRST     CLASS II
TF0925
TF0925.The horizontal coordinates were scaled from a topographic map and have
TF0925.an estimated accuracy of +/- 6 seconds.
TF0925
TF0925.The orthometric height was determined by differential leveling
TF0925.and adjusted by the National Geodetic Survey in June 1991.
TF0925.WARNING-Repeat measurements at this control monument indicate possible
TF0925.vertical movement.
TF0925
TF0925.The geoid height was determined by GEOID99.
TF0925
TF0925.The dynamic height is computed by dividing the NAVD 88
TF0925.geopotential number by the normal gravity value computed on the
TF0925.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF0925.degrees latitude (g = 980.6199 gals.).
TF0925
TF0925.The modeled gravity was interpolated from observed gravity values.
TF0925
TF0925;                      North         East     Units  Estimated Accuracy
TF0925;SPC ND N      -     137,920.      541,450.     MT   (+/- 180 meters Scaled)
TF0925
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TF0925                          SUPERSEDED SURVEY CONTROL
TF0925
TF0925  NGVD 29      -       474.252  (m)         1555.94   (f) ADJ UNCH     1 2
TF0925
TF0925.Superseded values are not recommended for survey control.
TF0925.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF0925.See file dsdata.txt to determine how the superseded data were derived.
TF0925
TF0925_MARKER: DB = BENCH MARK DISK
TF0925_SETTING: 36 = PIER
TF0925_STAMPING: N 221 1962
TF0925_MARK LOGO: CGS
TF0925_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
TF0925
TF0925  HISTORY      - Date     Condition        Report By
TF0925  HISTORY      - 1962     MONUMENTED       CGS
TF0925  HISTORY      - 1981     GOOD             NGS
TF0925  HISTORY      - 1982     GOOD             NGS
TF0925
TF0925                          STATION DESCRIPTION
TF0925
TF0925'DESCRIBED BY COAST AND GEODETIC SURVEY 1962
TF0925'0.5 MI E FROM MINOT.
TF0925'0.5 MILE EAST ALONG THE GREAT NORTHERN RAILROAD FROM THE STATION AT
TF0925'MINOT, SET VERTICALLY IN THE SOUTH FACE OF THE WEST LEG OF THE CENTER
TF0925'PIER OF THE OVERPASS OF THIRD STREET NORTHEAST, 10 FEET NORTH OF THE
TF0925'NORTH RAIL OF THE MAIN TRACK, 2 1/2 FEET ABOVE THE GROUND, AND ABOUT 1
TF0925'1/2 FEET ABOVE THE LEVEL OF THE TRACK.
TF0925
TF0925                          STATION RECOVERY (1981)
TF0925
TF0925'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1981
TF0925'RECOVERED IN GOOD CONDITION.
TF0925
TF0925                          STATION RECOVERY (1982)
TF0925
TF0925'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1982
TF0925'RECOVERED IN GOOD CONDITION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF1893 ********************************************************************
TF1893  DESIGNATION -  N 472
TF1893  PID         -  TF1893
TF1893  STATE/COUNTY-  ND/WARD
TF1893  USGS QUAD   -  MINOT (1979)
TF1893
TF1893                         *CURRENT SURVEY CONTROL
TF1893  ___________________________________________________________________
TF1893* NAD 83(1986)-  48 13 51.     (N)    101 15 07.      (W)     SCALED
TF1893* NAVD 88     -       473.193  (meters)     1552.47   (feet)  ADJUSTED
TF1893  ___________________________________________________________________
TF1893  GEOID HEIGHT-          -20.37  (meters)                     GEOID99
TF1893  DYNAMIC HT  -         473.272  (meters)     1552.73  (feet)  COMP
TF1893  MODELED GRAV-     980,762.2   (mgal)                        NAVD 88
TF1893
TF1893  VERT ORDER  -  FIRST     CLASS II
TF1893
TF1893.The horizontal coordinates were scaled from a topographic map and have
TF1893.an estimated accuracy of +/- 6 seconds.
TF1893
TF1893.The orthometric height was determined by differential leveling
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TF1893.and adjusted by the National Geodetic Survey in June 1991.
TF1893
TF1893.The geoid height was determined by GEOID99.
TF1893
TF1893.The dynamic height is computed by dividing the NAVD 88
TF1893.geopotential number by the normal gravity value computed on the
TF1893.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF1893.degrees latitude (g = 980.6199 gals.).
TF1893
TF1893.The modeled gravity was interpolated from observed gravity values.
TF1893
TF1893; North East Units Estimated Accuracy
TF1893;SPC ND N - 137,120. 544,140. MT (+/- 180 meters Scaled)
TF1893
TF1893 SUPERSEDED SURVEY CONTROL
TF1893
TF1893.No superseded survey control is available for this station.
TF1893
TF1893_MARKER: I = METAL ROD
TF1893_SETTING: 15 = METAL ROD DRIVEN INTO GROUND. SEE TEXT FOR ADDITIONAL
TF1893+WITH SETTING: INFORMATION.
TF1893_STAMPING: N 472 1982
TF1893_MARK LOGO: NGS
TF1893_PROJECTION: FLUSH
TF1893_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
TF1893_ROD/PIPE-DEPTH: 1.8 meters
TF1893
TF1893 HISTORY - Date Condition Report By
TF1893 HISTORY - 1982 MONUMENTED NGS
TF1893
TF1893 STATION DESCRIPTION
TF1893
TF1893'DESCRIBED BY NATIONAL GEODETIC SURVEY 1982
TF1893'IN MINOT.
TF1893'2.7 KM (1.7 MI) WEST ALONG BUSINESS U.S. HIGHWAY 2 FROM THE JUNCTION
TF1893'OF U.S. HIGHWAY 2, THENCE 0.2 KM (0.1 MI) NORTH ALONG COUNTY ROAD 19,
TF1893'SET AT A LARGE METAL BUILDING, 48.3 METERS (158.5 FT) EAST OF THE
TF1893'CENTERLINE OF THE COUNTY ROAD, 54.8 METERS (180.0 FT) NORTH-NORTHWEST
TF1893'OF THE SOUTHWEST CORNER OF THE MAIN BUILDING, 4.2 METERS (14.0 FT)
TF1893'NORTHEAST OF A FLAGPOLE, AND 1.2 METERS (4.0 FT) WEST OF THE SOUTHWEST
TF1893'CORNER OF A METAL BUILDING, PRESENTLY OCCUPIED BY THE POLYCO AMERICAN
TF1893'WINDOW COMPANY, THE OFFICE ADDITION. NOTE, DRIVEN TO REFUSAL.
TF1893'THE MARK IS ABOVE LEVEL WITH PARKING LOT.
1 National Geodetic Survey, Retrieval Date = OCTOBER 3, 2002
TF0945 ***
TF0945 DESIGNATION - S 221
TF0945 PID - TF0945
TF0945 STATE/COUNTY- ND/WARD
TF0945 USGS QUAD - MINOT (1979)
TF0945
TF0945 *CURRENT SURVEY CONTROL
TF0945
TF0945* NAD 83(1986)- 48 13 09. (N) 101 20 51. (W) SCALED
TF0945* NAVD 88 - 496.681 (meters) 1629.53 (feet) ADJUSTED
TF0945
TF0945 GEOID HEIGHT- -20.14 (meters) GEOID99
TF0945 DYNAMIC HT - 496.761 (meters) 1629.79 (feet) COMP
TF0945 MODELED GRAV- 980,757.0 (mgal) NAVD 88
TF0945
TF0945 VERT ORDER - FIRST CLASS II

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 TF0945
 TF0945.The horizontal coordinates were scaled from a topographic map and have
 TF0945.an estimated accuracy of +/- 6 seconds.
 TF0945
 TF0945.The orthometric height was determined by differential leveling
 TF0945.and adjusted by the National Geodetic Survey in June 1991.
 TF0945
 TF0945.The geoid height was determined by GEOID99.
 TF0945
 TF0945.The dynamic height is computed by dividing the NAVD 88
 TF0945.geopotential number by the normal gravity value computed on the
 TF0945.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 TF0945.degrees latitude (g = 980.6199 gals.).
 TF0945
 TF0945.The modeled gravity was interpolated from observed gravity values.
 TF0945
 TF0945;                   North         East     Units  Estimated Accuracy
 TF0945;SPC ND N     -   135,900.      537,030.      MT  (+/- 180 meters Scaled)
 TF0945
 TF0945                         SUPERSEDED SURVEY CONTROL
 TF0945
 TF0945  NGVD 29     -        496.308  (m)          1628.30    (f) ADJ UNCH     1 2
 TF0945
 TF0945.Superseded values are not recommended for survey control.
 TF0945.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 TF0945.See file dsdata.txt to determine how the superseded data were derived.
 TF0945
 TF0945_MARKER: DB = BENCH MARK DISK
 TF0945_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
 TF0945_STAMPING: S 221 1962
 TF0945_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
 TF0945+STABILITY: SURFACE MOTION
 TF0945
 TF0945  HISTORY     - Date     Condition        Report By
 TF0945  HISTORY     - 1962     MONUMENTED       CGS
 TF0945  HISTORY     - 1981     GOOD             NGS
 TF0945
 TF0945                         STATION DESCRIPTION
 TF0945
 TF0945'DESCRIBED BY COAST AND GEODETIC SURVEY 1962
 TF0945'2.8 MI W FROM MINOT.
 TF0945'2.8 MILES WEST ALONG THE GREAT NORTHERN RAILROAD FROM THE STATION AT
 TF0945'MINOT, ABOUT 0.5 MILE WEST OF THE OVERPASS OF U.S. HIGHWAYS 2 AND 52,
 TF0945'ABOUT 0.1 MILE OR 3 POLES WEST OF MILEPOST 3, AT THE NORTH END OF A
 TF0945'RIDGE BETWEEN TWO DEEP RAVINES, 106.5 FEET SOUTHWEST AND ACROSS THE
 TF0945'TRACK FROM A STEEL POST SUPPORTING A SIGN WHICH READS 21.02, 28.2 FEET
 TF0945'SOUTH OF THE SOUTH RAIL OF THE SOUTH TRACK, 1.5 FEET WEST OF A METAL
 TF0945'WITNESS POST, ABOUT 2 1/2 FEET BELOW THE LEVEL OF THE TRACK, AND SET
 TF0945'IN THE TOP OF A CONCRETE POST PROJECTING 3 INCHES.
 TF0945
 TF0945                         STATION RECOVERY (1981)
 TF0945
 TF0945'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1981
 TF0945'RECOVERED IN GOOD CONDITION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
 TF0977 ***********************************************************************
 TF0977  DESIGNATION -  S 335
 TF0977  PID         -  TF0977
 TF0977  STATE/COUNTY-  ND/WARD
 TF0977  USGS QUAD   -  MINOT (1979)
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TF0977
TF0977                          *CURRENT SURVEY CONTROL
TF0977
TF0977* NAD 83(1986)-  48 14 24.     (N)    101 21 23.     (W)    SCALED
TF0977* NAVD 88     -       478.529  (meters)    1569.97    (feet)  ADJUSTED
TF0977
TF0977  GEOID HEIGHT-        -20.15  (meters)                       GEOID99
TF0977  DYNAMIC HT  -       478.608  (meters)    1570.23    (feet)  COMP
TF0977  MODELED GRAV-     980,759.7  (mgal)                         NAVD 88
TF0977
TF0977  VERT ORDER  -  SECOND     CLASS 0
TF0977
TF0977.The horizontal coordinates were scaled from a topographic map and have
TF0977.an estimated accuracy of +/- 6 seconds.
TF0977
TF0977.The orthometric height was determined by differential leveling
TF0977.and adjusted by the National Geodetic Survey in June 1991.
TF0977
TF0977.The geoid height was determined by GEOID99.
TF0977
TF0977.The dynamic height is computed by dividing the NAVD 88
TF0977.geopotential number by the normal gravity value computed on the
TF0977.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF0977.degrees latitude (g = 980.6199 gals.).
TF0977
TF0977.The modeled gravity was interpolated from observed gravity values.
TF0977
TF0977;                   North         East     Units  Estimated Accuracy
TF0977;SPC ND N     -   138,220.      536,390.      MT  (+/- 180 meters Scaled)
TF0977
TF0977                          SUPERSEDED SURVEY CONTROL
TF0977
TF0977  NGVD 29     -       478.098  (m)         1568.56    (f) ADJ UNCH    2 0
TF0977
TF0977.Superseded values are not recommended for survey control.
TF0977.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF0977.See file dsdata.txt to determine how the superseded data were derived.
TF0977
TF0977_MARKER: DB = BENCH MARK DISK
TF0977_SETTING: 30 = CULVERT
TF0977_STAMPING: S-335 1935
TF0977_STABILITY: D = MARK OF QUESTIONABLE OR UNKNOWN STABILITY
TF0977
TF0977  HISTORY     - Date     Condition        Report By
TF0977  HISTORY     - 1935     MONUMENTED       CGS
TF0977
TF0977                          STATION DESCRIPTION
TF0977
TF0977'DESCRIBED BY COAST AND GEODETIC SURVEY 1935
TF0977'3.4 MI NW FROM MINOT.
TF0977'3.4 MILES NORTHWEST OF SOO LINE PASSENGER DEPOT AT ON ROAD ALONG THE
TF0977'NORTHEAST BANK OF THE SOURIS RIVER, AT T-ROAD SOUTH, ABOUT 2.8 MILES
TF0977'NORTHWEST OF JUNCTION WITH NO. 83 HIWAY AT MINOT.  SET IN THE CENTER
TF0977'OF THE EAST HEADWALL OF CONCRETE CULVERT, 75 FT SOUTH OF CENTERLINE OF
TF0977'JUNCTION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF1797 ***********************************************************************
TF1797  DESIGNATION -  S 463
TF1797  PID         -  TF1797
TF1797  STATE/COUNTY-  ND/WARD
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TF1797  USGS QUAD    -  MINOT (1979)
TF1797
TF1797                         *CURRENT SURVEY CONTROL
TF1797  ___________________________________________________________________
TF1797* NAD 83(1986)-  48 14 14.     (N)    101 17 45.     (W)    SCALED
TF1797* NAVD 88     -      476.548   (meters)    1563.47   (feet)  ADJUSTED
TF1797  ___________________________________________________________________
TF1797  GEOID HEIGHT-         -20.28  (meters)                    GEOID99
TF1797  DYNAMIC HT  -         476.627 (meters)    1563.73  (feet)  COMP
TF1797  MODELED GRAV-      980,760.4  (mgal)                      NAVD 88
TF1797
TF1797  VERT ORDER  -  FIRST     CLASS II
TF1797
TF1797.The horizontal coordinates were scaled from a topographic map and have
TF1797.an estimated accuracy of +/- 6 seconds.
TF1797
TF1797.The orthometric height was determined by differential leveling
TF1797.and adjusted by the National Geodetic Survey in June 1991.
TF1797
TF1797.The geoid height was determined by GEOID99.
TF1797
TF1797.The dynamic height is computed by dividing the NAVD 88
TF1797.geopotential number by the normal gravity value computed on the
TF1797.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF1797.degrees latitude (g = 980.6199 gals.).
TF1797
TF1797.The modeled gravity was interpolated from observed gravity values.
TF1797
TF1797;                     North        East     Units  Estimated Accuracy
TF1797;SPC ND N     -    137,860.     540,890.     MT   (+/- 180 meters Scaled)
TF1797
TF1797                          SUPERSEDED SURVEY CONTROL
TF1797
TF1797.No superseded survey control is available for this station.
TF1797
TF1797_MARKER: DB = BENCH MARK DISK
TF1797_SETTING: 38 = PIER
TF1797_STAMPING: S 463 1981
TF1797_MARK LOGO: NGS
TF1797_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
TF1797
TF1797  HISTORY     - Date     Condition        Report By
TF1797  HISTORY     - 1981     MONUMENTED       NGS
TF1797  HISTORY     - 1982     GOOD             NGS
TF1797
TF1797                          STATION DESCRIPTION
TF1797
TF1797'DESCRIBED BY NATIONAL GEODETIC SURVEY 1981
TF1797'0.2 KM (0.1 MI) NE FROM MINOT.
TF1797'0.2 KM (0.1 MI) NORTHEASTERLY ALONG THE BURLINGTON NORTHERN RAILROAD
TF1797'FROM THE RAILROAD STATION IN MINOT, SET VERTICALLY IN THE NORTHWEST
TF1797'FACE OF THE MOST SOUTHWESTERLY 1 OF 2 PIERS OF THE SOUTH BOUND LANES
TF1797'OF THE NORTH BROADWAY OVERPASS, 18.4 METERS (60.4 FT) NORTHEAST OF THE
TF1797'NORTHWEST CORNER OF A BRICK BUILDING, 13.7 METERS (44.9 FT) SOUTH OF
TF1797'THE NEAR RAIL, 7.3 METERS (24.0 FT) SOUTH OF THE CENTER OF A PAVED
TF1797'ROAD.
TF1797'THE MARK IS 1.3 M ABOVE THE ROAD.
TF1797
TF1797                          STATION RECOVERY (1982)
TF1797
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 TF1797'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1982
 TF1797'RECOVERED IN GOOD CONDITION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
 TF2147 ***********************************************************************
 TF2147  DESIGNATION -  SOU EAST
 TF2147  PID         -  TF2147
 TF2147  STATE/COUNTY-  ND/WARD
 TF2147  USGS QUAD   -  SURREY (1981)
 TF2147
 TF2147                         *CURRENT SURVEY CONTROL
 TF2147  ___________________________________________________________________
 TF2147* NAD 83(1996)-  48 11 20.37513(N)    101 13 25.52257(W)     ADJUSTED
 TF2147* NAVD 88     -       512.     (meters)    1680.     (feet)  SCALED
 TF2147  ___________________________________________________________________
 TF2147  LAPLACE CORR-          -6.50  (seconds)                    DEFLEC99
 TF2147  GEOID HEIGHT-         -20.39  (meters)                     GEOID99
 TF2147
 TF2147  HORZ ORDER  -  FIRST
 TF2147
 TF2147.The horizontal coordinates were established by classical geodetic methods
 TF2147.and adjusted by the National Geodetic Survey in January 1998.
 TF2147
 TF2147.The orthometric height was scaled from a topographic map.
 TF2147
 TF2147.The Laplace correction was computed from DEFLEC99 derived deflections.
 TF2147
 TF2147.The geoid height was determined by GEOID99.
 TF2147
 TF2147;                    North         East     Units   Scale      Converg.
 TF2147;SPC ND N     -   132,446.705   546,191.152   MT  0.99993749 -0 32 18.9
 TF2147;UTM  14      - 5,339,697.445   334,729.121   MT  0.99993562 -1 39 28.2
 TF2147
 TF2147:                Primary Azimuth Mark                       Grid Az
 TF2147:SPC ND N     -  SOU EAST AZ MK                             127 07 51.7
 TF2147:UTM  14      -  SOU EAST AZ MK                             128 15 01.0
 TF2147
 TF2147|---------------------------------------------------------------------|
 TF2147| PID    Reference Object                     Distance      Geod. Az  |
 TF2147|                                                           dddmmss.s |
 TF2147| TF2145 SURREY PUBLIC SCHOOL FLAGPOLE        APPROX. 8.7 KM 0522815.5 |
 TF2147| CQ9557 SOU EAST AZ MK                                      1263532.8 |
 TF2147| CQ9558 SOU EAST RM 1                          12.725 METERS 21908     |
 TF2147| TF2152 MINOT MUNICIPAL TANK                 APPROX. 6.3 KM 3110825.4 |
 TF2147| CQ9559 SOU EAST RM 2                          16.051 METERS 32101     |
 TF2147| TF2148 MINOT KLPM RADIO TRANSM TOWER        APPROX. 2.7 KM 3313328.3 |
 TF2147|---------------------------------------------------------------------|
 TF2147
 TF2147                        SUPERSEDED SURVEY CONTROL
 TF2147
 TF2147  NAD 83(1986)-  48 11 20.37530(N)    101 13 25.52070(W) AD(       ) 1
 TF2147  NAD 27      -  48 11 20.33200(N)    101 13 23.93300(W) AD(       ) 1
 TF2147
 TF2147.Superseded values are not recommended for survey control.
 TF2147.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 TF2147.See file dsdata.txt to determine how the superseded data were derived.
 TF2147
 TF2147_MARKER: DS = TRIANGULATION STATION DISK
 TF2147_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
 TF2147
 TF2147  HISTORY     - Date     Condition        Report By
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TF2147  HISTORY     - 1946     MONUMENTED       CGS
TF2147  HISTORY     - 1958     GOOD             CGS
TF2147  HISTORY     - 1973     GOOD             NGS
TF2147
TF2147                          STATION DESCRIPTION
TF2147
TF2147'DESCRIBED BY COAST AND GEODETIC SURVEY 1946 (RAM)
TF2147'THE STATION IS LOCATED ON THE POINT OF A RIDGE ON A ROUND
TF2147'TOPPED KNOLL ABOUT 4 MILES SOUTHEAST OF MINOT, 4 MILES NORTHWEST
TF2147'OF LOGAN, 150 YARDS SOUTHWEST OF U.S. HIGHWAY 52 AND 6 FEET
TF2147'SOUTHWEST OF WITNESS POST.  THE MARK PROJECTS 4 INCHES AND
TF2147'THE DISK IS STAMPED SOU EAST 1946.
TF2147'
TF2147'REFERENCE MARK NO. 1 IS 41.75 FEET SOUTHWEST OF THE STATION.
TF2147'THE MARK PROJECTS 2 INCHES AND THE DISK IS STAMPED SOU EAST
TF2147'NO 1 1946.
TF2147'
TF2147'REFERENCE MARK NO. 2 IS 52.66 FEET NORTHWEST OF THE STATION.
TF2147'THE MARK PROJECTS 1 INCH AND THE DISK IS STAMPED SOU EAST NO
TF2147'2 1946.
TF2147'
TF2147'THE AZIMUTH MARK IS 0.4 MILE SOUTHEAST OF THE STATION, 33 FEET
TF2147'NORTH OF CONCRETE CULVERT, 29 FEET NORTHEAST OF THE CENTERLINE
TF2147'OF U.S. HIGHWAY 52, 3 FEET NORTHWEST OF WITNESS POST AND 2
TF2147'FEET SOUTHWEST OF FENCE.  THE MARK PROJECTS 3 INCHES AND THE
TF2147'DISK IS STAMPED SOU EAST 1946.
TF2147'
TF2147'TO REACH THE STATION FROM THE COURTHOUSE IN MINOT, GO EAST
TF2147'ON U.S. HIGHWAY 2 FOR 0.1 MILE TO THE JUNCTION OF U.S.
TF2147'HIGHWAYS 52 AND 2.  TURN RIGHT ON U.S. HIGHWAY 52 AND GO
TF2147'SOUTHEAST FOR 4.5 MILES TO A WIRE GATE ON THE RIGHT.  TURN
TF2147'RIGHT THROUGH GATE AND DRIVE WEST-NORTHWEST ACROSS PASTURE
TF2147'FOR 0.2 MILE TO THE TOP OF THE KNOLL AND THE STATION.
TF2147'
TF2147'TO REACH THE AZIMUTH MARK FROM THE STATION, GO EAST-SOUTHEAST
TF2147'ACROSS THE PASTURE FOR 0.2 MILE TO THE GATE.  PASS THROUGH
TF2147'GATE, TURN RIGHT AND GO SOUTHEAST ON U.S. HIGHWAY 52 FOR 0.25
TF2147'MILE TO THE AZIMUTH MARK ON THE LEFT.
TF2147'
TF2147'HEIGHT OF LIGHT ABOVE STATION MARK 1 METERS.
TF2147
TF2147                          STATION RECOVERY (1958)
TF2147
TF2147'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1958 (LFV)
TF2147'STATION, AZIMUTH, AND REFERENCE MARKS RECOVERED IN GOOD CONDITION.
TF2147'DESCRIPTION ADEQUATE AND CORRECT EXCEPT FOR THE FOLLOWING.
TF2147'TO REACH STATION FROM JUNCTION OF U.S. HIGHWAY 2 AND OLD STATE
TF2147'ROUTE 52 IN MINOT GO 4.2 MILES SOUTHEAST ON OLD STATE ROUTE 52
TF2147'TO WIRE GATE ON RIGHT, TURN RIGHT AND PASS THROUGH GATE, GO
TF2147'ABOUT 0.2 MILES SOUTHERLY TO HIGHEST POINT OF KNOLL NEAREST
TF2147'ROAD AND STATION.  TO REACH AZIMUTH MARK FROM WIRE GATE GO
TF2147'ABOUT 0.4 MILE SOUTHEAST ON OLD STATE ROUTE 52 TO DIRT ROAD
TF2147'ON RIGHT TO A FARMHOUSE AND AZIMUTH MARK ON LEFT ABOUT 19.2
TF2147'FEET WEST OF A POWER POLE.
TF2147
TF2147                          STATION RECOVERY (1973)
TF2147
TF2147'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1973 (ARB)
TF2147'THE MARK WAS RECOVERED, IN GOOD CONDITION, AS DESCRIBED WITH
TF2147'THE EXCEPTION THAT ACCESS IS LIMITED ONLY TO FOOT.
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1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
 TF2143 ***********************************************************************
 TF2143  DESIGNATION -  SURREY
 TF2143  PID         -  TF2143
 TF2143  STATE/COUNTY-  ND/WARD
 TF2143  USGS QUAD   -  SURREY (1981)
 TF2143
 TF2143                        *CURRENT SURVEY CONTROL
 TF2143  ___________________________________________________________________
 TF2143* NAD 83(1996)-  48 11 51.83526(N)     101 10 27.71284(W)     ADJUSTED
 TF2143* NAVD 88     -       517.     (meters)    1696.     (feet)   SCALED
 TF2143  ___________________________________________________________________
 TF2143  LAPLACE CORR-          -5.29  (seconds)                     DEFLEC99
 TF2143  GEOID HEIGHT-         -20.48  (meters)                      GEOID99
 TF2143
 TF2143  HORZ ORDER  -  FIRST
 TF2143
 TF2143.The horizontal coordinates were established by classical geodetic methods
 TF2143.and adjusted by the National Geodetic Survey in January 1998.
 TF2143
 TF2143.The orthometric height was scaled from a topographic map.
 TF2143
 TF2143.The Laplace correction was computed from DEFLEC99 derived deflections.
 TF2143
 TF2143.The geoid height was determined by GEOID99.
 TF2143
 TF2143;                  North         East     Units   Scale      Converg.
 TF2143;SPC ND N     -   133,384.985   549,871.664   MT  0.99993778 -0 30 06.5
 TF2143;UTM  14      - 5,340,563.639   338,427.225   MT  0.99992077 -1 37 16.4
 TF2143
 TF2143:                Primary Azimuth Mark                      Grid Az
 TF2143:SPC ND N     -  SURREY AZ MK RESET                        100 34 51.3
 TF2143:UTM  14      -  SURREY AZ MK RESET                        101 42 01.2
 TF2143
 TF2143|---------------------------------------------------------------------|
 TF2143| PID    Reference Object                    Distance      Geod. Az  |
 TF2143|                                                          dddmmss.s |
 TF2143| TF2145 SURREY PUBLIC SCHOOL FLAGPOLE      APPROX. 5.4 KM 0365211.8 |
 TF2143| CQ9641 SURREY AZ MK                                      1000442.0 |
 TF2143| CQ9642 SURREY AZ MK RESET                                1000444.8 |
 TF2143| CQ9643 SURREY RM 1                        174.956 METERS 13257     |
 TF2143| CQ9645 SURREY RM 3                        151.425 METERS 13258     |
 TF2143| CQ9644 SURREY RM 2                        122.164 METERS 19308     |
 TF2143| CQ9646 SURREY RM 4                        124.541 METERS 19308     |
 TF2143| TF2148 MINOT KLPM RADIO TRANSM TOWER      APPROX. 5.2 KM 2855534.1 |
 TF2143| TF2152 MINOT MUNICIPAL TANK               APPROX. 9.0 KM 2904559.7 |
 TF2143| TF2155 MINOT ST LEOS CATH CH SPIRE        APPROX. 9.6 KM 2943448.5 |
 TF2143| TF2153 MINOT MILLER MILLING CO TANK       APPROX. 9.4 KM 2964219.2 |
 TF2143| TF2154 MONOT FIRST LUTHERAN CHURCH SPIRE  APPROX.10.2 KM 2982243.9 |
 TF2143| TF2146 MINOT USCAA RADIO RANGE STATION    APPROX. 4.8 KM 3022107.1 |
 TF2143|---------------------------------------------------------------------|
 TF2143
 TF2143                         SUPERSEDED SURVEY CONTROL
 TF2143
 TF2143  NAD 83(1986)-  48 11 51.83550(N)     101 10 27.71120(W) AD(       ) 1
 TF2143  NAD 27      -  48 11 51.79340(N)     101 10 26.12570(W) AD(       ) 1
 TF2143
 TF2143.Superseded values are not recommended for survey control.
 TF2143.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
 TF2143.See file dsdata.txt to determine how the superseded data were derived.
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TF2143
TF2143_MARKER: DS = TRIANGULATION STATION DISK
TF2143_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF2143
TF2143  HISTORY     - Date     Condition         Report By
TF2143  HISTORY     - 1934     MONUMENTED        CGS
TF2143  HISTORY     - 1938     GOOD              CGS
TF2143  HISTORY     - 1946     GOOD              CGS
TF2143  HISTORY     - 1956     GOOD              LOCENG
TF2143  HISTORY     - 1958     MARK NOT FOUND    CGS
TF2143
TF2143                         STATION DESCRIPTION
TF2143
TF2143'DESCRIBED BY COAST AND GEODETIC SURVEY 1934 (WRP)
TF2143'STATION IS ABOUT 2-3/4 MILES S OF THE GREAT NORTHERN RAILROAD,
TF2143'3-1/2 MILES SW OF THE TOWN OF SURREY, 0.6 MILE ENE OF SORENSONS
TF2143'RANCH HOUSE AND 6 MILES ESE OF MINOT, IN SEC. 35, T 155 N,
TF2143'R 82 W, ON THE HIGHEST GROUND IN THE IMMEDIATE VICINITY,
TF2143'OVERLOOKING THE SOURIS, OR MOUSE, RIVER VALLEY.  IT PROJECTS
TF2143'8 INCHES AND IS ON LAND OWNED BY TILMAN SAUGETAD, WHO LIVES
TF2143'3-1/2 MILES W, ON THE SOURIS RIVER.
TF2143'
TF2143'SURFACE, UNDERGROUND, REFERENCE, AND AZIMUTH MARKS ARE STANDARD
TF2143'BRONZE DISKS SET IN CONCRETE.
TF2143'
TF2143'REFERENCE MARK NO. 1 IS SW OF THE STATION, 27 FEET N OF CENTER
TF2143'OF SECTION ROAD, AND PROJECTS 2 INCHES.  REFERENCE MARK
TF2143'NO. 2 IS S OF THE STATION, 27 FEET N OF CENTER OF SECTION ROAD
TF2143'AND PROJECTS 3 INCHES.
TF2143'
TF2143'AZIMUTH MARK IS ESE OF THE STATION, ON SECOND KNOLL, 21 FEET
TF2143'S OF CENTER LINE OF ROAD AND PROJECTS 4 INCHES.
TF2143'
TF2143'REACHED FROM WARD COUNTY COURTHOUSE IN MINOT, BY GOING E ON
TF2143'U.S. HIGHWAY 2 FOR 4.5 MILES, WHERE U.S. HIGHWAY 2 TURNS N.
TF2143'LEAVE PAVED HIGHWAY, TURN S, OR RIGHT, AND GO ON GRADED
TF2143'ROAD 2.1 MILES (THERE IS A WHITE SCHOOLHOUSE ON THIS ROAD
TF2143'0.3 MILE S OF PAVEMENT).  AT T-INTERSECTION, TURN E ON
TF2143'SECTION-LINE ROAD, PASS SORENSONS RANCH HOUSE, ON S SIDE OF
TF2143'ROAD, AND GO 0.6 MILE TO TOP OF GRADE.  LEAVE ROAD, TURN LEFT,
TF2143'OR N, INTO FIELD AND GO 0.1 MILE TO HIGHEST GROUND AND
TF2143'STATION.  A 4-FOOT STAND WILL SEE ALL STATIONS USED AT THIS
TF2143'TIME.
TF2143
TF2143                         STATION RECOVERY (1938)
TF2143
TF2143'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1938 (CDM)
TF2143'STATION, REFERENCE, AND AZIMUTH MARKS WERE RECOVERED AS DESCRIBED,
TF2143'AND FOUND IN GOOD CONDITION.  DISTANCES TO REFERENCE MARKS
TF2143'WERE MEASURED AND FOUND AS DESCRIBED.
TF2143'
TF2143'STATION MARK IS SET 18 INCHES BELOW THE SURFACE.
TF2143'
TF2143'AZIMUTH MARK IS LOCATED APPROXIMATELY 0.4 MILE SE OF STATION
TF2143'ON S SIDE OF E-W SECTION-LINE ROAD AND PROJECTS 8 INCHES.
TF2143
TF2143                         STATION RECOVERY (1946)
TF2143
TF2143'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1946 (RAM)
TF2143'THE STATION WAS RECOVERED AS DESCRIBED IN 1934 BY W.R.P. AND
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TF2143'ALL MARKS WERE FOUND IN GOOD CONDITION. A NEW DESCRIPTION
TF2143'FOLLOWS.
TF2143'
TF2143'THE STATION IS LOCATED ABOUT 6 MILES EAST-SOUTHEAST OF MINOT,
TF2143'3.5 MILES SOUTHWEST OF THE VILLAGE OF SURREY AND 2.75 MILES
TF2143'SOUTH OF THE GREAT NORTHERN RAILROAD TRACKS. IT IS LOCATED
TF2143'ON THE SUMMIT OF A PROMINENT HILL IN A CULTIVATED FIELD.
TF2143'THE SURFACE STATION MARK IS 15-INCHES BELOW THE SURFACE OF
TF2143'THE GROUND AND THE DISK IS STAMPED SURREY 1934.
TF2143'
TF2143'SURFACE, UNDERGROUND, REFERENCE MARKS AND AZIMUTH MARK ARE
TF2143'A STANDARD BRONZE DISK SET IN CONCRETE.
TF2143'
TF2143'REFERENCE MARK NO. 1 IS 574.0 FEET SOUTHEAST OF THE STATION,
TF2143'27 FEET NORTH OF THE APPROXIMATE CENTERLINE OF A SECTION LINE
TF2143'ROAD AND 2 FEET NORTHWEST OF A WITNESS POST. THE MARK IS
TF2143'FLUSH WITH THE GROUND AND THE DISK IS STAMPED SURREY NO 1 1934.
TF2143'
TF2143'REFERENCE MARK NO. 2 IS 400.8 FEET SOUTH OF THE STATION AND
TF2143'27 FEET NORTH OF THE APPROXIMATE CENTERLINE OF A SECTION LINE
TF2143'ROAD. THE MARK PROJECTS 3 INCHES AND THE DISK IS STAMPED SURREY
TF2143'NO 2 1934.
TF2143'
TF2143'THE AZIMUTH MARK IS 0.4 MILE EAST-SOUTHEAST OF THE STATION
TF2143'AND 21 FEET SOUTH OF THE APPROXIMATE CENTERLINE OF A SECTION
TF2143'LINE ROAD. THE MARK PROJECTS 4 INCHES AND THE DISK IS STAMPED
TF2143'SURREY AZIMUTH 1934.
TF2143'
TF2143'TO REACH THE STATION FROM THE WARD COUNTY COURTHOUSE IN MINOT,
TF2143'GO EAST ON U.S. HIGHWAY 2 FOR 4.5 MILES TO A GRADED DIRT ROAD
TF2143'RIGHT, TURN RIGHT AND GO SOUTH FOR 2.1 MILES TO A T ROAD LEFT,
TF2143'TURN LEFT AND GO 1.0 MILE ON SECTION LINE ROAD AND STATION
TF2143'ON THE LEFT AS DESCRIBED.
TF2143'
TF2143'TO REACH THE AZIMUTH MARK FROM THE STATION, GO EAST ON SECTION
TF2143'LINE ROAD FOR 0.4 MILE AND THE MARK ON THE RIGHT AS DESCRIBED.
TF2143'
TF2143'NOTE - THE 1934 MEASUREMENT OF REFERENCE MARKS WERE NOT CHECKED
TF2143'FOR DISTANCE BECAUSE OF WHEAT CROP AND BEING OF SUCH A DISTANCE.
TF2143'
TF2143'OBSERVATIONS TAKEN FROM A 10-FOOT WOOD STAND.
TF2143
TF2143   STATION RECOVERY (1956)
TF2143
TF2143'RECOVERY NOTE BY LOCAL ENGINEER (INDIVIDUAL OR FIRM) 1956
TF2143'STATION RECOVERED BY TRUEX AND BRUNNER
TF2143'
TF2143'THE AZIMUTH MARK AND REFERENCE MARKS 1 AND 2 WERE RESET IN
TF2143'THE FALL OF 1956 BY TRUAX AND BRUNNER, ENGINEERS AND SURVEYORS,
TF2143'BOX 133, MINOT, NORTH DAKOTA.
TF2143'
TF2143'REFERENCE MARK NO. 3 WAS ESTABLISHED ON LINE WITH REFERENCE
TF2143'MARK NO. 1 AND IS NOW SET IN THE TOE OF THE INSLOPE OF THE
TF2143'NEW ROAD. IT IS 582.8 FEET FROM THE STATION.
TF2143'
TF2143'REFERENCE MARK NO. 4 WAS ESTABLISHED ON LINE WITH REFERENCE
TF2143'MARK NO. 2 AND IS NOW SET IN THE TOE OF THE INSLOPE OF THE
TF2143'NEW ROAD. IT IS 408.6 FEET FROM THE STATION.
TF2143'
TF2143'THE AZIMUTH MARK WAS RESET ON THE SAME BEARING AS THE ORIGINAL

```
TF2143'IN APPROXIMATELY THE SAME LOCATION.  THE NEW MARK IS LOCATED
TF2143'AT THE TOE OF INSLOPE OF THE NEW ROAD ABOUT 18 FEET FROM
TF2143'THE CENTERLINE.
TF2143'
TF2143'REFERENCE MARKS 1 AND 2 AND THE ORIGINAL AZIMUTH MARK WERE
TF2143'DESTROYED.
TF2143'
TF2143'AZIMUTH MARK AND 1 REFERENCE MARK DISK WERE RECOVERED AND
TF2143'RECEIVED AT THIS OFFICE 1/10/57.
TF2143
TF2143                         STATION RECOVERY (1958)
TF2143
TF2143'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1958 (LFV)
TF2143'STATION AND REFERENCE MARKS SEARCHED FOR BUT NOT RECOVERED.
TF2143'A REFERENCE MARK STAMPED NO. 3, 1955 WAS FOUND ALONG NORTH
TF2143'EDGE OF SECTION LINE ROAD, BUT NO INFORMATION WAS FURNISHED
TF2143'IN DATA REGARDING THIS MARK.  AZIMUTH MARK NOT SEARCHED FOR.
TF2143'STATION MARK IS PROBABLY IN PLACE BUT AREA IS IN CULTIVATION.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF1844 ***********************************************************************
TF1844  DESIGNATION -  T 463
TF1844  PID         -  TF1844
TF1844  STATE/COUNTY-  ND/WARD
TF1844  USGS QUAD   -  MINOT (1979)
TF1844
TF1844                         *CURRENT SURVEY CONTROL
TF1844  ___________________________________________________________________
TF1844* NAD 83(1986)-  48 13 41.      (N)     101 18 55.      (W)     SCALED
TF1844* NAVD 88     -       471.610  (meters)     1547.27    (feet)  ADJUSTED
TF1844  ___________________________________________________________________
TF1844  GEOID HEIGHT-        -20.23  (meters)                         GEOID99
TF1844  DYNAMIC HT  -       471.687  (meters)     1547.53    (feet)  COMP
TF1844  MODELED GRAV-    980,758.5   (mgal)                           NAVD 88
TF1844
TF1844  VERT ORDER  -  FIRST     CLASS II
TF1844
TF1844.The horizontal coordinates were scaled from a topographic map and have
TF1844.an estimated accuracy of +/- 6 seconds.
TF1844
TF1844.The orthometric height was determined by differential leveling
TF1844.and adjusted by the National Geodetic Survey in June 1991.
TF1844
TF1844.The geoid height was determined by GEOID99.
TF1844
TF1844.The dynamic height is computed by dividing the NAVD 88
TF1844.geopotential number by the normal gravity value computed on the
TF1844.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF1844.degrees latitude (g = 980.6199 gals.).
TF1844
TF1844.The modeled gravity was interpolated from observed gravity values.
TF1844
TF1844;                    North         East     Units  Estimated Accuracy
TF1844;SPC ND N     -   136,860.      539,430.     MT  (+/- 180 meters Scaled)
TF1844
TF1844                         SUPERSEDED SURVEY CONTROL
TF1844
TF1844.No superseded survey control is available for this station.
TF1844
TF1844_MARKER: DB = BENCH MARK DISK
TF1844_SETTING: 36 = DAM
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TF1844_STAMPING: T 463 1981
TF1844_MARK LOGO: NGS
TF1844_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
TF1844
TF1844  HISTORY     - Date     Condition        Report By
TF1844  HISTORY     - 1981     MONUMENTED       NGS
TF1844
TF1844                          STATION DESCRIPTION
TF1844
TF1844'DESCRIBED BY NATIONAL GEODETIC SURVEY 1981
TF1844'IN MINOT.
TF1844'IN MINOT, AT THE JUNCTION OF SIXTEENTH STREET SOUTHWEST AND BURDICK
TF1844'EXPRESSWAY, AT THE MINOT WATER TREATMENT PLANT, IN THE SOUTH END OF A
TF1844'DIVERSION DAM, 35.8 METERS (117.5 FT) SOUTHWEST OF THE CENTERLINE OF
TF1844'SIXTEENTH STREET, 1.2 METERS (3.9 FT) NORTHWEST OF THE SOUTHEAST END
TF1844'OF THE DAM, 0.4 METERS (1.3 FT) SOUTHWEST OF THE NORTHEAST EDGE OF THE
TF1844'DAM.
TF1844'THE MARK IS 5.0 M BELOW THE STREET.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF0933 ***********************************************************************
TF0933  DESIGNATION -  TRANSPORT
TF0933  PID         -  TF0933
TF0933  STATE/COUNTY-  ND/WARD
TF0933  USGS QUAD   -  BURLINGTON SE (1979)
TF0933
TF0933                         *CURRENT SURVEY CONTROL
TF0933  ___________________________________________________________________
TF0933* NAD 83(1996)-  48 15 16.26968(N)    101 17 06.68307(W)     ADJUSTED
TF0933* NAVD 88     -       522.541  (meters)    1714.37    (feet)  ADJUSTED
TF0933  ___________________________________________________________________
TF0933  LAPLACE CORR-          -6.46  (seconds)                    DEFLEC99
TF0933  GEOID HEIGHT-         -20.32  (meters)                     GEOID99
TF0933  DYNAMIC HT  -        522.629 (meters)     1714.66   (feet)  COMP
TF0933  MODELED GRAV-     980,763.3   (mgal)                       NAVD 88
TF0933
TF0933  HORZ ORDER  -  SECOND
TF0933  VERT ORDER  -  FIRST     CLASS II
TF0933
TF0933.This mark is at Minot Airport (MOT)
TF0933
TF0933.The horizontal coordinates were established by classical geodetic methods
TF0933.and adjusted by the National Geodetic Survey in January 1998.
TF0933
TF0933.The orthometric height was determined by differential leveling
TF0933.and adjusted by the National Geodetic Survey in June 1991.
TF0933
TF0933.The Laplace correction was computed from DEFLEC99 derived deflections.
TF0933
TF0933.The geoid height was determined by GEOID99.
TF0933
TF0933.The dynamic height is computed by dividing the NAVD 88
TF0933.geopotential number by the normal gravity value computed on the
TF0933.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF0933.degrees latitude (g = 980.6199 gals.).
TF0933
TF0933.The modeled gravity was interpolated from observed gravity values.
TF0933
TF0933;                   North         East     Units   Scale      Converg.
TF0933;SPC ND N     -   139,776.804   541,698.228   MT  0.99994022 -0 35 03.4
TF0933;UTM  14      - 5,347,114.021   330,380.333   MT  0.99995351 -1 42 19.5
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TF0933
TF0933:                    Primary Azimuth Mark                    Grid Az
TF0933:SPC ND N      -     TRANSPORT AZ MK                         348 52 33.5
TF0933:UTM  14       -     TRANSPORT AZ MK                         349 59 49.6
TF0933
TF0933|-------------------------------------------------------------------|
TF0933| PID    Reference Object                     Distance      Geod. Az  |
TF0933|                                                           dddmmss.s |
TF0933| TF0934 TRANSPORT RM 1                        29.925 METERS 09126     |
TF0933| TF2146 MINOT USCAA RADIO RANGE STATION      APPROX. 5.6 KM 1315305.4 |
TF0933| TF2152 MINOT MUNICIPAL TANK                 APPROX. 3.1 KM 1834749.8 |
TF0933| TF2153 MINOT MILLER MILLING CO TANK         APPROX. 2.1 KM 1844734.1 |
TF0933| TF2155 MINOT ST LEOS CATH CH SPIRE          APPROX. 2.4 KM 1914651.4 |
TF0933| TF0932 TRANSPORT RM 2                        19.815 METERS 21205     |
TF0933| TF0939 TRANSPORT AZ MK                      APPROX. 1.8 KM 3481730.1 |
TF0933|-------------------------------------------------------------------|
TF0933
TF0933                         SUPERSEDED SURVEY CONTROL
TF0933
TF0933  NAD 83(1986)-  48 15 16.26948(N)    101 17 06.68122(W) AD(       ) 2
TF0933  NAD 27      -  48 15 16.23700(N)    101 17 05.09700(W) AD(       ) 2
TF0933  NGVD 29     -       522.174  (m)         1713.17   (f) ADJ UNCH    1 2
TF0933
TF0933.Superseded values are not recommended for survey control.
TF0933.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
TF0933.See file dsdata.txt to determine how the superseded data were derived.
TF0933
TF0933_MARKER: DS = TRIANGULATION STATION DISK
TF0933_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
TF0933_STAMPING: TRANSPORT 1946
TF0933_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
TF0933+STABILITY: SURFACE MOTION
TF0933
TF0933  HISTORY     - Date     Condition        Report By
TF0933  HISTORY     - 1946     MONUMENTED       CGS
TF0933  HISTORY     - 1954     GOOD             CGS
TF0933  HISTORY     - 1962     GOOD             CGS
TF0933  HISTORY     - 1962     GOOD             NGS
TF0933  HISTORY     - 1963     GOOD             CGS
TF0933  HISTORY     - 1963     GOOD             NGS
TF0933  HISTORY     - 1968     GOOD             CGS
TF0933  HISTORY     - 1973     GOOD             NGS
TF0933  HISTORY     - 1983     GOOD             NGS
TF0933  HISTORY     - 1983     GOOD             USGS
TF0933
TF0933                          STATION DESCRIPTION
TF0933
TF0933'DESCRIBED BY COAST AND GEODETIC SURVEY 1946 (RAM)
TF0933'THE STATION IS LOCATED ON THE MINOT COMMERCIAL AIRPORT, ABOUT
TF0933'1.5 MILES NORTH OF MINOT, 100 YARDS SOUTHWEST OF THE CONTROL
TF0933'HOUSE, 30 FEET EAST-NORTHEAST OF THE WIND DIRECTION INDICATOR
TF0933'AND 7 FEET NORTH-NORTHWEST OF A WHITE WITNESS POST.  THE MARK
TF0933'PROJECTS ABOUT 2 INCHES AND THE DISK IS STAMPED TRANSPORT 1946.
TF0933'
TF0933'REFERENCE MARK NO. 1 IS 98.18 FEET EAST OF THE STATION AND
TF0933'2 FEET NORTH OF AN EAST-WEST FENCE LINE.  THE MARK PROJECTS
TF0933'ABOUT 2 INCHES AND THE DISK IS STAMPED TRANSPORT NO 1 1946.
TF0933'
TF0933'REFERENCE MARK NO. 2 IS 65.01 FEET SOUTHWEST OF THE STATION
TF0933'AND 42 FEET SOUTH OF THE WIND INDICATOR.  THE MARK PROJECTS
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TF0933'ABOUT 2 INCHES AND THE DISK IS STAMPED TRANSPORT NO 2 1946.
TF0933'
TF0933'THE AZIMUTH MARK IS APPROXIMATELY 1.2 MILES NORTH OF THE
TF0933'STATION ALONG THE NORTH SIDE OF THE AIRFIELD. IT IS 100 FEET
TF0933'SOUTHEAST OF A RIGHT ANGLE CURVE IN A ROAD AND 1 FOOT SOUTH
TF0933'OF A NORTH-SOUTH FENCE LINE. THE MARK PROJECTS ABOUT 4 INCHES
TF0933'AND THE DISK IS STAMPED TRANSPORT 1946.
TF0933'
TF0933'TO REACH THE STATION FROM THE WARD COUNTY COURTHOUSE IN MINOT,
TF0933'GO NORTH ON EAST THIRD STREET FOR 1.6 MILES TO THE NORTH EDGE
TF0933'OF TOWN. CONTINUE NORTH UPHILL ON GRAVEL ROAD FOR 0.5 MILE
TF0933'TO AIRFIELD. TURN SHARP RIGHT AND GO AROUND THE SOUTH END
TF0933'OF THE HANGARS, THEN 0.3 MILE NORTHEAST TO WIND DIRECTION
TF0933'INDICATOR AND THE STATION AS DESCRIBED. TO REACH THE AZIMUTH
TF0933'FROM THE MAIN GATE OF THE AIRFIELD, GO IN A WESTERLY DIRECTION
TF0933'ALONG THE SOUTH FENCE OF THE AIRFIELD FOR 0.6 MILE TO U.S.
TF0933'HIGHWAY NO. 83. GO NORTH ALONG THE WEST SIDE OF THE AIRFIELD
TF0933'ON THIS ROAD FOR 1.1 MILES TO CROSSROADS. TURN RIGHT AND GO
TF0933'EAST FOR 0.4 MILE TO A RIGHT ANGLE TURN IN THE ROAD AND THE
TF0933'AZIMUTH ON THE RIGHT.
TF0933'
TF0933'HEIGHT OF LIGHT ABOVE STATION MARK 4 METERS.
TF0933
TF0933 STATION RECOVERY (1954)
TF0933
TF0933'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1954 (LWQ)
TF0933'THE STATION, REF. MK. NO. 1 AND THE AZIMUTH MARK WERE RECOVERED
TF0933'IN GOOD CONDITION. A SEARCH OF ABOUT 1/2 HOUR WAS MADE FOR
TF0933'REF. MK. NO. 2 BUT IT WAS NOT FOUND. THE ANGLE WAS MEASURED
TF0933'WITH AN INSTRUMENT AND THE DISTANCE TAPED. A GRADED ROAD
TF0933'HAS BEEN CONSTRUCTED AT THE SITE AND IT IS BELIEVED THAT
TF0933'THE MARK HAS BEEN DESTROYED.
TF0933'
TF0933'A NEW DESCRIPTION FOLLOWS--THE STATION IS LOCATED AT THE
TF0933'SOUTH EDGE OF THE PORT OMINOT AIRPORT, 12 FEET NORTH OF THE
TF0933'AIRPORT BEACON AND 7 FEET NORTH-NORTHWEST OF A WHITE WITNESS
TF0933'POST. THE MARK PROJECTS ABOUT 2 INCHES AND THE DISK IS
TF0933'STAMPED TRANSPORT 1946.
TF0933'
TF0933'REFERENCE MARK NO. 1 IS 98.18 FEET EAST OF THE STATION AND
TF0933'2 FEET NORTH OF EAST-WEST FENCE LINE. THE MARK IS STAMPED
TF0933'TRANSPORT NO 1 1946 AND PROJECTS ABOUT 2 INCHES.
TF0933'
TF0933'REFERENCE MARK NO. 2 IS DESTROYED.
TF0933'
TF0933'THE AZIMUTH MARK IS APPROXIMATELY 1.2 MILES NORTH OF THE
TF0933'STATION ALONG THE NORTH SIDE OF THE AIRFIELD. IT IS 100 FEET
TF0933'SOUTHEAST OF A RIGHT ANGLE CURVE IN A ROAD AND 1 FOOT SOUTH
TF0933'OF A CORNER FENCE POST. THE MARK PROJECTS ABOUT 4 INCHES AND
TF0933'THE DISK IS STAMPED TRANSPORT 1946.
TF0933'
TF0933'DESCRIPTION IS ADEQUATE.
TF0933
TF0933 STATION RECOVERY (1962)
TF0933
TF0933'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1962 (LBO)
TF0933'STATION RECOVERED AND ALL MARKS WERE FOUND IN GOOD CONDITION.
TF0933'THE STATION MARK IS 12 FEET NORTH OF THE MINOT INTERNATIONAL
TF0933'AIRPORT BEACON AND WIND-SOCK TOWER. A 4-FOOT 2 X 6 INCH POST
TF0933'WAS SET 2.5 FEET EAST OF THE STATION MARK. THE MARK PROJECTS

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TF0933'2 INCHES AND THE DISK IS STAMPED TRANSPORT 1946.
TF0933'
TF0933'REFERENCE MARK NO. 1 IS 98.18 FEET EAST OF THE STATION MARK
TF0933'AND 2 FEET NORTH OF AN EAST-WEST FENCE LINE.
TF0933'
TF0933'REFERENCE MARK NO. 2 IS 65.01 FEET SOUTHWEST OF THE STATION
TF0933'MARK.  IT IS NEAR THE SOUTH EDGE OF THE ROAD BED AND 2 INCHES
TF0933'BELOW THE SURFACE OF THE ROAD-BED.
TF0933'
TF0933'TO REACH THE STATION FROM THE COURTHOUSE IN MINOT, GO NORTH
TF0933'OF 3RD STREET FOR 1.5 MILES TO TOP OF HILL, THENCE TURN
TF0933'RIGHT AND GO SOUTHEAST, PASSING TO THE LEFT, (NORTH) SIDE
TF0933'OF A LARGE STORAGE TANK, THENCE GO NORTHEAST ON TRACK ROAD TO
TF0933'THE BEACON FOR 0.25 MILE AND THE STATION AS DESCRIBED.
TF0933'
TF0933'TO REACH THE AZIMUTH MARK FROM THE STATION, GO WESTERLY FOR
TF0933'0.9 MILE TO U.S. HIGHWAY 83 JUST EAST OF THE BOWL AND CAFE
TF0933'BUILDING, THENCE GO NORTH ON U.S. HIGHWAY 83 FOR 0.55 MILE TO
TF0933'MINOT INTERNATIONAL AIRPORT ENTRANCE ON THE RIGHT, CONTINUE
TF0933'NORTH ON HIGHWAY FOR 0.6 MILE TO A SIDE ROAD RIGHT, TURN
TF0933'RIGHT AND GO EAST FOR 0.25 MILE TO A LEFT TURN IN THE ROAD AND
TF0933'THE AZIMUTH MARK ABOUT 100 FEET SOUTHEAST OF THE TURN IN
TF0933'THE ROAD AND 1 FOOT SOUTH OF THE SOUTHEAST CORNER FENCE POST.
TF0933
TF0933                          STATION RECOVERY (1962)
TF0933
TF0933'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1962
TF0933'1.6 MI NE FROM MINOT.
TF0933'0.9 MILE NORTH ALONG U.S. HIGHWAY 83 FROM THE FIRST LUTHERAN CHURCH AT
TF0933'MINOT, THENCE 0.7 MILE EAST ALONG GRAVELED ROADS AROUND THE SOUTH END
TF0933'OF THE PORT O MINOT AIRPORT, ABOUT MIDWAY BETWEEN THE TWO MAIN RUNWAYS
TF0933'OF THE AIRPORT, 319.0 FEET WEST OF THE SOUTHWEST CORNER OF THE
TF0933'NATIONAL GUARD BUILDING, 45.0 FEET NORTH OF THE CENTERLINE OF THE ROAD
TF0933'LEADING EAST, 34.0 FEET WEST OF A POWER POLE, 12.4 FEET NORTH OF THE
TF0933'NORTHEAST LEG OF A BEACON TOWER, 67.0 FEET SOUTHEAST OF THE CENTERLINE
TF0933'OF A ROAD LEADING NORTHEAST, 2.6 FEET WEST OF A METAL WITNESS POST,
TF0933'ABOUT 2 FEET BELOW THE LEVEL OF THE ROAD, AND SET IN THE TOP OF A
TF0933'CONCRETE POST PROJECTING 2 INCHES.
TF0933
TF0933                          STATION RECOVERY (1963)
TF0933
TF0933'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1963 (JVT)
TF0933'THE STATION MARK, REFERENCE MARKS 1 AND 2, AND THE AZIMUTH
TF0933'MARK WERE RECOVERED AND FOUND TO BE IN GOOD CONDITION.  THE
TF0933'DISTANCES AND DIRECTIONS TO THE REFERENCE MARKS WAS VERIFIED.
TF0933'THE ORIGINAL DESCRIPTION IS OBSOLETE AND A NEW DESCRIPTION
TF0933'FOLLOWS.
TF0933'
TF0933'THE STATION IS LOCATED ABOUT 2.1 MILES NORTH OF MINOT, ALONG
TF0933'THE SOUTH SIDE OF THE MINOT INTERNATIONAL AIRPORT, 319 FEET
TF0933'WEST OF THE SOUTHWEST CORNER OF THE NATIONAL GUARD BUILDING,
TF0933'12.4 FEET NORTH OF THE NORTHEAST LEG OF THE AIRPORT BEACON,
TF0933'AND 2.6 FEET WEST OF A METAL WITNESS POST.
TF0933'
TF0933'THE STATION MARK, A STANDARD DISK STAMPED TRANSPORT 1946, IS
TF0933'SET IN THE TOP OF A SQUARE CONCRETE MONUMENT THAT PROJECTS
TF0933'ABOUT 2 INCHES ABOVE THE GROUND.
TF0933'
TF0933'REFERENCE MARK 1, A STANDARD DISK STAMPED TRANSPORT NO 1 1946,
TF0933'IS SET IN THE TOP OF A SQUARE CONCRETE MONUMENT THAT PROJECTS
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TF0933'ABOUT 2 INCHES ABOVE THE GROUND. IT IS ABOUT 40 FEET NORTH OF
TF0933'THE APPROXIMATE CENTERLINE OF A DIRT ROAD AND 2.5 FEET NORTH
TF0933'OF AN EAST-WEST FENCE LINE.
TF0933'
TF0933'REFERENCE MARK 2, A STANDARD DISK STAMPED TRANSPORT NO 2 1946,
TF0933'IS SET IN THE TOP OF A SQUARE CONCRETE MONUMENT THAT IS ABOUT
TF0933'2 INCHES BELOW THE ROAD SURFACE. IT IS ABOUT 11 FEET SOUTH
TF0933'OF THE APPROXIMATE CENTERLINE OF A DIRT ROAD AND AT THE VERY
TF0933'EDGE OF VEGITATION ALONG THE SHOULDER OF THE ROAD.
TF0933'
TF0933'THE AZIMUTH MARK, A STANDARD DISK STAMPED TRANSPORT 1946,
TF0933'IS SET IN THE TOP OF A SQUARE CONCRETE MONUMENT THAT IS
TF0933'PROJECTING ABOUT 2 INCHES. IT IS ABOUT 490 FEET WEST OF THE
TF0933'APPROXIMATE CENTERLINE OF THE NORTH END OF THE NORTH-SOUTH
TF0933'RUNWAY, 120 FEET SOUTHEAST OF THE APPROXIMATE CENTERLINE OF A
TF0933'LEFT TURN IN THE ROAD, 2.9 FEET EAST OF A METAL WITNESS POST,
TF0933'AND 2.0 FEET SOUTH OF A FENCE CORNER.
TF0933'
TF0933'TO REACH THE STATION FROM THE ENTRANCE DRIVE TO THE MINOT
TF0933'INTERNATIONAL AIRPORT GO SOUTH ON U.S. HIGHWAY 83 FOR 0.5
TF0933'MILE TO A GRAVELED ROAD LEADING EAST. TURN LEFT AND FOLLOW
TF0933'THE ROADS EAST ALONG THE FENCE LINE AT THE SOUTH EDGE OF THE
TF0933'AIRPORT AND GO ABOUT 0.7 MILE TO THE STATION SITE AS DESCRIBED.
TF0933'
TF0933'TO REACH THE AZIMUTH MARK FROM THE AIRPORT ENTRANCE GO NORTH
TF0933'ON U.S. HIGHWAY 83 FOR 0.6 MILE TO A GRAVELED ROAD LEADING
TF0933'EAST. TURN RIGHT AND GO 0.25 MILE TO A LEFT TURN IN THE ROAD
TF0933'AND THE MARK AS DESCRIBED.
TF0933
TF0933   STATION RECOVERY (1963)
TF0933
TF0933'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1963
TF0933'RECOVERED IN GOOD CONDITION.
TF0933
TF0933   STATION RECOVERY (1968)
TF0933
TF0933'RECOVERY NOTE BY COAST AND GEODETIC SURVEY 1968 (DLW)
TF0933'STATION WAS RECOVERED AS DESCRIBED IN HORIZONTAL CONTROL DATA
TF0933'SUPPLIMENT DATED JULY 1961. DESCRIPTION IS ADEQUATE.
TF0933'
TF0933'AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN--0.9 MILE NORTH
TF0933
TF0933   STATION RECOVERY (1973)
TF0933
TF0933'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1973 (ARB)
TF0933'THE STATION WAS RECOVERED, IN GOOD CONDITION, AS DESCRIBED.
TF0933
TF0933   STATION RECOVERY (1983)
TF0933
TF0933'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1983 (GFS)
TF0933'THE STATION MARK WAS RECOVERED AS DESCRIBED IN GOOD CONDITION.
TF0933'THE R.M.S AND AZIMUTH MARK WERE NOT SEARCHED FOR.
TF0933'
TF0933'AIRLINE DISTANCE AND DIRECTION FROM NEAREST TOWN--1-1/2 MILES NORTH
TF0933'OF MINOT.
TF0933
TF0933   STATION RECOVERY (1983)
TF0933
TF0933'RECOVERY NOTE BY US GEOLOGICAL SURVEY 1983
TF0933'RECOVERED IN GOOD CONDITION.

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1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
 TF1801 ***********************************************************************
 TF1801  DESIGNATION -  U 467
 TF1801  PID         -  TF1801
 TF1801  STATE/COUNTY-  ND/WARD
 TF1801  USGS QUAD   -  MINOT (1979)
 TF1801
 TF1801                         *CURRENT SURVEY CONTROL
 TF1801  ___________________________________________________________________
 TF1801* NAD 83(1986)-  48 12 26.     (N)    101 17 44.     (W)     SCALED
 TF1801* NAVD 88     -       527.843  (meters)    1731.76   (feet)  ADJUSTED
 TF1801  ___________________________________________________________________
 TF1801  GEOID HEIGHT-         -20.25  (meters)                     GEOID99
 TF1801  DYNAMIC HT  -        527.928 (meters)     1732.04  (feet)  COMP
 TF1801  MODELED GRAV-     980,756.1   (mgal)                       NAVD 88
 TF1801
 TF1801  VERT ORDER  -  FIRST     CLASS II
 TF1801
 TF1801.The horizontal coordinates were scaled from a topographic map and have
 TF1801.an estimated accuracy of +/- 6 seconds.
 TF1801
 TF1801.The orthometric height was determined by differential leveling
 TF1801.and adjusted by the National Geodetic Survey in June 1991.
 TF1801
 TF1801.The geoid height was determined by GEOID99.
 TF1801
 TF1801.The dynamic height is computed by dividing the NAVD 88
 TF1801.geopotential number by the normal gravity value computed on the
 TF1801.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 TF1801.degrees latitude (g = 980.6199 gals.).
 TF1801
 TF1801.The modeled gravity was interpolated from observed gravity values.
 TF1801
 TF1801;                    North         East     Units  Estimated Accuracy
 TF1801;SPC ND N     -   134,530.      540,870.      MT   (+/- 180 meters Scaled)
 TF1801
 TF1801                         SUPERSEDED SURVEY CONTROL
 TF1801
 TF1801.No superseded survey control is available for this station.
 TF1801
 TF1801_MARKER: DB = BENCH MARK DISK
 TF1801_SETTING: 38 = ABUTMENT
 TF1801_STAMPING: U 467 1982
 TF1801_MARK LOGO: NGS
 TF1801_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
 TF1801+STABILITY: POSITION/ELEVATION WELL
 TF1801
 TF1801  HISTORY     - Date     Condition        Report By
 TF1801  HISTORY     - 1982     MONUMENTED       NGS
 TF1801
 TF1801                         STATION DESCRIPTION
 TF1801
 TF1801'DESCRIBED BY NATIONAL GEODETIC SURVEY 1982
 TF1801'IN MINOT.
 TF1801'IN MINOT, AT THE INTERSECTION OF U. S. HIGHWAY 83, 2 AND 85, IN TOP OF
 TF1801'AND 0.8 METER (2.6 FT) WEST OF THE EAST END OF THE SOUTH CONCRETE
 TF1801'ABUTMENT OF THE U. S. HIGHWAY 83 OVERPASS, 8.3 METERS (27.2 FT) EAST
 TF1801'OF THE CENTERLINE OF THE NORTH BOUND LANES OF THE HIGHWAY AND 0.1
 TF1801'METER (0.3 FT) WEST OF THE WEST EDGE OF THE BRIDGE CURB.
 TF1801'THE MARK IS ABOVE LEVEL WITH THE HIGHWAY.
```

```
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
 TF1842 ***********************************************************************
 TF1842  DESIGNATION -  V 463
 TF1842  PID         -  TF1842
 TF1842  STATE/COUNTY-  ND/WARD
 TF1842  USGS QUAD   -  MINOT (1979)
 TF1842
 TF1842                         *CURRENT SURVEY CONTROL
 TF1842  ___________________________________________________________________
 TF1842* NAD 83(1986)-  48 13 44.     (N)     101 21 58.     (W)     SCALED
 TF1842* NAVD 88     -       479.017  (meters)     1571.57   (feet)  ADJUSTED
 TF1842  ___________________________________________________________________
 TF1842  GEOID HEIGHT-        -20.11  (meters)                       GEOID99
 TF1842  DYNAMIC HT  -        479.094 (meters)     1571.83   (feet)  COMP
 TF1842  MODELED GRAV-     980,758.7  (mgal)                         NAVD 88
 TF1842
 TF1842  VERT ORDER  -  FIRST     CLASS II
 TF1842
 TF1842.The horizontal coordinates were scaled from a topographic map and have
 TF1842.an estimated accuracy of +/- 6 seconds.
 TF1842
 TF1842.The orthometric height was determined by differential leveling
 TF1842.and adjusted by the National Geodetic Survey in June 1991.
 TF1842
 TF1842.The geoid height was determined by GEOID99.
 TF1842
 TF1842.The dynamic height is computed by dividing the NAVD 88
 TF1842.geopotential number by the normal gravity value computed on the
 TF1842.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
 TF1842.degrees latitude (g = 980.6199 gals.).
 TF1842
 TF1842.The modeled gravity was interpolated from observed gravity values.
 TF1842
 TF1842;                    North         East     Units  Estimated Accuracy
 TF1842;SPC ND N     -   136,990.      535,660.      MT  (+/- 180 meters Scaled)
 TF1842
 TF1842                          SUPERSEDED SURVEY CONTROL
 TF1842
 TF1842.No superseded survey control is available for this station.
 TF1842
 TF1842_MARKER: I = METAL ROD
 TF1842_SETTING: 49 = STAINLESS STEEL ROD W/O SLEEVE (10 FT.+)
 TF1842_STAMPING: V 463 1981
 TF1842_MARK LOGO: NGS
 TF1842_PROJECTION: FLUSH
 TF1842_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
 TF1842_ROD/PIPE-DEPTH: 20.1 meters
 TF1842
 TF1842  HISTORY     - Date     Condition        Report By
 TF1842  HISTORY     - 1981     MONUMENTED       NGS
 TF1842
 TF1842                          STATION DESCRIPTION
 TF1842
 TF1842'DESCRIBED BY NATIONAL GEODETIC SURVEY 1981
 TF1842'6.2 KM (3.85 MI) WEST FROM MINOT.
 TF1842'3.7 KM (2.3 MI) SOUTHWESTERLY ALONG THE BURLINGTON NORTHERN RAILROAD
 TF1842'FROM THE RAILROAD STATION IN MINOT, THENCE 2.5 KM (1.55 MI) WESTERLY
 TF1842'ALONG U.S. HIGHWAY 2, 46.0 METERS (150.9 FT) SOUTHEAST OF THE CENTER
 TF1842'OF A DRIVEWAY LEADING INTO THE CENTEX PIPELINE TERMINAL, 34.7 METERS
 TF1842'(113.8 FT) SOUTHWEST OF THE CENTERLINE OF THE EAST BOUND LANES OF THE
```

```
TF1842'HIGHWAY AND 1.9 METERS (6.2 FT) WEST OF A UTILITY POLE.  NOTE=ACCESS
TF1842'TO THE DATUM POINT IS THROUGH A 5-INCH LOGO CAP.
TF1842'THE MARK IS 0.5 METERS  NE FROM  A FENCE AND WITNESS POST
TF1842'THE MARK IS 1.0 M BELOW THE HIGHWAY.
1        National Geodetic Survey,   Retrieval Date = OCTOBER  3, 2002
TF1798 ***********************************************************************
TF1798  DESIGNATION -  V 467
TF1798  PID         -  TF1798
TF1798  STATE/COUNTY-  ND/WARD
TF1798  USGS QUAD   -  MINOT (1979)
TF1798
TF1798                         *CURRENT SURVEY CONTROL
TF1798  ___________________________________________________________________
TF1798* NAD 83(1986)-  48 13 39.     (N)    101 17 45.      (W)     SCALED
TF1798* NAVD 88     -        511.007  (meters)    1676.53    (feet)   ADJUSTED
TF1798  ___________________________________________________________________
TF1798  GEOID HEIGHT-         -20.27  (meters)                         GEOID99
TF1798  DYNAMIC HT  -        511.091  (meters)     1676.80   (feet)   COMP
TF1798  MODELED GRAV-     980,759.1   (mgal)                           NAVD 88
TF1798
TF1798  VERT ORDER  -  FIRST     CLASS II
TF1798
TF1798.The horizontal coordinates were scaled from a topographic map and have
TF1798.an estimated accuracy of +/- 6 seconds.
TF1798
TF1798.The orthometric height was determined by differential leveling
TF1798.and adjusted by the National Geodetic Survey in June 1991.
TF1798
TF1798.The geoid height was determined by GEOID99.
TF1798
TF1798.The dynamic height is computed by dividing the NAVD 88
TF1798.geopotential number by the normal gravity value computed on the
TF1798.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
TF1798.degrees latitude (g = 980.6199 gals.).
TF1798
TF1798.The modeled gravity was interpolated from observed gravity values.
TF1798
TF1798;                    North         East     Units  Estimated Accuracy
TF1798;SPC ND N     -   136,780.      540,880.      MT  (+/- 180 meters Scaled)
TF1798
TF1798                          SUPERSEDED SURVEY CONTROL
TF1798
TF1798.No superseded survey control is available for this station.
TF1798
TF1798_MARKER: I = METAL ROD
TF1798_SETTING: 49 = STAINLESS STEEL ROD W/O SLEEVE (10 FT.+)
TF1798_STAMPING: V 467 1982
TF1798_MARK LOGO: NGS
TF1798_PROJECTION: FLUSH
TF1798_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
TF1798_ROD/PIPE-DEPTH: 9.8  meters
TF1798
TF1798  HISTORY     - Date     Condition        Report By
TF1798  HISTORY     - 1982     MONUMENTED       NGS
TF1798
TF1798                          STATION DESCRIPTION
TF1798
TF1798'DESCRIBED BY NATIONAL GEODETIC SURVEY 1982
TF1798'IN MINOT.
TF1798'IN MINOT, AT THE NORTHWEST CORNER OF THE INTERSECTION OF 9TH AVENUE
```

```
TF1798'SOUTHWEST AND SOUTH BROADWAY (U. S. HIGHWAY 83), 11.7 METERS (38.4 FT)
TF1798'WEST OF THE CENTERLINE OF THE SOUTH BOUND LANES OF SOUTH BROADWAY AND
TF1798'9.0 METERS (29.5 FT) NORTH OF THE CENTER OF THE AVENUE.  NOTE=ACCESS
TF1798'TO THE DATUM POINT IS THROUGH A 5-INCH LOGO CAP.
TF1798'THE MARK IS 0.3 METERS  E FROM A WITNESS POST.
TF1798'THE MARK IS 0.5 M ABOVE SOUTH BROADWAY.

*** retrieval complete.
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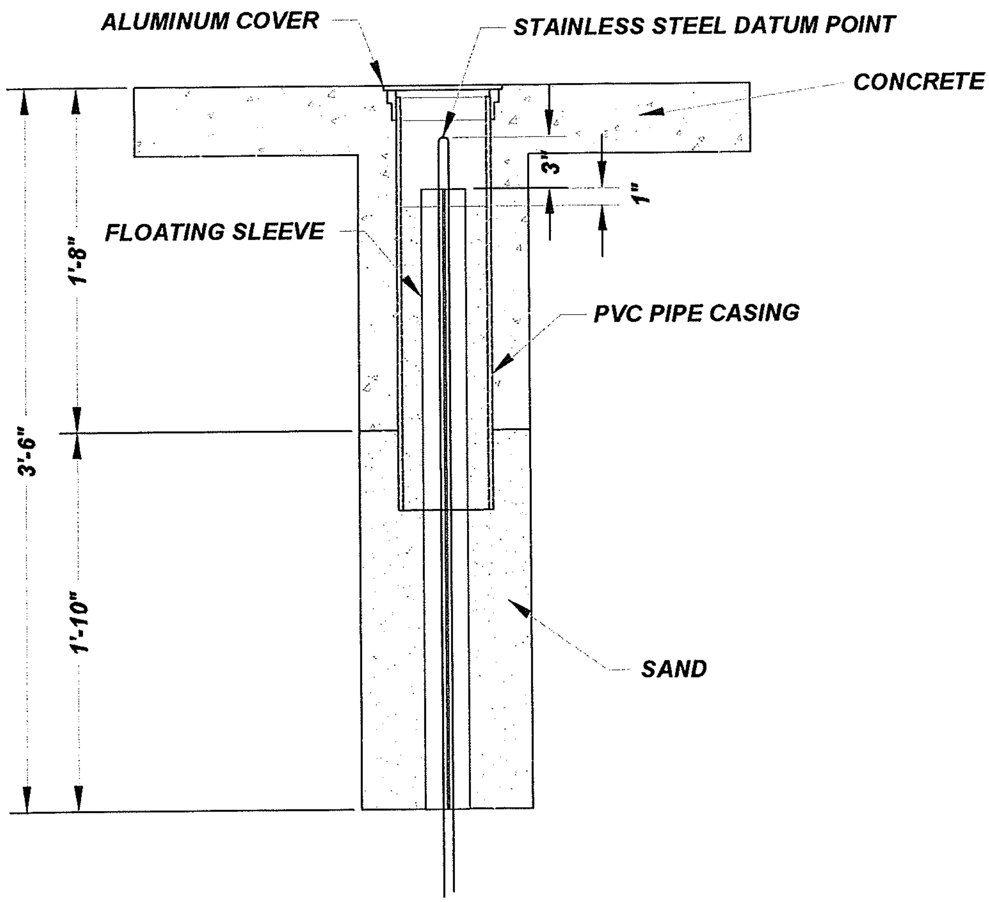
Appendix -C-

Monument Details

TYPICAL CONTROL MONUMENT



Puppydog Coulee Wastewater System

A Sanitary Sewer Capacity Evaluation

City of Minot

September 2001

Houston Engineering, Inc.
2505 North University Drive
Box 5054
Fargo, ND 58105
HE Project No. 4054.010

Puppydog Coulee Wastewater System

A Sanitary Sewer Capacity Evaluation

September 2001

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 Engineer under the laws of the State of North Dakota.

Jeffrey R. LeDoux
North Dakota Reg. No. 3206

Date: 9/24/01

Erik S. Jones
North Dakota Reg. No. 4614

Date: 9/24/2001

Houston Engineering, Inc.
2505 North University Drive
Box 5054
Fargo, ND 58105
Phone 701-237-5065
HE Project No. 4054.010

TABLE OF CONTENTS

I. INTRODUCTION

The city of Minot is currently experiencing moderate growth. Much of this growth is occurring south of US Highways No. 2 and 52. The Puppydog Coulee collection system serves the southernmost contributors to the city's wastewater treatment facilities. At the present time, there are several rural areas/subdivisions that are experiencing moderate to severe private sewage disposal system failures. At some point in the future, these properties will likely be served by the city of Minot sanitary system. As a result, there is concern over the existing capacity of the Puppydog system and whether it can handle additional wastewater contributors. The city of Minot, therefore, requested an evaluation of the Puppydog Coulee and its existing sanitary system capacity.

A. Study Area

The study area is known as the Puppydog Coulee wastewater collection system. This area is served by the Puppydog Lift, which is located just west of the Souris River on the north side of 37th Avenue SE. A map of the study area is shown in Appendix A. The Puppydog Lift pumps wastewater through a 12" Class 160 PVC forcemain to aeration ponds located in SE ¼, SE ¼, Sec. 27, T155N, R82W (Nedrose Township), Ward County. From the aeration ponds, the wastewater flows by gravity to the city lagoons. The collection system to the Puppydog Lift consists of PVC pipe. Upstream of the lift station, the collection trunk line generally follows the meanders of Puppydog Coulee. At approximately 6th Street SE, the collection system branches. One branch extends north of US Highways No. 2 and 52 to serve a largely residential area. The other branch continues generally in a west direction and collects wastewater from an area south of the US Highways No. 2 and 52 and west of 6^{th} Street SE.

B. Purpose

The purpose of this study is to evaluate the current system capacity and existing hydraulic condition of the Puppydog Coulee wastewater collection system.

II. STUDY PROCEDURE

To determine the efficiency of the existing sanitary system, the city requested that a sanitary computer model be developed. The model chosen for this study was the Storm Water Management Model (SWMM). SWMM is a hydrologic/hydraulic model developed in the late 1960s. Since that time, improvements have been made to the program to enhance its capabilities which allows it to be useful in modeling complex hydraulic systems. SWMM is well adapted to modeling wastewater systems. SWMM is a dynamic modeling software, in which varying discharges can be simulated and routed through the sanitary sewer system to determine the effects of various events. During the development of the model, a number of data sources were utilized.

A. Data Sources

Information for this study and model came from a combination of the city of Minot and other general information sources. The following is a brief listing of the data utilized:

1. As-Built Plan and Profile Sheets. As-built plan and profile sheets were obtained from the city of Minot. These as-builts included information for Improvement Districts No. 80 and 136. The as-builts were used to obtain detailed information necessary for the SWMM model, including information on sanitary pipes, manholes, and lid elevations. This information included diameters, pipe material, invert elevations, and slopes.

2. Puppydog Lift Station Improvement Plans (December 1998). Improvement plans for the Puppydog lift station were provided by the city of Minot. These plans provided information on the emergency storage pond as well as piping information around the lift station. In addition, pump operating levels were provided in this plan. Pump operating level information used in the modeling were as follows:

   a. First Pump Start Elevation 1530.5

   b. Second Pump Start Elevation 1531.5

   c. Pump Shut-Off Level 1525.0

3. Puppydog Lift Pump Information. Information regarding pump performance was provided by the city of Minot. Discharges for various head conditions were provided and are as follows:

Discharge (Gal./Min.)	Head (Ft.)
1402	205
1168	213
934	221
701	229

4. Facility Plan for the City of Minot, ND (December 1983). The Facility Plan was provided by the city of Minot. Per capita wastewater generation rates as well as other general information was provided in the Facility Plan report.

5. Location Map for Sewer and Water Facilities. This map, provided by the city of Minot, was used to determine the extent of the Puppydog Coulee system.

6. 2000 Census. Census information for the study area was obtained from the U.S. Census Bureau via their website (www.census.gov). Census information was used to determine the population contributing wastewater to the Puppydog Coulee system. Approximately 6,200 people live on the Puppydog Coulee system.

7. Aerial photos. Aerial photos were used in the study process to determine the character and uniformity of wastewater contributors.

B. SWMM Modeling

Modeling for this study involved using the hydraulic capabilities of SWMM. SWMM has three computational layers: Runoff (hydrology), Transport, and Hydraulics. The hydraulics layer was necessary for the development of the model used in this study.

The hydraulic layer accomplishes the hydraulic routing of wastewater from manhole to manhole and eventually to the outlet of the system using the momentum theory. SWMM has the unique capability to take backwater and storage effects into consideration while completing its hydraulic routing of the wastewater. The hydraulic layer routes the wastewater discharges generated through the conveyance system.

III. MODELING

To determine the conditions of the existing system, a SWMM hydrologic and hydraulic computer model was developed. The input to the model included physical data and hydraulic and wastewater generation data discussed previously. The input data (i.e., manhole data, pipe data…) are presented in Appendixes B and C. All input information is organized and has been named based on the Improvement District in which the manhole or pipe was installed. A map of the study area has been included in Appendix A.

A. Wastewater Generation Rates

Existing wastewater generation rates were determined from a number of sources of information. The first consideration for determining average daily wastewater discharge was to consider per capita wastewater generation rates. In April and May of 1983, flow measurements were completed by installing weirs in manholes upstream of the pump stations at various locations in the Minot sanitary system. These measurements indicated an average per capita flow of 131.63 gallons per day in the Puppydog system. In August of the same year, the flow was again measured and determined to be 140.4 gpcd.

2000 Census information was obtained from the U.S. Census Bureau via their website. This information indicates that there are approximately 6,200 people contributing wastewater on the Puppydog Coulee wastewater system. Based on the average daily flow rates measured in 1983 of 131.63 and 140.4 gpcd, the average daily flow for the Puppydog Coulee system would be between 0.8 and 0.9 MGD.

According to the city of Minot, the average daily wastewater generation rate for the city is 4 to 4.5 MGD. Of this amount, approximately 20% is contributed from the Puppydog Coulee sanitary sewer system. This also corresponds to an average daily inflow of 0.8 to 0.9 MGD.

In 1999, the Puppydog Coulee lift station was reconstructed. During the reconstruction of the lift station, the flow was diverted into the emergency storage pond located just west of the lift station. According to the city of Minot, when the lift station was out of service during the reconstruction, the emergency storage pond would fill to within three feet of the top of the pond in 10 to 12 hours. The volume of the emergency storage pond utilized during lift station reconstruction seems to be consistent with the 0.8 to 0.9 MGD as estimated by other means.

For the analysis in this study, the average daily wastewater rate of 0.9 MGD was utilized and is consistent with the previously discussed estimations. Inflow and infiltration (I/I) are assumed to be included in the 0.9 MGD average daily discharge.

1. Inflow and Infiltration

The amount of inflow and infiltration (I/I) on the Puppydog Coulee system is an unknown. I/I has been considered in this modeling study by virtue of the techniques used to estimate the average daily discharge discussed previously. Based on conversations with the city, infiltration as well as inflow is a significant problem on the Puppydog Coulee system. Beaver activity in the coulee could be a significant cause of system inflow problems based on discussions with the city of Minot. The level of I/I could be better understood by gauging lift station flows and determining how wet conditions, rainfall events, and beaver activity affect flows in the sanitary sewer system. If the measured flows reported in the ***1983 Facility Plan*** (131.63 and 140.4 gpcd) are still valid today, there is a significant I/I problem. The actual average wastewater generation rates are generally less than 100 gpcd.

B. Wastewater Distribution

The distribution of wastewater generated in the Puppydog system was assumed to be directly related to the percentage of population contributing at various points along the system. For example, approximately 59% of the population lives west of 6th Street SE and south of US Highways No. 2 and 52, therefore 59% of the wastewater generated has been assumed to originate from this area with respect to both wastewater volume and discharge rates. Table 1 lists the node locations of significant inflows as a percentage of total flow to the Puppydog Lift. In general, the nodes in the table are manholes where significant wastewater flows enter the Puppydog Coulee main sewer lines.

Table 1

Manhole (Node) at Contribution Point	Population Census Estimate	Percent of Contributing Population = Percent of Puppydog Lift Discharge
ID 80 MH 51	50	0.805%
ID 80 MH 70	116	1.867%
ID 80 MH 79	29	0.467%
ID 80 MH 81	13	0.209%
ID 80 MH 82	2339	37.641%
ID 136 MH 3	272	4.377%
ID 136 MH 13	834	13.421%
ID 136 MH 14	22	0.354%
ID 136 MH 16	146	2.350%
ID 136 MH 17	57	0.917%
ID 136 MH 20	1676	26.971%
ID 136 MH 27	125	2.012%
ID 136 MH 37	535	8.610%
Totals:	6214	100.000%

C. Existing System Capacity

In order to evaluate the existing system capacity, three components of the system need to be considered. These include the capacity of the force main, the capacity of the lift station, and the capacity of the collection pipes contributing flow to the lift station. In order to evaluate each of the three components, flows were increased incrementally until capacity of the individual components were exceeded. From this analysis, it appears the capacity limiting component of the Puppydog Coulee system is the collection system upstream from the lift station. Maximum water surface elevations for various locations along the Puppydog system for various flows are provided in Appendix D. A more detailed description of the analysis for the collection systeim pipe, forcemain and lift station is presented below. Note that the model node names given in the table found in Appendix D are based on the Improvement District (ID) in which the manhole was installed. The node names given in Appendix D correspond to the node names shown on the study map in Appendix A.

1. <u>Collection System Pipe Capacity</u>

SWMM modeling was completed to analyze pipe capacities. In order to determine existing pipe capacity, the total flow was increased incrementally in the system to and beyond the point where the pipes began to run full. The distribution of the discharge from the various areas in the system was directly related to the distribution of population (2000 Census) on the system. Based on this analysis, it appears that the pipes in the system begin to become surcharged when the flow from the system is slightly more than 1.5 MGD.

Based on the SWMM analysis, it appears that certain pipes may be undersized. Pipes should be sized for the Peak Hourly Discharge. In general, the maximum (peak) hourly discharge is dependent on population (flow), and can range from over four (4) to two (2) times the average daily flow. However, in absence of actual flow data, the peak hourly discharge is taken as 3 times the average daily discharge (though some sources suggest using a higher multiplier, particularly on the lesser populated branches). The Puppydog collection system therefore should have a capacity of 2.4 to 2.7 MGD. Many pipes in the system flow full before reaching the peak hourly discharge.

For a peak hourly discharge of 2.7 MGD, the following pipes are under surcharged flow (exceeds capacity):

Conduit	**Description**
61	ID No. 80 MH 17 to MH 16
67, 91, 93, 95, 97, 99, 101, 103, 105, 107, 109, 111, 112, 115, 117, 119, 121, 123, 125, 127, 129, 131, 133, 135, 137, 139, 141, 143, and 144	ID No. 80 MH 34 to MH 61
223, 225, 227, and 228	ID No. 80 MH 61 to ID No. 136 MH 4
205, 207, 209, 211, 213, and 270	ID No. 136 MH 8 to ID No. 136 MH 13

Specifically, pipe capacity issues exist upstream from the location where the pipe size decreases from 15" to 12" between ID No. 80 (MH 32 and 33) and ID No. 80 (MH 33 and 34). Upstream of this reach (MH 34 to MH 61) the system is surcharged during the peak hourly rate. This backup also affects water levels in I.D. No. 136 MH 1 through 4. A sustained peak hourly flow will cause the wastewater in many of the manholes to approach the ground level. Appendix E highlights pipe reaches that become surcharged during a sustained 2.7 MGD flow.

Some pipes on the Puppydog system are installed with adverse slopes (sloped backwards). Adversely sloped pipes can become maintenance problems if solids are deposited and build up over time in these pipes. The following pipes are adversely sloped based on the as-builts information obtained during the study.

Conduit	**Description**
63	ID No. 80 MH 15 to MH 16
215	ID No. 136 MH 7 to ID No. 136 MH 8
237	ID No. 136 MH 33 to ID No. 136 MH 34

It appears that the pipe capacity is also first exceeded at slightly more than 1.5 MGD between Manhole 8 and 9 on the I.D. 136 project. This section of pipe (213) is located one pipe segment above a section of pipe with an adverse slope. The adverse slope of the pipe (215) between Manholes 7 and 8 is responsible for causing the pipe between Manholes 8 and 9 to become surcharged before other pipes on the system. Appendix F highlights adversely sloped pipes on the modeled portion of the Puppydog Coulee system.

In addition to pipes with adverse slopes, other pipes in the Puppydog system do not meet minimum recommended slopes found in ***Recommended Standards for Wastewater Facilities*** (1997) published by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. These minimum slopes are used to ensure adequate velocities (2fps) in the pipes to prevent sedimentation. Those pipes are as follows:

Conduit	Description
63	ID No. 80 MH 15 to MH 16
153	ID No. 80 MH 67 to MH 68
151	ID No. 80 MH 68 to MH 69
149	ID No. 80 MH 69 to MH 70
178	ID No. 80 MH 70 to MH 77
177	ID No. 80 MH 77 to MH 78
175	ID No. 80 MH 78 to MH 79
171	ID No. 80 MH 80 to MH 81
215	ID No. 136 MH 7 to ID No. 136 MH 8
209	ID No. 136 MH 10 to ID No. 136 MH 11
272	ID No. 136 MH 20 to ID No. 136 MH 21
261	ID No. 136 MH 21 to ID No. 136 MH 22
259	ID No. 136 MH 22 to ID No. 136 MH 23
251	ID No. 136 MH 26 to ID No. 136 MH 27
247	ID No. 136 MH 28 to ID No. 136 MH 29
245	ID No. 136 MH 29 to ID No. 136 MH 30
243	ID No. 136 MH 30 to ID No. 136 MH 31
241	ID No. 136 MH 31 to ID No. 136 MH 32
239	ID No. 136 MH 32 to ID No. 136 MH 33
237	ID No. 136 MH 33 to ID No. 136 MH 34

Appendix G shows the wastewater pipe segments that do not meet the minimum slope standards.

2. Forcemain Capacity

Based on analysis, it appears that the forcemain is of adequate pressure rating and the velocities are acceptable. Forcemain velocities exceed 2 fps, which is desirable to prevent sediment from building up in the forcemain, and are also less than 15 fps. The analysis does not indicate pressures high enough to rupture the pipe. The forcemain is Class 160, 12" PVC Pipe. Even with both existing pumps running, the pressure in the forcemain does not appear to reach the 160-psi level. Based on the modeling, with both pumps running, the maximum forcemain discharge is 5.10 cfs (2290 gpm). This is approximately 3.3 MGD which exceeds the peak hourly flow of 2.7 MGD. Water hammer does not appear to be a problem based on conversations with the city of Minot. There have been no problems with the forcemain since adding "Smart Starts" to the pumps.

3. Lift Station Capacity

Based on information provided, it appears that the lift station has capacity to handle the expected peak hourly discharges, but not with a significant factor of safety. Operation of both pumps is required to handle the expected peak hourly discharge. If one pump was malfunctioning, however, a single pump would be unable to keep up with the peak hourly discharge. There is some factor of safety built into the lift station with the provision of the volume in the emergency storage pond. The emergency pond would likely provide a minimum of four hours of storage if the lift station was shut down and would provide a minimum of 16 hours of storage if one of the pumps was not functioning during a sustained peak hourly flow (16 hours at the peak hourly flow rate).

According to ***Recommended Standards for Wastewater Facilities*** (1997), "Multiple pumps shall be provided. Where only two units are provided, they shall be of the same size. Units shall have capacity such that, with any unit out of service, the remaining units will have capacity to handle the design peak hourly flow." In the case of the Puppydog Coulee lift, it appears that the recommended pump capacity is not provided.

IV. CONCLUSIONS

In general, the capacity of much of the existing Puppydog Coulee system is acceptable, except for a few areas of the collection system. Portions of the existing collection system begin flow full at slightly more than 1.5 million gallons per day. Some areas of the collection system have maintenance issues due to nearly flat or adverse slope of the pipes. The existing lift station has a capacity of approximately 3.3 million gallons per day and is adequate for the existing flows. A more significant factor of safety should be given to the lift station by increasing the pump sizes or by the addition of a third pump. The force main is also adequate for the existing conditions and its velocities are within the acceptable range.

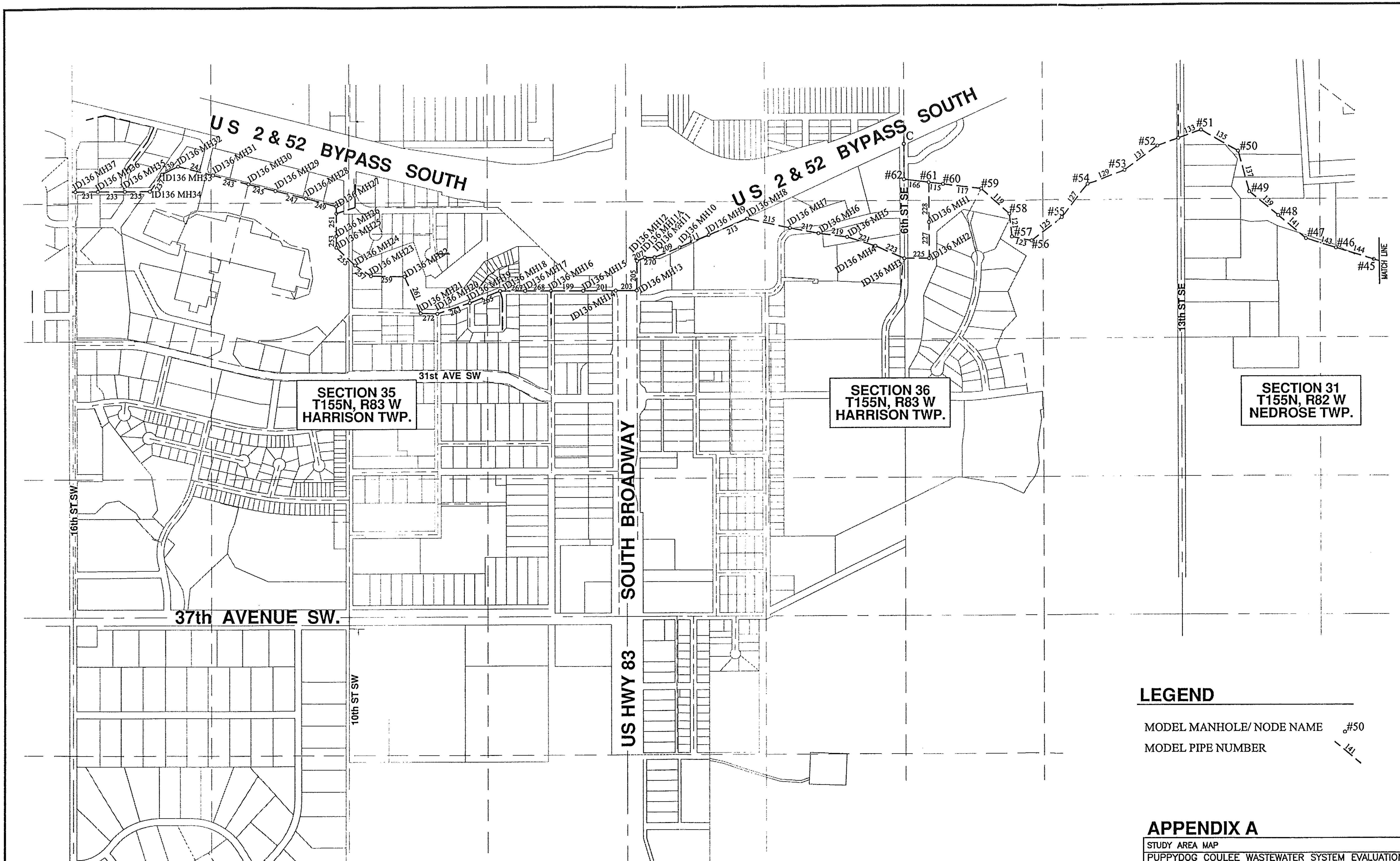
V. RECOMMENDATIONS

The following are recommendations the city should consider as a result of this study:

- Perform gaging monitoring to determine and verify average and peak wastewater generation rates
- Perform continuous flow measurement of Puppydog system to determine extent of I/I problem
- Monitor and control beaver activity along the Coulee to prevent manhole inflow problems along the Coulee
- Pursue elimination of sump connections and other large inflows to sanitary system
- Pursue measures to improve capacity of section of the collection systems lacking capacity
- Increase the pump capacity of the Puppydog lift.

APPENDIX A

STUDY AREA MAP



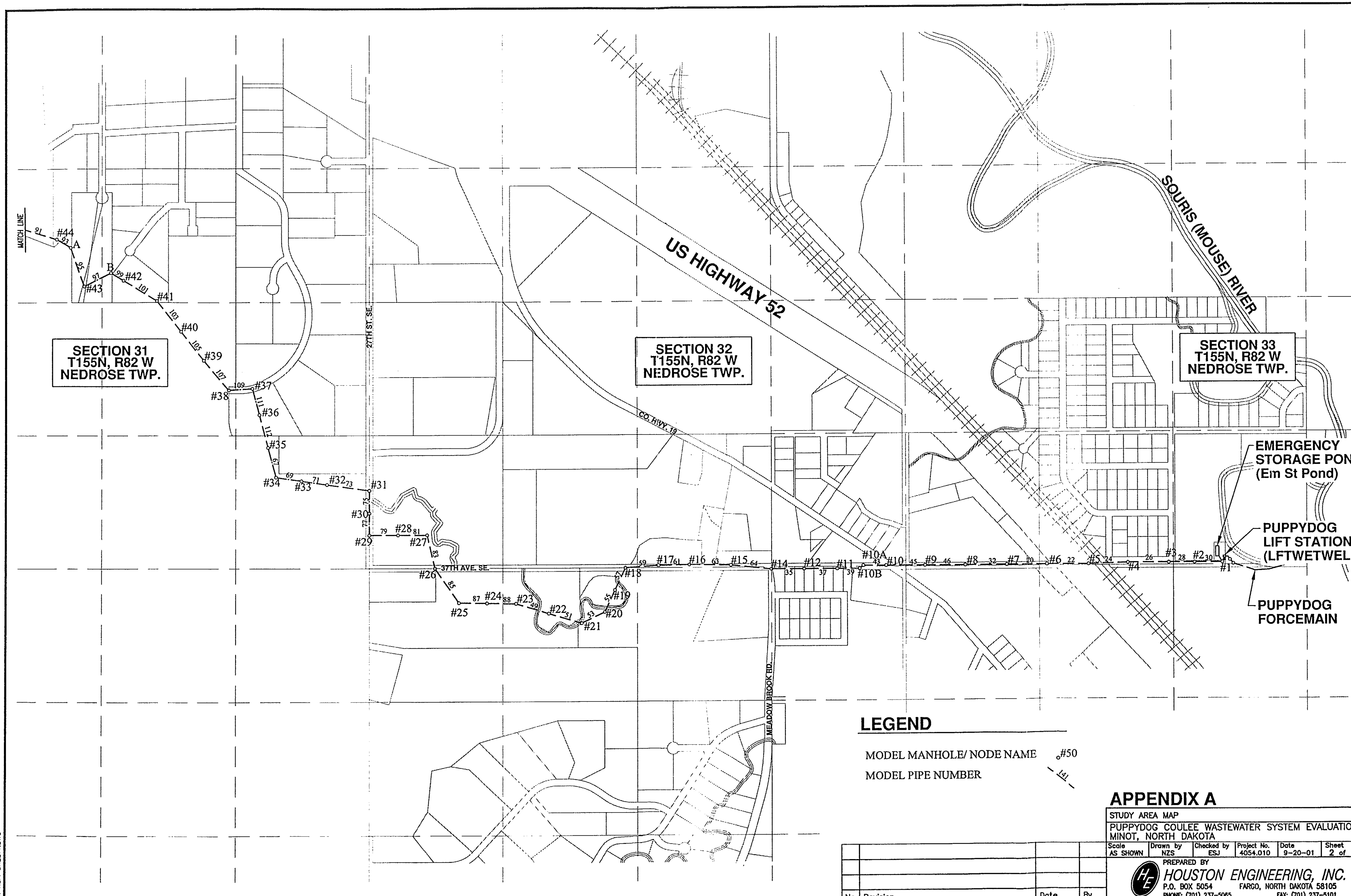
APPENDIX A

STUDY AREA MAP
PUPPYDOG COULEE WASTEWATER SYSTEM EVALUATION
MINOT, NORTH DAKOTA

Scale	Drawn by	Checked by	Project No.	Date	Sheet
AS SHOWN	NZS	ESJ	4054.010	9-20-01	1 of 2

PREPARED BY
HOUSTON ENGINEERING, INC.
P.O. BOX 5054 FARGO, NORTH DAKOTA 58105
PHONE: (701) 237-5065 FAX: (701) 237-5101

No.	Revision	Date	By



APPENDIX A

STUDY AREA MAP
PUPPYDOG COULEE WASTEWATER SYSTEM EVALUATION
MINOT, NORTH DAKOTA

Scale	Drawn by	Checked by	Project No.	Date	Sheet
AS SHOWN	NZS	ESJ	4054.010	9-20-01	2 of 2

No.	Revision	Date	By

PREPARED BY
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APPENDIX B

SWMM MODEL CONDUIT INPUT DATA

SWMM MODEL CONDUIT INPUT DATA

SWMM Model Conduit Name	Description	Length (feet)	Nominal Pipe size (inches)	Inside Diameter (feet)	Inside Diameter (inches)	Conduit Material/ Shape	Area (sq.ft.)	Manning Coefficient	Upstream Invert (feet)	Downstream Invert (feet)
20	ID#80 MH 7 to MH 6	404.10	21	1.73	20.78	Circular	2.36	0.010	1540.27	1538.80
22	ID#80 MH 6 to MH 5	403.30	21	1.73	20.78	Circular	2.36	0.010	1538.78	1537.37
24	ID#80 MH 5 to MH 4	393.90	21	1.73	20.78	Circular	2.36	0.010	1537.48	1535.76
26	ID#80 MH 4 to MH 3	402.50	21	1.73	20.78	Circular	2.36	0.010	1535.63	1534.42
28	ID#80 MH 3 to MH 2	251.40	21	1.73	20.78	Circular	2.36	0.010	1534.09	1532.93
30	ID#80 MH 2 to MH 1	274.00	21	1.73	20.78	Circular	2.36	0.010	1532.75	1531.91
32	ID#80 MH 8 to MH 9	404.80	21	1.73	20.78	Circular	2.36	0.010	1541.93	1540.33
35	ID#80 MH 14 to MH 12	321.80	21	1.73	20.78	Circular	2.36	0.010	1550.07	1548.68
37	ID#80 MH 12 to MH 11	323.30	21	1.73	20.78	Circular	2.36	0.010	1548.67	1547.64
39	ID#80 MH 11 to MH 10B	218.50	21	1.73	20.78	Circular	2.36	0.010	1547.59	1546.64
41	ID#80 MH 10B to MH 10A	46.90	21	1.73	20.78	Circular	2.36	0.010	1546.68	1546.29
43	ID#80 MH 10A to MH 10	226.25	21	1.73	20.78	Circular	2.36	0.010	1546.24	1545.77
45	ID#80 MH 10 to MH 9	388.50	21	1.73	20.78	Circular	2.36	0.010	1545.75	1544.17
46	ID#80 MH 9 to MH 8	396.80	21	1.73	20.78	Circular	2.36	0.010	1544.06	1542.22
49	ID#80 MH 23 to MH 22	338.90	15	1.20	14.42	Circular	1.13	0.010	1562.56	1561.26
51	ID#80 MH 22 to MH 21	335.60	15	1.20	14.42	Circular	1.13	0.010	1561.19	1559.81
53	ID#80 MH 21 to MH 20	250.80	15	1.20	14.42	Circular	1.13	0.010	1559.62	1558.53
55	ID#80 MH 20 to MH 19	239.10	15	1.20	14.42	Circular	1.13	0.010	1558.36	1557.50
57	ID#80 MH 19 to MH 18	241.60	15	1.20	14.42	Circular	1.13	0.010	1557.53	1556.36
59	ID#80 MH 18 to MH 17	327.90	15	1.20	14.42	Circular	1.13	0.010	1556.18	1554.11
61	ID#80 MH 17 to MH 16	326.00	15	1.20	14.42	Circular	1.13	0.010	1554.03	1552.12
63	ID#80 MH 15 to MH 16	406.80	15	1.20	14.42	Circular	1.13	0.010	1552.12	1552.14
64	ID#80 MH 15 to MH 14	402.50	15	1.20	14.42	Circular	1.13	0.010	1552.12	1550.25
67	ID#80 MH 35 to MH 34	305.00	12	0.98	11.78	Circular	0.76	0.010	1583.37	1580.84
69	ID#80 MH 34 to MH 33	257.30	12	0.98	11.78	Circular	0.76	0.010	1580.73	1578.61
71	ID#80 MH 33 to MH 32	156.00	15	1.20	14.42	Circular	1.13	0.010	1578.63	1576.85
73	ID#80 MH 32 to MH 31	418.80	15	1.20	14.42	Circular	1.13	0.010	1576.83	1573.95
75	ID#80 MH 31 to MH 30	225.80	15	1.20	14.42	Circular	1.13	0.010	1573.79	1572.80
77	ID#80 MH 30 to MH 29	225.80	15	1.20	14.42	Circular	1.13	0.010	1572.80	1571.83
79	ID#80 MH 29 to MH 28	286.70	15	1.20	14.42	Circular	1.13	0.010	1571.83	1570.60
81	ID#80 MH 28 to MH 27	288.50	15	1.20	14.42	Circular	1.13	0.010	1570.44	1569.22
83	ID#80 MH 27 to MH 26	329.65	15	1.20	14.42	Circular	1.13	0.010	1569.17	1567.51
85	ID#80 MH 26 to MH 25	410.20	15	1.20	14.42	Circular	1.13	0.010	1567.33	1565.22
87	ID#80 MH 25 to MH 24	279.40	15	1.20	14.42	Circular	1.13	0.010	1565.10	1563.95
88	ID#80 MH 24 to MH 23	284.90	15	1.20	14.42	Circular	1.13	0.010	1563.93	1562.74
91	ID#80 MH 45 to MH 44	382.20	12	0.98	11.78	Circular	0.76	0.010	1609.57	1606.85
93	ID#80 MH 44 to MH A	158.00	12	0.98	11.78	Circular	0.76	0.010	1606.66	1605.60
95	ID#80 MH A to MH 43	405.30	12	0.98	11.78	Circular	0.76	0.010	1605.47	1604.35
97	ID#80 MH 43 to MH B	296.80	12	0.98	11.78	Circular	0.76	0.010	1603.96	1603.02
99	ID#80 MH B to MH 42	144.30	12	0.98	11.78	Circular	0.76	0.010	1602.84	1601.90
101	ID#80 MH 42 to MH 41	390.30	12	0.98	11.78	Circular	0.76	0.010	1601.93	1599.44
103	ID#80 MH 41 to MH 40	386.30	12	0.98	11.78	Circular	0.76	0.010	1599.29	1596.44
105	ID#80 MH 40 to MH 39	366.90	12	0.98	11.78	Circular	0.76	0.010	1596.44	1593.49
107	ID#80 MH 39 to MH 38	375.60	12	0.98	11.78	Circular	0.76	0.010	1593.34	1590.41
109	ID#80 MH 38 to MH 37	229.00	12	0.98	11.78	Circular	0.76	0.010	1590.29	1588.44
111	ID#80 MH 37 to MH 36	271.40	12	0.98	11.78	Circular	0.76	0.010	1588.32	1586.10
112	ID#80 MH 36 to MH 35	333.50	12	0.98	11.78	Circular	0.76	0.010	1586.10	1583.45
115	ID#80 MH 61 to MH 60	159.30	12	0.98	11.78	Circular	0.76	0.010	1649.10	1647.89
117	ID#80 MH 60 to MH 59	367.20	12	0.98	11.78	Circular	0.76	0.010	1648.02	1645.88
119	ID#80 MH 59 to MH 58	358.30	12	0.98	11.78	Circular	0.76	0.010	1645.70	1643.49
121	ID#80 MH 58 to MH 57	218.60	12	0.98	11.78	Circular	0.76	0.010	1643.47	1642.12
123	ID#80 MH 57 to MH 56	186.40	12	0.98	11.78	Circular	0.76	0.010	1642.04	1641.03
125	ID#80 MH 56 to MH 55	363.80	12	0.98	11.78	Circular	0.76	0.010	1640.33	1638.73
127	ID#80 MH 55 to MH 54	409.10	12	0.98	11.78	Circular	0.76	0.010	1638.63	1635.72
129	ID#80 MH 54 to MH 53	365.00	12	0.98	11.78	Circular	0.76	0.010	1635.53	1632.75
131	ID#80 MH 53 to MH52	396.30	12	0.98	11.78	Circular	0.76	0.010	1632.72	1629.54
133	ID#80 MH 52 to MH 51	407.40	12	0.98	11.78	Circular	0.76	0.010	1629.35	1625.71
135	ID#80 MH 51 to MH 50	401.60	12	0.98	11.78	Circular	0.76	0.010	1625.70	1622.13
137	ID#80 MH 50 to MH 49	401.70	12	0.98	11.78	Circular	0.76	0.010	1621.98	1619.52

SWMM Model Conduit Name	Description	Length (feet)	Nominal Pipe size (inches)	Inside Diameter (feet)	Inside Diameter (inches)	Conduit Material/ Shape	Area (sq.ft.)	Manning Coefficient	Upstream Invert (feet)	Downstream Invert (feet)
139	ID#80 MH 49 to MH 48	354.50	12	0.98	11.78	Circular	0.76	0.010	1619.46	1617.12
141	ID#80 MH 48 to MH 47	345.30	12	0.98	11.78	Circular	0.76	0.010	1617.19	1614.96
143	ID#80 MH 47 to MH 46	301.20	12	0.98	11.78	Circular	0.76	0.010	1614.93	1612.71
144	ID#80 MH 46 to MH 45	375.70	12	0.98	11.78	Circular	0.76	0.010	1612.63	1609.61
149	ID#80 MH 70 to MH 69	339.00	12	0.98	11.78	Circular	0.76	0.010	1712.32	1711.79
151	ID#80 MH 69 to MH 68	329.50	12	0.98	11.78	Circular	0.76	0.010	1711.70	1711.12
153	ID#80 MH 68 to MH 67	339.00	12	0.98	11.78	Circular	0.76	0.010	1710.98	1710.40
155	ID#80 MH 67 to MH 66	336.60	12	0.98	11.78	Circular	0.76	0.010	1710.36	1708.52
157	ID#80 MH 66 to MH 65	208.70	12	0.98	11.78	Circular	0.76	0.010	1708.43	1707.76
159	ID#80 MH 65 to MH 64	234.70	12	0.98	11.78	Circular	0.76	0.010	1707.60	1702.12
161	ID#80 MH 64 to MH 63	325.60	12	0.98	11.78	Circular	0.76	0.010	1701.80	1692.06
163	ID#80 MH 63 to MH C	334.80	12	0.98	11.78	Circular	0.76	0.010	1692.50	1691.05
165	ID#80 MH C to MH 62	90.00	12	0.98	11.78	Circular	0.76	0.010	1690.93	1690.51
166	ID#80 MH 62 to MH 61	150.90	12	0.98	11.78	Circular	0.76	0.010	1689.27	1655.76
169	Main&18th to ID#80 MH 81	330.00	12	0.98	11.78	Circular	0.76	0.010	1722.86	1719.53
171	ID#80 MH 81 to MH 80	313.60	12	0.98	11.78	Circular	0.76	0.010	1719.43	1718.76
173	ID#80 MH 80 to MH 79	315.10	12	0.98	11.78	Circular	0.76	0.010	1718.67	1718.01
175	ID#80 MH 79 to MH 78	304.60	12	0.98	11.78	Circular	0.76	0.010	1717.66	1717.08
177	ID#80 MH 78 to MH 77	384.20	12	0.98	11.78	Circular	0.76	0.010	1716.67	1716.50
178	ID#80 MH 70 to MH 77	389.00	12	0.98	11.78	Circular	0.76	0.010	1716.50	1715.65
190	ID#80 MH 1 to LFTWETWELL	42.00	21	1.73	20.78	Circular	2.36	0.010	1530.76	1530.50
194	EmStPond to ID#80 MH 1	65.00	12	0.98	11.78	Circular	0.76	0.010	1533.00	1531.00
Forcemain	aer.pond to fmstarts	15371.00	12	0.96	11.53	Circular	0.73	0.010	1537.00	1655.00
199	ID136 MH 16 TO MH 15	292.00	12	0.98	11.78	Circular	0.76	0.010	1704.90	1703.02
201	ID136 MH 15 TO MH 14	306.60	12	0.98	11.78	Circular	0.76	0.010	1703.02	1701.93
203	ID136 MH 14 TO MH 13	214.70	12	0.98	11.78	Circular	0.76	0.010	1701.93	1700.24
205	ID136 MH 13 TO MH 12	270.00	12	0.98	11.78	Circular	0.76	0.010	1699.92	1699.72
207	ID136 MH 12 TO MH 11A	78.00	12	0.98	11.78	Circular	0.76	0.010	1699.72	1698.92
209	ID136 MH 11 TO MH 10	260.00	12	0.98	11.78	Circular	0.76	0.010	1697.98	1697.43
211	ID136 MH 10 TO MH 9	302.00	12	0.98	11.78	Circular	0.76	0.010	1697.43	1696.69
213	ID136 MH 9 TO MH 8	400.00	12	0.98	11.78	Circular	0.76	0.010	1696.69	1695.56
215	ID136 MH 7 TO MH 8	410.00	12	0.98	11.78	Circular	0.76	0.010	1695.56	1695.68
217	ID136 MH 7 TO MH 6	277.00	12	0.98	11.78	Circular	0.76	0.010	1695.68	1685.17
219	ID136 MH 6 TO MH 5	278.00	12	0.98	11.78	Circular	0.76	0.010	1685.17	1665.99
221	ID136 MH 5 TO MH 4	288.00	12	0.98	11.78	Circular	0.76	0.010	1665.69	1662.90
223	ID136 MH 4 TO MH 3	300.00	12	0.98	11.78	Circular	0.76	0.010	1662.79	1659.02
225	ID136 MH 3 TO MH 2	239.30	12	0.98	11.78	Circular	0.76	0.010	1658.93	1655.11
227	ID136 MH 2 TO MH 1	245.70	12	0.98	11.78	Circular	0.76	0.010	1654.53	1653.61
228	ID136 MH 1 TO ID80 MH 61	382.70	12	0.98	11.78	Circular	0.76	0.010	1653.61	1652.65
231	ID136 MH 37 TO MH 36	249.30	12	0.98	11.78	Circular	0.76	0.010	1724.30	1723.62
233	ID136 MH 36 TO MH 35	264.00	12	0.98	11.78	Circular	0.76	0.010	1723.60	1722.79
235	ID136 MH 35 TO MH 34	232.30	12	0.98	11.78	Circular	0.76	0.010	1722.79	1722.08
237	ID136 MH 33 TO MH 34	198.00	12	0.98	11.78	Circular	0.76	0.010	1722.21	1722.33
239	ID136 MH 33 TO MH 32	169.00	12	0.98	11.78	Circular	0.76	0.010	1722.26	1722.17
241	ID136 MH 32 TO MH 31	342.50	12	0.98	11.78	Circular	0.76	0.010	1722.20	1721.60
243	ID136 MH 31 TO MH 30	347.00	12	0.98	11.78	Circular	0.76	0.010	1721.43	1720.71
245	ID136 MH 30 TO MH 29	267.00	12	0.98	11.78	Circular	0.76	0.010	1720.66	1720.13
247	ID136 MH 29 TO MH 28	296.00	12	0.98	11.78	Circular	0.76	0.010	1719.96	1719.42
249	ID136 MH 28 TO MH 27	305.00	12	0.98	11.78	Circular	0.76	0.010	1719.34	1718.53
251	ID136 MH 27 TO MH 26	305.00	12	0.98	11.78	Circular	0.76	0.010	1718.48	1718.30
253	ID136 MH 26 TO MH 25	108.00	12	0.98	11.78	Circular	0.76	0.010	1718.30	1715.04
255	ID136 MH 25 TO MH 24	248.00	12	0.98	11.78	Circular	0.76	0.010	1714.86	1713.22
257	ID136 MH 24 TO MH 23	181.00	12	0.98	11.78	Circular	0.76	0.010	1713.21	1712.61
259	ID136 MH 23 TO MH 22	317.00	12	0.98	11.78	Circular	0.76	0.010	1712.56	1712.05
261	ID136 MH 22 TO MH 21	380.00	12	0.98	11.78	Circular	0.76	0.010	1711.93	1711.12
263	ID136 MH 20 TO MH 19	334.00	12	0.98	11.78	Circular	0.76	0.010	1711.02	1709.73
265	ID136 MH 19 TO MH 18	301.00	12	0.98	11.78	Circular	0.76	0.010	1709.73	1708.56
267	ID136 MH 18 TO MH 17	241.00	12	0.98	11.78	Circular	0.76	0.010	1708.56	1706.85
268	ID136 MH 17 TO MH 16	249.00	12	0.98	11.78	Circular	0.76	0.010	1706.85	1704.90
270	ID136 MH 11A TO MH 11	91.00	12	0.98	11.78	Circular	0.76	0.010	1698.92	1697.98
272	ID136 MH 21 TO MH 20	150.00	12	0.98	11.78	Circular	0.76	0.010	1711.08	1711.02

APPENDIX C

SWMM MODEL NODE INPUT DATA

SWMM MODEL NODE INPUT DATA

SWMM Node Name	Node/Manhole Lid Elevation (feet)	Node/Manhole Invert Elevation (feet)
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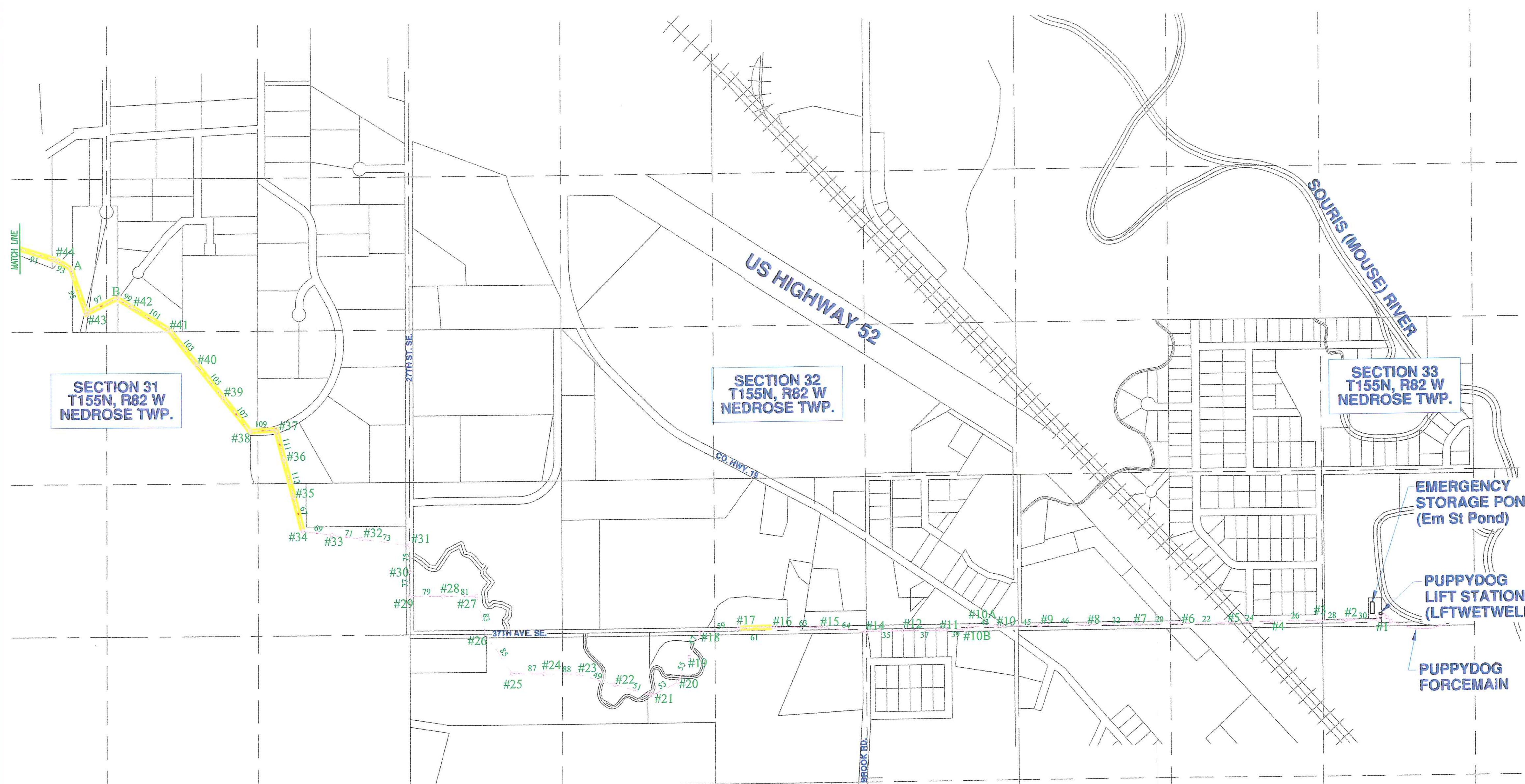
#7	1555.49	1540.27
#6	1552.27	1538.78
#5	1549.56	1537.48
#4	1544.19	1535.63
#3	1547.56	1534.09
#2	1542.79	1532.75
#1	1542.82	1530.76
#8	1557.44	1541.93
#14	1561.37	1550.07
#12	1558.52	1548.67
#11	1557.98	1547.59
#10B	1554.82	1546.68
#10A	1562.93	1546.24
#10	1561.13	1545.75
#9	1555.02	1544.06
#23	1574.41	1562.56
#22	1574.89	1561.19
#21	1571.47	1559.62
#20	1571.21	1558.36
#19	1569.50	1557.53
#18	1566.81	1556.18
#17	1572.83	1554.03
#16	1574.14	1552.12
#15	1569.86	1552.12
#35	1593.83	1583.37
#34	1593.16	1580.73
#33	1588.37	1578.63
#32	1588.07	1576.83
#31	1582.97	1573.79
#30	1585.00	1572.80
#29	1585.50	1571.83
#28	1583.30	1570.44
#27	1583.56	1569.17
#26	1578.28	1567.33
#25	1576.81	1565.10
#24	1576.67	1563.93
#45	1618.23	1609.57
#44	1615.66	1606.66
A	1615.92	1605.47
#43	1611.85	1603.96
B	1611.07	1602.84
#42	1612.16	1601.93
#41	1608.04	1599.29
#40	1603.96	1596.44
#39	1601.54	1593.34
#38	1597.46	1590.29

SWMM Node Name	Node/Manhole Lid Elevation (feet)	Node/Manhole Invert Elevation (feet)
#37	1597.99	1588.32
#36	1593.99	1586.10
#61	1665.70	1649.10
#60	1658.64	1648.02
#59	1657.78	1645.70
#58	1657.48	1643.47
#57	1649.89	1642.04
#56	1651.15	1640.33
#55	1649.97	1638.63
#54	1643.17	1635.53
#53	1649.60	1632.72
#52	1638.49	1629.35
#51	1633.75	1625.70
#50	1630.93	1621.98
#49	1627.04	1619.46
#48	1624.59	1617.09
#47	1622.71	1614.93
#46	1620.85	1612.63
#70	1723.34	1712.32
#69	1719.85	1711.70
#68	1722.19	1710.98
#67	1726.72	1710.36
#66	1731.32	1708.43
#65	1724.05	1707.60
#64	1712.94	1701.80
#63	1703.68	1692.50
C	1711.26	1690.93
#62	1703.34	1689.27
MAIN&18TH	1737.66	1722.56
#81	1732.86	1719.43
#80	1728.43	1718.76
#79	1728.07	1717.66
#78	1726.49	1716.67
#77	1725.24	1716.50
LFTWETWELL	1546.00	1522.00
fmstarts	1546.80	1537.00
EmStPond	1542.00	1533.00
aer.ponds	1672.00	1655.00
ID136 MH16	1724.80	1704.90
ID136 MH15	1721.79	1703.02
ID136 MH14	1718.41	1701.93
ID136 MH13	1717.92	1699.92
ID136 MH12	1712.20	1699.72
ID136 MH11	1712.08	1697.98
ID136 MH10	1712.95	1697.43
ID136 MH9	1714.14	1696.69
ID 136 MH8	1712.68	1695.56
ID136 MH7	1713.48	1695.68
ID136 MH6	1705.60	1685.17

SWMM Node Name	Node/Manhole Lid Elevation (feet)	Node/Manhole Invert Elevation (feet)
ID136 MH5	1675.24	1665.69
ID136 MH4	1673.76	1662.79
ID136 MH3	1666.43	1658.93
ID136 MH2	1663.61	1654.53
ID136 MH1	1671.98	1653.61
ID136 MH37	1747.55	1724.30
ID136 MH36	1741.19	1723.60
ID136 MH35	1744.50	1722.79
ID136 MH34	1740.91	1722.21
ID136 MH33	1737.06	1722.26
ID136 MH32	1734.46	1722.20
ID136 MH31	1735.36	1721.43
ID136 MH30	1735.13	1720.66
ID136 MH29	1735.75	1719.96
ID136 MH28	1735.10	1719.34
ID136 MH27	1732.68	1718.48
ID136 MH26	1736.50	1718.30
ID136 MH25	1735.36	1714.86
ID136 MH24	1722.45	1713.21
ID136 MH23	1722.84	1712.56
ID136 MH22	1717.63	1711.93
ID136 MH20	1723.12	1711.02
ID136 MH19	1728.20	1709.73
ID136 MH18	1731.93	1708.56
ID136 MH17	1728.87	1706.85
ID136MH11A	1712.15	1698.32
ID136 MH21	1724.10	1711.08

APPENDIX E

PIPES SURCHARGED DURING CONSTANT 2.7 MGD FLOW



LEGEND

MODEL MANHOLE/ NODE NAME #50

MODEL PIPE NUMBER 141

SURCHARGED PIPE 141

APPENDIX E

PIPES SURCHARGED DURING CONSTANT 2.7 MGD FLOW

PUPPYDOG COULEE WASTEWATER SYSTEM EVALUATION
MINOT, NORTH DAKOTA

Scale	Drawn by	Checked by	Project No.	Date	Sheet
AS SHOWN	NZS	ESJ	4054.010	9-24-01	2 of 2

PREPARED BY

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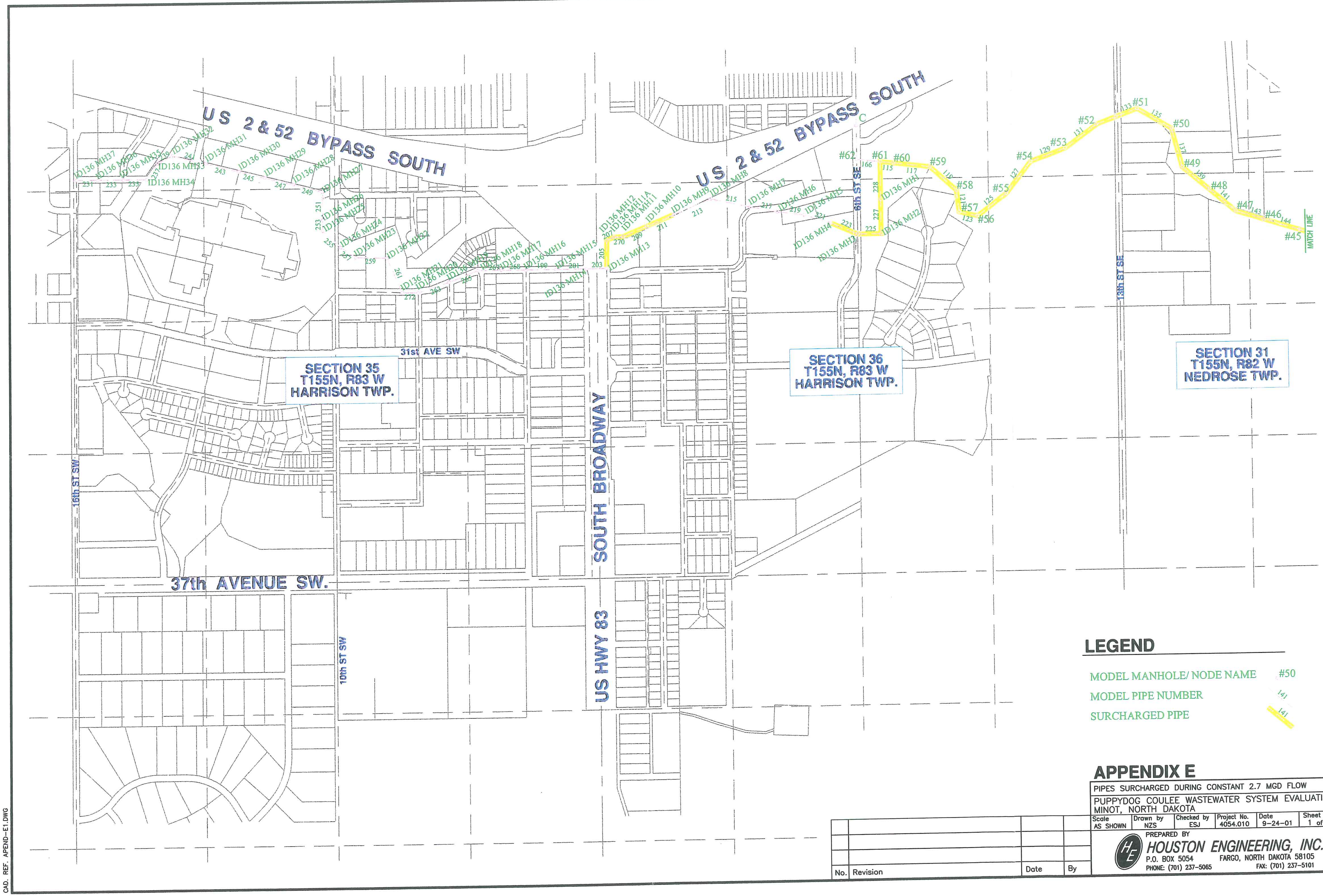
No.	Revision	Date	By

CAD. REF. APEND-E2.DWG



APPENDIX E

PIPES SURCHARGED DURING CONSTANT 2.7 MGD FLOW

PUPPYDOG COULEE WASTEWATER SYSTEM EVALUATION
MINOT, NORTH DAKOTA

Scale	Drawn by	Checked by	Project No.	Date	Sheet
AS SHOWN	NZS	ESJ	4054.010	9-24-01	1 of 2

No.	Revision	Date	By

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APPENDIX F

ADVERSELY SLOPED PIPES

APPENDIX F

ADVERSELY SLOPED PIPE

PUPPYDOG COULEE WASTEWATER SYSTEM EVALUATION
MINOT, NORTH DAKOTA

Scale	Drawn by	Checked by	Project No.	Date	Sheet
AS SHOWN	NZS	ESJ	4054.010	9-24-01	1 of 2

PREPARED BY
HOUSTON ENGINEERING, INC.
P.O. BOX 5054
FARGO, NORTH DAKOTA 58105
PHONE: (701) 237-5065
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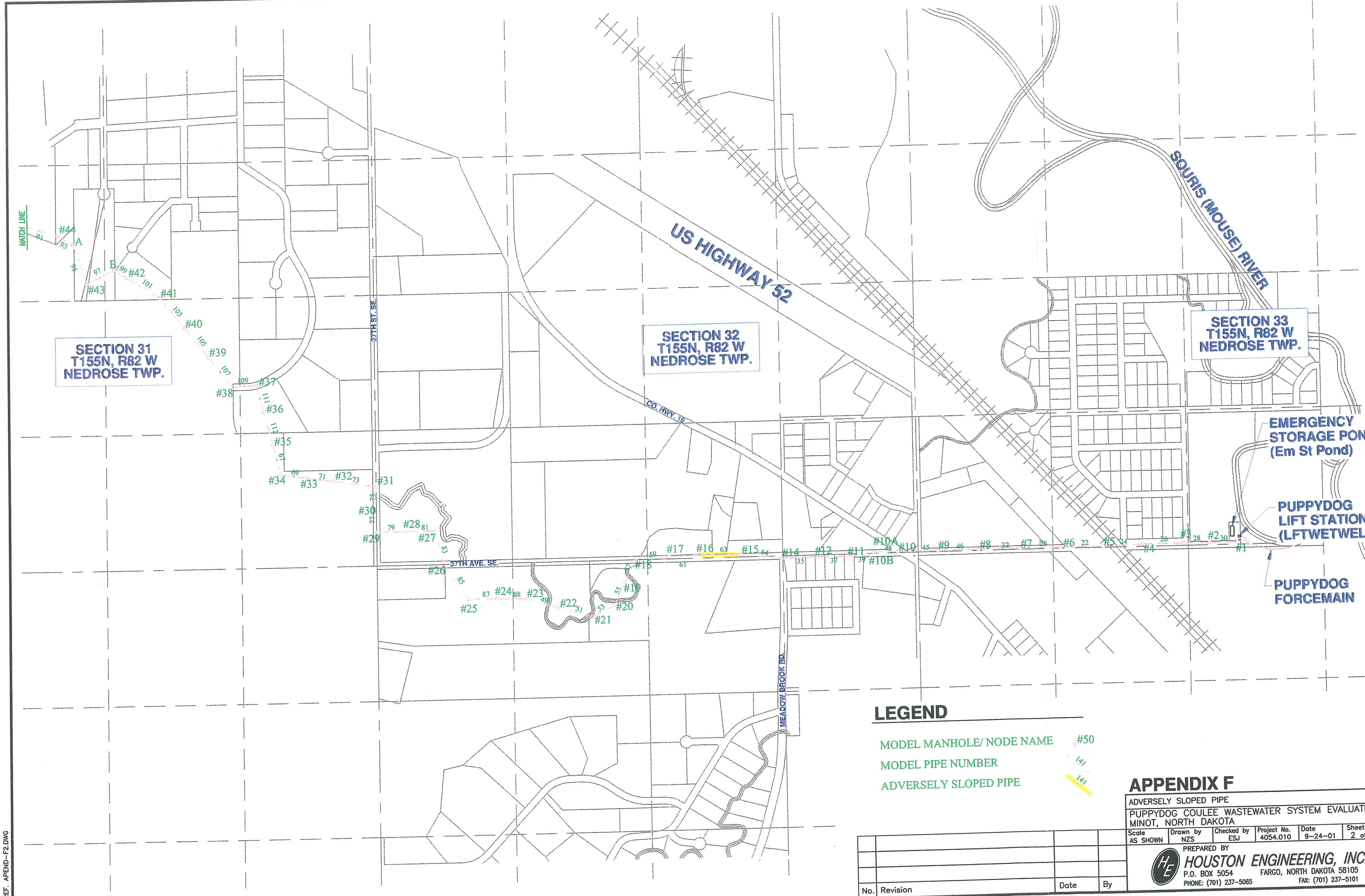
No.	Revision	Date	By

CAD. REF. APEND-F1.DWG



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ADVERSELY SLOPED PIPE

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MINOT, NORTH DAKOTA

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AS SHOWN	NZS	ESJ	4054.010	9-24-01	2 of 2

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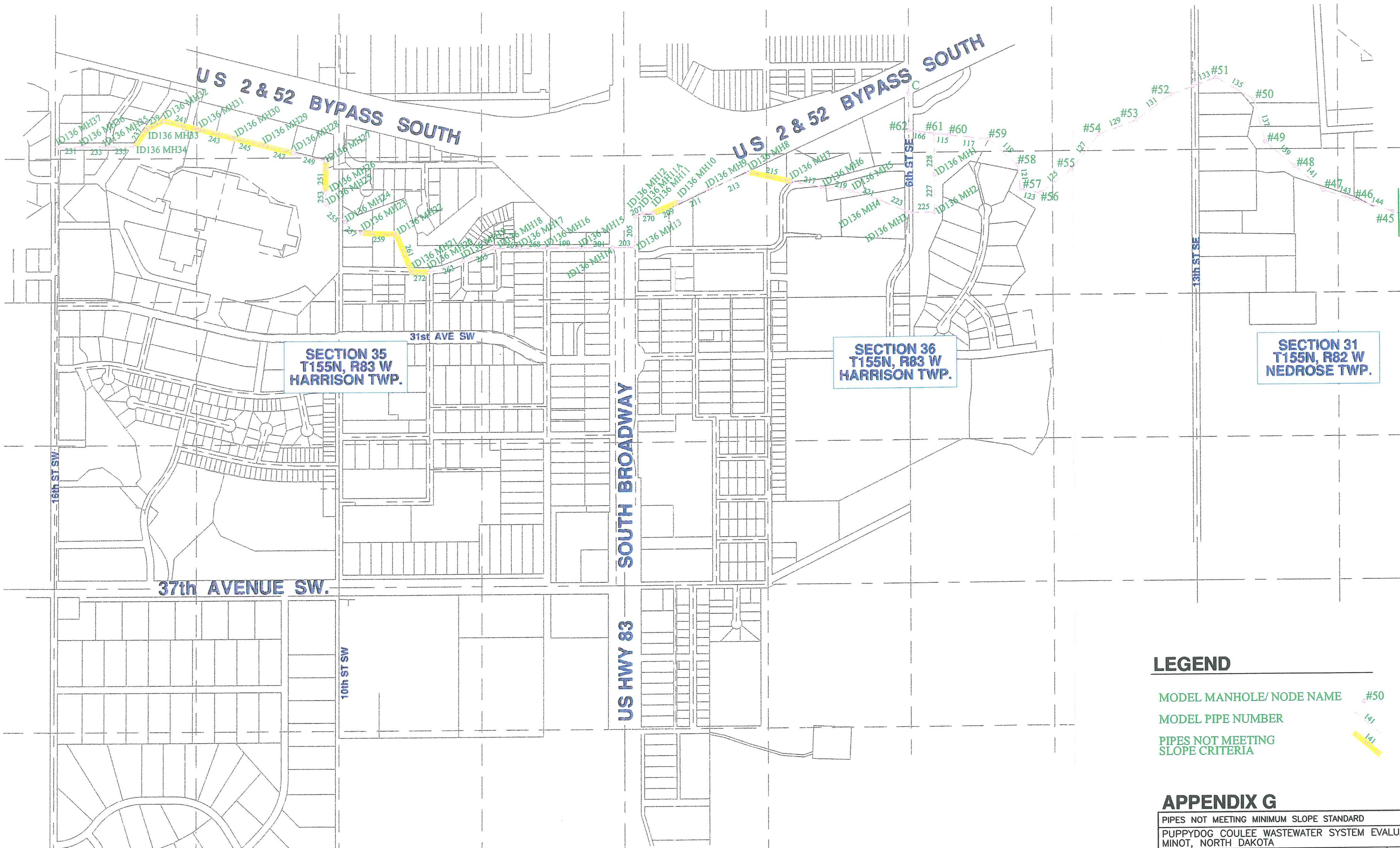
CAD. REF. APEND-F2.DWG

APPENDIX G

PIPES NOT MEETING MINIMUM SLOPE STANDARD



LEGEND

MODEL MANHOLE/ NODE NAME #50

MODEL PIPE NUMBER 141

PIPES NOT MEETING SLOPE CRITERIA 141

APPENDIX G

PIPES NOT MEETING MINIMUM SLOPE STANDARD

PUPPYDOG COULEE WASTEWATER SYSTEM EVALUATION
MINOT, NORTH DAKOTA

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AS SHOWN	NZS	ESJ	4054.010	9-24-01	1 of 2

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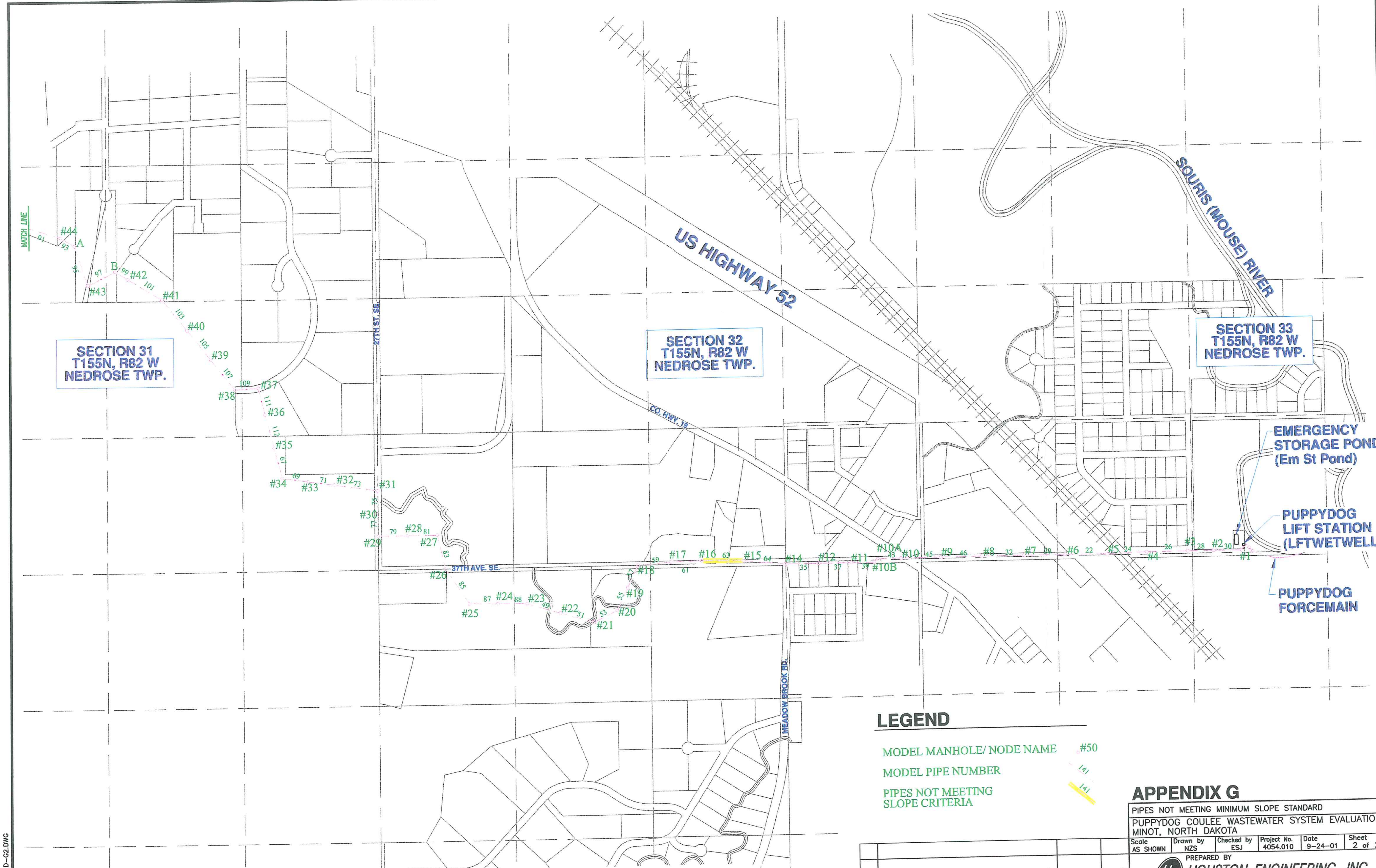

LEGEND

MODEL MANHOLE/ NODE NAME #50

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PIPES NOT MEETING MINIMUM SLOPE STANDARD

PUPPYDOG COULEE WASTEWATER SYSTEM EVALUATION
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