Soils of the Municipality of Whitehead
Report No. D99

2020

Manitoba

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Part 1 General Description of the Study Area

1.1 Location and Extent

The Rural Municipality (RM) of Whitehead (WHD) is located in the southwestern part of Manitoba and involves an area of approximately 58,160 hectares (ha) or 143,716 acres (ac) of land within townships (TWP) 9 and 10 in Ranges of 20, 21 and 22 west of the Principal Meridian. The RM of Whitehead is bordered to the east by the RM of Cornwallis, to the north by the two RMs of Riverdale and Elton, to the west by the RM of Sifton and Wallace-Woodworth, and to the south by the RM of Souris-Glenwood (Figure 1).

This report contains soil resource information and maps at a scale of 1:20,000 for an area formerly covered in the Reconnaissance Soil Survey Reports (1:126,720) of Rossburn and Virden Map Sheet Areas, Soils Report No. 6 (Ehrlich et al., 1956); and Soil mapping from previously surveyed (1:20,000) “Soils of the Brandon Region Study Area, Report No. 30 (Michalyna et al., 1976).

1.2 Drainage and Relief

Drainage of the study area is facilitated by the network of streams contributory to the Assiniboine River (Assiniboine West Watershed) and Little Souris River (Central Assiniboine Watershed). The Assiniboine River enters the RM in TWP 10, Range 22, and flows northeasterly and then southeasterly out of the study area. Most of the surface drainage on the undulating till plain (particularly in TWP 9, Range 21W) is local in nature. Runoff water from the knolls and ridges accumulates in the intervening depressions to form sloughs and marshes. The removal of water from these local catch basins is largely through evaporation and seepage (Ehrlich et al., 1956).

The elevation of the study area ranges from 358 metres above sea level (a.s.l) in the flood plain along the Assiniboine River to 445 metres a.s.l. in the north of Alexander. Most of the landscape consists of lacustrine plains with a nearly level to undulating topography. Greater relief is confined to the till moraines and the deeply incised channel of the Assiniboine River in the north of TWP 10, Range 21W. The southern three townships are basically leveled, ranging in elevation from approximately 430 metres a.s.l. in southwest to 415 metres a.s.l. in southeast, resulting in a general gradient of 0.05 per cent.

1.3 Geology

The dominant underlying bedrocks in the RM of Whitehead are shale of the Riding Mountain Formation, accounting for approximately 95 per cent, and the remaining five per cent is from Vermilion River Formation. These two formations established during the Cretaceous Period. Figure 2 shows that there are four types of shale within the study area.

- Riding Mountain Formation includes three members 1) Millwood Member –soft green bentonitic shale; 2) Coulter Member – soft grey bentonitic clayed siltstone and shale and 3) Odanah Member – hard grey siliceous shale.
- The Vermillion River Formation includes Morden, Boyne and Pembina members which consist of black, carbonaceous shale, calcareous and carbonaceous shale, and calcareous shale and bentonite, respectively.

1.4 Physiography and Surface Deposits

The study area lies within two ecodistricts - the Stockton (758) and the Oak Lake (763) in the Aspen Parkland Ecoregion (ESWG, 1995, Smith et al., 1998), which were previously referred to as the Lake Souris Basin (Ehrlich

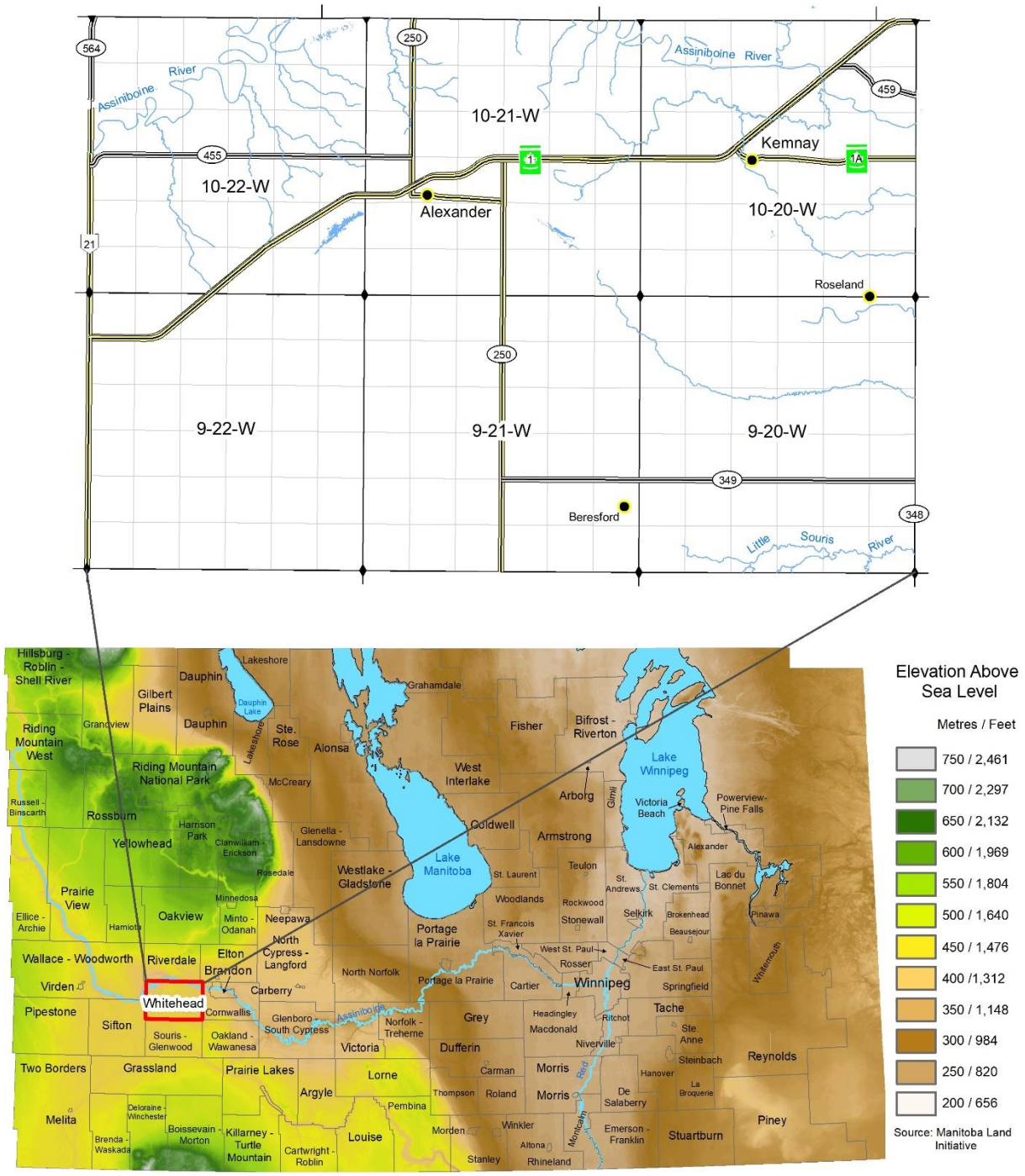


Figure 1. Location of the Study Area: The Rural Municipality of Whitehead

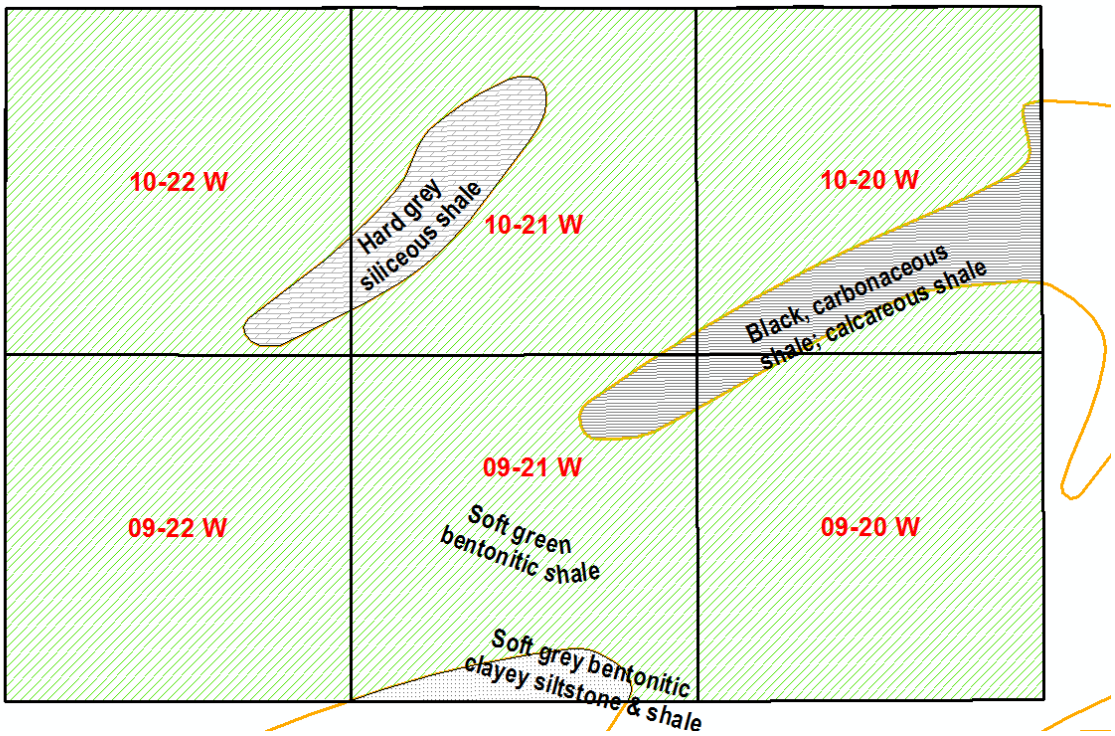


Figure 2. Surface Contacts of the Rock Formations in the RM of Whitehead

et al., 1956). The Stockton district covers approximately 95.7 per cent of the study area, the remaining 4.3 per cent is under the Oak Lake district (Figure 3). Both the Stockton and Oak Lake ecodistricts are within the commonly known Grassland Transition Ecoclimatic Region - subregion 2 (Gt2).

The surface deposits throughout the study area are dominantly deep lacustrine materials, varying considerably in texture from one location to another.

The dominant landform in the study area is undulating, making up 54 per cent of the RM. Its slopes are either nearly level or very gentle. Hummocky landforms account for 31 per cent, mainly located in TWP 9, Range 21W and TWP 9 Range 22W. Level landforms comprise 11 per cent of the study area.

1.5 Soils

As the RM of Whitehead is located entirely in the Lake Souris Basin, most soils are developed from deep lacustrine sediments (Figure 4), accounting for 73 per cent of the study area (Table 1). Coarse-textured Stockton soil association and medium-textured Fairland association are two major deep lacustrine associations observed in the RM, each approximately accounting for 20 per cent. The Stockton soil association is primarily distributed in TWP 9, Range 20W (Figure 4), but some are scattered in TWPs 9-21W, 10-21W, and 9-22W. Fairland soil association is mainly observed in TWP 10, Range 20W and TWP 10, Range 21W (Figure 4), although some proportions of this association are found in other townships.

Moderately coarse Prosser soil association consists of 15 per cent of the study area, and it is commonly seen in TWP 9, Range 22W. The moderately fine soil association of Carroll is found primarily northwest of TWP 10, Range 22W. All these four associations are characterized by a relatively uniform texture profile within 100 centimetres. However, Glenboro and Wellwood soil associations, although their acreages are very small, have a finer texture in top layer(s), overlaying by a coarser texture group.

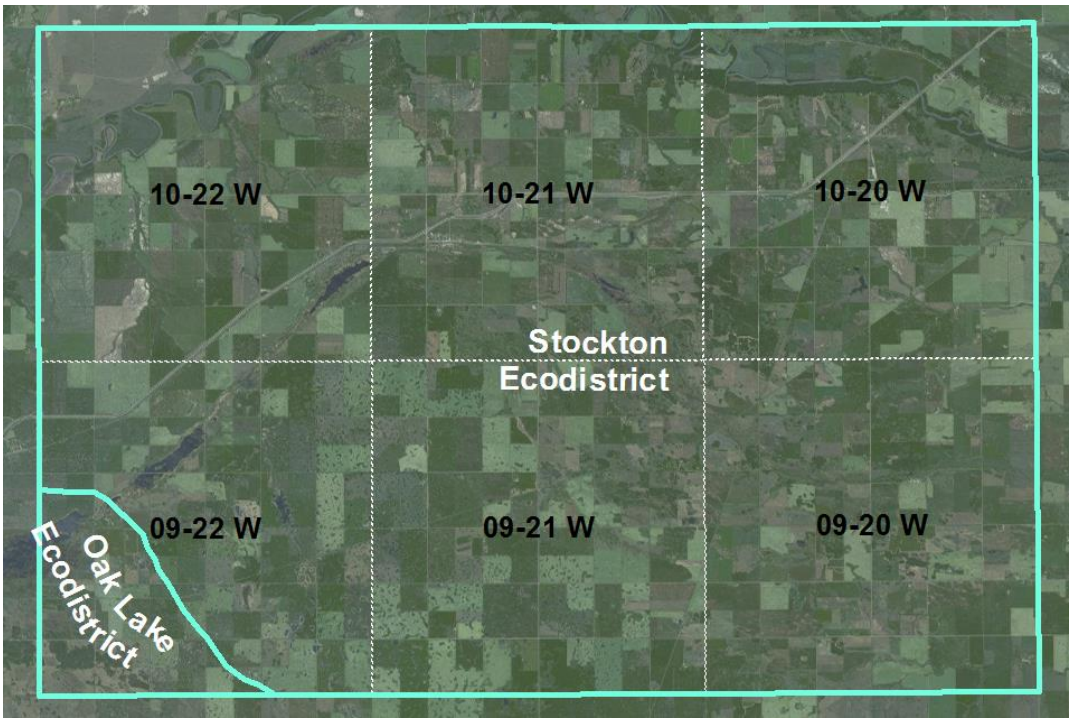


Figure 3. Ecodistricts of the Rural Municipality of Whitehead

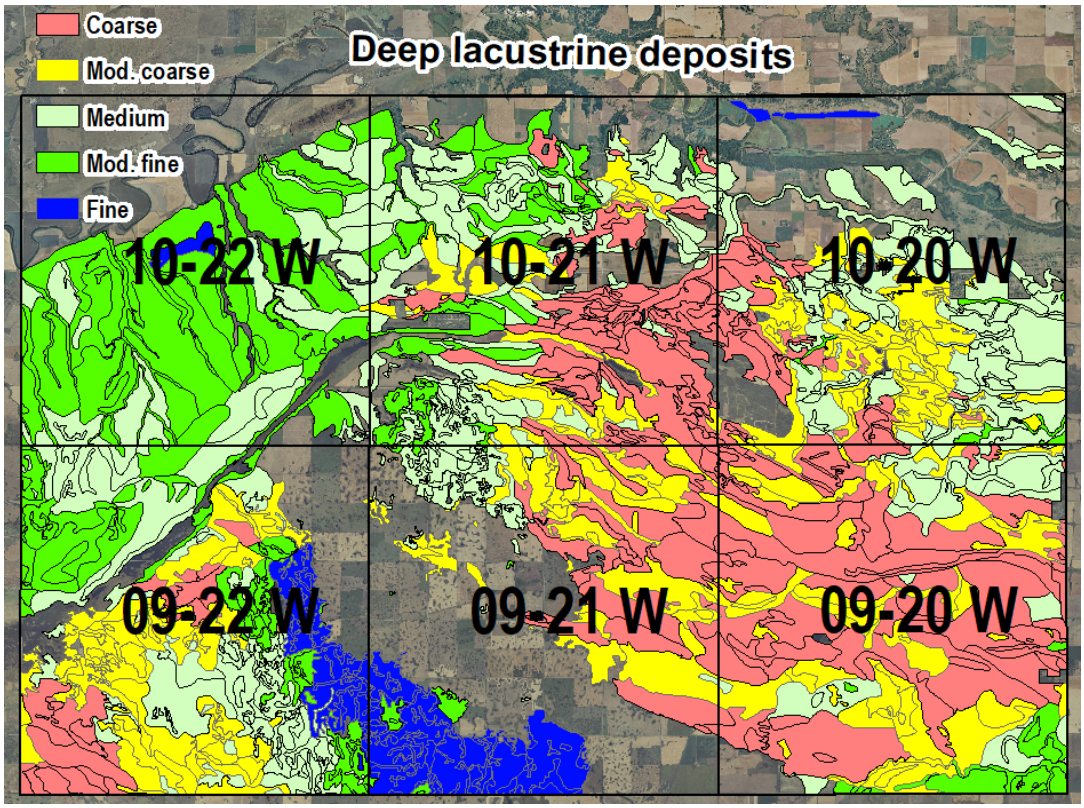


Figure 4. Deep Lacustrine Deposits in the RM of Whitehead

Table 1 Soil Parent Material in the Rural Municipality of Whitehead

Parent material (0 to 100 cm)	Total area		Per cent of RM
	ha	ac	
Deep Lacustrine	42,441	104,873	73.0
Lacustrine over glacial till	6,765	16,716	11.6
Alluvium	2,670	6,597	4.59
Glacial till	1,434	3,545	2.47
Lacustrine over fluvial	1,108	2,737	1.90
Fluvial	587	1,450	1.01
Eolian	331	817	0.57
Fluvial over glacial till	290	716	0.50
Lacustrine over fluvial over till	1.00	2.48	0.002
Eroded slope, mash, water & unclassified	2,535	6,263	4.36
Total	**58,160**	**143,716**	**100**

Soils derived from lacustrine over glacial till comprise over 11.6 per cent, dominantly located in TWP 9, Range 21W (Figure 5).

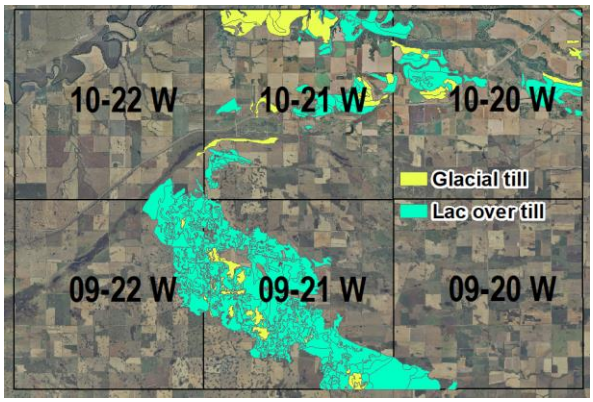


Figure 5. Lacustrine over Glacial Till and Glacial Till Distributions in the RM of Whitehead

The lacustrine overlying glacial till soils are classified as four associations, among which the Beresford association is predominant. The Beresford association includes three well drained soil series (Clementi - Orthic Black Chernozem, Kleysen – Calcareous Black Chernozem, and Chambers – Rego Black Chernozem), two imperfectly drained soil series (Cobfield – Gleyed Black Chernozem and Beresford – Gleyed Rego Black Chernozem) and one poorly drained soil series (Vodroff - Rego Humic Gleysol).

Soils developed from alluvium deposits are distributed along the Assiniboine River (Figure 6), entirely on riverbeds or terraces well over present streams, accounting for 4.6 per cent. Soil texture ranges from medium to fine.

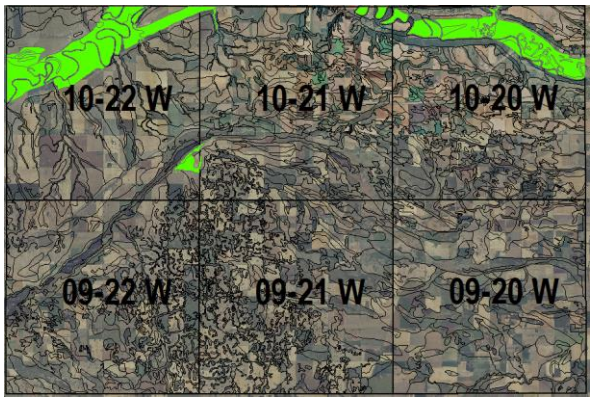


Figure 6. Alluvium Deposits in the RM of Whitehead

Fluvial associated parent materials have a wide variety of surface textures, ranging from coarse to moderately fine. Their proportions in the study are relatively small. These soils are primarily distributed in TWP 10, Range 20W, an some in TWP 10, Range 22W (Figure 5).

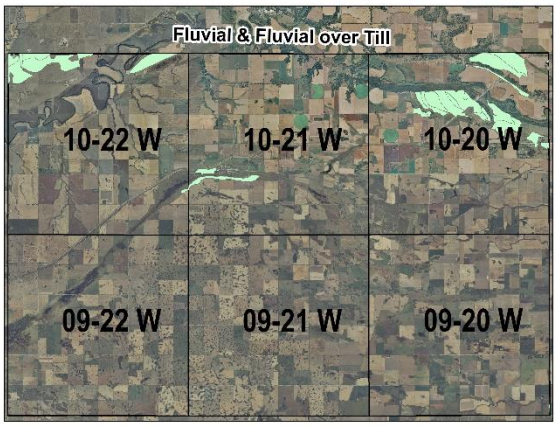


Figure 7. Fluvial associated soils in the RM of Whitehead

Part 2 Methodology

2.1 Mapping and Map Scale

Detailed soil mapping at a 1:20,000 scale (approx. 5 cm equals one km) was completed for the Rural Municipality of Whitehead. Soil profiles were examined to a depth of one meter at sites at an approximate 160-metre interval along traverses that were spaced 800 metres apart. The direction of each traverse was determined on the basis of enhancing the information that could be derived from the range of soil-landscape variation in each section. Additional soil inspections occurred in complex soil areas to help locate boundaries between different soil series or variable soil phases. This method of surveying provided approximately 25 to 30 inspections per section of land, or a soil inspection density of one site per 10 hectares (25 acres).

Based on all soil and landscape information collected during field inspections, the boundaries delineating various soil series are digitized using Geographic Information Systems (GIS) and 3-dimensional viewing software – Summit Lite. This allows higher positional accuracy of soil polygons and contrast features. In the areas where previous soil surveys were done, some of the old soil polylines were revised based on new images and updated information. These areas include “Soils of the Brandon Region Study Area, Report No. 30 (Michalyna et al., 1976).

2.2 Map Units

The information from soil inspection sites forms the basis for delineating soil boundaries on a map. Each geographic area enclosed by these soil boundaries is referred to as a soil polygon. Each soil polygon is named according to the soil series present in the polygon.
A soil series is defined as a naturally occurring soil body so that any profile within that body has a similar number and arrangement of horizons whose colour, texture, structure, consistence, reaction and composition are within a narrowly defined range. If a soil has properties that vary slightly from the prescribed range of the series, a soil series **variant** is established.

A soil polygon can contain up to three named soil series. The collective name or label of a soil polygon is referred to as a map unit.

A map unit represents portions of the soil landscape that have characteristics and properties varying within narrow limits that are determined by the intensity of the survey. The map unit contains one or more than one soil or non-soil plus a certain proportion of unnamed and un-described inclusions. Map units are delineated on the basis of the types and relative proportions of their soils or non-soils, as well as on the basis of external criteria such as slope, stoniness, erosion or salinity. Some examples of a non-soil include water or bedrock.

2.3 Simple and Compound Map Units

There are two major types of map units: simple and compound. The difference between a simple and compound map unit is the proportion and contrast of their components.

A **Simple Map Unit** contains predominantly one soil or non-soil. Its components vary as follows: the predominant component comprises at least 65 per cent with up to 35 per cent of non-limiting, similar components (components that are alike in most properties and behaviour), or up to 25 per cent of non-limiting dissimilar components (components that do not affect management of the map unit but have a significant number of properties that vary from the predominant component), or up to 15 per cent of limiting, dissimilar components (components which have many contrasting properties and usually affect management differently).

A **Compound Map Unit** contains predominantly more than one soil or non-soil (or a combination of both). The proportions of the two major components in a compound map unit, for example, may vary from one considerably exceeding the other to both being approximately equal. Complementary to the definition of a single map unit, the proportions of components vary according to

their areal extent and contrasting characteristics as they may affect soil management or use. Major components vary as follows: if other components are similar and non-limiting, no single component represents more than 65 per cent; or if other components are dissimilar and non-limiting, no single component represents 75 per cent or more; or if other components are dissimilar and limiting, no single component represents 85 per cent or more.

For the purpose of describing compound map units, components are considered dominant if they occupy over 40 per cent of the unit. They are considered significant between 15 and 40 per cent and minor if they occupy less than 15 per cent. Minor components are described only if they are highly contrasting.

2.4 Phases

It is often desirable to indicate a condition or quality of soil property or landscape feature that deviates significantly from the normal definition of map units using a map unit symbol. These variations or phases of soil properties and landscape features, varying from delineation to delineation, significantly affect soil behaviour and land management or use.

Soil properties that are commonly used as phase criteria include texture, depth, surface peat, salinity and physical disruption. Properties of land that are used include slope, wind and water erosion, stoniness, rockiness and altered drainage.

The four properties are identified below the soil series symbol. They are severity of erosion, slope class, degree of stoniness and salinity. The degree or magnitude of each is designated in Figure 9.

The convention employed to indicate these features in the map symbol is as follows:

If none of the above properties is observed to be significant, the map symbol representing the normal or unaffected soil series is used alone without modifiers (example in Figure 9).

If one or more phase features are recognized, the appropriate letter or number is placed below the soil series symbol in one of four designated locations in the map unit symbol. The designated order is erosion, slope class, stoniness and salinity. If a particular feature is not observed to be significant, an x is used in its appropriate designated location in the map symbol (Figure 9).

An example of a compound unit is as follows: 50 per cent consists of Fairland (FND^5) series having no erosion (x), very gently sloping topography (c), stoniness 2 at the surface (2), no salinity (x), 30 per cent Travers (TAV^3) series having slight erosion (1), very gently sloping topography (c), no stones (x) and no (x) salinity, and 20 per cent Ramada (RAM^2) series having no erosion (x), nearly level sloping topography (b), no stones (x) and no (x) salinity (Figure 9). If all the phases and features have an x designation, the four (x) phases are not shown in the map symbol (for example, Miniota (MXI) in figure 9).

2.5 Soil Sampling and Analysing

Over 300 soil surface and subsurface samples were collected and analyzed for texture (particle size), pH, organic carbon, electrical conductivity (EC) and calcium carbonate content. Soil cation exchangeable capacity (CEC) was also determined in detailed soil profile samples.

The brief methodologies of lab analyses used to determine soil characteristics are:

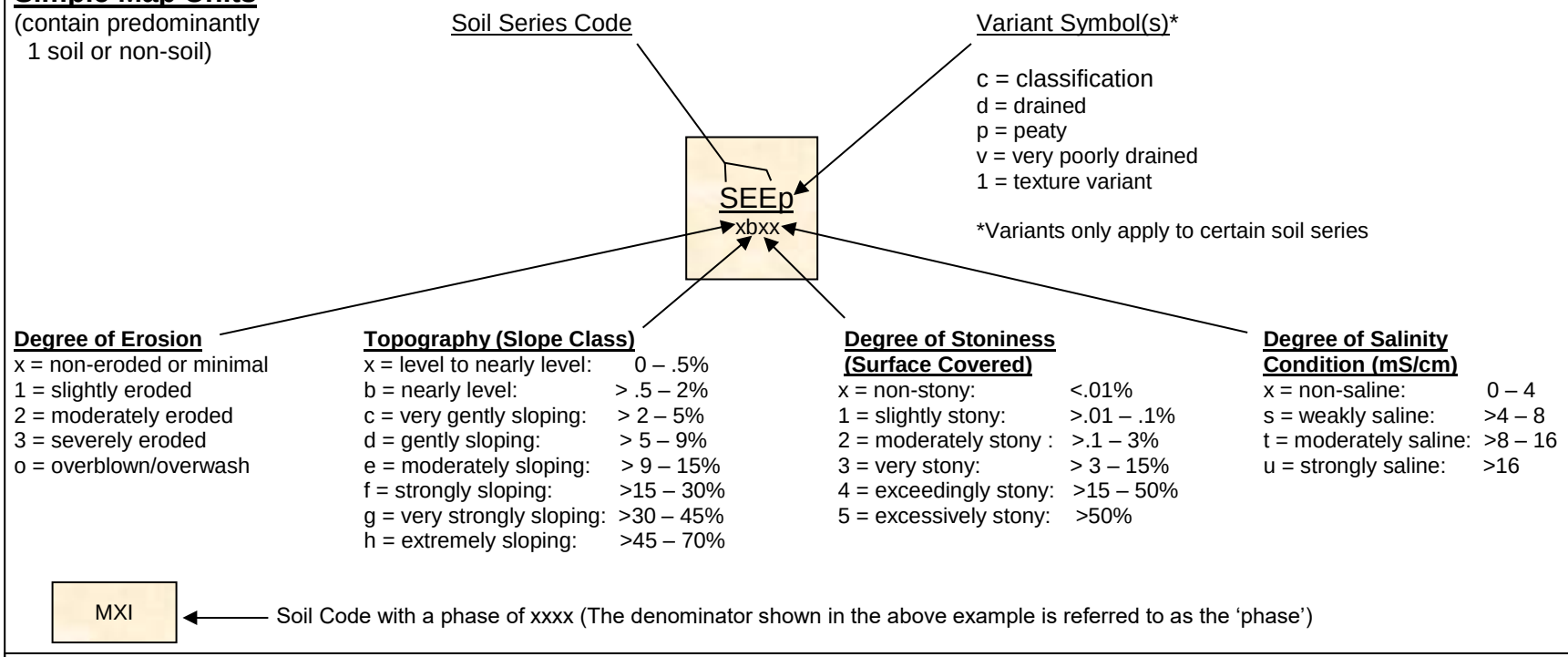
Calcium carbonate: Calcimeter using 1M HCl
CEC: Ammonia electrode
EC: Saturated paste
pH: 2:1 water to soil ratio
Organic carbon: Walkley-Black method
Particle size: Pipette method

Figure 8. Map Unit Symbol

Soil series maps contain labels similar to those shown in the pale brown boxes below. A description of each kind of label is indicated below.

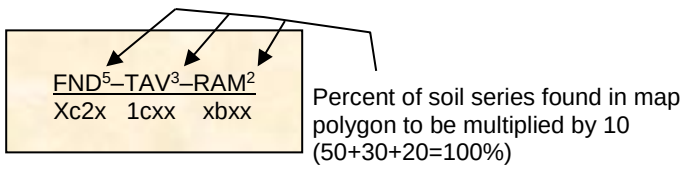
Simple Map Units

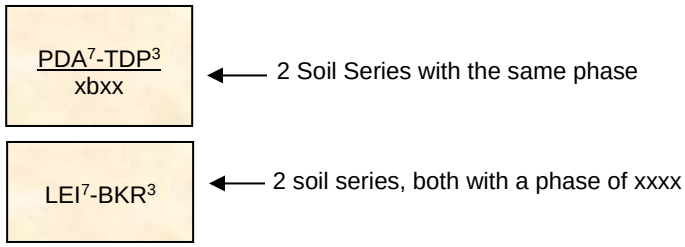
(contain predominantly 1 soil or non-soil)



Compound Map Units

(Contain up to 3 soils or non-soils)





Part 3 Soil Development and Classification

3.1 Introduction

This section of the report describes the main characteristics of the soils and their relationship to the factors of soil development. Soil development is related to the regional climate and the degree of leaching, translocation and accumulation of soluble and colloidal fractions of the soil. Soil drainage also plays a significant role in soil development. Soils in the RM of Whitehead have developed under a cool subhumid boreal climate (Grassland Transition of Ecoclimatic Region) which provides sufficient moisture and heat for development of aspen-oak groves, tall prairie grasses and associated herbs. Consequently, the majority of soils in the area are Chernozemic soils.

3.2 Classification

Soils in the study area are classified according to the Canadian System of Soil Classification (SCWG, 1998). This system is hierarchical, employing five levels of generalization or categories of classification. Beginning with the most generalized, these categories are the order, great group, subgroup, family (association) and series. The classification is based on measurable soil properties that can be observed in the field, or can be inferred from other properties observable in the field. The properties selected as criteria for the higher categories are the result of soil genesis or of factors that affect soil genesis. Properties utilized to differentiate soils at the lower levels of family and series affect management. The five levels of generalization are defined as follows:

Order - Soil orders are defined on the basis of soil properties of the pedon that reflect the nature of the soil environment and the effects of the dominant soil forming process. An example is a Chernozem in which soils with dark coloured surface horizons developed under sub-humid climate and dominantly grassland environments.

Great Group - Each order is subdivided into great groups based on differences in the strength of dominant processes or a major contribution of a process in addition to a dominant one. Such processes result in particular kinds, arrangements and degrees of expressions of pedogenic horizons. An example is a Luvic Gleysol in which the dominant process is considered to be gleying, but clay translocation is also a major process.

Subgroup - Subgroups are subdivisions of great groups and are defined according to the kind and arrangement of horizons that indicate the conformity to the central concept of the great group ex. Orthic, intergrades toward soils in other orders, ex. Gleyed or special features such as carbonate accumulation in B-horizons.

Family - Families are established within a subgroup based on the similarity of physical and chemical properties that affect management. The properties that are considered important for recognizing families are particle size distribution, mineralogy, soil climate, soil reaction and thickness of solum.

Series - The series consists of soils that formed in a particular kind of material and have horizons with colour, texture, structure, consistence, thickness, reaction and chemical composition that are similar in differentiating characteristics and in arrangement in the soil profile.

The classification of soils in the study area in relation to parent material, texture and drainage is listed in Table 2. The proportion of soils in terms of land area and surface texture in the RM of Whitehead is shown in Table 3. Each individual soil series is described in detail in Appendix 2.

Table 2-1. Relationship between Soil Series, Drainage, Parent Material and Classification in the RM of Whitehead

Drainage	Soil Classification	Till (L, CL, SCL)			Lacustrine over Till			
		Loamy Extremely calcareous Till (L, CL, SiCL)	Loamy Mixed, Calc.	Loamy Or CL, SiCL) (shaly)	(FS, LFS) over Mixed Till or Extr. Calc.Till	(LVFS, FSL) over Mixed Till or Extr. Calc.Till	Fine Loamy (CL, SiCL) over Mixed Till	Clayey (SiC, C) over Mixed Till
Well to Mod. Well	Orthic Regosol	Madill (MXH)					Roddan (ROD)	
	Orthic Black Chernozem	Hilton (HIT)	Newdale (NDL)	Lenore (LNO)	Kirkness (KKS)	Lockhart (LKH)=2M	Clementi (CLN)	Everton (EVO)
	Calc. Black Chernozem		Cordova (CVA)				Kleysen (KYS)	
	Rego Black Chernozem	Bermont (BMN)	Rufford (RUF)				Chambers (CBS)	
	Orthic Dark Gray Chernozem							
Imperfectly	Gleyed Black Chernozem		Moore Park (MPK)				Cobfield (CBF)	Justice (JUC)
	Gl. Eluv. Black Chernozem		Angusville (ANL)					
	Gl. Calc. Black Chernozem		Lavinia (LAV)					
	Gl. Rego Black Chernozem	Barwood (BWO)	Varcoe (VRC)		Killeen (KLL)	Lindstrom (LDM)	Beresford * (BSF)	Forrest (FRT)
	Gl. Dark Gray Chernozem		Petlura (PTU)					
Poorly	Orthic Gleysol		Hamiota (HMI)					
	Rego Humic Gleysol	Hickson (HKS)	Drokan (DRO)			Lonery (LOE)	Vodroff (VFF)	Fenton (FET)
	Humic Luvic Gleysol		Penrith (PEN)					

Soil texture abbreviations: C = clay, Co = coarse, F = fine, H = heavy, L = loam(y), S = sand(y), Si = silt(y), and V = very.

* : Including a texture variant.

Table 2-2. Relationship between Soil Series, Drainage, Parent Material and Classification in the RM of Whitehead

Drainage	Soil Classification	Lacustrine over Outwash			Outwash	Lacustrine over Outwash over Till	Fluvial over Till	Alluvium	
		MS, FS, LS over (CoS, MS)	(VFS, LVFS, SL, FSL) over (S & Gravel)	(L, SiL CL, SiCL) over (S + Gravel)	Sand and Gravel	(L, SiL, SiCL, CL) over (S & Gravel) Over (L, CL, SiCL)	(S & Gravel) over (L, CL, SiCL)	(VFSL, L, SiL, CL, SiCL)	(SiC, C)
Well to Mod. Well	Cumulic Regosol							Mowbray (MOW)	Manson (MXD)
	Orthic BL Chernozem	Wheatland (WHL)	Miniota (MXI)	Croyon (CYN)	Dorset (DOT)	Jaymar (JAY)			
	Calc. BL Chernozem				Marringhurst (MRH)	Dogand (DGA)	Chater (CXW)		
	Rego BL Chernozem		Ashmore (AHO)	Zarnet (ZRT)	Floors (FLS)				
Imperfectly	Gleyed Cumulic Regosol							Levine (LEI)	Assiniboine (ASB)
	Gleyed BL Chernozem	Hughes (HGH)	Wytonville (WVI)	Druxman (DXM)	Dexter (DXT)				
	Gleyed El. Bl. Chernozem					Longdens (LGD)			
	Gleyed Rego Bl. Chernozem	Gendzel (GDZ)	Kilmury (KUY)	Capell (CXT)	Mansfield (MFI)	Melland (MXT)	Barager (BAA)		
Poorly	Rego Humic Gleysol	Lowroy (LOW)	Bornett (BOR)	Carvey (CAV) Carvey, peaty (CAVp)	Fortina (FTN) Fortina, peaty (FTNp)	Marsden (MDN)		Basker (BKR) Basker, peaty (BKRp)	Kerran (KRN)

Table 2-3. Relationship between Soil Series, Drainage, Parent Material and Classification in the RM of Whitehead

Drainage	Soil Classification	Eolian	Lacustrine							
		Coarse (FS, LFS)	Coarse (FS, LFS)	Mod. coarse (VFS, LVFS, FSL)	Medium (VFSL, L, SiL)	Mod. Fine (CL, SiCL)	Fine (SiC, C)	(VFSL, L, SiL) over (FS, LFS, VFS, LVFS)	(CL, SiCL) over (FS, LFS, VFS, LVFS)	(SiC, C) over (FS, LFS, VFS, LVFS)
Well to Mod. Well	Orthic Regosol	Shilox (SHX)	Arizona (AIZ)	Brownridge (BWD)	Knolls (KLS)	Barren (BAE)				
	Orthic BL Chernozem		Stockton (SCK)	Prosser (PSE)	Fairland (FND)	Ramada (RAM)	Janick (JIK)	Glenboro (GBO)	Wellwood (WWD)	
	Calc. BL Chernozem				Traverse (TAV)	Rempel (RMP)				
	Rego BL Chernozem		Cactus (CCS)	Porple (POR)	Durnan (DRN)	Carroll (CXF)	Bankton (BAO)			
	Orthic Dark Gray Chern.		Dobbin (DOB)	Halstead (HAT)	Pollen (POL)	Firdale (FIR)				
Imperfectly	Gleyed Regosol	Onahan (ONH)								
	Gleyed BL Solonetz									Oliver (OIV)
	Gleyed BL Chernozem		Lavenham (LVH)	Gateside (GTD)	Torcan (TOC)	Charman (CXV	Harding (HRG)	Petrel (PTR)	Oberon (OBR)	
	Gleyed El. Bl. Chernozem					Gregg (GRG)				
	Gleyed Rego Bl. Chernozem		Hummerston (HMO)	Pleasant (PLE)	Taggart (TGR)	Prodan (PDA)	Sigmund (SGO)	Grover (GRO)	Crookdale (CKD)	
	Gl. D.Gray Chernozem			Bone (BNE)		Danlin (DLN)				
Poorly	Rego Humic Gleysol	Mockry (MKY)	Sewell (SEE)	Poolex (POX)	Vordas (VDS)	Tadpole (TDP)	Lowton (LWN)	Grayson (GYS)	Sutton (SXP)	Landseer (LSR)

Table 3-1. Soil Series, Drainage and Surface Texture in the RM of Whitehead

Soil name	Soil code	Drainage	Surface texture	Textural group of soil profile within 1 m	Total area		% of RM
					ha	ac	
Arizona	AIZ	Rapid	Fine sand to LFS*	Coarse	33	81	0.06
Ashmore	AHO	Well	LVFS* to fine sandy loam	Mod. coarse over very coarse	6	14	0.01
Assiniboine	ASB	Imperfect	Clay or silty clay	Fine	1,684	4,160	2.89
Bankton	BAO	Well	Clay or silty clay	Fine	549	1,357	0.94
Barren	BAE	Well	Silty clay loam	Mod. fine	3	7	0.01
Basker	BKR	Poor	Loam to clay loam	Medium to mod. fine	88	218	0.15
Beresford	BSF	Imperfect	Clay loam	Mod. fine over medium or mod. fine	2,299	5,680	3.95
Beresford @	BSF	Imperfect	Loam	Medium over medium or mod. fine	34	85	0.06
Bermont	BMN	Well	Loam to clay loam	Medium to mod. fine	3	6	0.004
Brownridge	BWD	Well	LVFS to fine sandy loam	Mod. coarse	354	875	0.61
Cactus	CCS	Well	Fine sand to LFS	Coarse	375	928	0.65
Capell	CXT	Imperfect	Loam to clay loam	Medium or mod. Fine over very coarse	56	139	0.10
Carroll	CXF	Well	Clay loam	Mod. fine	1,447	3,575	2.49
Carvey	CAV	Poor	Loam to clay loam	Medium or mod. Fine over very coarse	64	158	0.11
Chambers	CBS	Well	Clay loam	Mod. fine	706	1,746	1.21
Charman	CXV	Imperfect	Clay loam	Mod. fine	1,110	2,742	1.91
Chater	CXW	Well	Loamy sand	Coarse over medium or mod. fine	290	716	0.50
Clementi	CLN	Well	Clay loam	Mod. fine over medium or mod. fine	750	1,853	1.29
Cobfield	CBF	Imperfect	Clay loam	Mod. fine over medium or mod. fine	1,201	2,969	2.07
Cordova	CVA	Well	Loam to clay loam	Medium or mod. fine	451	1,115	0.78
Crookdale	CKD	Imperfect	Clay loam	Mod. fine over coarse to mod. coarse	3	8	0.01
Croyon	CYN	Well	Sandy clay loam	Mod. fine	521	1,287	0.90
Dexter	DXT	Imperfect	Loamy coarse sand/LS*	Very coarse	8	20	0.01
Dorset	DOT	Rapid	Loamy coarse sand/LS	Very coarse	74	184	0.13
Drokan	DRO	Poor	Loam to clay loam	Medium or mod. fine	132	327	0.23
Druxman	DXM	Imperfect	Loam to clay loam	Medium or mod. fine over very coarse	47	117	0.08
Durnan	DRN	Well	Loam	Medium	2,547	6,294	4.38
Fairland	FND	Well	Loam	Medium	2,159	5,335	3.71
Fenton	FET	Poor	Clay	Fine over medium or mod. fine	5	12	0.01
Floors	FLS	Rapid	Loamy coarse sand/LS	Very coarse	71	174	0.12
Forrest	FRT	Imperfect	Clay	Fine over medium or mod. fine	15	38	0.03
Gateside	GTD	Imperfect	Very fine sand to FSL*	Mod. coarse	2,544	6,285	4.37
Gendzel	GDZ	Imperfect	Fine sand to LFS	Coarse over very coarse	7	18	0.01
Glenboro	GBO	Well	Loam	Medium over coarse or mod. coarse	112	277	0.19

* LFS = Loamy fine sand; FSL = fine sandy loam; LVFS =loamy very fine sand; LS = Loamy sand.

@ A texture variant.

Table 3-2. Soil Series, Drainage and Surface Texture in the RM of Whitehead (continued)

Soil name	Soil code	Drainage	Surface texture	Textural group of soil profile within 1 meter	Total area		% of RM
					ha	ac	
Grayson	GYS	Poor	Loam	Medium over coarse or mod. coarse	98	242	0.17
Grover	GRO	Imperfect	Loam	Medium over coarse or mod. coarse	231	571	0.40
Harding	HRG	Imperfect	Clay	Fine	665	1,643	1.14
Hummerston	HMO	Imperfect	Fine sand to LFS	Coarse	2,005	4,956	3.45
Janick	JIK	Well	Clay	Fine	36	89	0.06
Justice	JUC	Imperfect	Clay	Fine over medium or mod. fine	3	8	0.01
Kerran	KRN	Poor	Clay or silty clay	Fine	459	1,133	0.79
Killeen	KLL	Imperfect	Fine sand to LFS	Coarse over medium or mod. fine	14	35	0.02
Kilmury	KUY	Imperfect	Very fine sand to FSL	Mod. coarse over very coarse	96	237	0.17
Kirkness	KKS	Well	Fine sand to LFS	Coarse over medium or mod. fine	8	21	0.01
Kleysen	KYS	Well	Clay loam	Mod. fine	109	270	0.19
Knolls	KLS	Well	Loam	Medium	348	860	0.60
Lavenham	LVH	Imperfect	Fine sand to LFS	Coarse	3,235	7,994	5.56
Lavinia	LAV	Imperfect	Loam to clay loam	Medium to mod. fine	4	10	0.01
Levine	LEI	Imperfect	Loam to clay loam	Medium to mod. fine	390	964	0.67
Lindstrom	LDM	Imperfect	Fine sandy loam to LVFS	Mod. coarse over medium or mod. Fine	64	157	0.11
Lockhart	LKH	Well	Fine sandy loam to LVFS	Mod. coarse over medium or mod. fine	47	117	0.08
Lonery	LOE	Poor	Fine sandy loam to LVFS	Mod. coarse over medium or mod. fine	6	16	0.01
Lowroy	LOW	Poor	Fine sand to LFS	Coarse over very coarse	6	14	0.01
Lowton	LWN	Poor	Clay	Fine	505	1,249	0.87
Mansfield	MFI	Imperfect	Loamy coarse sand/LS	Very coarse	117	290	0.20
Manson	MXD	Well	Clay	Fine	39	95	0.07
Marringhurst	MRH	Rapid	Loamy coarse sand/LS	Very coarse	316	782	0.54
Marsden	MDN	Poor	Loam to clay loam	Medium over very coarse over mod. fine	1	2	0.002
Miniota	MXI	Well	Very fine sand to FSL	Mod. coarse over very coarse	278	688	0.48
Moore Park	MPK	Imperfect	Loam to clay loam	Medium to mod. fine	3	8	0.01
Mowbray	MOW	Well	Loam to clay loam	Medium to mod. fine	11	26	0.02
Onahan	ONH	Imperfect	Fine sand to LFS	Coarse	187	462	0.32
Petrel	PTR	Imperfect	Loam	Medium over coarse or mod. coarse	24	59	0.04
Pleasant	PLE	Imperfect	Very fine sand to FSL	Mod. coarse	2,521	6,230	4.34
Poolex	POX	Poor	Very fine sand to FSL	Mod. coarse	1,450	3,582	2.49
Porple	POR	Well	Very fine sand to FSL	Mod. coarse	382	945	0.66
Prodan	PDA	Imperfect	Clay loam	Mod. fine	1,812	4,477	3.12

Table 3-3. Soil Series, Drainage and Surface Texture in the RM of Whitehead (continued)

Soil name	Soil code	Drainage	Surface texture	Textural group of soil profile	Total area		% of RM
					ha	ac	
Prosser	PSE	Well	Very fine sand to FSL	Mod. coarse	1,399	3,456	2.40
Ramada	RAM	Well	Clay loam	Mod. fine	1,678	4,145	2.88
Rempel	RMP	Well	Clay loam	Mod. fine	932	2,304	1.60
Roddan	ROD	Well	Clay loam	Mod. fine over medium or mod. fine	71	176	0.12
Rufford	RUF	Well	Loam to clay loam	Medium to mod. fine	567	1,401	0.97
Sewell	SEE	Poor	Fine sand to LFS	Coarse	1,216	3,006	2.09
Shilox	SHX	Rapid	Fine sand to LFS	Coarse	144	355	0.25
Sigmund	SGO	Imperfect	Clay	Fine	478	1,181	0.82
Stockton	SCK	Well	Fine sand to LFS	Coarse	4,238	10,471	7.29
Tadpole	TDP	Poor	Clay loam	Mod. fine	1,265	3,126	2.17
Taggart	TGR	Imperfect	Loam	Medium	3,208	7,928	5.52
Torcan	TOC	Imperfect	Loam	Medium	1,297	3,205	2.23
Traverse	TAV	Well	Loam	Medium	678	1,675	1.17
Varcoe	VRC	Imperfect	Loam to clay loam	Medium to mod. fine	274	678	0.47
Vodroff	VFF	Poor	Clay loam	Mod. fine over medium or mod. fine	1,430	3,533	2.46
Vordas	VDS	Poor	Loam	Medium	1,498	3,701	2.57
Wellwood	WWD	Well	Clay loam	Mod. fine over coarse to mod. coarse	6	14	0.01
Wheatland	WHL	Rapid	Fine sand to LFS	Coarse over very coarse	8	21	0.01
Wytonville	WVI	Imperfect	Very fine sand to FSL	Coarse over very coarse	18	44	0.03
Eroded Slope	$ER				1,250	3,088	2.15
Marsh	$MH				384	949	0.66
Unclassified land	$UL	-			49	121	0.08
Urban land	$UR	-			319	789	0.55
Water	$ZZ	-			533	1,316	0.92
Total					**58,160**	**143,716**	**100**

Part 4 Agricultural Use and Management Interpretations of Soils

4.1 Introduction

These sections provide predictions for the performance or soil suitability ratings for various land uses, based on soil and landscape characteristics, laboratory data, and on soil behaviour under specified conditions of land use and management. Suitability ratings or interpretations for various land use applications are intended to serve as guides for planners and managers.

The management of soil and landscape data using GIS technology enables rapid and more quantitative analysis of natural soil variability than is possible using manual techniques. The areal distribution of various soil components and properties that occur in complex landscapes can be highlighted in a mapped form and can thereby assist in planning and managing the soil resource. Such single factor maps and interpretative maps illustrate the distribution of individual soil properties and indicate the degree of soil limitation or potential for agricultural use and environmental applications.

A series of derived and interpretive maps are included in this section to assist in the interpretation of the soil resource information for the study area. The GIS uses the 1:20, 000 scale soil map and related soil analysis and landscape information to generate these colour thematic maps.

The maps portray a selection of individual soil properties or landscape conditions for map unit delineations. Combinations of soil properties or landscape features affecting land use and management are derived as specific interpretations. Derived maps portray specific interpretations based on the dominant condition in each map polygon.

Soil properties determine to a great extent the potential and limitations for both dryland and irrigation agriculture. In this section, interpretive soil information is provided for agricultural land use evaluations such as soil capability for agriculture and irrigation suitability.

4.2 Soil Capability for Agriculture

The soil capability rating for agriculture is based on an evaluation of both the soil characteristics and landscape conditions that influence the soil suitability and limitations for agricultural use (Anon, 1965) (Appendix 1, Section A).

The class indicates the general suitability of the soils for agriculture. The first three classes are considered capable of sustained production of common field crops, the fourth is marginal for sustained arable agriculture, the fifth is suitable only for improved permanent pasture, the sixth is capable of use only for native pasture while the seventh class is for soils and land types considered incapable of use for arable agriculture or permanent pasture.

Soil capability subclasses identify the soil properties or landscape conditions that may limit use or be a hazard. The various kinds of limitations recognized at the subclass level are defined in Section B of Appendix 1.

Class 1 soils in the map area have level to very gently sloping topography; they are deep, well to moderately well drained, have moderate water holding capacity and have no major limitations for crop use.

Class 2 soils have moderate limitations that reduce the choice of crops or require moderate conservation practice. They include the imperfectly drained soils with a wetness limitation (2W) and the well-drained and imperfectly drained soils having a topographic limitation (2T). The two to five per cent slopes associated with the 2T soils may increase cultivation costs over that of a

smooth landscape and increase the risk of water erosion.

Class 3 soils have moderately severe limitations that restrict the range of crops or require moderate conservation practices. These soils usually associate with gently sloping topography (five to nine per cent) resulting in a moderate risk of water erosion.

Class 4 soils have significant limitations that restrict the choice of crops or require special conservation practices. Poorly drained soils with no improvement are grouped in this class. The timing of cultivation or choice of crops is severely limited because of the wetness limitation.

Class 5 soils have very severe limitations that restrict their capability to producing perennial forage crops. This class of soils usually has excess water (5W) or moisture limitation (5M), including the lower, depressional areas of the poorly drained soils.

Class 6 soils have an extremely severe limitation due to excess wetness (6W), moisture (6M), or soil erosion (6E), which restricts their capability to producing perennial forage crops.

Class 7 soils have no capability for arable culture. However, these soils may have high capability for native vegetation species and habitant for waterfowl and wildlife.

A guideline table of agriculture capability as affected by soil characteristics and landscape is listed in Table A1 of Appendix 1.

A summary of classification for dryland agriculture capability in the RM of Whitehead is presented in Table 4. Approximately one-third of land in the RM is grouped into class 2. Class 3 and 5 lands are in the 2nd and 3rd place, comprising 28.8 and 16.3 per cent of the study area, respectively. Class 4 land covers approximately 7,622 acres, or 13.1 per cent of the total. Class 6 and class 7 account for only three per cent.

The most limiting factor in Class 2 land is a combination of excess water and topography (2WT), accounting for one-third of the Class 2, followed by topography (2T) and moisture limitation (2M), exclusively.

Soils grouped as Class 3 are largely grouped this way because of topography (3T) and a combination of moisture limitation and excess water (3MW), comprising 31.1 and 29.4 per cent of the Class 3 area, respectively.

Class 4 lands in the study area are predominantly covered by sandier soil texture, which limits crop production considerably. This sandier (4M) soil is approximately 5,182 acres, or 68 per cent of the Class 4 area.

Class 5 lands are predominantly grouped this way because of poorly drained (5W) soils in the study area. Class 6 land consists of only 2.41 per cent of the study area. Soil erosion (6E) has more impact on Class 6.

It is evident that both excess water (the class with a letter of W) and moisture limitation (M) are major factors affecting dryland agriculture capability in the study area, accounting for approximately 38 and 28 per cent, respectively, of the RM.

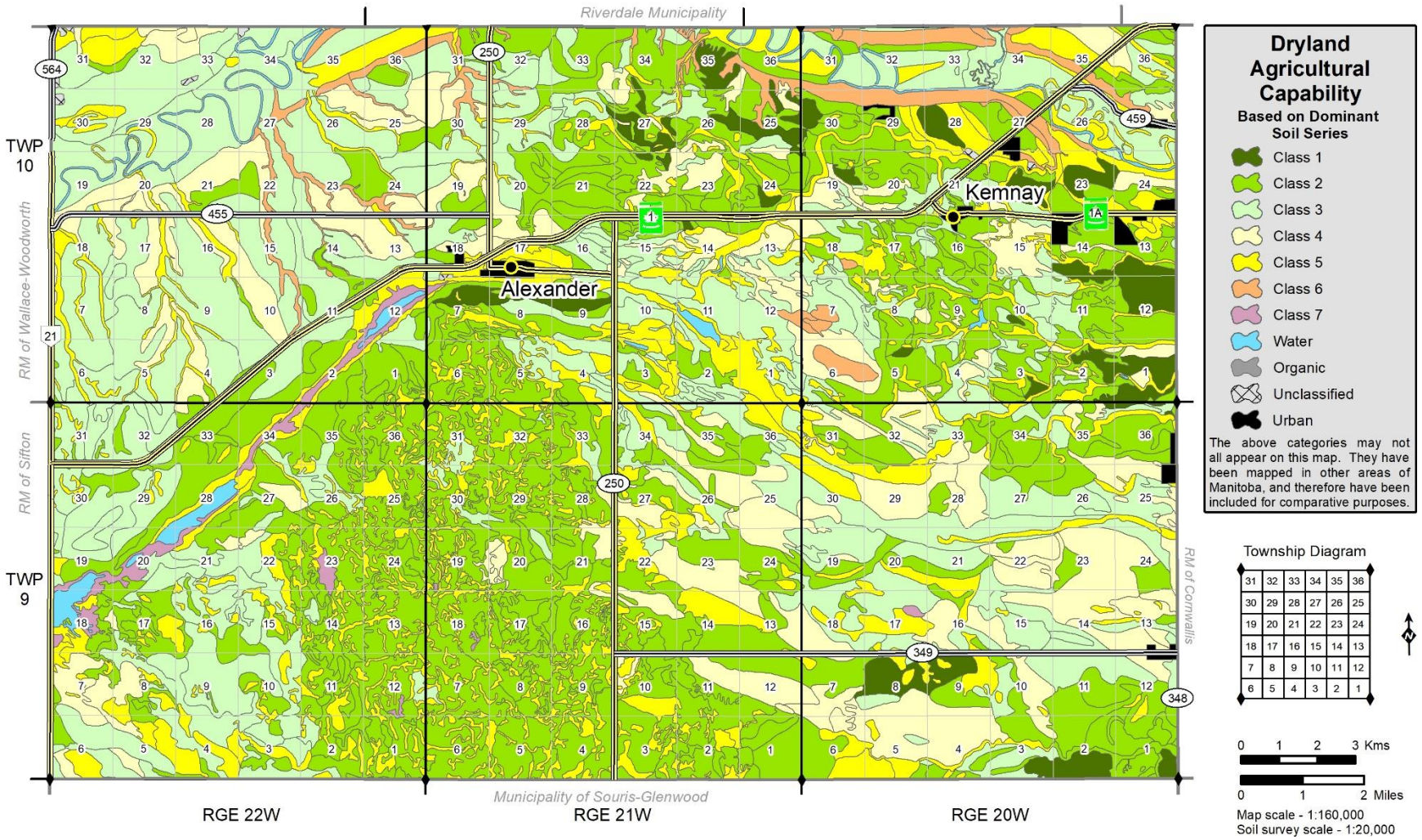
An interpretative map (Map 1) depicts the rating of the dominant soil series and landscape features for each polygon. The nature of the subclass limitations and the ratings of subdominant soil and landscape components are not shown at the scale of this map, but they are detailed in Table A2 of Appendix 1. A poster-sized agricultural capability map (1:20,000) is also included with this report.

Map 1 indicates that most Class 1 and Class 2 lands are distributed in the southwestern and northeastern areas of the RM, particularly in TWP 9, Range 21 and TWP 10, Range 20. The majority of Class 3 lands are located in TWP 10, Range 22.

Table 4. Agriculture Capability of Land in the RM of Whitehead

Agricultural Capability Class		Total area		% of RM
		ha	ac	
1		1,296	3,202	2.23
2	2D	7	16	0.01
	2I	26	64	0.04
	2IT	23	57	0.04
	2M	3,649	9,016	6.27
	2MT	1,174	2,902	2.02
	2T	3,935	9,723	6.77
	2TD	536	1,325	0.92
	2TE	173	429	0.30
	2TP	17	42	0.03
	2W	3,292	8,136	5.66
	2WT	6,984	17,259	12.0
	2X	517	1,278	0.89
Subtotal		**20,334**	**50,247**	**35.0**
3	3E	354	875	0.61
	3ET	11	28	0.02
	3I	2,030	5,016	3.49
	3IN	28	70	0.05
	3IT	15	38	0.03
	3M	1,736	4,289	2.98
	3MN	41	101	0.07
	3MT	659	1,629	1.13
	3M	4,933	12,190	8.48
	3N	1,166	2,881	2.00
	3NW	65	160	0.11
	3T	5,215	12,887	8.97
	3TD	6	16	0.01
	3TE	382	943	0.66
	3TN	115	285	0.20
Subtotal		**16,757**	**41,408**	**28.8**
4	4E	12	30	0.02
	4M	5,182	12,805	8.91
	4ME	266	658	0.46
	4MT	48	120	0.08
	4N	308	761	0.53
	4P	50	123	0.09
	4T	1,664	4,112	2.86
	4TE	92	227	0.16
Subtotal		**7,622**	**18,834**	**13.1**
5	5IW	432	1,068	0.74
	5M	715	1,768	1.23
	5ME	76	187	0.13
	5MP	1	3	0.00
	5N	148	367	0.26
	5T	105	260	0.18
	5TE	17	42	0.03
	5W	7,967	19,687	13.7
Subtotal		**9,462**	**23,382**	**16.3**
6	6E	1,218	3,010	2.09
	6ET	30	75	0.05
	6M	144	355	0.25
	6NW	11	26	0.02
Subtotal		**1,402**	**3,466**	**2.41**
7	7W	383	947	0.66
Unclassified, urban and water		902	2,229	1.55
Grand Total		**58,160**	**143,716**	**100**

Map 1. Dryland Agricultural Capability Map of the RM of Whitehead



4.3 Irrigation Suitability

The rating guidelines in this section are derived from "An Irrigation Suitability Classification System for the Canadian Prairies" (ISC, 1987). The irrigation suitability rating of the soils is based on soil and landscape characteristics. It does not consider factors such as method of water application, water availability, water quality or economics of this type of land use.

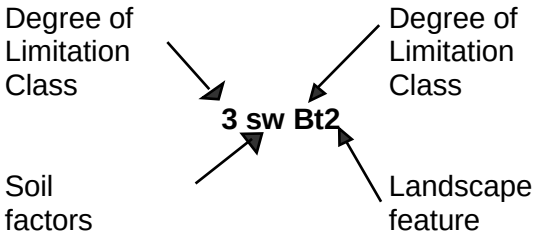
Soil properties considered important for evaluating irrigation suitability are texture, soil drainage, depth to water table, salinity and geological uniformity.

Landscape features considered important for rating irrigation suitability are topography and stoniness.

The irrigation suitability of the soil and landscape characteristics in the study area assist in making initial irrigation plans. The next step involves on-site field investigation to examine the depth to water table, salinity and geological uniformity to a depth of 3 m. Drainability, drainage outlet requirement, organic matter status and potential for surface crusting are other factors to consider. This assessment also considers potential impact of irrigation on non-irrigated areas as well as on the irrigated area.

The most limiting soil property and landscape feature are combined to determine the placement of a land area in one of 16 classes of irrigation suitability, which are grouped and described by four ratings: **Excellent, Good, Fair** and **Poor**. (Table A3 of Appendix 1). The guidelines of assessing irrigation suitability are listed in Table A4 and A5 of Appendix 1, respectively.

An example of an irrigation suitability class rating with subclass limitations is shown:



A maximum of 3 codes is used to identify the subclass rating. Salinity (s) and drainage class (w) are soil factors that contribute to the soil rating of 3 or Moderate. The landscape limitation due to complex topography (t2) is Slight or (B). As the soil factor (3 or Moderate) is more limiting than the landscape feature (B or Slight), the general rating for this land area (3B) is fair (Appendix 1, Table A3 to A5).

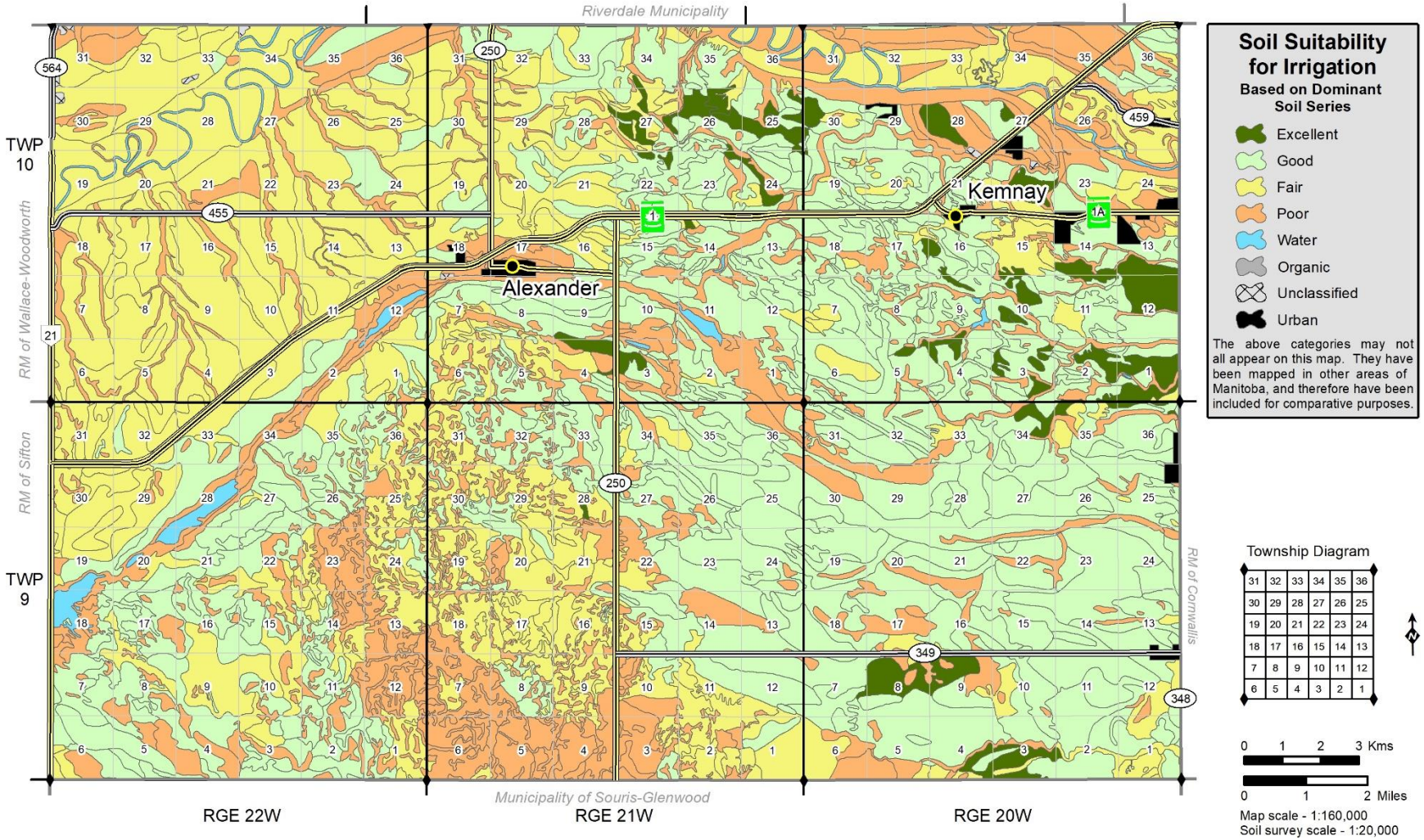
A summary of soils and their interpretive classification for irrigation suitability is presented in Table 5. The subdominant soil series and phases are considered when analyzing the data. Approximately three per cent of lands in the RM of Whitehead are excellent for irrigation project development; 42 per cent of the lands are classified as good. In this class, well or moderately well drained soil (2w A) or combined with the topography (2w Bt2), as well as 2mw Bt2 are attributed most to this class. The fair class lands account for 31 per cent. It is evident that imperfectly drained soil (3w Bt2 & 3w A) and topography (2k Ct2 & 1 Ct2) are major factors attributing to this class. Poorly drained conditions (4w A) and heavier texture (4kx Bt2) in the poor class are limiting factors for irrigation suitability.

An interpretative map (Map 2) illustrates the rating of the dominant soil series and landscape features for each polygon. It shows that most lands in TWP 9, Range 20 and some lands in TWP 10 Range 20 are suitable for irrigation. Lands in fair class are primarily TWP 10, Range 22.

Table 5. Soil Irrigation Suitability in the RM of Whitehead

Class (per cent)	Soil & landscape features	Total area		% of RM
		ha	ac	
Excellent (2.27)	1 A	1,581	3,907	2.72
Good (42.4)	1 Bt2	3,096	7,650	5.32
	2gm A	29	72	0.05
	2gm Bt2	53	131	0.09
	2k A	296	733	0.51
	2k Bt2	335	828	0.58
	2kx A	505	1,247	0.87
	2kx Bt2	1,841	4,550	3.17
	2m A	2,522	6,232	4.34
	2m Bt2	2,329	5,756	4.00
	2mw A	4,898	12,103	8.42
	2mw Bt2	336	830	0.58
	2mx Bt2	8	20	0.01
	2w A	5,173	12,783	8.89
	2w Bt2	3,170	7,832	5.45
	2x A	34	85	0.06
	2x Bt2	13	32	0.02
Fair (30.6)	1 Ct2	2,821	6,970	4.85
	2gm Ct2	439	1,085	0.75
	2k Ct2	3,381	8,355	5.81
	2kx Cp	50	123	0.09
	2kx Ct2	219	542	0.38
	2m Ct2	394	974	0.68
	2mw Ct2	20	48	0.03
	2w Ct2	436	1,078	0.75
	3kw Bi	764	1,888	1.31
	3kw Bt2i	919	2,272	1.58
	3kx A	26	64	0.04
	3kx Bt2	12	31	0.02
	3m A	24	59	0.04
	3m Bt2	60	147	0.10
	3m Ct2	101	250	0.17
	3mw Bt2	7	18	0.01
	3s A	323	799	0.56
	3s Bt2	533	1,318	0.92
	3s Ct2	86	213	0.15
	3sw A	161	399	0.28
	3sw Bt2	227	562	0.39
	3sw Ct2	29	73	0.05
	3w A	1,431	3,535	2.46
	3w Bi	98	242	0.17
	3w Bt2	4,031	9,961	6.93
	3w Bt2i	277	684	0.48
	3w Ct2	859	2,121	1.48
	3wx A	47	117	0.08
	3wx Bt2	16	40	0.03
Poor (22.8)	1 Dt2	17	42	0.03
	2k Dt2	63	155	0.11
	2kx Dt2	42	105	0.07
	4gm A	168	416	0.29
	4gm Bt2	79	196	0.14
	4gm Ct2	42	104	0.07
	4k Bt2	19	47	0.03
	4ks A	2	5	0.003
	4kw A	501	1,239	0.86
	4kw Bt2	8	19	0.01
	4kw Ci	459	1,134	0.79
	4kx A	262	648	0.45
	4kx Bt2	1,452	3,589	2.50
	4m A	180	445	0.31
	4m Bt2	240	593	0.41
	4m Cp	1	3	0.002
	4m Ct2	739	1,826	1.27
	4m Dt2	688	1,700	1.18
	4s A	366	904	0.63
	4s Bt2	90	223	0.16
	4sw A	72	179	0.12
	4w A	6,447	15,932	11.1
	4w Bt2	799	1,974	1.37
	4w Ci	88	218	0.15
	4w Ct2	33	83	0.06
	4wx Di	383	947	0.66
Unclassified land, urban and water (1.55)		902	2,229	1.55
Total		**58,160**	**143,716**	**100**

Map 2. Irrigation Suitability Map of the RM of Whitehead



4.4 Soil Suitability for Irrigated Potato Production

An evaluation of soil properties and landscape features was used to generate a five-class rating of land for irrigated potato production. Soil properties considered are texture, soil drainage, salinity and sodicity. Landscape features considered are topography and stoniness. The most suitable soil and landscape conditions occur in **Class 1** and the least desirable conditions occur in **Class 5**. Details regarding the criteria applied in the suitability rating are described in Tables A6 and A7 of Appendix 1.

Assumptions:

This evaluation examines soil and landscape factors that are important for irrigated production of potatoes for processing. Production of seed and table potatoes with irrigation may not be impacted to the same degree by soil conditions such as stoniness and texture.

Stoniness hinders soil preparation, interferes with harvesting, and increases the chances of potato bruising during harvest.

Deep, well-drained sandy loam to loam soils exhibit favourable properties for the production of high quality potatoes. Clay soils with impeded internal soil drainage have a severe limitation to potato production because of reduced oxygen supply and increased incidence of fungal diseases. An increased risk of delayed spring tillage and planting and crop harvesting due to wet conditions can occur on fine textured soils.

Slope or topography reduces uniform water infiltration and increases the potential for soil erosion and nutrient loss.

This evaluation of soil and landscape properties does not incorporate additional factors that must be assessed for sustainable irrigated production of potatoes.

The environmental impact of intensive management practices on soil and water quality, the supply of good quality water, and the suitability of climatic conditions for optimum potato production must all be evaluated.

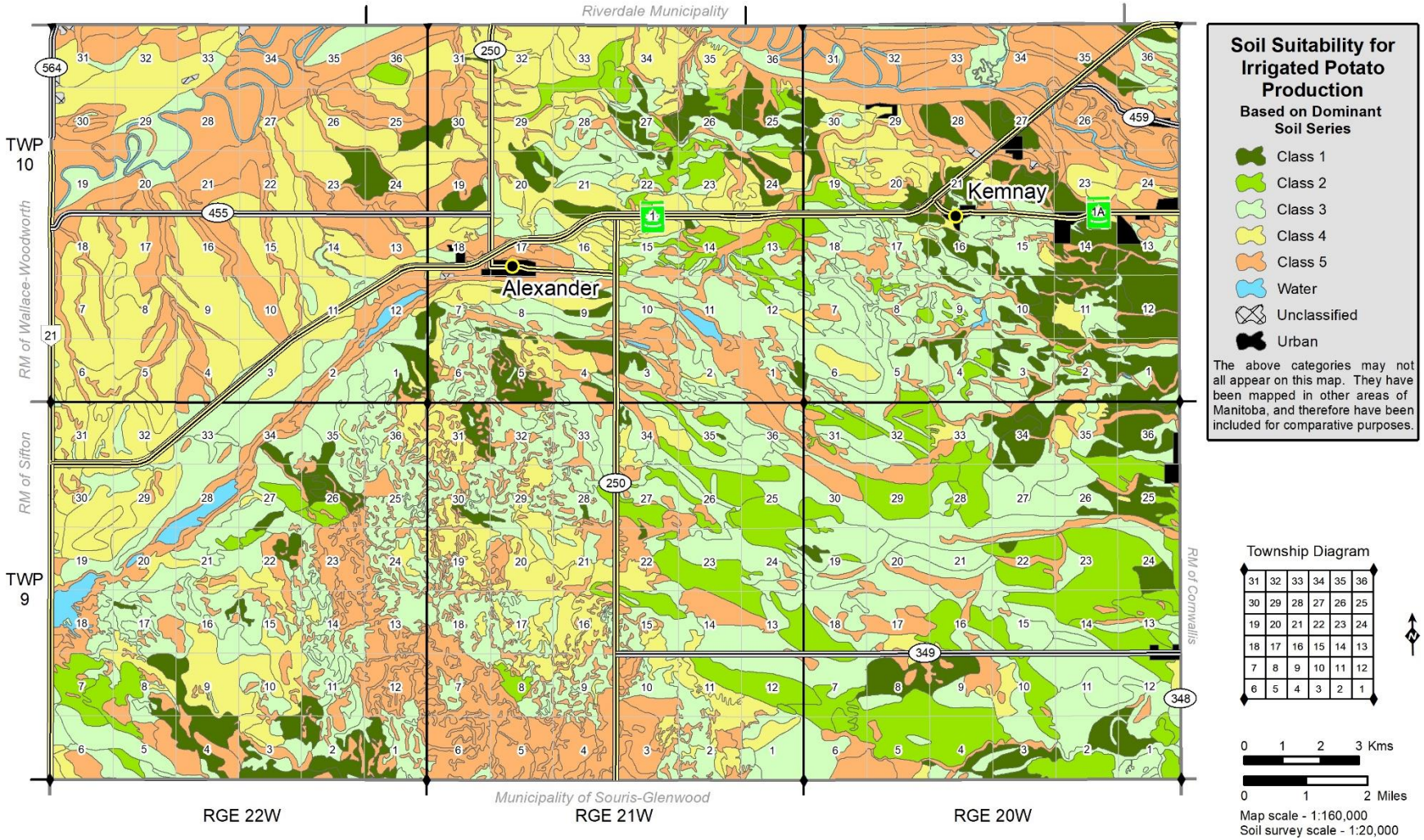
Integration of related databases in a GIS environment can be used to create a map that depicts the rating of the dominant soil and landscape feature for each soil polygon. The nature of the subclass limitations and the rating of subdominant soil and landscape components are not shown at this scale, but are indicated in Table A2 of Appendix 1. An interpretative map (Map 3) illustrates the rating of the dominant soil series and landscape features for each polygon.

Approximately, 16 per cent of soils in the RM of Whitehead are suitable for potato production (class 1 & 2 in Table 6). These soils are mainly located in TWP 9, Range 20 and TWP 10, Range 20 (Map 3). Class 4 and 5 soils are not suitable for potato production, primarily due to soil moisture, topography and texture limitations.

Table 6. Soil Irrigation Suitability for Potato Production in the RM of Whitehead

Potato Suitability Class	Total area		% of RM
	ha	ac	
Class 1	4,557	11,260	7.84
Class 2	5,085	12,566	8.74
Class 3	19,271	47,619	33.1
Class 4	11,487	28,384	19.8
Class 5	16,858	41,657	29.0
Water, urban & unclassified	902	2,229	1.55
Total	**58,160**	**143,716**	**100**

Map 3. Soil Suitability for Irrigated Potato in the RM of Whitehead



4.5 Soil Texture

Mineral particles in soil are grouped according to size into sand (2 - 0.05 mm in diameter), silt (0.05 - 0.002 mm) and clay (less than 0.002 mm). The proportion of individual mineral particles present in a soil is referred to as texture. Soil texture is described by means of 13 textural classes defined according to the relative proportions of sand, silt and clay (Figure 10). The presence of larger particles (diameter is greater than 2 mm) in soil is recognized as:

gravelly - particles ranging from 0.2 to 7.5 cm in diameter

cobbly - rock fragments ranging from 7.5 to 25 cm in diameter

stony - rock fragments ranging from 25 to 60 cm in diameter, or if flat, 38 to 60 cm long

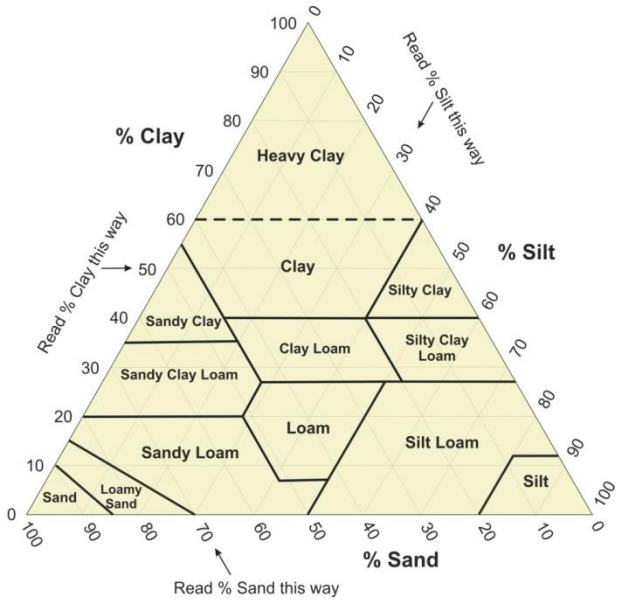


Figure 10. Soil Texture Triangle

Soil texture strongly influences the soil's ability to retain moisture, soil fertility and ease or difficulty of cultivation. Water moves easily through coarse-textured (sandy) soils, so little moisture is retained and they dry out more quickly than fine textured (clay) soils. Sandy soils do not retain plant nutrients as well as clay soils and are lower in natural fertility. Sandy soils are often characterized by loose or single grained structure, which is very susceptible to wind erosion. Clay soils have a high proportion of very small pore spaces, which hold moisture tightly and are usually fertile because they are able to retain plant nutrients. Clay soils transmit water very slowly; therefore, these soils are susceptible to excess soil moisture conditions. Textural class names are grouped as coarse, medium and fine (Table 7).

Table 7. Soil Texture Group

Texture group		Texture	
		Class	Symbol
Coarse	Very coarse	Very coarse sand	VCoS
		Coarse sand	CoS
		Medium sand	S or MS
	Coarse	Fine sand	FS
		Loamy coarse sand	LCoS
		Loamy sand	LS or LMS
		Loamy fine sand	LFS
	Mod. coarse	Very fine sand	VFS
		Loamy very fine sand	LVFS
		Coarse sandy loam	CoSL
		Sandy loam	SL or MSL
		Fine sandy loam	FSL
Medium	Medium	Very fine sandy loam	VFSL
		Loam	L
		Silt loam	SiL
		Silt	Si
Fine	Mod. fine	Sandy clay loam	SCL
		Clay loam	CL
		Silty clay loam	SiCL
	fine	Sandy clay	SC
		Silty clay	SiC
		Clay	C
	Very fine	Heavy clay	HC

Particle analysis showed that among 242 soil samples randomly collected from A horizon in the study area, medium and moderately fine soil texture accounts for 27 and 29 per cent respectively. Fine sandy loam and sandy loam each account for approximately 10 per cent.

Table 8. Lab Results of Soil Surface Texture in the RM of Whitehead

Texture		# of amples	% of total
Very coarse (0.4%)	S	1	0.41
Coarse (17.8%)	FS	7	2.89
	LFS	17	7.02
	LS	19	7.85
Mod coarse (19.8%)	FSL	24	9.92
	SL	24	9.92
Medium (27.3%)	L	31	12.8
	Si	4	1.65
	SiL	28	11.6
	VFSL	3	1.24
Mod fine (29.3%)	CL	40	16.5
	SCL	17	7.02
	SiCL	14	5.79
Fine (5.4%)	C	8	3.31
	SiC	5	2.07
Total		**242**	**100**

Based on soil polygons, the different texture groups and their proportions in terms of land area in the RM of Whitehead are listed in Table 9. Soil textures determined in the laboratory and those delineated from soil polygons show a similar trend as most previously surveyed RMs. For example, moderately fine soil ranks the first, accounting for 30 per cent, followed by medium soil texture with 22 per cent.

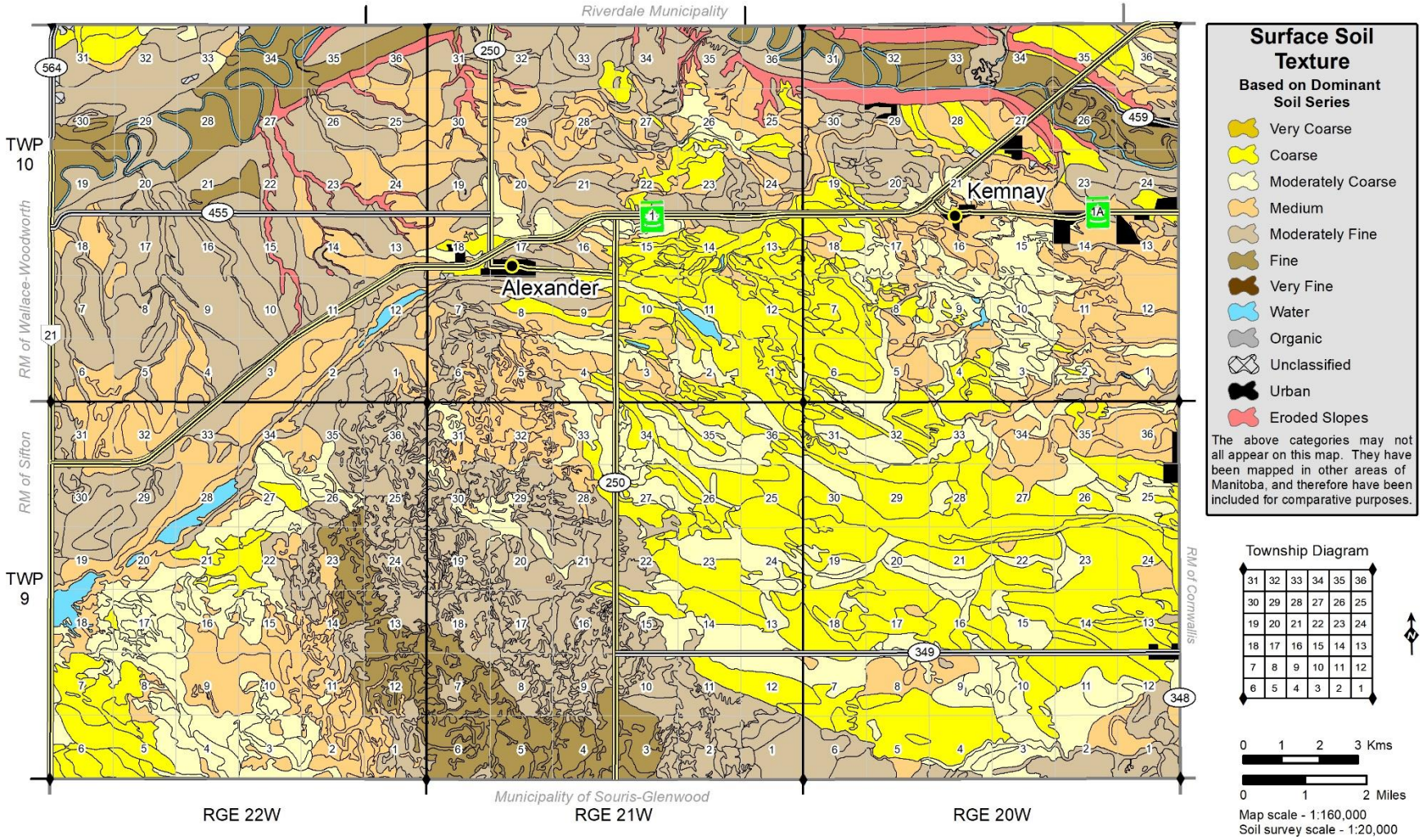
Table 9. Soil Surface Textures and their Proportions in the Study Area

Texture group	Texture	Total area		% of RM
		ha	ac	
Very coarse (0.67%)	GRSL*	387	957	0.67
Coarse (20.4%)	FS	144	355	0.25
	LCOS	83	204	0.14
	LFS	11,235	27,761	19.3
	LS	423	1,045	0.73
Mod. coarse (15.5%)	FSL	8,291	20,488	14.3
	LVFS	342	845	0.59
	SL	388	958	0.67
Medium (22.0%)	L	6,243	15,426	10.7
	SIL	4,861	12,013	8.36
	VFSL	1,664	4,112	2.86
Mod. fine (30.1%)	CL	16,856	41,652	29.0
	SCL	578	1,427	0.99
	SICL	91	225	0.16
Fine (7.61%)	C	1,743	4,306	3.00
	SIC	2,682	6,628	4.61
Unclassified, eroded slope, urban & water		2,150	5,313	3.70
Total		**58,160**	**143,716**	**100**

* GRSL = gravelly sandy loam.

Surface soil texture shown in Map 4 illustrates the textural group of the dominant soil for each polygon. Coarse and moderately coarse soil texture are observed in TWP 9, Range 20.

Map 4. Soil Surface Texture in the RM of Whitehead



4.6 Soil Drainage

Soil drainage refers to the frequency and duration of periods when the soil is free of saturation. Excessive water content in soil limits the free movement of oxygen and decreases the efficiency of nutrient uptake. Delays in spring tillage and planting are more frequent in depressional or imperfectly to poorly drained areas of a field. Improved surface drainage and underground tile drainage are management considerations that can reduce excessive moisture conditions in soils. The majority of poorly drained soils remain in the native state supporting vegetation associated with wetlands and marsh. Five soil drainage classes are described below.

Rapidly drained - water is quickly removed from the soil in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow can occur on steep slopes during heavy rainfall. Soils have low water storage capacity and are usually coarse in texture.

Well-drained - excess water is removed from the soil, flowing downward readily into underlying pervious material or laterally as subsurface flow.

Imperfectly drained - water is removed from the soil, sufficiently slowly, in relation to supply to keep the soil wet for a significant part of the growing season. The source of moisture includes precipitation or groundwater.

Poorly drained - water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time when the soil is not frozen. The main water source is subsurface flowor groundwater in addition to precipitation.

Very poorly drained - water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time that the soil is not frozen. Excess water is present in the soil throughout most of the year.

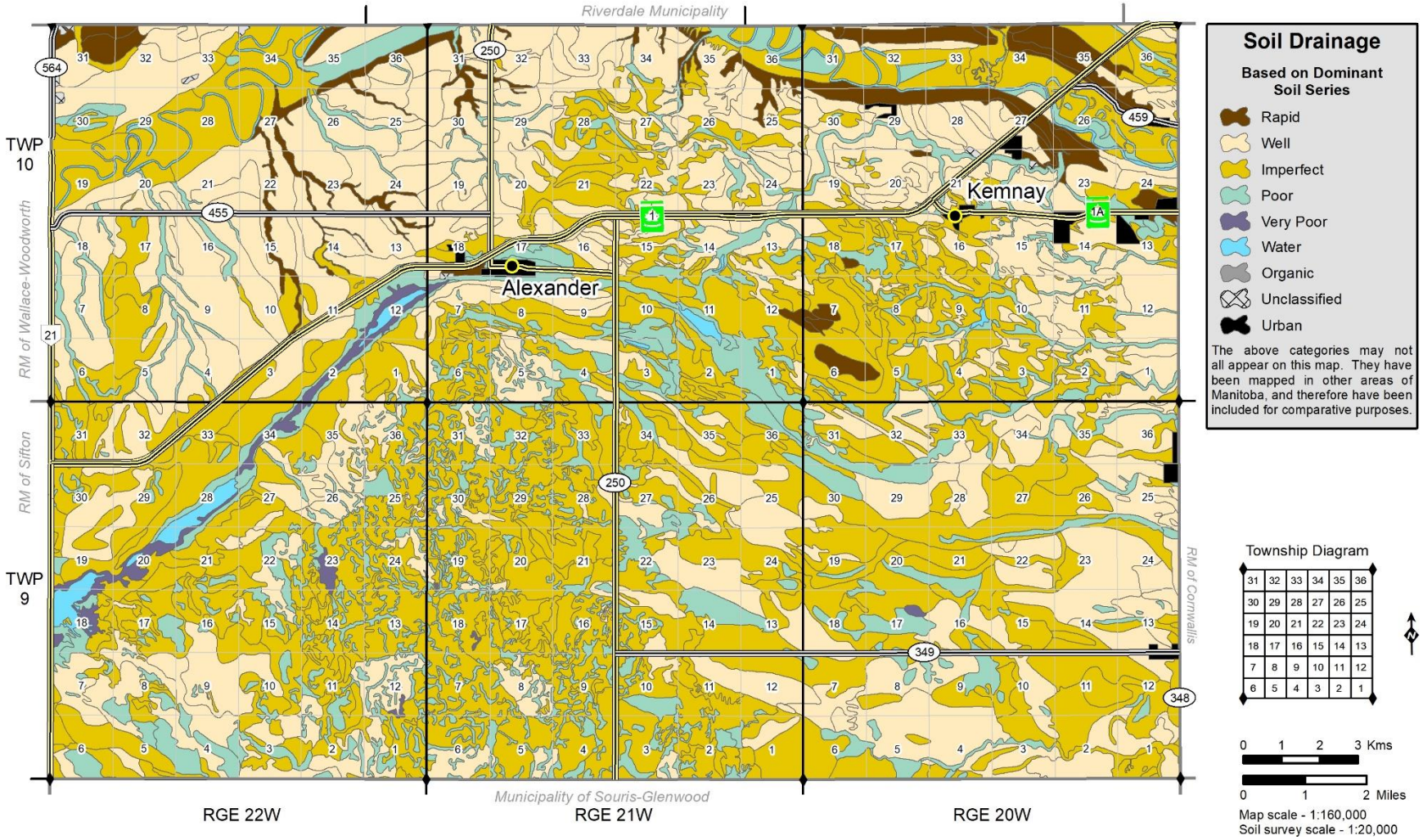
Soil drainage in Table 10 indicates that approximately 40 per cent of the soils in the RM of Whitehead are well and rapidly drained. The imperfectly drained soils comprise 44 per cent of the lands. The poorly and very poorly drained soils in the RM account for approximately 15 per cent.

Table 10. Soil Drainage Classes in the RM of Whitehead

Drainage Class	Total area		% of RM
	ha	ac	
Rapid	1,894	4,681	3.26
Well	20,997	51,884	36.1
Imperfect	25,573	63,193	44.0
Poor	8,410	20,781	14.5
Very poor	383	947	0.66
Water, urban & unclassified	902	2,229	1.55
Total	**58,160**	**143,716**	**100**

The soil drainage map (Map 5) shows that well and rapidly drained soils are mainly found in northern townships, such as TWP 10, Range 22 and TWP 10, Range 21, and some are in TWP 9, Range 20. The imperfectly drained soils are primarily in TWP 9, Range 21, but these soils can also be observed throughout the whole RM. The poorly drained soils are located in ditches and close to sloughs.

Map 5. Soil Drainage in the RM of Whitehead



4.7 Soil Erosion

Erosion is defined as the detachment and movement of soil particles by water, wind, ice or gravity. Soil erosion by water is the main concern on undulating and hummocky soil landscapes in the agricultural region of Manitoba. Soil loss resulting from rainfall-runoff is usually due to combinations of raindrop splash, sheet, and rill, gully and channel bank erosion. Sheet and rill erosion are usually least apparent in the landscape, but often the most damaging since they cause gradual thinning of the soil profile over the entire slope. Sheet erosion tends to occur on upper slopes and ridges, whereas the more visible rills form in the area of concentrated runoff on mid and lower slopes. The deposition of eroded soil at the base of slopes or in ditches constitutes additional losses and costs attributed to erosion.

Wind erosion has its largest influence on sandy (coarse) textured, cultivated soils on relatively level landscapes. However, all soils are subject to wind erosion if vegetation or crop residues do not cover the soil surface. Continuous cropping and minimum or zero tillage to maximize residue cover will reduce the risk of erosion. Row crops such as potatoes produce low amounts of residue, therefore seeding annual crops, such as fall rye and winter wheat, will help to protect the soil surface during the critical post harvest period until the establishment of groundcover the following spring.

The impact of soil erosion on soil loss and productivity is not easily measured. In addition to nutrient loss from soil erosion, there is physical deterioration of the soil resulting in lower water holding and infiltration capacity, and poorer surface structure. Crops are thus susceptible to more frequent and severe water stress and lower crop yields occur.

The ratings of soil erosion are generally classified into three classes.

Slightly eroded - soil with a sufficient amount of the A horizon removed that ordinary tillage will bring up and mix the B-horizon or lower horizons.

Moderately eroded - soil with the entire A horizon and a part of the B or lower horizons removed.

Severely eroded - soils which have practically all of the original surface soil removed and the tilled layer consists mainly of C-horizon material. This condition occurs on knolls and steep upper slope positions.

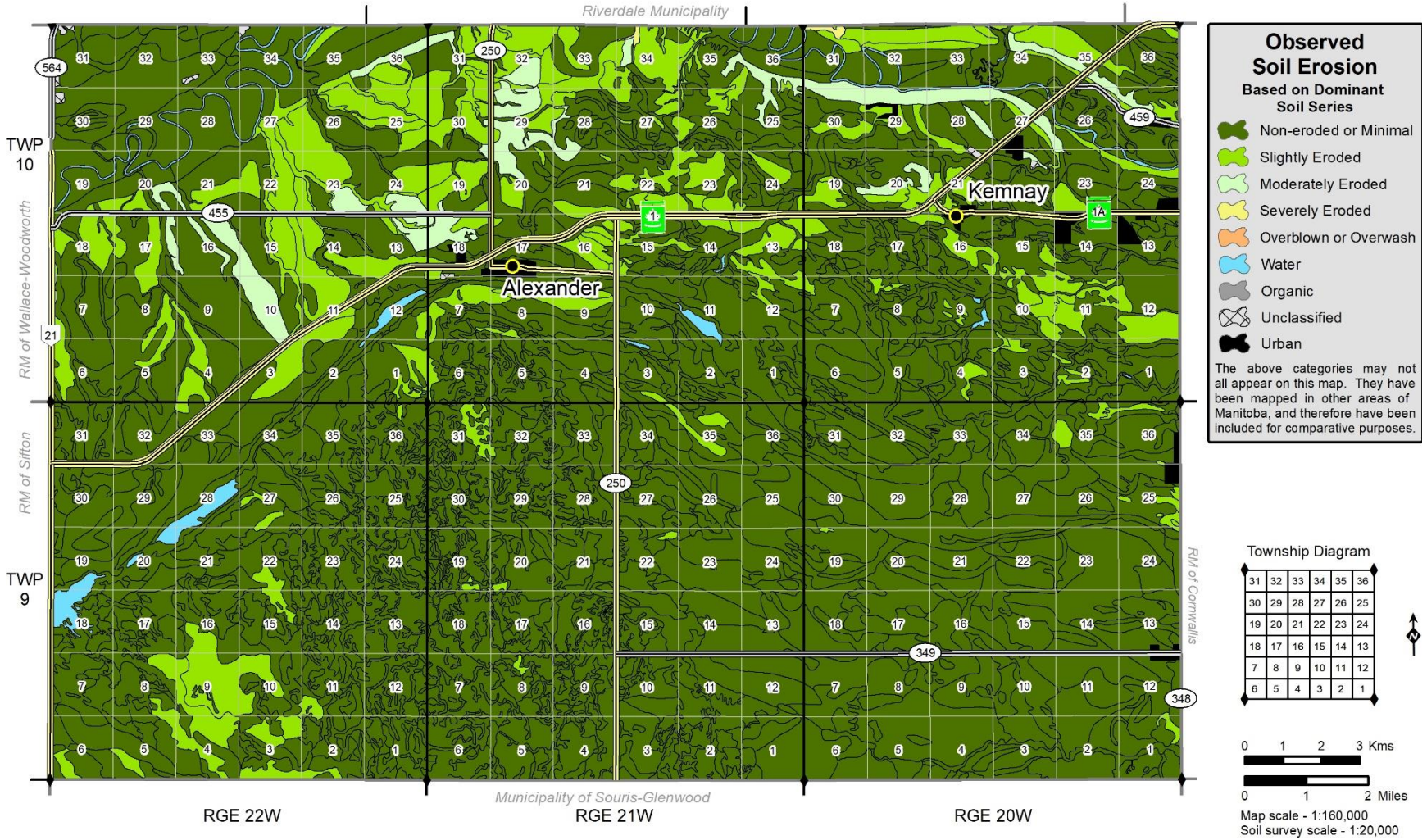
In general, soil erosion in the RM of Whitehead is not severe. Approximately, 83.5 per cent of the study area has minimal or non-eroded lands (Table 11). The slightly eroded areas comprise 12.4 per cent, and moderate to severely eroded lands comprise a small proportion of the lands.

Table 11. Soil Erosion Classes in the RM of Whitehead

Observed Erosion Class	Total area		% of RM
	ha	ac	
Non-eroded or minimal	48,574	120,029	83.5
Slightly	7,186	17,757	12.4
Moderately	1,471	3,636	2.53
Severely	26	64	0.04
Water, urban & unclassified	902	2,229	1.55
Total	**58,160**	**143,716**	**100**

The degree of observed soil erosion shown on Map 6 is based on the dominant soil for each polygon. In general, soil erosion in the RM of Whitehead is not a problem. Slightly eroded soils are scattered in two northern townships (TWP 10, Range 22 and TWP 10, Range 21).

Map 6. Soil Erosion Observed in the RM of Whitehead



4.8 Topography

Slope describes the steepness of the landscape surface. The degree and length of slope are important topographic factors affecting the potential for surface runoff and infiltration of precipitation.

Ten slope classes are used to denote the dominant but not necessarily most severe slopes within a mapping unit (Table 12).

Table 12. Slope Classes Used in Soil Map

Slope Class	Slope Description	% Slope
x	Level	0 - 0.5
b	Nearly level	>0.5 - 2.0
c	Very gently sloping	>2.0 - 5.0
d	Gently sloping	>5.0 - 9.0
e	Moderately sloping	>9.0 -15.0
f	Strongly sloping	>15.0-30.0
g	Very strongly sloping	>30.0-45.0
h	Extremely sloping	>45.0-70.0
i	Steeply sloping	>70.0-100
j	Very steeply sloping	>100

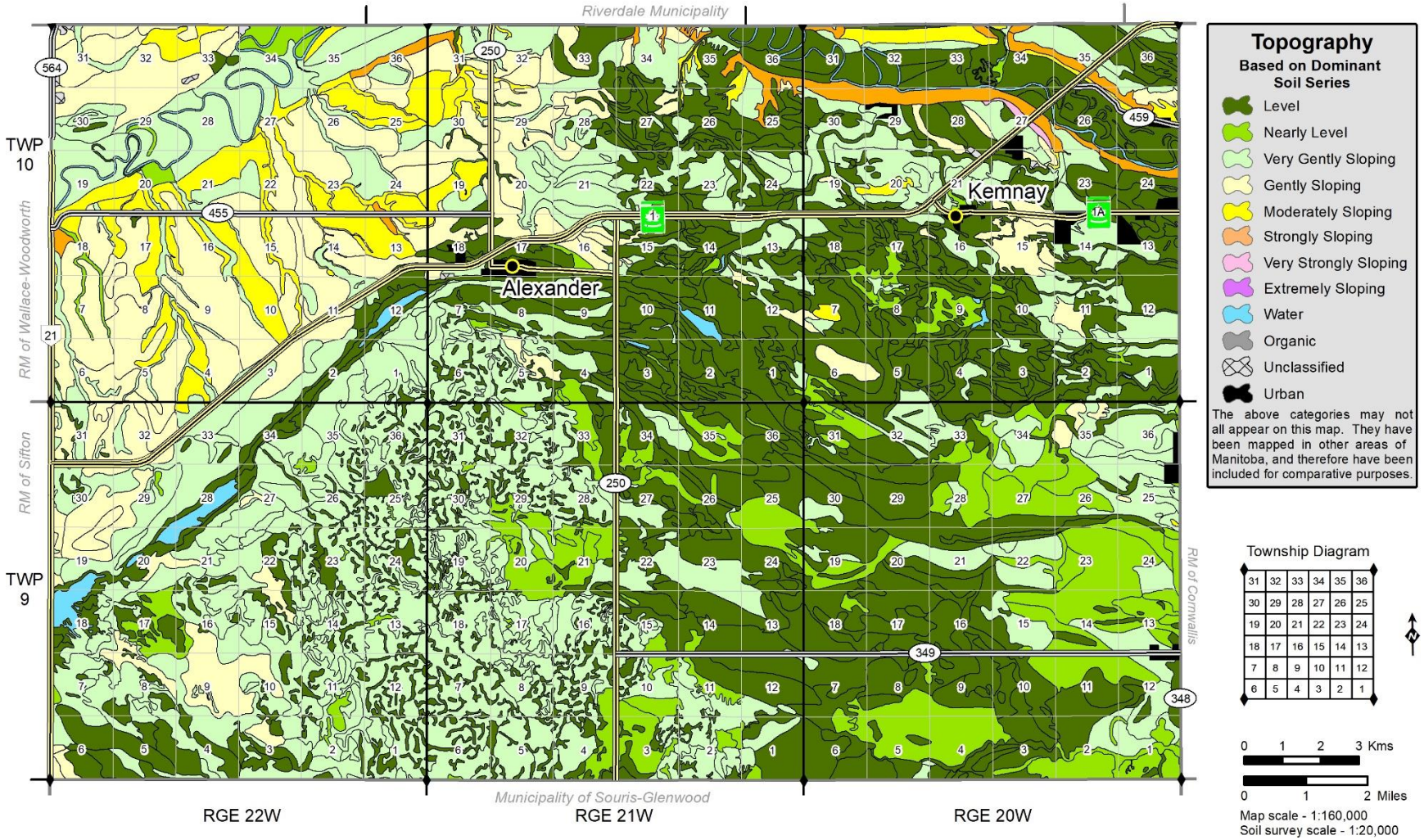
Because surface deposits of the RM of Whitehead is predominantly from the Lake Souris Basin, the land slopes in the study area are relatively flat in general (Table 13). Approximately, over one-third of lands are classified as level slopes. Very gentle slope accounts for another one-third. The steep slopes are not common in this RM.

Table 13. Topography observed in the RM of Whitehead

Topography (slope classes)	Total area		% of RM
	ha	ac	
x	21,384	52,840	36.8
b	5,333	13,179	9.17
c	20,124	49,728	34.6
d	7,191	17,769	12.4
e	2,415	5,968	4.15
f	780	1,927	1.34
g	30	75	0.05
Water, urban & unclassified	902	2,229	1.55
Total	**58,160**	**143,716**	**100**

Topography classes shown on Map 7 are based on the dominant soil for each polygon. It clearly shows that two townships in the east side of the RM of Whitehead are level to nearly level, i.e. slopes are less than two per cent. Relatively steeper slopes such as moderately sloping and strongly sloping are mainly observed in the northwest townships and along the Assiniboine River.

Map 7. Topography of the RM of Whitehead



4.9 Stoniness

Soils with stones can hinder tillage, planting and harvesting operations. The degree of stoniness is described by five classes. Class 1 stoniness is not considered a limitation for soil capability since there is little or no hindrance to cultivation and clearing is generally not required. Although stone clearing can be a mechanized procedure, it presents a management cost that does not occur in non-stony soils.

As aforementioned, stones are 25 to 60 cm in diameter, or if flat, 38 to 60 cm long. The classes of stoniness are defined as follows:

Stones 0 or x. (Non-stony) - Land having less than 0.01 per cent of surface occupied by stones.

Stones 1. (Slightly stony) - Land having 0.01 to 0.1 per cent of surface occupied by stones. Stones are 15 to 30 cm in diameter and 10 to 30 m apart. The stones offer only slight to no hindrance to cultivation.

Stones 2. (Moderately stony) - Land having 0.1 to 3 per cent of surface occupied by stones. Stones are 15 to 30 cm in diameter and 2 to 10 m apart. Stones cause some interference with cultivation.

Stones 3. (Very stony) - Land having 3 to 15 per cent of surface occupied by stones. Stones are 15 to 30 cm in diameter and 1 to 2 m apart. There are sufficient stones to constitute a serious handicap to cultivation.

Stones 4. (Exceedingly stony) - Land having 15 to 50 per cent of surface occupied by stones. Stones are 15 to 30 cm in diameter and 0.7 to 1.5 m apart. There are sufficient stones to prevent cultivation until considerable clearing has been done.

Stones 5. (Excessively stony) - Land having more than 50 per cent of surface occupied by stones. Stones are 15 to 30 cm in diameter and less than 0.7 m apart. The land is too stony to permit cultivation until considerable clearing has occurred.

Lands in the RM of Whitehead are not considered stony, as approximately 94 per cent of the lands fall into the non-stony category (Table 14). Slightly stony soils account only for roughly two per cent of the study area.

The degree of stoniness shown on Map 8 is based on the dominant soil for each polygon. In general, lands in the RM of Whitehead are non-stony. Some previous stony fields have been improved as producers have been removing stones from their fields since the early 1970s. Some slightly stony lands are observed in TWP 10, Range 21.

Table 14. Stoniness Classes in the RM of Whitehead

Degree of Stoniness	Total area		% of RM
	ha	ac	
Non-stony	54,910	135,686	94.4
Slightly stony	1,002	2,475	1.72
Moderately stony	46	115	0.08
Very stony	-	-	-
Exceedingly stony	51	126	0.09
Eroded slope, water, urban, & unclassified	2,150	5,313	3.70
Total	**58,160**	**143,716**	**100**

Map 8. Degree of Stoniness of the RM of Whitehead

4.10 Soil chemical properties

4.10.1 Salinity

Saline soils have a high concentration of soluble salts. The salts include sodium sulphate, magnesium sulphate, calcium sulphate, sodium chloride, magnesium chloride, calcium chloride and others.

The primary effect of salts in soils is the deprivation of water to plants. If the soil solution becomes too high in salts, the plants slowly starve, though the supply of water and dissolved nutrients in the soil may be sufficient.

In saline soils, crops usually grow poorly or not at all. At certain times of the year, the salts may precipitate out on the surface of the soil, leaving a white crust. Generally, plants which are affected by soil salinity have a bluish-green appearance. Common field weeds such as Russian Thistle, Kochia, Wild Barley, and Foxtail often occur in areas of high salt concentration. In uncultivated areas, plants such as Samphire, Desert Salt Grass and Greasewood are frequently dominant species (Henry et al, 1987).

Soil salinity is difficult to manage because it is influenced by soil moisture conditions. In wet years, there is sufficient leaching and dissolving of salts so that salts are not visible on the surface and some crop growth may be possible. In dry years, increased evaporation dries out the soil and draws salts up to the soil surface, producing a white crust.

Field instrumentation, using a non-contacting terrain conductivity meter (EM-38 or a Dual EM), can determine if soluble salts are present.

Identification of salt affected areas and the selection of a salt-tolerant crop are the most important management practices available to farmers.

A saline soil is defined as a soil with an electrical conductivity (EC) of the saturation extract greater than 4 milli-Siemens/cm (mS/cm). The exchangeable sodium per centage is less than 15, and the pH is usually less than 8.5.

Approximate limits of salinity classes are:

Class	EC mS/cm
Non-saline (x)	0 to 4
Weakly saline (s)	>4 to 8
Moderately saline (t)	>8 to 16
Strongly saline (u)	>16

Note: mS/cm is equivalent to dS/m

Most soils in the RM of Whitehead (Table 15) are classified as non-saline and some are slightly saline (EC = 2 to 4mS/cm). Weakly saline soils account for approximately 3.6 per cent and moderately plus strongly saline soils account for one per cent. The class of salinity shown on Map 9 is based on the dominant soil for each polygon. It is indicated that weakly and moderately saline soils are scattered in all townships except TWP 10 Range 22 (Map 9).

Table 15. Soil Salinity Classes in the RM of Whitehead

Class of Salinity	Total area		% of RM
	ha	ac	
Non-saline	54,612	134,949	93.9
Weakly saline	2,111	5,216	3.63
Moderately saline	376	929	0.65
Strongly saline	159	393	0.27
Water, urban & unclassified	902	2,229	1.55
Total	**58,160**	**143,716**	**100**

Map 9. Soil Salinity in the RM of Whitehead

4.10.2 Soil organic carbon, pH and $CaCO_3$

Selected soil chemical properties are summarized based on 442 soil organic carbon (SOC), 441 soil pH and 295 soil carbonate calcium determinations. Soil organic carbon in A horizon is affected by several factors. One of these factors is soil texture. Data analysis from 242 soil samples from A horizon shows that SOC increases when soil particles become finer under well-drained conditions, except fine-textured Janick soil (Table 16). For example, coarse-textured Stockton soil averages 14.4 g per kg (or 1.44 per cent) of SOC, while SOC from moderately coarse Prosser, medium-textured Fairland and moderately fine Ramada soils increases to 30.4, 31.7 and 37.2 g/kg respectively. The fine-textured Janick soil is relatively low in SOC. This shows the same pattern as observed in the Cornwallis Soil Report (Manitoba Agriculture, 2017). A further scientific study of this pattern is needed.

Table 16. SOC in A horizon Affected by Soil Texture and drainage in the RM of Whitehead

Drainage	Deep lacustrine soils		# of samples	SOC
	Soil texture	Soil & Code		g/kg
Well or med. well	Coarse	Stockton (SCK)	4	14.4
	Mod. coarse	Prosser (PSE)	7	30.4
	Medium	Fairland (FND)	6	31.7
	Mod. fine	Ramada (RAM)	4	37.2
	Fine	Janick (JIK)	3	29.2
Imperfect	Coarse	Lavenham (LVH)	14	22.6
	Mod. coarse	Gateside (GTD)	19	28.7
	Medium	Torcan (TOC)	8	36.6
	Mod. fine	Charman (CXV)	10	38.2
	Fine	Harding (HRG)	5	36.5

Soil organic carbon changes under imperfect drainage conditions generally follow a similar trend as those in well- or moderately well-drained conditions (Table 16). Imperfectly drained soils usually result in higher SOC content, compared to well-drained soils with the same texture group. However, analysis data from moderately coarse soils does not show this trend when well-drained Prosser is compared with imperfectly-drained Gateside of Gleyed Black Chernozem. It does indicate this trend in Gleyed Rego Black Chernozemic soil series of the same moderately coarse-textured Pleasant soil (35.5 g/kg), compared to well-drained Rego Black Chernozemic Porple (8.9 g/kg) (Table 17).

Soil pH in A horizon ranges from 5.20 to 8.06. Large variations are due to different chemical processes occurring in the A horizon. All carbonate is basically leached out from A horizon in well-drained Orthic Black Chernozems, resulting in a low pH value. It is particularly evident in those soils which underlying materials are gravel or coarse materials. For example, Croyon and Miniota soils are developed from lacustrine over fluvial outwash, and their pH values in A horizon are 5.42 and 5.20 respectively (Table 17). Imperfectly drained Gleyed Black Chernozemic soils, regardless of soil texture, (Lavenham, Gateside, Torcan and Charman) also show less carbonate presented in A horizon, compared to their counterparts of Gleyed Rego Black Chernozemic soils (Hummerston, Pleasant, Taggart and Prodan) (Table 17).

Table 17. Soil Chemical Properties in A horizon from Selected Soils in the RM of Whitehead

Soil name	Soil code	Organic C (g/kg)		Soil pH (2:1)		Ca carbonate (g/kg)	
		#	Ave	#	Ave	#	Ave
Bankton	BAO	1	31.0	1	7.59	1	35.0
Basker	BKR	1	58.0	-	-	1	15.0
Beresford	BSF	15	34.6	14	7.72	10	56.0
Cactus	CCS	5	26.5	3	7.23	1	7.0
Carroll	CXF	13	25.6	10	7.35	9	79.0
Chambers	CBS	3	28.7	3	7.62	3	88.3
Charman	CXV	10	38.2	7	7.72	3	38.3
Clementi	CLN	1	23.0	1	7.22	-	-
Cobfield	CBF	8	38.5	8	7.64	3	19.0
Croyon	CYN	6	39.1	1	5.20	-	-
Durnan	DRN	13	23.3	6	7.38	5	115.0
Fairland	FND	6	31.7	1	7.47	1	0.0
Forrest	FRT	1	31.0	1	7.42	1	21.0
Gateside	GTD	19	28.7	18	7.57	11	27.0
Grover	GRO	4	18.6	1	7.17	1	48.0
Harding	HRG	5	36.5	5	7.31	2	30.5
Hummerston	HMO	7	28.0	5	7.72	1	38.0
Janick	JIK	3	29.0	2	6.73	1	10.0
Lavenham	LVH	14	22.6	14	7.46	8	12.0
Levine	LEI	1	39.0	-	-	1	18.0
Lockhart	LKH	1	17.0	1	6.12	-	-
Lowton	LWN	1	34.0	1	7.45	1	12.0
Miniota	MXI	4	33.9	1	5.42	1	0.0
Pleasant	PLE	11	35.5	10	7.93	5	101.6
Poolex	POX	1	25.0	1	7.22	1	16.0
Porple	POR	1	8.90	1	7.46	1	8.10
Prodan	PDA	15	34.1	15	7.56	13	53.5
Prosser	PSE	7	30.4	6	6.89	1	55.0
Ramada	RAM	4	37.2	1	6.72	-	-
Rufford	RUF	2	37.3	2	7.63	1	130.0
Shilox	SHX	1	24.3	1	6.85	1	0.0
Sigmund	SGO	3	32.5	3	7.43	2	11.5
Stockton	SCK	4	14.4	4	6.83	1	0.0
Tadpole	TDP	2	16.5	2	6.91	1	6.9
Taggart	TGR	17	35.2	17	7.84	11	78.8
Torcan	TOC	8	36.6	8	7.81	5	51.6
Traverse	TAV	5	31.1	4	7.47	3	76.3
Varcoe	VRC	2	37.7	2	8.06	-	-

Part 5 Soil Suitability for Selected Engineering and Recreational Uses

5.1 Introduction

This section provides information that can be used by engineers and land use planners. It is intended to supplement the information on the soil map with additional data on engineering properties of soils.

5.2 Soil Suitability for Selected Engineering Uses

The criteria used to evaluate soil suitability for selected engineering and related recreational uses are adopted from guides outlined by Coen et al (1977), and from guidelines developed by the Soil Conservation Service, United States Department of Agriculture (USDA, 1971), and the Canada Soil Survey Committee (CSSC, 1973).

The evaluation of soil suitability for engineering and recreation uses is based on both internal and external soil characteristics. Four soil suitability classes are used to evaluate both mineral and organic soils. These ratings express relative degrees of suitability or limitation for potential uses of natural or essentially undisturbed soils. The long-term effects of the potential use on the behaviour of the soil are considered in the rating.

The four suitability class ratings are defined as follows:

(G) Good - Soils in their present state have few or minor limitations that would affect the proposed use. The limitations can easily be overcome with minimal cost.

(F) Fair - Soils in their present state have one or more moderate limitations that would affect the proposed use. These moderate limitations can be overcome with special construction, design, planning or maintenance.

(P) Poor - Soils in their present state have one or more severe limitations that can severely affect the proposed use. Removing these limitations would be difficult or costly.

(V) Very Poor - Soils have one or more unfavourable features for the proposed use and the limitation is very difficult and expensive to overcome, or the soil would require such extreme alteration that the proposed use is economically impractical.

The basic soil properties that singly, or in combination with others, affect soil suitability for selected engineering and recreation uses are provided in Table 18. These subclass designations serve to identify the kind of limitation or hazard for a particular use.

In assessing soil suitability for various engineering uses, the degree of suitability is determined by the most restrictive or severe rating assigned to any one of the listed soil properties. For example, if the suitability is good for all but one soil property and it is estimated to be very poor, then the overall rating of the soil for that selected use is Very poor. Suitability of individual soil properties, if estimated to be fair or poor, can be accumulative in their effect for a particular use. Judgement is required to determine whether the severity of the combined effects of several soil properties on suitability for a particular use will result in downgrading an evaluation. This is left to the discretion of the interpreter. It is incorrect to assume that each of the major soil properties influencing a particular use has an equal effect. Class limits established for rating the suitability of individual soil properties take this into account. For a selected use, therefore, only those soil properties, which most severely limit that use, are specified.

The suitability ratings of soils for ten selected engineering uses are shown in Table A8 of Appendix 1. When using these interpretations, consideration must be given to the following assumptions:

1. Soil ratings do not include site factors such as proximity to towns and highways, water supply or aesthetic values.

2. Soil ratings are based on natural, undisturbed conditions.

3. Soil suitability ratings are usually given for the entire soil depth, but for some uses, they may be based on the limitations of an individual soil horizon or layer, because of its overriding importance. Ratings rarely apply to soil depths greater than 1 to 2 metres, but in some soils, reasonable estimates can be given for soil material at greater depths.

4. Poor and very poor soil ratings do not imply that a site cannot be changed to remove, correct or modify the limitations.

5. Interpretations of map units do not eliminate the need for on-site evaluation by qualified professionals. Because of the variable nature of soils and the scale of mapping, small, unmappable inclusions of soils with different properties may be present in an area where a development is planned.

Guides for evaluating soil suitability for engineering uses are presented in Tables A9 to A18 of Appendix 1.

Table18. Codes Used to Identify Subclass Limitations in Evaluating Soil Suitability for Selected Engineering Uses in Table A8 of Appendix 1

Code	Description
a	sub-grade properties
b	thickness of topsoil
c	coarse fragments on surface
d	depth to bedrock
e	erosion or erodibility
f	susceptibility to frost hazard
g	contamination hazard of groundwater
h	depth to seasonal water table
i	flooding or inundation
j	thickness of slowly permeable material
k	permeability or hydraulic conductivity
l	shrink-swell properties
m	moisture limitations or deficit
n	salinity or sulphate hazard
o	organic matter
p	stoniness
q	depth to sand or gravel
r	rockiness
s	surface texture
t	topographic slope class
u	moist consistency
w	wetness or soil drainage class
z	permafrost

5.3 Soil Suitability for Selected Recreational Uses

This section provides interpretations of the soil suitability for recreational development. All types of soil can be used for recreational activities of some kind.

Soils and their properties contribute to the determination of the type and location of recreational facilities. Wet soils are not suitable for campsites, roads, playgrounds or picnic areas. Soils that pond and dry out slowly after heavy rains present problems where intensive use is planned. It is difficult to maintain grass cover for playing fields and golf courses on dry soils. The feasibility of many kinds of outdoor activities is determined by many basic soil properties such as depth to bedrock, stoniness, topography or land pattern, and the ability of the soil to support vegetation of different kinds as related to its natural fertility.

The suitability of the various soil series and phases for selected recreational uses is shown in Table A8 of Appendix 1. The four classes, **Good, Fair, Poor and Very Poor,** are defined in the section on Engineering Uses. Subclasses are the same as described in Table 18. Guides for evaluating soil suitability for recreational uses are presented in Tables A19 to A22 of Appendix 1.

Appendix 1

A: Definitions of the Agricultural Capability Classes

Class 1

Soils in this class have no important limitations for crop use. The soils have level or gently sloping topography, are deep, well to imperfectly drained and have moderate water holding capacity. The soils are naturally well supplied with plant nutrients, easily maintained in good tilth and fertility. Soils are moderately high to high in productivity for a wide range of cereal and special crops.

Class 2

Soils in this class have moderate limitations that reduce the choice of crops or require moderate conservation practices. The soils have good water holding capacity and are either naturally well supplied with plant nutrients or are highly responsive to the addition of fertilizer. They are moderate to high in productivity for a wide range of crops. The limitations are not severe and good soil management and cropping practices can be applied without serious difficulty.

Class 3

Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices. The limitations in Class 3 are more severe than those in Class 2 and conservation practices are more difficult to apply and maintain. The limitations affect the timing and ease of tillage, planting and harvesting, the choice of crops and maintenance of conservation practices. The limitations include one or more of the following: moderate climatic limitation, erosion, structure or permeability, low fertility, topography, overflow, wetness, low water holding capacity or slowness in release of water to plants, stoniness and depth of soil to consolidated bedrock. Under good management, these soils are fair to moderately high in productivity for a wide range of field crops.

Class 4

Soils in this class have severe limitations that restrict the choice of crops or require special conservation practices or both. These soils have such limitations that they are only suited for a few crops, the yield for a range of crops may be low, or the risk of crop failure is high. The limitations may seriously affect such farm practices as the timing and ease of tillage, planting and harvesting, and the application and maintenance of conservation practices. These soils are low to medium in productivity for a narrow range of crops but may have higher productivity for a specially adapted crop. The limitations include the adverse effects of one or more of the following: climate, accumulative undesirable soil characteristics, low fertility, reduced storage capacity or release of soil moisture to plants, structure or permeability, salinity, erosion, topography, overflow, wetness, stoniness, and depth of soil to consolidated bedrock.

Class 5

Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible. These soils have severe soil, climatic or other limitations and are not capable of sustained production of annual field crops. However, they may be improved by the use of farm machinery for the production of native or tame perennial forage species. Feasible improvement practices include clearing of bush, cultivation, seeding, fertilization and water control. Some soils in class 5 can be used for cultivated field crops provided intensive management is used. Some of these soils are also adapted to special crops requiring soil conditions, unlike those needed by the common crops.

Class 6

Soils in this class are capable only of producing perennial forage crops and improvement practices are not feasible. Class 6 soils have some natural sustained grazing capacity for farm animals, but have such serious soil, climatic or other limitations as to make impractical the application of improvement practices that can be carried out on Class 5 soils. Soils may be placed in this class because their physical nature prevents the use of farm machinery, or because the soils are not responsive to improvement practices, or because stock watering facilities are inadequate.

Class 7

Soils in this class have no capability for arable culture or permanent pasture because of extremely severe limitations. Bodies of water too small to delineate on the map are included in this class. These soils may or may not have a high capability for forestry, wildlife and recreation.

B: Agricultural Capability Subclass Limitations

C - Adverse climate: This subclass denotes a significant adverse climate for crop production, as compared to the median climate, which is defined as one with sufficiently high growing season temperatures to bring field crops to maturity, and with sufficient precipitation to permit crops to be grown each year on the same land, without a serious risk of partial or total crop failures.

D - **Undesirable soil structure or low permeability:** This subclass is used for soils difficult to till, which absorb water very slowly or in which the depth of rooting zone is restricted by conditions other than a high water table or consolidated bedrock.

E - **Erosion:** Subclass E includes soils where damage from erosion is a limitation to agricultural use. Damage is assessed on the loss of productivity and on the difficulties in farming land with gullies.

F - Low fertility: This subclass is made up of soils having low fertility that, either is correctable with careful management in the use of fertilizers and soil amendments, or is difficult to correct in a feasible way. The limitation may be due to lack of available plant nutrients, high acidity or alkalinity, low exchange capacity, high levels of carbonates or presence of toxic compounds.

I - Inundation by streams or lakes: This subclass includes soils subjected to inundation causing crop damage or restricting agricultural use.

L - **Coarse wood fragments:** In the rating of organic soils, woody inclusions in the form of trunks, stumps and branches (>10 cm diameter) in sufficient quantity to significantly hinder tillage, planting and harvesting operations.

M - Moisture limitation: This subclass consists of soils where crops are adversely affected by drought, owing to inherent soil characteristics. They are usually soils with low water-holding capacity.

N - **Salinity:** Designates soils, which are adversely affected by the presence of soluble salts.

P - **Stoniness:** This subclass is comprised of soils sufficiently stony to significantly hinder tillage, planting, and harvesting operations. Stony soils are usually less productive than comparable non-stony soils.

R - **Consolidated bedrock:** This subclass includes soils where the presence of bedrock near the surface restricts their agricultural use. Consolidated bedrock at depths greater than 1 metre from the surface is not considered as a limitation, except on irrigated lands where a greater depth of soil is desirable.

T - **Topography:** This subclass is made up of soils where topography is a limitation. Both the per centage of slope and the pattern or frequency of slopes in different directions are important factors in increasing the cost of farming over that of smooth land, in decreasing the uniformity of growth and maturity of crops, and in increasing the hazard of water erosion.

W - Excess water: Subclass W is made up of soils where excess water other than that brought about by inundation is a limitation to their use for agriculture. Excess water may result from inadequate soil drainage, a high water table, seepage or runoff from surrounding areas.

X - **Cumulative minor adverse characteristics:** This subclass is made up of soils having a moderate limitation caused by the cumulative effect of two or more adverse characteristics which singly are not serious enough to affect the class rating.

Table A1. Dryland Agriculture Capability Guidelines for Manitoba*

	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
Subclass Limitations	No significant limitations in use for crops.	Moderate limitations that restrict the range of crops or require moderate conservation practices.	Moderately severe limitation that restricts the range of crops or requires special conservation practices.	Severe limitations that restrict the range of crops or require special conservation practices or both.	Very severe limitations that restrict soil capability to produce perennial forage crops, and improvement practices are feasible.	Soils are capable only of producing perennial forage crops, and improvement practices are not feasible.	No capability for arable culture or permanent pasture.
Climate (C)	All Ecodistricts[1] within ARDA boundary not explicitly listed under 2C and 3C.	Ecodistricts: 664, 666, 668, 670, 671, 672, 674, 675, 676, 677, 714, 715, 716	Ecodistricts: 356, 357, 358, 359, 363, 366, 663, 665	None within ARDA boundary			
Consolidated Bedrock (R)				> 50 -100 cm	20 - 50 cm	< 20 cm	Surface bedrock Fragmental over bedrock
Moisture limitation[2] (M)		Stratified loams Moderate moisture holding capacity	Loamy sands Low moisture holding capacity	Sands Very low moisture holding capacity	Skeletal sands Very severe moisture deficiency	Stabilized sand dunes	Active sand dunes
Topography[3] (T)	a, b (0 - 2%)	c (> 2 - 5%)	d (> 5 - 9%)	e (> 9 - 15%)	f (> 15 - 30%)	g (> 30 - 45%) Eroded slope complex	h (> 45 - 70%) i (> 70 - 100%) j (> 100%)
Structure or Permeability (D)	Granular clay	Massive clay or till soils[4] Slow permeability	Solonetzic intergrades Very slow permeability	Black Solonetz Extremely slow permeability			
Salinity[5] (N) **0 - 60 cm depth** **60 - 120 cm depth**	NONE < 2 dS/m < 4 dS/m	WEAK 2 - 4 dS/m 4 - 8 dS/m	MODERATE (s) > 4 - 8 dS/m > 8 - 16 dS/m	STRONG (t) > 8 - 16 dS/m > 16 - 24 dS/m	VERY STRONG (u) [6] > 16 - 24 dS/m > 24 dS/m		Salt Flats
Inundation[7] (I)	No overflow during growing season	Occasional overflow (1 in 10 years)	Frequent overflow (1 in 5 years) Some crop damage	Frequent overflow (1 in 5 years) Severe crop damage	Very frequent (1 in 3 years) Grazing > 10 weeks	Very frequent Grazing 5 - 10 weeks	Land is inundated for most of the season
Excess Water (W)	Well and Imperfectly drained		Loamy to fine textured Gleysols with improved drainage	Coarse textured Gleysols with improved drainage	Poorly drained, no improvements	Very Poorly drained	Open water, marsh
Stoniness (P)	Nonstony (0) and Slightly Stony (1)	Moderately Stony (2)	Very Stony (3) [8]	Exceedingly Stony (4) [9]		Excessively Stony (5)	Cobbly Beach Fragmental
Erosion[10] (E)		Moderate erosion (2)	Severe wind or water erosion (3) lowers the basic rating by one class to a maximum rating of Class 6 [11].				
Cumulative minor adverse Characteristics[12] (X)							

* Based on the Canada Land Inventory Soil Capability Classification for Agriculture (1965), with modifications made for soil application at larger mapping scales.

1 Smith, R.E., H. Veldhuis, G.F. Mills, R.G. Eilers, W.R. Fraser, M. Santry, 1996. Terrestrial Ecoregions and Ecodistricts of Manitoba, An Ecological Stratification of Manitoba's Natural Landscapes. Agriculture and Agri-Food Canada, Research Branch, Brandon Research Centre, Manitoba Land Resource Unit, Winnipeg, MB. Report and Provincial Map at scale of 1:1.5m.

2 With the exception of Class 2, ratings as indicated are based on the assumption of a single parent material, using the most readily drained representative of each textural class. Prevailing climatic conditions within the Ecodistrict, soil drainage and stratification will affect the moisture limitation accordingly.

3 Topographic classes are based on the most limiting slope covering a significant portion of an area of complex, variable slopes. Map units with long, unidirectional slopes may be considered equivalent or one class worse due to an increased erosion hazard.

4 Extremely calcareous loamy till soils with a high bulk density (>1.7 g/cm^3) are rated 3D.

5 Soil Salinity is reported in DeciSiemens/metre (dS/m). Soil will be classed according to the most saline depth. For example, if a soil is non-saline from 0 to 60 cm, but moderately saline from 60 to 120 cm, the soil will be classed as moderately saline (3N).

6 Strongly saline (u) soils are rated 5N with the exception of poorly and very poorly drained soils, which are rated 6NW.

7 Inundation may be listed as a secondary subclass for some fluvial soils. In this case, inundation is not class determining, but may become a limitation if the soil is otherwise improved.

8 Extremely calcareous loamy till soils with a high bulk density (>1.7 g/cm^3) and stony 3 are rated 4DP (4RP if depth to bedrock is 50 - 100 cm).

9 Stony 4 soils will be rated 4P unless their primary physical composition is sandy skeletal or their parent material is till. In either or both of these cases, the soil will be rated 5P.

10 If erosion is moderate, a subclass of E is assigned as a secondary limitation, but the basic rating is not lowered. If erosion is severe, the basic soil rating is downgraded by one class, and E becomes the primary limitation. For example, if a soil has a basic rating of 4T, the presence of moderate erosion will result in a rating of 4TE. If erosion is severe, the rating will be lowered to 5ET. Erosion will be the sole limitation only if the basic rating has a subclass of X. For example, a soil with a rating of 3X will be assigned a rating of 3E if moderate erosion is present.

11 The rating is not lowered from Class 6 based on erosion. A rating of 6TE indicates a soil with g topography and either moderate or severe erosion.

12 Use only for soils with no other limitation except climate. The subclass represents soils with a moderate limitation caused by the cumulative effect of two or more adverse characteristics which are singly not serious enough to affect the rating. Because the limitation is moderate, soils may only be downgraded by one class from their initial climate limitation. Therefore, a soil with a climate limitation of 2C and 2 or more minor adverse characteristics will be rated as 3X. This symbol is always used alone.

Table A2. Ag Capability and Irrigation Suitability of Soils in the RM of Whitehead

Soil name (Soil code)	Soil phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Arizona (AIZ)	xcxx	5ME	3m Bt2	Fair	3	25.7	63.4	0.44
	xxxx	5ME	3m A	Fair	3	7.2	17.7	0.12
Ashmore (AHO)	xxxx	4M	2m A	Good	3	5.7	14.2	0.10
Assiniboine (ASB)	xbxx	3I	3kw Bi	Fair	5	116.6	288.1	2.00
	xcxs	3IN	3kw Bt2i	Fair	5	28.3	70.0	0.49
	xcxx	3I	3kw Bt2i	Fair	5	891.5	2,203	15.3
	xxxx	3I	3kw Bi	Fair	5	647.1	1,599	11.1
Bankton (BAO)	1cxx	2TD	4kx Bt2	Poor	5	193.6	478.3	3.33
	1dxx	3TD	4kx Bt2	Poor	5	6.5	16.0	0.11
	xcxx	2TD	4kx Bt2	Poor	5	342.7	846.9	5.89
	xxxx	2D	4kx A	Poor	5	6.5	16.2	0.11
Barren (BAE)	xxxx	3E	2k A	Good	4	2.9	7.3	0.05
Basker (BKR)	xbxx	5IW	4w Ci	Poor	5	0.06	0.15	0.001
	xcxx	5IW	4w Ci	Poor	5	53.3	131.8	0.92
	xxxx	5IW	4w Ci	Poor	5	34.9	86.3	0.60
Beresford (BSF)	xbxs	3N	3sw A	Fair	4	9.3	22.9	0.16
	xbxt	4N	4s A	Poor	5	51.6	127.4	0.89
	xbxx	2W	3w A	Fair	3	54.9	135.6	0.94
	xcxs	3N	3sw Bt2	Fair	4	4.2	10.4	0.07
	xcxs*	3N	3sw Bt2	Fair	4	34.3	84.7	0.59
	xcxt	4N	4s Bt2	Poor	5	44.7	110.5	0.77
	xcxx	2WT	3w Bt2	Fair	3	1,490	3,682.2	25.6
	xdxx	3T	3w Ct2	Fair	4	5.2	12.9	0.09
	xx1x	2W	3w A	Fair	4	102.0	252.0	1.75
	xxxs	3N	3sw A	Fair	4	2.3	5.8	0.04
	xxxu	5N	4s A	Poor	5	65.8	162.7	1.13
	xxxx	2W	3w A	Fair	3	468.3	1,157.2	8.05
Bermont (BMN)	xxxx	2X	2kx A	Good	4	2.6	6.4	0.04
Brownridge (BWD)	xcxx	4ME	1 Bt2	Good	3	81.9	202.3	1.41
	xdxx	4ME	1 Ct2	Fair	3	256.9	634.8	4.42
	xxxx	4ME	1 A	Excellent	3	15.4	38.2	0.27
Cactus (CCS)	1cxx	4M	2m Bt2	Good	2	115.8	286.2	1.99
	1dxx	4M	2m Ct2	Fair	4	51.3	126.7	0.88
	1exx	4TM	2m Ct2	Fair	5	2.4	6.0	0.04
	2exx	4TM	2m Ct2	Fair	5	16.8	41.5	0.29
	xbxx	4M	2m A	Good	2	7.6	18.8	0.13
	xcxx	4M	2m Bt2	Good	2	124.5	307.6	2.14
	xxxx	4M	2m A	Good	2	57.0	140.9	0.98
Capell (CXT)	xbxx	2M	3w A	Fair	3	13.1	32.4	0.23
	xxxx	2M	3w A	Fair	3	43.0	106.3	0.74

* A texture variant.

Table A2-2. Ag Capability and Irrigation Suitability of Soils in the RM of Whitehead

Soil name (Soil code)	Soil phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Carroll (CXF)	1cxx	2T	2k Bt2	Good	2	15.1	37.4	0.26
	1dxx	3T	2k Ct2	Fair	4	232.2	573.7	3.99
	1exx	4T	2k Ct2	Fair	5	373.6	923.2	6.42
	1fxx	5T	2k Dt2	Poor	5	62.8	155.1	1.08
	2dxx	3TE	2k Ct2	Fair	4	59.1	146.0	1.02
	2exx	4T	2k Ct2	Fair	5	195.2	482.4	3.36
	xbxx	2X	2k A	Good	2	24.2	59.9	0.42
	xcxx	2T	2k Bt2	Good	2	116.8	288.7	2.01
	xdxx	3T	2k Ct2	Fair	4	206.9	511.2	3.56
	xexx	4T	2k Ct2	Fair	5	156.7	387.1	2.69
	xxxx	2X	2k A	Good	2	4.2	10.5	0.07
Carvey (CAV)	xdxx	5W	4w Ct2	Poor	5	18.7	46.2	0.32
	xxxx	5W	4w A	Poor	5	45.2	111.7	0.78
Chambers (CBS)	1c1x	2T	2kx Bt2	Good	4	39.5	97.6	0.68
	1cxx	2T	2kx Bt2	Good	4	25.2	62.3	0.43
	2cxx	2TE	2kx Bt2	Good	4	12.8	31.6	0.22
	xbxx	2X	2kx A	Good	4	60.1	148.5	1.03
	xcxx	2T	2kx Bt2	Good	4	546.0	1,349	9.39
	xdxx	3T	2kx Ct2	Fair	4	0.3	0.9	0.01
	xxxx	2X	2kx A	Good	4	22.6	55.8	0.39
Charman (CXV)	xbxx	2W	3w A	Fair	3	60.0	148.3	1.03
	xcxs	3N	3sw Bt2	Fair	4	76.0	187.7	1.31
	xcxt	4N	4s Bt2	Poor	5	14.6	36.0	0.25
	xcxx	2WT	3w Bt2	Fair	3	549.1	1,357	9.44
	xdxs	3NT	3sw Ct2	Fair	4	24.0	59.3	0.41
	xdxx	3T	3w Ct2	Fair	4	380.4	940.1	6.54
	xxxx	2W	3w A	Fair	3	5.6	13.8	0.10
Chater (CXW)	1cxx	5M	4gm Bt2	Poor	5	13.7	34.0	0.24
	1dxx	5M	4gm Ct2	Poor	5	26.4	65.2	0.45
	2dxx	5ME	4gm Ct2	Poor	5	15.6	38.7	0.27
	xc1x	5M	4gm Bt2	Poor	5	30.3	74.8	0.52
	xc2x	5M	4gm Bt2	Poor	5	24.6	60.8	0.42
	xcxx	5M	4gm Bt2	Poor	5	10.8	26.6	0.19
	xxxx	5M	4gm A	Poor	5	168.3	416.0	2.89
Clementi (CLN)	1c1x	2T	2kx Bt2	Good	4	16.1	39.7	0.28
	1cxx	2T	2kx Bt2	Good	4	86.8	214.5	1.49
	1dxx	3T	2kx Ct2	Fair	4	17.2	42.5	0.30
	1xxx	2X	2kx A	Good	4	120.3	297.3	2.07
	xc1x	2T	2kx Bt2	Good	4	109.8	271.4	1.89
	xcxx	2T	2kx Bt2	Good	4	203.2	502.0	3.49
	xdxx	3T	2kx Ct2	Fair	4	14.8	36.6	0.25

Table A2-3. Ag Capability and Irrigation Suitability of Soils in the RM of Whitehead

Soil name (Soil code)	Soil phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Clementi (CLN)	xe1x	4T	2kx Ct2	Fair	5	11.0	27.2	0.19
	xx4x	4P	2kx Cp	Fair	5	49.9	123.2	0.86
	xxxx	1	2kx A	Good	4	120.8	298.4	2.08
Cobfield (CBF)	xbxx	2W	3w A	Fair	4	243.0	600.6	4.18
	xcxs	3N	3sw Bt2	Fair	4	6.3	15.6	0.11
	xcxt	4N	4s Bt2	Poor	5	14.1	34.9	0.24
	xcxx	2WT	3w Bt2	Fair	4	778.0	1,922.4	13.4
	xxxs	3N	3sw A	Fair	4	121.1	299.1	2.08
	xxxx	2W	3w A	Fair	4	39.0	96.3	0.67
Cordova (CVA)	1c1x	2T	2kx Bt2	Good	4	119.1	294.2	2.05
	1d1x	3T	2kx Ct2	Fair	4	39.4	97.4	0.68
	1fxx	5T	2kx Dt2	Poor	5	25.5	62.9	0.44
	xbxx	2X	2kx A	Good	4	0.6	1.5	0.01
	xc1x	2T	2kx Bt2	Good	4	95.0	234.7	1.63
	xc2x	2TP	2kx Bt2	Good	5	17.0	42.1	0.29
	xcxx	2T	2kx Bt2	Good	4	45.8	113.3	0.79
	xxxx	2X	2kx A	Good	4	108.6	268.5	1.87
Crookdale (CKD)	xcxx	2WT	3w Bt2	Fair	3	3.4	8.3	0.06
Croyon (CYN)	1cxx	3M	2gm Bt2	Good	3	1.0	2.4	0.02
	xcxx	3M	2gm Bt2	Good	3	51.7	127.7	0.89
	xdxx	3MT	2gm Ct2	Fair	4	390.3	964.6	6.71
	xexx	4T	2gm Ct2	Fair	5	48.7	120.3	0.84
	xxxx	3M	2gm A	Good	3	29.3	72.3	0.50
Dexter (DXT)	xxxx	4M	4m A	Poor	5	8.2	20.2	0.14
Dorset (DOT)	xdxx	5M	4m Ct2	Poor	5	54.8	135.4	0.94
	xexx	5M	4m Ct2	Poor	5	19.5	48.1	0.33
Drokan (DRO)	xcxx	5W	4w Bt2	Poor	5	32.2	79.6	0.55
	xxxx	5W	4w A	Poor	5	100.0	247.1	1.72
Druxman (DXM)	xcxx	2MT	3w Bt2	Fair	3	28.1	69.4	0.48
	xdxx	3T	3w Ct2	Fair	4	19.4	47.8	0.33
Durnan (DRN)	1cxx	2T	1 Bt2	Good	1	310.6	767.6	5.34
	1dxx	3T	1 Ct2	Fair	4	924.9	2,285	15.9
	1exx	4T	1 Ct2	Fair	5	346.3	855.8	5.95
	1fxx	5T	1 Dt2	Poor	5	17.1	42.3	0.29
	1xxx	2X	1 A	Excellent	2	33.5	82.8	0.58
	2dxx	3TE	1 Ct2	Fair	4	191.6	473.5	3.29
	2exx	4TE	1 Ct2	fair	5	66.2	163.5	1.14
	xcxx	2T	1 Bt2	Good	1	337.4	833.7	5.80
	xdxx	3T	1 Ct2	Fair	4	247.5	611.7	4.26
	xxxx	2X	1 A	Excellent	1	71.9	177.8	1.24

Table A2-4. Ag Capability and Irrigation Suitability of Soils in the RM of Whitehead

Soil name (Soil code)	Soil phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Fairland (FND)	1cxx	2T	1 Bt2	Good	1	163.6	404.4	2.81
	1dxx	3T	1 Ct2	Fair	4	67.4	166.7	1.16
	1exx	4T	1 Ct2	Fair	5	11.6	28.7	0.20
	xbxx	1	1 A	Excellent	1	56.3	139.1	0.97
	xcxx	2T	1 Bt2	Good	1	695.2	1,718	12.0
	xdxx	3T	1 Ct2	Fair	4	380.2	939.5	6.54
	xxxx	1	1 A	Excellent	1	784.7	1,939	13.5
Fenton (FET)	xcxx	5W	4kw A	Poor	5	4.9	12.2	0.08
Floors (FLS)	1dxx	5M	4m Ct2	Poor	5	20.7	51.1	0.36
	xdxx	5M	4m Ct2	Poor	5	49.9	123.4	0.86
Forrest (FRT)	xcxx	2WT	4k Bt2	Poor	5	15.4	38.2	0.27
Gateside (GTD)	xbxs	3N	3s A	Fair	4	33.6	83.0	0.58
	xbxx	2M	2w A	Good	3	501.0	1,238	8.61
	xcxs	3N	3s Bt2	Fair	4	109.2	269.7	1.88
	xcxx	2MT	2w Bt2	Good	3	528.5	1,306	9.09
	xxxs	3N	3s A	Fair	4	65.6	162.2	1.13
	xxxx	2M	2w A	Good	3	1,306	3,226	22.4
Gendzel (GDZ)	xcxx	4M	3mw Bt2	Fair	3	7.2	17.7	0.12
Glenboro (GBO)	2dxx	3TE	1 Ct2	Fair	4	50.4	124.5	0.87
	xcxx	2MT	1 Bt2	Good	1	61.7	152.5	1.06
Grayson (GYS)	xcxx	5W	4w Bt2	Poor	5	7.2	17.7	0.12
	xdxx	5W	4w Ct2	Poor	5	14.7	36.4	0.25
	xxxx	5W	4w A	Poor	5	76.2	188.4	1.31
Grover (GRO)	1dxx	3T	2w Ct2	Fair	4	12.7	31.4	0.22
	xcxx	2WT	2w Bt2	Good	3	70.1	173.3	1.21
	xdxx	3T	2w Ct2	Fair	4	41.2	101.9	0.71
	xxxx	2W	2w A	Good	3	106.9	264.3	1.84
Harding (HRG)	xbxx	2W	4kx A	Poor	5	220.3	544.4	3.79
	xcxx	2WT	4kx Bt2	Poor	5	425.9	1,052	7.32
	xxxx	2W	4kx A	Poor	5	18.8	46.4	0.32
Hummerston (HMO)	xbxx	3MW	2mw A	Good	3	134.5	332.4	2.31
	xcxs	3MN	3s Bt2	Fair	4	41.2	101.7	0.71
	xcxx	3MW	2mw Bt2	Good	3	151.2	373.6	2.60
	xdxx	3MT	2mw Ct2	Fair	4	19.3	47.7	0.33
	xxxt	4N	4s A	Poor	5	78.9	194.9	1.36
	xxxx	3MW	2mw A	Good	3	1,580	3,905	27.2
Janick (JIK)	xcxx	2T	4kx Bt2	Poor	5	35.9	88.6	0.62

Table A2-5. Ag Capability and Irrigation Suitability of Soils in the RM of Whitehead

Soil name (Soil code)	Soil phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Justice (JUC)	xcxx	2WT	4k Bt2	Poor	5	3.4	8.5	0.06
Kerran (KRN)	xbxx	5IW	4kw Ci	Poor	5	13.8	34.2	0.24
	xcxx	5IW	4kw Ci	Poor	5	114.9	284.0	1.98
	xxxx	5IW	4kw Ci	Poor	5	329.9	815.1	5.67
Killeen (KLL)	xxxx	2M	3w A	Fair	4	14.4	35.5	0.25
Kilmury (KUY)	xxxx	3M	2mw A	Good	3	96.0	237.3	1.65
Kirkness (KKS)	xcxx	3M	2mx Bt2	Good	4	8.3	20.5	0.14
Kleysen (KYS)	xbxx	2X	2kx A	Good	4	64.6	159.6	1.11
	xcxx	2T	2kx Bt2	Good	4	44.8	110.6	0.77
Knolls (KLS)	1cxx	3E	2m Bt2	Good	3	102.4	252.9	1.76
	xcxx	3E	2m Bt2	Good	3	172.8	426.9	2.97
	xdxx	3TE	2m Ct2	Fair	3	44.8	110.6	0.77
	xxxx	3E	2m A	Good	3	28.1	69.5	0.48
Lavenham (LVH)	xbxs	3NW	3s A	Fair	4	18.9	46.6	0.32
	xbxt	4N	4s A	poor	5	19.1	47.2	0.33
	xbxx	3MW	2mw A	Good	3	1,013	2,502	17.4
	xcxs	3NW	3s Bt2	Fair	4	32.8	81.2	0.56
	xcxx	3MW	2mw Bt2	Good	3	185.0	457.2	3.18
	xxxs	3NW	3s A	Fair	4	13.1	32.4	0.23
	xxxx	3MW	2mw A	Good	3	1,953	4,827	33.6
Lavinia (LAV)	xcxx	2WT	3w Bt2	Fair	4	3.9	9.6	0.07
Levine (LEI)	xbxx	3I	3w Bi	Fair	3	36.1	89.2	0.62
	xcxx	3I	3w Bt2i	Fair	3	276.9	684.3	4.76
	xdxx	3IT	3w Ct2	Fair	4	15.1	37.4	0.26
	xxxx	3I	3w Bi	Fair	3	61.9	153.0	1.06
Lindstrom (LDM)	xbxx	2W	3wx A	Fair	4	12.9	31.9	0.22
	xcxx	2WT	3wx Bt2	Fair	4	16.3	40.3	0.28
	xxxx	2W	3wx A	Fair	4	34.3	84.9	0.59
Lockhart (LKH)	1cxx	2MT	2x Bt2	Good	4	13.0	32.2	0.22
	xxxx	2M	2x A	Good	4	34.3	84.8	0.59
Lonery (LOE)	xxxs	5W	4w A	Poor	5	5.0	12.3	0.09
	xxxx	5W	4w A	Poor	5	1.3	3.3	0.02
Lowroy (MOW)	xcxx	5W	4w Bt2	Poor	5	2.7	6.8	0.05
	xxxx	5W	4w A	Poor	5	3.1	7.6	0.05
Lowton (LWN)	xbxx	5W	4kw A	Poor	5	14.8	36.5	0.25
	xcxx	5W	4kw Bt2	Poor	5	7.6	18.7	0.13
	xxxs	5W	4kw A	Poor	5	32.6	80.6	0.56

Table A2-6. Ag Capability and Irrigation Suitability of Soils in the RM of Whitehead

Soil name (Soil code)	Soil phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Lowton (LWN)	xxxt	5W	4ks A	Poor	5	1.9	4.7	0.03
	xxxx	5W	4kw A	Poor	5	448.6	1,109	7.71
Mansfield (MFI)	xbxx	4M	4m A	Poor	5	1.7	4.2	0.03
	xcxx	4M	4m Bt2	Poor	5	11.2	27.6	0.19
	xxxx	4M	4m A	Poor	5	104.4	258.1	1.80
Manson (MXD)	xcxx	2IT	3kx Bt2	Fair	5	12.4	30.7	0.21
	xxxx	2I	3kx A	Fair	5	26.1	64.5	0.45
Marringhurst (MRH)	1cxx	5M	4m Bt2	Poor	5	81.5	201.4	1.40
	1exx	5M	4m Ct2	Poor	5	23.5	58.1	0.40
	2cxx	5ME	4m Bt2	Poor	5	27.2	67.1	0.47
	xc1x	5M	4m Bt2	Poor	5	19.1	47.1	0.33
	xc4x	5MP	4m Cp	Poor	5	1.3	3.3	0.02
	xcxx	5M	4m Bt2	Poor	5	88.1	217.8	1.52
	xdxx	5M	4m Ct2	Poor	5	9.7	24.1	0.17
	xx2x	5M	4m A	Poor	5	4.8	11.8	0.08
	xxxx	5M	4m A	Poor	5	61.0	150.7	1.05
Marsden (MDN)	xxxs	5W	4w A	Poor	5	1.0	2.5	0.02
Miniota (MXI)	xcxx	4M	2m Bt2	Good	3	31.0	76.6	0.53
	xdxx	4M	2m Ct2	Fair	4	218.2	539.2	3.75
	xexx	4MT	2m Ct2	Fair	5	29.2	72.2	0.50
Moore Park (MPK)	xcxx	2W	3w A	Fair	4	3.4	8.3	0.06
Mowbray (MOW)	1cxx	2IT	2k Bt2	Good	1	10.6	26.1	0.18
Onahan (ONH)	xxxx	4M	2mw A	Good	3	187.1	462.3	3.22
Petrel (PTR)	xxxx	2W	2w A	Good	3	23.8	58.7	0.41
Pleasant (PLE)	xbxt	4N	4s A	Poor	5	51.2	126.4	0.88
	xbxx	2M	2w A	Good	3	365.1	902.3	6.28
	xcxs	3N	3s Bt2	Fair	4	18.5	45.6	0.32
	xcxx	2MT	2w Bt2	Good	3	542.8	1,341	9.33
	xxxs	3N	3s A	Fair	4	114.7	283.3	1.97
	xxxx	2M	2w A	Good	3	1,429	3,531	24.6
Poolex (POX)	xbxs	5W	4w A	Poor	5	30.9	76.4	0.53
	xbxx	5W	4w A	Poor	5	27.8	68.8	0.48
	xcxs	5W	4w Bt2	Poor	5	14.4	35.6	0.25
	xcxx	5W	4w Bt2	Poor	5	10.2	25.1	0.17
	xxxs	5W	4w A	Poor	5	110.0	271.8	1.89
	xxxt	5W	4w A	Poor	5	4.3	10.7	0.07
	xxxx	5W	4w A	Poor	5	1,252	3,094	21.5
Porple (POR)	1cxx	3M	1 Bt2	Good	1	159.3	393.5	2.74
	1dxx	3MT	1 Ct2	Fair	4	71.9	177.6	1.24
	1xxx	3M	1 A	Excellent	1	10.0	24.6	0.17
	xcxx	3M	1 Bt2	Good	1	87.0	215.0	1.50

Table A2-7. Ag Capability and Irrigation Suitability of Soils in the RM of Whitehead

Soil name (Soil code)	Soil phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Porple (POR)	xdxx	3MT	1 Ct2	Fair	4	3.8	9.3	0.06
	xxxx	3M	1 A	Excellent	1	50.5	124.7	0.87
Prodan (PDA)	xbxs	3N	3sw A	Fair	4	26.2	64.8	0.45
	xbxx	2W	3w A	Fair	3	63.4	156.7	1.09
	xcxs	3N	3sw Bt2	Fair	4	93.5	230.9	1.61
	xcxx	2WT	3w Bt2	Fair	3	887.6	2,193	15.3
	xdxs	3TN	3sw Ct2	Fair	4	5.3	13.1	0.09
	xdxx	3T	3w Ct2	Fair	4	436.3	1,078	7.50
	xexx	4T	3w Ct2	Fair	5	2.2	5.3	0.04
	xxxs	3N	3sw A	Fair	4	2.3	5.7	0.04
	xxxt	4N	4s A	Poor	5	16.9	41.8	0.29
	xxxx	2W	3w A	Fair	3	278.2	687.4	4.78
Prosser (PSE)	1cxx	3M	1 Bt2	Good	1	310.3	766.8	5.34
	1dxx	3MT	1 Ct2	Fair	4	63.2	156.1	1.09
	1xxx	3M	1 A	Excellent	1	44.2	109.1	0.76
	xbxx	3M	1 A	Excellent	1	49.0	121.1	0.84
	xcxx	3M	1 Bt2	Good	1	424.0	1,048	7.29
	xdxx	3MT	1 Ct2	Fair	4	110.5	273.1	1.90
	xxxx	3M	1 A	Excellent	1	397.5	982.3	6.83
Ramada (RAM)	1cxx	2T	2k Bt2	Good	2	53.1	131.2	0.91
	1dxx	3T	2k Ct2	Fair	4	83.7	206.9	1.44
	1exx	4T	2k Ct2	Fair	5	249.7	617.0	4.29
	xbxx	1	2k A	Good	2	124.3	307.3	2.14
	xcxx	2T	2k Bt2	Good	2	77.2	190.8	1.33
	xdxx	3T	2k Ct2	Fair	4	885.3	2,188	15.2
	xexx	4T	2k Ct2	Fair	5	140.4	346.9	2.41
	xxxx	1	2k A	Good	2	63.7	157.5	1.10
Rempel (RMP	1cxx	2T	2k Bt2	Good	2	40.7	100.6	0.70
	1dxx	3T	2k Ct2	Fair	4	501.9	1,240	8.63
	1x1x	1	2k A	Good	4	76.8	189.8	1.32
	xcxx	2T	2k Bt2	Good	2	15.6	38.5	0.27
	xdxx	3T	2k Ct2	Fair	4	203.9	503.8	3.51
	xexx	4T	2k Ct2	Fair	5	93.4	230.8	1.61
Roddan (ROD)	2d1x	4E	2kx Ct2	Fair	5	11.9	29.5	0.21
	xcxx	3E	2kx Bt2	Good	4	47.8	118.2	0.82
	xdxx	3ET	2kx Ct2	Fair	4	11.5	28.3	0.20
Rufford (RUF)	1c1x	2T	2kx Bt2	Good	4	125.3	309.7	2.15
	1cxx	2T	2kx Bt2	Good	4	109.2	269.8	1.88
	1dxx	3T	2kx Ct2	Fair	4	24.2	59.8	0.42
	1e1x	4T	2kx Ct2	Fair	5	17.6	43.5	0.30
	1x1x	2X	2kx A	Good	4	4.2	10.5	0.07
	2c1x	2TE	2kx Bt2	Good	4	134.8	333.2	2.32
	2cxx	2TE	2kx Bt2	Good	4	25.7	63.6	0.44
	2d1x	3TE	2kx Ct2	Fair	4	23.7	58.5	0.41

Table A2-8. Ag Capability and Irrigation Suitability of Soils in the RM of Whitehead

Soil name (Soil code)	Soil phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Rufford (RUF)	2dxx	3TE	2kx Ct2	Fair	4	12.2	30.1	0.21
	2e1x	4TE	2kx Ct2	Fair	5	25.7	63.5	0.44
	2fxx	5TE	2kx Dt2	Poor	5	17.0	42.0	0.29
	xcxx	2T	2kx Bt2	Good	4	37.5	92.7	0.65
	xdxx	3T	2kx Ct2	Fair	4	9.9	24.4	0.17
Sewell (SEE)	xbxx	5W	4w A	Poor	5	6.9	16.9	0.12
	xxxs	5W	4w A	Poor	5	173.1	427.8	2.98
	xxxx	5W	4w A	Poor	5	1,036	2,561	17.8
Shilox (SHX)	xcxx	6M	3m Bt2	Fair	3	33.5	82.7	0.58
	xdxx	6M	3m Ct2	Fair	4	78.2	193.4	1.35
	xexx	6M	3m Ct2	Fair	5	22.8	56.3	0.39
	xxxx	6M	3m A	Fair	3	9.1	22.4	0.16
Sigmund (SGO)	xcxs	3N	4kx Bt2	Poor	5	26.0	64.2	0.45
	xcxx	2WT	4kx Bt2	Poor	5	435.3	1,076	7.48
	xxxx	2W	4kx A	Poor	5	16.7	41.2	0.29
Stockton (SCK)	1cxx	4M	2m Bt2	Good	2	518.0	1,280	8.91
	1xxx	4M	2m A	Good	2	112.2	277.3	1.93
	xbxx	4M	2m A	Good	2	1,216	3,005	20.9
	xcxx	4M	2m Bt2	Good	2	1,264	3,125	21.7
	xdxx	4M	2m Ct2	Fair	4	31.5	77.8	0.54
	xxxx	4M	2m A	Good	2	1,095	2,706	18.8
Tadpole TDP)	xbxx	5W	4w A	Poor	5	57.8	142.9	0.99
	xcxs	5W	4w Bt2	Poor	5	14.4	35.5	0.25
	xcxx	5W	4w Bt2	Poor	5	361.5	893.3	6.22
	xxxs	5W	4w A	Poor	5	120.7	298.3	2.08
	xxxu	6NW	4sw A	Poor	5	10.6	26.1	0.18
	xxxx	5W	4w A	Poor	5	700.0	1,730	12.0
Taggart (TGR)	xbxx	2W	2w A	Good	3	78.5	194.1	1.35
	xcxs	3N	3s Bt2	Fair	4	284.3	702.5	4.89
	xcxt	4N	4s Bt2	Poor	5	2.1	5.3	0.04
	xcxx	2WT	2w Bt2	Good	3	1,242	3,069	21.4
	xdxs	3NT	3s Ct2	Fair	4	68.6	169.6	1.18
	xdxx	3T	2w Ct2	Fair	4	324.9	802.9	5.59
	xxxs	3N	3s A	Fair	4	58.0	143.2	1.00
	xxxu	5N	4s A	Poor	5	82.8	204.5	1.42
	xxxx	2W	2w A	Good	3	1,067	2,637	18.3
Torcan (TOC)	xbxx	2W	2w A	Good	3	207.3	512.1	3.56
	xcxs	3N	3s Bt2	Fair	4	47.6	117.7	0.82
	xcxx	2WT	2w Bt2	Good	3	772.6	1,909	13.3
	xdxs	3NT	3s Ct2	Fair	4	17.4	43.1	0.30
	xdxx	3T	2w Ct2	Fair	4	57.2	141.3	0.98
	xxxs	3N	3s A	Fair	4	19.5	48.3	0.34
	xxxx	2W	2w A	Good	3	175.3	433.1	3.01

Table A2-9. Ag Capability and Irrigation Suitability of Soils in the RM of Whitehead

Soil name (Soil code)	Soil phase	Agriculture capability	Irrigation suitability			Total area		‰ of RM
			Class	General rating	Rating for potato production	ha	ac	
Traverse (TAV)	1cxx	2T	1 Bt2	Good	1	193.9	479.2	3.33
	1dxx	3T	1 Ct2	Fair	4	80.6	199.2	1.39
	xbxx	1	1 A	Excellent	1	27.3	67.4	0.47
	xcxx	2T	1 Bt2	Good	1	269.8	666.6	4.64
	xdxx	3T	1 Ct2	Fair	4	47.0	116.2	0.81
	xexx	4T	1 Ct2	Fair	5	17.3	42.7	0.30
	xxxx	1	1 A	Excellent	1	41.9	103.5	0.72
Varcoe (VRC)	xcxs	3N	3sw Bt2	Fair	4	13.4	33.1	0.23
	xcxt	4N	4s Bt2	Poor	5	14.8	36.7	0.26
	xcxx	2WT	3w Bt2	Fair	4	204.1	504.4	3.51
	xxxx	2W	3w A	Fair	4	41.9	103.5	0.72
Vodroff (VFF)	xbxs	5W	4w A	Poor	5	4.1	10.0	0.07
	xbxx	5W	4w A	Poor	5	143.2	353.9	2.46
	xcxs	5W	4w Bt2	Poor	5	2.1	5.1	0.04
	xcxx	5W	4w Bt2	Poor	5	128.8	318.3	2.21
	xxxs	5W	4w A	Poor	5	69.3	171.3	1.19
	xxxx	5W	4w A	Poor	5	1,082	2,675	18.6
Vordas (VDS)	xbxx	5W	4w A	Poor	5	75.0	185.3	1.29
	xcxs	5W	4w Bt2	Poor	5	58.8	145.3	1.01
	xcxx	5W	4w Bt2	Poor	5	166.9	412.3	2.87
	xxxs	5W	4w A	Poor	5	58.1	143.7	1.00
	xxxt	5W	4sw A	Poor	5	61.6	152.2	1.06
	xxxx	5W	4w A	Poor	5	1,077	2,662	18.5
Wellwood (WWD)	1cxx	2T	2k Bt2	Good	2	5.7	14.1	0.10
Wheatland (WHL)	xcxx	5M	3m Bt2	Fair	4	0.6	1.4	0.01
	xxxx	5M	3m A	Fair	4	7.8	19.2	0.13
Wytonville (WVI)	xxxx	3M	2mw A	Good	3	17.9	44.1	0.31
Eroded Slope Complex ($ER)	1dxx	6E	4m Ct2	Poor	5	7.0	17.4	0.12
	1e1x	6E	4m Ct2	Poor	5	9.4	23.3	0.16
	1exx	6E	4m Ct2	Poor	5	520.7	1,287	8.95
	1f3x	6E	4m Dt2	Poor	5	15.0	37.0	0.26
	1fxx	6E	4m Dt2	Poor	5	55.2	136.3	0.95
	1gxx	6ET	4m Dt2	Poor	5	30.5	75.3	0.52
	2dxx	6E	4m Ct2	Poor	5	8.2	20.2	0.14
	2exx	6E	4m Ct2	Poor	5	15.7	38.8	0.27
	2fxx	6E	4m Dt2	Poor	5	561.9	1,388	9.66
	xfxx	6E	4m Dt2	Poor	5	26.2	64.7	0.45
Marsh ($MH)	xxxx	7W	4wx Di	Poor	5	383.9	948.8	6.60
Unclassified Land ($UL)	xxxx	-	-	-	-	49.1	121.3	0.84
Urban land ($UR)	xxxx	-	-	-	-	319.3	788.9	5.49
Water ($ZZ)	xxxx	-	-	-	-	532.6	1,316	9.16
Total						**58,160**	**143,716**	**1,000**

Table A3. Description of Irrigation Suitability Classes

General Rating	Class	Degree of Limitation	Description
Excellent	**1A**	No soil or landscape limitations	These soils are medium textured, well drained and hold adequate available moisture. Topography is level to nearly level. Gravity irrigation methods may be feasible.
Good	**1B** **2A** **2B**	Slight soil or landscape limitations	The range of crops that can be grown may be limited. As well, higher development inputs and management are required. Sprinkler irrigation is usually the only feasible method of water application.
Fair	**1C** **2C** **3A** **3B** **3C**	Moderate soil or landscape limitations	Limitations reduce the range of crops that may be grown and increase development and improvement costs. Management may include special conservation techniques to minimize soil erosion, limit salt movement, limit water table build-up or flooding of depressional areas. Sprinkler irrigation is usually the only feasible method of water application.
Poor	**1D** **2D** **3D** **4A** **4B** **4C** **4D**	Severe soil or landscape limitations	Limitations generally result in a soil that is unsuitable for sustained irrigation. Some land may have limited potential when special crops, irrigation systems, and soil and water conservation techniques are used.

Table A4. Landscape Features Affecting Irrigation Suitability

Symbol	Landscape Features		Degree of Limitation			
			None (A)	Slight (B)	Moderate (C)	Severe (D)
t1	Slope (per cent)	Simple	<2	2 - 9	> 9 - 20	>20
t2		Complex	<5		> 5 - 15	>15
E	Relief, average local (m)		<1	1 - 3	> 3 - 5	>5
P	Stoniness	Classes	0, 1 & 2	3	4	5
		Cover (per cent)	(0 to 3)	(> 3 to 15)	(> 15 to 50)	(>50)
I	Inumdation – frequency of flooding (period)		1 in 10 years	1 in 5 years	Every year (annual-spring)	Every year (seasonal)

* Suitability interpretations are based on the criteria for complex slopes.

Table A5. Soil Features Affecting Irrigation Suitability

Symbol	Soil Feature	Degree of Limitation			
		None (1)	Slight (2)	Moderate (3)	Severe (4)
d	Structure	Granular, Single Grained, Prismatic, Blocky, Subangular Blocky	Columnar, Platy	Massive	Massive
k	Ksat (mm/hr) (0 - 1.2 m)	> 50	50 - 15	< 15 - 1.5	< 1.5
x	Drainability (mm/hr) (1.2 - 3 m)	> 15	15 - 5	< 5 - 0.5	< 0.5
m	AWHC subhumid (mm/1.2 m) (per cent by volume) Subarid (mm/1.2 m) (per cent by volume)	 > 120 (> 10) > 150 (> 12)	 120 - 100 (10 - 8) 150 - 120 (12 - 10)	 < 100 - 75 (< 8 - 6) < 120 - 100 (< 10 - 8)	 < 75 (< 6) < 100 (< 8)
q	Intake Rate (mm/hr)	> 15	15 - 1.5	15 - 1.5	< 1.5
s	Salinity (mS/cm or dS/m) 0 - 0.6 m depth 0.6 - 1.2 m depth 1.2 - 3 m depth	 < 2 < 4 < 8	 2 - 4 4 - 8 8 - 16	 > 4 - 8 > 8 - 16 > 16	 > 8 > 16 > 16
n	Sodicity (SAR) 0 - 1.2 m depth 1.2 - 3 m depth	 < 6 < 6	 6 - 9 6 - 9	 > 9 - 12 > 9 - 12	 > 12 > 12
g	Geological (0 - 1.2 m) Uniformity (1.2 – 3 m)	1 Textural Group 2 Textural Groups	2 Textural Groups Coarser below 3 Textural Groups Coarser below	2 Textural Groups Finer below 3 Textural Groups Coarser below 3 Textural Groups Finer below	3 Textural Groups Finer below
r	Depth to Bedrock (m)	> 3	3 - 2	< 2 - 1	< 1
h	Depth to Water Table (m)	> 2	2 - 1.2 (if salinity is a problem)	2 - 1.2 (if salinity is a problem)	< 1.2
w	Drainage class	Well, Moderately Well	Imperfect	Imperfect	Poor, Very Poor, Excessive, Rapid
	*Texture (classes) (0 - 1.2 m)	L, SiL, VFSL, FSL	CL, SiCL, SCL, SL, LVFS	C, SC, SiC VFS, FS, LS, CoSL	HC GR, CoS, LCoS, S
	*Organic Matter (per cent)	> 2	2 - 1	2 - 1	< 1
	*Surface Crusting Potential	Slight	Low	Low	Moderate

* Other important factors used to interpret type and degree of limitation but which do not present a limitation to irrigation themselves. No symbol is proposed for these factors since they will not be identified as subclass limitations.

Table A6. Guidelines for Assessing Land Suitability for Irrigated Potato Production under Rapid, Well and Moderately Well Drained Soil Conditions

In assessing suitability of land for irrigated potato production, the degree of suitability is determined by the most restrictive or severe rating assigned to any one of the listed characteristics or properties.

Characteristic or Property	Suitability Rating				
	Class 1	Class 2	Class 3	Class 4	Class 5
Texture Group*	CL CL/SF CL/SF/SC CL/FL/SF CL/LY LY/SF LY	SY,SY/SC, SY/CL, SY/LY, SY/FL, SY/SS/LY, SF, SY/UD/LY,SF/CS, SF/SC, SF/LY, SF/FL, SC/LY, SC, SF/SS/FL, CL/FL, SC/FL, CL/SS/FL, LY/FL, LY/SC, LY/LS, LY/SS/SF, LY/SS/SC, LY/FL/SF, LY/SS/LY, LY/SS/FL, FL FL/SF, FL/LY, FL/FL, FL/SY/SF, FL/SS/LY, FL/SS/FL, FL/CL	SY/SS, SY/CY/LY, SF/SS, CL/SS, SF/CY, CL/CY, SF/CY/LY, CL/CY/LY, CL/SS/CY, LY/CY, LY/SS, FL/SS	FL/CY, FL/CY/SF	SK, SS, SS/RK, SS/LY, SS/FL, SS/CY, SC/RK, SF/RK, CS, CL/RK, CL/FR, CL/FR/RK, LS/RK, LY/RK, LY/SY/RK, FL/LY/RK, CY, CY/SS, CY/SC, CY/SY, CY/SF, CY/CL, CY/LY, CY/FL, CY, CY/RK, CY/TX, CY/SS/CY, CY/LY/CY, CY/FL/CY, CY/LY/RK, CY/FL/RK, RK, TX, TX/LY, UD, UD/LY
Topography[1] (Slope)	0 - 5 per cent (a, b, c)			> 5 - 9 per cent (d)	> 9 per cent (e, f, g, h, i, j)
Stoniness[2] class	-			St. 1	St. 2, 3, 4, 5
Salinity[3] (mS/cm)	< 2		2 - 4	> 4 - 8	> 8
Soil Order and / or Subgroup			Orthic Regosol		Organic Order, Solonetzic Order, Solonetzic Subgroups

Topography[1]	Stoniness[2]	(Surface covered, per cent)	Salinity[3]	(mS/cm)
< 5 per cent level to very gently sloping	- non-stony	< 0.01	very low	0 - 2
5 - 9 per cent gently sloping	1 slightly stony	0.01 - 0.1	low	> 2 - 4
> 9 per cent mod. to extremely sloping	2 moderately stony	> 0.1 - 3	weakly (s)	> 4 - 8
	3 very stony	> 3 - 15	moderately (t)	> 8 - 16
	4 exceedingly stony	> 15 - 50	strongly (u)	> 16
	5 excessively stony	> 50		

* SK = Skeletal
SS = Sandy Skeletal
LS = Loamy Skeletal
CS = Clayey Skeletal
SC = Sandy Coarse
SY = Sandy
SF = Sandy Fine
CL = Coarse Loamy
LY = Loamy
FL = Fine Loamy
CY = Clayey
RK = Bedrock
FR = Fragmental
UD = Undifferentiated
TX = Texture Complex

Table A7. Guidelines for Assessing Land Suitability for Irrigated Potato Production under Imperfect, Poor and Very Poor Soil Conditions

In assessing suitability of land for irrigated potato production, the degree of suitability is determined by the most restrictive or severe rating assigned to any one of the listed characteristics or properties.

Characteristic or Property	Suitability Rating				
	Class 1	Class 2	Class 3	Class 4	Class 5
Texture Group*			SY, SY/SS, SY/SC, SY/CL, SY/LY, SC/LY, SY/SS/LY, SY/UD/LY, SC, SF, SF/SS, SF/CS, SF/LY, SF/SC, SF/FL, SY/FL, SF/SS/FL, CL, CL/SS, CL/SF, CL/LY, CL/FL, CL/SF/SC, CL/SS/FL, CL/FL/SF, LY/SS, LY/SC, LY/SF, LY/LS, LY/SS/SF, LY/SF/SC, SC/FL, LY, LY/FL, LY/SS/LY, LY/SS/FL, FL, FL/SF, FL/SS, FL/CL, FL/LY, FL/FL, FL/SY/SF, FL/SS/LY, FL/SS/FL	SF/CY, SY/CY/LYSF/CY/LY, SF/CY/FL, CL/CY, CL/CY/LY, CL/SS/CY, LY/CY, FL/CY/SF, FL/CY	SK, SS, SS/RK, SS/LY, SS/FL, SS/CY, SC/RK, SF/RK, CS, CL/RK, CL/FR, CL/FR/RK, LS/RK, LY/RK, LY/SY/RK, FL/LY/RK, CY, CY/SS, CY/SC, CY/SY, CY/SF, CY/CL, CY/LY, CY/FL, CY CY/RK, CY/TX, CY/SS/CY, CY/LY/CY, CY/FL/CY, CY/LY/RK, CY/FL/RK, RK, TX, TX/LY, UD, UD/LY
Topography[1] (Slope)			0 - 5 per cent	> 5 - 9 per cent	> 9 per cent
Stoniness[2] class				St. 1	St. 2, 3, 4, 5
Salinity[3] (mS/cm)			< 4	4 - 8	> 8
Soil Order and / or Subgroup					Organic Order, Gleysolic Order, Solonetzic Order, Solonetzic Subgroups

Topography[1]	Stoniness[2] (Surface covered)	Salinity[3] (mS/cm)
< 5 per cent level to very gently sloping	- non-stony < 0.01 per cent	very low 0 - 2
5 - 9 per cent gently sloping	1 slightly stony 0.01 - 0.1 per cent	low > 2 - 4
> 9 per cent mod. to extremely sloping	2 moderately stony > 0.1 - 3 per cent	weakly (s) > 4 - 8
	3 very stony > 3 - 15 per cent	Moderately (t) > 8 - 16
	4 exceedingly stony > 15 - 50 per cent	Strongly (u) > 16
	5 excessively stony > 50 per cent	

* SK = Skeletal
SS = Sandy Skeletal
LS = Loamy Skeletal
CS = Clayey Skeletal
SC = Sandy Coarse
SY = Sandy
SF = Sandy Fine
CL = Coarse Loamy
LY = Loamy
FL = Fine Loamy
CY = Clayey
RK = Bedrock
FR = Fragmental
UD = Undifferentiated
TX = Texture Complex

Table A8. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Arizona	AIZ	xcxx	Vb	Fa	G	G	G	G	Vks	Vk	Pq	Vkg	Gg	Fst	Fms	Fs	Ps
		xxxx	Vb	Fa	G	G	G	G	Vks	Vk	Pq	Vkg	Gg	Fms	Fms	Fs	Ps
Ashmore	AHO	xxxx	Fb	Faq	G	G	G	G	Vks	Vkg	Pcq	Vak	Gg	Fq	Fms	G	G
Assiniboine	ASB	xbxx, xcxx xxxx	Ps	Va	Pa	Piw	Pai	Pai	Pis	Pi	Ps	Pi	Vk	Ps	Ps	Pis	Ps
		xcxs	Pns	Va	Pa	Piw	Pai	Pai	Pis	pi	Ps	Pi	Vk	Ps	Ps	Pis	Ps
Bankton	BAO	1cxx	Ps	Va	Pa	Pa	Pa	Pa	Ps	G	Ps	Ft	Vk	Fst	Fs	Fks	Fs
		1dxx	Ps	Va	Pa	Pa	Pa	Pa	Ps	G	Ps	Pt	Vk	Pt	Fs	Fks	Fs
		xcxx	Ps	Va	Pa	Pa	Pa	Pa	Ps	G	Ps	Ft	VK	Fkt	Fs	Fks	Fs
		xxxx	Ps	Va	Pa	Pa	Pa	Pa	Ps	G	Ps	G	Vk	Fks	Fs	Fks	Fs
Barren	BAE	xxxx	Vb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
Basker	BKR	xbxx, xcxx xxxx	Pi	Va	Pw	Viw	Vi	Vi	Viw	Viw	Pw	Vi	Vhi	Viw	Piw	Viw	Piw
Beresford	BSF	xbxx, xxxx xx1x	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xbxs, xxxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fnw	Fnw	Fnw	Fsw
		xbxt, xcxt	Vn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Pn	Pn	Pn	Fsw
		xxxu	Vn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Vn	Vn	Vn	Fsw
		xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fnt	Fnw	Fnw	Fsw
		xcxs*	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	G	Fkt	Phk	Fnt	Fnw	Fnw	Fw
		xdxx	Fst	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Pt	Phk	Pt	Fsw	Fsw	Fsw
Bermont	BMN	xxxx	Fbs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
Brownridge	BWD	xcxx	Pb	Va	G	G	G	G	Pk	Pk	G	Pk	G	Ft	G	G	G
		xdxx	Fbt	Va	G	G	G	G	Pk	Pk	G	Pkt	G	Pt	G	G	G
		xxxx	Fb	Va	G	G	G	G	Pk	Pk	G	Pk	G	G	G	G	G
Cactus	CCS	1cxx	Vb	Pa	G	G	G	G	Vks	Vkg	Pq	Vkg	Gg	Fst	Fms	Fs	G
		1dxx	Vb	Pa	G	G	G	G	Vks	Vkg	Pq	Vkg	Gg	Pt	Fms	Fs	G
		1exx, 2exx	Vb	Pa	G	Ft	Ft	Ft	Vks	Vkg	Pq	Vtk	Ft	Vt	Fts	Fts	G
		xcxx	Pbs	Pa	G	G	G	G	Vks	Vkg	Pq	Vkg	Gg	Fst	Fms	Fs	G
		xbxx, xxxx	Pbs	Pa	G	G	G	G	Vks	Vkg	Pq	Vkg	Gg	Fms	Fms	Fs	G
Capell	CXT	xbxx, xxxx	Fbs	Faq	Fw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vak	Phg	Fsw	Fsw	Fsw	Fsw
Carroll	CXF	1cxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1dxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs

* BSF, a texture variant.

Table A8-2. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Carroll	CXF	1exx	Pbt	Va	Fa	Fat	Fat	Fat	Fs	Ft	Fst	Vt	Pk	Vt	Fst	Fst	Fs
		1fxx	Vt	Va	Fat	Pt	Pt	Pt	Fst	Pt	Pt	Vt	Pkt	Vt	Pt	Pt	Fst
		2dxx	Vb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		2exx	Vb	Va	Fa	Fat	Fat	Fat	Fs	Ft	Fst	Vt	Pk	Vt	Fst	Fst	Fs
		xbxx, xxxx	Fbs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		xcxx	Fbs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xdxx	Fst	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		xexx	Pt	Va	Fa	Fat	Fat	Fat	Fs	Ft	Fst	Vt	Pk	Vt	Fst	Fst	Fs
Carvey	CAV	xdxx	Fst	Fhq	Pw	Vhw	Phw	Pw	Vwg	Vhk	Pqw	Vkg	Vhg	Ptw	Pw	Pw	Pw
		xxxx	Fs	Fhq	Pw	Vhw	Phw	Pw	Vwg	Vhk	Pqw	Vkg	Vhg	Pw	Pw	Pw	Pw
Chambers	CBS	1c1x, 1cxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		2cxx	Vb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xbxx, xxxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xdxx	Fst	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	FS
Charman	CXV	xbxx, xxxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fnt	Fnw	Fnw	Fsw
		xcxt	Vn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Pn	Pn	Pn	Fsw
		xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
		xdxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Pt	Fnw	Fnw	Fsw
		xdxx	Fst	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Pt	Phk	Pt	Fsw	Fsw	Fsw
Chater	CXW	1cxx	Vb	Fx	G	Fa	G	G	Fsg	Gg	Fcs	Pk	Fk	Fst	Fms	Fs	G
		1dxx	Vb	Fx	G	Fa	G	G	Fsg	Gg	Fcs	Pkt	Fk	Pt	Fms	Fs	G
		2dxx	Vb	Fx	G	Fa	G	G	Fsg	Gg	Fcs	Pkt	Fk	Pt	Fms	Fs	Fs
		xc1x, xcxx	Pbs	Fx	G	Fa	G	G	Fsg	Gg	Fcs	Pk	Fk	Fst	Fms	Fs	G
		xc2x	Pbs	Fx	G	Fap	G	G	Fpg	Gg	Fps	Pk	Fk	Fpt	Fms	Fps	G
		xxxx	Pbs	Fx	G	Fa	G	G	Fsg	Gg	Fcs	Pk	Fk	Fs	Fms	Fs	G
Clementi	CLN	1c1x, 1cxx xc1x, xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1dxx, xdxx	Fst	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		1xxx, xxxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		xe1x	Pt	Va	Fa	Fat	Fat	Fat	Fs	Ft	Fst	Vt	Pk	Vt	Fst	Fst	Fs
		xx4x	Pp	Va	Pp	Pp	Fap	Pp	Pp	G	Pp	Pp	Pk	Pp	Pp	Pp	Pp
Cobfield	CBF	xbxx, xxxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw

Table A8-3. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Cobfield	CBF	xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fnt	Fnw	Fnw	Fsw
		xcxt	Vn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Pn	Pn	Pn	Fsw
		xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
		xxxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fnw	Fnw	Fnw	Fsw
Cordova	CVA	1c1x	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1d1x	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		1fxx	Vt	Va	Fat	Pt	Pt	Pt	Fst	Pt	Pt	Vt	Pkt	Vt	Pt	Pt	Fst
		xbxx, xxxx	Fbs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		xc1x, xcxx	Fbs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xc2x	Fbp	Va	Fa	Fap	Fa	Fa	Fps	G	Fps	Fkt	Pk	Fpt	Fs	Fps	Fs
Crookdale	CKD	xcxx	Fbs	Va	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Pkg	Fhg	Ftw	Fsw	Fsw	Fsw
Croyon	CYN	1cxx, xcxx	Pb	Faq	G	G	Fa	Fa	Vks	Pkg	Pcq	Vak	Gg	Ft	G	G	G
		xdxx	Fbt	Faq	G	G	Fa	Fa	Vks	Pkg	Pcq	Vak	Gg	Pt	G	G	G
		xexx	Pt	Faq	G	Ft	Fat	Fat	Vks	Pkg	Pcq	Vkt	Ftg	Vt	Fst	Fst	G
		xxxx	Fb	Faq	G	G	Fa	Fa	Vks	Pkg	Pcq	Vak	Gg	Fs	Fs	Fs	Fs
Dexter	DXT	xxxx	Ps	G	Fw	Pw	Fw	Fw	Vks	Vkg	Vcs	Vck	Fhg	Pq	Fsw	Fsw	Fw
Dorset	DOT	xdxx	Pbs	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pqt	Fms	Fs	G
		xexx	Pbt	G	G	Ft	Ft	Ft	Vks	Vkg	Vcs	Vkt	Ftg	Vqt	Fst	Fst	G
Drokan	DRO	xcxx, xxxx	Fs	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Druxman	DXM	xcxx	Fb	Faq	Faw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vkg	Phg	Ftw	Fw	Fw	Fw
		xdxx	Fbt	Faq	Faw	Pw	Faw	Faw	Vks	Pkg	Pcq	Vak	Phg	Pt	Fw	Fw	Fw
Durnan	DRN	1cxx, xcxx	Pb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	Fst	Fs	Fs	Fs
		1dxx	Pb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Pt	Fk	Pt	Fs	Fs	Fs
		1exx	Pbt	Va	Fa	Fat	Fat	Fat	Gg	Ftg	Ft	Vt	Fkt	Vt	Fst	Fst	Fs
		1fxx	Vt	Va	Fat	Pt	Fa	Pt	Ftg	Ptg	Pt	Vt	Pt	Vt	Pt	Pt	Fs
		1xxx	Pb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	Fs	Fs	Fs	Fs
		2dxx	Vb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Ptg	Fk	Pt	Fs	Fs	Fs
		2exx	Vb	Va	Fa	Fat	Fa	Fat	Gg	Ftg	Ft	Vt	Fkt	Vt	Fts	Fts	Fs
		xdxx	Fbt	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Pt	Fk	Pt	Fs	Fs	Fs
		xxxx	Fb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fak	Fk	Fs	Fs	Fs	Fs
Fairland	FND	1cxx	Fb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	Ft	G	G	G
		1dxx	Fbt	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Ptg	Fk	Pt	G	G	G
		1exx	Pt	Va	Fa	Fat	Fat	Fat	Gg	Ftg	Ft	Vtg	Fkt	Vt	Ft	Ft	G
		xbxx, xxxx	G	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	G	G	G	G
		xcxx	G	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	Ft	G	G	G

Table A8-4. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Fairland	FND	xdxx	Ft	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Ptg	Fk	Pt	G	G	G
Fenton	FET	xcxx	Ps	Va	Paw	Vw	Paw	Paw	Vhw	Pw	Psw	Ph	Vh	Psw	Psw	Psw	Psw
Floors	FLS	1dxx, xdxx	Pbs	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pqt	Fms	Fs	G
Forrest	FRT	xcxx	Ps	Va	Pa	Paw	Pa	Pa	Psw	Fw	Ps	Fjt	Pk	Ps	Ps	Ps	Ps
Gateside	GTD	xbxs, xxxs xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pkw	Pk	G	Pk	Fh	Fnw	Fnw	Fnw	Fw
		xbxx, xxxx	G	Va	Faw	Pw	Faw	Faw	Pkw	Pk	G	Pk	Fh	Fw	Fw	Fw	Fw
		xcxx	G	Va	Faw	Pw	Faw	Faw	Pkw	Pk	G	Pk	Fh	Ftw	Fw	Fw	Fw
Gendzel	GDZ	xcxx	Ps	G	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Phg	Fst	Fsw	Fsw	Fw
Glenboro	GBO	2dxx	Pb	Pa	G	G	Fa	G	Vks	Gg	Pq	Vkg	Gg	Pt	Fms	Fs	Fs
		xcxx	G	Pa	G	G	Fa	G	Vks	Gg	Pq	Vkg	Gg	Ft	G	G	G
Grayson	GYS	xcxx, xxxx	G	Pha	Pw	Vhw	Phw	Pfw	Vwg	Pwg	Pqw	Vhg	Vhg	Pw	Pw	Pw	Pw
		xdxx	Ft	Pha	Pw	Vhw	Phw	Pfw	Vwg	Pwg	Pqw	Vhg	Vhg	Ptw	Pw	Pw	Pw
Grover	GRO	1dxx	Ft	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Pt	Fw	Fw	Fw
		xcxx	G	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Ftw	Fw	Fw	Fw
		xxxx	G	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Fw	Fw	Fw	Fw
Harding	HRG	xbxx, xxxx	Ps	Va	Pa	Paw	Pa	Pa	Psw	Fw	Ps	G	Vk	Pks	Psw	Pks	Ps
		xcxx	Ps	Va	Pa	Paw	Pa	Pa	Psw	Fw	Ps	Ft	Vk	Pks	Psw	Pks	Ps
Hummerston	HMO	xbxx, xxxx	Ps	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Fsw	Fsw	Fsw	Fw
		xcxs	Pns	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Fnt	Fnt	Fnw	Fw
		xcxx	Ps	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Ftw	Fsw	Fsw	Fw
		xdxx	Ps	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Pt	Fsw	Fsw	Fw
		xxxt	Vn	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Pn	Pn	Pn	Fw
Janick	JIK	xcxx	Ps	Va	Pa	Pa	Pa	Pa	Ps	G	Ps	Ft	Vk	Fst	Fs	Fks	Fs
Justice	JUC	xcxx	Ps	Va	Pa	Paw	Pa	Pa	Psw	Fw	Ps	Fjt	Pk	Ps	Ps	Ps	Ps
Kerran	KRN	xbxx, xcxx xxxx	Pis	Va	Paw	Viw	Vi	Vi	Viw	Viw	Psw	Vi	Vhi	Viw	Piw	Viw	Piw
Killeen	KLL	xxxx	Ps	Pax	Fw	Pw	Fw	Fw	Pw	Fw	Fs	Pk	Ph	Fsw	Fsw	Fsw	Fw
Kilmury	KUY	xxxx	Fb	Faq	Fw	Pw	Faw	Fw	Vks	Vkg	Pcq	Vak	Phg	Fqw	Fw	Fw	Fw
Kirkness	KKS	xcxx	Ps	Pax	Fa	Fa	G	G	Fs	G	Fs	Pk	Fk	Fst	Fms	Fs	G
Kleysen	KYS	xbxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
Knolls	KLS	1cxx, xcxx	Vb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Ftg	Fk	Ft	G	G	G
		xdxx	Vb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Ptg	Fk	Pt	G	G	G
		xxxx	Vb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	G	G	G	G

Table A8-5. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Lavenham	LVH	xbxs, xxxs	Pns	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Fnw	Fnw	Fnw	Fw
		xbxt	Vn	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Pn	Pn	Pn	Fw
		xbxx, xxxx	Ps	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Fsw	Fsw	Fsw	Fw
		xcxs	Pns	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Fnt	Fnw	Fnw	Fw
		xcxx	Ps	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Ftw	Fsw	Fsw	Fw
Lavinia	LAV	xcxx	Fbs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fst	Fsw	Fsw	Fsw
Levine	LEI	xbxx, xxxx	Fis	Va	Faw	Piw	Pi	Pi	Piw	Pi	Fs	Pi	Phi	Fiw	Fsw	Pi	Fsw
		xcxx	Fis	Va	Faw	Piw	Pi	Pi	Piw	Pi	Fs	Pi	Phi	Fit	Fsw	Pi	Fsw
		xdxx	Fst	Va	Faw	Piw	Pi	Pi	Piw	Pi	Fs	Pi	Phi	Pt	Fsw	Pi	Fsw
Lindstrom	LDM	xbxx, xxxx	Fb	Vax	Faw	Pw	Fw	Fw	Pw	Fw	G	Fk	Ph	Fw	Fw	Fw	Fw
		xcxx	Fb	Vax	Faw	Pw	Fw	Fw	Pw	Fw	G	Fkt	Ph	Ftw	Fw	Fw	Fw
Lockhart	LKH	1cxx	Pb	Vax	Fa	Fa	Fa	G	Fs	G	G	Fkt	Fk	Ft	G	G	G
		xxxx	Fb	Vax	Fa	Fa	Fa	G	Fs	G	G	Fk	Fk	G	G	G	G
Lonery	LOE	xxxs	Pn	Vax	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xxxx	Fb	Vax	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Lowroy	LOW	xcxx, xxxx	Ps	Pa	Pw	Vhw	Phw	Pw	Vwg	Vhk	Vs	Vkg	Vhg	Pw	Pw	Pw	Pw
Lowton	LWN	xbxx, xxxx	Ps	Va	Paw	Vw	Paw	Paw	Vhw	Pw	Psw	G	Vhk	Psw	Psw	Psw	Psw
		xcxx	Ps	Va	Paw	Vw	Paw	Paw	Vhw	Pw	Psw	Ft	Vhk	Psw	Psw	Psw	Psw
		xxxs	Pns	Va	Paw	Vw	Paw	Paw	Vhw	Pw	Psw	G	Vhk	Psw	Psw	Psw	Psw
		xxxt	Vn	Va	Paw	Vw	Paw	Paw	Vhw	Pw	Psw	G	Vhk	Pnw	Pnw	Pnw	Psw
Mansfield	MFI	xbxx, xcxx xxxx	Ps	G	Fw	Pw	Fw	Fw	Vks	Vkg	Vcs	Vck	Fhg	Pq	Fsw	Fsw	Fw
Manson	MXD	xcxx	Ps	Va	Pa	Pa	Pa	Pa	Ps	Fi	Ps	Ft	Vk	Fst	Fs	Fis	Fs
		xxxx	Ps	Va	Pa	Pa	Pa	Pa	Ps	Fi	Ps	G	Vk	Fks	Fs	Fis	Fs
Marringhurst	MRH	1exx	Pst	G	G	Ft	Ft	Ft	Vks	Vkg	Vcs	Vkt	Ftg	Vqt	Fst	Fst	G
		2cxx	Vb	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pq	Fms	Fs	G
		xc4x	Pbp	Pp	Pp	Pp	Fp	Pp	Vks	Vkg	Vcs	Vck	Gg	Ppq	Pp	Pp	Pp
		1cxx, xcxx xxxx, xc1x	Pbs	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pq	Fms	Fs	G
		xdxx	Pbs	G	G	G	G	G	Vks	Vkg	Vcs	Vck	Gg	Pqt	Fms	Fs	G
		xx2x	Pbs	G	G	Fp	G	G	Vks	Vkg	Vcs	Vck	Gg	Pq	Fms	Fps	G
Marsden	MDN	xxxs	Pn	Pax	Pw	Vw	Pw	Pw	Vwg	Phw	Pw	Pkg	Vhg	Pw	Pw	Pw	Pw
Marsh	$MH	xxxx	Vw	Vah	Vhw	Vhw	Vhw	Vaw	Vhw	Vhw	Vw	Vhi	Vhi	Vsw	Vsw	Vsw	Vw
Miniota	MXI	xcxx	Fb	Faq	G	G	G	G	Vks	Vkg	Pcq	Vak	Gg	Fqt	Fms	G	G
		xdxx	Fbt	Faq	G	G	G	G	Vks	Vkg	Pcq	Vak	Gg	Pt	Fms	G	G
		xexx	Pt	Faq	G	Ft	Ft	Ft	Vks	Vkg	Pcq	Vkt	Ftg	Vt	Fmt	Fst	G

Table A8-6. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Moore Park	MPK	xcxx	Fbs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
Mowbray	MOW	1cxx	Fis	Va	Fa	Fa	Fa	Fa	Fis	Fi	Fs	Fkt	Fk	Fst	Fs	Fis	Fs
Onahan	ONH	xxxx	Ps	Pa	Fw	Pw	Fw	Fw	Vks	Vkg	Pq	Vkg	Fhg	Fsw	Fsw	Fsw	Fw
Petrel	PTR	xxxx	G	Pa	Faw	Pw	Faw	Faw	Vks	Fwg	Pq	Vkg	Fhg	Fw	Fw	Fw	Fw
Pleasant	PLE	xbxt	Vn	Va	Fw	Pw	Faw	Faw	Pkw	Pkg	G	Pk	Fh	Pn	Pn	Pn	Fw
		xbxx, xxxx	G	Va	Fw	Pw	Faw	Faw	Pkw	Pkg	G	Pk	Fh	Fw	Fw	Fw	Fw
		xcxs	Pn	Va	Fw	Pw	Faw	Faw	Pkw	Pkg	G	Pk	Fh	Fnt	Fnw	Fnw	Fw
		xcxx	G	Va	Fw	Pw	Faw	Faw	Pkw	Pkg	G	Pk	Fh	Ftw	Fw	Fw	Fw
		xxxs	Pn	Va	Fw	Pw	Faw	Faw	Pkw	Pkg	G	Pk	Fh	Fnw	Fnw	Fnw	Fw
Poolex	POX	xbxs, xcxs xxxs	Pn	Va	Phw	Vw	Pw	Pw	Vhw	Pkw	Pw	Vh	Vh	Pw	Pw	Pw	Pw
		xbxx, xxxx xcxx	Fb	Va	Phw	Vw	Pw	Pw	Vhw	Pkw	Pw	Vh	Vh	Pw	Pw	Pw	Pw
		xxxt	Vn	Va	Phw	Vw	Pw	Pw	Vhw	Pkw	Pw	Vh	Vh	Pnw	Pnw	Pnw	Pw
Porple	POR	1cxx	Pb	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pk	G	Ft	G	G	G
		1dxx	Pb	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pkt	G	Pt	G	G	G
		1xxx	Pb	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pk	G	G	G	G	G
		xcxx	G	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pk	G	Ft	G	G	G
		xdxx	Ft	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pkt	G	Pt	G	G	G
		xxxx	G	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pk	G	G	G	G	G
Prodan	PDA	xbxs, xxxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fnw	Fnw	Fnw	Fsw
		xbxx, xxxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fnt	Fnw	Fnw	Fsw
		xcxx	Fs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
		xdxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Pt	Phk	Pt	Fnw	Fnw	Fsw
		xdxx	Fst	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Pt	Phk	Pt	Fsw	Fsw	Fsw
		xexx	Pt	Va	Faw	Pw	Ftw	Ftw	Pw	Ftw	Fst	Vt	Phk	Vt	Ftw	Ftw	Fsw
		xxxt	Vn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Pn	Pn	Pn	Fsw
Prosser	PSE	1cxx	Fb	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pk	G	Ft	G	G	G
		1dxx	Fbt	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pkt	G	Pt	G	G	G
		1xxx	Fb	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pk	G	G	G	G	G
		xbxx, xxxx	G	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pk	G	G	G	G	G
		xcxx	G	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pk	G	Ft	G	G	G
		xdxx	Ft	Va	G	Fa	Fa	Fa	Pk	Pk	G	Pkt	G	Pt	G	G	G
Ramada	RAM	1cxx, xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1dxx, xdxx	Fst	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs

Table A8-7. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Ramada	RAM	xbxx, xxxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		1exx, xexx	Pt	Va	Fa	Fat	Fat	Fat	Fs	Ft	Fst	Vt	Pk	Vt	Fst	Fst	Fs
Rempel	RMP	1cxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1dxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		1x1x	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xdxx	Fst	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		xexx	Pt	Va	Fa	Fat	Fa	Fat	Fs	Ft	Fst	Vt	Pk	Vt	Fst	Fst	Fs
Roddan	ROD	2d1x, xdxx	Vb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Pt	Fs	Fs	Fs
		xcxx	Vb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fst	Fs	Fs	Fs
Rufford	RUF	1c1x, 1cxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		1dxx	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		1e1x	Pbt	Va	Fa	Fat	Fat	Fat	Fs	Ft	Fst	Vt	Pk	Vt	Fst	Fst	Fs
		1x1x	Pb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fak	Pk	Fs	Fs	Fs	Fs
		2c1x, 2cxx	Vb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		2d1x, 2dxx	Vb	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
		2e1x	Vb	Va	Fa	Fat	Fat	Fat	Fs	Ft	Fst	Vt	Pk	Vt	Fst	Fst	Fs
		2fxx	Vbt	Va	Fat	Pt	Pt	Pt	Fst	Pt	Pt	Vt	Pkt	Vt	Pt	Pt	Fst
		xcxx	Fs	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Fkt	Pk	Fst	Fs	Fs	Fs
		xdxx	Fbt	Va	Fa	Fa	Fa	Fa	Fs	G	Fs	Pt	Pk	Pt	Fs	Fs	Fs
Sewell	SEE	xbxx, xxxs xxxx	Ps	Pa	Pw	Vhw	Phw	Pw	Vwg	Vhk	Pqw	Vkg	Vhg	Pw	Pw	Pw	Pw
Shilox	SHX	xcxx, xxxx	Vb	Fa	G	G	G	G	Vks	Vk	Pq	Vkg	Gg	Pm	Pm	Fs	Ps
		xdxx	Vb	Fa	G	G	G	G	Vks	Vk	Pq	Vkg	Gg	Pmt	Pm	Fs	Ps
		xexx	Vb	Fa	G	Ft	Ft	Ft	Vks	Vk	Pq	Vkt	Ftg	Vt	Pm	Fst	Ps
Sigmund	SGO	xcxs	Pns	Va	Pa	Paw	Pa	Pa	Psw	Fw	Ps	Ft	Vk	Pks	Psw	Pks	Ps
		xcxx	Ps	Va	Pa	Paw	Pa	Pa	Psw	Fw	Ps	Ft	Vk	Pks	Psw	Pks	Ps
		xxxx	Ps	Va	Pa	Paw	Pa	Pa	Psw	Fw	Ps	G	Vk	Pks	Psw	Pks	Ps
		1cxx, xcxx	Ps	Pa	G	G	G	G	Vks	Vkg	Pq	Vkg	Gg	Fst	Fms	Fs	G
Stockton	SCK	1xxx, xbxx xxxx	Ps	Pa	G	G	G	G	Vks	Vkg	Pq	Vkg	Gg	Fms	Fms	Fs	G
		xdxx	Ps	Pa	G	G	G	G	Vks	Vkg	Pq	Vkg	Gg	Pt	Fms	Fs	G
Tadpole	TDP	xbxx, xxxx xcxx	Fs	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xcxs, xxxs	Pn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xxxu	Vn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Vn	Vn	Vn	Pw

Table A8-8. Suitability Ratings of Soils for Selected Engineering and Recreational Uses

Soil name	Soil code	Soil phases	Top soil	Sand & gravel	Road fill	Building - basement		Local roads/ streets	Sanitary trench	Land-fill area	Cover material	Sewage lagoon	Septic field	Play ground	Picnic area	Camp area	Paths & trails
						with	without										
Taggart	TGR	xbxx, xxxx	G	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Fw	Fw	Fw	Fw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Fnt	Fnw	Fnw	Fw
		xcxt	Vn	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Pn	Pn	Pn	Fw
		xcxx	G	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Ftw	Fw	Fw	Fw
		xdxs	Pn	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Ptg	Ph	Pt	Fnw	Fnw	Fw
		xdxx	Ft	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Ptg	Ph	Pt	Fw	Fw	Fw
		xxxs	Pn	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Fnw	Fnw	Fnw	Fw
		xxxu	Vn	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Vn	Vn	Vn	Fw
Torcan	TOC	xbxx, xxxx	G	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Fw	Fw	Fw	Fw
		xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Fnt	Fnw	Fnw	Fw
		xcxx	G	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Ftw	Fw	Fw	Fw
		xdxs	Pn	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Pt	Ph	Pt	Fnw	Fnw	Fw
		xdxx	Ft	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Pt	Ph	Pt	Fw	Fw	Fw
		xxxs	Pn	Va	Faw	Pw	Faw	Faw	Pwg	Fwg	G	Fkg	Ph	Fnw	Fnw	Fnw	Fw
Traverse	TAV	1cxx	Pb	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	Fs	Fs	Fs	Fs
		1dxx, xdxx	Ft	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Ptg	Fk	Pt	Fs	Fs	Fs
		xbxx, xxxx	G	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	Fs	Fs	Fs	Fs
		xcxx	G	Va	Fa	Fa	Fa	Fa	Gg	Gg	G	Fkg	Fk	Fst	Fs	Fs	Fs
		xexx	Pt	Va	Fa	Fat	Fat	Fat	Gg	Ftg	Ft	Vtg	Fkt	Vt	Fst	Fst	Fs
Varcoe	VRC	xcxs	Pn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Fnt	Fnw	Fnw	Fsw
		xcxt	Vn	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Pn	Pn	Pn	Fsw
		xcxx	Fbs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fkt	Phk	Ftw	Fsw	Fsw	Fsw
		xxxx	Fbs	Va	Faw	Pw	Faw	Faw	Pw	Fw	Fs	Fak	Phk	Fsw	Fsw	Fsw	Fsw
Vodroff	VFF	xbxs, xcxs xxxs	Pn	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Vodroff	VFF	xbxx, xcxx xxxx	Fs	Va	Pw	Vw	Pw	Pw	Vhw	Pw	Pw	Ph	Vh	Pw	Pw	Pw	Pw
Vordas	VDS	xbxx, xcxx xxxx	G	Va	Pw	Vw	Pw	Pw	Vhw	Pwg	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xcxs, xxxs	Pn	Va	Pw	Vw	Pw	Pw	Vhw	Pwg	Pw	Ph	Vh	Pw	Pw	Pw	Pw
		xxxt	Vn	Va	Pw	Vw	Pw	Pw	Vhw	Pwg	Pw	Ph	Vh	Pnw	Pnw	Pnw	Pw
Wellwood	WWD	1cxx	Fbs	Faq	Fa	G	Fa	Fa	Vks	Gg	Fs	Pkg	Fkg	Fst	Fs	Fs	Fs
Wheatland	WHL	xcxx	Ps	G	G	G	G	G	Vks	Vkg	Vq	Vkg	Gg	Fst	Fms	Fs	G
		xxxx	Ps	G	G	G	G	G	Vks	Vkg	Vq	Vkg	Gg	Fms	Fms	Fs	G
Wytonville	WVI	xxxx	Fb	Faq	Fw	Pw	Faw	Fw	Vks	Vkg	Pcq	Vak	Phg	Fqw	Fw	Fw	Fw

Table A9. Guide for Assessing Soil Suitability as a Source of Topsoil

The term topsoil includes soil materials used to cover barren surfaces exposed during construction, and materials used to improve soil conditions on lawns, gardens and flower beds. The factors to be considered include not only the characteristics of the soil itself, but also the ease or difficulty of excavation, and where removal of topsoil is involved, accessibility to the site.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
u	**Moist Consistency[2]**	Very friable, friable	Loose, firm	Very firm	Cemented
i	**Flooding**	None	May flood occasionally for short periods	Frequent flooding (every year)	Constantly flooding
w	**Wetness[2]**	Wetness is not determining if better than very poorly drained.			Very poorly drained and permanently wet soils
t	**Slope**	≤5% (a, b, c)	> 5 - 9% (d)	> 9 - 15% (e)	> 15% (f, g, h, i, j)
p	**Stoniness[2]**	Stones > 10 m apart (Class 0 and 1)	Stones > 2 - 10 m apart (Class 2)	Stones 0.1 - 2 m apart (Class 3 and 4)	Stones < 0.1 m apart (Class 5)
c	**Coarse fragments[2] (% by volume)**	≤ 3%	> 3 - 15%	> 15 - 35%	> 35%
s	**Texture[2]**	SL, FSL, VFSL, L, SiL; SC if 1:1 clay is dominant	SCL, CL, SiCL; SC if 2:1 clay is dominant; C and SiC if 1:1 clay is dominant	S, LS; SiC and C if 2:1 clay is dominant. organic soils[3]	Marl, diatomaceous earth
b	**Depth of Topsoil[4]**	> 40 cm	> 15 - 40 cm	8 - 15 cm	< 8 cm
n	**Salinity of Topsoil[5]**	EC < 1	EC 1 - 4	EC > 4 - 8 (s)	EC > 8 (t, u)

1 The symbol is used to indicate the property affecting use.
2 For an explanation of texture, consistence, stoniness, coarse fragments and soil drainage classes, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
3 Non-woody organic materials are assessed as good sources for topsoil if mixed with or incorporated into mineral soil.
4 The remaining soil material (at least 8 cm) must be reclaimable after the uppermost soil is removed.
5 EC = Electrical Conductivity (milliSiemens/cm).

Additional Notes:
Well drained Till soils with erosion 1, rated as **Fb** for depth of topsoil; erosion 2 rated as **Pb** for depth of topsoil; and erosion 3 rated as **Vb** for depth of topsoil.
Well drained Luvisols and Dark Gray Chernozems with erosion 2 or 3 rated as **Vb** for depth of topsoil.
Regosols rated as **Vb** for depth of topsoil.
Poorly drained Organic soils rated as **Vw** for topsoil and Organic soils, drained phase, are rated as **Ps** for topsoil.

Table A10. Guide for Assessing Soil Suitability as a Source of Sand and Gravel

The purpose of this table is to provide guidance for assessing the probable supply as well as quality of the sand or gravel for use as road base material and in concrete. The interpretation pertains mainly to the characteristics of substratum to a depth of 150 cm, augmented by observations made in deep cuts as well as geological knowledge where available.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
a	**Unified Soil Group** [2]	GW GP SW SP	GW - GM GP - GM SW - SM SP - SM	GM GW - GC GP - GC SM SW - SC SP -SC	All other groups and bedrock (ML, CL, OL, MH, CH, OH, PT)
h	**Depth to Seasonal Water Table**	Not class determining if deeper than 50 cm		< 50 cm	
q	**Depth to Sand and Gravel**	< 25 cm	25 - 75 cm [3]	> 75 cm [3]	
p	**Stoniness**[4]	Not class determining if stones > 0.5 m apart (Class 0, 1, 2 and 3)		Stones 0.1 - 0.5 m apart (Class 4)	Stones < 0.1 m apart (Class 5)
d	**Depth to Bedrock**	> 100 cm	50 - 100 cm	< 50 cm	
x	**Thickness of sand and gravel**	> 100 cm	50 - 100 cm	< 50 cm	

1 The symbol is used to indicate the property affecting use.
2 Shaly gravels rated as Poor (Pa). Meanings of the definition letters can be found at http://en.wikipedia.org/wiki/Unified_Soil_Classification_System
3 Rated good if it is known that the underlying gravel or sand deposit is thick (> 100 cm).
4 For an explanation of stoniness and rockiness, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).

Table A11. Guide for Assessing Soil Suitability as a Source of Roadfill

Fill material for building or roads are included in this use. The performance of the material when removed from its original location and placed under load at the building site or road bed are to be considered. **Since surface materials are generally removed during road or building construction, their properties are disregarded**. Aside from this layer, **the whole soil to a depth of 150-200 cm should be evaluated.** Soil materials which are suitable for fill can be considered equally suited for road subgrade construction.

Symbol[1]	Property Affecting Use[2]	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
a	**Subgrade[3]** **a.) AASHO Group Index[4]** **b.) Unified Soil Group**	< 5 GW, GP, SW, SP SM, GC[5] and SC[5]	5 - 8 CL (with P.I.[6] <15) and ML	> 8 CL (with P.I.[6] of 15 or more), CH and MH[7]	 OL, OH and PT
l	**Shrink-swell potential**	Low	Moderate	High	
f	**Susceptibility to frost action[8]**	Low	Moderate	High	
t	**Slope**	≤15% (a, b, c, d, e)	> 15 - 30% (f)	> 30 - 45% (g)	> 45% (h, i, j)
p	**Stoniness[9]**	Stones > 2 m apart (Class 0, 1 and 2)	Stones > 0.5 - 2 m apart (Class 3)	Stones 0.1 - 0.5 m apart (Class 4)	Stones < 0.1 m apart (Class 5)
r	**Rockiness[9]**	Rock exposures > 35 m apart and cover < 10% of the surface	Rock exposure > 10 - 35 m apart and cover 10 - 25% of the surface	Rock exposure 3.5 - 10 m apart and cover > 25 - 50% of the surface	Rock exposure < 3.5 m apart and cover > 50 - 90% of the surface
w	**Wetness[9]**	Excessively drained to moderately well drained	Imperfectly drained	Poorly drained	Very poorly drained or permanently wet soils
d	**Depth to Bedrock**	> 100 cm	> 50 - 100 cm	20 - 50 cm	< 20 cm
h	**Depth to Seasonal Water Table**	> 150 cm	> 75 - 150 cm	50 - 75 cm	< 50 cm

1 The symbol is used to indicate the property affecting use.
2 The first, three properties pertain to soil after it is placed in a fill; the last six properties pertain to soil in its natural condition before excavation for road fill.
3 This property estimates the strength of the soil material, that is, its ability to withstand applied loads.
4 Use AASHO group index only where laboratory data are available for the kind of soil being rated; otherwise, use Unified Soil Groups.
5 Downgrade suitability rating to fair if content of fines is more than about 30 per cent.
6 P.I. means plasticity index.
7 Upgrade suitability rating to fair if MH is largely kaolinitic, friable, and free of mica.
8 Use this property only where frost penetrates below the paved or hardened surface layer and where moisture transportable by capillary movement is sufficient to form ice lenses at the freezing front.
9 For an explanation of stoniness, rockiness and soil drainage classes, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).

Table A12. Guide for Assessing Soil Suitability for Permanent Buildings[1]

This guide applies to undisturbed soils to be evaluated for single-family dwellings and other structures with similar foundation requirements. The emphasis for rating soils for buildings is on foundation requirements. But soil slope, susceptibility to flooding and other hydrologic conditions, such as wetness, that have effects beyond those related exclusively to foundations are considered as well. Also considered are soil properties, particularly depth to bedrock, which influence excavation, landscaping and septic tank absorption fields.

Symbol[2]	Property Affecting Use	Degree of Soil Suitability[3]			
		Good - G	**Fair - F**	**Poor - P**	**Very Poor - V**
w	**Wetness[4]**	With Basements: Very rapidly, rapidly and well drained Without Basements: Very rapidly, rapidly well and moderately well drained	With Basements: Moderately well drained Without Basements: Imperfectly drained	With Basements: Imperfectly drained Without Basements: Poorly drained	With Basements: Poorly, and very poorly drained Permanently wet soils Without Basements: Very poorly drained Permanently wet soils.
h	**Depth to Seasonal Water Table**	With Basements: > 150 cm Without Basements: > 75 cm	With Basements: > 75 - 150 cm Without Basements: > 50 - 75 cm	With Basements: 25 - 75 cm Without Basements: 25 - 50 cm	With Basements: < 25 cm Without Basements: < 25 cm
i	**Flooding**	None	None	Occasional flooding or ponding (once in 5 years)	Frequent flooding or ponding (every year)
t	**Slope[5]**	≤ 9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
a	**Subgrade[6]** **a.) AASHO Group Index[7]** **b.) Unified Soil Group**	< 5 GW, GP, SW, SP, GC, SM and SC	5 - 8 CL (with P.I.[8] < 15) and ML	> 8 CL (with P.I.[8] of 15 or more), CH and MH	OH, OL and PT
f	**Potential Frost Action[9, 13]**	Low (F1, F2)	Moderate (F3)	High (F4)	
p	**Stoniness[4]**	Stones > 10 m apart (Class 0 to 1)	Stones > 2 - 10 m apart (Class 2[10])	Stones 0.1 - 2 m apart (Class 3[10] to 4)	Stones < 0.1 m apart (Class 5[10])
r	**Rockiness[4,11]**	Rock exposure > 100 m apart and cover < 2% of the surface	Rock exposure 30 - 100 m apart and cover 2 - 10% of the surface	Rock exposure < 30 m apart and cover > 10% of the surface	Rock exposure too frequent to allow location of permanent buildings
d	**Depth to Bedrock[11]**	With Basements: > 150 cm Without Basements: > 100 cm	With Basements: > 100 - 150 cm Without Basements: 50 - 100 cm	With Basements: 50 - 100 cm Without Basements: < 50 cm	With Basements: < 50 cm

1 By halving the slope limits, this table can be used for evaluating soil suitability for buildings with large floor areas, but with foundation requirements not exceeding those of ordinary three-storey dwellings.

2 The symbol is used to indicate the property affecting use.

3 Some soils are assessed as fair or poor sites from an aesthetic or use standpoint, but they will require more site preparation or maintenance.

4 For an explanation of rockiness, stoniness and soil drainage classes, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).

5 Reduce the slope limits by one-half for those soils subject to hillside slippage.

6 This property estimates the strength of the soil, that is, its ability to withstand applied loads. When available, AASHO Group Index values from laboratory tests were used; otherwise the estimated Unified Soil Groups were used.

7 Group Index values were estimated from information published by the Portland Cement Association (PCA, 1962), pp. 23 - 25.

8 P.I. means plasticity index.

9 Frost heave only applies where frost penetrates to the assumed depth of the footings and the soil is moist. The potential frost action classes are taken from the United States Army Corps of Engineers (1962), pp. 5 - 8. Use **z** for permanently frozen soils.

10 Rate one class better for building without basements.

11 Rate one class better if the bedrock is soft enough so it can be dug with light power equipment, such as backhoes.

Table A13. Guide for Assessing Soil Suitability for Local Roads and Streets[1]

This guide applies to soils to be evaluated for construction and maintenance of local roads and streets. These are improved roads and streets having some kind of all-weather surfacing, commonly asphalt or concrete, and are expected to carry automobile traffic all year. They consist of: (1) the underlying local soil material (either cut or fill) called the subgrade; (2) the base material of gravel, crushed rock, lime or soil cement, stabilized soil called the subbase; and (3) the actual road surface or pavement, either flexible or rigid. They are also graded to shed water and have ordinary provisions for drainage. With the probable exception of the hardened surface layer, the roads and streets are built mainly from the soil at hand, and cuts and fills are limited, usually less than 2 metres. Excluded from consideration in this guide are highways designed for fast moving, heavy trucks.

Properties that affect design and construction of roads and streets are those that affect the load supporting capacity and stability of the subgrade, and those that affect the workability and amount of cut and fill. The AASHO and Unified Classification give an indication of the traffic supporting capacity. Wetness and flooding affect stability. Slope, depth of bedrock, stoniness, rockiness, and wetness affect the ease of excavation, and the amount of cut and fill to reach an even grade.

Symbol[2]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	**Wetness[3]**	Very rapidly, rapidly, well and moderately well drained	Imperfectly drained	Poorly and very poorly drained	Permanently wet soils
i	**Flooding**	None	Infrequent (once in 5 years)	Occasional (once in 2 - 4 years)	Frequent (every year)
t	**Slope**	≤ 9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
d	**Depth to Bedrock[4]**	> 100 cm	50 - 100 cm	< 50 cm	
a	**Subgrade[5]** **a.) AASHO Group Index[6]**	< 5	5 - 8	> 8	
	b.) Unified Soil Group	GW, GP, GC[7], SW, SP, SM, and SC[7]	CL (with P.I.[8] < 15) and ML	CL (with P.I.[8] of 15 or more), CH and MH	OH, OL and PT and loose sand with high organic matter
f	**Susceptibility to Frost Heave[9]**	Low (F1, F2)	Moderate (F3)	High (F4)	
p	**Stoniness[3]**	Stones > 2 m apart (Class 0 to 2)	Stones > 0.5 - 2 m apart (Class 3)	Stones 0.1 - 0.5 m apart (Class 4)	Stones < 0.1 m apart (Class 5)
r	**Rockiness[3]**	Rock exposures > 100 m apart and cover < 2% of the surface	Rock exposures 30 -100 m apart and cover 2 - 10% of the surface	Rock exposures < 30 m apart and cover >10% of the surface	Rock exposures too frequent to permit location of roads and streets

1 These guidelines, with some adjustments of slope and rockiness limits, will also be useful for assessing soils for use as parking lots.
2 The symbol is used to indicate the property affecting use.
3 For an explanation of stoniness, rockiness and soil drainage classes, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
4 Rate one class better if the bedrock is soft enough so it can be dug with light power equipment and is rippable by machinery.
5 This property estimates the strength of soil materials as it applies to roadbeds. When available, AASHO Group Index values from laboratory tests were used; otherwise, the estimated Unified Soil Groups were used. The limitations were estimated assuming that the roads would be surfaced. On unsurfaced roads, rapidly drained, very sandy, poorly graded soils may cause washboard or rough roads.
6 Group index values were estimated from information published by the Portland Cement Association (PCA, 1962) pp. 23 - 25.
7 Downgrade to moderate if content of fines (less than 200 mesh) is greater than about 30 per cent.
8 P.I. means plasticity index.
9 Frost heave is important where frost penetrates below the paved or hardened surface and moisture movement by capillary action sufficient to form ice lenses at the freezing point. The susceptibility classes are taken from the United States Army Corps of Engineers (1962) pp. 5 - 8.

Table A14. Guide for Assessing Soil Suitability for Trench-type Sanitary Landfills[1]

The trench-type sanitary landfill involves the daily burial of dry garbage and trash in an open trench that is covered with a layer of soil material. Suitability of the site depends on the potential for pollution of water sources through groundwater contact with the refuse, or leachate arising from the site. Those properties affecting ease of excavation of the site must be supplemented with geological and hydrological knowledge to provide subsurface soil and groundwater data to a depth of at least 3 to 4.5 m, a common depth of landfills.

Symbol[2]	Property Affecting Use	Degree of Soil Suitability			
		Good - G[3]	Fair - F	Poor - P	Very Poor - V
h	**Depth to Seasonal High Water Table**	Not class determining if deeper than 180 cm		100 - 180 cm	< 100 cm
w	**Wetness[4]**	Not class determining if better than imperfectly drained		Imperfectly drained	Poorly and very poorly drained or permanently wet soils
i	**Flooding**	None	Rare	Occasional (Once in 2 - 4 years)	Frequent (Every year)
k	**Permeability[4,5,8]**	< 5 cm/hr	< 5 cm/hr	5 - 15 cm/hr	> 15 cm/hr
t	**Slope**	≤ 15% (a, b, c, d, e)	> 15 - 30% (f)	> 30 - 45% (g)	> 45% (h, i, j)
s	**Soil Texture[4,6] (dominant to a depth of 150 cm)**	Si, SiL, L, SCL, VFSL, SL, LVFS, LFS, VFS	SiCL[7], CL, SC, LS	SiC, C	Muck, peat, sand (CoS, MS, FS) and gravel
d	**Depth to Hard Bedrock**	> 150 cm	> 150 cm	100 - 150 cm	< 100 cm
	Rippable Bedrock	> 150 cm	100 - 150 cm	100 - 150 cm	< 100 cm
p	**Stoniness[4]**	Stones > 10 m apart (Class 0 and 1)	Stones > 2 - 10 m apart (Class 2)	Stones 0.1 - 2 m apart (Class 3 and 4)	Stones < 0.1 m apart (Class 5)
r	**Nature of Bedrock**	Impermeable			Highly permeable, fractured, easily soluble.

1 Based on soil depth (120 cm) commonly investigated in making soil surveys.
2 The symbol is used to indicate the property affecting use.
3 If probability is high that the soil material to a depth of 3 to 4.5 m will not alter a rating of good or fair, indicate this by an appropriate footnote, such as "Probably good to a depth of 3.5 m", or "Probably fair to a depth of 3.5 m".
4 For an explanation of stoniness, texture and soil drainage classes, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
5 Reflects ability of soil to retard movement of leachate from the landfills; may not reflect a limitation in arid and semiarid areas.
6 Reflects ease of digging, moving (workability) and trafficability in the immediate area of the trench where there may not be surfaced roads.
7 Soil high in expansive clays may need to be given a suitability rating of poor.
8 Contamination hazard (**g**) may apply at high permeability.

Table A15. Guide for Assessing Soil Suitability for Area-type Sanitary Landfills

In the area-type sanitary landfill, refuse is placed on the surface of the soil in successive layers. The daily and final cover material is generally imported. A final cover of soil material at least 60 cm thick is placed over the fill when it is completed.

The soil under the proposed site should be investigated to determine the probability that leachates from the landfill may penetrate the soil and pollute water supplies.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
h	**Depth to Seasonal Water Table[2]**	> 150 cm	> 100 - 150 cm	50 - 100 cm	< 50 cm
w	**Wetness[2,3]**	Rapid to moderately well drained	Imperfectly drained	Poorly drained	Very poorly drained or permanently wet soils
i	**Flooding**	None	Rare	Occasional (Once in 2 - 4 years)	Frequent (Every year)
k	**Permeability[4,5,6]**	Not class determining if less than 5 cm/hr		5 - 15 cm/hr	> 15 cm/hr
t	**Slope**	≤ 9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)

1 The symbol is used to indicate the property affecting use.
2 Reflects influence of wetness on operation of equipment.
3 For an explanation of drainage, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
4 Reflects ability of the soil to retard movement of leachate from landfills; may not reflect a limitation in arid and semiarid areas.
5 Because of possible groundwater contamination, impermeable bedrock is considered poor and permeable bedrock is rated very poor.
6 Contamination hazard (**g**) may apply at high permeability or proximity of the site to water supplies.

Table A16. Guide for Assessing Soil Suitability as Cover Material for Area-type Sanitary Landfills

The term cover material includes soil materials used to put a daily and final covering layer in area-type sanitary landfills. This cover material may be derived from the area of the landfill or may be brought in from surrounding areas.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
u	**Moist Consistence[2]**	Very friable, friable	Loose, firm	Very firm	Cemented
s	**Texture[2,3]**	Si, SiL, SCL, L, VFSL, FSL, LVFS, VFS	SiCL, CL, SC, LFS, LS	SiC, C	Muck, peat, sand, gravel
d	**Depth to bedrock[4]**	> 150 cm	> 100 - 150 cm	50 - 100 cm	< 50 cm
c	**Coarse fragments[2] (% by volume)**	≤ 15%	> 15 - 35%	> 35%	
p	**Stoniness[2]**	Stones > 10 m apart (Class 0 and 1)	Stones > 2 - 10 m apart (Class 2)	Stones 0.1 - 2 m apart (Class 3 and 4)	Stones < 0.1 m apart (Class 5)
t	**Slope**	≤ 9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
w	**Wetness[2]**	Not class determining if better than poorly drained.		Poorly drained	Very poorly drained or permanently wet soils.
q	**Depth to Sand and Gravel**	> 1.5 m	1 - 1.5 m	< 1 m	

1 The symbol is used to indicate the property affecting use.
2 For an explanation of consistence, texture, coarse fragments, stoniness and soil drainage classes, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
3 Soils having a high proportion of non-expansive clays may be given a suitability rating one class better than is shown for them in this table.
4 Thickness of material excluding topsoil, which will be stockpiled (see guide for topsoil).

Table A17. Guide for Assessing Soil Suitability for Reservoirs and Sewage Lagoons

Factors affecting the ability of undisturbed soils to impound water or sewage and prevent seepage, are considered for evaluating the suitability of soils for reservoir and lagoon areas. This evaluation considers soil both as a vessel for the impounded area and as material for the enclosing embankment. As the impounded liquids could be **potential sources of contamination of nearby water supplies**, e.g. sewage lagoons, the landscape position of the reservoir as it affects risk of flooding must also be considered.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
h	**Depth to Water Table[2]**	> 150 cm	> 100 - 150 cm	50 - 100 cm	< 50 cm
i	**Flooding[3]**	None	None	Subject to infrequent flooding (once in 50 years)	Subject to frequent high level flooding
k	**Soil Permeability[4]**	< 0.05 cm/hr	0.05 - 0.5 cm/hr	> 0.5 - 5 cm/hr	> 5 cm/hr
t	**Slope**	≤ 2% (a, b)	> 2 - 5% (c)	> 5 - 9% (d)	> 9% (e, f, g, h, i, j)
o	**Organic Matter**	≤ 2 %	> 2 - 10%	> 10 - 30%	> 30%
c	**Coarse Fragments[5] < 25 cm in diameter, (% by volume)**	≤ 20%	> 20 - 35%	> 35%	
p	**Stoniness[5], >25 cm diameter, (% of surface area)**	≤ 3% (Class 0, 1 and 2)	> 3 - 15% (Class 3)	> 15 - 50% (Class 4)	> 50% (Class 5)
d	**Depth to Bedrock[6]**	> 150 cm	> 100 - 150 cm	50 - 100 cm	< 50 cm
j	**Thickness of Slowly Permeable Layer**	> 100 cm	> 50 - 100 cm	50 - 25 cm	< 25 cm
a	**Sub-grade Unified Soil Group**	CH	GC, SC and CL	GM, SM, ML & MH	GW, GP, SW & SP, OL, OH & PT

1 The symbol is used to indicate the property affecting use.
2 If the floor of the lagoon has nearly impermeable material at least 50 cm thick, disregard depth to water table.
3 Disregard flooding if it is not likely to enter or damage the lagoon (flood waters have low velocity and depth less than 150 cm).
4 Contamination hazard (**g**) may apply at high permeability or proximity of the site to water supplies.
5 For an explanation of coarse fragments and stoniness classes, see the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
6 Surface exposures of non rippable rock are rated poor. If underlying bedrock is impermeable, rating should be one class better.
7 Material must be capable of compaction to 10^{-7} m/sec (0.04 cm/hr) for use as liner or embankment.

Table A18. Guide for Assessing Soil Suitability for Septic Tank Absorption Fields

This guide applies to soils to be used as an absorption and filtering medium for effluent from septic tank systems. A subsurface tile system laid in such a way that effluent from the septic tank is distributed reasonably uniformly into the natural soil is assumed when applying this guide. A rating of poor does not mean a septic system should not be installed in the given soil, but rather, may suggest the difficulty, in terms of installation and maintenance, which can be expected.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
k	**Permeability**[2,7]	Rapid to moderately rapid	Moderate	Slow	Very Slow
	Percolation Rate[3] **(Auger hole method)**	≤ 8 - 18 min/cm (> 3.3 - 7.5 cm/hr)	> 18 - 24 min/cm (2.5 - 3.3 cm/hr)	> 24 min/cm (< 2.5 cm/hr)	
h	**Depth to Seasonal Water Table**[4]	> 150 cm [5]	> 100 - 150 cm	50 - 100 cm	< 50 cm
i	**Flooding**	Not subject to flooding	Not subject to flooding	Subject to occasional flooding (once in 5 years)	Floods every year
t	**Slope**	≤ 9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
d	**Depth to Hard Rock, bedrock or other impervious materials**	> 150 cm	> 100 - 150 cm[6]	50 - 100 cm	< 50 cm

1 The symbol is used to indicate the property affecting use.
2 The suitability ratings should be related to the permeability of soil layers at and below depth of the graded filter bed (50 - 75 cm depth).
3 Soils having a percolating rate less than about 8 min/cm are likely to present a pollution hazard to adjacent waters. This hazard must be noted, but the degree of hazard must, in each case, be assessed by examining the proximity of the proposed installation to water bodies, water table, and related features**. The symbol g is used to indicate this condition.** Refer to U.S. Dept. of Health, Education and Welfare (1969) for details of this procedure.
4 Seasonal means for more than one month. It may, with caution, be possible to make some adjustment for the severity of a water table limitation in those cases where seasonal use of the facility does not coincide with the period of high water table.
5 A seasonal water table should be at least 100 cm below the bottom of the trench at all times for soils rated Good (U.S. Dept. of Health, Education and Welfare, 1969). The depths used to water table are based on an assumed tile depth of 50 cm. Where relief permits, the effective depth above a water table or rock can be increased by adding appropriate amounts of fill.
6 Where the slope is greater than 9 per cent, a depth to bedrock of 100 - 150 cm is assessed as Poor.
7 Contamination hazard (**g**) may apply at high permeability, e.g. (Gg).

Table A19. Guide for Assessing Soil Suitability for Playgrounds

This guide applies to soils to be used intensively for playgrounds, football, badminton and for other similar organized games. These areas are subject to intensive foot traffic. A nearly level surface, good drainage, and a soil texture and consistence that provide a firm surface generally are required. The most desirable soils are free of rock outcrops and coarse fragments.
Soil suitability for growing and maintaining vegetation is not a part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of the site.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	**Wetness[2]**	Rapidly, well and moderately well drained soils with no ponding or seepage. Water table below 75 cm during season of use.	Moderately well drained soils subject to occasional ponding or seepage for short duration and imperfectly drained soils. Water table below 50 cm during season use.	Imperfectly drained soils subject to ponding or seepage, and poorly drained soils. Water table above 50 cm during season of use.	Very poorly drained and permanently wet soils.
i	**Flooding**	None during season of use.	Occasional flooding. May flood once every 2 - 3 years during season of use.	Floods every year during season of use.	Prolonged flooding during season of use.
k	**Permeability**	Very rapid to moderate	Moderately slow and slow	Very slow	
t	**Slope**	≤ 2% (a, b)	> 2 - 5% (c)	> 5 - 9% (d)	> 9% (e, f, g, h, i, j)
d	**Depth to Bedrock**	> 100 cm	50 - 100 cm[3]	< 50 cm[3]	
c	**Coarse fragments on surface[2]**	Relatively free of coarse fragments	≤ 20% coarse fragments	> 20% coarse fragments	
p	**Stoniness[2]**	Stones > 10 m apart (Class 0 to 1)	Stones > 2 - 10 m apart (Class 2)	Stones 0.1 - 2 m apart (Class 3, 4)	Stones < 0.1 m apart (Class 5)
r	**Rockiness[2]**	Rock exposures > 100 m apart and cover < 2% of the surface	Rock exposures 30 - 100 m apart and cover about 2 - 10% of the surface	Rock exposures < 30 m apart and cover > 10% of the surface	Rock outcrops too frequent to permit playground location
s	**Surface Soil Texture[2,4]**	L, VFSL, FSL, SL, LVFS, VFS	SiL, CL, SiCL, SCL, LFS, LS, FS	SiC, C, SC[5], Si, S	Peaty soils; S and LS subject to blowing
q	**Depth to Sand or Gravel[6]**	> 100 cm	50 - 100 cm	< 50 cm	
m	**Useful Moisture[7]**	Water storage capacity[8] >15.0 cm and/or adequate rainfall and/or low evapotranspiration	Water storage capacity[8] 7.5 - 15 cm and/or moderate rainfall or moderate evapotranspiration	Water storage capacity[8] < 7.5 cm and/or low rainfall or high evapotranspiration	
n	**Salinity[9]**	EC < 4 mS/cm	EC 4 - 8 mS/cm (s)	EC > 8 - 16 mS/cm (t)	EC > 16 mS/cm (u)

1 The symbol is used to indicate the property affecting use.
2 See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada 2007).
3 Downgrade to a very poor suitability rating if the slope is greater than 5 per cent.
4 Surface soil texture influences soil ratings as it affects foot trafficability, surface wetness, dust and maintenance. Adverse soil textures may be partially or completely overcome with the addition of topsoil.
5 Moderately well and well drained SiC, C and SC soils may be rated fair.
6 Depth to sand or gravel is considered a limitation if the levelling operations expose sand or gravel, thereby bringing about adverse surface textures and undesirable amounts of coarse fragments. Adding topsoil after the levelling process would overcome this limitation.
7 This property attempts to evaluate the adequacy of moisture for vegetative growth. It incorporates the concept of supply through rainfall, loss through evapotranspiration and storage within the rooting zone. In soils where the water table is within rooting depth for a significant portion of the year, water storage capacity may not significantly influence vegetation growth.
8 Consult glossary for definitions of terms used.
9 EC = Electrical conductivity (milliSiemens/cm, mS/cm or deciSiemens/m, or dS/m).

Table A20. Guide for Assessing Soil Suitability for Picnic Areas

This guide applies to soils considered for intensive use as park-type picnic areas. It is assumed that most vehicular traffic will be confined to the access roads. Soil suitability for growing and maintaining vegetation is not a part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of the site.

Symbol[1]	Property affecting use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	**Wetness**[2]	Very rapidly, rapidly, well and moderately well drained soils not subject to seepage or ponding. Water table below 50 cm during season of use.	Moderately well drained soils subject to occasional seepage or ponding and imperfectly drained soils not subject to seepage or ponding. Water Table above 50 cm for short periods during season of use	Imperfectly drained soils subject to seepage or ponding. Poorly drained soil. Water table above 50 cm and often near surface for a month or more during season of use.	Very poorly drained and permanently wet soils.
i	**Flooding**	None during season of use.	May flood 1 or 2 times per year for short periods during season of use.	Floods more than 2 times during season of use.	Prolonged flooding during season of use.
t	**Slope**	≤ 9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
s	**Surface Soil Texture**[2,3]	L, VFSL, FSL, SL, LVFS, VFS	SiL, CL, SiCL, SCL, LFS, LS, FS and sand other than loose sand.	SiC, C, SC[4], Si	Peaty soils; loose sand subject to blowing.
c	**Coarse Fragments on Surface**[2]	< 20%	20 - 50%	> 50%	
p	**Stoniness**[2]	Stones > 2 m apart (Class 0 to 2)	Stones > 1 - 2 m apart (Class 3)	Stones 0.1 - 1 m apart (Class 4)	Stones < 0.1 m apart (Class 5)
r	**Rockiness**[2,5,6]	Rock exposure roughly > 30 - 100 m or more apart and cover < 10% of the surface.	Rock exposure roughly 10 - 30 m apart and cover 10 - 25 % of the surface.	Rock exposure < 10 m apart and cover > 25% of the surface.	Rock exposure too frequent to permit location of picnic areas.
m	**Useful Moisture**[7]	Water storage capacity[8] > 15 cm or adequate rainfall or low evapotranspiration.	Water storage capacity[8] 7.5 - 15 cm or moderate rainfall or moderate evapotranspiration.	Water storage capacity[8] < 7.5 cm or low rainfall or high evapotranspiration.	
n	**Salinity**[9]	EC < 4 mS/cm	EC 4 - 8 mS/cm (s)	EC > 8 - 16 mS/cm (t)	EC > 16 mS/cm (u)

1 The symbol is used to indicate the property affecting use.

2 See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada 2007). Coarse fragments for the purpose of this rating include gravel and cobbles. Some gravelly soils may be rated as having a slight limitation if the content of gravel exceeds 20 per cent by only a small margin, providing the gravel is embedded in the soil matrix or the fragments are less than 2 cm in size.

3 Surface soil texture influences soil ratings as it affects foot trafficability, dust and soil permeability.

4 Moderately well and well drained SiC, C and SC soils may be rated fair.

5 Very shallow soils are rated as having severe or very severe limitations for stoniness or rockiness.

6 The nature and topography of the bedrock exposures may significantly alter these ratings. As such, on-site investigations will be necessary in map units containing bedrock when these are considered as possible sites.

7 This property attempts to evaluate the adequacy of moisture for vegetative growth. It incorporates the concept of supply through rainfall, loss through evapotranspiration and storage within the rooting zone. In soils where the water table is within rooting depth for a significant portion of the year, water storage capacity may not significantly influence vegetation growth.

8 Consult glossary for definitions of terms used.

9 EC = Electrical conductivity (milliSiemens/cm, mS/cm or deciSiemens/m, or dS/m).

Table A21. Guide for Assessing Soil Suitability for Camp Areas

This guide applies to soils to be used intensively for tents and camp trailers and the accompanying activities of outdoor living. It is assumed that little site preparation will be done other than shaping and levelling for campsites and parking areas. The soil should be suitable for heavy foot traffic by humans and limited vehicular traffic. Soil suitability for growing and maintaining vegetation is not a part of this guide, but is an important item to consider in the final evaluation of the site.

Back country campsites differ in design, setting and management but require similar soil attributes. These guides should apply to evaluations for back country campsites but, depending on the nature of the facility, the interpreter may wish to adjust the criteria defining a given degree of limitation to reflect the changed requirement. For example, small tent sites may allow rock exposures greater than 10 m apart to be considered slight limitations.

Symbol[1]	Property Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	**Wetness**[2]	Very rapidly, rapidly, well and moderately well drained soils with no seepage or ponding. Water table below 75 cm during season of use.	Moderately well drained soils subject to occasional seepage or ponding and imperfectly drained soils with no seepage or ponding. Water table below 50 cm during season of use	Imperfectly drained soils subject to seepage or ponding and poorly drained soils. Water table above 50 cm during season of use.	Very poorly drained and permanently wet soils.
i	**Flooding**	None	Very occasional flooding during season of use. (Once in 5 - 10 years)	Occasional flooding during season of use. (Once in 2 - 4 years)	Flooding during every season of use.
k	**Permeability**	Very rapid to moderate	Moderately slow and slow	Very slow	
t	**Slope**	≤ 9% (a, b, c, d)	> 9 - 15% (e)	> 15 - 30% (f)	> 30% (g, h, i, j)
s	**Surface Soil Texture**[2,3]	L, VFSL, FSL, SL, LVFS, VFS	SiL, CL, SiCL, SCL, LFS, LS, FS and sand other than loose sand.	SiC, C, SC[4], Si	Peaty soils: loose sand subject to blowing.
c	**Coarse Fragments on Surface**[2,5]	< 20%	20 - 50%	> 50%	
p	**Stoniness**[2,6]	Stones > 10 m apart (Class 0 and 1)	Stones > 2 - 10 m apart (Class 2)	Stones 0.1 - 2 m apart (Class 3 and 4)	Stones < 0.1 m apart (Class 5)
r	**Rockiness**[2,6]	No rock exposures	Rock exposures 10 m apart and cover 25 per cent or less of the area.	Rock exposures < 10 m apart and cover > 25 per cent of the area.	Rock exposures too frequent to permit campground location.
n	**Salinity**[7]	EC < 4 mS/cm	EC 4 - 8 mS/cm (s)	EC > 8 - 16 mS/cm (t)	EC > 16 mS/cm (u)

1 The symbol is used to indicate the property affecting use.
2 See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).
3 Surface soil texture influences soil rating as it affects foot trafficability, dust and soil permeability.
4 Moderately well and well drained SiC, C and SC soils may be rated fair.
5 Coarse fragments for the purpose of this table include gravels and cobbles. Some gravelly soils may be rated as having slight limitations if the content of gravel exceeds 20 per cent by only a small margin, providing the gravel is embedded in the soil matrix or the fragments are less than 2 cm in size.
6 Very shallow soils are rated as having a limitation for rockiness or stoniness.
7 EC = Electrical conductivity (milliSiemens/cm, mS/cm or deciSiemens/m, or dS/m).

Table A22. Guide for Assessing Soil Suitability for Paths and Trails

It is assumed that the trails will be built at least 45 cm wide and that obstructions such as cobbles and stones will be removed during construction. It is also assumed that a dry, stable tread is desirable and that muddy, dusty, worn or eroded trail treads are undesirable. Hiking and riding trails are not treated separately, but as the design requirements for riding trails are more stringent, a given limitation will be more difficult to overcome. Poor or very poor suitability does not indicate that a trail cannot or should not be built. It does, however, suggest higher design requirements and maintenance to overcome the limitations.

Symbol[1]	Property[2] Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
s	**Texture**[3,4]	L, VFSL, FSL, SL, LVFS, LFS, LS, VFS	CL, SiCL, SiL, SCL	SiC, C, SC[5], Si, FS, S	Peaty soils; loose sand subject to blowing
c	**Coarse Fragment Content**[4,6]	< 20%	20 - 50%	> 50%	
p	**Stoniness**[4]	Stones > 2 m apart (Class 0 to 2)	Stones > 1 - 2 m apart (Class 3)	Stones 0.1 - 1 m apart (Class 4)	Stones < 0.1 m apart (Class 5)
w	**Wetness**[4]	Very rapidly, rapidly well, and moderately well drained soils. Water table below 50 cm during season of use.	Moderately well drained soils subject to occasional seepage and ponding and imperfectly drained soils. Water table may be above 50 cm for short periods during season of use.	Poorly and very poorly drained soils. Water table above 50 cm and often near surface for a month or more during season of use.	Permanently wet soils.
r	**Rockiness**[4,7]	Rock exposures > 30 m apart and cover < 10% of the surface.	Rock exposures 10 - 30 m apart and cover 10 - 25% of the surface.	Rock exposures < 10 m apart and cover > 25% of the surface.	Rock exposures too frequent to permit location of paths and trials.
t	**Slope**[8]	≤ 15% (a, b, c, d, e)	> 15 - 30% (f)	> 30 - 45% (g)	> 45% (h, i, j)
i	**Flooding**	Not subject to flooding during season of use.	Floods 1 or 2 times during season of use.	Floods more than 2 times during season of use.	Subject to prolonged flooding during season of use.

1 The symbol is used to indicate the property affecting use.

2 The properties affecting use listed in this table are those which have been shown to cause significant differences in trail response. Elevation, aspect, position on slope, and snow avalanching may have slight affects or influence trail management and should be considered in the final site evaluation. Items such as vegetation, fauna and scenic value are not considered in the guidelines.

3 Texture refers to the soil texture which will form the tread texture. This is the surface texture on level areas but may be a subsurface texture on slopes. Textural classes are based on the less than 2 mm soil fraction. Texture influences soil ratings as it influences foot trafficability, dust, design or maintenance of trails and erosion hazards.

4 See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Soil and Landscape Management Section, Manitoba Agriculture, Food and Rural Initiatives and Land Resource Unit, Agriculture and Agri-Food Canada, 2007).

5 Moderately well and well drained SiC, C and SC soils may be rated fair.

6 Coarse fragments for the purpose of this table, include gravels and cobbles. Gravels tend to cause unstable footing when present in high amounts, and are also associated with increased erosion. Cobbles (and stones) must be removed from the trail tread, increasing construction and maintenance difficulties. Some gravelly soils may be rated as having a slight limitation if the content of gravel exceeds 20 per cent by only a small margin, providing the gravel is embedded in the soil matrix or the fragments are less than 2 cm in size.

7 The type of rock outcrop (flat lying vs cliffs), and the orientation of the structure (linear cliffs vs massive blocks) can greatly alter the degree of the limitation. Each site with a Rockiness limitation, based on the per centage of rock outcrop above, should be evaluated on its own merits and the degree of limitation should then be modified appropriately if necessary.

8 Slope, in this context, refers to the slope of the ground surface, not the slope of the tread.

Appendix 2 Soil Series Description

Arizona Series (AIZ)
The Arizona series consists of moderately well to well drained Orthic Regosol soils developed on weakly to moderately calcareous, sandy (FS, LS, LFS), lacustrine and deltaic deposits. These soils occur in upper slope and knoll positions of gentle slopes on hummocky landscapes and have rapid permeability, low surface runoff, and a low water table during the growing season. Arizona soils are severely wind eroded, non-stony and non-saline. They have low available water-holding capacity, low organic matter content, and low natural fertility. Native vegetation includes scrub oak, black spruce and prairie grasses. The majority of these soils are currently wooded or used for natural grazing.

In a representative profile of Arizona soil, there is no solum. The profile is characterized by a gray to light gray Ah horizon, five to 15 cm thick, and a brown to very pale brown Ck horizon, with faint reddish brown mottles.

Arizona soils occur in close association with Cactus soils and are similar to Shilox soils by having a Regosolic profile in sand deposits, but differ from them by having deposits of lacustrine origin, while Shilox soils are eolian. Arizona soils were previously mapped as eroded phases of the Stockton Association in the Carberry (Ehrlich et al., 1957) soil report.

Ashmore Series (AHO)
The Ashmore series consists of moderately well to well drained Rego Black Chernozem soils developed on a thin mantle (25 to 50 cm) of moderately to strongly calcareous sediments of VFS, LVFS, FSL and SL texture, overlying moderately to strongly calcareous medium sand to gravelly glaciofluvial deposits. These soils occur in irregularly sloping terrain, ranging from gently undulating to strongly rolling. They have moderately rapid permeability in the upper sediments and very rapid permeability in the gravelly deposits. Runoff is moderate to rapid depending on the degree of slope. The stoniness varies from few to very stony land. The native vegetation consists of bur oak and aspen.

A very dark gray Ahk horizon, 10 to 17 cm thick, and a thin AC horizon characterize the soil. A lime accumulation layer (Cca) may be present. Cultivated soils on the gently undulating and undulating slopes may be slightly eroded.

Assiniboine Series (ASB)
The Assiniboine series consists of imperfectly drained Gleyed Cumulic Regosol soils developed on moderately to strongly calcareous, stratified, clayey (SiC, C) deposits. These soils occur in lower slope positions of very gentle slopes on flood plain landscapes and have moderately slow permeability, slow surface runoff, and a medium water table during the growing season. Assiniboine soils are slightly water eroded, non-stony and non-saline. They have high available water-holding capacity, medium organic matter content and medium natural fertility. Native vegetation includes ash, elm, tall prairie and meadow grasses. The majority of these soils are currently cultivated.

In a representative profile of Assiniboine soil, there is no solum. The profile is characterized by a dark gray to gray Ah horizon, five to 20 cm thick, and a dark gray Ckgj horizon, with many prominent mottles. The parent material is typically stratified and may contain dark strata, representing former surfaces.
Bankton Series (BAO)
The Bankton Series consists of well to moderately well drained Rego Black Chernozem soils, developed on moderately to strongly calcareous silty clay, to clay lacustrine deposits. They occur adjacent to the creeks in a level to very gently sloping topography. Permeability is slow; runoff is moderately slow. The natural vegetation consists of tall prairie grasses.

The soil is characterized by a very dark gray to black Ah horizon, 16 to 22 cm thick, and a calcareous, dark gray AC horizon of irregular thickness (due to past cracking and in-filling) grading to the grayish brown C horizon. Some mottles and duller colors occur below the 75 cm depth.

Barren Series (BAE)
The Barren series is an Orthic Regosol soil found on well to rapidly drained, strongly to very strongly calcareous, fine loamy (SCL, SiCL, CL), lacustrine sediments. This soil occurs above the escarpment in association with Ramada, Carroll, Charman, Prodan and Tadpole soils in the upper slope and knoll positions of gently undulating to moderately rolling topography. Surface runoff is moderate to rapid, and permeability is moderate to moderately slow. Originally, Barren soils had a dark surface horizon and a weak B horizon, but erosion has removed virtually all of the original solum. Wind and water erosion continues to be a problem for these soils.

The Barren soil profile has a gray to light gray, calcareous Ap horizon, 10 to 15 cm thick, and a light yellowish brown to pale brown Ck horizon.

Basker Series (BKR)
The Basker series consists of poorly to very poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous, stratified, loamy (FSL, VFSL, L, SiL, CL, SiCL), recent alluvial deposits. These soils occur in depressional positions of nearly level slopes on flood plain landscapes and have slow permeability, very slow surface runoff, and a high water table during the growing season. Basker soils are slightly water eroded, non-stony, and occasionally slightly saline. They have a high available water holding capacity, medium organic matter content and low natural fertility. Native vegetation includes sedges, rushes and willows. The majority of these soils are currently in native vegetation because they are subject to flooding and saturated conditions in the spring.

In a representative profile of Basker soil, there is no soil solum. The profile is characterized by light grayish brown Ahk horizon, five to 20 cm thick, with iron stains, and a stratified, olive brown Ckg horizon, with prominent iron mottles in the sandy strata. A typical profile also contains thin organic layers indicating former surfaces.

Basker soils occur in close association with Levine soils. They are similar to Kerran soils by having a poorly drained profile developed in recent alluvium, but differ from them in having mostly loam, rather than clay textures. Basker soils were previously mapped as Meadow associates of the Assiniboine Complex in the South-Central (Ellis and Shafer, 1943) and Carberry (Ehrlich et al., 1957) reports.

Beresford Series (BSF)
The Beresford series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on a thin mantle (<1 m) of loamy (L, SiL, CL, SiCL) lacustrine sediments over strongly to very strongly calcareous, loam to clay loam glacial till of shale, limestone and granitic origin. These soils occur on near level to undulating topographic landscapes in association with the Clementi (Orthic Black Chernozem) soils. They occur in landscapes which are considered to be in a discharge to weak recharge (groundwater) area and may have soluble salts within the rooting zone or subsoil. The runoff is slow, and permeability is moderately slow to slow.

The Beresford soils are characterized by a very dark gray to black Ah horizon 20 to 30 cm, a dark gray ACk horizon of six to 12 cm thick. A lime accumulation zone may occur in the loamy lacustrine sediments if the overlay is thick. The underlying, strongly calcareous till of shale limestone and granitic origin is generally more compact.

The Beresford, texture variant, BSF1, has similar solum properties as the normal Beresford, but differs in texture of the lacustrine deposit. The lacustrine deposit is medium texture, rather than moderately fine material.

Bermont Series (BMN)
The Bermont series consists of well drained Rego Black Chernozem soils developed on a thin mantle (50 to 75 cm) of very strongly to extremely calcareous loamy glacial till of limestone and granitic origin overlying strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin. These soils occur in the upper slope and knoll positions of gently undulating to moderately rolling topography. Runoff is rapid. Permeability is moderate to moderately slow in the upper till and slow in the lower till, which generally is more compact and weakly fissile.

The Bermont soil is characterized by a shallow Ah or a Ahk horizon, 10 to 16 cm thick, and an AC horizon of four to eight cm. This soil profile is similar to the Stewart series. It is associated with the well drained, Hilton series, the imperfectly drained Barwood series and the poorly drained Hickson series.

Brownridge Series (BWD)
The Brownridge series consists of well to moderately well drained Orthic Regosol soils on weakly to moderately calcareous, moderately coarse textured (VFS, LVFS, FSL) lacustrine and deltaic sediments. These soils occur in association with the Halstead (Orthic Dark Gray) or Pleasant (Gleyed Rego Black, carbonated) soils and occupy the upper slope and knoll positions. Originally, these soils had a dark surface and profile development, but have been sufficiently eroded that little of the original horizons remain. These soils have moderately rapid permeability. Runoff is moderately rapid to rapid, depending on the slope gradient. The topography is undulating to moderately rolling. The soil is characterized by a 10 to 15 cm light gray to light brownish gray calcareous plow layer and a light yellowish brown to very pale brown C horizon.

Cactus Series (CCS)
The Cactus series consists of well drained Rego Black Chernozem soils developed on moderately calcareous, deep, stratified, coarse (FS, LFS, LS), lacustrine and deltaic deposits. These soils occur in upper slope and crest positions of gentle slopes on undulating duned landscapes and have moderately rapid to rapid permeability, minimal surface runoff, and a low water table during the growing season. Cactus soils are highly prone to wind erosion, and are non-stony and non-saline. They have a low available water-holding capacity, medium organic matter content and medium natural fertility. Native vegetation includes aspen, bur oak and tall prairie grasses. The majority of these soils are currently used for natural grazing.

In a representative profile of Cactus soil, the solum is approximately 15 cm thick. The profile is characterized by a very dark gray Ah horizon, 12 to 16 cm thick, a dark gray AC horizon, four to eight cm thick which is calcareous, a thin Cca horizon, five to 10 cm thick with lime accumulation, and a light gray to pale brown Ck horizon. Cactus soils occur in close association with Stockton and Arizona soils. They are similar to Stockton soils by having a well drained profile developed in sandy deposits, but differ from them in having no Bm horizon. Cactus soils were previously mapped as minor Blackearth associates of the Stockton Association in the Carberry soil report (Ehrlich et al., 1957).

Capell Series (CXT)
The Capell series consists of imperfectly drained Gleyed Rego Black Chernozem soils, developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, stratified, loamy (SiL, L, CL, SiCL), lacustrine sediments over moderately to strongly calcareous, deep stratified, sandy to sandy-skeletal (GrS, GrLS) and glaciofluvial deposits. These soils occur in lower slope positions of gentle to moderate slopes on hummocky landscapes and have moderate to rapid permeability, moderate surface runoff, and a medium water table during the growing season. Capell soils are occasionally slightly saline. They have medium available water-holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes tall prairie and meadow grasses. The majority of these soils are currently used for grain crop production.

In a representative profile of Capell soil, the solum is approximately 25 cm thick. The profile is characterized by a very dark gray to black Apk or Ahk horizon, 15 to 25 cm thick, a dark gray to gray, calcareous AC horizon, five to 15 cm thick, a light gray IICca horizon, five to 10 cm thick with secondary carbonate accumulation, and a light yellowish brown IICkgj horizon with common, distinct iron mottles.

Carroll Series (CXF)
The Carroll series is a Rego Black Chernozem soil developed on moderately well to well drained, strongly to very strongly calcareous, moderately fine (SCL, CL, SiCL), lacustrine deposits. These soils occur in the Upper Assiniboine Delta and Brandon Lakes Plain on very gently sloping to undulating topography, in association with Ramada, Charman, Prodan and Tadpole soils. Surface runoff is moderately slow, and permeability is moderate. Careful management is required to reduce water or wind erosion, especially in undulating topography.

The Carroll soil profile has a very dark gray to black Ah or Ahk horizon, 15 to 20 cm thick, a dark gray AC horizon, 10 to 15 cm thick and a Cca horizon of lime carbonate accumulation, eight to 14 cm thick. The silty textured, pale brown Ck horizon is very erosive. This soil differs only slightly from the Ramada soil in not having a prominent Bm horizon. Carroll soils were previously mapped as the well drained associate of the Carroll Association in both the South-Central (Ellis and Shafer, 1943) and Carberry (Ehrlich et al., 1957) soil reports.

Carvey Series (CAV)
The Carvey series consists of poorly drained Rego Humic Gleysol soils developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, uniform, fine loamy (SiL, L, CL, SCL) lacustrine sediments over moderately to strongly calcareous, sandy to sandy skeletal glaciofluvial deposits. These soils occur in depressional positions of nearly level slopes on level landscapes and have moderate permeability slow surface runoff and a high water table during the growing season. Carvey soils are occasionally slightly saline. They have medium over low available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation often includes sedges and meadow grasses. The majority of these soils are currently used for natural grazing. In a representative profile of Carvey soil, the solum is approximately 20 cm thick. The profile is characterized by a thin (two to five cm) moderately decomposed LFH horizon a very dark gray, calcareous Ah horizon, seven to 15 cm thick and a dark gray, calcareous, transition ACg horizon, 10 to 20 cm thick, and a pale brown, calcareous II Ckg horizon with yellowish brown mottles. A typical profile also contains manganese concretions in the subsoil and shells at the surface.

Carvey soils occur in close association with Capell, and Croyon soils. They are similar to Tadpole soils by having a Rego Humic Gleysol profile developed in loamy lacustrine deposits, but differ from Tadpole soils by having a sandy to sandy-skeletal substrate within a meter of the mineral surface. Carvey soils were previously mapped as a Meadow associate with a loamy veneer of the Agassiz Association in the Carberry (Ehrlich et al., 1957) soil report.

Chambers Series (CBS)
The Chambers series is a Rego Black Chernozem soil developed on moderately well to well drained loamy (L, CL, SiCL) lacustrine sediments, less than one meter in depth, overlying moderately to strongly calcareous loamy (L, CL) glacial till deposits. These soils occur in the upper slope positions of gently sloping to hummocky, moderately rolling topography. Surface runoff is moderately rapid to rapid, depending on the slope gradient. Permeability is moderate in the lacustrine sediments and moderately slow to slow in the glacial till deposit. The Chambers soil profile is characterized by a very dark gray to black Ah or Ahk horizon of 10 to 15 cm thick, a thin dark gray to grayish brown ACk horizon of three to eight cm thick and a thin lime accumulation zone. The underlying till is a light yellowish brown color. Chambers soil series tend to be less stony than the very similar Rufford soils.

Charman Series (CXV)
The Charman series consists of imperfectly drained Gleyed Black Chernozem soils developed on strongly to very strongly calcareous, fine loamy (CL, SiCL), lacustrine deposits. In areas of seepage or discharge, soluble salts in the subsoil can be translocated near the surface in sufficient quantities to affect crop growth. These soils occur in middle positions of very gentle slopes on undulating landscapes and have moderate permeability, slow surface runoff, and a medium high water table during the growing season. Charman soils are non-eroded, non-stony, and frequently slightly saline. They have a moderately high available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation includes aspen, willows, shrubs and prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile of Charman soil, the solum is approximately 40 cm thick. The profile is characterized by very dark gray to black Ah horizon, 15 to 25 cm thick, a dark grayish brown Bmgj horizon, 12 to 30 cm thick, a transitional BC horizon, five to eight cm thick and a pale brown, silty textured Ckgj horizon, with iron mottles and frequently gypsum crystals.

Charman soils occur in close association with Ramada, Carroll and Tadpole soils. They are similar to Prodan soils by having an imperfectly drained profile and fine loamy deposits, but differ from them in having a Bmgj horizon. Charman soils were previously mapped as Black-Meadow associates of the Holland Association in the Carberry (Ehrlich et al., 1957) soil report.

Chater Series (CXW)
The Chater series is a Calcareous Black Chernozem soil developed on moderately well to well drained, moderately to strongly calcareous, sandy (S, CoS) to sandy-skeletal (GrS, GrCoS) outwash and glaciofluvial deposits, less than one meter in depth, overlying moderately to strongly calcareous loamy (L, CL) glacial till deposits. These soils occur in gently undulating to moderately rolling topography. Surface runoff is low, while permeability is rapid in the coarser deposits and moderate to moderately slow in the underlying till material. These soils are in favorable topographic positions to allow excess water above the till to flow laterally to down slope positions.

The Chater soil profile is characterized by a 12 to 18 cm thick, very dark gray Ah horizon and a grayish brown to brown Bmk horizon eight to 15 cm thick, with a lime accumulation horizon (Cca) in the coarser stratum. Chater soils are coarser textured and tend to be droughtier than glacial till soils like Kleysen series.

Clementi Series (CLN)
The Clementi series is characterized by an Orthic Black Chernozem profile developed on a thin mantle (25 to 90 cm) of loamy lacustrine sediments over moderately to very strongly calcareous morainal till of limestone, granitic and shale origin. These soils are moderately well drained and occur in mid to upper slope positions of very gently undulating or rolling topography. Runoff is moderate; permeability is moderate in the loamy overlay, and moderately slow to slow in the underlying till. The solum has a very dark gray to black Ah horizon, 10 to 20 cm thick and a dark brown to brown Bm horizon, eight to 12 cm thick. The solum is developed dominantly within the overlay, and may extend into the till material.

Cobfield Series (CBF)
The Cobfield series is a Gleyed Black Chernozem soil developed on imperfectly drained loamy (L, CL, SiCL) lacustrine sediments, less than one meter in depth, overlying moderately to strongly calcareous loamy (L, CL) glacial till deposits. These soils occur in the mid to lower slope position of gently sloping to undulating topography of dominantly weak recharge areas. The runoff is moderately slow with permeability being moderate in the upper lacustrine sediments and moderately slow to slow in the underlying glacial till. The Cobfield soil profile is characterized by a very dark gray to black Ap or Ah horizon, 10 to 18 cm thick, a brown to dark yellowish Bm horizon, eight to 12 cm thick, with few, yellowish brown to strong brown mottles, and a lime accumulation horizon (Ccagj). The underlying till is olive brown to light olive brown, which is indicative of periodic saturation and reducing conditions.

Cordova Series (CVA)
The Cordova series is characterized by a Calcareous Black Chernozem solum on moderately to strongly calcareous, fine loamy (L, CL, SCL) morainal till of mixed limestone, granitic and shale rock origin. These soils are well to rapidly drained and occur in the upper slope and crest positions of undulating to hummocky landscapes, in close association with the well drained Rufford and Newdale series. Surface runoff is moderately rapid to rapid, depending on slope. Permeability is moderately slow. Native vegetation consists of mixed tall prairie grasses and herbs.

The Cordova soil profile has a thin, very dark gray Ap (k) horizon, 12 to 18 cm thick, a calcareous, yellowish brown to dark yellowish brown Bmk horizon, five to 15 cm thick, a thin transitional BCk horizon and a light gray lime carbonate accumulation layer, 25 to 35 cm thick. Secondary carbonates may be found along vertical cracks within the underlying grayish brown (dry) or dark grayish brown (moist) Ck horizon. In many areas, these soils have been altered by wind and water erosion. The crest positions have lost most of the A horizon and part of the B horizon has been cultivated. In a few areas, the Cca horizon has been incorporated into the plow layer, imparting a light gray surface color.

Crookdale Series (CKD)
The Crookdale series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on a mantle (25 to 100 cm) of strongly calcareous, stratified, fine loamy (CL, SiCL) lacustrine sediments over strongly calcareous, deep uniform sandy (LFS, FS, S) fluvial lacustrine deposits. These soils occur in lower slope positions of level to nearly level slopes on level landscapes and have moderate permeability, moderately slow surface runoff and a medium water table during the growing season. Crookdale soils are non-eroded, non-stony and slightly saline. They have high available water holding capacity, medium organic

matter content and medium natural fertility. Native vegetation often includes tall prairie grasses. The majority of these soils are currently used for grain crop production.

In a representative profile of Crookdale soil, the solum is approximately 25 cm thick. The profile is characterized by a black Ah horizon, 10 to 25 cm thick, a dark grayish brown transitional AC horizon, 10 to 20 cm thick with faint iron mottles, a white Ccagj horizon, five to 10 cm thick of lime accumulation and a light olive brown II Ckgj horizon with prominent iron mottles.

Croyon Series (CYN)
The Croyon series consists of moderately well to well drained Orthic Black Chernozem soils developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, uniform, loamy (L, SiL, CL) lacustrine sediments over moderately to strongly calcareous, stratified, deep sandy-skeletal (GrS, GrLS), glacio-fluvial deposits. These soils occur in middle and upper slope positions of very gentle slopes on undulating landscapes and have medium over rapid permeability, moderately rapid surface runoff and a low water table during the growing season. Croyon soils have medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation often includes tall prairie grasses interspersed with aspen-oak groves. The majority of these soils are currently used for grain crop production.

In a representative profile of Croyon soil, the solum is approximately 35 cm thick. The profile is characterized by a very dark gray Ah or Ap horizon, 10 to 15 cm thick, a dark brown Bm horizon, 10 to 25 cm thick, a yellowish brown II Cca horizon, 10 to 20 cm thick with secondary carbonate accumulation and a light yellowish brown IICk horizon. The parent material is typically stratified with thin (< five cm) layers of SiL, CoS, GrS and SL textures.

Dexter Series (DXT)
The Dexter series consists of imperfectly drained Gleyed Black Chernozem soils developed on moderately to strongly calcareous, deep, stratified, sandy skeletal (FS, CoS, GrS), glaciofluvial deposits. These soils occur in middle positions of very gentle to gentle slopes on undulating landscapes and have rapid permeability, low surface runoff, and a medium water table during the growing season. Dexter soils are slightly eroded, non-stony, and non-saline. They have a low available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes bur oak, aspen, shrubs and prairie grasses. The majority of these soils are currently used for forage crops and grazing.

In a representative profile the solum is approximately 40 cm thick. The profile is characterized by very dark gray Ah horizon, 15 to 20 cm thick, a grayish brown to brown Bm horizon, 10 to 25 cm thick, a Cca (lime accumulation) horizon, five to eight cm thick and a mottled and calcareous Ckgj horizon. A typical profile also varies in depth, depending on the thickness of finer textured surface layers.

Dexter soils occur in close association with Dorset Marringhurst and Fortina soils. They are similar to Mansfield soils by having an imperfectly drained profile developed in sandy skeletal deposits in having a Bm horizon.

Dorset Series (DOT)
The Dorset series consists of moderately well to well drained Orthic Black Chernozem soils developed on moderately to strongly calcareous, deep , stratified, sandy to sandy skeletal (S, GrS, GrCoS), outwash and glaciofluvial deposits. These soils occur in upper positions of gentle slopes on hummocky landscapes and have very rapid permeability, low rapid surface runoff, and a low water table during the growing season. Dorset soils are non-eroded, non-stony, and non-saline. They have a low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation includes aspen-oak stands and tall prairie grasses. The majority of these soils are currently used for grazing or are excavated for gravel deposits.

In a representative profile, the solum is approximately 30 cm thick. The profile is characterized by a very dark gray Ah horizon, 12 to 18 cm thick, a dark brown Bm horizon, 15 to 22 cm thick, a Cca (lime accumulation) horizon, six to 12 cm thick and a light brown Ck horizon, with stratified sand and gravel.

Dorset soils occur in close association with Mansfield soils. They are similar to Marringhurst soils by having a well drained profile in glaciofluvial deposits, but differ from them in having a Bm horizon. Dorset soils were previously mapped as Blackearth associates of the Marringhurst Association in the Carberry soil report (Ehrlich et al., 1957).

Drokan Series (DRO)
The Drokan series is characterized by a Rego Humic Gleysol (carbonated) solum, developed on moderately to strongly calcareous, fine loamy (L, CL, SCL) morainal till of limestone, granitic and shale rock origin. They are poorly to very poorly drained and occur in depressional positions of the undulating to hummocky morainal landscape. Surface runoff is negligible and the soils may remain in a ponded condition unless the surface drainage had been improved. Permeability is moderately slow to slow. In some landscapes, these areas are influenced by seepage from adjacent higher lands, and may have a considerable content of soluble salts. Native vegetation consists of sedges, cattails, rushes and willows. Saline areas have baltic rush, wild barley and saline goosefoot.

The Drokan soil profile has a moderately decomposed organic layer, two to five cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a mottled transitional AC horizon, four to eight cm thick and a lime accumulation layer, eight to 12 cm thick. The C horizon is olive gray to olive with yellowish brown mottles. Gypsum crystals are common in the lime accumulation layer and C horizon. In saline areas, white flecks of salt and gypsum are present in the Ah and AC horizons; soils with appreciable soluble salt are delineated as Drokan saline phase.
Generally, the average A horizon is 22 cm thick and varies from 15 to 35 cm; the average depth of its solum is 35 cm and varies from 15 to 70 cm. It differs from the closely related Penrith soil series in being less well developed and having shallower, less distinct horizons.

Druxman Series (DXM)
The Druxman series consists of imperfectly drained Gleyed Black Chernozem soils developed on a mantle (25 to 100 cm) of moderately to strongly calcareous, stratified, fine loamy (SiL, L, CL, SiCL), lacustrine sediments over moderately to strongly calcareous, deep, sandy-skeletal (GrS, GrLS), glacio-fluvial deposits. These soils occur in lower slope positions of very gentle slopes on undulating landscapes and have medium over rapid permeability, low surface runoff and a medium water table during the growing season. Druxman soils have medium available water holding capacity, medium organic matter content and medium natural fertility. Native vegetation often includes meadow and tall prairie grasses interspersed with willow clumps. The majority of these soils are currently used for grain crop production.

In a representative profile, the solum is approximately 50 cm thick. The profile is characterized by a very dark gray Ah or Ap horizon, 15 to 25 cm thick, a dark yellowish brown to olive brown Bmgj horizon, 20 to 30 cm thick with many, fine, distinct, yellowish brown iron mottles, a transitional dark yellowish brown BC, five to 10 cm thick, occasionally a yellowish brown II Ccagj horizon, five to 10 cm thick and light yellowish brown II Ckgj horizon with many, large prominent iron mottles.

Durnan Series (DRN)
The Durnan series consists of moderately well to well drained Rego Black Chernozem soils developed on strongly to very strongly calcareous, deep, stratified, medium textured (VFSL, L, SiL), lacustrine deposits. These soils occur in upper slope and crest positions of gentle slopes on hummocky to undulating landscapes and have moderate to moderately rapid permeability, moderate to rapid surface runoff, and a low water table during the growing season. Durnan soils are occasionally slightly eroded, non-stony, and non-saline. They have medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes aspen, oak, prairie grasses and shrubs. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 10 cm thick. The profile is characterized by a very dark gray Ahk horizon, 10 to 15 cm thick, frequently a Cca horizon, four to seven cm thick and a pale brown, calcareous C horizon.

Durnan soils occur in close association with Fairland, Torcan and Vordas soils. They are similar to Traverse soils by having a well drained profile in coarse loamy deposits, but differ from them in having no Bmk horizon.

Durnan soils were previously mapped as Blackearth associates of the Holland Association in the Carberry (Ehrlich et al., 1957) soil report.

Eroded Slope Complex ($ER)
This soil complex includes all the land occupied by the eroded slopes of river valleys and walls, incised stream channels and ravines that have down-cut through the surface deposits and shale bedrock. These are generally well drained, strongly to steeply sloping landforms that have variable soils development on materials that are variable in composition, depending on the nature of the surrounding deposits. Due to its complexity, this is a miscellaneous land type rather than a unit of normal soil. These areas are typically influenced by mass wasting processes such as slump, creep, solifluction and erosion.

The soils range from Orthic Black Chernozems to Regosols. The slopes are characterized by numerous major seepage zones where the water table intersects the slope walls or scarps, generally in the mid to lower slopes. The maintenance of vegetation on the Eroded Slopes is essential for their stability.

Fairland Series (FND)
The Fairland series consists of moderately well to well drained Orthic Black Chernozem soils developed on strongly to very strongly calcareous, deep, stratified, medium textured (VFSL, L, SiL), lacustrine deposits. These soils occur in upper positions of gentle slopes on rolling landscapes and have moderate permeability, moderate surface runoff, and a low water table during the growing season. Fairland soils are often slightly eroded, non-stony, and non-saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes aspen, oak, shrubs and prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 25 cm thick. The profile is characterized by a very dark gray to very dark grayish brown Ap horizon, 10 to 15 cm thick, a brown to dark brown Bm horizon, 10 to 15 cm thick, a pale brown BC horizon, five to 10 cm thick with carbonates and a light gray Cca horizon, five to 10 cm thick with lime accumulation. The parent material is typically very pale brown and calcareous.

Fairland soils occur in close association with Traverse, Taggart and Vordas soils. They are similar to Durnan soils by having well developed profile in loamy deposits but differ from them in having a strongly developed Bm horizon. Fairland soils were previously mapped as Blackearth associates of the Holland Association in the Carberry (Ehrlich et al., 1957) soil report.

Fenton Series (FET)
The Fenton series consists of poorly drained, carbonated Rego Humic Gleysol soils developed on a thin mantle (25 to 75 cm) of silty clay to clay sediments over a moderately to very strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin. These soils occur in level to depressional topography and are subject to ponding and prolonged wetness. Runoff is very slow; permeability is slow to very slow. Some salts may occur in the soil in areas of seepage or upward movement of groundwater containing appreciable soluble salts toward the surface.

The soil is characterized by a thin, moderately decomposed organic layer, two to five cm thick, a very dark gray Ah horizon, eight to 12 cm thick, a thin olive gray AC horizon, and olive Cg horizon that may have some yellowish brown mottles. Silt sized, pseudomycelium of magnesium sulfate or gypsum may be present in the surface horizon of saline areas.

Forrest Series (FRT)
The Forrest series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on a thin mantle (25 to 75 cm) of silty clay to clay sediments over a thin strata (10 to 40 cm) of very strongly calcareous loamy glacial till of shale, limestone and granitic origin. The topography is level to very gently sloping; runoff is moderately slow to slow and permeability is moderately slow to slow. These soils are influenced by a subsoil seepage condition in the very strongly calcareous till and an upward pressure of groundwater. Soluble salts are usually found in the subsoil.

The soil is characterized by an irregular, very dark gray Ah or Ahk horizon, 10 to 15 cm thick, with tongues to 25 cm, and a dark gray to olive gray AC, four to eight cm thick. A weakly mottled, calcareous light olive brown Ckgj horizon is also present.

Gateside Series (GTD)
The Gateside series consists of imperfectly drained Gleyed Black Chernozem soils developed on moderately to strongly calcareous, deep, coarse loamy (VFS, LVFS, FSL, SL), lacustrine deposits. These soils occur in middle positions of very gentle to nearly level slopes on undulating landscapes and have moderately rapid permeability, moderately slow surface runoff, and a high water table during the growing season. Gateside soils are nonstony, and occasionally slightly saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses, aspen-oak groves, shrubs and meadow grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 35 cm thick. The profile is characterized by a very dark gray to black Ah horizon, 12 to 18 cm thick, a brown to olive brown Bmgj horizon, 15 to 30 cm thick with faint iron mottles, a light olive brown BC horizon, five to 15 cm thick with carbonates and a light olive brown to yellowish brown Ckgj horizon with distinct yellowish brown mottles.

Gateside soils occur in close association with Prosser, Pleasant and Poolex soils. They are similar to Pleasant soils by having imperfect drainage in coarse loamy deposits, but differ from them in having a Bmgj horizon. Gateside soils were previously mapped as Black Meadow associates of the Holland Association in the Carberry soil report (Ehrlich et al., 1957).

Gendzel Series (GDZ)
The Gendzel series consists of imperfectly drained, carbonated, Gleyed Rego Black Chernozem soils developed on a thin mantle (25 to 60 cm) of moderately to strongly calcareous sandy textured sediments, overlying moderately to strongly calcareous medium sand, to gravelly textured sediments. The soil occurs in a level to gently sloping topography. Runoff is moderately slow. Permeability is moderately rapid to rapid, but may be restricted in the subsoil during periods when the water table is high.

The soil is characterized by a very dark gray to black Ahk horizon, 10 to 16 cm thick, a dark gray to light gray AC horizon, five to nine cm thick, And a lime accumulation (Cca) horizon six to 12 cm thick. In the soils with a shallow solum, the lime accumulation (Cca) horizon occurs at the transition of the sandy to gravelly sediments.

Glenboro Series (GBO)
The Glenboro series consists of moderately well to well drained Orthic Black Chernozem soils developed on a mantle (25 to 90 cm) of moderately to strongly calcareous, shallow, medium textured (VFSL, L, SiL), lacustrine deposits over moderately calcareous, stratified, deep, sandy (FS, LFS, LS) deposits. These soils occur in upper positions of gentle slopes on sloping to undulating landscapes and have moderate over moderately rapid permeability, moderately slow surface runoff, and a low water table during the growing season. Glenboro soils are often slightly eroded, non-stony, and non-saline. They have a medium available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses and aspen-oak groves. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 30 cm thick. The profile is characterized by a very dark gray to black Ah horizon, 12 to 18 cm thick, with granular structure, a dark brown to brown Bm or Btj horizon, 10 to 16 cm thick, with subangular blocky structure, a brown to pale brown BC horizon, six to 14 cm thick and a light gray to very pale brown Cca horizon, five to eight cm thick. The parent material is typically pale brown to light yellowish brown sandy. Some stratified sands to loams may occur in the loam to sand transition.

Glenboro soils occur in close association with Grover and Grayson soils. They are similar to Fairland soils by having an Orthic Black Chernozem profile and loamy surface mantle but differ from them in having a sandy substrate. Glenboro soils were previously mapped as Blackearth associates of the Glenboro Association in the Carberry soil report (Ehrlich et al., 1957).

Grayson Series (GYS)
The Grayson series consists of poorly drained Rego Humic Gleysol soils developed on a thin mantle (25-95 cm) of moderately to strongly calcareous medium-textured (VFSL, L, SiL) sediments grading to moderately calcareous sandy (FS, LFS, LS) deposits. The soils occur in level to depressional topography and have a saturation zone at or very near the surface for a considerable time. Runoff is very slow to negligible. Permeability of the soil material is moderate, but restricted during periods when the soil is saturated. The soil is characterized by a thin, moderately decomposed organic layer, two to five cm thick, a very dark Ah or Ahk horizon eight to 12 cm thick and a dark gray AC. In some soils, thin cumulic layers of organic and mineral matter may be present at the surface. A lime carbonate horizon is often present below the AC. The subsoil is light olive brown to olive and may have yellowish brown mottles.

Grover Series (GRO)
The Grover series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on a mantle (25 to 75 cm) of moderately to strongly calcareous, shallow, medium (VFSL, L, SiL) textured, lacustrine deposits over moderately calcareous, deep, sandy (FS,LFS,LS), lacustrine deposits. These soils occur in middle positions of very gentle slopes on undulating landscapes and have moderate over moderately rapid permeability, moderately slow surface runoff, and a high water table during the growing season. Grover soils are non-eroded, non-stony, and non-saline. They have medium available water holding capacity, high organic matter content, and medium natural fertility. Native vegetation includes aspen oak, ash and tall prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 20 cm thick. The profile is characterized by a very dark gray to black Ah or Ahk horizon, 15 to 25 cm thick, a dark grayish brown AC horizon, 15 to 20 cm thick with faint mottles, a Ccagj horizon, five to eight cm thick, and a light yellowish brown, sandy Ckgj horizon, with yellowish brown mottles.

Grover soils occur in close association with Glenboro and Grayson soils. They are similar to Crookdale soils by being imperfectly drained with a sandy substrate, but differ from them by having a loamy, rather than fine loamy surface. Grover soils were previously mapped as Black Meadow associates of the Glenboro Association in the Carberry soil report (Ehrlich et al., 1957).

Harding Series (HRG)
The Harding series consists of imperfectly drained Gleyed Black Chernozem soils developed on moderately to strongly calcareous, silty clay to clay lacustrine deposits. These soils occur on level to very gently sloping topography. Runoff is slow; permeability is moderately slow to slow. Most of these soils occur within a discharge region characterized by an upward pressure of groundwater or a lateral flow of water through the underlying very strongly calcareous till, which may occur at a depth of one to two metres. Appreciable soluble salts may be present within the rooting zone and gypsum crystals are common.

The soil is characterized by a very dark gray Ah horizon, 12 to 22 cm thick, a dark grayish brown, prismatic to subangular blocky Bmgj horizon, 15 to 20 cm thick with fine yellowish brown mottles; a lime accumulation horizon (Ccagj) is common. Salt pseudomycelium and gypsum concretions are common in the olive brown to olive Ckgj horizon.

Hummerston Series (HMO)
The Hummerston series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on weakly to moderately calcareous, deep, uniform, coarse-textured (FS, LFS, LS) lacustrine deposits. These soils occur in middle to lower positions of very gentle slopes on undulating landscapes and have moderately rapid permeability, low surface runoff, and a high water table during the growing season. Hummerston soils are often slightly wind eroded, non-stony, and slightly saline. They have a low available water holding capacity, medium to low organic matter content, and medium to low natural fertility. Native vegetation includes aspen-oak groves, shrubs, tall prairie and meadow grasses. The majority of these soils are currently cultivated for forage and grain crops.

In a representative profile, the solum is approximately 20 cm thick. The profile is characterized by a very dark gray Ah horizon, 15 to 20 cm thick, a dark gray ACgj horizon, 10 to 18 cm thick with moderate calcareousness, and a yellowish brown Ckgj horizon, with prominent yellow mottles.

Hummerston soils occur in close association with Stockton, Lavenham and Sewell soils. They are similar to Lavenham soils by having an imperfectly drained profile in sandy deposits, but differ from them in having no diagnostic Bm Horizon. Hummerston soils were previously mapped as Black Meadow associates of the Stockton Association in the Carberry soil report (Ehrlich et al., 1957).

Janick Series (JIK)
The Janick series consists of well to moderately well drained Orthic Black Chernozem soils developed on moderately to strongly calcareous, deep, uniform, clayey (C, SiC), lacustrine deposits. These soils occur in upper positions of nearly level slopes on undulating landscapes and have slow permeability, moderately slow surface runoff, and a medium water table during the growing season. Janick soils are non-eroded, non-stony, and non-saline. They have a high available water holding capacity, high organic matter content, and high natural fertility. Native vegetation includes prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 30 cm thick. The profile is characterized by a very dark gray to black Ah horizon, 10 to 18 cm thick, a dark grayish brown to brown Bm horizon, eight to 15 cm thick with fine subangular blocky structure, a pale brown BC horizon, five to 10 cm thick, weakly calcareous, and a light grayish brown to pale brown Ck horizon, with a few faint mottles.

Justice Series (JUC)
The Justice series consists of imperfectly drained Gleyed Black Chernozem soils developed on a thin mantle (25 to 75 cm) of silty clay to clay sediments over a thin strata(10 to 40 cm) of very strongly calcareous loamy glacial till of shale, limestone and granitic origin over a strongly calcareous till of shale, limestone and granitic origin. The topography is level to gently sloping. Runoff is slow and permeability is moderately slow to slow. These soils are influenced by a subsoil seepage condition in the very strongly calcareous till and an upward pressure of groundwater. Although these soils are not saline, some of the adjacent soil types have appreciable soluble salts in their solum.

The soil is characterized by a very dark gray Ah horizon, 12 to 22 cm thick, a dark grayish brown, prismatic to subangular blocky Bm horizon, 15 to 20 cm thick, with fine yellowish brown mottles; a calcium carbonate accumulation horizon is common. Where the clay overlay is shallow, the depth of solum extends to the contact of the very strongly calcareous till.

The soil is characterized by a very dark gray Ah horizon, 10 to 15 cm thick, a dark brown to brown Bm horizon, eight to 15 cm thick, and a lime accumulation layer (Cca) that occurs at the contact of the loamy sediments and underlying coarser wash zone. Jaymar soils occur as well drained inclusions of the Heaslip Complex in the South-Central soil report (Ellis and Shafer, 1943).

Kerran Series (KRN)
The Kerran series consists of poorly to very poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous, deep, stratified, clayey (SiC, C), recent alluvial deposits with strata of silty clay loam and clay loam textures. These soils occur in depressional positions of level slopes on flood prone terraced landscapes and have very slow permeability, very slow surface runoff, and a high water table during the growing season. Kerran soils are non-eroded, non-stony, and frequently moderately saline. They have a high available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes reeds, rushes, sedges and willows. The majority of these soils are currently in native vegetation.

In a representative profile, the solum is not developed. The profile is characterized by a thin organic horizon, two to four cm thick, a weakly developed dark gray Ahk horizon, 10 to 15 cm thick, and a pale brown to light gray Ckg horizon, with prominent iron mottles. The parent material is typically stratified, mottled, and may contain buried former Ah horizons. Kerran soils occur in close association with Assiniboine soils. They are similar to Basker soils by having a poorly drained profile in recent alluvium, but differ from them in having

finer textures throughout the profile. Kerran soils were previously mapped as associates of the Assiniboine Complex in the Carberry soil report (Ehrlich et al., 1957).

Killeen Series (KLL)
The Killeen series consists of imperfectly drained, carbonated, Gleyed Rego Black Chernozem soils developed on a thin mantle (25 to 60 cm) of sandy sediments (FS, LFS, LS) over a moderately to very strongly calcareous loam to clay loam till of shale, limestone and granitic origin. The topography is level to very gently sloping; runoff is moderately slow to slow, and permeability is moderately rapid in the upper sandy strata and decreases to moderately slow to slow in the lower, more compact, weakly to moderately fissile till.

The soil is characterized by a very dark gray Ah horizon, 15 to 20 cm thick, a dark gray to grayish brown, weakly mottled ACgj horizon, and a light gray lime accumulation (Ccagj) layer. Where the overlay is relatively shallow, the lime accumulation horizon occurs at the contact of very strongly calcareous till.

Kilmury Series (KUY)
The Kilmury series consists of imperfectly drained Gleyed Rego Black carbonated soils developed on a thin mantle (<1 m) of moderately to strongly calcareous sediments of VFS, LVFS, SL and FSL texture overlying moderately, to strongly calcareous stratified medium sands, to gravelly textured deposits. They occur in close association with Wytonville series, the well drained Miniota series and the poorly drained Bornett series. The topography is level to very gently sloping; runoff is moderately slow. Permeability is moderately rapid in the very fine sandy sediments and rapid in the subsoil, but restricted by a high water table during spring and early summer.

The soil is characterized by a very dark gray Ah horizon, 20 to 35 cm thick, a dark gray to grayish brown AC horizon, 10 to 16 cm thick, and a Cca horizon, 10 to 18 cm thick. Yellowish brown mottles are common in the sandy and coarser subsoil. Kilmury profiles differ from Wytonville profiles in not having a Bmgj horizon and in having free lime carbonate in their Ah horizons.

Kirkness Series (KKS)
The Kirkness series consists of moderately well to well drained Orthic Black Chernozem soils developed on a thin mantle (25 to 60 cm) of sandy sediments (FS, LFS, LS) over a moderately to very strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin. They occur on gently sloping to gently undulating topography. Runoff is low. Permeability is rapid in the upper strata and moderately slow in the underlying till deposits.

The soil is characterized by a very dark gray Ah horizon, 15 to 22 cm thick, and a brown Bm horizon, 12 to 18 cm thick. The depth of the solum varies with the thickness of the overlay. Generally the BC horizon extends to the contact of the sandy strata and the very strongly calcareous loamy till, which appears as a prominent Cca horizon.

Kleysen Series (KYS)
The Kleysen series consists of moderately well to well drained Calcareous Black Chernozem soils developed on a thin mantle (25 to 60 cm) of loamy lacustrine sediments over a moderately to very strongly calcareous loam to clay loam till of shale, limestone and granitic origin. These soils in the upper slope positions are of gently sloping, undulating or rolling topography. Runoff is moderate to moderately rapid. Permeability is moderate in the lacustrine sediments and in the loose, very strongly calcareous till, and moderately slow to slow in the more compact, somewhat fissile loam to clay loam till.

The soil is characterized by a very dark gray to black Ah horizon, 10 to 14 cm thick, and a brown to dark brown calcareous Bmk horizon, eight to 12 cm thick. The solum usually extends to the contact of the very strongly calcareous till.

Knolls Series (KLS)
The Knolls series is an Orthic Regosol soil developed on well to excessively drained, strongly to very strongly calcareous, loamy (VFSL, L, SiL), lacustrine sediments. These soils occur on the Brandon Lakes Plain and Upper Assiniboine Delta in the upper slope and knoll positions on gently undulating to moderately rolling

topography in association with Fairland, Durnan, Torcan, Taggart and Vordas soil series. Surface runoff is moderate to rapid, and permeability is moderate. These soils are severely eroded remnants of Fairland and Durnan soils whose surface horizons have been removed by wind and water erosion. They continue to be very susceptible to both wind and water erosion.

The Knolls soil profile has a gray to light gray, calcareous Ap horizon, 10 to 15 cm thick that is slightly darker in color than the light yellowish brown to pale brown C horizon.

Lavenham Series (LVH)
The Lavenham series is a Gleyed Black Chernozem soil developed on imperfectly drained, weakly to moderately calcareous, sandy (FS, LFS, LS), lacustrine sediments. These soils occur in the Upper Assiniboine Delta on level to very gently sloping topography, in association with Stockton, Cactus, Hummerston and Sewell soils. Surface runoff is slow, and permeability is moderately rapid. Downward movement of water is restricted in the subsoil during periods of high water table. The water table ranges from one metre shortly after spring runoff, to three metres below the surface in late fall and winter. These soils are also susceptible to erosion.

The Lavenham soil profile has a very dark gray to very dark brown Ah horizon, 18 to 25 cm thick, a dark brown to yellowish brown Bmgj horizon, 20 to 40 cm thick, with distinct brown mottles in the lower part of the horizon, a lime carbonate accumulation (Ccagj) horizon, 12 to 20 cm thick, and a pale brown Ckgj horizon with distinct to prominent brown mottles. This soil profile differs from the very similar Hummerston soil series in having a prominent Bmgj horizon. Lavenham and Hummerston soils are coarser and more permeable than the finer textured Gateside and Pleasant soils. Lavenham soils were mapped as Black Meadow associates of the Stockton Association in the Carberry soil report (Ehrlich et al., 1957).

Lavinia Series (LAV)
The Lavinia series is imperfectly drained, Gleyed Calcareous Black Chernozem member of the Newdale Association, developed on deep (100cm) moderately to strongly calcareous, fine loamy (L, CL, SCL) morainal till of mixed limestone, granitic and shale rock origin. The topography is gently sloping with either undulating or hummocky landforms. The permeability is moderate, and surface run off is slow. These soils occur in lower slope and depressional positions and are cultivated.

The Lavinia soil profile has a thin, very dark gray Ap(k), or Ah(k) horizon, 10 to 29 cm thick (averaged from 81 soil profiles), a calcareous, dark grayish brown Bmkgj horizon, five to 34 cm thick, a carbonate accumulation horizon (Ccagj) is commonly present, but may be discontinuous. The Ckgj horizon averages 38 cm thick, from 15 to 75cm, and is usually light olive brown in color.

Levine Series (LEI)
The Levine series consists of imperfectly drained Gleyed Cumulic Regosol soils developed on moderately to strongly calcareous, deep, stratified, coarse loamy to fine loamy (VFSL, L, CL) recent alluvial deposits. These soils occur in flood plains on level slopes in level landscapes. They have rapid permeability, moderately slow surface runoff and a medium water table during the growing season. Levine soils are occasionally slightly saline and are subject to periodic inundation during spring runoff or after heavy rains. They have a moderate to low available water holding capacity, low organic matter content and medium natural fertility. The majority of these soils are currently used for crop production.

In a representative profile, the solum is approximately 15 cm thick and the profile is characterized by a dark gray Apk or Ahk horizon 10 to 20 cm thick and a light yellowish brown Ckgj horizon. The underlying strata may vary in colour from light to dark. The thin dark colored mineral and organic layers are former surface horizons that have been exposed to soil forming processes for a significant period before burial by alluvial deposits. Medium, distinct yellowish brown iron mottles occur through the soil. Levine soils were previously mapped as inclusions of Eroded Slope Complexes in the reconnaissance soil survey of South-Central Manitoba (Ellis and Shafer, 1943).

Lindstrom Series (LDM)
The Lindstrom series consists of imperfectly drained, carbonated, Gleyed Rego Black Chernozem soils developed on a thin mantle (25 to 60 cm) of moderately coarse sediments (VFS, LVFS, FSL) over a thin

strata (10 to 50 cm) of very strongly calcareous loamy glacial till of limestone and granitic origin over strongly calcareous glacial till of shale, limestone and granitic origin. Topography is level to very gently sloping; runoff is moderately slow; permeability is moderate in the sandy strata and moderately slow in the underlying till.

The soil is characterized by a very dark gray Ah (k) horizon, 18 to 25 cm thick, a dark gray to grayish brown ACgj horizon, 10 to 18 cm thick and a lime accumulation horizon (Ccagj), six to 10 cm thick. Where the sandy stratum is shallow, the lime accumulation layer grades to the very strongly calcareous glacial till. A few yellowish brown mottles may be present in the ACgj and Ccagj horizons.

Lockhart Series (LKH)
The Lockhart series consists of moderately well to well drained Orthic Black Chernozem soils developed on a thin mantle (25 to 60 cm) of moderately coarse sediments (VFS, LVFS, FSL) over a thin strata (10 to 50 cm) of very strongly calcareous loamy glacial till of limestone and granitic origin, over a strongly calcareous loam to clay loam glacial till of shale, limestone, and granitic origin. These soils occur on gently sloping to undulating topography. Runoff is moderate to moderately rapid. Permeability is moderately rapid in the upper sandy strata and moderately slow in the underlying till. These soils have been slightly eroded.

The soil is characterized by a very dark gray Ah horizon 18 to 25 cm thick and a grayish brown to brown Bm horizon, 12 to 20 cm thick. The depth of solum varies with the depth of the sandy overlay with the BC terminating at the contact of the sandy surface and very strongly calcareous till.

Lonery Series (LOE)
The Lonery series consists of poorly drained, carbonated Rego Humic Gleysol soils developed on a thin mantle (25 to 60 cm) of moderately coarse sediments (VFS, LVFS, FSL) over a thin strata (10 to 50 cm) of very strongly calcareous loamy glacial till of limestone and granitic origin over a strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin. These soils occur on level to depressional topography. Runoff is very slow to negligible; permeability is very slow.

The soil is characterized by a thin, moderately decomposed organic layer, two to five cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, and a dark gray to olive gray ACg horizon, six to 10 cm thick. A lime accumulation horizon (Ccag) is usually present in the sandy strata and may extend to the very strongly calcareous till. Yellowish brown mottles are usually present below the Ah horizon.

Lowroy Series (LOW)
The Lowroy series consists of poorly drained Rego Humic Gleysol (carbonated) soils developed on a thin mantle (<1 m) of moderately to strongly calcareous sandy (FS, LFS, LS) sediments overlying moderately to strongly calcareous, medium sand to gravelly textured deposits. They occur in level to depressional sites which have a water table at or near the surface for part of the year. Runoff is negligible; permeability of the sandy sediments is moderate to moderately rapid above the saturation zone. In areas where the seepage water contains soluble salts, a sufficient concentration of salts may occur in the soil to inhibit the growth of the normal sedge and meadow grasses.

The soil is characterized by a moderately decomposed organic layer, two to five cm thick, a very dark gray Ahk horizon seven to 15 cm thick, a thin dark gray ACg horizon and a Ccag horizon. Yellowish brown mottles are common in the ACg and Ccag horizon and subsoil.

Lowton Series (LWN)
The Lowton series consists of poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous, clayey, (SiC, C), lacustrine deposits. These soils occur in lower to depressional positions of nearly level landscapes and have very slow permeability, very slow surface runoff, and a high water table during the growing season. Lowton soils are non-eroded, non-stony, and moderately saline. They have a high available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes native grasses, willows and sedges. The majority of these soils are currently under native vegetation.

In a representative profile, the solum is approximately 20 cm thick. The profile is characterized by a moderately decomposed LFH horizon, one to five cm thick, a very dark gray Ah horizon, five to 20 cm thick with carbonates, and a dark gray to olive gray Ckg horizon, with many mottles and carbonate concentrations. A typical profile also contains till at one to 2.5 m below the surface. Lowton, soils occur in close association with Sigmund and Janick soils. They are similar to Landseer soils by having a Rego Humic Gleysol profile developed in clayey sediments, but differ from them in having uniform textures throughout, while Landseer soils are stratified at depth. Lowton soils were previously mapped as minor inclusions of the Oliver Association in the South-Central Manitoba soil survey (Ellis and Shafer, 1943).

Mansfield Series (MFI)
The Mansfield series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on moderately to strongly calcareous, stratified, deep, sandy skeletal (S, GrS, CoS), glaciofluvial deposits. These soils occur in middle positions of nearly level landscapes and have rapid permeability, moderately slow surface runoff, and a high water table during the growing season. Mansfield soils are non-eroded, non-stony, and non-saline. They have a low available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes prairie grasses, shrubs, aspen and bur oak. The majority of these soils are currently used for grazing or forage crops.

In a representative profile, the solum is approximately 20 cm thick. The profile is characterized by a very dark gray Ah horizon, 15 to 25 cm thick, a dark gray to grayish brown AC horizon, eight to 15 cm thick, moderately calcareous, a Ccagj horizon, five to eight cm thick, and a Ckgj horizon, with distinct yellowish brown mottles.

Mansfield soils occur in close association with Dorset and Fortina soils. They are similar to Dexter soils by having an imperfectly drained profile in sandy skeletal deposits, but differ from them in having no Bm horizon. Mansfield soils were mapped as associates of the Marringhurst and Agassiz Associations in the South-Central or Carberry soil reports.

Manson Series (MXD)
The Manson series consists of moderately well drained Cumulic Regosol soils on moderately to strongly calcareous, stratified dominantly clayey (SiC, C) alluvial deposits with layers of silty clay loam and clay loam. These soils are located in flood plain areas that have been inundated during years of high flood waters. They occur in association with Assiniboine and Kerran soils. Topography is gently sloping to gently undulating; runoff is moderate; permeability is moderately slow to slow.

The soil is characterized by a dark gray to gray surface horizon (Ah or Ap), eight to 15 cm thick, and generally lighter colored (C) substratum, but some dark stratum consisting of former organic material or Ah horizon may be present. Weak profile development may occur on the upper terrace positions.

Marringhurst Series (MRH)
The Marringhurst series consists of moderately well to well drained Calcareous Black Chernozem soils developed on moderately strongly to strongly calcareous, stratified, deep, sandy (CoS, S) and sandy skeletal (GrS, GrCoS) glaciofluvial deposits. These soils occur in upper positions of very gentle slopes on rolling to irregular landscapes and have very rapid permeability, low surface runoff, and a low water table during the growing season. Marringhurst soils are often moderately eroded, non-stony, and non-saline. They have a low available water holding capacity, low organic matter content and low natural fertility. Native vegetation includes shrubs, bur oak and prairie grasses. The majority of these soils are currently excavated for gravel or used for grazing.

In a representative profile, the solum is approximately 25 cm thick. The profile is characterized by a very dark gray to very dark grayish brown Ah horizon, 14 to 18 cm thick, a dark brown to brown Bmk horizon, 10 to 18 cm thick, a Cca horizon, 20 to 30 cm thick with coarser gravelly strata and a Ck horizon.

Marsden Series (MDN)
The Marsden series consists of poorly drained Rego Humic Gleysol, carbonated soils developed on a sequence of strata consisting of a thin lacustrine mantle (25 to 60 cm) of moderately to strongly calcareous loamy sediments (VFSL to SiCL), over thin (10 to 40 cm) of medium sand to gravel strata, over strongly

calcareous loam to clay loam glacial till of shale, limestone and granitic origin. The topography is level to depressional. Runoff is negligible, and permeability is restricted during periods when free water is at or near the surface.

The soils are characterized by a thin, moderately decomposed organic layer, one to four cm, a very dark gray Ah horizon, 12 to 18 cm, and an olive brown ACg frequently developed in the sand strata. The Cg horizon is olive gray with many prominent mottles and usually occurs at the till contact. Marsden soils were previously mapped as minor associates of the Heaslip complex in the Reconnaissance soil survey of South-Central Manitoba (Ellis and Shafer, 1943).

Marsh Complex ($MH)
The Marsh complex consists of very poorly drained, Rego Gleysol soils developed on lacustrine clay or thin mucky loam deposits over extremely calcareous till or moderately calcareous clay. These soils occur on level to depressional areas that are covered with water and are usually saturated for most of the year. The native vegetation consists entirely of reeds and sedges.

These soils have a thin surface layer of either muck or mineral material, high in organic matter content, and are underlain by strongly gleyed, olive gray mineral materials. A very thin Ahg horizon, less than three cm thick, may be present below the muck surface layer. Marsh soils are undifferentiated with respect to texture and composition of their parent material. They are also much more poorly drained than other Gleysolic soils.

Miniota Series (MXI)
The Miniota series consists of moderately well to well drained Orthic Black Chernozem soils developed on a thin mantle (<1 m) of moderately to strongly calcareous very fine sand, to fine sandy loam textured sediments, over moderately to strongly calcareous, medium sand to gravelly textured deposits. The topography varies from gently sloping to irregular, moderately rolling. Runoff is moderate to moderately rapid, and permeability is rapid in the sandy strata and very rapid in the lower coarser strata. They occur in close association with the imperfectly drained Wytonville and Kilmury soils and the poorly drained Bornett series.

The soil is characterized by a very dark gray to very dark grayish brown Ah horizon, 12 to 20 cm thick, a dark brown to brown Bm horizon, 10 to 18 cm thick, and a pale brown BC horizon. The depth of solum varies with the depth of the sandy strata. The lime accumulation (Cca) horizon usually occurs at the transition from sandy to coarser sediments. Miniota soils are less permeable and less droughty than the very similar coarser textured Wheatland and Dorset soils. The similar, finer textured Croyon soils are less droughty.

Moore Park (MPK)
The Moore Park series is the imperfectly drained, Gleyed Black Chernozem member of the Newdale Association, developed on deep (> 100 cm) strongly calcareous, fine loamy (L, CL,, SCL) textured glacial till. The till is composed of mixed materials derived from shale, limestone, and granitic rock. A thin overlay (< 25 cm) may occur on some soils. The topography is gently sloping, permeability is moderate, and surface runoff is slow. These soils occur in lower slope and depressional positions and are cultivated. Newdale and Angusville soils are commonly found in close association with Moore Park soils. These soils are occasionally weakly saline and sometimes have a few isolated stones on the surface.

The Moore Park series has a black Ap or Ah horizon, 10 to 34 cm thick (averaged from 114 soil profiles), a very dark grayish brown Bmgj, five to 44 cm thick, and a light olive brown Ckgj horizon, 45 to 87 cm thick.

Mowbray Series (MOW)
The Mowbray series consists of a well drained, Cumulic Regosol soil, developed on deep, moderately to strongly calcareous, loamy (L, SiL, CL, SiCL) recent alluvial sediments. These deposits are stratified and contain dark colored bands of former Ah horizons in the profile. The soils are located in upper terrace and flood plain areas that have been inundated during years of high flood waters. Topography is very gently to moderately sloping, runoff is moderate and permeability is moderate.

The soil is characterized by a dark gray to gray surface horizon (Ah or Ap), eight to 20 cm thick, and a lighter colored (C) substratum with dark bands consisting of former organic layers or buried Ah horizons. These soils may exhibit weak profile development. They occur in association with the Levine and Basker soils.

Onahan Series (ONH)
The Onahan series is a Gleyed Regosol soil developed on imperfectly drained, weakly to noncalcareous, sandy (FS, LS, S), eolian sediments. These soils occur in lower and mid-slope positions on complex hummocky topography in association with the Shilox series, which is found on upper slopes, and Mockry soils in associated depressions. Surface runoff is low, and permeability is rapid, but can be restricted by a high water table in the spring and early summer. These soils have been stabilized for more than 60 years, as indicated by tree growth. Some areas have been seeded to grasses and used for pasture.

The Onahan soil profile has a partially decomposed LH horizon, one to three cm thick, and a gray to dark gray Ah horizon, five to 18 cm thick. The Cgj horizon is pale brown with strong brown to yellowish brown mottles. This profile differs from the somewhat similar Hummerston soil series, in not having a Chernozemic A horizon. Onahan soils were included in duned landscape areas of the Stockton Association in the Carberry soil report (Ehrlich et al., 1957).

Petrel Series (PTR)
The Petrel series consists of imperfectly drained Gleyed Black Chernozem soils developed on a mantle (25 to 75 cm) of moderately to strongly calcareous, shallow, medium textured (VFSL, L, SiL), deposits over moderately calcareous, uniform, deep, moderately coarse (FS, LFS, LS), lacustrine deposits. These soils occur in middle positions of very gentle slopes on undulating landscapes and have moderate over moderately rapid permeability, moderately slow surface runoff, and a high water table during the growing season. Petrel soils are non-eroded, non-stony, and occasionally slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes prairie grasses, shrubs, aspen and oak. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 40 cm thick. The profile is characterized by a very dark gray Ah horizon, 18 to 25 cm thick, a brown Bm horizon, 14 to 20 cm thick, a BCgj horizon, 20 to 30 cm thick with faint mottles and a light yellowish brown Ckgj horizon, with yellowish brown to strong brown mottles. A typical profile also contains a weak Cca in the upper part of the sandy substrate.

Petrel soils occur in close association with Glenboro, Grover and Grayson soils. They are similar to Torcan soils by having imperfect drainage and a loamy surface, but differ from them in having a sandy substrate. Petrel soils were previously mapped as Black Meadow associates of the Glenboro Association in the Carberry soil report (Ehrlich et al., 1957).

Pleasant Series (PLE)
The Pleasant series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on moderately to strongly calcareous, deep, uniform, moderately coarse (VFS, LVFS, FSL), lacustrine deposits. These soils occur in middle positions of irregular to undulating landscapes and have moderate permeability, moderately slow surface runoff, and a high water table during the growing season. Pleasant soils are non-eroded, non-stony, and frequently slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes tall prairie grasses, prairie-meadow grasses, shrubs and aspen-oak groves. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 20 cm thick. The profile is characterized by a very dark gray Ah horizon, 15 to 25 cm thick, a dark grayish brown AC horizon, six to 10 cm thick, a Ccagj horizon, 10 to 15 cm thick and a light olive brown Ckgj horizon, with yellowish brown mottles. A typical profile also contains gypsum crystals below the Ccagj horizon.

Pleasant soils occur in close association with Prosser, Gateside and Poolex soils. They are similar to Taggart soils by having an imperfectly drained Gleyed Rego Black Chernozem profile, but differ from them

in having coarse loamy, rather than loamy deposits. Pleasant soils were previously mapped as Black Meadow associates of the Holland Association in the Carberry soil report (Ehrlich et al., 1957).

Poolex Series (POX)
The Poolex series consists of poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous, deep, uniform, coarse loamy (VFS, LVFS, FSL, SL) lacustrine deposits. These soils occur in level to depressional positions on undulating landscapes and have moderate permeability, slow surface runoff, and a high to ponded water table during the growing season. Poolex soils are non-eroded, non-stony, and often slightly saline. They have a medium available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes sedges, rushes, seeds and willows. The majority of these soils are currently in native vegetation.

In a representative profile, the solum is approximately 20 cm thick. The profile is characterized by a moderately decomposed organic horizon, one to four cm thick, a very dark gray Ah horizon, 15 to 22 cm thick, an olive gray to gray AC horizon, six to 12 cm thick, moderately calcareous and a Ccag horizon, 10 to 15 cm thick. The parent material is typically olive brown to pale olive with yellowish brown mottles.

Poolex soils occur in close association with Porple, Pleasant and Gateside soils. They are similar to Vordas soils by having a poorly drained profile in loamy deposits, but differ from them by having slightly coarser textures. Poolex soils were previously mapped as Meadow associates of the Poolex Association in the Carberry soil report (Ehrlich et al., 1957).

Porple Series (POR)
The Porple series is a Rego Black Chernozem soil developed on moderately well to well drained, moderately to strongly calcareous, moderately coarse (VFS, LVFS, FSL, SL), lacustrine sediments. These soils occur on the upper slope positions of gently undulating topography associated with Prosser and Pleasant soils. Surface runoff is moderately rapid, and permeability is moderate to moderately rapid. These soils have had some erosion and are susceptible to both wind or water erosion, if not protected.

The Porple series is characterized by a very dark gray Ap and Ah horizon, 15 to 20 cm thick, and a calcareous AC horizon, eight to 15 cm thick. A layer of lime carbonate accumulation (Cca horizon) may be present. This soil differs from the similar Prosser soils in not having a prominent Bm horizon. Porple soils are finer textured and less permeable than the sandy Stockton soils, and in turn, are coarser textured and more permeable than the very similar loamy textured Durnan and Fairland soils.

Prodan Series (PDA)
The Prodan series is a Gleyed Rego Black Chernozem, carbonated soil developed on imperfectly drained, strongly to very strongly calcareous, moderately fine (SCL, CL, SiCL), lacustrine sediments. These soils occur in the Upper Assiniboine Delta and Brandon Lakes Plain on gently sloping topography in association with Ramada, Charman, Carroll and Tadpole soils. Surface runoff is moderately slow, and permeability is moderate to moderately slow. A seasonal water table frequently occurs within 70 cm of the surface.

The Prodan soil profile has a very dark gray Ah horizon, 18 to 25 cm thick, a dark gray to gray AC horizon, eight to 15 cm thick, and a Ccagj horizon. The Ckgj horizon is light brownish gray with yellowish brown mottles. This soil differs from the similar Charman series in not having a prominent Bmgj horizon. Prodan soils are finer textured and less permeable than the similar loamy textured Taggart and Torcan soils. The very similar Capell soils have coarse, sandy and gravelly textured subsoils that are very rapidly permeable. Prodan soils were previously mapped as Black Meadow associates of the Holland Association in the reconnaissance soil survey of South-Central Manitoba (Ellis and Shafer, 1943).

Prosser Series (PSE)
The Prosser series is an Orthic Black Chernozem soil developed on moderately well to well drained, moderately to strongly calcareous, coarse loamy (VFS, LVFS, FSL, SL), lacustrine sediments. These soils occur in the Upper Assiniboine Delta and Brandon Lakes Plain in association with Porple, Gateside, Pleasant and Poolex soils, on mid and upper slopes of undulating to gently rolling topography. Surface runoff is moderate to rapid, and permeability is moderate to moderately rapid.

The Prosser soil profile has a very dark gray Ah horizon, 18 to 25 cm thick, a dark brown to brown Bm horizon, 12 to 20 cm thick, a pale brown BCk horizon, and usually a Cca horizon, 12 to 18 cm thick. This soil differs from the similar Porple series in having a prominent Bm horizon. The coarse loamy Prosser soils are somewhat finer textured and less permeable than the sandy Stockton and Cactus soils, and in turn, are coarser textured and more permeable than the similar loamy textured Fairland and Durnan soils.

Ramada Series (RAM)
The Ramada series is an Orthic Black Chernozem soil developed on well to moderately well drained, strongly to very strongly calcareous, moderately fine (CL, SiCL), lacustrine sediments. These soils occur in the Upper Assiniboine Delta, and Brandon Lakes Plain on very gently sloping topography or on mid and upper slope positions of undulating topography associated with Barren, Carroll, Charman, Prodan and Tadpole soils. Surface runoff is moderately rapid, and permeability is moderate to moderately slow.

The Ramada soil profile has a very dark gray Ah horizon, 10 to 20 cm thick, a dark grayish brown to brown Bm horizon, eight to 12 cm thick, and a BC horizon, six to 10 cm thick. A Cca horizon is usually present. The Ck horizon is pale brown to light yellowish brown. This soil differs slightly from the Carroll soil in having a prominent Bm horizon. Ramada soils are finer textured and less permeable than the similar coarser textured, loamy Fairland soils, as well as the Croyon and Zarnet soils which have coarse sandy and gravelly textured subsurface layers and very rapid permeability. Ramada soils were previously mapped as the dominant associate of the Holland Association in the reconnaissance soil survey of South-Central Manitoba (Ellis and Shafer, 1943).

Rempel Series (RMP)
The Rempel series consists of moderately well to well drained Calcareous Black Chernozem soils developed on strongly to very strongly calcareous, deep, uniform, moderately fine (CL, SiCL), lacustrine deposits. These soils occur in upper positions of undulating landscapes and have moderate permeability, moderately rapid surface runoff, and a low water table during the growing season. Rempel soils are occasionally slightly eroded, non-stony, and non-saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes tall prairie grasses, meadow grasses and aspen-oak groves. The majority of these soils are cultivated for crop production.

In a representative profile, the solum is approximately 20 cm thick. The profile has a weakly calcareous, very dark gray to very dark grayish brown Ah horizon, 15 to 22 cm thick, a dark grayish brown to brown Bmk horizon, 10 to 15 cm thick, a pale brown BCk horizon, five to 10 cm thick, moderately calcareous and a light gray to white Cca horizon, 10 to 15 cm thick. Rempel soils occur in close association with Ramada, Prodan and Tadpole soils. They are similar to Ramada soils by having well drained, fine loamy soils but differ from them in having a Bmk rather than Bm horizon. Rempel soils were previously mapped as Blackearth associate of the Holland Association in the Carberry soil report (Ehrlich et al., 1957).

Roddan Series (ROD)
The Roddan series consists of well to excessively drained Orthic Regosol soils on a thin mantle (25 to 60 cm) of loamy sediments over a thin strata (10 to 40 cm) of very strongly calcareous, loamy glacial till of limestone and granitic origin over a strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin. These soils occur in the upper slope and knoll positions of irregular undulating to moderately rolling topography. Runoff is moderate to rapid, depending on the gradient; permeability is moderate to moderately slow. Originally, these soils had a dark surface and profile development, but have been sufficiently eroded that little of the original horizons remain. They continue to be very susceptible to both wind and water erosion.

The soil is characterized by a 10 to 15 cm gray to light gray, calcareous plow layer and a very pale brown to white, Ck horizon.

Rufford Series (RUF)
The Rufford series is characterized by a Rego Black Chernozem solum on moderately to strongly calcareous, fine loamy (L, CL, SCL) morainal till of limestone, granite and shale origin. These soils are moderately well to well drained and occur on the upper slopes and knoll positions in undulating to hummocky landscapes in

close association with Cordova and Newdale soils. Runoff is moderately rapid to rapid; permeability is moderately slow.

Rufford profiles have a very dark gray to very dark grayish brown Ah horizon, 12 to 18 cm thick, and a thin ACk horizon, six to 10 cm thick. A carbonate accumulation (Cca) layer, five to 15 cm thick, is usually present. Rufford soils differ from Cordova soils in being less leached and having thinner, less distinct horizons. Both Rufford and Cordova differ from Newdale in being less leached and having free lime carbonate in their A or B horizons.

Sewell Series (SEE)
The Sewell series consists of poorly drained Rego Humic Gleysol soils developed on weakly to moderately calcareous, deep, uniform, coarse (FS, LS, LFS) lacustrine deposits. These soils occur in depressional positions of gentle slopes on hummocky landscapes and have moderately rapid permeability, very slow surface runoff, and a high to ponded water table during the growing season. Sewell soils are non-eroded, non-stony, and often slightly saline. They have a low available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes sedges, rushes, reeds and willows. The majority of these soils are currently in native vegetation.

In a representative profile, the solum is approximately 15 cm thick. The profile is characterized by moderately decomposed organic horizon, two to five cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a dark gray to gray ACkg horizon, 10 to 15 cm thick with carbonates and mottles, and usually a Ccag horizon, five to eight cm thick. A typical profile also contains an olive to pale olive Ckg horizon with yellowish brown mottles and manganese concretions.

Sewell soils occur in close association with Stockton, Lavenham and Hummerston soils. They are similar to Poolex soils by having poor drainage and a Rego Humic Gleysol profile, but differ from them in having sandy, rather than coarse loamy deposits. Sewell soils were previously mapped as Meadow associates of the Stockton Association in the Carberry soil report (Ehrlich et al., 1957).

Shilox Series (SHX)
The Shilox series consists of moderately well to excessively drained Orthic Regosol soils developed on weakly to noncalcareous, deep, uniform, sandy (FS, LS, S), eolian deposits. These soils occur in middle and upper positions of moderate to strong slopes on hummocky to duned landscapes and have rapid to very rapid permeability, minimal surface runoff, and a low water table during the growing season. Shilox soils are severely wind eroded, non-stony, and non-saline. They have low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation includes oak, black spruce, juniper and prairie grasses. The majority of these soils are currently wooded.

In a representative profile, the solum is not developed. The profile is characterized by a partially decomposed LH horizon, one to two cm thick, a grayish brown to pale brown Ah horizon, six to 10 cm thick, and a light yellowish brown to pale brown C horizon. A typical profile also contains an occasional buried Ah horizon, two to four cm thick.

Shilox soils occur in close association with Onahan and Mockry soils. They are similar to Arizona soils by having a Regosol profile in sandy deposits, but differ from them in having less stratification and more uniform textures. Shilox soils were previously mapped as duned associates of the Stockton Association in the Carberry soil report (Ehrlich et al., 1957).

Sigmund Series (SGO)
The Sigmund series consists of imperfectly drained, Gleyed Rego Black Chernozem soils developed on moderately to strongly calcareous, deep, uniform clayey (SiC, C), lacustrine deposits. These soils occur in lower slope positions of very gentle slopes on undulating landscapes and have slow permeability, moderately slow surface runoff, and a high water table during the growing season. Sigmund soils are non-eroded, non-stony, and frequently slightly saline. They have a high available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes aspen-oak groves, willow and prairie grasses. The majority of these soils are currently annual crop production.

In a representative profile, the solum is approximately 20 cm thick. The profile is characterized by a very dark gray Ah horizon, 15 to 25 cm thick, a dark gray ACgj horizon, five to 18 cm thick with many faint mottles, a light gray Ccagj horizon, five to 15 cm thick with many prominent mottles, and a light olive brown Ckgj horizon, with many prominent mottles. A typical profile also contains gypsum crystals in the subsoil.

Sigmund soils occur in close association with Janick, Harding and Lowton soils. They are similar to Harding soils by having an imperfectly drained profile in clayey deposits, but differ from them by having no B horizon. Sigmund soils were previously mapped as minor inclusions of the Oliver Association in the soil survey of South-Central Manitoba (Ellis and Shafer, 1943).

Stockton Series (SCK)
The Stockton series is an Orthic Black Chernozem soil developed on moderately well to well drained, weakly to moderately calcareous, coarse textured (FS, LFS, LS), lacustrine sediments. These soils occur in the Upper Assiniboine Delta, the Brandon Lakes Plain and a few areas within the Lower Assiniboine Delta on very gently sloping to irregular undulating topography in association with Cactus, Lavenham, Hummerston and Sewell soils. Surface runoff is low, and permeability is rapid. Wind erosion is common if the soil is not protected with adequate surface residue.

The Stockton soil profile has a very dark gray to very dark grayish brown Ah, 18 to 25 cm thick, a brown to grayish brown Bm horizon, 12 to 22 cm thick, a pale brown to light yellowish brown BC horizon, eight to 12 cm thick, and a very pale brown Ck horizon with a few yellowish brown mottles at approximately 70 cm depth. A Cca horizon is also frequently present. This soil differs from the very similar Cactus series by having a prominent Bm horizon. The sandy Stockton soils are coarser textured and significantly more rapidly permeable than the finer textured Prosser, Fairland and Ramada soils.

Tadpole Series (TDP)
The Tadpole series is a Rego Humic Gleysol, developed on poorly drained, strongly to very strongly calcareous, moderately fine (CL, SiCL), lacustrine sediments. These soils occur in level to depressional positions of gently sloping to undulating topography in association with Carroll, Firdale, Charman and Danlin soils. Surface runoff is very slow and permeability is restricted. Free water occurs at or near the surface for a considerable part of the year. In areas where seepage water contains appreciable soluble salt, a sufficient salt accumulation can occur to inhibit or retard the growth of normal hydrophytic vegetation.

The Tadpole soil profile has a moderately decomposed organic layer, two to six cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a dark gray AC horizon, four to six cm thick, a Ccag horizon, 10 to 15 cm thick, and an olive to olive gray Ckg horizon with distinct yellowish brown mottles. In areas affected by salts, white pseudomycelia are common in the surface horizons. Tadpole soils are finer textured and less permeable than the very similar and coarser textured Vordas, Poolex and sandy Mockry and Sewell soils. The similar Carvey soils have coarser textured sandy to gravelly subsurface layers that are much more rapidly permeable than the Tadpole soils.

Taggart Series (TGR)
The Taggart series consists of imperfectly drained Gleyed Rego Black Chernozem soils developed on strongly to very strongly calcareous, deep, uniform, medium textured (VFSL, L, SiL), lacustrine deposits. These soils occur in middle positions of undulating landscapes and have moderate permeability, slow surface runoff, and a high water table during the growing season. Taggart soils are non-eroded, non-stony, and often slightly saline. They have a medium available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation includes aspen, oak, willow and prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 20 cm thick. The profile is characterized by a very dark gray Ah horizon, 15 to 24 cm thick, a dark gray AC horizon, five to 15 cm thick, moderately calcareous, a Cca horizon, eight to 12 cm thick with a carbonate accumulation, and an olive brown Ckgj horizon, with yellowish brown mottles. A typical profile also contains gypsum crystals below the Cca horizon.

Taggart soils occur in close association with Fairland, Durnan and Vordas soils. They are similar to Torcan soils by having imperfect drainage and loamy deposits, but differ from them by having no prominent Bm

horizon. Taggart soils were previously mapped as associates of the Holland Association in the Carberry soil report (Ehrlich et al., 1957).

Torcan Series (TOC)
The Torcan series consists of imperfectly drained Gleyed Black Chernozem soils developed on strongly to very strongly calcareous, deep, uniform, medium textured (VFSL, L, SiL), lacustrine deposits. These soils occur in middle to lower positions of undulating to rolling landscapes and have moderate permeability, moderately slow surface runoff, and a medium water table during the growing season. Torcan soils are non-eroded, non-stony, and occasionally slightly saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes aspen, willow, shrubs and meadow grasses. The majority of these soils are cultivated for crop production.

In a representative profile, the solum is approximately 45 cm thick. The profile is characterized by a very dark gray Ah horizon, 18 to 25 cm thick, a light brown Bmgj horizon, 10 to 18 cm thick with yellowish brown mottles, a Ccagj horizon, eight to 12 cm thick, and a light olive brown Ckgj horizon, with yellowish brown mottles. Torcan soils occur in close association with Fairland, Taggart and Vordas soils. They are similar to Taggart soils by having imperfect drainage and loamy deposits, but differ from them by having a prominent Bm horizon. Torcan soils were previously mapped as associates of the Holland Association in the Carberry soil report (Ehrlich et al., 1957).

Traverse Series (TAV)
The Traverse series consists of well to moderately well drained Calcareous Black Chernozem soils developed on strongly to very strongly calcareous, deep, uniform, medium textured (VFSL, L, SiL), lacustrine deposits. These soils occur in middle and upper positions of very gentle slopes on undulating landscapes and have moderate permeability, moderate to rapid surface runoff, and a low water table during the growing season. Traverse soils are often slightly eroded, non-stony, and non-saline. They have a medium available water holding capacity, medium organic matter content, and high natural fertility. Native vegetation includes oak, aspen, shrubs and prairie grasses. The majority of these soils are currently cultivated for crop production.

In a representative profile, the solum is approximately 25 cm thick. The profile is characterized by a very dark gray Ah horizon, 10 to 18 cm thick, a dark grayish brown Bmk horizon, eight to 15 cm thick, moderately calcareous, a brown to pale brown BC horizon, 10 to 15 cm thick, moderately calcareous and a white Cca horizon, eight to 12 cm thick with carbonate accumulation. The parent material is typically dark yellowish brown.

Traverse soils occur in close association with Fairland, Taggart and Vordas soils. They are similar to Rempel soils by having a Calcareous Black Chernozem profile, but differ from them by having loamy rather than fine loamy deposits. Traverse soils were mapped as Calcareous Black associates of the Holland Association in the Carberry soil report (Ehrlich et al., 1957).

Varcoe Series (VRC)
The Varcoe series is characterized by a Gleyed Rego Black Chernozem (carbonated) solum on moderately to strongly calcareous, fine loamy (L, CL, SCL) morainal till of limestone, granite and shale origin. These soils are imperfectly drained and occur in the lower slope positions of undulating to hummocky landscapes in close association with Angusville soils. They receive runoff from the upper slopes, and in some landscapes, may be influenced by seepage. Permeability is slow and may be restricted during periods of subsoil saturation. In areas where upward groundwater or seepage waters contain appreciable salts, accumulation of salts may occur within the soil.

Varcoe profiles average 42 cm in thickness and range from 20 to 60 cm. The A horizon is usually 28 cm thick and ranges from 20 to 50 cm, very dark gray in color and is underlain by a dark gray transitional AC horizon, four to eight cm thick. A carbonate accumulation horizon (Ccagj) is commonly present, but may be discontinuous. Gypsum crystals are usually present below and within the carbonate accumulation layer. Varcoe soils containing significant soluble salts in the A horizon, as well as gypsum, have been identified as the saline phase of the series.

Vodroff Series (VFF)
The Vodroff series consists of poorly drained Rego Humic Gleysol soils developed on a thin mantle (<1 m) of loamy (L, CL, SiCL) lacustrine sediments over a strongly calcareous loam to clay loam glacial till of shale, limestone and granitic origin. These soils have free water at or near the surface for a considerable period of the year. The topography is level to depressional; runoff is negligible; permeability is restricted during periods of free water within a metre. In areas where the inflowing waters contain appreciable soluble salts, the salt may accumulate in the soil in sufficient amounts to affect the growth of normal hydrophytic vegetation. The soil is characterized by a moderately decomposed organic layer, two to five cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a mottled dark gray ACg horizon, four to eight cm thick, and a carbonate accumulation horizon, eight to 12 cm thick. The Ckg horizon is olive to pale olive and usually contains yellowish brown mottles.

Vordas Series (VDS)
The Vordas series consists of poorly drained Rego Humic Gleysol soils developed on strongly to very strongly calcareous, deep, uniform, medium textured (VFSL, SiL, L), lacustrine deposits. These soils occur in level to depressional positions of undulating landscapes and have moderate permeability, very slow surface runoff, and a high to ponded water table during the growing season. Vordas soils are non-eroded, non-stony, and often slightly saline. They have a medium available water holding capacity, high organic matter content, and low natural fertility. Native vegetation includes sedges, rushes, reeds and willows. The majority of these soils are currently in native vegetation.

In a representative profile, the solum is approximately 15 cm thick. The profile is characterized by a moderately decomposed organic horizon, two to five cm thick, a very dark gray Ah horizon, 10 to 18 cm thick, a dark gray ACkg horizon, four to six cm thick with carbonates and mottles, and an olive to pale olive Ckg horizon, with yellowish brown iron mottles. A typical profile also contains white pseudomycelia of salt in the Ah and ACkg horizons in saline areas.

Vordas soils occur in close association with Fairland, Taggart and Torcan soils. They are similar to Tadpole soils by having poor drainage and loamy deposits, but differ from them by having slightly coarser textures. Vordas soils were previously mapped as Meadow associates of the Holland Association in the Carberry soil report (Ehrlich et al., 1957).

Wellwood Series (WWD)
The Wellwood series consists of well to moderately well drained Orthic Black Chernozem soils, developed on a thin mantle (25 to 75 cm) of strongly calcareous fine loamy (CL, SCL, SiCL) sediments grading to moderately calcareous sandy (FS, LS, LFS) deposits. Topography is nearly level to very gently sloping; runoff is moderate to moderately slow; permeability is moderate in the upper loamy strata and rapid in the sandy strata.

The soil is characterized by a deep black to very dark gray, loam to clay loam, Ah horizon, 18 to 30 cm thick, a dark brown to brown, prismatic to subangular blocky, clay loam to silty clay loam, Bm horizon, 16 to 24 cm thick, and a yellowish brown to pale brown, clay loam to silty clay loam, BC horizon, eight to 14 cm thick. A Cca horizon may be present, underlain by a II Ck that ranges from fine sand to loamy fine sand.

Wheatland Series (WHL)
The Wheatland series consists of well to moderately well drained Orthic Black Chernozem soils developed on a mantle (60 to 95 cm) of moderately to strongly calcareous, shallow sandy (FS, LS), deposits over moderately to strongly calcareous, deep, stratified, sandy-skeletal (CoS, MS), fluvial deposits. These soils occur in upper positions of gentle to very gentle slopes on undulating landscapes and have rapid over very rapid permeability, moderately slow surface runoff, and a low water table during the growing season. Wheatland soils are occasionally slightly eroded, non-stony, and non-saline. They have a low available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation includes oak, aspen, shrubs and prairie grasses. The majority of these soils are currently used for grazing and for some crop production.

In a representative profile, the solum is approximately 40 cm thick. The profile is characterized by very dark gray to very dark grayish brown Ah horizon, 18 to 25 cm thick, a brown to yellowish brown Bm horizon, 12

to 24 cm thick, a light yellowish brown BCk horizon, 10 to 15 cm thick with carbonates and a Cca horizon, five to eight cm thick at the sand and gravel contact. They are similar to Dorset soils by having an Orthic Black Chernozem profile and sandy-skeletal substrate, but differ from them in having a sandy surface mantle. Wheatland soils were previously mapped as associates of the Agassiz Association in the Carberry soil report (Ehrlich et al., 1957).

Wytonville Series (WVI)

The Wytonville series consists of imperfectly drained Gleyed Black Chernozem soils developed on a thin mantle (<1 m) of moderately to strongly calcareous, coarse loamy (VFS, LVFS, SL, FSL) sediments, overlying moderately, to strongly calcareous medium sand to gravelly textured deposits. Topography is gently sloping to irregular, undulating. Runoff is moderately slow. Permeability is moderately rapid on the upper strata, and very rapid in the lower strata, unless restricted by a water table within a metre of the surface during the spring or following heavy rains.

The soil is characterized by a very dark gray to very dark grayish brown Ah horizon, 18 to 25 cm thick, a brown to dark brown, weakly mottled Bmgj horizon, 14 to 22 cm thick, and a light yellowish brown BCgj with strong brown mottles. A carbonate accumulation horizon (Ccagj) occurs at the upper boundary of the coarse strata. Wytonville profiles differ from Kilmury soil profiles in not having the presence of carbonates in their Ah. They are also more permeable than the very similar Druxman soils. They occur in close association with the Kilmury soils, the well drained Miniota soils and the poorly drained Bornett series.

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