Voyageurs development potential and absorption study.

Landmark Research, Inc.
[s.l.]: [s.n.], [s.d.]

VOYAGEURS DEVELOPMENT POTENTIAL AND ABSORPTION STUDY

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February 29, 1980

Mr. Philip Zeidner
Lands Division
Department of Justice
P.O. Box 7415
Benjamin Franklin Station
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James A. Graaskamp, Ph.D., SREA, CRE
Tim Warner, MS, MAI, SRPA
Jean B. Davis, MS

Landmark Research Inc.

Dear Mr. Zeidner:

With this letter we are transmitting our study relative to development potential, past activity, and characteristics of properties that are most value related in the Voyageurs Area.

We regret that this is not as highly polished a final work as is our custom to deliver, but delays in obtaining several important informational items impeded report production.

Your attention is called briefly to two items which may speed your conceptualization of the report matter. Exhibit 4 is a graphic display of seasonal building permits in St. Louis County for the years 1970 to 1979. Exhibit 14 is a stylized pro forma analysis of a seasonal land development prepared in accordance with methodology recommended by The American Institute of Real Estate Appraisers as reproduced in the report. The resulting value of raw land was 37 percent of the finished lot selling price.

All of us at Landmark Research, Inc., have appreciated the opportunity to be of service and remain available to you for clarification and discussion of this report.

Sincerely,

James A Graaskamp

James A. Graaskamp, Ph.D., CRE, SREA

Tim Warner

Tim Warner, MS, MAI, SRPA

Yvonne M Schell

Yvonne M. Schell

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16. Educational Memorandum Number One, The American Institute of Real Estate Appraisers - Subdivision Analysis

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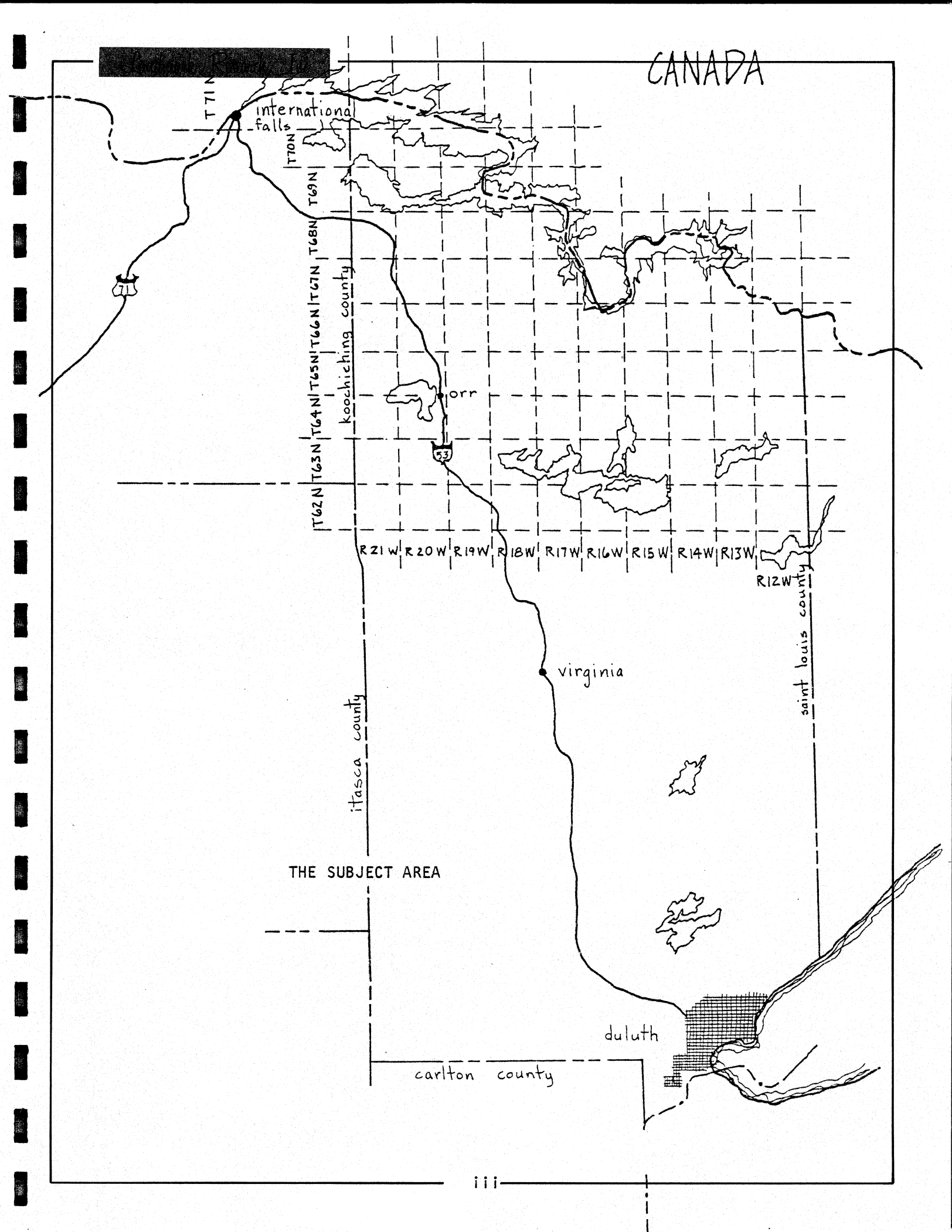
18. Results of the Multivariate Analysis for Relationships

19. Variable Coding Legend


CANADA
international falls
T71N
T70N
T69N
T68N
T67N
T66N
T65N
T64N
T63N
T62N
R21W
R20W
R19W
R18W
R17W
R16W
R15W
R14W
R13W
R12W
koochiching county
orr
53
virginia
itasca county
saint louis county
THE SUBJECT AREA
duluth
carlton county

SUMMARY

The purpose of this study is to investigate current and past land development enterprises for their costs, market acceptance, and time factors, and to establish the perceptions of those associated with the real estate market or the development process and to analyze sales of comparable lands to determine those attributes of the property which most closely correlate to its value.

The major limiting factor in the scope of the assignment has been the report deadline date of March 1, 1980. After our verbal acceptance of late January, 1980, we instituted a campaign to obtain, catalog, categorize, and analyze information relative to comparable land transactions and to determine the characteristics of the land and water environments comprising the park and similar peripheral areas and to conduct a number of private interviews. The study area covered in this report encompasses all of St. Louis County, from the 62 TNSP north to the border and that area in Koochiching County east of R24W. This area was chosen because of its proximity to the Voyageur's National Park and because of its similar geologic characteristics. The geology, water, and forest along with its general privacy and remoteness are the real and perceived draws of this area.

Land development enterprises within the area can be grouped into three general categories: A would be entrepreneur who uses the land he has owned for some time. A resort owner who is seeking to sell off his cabins and their underlying land as well as newly created vacant lots. A minority of local land developers who have created two or more subdivisions.

None of the subdivisions that we have studied with plats dating back to 1969 have been entirely sold out. Individual lot absorption in the area is very slow, with total average near one and a half lots per year.

Effective demand for lots falls off the further the property is from a major population center as there is a definite trade off in the mind of probable

purchasers between convenience of location and privacy or seclusion that is a function of remoteness.

The soil types in the area are particularly inhospitable to development with 17 of the 20 soil types described in the Soil Survey Interpretations for the Voyageur's Corridor Area, prepared in November of 1974, imposing severe limitations to both construction of septic tank filter fields and to dwellings with or without basements.

Financing for development of a subdivision is particularly difficult to obtain due to the lack of thrift institutions within the area and reluctance of institutions in the major money centers to finance ventures in remote areas.

The average time to obtain final plat approval varies. For resorts with cabins or where variances need to be obtained, it may take two years. Vacant acreage averages one year. This is further complicated by title clouds that have affected the timely issuance of title policies for a number of proposed subdivisions.

In analyzing 442 sales of similar lands, the property characteristics most strongly associated with sales price were in order of strenth of correlation, lineal feet of water frontage, type of road access, the specific lake the property in located on and the total size of the property. Although not a property characteristic, the time of sale was strongly associated with sale price.

A stylized pro forma analysis of a seasonal land development prepared in accordance with methods recommended by the American Institute of Real Estate Appraisers showed the value of raw land to be thirty-seven percent of the sales price of a finished lot.

DEVELOPMENT POTENTIAL

History of Lakeshore Development

When examining development possibilities of any given area, it is necessary not only to examine current development activity in that area but also to explore historical development activity and to examine the various characteristics attributable to the success or failure of those projects. The historical development climate of St. Louis County can be observed by referring to Exhibits 1, 2, and 3.

Exhibit 1 indicates townships in which seasonal residences in St. Louis County are located. Outside of established townships such as Greenwood, Beatty and Breitung (all located in the vicinity of Vermillion Lake), the lakeshores of Vermillion (TN62-R17 and TN63-R17), Crane (TN67-R17) and Kabetogama (TN69-R21) accommodate the bulk of the recreational dwellings. A smaller but significant number of homes are also found in TN63-R15 (Vermillion and Trout Lakes), TN68-R19 (Gannon and Amundsen Lakes) and TN66-R20 (Ash and Black Duck Lakes).

Exhibit 2 lists all the lakeshore subdivisions, platted and proposed, that have been filed in St. Louis and Koochiching Counties within the last ten years. The following three items of significance can be noted from this chart:

1. The number of subdivisions platted or proposed that lie north of the 63 TNSP is only 30 percent of the total.
2. Thirteen subdivisions or 43 percent of the total platted or proposed subdivisions lie on Lake Vermillion.
3. 26 subdivisions or 89 percent of the total have access by road.*

Exhibits 3&4 indicate building permits which have been issued throughout St. Louis County in the past ten years. Again, the bulk of the development activity has taken place in the southern townships, with 74 percent lying south of TNSP 64 and 84 percent lying south of TNSP 65. Development activity has varied greatly

*Two of the four subdivisions that are accessed by water only are less than two miles from public access points.

investigate further

EXHIBIT 1

TOTAL CLASSIFIED SEASONAL RESIDENCES IN ST. LOUIS COUNTY BY TOWNSHIP

TNSP	12			13			14			15			16			17			18			19			20			21		
	77	78	79	77	78	79	77	78	79	77	78	79	77	78	79	77	78	79	77	78	79	77	78	79	77	78	79	77	78	79
62	-	M	-	-	M	-	-	B	-	-	B	-	684	-G-		179	85	86												
63	-	M	-	-	M	-	7	8	8	36	35	35	66	-G-		222	213	214	-	BT	-									
64	7	5	5	29	29	31	0	0	0	0	0	0	0	0	0	11	12	12	-	BT	-		L	-		L	-			
65	0	0	0	3	3	2	0	0	0	0	0	0	0	0	0		P	-		P	-		L	-		L	-	2	2	2
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		P	-		P	-		P	-	45	47	47	2	2	2
67							0	0	0				2	3	3	106	106	100	4	5	5	2	3	3	1	1	1	5	6	6
68							0	0	0							44	19	13	13	13	13	47	45	47	4	4	5	10	10	10
69																12	10	10	6	5	4	44	27	21	23	15	5	130	92	92
70																						2	2	1	13	13	11	7	4	3
71																												27	12	9

Key	Township Name	1977	1978	1979
M	= Morris	351	357	356
B	= Breitung	399	418	410
G	= Greenwood		823	843
P	= Portage	130	130	133
BT	= Beatty	426	414	412
L	= Leiding	154	156	154
Total without named TNSP's		1795	836	806
Total with named TNSP's		3255	3134	3114*

*Decrease indicates trend of converting seasonal residences to permanent residences.

– 62TNSP, N.

LAKESHORE SUBDIVISIONS PLATTED IN ST. LOUIS AND KOOCHICHING COUNTIES FROM 1969 TO PRESENT[1]

	Subdivision Name	Location	Legal Description TN-RG-SEC	Date Plat Filed
St. Louis County				
1	Ring Rock	White Iron Lake	62-12-12	10/77
2	One Pine Estates	One Pine Lake	62-12-28,33	1/73
3	Chippewa Shores	White Iron Lake	62-12-12	5/76
4	Bulinski's Point	Shagawa Lake	63-12-29	9/77
5	Everett Lake	Everett Lake	64-12-16	6/78
6	Bevis Kenney Burntside Lots	Burntside Lake	63-13-24	5/75
7	Wildgate	Armstrong Lake	62-14-13	3/78
8	Three Deer Haven	Clear Lake	62-14-13	2/70
9	Aga Ming	Vermillion Lake	62-15-30	1/70
10	Pine Narrows	Pine Island (N. Vermillion)	63-15-33	11/69
11	Onamen Beach	Vermillion Lake	62-16-?	Late 79
12	Daisy Green Acres	Vermillion Lake	62-16-9	6/78
13	Squires Roost	Vermillion Lake	62-16-23	12/68
14	Tibbets Addn. to Wolf Bay Shores	Vermillion Lake	63-17-12	12/77
15	Robergs Acres	Wolf Bay/VermillionLake	63-17-11	6/77
16	Lu Claire Narrows	Lake Vermillion	63-17-35	1/76
17	Sime-~~Simi~~ Shores *	Niles Bay/Vermillion Lake	63-17-21	2/71
18	Wolf Bay Shores*	Vermillion Lake	63-17-11,12	4/71
19	Handberg's Addition	Crane Lake	67-17-5	12/75
20	Ev Lor Island*	Sandpoint Lake	68-17-14	4/71
21	Mitawanga	Sandpoint Lake	68-17-1	7/67
22	Mannikko (Pine Ridge)	Black Bay/Vermillion Lake	63-18-10	8/73
23	Kennedy Home Sites	Elbow Lake	64-18-27	Unknown
24	Pelican Lots	Pelican Lake	64-20-7	12/71
25	Krambeck's Ash Lake Addition	Ash Lake	66-20-9	12/69
26	Diamond Island*	Rainy Lake	71-21-22	9/70
~~264~~ Proposed	Chg A Big - 1st	Shagawa	63-12-21	4/78
27 & 28	Ely Island* (2 Proposed)	Vermillion Lake	62-15-16	
29	Northern Lights	Kabetogama	69-21	
Koochiching County				
30	Gold Shores Second Addition	Rainy Lake	71-22-31	3/76

what happened to #?

Number of Subdivisions (Platted and Proposed) above 63 TNSP = 9 30%
Number of Subdivisions (Platted and Proposed) on Vermillion Lake = 13 43%

*Water Access Only

[1]No division between Permanent and Seasonal Developments

EXHIBIT 2

EXHIBIT 3

BUILDING PERMITS ISSUED FOR SEASONAL DWELLINGS
ST. LOUIS COUNTY (1970-1979)

TNSP	Rg.	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Total	% of Total	Location
62	12	2	2	0	2	4	3	8	3	3	2	29		One Pine Lake/White Iron Lake
	13	0	0	0	4	3	3	1	1	1	0	13		Twin Lakes
	14	0	1	0	6	4	3	2	0	3	4	23		Eagles Nest Lake
	15	6	8	0	10	9	5	6	9	5	21	79		S. Shore Vermillion Lake
	16	0	1	1	10	12	10	10	11	9	13	77		S. Shore Vermillion Lake
	17	3	5	0	4	5	7	0	4	6	4	38		S. Shore Vermillion Lake
	18	0	0	0	0	0	0	0	0	0	0	0		
	19	0	0	0	0	0	1	1	0	2	1	5		
	20	0	0	0	1	1	0	0	0	0	1	3		
	21	0	0	0	1	2	1	4	0	0	2	10		Sturgeon River
Subtotal												277	44%	
63	12	2	2	0	1	5	8	2	6	9	2	37		Shagawa Lake (Ely)
	13	1	0	0	4	3	4	2	3	1	3	21		Burntside Lake
	14	0	0	0	1	1	0	1	0	0	1	4		
	15	0	0	0	1	2	0	1	3	3	5	15		Trout and Pine Lakes
	16	6	5	0	2	1	10	3	2	3	1	33		N. Vermillion Bay and Trout Lake
	17	3	8	0	1	7	10	9	0	0	0	38		Niles Bay and Vermillion Lake
	18	5	5	0	0	8	1	2	2	0	1	24		N.W. Vermillion Lake
	19	1	0	0	2	1	0	1	2	0	0	7		
	20	0	0	0	2	1	0	0	1	1	0	5		
	21	0	0	0	1	0	2	1	0	0	0	4		
Subtotal												188	30%	
64	12	0	0	0	1	0	0	0	0	2	2	5		
	13	2	1	0	1	3	2	0	2	0	0	11		
	14	0	0	0	0	0	0	0	0	0	0	0		
	15	0	0	0	0	0	0	0	0	0	0	0		
	16	0	0	0	0	0	0	0	0	0	0	0		
	17	0	0	0	0	0	0	0	1	1	1	3		
	18	0	8	0	4	3	0	2	0	4	4	25		Elbow Lake
	19	0	0	0	0	0	0	0	0	1	1	2		
	20	2	1	0	2	1	1	3	1	0	3	14		S. Shore Pelican Lake
	21	0	0	0	0	0	0	0	1	0	0	1		
Subtotal												61	10%	

EXHIBIT 3 (Continued)

BUILDING PERMITS ISSUED FOR SEASONAL DWELLINGS
ST. LOUIS COUNTY

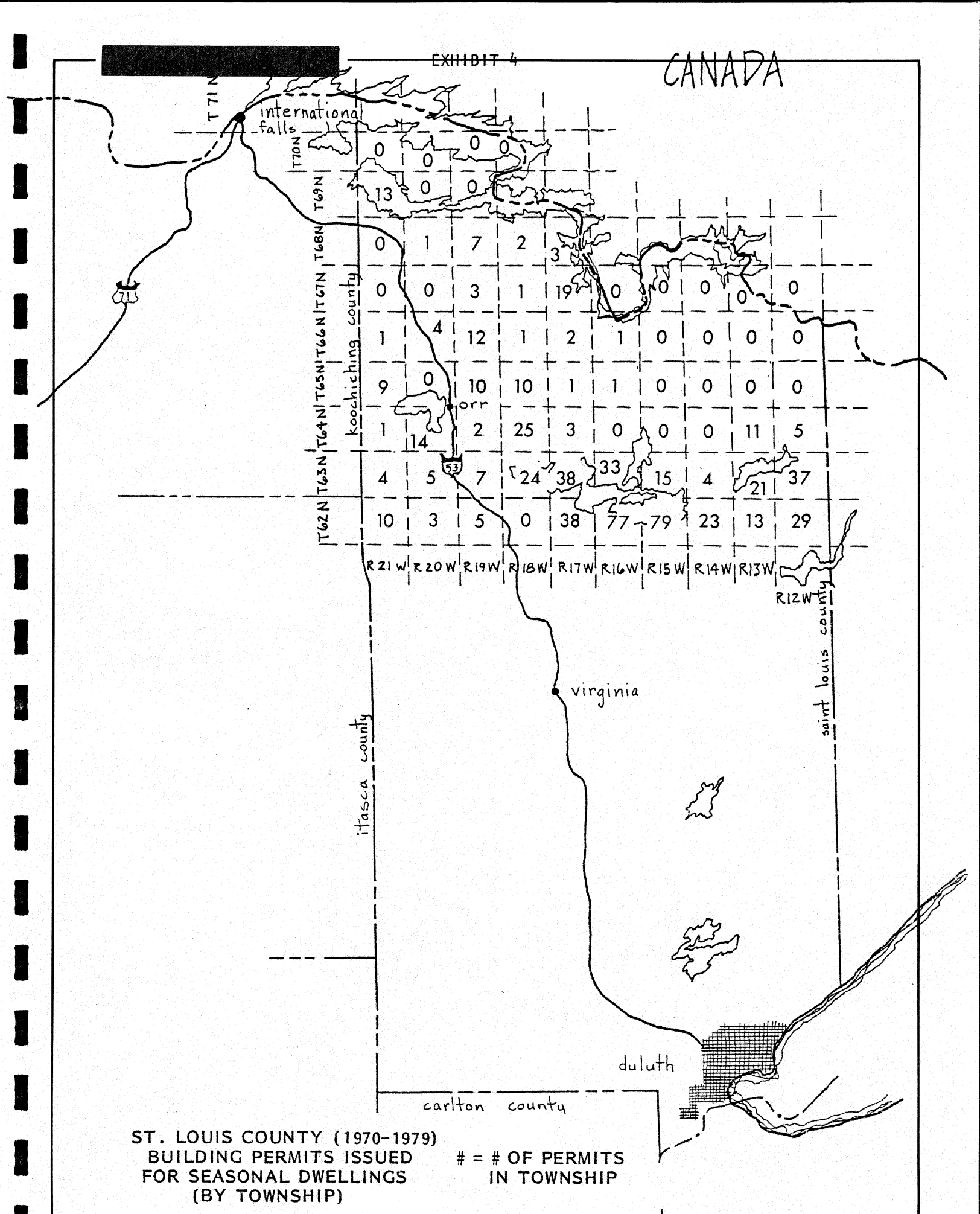
TNSP	Rg.	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Total	% of Total	Location
65	12	0	0	0	0	0	0	0	0	0	0	0		
	13	0	0	0	0	0	0	0	0	0	0	0		
	14	0	0	0	0	0	0	0	0	0	0	0		
	15	0	0	0	0	0	0	0	0	0	0	0		
	16	0	0	0	0	0	0	0	0	1	0	1		
	17	0	0	0	1	1	4	1	3	0	0	1		
	18	0	1	0	1	0	0	2	0	4	2	10		Vermillion River
	19	0	0	0	0	0	0	0	0	0	0	10		Myrtle & Kjostad Lake
	20	0	1	0	0	1	2	3	1	0	1	0		
	21	0	0	0	0	0	0	0	0	0	0	9		N. Shore Pelican
Subtotal												31	5%	
66	12	0	0	0	0	0	0	0	0	0	0	0		
	13	0	0	0	0	0	0	0	0	0	0	0		
	14	0	0	0	0	0	0	0	0	0	0	0		
	15	0	0	0	0	0	0	0	0	0	0	0		
	16	0	0	0	1	0	0	0	0	0	0	1		
	17	0	0	0	0	1	0	0	0	0	1	2		
	18	0	0	0	1	0	0	0	0	0	0	1		
	19	2	3	0	2	0	1	1	1	1	1	12		Black Duck Lake & Elephant Lake
	20	0	3	0	0	0	0	0	1	0	0	4		
	21	0	0	0	1	0	0	0	0	0	0	1		
Subtotal												21	3%	
67	12	0	0	0	0	0	0	0	0	0	0	0		
	13	0	0	0	0	0	0	0	0	0	0	0		
	14	0	0	0	0	0	0	0	0	0	0	0		
	15	0	0	0	0	0	0	0	0	0	0	0		
	16	0	0	0	0	0	0	0	0	0	0	0		
	17	1	7	0	1	1	0	2	1	5	3	19		Crane Lake
	18	0	0	0	0	0	0	1	0	0	0	1		
	19	1	0	0	0	0	0	1	0	0	1	3		
	20	0	0	0	0	0	0	0	0	0	0	0		
	21	0	0	0	0	0	0	0	0	0	0	0		
Subtotal												23	4%	

EXHIBIT 3 (Continued)

BUILDING PERMITS FOR SEASONAL DWELLINGS
ST. LOUIS COUNTY

TNSP	Rg.	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Total	% of Total	Location
68	12	0	0	0	0	0	0	0	0	0	0	0		
	13	0	0	0	0	0	0	0	0	0	0	0		
	14	0	0	0	0	0	0	0	0	0	0	0		
	15	0	0	0	0	0	0	0	0	0	0	0		
	16	0	0	0	0	0	0	0	0	0	0	0		
	17	0	0	0	0	1	0	0	0	2	0	3		
	18	0	0	0	0	0	1	0	1	0	0	2		
	19	0	0	0	1	1	2	0	1	1	1	7		
	20	0	0	0	0	0	0	0	0	0	1	1		
	21	0	0	0	0	0	0	0	0	0	0	0		
Subtotal												13	2%	
69	12	0	0	0	0	0	0	0	0	0	0	0		
	13	0	0	0	0	0	0	0	0	0	0	0		
	14	0	0	0	0	0	0	0	0	0	0	0		
	15	0	0	0	0	0	0	0	0	0	0	0		
	16	0	0	0	0	0	0	0	0	0	0	0		
	17	0	0	0	0	0	0	0	0	0	0	0		
	18	0	0	0	0	0	0	0	0	0	0	0		
	19	0	0	0	0	0	0	0	0	0	0	0		
	20	0	0	0	0	0	0	0	0	0	0	0		
	21	0	0	0	7	1	1	0	0	0	4	13		So. Shore Kabetogama Lake
Subtotal												13	2%	
70	12	0	0	0	0	0	0	0	0	0	0	0		
	13	0	0	0	0	0	0	0	0	0	0	0		
	14	0	0	0	0	0	0	0	0	0	0	0		
	15	0	0	0	0	0	0	0	0	0	0	0		
	16	0	0	0	0	0	0	0	0	0	0	0		
	17	0	0	0	0	0	0	0	0	0	0	0		
	18	0	0	0	0	0	0	0	0	0	0	0		
	19	0	0	0	0	0	0	0	0	0	0	0		
	20	0	0	0	0	0	0	0	0	0	0	0		
	21	0	0	0	0	0	0	0	0	0	0	0		
Subtotal												0		
TOTAL		37	62	1	77	83	83	70	58	68	87	626		

EXHIBIT 4



ST. LOUIS COUNTY (1970-1979)
BUILDING PERMITS ISSUED
FOR SEASONAL DWELLINGS
(BY TOWNSHIP)

= # OF PERMITS
IN TOWNSHIP

from year to year and no relevant trend has been discerned. There has been no noticeable shift in area activity which indicates that demand levels for each township has not changed substantially with respect to each other during this time period.

Significant Site Characteristics

The data in the aforementioned exhibits indicates that people tend to buy lots or build around the more populated areas in the southern townships (62 and 63) and activity drops in the more remote areas to the north. The most desired area is the southern shore of Lake Vermillion where local realtors attest to an insatiable demand for lakefront lots. Although Lake Vermillion lots tend to be the most desired of the lake lots in that area, demand for lots on other major lakes must be scrutinized more carefully. Historical demand alone cannot be used to determine current levels of demand on these lakes. Much less activity has taken place on Kabetogama Lake and Crane Lake, but this is also due to a diminished supply of land available for sale. The perception of local realtors and appraisers is that the level of demand relative to supply is as high in these areas as on Lake Vermillion. The three lakes have these attributes in common:

1. Existence of resorts, boating facilities and thereby good access to the lake
2. Nearby population centers
3. Privacy and recreational flexibilitly provided by a large lake or chain lake
4. The aesthetics of a deep lake with wooded shoreline.

These four attributes were listed as being important determinates of demand and value by all realtors, appraisers, and developers interviewed.

This is also supported by Exhibit 1 which indicates these three areas as having the most significant number of seasonal dwelling units.

Geology and Soil Type Influences

The general area of this study is located in the southern portion of the Canadian shield, a peneplain of Precambrian rocks that form the underlayment of the North American continent and represent some of the oldest rock formations in the world.

Minnesota's Rocks and Waters* states, "The northeastern part of Minnesota is probably as complex geologically as any area in the world. It is underlain exclusively by Precambrian rocks beneath glacial deposits of several invasions. This sequence of Precambrian rocks (shown on p. 101), from the oldest Ely Greenstone up to the later Keweenawan sedimentary rocks, is one of the most complete found anywhere in the world. The detailed geology of this area is unusally well known because the presence of great iron ore deposits in the Mesabi and Vermilion districts has stimulated much geological work in the region. Then, too, outcrops of the underlying bedrock are much more numerous in northeastern Minnesota than over most of the state, and consequently the basic structure of the region is more easily observed."

The forces of glaciation and sedimentation determine the present character of soils in the area with rocky shallow soils on the uplands and deeper organic soils on the lowlands. The soils within the Voyageur's corridor area are generally inhospitable to possible development. 17 of the 20 soil types provide severe limitations to the construction of dwellings with or without basements and to the construction of septic tank filter fields. The soil typings within the Voyageur's National Park as reproduced from the draft environmental statement of September 1978 differentiates between only two basic soil types. This survey was generally done on the basis of an older and much more general classification.

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*Schwartz & Thiel, Minnesota's Rocks and Waters (University of Minnesota Press), 6th Edition, p. 191.

The 1974 Voyageur's Corridor Area Study was a much more detailed sampling and reporting of soils. This map, however, generally follows the major road corridors with only approximately seven of the sheets providing mapping coverage of the south shores of Lake Kabetogama. Within this area of the south shore of Kabetogama, the dominant series type is the Quetico #560. This is a very well drained soil formed by 4-8 inches of dark and strongly acid loam over the bedrock. It is generally broken, irregular and hilly. It imposes severe limitations to almost any use or suitability. The limitations ratings are slight, moderate, severe, and very severe. Slight soil limitation is a rating given by soil scientists to soils that have properties favorable for the use considered and rated. This degree of limitation is rather minor and can be overcome easily. Moderate soil limitation is a rating given to soils that have properties somewhat at variance of the rated use. This degree of limitation can be overcome or modified by special planning, design, or maintenance. Modification may include special foundations, extra reinforcement of a structure or installation of sump pumps because in part of the year the performance of the structure or some other planned use would be somewhat less than desired. A severe soil limitation is the rating given the soils that have one or more properties unfavorable to the rated use such as steep slopes, bedrock near the surface, a flooding hazard, high shrink-swell potential, a seasonal high water table or low bearing strength. To be utilizable, this degree of limitation generally requires major soil reclamation, special design, or intensive maintenance. Some of the soil, however, can be improved by reducing or removing the soil feature that limits use, but in most situtations this is very difficult and costly. A very severe rating is confined to soils that require extreme alteration for the most part and are not used for the purposes being rated.

Exhibit 5 is a reproduction of the soil interpretation sheets from the 1974 Voyageur's Corridor Area Study.

Historical Absorption Rates

While one forms a picture of an interminable demand by the public for lakeshore property when speaking with area persons working in the real estate profession, historical absorption rates of seasonal subdivisions seem to indicate a different level of demand. In reviewing Exhibit 6, note that the total average absorption rate experienced by the seasonal subdivisions studied is 1.4 lot sales per year. Onamen Beach, on the south shore of Lake Vermillion indicates a much higher absorption rate than the other subdivisions studied. However, because of the limited size of the subdivision, this figure should not be generalized as representative of demand in the area. It is also a better relative location. St. Louis County does not specify an official classification of subdivisions as to intended use, i.e., seasonal or permanent dwelling units. The classification of seasonal developments can only be assumed based on the location of the subdivisions and degree of improvement as listed on the city assessor's records. It is believed that seasonal use is the predominant use of lots in the subdivisions listed, but permanent residences are not precluded in any of these areas. Some of the subdivisions platted since 1969 that are located nearer to population centers are comprised of both seasonal and permanent residences. Absorption rates in these areas are somewhat higher than those seasonal subdivisions listed in Exhibit 4.

Factors and Trends Affecting Development

Real estate taxes charged per foot of water frontage increased threefold from 1965 to 1975[1] and have continued to increase. This along with general economic conditions have caused many seasonal residences to be converted to permanent residences and occurs in areas located nearer to population centers. This trend can be recognized in the decrease of total dwellings classified as seasonal residences in St. Louis County from 1977 through 1979. (See Exhibit 1). A decrease of 52 percent in the number of total seasonal residences was experienced from 1977 to 1979 in TN62-R17 which encompasses the south shore of Lake Vermillion.

[1] Minnesota Touris Travel, Fall 1977, Agricultural Extension Service, University of Minnesota.

LOT SALES OF SEASONAL RESIDENTIAL SUBDIVISIONS IN ST. LOUIS COUNTY FROM 1969 TO PRESENT

Subdivision Name	Location (TN-RG-SEC)	Date Plat Filed	Total No. of Lots	Total Acreage	Average Lot Size	Apsorption Rate First Sale	Apsorption Rate Last Sale	No. of Lots Unsold to Date	Percent of Total	Average Sold Per Year (Rate)
Everett Lake Shores	Everett Lake (64-12-16)	6/78	19	90.93	4.79	12/8/78	3/19/79	17	89%	1.3
Tibbetts Addition to Wolf Bay Shores	Wolf Bay (Vermillion) (63-17-12)	12/77	12	29.2	2.39	2/27/79	1 sale	11	92%	.5
Roberg's Acres (Very remote)	Dago Bay (Vermillion) (63-17-11)	6/77	5	20.2	4.04	6/30/78	1 sale	4	80%	.4
Simi Shores (Water Access Only)	Niles Bay (Vermillion) (63-17-21)	2/71	18	15.8	.88	8/5/71	3/19/75	2	11%	3.84*
Handberg's Addition	Crane Lake (67-17-5)	12/75	7	26.8	2.22	3/3/76	5/23/78	5 undesirable lowland $7500/piece	71%	.5
Ev Lor Island	Sand Point Lake (68-17-14)	4/71	26	48.1	1.85	6/8/77	Sold all to USA	Sold None from 4/71 to 6/77		
Mannikko (Pine Ridge)	N.W. Vermillion (63-18-10)	8/73	9	10.1	.9	1/20/73	9/26/79	2	22%	1.1
Diamond Island	Rainy Lake (71-21-22)	9/70	10	10.7	1.07	2/5/71	4/3/77	3	30%	.7
Kennedy Home Sites	Elbow Lake (64-18-27)	Not Available	20	21.6	1.08	11/20/67	9/14/70	2	10%	5.9*
Onamen Beach	S. Shore Verimillion (62-16-21)	Late 1979	5	25.8	5.16	1/11/80	4 Sold Same date	1	20%	3.0

Total average calculated by dividing lots sold over total marketing exposure of all lots

*Assumes marketing effort terminated on date of last sale

1.44 Total Average Lots Sold a Year

.52 Standard Deviation

EXHIBIT 6

In TN69-R21 which includes the south shore of Kabetogama Lake, there was a 29 percent decrease. Both these areas are located near a town. Although increased property taxes have disgruntled long-term owners of lake shore property, realtors and appraisers of lake shore property in the study area, particularly around Lake Vermillion, do not feel that this factor has significantly affected nor will it affect demand for lakeshore property in the near future.

Of much greater relevance in affecting demand for lakeshore properties appears to be the continually increasing price of gasoline and the economy in general. Realtors in all of the areas involved observed repercussions of varying degrees upon demand for land and on real estate sales volume of their offices. South shore Lake Vermillion properties were cited as the exception to this statement with local realtors attesting to the continually increasing appreciation with no plateauing for lakeshore properties. Given the size of Lake Vermillion, appreciation rates and demand vary greatly depending upon the specific location of the property on the lake. For instance, pressure by would be purchasers is substantially greater for lots near the Tower end of Lake Vermillion than for lots near the Cook end of the lake. A drop in demand has also been noted for the more remote north shore and northwest sector of the lake. Real estate professionals in both Ely and Crane Lake have noticed a stabilization of lakefront property prices and demand in their area in the past year.

The affects of the current energy shortage were felt by area businesses as well. All private firms interviewed by the Agricultural Extension Service, October, 1979 (Exhibit 7) indicated that they were hurt to some degree by the energy shortage. This would reflect most heavily on the remote areas and must be weighed against the statements of those we interviewed that in the Crane Lake and Kabetogama Lake areas the demand of lakeshore lots still appears to outweigh the available supply. The interviews did note that demand does drop off substantially with increased distance from towns or boat docking and shopping facilities.

FIRMS CONTACTED BY STUDY TEAM IN BWCAW VICINITY AND RESPONSE RATES BY COMMUNITY AND TYPE OF FIRM.

	Community																			
	Ely				Grand Marais				Crane Lake				Tower & Cook				Totals			
	Contacts	Refused	Responded	Response Rate	Contacts	Refused	Responded	Response Rate	Contacts	Refused	Responded	Response Rate	Contacts	Refused	Responded	Response Rate	Contacts	Refused	Responded	Response Rate
	#	#	#	%	#	#	#	%	#	#	#	%	#	#	#	%	#	#	#	%
Resorts	38	3	28	73.7	16	1	15	93.8	9	0	9	100.0	34	2	24	70.6	97	6	76	78.4
Outfitters	13	1	7	53.8	10	0	4	40.0	1	0	1	100.0	1	0	1	100.0	25	1	13	52.0
Combinations[1]	11	0	10	90.9	13	0	10	76.9	9	0	7	77.8	5	0	5	100.0	38	0	32	84.2
Totals	62	4	45	72.6	39	1	29	74.4	19	0	17	89.5	40	2	30	75.0	160	7	121	75.6

1/ "Combinations" category includes firms identified as resort/outfitter combinations and marinas.

2/ Number of contacts minus the number of responses plus the number of refusals equals the number of firms who said they would respond but have not yet returned their questionnaires.

Source: "A Needs Assessment of Tourism Firms Serving the Boundary Waters Canoe Area Wilderness Vicinity" October 1979, Agriculture Extension Service, University of Minnesota

EXHIBIT 7

EFFECTS ESTIMATED BY OPERATORS OF FOUR FACTORS ON THE 1979 BUSINESS OF TOURISM FIRMS DIRECTLY SERVING THE BWCAW VICINITY, BY COMMUNITY.

Factor	Community				
	Grand Marais	Ely	Crane Lake	Cook & Tower	All firms
	Average scale value [1].				
Gasoline and energy shortage	4.3	4.2	4.0	4.1	4.2
BWCAW legislation	4.0	4.2	4.5	4.1	4.2
Inflation and general prices	4.0	3.9	3.4	4.1	3.9
Access to BWCAW through permit system	3.3	3.7	4.1	3.8	3.7

1. Averages were calculated by assigning the following values to responses:

1 = Helped a lot
2 = Helped
3 = No effect
4 = Hurt
5 = Hurt a lot

EXHIBIT 7 (Continued)

OPERATOR ESTIMATES OF CHANGES IN KINDS OR AMOUNTS OF BUSINESS IN 1979 FOR TOURISM FIRMS DIRECTLY SERVING THE BWCAW VICINITY, BY COMMUNITY AND TYPE CHANGE.

Type change	Community				
	Grand Marais	Ely	Crane Lake	Cook & Tower	All firms
	Average scale value [1].				
Advance reservation rate	3.1	3.3	2.9	3.1	3.2
Repeat business	2.9	3.3	2.6	3.0	3.1
Cancellation rate	2.7	2.4	2.6	2.4	2.5
Customer calls	2.2	1.8	1.5	2.7	2.1

1. Averages were calculated by assigning the following values to responses:
   1 = Much above normal
   2 = Above normal
   3 = Normal
   4 = Below normal
   5 = Much below normal

The National Park Statistical Abstract, 1979, published by the U.S. Department of the Interior, National Park Service indicated that visits to the Voyageur National Park were down 23% or by 58,611 visitors in 1979 as compared to 1978 visits. During the same period of time, total visits to national parks in the Midwest Region increased .7% or by 72,724 visitors. Areas showing significant increases in the number of visitors were parks located near major population centers. This would provide some support to the hypothesis of the negative affects of high gasoline prices on people's desire to travel to distant and remote areas. This statistic poses the speculation of decreased future demand for land in the study area due to lack of familiarity derived from frequent visits. Fourteen percent of the respondents in the 1970 Minnesota Lakeshore Development Study, John R. Borchert, Director, University of Minnesota (pg. 35), ranked familiarity with the area and the people as the major factor considered in selection of location for a lakeshore seasonal home in Minnesota. Along with people's reluctance to travel to remote areas it is postulated that their desire to own land in these ares will also diminish. This is of particular concern to would-be developers because of the parks removal from any major population center, (the nearest being Minneapolis, over 300 miles away) and because of reliance in the past upon a large number of out-of-state purchasers. Further time is needed to assess the effects of energy prices and reduced supply upon future travel patterns.

Still another factor affecting demand of lakeshore property in the vicinity of the parks is public reaction to regulation and restrictions levied and proposed by the National Park Service. Developers, as well as private land purchasers,

are inhibited by the specter of excessively restrictive regulations and policies levied to govern parks. Some real estate professionals interviewed felt that this has negatively affected demand for property on lakes abutting national parks.

Along with the steady price appreciation and high demand for lakeshore properties has come the effort of small resort owners to "cash in" by subdividing their acreage and selling off individual lots. Mark Johnson with the St. Louis County Planning & Zoning office has noted that eight or nine such would-be entrepreneurs have approached him on this subject within the last two years. Only a small number of these resorts are designed in a manner that is conducive to subdivision.

For the resort subdivider as well as the local developers is the problem of availability of working capital with which to improve lakeshore lots. Presence of thrift institutions is minimal. Major financial institutions are located in the Virginia-Cook area and in the International Falls area. No major institutions service the area that lies between these population centers. Thrift institutions in the areas of Cook and Virginia and International Falls are not willing to commit funds to speculative projects such as lakeshore development. Because of strict lending policies of thrift institutions, lakeshore lots are most often offered under terms of a contract for deed. Developers in the area quoted an 8% interest rate ceiling on these notes. Terms vary from ten to twenty year amortizations, and a 20% to 29% required downpayment.

Development in the study area is also affected by the adjacent Canadian market. A land purchase tax of 20% for nonresidents along with increased gasoline prices has been attributed to a decline in demand by U.S. citizens for Canadian land in recent years. Despite these factors which are coupled with the scarcity of privately owned Canadian shoreland, demand for this property

by U.S. citizens is still reported good by realtors on both sides of the border. This is not true of Canadian residents seeking U.S. land. The occasional opportunity to lease shorefront parcels owned by the Canadian government is an option available to U.S. citizens. These parcels are available for lease only after they have been offered to Canadian citizens for a period of two years. These leases are drafted for a term of thirty years with two ten-year extensions. The annual payment is 10% of the property market value which is reassessed every ten years.

Regulatory Influences

Lakeshore developement in the Voyageur area is subject to the Minnesota Shoreland Management Act (MSMA) and revisions thereto, as well as zoning regulations of county and local government agencies.

The classification of public waters by MSMA is based upon the state's determination of the suitability of each lake or stream for future or additional development and the level of that development. This classification consists of (W1) - Natural Environmental Lakes & Streams, (W2) - Recreational Development Lakes, (W3) - General Development Lakes & Streams and (W4) Critical Lakes.

Management goals and objectives for these lake types are defined by the Minnesota Department of Natural Resources in the act as follows:

Natural Environment Lakes and Streams: to preserve and enhance high quality waters by protecting them from pollution and to protect shorelands of waters which are unsuitable for development; to maintain a low density of development; and to maintain high standards of quality for permitted development.

General Development Lakes and Streams: to provide minimum regulations of areas presently developed as high density, multiple use areas; and to provide guidance for future growth of commercial and industrial establishments which require locations on public waters.

Critical Lakes: to provide a more restrictive set of standards for badly deteriorated lakes which cannot be reasonably managed in any of the public waters classes defined above. These lakes, designated by the Commissioner, shall be studied in further detail to determine appropriate standards for shoreland development for each individual lake. Until such studies are completed. these lakes shall be subject to the standards applied to Natural Environment Lakes and Streams.

These classifications include all lands in unincorporated areas within the following distance from the normal high-water elevation of navigable water: 1000 feet from a lake, pond, or flowage and 300 feet from a river or stream or to the landward side of a flood plain, whichever distance is greater.

Minnesota shorelines are requlated more specifically by county planning and zoning agencies. Both Koochiching and St. Louis County zoning ordinances have been accepted and approved by the state. In both of these counties, regulatory agencies and officials appear very conscious of the effects of development upon Minnesota shorelines. Regulating requirements in the last couple of years have been enforced and adhered to more strictly than in the past. This is evidenced in St. Louis county by the number of variances granted and denied as compared to previous years. Although 35% less variances were requested in 1978 than in 1977, only 70% of these requests were approved as compared to 93.5% approval of variance requests in 1977.[1] (See Exhibit 8 for total variances granted and denied from 1975 to 1978)

Basic requirements of lakeshore and flood plain classified land for Koochiching and St. Louis counties are itemized in Exhibit 9. Exhibit 10 specifies the classification of lakes within the study area.

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[1] St. Louis County Planning and Zoning Annual Report, 1978

EXHIBIT 8

TOTAL VARIANCES GRANTED AS COMPARED TO THREE PREVIOUS YEARS

	1975	1976	1977	1978
RANGE 12	15	13	16	2
RANGE 13	11	7	7	2
RANGE 14	11	7	6	4
RANGE 15	15	22	19	14
RANGE 16	30	34	29	17
RANGE 17	27	19	36	8
RANGE 18	16	17	15	10
RANGE 19	12	12	20	12
RANGE 20	7	2	13	8
RANGE 21	20	29	35	16
TOTAL	164	162	196	93

TOTAL VARIANCES DENIED AS COMPARED TO THREE PREVIOUS YEARS

	1975	1976	1977	1978
RANGE 12	0	0	0	1
RANGE 13	0	2	0	5
RANGE 14	0	0	0	2
RANGE 15	1	1	1	2
RANGE 16	5	1	0	6
RANGE 17	3	3	0	3
RANGE 18	1	0	3	1
RANGE 19	1	2	0	3
RANGE 20	1	0	2	2
RANGE 21	6	1	2	3
TOTAL	18	10	8	28

Source: Planning & Zoning, St. Louis County Annual Report 1978

LAKESHORE ZONING RESTRICTIONS FOR LAKESHORE AND FLOODPLANE AREAS
IN ST. LOUIS AND KOOCHICHING COUNTIES

KOOCHICHING COUNTY

Zone Name	Symbol	Permitted Uses	Lot Width	Lot Area	Structure Set Back From High Water Mark	Height Requirement from High Water Mark	Maximum Structure Lot Coverage Ratio	Side Yard Set Back	Rear Yard Set Back
Waterfront	W-1	Natural environment lakes and streams. Seasonal cabin & other recreational structures allowed when not visible from shore.	200'	80,000 sq. ft.	200'	3'	30%	10'	N/AV
Waterfront	W-2	Recreational development lakes & streams. Single family, 2-family seasonal homes.	150'	40,000 sq. ft.	100'	3'	30%	10'	N/AV
Waterfront	W-3	General development lakes & streams. High density, multiple use area.	100'	20,000 sq. ft.	75'	3'	30%	10'	N/Av
Waterfront	W-4	Critical shoreland. Uses not specified.	200'	2 acres	200'	-	--	--	--
Open Space	O-2 O-1	Open space, distinct including flood plains, swamps & other areas unsafe or unsuitable for development.	200'	5 acres	--	-	--	--	--
									75

CA-1 CRITICAL AREAS 300 10 Acres

ST. LOUIS COUNTY

(SFC)

Waterfront	W-1	(Same as above)	200'	2 acres	200'	3'	20%	20'	50'
Waterfront	W-2	(Same as above)	150'	1 acre	100'	3'	25%	20'	45'
Waterfront	W-3	(Same as above)	100'	½ acre	75'	3'	35%	15'	40'
*									
Open Space	O-1	(Same as above)	600'	9 acres	--	-	2%	100'	100'
	O		200	2.5 --	50			50	50

*No W-4 classification

EXHIBIT 9

EXHIBIT 10

CLASSIFICATION OF MINNESOTA LAKES
WITHIN STUDY AREA

Natural Environmental Lakes & Streams W-1	Recreational Development Lakes & Streams W-2	General Development Lakes & Streams W-3
Amundsen	Ash	Kabetogma
Ban	Black Duck	Rainy
Black	Crane	Vermillion
Bog	Echo	
Bug	Elephant	
Carlson	Johnson	
Chub	Kjostad	
Clear	Little Johnson	
Corner	Long	
Franklin	Moose	
Gannon	Myrtle	
Hoodoo	Pelican	
Kabustasa		
Little Elbow		
Marion		
Moose		
Nett		
Olive		
Pearl		
Rice		
Silver		
Spring		
Sunset		
Susan		
Swan		
Winchester		

Zoning regulations also govern the removal of vegetation and soil from along the lakeshores. Stringency of these regulations varies with the lake classification as well as with individual shoreline properties. Waste disposal systems are given particular attention in both of the counties studied because of the previously discussed poor percolation capacity of a majority of the soil types in the area. Standards for effluent treatment are governed by the Minnesota Pollution Control Agency and are specified in Rule WPC 14. (See Exhibit 11)

The procedure for plat approval in Koochiching County involves a concept plan review, preliminary plat review, and final plat review. In the concept plan stage, the prospective developer presents his concept inclusive of sketches and general information to various county departments. At this time the county engineer inspects the proposed site for water supply, soil type, slope and general conditions of the land. At this stage, a survey of the property is obtained and copies submitted to the county for distribution to various departments. The preliminary plat which depicts lots, design features, topography, rights of way, and soil types is then submitted to the Planning Commission for review.

Prior to final review, soil tests, title policies, entry roads conforming to a minimum 24 feet of driving surface on a five inch classified gravelbed in Koochiching county and a minimum 26 feet driving surface on a six inch classified gravel bed in St. Louis County, and an examination report by a disinterested surveyor* are reviewed.

Procedures for obtaining final plat approval in St. Louis County do not differ substantially from the procedure oulined above. Submission dates for plats in St. Louis County, are as follows:

1. Concept Plan: A complete Concept Plan may be submitted at any time

*Examination by a disinterested surveyor has been determined necessary by the County Planning & Zoning Department. Subdivision regulations are being redrafted to reflect this and other changes at this time.

and acted upon within 15 days.

2. Preliminary Plats: A complete preliminary plat application shall be submitted at least 45 days prior to the Planning Commission meeting at which the applicant desires to have the application heard.
3. Final Plats: A complete final plat application shall be submitted at least 75 days prior to the County Board meeting at which the application is to be heard.

Performance standards set forth in the St. Louis County Subdivision regulations are based on the existence of the following limition factors on each lot:

1. Individual lot water supply.
2. Percolation rate greater than 60 minutes per inch or less than .1 minute per inch.
3. Water table within five feet of surface.
4. Slope in excess of 20%.
5. Bedrock generally within three feet of surface.

Whenever one or more of the listed limiting factors exist on a lot such, lots shall have the following minimum lot sizes. Zoning and other conditions may require more stringent requirements than resulting from these standards.

1. Minimum lot area of one acre with a minimum lot width of 150 feet if one limiting factor is present.
2. Minimum lot area of two acres with a mimimum lot width of 200 feet if two limiting factors are present.
3. Minimum lot area of 4.5 acres with a minimum lot width of 300 feet if three limiting factors are present.

The existence of four limiting factors may result in denial of the proposal.

Whenever a town has adopted more restrictive sanitary regulations, those requirements shall be in effect. The developer shall make all necessary tests and forward the results to the Director, appropriate Town Sanitarian and County Health Department.

The time that it takes a developer to proceed from the conceptual stage to final plat approval varies from four months to three years. The average has been ranging from nine months in Koochiching County to twelve months in St. Louis County. Many developers have been experiencing title problems which have further slowed down proceedings. Of the 20 most recently approved subdivision plats in St. Louis County, 16 experienced title complications. Another factor affecting the delay of final plat approval is the relative inexperience of the developer, both with development technicalities and with administrative proceedings. The developments typically experiencing longer approval time are subdivisions applying for variances. Falling within this category are resort subdivisions. Because of complications involved in platting around cabins and lakefront, variances from the regulation are often needed. A two year time span is more typical for these developments.

In incorporated areas, the municipality governs development activity.

A PRO FORMA FOR A PREDOMINANTLY SEASONAL LAND DEVELOPMENT

The subdivision value changes over time as work is completed:

> The "subdivision value" is constantly changing, from the time it is raw land (when the development is little more than a gleam in the developer's eye) to the time it is developed with only a few remaining lots to be retailed. Value is different at each stage of development and sale. These stages may be broadly categorized as follows:

1. Raw land with highest use being a form of development.
2. Raw land plus completed engineering plans and specifications.
3. Raw land plus completed plans, specifications, and contractor commitments.
4. Raw land with partial physical development in progress.
5. Ready for retail sale of individual lot units.
6. Individual lot units partially sold at retail. It is likely that the subdivision is no longer saleable as a market entity at this stage.
7. Developed lots completely sold at retail.*

The input variables are based on the central tendency of these factors based on an analysis of the plats of record as detailed in Exhibits 6 and 12.

Average total acres in plat: 30.61

Average number of lots: 15

Average lot size: 1.94

Average lots sold in a year: 1.5; $\pm$ .5 variance

The purpose of the pro forma is to capture the sources and uses of funds across the enterprise from a single perspective, the developer.

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*"A Basic Methodology For Estimating the Market Value of Subdivision Land Development," The Real Estate Appraiser, by Dan L. Swango, Nov-Dec 1971, p.14

Valuation of a Land Subdivision

The oldest and most influential appraisal society, The American Institute of Real Estate Appraisers has published tracts on the valuation of land development enterprises. It's official textbook states:

> Land Value by Anticipated Use or Development
>
> This procedure involves the comparison of undeveloped land to be appraised with a developed parcel or parcels for which individual lot sale prices are known. If available, data on sales of comparable raw land to developers is the best evidence of value. When such market data is lacking, however, the anticipated use or development procedure may be applicable to raw unsubdivided land, potential residential subdivisions, new neighborhoods, reuse neighborhoods, or industrial parks. In some circumstances this procedure may be the only one available for valuing raw land.*
>
> For example, a 20-acre parcel of undeveloped land is presently suitable for development as a single family subdivision and is appropriately zoned. Sales of comparable parcels are lacking, but the value of residential lots in similar subdivision developments can be ascertained. A typical appraisal procedure follows:
>
> 1. Idenitify the economic bracket of the residents and check the range of sale prices of typical new homes in the area.
>
> 2. By distribution, or comparison with lot sales in similar subdivisions, decide what figure represents a typical lot value in the category of development.
>
> 3. Study and lay out a subdivision plan to develop typical lots.
>
> 4. Project the total probable gross sale price for these lots.
>
> 5. Estimate development costs to include:
>   a. Engineering or other fees
>   b. Cost of streets and utilities
>   c. Advertising and cost of sales
>
> 6. Estimate overhead and administrative costs to include:
>   a. Taxes and inspection fees
>   b. Financing fees and carrying costs
>
> 7. Deduct these direct expenses for development from the figure derived in Step 4.

---

*Education Memorandum N. 1, Subdivision Analyses, rev. ed. (Chicago: American Institute of Real Estate Appraisers, 1978).

8. Deduct an adequate profit allowance to provide incentive for the developer so that the calculated value of the raw land is exclusive of development profit. (Alternatively, profit may be provided for in the rate used for capitalization in the discounting process.)

9. Deduct for time lag by discounting, at an appropriate risk rate, the annual net income flow over the time needed for completion and market absorption of the project.

The sum of these discounted cash flows represents the price at which the land could reasonably be expected to sell and reflects the price a developer would be justified in paying for the raw land under the assumptions made. A critical assumption is the projection of the probable time required for market absorption of the developed sites.

Frequently the services of an engineer are required to establish a subdivision plan permissible under an existing building code. Evidence to support the projected cost of streets and utilities may involve obtaining formal estimates from contractors.

There are variations of this procedure for processing the income and expenses from the hypothetical development, including a discounted cash flow analysis. The important factors in the anticipated use procedure are projected time for sale of the developed lots, estimation of development costs, and discounting of income from sales for the estimated waiting period before recieving this income.*

Educational Memorandum #1 is reproduced as Exhibit 15. This memorandum provides examples to show how the value of the underlying raw land should be arrived at.

It is obviously impossible to provide complete valuations by this appropriate methodology for each parcel of land to be acquired. It is possible to provide a proforma analysis of a typical parcel of land to be developed in the study area based on the data we have gathered. This would demonstrate the sources and uses of funds and portion of total sales revenues attributable to the land. This would be far more relevant than some rules of thumb such as the stylized rhetoric of the archetypal developer's formula "A third to the dirt, a third to bringing it out and a third to me."

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*The Appraisal of Real Estate, Seventh Edition, Textbook Revision Committee, American Institute of Real Estate Appraisers, P. 147-148.

Exhibit 6 shows an overall average lot sales for a year to be 1.44 with a variance (standard deviation) of plus or minus .52 lots. This will be rounded to 1.5 lot sales a year or 3 lots sold in two years. No lots are sold in year one as this is the average delay to allow for engineering, platting, county and state approvals, road construction, utility extension and other physical and legal preparation.

The ideal lot would have a two to one, length to width, ratio. This lot from a developer's dream would have 150 feet of frontage with 300 feet of depth. But other considerations such as access within and to the subdivision, configuration and topography, market reaction and the subdivider's aesthetic and econcomic motivations all work toward larger actual lot sizes. Exhibit 12 is an analysis of 11 subdivisions showing size relationships and number of lots produced from the total acreage. A typical or average subdivision would have 30.61 total gross acres with 1.55 acres lost to access or roads for a total net acreage of 29.06 acres. There would be 15 lots in this prototype subdivision with an average lot size of 1.94 acres. These figures reflect the actual practices of developers against a best case or minimum permitted by zoning. To dimension an average lot, we'll use the two to one ratio. This would produce approximately 205 feet of water frontage for a lot size of 1.94 acres or 84,506 square feet. The retail sales price of the lot would be a function of the lake on which it is located, where it is located on the lake and the individual physical characteristics of the site. Currently, lots with good rock ledge and that are well wooded on the smaller or relatively remote lakes would bring $80 a front foot, or a typical selling price of $16,400. Appreciation in the future for the pro forma will be calculated by adding $1,600 after the first year of sales and $1,500 each year thereafter.

Construction expenses are minimal for this class of development as there are usually only access roads, electricity and surveying and platting. Gravel roads according to Bob Jovet of Leustek Engineering, Ely, Bill Trygg of the

SIZE RELATIONSHIP OF PLATTED SUBDIVISIONS

Subdivision	Total Acres	Acres Out by Plat	Net Acres	Number of Lots	Average Lot Size In Acres
Everett Lake Shores	90.93	- 0 -	90.93	19	4.79
Mitawanga	29.66	.8 (Walkway)	28.86	13	2.22
Tibbett's Addition	29.2	.58(Access)	28.62	12	2.39
Pfeiffer's Subdivision	16.1	- 0 -	16.1	8	2.01
McMullin's Sand Point	30.1	.89(Walkway)	29.21	23	1.27
Pine Narrows	23.4	.3 (Walkway)	23.1	13	1.78
Tomahawk Beach	21.45	3.45(Roads)	18.0	24	.75
Diamond Island	10.92	- 0 -	10.92	10	1.09
Handberg's Addition	26.8	9.04(Roads and outlots)	17.76	8	2.22
Ev Lor Island	48.1	- 0 -	48.1	26	1.85
Mannikko	10.1	2.0 (Roads)	8.1	9	
Grand Total Acres	336.76	Total Acres Out 17.06	Total Net Acres 319.70	Total Number of Lots 165	
Avg. Acres	30.61	Avg. Out 1.55	Avg. Net 29.06	Avg. Lots 15	
			Total Net Acres 319.70	Total Lots 165 =	Avg. Lot Size 1.94

Total Acres Out 4.06 ÷ Grand Total Acres 336.76 = Average Percentage Reduction 5.0

EXHIBIT 12

Trygg Land Office, Ely, and Bill Culbert of Culbert Realty, Virginia, cost between $5 and $6 a lineal foot. If all the lots would butt to the road, the minimum point to point distance would be .3 miles, but .5 miles would be more likely for the roadway to follow the topography of the shoreline or land contours. 2,640 lineal feet priced at $5.50 is $14,520 which will be used as the road cost. Surveying costs average $6,000 to $7,000 according to Dick Floyd of Zenith Surveying in Ely. Harold Darlington had his Northern Lights Resorts surveyed for sale of 13 acres divided into 18 to 20 lots for $10,000, but existing buildings had to be placed. $6,500 will be used as the surveying and platting cost. Northern Electric which services the area allows for an installation cost of up to $2,650. Distances over that are billed at estimated cost. If the actual cost exceeds the estimate, Northern Electric will absorb the cost, if the actual cost is less, the difference will be refunded. The cost of installation over $2,650 must be paid one-half in cash and the other half is billed to future customers on their electric bill over 120 months. The developer pays the first half as deposit. Of course, the cost to bring the electricity to the property can vary greatly. Emery Bulinski who has developed Everett Lake Shores, Ring Rock, White Iron Lake and Bulinski's Point says that down payments run between $5,000 to $8,000. If .3 of a mile is the minimum distance between lots and roadway, to service lots would take at least .5 mile, one mile total extension of lines for electrical service would require a $3,960 downpayment. Based upon discussions with Ernie Nelson of the St. Louis County Assessor's Office and a review of the ratios of real estate taxes to sale prices of properties sold in the last three years, projected real estate taxes should be between $80 and $150 dollars per year. $125 will be used and this will be decreased 7 percent the year after a lot is sold. Sales commissions run between 7 to 10 percent according to Harold Darlington and

Emery Bulinski. 8 percent was used. The category of management, supervisions and miscellaneous is computed from 20 percent of the total undiscounted sales price apportioned equally over the 11 year sell out. This category would also account for a minimal profit if everything went according to schedule. Financing looms as a key element in the analysis. Although construction financing is available, it is expensive. The front end hard construction costs are conservatively low which in turn keeps the cost of borrowed funds to a minimum. Interest is calculated at 15 percent on an added basis carried against future positive cash flows. Further, it is assumed that the developer owns the land in question free and clear. If the land was purchased for development or if there was an existing mortgage, these payments would also be subtracted from income. The majority of lots of this type are financed by the developer with a contract for deed. Typical terms are 20 to 29 percent down, 8 percent interest for 10 to 20 years, although there is a trend to shorter 5 to 10 year notes or balloon provisions. We have used 25 percent down, 8 percent interest and a 5 year term to reflect prepayments and shorter terms. 80 percent of the lots will be assumed to be sold with contract for deed financing taken back, with the balance sold for cash.

Exhibit 13 shows the calculation of the annual receipts from the contract for deed financing. These amounts are then added to cash sales and downpayments as sources of funds, see Exhibit 14. From the revenues the construction costs and the ongoing, recurring expenses are subtracted, including interest for years with negative cash flow. The cash flows must then be discounted to account for the time value of money as the American Institute of Real Estate Appraisers materials previously quoted prescribes. The discount rate applied was 10 percent, a modest amount considering the risks involved, the long absorption period and the rate of inflation currently existing.

EXHIBIT 13

ANNUAL RECEIPTS FROM CONTRACT FOR DEEDS

Year Financed		Year 3	4	5	6	7	8	9
2	$12,300	$3,081	$3,081	$ 3,081	$ 3,081	$ 3,081		
3	27,000		6,762	6,762	6,762	6,762	$ 6,762	
4	14,625			3,663	3,663	3,663	3,663	$ 3,663
5	15,750				3,945	3,945	3,945	3,945
6	16,875					4,227	4,227	4,227
7	18,000						4,508	4,508
8	19,125							4,790
Total Receipts for Year		$3,081	$9,843	$13,506	$17,451	$21,678	$23,105	$21,133

Year Financed		Year 10	11	12	13	14	15	16
5	$15,750	$ 3,945						
6	16,875	4,227	$ 4,227					
7	18,000	4,508	4,508	$ 4,508				
8	19,125	4,790	4,790	4,790	$ 4,790			
9	40,500	10,143	10,143	10,143	10,143	$10,143		
11	45,000			11,271	11,271	11,271	$11,271	$11,271
Total Receipts for Year		$27,613	$23,668	$30,712	$26,204	$21,414	$11,271	$11,271

EXHIBIT 14

PRO FORMA DISCOUNTED CASH FLOW OF A SEASONAL LAND DEVELOPMENT

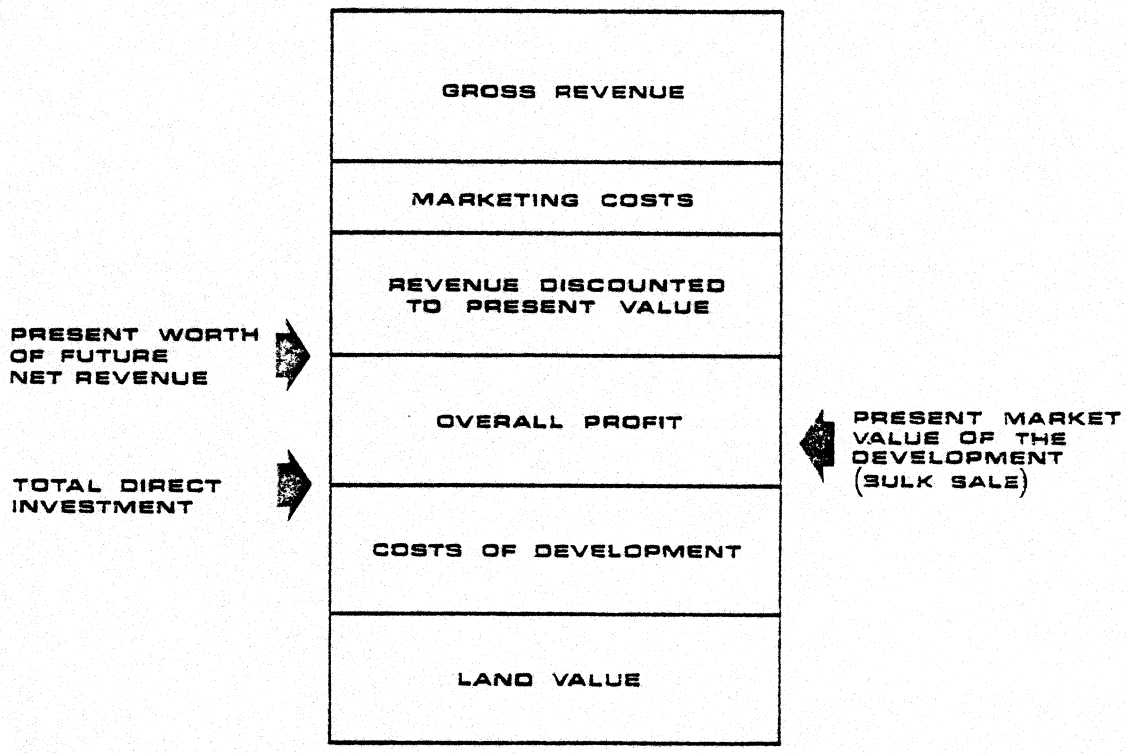
	Year 1	2	3	4	5	6	7	8	9	10	11	12
Lots Sold	0	1	2	1	2	1	2	1	2	1	2	
Total Sales Price of Lots	0	$16,400	$36,000	$19,500	$42,000	$22,500	$48,000	$25,500	$54,000	$28,500	$60,000	
SOURCES OF FUNDS												
Downpayments 25%		4,100	9,000	4,875	5,250	5,625	6,000	6,375	13,500		15,000	
Cash Sales					21,000		24,000			28,500		
Annual Contract Payments			3,081	9,843	13,506	17,451	21,678	23,105	21,133	27,613	23,668	$30,712
Total Revenues		4,100	12,081	14,718	39,756	23,076	51,678	29,480	34,633	56,113	38,668	30,712
USES OF FUNDS												
Construction Costs												
Surveying	$ 6,500											
Roads	14,520											
Electricity	3,960											
Miscellaneous	1,000											
Total Costs	$25,980											
Real Estate Taxes	125	125	116	100	93	80	74	64	60	52	48	
Sales Commission 8%		1,310	2,880	1,560	3,360	1,800	3,840	2,040	4,320	2,280	4,800	
Overhead, Management, Supervision, Legal and Miscellaneous	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	
Total Uses	32,505	7,835	9,396	8,060	9,853	8,280	10,314	8,504	10,780	8,732	11,248	
Net Operating Income	(32,505)	(3,735)	2,685	6,658	29,903	14,790	41,364	20,976	23,853	47,381	27,420	30,712
Principle Financed	32,505	41,116	44,598	44,630	21,422	9,839	0					
Interest on Loan 15%	4,876	6,167	6,690	6,695	3,213	1,476	0					
Total Loan Carried Forward	37,381	47,283	51,288	51,325	24,635	11,315	0					
Cash Flow	0	0	0	0	0	0	$30,049	$20,976	$23,853	$47,381	$27,420	$30,712
Present Worth Factor							.513158	.466507	.424098	.385543	.350494	.318631
Discounted Cash Flow							$15,420	$ 9,785	$10,116	$18,267	$ 9,611	$ 9,786
Total Present Value	$91,365											
	$91,500 (Rounded)											

The present value of the discounted cash flow ". . .represents the price at which the land could reasonably be expected to sell and reflects the price a developer would be justified in paying for raw land under the assumptions made." In this hypothetical case with its average or conservative assumptions, the present value was $91,500, or for the 30.61 acres of gross acreage, $2,989 an acre; or on a front foot basis for the 15 lots with 205 feet of frontage, $29.76 a front foot. $29.76 is 37 percent of the hypothetical sales price of $80 a front foot.

Exhibit 15 is a graphic representation of the allocation of $1 from the sale of a lot as it would be partitioned among expenses, profits, and discount factors.

EXHIBIT 15

ALLOCATION OF ONE DOLLAR OF TYPICAL LOT SALES REVENUE



When we look at the relation of price of a parcel of land to its size or waterfrontage, we are hypothesizing an associative relationship. When we say that two or more of these variables are associated, we mean that the values they take on tend to vary together. For example, taller people tend to be heavier, that is, height is associated with weight.

Another way of looking at association between two or more variables is as a problem in estimating or predicting the values of one variable, given the knowledge of the values of other variables. Those variables predicted are called criterion variables, while those variables which have measured values are called predictor variables. Two variables are associated if one can improve the accuracy of the estimates about a criterion variable based on information about the value of the predictor variable.

Most all variables are represented quantitatively by means of number. Statistics is the area of knowledge that controls the methods and manner of associative data analysis. This field is vast and no attempt will be made to summarize it; however, we are essentially concerned with its multivariate methods. Our interest will be on three types: 1) Multiple regression and correlation; 2) Discriminant analysis; and 3) Canonical correlation. These methods are described and distinguished as follows:

1. In multiple regression the criterion subset consists of a single variable which is presumed to be interval scaled with predictor variables that are similarly scaled or, ("dummy" variables). The objectives of this class of techniques are to: a) Predict the value of the criterion variable in terms of a linear combination of predictor variables. b) Describe the contribution of each predictor variable to total explained variation in the criterion variable. c) Measure the overall strength of association between the criterion variable and the full set of predictor variables. d) Make inferential statements regarding any of the above.

2. In discriminant analysis the criterion variable is nominal scaled, whereas the predictor variables are (typically) interval scaled. The discriminant(s) are determined from known assignment of sample members to categories. The objectives of this class of techniques (including classification analysis) are to: a) Find linear combinations of the variables which best separate the group means, i.e., maximize among group variance relative to within group variance. b) Test whether the sample means have arisen from a single population versus two or more populations. c) Predict an individual's assignment to one or two or more categories on the basis of his scores on the set of measured characteristics. d) Determine the relative importance of each predictor variable in making "optimal" assignments of individuals to categories.

3. In canonical analysis the analyst is not concerned with a single criterion-multiple predictor relationship (as in ordinary multiple regression) but with linear relationships among sets of criterion variables and predictor variables. His objectives are to: a) Determine the maximum correlation between "p" criterion variables ("p" ≥ 1) and "q" predictor variables ("q" ≤ 1). b) Derive a set of "weights" for each set of criterion and predictor variables such that the weighted sums are maximally correlated. c) Derive additional linear functions that maximize remaining dependence, subject to being uncorrelated with the preceding set(s) of linear compounds. Accordingly, multiple regression will be utilized to analyze the data and search out significant relationships.

A data base of 442 comparable sales was assembled from our search of courthouse and assessor's records and the computerized data base constructed from appraisers' reports by the National Park Service.

This data base is in Exhibit 17. Each line (row) represents a separate sale. Each column represents a characteristic or attribute as shown in the legend of explanation and its score or amount. These are the variables to be analyzed. Price is set as the criterion variable. The other variables size, water frontage

and the like are the predictor variables. Multiple regression has already been determined to be the method of analysis. Stepwise multiple regression will be the particular multiple regression technique. Stepwise regression mathematicaly selects the predictor variable which best explains association. The predictor variables are selected in relative order of explanatory power. Obviously, this is a laborious and somewhat complicated procedure, but the use of a computer can make this task managable. The Stat II*** group of statistical analysis programs available on the GE computer timesharing network was utilized. Exhibit 18 shows the results of the computer calculations. The database file was read in and analyzed. The method or measure for selecting the most important variables is the F ratio. This is a measure of difference whose premise is that the larger the value of F, the less we would expect differences to be the result of pure chance. Usually an F value of 3 would indicate significant relationships associated with a particular predictor variable. These are the variables the analysis showed to be pertinent:

Analysis Step	The Variable	Incremental F Ratio
1	Lineal water frontage	47.37
2	Type of road access	24.69
3	The lake where the the property is located	4.12
4	Size in acres	4.26

These then are the factors of variables and analysis of 442 comparable sales reveals as the dominant contributors to value. They are shown in rank order (a scalar measure) as the computer program selected them for their degree of relation to value.

EXHIBIT 18

```
READY
?READ (PRICE,1,ACRE,WFF,WFFAC,LAKE,LSIZE,RDAC,DOCKM) FROM ZZLAND BY CASE


DUPLICATE VARIABLE:     PRICE

READY
?STOP


USED    28.88 UNITS
RUN STATII***


STATII      13:38CST    02/27/80


VERSION    79 JUL 30


READY
?READ (PRICE,#1,ACRE,WFF,WFFAC,LAKE,LSIZE,RDAC,DOCKM) FROM ZZLAND BY CASE


  442 CASES READ.

READY
?RUN SREG(PRICE,ACRE,WFF,WFFAC,LAKE,LSIZE,RDAC,DOCKM)


THIS ROUTINE REQUIRES 5 SCALARS.

FIRST, ENTER NUMBER OF INDEPENDENT VARIABLES --?7

VALUE OF F-RATIO TO ENTER A VARIABLE INTO REGRESSION --?3

ENTER "1" FOR YES OR "0" FOR NO.   DESIRE PRINTOUT OF RESIDUALS?

YOUR CHOICE --?0

ENTER INDEX OF A FORCED VARIABLE.   ENTER "0" IF NONE,

YOUR CHOICE --?0

ENTER "1" FOR YES OR "0" FOR NO.   DESIRE CORRELATION MATRIX?

YOUR CHOICE --?0
```

EXHIBIT 18 (Continued)

PROBLEM: 1 DEP VAR: PRICE

VARIABLE	MEAN	STD DEV
PRICE	13731.	17453.
ACRE	10.425	18.150
WFF	833.74	1026.2
WFFAC	201.94	439.36
LAKE	25.600	8.0773
LSIZE	1.3348	0.66059
RDAC	0.52941	0.82495
DOCKN	2.2050	2.6867

STEP	ACTION	VARIABLE	INCREMENTAL F	ADJ R^2	R^2	R	
1	ENTER	WFF	47.37	0.0951	0.0972	0.3118	.06930
2	ENTER	RDAC	24.69	0.1414	0.1453	0.3811	.01040
3	ENTER	LAKE	4.12	0.1474	0.1532	0.3915	.01030
4	ENTER	ACRE	4.26	0.1537	0.1614	0.4018	

VARIABLE	COEFFICIENT	STD ERROR	PARTIAL F	SIG LEVEL
CONSTANT	11363.0	-	-	-
ACRE	107.734	52.1769	4.26	96.05%
WFF	4.73165	0.945768	25.03	100.00%
LAKE	-202.260	95.8350	4.45	96.46%
RDAC	4680.15	954.634	24.04	100.00%

STD ERR OF ESTIMATE: 16055.5

STATEMENT OF LIMITING CONDITIONS

1. A great deal of the information in this report was furnished by others. While we believe it to be reliable, Landmark Research, Inc., cannot guarantee it.

2. Possession of this report or any copy thereof does not carry with it the right of publication nor may the same be used for any other purpose by anyone without the previous written consent of Landmark Research, Inc., and in any event, only in its entirety.

3. Neither all nor any part of the contents of this report shall be conveyed to the public through advertising, public relations, news, sales or other media without the written consent and approval of the author, particularly as to the conclusions.

4. Protection of the client's interest regarding the report and its contents is governed by the by-laws and regulations of the professional appraisal organizations with which we are affiliated.

5. Landmark Research, Inc., will expect to be held harmless from any and all claims that might be brought by third parties which might relate in any way to claims for injury or damage suffered as the result of the implementation of any advice we may have given or services we may have rendered in this connection.

6. The authors will not be required to give testimony or to appear in court by reason of this report, with reference to the property in question, unless timely arrangements have been previously made therefore at prevailing per diem rates.

SOURCES OF INTERVIEWS

St. Louis County Court House

Ernie Nelson and other Office Appraisers, Assessor's Office
Mark Johnson, Tom Cambell, Planning and Zoning Office
Randy Tyo, Register of Deeds Office

Koochiching County Court House

Ruth McLinn, Planning and Zoning Office
Tom Bartel, Don Petman, Water Sanitation Office

Contractors and Developers

Dick Floyd, Surveyor, Zenith Surveying, Ely, MN
Norm Kauffman, Developer, Energy Sciences, Biwabik, MN
Bill Culbert, Developer, Realtor, Appraiser, Culbert Realty, Virginia, MN
Russel Daniels, Contractor, Bike, MN
Bill Trygg, Contractor, Ely, MN
Bob Jovet, Engineer, Leustek Engineering, Ely, MN
Herb Novesel, Engineer, Excavator, Ely, MN
Ollie Egan, Developer, Appraiser, Realtor, Crane Lake, MN
Ray Ranta, Developer, Cook, MN
Emery Bulinski, Developer, Appraiser, Ely, MN
Harold Darlington, Developer, Kabetogama, MN

Realtors

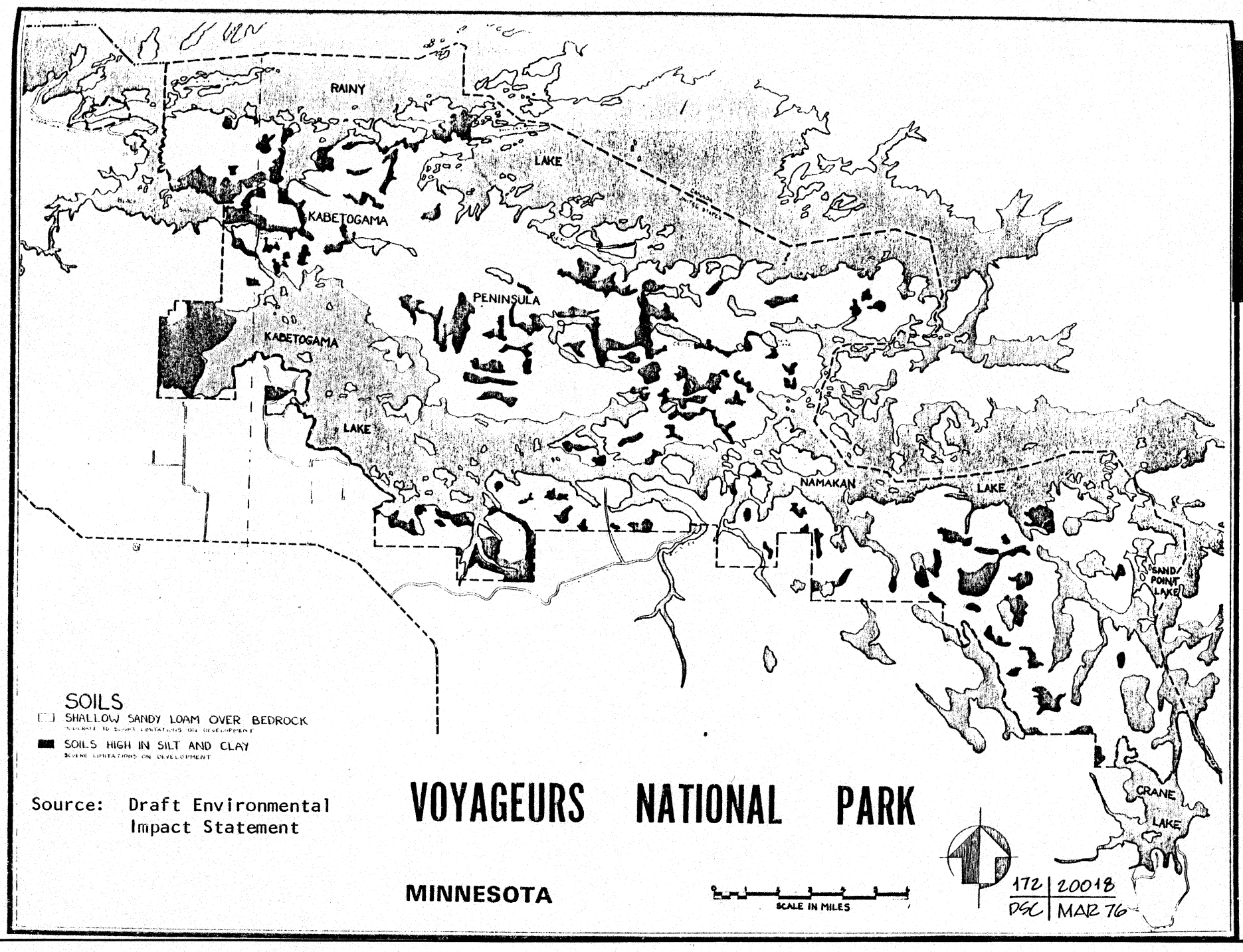
John McKibbage, Manager, John's Real Estate, International Falls, MN
Swede Sundberg, Town & Country Realty, International Falls, MN
Dave Culbert, Culbert Realty, Virginia, MN
Verna Samich and Sales Associates, East West Realty, Virginia, MN
Broker, Landry Agencies, Century 21, Fort Francis, Ontario

Other

Allen Johansen, Cecil Hoard, Canadian Ministry of Natural Resources,
Land Department, Fort Francis, Ontario
Northern Electric Co., Virginia, MN

[redacted]

EXHIBIT 5



Source: Draft Environmental Impact Statement

VOYAGEURS NATIONAL PARK

MINNESOTA

172 | 20018
DSC | MAR 76

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

200

SERIES Alluvial land, frequently flooded
STATE Minnesota
MLRA

CKS 3/73

These are poorly and very poorly drained, mixed alluvial soils. These materials are commonly 10 feet or more thick and are variable in color and texture. Some areas have thick organic surface layers. Reaction is generally slightly acid to neutral. They occupy 3 to 50 acre nearly level bottomlands adjacent to major streams and drainageways. These soils are subject to frequent flooding.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
Surface layer Subsoil Underlying material	MATERIAL IS TOO VARIABLE TO RATE												6.1-7.3	Low to Moderate

Flooding: Frequent after snowmelt and heavy rains
Hydrologic group: ---------
Depth to water table: 0 to 2 feet
Depth to bedrock: Greater than 10 feet
Corrosivity - uncoated steel: Moderate
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: surface soil is low in organic matter and has seams of sand
Sand	Poor: sand occurs as bands with finer textured materials
Gravel	Poor:
Topsoil	Poor: wet, variable soil texture; frequently flooded

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: high seasonal water table; frequently flooded; hazard of pollution
Sewage Lagoons	Severe: high seasonal water table; frequently flooded; variable soil material and compacted permeability; danger of downstream pollution
Shallow Excavations	Severe: water table is seasonally high for short periods; frequent flooding; variable material; poor sideslope stability
Dwellings:	
With Basements	Severe: high seasonal water table; frequently flooded
Without Basements	Severe: high seasonal water table; frequently flooded
Sanitary Landfill	Severe: high seasonal water table; frequently flooded; variable permeability
Local Roads and Streets	Severe: frequent flooding; high seasonal water table; moderate to high susceptibility to frost action
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Subject to flooding; high seasonal water table; variable permeability
Embankments, Dikes, and Levees	High seasonal water table; frequent flooding; variable soil material
Drainage of Cropland and Pasture	Not applicable
Irrigation	Not applicable; poorly and very poorly drained soils
Terraces and Diversions	Not applicable
Grassed Waterways	Not applicable; nearly level soils

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

USDA-SCS-LINCOLN, NEBR. 1971

MN-SOILS-3
11-71
(File Code SOILS-12)

Alluvial land, frequently flooded

20C

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: likely to flood after snowmelt and heavy rains
Picnic Areas	Severe: likely to flood after snowmelt and heavy rains
Playgrounds	Severe: likely to flood after snowmelt and heavy rains
Paths and Trails	Moderate: likely to flood after snowmelt and heavy rains

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Bluegrass AUM			Z
All	VIw			3.0			

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Poor	Fair	Poor	Poor	Good	Good	Poor	Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
			NOT APPLICABLE							

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Flooding, scouring and high seasonal water table limit the use of these soils. Most areas are in unimproved pasture or are idle. The water table depth is dependent upon the streamflow and water table of adjacent streams and drainageways.

FOR INTERIM USE
Subject to change on completion of coordination between MLRA'S

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

LAND TYPE Marsh 53
STATE Minnesota
MLRA _____ 3/73
CKS

This miscellaneous land type includes shallow lakes, ponds and sloughs that support aquatic vegetation. Emergent plants such as cattails, reeds, sedges and water tolerant grasses are present. These areas have open water most of the year. The soil material is too wet to be classified, but is commonly a peaty muck or a loamy mineral soil. Size of the areas ranges from 2 to 100 acres and occupies closed depressions and borders of lakes and streams.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
PROPERTIES NOT RATED - SOIL MATERIAL UNKNOWN														

Flooding: Continual
Hydrologic group: D
Depth to water table: 0 to 5 feet above soil level
Depth to bedrock: Greater than 10 feet
Corrosivity - uncoated steel: ----
Corrosivity - concrete: ----

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high water table; ponded most of the year; usually highly organic material
Sand	Not suitable
Gravel	Not suitable
Topsoil	Poor: very poorly drained, usually ponded; poor trafficability; usually highly organic material; needs mixing with mineral soil.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: high water table; ponded most of the year; high hazard of water contamination
Sewage Lagoons	Severe: high water table; ponded most of the year; high organic content in surface soil
Shallow Excavations	Severe: high water table; ponded most of the year; usually organic soils
Dwellings: With Basements	Severe: high water table; low bearing values and shear strength; high shrink-swell and usually high compressibility
Sanitary Landfill	Severe: high water table; poor trafficability
Local Roads and Streets	Severe: high water table; ponded most of the year; high susceptibility to frost action; high shrink-swell; low bearing values
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High water table; ponded most of the year
Embankments, Dikes, and Levees	Soil material usually high in organic materials; permeable and unstable
Drainage of Cropland and Pasture	High water table; ponded most of the year; usually drained by open ditches
Irrigation	Not applicable; excess of moisture is present
Terraces and Diversions	Not applicable; no erosion evident
Grassed Waterways	Not applicable; level land

USDA-SCS-LINCOLN, NEBR. 1971

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

Marsh

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: high water table; ponded most of the year
Picnic Areas	Severe: high water table; ponded most of the year
Playgrounds	Severe: high water table; ponded most of the year
Paths and Trails	Severe: high water table; ponded most of the year

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn Bu./Ac.	C.Silage Tons/Ac.	Soybeans Bu./Ac.	Oats Bu./Ac.
All							

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Good	Good	Very Poor	Very Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All										

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS [1]

SERIES Wildwood-118
STATE Minnesota
MLRA 88-1
Rev. RRL 11-72

The Wildwood series consists of very poorly drained clayey soils occupying concave slopes on glacial lake plains. Typically these soils have a mucky surface layer about 6 inches thick. The subsoil is mottled, dark gray, noncalcareous clay about 12 inches thick. The substratum is gray or olive gray calcareous clay. Most areas are irregular shaped and range from 5 to 15 acres in size.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-6	Muck	--	A-8	--	Not suitable for engineering sieve analysis				--	--	.06-0.6	.35-.48	5.6-6.5	--
6-18	Clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.10-.14	5.6-7.3	High
18-60	Clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.09-.13	7.4-8.4	High

Flooding: Occasionally ponded
Hydrologic group: D
Depth to water table: 0.5 - 2 ft. perched May to November
Depth to bedrock: Greater than 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high shrink-swell, low strength, wet
Sand	Unsuited
Gravel	Unsuited
Topsoil	Poor: too clayey, wet

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields
Severe: water moves through the soil too slowly, wet

Sewage Lagoons
Severe: too much organic matter in surface layer, wet

Shallow Excavations
Severe: wet, clayey

Dwellings:
With Basements Severe: wet, high shrink-swell, low strength

Sanitary Landfill
Trench type Severe: wet, clayey

Local Roads and Streets
Severe: wet, clayey

Potential Frost Action Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas
Favorable, slow permeability

Embankments, Dikes, and Levees
Low strength, high compressibility

Drainage of Cropland and Pasture
Slow permeability, clayey, wet

Irrigation
Not needed

Terraces and Diversions
Not needed

Grassed Waterways
Not needed

USDA SCS LINCOLN, NEBR. 1971

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets

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DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: wet, poor trafficability
Picnic Areas	Severe: wet, poor trafficability
Playgrounds	Severe: wet, poor trafficability
Paths and Trails	Severe: wet, poor trafficability

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	OATS	CORN SILAGE	BLUEGRASS PASTURE	LEGUME GRASS	LEGUME GRASS
				Bu/A	T/A	AUM	T/A	AUM
All	IVw	--	--	55	14	4.1	3.5	5.2

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	5W	Black Ash Aspen Black Spruce	45 60	Slight	Severe	Moderate	Severe		Black Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

FOR INTERIM USE
Subject to change on completion of coordination between MLRA'S

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES Taylor - 122
STATE Minnesota
MLRA 88
Rev. RRL 11-72

The Taylor series consists of well drained and moderately well drained clayey soils occupying nearly level to hilly slopes in glacial lake plains. Typically these soils have a silt loam surface layer about 6 inches thick. The subsoil is dark brown or dark grayish brown medium to slightly acid clay. The substratum is grayish brown calcareous silty clay. Most areas are irregular shaped but some areas are elongated ridges.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-6	Silt loam	ML	A-4	0	100	100	95-100	95-100	20-35	0-5	.63-2.00	.22-.24	5.6-6.5	Low
6-21	Clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.10-.14	5.6-6.5	High
21-60	Silty clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.09-.13	7.4-8.4	High

Flooding: None
Hydrologic group: D
Depth to water table: Greater than 5 feet
Depth to bedrock: Greater than 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: poor shear strength, poor workability, high shrink-swell
Sand	Unsuitable
Gravel	Unsuitable
Topsoil	Poor: friable material is thick, low organic matter

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields
Severe: slow permeability

Sewage Lagoons
Slight: 0-2 percent slopes; Moderate: 2 to 6 percent slopes; Severe: more than 6 percent slopes

Shallow Excavations
Severe; poor workability

Dwellings:
With Basements Severe; high shrink-swell

Sanitary Landfill
(trench type) Severe: poor workability

Local Roads and Streets
Severe; high shrink-swell, low bearing strength

Potential Frost Action Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas
Slow permeability

Embankments, Dikes, and Levees
Low to medium shear strength; fair to poor compaction characteristics

Drainage of Cropland and Pasture
Usually not needed

Irrigation
Slow infiltration; slow permeability

Terraces and Diversions
Poor workability

Grassed Waterways
Poor workability

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

(File Code SOILS-12)

Taylor

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate: slow permeability; Severe: greater than 12 percent slopes
Picnic Areas	Slight: 0 to 6 percent slopes; Moderate: 6 to 12 percent slopes; Severe: greater than 12 percent slopes
Playgrounds	Moderate: slow permeability; Severe: greater than 6 percent slopes
Paths and Trails	Slight: 0 to 18 percent slopes; Moderate: 18 to 25 percent slopes

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage		Legume - Grass Hay	Legume - Grass Pasture	Bluegrass Pasture
				B/A	T/A		T/A	AUM	AUM
0-2% slopes	IIs	.43	3.2	70	14		4	6.6	5.4
2-6% slopes	IIe			70	12		4	6.6	5.4
6-12% slopes	IIIe			65	12		3.5	5.9	4.8
2-12% slopes	IIIe			65	12		3.5	5.9	4.8
12-25% Slopes	VIe			--	--		---	5.0	4.1

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity Important Trees	Site Index	Woodland Management Hazards Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species To Favor	To Plant	Other
All	10	Aspen Red Pine WhitePine White Spruce	79 55 50 58	Slight to Moderate 0 to 12% slopes; Severe 12 to 25% slopes	Moderate to Severe	Slight to Moderate	Moderate to Severe	W. Spruce Red Pine Basswood Aspen	W. Spruce Red Pine Basswood	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

FOR INTERIM USE
Subject to change on completion of coordination between MLRA's

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS [1]/

SERIES Spooner 147
STATE Minnesota
MLRA 88 and 92
Revised Draft DDB 1-73

The Spooner series consists of nearly level, poorly to somewhat poorly drained soils formed in silty lake laid sediment. These soils are slightly concave areas in glacial lake bottoms. Native vegetation was forest. In a representative profile, the surface layer is very dark gray, very fine sandy loam about 6 inches thick. The subsurface layer is light brownish gray loamy very fine sand about 9 inches thick. The subsoil is mottled olive gray friable loam about 7 inches thick. The underlying material is light olive gray silt loam. Permeability is moderate. The available water capacity is high to very high and the organic matter content is medium. The inherent fertility is medium. **These soils are stone free.**

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-15	Very fine sandy loam	SM or ML	A-4	0	100	100	90-100	35-80	20-30	1-10	2.0-6.0	0.20-0.22	6.1-7.8	Low
15-22	Loam	ML or CL	A-4 or A-6	0	100	100	90-100	75-90	20-40	5-15	0.6-2.0	0.17-0.19	6.1 7.8	Low to Moderate
22-60	Silt loam	ML	A-4	0	100	100	90-100	75-90	20-30	1-10	0.6-2.0	0.20-0.22	7.4-8.4	Low

Flooding: Slight
Hydrologic group: C
Depth to water table: 1 to 3 feet
Depth to bedrock: Over 10 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high frost action; poorly to somewhat poorly drained; poor stability; ML material; low to moderate shrink-swell
Sand	Not suitable
Gravel	Not suitable
Topsoil	Poor: thin surface; poorly to somewhat poorly drained

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: high seasonal water table; moderate permeability
Sewage Lagoons	Severe: high seasonal water table
Shallow Excavations	Severe: high seasonal water table; poor stability; good workability; poorly to somewhat poorly drained
Dwellings: With Basements	Severe: high seasonal water table; poorly to somewhat poorly drained; severe frost action
Without Basements	Severe: high seasonal water table; poorly to somewhat poorly drained; severe frost action
Sanitary Landfill	Severe: seasonal water table at depths of 1 to 3 feet; fair trafficability when wet; silty texture; poorly to somewhat poorly drained
Local Roads and Streets	Severe: high susceptibility to frost action; high seasonal water table; poorly to somewhat poorly drained; ML material
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Permeability is moderate; organic matter content is medium
Embankments, Dikes, and Levees	Compacted permeability and compressibility are medium; water table seasonally high; piping resistance is poor; shear strength and shrink-swell is low
Drainage of Cropland and Pasture	water table is seasonally high; permeability is moderate; there are no stones present
Irrigation	High to very high available water capacity; medium water intake rate; moderate permeability; poorly to somewhat poorly drained; nearly level
Terraces and Diversions	Not applicable; nearly level
Grassed Waterways	Poorly to somewhat poorly drained; moderately erodible; nearly level; good to fair workability

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

Spooner--2

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: if not drained; high seasonal water table; occasionally ponded; fair trafficability; stone free; level.
Picnic Areas	Severe: if not drained; high seasonal water table; occasionally ponded; fair trafficability; stone free; level.
Playgrounds	Severe: if not drained; high seasonal water table; occasionally ponded; fair trafficability; stone free; level.
Paths and Trails	Severe: if not drained; high seasonal water table; occasionally ponded; fair trafficability; stone free; level.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn Silage	Oats	Bluegrass Pasture	Potatoes	Legume-Grass Hay	
				T/A	Bu	AUM	Cwt.	Tons	AUM
0-2% slopes	IIIw	-	-	14	90	5.0	500	4.5	6.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	3w	Aspen Red Pine W. Pine W. Spruce	50-60 50-60 50-55 50-60	Slight	Moderate	Moderate	Severe	Aspen W. Spruce W. Pine	W. Spruce W. Pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

CROPLAND

Moderate natural productivity. Choice of crops is restricted by the poorly drained condition of the soil and by soil temperatures. Workability is good; the rooting zone is deep. This soil must be drained for maximum production. Fertility must also be increased. High to very high available water capacity.

OTHER

FOR INTERIM USE

Subject to change on completion of coordination between MLRA's

USDA-SCS-LINCOLN, NEBR. 1973

Initial Review Draft - WJA-2-72

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES Baudette 167
STATE Minnesota
MLRA 88

SOIL SURVEY INTERPRETATIONS 1/

The Baudette series consists of nearly level to sloping, moderately well to well drained soils formed in lake laid silts. These are generally on broad flat areas but are also on gentle sloping or sloping areas along drainage ways. Native vegetation was forest. In a representative profile, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is dark yellowish brown, friable clay loam about 7 inches thick. The underlying material is yellowish brown silt loam. Permeability is moderate. The available water capacity is high to very high. The inherent fertility is moderate. The organic matter content is low. Stone free.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-8"	loam	ML	A-4	0	100	100	95-100	75-90	20-40	1-10	0.6-2.0	0.20-0.22	6.6-7.3	Low
8-15"	clay loam	CL	A-6	0	100	100	95-100	75-90	20-40	10-20	0.2-0.6	0.15-0.19	6.1-7.3	Mod.
15-60"	silt loam	ML	A-4	0	100	100	95-100	75-90	20-40	1-10	0.6-2.0	0.20-0.22	7.4-8.4	Low

Flooding: Slight
Hydrologic group: B
Depth to water table: 3 to 6 feet
Depth to bedrock: Over 10 feet
Corrosivity - uncoated steel: Moderate
Corrosivity - concrete: Slight

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: Low to moderate shear strength and medium compressibility; moderate frost action.
Sand	Unsuitable.
Gravel	Unsuitable.
Topsoil	Good to fair: Surface texture is a silt loam with a low amount of organic matter.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe:	Moderate permeability; seasonal water table at 3 to 6 feet. Severe on slopes over 12%.
Sewage Lagoons	Moderate:	Severe on slopes over 6%; permeability is moderate. There are no coarse fragments present and there is low organic matter content.
Shallow Excavations	Moderate:	Poor to fair stability; seasonal water table at 3 to 6 feet; medium resistance to piping.
Dwellings:		
With Basements	Moderate:	Moderate frost action; severe on slopes over 15%.
Without Basements	Moderate:	Seasonal water table at 3 to 6 feet. Moderately well to well drained. / Moderate frost action; severe on slopes over 15%.
Sanitary Landfill	Moderate:	Moderately well to well drained, seasonal water table at 3 to 6 feet.
Local Roads and Streets	Moderate:	Moderate frost action; moderate on slopes over 12%. ML material.
Potential Frost Action	Moderate.	

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Permeability and resistance to piping are medium; organic matter content is low.
Embankments, Dikes, and Levees	Compacted permeability and compressibility are medium; depth to the water table is 3 to 6 feet. Piping resistance is poor, poor stability, poor compaction characteristics.
Drainage of Cropland and Pasture	Not needed.
Irrigation	Available water capacity is high to very high. Intake rate rapid; moderate permeability and is moderately well to well drained; soils occupy nearly level to rolling areas.
Terraces and Diversions	Not applicable because of the shortness of the slopes.
Grassed Waterways	Moderately erodible; moderate slope limitation on 2 to 6% slopes; severe on slopes over 6%.

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets

MN-SOILS-3
11-71
(File Code SOILS-12)

Baudette

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Slight - Good natural drainage and depth to water table is deep; permeability is moderate. Surface texture is a loam and no stones present; mod.on 6-12% slopes; severe on slopes over 12%.
Picnic Areas	Slight - Good natural drainage and depth to water table is deep. Surface texture is a loam & no stones present; moderate on 6-12% slopes; severe on slopes over 12%.
Playgrounds	Slight - Erosion increases with slope; natural drainage is moderately well to well and depth to water table is deep.Surface texture is loam;no stones present.Mod.on 2-6% slopes; Severe on 6-12% slopes.
Paths and Trails	Slight - Surface texture is a loam and there are no stones present; moderate on 12-18% slopes.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn Tons	Oats Bu.	Leg.-Grass Pasture AUM	Potatoes Bu.	Legume-Grass T/A
A 0-2% slope	IIc	.37	4.3	14	90	5.2	500	4.5
B 2-6% slope	IIe	.37	4.3	13	90	5.2	450	4.5
BC 2-12% slope	IIIe	.37	4.3	12	90	5.2	400	4.5
DE 12-25% slope	VIe	.37	4.3			120		

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
0-2%	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor
2-6%	Fair	Good	Good	Good	Poor	Very Poor	Poor	Good	Good	Very Poor
6-12%	Fair	Good	Good	Good	Poor	Very Poor	Very Poor	Good	Good	Very Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	lo	Aspen Red Pine White Pine	70-85 55-65 50-60	Slight Mod. on slopes over 12%	Slight Mod. on slopes over 12%	Slight	Severe	Red Pine White spruce Aspen White Pine	Red Pine White spruce Birch Basswood	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

CROPLAND: Above average general productivity. Choice of crops is restricted by cool soil temperatures. Workability is good; the rooting zone is deep; depth to water table is deep; susceptibility to erosion is great on the steeper slopes. Very responsive to proper fertilization and management. Generally has an effective snow cover over winter. High to very high available moisture capacity. Average annual precipitation ranges from 20 to 27 inches with 3/4 of it during the growing season.

MRTSC Trial Form
File Code Soils-12
Rev. 9-10-71

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES Indus 172
STATE Minnesota
MLRA 88, 89
REV. ROP-ELB 8-71

These are deep, poorly and somewhat poorly drained, nearly level, clayey soils with slow permeabiaity on glacial lake plains. The surface layer is black clay about 2 inches thick. The subsurface layer is dark gray clay loam about 4 inches thick. The subsoil is very firm dark gray and olive gray clay. The underlying material is olive and olive gray clay with mottles. Native vegetation was mixed deciduous and coniferous forest.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-5	Clay and clay loam	CH	A-7		100	95-100	85-95	70-90	50-70	30-50	.06-.20	.13-.16	5.6-6.5	Mod.-High
5-23	clay	CH	A-7		100	100	95-100	85-95	50-70	30-50	.06-.20	.10-.14	5.6-7.8	High
23-60	clay	CH	A-7		100	100	95-100	85-95	50-70	30-50	.06-.20	.09-.13	7.5-8.0	High

Flooding Slight — Hydrologic group: D

Depth to water table: Seasonsal high water table at 1 to 3 feet. — Depth to bedrock: Greater than 5 feet.

Corrosivity - uncoated steel: Very High — Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: poor shear strength, poor workability, high shrink-swell, high compressibility.
Sand	Not suitable.
Gravel	Not suitable.
Topsoil	Poor: fine textured, low organic matter.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: slow permeability; fine soil texture; seasonal high water table at 1 to 3 feet; poorly and very poorly drained.
Sewage Lagoons	Severe: slow permeability; nearly level slopes; fine soil texture; but seasonal high water table at 1 to 3 feet.
Shallow Excavations	Severe: high water table; fine textured.
Dwellings:	Severe: Poor shear strength; high shrink-swell; high compressibility; seasonal high water table at 1 to 3 feet.
Sanitary Landfill	Severe: Poorly and very poorly drained; slow permeability; fine soil texture; poor workability; slippery when wet.
Local Roads and Streets	Severe: Poorly and somewhat poorly drained; fine soil texture; high shrink-swell potential.
Potential Frost Action	Moderate - Soil texture, poor and somewhat poor drainage

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Slow permeability; good resistance to piping.
Embankments, Dikes, and Levees	High compacted permeability; high compressibility; seasonal high water table at 1 to 3 feet; good resistance to piping; poor shear strength; high shrink-swell potential; poor workability.
Drainage of Cropland and Pasture	Fine textured material throughout; seasonal high water table at 1 to 3 feet; slow permeability; occasionally flooded or ponded.
Irrigation	Usually not considered because of the poor and somewhat poor soil drainage; slow permeability; very slow intake rate.
Terraces and Diversions	
Grassed Waterways	Fine textured material throughout; poor and somewhat poorly drained; usually nearly level topography; poor workability.

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1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: Slow permeability; poorly and somewhat poorly drained; moderately fine and fine textured surface.
Picnic Areas	Severe: Poorly and somewhat poorly drained; moderately fine and fine textured surface.
Playgrounds	Severe: Slow permeability; poorly and somewhat poorly drained; moderately fine and fine textured surface.
Paths and Trails	Severe: Poorly and somewhat poorly drained; moderately fine and fine textured surface.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats Bu.	Alfalfa-grass Tons	Alfalfa-grass Pasture AUM	Clover-grass TONS	Clover-grass Pasture AUM	Bluegrass Pasture AUM
0 to 2% slopes	IIIw	-	-	65	4.0	6.0	3.5	5.2	4.8

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	To Plant	Other
0 to 2% slopes	2w	Aspen	76	Slight	Moderate	Moderate	Severe		White spruce, White pine	
		White spruce	53							

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

CROPLAND

General productivity is moderate to high if the wetness hazard has been corrected and the lime and fertilizer requirements are met. Climate restricts the choice of crops. Snow cover is commonly continuous throughout the winter.

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES TOIVOLA 215
STATE Minnesota
MLRA 89 & 90-2
D.P. RL 2-72

This series consists of nearly level to very steep, excessively drained soils formed in outwash material. These soils are on outwash eskers and ice-contact glacial deposits. Native vegetation was forest. The surface layer is dark reddish brown decomposed plant remains about 2 inches thick. The subsurface layer is gray very gravelly coarse sandy loam about 5 inches thick. The subsoil is strong brown, gravelly loamy sand about 10 inches thick. The underlying material is brown very gravelly coarse sand. Permeability is very rapid. The available water capacity is very low and organic matter content is low. These soils contain many cobbles and boulders.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-15	Very Gravelly loamy sand	GW, GP or SP	A-1	0-10	20-60	10-50	4-30	0-5	NP	NP	Greater than 20	0.03-0.05	5.1-6.5	Low
15-60	Very Gravelly loamy sand	GW, GP or SP	A-1	5-20	20-60	10-50	4-30	0-5	NP	NP	Greater than 20	0.02-0.04	5.1-6.5	Low

Flooding: None
Hydrologic group: A
Depth to water table: Greater than 5 feet
Depth to bedrock: Normally greater than 6 feet
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good: high shear strength; low compressibility
Sand	Poor: quantity of sand is low
Gravel	Good: stones and boulders
Topsoil	Poor: coarse textured; stones and boulders

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Slight: very rapid permeability; moderate on 6 to 12 percent slopes; severe on slopes over 12 percent; hazard of polluting underground water
Sewage Lagoons	Severe: very rapid permeability; coarse textured
Shallow Excavations	Severe: stones and boulders; very gravelly
Dwellings: With Basements	Slight: on 0 to 6 percent slopes; moderate on 6 to 12 percent slopes; severe on more than 12 percent slopes
Sanitary Landfill (trench type)	Severe: very rapid permeability; coarse textured
Local Roads and Streets	Slight: on 0 to 6 percent slopes; moderate on 6 to 12 percent slopes; severe on more than 12 percent slopes.
Potential Frost Action	

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High compacted permeability
Embankments, Dikes, and Levees	High compacted permeability; low compressibility; high shear strength
Drainage of Cropland and Pasture	Not needed; excessively drained
Irrigation	Very low available water capacity
Terraces and Diversions	Coarse textured; stones and boulders
Grassed Waterways	Coarse textured; stones and boulders

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1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

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11-71
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Toivola 215

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate: many coarse fragments at the surface; 0 to 12 percent slopes; severe on more than 12 percent slopes
Picnic Areas	Moderate: many coarse fragments at the surface; 0 to 12 percent slopes; severe on more than 12 percent slopes
Playgrounds	Severe: many coarse fragments at the surface
Paths and Trails	Moderate: many coarse fragments at the surface; 0 to 25 percent slopes; severe more than 25 percent slopes

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Pasture	Grass-Legume		
				AUM	T/A		
2-12% slopes	IVs	.20	3	3	2.0		
12-45% slopes	VIIs			2.25	-		

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Poor	Poor	Very Poor	Very Poor	Very Poor	Very Poor	Poor	Very Poor	Very Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	4s	Jack Pine Trembling Aspen	40 or less 50 or less	Slight increases with steep slopes	Moderate 0-12% slopes increases with steep slopes	Moderate to severe	Low	Jack Pine	Jack Pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

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11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES Menahga 258
STATE Minnesota
MLRA 88, 90

This series consists of deep excessively drained soils formed in glacial outwash under coniferous forest on outwash plains and valley trains. Typically they have black and very dark grayish brown loamy coarse sand 4 inches thick; dark brown, dark yellowish brown and brown coarse sand subsoils 20 inches thick; and pale brown coarse sand underlying material. Slopes range from 0 to 12 percent. Most areas are forested, a few cropped or pastured.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-4	LCOS	SM	A-2	-	95-100	85-100	60-80	10-30	-	-	6.0-20	0.10-0.12	4.5-6.0	Low
4-60	COS, S	SP	A-3	-	95-100	85-100	50-75	0-10	-	-	6.0-20	0.05-0.07	4.5-6.0	Low

Flooding: None
Hydrologic group: A
Depth to water table: greater than 6 feet
Depth to bedrock: greater than 60 inches
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good
Sand	Good
Gravel	Unsuited
Topsoil	Poor - too sandy

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Hazard of pollution 0-8%: slight 8+%: moderate - slope
Sewage Lagoons	Hazard of pollution Severe - seepage
Shallow Excavations	Severe - cutbanks cave
Dwellings: With Basements Without Basements	0-8%: slight 8+%: moderate - slope
Sanitary Landfill	Hazard of pollution Severe - seepage
Local Roads and Streets	0-8%: slight 8+%: moderate - slope
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Seepage
Embankments, Dikes, and Levees	Seepage
Drainage of Cropland and Pasture	Not needed
Irrigation	Droughty, seepage
Terraces and Diversions	Erodes easily, too sandy
Grassed Waterways	Droughty

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

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Menahga 258

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate - too sandy
Picnic Areas	Moderate - too sandy
Playgrounds	0-6%: moderate - too sandy 6+%: severe - slope
Paths and Trails	Moderate - too sandy

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn Silage (tons)	Oats (Bu)	Grass-Legume Hay (tons)	Kentucky Bluegrass (AUM)
0-12%	4s	.20	5	8	40	2.5	1.2

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Poor	Fair	Poor	Poor	V. Poor	V. Poor	Poor	Poor	V. Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	3s	Red Pine White Pine Jack Pine White Spruce	56 54 60 59						Red Pine White Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor
Group 6	Eastern Red Cedar	15	
	Red Pine	20	
	Jack Pine	21	
	Ponderosa Pine	20	

OTHER

FOR INTERIM USE
Subject to change on completion of coordination between MLRA's

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES Unnamed (482)
STATE Minnesota
MLRA 88

Initial Review Draft JAS 4-74

This series consits of nearly level, somewhat poorly and poorly drained soils, formed in fine sands underlain by clayey material at about 28 inches. Native vegetation is forest. The surface layer is grayish brown fine sand about 6 inches thick. The subsoil is olive brown fine sand about 22 inches thick. The underlying material is olive gray clay. Permeability is rapid in the sandy portion and slow in the clayey portion. The inherent fertility and organic matter content are low.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-6	fine sand	SP-SM	A-2 or A-3	0	100	100	90-100	5-10	NP	NP	6.0-20.0	.07-.09	5.1-6.0	Low
6-28	fine sand	SP-SM	A-2 or A-3	0	100	100	90-100	5-10	NP	NP	6.0-20.0	.07-.09	5.1-7.3	Low
28-60	clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.09-.13	7.4-8.4	High

Flooding: Slight

Hydrologic group: B

Depth to water table: Seasonal high water table at 1 to 3 feet

Depth to bedrock: Greater than 5 feet

Corrosivity - uncoated steel: Moderate: in the sandy material
Very High: in the clayey material

Corrosivity - concrete: High: in the sandy material
Moderate: in the clayey material

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high shrink-swell potential in clayey underlying material
Sand	Poor: thickness of sand layer and somewhat poorly and poorly drained condition limits use
Gravel	Unsuited
Topsoil	Poor: sandy textures; low organic matter content

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: seasonal high water table; slow permeability in clayey underlying material
Sewage Lagoons	Severe: high seasonal water table
Shallow Excavations	Severe: somewhat poorly and poorly drained; seasonal high water table; clayey texture in underlying material
Dwellings: With Basements, Without Basements	Severe: seasonal high water table; poor shear strength, high shrink-swell potential and high compresssibility in the underlying clayey material
Sanitary Landfill	Severe: seasonal high water table; slow permeability, fine soil texture, and poor workability in the underlying clayey material
Local Roads and Streets	Severe: somewhat poorly and poorly drained; fine soil texture and high shrink-swell potential in the underlying clayey material
Potential Frost Action	Low in the sandy portion. Moderate in the clayey portion

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Surface sandy layer ranging from 20 to 40 inches thick
Embankments, Dikes, and Levees	Fair to poor compaction characteristics in clayey underlying material
Drainage of Cropland and Pasture	Surface sandy layer ranging from 20 to 40 inches thick; rapid permeability; high seasonal water table
Irrigation	Sandy surface layer has low available water capacity; underlying clayey material at 20 to 40 inches depth; somewhat poorly and poorly drained
Terraces and Diversions	Not applicable
Grassed Waterways	Sandy surface layer; low available water capacity; somewhat poorly and poorly drained

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

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Unnamed (482)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: somewhat poorly and poorly drained; sandy surface texture
Picnic Areas	Severe: somewhat poorly and poorly drained; sandy surface texture
Playgrounds	Severe: somewhat poorly and poorly drained; sandy surface texture
Paths and Trails	Severe: somewhat poorly and poorly drained; sandy surface

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Legume-Grass	Legume-Grass Past.	Perm. Past.
				BU	T/A	AUM	AUM
0-2%	IVw	.20	5.5	60	3.0	5	3

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Fair	Good	Poor	Good	Good	Moderate	Moderate	Slight

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	2w	aspen wh spruce	80 55	slight	moderate	moderate	moderate or severe	aspen wh pine red pine wh spruce	wh spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER CROPLAND

Suitable for most crops grown in the area but requires effective drainage systems for water removal. The rooting zone is restricted by the depth of the water table which is seasonally at 1 to 3 feet. Fertilization and good management effect moderate production increases. Climate conditions restrict the choice of crops. Precipitation averages 21 to 28 inches with most of it coming during the growing season.

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES Newfound 515
STATE Minnesota
MLRA 89, 90
Rev. DHP-ELB 11/71
Rev. DHP-ELB-JAS 9/74

The Newfound series consists of gently sloping to steep well drained soils formed in more than 40 inches of brownish, medium and strongly acid gravelly sandy loam. At depths of 14 to 28 inches there occurs a well developed fragipan ranging in thickness from 10 to 35 inches or more. Percent of coarse fragment typically is 25 to 35 percent. The fragipan restricts root penetration. The terrain is sloping to hilly. The slope ranges from 2 to 25 percent. The predominant present land use is woodland.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0 to 16	Gravelly sandy loam	SM	A-2	5-15	50-75	40-65	30-55	20-35	10-20	0-4	2.0-6.3	0.10-0.14	4.5-6.0	Low
16 to 50 (fragipan)	Gravelly sandy loam	SM	A-2	5-15	50-75	40-65	30-55	20-35	10-20	0-4	0.06-0.2	.05-.09	5.1-6.0	Low

Flooding: None
Hydrologic group: C
Depth to water table: Below 5 feet
Depth to bedrock: Below 5 feet
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good to fair: difficult to dig if dry; high content of coarse fragments
Sand	Not suitable
Gravel	Poor
Topsoil	Poor: high coarse fragment content

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: slow permeability
Sewage Lagoons	Moderate: 2 to 7% slopes Severe: more than 7% slopes
Shallow Excavations	Moderate: 0 to 15% slopes, large stones, high coarse fragment content, difficult to dig when dry. Severe: more than 15% slope
Dwellings: With Basements	Moderate: large stones, 0 to 15% slope
Sanitary Landfill (trench)	Moderate: large stones
Local Roads and Streets	Slight: 0 to 8% slopes; Moderate: 8 to 15% slopes; Severe: more than 15% slopes
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	
Embankments, Dikes, and Levees	Large stones, piping
Drainage of Cropland and Pasture	Generally not needed; well and moderately well drained
Irrigation	Slow permeability; fragipan
Terraces and Diversions	High coarse fragment content
Grassed Waterways	High coarse fragment content; slow permeability; fragipan

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

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Newfound 515

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate: large stones Severe: on slopes over 15%
Picnic Areas	Slight: on slopes less than 8 percent; Moderate: 8 to 15% slopes; Severe: more than 15% slopes
Playgrounds	Moderate: 2 to 6% slope Severe: more than 6% slopes
Paths and Trails	Slight: 0 to 15% slopes; Moderate: 15 to 25% slope;

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
2 to 12 percent slopes	IVs	.37	2				
12 to 25 percent slopes	VIe						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Fair	Fair	Fair	Very Poor	Very Poor	Poor	Fair	Very Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
0-12%	2d1	Trembling aspen	75	Slight	Slight	Moderate	Moderate	Aspen Red Pine	Red Pine White	
12-25%	2d2	White Pine Red Pine White Spruce Jack Pine	55 60 59 54	Moderate	Moderate	Severe	Slight	White Pine White spruce	spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Low potential productivity. Moderate to low natural fertility; no native plants suitable for grazing. Watershed - Deep to bedrock; mornumus; permeability 0.06-0.2"/hr.; moderate runoff; well drained.

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Series - Greenwood 530S
STATE Minnesota
MLRA 88-90
Revised Draft GDN, RRL 2-72

These are extremely to very strongly acid deep organic soils. They consist of moderately decomposed dark brown or dark reddish brown herbaceous material throughout most of the layers from 12 to 51 inches. Normally these soils occupy bogs ranging from 10 to more than 600 acres in size. Black spruce along with a few tamarack are the major trees growing on these soils. The permeability is moderate to moderately rapid. The available water capacity is very high.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-20	Peat (fibric)	PT	A-8	0	Not suitable for engineering seive analysis				--	--	6-20+	0.58-0.70	3.5-4.5	High
20-70	Peat (hemic)	PT	A-8	0					--	--	0.6-6.0	0.48-0.58	4.0-5.0	High

Flooding: None
Hydrologic group: D
Depth to water table: Near surface during most of growing season
Depth to bedrock: Greater than 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: High

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: organic soils; low bearing capacity
Sand	Not suitable
Gravel	Not suitable
Topsoil	Poor when used alone. Fair to good when mixed mineral soils; needs lime

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: high water table; very poorly drained
Sewage Lagoons	Severe: high water table; more than 30 percent organic matter
Shallow Excavations	Severe: high water table; poor side slope stability
Dwellings: With Basements [redacted]	Severe: very poorly drained; high water table
Sanitary Landfill (trench type)	Severe: very poorly drained; high water table
Local Roads and Streets	Severe: high water table; high susceptibility to frost action; high shrink-swell potential more than 30 percent organic matter
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High water table
Embankments, Dikes, and Levees	High water table; low compacted loaded permeability; poor stability more than 30 percent organic matter
Drainage of Cropland and Pasture	High water table; subsidence is common after drainage
Irrigation	High water table; very poorly drained
Terraces and Diversions	Not applicable; nearly level
Grassed Waterways	Not applicable; nearly level

USDA SCS LINCOLN NEBR 1971

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: high water table; poor trafficability
Picnic Areas	Severe: high water table; poor trafficability
Playgrounds	Severe: high water table; poor trafficability
Paths and Trails	Severe: high water table; poor trafficability

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage		Legume - Grass Hay	Legume - Grass Pasture	Bluegrass Pasture
				B/A	T/A		T/A	AUM	AUM
All	IVW	--	--	60	12		4.5	6.7	5.3

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
530S	Very Poor	Very Poor	Poor	Very Poor	Poor	Poor	Good	Very Poor	Very Poor	Fair
530	Very Poor	Poor	Poor	Poor	Poor	Good	Good	Very Poor	Very Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	5w	Black Spruce Tamarack	15-40	Slight	Severe	Severe	Severe	Black Spruce Tamarack	Black Spruce Tamarack	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

CROPLAND OTHER

Potential yields are moderate for the commonly cultivated crops. The choice of crops is limited by climate, low fertility, and a high water table. Crops that can withstand light frost and have a short growing season are best suited. These include carrots, cabbage, cauliflower, celery, potatoes, cultured sod, radishes, onions and the like. Wind erosion and fire are special hazards.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES Mooselake 534
STATE Minnesota
MLRA 89-90

SOIL SURVEY INTERPRETATIONS 1/

Revised Draft GDN-RRL 1-73

The Mooselake Series consists of medium to slightly acid deep very poorly drained organic soils. They consist of moderately decomposed dark reddish brown woody materials throughout most of the layers from 12 to 51 inches. Normally these soils occupy bogs ranging from 10 to more than 600 acres in size. White cedar, tamarack, black spruce and in places black ash are the major trees growing on these soils. Some areas are nearly treeless and have chiefly lowland brush. These soils have a high inherent fertility.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-60	Mucky Peat (hemic)	PT	A-B	0	Not suitable for engineering seive analysis				—	—	10-20	.48-.58	5.1-6.5	High 2/

Flooding: None
Hydrologic group: D
Depth to water table: Near surface during most of growing season
Depth to bedrock: Greater than 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: organic soils; low bearing capacity; high water table
Sand	Not suitable
Gravel	Not suitable
Topsoil	Poor when used alone. Fair to good when mixed with mineral soil; high water table.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: high water table; very poorly drained
Sewage Lagoons	Severe: high water table; more than 30 percent organic matter.
Shallow Excavations	Severe: high water table; very poorly drained; low resistance to sloughing
Dwellings: With Basements	Severe: high water table; very poorly drained
Sanitary Landfill (Trench type)	Severe: very poorly drained; high water table
Local Roads and Streets	Severe: high water table; high susceptibility to frost action; high shrink-swell potential more than 30 percent organic matter
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High water table
Embankments, Dikes, and Levees	High water table; low shear strength
Drainage of Cropland and Pasture	High water table; very poorly drained; organic soil;
Irrigation	High water table; very poorly drained
Terraces and Diversions	Not applicable; nearly level bog
Grassed Waterways	Not applicable; nearly level bog

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

2/ Shrinkage is very high, but the pressure exerted upon swelling is rather low.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: high water table; poor trafficability
Picnic Areas	Severe: high water table; poor trafficability
Playgrounds	Severe: high water table; poor trafficability
Paths and Trails	Severe: high water table; poor trafficability

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Bu. Oats	Tons-Corn Silage	AUM Pasture	Tons Legume-grass	AUM
						Bluegrass		
All	IVW	—	—	60	12	5.0	4.5	6.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Poor	Good	Fair	Fair	Good	Good	Poor	Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	5w	Black Spruce Tamarack White Cedar	30-40	Slight	Severe	Severe	Severe	Black Spruce Tamarack White Cedar	Black Spruce Tamarack White Cedar	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

CROPLAND

Potential yields are moderate for the commonly cultivated crops. The choice of crops is limited by climate, and a high water table. Crops that can withstand light frost and have a short growing season are best suited. These include carrots, cabbage, cauliflower, celery, potatoes, cultured sod, radishes, onions and the like. Soil blowing and fire are special hazards.

MRTSC Trial Form
File Code Soils-12
Rev. 9-10-71

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES WASKISH 538
STATE MINNESOTA
MLRA 88, 89
REV. RRL 8-18-71

The Waskish soils are extremely acid, deep organic soils. They consist of slightly decomposed, reddish brown sphagnum fibers throughout most of the upper 5 feet. Normally they occupy areas within large bogs that have slightly convex surfaces. Mapped areas are usually circular or oblong and range from about 100 to more than 600 acres in size. Black spruce along with a few tamarack are the major trees growing on these soils.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-60"	Fibric	Pt	-		Not suitable for engineering -- sieve analysis				--	--	12-20	0.55-0.65	3.5-4.5	High

Flooding: None
Hydrologic group: D
Depth to water table: 0 to 2 feet.
Depth to bedrock: 5 to many feet.
Corrosivity - uncoated steel: Very high.
Corrosivity - concrete: High

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor; organic soils; very low bearing capacity.
Sand	Not suitable.
Gravel	Not suitable.
Topsoil	Poor when used alone. Fair to good when mixed with mineral soil; needs lime. High water table.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: High water table, organic material.
Sewage Lagoons	Severe: High water table; more than 30% organic matter.
Shallow Excavations	Severe: High water table, organic material.
Dwellings: With Basements, Without Basements	Severe: High water table; low shear strength; high shrink-swell potential high compressibility; very low bearing values.
Sanitary Landfill	Severe: High water table; poor trafficability.
Local Roads and Streets	Severe: High water table; high susceptibility to frost action; high shrink-swell potential; more than 30% organic matter.
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Organic soil, high water table.
Embankments, Dikes, and Levees	High water table; poor stability; more than 30% organic matter.
Drainage of Cropland and Pasture	Water table at the surface or within 1-2 feet during the growing season; usually drained by open ditches.
Irrigation	
Terraces and Diversions	
Grassed Waterways	

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: High water table; poor trafficability.
Picnic Areas	Severe: High water table; poor trafficability.
Playgrounds	Severe: High water table; poor trafficability.
Paths and Trails	Severe: High water table; poor trafficability.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
0 to 2% slope	VIIw	-	-				

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Good	Good	Very Poor	Very Poor	Fair

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	5w	Black spruce	20-30	Slight	Severe	Severe	Severe		Black Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Potential yields are poor for the commonly cultivated crops. The choice of crops is limited by climate, low fertility, and a high water table. Crops that can withstand light frost and have a short growing season are best suited. These include carrots, cabbage, cauliflower, celery, potatoes, cultured sod, radishes, onions and the like. These peats are well suited for commercial peat harvesting.

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS [1]

SERIES Lupton - 546
STATE Minnesota
MLRA 88
Rev. RRL, 11-72

These are medium acid to mildly alkaline deep organic soils. They consist of highly decomposed black or dark reddish brown woody material throughout most of the profile. Normally these soils occupy bogs ranging from 10 to 160 acres in size. Black spruce and cedar along with a few tamarack are the major trees growing on these soils. Some areas are treeless and have chiefly lowland brush. The permeability is slow to moderately slow, The available water capacity is very high.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-51	Muck (sapric)	PT	A-8		Not suitable for engineering seive analysis				--	--	.06-.6	.35-.48	5.6-7.8	---

Flooding: Occasional flooding along streams
Hydrologic group: D
Depth to water table: 0-0.5 feet May to November
Depth to bedrock: Greater 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: High

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: organic soils; low bearing capacity
Sand	Not suitable
Gravel	Not suitable
Topsoil	Poor when used alone. Fair to good when mixed with mineral soil;

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: high water table; very poorly drained
Sewage Lagoons	Severe: high water table; more than 30 percent organic matter
Shallow Excavations	Severe: high water table; very poorly drained; low resistance to sloughing
Dwellings: With Basements	Severe: high water table; very poorly drained; high potential frost action
Sanitary Landfill (trench type)	Severe: high water table; very poorly drained; occasional flooding
Local Roads and Streets	Severe: high water table; high susceptibility to frost action; high shrink-swell potential; more than 30 percent organic matter
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High water table
Embankments, Dikes, and Levees	High water table; low shear strength; low compacted permeability
Drainage of Cropland and Pasture	High water table; very poorly drained, occasionally flooded
Irrigation	High water table; very poorly drained
Terraces and Diversions	Not applicable
Grassed Waterways	Not applicable

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: high water table; poor trafficability
Picnic Areas	Severe: high water table; poor trafficability
Playgrounds	Severe: high water table; poor trafficability
Paths and Trails	Severe: high water table; poor trafficability

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage		Legume - Grass Hay	Legume - Grass Pasture	Bluegrass Pasture
				B/A	T/A		T/A	AUM	AUM
All	IVW	--	--	60	12		4.5	6.7	5.3

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very poor	Poor	Poor	Poor	Poor	Good	Good	Very poor	Very poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	5W	Black Spruce Tamarack	15-40 40-50	Slight	Severe	Severe	Severe	Black Spruce Tamarack	Black Spruce Tamarack	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Potential yields are moderate for the commonly cultivated crops. The choice of crops is limited by climate, low fertility, and a high water table. Crops that can withstand light frost and have a short growing season are best suited. These include carrots, cabbage, cauliflower, celery, potatoes, cultured sod, radishes, onions and the like. Wind erosion and fire are special hazards.

[redacted]-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES Unnamed muck - 559
STATE Minnesota
MLRA 88
Rev. RRL, 11-72

This series consists of very poorly drained organic soils underlain by clayey material at depths of 16 to 51 inches. Typically these soils have black, highly decomposed organic material from herbaceous plants. Normally these soils occupy bogs that range in size from a few acres to one hundred acres.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-27	muck (sapric)	PT	A-8	--	Not suitable for engineering sieve analysis				--	--	.06-.6	.25-.35	6.6-7.3	
27-60	sic	CH	A-7	--	100	100	90-95	90-95	60-65	30-35	0.06	.08-.10	6.6-8.4	High

Flooding: Occasional flooding along streams
Hydrologic group: D
Depth to water table: 0.5 feet, May to November
Depth to bedrock: greater than 5 feet
Corrosivity - uncoated steel: High; wet soil; high carbonate content
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Unsuitable; organic part unstable; mineral part low shear strength; high compressibility
Sand	Unsuitable; little or no sand present
Gravel	Unsuitable; little or no gravel present
Topsoil	Poor; very poorly drained

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Very severe; very poorly drained
Sewage Lagoons	Very severe; very poorly drained
Shallow Excavations	Very severe; very poorly drained
Dwellings: With Basements	Very severe; very poorly drained
Dwellings: Without Basements	very severe; very poorly drained
Sanitary Landfill (trench type)	Very severe; very poorly drained
Local Roads and Streets	Severe; very poorly drained; unstable material
Potential Frost Action	Moderate; wet soil; saturation throughout winter reduces freezing

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Suitable for dugout ponds
Embankments, Dikes, and Levees	Organic part unstable; mineral part has low shear strength; high compressibility
Drainage of Cropland and Pasture	Very slow permeability at 28 to 42 inches depth.
Irrigation	High available water capacity; moderately rapid in upper part; very slowly permeable in lower part.
Terraces and Diversions	Nearly level; very poorly drained
Grassed Waterways	Nearly level; very poorly drained

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

Unnamed muck

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe; very poorly drained; poor trafficability
Picnic Areas	Severe; very poorly drained; poor trafficability
Playgrounds	Severe; very poorly drained; poor trafficability
Paths and Trails	Severe; very poorly drained; poor trafficability

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T		Corn Silage	Oats	Legume - Grass Hay	Legume - Grass Pasture	Bluegrass Pasture
					T/A	B/A	T/A	AUM	AUM
All	IVw				12	60	4.5	6.7	5.3

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very poor	Very poor	Poor	Poor	Poor	Good	Good	Very poor	Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	5w	Tamarack White Cedar Black Spruce	VL	Slight	Severe	Severe	Severe	Tamarack White Cedar	Black Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

FOR INTERIM USE
Subject to change on completion of coordination between MLRA's

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES Quetico 560*
STATE Minnesota
MLRA 90
Rev. DHI-ELP 11/71

The Quetico series consists of somewhat excessively drained soils formed in 4 to 8 inches of dark brown and strong brown, strongly and very strongly acid loam over bedrock. Bedrock outcroppings are common. The terrain is broken, irregular and sloping to hilly.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0 to 8	Loam	ML-CL	A-4		75-95	70-90	60-80	55-70	10-30	5-10	0.63 to 2.0	0.15 to 0.20	4.5 to 5.5	Low
8+	Bedrock													

Flooding: None
Hydrologic group: D
Depth to water table: Over 5 feet
Depth to bedrock: 8 inches or less
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate to high

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: shallow soil, outcrops of bedrock are common
Sand	Unsuited
Gravel	Unsuited
Topsoil	Poor: extremely shallow to bedrock

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: extremely shallow to bedrock; sloping to hilly terrain
Sewage Lagoons	Severe: extremely shallow to bedrock; sloping to hilly terrain
Shallow Excavations	Severe: extremely shallow to bedrock; sloping to hilly terrain
Dwellings: With Basements / Without Basements	Severe: extremely shallow to bedrock; sloping to hilly terrain; low clay content; well drained
Sanitary Landfill	Severe: extremely shallow to bedrock; sloping to hilly terrain
Local Roads and Streets	Severe: extremely shallow to bedrock; sloping to hilly terrain
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Shallow to bedrock, no suitable sites
Embankments, Dikes, and Levees	Shallow to bedrock limited volume of material
Drainage of Cropland and Pasture	
Irrigation	
Terraces and Diversions	
Grassed Waterways	

1/ Use in conjunction with Quetico Soil Interpretation Key Sheet

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: irregular, broken sloping to hilly terrain; extremely shallow soils; soils subject to compaction; low natural fertility
Picnic Areas	Severe: irregular, broken, sloping to hilly terrain
Playgrounds	Severe: irregular, broken, sloping to hilly terrain; extremely shallow soils
Paths and Trails	Moderate on 5 to 18 percent slopes and severe on slopes over 18 percent; irregular broken, sloping to hilly terrain

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
2-45%	VIIs	-	-				

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
	V. Poor	Poor	Poor	Poor	Poor	V. Poor	V.Poor	Poor	Poor	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All		Jack pine	<40	Moderate to severe	Moderate to severe	Slight	Slight		Jack pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Watershed - Extremely shallow to bedrock; morhumus; permeability 0.63-2.0"/hr.; rapid runoff; low storage; somewhat excessively drained.

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Land Type ~~SERIES~~ Rock Outcrop 560 *
STATE Minnesota
MLRA 88, 89, 90, 92
Rev. RRL. 11-72

This land type consists of relatively impermeable hard igneous and sedimentary bedrock. , Typically this type of land consists of bedrock outcrop that is in complex patterns with extremely shallow Quetico soils and other deeper soils. The land is typically broken and irregular with nearly level to steep slopes.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
---	-----	-----	-----	Hard bedrock, material is unclassified							-----	-----	---	-----

Flooding: None
Hydrologic group: D
Depth to water table: Deeper than 10 feet
Depth to bedrock: 0 to 4 inches
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: hard bedrock
Sand	Unsuited
Gravel	Unsuited
Topsoil	Unsuited

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe, hard bedrock
Sewage Lagoons	Severe, hard bedrock
Shallow Excavations	Severe, hard bedrock
Dwellings: With Basements ~~xxxxxxxxxxxx~~	Severe, hard bedrock
Sanitary Landfill	Severe, hard bedrock
Local Roads and Streets	Severe, hard bedrock
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	hard bedrock
Embankments, Dikes, and Levees	hard bedrock
Drainage of Cropland and Pasture	unsuited
Irrigation	unsuited
Terraces and Diversions	unsuited
Grassed Waterways	unsuited

USDA SCS LINCOLN, NEBR. 1971

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

Rock Outcrop

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: hard bedrock
Picnic Areas	Severe: hard bedrock; includes nearly level areas that are suited for this use.
Playgrounds	Severe: hard bedrock
Paths and Trails	Slight: 0 to 18% slopes; Severe: 18 to 35% slopes; slippery when wet

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
All	VIII	--	--	Not suited for cultivated crops			

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	D	Jack Pine Red Pine Cedar	Very low	Severe	Severe	Severe	Severe		Jack Pine Juniper-shrub type	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

FOR INTERIM USE
Subject to change on completion of coordination between MLRA'S

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES Unnamed 716
STATE Minnesota
MLRA 88

Initial Review Draft JAS 4-74

This series consists of nearly level to gently sloping well and moderatley well drained soils, formed in fine sands underlain by clayey material at about 27 inches. Native vegetation is forest. The surface layer is grayish brown loamy fine sand about 6 inches thick. The subsoil is a brownish fine sand about 21 inches thick. The underlying material is olive gray clay. Permeability is rapid in the sandy portion and slow in the clayey portion. The inherent fertility and organic matter content are low.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-6	loamy fine sand	SM	A-2	0	100	100	90-100	10-25	0-2	0-2	2.0-6.0	.09-.12	5.1-6.5	Low
6-27	fine sand	SP-SM	A-2 or A3	0	100	100	90-100	5-10	NP	NP	6.0-20.0	.07-.09	5.1-7.3	Low
27-60	clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.09-.13	6.6-8.4	High

Flooding: None

Hydrologic group: C

Depth to water table: Occasionally perched water table above clayey material in the spring. Otherwise deep.

Depth to bedrock: Greater than 5 feet

Corrosivity - uncoated steel: High: in the clayey material
Low: in the sandy material

Corrosivity - concrete: Moderate: in the sandy material
Low: in the clayey material

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high shrink-swell potential in clayey underlying material
Sand	Fair: thickness of sand layer limits use: ranges from 20 to 40 inches thick
Gravel	Unsuited
Topsoil	Poor: sandy textures: low organic matter content

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: thin sandy surface layer: slow permeability in the clayey underlying material
Sewage Lagoons	Slight: on 0-2 percent slopes Moderate: on 2-6 percent slopes
Shallow Excavations	Severe: clayey texture in underlying material; poor workability
Dwellings: With Basements	Severe: poor shear strength, high shrink-swell, and high compressibility in the underlying clayey material
Sanitary Landfill	Severe: slow permeability and poor workability in the underlying clayey material
Local Roads and Streets	Severe: low bearing strength and high shrink-swell potential in the underlying clayey material
Potential Frost Action	Low: in the sandy portion Moderate: in the clayey portion

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Sandy surface layer ranging from 20 to 40 inches thick
Embankments, Dikes, and Levees	Fair to poor compaction characteristics in clayey underlying material
Drainage of Cropland and Pasture	Sandy surface layer ranging from 20 to 40 inches thick: rapid permeability
Irrigation	Sandy surface layer has low available water capacity; underlying clayey material at 20 to 40 inch depth; well and moderately well drained
Terraces and Diversions	Usually not needed
Grassed Waterways	Sandy surface layer; low available water capacity

USDA SCS LINCOLN NEBR 1971

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

Unnamed 716

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate: loamy fine sand surface texture
Picnic Areas	Moderate: loamy fine sand surface texture
Playgrounds	Moderate: loamy fine sand surface texture
Paths and Trails	Moderate: loamy fine sand surface texture

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Legume-Grass	Legume-Grass past.	Perm. Past.
				Bu	T/A	AUM	AUM
0-2%	IIIs	.20	5.5	65	3.0	5	3
2-6%	IIIs	.20	5.5	65	3.0	5	3

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Good	Good	Good	Good	Fair	Poor	Poor	Slight	Slight	Severe

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	2Ø	jack pine aspen red pine wh spruce wh pine	60 77 60 60 60	moderate	moderate	slight	moderate	red pine wh spruce wh pine aspen	red pine wh spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OUTDOOR CROPLAND

Suitable for most crops grown in the area. Workability is good. A perched water table may occur above the clayey underlying material in the spring. Fertilization and good management can effect moderate production increases. May be somewhat droughty is shallow rooted crops are grown. Precipitation averages from 21 to 28 inches with most of it coming during the growing season. Early maturing crops are best adapted to the climatic limitations.

FOR INTERIM USE
Subject to change on completion of coordination between MLRA'S

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES Unnamed 1301
STATE Minnesota
MLRA 88

Initial Review Draft JAS 9/74

These are deep, somewhat poorly drained, nearly level clayey over sandy soils. The surface layer is dark colored silty clay loam about 5 inches thick. The subsoil layer is slowly permeable dark gray and olive gray clay about 18 inches thick. The underlying material is rapidly permeable pale brown fine sand.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-5	silty clay loam	CL	A-6	0	100	100	95-100	85-95	38	4	0.2-0.6	.15-.18	5.6-6.5	Mod High
5-23	clay	CH	A-7	0	100	100	90-100	75-95	50-70	30-50	.06-.20	.10-.14	5.6-7.8	High
23-60	fine sand	SM	A-2	0	100	100	65-80	20-35	NP	NP	6.0-20.0	.05-.07	5.6-6.5	Low

Flooding Slight

Hydrologic group: D

Depth to water table: Seasonal high water table at 2 to 4 feet

Depth to bedrock: Greater than 8 feet

Corrosivity - uncoated steel: Very high in clay; low in sand

Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: fine textured surface layers and seasonal high water table at 2 to 4 feet
Sand	Fair: fine textured surface layers and seasonal high water table make sand removal difficult
Gravel	Not suitable
Topsoil	Poor: fine textured surfaces layers, low organic matter

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: seasonal high water table
Sewage Lagoons	Severe: underlying material sandy
Shallow Excavations	Severe: seasonal high water table
Dwellings: With Basements	Severe: seasonal high water table
Sanitary Landfill	Severe: rapid permeability in sand; seasonal high water table
Local Roads and Streets	Severe: fine textured surface layers; somewhat poorly drained
Potential Frost Action	Moderate: somewhat poorly drained

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Rapid permeability in sand; seasonal high water table
Embankments, Dikes, and Levees	Underlying material has medium to high shear strength; medium to high susceptibility to piping
Drainage of Cropland and Pasture	Fine textured surface layers; seasonal high water table at 2-4 feet; slow permeability in surface layers and rapid permeability in underlying material.
Irrigation	Somewhat poorly drained; slow permeability in surface layers; very slow intake rate
Terraces and Diversions	Not needed
Grassed Waterways	Nearly level slopes; somewhat poorly drained

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

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Unnamed 1301

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: somewhat poorly drained; fine textured surface layers
Picnic Areas	Severe: somewhat poorly drained; fine textured surface layers
Playgrounds	Severe: somewhat poorly drained; fine textured surface layers
Paths and Trails	Severe: somewhat poorly drained; fine textured surface layers

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Alfalfa grass	Alfalfa grass past.	Clover grass	Clover-grass Pasture	Bluegrass Pasture
				Bu.	Tons	AUM	Tons	AUM	AUM
0-2% slopes	IIIw	-	-	65	4.0	6.0	3.5	5.2	4.8

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
0-2% slopes	3w1	Aspen White spruce	76 53	Slight	Moderate	Moderate	Severe	White spruce Aspen	White spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

General productivity is moderate to high if the wetness hazard has been corrected and the lime and fertilizer requirements are met. Climate restricts the choice of crops. Snow cover is commonly continuous throughout the winter.

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Land Type Clayey Udorthents RB
STATE Minnesota
MLRA 88-1
Rev. RRL 11-72

These very steep soils are normally adjacent to rivers and streams. The slopes range from 25 to 60 percent. Typically the soils have a thin very dark gray surface layer 1 to 3 inches thick. Below this is a clay subsoil about 6 inches thick. The underlying material is calcareous clay. The available water capacity is moderate and the organic matter content is very low. Surface runoff is very rapid.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-7	Clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.10-.14	6.5-7.4	High
7-60	Clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	less than 0.06	.09-.13	7.4-8.4	High

Flooding: None
Hydrologic group: D
Depth to water table: greater than 5 feet
Depth to bedrock: greater than 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high shrink-swell, low strength
Sand	Unsuited
Gravel	Unsuited
Topsoil	Poor: very steep slopes

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: very steep slopes
Sewage Lagoons	Severe: very steep slopes
Shallow Excavations	Severe: very steep slopes
Dwellings: With Basements	Severe: very steep slopes, high shrink-swell
Sanitary Landfill	Severe: very steep slopes
Local Roads and Streets	Severe: very steep slopes, high shrink-swell
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Very steep slopes
Embankments, Dikes, and Levees	High shrink-swell, low strength, very steep slopes
Drainage of Cropland and Pasture	Unsuited, very steep slopes
Irrigation	Unsuited, very steep slopes
Terraces and Diversions	Very steep slopes, low fertility
Grassed Waterways	Very steep slopes, low fertility

USDA-SCS-LINCOLN, NEBR. (1971)

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

Clayey Udorthents

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: very steep slopes, clay texture
Picnic Areas	Severe: very steep slopes, clay texture
Playgrounds	Severe: very steep slopes, clay texture
Paths and Trails	Severe: very steep slopes, clay texture

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
All	VIII			Unsuitable for crop production			

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Poor	Good	Good	Good	Poor	Poor	Poor	Good	Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	4r	Red Pine White Spruce Northern Hardwoods	45 45 55	Severe	Severe	Severe	Severe	Red Pine White Spruce Northern Hardwoods	Red Pine White Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

FOR INTERIM USE
Subject to change on completion of coordination between MLRA's

EXHIBIT 11

MINNESOTA CODE OF AGENCY RULES

POLLUTION CONTROL AGENCY

EFFLUENT STANDARDS FOR DISPOSAL SYSTEMS DISCHARGING TO THE SOUTH FORK OF THE ZUMBRO RIVER

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DEPARTMENT OF ADMINISTRATION

Room 140, Centennial Building, St. Paul, Minnesota 55155

6 MCAR § 4.8043 Effluent standards for disposal systems discharging to the South Fork of the Zumbro river. The following standards of effluent quality and purity are hereby adopted and established for all of the intrastate waters of the South Fork of the Zumbro River from the dam at Silver Lake in Section 26, Township 107 North, Range 14 West in the city of Rochester to the beginning of Lake Zumbro in Section 23, Township 108 North, Range 14 West, Olmsted County.

A. Scope. These effluent standard requirements shall be in addition to the effluent standards imposed by WPC 14 and any other standards imposed by other rules applying to these waters, and shall supersede any less stringent effluent standards conflicting with provisions of this rule.

B. Severability. All provisions of this rule shall be severable and the invalidity of any lettered paragraph or any subparagraph or subdivision thereof shall not void any other lettered paragraph or subparagraph, subdivision or any part thereof.

C. Definitions. The terms "seepage," "industrial wastes," "other wastes," "treatment works," "disposal systems," and "waters of the state," as well as any other terms for which definitions are given in the Water Pollution Control Statutes, as used herein have the meanings ascribed to them in Minn. Stat., §§ 115.01 and 115.41 (1976) with the exception that disposal systems or treatment works operated under permit of the Agency shall not be construed to be "waters of the state" as the term is used herein. Other terms and abbreviations used herein which are not specifically defined in applicable federal or state law shall be construed in conformance with the context, and in relation to the applicable section of the statutes pertaining to the matter at hand and current professional usage.

D. Standards of effluent quality and purity. It is herein established that the Agency shall require the treatment of all discharges of sewage, industrial waste or other waste effluent to meet the following effluent standards (see Section (c) (6), WPC 14 for additional effluent requirements):

Substance or Characteristic**	Limiting Concentration or Range
5-Day Biochemical Oxygen Demand*	14 milligrams per liter
Total Suspended Solids*	20 milligrams per liter
Minimum Dissolved Oxygen*	5 milligrams per liter
Ammonia (N)*	1.6 milligrams per liter

*The concentration specified in Rule WPC 14 Section (c) (6) may be used in lieu of the concentrations specified herein if the discharge of effluent is restricted to the spring flush or other high runoff periods when the stream flow rate above the discharge point is sufficiently greater than the effluent flow rate to insure that the applicable water quality standards are met during such

discharge periods. The ammonia (N) and dissolved oxygen effluent standards are not applicable if a controlled form of discharge is utilized and the applicable water quality standards for ammonia (N) and dissolved oxygen, respectively, are not violated during the discharge period.

**If treatment works are designed and constructed to meet the specified limits given above for a continuous discharge, at the discretion of the Agency the operation of such works may allow for the effluent quality to vary between the limits specified above and in Rule WPC 14 Section (c) (6), provided the water quality standards and all other requirements of the Agency and the U.S. Environmental Protection Agency are being met. Under this variability of treatment option the ammonia (N) effluent concentration could vary up to levels normally obtained by operation of secondary treatment facilities provided the applicable water quality standard for ammonia (N) is met. Such variability of operation must be based on adequate monitoring of the treatment works and the effluent and receiving waters as specified by the Agency.

E. Determination of compliance. Compliance will be based on effluent samples which are representative of the discharge. In making tests or analyses of the sewage, industrial wastes or other wastes to determine compliance with the standards, samples shall be collected in such manner and place, and shall be of such type, number and frequency as may be considered satisfactory by the Agency from the viewpoint of adequately reflecting the condition of the composition of the effluents. Reasonable allowance will be made for dilution of the effluents, which are in compliance with Section D., to meet established water quality standards following discharge into waters of the state. The Agency by allowing dilution may consider the effect on all uses of the waters into which the effluents are discharged. The samples shall be preserved in accordance with procedures given in the fourteenth edition of Standard Methods for the Examination of Water and Waste-Water, by the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation, dated 1976. Test procedures for the analysis of pollutants shall conform to rules and regulations promulgated pursuant to Section 304 of the Federal Water Pollution Control Act of 1972, 33 U.S.C. Section 1314 (1972) and Minn. Stat., § 115.03, subd. 1 (e) (7) (1976). The arithmetic mean for concentrations of 5-day biochemical oxygen demand, total suspended solids, and ammonia (N) shall not exceed the stated values in Section D. of this rule in a period of 30 consecutive days. The value of dissolved oxygen shall never be less than 5 milligrams per liter.

F. Variance from standards. Any person may apply for a variance from any requirements of this rule. Such variance shall be applied for and acted upon by the Agency in accordance with Minn. Stat., ch. 116.07, subd. 5 (1976) and other applicable statutes and rules.

POLLUTION CONTROL AGENCY

6 MCAR § 4.8040 Individual Sewage Treatment Systems Standards

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§ 4.8040

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§ 4.8040 Individual sewage treatment systems standards.

A. Intent. The improper design, location, installation, use and maintenance of individual sewage treatment systems adversely affects the public health, safety and general welfare by discharge of inadequately treated sewage to surface and ground waters. In accordance with the authority granted in Minn. Stat. ch. 104, 105, 115, and 116 (1976), the Minnesota Poilution Control Agency, hereinafter referred to as the Agency, does hereby provide the minimum standards and criteria for the design, location, installation, use and maintenance of individual sewage treatment systems, and thus protect the surface and ground waters of the state, and promote the public health and general welfare.

Further, it is intended that the administration and enforcement of these standards be conducted by local units of government, since experience has shown that sanitary ordinances can most effectively be administered at the local level.

B. Definitions. For the purposes of these standards, certain terms or words used herein shall be interpreted as follows: the word "shall" is mandatory, the words "should" and "may" are permissive. All distances, unless otherwise specified, shall be measured horizontally.

1. Aerobic tank. Any sewage tank which utilizes the principle of oxidation in the decomposition of sewage by the introduction of air into the sewage.

2. Agency. The Minnesota Pollution Control Agency.

3. Alternative system. An individual sewage treatment system employing such methods and devices as presented in section I.

4. Baffle. A device installed in a septic tank for proper operation of the tank, and to provide maximum retention of solids. Includes vented sanitary tees and submerged pipes in addition to those devices that are normally called baffles.

5. Bedrock. That layer of parent material which is consolidated and unweathered.

6. Bedroom. Any room within a dwelling that might reasonably be used as a sleeping room.

7. Building drain. That part of the lowest piping of the drainage system which receives the sewage discharge inside the walls of the building and conveys it to the building sewer beginning at least one foot outside the building footings.

8. Building sewer. That part of the drainage system which extends from the end of the building drain and conveys its discharge to an individual sewage treatment system.

9. Capacity. The liquid volume of a sewage tank using inside dimensions below the outlet.

10. Cesspool. An underground pit into which raw household sewage or other untreated liquid waste is discharged and from which the liquid seeps into the surrounding soil. See section C. 2. d.

11. Distribution pipes. Perforated pipes or agricultural drain tiles that are used to distribute sewage tank effluent in a soil treatment system.

12. DNR. The Minnesota Department of Natural Resources.

13. Dosing chamber (or pump pit or wet well). A tank or separate compartment following the sewage tank which serves as a reservoir for the dosing device.

14. Dosing device. A pump, siphon, or other device that discharges sewage tank effluent from the dosing chamber to the soil treatment system.

15. Dwelling. Any building or place used or intended to be used by human occupants as a single family or two family unit.

16. Filter material. Clean rock, crushed igneous rock or similar insoluble, durable and decay-resistant material free from dust, sand, silt, or clay. The size shall range from three-fourths inch to two and one-half inches.

17. Greywater. Liquid waste from a dwelling or other establishment produced by bathing, laundry, culinary operations and from floor drains, and specifically excluding toilet waste.

18. Holding tank. A watertight tank for storage of sewage until it can be transported to a point of approved treatment and disposal.

19. Impermeable. With regard to bedrock, a bedrock having no cracks or crevices and having a vertical permeability less than one inch in 24 hours shall be considered impermeable. With regard to soils, a soil horizon or layer having a vertical permeability less than one inch in 24 hours shall be considered impermeable.

20. Individual sewage treatment system. A sewage treatment system, or part thereof, serving a dwelling, or other establishment, or group thereof, which utilizes subsurface soil treatment and disposal.

21. Local unit of government. A township, city or county organized under the laws of the State of Minnesota.

22. Mottling. A zone of chemical oxidation and reduction activity, appearing as splotchy patches of red, brown, orange and gray in the soil.

23. Mound system. A system where the soil treatment area is built above the ground to overcome limits imposed by proximity to water table or bedrock, or by rapidly or slowly permeable soils.

24. Other establishment. Any public or private structure other than a dwelling which generates sewage.

25. Percolation rate. The time rate of drop of a water surface in a test hole as specified in section D. 3. b. of this regulation.

26. Permitting authority. Any State agency or local unit of government which administers the provisions of these standards.

27. Plastic limit. A soil moisture content below which the soil may be manipulated for purposes of installing a soil treatment system, and above which manipulation will cause compaction and puddling.

28. Sand. A soil texture composed by weight of at least 85 percent of soil particles ranging in size between 0.05 and 2.0 mm.

29. Seepage pit (or leaching pit or dry well). An underground pit into which a sewage tank discharges effluent or other liquid waste and from which the liquid seeps into the surrounding soil through the bottom and openings in the side of the pit.

30. Septage. Those solids and liquids removed during periodic maintenance of a septic or aerobic tank, or those solids and liquids which are removed from a holding tank.

31. Setback. A separation distance measured horizontally.

32. Sewage. Any water carried domestic waste, exclusive of footing and roof drainage, from any industrial, agricultural, or commercial establishment, or any dwelling, or any other structure. Domestic waste includes but is not limited to liquid waste produced by bathing, laundry, culinary operations and liquid wastes from toilets and floor drains, and specifically excludes animal waste and commercial process water.

33. Sewage flow. Flow as determined by measurement of actual water use or, if actual measurements are unavailable, as estimated by the best available data provided by the Agency.

34. Sewage tank. A watertight tank used in the treatment of sewage. Includes, but is not limited to septic tanks and aerobic tanks.

35. Sewage tank effluent. That liquid which flows from a septic or aerobic tank under normal operation.

36. Septic tank. Any watertight, covered receptacle designed and constructed to receive the discharge of sewage from a building sewer, separate solids from liquid, digest organic matter, and store liquids through a period of detention, and allow the clarified liquids to discharge to a soil treatment system.

37. Shoreland. Land located within the following distances from public waters: (1) 1,000 feet from the ordinary high water mark of a lake, pond or flowage; and (2) 300 feet from a river or stream or the landward extent of a flood plain designated by ordinance on such a river or stream, whichever is greater.

38. Site. The area bounded by the dimensions required for the proper location of the soil treatment system.

39. Slope. The ratio of vertical rise or fall to horizontal distance.

40. Soil characteristics, limiting. Those soil characteristics which preclude the installation of a standard system, including but not limited to evidence of water table or bedrock closer than three feet to the ground surface, and percolation rates faster than one-tenth or slower than 60 minutes per inch.

41. Soil textural classification. Where soil particle sizes or textures are specified in this regulation, they refer to the soil textural classification in the Soil Survey Manual, Handbook No. 18, U. S. Department of Agriculture, 1951.

42. Soil treatment area. That area of trench or bed bottom which is in direct contact with the filter material of the soil treatment system.

43. Soil treatment system. A system whereby sewage tank effluent is treated and disposed of below the ground surface by filtration and percolation through the soil. Includes those systems commonly known as seepage bed, trench, drainfield, disposal field, and includes mounds, Electroosmosis systems, and seepage pits.

44. Standard system. An individual sewage treatment system employing a building sewer, sewage tank and the soil treatment system commonly known as seepage bed or trenches, drainfield, or leachfield.

45. Surface water flooding. The 100 year flood plain along rivers and streams as defined by the DNR, or in the absence of such data, as defined by the largest flood of record. On lakes, high water levels as determined or recorded by the DNR or, in the case of no DNR record, by local records or experience. Other surface water flooding or high water areas should be determined by local information.

46. Ten year flood. That flood which can be expected to occur, on an average, of once in ten years; or the level to which flood waters have a ten percent chance of rising in any given year.

47. Toilet waste. Fecal matter, urine, toilet paper and any water used for flushing.

48. Valve box. Any device which can stop sewage tank effluent from flowing to a portion of the soil treatment area. Includes, but is not limited to caps or plugs on distribution or drop box outlets, divider boards, butterfly valves, gate valves, or other mechanisms.

49. Water table. The highest elevation in the soil where all voids are filled with water, as evidenced by presence of water or soil mottling or other information.

50. Ordinary high water mark. A mark delineating the highest water level which has been maintained for a sufficient period of time to leave evidence upon the landscape. The ordinary high water mark is commonly that point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial.

51. Watertight. Constructed so that no water can get in or out below the level of the outlet.

52. Wild and scenic river land use district. Those lands designated by the Commissioner of the DNR as the protected land corridor along those rivers or river segments designated as wild, scenic or recreational rivers.

C. General provisions.

1. Applicability.

a. Administration by State Agencies.

(1) Individual sewage treatment systems which serve a single facility generating greater than 15,000 gallons per day shall conform to the requirements of these standards and shall make application for and obtain a State Disposal System Permit from the Agency.

(2) Collector systems which serve 15 dwellings or 5,000 gallons per day, whichever is less, shall conform to the requirements of these standards and shall make application for and obtain a State Disposal System Permit from the Agency.

(3) Individual sewage treatment systems serving establishments or facilities licensed or otherwise regulated by the State of Minnesota shall conform to the requirements of these standards.

(4) Any individual sewage treatment system requiring approval by the State of Minnesota shall also comply with all local codes and ordinances.

b. Administration by local units of government.

(1) Shoreland and floodplain areas, and wild and scenic river land use districts. Pursuant to Minn. Stat., §§ 104.04, 104.36 and 105.485 (1976), certain counties and municipalities must enact ordinances which comply with the appropriate regulations of the Minnesota Department of Natural Resources, some of which in turn require compliance with the regulations of the Minnesota Pollution Control Agency.

(2) Other areas. Outside of the above mentioned areas, these standards provide recommended guidelines for the adoption of local ordinances and for the design, location, construction, use and maintenance of individual sewage treatment systems.

(3) Localized standards. Nothing in these standards shall prevent local units of government from enacting ordinances which provide more adequate sewage treatment under local conditions.

2. General.

a. Surface discharge. Unless specifically permitted by the Agency*, sewage, sewage tank effluent, or seepage from a soil treatment system shall not be discharged to the ground surface, abandoned wells, or bodies of surface water, or into any rock or soil formation the structure of which is not conducive to purification of water by filtration, or into any well or other excavation in the ground.

b. Treatment required. The system, or systems, shall be designed to receive all sewage from the dwelling, building, or other establishment served. Footing or roof drainage shall not enter any part of the system.

c. System components. The system shall consist of a building sewer, sewage tank and soil treatment system. All sewage shall be treated in a sewage tank or toilet waste treatment device, and the sewage tank effluent shall be discharged to the soil treatment system.

d. Prohibited installations. Cesspools shall not be installed.

e. System sizing. Where the construction of additional bedrooms, the installation of mechanical equipment or other factors likely to affect the operation of the system can be reasonably anticipated, the installation of a system for such anticipated need shall be required.

3. Advisory committee.

a. There is hereby created an Advisory Committee on Individual Sewage Treatment Systems (ISTS) hereinafter referred to as the Committee.

*All new or existing systems which discharge to surface waters or the ground surface must obtain either a National Pollutant Discharge Elimination System (NPDES) or State Disposal System Permit from the Agency and shall comply with all requirements pertaining thereto.

b. The Committee shall, subject to the approval of the Agency:

(1) Review and advise the Agency on revisions of standards and legislation relating to ISTS.

(2) Review technical data relating to ISTS.

(3) Develop and revise a technical manual on ISTS.

(4) Develop educational materials and programs for ISTS.

(5) Advise the Agency and local unit of government on the administration of standards and ordinances pertaining to ISTS.

c. The Committee shall consist of 16 voting members. Of the 16 voting members:

One shall be a citizen of Minnesota, representative of the public;

One shall be from the Agricultural Extension Service of the U.S.D.A. and the University of Minnesota;

Six shall be county administrators (such as zoning administrators, sanitarians, etc.), one from each of the five Agency regions and one from the seven-county metropolitan area;

One shall be a municipal building inspector;

Six shall be sewage treatment contractors, one from each of the five Agency regions and one from the seven-county metropolitan area; and

One shall be a water well contractor.

d. The following agencies and associations shall each have one nonvoting ex officio member to assist the Advisory Committee and to be advised, in turn, on matters relating to ISTS: the Agency, the DNR, Department of Health, the U.S.D.A. Soil Conservation Service, the Metropolitan Council, the Association of Minnesota Counties, the Minnesota Association of Township Officials, the League of Minnesota Cities, and the Minnesota Society of Professional Engineers.

e. All members shall be appointed by the Agency Board from recommendations by the affected groups. All members shall serve for two years, with terms staggered so as to maintain continuity.

f. In the case of a vacancy, an appointment shall be made for the unexpired balance of the term. The administrators, inspectors, and contractors shall have been bona fide residents of this state for a period of at least three years prior to appointment, and shall have had at least three years experience in their respective businesses.

g. Robert's Rules of Order shall prevail at all meetings of the Advisory Committee.

D. Site evaluation.

1. All proposed sites for individual sewage treatment systems shall 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 within 150 feet of the proposed soil treatment system, sewage tank and water supply well;

f. Surface water flooding probability.

2. A preliminary evaluation shall be made of publicly available, existing data. If this evaluation, in the opinion of the permitting authority, yields enough information that the site is suitable, approval may be given for the installation of a standard system as specified in section H. 2. If a preliminary evaluation does not produce sufficient information, a field evaluation shall be made to determine the necessary information as specified in section D. 1.

3. Procedures for soil borings and percolation tests.

a. Soil borings. Where soil borings are required, they shall be made as follows:

(1) Each boring or excavation shall 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 shall be recorded by depth and notations made where texture changes occur.

(3) Particular effort shall 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 shall be observed after standing undisturbed a minimum of 16 hours, and depth to standing water, if present, shall be measured.

b. Percolation tests. Where percolation tests are required, they shall be made as follows:

(1) Test hole dimensions and locations:

(a) Each test hole shall be six to eight inches in diameter, have vertical sides, and be bored or dug to the depth of the bottom of the proposed individual sewage treatment system.

(b) Soil texture descriptions shall be recorded noting depths where texture changes occur.

(2) Preparation of the test hole:

(a) The bottom and sides of the hole shall be carefully scratched to remove any smearing and to provide a natural soil surface into which water may penetrate.

(b) All loose material shall be removed from the bottom of the test hole and two inches of one-fourth to three-fourths inch gravel shall be added to protect the bottom from scouring.

(3) Soil saturation and swelling:

(a) The hole shall be carefully filled with clear water to a minimum depth of 12 inches over the soil at the bottom of the test hole and maintained for no less than four hours.

(b) The soil shall then be allowed to swell for at least 16, but no more than 30 hours. In sandy soils, the saturation and swelling procedure shall not be required and the test may proceed if one filling of the hole has seeped away in less than ten minutes.

(4) Percolation rate measurement:

(a) In sandy soils adjust the water depth to eight inches over the soil at the bottom of the test hole. From a fixed reference point, the drop in water level shall be measured in inches to the nearest one-eighth inch at approximately ten minute intervals. A measurement can also be made by determining the time it takes for the water level to drop one inch from an eight-inch reference point. If eight inches of water seeps away in less than ten minutes, a shorter interval between measurements shall be used, but in no case shall the water depth exceed eight inches. The test shall continue until three consecutive percolation rate measurements vary by a range of no more than ten percent.

(b) In other soils, adjust the water depth to eight inches over the soil at the bottom of the test hole. From a fixed reference point, the drop in water level shall be measured in inches to the nearest one-eighth inch at approximately 30 minute intervals, refilling between measurements to main-

tain an eight-inch starting head. The test shall continue until three consecutive percolation rate measurements vary by a range of no more than ten percent. The percolation rate can also be made by observing the time it takes the water level to drop one inch from an eight-inch reference point if a constant water depth of at least eight inches has been maintained for at least four hours prior to the measurement.

(5) Calculating the percolation rate:

(a) Divide the time interval by the drop in water level to obtain the percolation rate in minutes per inch.

(b) Percolation rates determined for each test hole shall be averaged to determine the final soil treatment system design.

(6) For reporting the percolation rate, worksheets showing all calculations and measurements shall be submitted.

(7) A percolation test shall not be run where frost exists below the depth of the proposed soil treatment system.

E. Building sewers. The design, construction, and location of, and the materials for use in building sewers are presently governed by the Minnesota Building Code which, in Minn. Reg. SBC 8701, incorporates by reference the Minnesota Plumbing Code, Minn. Reg. MHD 120-135, and by specific provisions of the Minnesota Water Well Construction Code, Minn. Reg. MHD 217 (c)(1)(dd), (ee) and (ff). Relevant portions of the Minnesota Plumbing Code, as of the date of enactment of this rule, are reproduced in Appendix C. Minn. Reg. MHD 217(c)(1)(dd), (ee) and (ff), as of the date of enactment of this rule, is reproduced in Appendix D.

F. Sewage tanks.

1. General.

a. All tanks, regardless of material or method of construction shall be:

(1) Watertight.

(2) So designed and constructed as to withstand all lateral earth pressures under saturated soil conditions with the tank empty.

(3) So designed and constructed as to withstand a minimum of seven feet of saturated earth cover above the tank top.

(4) Not subject to excessive corrosion or decay.

b. Any tank not having an integrally cast bottom shall not be installed when the water table is closer than three inches to the bottom of the excavation at the time of construction.

2. Septic tanks.

a. Design. All tanks, regardless of material or method of construction, shall conform to the following criteria:

(1) The liquid depth of any septic tank or compartment thereof shall be not less than 30 inches. A liquid depth greater than six and one-half feet shall not be considered in determining tank capacity.

(2) No tank or compartment thereof shall have an inside horizontal dimension less than 24 inches.

(3) Inlet and outlet connections of the tank shall be submerged by means of baffles.

(4) The space in the tank between the liquid surface and the top of the inlet and outlet baffles shall be not less than 20 percent of the total required liquid capacity, except that in horizontal cylindrical tanks this space shall be not less than 15 percent of the total required liquid capacity.

(5) Inlet and outlet baffles shall be constructed of acid resistant concrete, acid resistant fiberglass or plastic.

(6) Sanitary tees shall be affixed to the inlet or outlet pipes with a permanent waterproof adhesive. Baffles shall be integrally cast with the tank, affixed with a permanent waterproof adhesive or affixed with stainless steel connectors, top and bottom.

(7) The inlet baffle shall extend at least six inches but not more than 20 percent of the total liquid depth below the liquid surface and at least one inch above the crown of the inlet sewer.

(8) The outlet baffle and the baffles between compartments shall extend below the liquid surface a distance equal to 40 percent of the liquid depth except that the penetration of the indicated baffles or sanitary tees for horizontal cylindrical tanks shall be 35 percent of the total liquid depth. They also shall extend above the liquid surface as required in section F. 2. a. (4). In no case shall they extend less than six inches above the liquid surface.

(9) There shall be at least one inch between the underside of the top of the tank and the highest point of the inlet and outlet devices.

(10) The inlet invert shall be not less than three inches above the outlet invert.

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

(12) Sanitary tees shall be at least four inches in diameter. Inlet

baffles shall be no less than six inches or no more than 12 inches measured from the end of the inlet pipe to the nearest point on the baffle. Outlet baffles shall be six inches measured from beginning of the outlet pipe to the nearest point on the baffle.

(13) Access to the septic tank shall be as follows:

(a) There shall be one or more manholes, at least 20 inches least dimension, and located within six feet of all walls of the tank. The manhole shall extend through the cover to a point within 12 inches but no closer than six inches below finished grade. The manhole cover shall be covered with at least six inches of earth.

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

(14) Compartmentation of single tanks.

(a) Septic tanks larger than 3,000 gallons and fabricated as a single unit shall be divided into two or more compartments.

(b) When a septic tank is divided into two compartments, not less than one-half nor more than two-thirds of the total volume shall be in the first compartment.

(c) When a septic tank is divided into three or more compartments, one-half of the total volume shall be in the first compartment and the other half equally divided in the other compartments.

(d) Connections between compartments shall be baffled so as to obtain effective retention of scum and sludge. The submergence of the inlet and outlet baffles of each compartment shall be as specified in sections F. 2. a. (7) and (8).

(e) Adequate venting shall be provided between compartments by baffles or by an opening of at least 50 square inches near the top of the compartment wall.

(f) Adequate access to each compartment shall be provided by one or more manholes, at least 20 inches least dimension, and located within six feet of all walls of the tank. The manhole shall extend through the cover to a point within 12 inches but no closer than six inches below finished grade. The manhole cover shall be covered with at least six inches of earth.

(15) Multiple tanks.

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

(b) Each tank shall comply with all other provisions of section F. 1.

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

(d) The first tank shall be no smaller than any subsequent tanks in series.

b. Capacity.

(1) Dwellings. The liquid capacity of a septic tank serving a dwelling shall be based on the number of bedrooms contemplated in the dwelling served and shall be at least as large as the capacities given below (see sections B. 6. and C. 2. e.):

Number of Bedrooms	Tank Liquid Capacities (gallons)
2 or less	750
3 or 4	1,000
5 or 6	1,500
7, 8 or 9	2,000

For ten or more bedrooms, the septic tank shall be sized as an other establishment. See section F. 2. b. (2).

(2) Other establishments. The liquid capacity of a septic tank serving an establishment other than a dwelling shall be sufficient to provide a sewage detention period of not less than 36 hours in the tank for sewage flows less than 1,500 gallons per day, but in no instance shall the liquid capacity be less than 750 gallons. For sewage flows greater than 1,500 gallons per day the minimum liquid capacity shall equal 1,125 gallons plus 75 percent of the daily sewage flow.

c. Location.

(1) The sewage tank shall be placed so that it is accessible for the removal of liquids and accumulated solids.

(2) The sewage tank shall be placed on firm and settled soil capable of bearing the weight of the tank and its contents.

(3) Sewage tanks shall be set back as specified in Table IV following section H. 2. d. (3).

(4) Sewage tanks shall not be placed in areas subject to flooding or in flood plains delineated by local ordinances adopted in compliance with the "State-wide Standards for Management of Flood Areas of Minnesota" (Minn. Reg. NR 85-93), or in areas for which regional flood information is

available from the DNR, except that in areas where ten year flood information is available from and/or approved by the DNR, sewage tanks may be installed in accordance with all provisions of Appendix A, section C. 6. of these standards.

d. Maintenance. The owner of any septic tank or his agent shall regularly inspect and arrange for the removal and sanitary disposal of septage from the tank whenever the top of the sludge layer is less than 12 inches below the bottom of the outlet baffle or whenever the bottom of the scum layer is less than three inches above the bottom of the outlet baffle.

3. Aerobic tanks. Aerobic tank treatment systems shall comply with the general requirements for sewage tanks set forth in section F. 1., and with the following:

a. The treatment system including each individual unit or compartment shall be easily accessible for inspection and maintenance and shall be provided with secured covers.

b. The raw sewage flow from the dwelling shall be intercepted by a trash trap prior to its entering the aeration compartment. The trash trap shall have a net holding capacity of not less than 20 percent of the average daily flow. The invert level to the trap shall be above the liquid level and discharge directly into the trap. The outlet from the trap to the aeration compartment shall be deep baffled or equipped with a tee or long ell.

c. The trash trap shall be readily accessible for inspection and effective cleaning and shall be so constructed as to prevent unauthorized entry.

d. The aeration compartment shall have a minimum holding capacity of 500 gallons or 120 gallons per bedroom, whichever is greater.

e. The method of aeration shall be accomplished by mechanical aeration, diffused air, or both. The method used shall maintain aerobic conditions at all times.

f. The settling compartment shall have a minimum net holding capacity equal to 20 percent of the volume of the aeration compartment. The design shall provide for effective settling and continuous return of settled sludge to the aeration compartment.

g. A minimum one year warranty and an initial two year service contract which specifies regular inspection calls and effluent quality checks shall be provided as a part of the purchase agreement.

h. All other features of the aerobic tanks not specifically mentioned above shall comply with National Sanitation Foundation Standard No. 40 (November 1970).

G. Distribution and dosing of effluent.

1. Distribution.

a. Gravity distribution.

(1) Level ground. Where the elevation difference of the ground surface does not exceed 28 inches in any direction within the soil treatment system, the sewage tank effluent may be directed to the soil treatment system through a system of interconnected distribution pipes or trenches in a continuous system.

(2) Slightly sloping ground.

(a) Sewage tank effluent may be distributed by a distribution box provided the final ground surface elevation of the lowest trench is at least one foot higher than the outlet inverts of the distribution box.

(b) Distribution box.

(i) The box shall be watertight with a removable cover and shall be constructed of durable materials not subject to excessive corrosion or decay.

(ii) The inverts of all outlets shall be at the same elevation as measured from a liquid surface in the bottom of the box.

(iii) The inlet invert shall be at least one inch above the outlet inverts.

(iv) The outlet inverts shall be at least four inches above the distribution box floor.

(v) Each drainfield trench line shall be connected separately to the distribution box and shall not be subdivided.

(vi) When sewage tank effluent is delivered to the distribution box by pump, either a baffle wall shall be installed in the distribution box or the pump discharge shall be directed against a wall or side of the box on which there is no outlet. The baffle shall be secured to the box and shall extend at least one inch above the crown of the inlet flow line.

(3) Sloping ground.

(a) Where the elevation difference of the ground surface exceeds 28 inches in any direction within the soil treatment system and a distribution box cannot be used as specified in section G. 1. a. (2), a drop box shall be installed at the head end of each lateral line. Connections between drop boxes shall be by watertight pipes.

(b) Drop boxes.

(i) The drop box shall be watertight and constructed of durable materials not subject to excessive corrosion or decay.

(ii) The invert of the inlet pipe shall be at least one inch higher than the invert of the outlet pipe to the next trench.

(iii) The invert of the outlet pipe to the next trench shall be at least two inches higher than the invert of the outlet pipe of the trench in which the box is located.

(iv) When sewage tank effluent is delivered to the drop box by a pump, the pump discharge shall be directed against a wall or side of the box on which there is no outlet.

(v) The drop box shall have a removable cover either flush or above finished grade or covered by no more than six inches of soil.

b. Pressure distribution.

(1) Pressure distribution laterals shall be sized as shown in Table I.

(2) Laterals shall be spaced no further than 20 inches from a trench or bed wall.

(3) Laterals shall be spaced no further than 40 inches apart.

(4) Laterals shall be connected to a header pipe which is at least one and one-half inch and no more than two inches in diameter.

TABLE I
Maximum Allowable Lateral Lengths In Feet From Header Pipe

Perf. Dia.	Perforation Spacing 2.5 Feet Pipe Dia.			3.0 Feet Pipe Dia.		
	1"	1-1/4"	1-1/2"	1"	1-1/4"	1-1/2"
3/16"	34	52	70	36	60	75
7/32"	30	45	57	33	51	63
1/4"	25	38	50	27	42	54

2. Dosing.

a. Dosing chamber. A dosing device is not necessary in all situations but, where used, shall comply with the following requirements.

(1) The dosing chamber shall be watertight and constructed of sound and durable materials not subject to excessive corrosion or decay.

(2) There shall be one or more manholes, at least 20 inches least

dimension and preferably located directly above the dosing device. The manhole shall extend through the dosing chamber cover to final grade and shall be so constructed as to prevent unauthorized entry.

(3) The size of the effluent dose shall be determined by design of the soil treatment unit but in no case shall the dosing chamber be sized to provide a dose of less than 75 gallons.

b. Dosing devices for gravity distribution.

(1) Where a dosing device is employed, a pump or siphon shall deliver the dose to the soil treatment unit for gravity distribution over the soil treatment area.

(2) For dwellings, the dosing device shall discharge at least 600 gallons per hour but no more than 2,700 gallons per hour.

(3) For other establishments, the dosing device should discharge at a rate at least ten percent greater than the water supply flow rate but no faster than the rate at which effluent will flow out of the distribution device.

(4) If the dosing device is a siphon, a maintenance inspection shall be made every six months by the owner or his agent. The siphon shall be maintained in proper operating condition.

(5) If the dosing device is a pump, it shall be cast iron or bronze fitted and with stainless steel screws or constructed of other sound, durable and corrosion-resistant materials.

(6) Where the soil treatment area is at a higher elevation than the pump, sufficient dynamic head shall be provided for both the elevation difference and friction loss.

(7) Where the dosing device is a pump, an alarm device shall be installed to warn of pump failure.

c. Dosing devices for pressure distribution.

(1) The dosing device shall be a pump which is cast iron or bronze fitted and with stainless steel screws or constructed of sound, durable and corrosion-resistant materials.

(2) The pump discharge capacity shall be at least seven and one-half gallons per minute for each 100 square feet of soil treatment area.

(3) The pump discharge head shall be at least five feet greater than the head required to overcome pipe friction losses and the elevation difference between the pump and the distribution device.

(4) The quantity of effluent delivered for each pump cycle shall be no greater than 25 percent of one day's sewage flow.

(5) An alarm device shall be installed to warn of pump failure.

H. Final treatment and disposal.

1. General. Final treatment and disposal of all sewage tank effluent shall be by means of soil treatment and disposal.

2. Standard system.

a. Sizing.

(1) The required soil treatment area shall be determined by the daily sewage flow and the percolation rate of the soil.

(2) Acceptable methods for estimating sewage flow for dwellings are given in Table II. The minimum daily sewage flow estimated for any dwelling shall provide for at least two bedrooms. For multiple residential units, the estimated daily sewage flow shall consist of the sum of the flows of each individual unit.

TABLE II
Sewage Flow (Gallons Per Day)

Number of Bedrooms	Classification of Dwelling* I	II	III	IV
2	300	225	180	–
3	450	300	218	–
4	600	375	256	–
5	750	450	294	–
6	900	525	332	–

*Table II is based on the following formulas:

Classification I: Sewage Flow = 150 (No. of Bedrooms)
Classification II: Sewage Flow = 75 (No. of Bedrooms + 1)
Classification III: Sewage Flow = 66 + 38 (No. of Bedrooms + 1)
Classification IV: If a greywater system is employed pursuant to Appendix A, section D. 2., estimated sewage flow shall equal 60% of the amount provided in column I, II, or III of Table II.

(3) For other establishments, the daily sewage flow shall be determined as provided in section B. 33.

(4) The soil treatment area shall be at least as large as set forth in Table III.

TABLE III

Percolation Rate (Minutes per inch)	Required Soil Treatment Area in Square Feet (Per Gallon of Sewage Flow per Day)
Faster than 0.1**	-
0.1 to 5***	0.83
6 to 15	1.27
16 to 30	1.67
31 to 45	2.00
46 to 60	2.20
Slower than 60****	-

** Soil is unsuitable for standard system if percolation rate is less than 0.1 minutes per inch. See Appendix A, section C. 5.

*** Consider alternative sewage treatment systems for soils with this percolation rate range. See Appendix A, section C. 5.

**** Soil is unsuitable for standard system if percolation rate is slower than 60 minutes per inch. See Appendix A, section C. 4.

(5) Table III gives the required bottom area assuming six inches of filter material below the distribution pipe for trenches and beds. The required bottom area may be reduced, for trenches only, by the following percentages: 20 percent for 12 inches of filter material below the distribution pipe; 34 percent for 18 inches; and 40 percent for 24 inches. The filter material shall completely encase the distribution pipe to a depth of at least two inches.

b. Location.

(1) On slopes in excess of 12 percent, the soil profile shall be carefully evaluated in the location of the proposed soil treatment system and downslope to identify the presence of layers with different permeabilities that may cause sidehill seepage. In no case shall a trench be located within 15 feet of where such a layer surfaces on the downslope.

(2) Bed construction shall be limited to areas having natural slopes of less than six percent.

(3) Soil treatment systems shall be located as specified in Table IV following section H. 2. d. (3).

(4) Soil treatment areas shall not be placed in areas subject to flooding or in flood plains delineated by local ordinances adopted in compliance with the "State-wide Standards and Criteria for Management of Flood Plain Areas of Minnesota" (Minn. Reg. NR 85-93), or in areas for which regional flood information is available from the DNR, except that in areas where ten year flood information is available from and/or approved by the DNR, soil treatment systems may be installed in accordance with the provisions of Appendix A, section C. 6.

c. Design and construction.

(1) The bottom of trenches and beds shall be at least three feet above the water table or bedrock.

(2) The trenches shall be not less than 18 inches nor more than 36 inches wide. Any trench wider than 36 inches shall be considered a bed.

(3) Trenches and beds shall be not more than 100 feet in length.

(4) The bottom of the trench or bed excavation shall be level.

(5) The bottom and sides of the soil treatment system to the top of the filter material shall be excavated in such a manner as to leave the soil in a natural, unsmeared, and uncompacted condition. Excavation shall be made only when the soil moisture content is at or less than the plastic limit.

(6) When the percolation rate is slower than 15 minutes per inch, excavation shall be by back hoe or other means that allow the equipment wheels or tracks to remain on the surface soil. Excavation equipment or other vehicles shall not be driven on the soil treatment area.

(7) There shall be a layer of at least six but no more than 24 inches of filter material in the bottom of the trenches and beds.

(8) Where disposal trenches are constructed within ten feet of trees six inches or larger in diameter, or dense shrubbery, or where it can reasonably be anticipated that such vegetation will be present during the expected life of the system, at least 12 inches of filter material shall be placed beneath the distribution pipe.

(9) Distribution pipes—gravity distribution.

(a) Distribution pipe used in trenches or beds for gravity flow distribution shall be at least four inches in diameter and constructed of sound and durable material not subject to corrosion or decay or to loss of strength under continuously wet conditions.

(b) Perforated pipe used for sewage distribution pipes shall have one or more rows of holes of no less than one-half inch in diameter spaced no more than 36 inches apart. Holes shall be spaced to prevent failure due to loads. Distribution pipes shall have a load bearing capacity of not less than 1,000 pounds per lineal foot.

(c) Agricultural drain tile shall be in 12-inch lengths and laid with one-fourth inch open joints on grade boards. All open joints shall be protected on top by strips of asphalt-treated building paper at least ten inches long and three to six inches wide or by other acceptable means.

(d) Other devices may be used to distribute sewage tank effluent over the soil treatment area upon approval of the permitting authority.

(10) Pressure distribution.

(a) Distribution pipes used in trenches or beds for pressure distribution shall be at least one inch in diameter and constructed of sound and durable material not subject to corrosion or decay or to loss of strength under continuously wet conditions.

(b) Perforations shall be sized and spaced as shown in Table I set forth following section G. 1. b. (4).

(11) The distribution pipes shall be laid level or on a uniform slope away from the distribution device of no more than four inches per 100 feet.

(12) Gravity distribution pipes in beds shall be uniformly spaced no more than five feet apart and not more than 30 inches from the side walls of the bed.

(13) The filter material shall completely encase the disposal pipes to a depth of at least two inches.

(14) The filter material shall be covered with untreated building paper or a two-inch layer of hay or straw or similar, approved permeable materials.

(15) The trenches or beds shall be backfilled and crowned above finished grade to allow for settling. The top six inches of soil shall have the same texture and density as the adjacent soil.

(16) The minimum depth of cover over the distribution pipes shall be at least eight inches. The maximum depth of cover over the distribution pipes shall be no more than 36 inches and preferably no more than 24 inches.

(17) A grass cover shall be established by the owner or his agent over the soil treatment system.

d. Dual field.

(1) Dual field systems shall be used only where the percolation rate is slower than five minutes per inch.

(2) Dual field systems shall be sized, designed, and constructed as set forth above for standard systems except as follows:

(a) The soil treatment area shall be divided into two or more parts.

(b) Alternating soil treatment areas shall each be connected to a valve box outlet.

(3) A part of the soil treatment area shall be used no more than one year unless inspection of the effluent level indicates that a longer duration can be used.

TABLE IV
Minimum Setback Distances (feet)

Feature	Sewage Tank	Soil Treatment Area
Water Supply well less than 50 feet deep and not encountering at least ten feet of impervious material	*	*
Any other water supply well or buried water suction pipe	*	*
Buried pipe distributing water under pressure	*	*
Buildings	10	20
Property Lines	10	10
The Ordinary High Water Mark of:		
Natural Environment Lakes and Rivers	**	**
Recreational Development Lakes and Streams	**	**
General Development Lakes and Streams	**	**
Wild Rivers	**	**
Scenic Rivers	**	**
Recreational Rivers and Designated Tributaries of Wild, Scenic, and Recreational Rivers	**	**

* Setbacks from water supply wells and buried water pipes are presently governed by Minn. Reg. MHD 217(c)(1)(dd), (ee) and (ff). These regulations, as of the date of enactment of this rule, are reproduced in Appendix D.

** Setbacks from lakes, rivers and streams are presently governed by Minn. Reg. Cons. 72(b)(4), NR 79(d)(2) and NR 83(d)(2)(dd). These regulations, as of the date of enactment of this rule, are reproduced in Appendix E.

I. Alternative systems. Where limiting soil characteristics exist, special systems of sewage treatment and disposal, including but not limited to those in Appendix A, may be employed provided:

1. reasonable assurance of performance of such system is presented to the permitting authority;

2. the engineering design of such system is first approved by the permitting authority;

3. there is no discharge to the ground surface or to surface waters;

4. treatment and disposal of wastes is in such a manner so as to protect the public health and general welfare; and

5. such systems comply with all applicable requirements of these standards and with all local codes and ordinances.

J. Severability. If any provision of these standards or the application thereof to any person or circumstances is held to be invalid, such invalidity shall not affect other provisions of these standards or application of any other part of these standards which can be given effect without application of the invalid provision. To this end the provisions of all sections, subsections or subdivisions herein and the various applications thereof are declared to be severable.

K. Variance. In any cases where a permit is required by the Agency, and upon application of the responsible person or persons, the Agency finds that by reason of exceptional circumstances the strict enforcement of any provision of these standards would cause undue hardship, that disposal of the sewage, industrial waste or other waste is necessary for the public health, safety or welfare, or that strict conformity with the standards would be unreasonable, impractical or not feasible under the circumstances, the Agency in its discretion may permit a variance therefrom upon such conditions as it may prescribe for prevention, control or abatement of pollution in harmony with the general purpose of these standards and the intent of applicable state and federal laws.

Appendix A
Alternative Systems

A. General. The intent of this appendix is to provide standards for the design, location, installation, use and maintenance of alternative sewage treatment systems in areas of limiting soil characteristics, or where a standard system cannot be installed or is not the most suitable treatment. Where such systems are employed, they shall comply with all local codes and ordinances, and be subject to timely inspections to assure adherance to specifications.

B. Adoption and use.

1. Where 6 MCAR § 4.8040 is administered by a local unit of government, those local units of government may adopt this appendix, in whole or in part, as part of a local code or ordinance. Nothin in 6 MCAR § 4.8040 or this appendix, however, shall require the adoption of any part of this appendix as a local ordinance or code. Further, nothing in 6 MCAR § 4.8040 or this appendix shall require local units of government to allow the installation of any system in this appendix.

2. This appendix defines the minimum requirements for alternative systems serving establishments or facilities licensed or otherwise regulated by the State of Minnesota or this Agency pursuant to section C. 1. a.

C. Class I alternatives—modified standard systems.

1. Extreme caution and careful planning shall be employed wherever limiting characteristics including, but not limited to water table or bedrock, exist within two feet of the original ground surface.

2. Fluctuating ground water.

a. Where natural drainage will not provide three feet of separation between the bottom of the soil treatment area and the highest known or calculated level of the water table, agricultural drain tile may be used to intercept or lower the seasonal high water table, except within shorelands of public waters. There shall be at least ten feet of undisturbed soil between the sidewall of the soil treatment unit and the agricultural drain tile.

b. Within shorelands of public waters, agricultural drain tile may be used to intercept the seasonal high water table provided the ground water table has a slope of at least two feet per hundred feet toward the public water and provided the drain tile are installed upslope of the soil treatment system. There shall be at least 20 feet of undisturbed soil between the sidewall of the soil treatment unit and the agricultural drain tile.

c. In all cases the greatest practicable vertical separation distance from the water table shall be provided.

3. Bedrock proximity. In no case shall filter material of the soil treatment system be placed closer than three feet to creviced bedrock or to consolidated permeable bedrock. When all horizons of the original soil profile have percolation rates slower than 60 minutes per inch, filter material of the soil treatment system shall be placed no closer than seven feet to consolidated impermeable bedrock. A maximum depth of 24 inches of sand may be used under the filter material. Where additional fill is required to achieve the required separation distance, a soil having a percolation rate between five and 45 minutes per inch (loamy sand to silt loam) 12 months after placement shall be used. If it is not possible to allow the soil to settle for 12 months after placement, mechanical methods may be used to settle the fill to within ten percent of its "in situ" density.

4. Slowly permeable soils.

a. In no case shall excavation for the purpose of constructing a soil treatment system be made in any soil layer having a percolation rate slower than 120 minutes per inch.

b. In no case shall excavation for the purpose of constructing a soil treatment system be made in a soil layer having a percolation rate slower than 60 minutes per inch unless the moisture content is lower than the plastic limit of the soil.

c. In no case shall filter material be placed in contact with original soil having a percolation rate slower than 60 minutes per inch.

d. Where the percolation rate of the original soil is slower than 60 minutes per inch, at least six inches but no more than 12 inches of fill material having a percolation rate of between five and 30 minutes per inch (loamy sands and loams) after placement shall be placed between the filter material and the original soil along the excavation bottom and sidewalls.

e. In no case shall construction equipment, wheels or tracks be placed in contact with the bottom of the excavation during the construction of a soil treatment system in soils having a percolation rate slower than 15 minutes per inch.

f. The size of soil treatment system shall be based on the required treatment area for a soil having a percolation rate of 60 minutes per inch as specified in Table III set forth in section H. 2. a. (4).

5. Rapidly permeable soils.

a. Filter material for a soil treatment unit shall not be placed in contact with original soil having a percolation rate faster than one-tenth minute per inch.

b. For coarse soils having a percolation rate faster than one-tenth minute per inch, at least six inches of sandy loam textured soil having a per-

colation rate between five and 15 minutes per inch after placement (loamy sand to sandy loam) shall be placed between the filter material and the coarse soil along the excavation bottom and sidewalls.

c. For soils with percolation rates between one-tenth and five minutes per inch at least one of the following treatment techniques shall be used:

(1) Provide at least six inches of sandy loam textured soil with a percolation rate between five and 15 minutes per inch after placement between the filter material and the coarse soil.

(2) Distribution of sewage tank effluent by pressure flow over the treatment area as specified in section G. 1. b.

(3) Divide the total soil treatment area into at least four equal parts connected serially.

6. Flood plain areas.

a. The soil treatment area shall be a trench system with at least 12 inches of filter material below the distribution pipe. There shall be no pipe or other installed opening between the filter material and the soil surface.

b. The trench system shall be located on the highest feasible area of the lot and shall have location preference over all other improvements except the water supply well. The bottom of the trench shall be at least as high as the elevation of the ten year flood. The sewage tank may be located so as to provide gravity flow to the soil treatment area.

c. If a pumping station is used to move effluent from the sewage tank to the drainfield, provisions shall be made to prevent the pump from operating when inundated with flood waters.

d. When fill is needed to raise the elevation of the soil treatment area, a mound system may be used with the following additional requirement: The elevation of the mound shall be such that the elevation of the bottom of the rock layer shall be at least one-half foot above the ten year flood elevation. Inspection wells shall not be installed unless the top of the mound is above the elevation of the regional flood.

e. When the top of the sewage tank is inundated, the dwelling must cease discharging sewage into it. This may be accomplished by either temporarily evacuating the structure until the system again becomes functional, or by diverting the sewage into a holding tank sized and installed according to the requirements below.

f. The building sewer shall be designed to prevent backflow of liquid into the building when the system is inundated. If a holding tank is utilized, the building sewer shall be designed to permit rapid diversion of sewage into the holding tank when the system is inundated.

(f) Privies shall be adequately vented.

(g) When the pit is filled to within one foot of the top the solids shall be removed or a new pit shall be constructed. The abandoned pit shall be filled with clean earth and slightly mounded to allow for settling. Removed solids shall be disposed of by land application in accordance with Agency guidelines for septage disposal and all local ordinances and codes.

(h) All liquids and solids removed from a vault privy shall be treated and disposed of by application in accordance with the Agency's septage disposal guidelines.

(3) Type II—other devices.

(a) Other devices may be used where reasonable assurance of performance is provided.

(b) All Type II devices shall be vented.

(c) All electric, gas and water connections to a Type II device shall conform to all local ordinances and codes.

(d) Operation and maintenance of all Type II devices shall follow the manufacturer's recommendations.

(4) All materials removed from a Type I or II toilet waste treatment device, including but not limited to, ashes, compost and all solids and liquids shall be disposed of in a public sewage system or by land application in accordance with the Agency's septage disposal guidelines and all local ordinances and codes.

c. Greywater system.

(1) Plumbing.

(a) The drainage system in new systems shall be based on a pipe diameter of two inches to prevent installation of a water flush toilet. There shall be no openings or connections to the drainage system, including floor drains, larger than two inches in diameter. For repair or replacement of an existing system, the existing drainage system may be used.

(b) Toilets or urinals of any kind shall not be connected to the drainage system. Toilet waste or garbage shall not be discharged to the drainage system.

(c) Garbage grinders shall not be connected to the drainage system.

(2) Building sewer. The building sewer shall meet all requirements of section E. except that the building sewer for a greywater system shall be at least two inches in diameter.

(3) Sewage tank.

(a) Greywater septic tanks shall meet all requirements of section F. 1., except that the liquid capacity of a greywater septic tank serving a dwelling shall be based on the number of bedrooms contemplated in the dwelling served and shall be at least as large as the capacities given below (see sections B. 6. and C. 2. e.):

TABLE A-1

Number of Bedrooms	Tank Liquid Capacity (gallons)
2 or less or hand pump	300
3 or 4	500
5 or 6	750
7, 8 or 9	1,000

(b) For ten or more bedrooms or other establishments, the greywater septic tank shall be sized as for an other establishment (see section F. 2. 6. (2)) except that the minimum liquid capacity shall be at least 300 gallons.

(c) Greywater aerobic tanks shall meet all requirements of section F. 3.

(4) Distribution and dosing. Distribution and dosing of greywater shall meet all requirements of section G.

(5) Final treatment and disposal.

(a) Standard system. A standard greywater system shall meet all requirements of sections H. 1. and 2.

(b) Alternative system. A greywater mound system shall meet all requirements of Appendix A, section E. 1.

3. Seasonal use.

a. Where a commercial establishment is occupied or used for less than 180 days per year and less than 120 days consecutively, the maximum daily sewage flow shall be determined and the average daily sewage flow shall be computed by dividing the total annual estimated or measured sewage flow by 365 days. The size of the soil treatment system shall be based on the average daily sewage flow and the areas specified in Table III set forth in section H. 2. a. (4). All other requirements of soil treatment system construction shall be followed.

b. The maximum daily sewage flow shall be used to determine sewage tank size for other establishments. There shall be no reduction in the size of sewage tanks for seasonal use.

c. In no case shall a seasonal use establishment be converted to full-time use until the soil treatment system meets the size requirements of Table III set forth in section H. 2. a. (4).

E. Class III—alternatives—advanced alternative system.

1. Mounds.

a. Mounds may be constructed on soils having the site or soil conditions specified in Appendix A, section C.

b. The soil percolation rate in all layers of the natural or fill soil to a depth of at least 24 inches below the sand, as specified in Appendix A, section E. 1. l., shall be faster than 120 minutes per inch.

c. Below the sand layer there shall be at least one layer of soil, either natural or fill, at least 12 inches thick, which has a percolation rate slower than five minutes per inch (loamy sand).

d. Wherever possible, mounds shall be located on flat areas or crests of slopes. Mounds shall not be located on natural slopes of more than three percent if the percolation rate is slower than 60 minutes per inch to a depth of at least 24 inches below the sand layer.

e. Mounds shall not be located on slopes exceeding six percent if the soil percolation rate is slower than 30 minutes per inch to a depth of at least 24 inches below the sand layer.

f. Mounds shall not be located on natural slopes exceeding 12 percent under any soil percolation rate conditions.

g. The bottom area of the filter material shall be sized on the basis of 0.83 square feet per gallon of waste per day.

h. In no case shall the width of the filter material in a single bed exceed ten feet.

i. A rubber tired tractor may be used for plowing or discing but in no case shall a rubber tired tractor be used after the surface preparation is completed where the soil is slower than 15 minutes per inch. A crawler or track type tractor shall be used for mound construction where the soil is slower than 15 minutes per inch.

j. The discharge pipe from the pump to the mound area shall be installed prior to soil surface preparation. The trench shall be carefully backfilled and compacted to prevent seepage of effluent.

k. Soil surface preparation.

(1) The total area selected for the mound, including the dikes

shall be plowed to a depth of at least eight inches or the sod layer broken and roughened by backhoe teeth. Furrows shall be thrown uphill and there shall be no deadfurrow under the mound. The soil shall be plowed only when the moisture content of a fragment eight inches below the surface is below the plastic limit.

(2) In soils having percolation rates faster than 15 minutes per inch (sandy loam) in the top eight-inch depth, discing may be used for surface preparation as a substitute for plowing.

(3) Mound construction shall proceed immediately after surface preparation is completed.

l. A minimum of twelve inches of soil defined as sand shall be placed where the filter material is to be located. A crawler tractor with a blade shall be used to move the sand into place. At least six inches of sand shall be kept beneath equipment to minimize compaction of the plowed layer. The sand layer upon which the filter material is placed shall be level.

m. A depth of at least nine inches of filter material shall be placed over the bed area below the distribution pipe.

n. Distribution of effluent over the filter material shall be either by four-inch distribution pipes with gravity flow from a distribution box or by perforated pipe under pressure from a manifold.

o. Gravity distribution.

(1) The four-inch distribution pipes shall be rigid plastic with holes at least one-half inch diameter spaced no further than 36 inches. One row of holes shall be laid at the bottom of the pipe.

(2) The distribution pipe shall slope downward two inches per 100 feet away from the distribution box.

(3) The far ends of the distribution pipe shall be connected.

(4) The distribution pipes shall be spaced no further than five feet apart and no further than 30 inches from the edge of the filter material.

(5) The distribution pipes shall connect to the outlets of a distribution box.

(6) The quantity of effluent per pump dose shall be at least 25 percent of the estimated or measured daily sewage flow.

p. Pressure distribution.

(1) Perforation holes shall be as set forth in Table I set forth in

section G. 1. b. (4). Holes shall be drilled straight into the pipe and not at an angle.

(2) The perforated pipe laterals shall be connected to a two-inch diameter manifold pipe with the ends capped. The laterals shall be spaced no further than 40 inches on center and no further than 20 inches from the edge of the filter material.

(3) The perforated pipe laterals shall be installed level with the perforations downward.

(4) The manifold pipe shall be connected to the supply pipe from the pump. The manifold shall be sloped toward the supply pipe from the pump.

q. At least two inches of filter material shall be placed over the lateral or distribution pipes.

r. Straw or marsh hay to an uncompacted depth of three to four inches shall be placed over the filter material.

s. Construction vehicles shall not be allowed on the filter material until backfill is placed.

t. Sandy loam soil shall be placed on the filter material to a depth of one foot in the center of the mound and to a depth of six inches at the sides.

u. A maximum of two ten-foot wide beds may be installed side by side in a single mound if the soil percolation rate is between five and 60 minutes per inch to a depth of at least 24 inches below the sand layer. The beds shall be separated by four feet of sand.

v. When two beds are installed side by side the sandy loam fill at the center of the mound shall be 18 inches deep and six inches deep at the sides.

w. Six inches of topsoil shall be placed on the fill material over the entire area of the mound.

x. A grass cover shall be established over the entire area of the mound.

y. No shrubs shall be planted on the top of the mound. Shrubs may be placed at the foot and side slopes of the mound.

z. The side slopes on the mound shall be no steeper than three to one.

aa. Whenever mounds are located on slopes, a diversion shall be constructed immediately upslope from the mound to intercept and direct runoff.

bb. A pump shall be used as specified in section G. 2. c.

2. Collector systems.

a. General.

(1) Where site or soil conditions do not allow for final treatment and disposal on an individual lot, a system whereby a soil treatment system is located on another lot or lots may be employed, where approved by the local unit of government.

(2) Plans and specifications shall comply with local ordinances on such issues as zoning, joint ownership of land, joint maintenance responsibilities, easements, and other considerations and shall be approved by the local unit of government.

b. Design.

(1) Common soil treatment system. The size of common soil treatment systems shall be based on the sum of the areas required for each residence.

(2) Sewage tanks. The system shall be designed with each residence having a sewage tank or with a common sewage tank. In the case of a common tank, the capacity of the tank shall be sized according to section F. 2. b. (2) except that the minimum capacity shall be at least 3,000 gallons, and shall be compartmented if in a single tank.

(3) Sewers.

(a) Sewer systems shall be designed on an estimated average daily flow for dwellings based on Table II, set forth in section H. 2. a. (2), plus estimated flows from other establishments.

(b) The sewer for systems with common sewage tanks shall be so constructed to give mean velocities, when flowing full, of not less than two feet per second. The sewer for systems with individual sewage tanks shall be so constructed and designed to hydraulically conduct the flow for which they were designed. In no case shall a gravity sewer be less than four inches in diameter.

(c) Infiltration or exfiltration shall not exceed 200 gallons per inch of pipe diameter per mile per day.

(d) Cleanouts, brought flush with or above finished grade, shall be provided wherever a common sewer joins an individual building sewer or piping from an individual sewage tank, or every 100 feet, whichever is less, unless manhole access is provided.

(e) There shall be no physical connection between sewers

and water supply systems. Sewers shall be set back from water supply systems and piping as required for building sewers. See section E. 3. Where it is not possible to obtain proper separation distances, the sewer connections shall be watertight and pressure tested as in section E. 3.

(4) Pumps and pump stations.

(a) Pump stations shall be watertight.

(b) Pump stations shall have manholes flush with or above finished grade for cleaning and maintenance.

(c) Manhole covers shall be so constructed as to prevent unauthorized entry.

(d) Pumps and pump stations shall be sized to handle peak flows.

(e) An alarm system shall be provided for all pumping stations to warn of pump failure, overflow or other malfunction.

c. Maintenance. All persons using a common drainfield system shall assure, by contract with maintenance personnel or other equivalent means, that the system will be adequately maintained throughout its useful life. The system so maintained includes, but is not limited to, common drainfields, common sewage tanks, common pumps, common pump stations, common sewers and all individual tanks connected to the common system.

3. Sewage osmosis.

a. The Electroosmosis System (a proprietary installation process under U. S. and Canadian patents) may be permitted as an alternative system in clay soils having percolation rates slower than 60 minutes per inch.

b. Standards and criteria for approval.

(1) Installation shall comply with all applicable requirements for standard systems contained in these regulations as pertain to system location, water table and bedrock separation distances, septic tanks, pumping stations, distribution or drop boxes, and materials.

(2) Conditions for installation and reporting of performance shall be subject to the provisions in Appendix A, section E. 5.

4. Seepage pits.

a. Seepage pits may be used for disposal of sewage tank effluent only when it can be clearly demonstrated that a standard drainfield system or mound system is not feasible on the particular site in question and when such use is indicated by favorable conditions of soil, ground water level or topog-

raphy and where such use does not reduce the safety of surrounding ground water supplies. In areas where limestone or any geological formation characterized by similar fault patterns is covered by less than 50 feet of earth, seepage pits shall not be installed. The pit excavation shall terminate at least three feet above the highest known or calculated ground water table. The depth of the excavation shall not exceed 50 percent of the depth of any well casing in the area or ten feet, whichever is least.

b. When two or more seepage pits are used, a distribution box constructed in accordance with section G. 1. a. (2) (b) shall be used if the inlet inverts of the seepage pits have no more than one foot difference in elevation. If the difference in elevation between the inlet inverts is greater than one foot, the seepage pits shall be connected in series.

c. Seepage pits, in addition to the general provisions specified in Table IV following section H. 2. d. (3) shall be set back not less than the stated minimum distances from the following:

(1) Wells less than 50 feet in depth and not encountering at least 10 feet of impervious material . . . . . 150 ft.

(2) Any water supply well or buried water suction pipe . . 75 ft.

(3) Buildings . . . . . 20 ft.

(4) Property lines and buried pipe distributing water under pressure . . . . . 10 ft.

(5) Other seepage pits . . . . . three times the diameter of the largest pit (edge to edge).

d. Effective soil treatment area of a seepage pit shall be calculated as the sidewall area below the inlet, exclusive of any hardpan, rock or clay formations. The sidewall area shall be based on the outer diameter of the pit lining plus 12 inches of rock in the annular space.

(1) Required treatment area shall be determined by the percolation test described in section D. and from Tables II and III, set forth in sections H. 2. a. (2) and (4), with no reduction for increased filter material below or around the pit. In no case shall a seepage pit be installed in soils where the percolation rate of any stratum is faster than one-tenth minute per inch (coarse sand). A percolation test shall be made in each vertical stratum penetrated by the seepage pit, and the weighted average of the results, exclusive of results from soil strata in which the percolation rate is slower than 30 minutes per inch, shall be computed and applied to the seepage bed column of Table III as indicated.

(2) A minimum of four feet composite depth of porous formation for each installation shall be provided in one or more pits.

(3) All pits shall have an inside diameter of at least five feet.

e. Construction of all seepage pits shall conform to the following requirements:

(1) To prevent cave-in, the pit shall be precast concrete or lined with brick, stone or block at least four inches thick, laid in a radial arch to support the pit walls.

(2) The brick, stone or block shall be laid watertight above the inlet and with open joints below the inlet to provide adequate passage of liquids.

(3) A minimum annular space of 12 inches between the pit lining and excavation wall shall be filled with crushed rock or gravel.

(4) The seepage pit shall be so constructed at the top as to be capable of supporting the overburden of earth and any reasonable load to which it is subjected. Access to the pit shall be provided by means of a manhole or inspection hole equipped with a watertight cover. The seepage pit may terminate in a conventional manhole top, frame and cover to a point within 12 inches, but no closer than six inches below finished grade. The manhole cover shall be covered with at least six inches of earth. The top of the seepage pit shall be not less than 12 inches below the ground surface. The top shall be provided with an inspection pipe of not less than four-inch diameter extending through the cover to a point flush with finished ground level. The top of the inspection pipe shall be provided with a readily removable watertight cap.

5. Other systems. Where unusual conditions exist, special systems of treatment and disposal other than those specifically mentioned in Appendix A, sections E. 1. to E. 4. above, may be employed provided:

a. reasonable assurance of performance of such system is presented to the permitting authority;

b. the engineering design of such system is first approved by the permitting authority;

c. there is no discharge to the ground surface or to surface waters;

d. treatment and disposal of wastes is in such a manner so as to protect the public health and general welfare;

e. such systems comply with all applicable requirements of these standards and with all local codes and ordinances.

F. Class IV alternatives—holding tanks.

1. General. 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 standards and only where it can conclusively be shown that a standard, Class I, Class II or mound system cannot be feasibly installed.

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

3. Access. A cleanout pipe of at least six inches diameter shall extend to the ground surface and be provided with seals to prevent odor and to exclude insects and vermin. A manhole of at least 20 inches least dimension shall extend through the cover to a point within 12 inches, but no closer than six inches below finished grade. The manhole cover shall be covered with at least six inches of earth.

4. Depth of bury. The tank shall be protected against flotation under high water table conditions. This shall be achieved by weight of tank, earth anchors or shallow bury depths.

5. Capacity.

a. For a dwelling the size shall be 1,000 gallons, or 400 gallons times the number of bedrooms, whichever is greater.

b. For permanent structures other than dwellings, the capacity shall be based on measured flow rates or estimated flow rates. The tank capacity shall be at least five times the daily flow rate.

6. Location. Holding tanks shall be located:

a. In an area readily accessible to the pump truck under all weather conditions.

b. As specified for septic tanks in Table IV, set forth following section H. 2. d. (3).

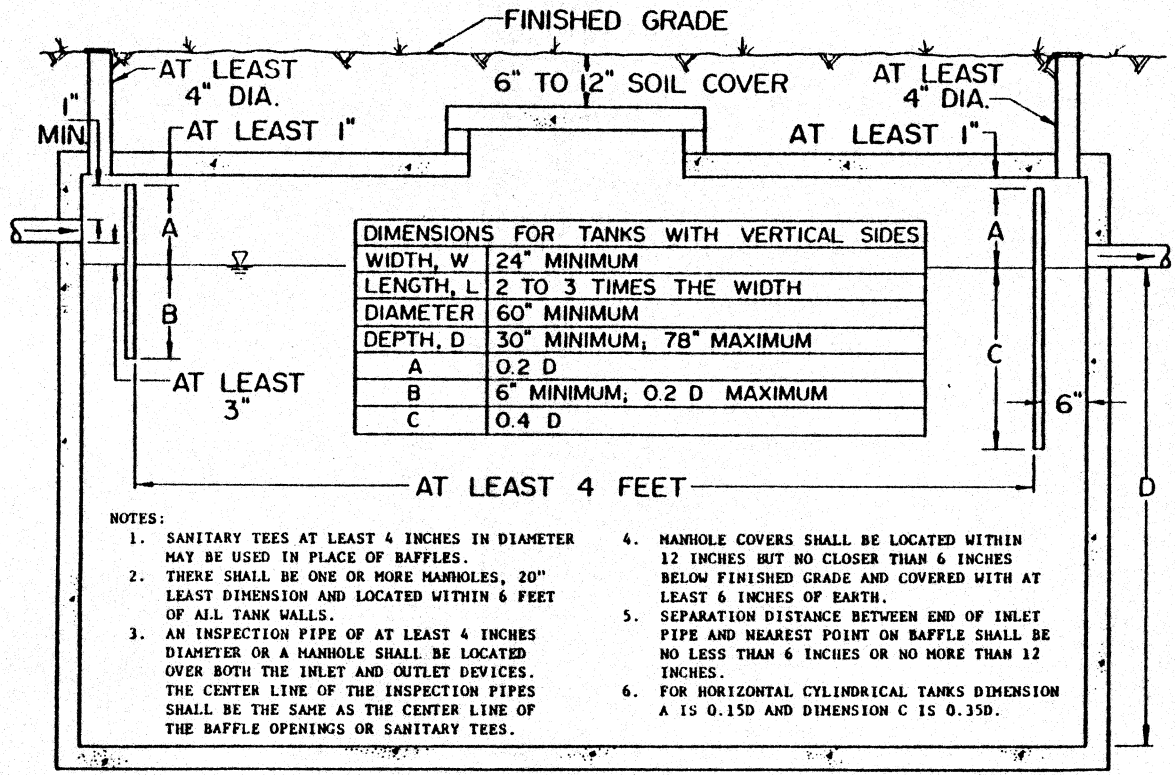
c. Where accidental spillage during pumping will not create a nuisance.

7. Contract. 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.

8. Accidental overflow. Holding tanks shall be monitored to minimize the chance of accidental sewage overflows. Techniques such as visual observation, warning lights or bells, or regularly scheduled pumping shall be used. For other establishments, a positive warning system shall be installed which allows 25 percent reserve capacity after actuation.

FIGURE 1

VERTICAL SIDEWALL SEPTIC TANK



DIMENSIONS FOR TANKS WITH VERTICAL SIDES	
WIDTH, W	24" MINIMUM
LENGTH, L	2 TO 3 TIMES THE WIDTH
DIAMETER	60" MINIMUM
DEPTH, D	30" MINIMUM; 78" MAXIMUM
A	0.2 D
B	6" MINIMUM; 0.2 D MAXIMUM
C	0.4 D

NOTES:

1. SANITARY TEES AT LEAST 4 INCHES IN DIAMETER MAY BE USED IN PLACE OF BAFFLES.
2. THERE SHALL BE ONE OR MORE MANHOLES, 20" LEAST DIMENSION AND LOCATED WITHIN 6 FEET OF ALL TANK WALLS.
3. AN INSPECTION PIPE OF AT LEAST 4 INCHES DIAMETER OR A MANHOLE SHALL BE LOCATED OVER BOTH THE INLET AND OUTLET DEVICES. THE CENTER LINE OF THE INSPECTION PIPES SHALL BE THE SAME AS THE CENTER LINE OF THE BAFFLE OPENINGS OR SANITARY TEES.
4. MANHOLE COVERS SHALL BE LOCATED WITHIN 12 INCHES BUT NO CLOSER THAN 6 INCHES BELOW FINISHED GRADE AND COVERED WITH AT LEAST 6 INCHES OF EARTH.
5. SEPARATION DISTANCE BETWEEN END OF INLET PIPE AND NEAREST POINT ON BAFFLE SHALL BE NO LESS THAN 6 INCHES OR NO MORE THAN 12 INCHES.
6. FOR HORIZONTAL CYLINDRICAL TANKS DIMENSION A IS 0.15D AND DIMENSION C IS 0.35D.

FIGURE 2

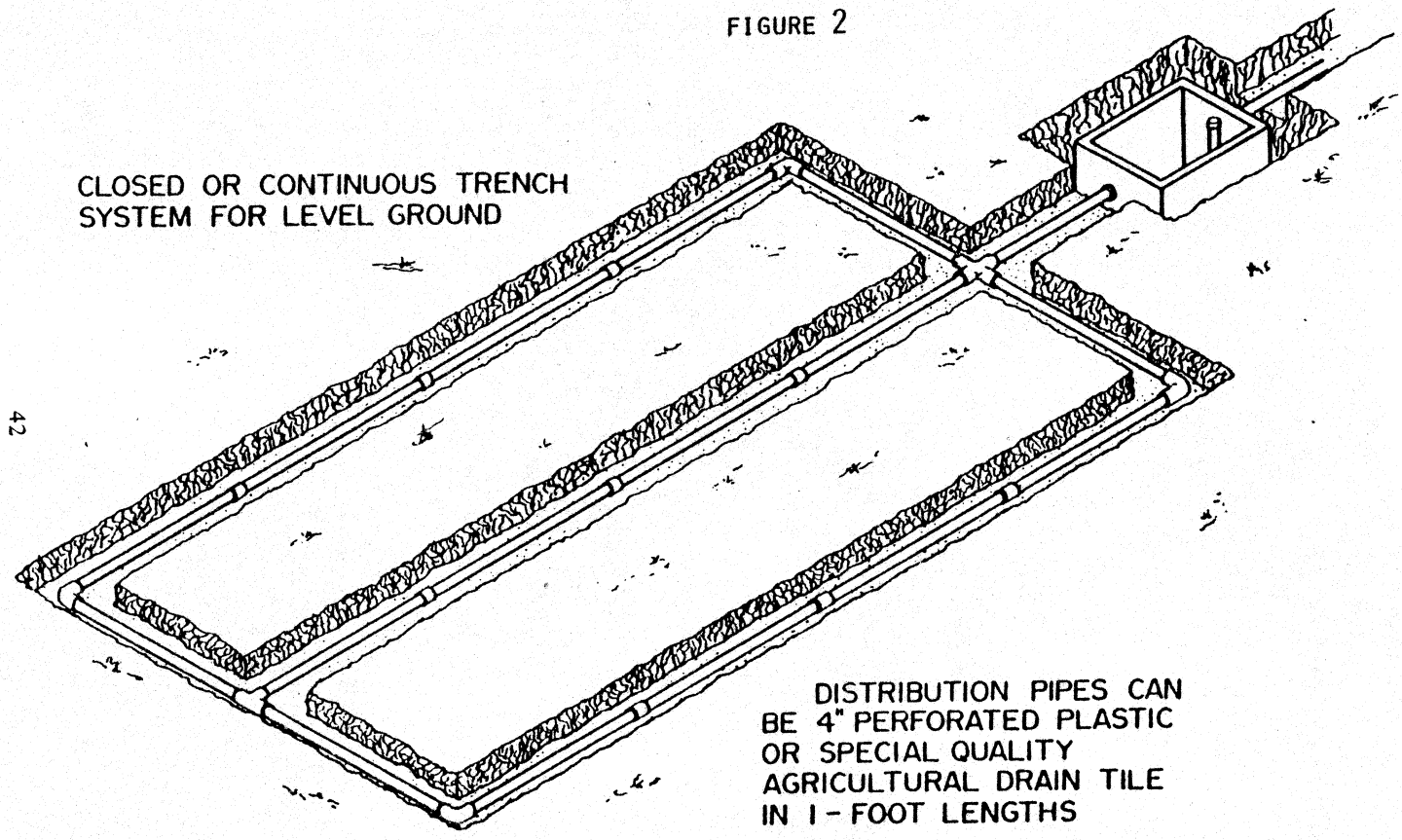
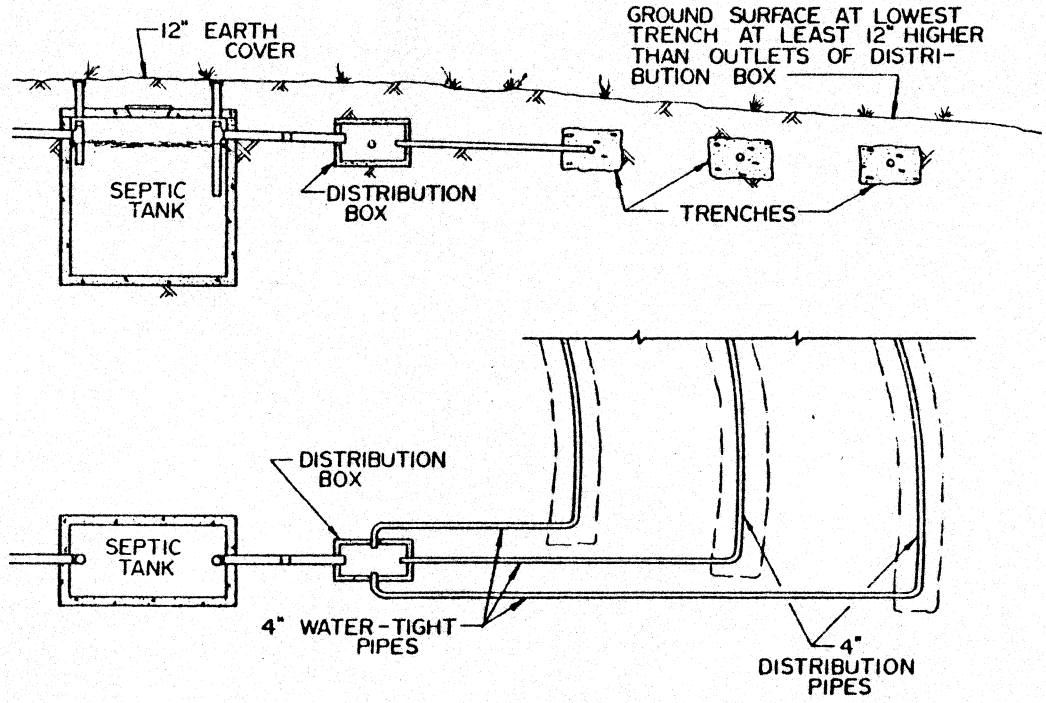

CLOSED OR CONTINUOUS TRENCH
SYSTEM FOR LEVEL GROUND
DISTRIBUTION PIPES CAN
BE 4" PERFORATED PLASTIC
OR SPECIAL QUALITY
AGRICULTURAL DRAIN TILE
IN 1 - FOOT LENGTHS

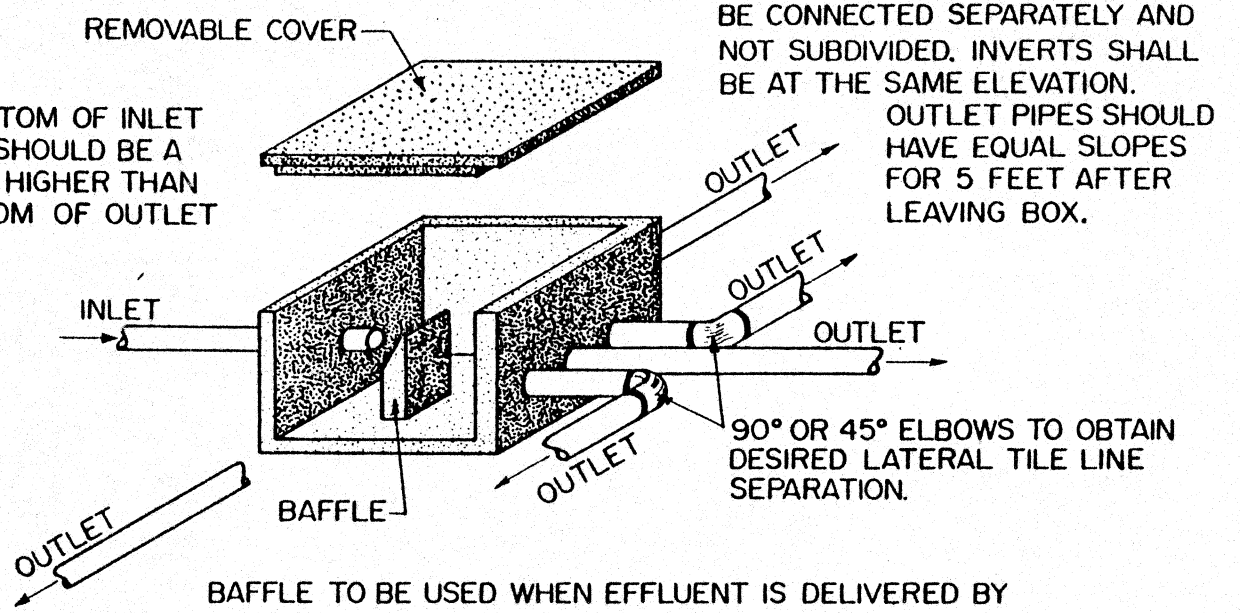
FIGURE 3



SEWAGE TREATMENT SYSTEM WITH DISTRIBUTION BOX

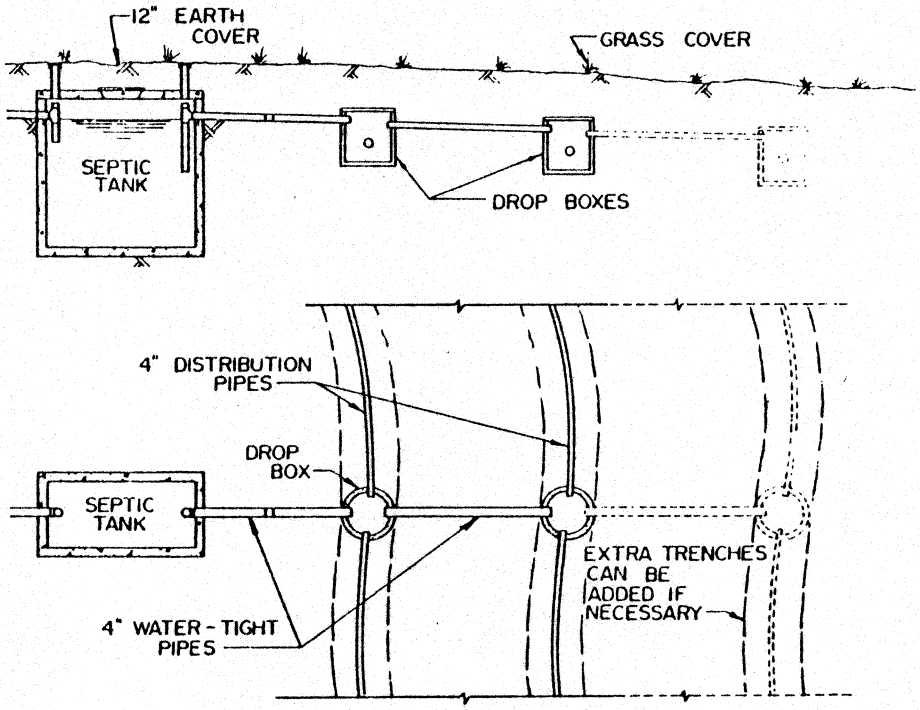
FIGURE 4

DISTRIBUTION BOX



BAFFLE TO BE USED WHEN EFFLUENT IS DELIVERED BY PUMP OR SIPHON, OR THE SLOPE OF THE INLET LINE IS SUCH THAT UNEVEN DISTRIBUTION COULD OCCUR. TOP OF THE BAFFLE AT LEAST LEVEL WITH THE CROWN OF THE INLET PIPE.

FIGURE 5



SEWAGE TREATMENT SYSTEM WITH DROP BOXES

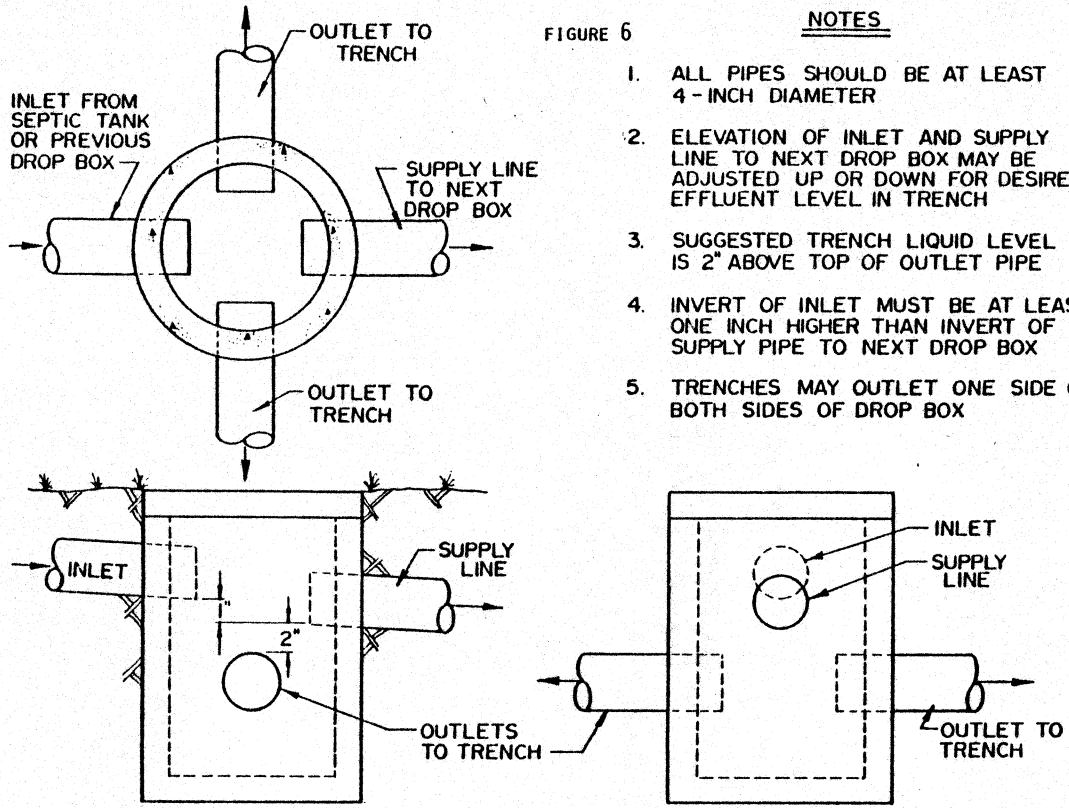


FIGURE 6

DROP BOX

NOTES

1. ALL PIPES SHOULD BE AT LEAST 4-INCH DIAMETER
2. ELEVATION OF INLET AND SUPPLY LINE TO NEXT DROP BOX MAY BE ADJUSTED UP OR DOWN FOR DESIRED EFFLUENT LEVEL IN TRENCH
3. SUGGESTED TRENCH LIQUID LEVEL IS 2" ABOVE TOP OF OUTLET PIPE
4. INVERT OF INLET MUST BE AT LEAST ONE INCH HIGHER THAN INVERT OF SUPPLY PIPE TO NEXT DROP BOX
5. TRENCHES MAY OUTLET ONE SIDE OR BOTH SIDES OF DROP BOX

FIGURE 7

LAYOUT OF PERFORATED PIPE LATERALS FOR PRESSURE DISTRIBUTION

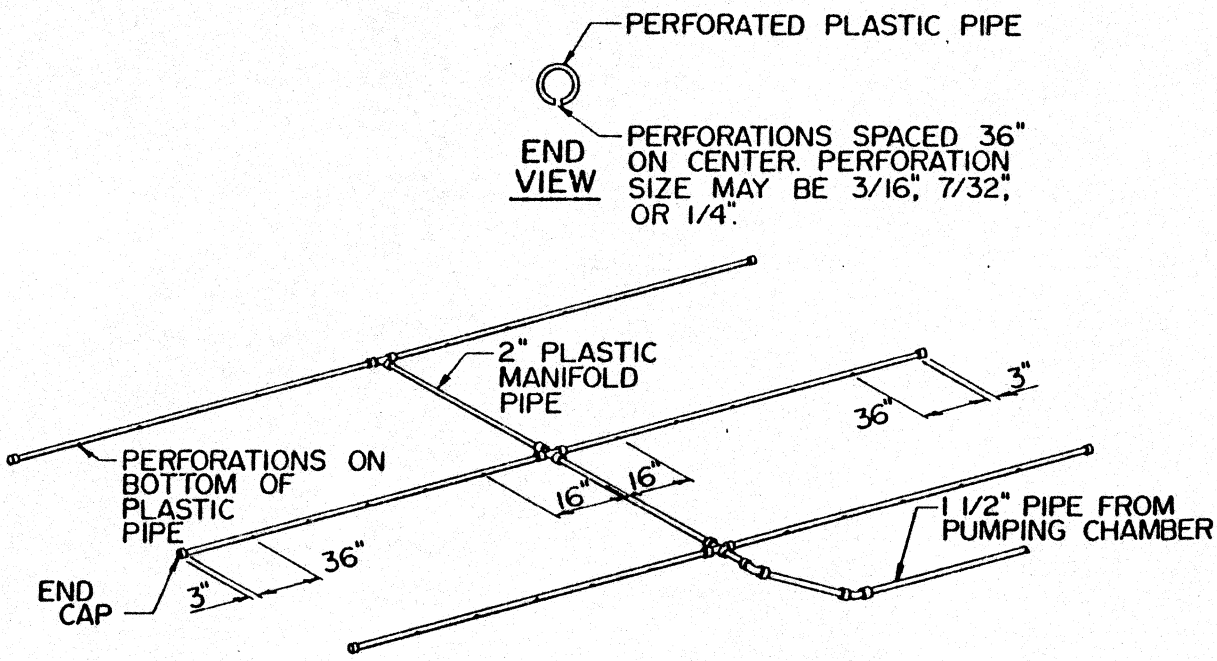
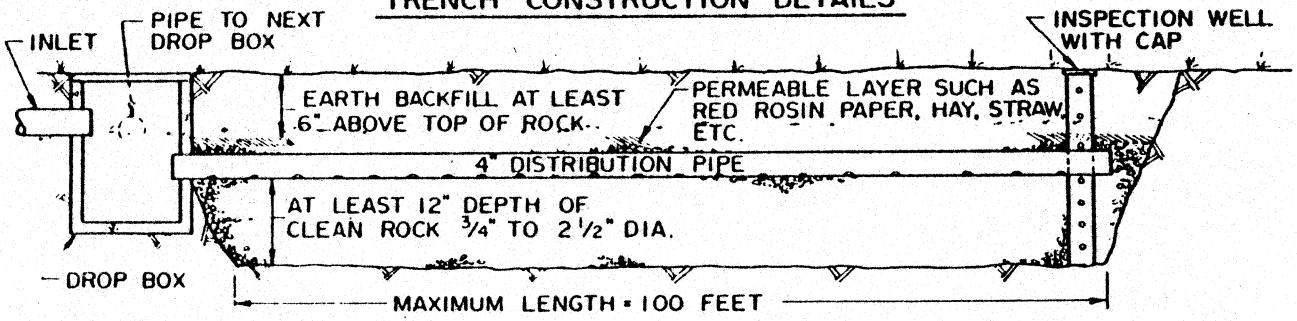
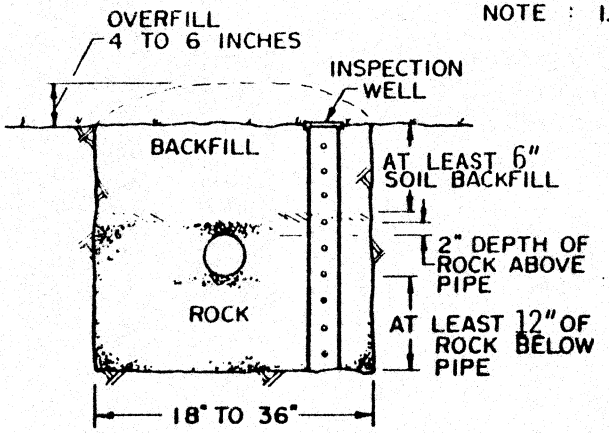


FIGURE 8

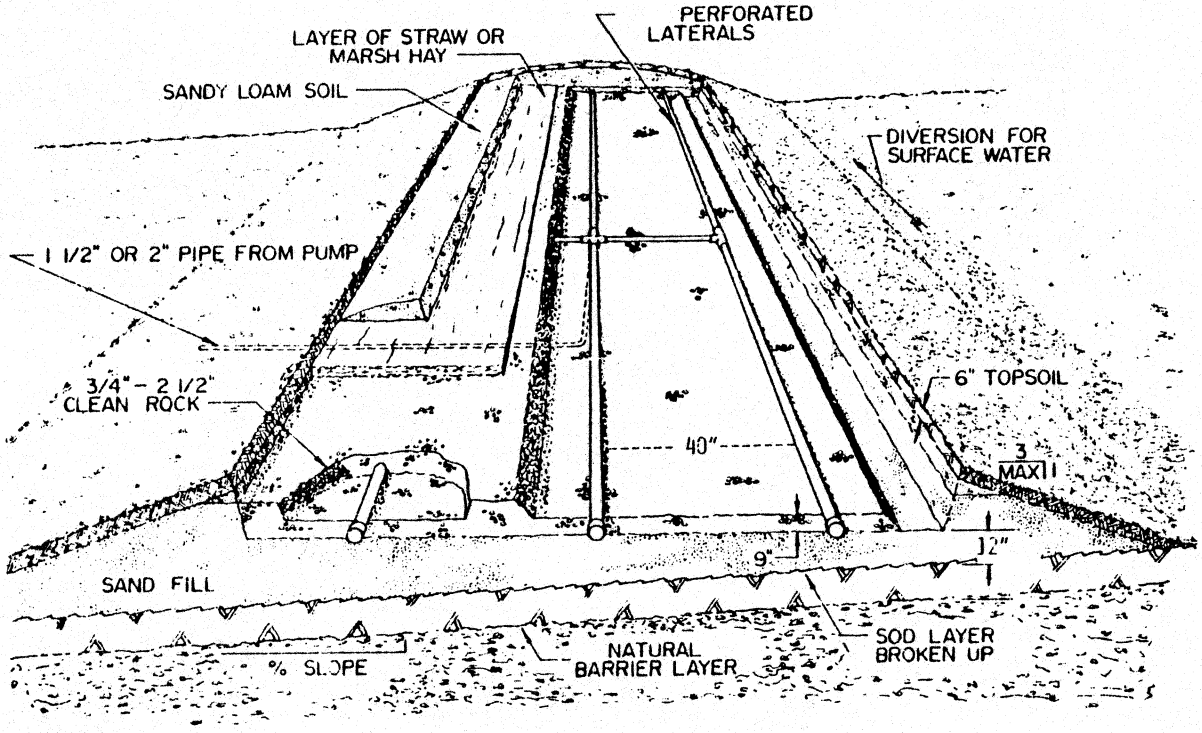
TRENCH CONSTRUCTION DETAILS





NOTE : 1. BOTTOM OF TRENCH MUST BE FLAT ALONG LENGTH

FIGURE 9



SEWAGE TREATMENT MOUND (PRESSURE DISTRIBUTION)

APPENDIX C

MHD 123 Materials.

(a) Quality of Materials. All materials used in any drainage or plumbing system or part thereof, shall be free from defects, and no materials which are damaged or defective, shall knowingly be installed.

(b) Identification of Materials. All materials must be marked, unless otherwise easily identifiable, so as to provide a visual means of identification as to types, grades, weights, and strengths. The installer shall, as far as possible, position the identification marks so as to provide ease of inspection by the Administrative Authority.

(c) Standards for Plumbing Materials.

(1) Approved Materials. A material shall be considered approved if it meets one or more of the standards cited in Table 123(c)(3) Standards for Plumbing Materials. Materials not listed in Table 123(c)(3) shall be used only as provided for in MHD 122(h)(3), or as permitted elsewhere in this Code.

(2) Abbreviations. Abbreviations in Table 123(c)(3) refer to the following:

ANSI – American National Standards Institute
10 East 40th Street
New York, New York 10016

ASTM – American Society for Testing and Materials
1916 Race Street
Philadelphia, Pennsylvania 19103

AWWA – American Water Works Association
2 Park Avenue
New York City, New York 10016

CS – Commercial Standards Available From:
Commodity Standards Division
Office of Industry and Commerce
U. S. Department of Commerce
Washington, D. C. 20234

FS – Federal Specifications Available From:
Federal Supply Service
Standards Division—General Services Administration
Washington, D. C. 20406

NSF – National Sanitation Foundation
Ann Arbor, Michigan 48106

FHA – Federal Housing Authority
Architectural Standards Division
Washington, D. C.

TABLE 123 (C) (3)
STANDARDS FOR PLUMBING MATERIALS

	DESCRIPTION	ANSI	ASTM	FS	OTHER
1.	CAST IRON PIPE & FITTINGS	A21.2 A21.6	A-74	WW.P.401C	CS188
1A	Cast Iron Pipe & Fittings. Extra Heavy	A21.8			
1B	Cast Iron Pipe Centrifugally Cast only and fittings.	A21.6	A-74	WW.P.401C	CS188
	Service Weight	A21.8			
1C	Cast Iron Mechanical (Gland Type) Pipe	A21.11 A21.2 A21.6		WW-P-421a	
1D	Cast Iron Mechanical (Gland Type) Pipe Cement Lined	A21.8 A21.4 A21.2 A21.6 A21.8			
1E	Cast Iron Short Body Water Service Fittings (2"-12")	A21.10			AWWA C100
1F	Cast Iron Threaded Pipe	A40.5			
1G	High Silicon Pipe, Fittings Cast Iron				
1H	Cast Iron Threaded Fittings Black and galvanized 125#	B16.4		WW-P-501	
1J	Cast Iron Drainage Fittings Black and Galvanized	B16.12		WW-P-491	
1K	Hubless Cast Iron Pipe and Fittings (amended 8-31-72)				CISPI Standard 301-69T

* * * * *

V.	SILICA AND EARTH PRODUCTS PIPE AND FITTINGS, NON METALLIC			
5A	Asbestos–Cement Pressure Pipe and Fitting.	C500 C296	SS-P351	
5B	Absestos–Cement Water Pipe and Fittings.	C500	SS-P-351	AWWA C400
5C	Asbestos–Cement Non Pressure Pipe and Fittings.	C428	XX-P-331	
5D	Asbestos–Cement Perforated Underdrain Pipe and Fittings	C508		
5E	Vitrified Clay Pipe, Standard Strength and Stronger fittings	C13 C200		
5F	Unglazed Clay Pipe, Extra Strength and fittings	C278		
5G	Perforated Clay Pipe and Fittings	C211		
5H	Borosilicate Glass Pipe and Fittings 60 psi			
5J	Non Reinforced Concrete Draintile	C412		AASHO M178

5K	Non Reinforced Concrete Pipe .	C14	SS-P-371	AASHO M86
5L	Perforated Concrete Pipe, Underdrainage	C444		
5M	Reinforced Concrete Pipe . .	C76	SS-P-375	
5N	Reinforced and Prestressed Concrete Pipe, Pressure Type and Fittings			
5O	Bituminized Fiber Drain and Sewer Pipe	D1860	SS-P-1540A	(Amended 8-31-72)
5P	Perforated Bituminized Fiber Pipe for General Drainage	D2311	SS-P-1540A	(Amended 8-31-72)
VI.	PLASTIC PIPE AND FITTINGS DRAIN, WASTE and VENT			
6A	Acrylonitrile-Butadiene-Styrene (ABS)	D2661	L-P-322a	HSF14
	Type 1, Schedule 40		FHA-MPS	CS270
6B	Polyvinyl Chloride (pvc) . . .	D2665	L-P-320a	NSF14
	Schedule 40 Unthreaded . . .		FHA-MPS	CS272
	Schedule 80 can be threaded			
	BUILDING SEWER		L-P-001221	
6C	(1) Styrene–Rubber	D2852	(Filed 4-5-73)	CS228
6C	(2) Polyvinyl Chloride (pvc) . .	D3033	FHA-UM-26	
	(Amended 4-5-73)	D3034	WW-P-00380a	

* * * * *

(d) Piping System Materials

* * * * *

(4) Building Sewers

(aa) Cast Iron 1A and 1B and fittings and Hubless Cast Iron 1K. *(Amended 6-26-72)*

(bb) Cast Iron 1C and 1D with 1 E fittings.

(cc) Asbestos Cement 5A and 5C and fittings laid on a continuous granular bed and only in yard areas.

(dd) Clay pipe and fittings 5E laid on a continuous granular bed.

(ee) Concrete pipe 5K in yard areas and not under permanent streets, laid on a continuous granular bed.

(ff) Concrete 5N.

(gg) Plastic 6A, 6B, 6C(1), and 6C(2) laid on a continuous granular bed in yard areas. *(Amended 4-5-73)*

(hh) Bituminized-fiber drain and sewer pipe 50, laid on a continuous granular bed. *(Amended 8-31-72)*

* * * * *

MHD 124 Joints and Connections.

(a) Types of Joints for Piping Materials.

(1) Tightness. Joints and connections in the plumbing system shall be gastight and watertight for the pressure required by test, with the exception of those portions of perforated or open joint piping which are installed for the purpose of collecting and conveying ground or seepage water.

(2) Types of Joints.

(aa) Caulked Joints. Caulked joints for cast-iron bell and spigot soil pipe shall be firmly packed with oakum or hemp and filled with molten lead not less than 1 inch deep and shall extend not more than 1/8 inch below rim of hub. No paint, varnish, or any other coatings shall be permitted on the jointing material until after the joint has been tested and approved. Lead shall be caulked tight.

(bb) Threaded Joints–Screwed Joints. Threaded joints shall conform to American National taper pipe thread, ASA - B2.1 - 1945 or FS GGG - P - 351a. All burrs shall be removed. Pipe ends shall be reamed out to size of bore and chips removed. Pipe joint compound shall be used on male threads only.

(cc) Wiped Joints. Joints in lead pipe or fittings, or between lead pipe or fittings and brass or copper pipe, ferrules, solder nipples, or traps, shall be full wiped joints. Wiped joints shall have an exposed surface on each side of the joint not less than 3/4 inch, and a minimum thickness at the thickest part of the joint of not less than 3/8 inch. Joints between lead pipe and cast iron, steel, or wrought iron shall be made by means of a caulking ferrule, soldering nipple, or bushing.

(dd) Soldered or Brazed Joints. Joints with copper tube with solder joint fittings shall be soldered or brazed. Surfaces to be soldered or brazed shall be thoroughly cleaned. Joints to be soldered shall be properly fluxed with non-corrosive paste type flux. Solder used for joints shall have a nominal composition of 50% tin and 50% lead, or 95% tin and 5% antimony, conforming to ASTM Standard Specification for soft solder metal B32-60T. Joints to be brazed shall be properly fluxed with a flux suitable for brazing material which is used. Brazing material shall conform to ASTM Standard Specification for Brazing Filler Metal B260-52T.

(ee) Flared Joints. Flared joints for soft copper water tubing shall be made with fittings meeting approved standards. (See Table 123(c)(3)). The tubing shall be reamed and expanded with proper flaring tools.

(ff) Hot-poured Joints. Hot-poured compound for clay or concrete sewer pipe, or other materials, shall not be water absorbent, and when poured against a dry surface shall have a bond of not less than 100 pounds per square inch. All surfaces of the joint shall be clean and dried before pouring. If wet surfaces are unavoidable, a suitable primer shall be applied.

The compound shall not soften sufficiently to destroy the effectiveness of the joint when subjected to a temperature of 160° Fahrenheit nor soluable in any of the waste carried by the drainage system. Approximately 25% of the joint space at the base of the socket shall be filled with jute or hemp. A pouring collar, rope, or other device shall be used to hold the hot compound when pouring. Each joint shall be poured in one operation until the joint is filled. Joints shall not be tested until one hour after pouring.

(gg) Cold Joint Compound (Tar Base). Cold joint compound (tar base) for clay and concrete pipe shall not be water absorbent, and shall bond itself to vitrified clay and concrete pipe. Half of the joint must be packed with oakum, and the remainder with cold tar compound.

(hh) Gasket Type Joints. Resilient Rubber Joints for Clay or Concrete. Flexible joints between lengths of clay or concrete pipe may be made by using approved resilient on rubber materials, both on the spigot end and in the bell end of the pipe.

(ii) Cement Mortar Joints. Except for repairs and connections of existing lines constructed with such joints, cement mortar joints are prohibited. Where permitted, cement mortar joints shall be made in the following manner: A layer of jute or hemp shall be inserted into the base of the annular joint space and packed tightly to prevent mortar from entering the interior of the pipe or fitting. Not more than 25% of the annular space shall be used for jute or hemp. The remaining space shall be filled in one continuous operation with a thoroughly mixed mortar composed of one part cement and two parts sand, with only sufficient water to make the mixture workable by hand. Additional mortar of the same composition shall then be applied to form a one to one slope with the barrel of the pipe. The bell or hub of the pipe shall be left exposed and when necessary the interior of the pipe shall be swabbed to remove any mortar or other material which may have found its way into such pipe.

(jj) Burned Lead Joints. Burned (welded) lead joints shall be fused together to form a uniform weld at least as thick as the lead being joined.

(kk) Asbestos Cement Sewer Pipe Joints. Joints in asbestos cement pipe shall be made with sleeve couplings of the same composition as the pipe, sealed with rubber rings. Joints between asbestos cement pipe and metal pipe shall be made by means of an adapter coupling caulked as required in MHD 124(a)(2)(aa). No adapted coupling shall be used that does not have a center ridge. Pipe must not be able to pass through the coupling.

(ll) Mechanical Joints.

(ll-1) Mechanical Joints for Cast-Iron Water Pipe. Mechanical joints in cast-iron water pipe shall be made by means of a flanged collar and rubber ring gasket, secured by the use of an adequate number of

steel bolts. The rubber sealing ring shall conform to A.S.A. A21-Point 11 Requirements.

(ll-2) Mechanical Joints in Cast-Iron Soil Pipe. Mechanical joints in cast-iron soil pipe shall be made by means of a preformed molded rubber ring, secured by pulling the pipe and fittings together in such a way as to compress the molded rubber ring in a manner that will assure a gas and water tight joint. The rubber sealing ring shall conform to A.S.T.M. 564-65 requirements.

(ll-3) Mechanical Joints to Chemical Waste Pipe. Mechanical joints in chemical waste pipe, of prestressed, low-expansion borosilicate glass pipe and high silicon content cast-iron pipe, shall be jointed by means of a stainless steel corrosion resistant clamp assembly, or a clamp assembly utilizing a fiberglass reinforced nylon shell surrounding a sealing sleeve of an elastomeric material containing an approved acid and corrosion resistant seal ring or gasket in such a manner that the sleeve and ring seal or gasket are firmly compressed by the tightening device in order that a gas and water tight joint is provided. The sleeves or bands for this type joint shall be marked with the words "All Stainless", or the recognized abbreviation therefore, and marked with the pipe size for which its use is intended. Fiberglass reinforced shells must bear the manufacturer name. The sleeve must be used as factory assembled. During installation assembly, the pipe or fittings must be inserted into the sleeve so as to be firmly seated against the center rib or shoulder of the gasket, and on all field cut lengths the ends must be as square and smooth as possible. *(Amended 6-26-72)*

(ll-4) Mechanical Joints in Hubless Cast Iron Soil Pipe. Mechanical joints for hubless cast iron soil pipe and fittings shall be made by using a neoprene sleeve and stainless steel retaining band as specified in CISPI standard 301. *(Amended 6-26-72)*

(ll-5) Mechanical Pipe Couplings and Fittings. Couplings shall be made with the housing fabricated in two or more parts of malleable iron castings in accordance with Federal Specification QQ-I-666c, Grand 11, or with ASTM A47 or ASTM A339. The coupling gasket shall be molded synthetic rubber, per ASTM D-735-61, Grade No. R615BZ. Coupling bolts shall be oval neck track head type with hexagonal heavy nuts, per ASTM-A-183-60, or ASTM A325.

Pipe fittings used with these pipe couplings shall be fabricated or malleable iron castings in accordance with Federal Specifications QQ-I-666c, Grade 11, or with ASTM A47; ductile iron ASTM A339; segweld steel ASTM53 or A106.

These couplings and fittings may be used above ground, for storm drains and leaders and for water distribution pipe provided exposed parts in contact with water are galvanized. *(Amended 6-26-72)*

(mm) Plastic Joints. Every joint in plastic piping shall be made with approved fittings by either solvent welded or fusion welded connections or with approved insert fittings and metal clamps and screws of corrosion re-

sistant material or threaded joints according to accepted standards. All solvent materials must meet approved recognized standards.

(nn) Bituminized Fiber Drain Pipe Joints. Pipe and bends shall be provided with accurately machined or molded tapered joints, and a taper-sleeve coupling shall be provided for each length of pipe and for each bend. The slope of the taper in both pipe and coupling shall be 2^{o}. *(Amended 6-26-72)*

(3) Use of Joints.

(aa) Clay Sewer Pipe. Joints in clay sewer pipe, or between such pipe and metal pipe shall be made as provided in MHD 124(a)(2)(ff), (gg), (hh), and (ii).

(bb) Concrete Sewer Pipe. Joints in concrete sewer pipe, or between pipe and metal pipe, shall be made by means as provided in MHD 124(a)(2)(ff), (gg), (hh) and (ii).

(cc) Cast-Iron Pipe. Joints in cast-iron shall be either caulked or screwed, as provided in MHD 124(a)(2)(aa), (bb), and (cc).

(dd) Cast-Iron Soil Pipe. Joints in cast-iron soil pipe may be made by means as provided in MHD 124(a)(2)(aa) or (ll-2).

(ee) Threaded Pipe to Cast-Iron. Every joint between wrought iron, steel, brass, copper and cast-iron pipe shall be either caulked or threaded joints as provided in MHD 124(a)(2)(aa), (bb) and (cc) and shall be made with approved adapter fittings.

(ff) Lead to Cast-Iron, Wrought Iron and Steel. Joints between lead and cast-iron, wrought iron, or steel shall be made by means of wiped joints to a caulking ferrule, soldering nipple or bushing as provided in MHD 124(a)(2)(cc).

(gg) Copper Water Tube. Joints in copper water tubing shall be made either by the appropriate use of approved brass or wrought copper water fittings properly soldered or brazed, or by means of approved flared fittings as provided in MHD 124(a)(2)(ee).

(hh) Plastic Pipe Joints. Joints in plastic pipe or between plastic and cast-iron, steel, brass or copper pipe shall be made as provided in MHD 124(a)(2)(mm).

(ii) Bituminized Fiber Pipe Joints. Joints in bituminized fiber pipe shall be made as provided for in MHD 124(a)(2)(nn). *(Amended 6-26-72)*

(4) Special Joints.

(aa) Copper Tubing to Threaded Pipe Joints. Joints from copper tubing to threaded pipe shall be made by the use of brass or copper adapter fittings. The joint between the copper pipe and fitting shall be properly soldered, brazed or flared.

(bb) Cast-Iron to Copper Tube. Caulked joints between copper tubing and cast-iron soil pipe shall be made by means of brass or copper ferrules or other approved adapter fittings.

(cc) Slip Joints. In drainage piping, slip joints shall be used only on the inlet side of the trap or in the trap seal. Every slip joint shall be made using approved packings of gasket material or approved ground joint brass compression rings. Ground faced connections which allow adjustments of tubing but provide a durable rigid joint when made up shall not be considered as a slip joint.

(dd) Expansion Joints. Every expansion joint shall be of an approved type and the material used in its manufacture shall be compatible with the type of piping in which it is installed. Every expansion joint, other than an expansion loop, shall be accessible. (Also see MHD 133(i))

(ee) Bituminized Fiber to Other Types of Pipe. When connecting bituminized fiber pipe to other types of materials, only approved types of fittings and adaptors designed for the specific transition intended shall be used. *(Amended 6-26-72)*

(5) Flanged Fixture Connections. Fixture connections between drainage pipes and water closets, pedestal urinals, and earthenware trap standards shall be made by means of brass, plastic, or iron flanges, caulked, soldered, solvent welded, or screwed to the drainage pipe. The connection shall be bolted, with an approved gasket, washer or setting compound between the earthenware and the connection. Floor flanges of other equivalent materials may be used when approved by the Administrative Authority.

The bottom of the floor flange shall be set on the top of the finished floor or on a structurally firm base. Closet bends or stubs must be cut off so as to present a smooth surface, even with the top of the closet flange. Use of commercial putty or plastic as fixture setting compound is prohibited.

(6) Prohibited Joints and Connections. See MHD 131(b)(3).

(7) Increasers and Reducers. Brass or cast-iron body cleanouts shall not be used as a reducer or adapter from cast-iron soil pipe to steel or wrought iron pipe. Where different sizes of pipe or pipes and fittings are to be connected, the proper size increasers, reducers, or reducing fittings shall be used between the two sizes. Hexagon screwed bushings shall not be used in drainage piping.

MHD 125 Traps and Clean Outs.

* * * * *

(b) Drainage Pipe Cleanouts.

(1) Location. There shall be at least 2 cleanouts in the building drain, one at or near the base of the stack and one near the connection between the building drain and the building sewer. The cleanout at the outside wall may be inside or outside the building, and shall be made with a full "Y" branch fitting and shall extend at least 2 inches above grade or finished floor, except that the Administrative Authority may grant permission to use a flush cover in traffic areas.

A cleanout which is easily accessible shall be provided at or near the foot of each vertical soil or waste stack.

Each horizontal branch drain pipe shall be provided with a cleanout at its upper terminal, except that a fixture trap or a fixture with an integral trap, readily removable without disturbing concealed piping, may be accepted as a cleanout equivalent for this purpose.

(2) Size of Cleanouts. The cleanout shall be of the same nominal size as the pipes they serve up to 4 inches in diameter and not less than 4 inches for larger piping.

The distance between cleanouts in horizontal piping shall not exceed 50 feet for 3 inch or less in size and not over 100 feet for 4 inch and over in size.

(3) Cleanout Materials. The bodies of cleanout ferrules shall be made to standard pipe sizes, conform in thickness to that required for pipe and fittings of the same material and extend not less than ¼ inch above the hub. The cleanout cover or plug shall be of brass, cast-iron or approved plastic and be provided with a raised nut or recessed socket for removal.

Cleanouts for cast-iron soil pipe shall have cleanout covers made of brass and conform to specifications and details as shown in Figure 125(b)(3), Appendix B.

(4) Cleanouts to be Accessible. Each cleanout, unless installed under an approved cover plate or left flush with the finished floor, shall be at least 2 inches above grade, readily accessible and shall not be covered with cement, plaster, or other permanent finish material. Where a soil stack cleanout is located within 10 feet of where the building drain leaves the building, the cleanout at the outside wall may be eliminated.

MHD 131 Drainage Systems.

(a) Determining Size of Drainage System.

(1) Load on Drainage Piping. The load on drainage system piping shall be computed in terms of drainage fixture units in accordance with Table 131 (a)(1) and MHD 131(a)(1)(aa), except the Administrative Authority may allow variations where it is shown by a hydraulic analysis of the piping system, submitted to the Administrative Authority, that such variation would result in a more desirable flow rate in the piping system.

TABLE 131 (a) (1)
FIXTURE UNIT VALUES FOR VARIOUS PLUMBING FIXTURES

Type of Fixture	Fixture Unit Value	Minimum Fixture Trap and drain size
Clothes Washer (Domestic Use)	2	1½
Clothes Washer (Public Use in Groups of 8 or more)	6 each	
Bath tub with or without shower	2	1½
Bidet	2	1½
Dental unit or cuspidor	1	1¼
Drinking Fountain	1	1¼
Dishwasher, Domestic	2	1½
Dishwasher, Domestic	2	1½
Dishwasher, Commercial	4	2
Floor Drain with 2 inch waste	2	2
Floor drain with 3 inch waste	3	3
Floor Drain with 4 inch waste	4	4
Lavatory	1	1¼
Laundry Tray (1 or 2 Compartment)	2	1½
Shower Stall, Domestic	2	1½
Shower (Gang) per head	1	
SINKS:		
Combination, Sink and Tray (with disposal unit)	3	1½
Combination, Sink and Tray (with one trap)	2	1½
Domestic	2	1½
Domestic, with disposal unit	2	1½
Surgeons	3	1½
Laboratory	1	1½
Flushrim or Bedpan washer	6	3
Service	3	2
Pot or Scullery	4	2
Soda Fountain	2	1½
Commercial, Flat Rim, Bar or Counter	3	1½
Wash, Circular or Multiple (per set of faucets)	2	1½
URINAL Pedestal, Wall Hung, with 3 inch trap (Blowout and Syphon Jet)	6	3
Wall Hung with 2 inch trap	3	2
Wall Hung with 1½ inch trap	2	1½
Trough (per 6 foot section)	2	1½
Stall	3	2
WATER CLOSET	6	3
Unlisted Fixture or Trap Size		
1¼ inch	1	
1½ inch	2	
2 inch	3	
2½ inch	4	
3 inch	5	
4 inch	6	

(aa) Values for Continuous Flow. Fixture unit values for continuous or semi-continuous flow into the drainage system, such as from a pump, sump ejector, air conditioning equipment, or similar device shall be computed on the basis of one fixture unit for each gallon per minute flow.

(2) Selecting Size of Drainage Piping. Pipe sizes shall be determined from Table 131(a)(2)A and Table 131(a)(2)B on the basis of drainage load computed from Table 131(a)(1) and MHD 131(a)(1)(aa).

TABLE 131 (a) (2) A
MAXIMUM LOADS FOR HORIZONTAL DRAINS IN FIXTURE UNITS

Diameter of Drain (inches)	Horizontal Fixture Branch*- 1/4 in/ft. (f. u.)	Building Sewer, Building Drain and Building Drain Branches-from Stacks**** Slope 1/16 in/ft. (f. u.)	1/8 in/ft. (f. u.)	1/4 in/ft. (f. u.)	1/2 in/ft. (f. u.)
1¼	1				
1½	3				
2	6			21	26
2½	12			24	31
3**	32***		36***	42***	50***
4	160		180	216	250
5	360		390	480	575
6	620		700	840	1,000
8	—	1,400	1,600	1,920	2,300
10	—	2,500	2,900	3,500	4,200
12	—	3,900	4,600	5,600	6,700
15	—	7,000	8,300	10,000	12,000

* Includes Horizontal Branches of the Building Drain.
** No water closet shall discharge into a drain less than 3 inch.
*** Not over 2 Water Closets.
**** Every building drain that receives the discharge of (3) or more water closets, shall not be less than 4 inch in diameter. *(Amended 7-26-73)*

(3) Minimum Size of Soil and Waste Stacks. No soil or waste stack shall be smaller than the largest horizontal branch connected thereto except that a 4x3 water closet connection shall not be considered as a reduction in pipe size.

(4) Minimum Size of Stack Vent or Vent Stack. Any structure in which a building drain is installed shall have at least one stack vent or vent stack carried full size through the roof not less than 3 inches in diameter. Where one or more soil stacks are required to extend through the roof undiminished in size they should be the stack or stacks most remote from the location where the building drain leaves the building. When a soil or waste stack receives the discharge of fixtures located on 2 or more floors, and the uppermost fixture is located 3 or more floors above the building drain, such stack and stack vent shall continue undiminished in size through the roof. *(Amended 4-5-73)*

(5) Provisions for Future Fixtures. When provision is made for future installation of fixtures, those provided for shall be considered in determining the required sizes of drain and vent pipes. Construction to provide for such future installations shall be terminated with a plugged fitting or fittings.

TABLE 131 (a) (2) B

MAXIMUM LOADS FOR SOIL AND WASTE STACKS IN FIXTURE UNITS

Diameter of Stack	Stacks of not more than 3 stories or Branch Intervals	Stacks of more than 3 stories or Branch Intervals	Total at One Story or Branch Interval
1¼*	2	2	1
1½*	4	4	2
2*	9	18	6
2½*	20	42	9
3	36***	72***	24**
4	240	500	90
5	540	1,100	200
6	960	1,900	350
8	—	3,600	600
10	—	5,600	1,000
12	—	8,400	1,500

* No water closets permitted.
** Not over 2 water closets permitted.
*** Not over 6 water closets permitted, and not over 6 branch intervals on a 3 inch soil stack. *(Amended 12-26-72)*

(6) Minimum Size of Underground Drainage Piping. No portion of the drainage system installed underground shall be less than 2 inches in diameter.

(7) Sizing of Offsets on Drainage Piping.

(aa) Offsets of 45 Degrees of Less. An offset in a vertical stack with a change of direction of 45° or less from the vertical, may be sized as a straight vertical stack.

(bb) Offsets of more than 45 Degrees. A stack with an offset of more than 45 degrees from the vertical shall be sized as follows:

The portion of the stack above the offset shall be sized as for a regular stack based on the total number of fixture units above the offset.

The offset shall be sized as for a building drain branch. Table 131 (a) (2) A Maximum Loads for Horizontal Drains.

The portion of the stack below the offset shall be sized at least as large as the offset. *(Amended 4-5-73)*

(cc) Above Highest Branch. An offset above the highest branch connection is an offset in the stack vent and shall be considered only as it affects the developed length of the vent.

(dd) Below Lowest Branch. In the case of an offset in a soil or waste stack below the lowest branch connection, there shall be no change in diameter required if the offset is made at an angle of not greater than 45 degrees from the vertical.

If such offset is made at an angle of greater than 45 degrees from the vertical, the required diameter of the offset and the stack below it shall be sized as for a building drain. (Table 131 (a) (2) A)

(8) Fixture Connections to an Offset of More than 45' or at Base of Stack. When stacks in buildings of 5 or more stories in height receive the discharge of fixtures 4 or more stories above the offset, no fixtures on the floor at which the offset occurs shall be connected to the stack within 8 feet of the base of the offset measured vertically or horizontally. Said fixtures may also be connected into vertical section of the stack more than 2 feet below the offset. Fixture connections to horizontal piping at the bases of such stacks shall be made in the same manner, or at a point acceptable to the Administrative authority.

(b) Drainage Piping Installation.

(1) Pitch or Horizontal Drainage Piping. Horizontal drainage piping shall be installed in uniform alignment at uniform slopes in accordance with the following requirements and in no case at a slope which will produce a computed velocity of less than 2 feet per second, unless otherwise permitted by the Administrative Authority, based on hydraulic analysis of the piping system.

Size of Piping	Minimum Slope
Less than 3 inches	1/4 inch per foot
3 inches to 6 inches	1/8 inch per foot
8 inches and over	1/16 inch per foot

(2) Change in Direction. Changes in direction in drainage piping shall be made by the appropriate use of 45 degree wyes, long or short sweep quarter bends, sixth, eighth, or sixteenth bends, or by combination of these or equivalent fittings. Single and double sanitary tees, quarter bends, and long turn ells may be used in drainage lines only where the direction of the flow is from the horizontal to the vertical.

(aa) Short Sweeps Permitted. Short sweep bends or long turn ells 3 inch or larger in diameter may be used in soil or waste lines where the change in direction of flow is from either the horizontal to the vertical or from the vertical to the horizontal.

(3) Prohibited Fittings and Connections. No fittings having a hub in the direction opposite to flow, or straight tee branch shall be used as a drainage fitting. No fitting or connection which has an enlargement chamber or recess with a ledge or shoulder, or reduction in pipe area shall be used. No drainage or vent piping shall be drilled, tapped, or welded unless otherwise permitted by the Administrative Authority. Fittings used for back-to-back, wall outlet, blowout type water closet bowls shall have a baffle plate or other device to prevent the waste water from one water closet from entering the opposite water closet. No fixture connection shall be made to a closet bend. No running threads, bands, or saddles shall be used. The short pattern fitting in a horizontal position is prohibited in underground work.

(aa) Heel or Side-Inlet Bends. A heel or side-inlet quarter bend shall not be used as a vent when the inlet is placed in a horizontal position or any similar arrangement of pipe or fittings producing a similar effect.

(bb) Obstruction to Flow. No fitting, connection, device or method of installation which obstructs or retards the flow of water, wastes, sewage, or air in the drainage or venting system in an amount greater than the normal frictional resistance to flow, shall be used unless it is indicated as acceptable to this Code by having a desirable and acceptable function and as of ultimate benefit to the proper and continuing functioning of the plumb-

ing system. The enlargement of a 3 inch closet bend or stub to 4 inches shall not be considered an obstruction, provided the horizontal flow line or insert is continuous without forming a ledge.

(4) Dead Ends. In the installation of a drainage system, dead ends shall be avoided except where necessary to extend piping for a cleanout so as to be accessible.

(5) Building Drains Below Building Sewer. Building drains which cannot be discharged to the sewer by gravity flow shall discharge into an approved watertight, gas tight vented sump or receiving tank, so located as to receive the sewage or wastes by gravity. From such sump or receiving tank the sewage or other liquid wastes shall be lifted and discharged into the building gravity drain by approved automatic pumping equipment. The system or drainage piping entering such sump shall be installed and vented as required in this section for a gravity system.

(aa) Design of Sumps.

(aa-1) Sumps and receiving tanks shall be constructed of poured concrete, metal, or other approved materials. If constructed of poured concrete, the walls and bottom shall be adequately reinforced and designed to acceptable standards. Metal sumps or tanks shall be of such thickness as to serve their intended purpose and shall be treated internally and externally to resist corrosion.

(aa-2) The discharge line from such pumping equipment shall be provided with an accessible back-water valve and gate valve, and if the gravity drainage line to which such discharge line connects is horizontal, the method of connection shall be from the top through a wye branch fitting. The minimum size of any pump or discharge pipe from a sump having a water closet connected thereto shall not be less than 2 inches.

(aa-3) Building drains or building sewers receiving discharge from any pumping equipment shall be adequately sized to prevent over-loading. In all buildings, other than single and 2 family dwellings, should 3 or more water closets discharge into the sump, duplicate pumping equipment shall be installed.

(aa-4) Sumps and receiving tanks shall be provided with gastight metal covers, except that float control or switch rods shall operate without binding. Such cover shall be of a bolt and gasket type or equivalent manhole opening to permit access for inspection, repairs, and cleaning.

(bb) Sump Vent. The top of the sump tank shall be provided with a vent pipe which shall extend separately through the roof, or may be combined with other vent pipes. Such vent shall be large enough to maintain atmospheric pressure within the sump under all normal operating conditions and in no case less than in accordance with the number of fixture units discharging into the sump. When the foregoing requirements are met and the vent after leaving the sump, is combined with vents from fixtures discharging into the sump, the size of the combined vent need not exceed that required for the total number of fixtures discharging into the sump. No vent from an air operated sewage ejector shall combine with other vents.

(cc) Clear Water Sumps. Sumps and receiving tanks which receive only clear water drainage, and from which sewage is excluded, need not be air tight or vented.

MHD 134 Inspection, Tests and Maintenance.

(a) Inspections. New plumbing systems and parts of existing systems which have been altered, extended or repaired shall be inspected and tested by the proper Administrative Authority to insure compliance with all the requirements of this Code and the installation and construction of the system in accordance with the approved plan and the permit, except that testing may be waived for work which does not include addition to, replacement, alteration, or relocation of any water supply, drainage or vent piping.

All the piping shall be tested and after the plumbing fixtures have been set, and before the system is put into use, the system shall be given a final inspection and test by the proper Administrative Authority.

(b) Notifications.

(1) It shall be the duty of the plumbing contractor to notify the proper Administrative Authority and the Owner, or his authorized agent orally, by telephone, or in writing, not less than eight working hours between the hours of 8 a.m. and 4 p.m. before the work is to be inspected or tested.

(2) It shall be the duty of the plumbing contractor to make sure that the work will stand the test prescribed before giving the above notification.

(3) If the proper Administrative Authority finds that the work will not stand the test, the plumbing contractor shall be required to renotify as above.

(4) If the proper Administrative Authority does not appear for an inspection within 24 hours of the time set, excluding Saturdays, Sundays and Holidays, the inspection or test shall be deemed to have been made, and the plumbing contractor is required to file an affidavit with the proper Administrative Authority that the work was installed in accordance with the Code, the approved plans and permit, and that it was free from defects and that the required tests had been made and the system found free from leaks; also whether the owner or his authorized agent was present when such inspection or test was made.

(c) Material and Labor for Tests. The equipment, material, power, and labor necessary for the inspection and test shall be furnished by the plumbing contractor.

(d) Method of Testing. The air tests shall be applied to the plumbing drainage system in its entirety or in sections. Sections which are found satisfactory need not be retested after completion of the entire system unless considered necessary by the proper Administrative Authority.

(1) Rough Plumbing. Except for outside leaders and perforated or open drain tile, the piping of plumbing drainage and venting systems shall be air tested upon completion of the rough piping.

(aa) The air test shall be made by attaching the air compressor or testing apparatus to any suitable opening and closing all other inlets and outlets to the system by means of proper testing plugs. Plaster paris shall not be used in roof terminals.

(bb) Air shall be forced into the system until there is a uniform pressure of 5 pounds per square inch on the portion of the system being tested. The pressure shall remain constant for 15 minutes without the addition of air.

APPENDIX D

WATER WELL CONSTRUCTION CODE

MHD 217 Location of Wells.

* * * * *

(c) Distance from Pollution or Contamination Sources.

(1) A well shall be at least:

* * * * *

(dd) Fifty feet (50 ft.) from a buried sewer, septic tank, subsurface disposal field, grave, animal or poultry yard or building, privy, petroleum storage tank, or any other sewage or liquid wastes that may drain into the soil.

(ee) Twenty feet (20 ft.) from a buried sewer constructed of cast iron pipe with tested watertight joints or other material acceptable to the Board; or a pit or unfilled space below ground surface, except an approved basement.

(ff) Wells less than 50 feet in depth and not encountering at least 10 feet of impervious material shall be located at least 150 feet from cesspools, leaching pits, or dry wells and at least 100 feet from a subsurface disposal field, manure storage pile or other sources of contamination.[2]

* * * * *

APPENDIX E

Cons 72 Sanitary Provisions.

* * * * *

(b) SEWAGE AND WASTE DISPOSAL.

* * * * *

(4) Septic tank and soil absorption systems shall be set back from the normal high water mark in accordance with class of public waters:

(aa) On Natural Environment Lakes and Streams, at least 150 feet;

(bb) On Recreational Development Lakes, at least 75 feet;

(cc) On General Development Lakes and Streams, at least 50 feet.

* * * * *

NR 83 LAND USE CONTROL PROVISIONS.

* * * * *

(d) Sanitary Provisions.

* * * * *

(2) Sewage and Waste Disposal.

* * * * *

(dd) Septic tank and soil absorption systems shall be set back from the ordinary high water mark in accordance with the class of public waters:

(i) On Natural Environment Waters, at least 150 feet;

(ii) On Recreational Development Waters, at least 75 feet; and

(iii) On General Development Waters, at least 50 feet.

* * * * *

EXHIBIT 16

SUBDIVISION ANALYSIS

AN EDUCATIONAL MEMORANDUM OF

AMERICAN INSTITUTE OF REAL ESTATE APPRAISERS
OF THE NATIONAL ASSOCIATION OF REALTORS

For Educational Purposes Only

The opinions and statements set forth herein do not necessarily reflect the viewpoint of the American Institute of Real Estate Appraisers or its individual members, and neither the Institute nor its editors and staff assume responsibility for such expressions of opinion or statements.

Subdivision appraising is an important but highly controversial part of modern appraisal practice. The considerations presented here are focused on areas of potential misuse or misinterpretation. This is not an exhaustive treatment of the subject of subdivision analysis but is intended to be instructional in maintaining professional appraisal standards.

The development method to the value of potential subdivision acreage is used often—and heavily relied on—even though conclusions reached by this method may not fit the pattern of available market data. The development method should be limited to cases where the current highest and best use is a subdivision. A primary consideration in such a conclusion is that the land must be ripe for development and either zoning permits such use or a reasonable probability of a change in zoning to such use exists.

Although anticipated use is a valid technique and should be used, numerous valuation deficiencies can be found. Many appraisers fail to deduct from the anticipated gross proceeds all the necessary development costs, including the developer's unrealized profit, overhead, and engineering costs, and the expense of rezoning the property. If the anticipated "sell-out" period extends over a period of time, the appraiser may fail to discount for time in estimating the value of the raw land.

UNACCEPTABLE TECHNIQUES

Specific unacceptable techniques fall into the following general categories:

1. Misapplication of the development (anticipated use) method in estimating the value of potential subdivision acreage.

2. Blind acceptance of a legal concept or premise that violates acceptable appraisal practice or normal concepts of market value. This may occur when an attorney "leads" an appraiser to accept a premise for valuation purposes although the premise does not reflect, or contradicts, market activity.

3. Misapplication of the market data approach by:

   a. Ignoring applicable, nearby comparables and using sales of dissimilar, far-removed properties.

   b. Adding for potential development possibilities when the comparables already include the value of these anticipated benefits.

   c. Failing to consider the recent sale and/or assemblage of the subject property.

4. Adding the value of existing improvements to the land value when such improvements are not consistent with future use and/or market data. Addition of improvement value under these circumstances violates the principles of contribution, consistent use, and highest and best use.

5. Adding the value of amenities to the land value. Amenities may contribute to value or may have a negative impact; therefore, their effect warrants separate analysis.

6. Failure to distinguish between gross sellout (retail basis) and the discounted (or wholesale) value—that is, the market value—of the tract as a whole.

7. Acceptance of a previous value conclusion without reassessing current market conditions if a significant period of time has elapsed.

8. Failure to recognize and account properly for developer's profit separately from return to or value of land.

9. Misapplication of required return on investment versus payment of mortgage principal and interest.

FACTORS THAT MUST NOT BE OVERLOOKED

The development method may not be needed if market value can be estimated from comparable sales. However, a development method application can be useful in confirming comparative value indications, reasonableness of possible absorption periods, and so on.

The highest, best and most profitable use analysis must be compatible with the development or anticipated use valuation premise. The basis for the decision should be documented by:

- One or more successful subdivisions within reasonable proximity to the subject, reflecting market activity and the reasonable assurance of its continuance. In the absence of nearby subdivisions, other economic data may be analyzed to evaluate market demand.

- Competent analysis of supply and demand factors relating to absorption rates, sale prices, and costs. This includes complete analysis of existing and potential competition.

- Utilities common to the area that are available at the site or can be extended within a reasonable time. The mere presence of utilities is not sufficient justification; assurance must be submitted that they can be tapped and are of sufficient capacity to serve the proposed subdivision.

- Completion of required environmental studies or approvals before final plat approval can be obtained or actual construction can begin. Federal and state regulations vary as to the minimum acreage subject to regulation; when applicable, both regulations should be investigated.

All costs and trends must be currently market supportable; labor and material prices, as well as interest rates, change rapidly.

- Individual cost figures should be confirmed with responsible local sources (contractors or professional engineers). If practical, an engineer's estimate should be obtained by the appraiser for inclusion in the report. (Its cost may be paid for by the appraiser or the client.)

- Site and offsite costs vary considerably from one parcel to another. Topography, engineering and offsite requirements of comparable sales and the property being appraised should be similar, or adjustments must be made to compensate for differences. The appraiser should avoid using assumptions as the basis for adjustments and should obtain engineering studies or other factual evidence to support any adjustment.

- Standard area fees or practices should be investigated. For example, some municipalities require donations of land for school or park purposes. Others charge "tap-in" fees, of which certain portions may be rebated to the developer.

Hypothetical premises may be acceptable only if there is a reasonable possibility that such conditions may occur.

Amenity value is not to be added to land value. Amenities may contribute to land value or have a negative effect on it; therefore, they warrant a separate analysis. When sufficient data is available, the best valuation procedure is the market approach. In the absence of sufficient meaningful market data for direct comparison, the income approach is used. Use of the income approach additionally should include the use of discounting procedures and deductions for negative or lower-than-stabilized income flows if stabilized net income will not be achieved until some future date.

The value of existing improvements should not be added to the land value if the improvements will be removed when development takes place. In many instances they will have a negative value equal to the cost of demolition and removal.

The accuracy of the value conclusion is related to the time frame projected for the development. A majority of developers consider a three- to five-year span to be most typical. Time spans, however, can exceed these parameters. The appraiser should study the absorption rates of competitive and other developments in the area to anticipate a proper time frame.

The discounting method should not be used when the resulting value per acre is significantly less than the reasonable expectation of market value of the raw land.

Averaging annual cash inflows and outputs can produce misleading and erroneous value conclusions. Use of averages is particularly inappropriate where large initial or front-end costs are incurred.

The discount rate must be equated to the risk involved and be market supportable. The risk rate employed in land development is generally higher than for income-producing real estate or safer alternate investment opportunities. Different rates of return and profit percentages may be selected, depending on the valuation method used. Seven suggested methods are detailed later in this Memorandum.

One of the most common errors in discounting future "retail" lot prices to reasonable "wholesale" acreage values is failure to allow for the full influence of the land developer's profit motive. In a sense, the typical land developer is a manufacturer or a merchant who depends on a cost markup sufficient to cover expenses and produce a reasonable profit as a reward for risks and efforts. This provision for profit may be expressed in a variety of ways: as a percentage markup of original cost or a percentage discount of final selling prices; as "interest" on borrowed capital, "yield" on equity capital or a "rate of return" on invested capital. However expressed, the provision for profit and/or return on capital should not be excessive but should be sufficient to attract the necessary capital to the project. A particular level of profit is not always appropriate, obtainable or in the public interest. Profitability is influenced not only by competition but by public policy promoting or curtailing the development of land.

The appraiser must distinguish between gross sellout, which is the aggregate of individual retail lot prices, and the discounted or wholesale value, which is market value. A value conclusion is rendered as of a specific point in time. When a significant period of time has elapsed since the original valuation, the opinion of value previously rendered may no longer be appropriate in light of existing market conditions. No value opinion can be rendered without a reassessment of current market conditions.

APPLICATION

The concepts of subdivision or development analysis have wide applicability. In addition to customary residential subdivisions, they may be applied to recreational and other mass merchandising land development projects, industrial and office subdivisions, and staged developments of all types. The seeming precision of various available processes should not be mistaken for or necessarily presented as being more accurate than direct market comparison.

Estimates of market value require appraisal skill and performance of objective valuation research and analysis. The appraiser must rely on market data in subdivision analysis. If market evidence for one or more important elements of the analysis is lacking, there may be serious reason to question whether the result is market value.

BASIC ASSUMPTIONS OF ILLUSTRATIONS

The valuation methods that follow are illustrative; there can be many variations. The costs, ratios and interest rates given should not be relied on as being typical. In actual practice all costs associated with development must be shown and documented by market evidence.

The seven suggested methods are based on the following assumptions:

- One or more successful subdivisions exist within reasonable proximity to the subject, reflecting current market activity and the reasonable assurance of its continuance.
- The subject property is located in the direction of growth, and utilities common to the area are available at the site or can be extended to it within a reasonable time.
- Lots of the size proposed (typically 70' X 120') are selling in the range of $15,000-$17,000, completely improved with all city utilities available at the site.
- The area of the subject property is 100 acres of reasonably level terrain with no unusual construction problems. A logical subdivision plan shows 350 lots with 12,000 lineal feet of streets (24,000 lineal feet of lot frontage).
- Analysis of key supply and demand factors, prices, costs, timing, and market segments produced a basis for projections shown.
- Development costs, as verified by other developers and/or reliable engineers, are as follows:

Grading and clearing @ $400 per lot	$ 140,000
Sanitary sewers @ $10 per F/F	240,000
Storm sewers @ $8 per F/F	192,000
Paving (32-foot width) @ $120 per lineal foot	1,440,000
Curbs and gutters @ $600 per lot	210,000
Water lines @ $10 per F/F	240,000
Engineering	38,000
Total	$2,500,000

- Other costs

Cost of capital is 10%. (This rate is for illustrative purposes only.) This charge would apply whether the developer used equity funds or borrowed funds.

Overhead and sales expenses are 12.5% of sales price. The developer has his own sales force. Sales commission, title work, office expenses, advertising and insurance are included, but a profit allowance is not. (Prevailing area commission rate could be substituted for sales staff salaries if an outside sales agent is engaged.)

Management and supervision are $15,000 per year for field supervision, paid as salary to builder/developer or employee.

Taxes are $72,000 total for the sellout period. (Taxes are calculated period by period. The amount is reduced each period as more lots are sold.)

The selling period is four years.

Anticipated income from lot sales

175 lots @ $15,000	$2,625,000
100 lots @ $16,000	1,600,000
75 lots @ $17,000	1,275,000
350	$5,500,000

The above sale prices vary due to different value attributes, such as location, size, corner influence, and trees. Individual lot prices remain the same for the four-year period. Any use of increased (or decreased) lot prices in the second, third or fourth years must be justified by the appraiser. In the event increased revenues are shown, expenses should also be increased. A more common practice is to show no annual increases in income or expenses on the assumption that an increase in one category would be offset by a corresponding increase in the other.

All figures are rounded.

Developer's profit is discussed for each method.

SUGGESTED METHOD 1

Gross sale price of lots		$5,500,000
Development costs	$2,500,000	
Overhead and sales expenses (12.5%)	687,500	
Management and supervision	60,000	
Taxes	72,000	
	$3,319,500	3,319,500
Net before return on capital and profit		$2,180,500

Discount 4 years at 10%:

PW of 1 per period factor for 4 years, 10%, is 3.1699
Average annual return
$2,180,500 ÷ 4 = $545,125
Present worth of capital and profit
$545,125 x 3.1699 $1,727,992
Rounded $1,728,000

Profit 50%
$1,728,000 ÷ 150% Indicated land value $1,152,000

The above figure indicates the amount the developer could pay for raw land and make 50% profit on the investment in the land only after allowing for a "cost of capital."

ALTERNATE 1

The same result is obtained by discounting all positives and all negatives and adding the totals.

Positives

Lot sales $5,500,000 ÷ 4 = $1,375,000 per year
$1,375,000 x 3.1699 $4,358,612

Negatives

Costs $3,319,500 ÷ 4 = $829,875 per year
$829,875 x 3.1699 2,630,621
$1,727,991
Rounded $1,728,000

$1,728,000 ÷ 150% Indicated land value $1,152,000

Comments on Use of Method 1

Pros: Simple and easy to understand.

Cons: Does not account for income and revenue sources in the period in which they occur.

Implies that development costs go into a project evenly over the development period, which is a highly unlikely occurrence. Costs generally tend to be incurred in uneven large amounts or "chunks" particularly in early stages of development.

Profit is based on raw land cost and does not follow the general market practice of being based on a percentage of gross sale price or a specific dollar amount per lot.

SUGGESTED METHOD 2

This method is identical to Method 1, but discounts average net proceeds to present worth for each of the four years at the 10% discount rate.

Gross sale price of lots	$5,500,000 ÷ 4	$1,375,000
Total costs as in Method 1	3,319,500 ÷ 4	829,875
Average annual net before interest and profit		$ 545,125
Less 50% profit ($545,125 ÷ 150%) leaves average annual net interest		$ 363,417

Annual Net		Reversion Factor at 10%		Present Worth
$363,417	x	3.1699		$1,151,996
			Rounded	$1,152,000
			Indicated land value	$1,152,000

Comments on Use of Method 2

Pros and cons are the same as in Method 1.

SUGGESTED METHOD 3

The difference between this method and Method 1 is that the developer's profit is based on the gross sale price.

Gross sale price of lots		$5,500,000
Profit 13%*	$ 715,000	
Costs	3,319,500	
	$4,034,500	4,034,500
Net before cost of capital		$1,465,500
Discount 4 years at 10%		
$1,465,500 ÷ 4 = $366,375 per year		
$366,375 x 3.1699		$1,161,372
	Rounded	$1,161,000
	Indicated land value	$1,161,000

*Rate introduced for illustrative purposes only. In practice, the rate would be supported by market evidence.

Comments on Use of Method 3

Pros: Profit calculated more as perceived in the marketplace. (Most developers base profit on gross sale price.) Profit of 50% on land only changes to 13% of retail price.

Cons: Same as Methods 1 and 2 regarding costs and timing of individual revenue and expense items.

SUGGESTED METHOD 4

This method is based on the assumption that all development activity is completed in three years and lot sales vary over a four-year period. The varying annual sales history is a common occurrence in most subdivisions. Again, the basis for projections, whether on level or varying annual amounts, should be supported by market evidence.

SUMMARY OF PROJECTIONS

Year	Development Cost	Lots Sold	Income
1	$1,400,000	71	$1,075,000
2	600,000	176	2,750,000
3	500,000	78	1,260,000
4		25	415,000
Total	$2,500,000	350	$5,500,000

FIRST YEAR

Gross Sales Income

	Lots Sold	Sale Price/Lot	Gross Sales	
	61	$15,000	$ 915,000	
	10	16,000	160,000	
Total	71		$1,075,000	$1,075,000

Expenses

Overhead and sales 12.5%	$ 134,376	
Management, supervision and taxes	33,000	
Development cost	1,400,000	
Profit 13%	139,750	
	$1,707,126	1,707,126
	Net cash flow (deficit)	($632,126)

SECOND YEAR

Gross Sales Income

	Lots Sold	Sale Price/Lot	Gross Sales	
	87	$15,000	$1,305,000	
	68	16,000	1,088,000	
	21	17,000	357,000	
Total	176		$2,750,000	$2,750,000

Expenses

Overhead and sales 12.5%	$ 343,750	
Management, supervision and taxes	33,000	
Development cost	600,000	
Profit 13%	357,500	
	$1,334,250	1,334,250
	Net cash flow	$1,415,750

THIRD YEAR

Gross Sales Income

Lots Sold	Sale Price/Lot	Gross Sales	
24	$15,000	$ 360,000	
18	16,000	288,000	
36	17,000	612,000	
Total 78		$1,260,000	$1,260,000

Expenses

Overhead and sales 12.5%	$157,500	
Management, supervision and taxes	33,000	
Development cost	500,000	
Profit 13%	163,800	
	$854,300	854,300
	Net cash flow	$ 405,700

FOURTH YEAR

Gross Sales Income

Lots Sold	Sale Price/Lot	Gross Sales	
3	$15,000	$ 45,000	
4	16,000	64,000	
18	17,000	306,000	
Total 25		$415,000	$415,000

Expenses

Overhead and sales 12.5%	$ 51,875	
Management, supervision and taxes	33,000	
Development cost	0	
Profit 13%	53,950	
	$138,825	138,825
	Net cash flow	$ 276,175

Present Worth of Net Cash Flow

Year	Cash Flow		Reversion Factor @ 10%	Present Worth
1	$ (632,126)	x	.9091	$ (574,666)
2	1,415,750	x	.8264	1,169,976
3	405,700	x	.7513	304,802
4	276,175	x	.6830	188,628
Total				$1,088,740
			Rounded	$1,089,000
			Indicated land value	$1,089,000

Note: Management, supervision and taxes would probably vary each year as the number of remaining lots diminishes, but the average of $33,000 per year is used for illustrative purposes.

Comments on Use of Method 4

Pros: Accounts for revenue and expense sources in the period in which they are projected to occur. More representative of actions in the market (sales volume and expense outlays) than Methods 1, 2 and 3.

Cons: Generally requires use of independent engineer to estimate periodic allocation of development costs. Data to estimate varying periodic sales activity is sometimes difficult to obtain.

SUGGESTED METHOD 5 — Development Comparison Method

Many appraisers believe that the entrepreneur's profit should be taken on the total investment the developer has in the property. Data must be obtained from developers who have completed their projects. Data needed is the total sale price, land cost and total development costs and expenses.

A formula for computing the rate of profit can be based on the premise that the gross proceeds from sales equal the sum of land cost, development cost and profit.

A = Gross proceeds
B = Land cost (or value)
C = Development cost
D = Rate of profit

$$A = B + C + [D\ (B + C)\ ]$$

Assume three developers furnish their actual figures. When these figures are used in the above formula and solving for D (rate of profit), the typical rate is 24%.

The land value for the subject property is estimated by solving for B.

$\$5,500,000 = B + \$3,319,500 + .24\ (B + \$3,319,500)$

$\$5,500,000 = B + \$3,319,500 + .24B + \$796,680$

$\$5,500,000 = 1.24B + \$4,116,180$

$1.24B = \$1,383,820$

$B = \$1,115,983$
Rounded $\$1,116,000$

Indicated land value: $1,116,000

Comments on Use of Method 5

Pros: Simple.

Cons: Profit is included as an element of discount rate, a method having limited acceptance in actual practice.

SUGGESTED METHOD 6

Methods 1, 2, 3 and 4 provided for the time value of capital by including interest charges and/or discounting techniques in the valuation process. In addition, the developer's profit was provided for as a separate lump sum "mark-up" or "discount." Method 5 applied a single rate of profit to the entire investment. Although such methods are widely used by developers and appraisers, the use of discounted cash flow analysis is growing in popularity particularly where there is ready access to a calculator or computer that can be programmed. Many analysts prefer the accuracy and refinements of a detailed cash flow analysis which itemizes the entire expected flow of cash in and out, year by year, or month by month.

Illustration: Part of the developer's total reward (or profit) is in the form of annual compensation. The project will be financed without loans, and the minimum annual rate of return (before income taxes) required to attract capital is 15%.

A simplified discounted cash flow model could develop value without a computer as follows.

The assumptions are the same as those used in preceding methods except that Management and Supervision has been increased to $60,000 per year, which includes the $15,000 per year used in the preceding examples, plus a developer's reward which may be considered as either profit or compensation. Real estate taxes are estimated at $24,000 for the first year, $24,000 for the second year, $16,000 for the third year, and $8,000 for the fourth year. Gross proceeds from sales are spread evenly over the second, third and fourth years. Overhead and sales expense are spread evenly over four years, and all engineering expense is accounted for in the first year.

Discounted Cash Flow Analysis

	Year 1	Year 2	Year 3	Year 4	Total
Gross sales income		$1,833,334	$1,833,334	$1,833,332	$5,500,000
Less: Expenses					
Overhead and sales	$171,874	$ 171,874	$ 171,874	$ 171,878	$ 687,500
Development costs	653,500	615,500	615,500	615,500	2,500,000
Real estate taxes	24,000	24,000	16,000	8,000	72,000
Management and supervision	60,000	60,000	60,000	60,000	240,000
Total	$909,374	$ 871,374	$ 863,374	$ 855,378	$3,499,500
Net cash flow	($909,374)	$ 961,960	$ 969,960	$ 977,954	$2,000,500

Discounted cash flow analysis @ 15% annual rate of return

Year	Amount		PW Factor @ 15%		Present Worth
1	($909,374)	x	.8696	=	($790,972)
2	961,960	x	.7561	=	727,338
3	969,960	x	.6575	=	637,749
4	977,954	x	.5718	=	559,194
					$1,133,309
				Rounded to	$1,133,000
				Indicated land value	$1,133,000

Note: In the above analysis, all income and expense is treated as if it were received at the end of each year.

Comments on Use of Method 6

Pros: Accounts for revenue and expenses in the period in which they occur.

Cons: Choice of discount rate and expense amount that compensates for developer's reward can increase or decrease value indication significantly. Both elements are difficult to substantiate.

SUGGESTED METHOD 7

Method 7 differs from the preceding methods in that the cash flow projections presented reflect the developer's actual cash flow, given a defined set of circumstances. The major benefit to be gained from this method is that a potential investor or lender can easily recognize the negative cash flows to be borne by the developer and structure the loan accordingly. Although a mathematically correct value is arrived at in the other methods, the characteristics and magnitude of the actual cash flows are not defined.

The following example is based on the assumption of a proven developer in an active market. The sales revenues and expenses are the same as those in Method 4 in that they most accurately reflect the typical sales history profile of a successful subdivision. Also, as in Method 4, all development is in three years, and lot sales vary per year. Additional factors influencing value are the availability of financing for acquisition and development. Discussions with construction lenders reveal their reluctance to lend on anything other than development costs (both hard and directly related professional fees), and they generally avoid site acquisition loans. As a result, most land being sold today is either bought upon exercising an option or financed by the seller through a purchase money mortgage. A typical subdivision development package usually consists of construction financing for the full hard and related soft costs at rates of 2 to 2.5% over prime with accelerated repayments based on 110 to 120% of the prorated development loan per lot, assuming that the land is either owned by the developer or subordinated if mortgaged. Subordinated purchase money mortgages are essentially options purchased at, say, 10 to 20% down, with releases corresponding to lot sales also at an accelerated rate. For this example, 10% is used.

The final value estimate of $1,150,000 is calculated by the algebraic formula in which value (V) is arrived at through a series of cash flows where the equity (.10V) is equal to the sum of the net incomes less mortgage requirements. The value in this example is $106,000 greater (10.15%) than in Method 4 due to the change in the developer's profit from 13% to 10% because of the lesser risk involved as a result of greater leverage assumptions, thus less equity exposure.

	Year 1	Year 2	Year 3	Year 4	Total
Number of lots sold	71	176	78	25	350
Income from lot sales	$1,075,000	$2,750,000	$1,260,000	$415,000	$5,500,000
Percentage of total income	19.55%	50.00%	22.91%	7.55%	100.00%
Development loan advance	$1,400,000	$ 600,000	$ 500,000		$2,500,000
Total revenues	$2,475,000	$3,350,000	$1,760,000	$415,000	$8,000,000
Expenses					
Overhead and sales @12.5%	$ 134,375	$ 343,750	$ 157,500	$ 51,875	$ 687,500
Management, supervision and taxes	33,000	33,000	33,000	33,000	132,000
Development cost	1,400,000	600,000	500,000		2,500,000
Developer's profit @ 10%	107,500	275,000	126,000	41,500	550,000
Total expenses	$1,674,875	$1,251,750	$ 816,500	$126,375	$3,869,500
Net income	$ 800,125	$2,098,250	$ 943,500	$288,625	$4,130,500
Development loan repayment					
Beginning of period balance	$1,400,000	$1,492,857	$ 610,000	0	$2,500,000
Repayment	507,143	2,382,857	610,000		2,500,000
End of period balance	892,857	110,000	0		0
Average balance	1,146,428	801,429	305,000		
Interest at 10%	114,644	80,143	30,500		225,286
Total development loan expense	$ 621,787	$1,463,000	$ 640,500	0	$2,725,286
Cash flow before PMM	$ 178,338	$ 635,250	$ 303,000	$288,625	$1,405,214

Calculation of Value

		Net Income		Percent Paid		Average Balance		Interest		Equity Discount Rate
BOP	.9000	[$178,338	–	(.1955V x .90 x 1.10)	–	(.90V – .1935V + .90V) ÷ 2	x	(.10)]	x	(.9091)
Percent paid	.1935	[$178,338	–	(.1935V)	–	(.8033V)		(.10)]		(.9091)
EOP	.7065	[$178,338	–	.1935V	–	.0803V]				(.9091)
		$162,128	–	.2489V						
BOP	.7065	[$635,250	–	(.5000V x .90 x 1.10)	–	(.7065V – .4950V + 7065V) ÷ 2	x	(.10)]	x	(.8264)
Percent paid	.4950	[$635,250	–	(.4950V)	–	(.4590V)		(.10)]	x	(.8264)
EOP	.2115	[$635,250	–	.4950V	–	.0459V]				(.8264)
		$524,971	–	.4470V						
BOP	.2115	[$303,000	–	(.2115V)	–	(.2115V – .2115V + .2115V) ÷ 2	x	(.10)]	x	(.7513)
Percent paid	.2115	[$303,000	–	(.2115V)	–	(.1058V)		(.10)]		(.7513)
EOP	0	[$303,000	–	.2115V	–	.0158V]				(.7513)
		$227,644	–	.1708V						
BOP	0	[$288,625	–	0	–	0]				(.6830)

.10V = $ 162,128 – .2489V + $524,971 – .4470V + $227,644 – .1708V + $197,131
.10V = $1,111,874 – .8667V
.9667V = $1,111,874
V = $1,150,175 (say) $1,150,000

Proof:

	Year 1	Year 2	Year 3	Year 4	Total
Cash flow before PMM	$ 178,338	$635,250	$303,000	$288,625	$1,405,214
PMM repayment					
Beginning of period balance	$1,035,000	$812,423	$243,173	0	$1,035,000
Repayment	222,577	569,250	243,173		$1,035,000
End of period balance	812,243	243,173	0		0
Average balance	923,721	527,798	121,587		
Interest at 10%	92,372	52,780	12,159		157,311
Total PMM expense	$ 314,949	$622,030	$255,332	0	$1,192,311
Cash flow to developer	($136,611)	$ 13,220	$ 47,668	$288,625	$ 212,902
Discounted at 10%	x .9091	x .8264	x .7513	x .6830	
Present worth	($124,193)	$ 10,925	$ 35,813	$197,131	$ 119,676
Add PMM					1,035,000
					$1,154,676
				Say	$1,150,000

Comments on Use of Method 7

Pros: Accounts for all sources of revenues and expense (including mortgage loan disbursements, interest charges and loan amortization) in the period in which they occur.

Cons: Requires the greatest amount of market investigation and documentation of all methods illustrated. The basis for each income and revenue source must be substantiated and documented.

SUMMARY

These seven methods are intended to show different mathematical and mechanical approaches to a typical problem. Because of variations in the underlying assumptions, the conclusions do not lend themselves to comparison. In any appraisal such assumptions should be backed up by as much market research as possible.

Computers are being used with increased frequency to solve appraisal problems in areas such as subdivision analysis. Appraisers with limited experience in this area are cautioned to understand the subdivision method thoroughly before accepting or using answers provided by a computer.

A method should be chosen that best fits the circumstances applicable to the appraisal, or a method may be developed by the appraiser. The appraiser must use reason and deduct for all possible costs. The final conclusion should be judged on its merits and not as only a mathematical answer.

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ERRATA FOR

SUBDIVISION ANALYSIS

An error in computation occurred in the Educational Memorandum on Subdivision Analysis, published by the American Institute of Real Estate Appraisers in mid-1978. The correct computations are given here.

New page 17

	Year 1	Year 2	Year 3	Year 4	Total
Number of lots sold	71	176	78	25	350
Income from lot sales	$1,075,000	$2,750,000	$1,260,000	$415,000	$5,500,000
Percentage of total income	19.55%	50.00%	22.91%	7.55%	100.00%
Development loan advance	$1,400,000	$ 600,000	$ 500,000		$2,500,000
Total revenues	$2,475,000	$3,350,000	$1,760,000	$415,000	$8,000,000
Expenses					
Overhead and sales @12.5%	$ 134,375	$ 343,750	$ 157,500	$ 51,875	$ 687,500
Management, supervision and taxes	33,000	33,000	33,000	33,000	132,000
Development cost	1,400,000	600,000	500,000		2,500,000
Developer's profit @ 10%	107,500	275,000	126,000	41,500	550,000
Total expenses	$1,674,875	$1,251,750	$ 816,500	$126,375	$3,869,500
Net income	$ 800,125	$2,098,250	$ 943,500	$288,625	$4,130,500
Development loan repayment					
Beginning of period balance	$1,400,000	$1,462,375	$ 587,375	0	$2,500,000
Repayment	537,625	1,375,000	587,375		2,500,000
End of period balance	862,375	87,375	0		0
Average balance	1,131,188	774,875	293,688		
Interest at 10%	113,119	77,488	29,369		219,976
Total development loan expense	$ 650,744	$1,452,488	$ 616,744	0	$2,719,976
Cash flow before PMM	$ 149,381	$ 645,762	$ 326,756	$288,625	$1,410,524

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New page 18

Calculation of Value

		Net Income		Percent Paid		Average Balance		Interest		Equity Discount Rate
BOP	.9000	[$149,381	–	(.1955V x .90 x 1.10)	–	(.90V – .1935V + .90V) ÷ 2	x	(.10)]	x	(.9091)
Percent paid	.1935	[$149,381	–	(.1935V)	–	(.8033V)		(.10)]		(.9091)
EOP	.7065	[$149,381	–	.1935V	–	.0803V]				(.9091)
		$135,802	–	.2489V						
BOP	.7065	[$645,762	–	(.5000V x .90 x 1.10)	–	(.7065V – .4950V + 7065V) ÷ 2	x	(.10)]	x	(.8264)
Percent paid	.4950	[$645,762	–	(.4950V)	–	(.4590V)		(.10)]	x	(.8264)
EOP	.2115	[$645,762	–	.4950V	–	.0459V]				(.8264)
		$533,658	–	.4470V						
BOP	.2115	[$326,756	–	(.2115V)	–	(.2115V – .2115V + .2115V) ÷ 2	x	(.10)]	x	(.7513)
Percent paid	.2115	[$326,756	–	(.2115V)	–	(.1058V)		(.10)]		(.7513)
EOP	0	[$326,756	–	.2115V	–	.0106V]				(.7513)
		$245,494	–	.1668V						
BOP	0	[$288,625	–	0	–	0]				(.6830)

.10V = $ 135,802 – .2489V + $533,658 – .4470V + $245,492 – .1668V + $197,131
.10V = $1,112,083 – .8627V
.9627V = $1,112,083
V = $1,155,171 (say) $1,155,000

New page 19

Proof:

	Year 1	Year 2	Year 3	Year 4	Total
Cash flow before PMM	$ 149,381	$645,762	$326,756	$288,625	$1,410,524
PMM repayment					
Beginning of period balance	$1,039,500	$815,956	$244,231	0	$1,039,500
Repayment	223,544	571,725	244,231		1,039,500
End of period balance	815,956	244,231	0		0
Average balance	927,728	530,094	122,116		
Interest at 10%	92,773	53,009	12,212		157,994
Total PMM expense	$ 316,317	$624,734	$256,443	0	$1,197,494
Cash flow to developer	($166,936)	$ 21,028	$ 70,313	$288,625	$ 213,030
Discounted at 10%	x.9091	x.8264	x.7513	x.6830	
Present worth	($151,761)	$ 17,378	$ 52,826	$197,131	$ 115,574
Add PMM					1,039,500
					$1,155,074
					Say $1,155,000

EXHIBIT 17

[redacted] Comparable Sales Database Used for Relationship Analysis

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101	23000	70	38.00	5000	131	33	3	0	1.0
102	58500	94	40.00	800	20	33	3	2	0.0
103	31500	90	6.00	460	76	33	3	2	0.0
104	28600	82	13.20	750	56	33	3	2	0.0
105	3000	21	9.20	1500	163	22	1	0	3.0
106	6500	79	2.23	250	112	22	1	0	2.0
107	3500	96	1.33	240	180	22	1	0	1.0
108	2000	106	.47	90	191	22	1	0	1.0
109	6000	79	1.20	250	208	22	1	0	2.0
110	2500	45	2.57	1280	498	22	1	0	3.0
111	2000	45	2.30	840	385	22	1	0	3.0
112	1750	33	1.00	155	155	22	1	0	3.0
113	6250	59	1.60	365	228	22	1	0	2.0
114	10100	67	4.03	1116	276	22	1	0	2.0
115	6000	69	2.11	375	177	22	1	0	2.0
116	23000	81	10.00	1802	180	22	1	0	3.0
117	25500	81	11.00	1994	181	22	1	0	3.0
118	14500	117	3.00	1010	336	22	1	0	2.0
119	2500	26	1.21	500	413	22	1	0	3.0
120	1000	45	2.00	300	150	22	1	0	3.0
121	6500	36	7.00	1200	171	22	1	0	3.0
122	4000	66	2.75	212	77	22	1	0	3.0
123	18000	106	1.65	250	151	22	1	0	3.0
124	9000	57	4.80	400	83	22	1	0	3.0
125	6500	64	6.25	1250	200	22	1	0	3.0
126	4000	20	2.00	160	80	22	1	0	2.0
127	1000	43	3.40	331	97	22	1	0	2.0
128	1000	19	1.30	150	115	22	1	0	2.0
129	2800	79	1.25	125	100	22	1	0	2.0
130	3500	93	1.00	125	125	22	1	0	2.0
131	6000	80	5.00	330	66	22	1	0	3.0
132	37500	115	4.20	1680	400	22	1	0	1.0
133	10000	106	3.00	693	231	22	1	0	2.0
134	5500	117	1.00	125	125	22	1	0	1.0
135	3875	115	11.57	1200	103	22	1	2	0.0
136	6000	93	.94	100	106	22	1	0	3.0
137	2350	35	6.75	1200	177	22	1	1	4.0
138	8000	77	19.25	4900	254	22	1	0	9.0
139	6000	98	5.75	1650	286	22	1	0	6.0
140	2000	110	2.50	720	288	22	1	0	5.0
141	22500	102	21.50	2600	120	22	1	0	5.0
142	3000	47	8.50	2400	282	22	1	0	4.0
143	1000	42	3.50	1800	514	22	1	0	4.0
144	4000	52	1.25	230	184	22	1	0	5.0
145	3500	49	1.25	416	332	22	1	0	5.0
146	3500	49	1.00	200	200	22	1	0	5.0
147	4000	49	1.00	400	400	22	1	0	5.0
148	4000	51	1.25	440	352	22	1	0	5.0
149	10000	52	.85	217	255	22	1	0	5.0
150	4000	33	24.16	2550	105	22	1	0	7.0
151	10000	119	3.25	840	258	22	1	0	7.0
152	1000	21	2.00	338	169	24	1	0	1.0
153	4500	69	2.00	277	138	24	1	0	1.0
154	450	63	2.00	600	300	24	1	0	1.0
155	950	63	4.20	900	214	24	1	0	1.0
156	4000	55	12.50	2600	208	24	1	0	1.0
157	235	67	1.00	200	200	24	1	0	1.0
158	10000	63	22.00	2640	120	15	1	0	4.0
159	15000	41	17.50	2200	125	15	1	0	3.0
160	10900	85	9.90	2550	257	15	1	0	3.0
161	6000	41	9.90	2590	261	15	1	0	3.0
162	500	58	1.00	225	225	23	1	0	15.0
163	1000	24	1.00	600	600	23	1	0	16.0
164	1000	19	12.00	2950	245	23	1	0	16.0
165	132700	73	10.00	1500	150	15	1	2	0.0
166	9500	67	29.50	660	22	15	1	0	5.0
167	9000	56	5.50	850	154	15	1	0	6.0
168	7000	138	6.50	300	46	18	1	0	9.0
169	7000	138	6.50	400	61	18	1	0	9.0
170	9500	54	.40	525	1312	18	1	0	9.0
171	4500	2	5.96	350	58	18	1	0	7.0
172	4000	23	3.31	240	72	18	1	0	7.0
173	9500	57	1.20	1450	1208	18	1	0	8.0
174	120000	84	47.00	1800	38	18	1	0	8.0
175	8000	57	20.00	3700	185	18	1	0	9.0
176	4000	48	17.00	1900	111	18	1	0	12.0
177	18000	53	13.75	3600	261	18	1	0	15.0
178	24000	70	18.00	2100	116	18	1	0	10.0
179	15000	45	23.75	2800	117	18	1	0	16.0
180	6900	61	3.40	1350	397	26	2	0	11.0
181	6500	18	5.53	1500	271	26	2	0	11.0
182	11500	111	79.50	300	3	14	3	2	0.0
183	10000	21	50.00	2500	50	26	2	0	11.0
184	12000	44	81.75	2300	28	26	2	0	8.0
185	8200	21	40.00	2000	50	26	2	0	1.0
186	10000	95	4.00	300	75	26	2	0	6.0
187	5000	67	17.12	1175	68	26	2	0	6.0
188	22000	117	4.00	206	51	7	2	0	3.0
189	2500	131	40.00	500	13	7	2	0	3.7
190	2800	114	3.00	280	93	7	2	0	1.0
191	16000	91	2.00	175	87	7	2	0	1.0
192	17000	115	1.70	125	73	7	2	0	2.0
193	6200	104	2.20	150	68	7	2	0	2.0
194	22000	63	36.50	1320	36	7	2	0	2.0
195	12000	119	4.10	166	40	7	2	0	1.0
196	59600	123	1.22	265	217	7	2	0	0.7
197	70000	132	1.83	111	60	7	2	0	0.1
198	15000	140	1.47	250	170	7	2	0	0.6
199	35500	137	1.07	350	327	7	2	0	0.8
200	36000	139	1.33	230	172	7	2	0	0.6
201	8000	130	0.64	102	155	7	2	0	0.7
202	5000	139	1.03	200	194	7	2	1	0.0
203	17000	115	0.91	125	137	7	2	0	0.7
204	35500	140	1.61	200	124	7	2	0	0.7
205	70000	132	1.83	112	61	7	2	1	0.0
206	12000	77	1.25	200	160	7	2	0	1.0
207	40000	130	0.61	195	319	7	2	0	1.5

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208	20000	123	1.42	278	195	7	2	2	0.0
209	5000	132	3.04	222	73	7	2	2	0.0
210	20000	111	1.42	278	195	7	2	1	0.0
211	20000	135	2.39	222	92	7	2	1	0.0
212	5000	119	4.94	105	21	7	2	1	0.0
213	11000	94	37.00	1100	29	4	3	0	2.0
214	2400	38	0.70	500	714	9	3	0	2.0
215	85000	84	9.70	1600	164	31	1	2	0.0
216	5000	61	31.25	2000	64	31	1	0	3.0
217	2000	39	50.25	1320	26	31	1	2	2.0
218	162000	94	10.00	700	70	31	1	2	0.0
219	12600	104	6.00	1200	200	31	1	2	0.0
220	16000	131	34.95	3000	85	10	3	0	1.8
221	10000	138	2.15	800	372	10	3	0	1.0
222	2500	55	5.49	1440	262	31	1	0	2.0
223	3000	55	5.50	600	109	31	1	0	2.0
224	4000	50	50.25	1800	35	31	1	0	2.0
225	7500	19	127.80	3400	26	11	3	0	3.0
226	75000	142	79.55	3500	43	31	1	2	5.3
227	20000	116	23.00	700	30	31	1	2	0.2
228	8100	62	43.19	1400	32	31	1	0	2.0
229	15000	119	39.97	1600	40	31	1	2	0.0
230	30000	146	32.50	1400	43	31	1	0	5.0
231	84000	132	115.00	2800	24	31	1	2	0.0
232	20000	94	39.00	1320	33	31	1	0	2.0
233	20000	94	5.00	800	160	31	1	0	1.0
234	5000	57	20.00	1320	66	31	1	0	2.0
235	4500	60	12.75	1300	101	31	1	0	3.0
236	22400	121	63.00	2640	41	31	1	0	3.3
237	40000	128	22.00	1950	88	31	1	0	2.5
238	60000	126	20.50	4200	204	31	1	0	2.5
239	3200	70	1.75	600	342	31	1	0	3.0
240	6000	35	40.00	1200	30	31	1	0	3.0
241	20000	35	11.50	2800	243	31	1	0	1.0
242	6500	74	2.16	880	407	31	1	0	2.0
243	29000	140	0.92	350	380	31	1	0	0.1
244	18500	140	0.63	204	323	31	1	2	0.0
245	12000	107	3.45	275	79	31	1	2	0.0
246	25500	129	6.90	320	46	31	1	0	0.0
247	8500	116	4.30	175	40	31	1	0	0.3
248	14000	130	1.51	220	146	31	1	0	4.8
249	25000	134	2.87	391	136	31	1	2	0.0
250	13000	59	0.47	500	1063	31	1	0	1.0
251	5000	118	40.00	100	2	31	1	0	6.0
252	6000	94	1.80	222	123	31	1	0	2.0
253	6000	93	1.60	200	125	31	1	0	2.0
254	7000	113	1.60	200	125	31	1	0	2.0
255	12000	118	8.00	420	53	31	1	0	0.4
256	25000	131	33.75	1100	32	31	1	0	2.5
257	6000	136	2.67	211	79	31	1	0	1.0
258	11000	134	2.35	200	85	31	1	0	1.0
259	8000	95	15.00	200	13	31	1	0	2.0
260	4000	77	1.20	107	89	31	1	2	0.0
261	4000	77	1.20	101	84	31	1	2	0.0
262	9000	82	2.20	201	91	31	1	2	0.0
263	4500	77	1.20	100	83	31	1	2	0.0
264	4500	77	1.20	100	83	31	1	2	0.0
265	5500	97	1.20	101	84	31	1	2	0.0
266	6500	62	10.60	450	42	31	1	0	3.0
267	3000	86	3.00	250	83	31	1	0	1.0
268	4800	107	3.00	250	83	31	1	0	1.0
269	10100	116	4.88	330	67	31	1	0	1.0
270	10100	116	4.88	350	72	31	1	0	1.1
271	28500	132	24.50	650	26	31	1	0	1.6
272	4200	69	5.95	390	65	31	1	0	1.0
273	10000	94	4.00	1600	400	31	1	0	1.0
274	3000	102	4.83	200	41	31	1	0	1.0
275	4500	43	41.75	1600	38	31	1	2	1.0
276	32500	101	70.00	1000	14	31	1	0	1.0
277	6750	83	4.00	800	200	31	1	0	2.0
278	6000	108	1.00	230	230	31	1	0	1.0
279	6000	90	5.00	1700	340	31	1	0	1.6
280	34500	80	48.75	1400	28	31	1	0	1.0
281	25000	140	1.11	350	315	31	1	2	0.0
282	2000	112	.15	400	2666	31	1	0	2.0
283	2500	36	.43	400	930	31	1	0	1.0
284	48000	114	23.90	1100	46	31	1	0	6.0
285	30000	119	1.46	1300	890	31	1	0	4.0
286	5500	75	14.12	660	46	31	1	0	3.0
287	1800	102	3.00	880	266	31	1	0	6.0
288	14500	113	15.77	1000	63	31	1	0	2.0
289	14500	113	15.77	1550	98	31	1	0	0.9
290	50000	139	38.00	2500	65	31	1	0	0.7
291	4000	132	1.25	480	384	31	1	0	1.0
292	5000	82	5.50	1200	218	31	1	0	1.0
293	5500	82	2.63	1630	619	31	1	0	2.0
294	12500	134	12.75	2000	157	31	1	0	1.5
295	5000	126	18.99	1000	53	31	1	0	0.6
296	3500	86	1.20	106	88	31	1	2	0.0
297	4000	80	0.80	100	125	31	1	2	0.0
298	4000	80	0.80	103	128	31	1	2	0.0
299	5000	93	0.90	107	118	31	1	2	0.0
300	10000	66	16.19	660	40	31	1	0	2.0
301	1754	98	0.83	100	120	31	1	0	1.0
302	4000	35	14.72	400	27	31	1	0	1.0
303	6000	82	7.36	200	27	31	1	0	5.0
304	10000	131	7.36	200	27	31	1	0	0.3
305	3650	88	1.49	200	134	31	1	0	4.0
306	4000	98	1.10	198	180	31	1	0	4.0
307	4000	81	1.29	317	245	31	1	0	4.0
308	4000	98	1.68	280	166	31	1	0	4.0
309	6700	144	2.70	200	74	31	1	0	1.5
310	6200	135	4.60	200	43	31	1	0	1.5
311	27000	82	29.75	1320	44	5	2	2	0.0
312	28000	101	19.35	900	46	5	2	2	0.0
313	35000	79	26.00	3780	145	5	2	0	1.0
314	12500	39	23.00	3000	130	5	2	0	2.0
315	38000	137	8.00	2100	263	5	2	0	2.8
316	6000	110	6.50	1300	200	5	2	0	1.0

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317	52000	95	39.69	2800	70	31	1	0	2.0
318	87500	143	50.25	8500	169	5	2	0	1.5
319	33000	145	5.60	624	111	16	3	2	0.0
320	16000	127	2.15	500	232	16	3	2	0.0
321	14800	136	6.90	250	36	16	3	2	0.0
322	6500	25	33.75	3000	88	33	3	0	1.0
323	16500	113	72.50	1800	24	33	3	0	1.0
324	10000	71	23.20	1300	56	33	3	0	2.0
325	8000	112	2.75	1028	373	31	1	0	2.0
326	8000	121	3.00	960	320	31	1	0	2.0
327	7800	100	4.50	1200	266	31	1	0	2.0
328	20000	111	36.45	6000	164	31	1	0	2.0
329	3000	95	26.70	708	26	31	1	0	2.0
330	1500	95	7.75	660	85	31	1	0	2.0
331	4500	101	1.20	100	83	31	1	2	0.0
332	5950	94	0.84	500	595	31	1	0	1.5
333	7800	92	2.20	260	118	31	1	2	0.0
334	7500	90	2.20	230	104	31	1	2	0.0
335	50000	141	0.42	750	1785	31	1	2	0.2
336	12000	81	27.00	990	36	31	1	0	6.0
337	5000	115	7.88	340	43	31	1	0	1.6
338	4000	94	0.70	50	71	31	1	0	4.0
339	23500	100	2.80	260	92	31	1	0	4.0
340	17500	106	1.20	100	83	31	1	0	4.0
341	6400	113	1.40	106	75	31	1	2	0.0
342	7000	101	2.20	200	90	31	1	2	0.0
343	6500	80	1.90	185	97	31	1	2	0.0
344	6500	90	1.70	175	102	31	1	2	0.0
345	2500	127	0.57	650	1140	31	1	2	0.4
346	14000	105	0.33	800	2424	31	1	2	0.8
347	16500	94	3.30	1200	363	31	1	2	0.8
348	5000	139	4.25	625	147	31	1	2	0.6
349	6500	144	30.12	1400	46	31	1	0	1.5
350	26000	106	3.00	100	33	31	1	1	0.0
351	15000	96	6.20	200	32	31	1	1	0.0
352	3000	103	1.50	100	66	31	1	2	0.0
353	3000	103	1.20	100	83	31	1	2	0.0
354	10000	95	1.20	100	83	31	1	2	0.0
355	6000	84	4.48	150	33	31	1	2	0.0
356	8000	91	4.48	150	33	31	1	2	0.0
357	6000	91	1.50	300	200	31	1	0	4.0
358	8000	110	5.00	900	180	31	1	0	4.0
359	6000	93	1.20	100	83	31	1	2	0.0
360	3000	93	.60	50	83	31	1	2	0.0
361	8500	107	1.40	120	85	31	1	2	0.0
362	7000	92	1.20	100	83	31	1	2	0.0
363	11400	103	1.50	152	101	31	1	1	0.0
364	9000	102	1.40	140	100	31	1	1	0.0
365	10500	102	1.60	161	100	31	1	1	0.0
366	19000	106	3.20	290	90	31	1	1	0.0
367	15000	94	2.40	204	85	31	1	1	0.0
368	5000	89	1.20	100	83	31	1	1	0.0
369	7500	88	1.50	100	66	31	1	2	0.0
370	13500	99	6.25	1900	304	31	1	0	0.7
371	16000	102	9.50	3000	315	31	1	0	2.0
372	9000	58	9.50	2000	210	31	1	0	3.0
373	6000	91	1.55	200	129	31	1	2	0.0
374	4000	104	1.80	178	98	31	1	2	0.0
375	6000	81	1.60	160	100	31	1	2	0.0
376	4500	105	2.60	327	125	31	1	0	1.0
377	2500	81	2.20	215	97	31	1	0	1.0
378	600	55	0.50	400	800	31	1	0	2.0
379	6000	62	32.50	1400	43	31	1	0	2.0
380	3000	75	16.25	660	40	31	1	0	4.0
381	25000	127	9.00	2655	295	31	1	0	2.9
382	27000	128	5.75	2000	347	31	1	0	4.4
383	8500	127	2.27	400	176	31	1	0	2.9
384	6000	133	1.42	200	140	31	1	0	2.9
385	17000	139	2.30	200	86	31	1	0	0.9
386	13000	44	49.50	3300	66	31	1	0	2.0
387	12000	122	7.14	620	87	31	1	0	2.1
388	5000	93	2.25	800	355	31	1	0	3.0
389	4500	80	1.80	187	103	31	1	2	0.0
390	4100	94	2.20	248	112	31	1	2	0.0
391	2400	80	1.60	151	94	31	1	2	0.0
392	4500	76	1.40	157	112	31	1	2	0.0
393	3500	77	1.20	85	70	31	1	2	0.0
394	2300	84	1.40	125	89	31	1	2	0.0
395	105000	49	52.28	5600	107	31	1	2	2.0
396	8500	99	6.50	1200	184	31	1	0	2.0
397	25000	98	9.86	1100	101	31	1	0	2.0
398	6500	104	1.50	125	83	31	1	2	0.0
399	7000	79	1.20	115	95	31	1	2	0.0
400	7000	88	1.80	174	96	31	1	2	0.0
401	9000	94	1.90	188	98	31	1	2	0.0
402	8500	93	1.70	175	102	31	1	2	0.0
403	14500	107	1.80	183	101	31	1	2	0.0
404	10000	105	6.60	700	106	31	1	0	2.0
405	4000	74	3.50	1000	285	31	1	0	1.0
406	8000	81	7.75	1700	219	31	1	0	2.0
407	6000	126	110.00	2700	24	21	3	1	0.0
408	1500	97	0.85	1000	1000	8	3	0	2.0
409	400	97	1.00	1000	1000	8	3	0	1.0
410	8800	83	3.87	1300	335	8	3	0	1.0
411	27000	81	29.75	580	17	5	2	2	0.0
412	13000	132	1.20	189	157	32	3	2	0.0
413	10100	104	1.03	235	228	32	3	1	0.0
414	11000	97	1.88	213	113	32	3	1	0.0
415	65000	136	2.30	208	90	32	3	1	0.0
416	12000	115	2.30	208	90	32	3	1	0.0
417	11900	106	2.40	210	87	32	3	1	0.0
418	13300	134	1.03	221	214	32	3	1	0.0
419	13000	133	1.50	222	148	32	3	1	0.0
420	13077	114	1.60	222	138	32	3	1	0.0
421	12255	117	1.35	229	169	32	3	1	0.0
422	14700	139	1.46	210	143	32	3	1	0.0
423	10000	138	5.17	216	41	33	3	1	0.0
424	11000	122	7.72	649	84	33	3	1	0.0
425	10000	130	5.01	350	69	33	3	1	0.0
426	6500	23	24.00	1400	58	33	3	0	1.0
427	12500	64	67.00	2000	29	33	3	0	1.0
428	16500	61	40.00	1800	45	33	3	0	1.0

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429	32000	38	29.70	1800	60	33	3	2	0.0
430	37000	60	27.65	1000	36	33	3	2	0.0
431	15000	44	19.00	600	31	33	3	2	0.0
432	9450	134	2.35	185	78	31	1	0	1.0
433	10000	144	1.60	300	187	5	2	1	0.0
434	5250	81	4.40	450	102	31	1	2	0.0
435	19500	127	48.42	1700	38	16	3	2	0.0
436	7500	156	37.00	775	21	16	3	2	0.0
437	6000	119	9.86	2500	254	18	1	0	5.0
438	38000	137	21.25	2975	140	1	3	1	0.0
439	4500	106	9.50	800	84	1	3	1	0.0
440	2000	127	0.73	93	114	1	3	1	0.0
441	40000	128	140.75	4725	34	23	1	0	17.5
442	23307	142	5.31	402	76	33	3	1	0.0
443	36000	141	4.08	185	45	33	3	1	0.0
444	5000	109	18.00	3550	197	31	1	0	3.5
445	10000	131	7.36	250	34	31	1	0	3.0
446	6700	142	6.70	200	30	31	1	0	2.0
447	6200	135	4.60	200	43	31	1	0	2.0
448	6200	139	2.30	200	87	31	1	0	2.0
449	4000	101	2.22	304	137	31	1	0	1.5
450	1800	118	7.25	600	77	31	1	0	1.5
451	5950	94	0.84	825	982	31	1	0	0.5
452	5950	136	0.84	825	982	31	1	0	0.5
453	4500	101	0.63	106	168	31	1	2	1.0
454	25000	134	2.90	391	135	31	1	0	1.0
455	5000	118	40.00	175	4	31	1	0	1.5
456	12000	118	8.00	400	50	31	1	0	0.5
457	18000	138	75.25	850	11	31	1	0	2.5
458	10100	116	4.90	350	71	31	1	0	2.0
459	65000	110	4.00	200	50	31	1	2	3.5
460	12900	155	12.60	283	22	31	1	2	2.5
461	6000	108	1.00	250	250	31	1	0	1.5
462	5833	142	2.70	103	38	31	1	0	1.5
463	11666	142	8.30	205	39	31	1	0	1.5
464	11666	142	8.30	205	25	31	1	0	1.5
465	11666	142	4.70	200	42	31	1	0	1.5
466	2000	112	0.15	1150	7667	31	1	0	1.5
467	35000	154	5.70	2807	492	31	1	0	2.0
468	5000	106	0.50	135	270	31	1	2	4.0
469	7000	112	0.70	182	260	31	1	2	2.5
470	4500	107	3.70	299	81	31	1	0	2.0
471	5300	156	1.60	241	151	31	1	0	2.0
472	12000	141	2.00	229	114	31	1	0	4.0
473	17000	143	2.60	265	102	31	1	0	4.0
474	18600	143	2.80	1122	401	31	1	0	4.0
475	750	114	1.00	113	113	31	1	0	4.0
476	8000	103	2.00	370	185	31	1	0	4.0
477	15000	98	2.00	370	185	31	1	0	4.0
478	15000	143	1.20	656	547	31	1	0	4.0
479	3000	137	1.00	190	190	31	1	0	3.0
480	9450	134	2.40	188	78	31	1	0	1.0
481	7950	133	1.90	159	84	31	1	0	1.0
482	11000	134	2.50	253	101	31	1	0	1.0
483	9250	133	2.20	194	88	31	1	0	1.0
484	9250	133	1.90	179	94	31	1	0	1.0
485	8550	133	1.80	175	97	31	1	0	1.0
486	8350	133	1.90	165	87	31	1	0	1.0
487	12000	140	1.90	173	91	31	1	0	1.0
488	13500	154	1.70	166	98	31	1	0	1.0
489	14500	154	2.40	171	71	31	1	0	1.0
490	12000	154	3.30	165	50	31	1	0	1.0
491	13000	140	5.20	256	49	31	1	0	1.0
492	6000	145	2.70	201	74	31	1	0	1.0
493	7000	113	2.50	204	82	31	1	0	1.0
494	6000	134	2.60	211	81	31	1	0	1.0
495	15000	113	27.08	250	9	26	2	2	2.5
496	12000	119	4.10	2450	598	26	2	0	0.0
497	2800	114	2.12	301	142	26	2	0	1.0
498	15000	140	1.54	261	169	26	2	0	1.0
499	15000	140	1.54	261	169	26	2	0	1.0
500	8000	130	0.62	95	153	26	2	0	1.0
501	20000	123	1.66	291	175	26	2	2	1.0
502	20000	135	2.51	212	84	26	2	2	1.0
503	5000	119	3.69	750	203	26	2	2	1.0
504	6200	104	1.44	242	168	26	2	2	0.5
505	5000	139	1.03	181	176	26	2	2	0.5
506	55000	102	6.38	402	63	26	2	0	5.5
507	7000	135	17.60	600	34	23	1	0	4.0
508	23000	98	1.28	439	343	23	1	0	5.0
509	7000	99	.93	425	457	23	1	0	5.0
510	24000	114	.93	425	457	23	1	0	5.0
511	25000	109	1.10	389	354	23	1	0	5.0
512	4500	98	1.10	389	354	23	1	0	5.0
513	4000	98	1.19	268	225	23	1	0	5.0
514	20000	123	1.19	268	225	23	1	0	5.0
515	10000	114	4.65	225	48	5	2	2	0.0
516	10900	123	17.50	3000	171	15	1	0	2.5
517	18000	102	0.73	90	123	15	1	1	2.0
518	29500	142	4.05	288	71	15	1	2	1.0
519	14500	151	40.00	1750	44	15	1	1	2.0
520	1611	127	16.88	1350	80	22	1	0	1.0
521	12000	131	2.50	1300	520	22	1	0	1.5
522	2000	131	48.50	3600	74	22	1	0	3.0
523	1800	132	1.39	291	209	24	1	0	2.5
524	9500	140	2.14	722	337	24	1	0	2.5
525	6000	141	1.17	152	130	24	1	0	2.5
526	26000	130	1.96	100	51	22	1	1	7.5
527	20000	152	2.96	183	62	22	1	1	3.0
528	11000	117	2.50	639	256	22	1	1	5.0
529	7200	122	3.47	1576	454	22	1	1	5.0
530	10000	131	0.61	133	218	22	1	1	5.0
531	2500	137	0.62	211	340	22	1	1	5.0
532	10000	132	5.43	423	78	22	1	0	4.0
533	10000	140	4.65	466	100	22	1	0	4.0
534	10000	143	1.08	200	185	22	1	0	4.0
535	8000	153	0.67	125	186	22	1	0	4.0
536	11220	124	3.59	1457	406	22	1	0	2.5
537	18000	127	2.28	1160	509	22	1	0	2.5
538	20000	127	2.28	1160	509	22	1	0	2.5
539	18000	128	3.57	718	201	22	1	0	2.5
540	32500	135	4.10	1030	251	22	1	0	2.5
541	12800	142	1.10	111	101	22	1	1	5.0
542	4000	130	.05	50	1000	22	1	1	7.5

[redacted]

EXHIBIT 19

VARIABLE CODING LEGEND

COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8	COL 9
Price	Date	Acres	Frontage On Lake In Feet	COL 4 / COL 3 Ratio of Frontage to Acreage	Lake Location	Lake Size	Road Access Type	Distance to Nearest Public Access (Highway Map)

Lake	Location (LAKE)
1	Ash
2	Astrid
5	Burntside
4	Black Duck
3	Bear Island River
7	Crane
6	Cedar
9	Echo
10	Elbow
8	Eagles Nest
12	Franklin
11	Fenshe
13	Gannon
14	Johnson
15	Kabetogama
16	Long, Little Long
17	Mukooda
18	Namakan
19	One Pine
20	Pelican

Lake	Location (LAKE)
21	Pickerel
	Rainy Lake
22	Upper (W of R22)
23	Lower (E of R21)
24	Black Bay Area
25	Rollick
27	Shagawa
26	Sandpoint
28	Spring
29	Trout
30	Twin Lakes
31	Vermillion
	North Shore
	South Shore
	NW Section
32	White Iron
33	Other

Lake Size (LSIZE)

1. Large
   Rainy
   Kabetogama
   Vermillion
   Pelican
   Namahan
2. Medium
   Burntside
   Trout
   Shagawa
   Crane
   Sandpoint
3. Small
   All others
4. River

Roads (RDAC)

0 = None
1 = Paved
2 = Gravel