MAP UNIT FIELD CODE KEY TABLE FOR Mn/MODEL v. 7.0
(last modified January 26, 2012)

GEOMORPHIC FIELD CODES

Can be supplemented with USGS Digital Elevation Data layer and its derivative layers (Slope; Relative Elevation; Surface Roughness). Also can be supplemented with MPCA Stream Order layer, although this is a coarser scale than Code No. 10.

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
CODE NO. 1 GEOMORPHIC REGION (GEOM_REG1)				Polygons can be adapted from editing the DNR GIS Minnesota Geomorphology coverage or created by new landform-sediment assemblage mapping for Mn/Model.
	No Distinction Made	NO_DIST	*	
	Glacial Lobe	GLA_LOB	L	
	Glacial Lake Plain	GLA_LAK	P	
	Glaciofluvial Valley	GLF_VAL	V	
	Glacial-Scoured Bedrock Terrain	GLA_SBRT	B	
	Bedrock Terrain	BRT	T	
CODE NO. 2 GEOMORPHIC REGION IDENTIFIER (REGION_ID2)				This code consists of the geographic or commonly used name for a **Geomorphic Region**.
	No Distinction Made	NO_DIST	*	
Glacial Lobe				
	Des Moines	DES	D	
	Grantsburg	GRANT	G	
	Koochiching	KOOCH	K	
	Pre-Wisconsinan	PRE_WI	P	
	Rainy	RAINY	Y	
	Red River	RED	R	
	St. Louis	STL	S	
	Superior	SUPER	X	
	Wadena	WADEN	W	
Glacial Lake Plain				
	Lake Agassiz	LAK_AGA	LA	This value excludes the Beltrami Arm of Lake Agassiz.
	Lake Agassiz, Beltrami Arm	LAK_AGAB	LB	
	Lake Aitkin	LAK_AIT	LI	

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Lake Duluth	LAK_DUL	LD	
	Lake Upham	LAK_UPH	LU	
	Lake Minnesota	LAK_MIN	LM	
	Lake Benson	LAK_BEN	LE	
Glaciofluvial Valley				
	Glacial River Warren	RIV_WAR	VW	
	St. Croix River Valley	STC_VAL	VS	
	Mississippi River Valley	MIS_VAL	VM	
	Rum River Valley	RUM_VAL	VU	
	St. Louis River Valley	STL_VAL	VT	
	Sauk River Valley	SAK_VAL	VK	
Bedrock Terrain				
	Border Lakes Area	BORDER	BO	
	Giants Range	GIANT	GI	
	Mesabi Range	MESAB	ME	
CODE NO. 3 GEOMORPHIC SUB-REGION (GEOM_SUBR3)				Polygons can be adapted from editing the DNR GIS Minnesota Geomorphology coverage or created by new landform-sediment assemblage mapping for Mn/Model.
	No Distinction Made	NO_DIST	*	
	Ground Moraine	GRO_MOR	G	
	End Moraine	END_MOR	E	
	Beach (Level)	BEA_LEV	B	
	Eolian Dune Field	EOL_FLD	D	
	Drumlin Field	DRU_FLD	U	
	Outwash Plain	OUT_PLA	O	
	Paleo-Valley	PAL_VAL	Y	This value can include outwash, collapsed outwash, tunnel valley, glacial lake outlet, etc. cut during glacial activity.
	River Valley	RIV_VAL	R	
	Sand Plain	SAND_PLA	S	This value is descriptive (i.e., not genetic) for a sand plain of unknown or complex origin(s).

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
CODE NO. 4 GEOMORPHIC SUB-REGION IDENTIFIER (SUBREG_ID4)				This code consists of the geographic or commonly used name for a **Geomorphic Sub-Region**.
	No Distinction Made	NO_DIST	*	
Moraine				
	Alexandria	ALEX	AX	
	Algona	ALGO	AG	
	Altamont	ALTA	AL	
	Ann	ANN	AN	
	Bemis	BEMI	BE	
	Big Stone	BIGS	BS	
	Cloquet	CLOQ	CL	
	Culver	CULV	CU	
	Dent	DENT	DE	
	Erskine	ERSK	ER	
	Frazee	FRAZ	FR	
	Guthrie	GUTH	GU	
	Highland	HIGH	HI	
	Itasca	ITAS	IT	
	Knife	KNIF	KI	
	Mille Lacs	MILL	MI	
	Nashwauk	NASH	NA	
	Nemadji	NEMA	NE	
	Nickerson	NICK	NI	
	Outing	OUTI	OU	
	Pine City	PINE	PI	
	St. Croix	STCR	ST	
	Sugar Hills	SUGA	SU	
	Vermillion	VERM	VE	
Beach (Level)				
	Blanchard	BLAN	BL	
	Campbell	CAMP	CA	
	Emerado	EMER	EM	
	Herman	HERM	HE	
	Hillsboro	HILL	HI	
	Lower Campbell	LOCA	LO	

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	McCauleyville	MCCA	MC	
	Norcross	NORC	NO	
	Ojata	OJAT	OJ	
	Tintah	TINT	TI	
Eolian Dune Field				
Drumlin Field				
	Wadena	WAD_DRU	WD	
	Toimi	TOI_DRU	TD	
	Pierz	PIE_DRU	PD	
	Brainerd	BRA_DRU	BD	
	Automba	AUT_DRU	AD	
Outwash Plain				
	Anoka Sand Plain	ANOKA	AK	The Anoka Sand Plain is generally considered an outwash or lake plain (Wright, 1972; Patterson, 1992; Meyer and Patterson, 1997). However, much of the area was subsequently modified by eolian processes forming dunes and possibly sand sheets.
	Park Rapids	PARK_OP	PR	
River Valley				
	Blue Earth Valley	BLU_VAL	BLU	
	Rainy River Valley	RAINY_VAL	RA	
	Red River Valley	RED_VAL	RE	
	Root River Valley	ROOT_VAL	RO	
	Rock River Valley	ROCK_VAL	RK	
	Rum River Valley	RUM_VAL	RU	
	Minnesota Valley	MINN_VAL	MN	The Minnesota Valley is separated from the geomorphically broader Glacial River Warren valley because it contains the bulk of the Holocene-aged sediments
	St. Croix Valley	STC_VAL	CRX	
	Sauk Valley	SAUK_VAL	SK	
	Upper Mississippi Valley - Headwaters Reach	MISS_HEAD	UMH	The headwaters region is typified by a series of lake basins interconnected by ancient outwash channels.
	Upper Mississippi Valley - Glacial	MISS_AITKIN	UMA	The Mississippi River Valley cross-cuts the relatively flat

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Lake Aitkin Reach			Glacial Lake Aitkin basin.
	Upper Mississippi Valley - Brainerd to St. Cloud Reach	MISS_BRAIN	UMB	The Mississippi River Valley cross-cuts a broad outwash valley train.
	Upper Mississippi Valley - St. Cloud to Minnesota Valley Confluence	MISS_STCLD	UMS	
	Upper Mississippi Valley - Glacial River Warren Reach	MISS_WARREN	UMW	
	Upper Mississippi Valley - St. Croix Valley Confluence to Iowa Border	MISS_STCROIX	UMC	
CODE NO. 5 LANDSCAPE (LANDSCAPE5)				Landscapes that are composed of one or more related **Landforms**.
	No Distinction Made	NO_DIST	*	
	Upland, Undifferentiated	UPL_UNDIFF	U	
	Active Ice	ACT_ICE	I	Active Ice landscape is dominated by landforms that result from flowing glacial ice. Thus many landforms have a preferred orientation in relation to the direction of ice flow. Ice flows by a combination of internal deformation of the ice mass and basal sliding. Landforms can develop as a result of erosion and sedimentation in the subglacial environment, largely dependent on the thermal conditions at the ice – bed interface through time and space. Active ice landforms also develop in the supraglacial environment as a result of compressive flow of the glacial ice bringing ice-borne debris to the surface.
	Stagnant Ice	STAG_ICE	S	Elements of the Stagnant Ice landscape develop primarily, but not only, in the supraglacial environment at the contact of stagnant or dead ice with overlying debris or the atmosphere. The environment is one that evolves as the glacial ice down-wastes rather than retreats as active ice does, and hence oriented landforms are uncommon. During formation, alterations of the supraglacial landscape can be rapid, involving multiple generations of landscape inversion, transitory streams, lakes, hummocks and depressions, and unstable ridges. The net result is a complex landscape with a potentially wide range of landforms, each of which can exhibit a wide range of

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				variability in form and sediment caliber of the associated sediment assemblage.
	Ice Contact	ICE_CONT	N	The Ice Contact landscape consists of landforms that develop primarily in the englacial and subglacial environments by the actions of glacial meltwater in direct contact with glacial ice. Because of the dynamic character of glacial ice and the glaciofluvial system, glaciofluvial deposition is often temporary due to abrupt and extreme fluctuations in glacial stream discharge. Only a fraction of the resulting landforms are ultimately preserved. Thus, the elements of the Ice Contact landscape tend to be discontinuous, and subject to abrupt changes in orientation and caliber of sediment. Classic landforms of the Ice Contact landscape include kames, kame terraces and eskers.
	Pediment	PEDIMENT	P	A landscape (at this scale) composed of a gently sloping bedrock erosional surface formed by either alluvial or colluvial (e.g., sheetwash) waters under arid or semiarid conditions and at or near the base of a mountain, bluff, or escarpment. The bedrock surface slope may be mantled by a thin veneer of younger alluvium or colluvium derived from the receding mountain or escarpment, and in transit across the surface.
	Glaciofluvial	OUTWASH	O	The Glaciofluvial landscape consists of landforms that result from the activity of glacial meltwater streams generally beyond the limits of active, and in some cases wasting, ice fronts. The landscape can have elements formed on or inset into nearly contemporaneous glacial drift. Glaciofluvial systems are subject to seasonal and diurnal discharge cycles, sometimes with violent summer floods, and less frequent floods of larger magnitude.
	Catastrophic Flood	CAT_FLOOD	C	Large magnitude flooding; typically but not necessarily related to glaciolacustrine breaches; see Kehew (1982)
	Glaciolacustrine	GLAC_LAC	A	Pertaining to lakes that are mostly derived from glacial meltwater streams and supposedly still in contact with glacial ice; also refers to the deposits and landforms produced by such lakes.

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Collapsed Sand Plain	C_SAND_PLA	D	This value is used for a sand plain of unknown or polygenetic origin that for the most part exhibits the muted morphology of a buried, collapsed stagnant ice landscape. The depositional environment (glaciofluvial, glaciolacustrine, eolian, or in combination) of the covering sand may or may not be related in part or in whole to the buried ice and its stagnation. Such a sand plain is distinguished from a strictly Stagnant Ice Landscape due to its unknown, and likely polygenetic origin, and the apparent discordance between the origin of the sand body and its existing morphology.
	Collapsed Meltwater Trough	MELT_T	T	This landscape consists of landforms in a series of linear, parallel to subparallel, troughs marked by irregular trough walls and trough width due to collapse within and along the trough. Troughs can be discontinuous. The original formation of troughs has been interpreted to be subglacial glaciofluvial in origin, in the form of tunnel valleys (Wright, 1973; Patterson, 1992). An origin as subglacial tunnel channels is an alternative interpretation (Cushing, 1963). In either case, the collapsed aspect of the troughs is interpreted to result from melting of glacial ice that subsequently filled the troughs when they were overridden by and filled with glacial ice by a later glacial advance. Landforms of the Collapsed Meltwater Trough landscape are variable, reflecting both the original collapse as well as the subsequent modification by potentially younger glaciofluvial processes, followed by alluvial, colluvial and lacustrine processes.
	Meltwater Trough Fan	MELT_F	MF	This value is used for large positive features that are interpreted as fans at the mouths of Collapsed Meltwater Troughs, or tunnel valleys (Patterson, 1994). The associated sediment assemblage consists of interstratified sand, gravel and diamicton. This value is discontinuous, unlike other modes of glacial fluvial landscape that tend to exhibit a strong linearity. Nevertheless, they are widespread, and cumulatively exist at the landscape scale.
	Paleo-Valley	PALEO_VAL	Y	During advances and retreats of glacial lobes, at times substantial segments of pre-existing river valleys are abandoned. The Paleo-Valley landscape is formed by largely relict fluvial or glaciofluvial landforms within the confines of

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				abandoned valleys.
	Peatland	PEAT	B	An expansive area of current or former peatland marshes.
	Valley Terrace	VAL_TERR	V	The Valley Terrace landscape consists of alluvial terraces formed in river and stream valleys. Terraces of the Valley Terrace landscape are distinguished from terraces formed in response to glaciofluvial processes in the Glaciofluvial landscape.
	Floodplain	FLOOD	F	The area of relatively smooth land adjacent to a river channel, constructed by the present river in its existing regimen and covered with water when the river overflows its banks. It is built of alluvium carried by the river during floods and deposited in the sluggish water beyond the influence of the swiftest current.
	Valley Margin	VAL_MARG	M	The Valley Margin landscape consists of landforms that develop in response to the abrupt change in slope typically imposed by valley walls, and / or the transition from confined flow, such as streams in tributary valleys, to unconfined flow. The landforms are dominated by depositional forms that develop at and beyond the foot of valley slopes. Typical landforms include alluvial fans and colluvial foot and toe slopes.
	Eolian	EOLIAN	E	Describes an expansive area of rock or sediment that is derived from wind energy.
	Lacustrine	LAKE	L	This value may include **River Lake** and river **Delta** landforms.
CODE NO. 6 LANDSCAPE GEOGRAPHIC OR INFORMAL IDENTIFIER (LNDSCP_ID6)				This code consists of the geographic or commonly used name for a **Landscape** in a particular **Geomorphic Region** or **Geomorphic Sub-Region**.
	No Distinction Made	NO_DIST	*	
CODE NO. 7 LANDFORM (LANDFORM7)				This code consists of individual values of **Landscape** at a landform scale.
	No Distinction Made	NO_DIST	*	
	Alluvial Fan	FAN	AF	The morphologic transition between **Alluvial Fan** and **Colluvial Slope** can be gradational. In general, **Alluvial Fan**

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				includes fan-shaped forms of mappable size. Smaller fans not practical to differentiate at the 1:24,000 scale of mapping, whether alluvial or colluvial, are included in the **Colluvial Slope** value. Where multiple **Alluvial Fan**s have coalesced, no attempt is made to differentiated individual fans.
	Alluvial Fan-Delta	FAN_DELTA	FD	This code refers to alluvial fan-deltas, which are usually at or near the floodplain along major rivers such as in the Mississippi Valley.
	Alluvial Fan-Delta, Distal	FD_DISTAL	FD(D)	This code distinguishes the distal position of a fan-delta from the proximal position. The distal fan-delta position is typically characterized by a lower landscape position, more poorly drained soils, and in some locations a thinner and / or finer sediment assemblage and to some degree, different sediment processes, compared to the proximal fan-delta position.
	Alluvial Fan, Distal	FAN_DISTAL	AF(D)	This code distinguishes the distal position of an alluvial fan from the proximal and medial positions. The distal fan is dominated by processes (distributaries and wash) that differ from the proximal fan environment. Also, the distal fan is thinner than the proximal fan, and can be underlain by shallower and younger geomorphic surfaces. This code is used within large fans typically developed in the Mississippi River valley.
	Arterial Drain Patterned Bog (Water Track)	ART_BOG	AB	Bogs and fens that exhibit micro-ridges superimposed across linear bands of differing vegetation and corresponding bands of tonal contrast on aerial photography are referred to collectively as patterned bogs. The surface of the patterned bog is marked by sinuous, more or less parallel, micro-ridges oriented perpendicular to water flow. Micro-ridges rise on the order of 0.3 m and usually exhibit a spacing ranging between three and 15 meters. Orientation of linear bands along with topography indicate the direction of water flow in patterned bogs, and the lighter toned bands, or water tracks, mark the flow of waters relatively enriched in minerals. Patterned bogs tend to surround streamlined-shaped raised bogs (see Ovoid Shaped Bog) elongated parallel with the orientation of the patterned bog. See Heinselman (1963, 1970), Glaser et al. (1981), Wright and

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				Glaser (1983), Minnesota DNR (1984), and Eng (1980).
	Bar	BAR	B	This value is usually, but not exclusively, used in conjunction with the **Catastrophic Flood Landform**.
	Bar, Distal	BAR_DISTAL	B(D)	This code distinguishes the distal position of a fluvial bar from the proximal position. The distal bar position is typically characterized by a lower landscape position, more poorly drained soils, and in some locations a thinner and / or finer sediment assemblage and to some degree, different sediment processes, compared to the proximal bar position.
	Beach Ridge, Spit, Cusp, or Shore	SHORE	SH	Geomorphological beach line.
	Colluvial Slope	COLLUV	C	The morphologic transition between Alluvial Fan and Colluvial Slope can be gradational. In general, Colluvial Slope includes various forms of slopes dominated by sheetflood depositional processes as well as those dominated by slumps and other slope failures. Smaller fans not practical to differentiate at the 1:24,000 scale of mapping, whether alluvial or colluvial, are included in the Colluvial Slope value. Areas of Colluvial Slope often are present but are too narrow to be reasonably mapped at a scale of 1:24,000.

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	Compaction Ridge	COMP_RIDG	CR	Ridges of coarser grained sand and gravel deposited by streams that flowed on a lake plain between glacial lake stages, therefore covered by a layer of lake clays. Defined in the Glacial Lake Agassiz **Geomorphic Region** by Bluemle (1967).
	Crevasse Splay	SPLAY	CS	A crevasse splay is a distinct type of floodplain overbank deposit formed when a levee or other barrier is breached, generally rapidly, and floodwaters pour through the breach into the adjacent floodbasin. The crevasse splay has a crevasse splay channel that typically forms a branching distributary pattern with distance from the breach. Additional geomorphic elements of a crevasse splay can include natural levees and overbank belts that often are fan-shaped when unconfined. The form of a crevasse splay can be greatly influenced by the pre-existing floodplain geometry.This value includes crevasse channels, splay channels, and splay overbank belts.
	Crevasse Splay Channel	CS_CHANNEL	CH	This code is used for significantly sized crevasse splay channels.
	Crevasse Splay Distributary Mouth Bar	CS_DIST_BAR	SD	This code is used for distributary mouth bars of substantial crevasse splays.
	Crevasse Splay Distributary Mouth Bar, Distal	CS_D_B_DISTAL	SD(D)	This code distinguishes the distal position of a crevasse splay distributary mouth bar from the proximal position. The distal distributary bar position is typically characterized by a lower landscape position, more poorly drained soils, and in some locations a thinner and / or finer sediment assemblage and to some degree, different sediment processes, compared to the proximal distributary bar position.
	Crevasse Splay Meander Belt	CS_MEANDER	CM	This code is used for meander belts of substantial crevasse splays.
	Crevasse Splay, Distal	CS_DISTAL	CS(D)	This code distinguishes the distal position of a crevasse splay from the proximal position. The distal crevasse splay position is typically characterized by a lower landscape position, more poorly drained soils, and in some locations a thinner and / or finer sediment assemblage and to some degree, different

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				sediment processes, compared to the proximal crevasse splay position.
	Delta	DELTA	DE	This value does not differentiate between different types of deltas. It includes deltas formed in lakes; fan deltas, where a river enters a riverine lake; and, deltas deposited where a river enters a larger river valley.
	Depression	DEPR	D	As used in the code, **Depression** is a general descriptive term for a relatively small topographic basin. It usually is used in conjunction with glacial **Landscape**s. The value may include **Linked Depression**s or **Interdunal Depression**s where they are not differentiated. Some **Depression**s may be old abandoned quarries which are indistinguishable as to their origin without a historic landuse record search.
	Depression, Kettle	DEPR_KETTLE	DK	Ice-block meltout depressions or parts parts of depressions not typically occupied by standing water.
	Depression, Rectangular	DEPR_RECT	DB	This code is used for rectangular ice block depressions reflecting surface ice with little to moderate subsequent modifications.
	Disintegration Ridge	DIS_RIDGE	DS	Disintegration ridges are ridges of glacial drift on moraines that exhibit a reticulated or rectilinear pattern, but exhibit no preferred orientation. They formed in the complex ice-contact enivironment at the top of stagnating glacial ice. Defined by the DNR for their (1:100k) geomorphology maps.
	Disturbed Areas	DISTURB	DI	This value primarily consists of quarries and pits, but can include vast construction sites and sewage treatment reservoirs. Excludes plowed fields.
	Doughnut	DOUGH	DO	Doughnut-shaped landforms typically associated with glacial landscapes.
	Drainageway	DRAIN	DA	This value consists of low-order valleys that have a shallow "u" shape and ill-defined floodplain. They are typical of low-order upland valleys.
	Drumlin	DRUMLIN	DR	Oval, elongated hills derived by the streamlined motion under glacial ice.
	Dune	DUNE	ED	Eolian- or beach-derived topographical landforms
	Erosional Residual	RESIDUAL	ER	A remnant of a once larger stratigraphic unit or body of rock that has been mostly eroded. This value is used in conjunction with **Catastrophic Flood** or, less frequently, **Outwash Landscape**s.

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	Erosional Strath	STRATH	ST	A bench cut in bedrock or till by fluvial or glaciofluvial processes. It may or may not have a continuous or discontinuous veneer of younger fluvial deposits on it. This value is usually used in conjunction with **Catastrophic Flood** or **Outwash Landscape**s.
	Escarpment Complex	ESCARP_C	EC	This value is used in areas where the major landform is an escarpment within the **Glaciolacustrine** landscape and includes smaller **Terrace** and possibly **Beach Ridge** landforms which are not readily apparent at the 1:24,000 scale
	Esker	ESKER	EK	A meandering ridge of fluvial gravel and sands deposited under a wasting glacial ice front.
	Floodplain, Undifferentiated	FLOOD	F	This value is mapped in lower order valleys where individual **Floodplain** types are not large enough, or distinct enough, to map at a scale of 1:24,000. Marshes and lakes on **Floodplain**s are considered subdivisions of **Floodplain**s and usually are not distinguished individually because many are seasonal and subject to large seasonal fluctuations in water depth and size. Individual sloughs on **Floodplain**s are not distinguished unless they are of considerable length and mapped as a **Paleochannel**. Otherwise, they are considered part of the lateral accretion **Floodplain** morphology.
	Floodplain, Type "W"	FL_W	FW	**Type "W" Floodplain**s have point bars or other channel migration features evident and recently active based on the lack, paucity, or type of vegetation. It often is associated with comparatively sparse or no vegetation; typically occurs between a marked discontinuity with other **Floodplain** types and the active river channel; and, lacking the aforementioned, may be an arbitrary distinction between **Type "W"** and **Type "X" Floodplain** types.
	Floodplain, Type "X"	FL_X	FX	**Type "X" Floodplain**s have point bars or other channel migration features evident, but they have not been recently active. They are usually vegetated.
	Floodplain, Type "Y"	FL_Y	FY	Point bars or other channel migration features not evident on **Type "Y" Floodplain**s, either due to burial by younger overbank deposits, or they were never present.
	Floodplain, Type "Z"	FL_Z	FZ	**Type "Z" Floodplain**s do not have evident point bars or other channel migration features; usually are surrounded or partially surrounded by **Valley Terrace** or **Catastrophic Flood**

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				Landscapes; and/or are outside of, or otherwise isolated from, obvious former channel and/or overbank belts.
	Floodplain and Terraces, Undifferentiated	FLO&TERR	FN	This value is mapped in lower order valleys wide enough to have **Floodplain**s and **Terrace**s, but where individual **terrace** areas are not large enough, or distinct enough from **Floodplain** areas, to map at a scale of 1:24,000.
	Floodplain, Island Braided	FL_IB	FI	Floodplain with an island-braided pattern.
	Hillslope	HILL	H	This value refers only to relatively steep and high 1) valley walls along higher order valleys with floodplains; 2) ***upland*** hillslopes; and, 3) ***upland or valley*** slopes in bedrock terrains. It primarily consists of backslope hillslope components (*sensu* Ruhe, 1969). The upper limit usually is mapped where contour lines become more widely spaced, generally representing the position of the shoulder slope.
	Hummock	HUMMOCK	HU	As used in the code, **Hummock** is a general descriptive term for a relatively small topographic rise. It usually is used in conjunction with glacial **Landscape**s. The value may include Doughnuts and **Ice-Walled Lake Bed**s where they are not differentiated.
	Ice-Block Kame Terrace	ICEBK_KAME	IK	An often ring-shaped kame terrace formed in a glaciolacustrine or glaciofluvial setting at the perimeter of a stagnating glacial ice block (Hudak and Hajic 1999; Hudak and Hajic in preparation)
	Ice-Walled Lake Bed	ICE_WALLED	IW	This value is mapped in conjunction with the **Stagnant Ice Landscape**. It is used for circular Hummocks where associated stratified fine-textured deposits >2m thick are interpreted as lake sediments.
	Ice-Walled Lake Beach Ridge	ICE_WAL_BR	IB	This value is mapped in conjunction with the **Stagnant Ice Landscape**. It consists of narrow, arcuate, ridges that rise above surrounding **Stagnant Ice** LsSA terrain. It often is associated with, but not necessarily adjacent to, H**ummock**s mapped as **Ice-Walled Lake Beds**
	Inter-Drumlin Trough	INTER_D	ID	This value is for troughs between drumlins.
	Interdunal Depression or Pond	POND	DP	This value refers to a **Depression** that is interpreted to have been formed wholly or in part by eolian processes. It typically, but not necessarily, is at least partially surrounded by **Eolian Dune**s. Such a depression may seasonally or perennially contain a relatively small water body.

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	Island	ISLAND	I	If other **Landform** assignments are deemed more significant than the **Island**-lake or **Island**-river relationship, **Island** is not used. Islands may have complicated stratigraphy, but were not field tested during the Mn/Model project.
	Isthmus	ISTHMUS	IT	
	Kame	KAME	K	Mound of stratified gravel and sands deposited by glacial meltwaters and in contact with the glacial ice, either englacial or periglacial.
	Kame Terrace	KAMET	KT	Stratified drift deposited in depressions and cavities in stagnant ice and left as irregular steep-sided hills when the ice melts.
	Lake	LAKE	LN	
	Lake, Kettle	LAKE_KETTLE	LK	Lakes occupying all or parts of kettle depressions.
	Lake Bed, Exposed	LAKEBED	LB	Exposure may be naturally or artificially caused. This value is generally used for lake basins of intermediate size, not relatively small **Depression**s or **Linked Depression**s that may have at one time supported small lakes or ponds, or relatively large lake **Plain**s.
	Linked Depression(s)	DEPR_LINK	LD	See Kemmis (1991). This value is related to glacial karst development. Many areas mapped as **Depression**s may fall within this value genetically, but either the linkage between individual **Depression**s was unclear, or **Depression**s were too small to map at the scale of 1:24,000.
	Marginal Channel	MARG_CHAN	MC	This value is usually used in conjunction with **Catastrophic Flood** LsSA. A marginal channel is one element of the Catastrophic Flood landscape. The marginal channel is a secondary though substantial channel form, the outer edge of which generally is defined by flood-scoured valley wall or higher fluvial surfaces, and the inner edge of which can be defined by the margin of a flood bar or other flood-modified landforms. Marginal channels form in response to flow characteristics, bedforms, and boundary conditions within the flood flow.
	Meander Belt	MEANDER	MB	This value is mapped in conjunction with lower or intermediate order streams in their valleys, and where they cross **Floodplain**s or **Terrace**s in valleys of higher order streams.
	Nivation Hollow	NIV_HOL	NH	Nivation hollow is a relatively small, shallow depression that during formation was occupied at least part of the year by a snow field. The depression forms through the process of

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				nivation, the weathering of material around and beneath a snow patch by repeated cycles of freezing and thawing. Nivation can and probably does interact with periglacial erosional processes to form the Minnesota examples. Open basins on valley sideslopes and upper colluvial slopes that are mapped as nivation hollows in MnMODEL are somewhat larger than those typically considered as nivation hollows. Adjacent basins can form narrow arete-like ridges.
	Nivation Hollow Ramp	NIV_HOL_RAMP	NR	The nivation hollow ramp is a colluvial slope feature that gradually narrows as it ascends to the mouth of a nivation hollow. The ramps probably form by a combination of solifluction and sheetflood erosional and sedimentation processes that transport sediment weathered and eroded from nivation hollows under periglacial conditions.
	Natural Levee	LEVEE	NL	**Natural Levee**s form a continuum with lower, broader, more subtle rises of overbank deposits that are mapped as part of **Floodplain Types "y"** and **"z"** in some valleys.
	Natural Levee, Distal	LEVEE_DISTAL	NL(D)	This code distinguishes the distal position of a natural levee from the proximal position. The distal natural levee position is typically characterized by a lower landscape position, more poorly drained soils, a finer sediment assemblage, and in some locations a thinner sediment assemblage and to some degree, different sediment processes, compared to the proximal natural levee position.
	Outwash Fan, Apron	OUT_FAN	OF	
	Overbank Belt	OVERBANK	OB	**Overbank Belt** is used in conjunction with floodplains of relatively lower order streams where they cross **Floodplain**s or **Terrace**s in valleys of higher order streams.
	Ovoid-Shaped Bog (Ovoid Island)	OVOID_BOG	OV	The ovoid shaped bog is a type of raised bog. It typically exhibits an ovoid to teardrop shape, and is raised above surrounding wetland by low angle slopes. Surrounding water tracks lead to the ovoid shape, as mineral-rich water bypasses the raised part of the bog. Water tracks are linear bands of fen that mark the course of mineral-influenced waters, as opposed to mineral-poor rainwater. The water tracks are usually expressed as lighter tones on aerial photography compared to

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				the darker or grayer tones of the ovoid shaped bog, reflecting different wetland flora. See Arterial Drain Patterned Bog, and Heinselman (1963, 1970), Glaser et al. (1981), Wright and Glaser (1983), Minnesota Department of Natural Resources and Eng (1980).
	Paleochannel	PALEO_C	PC	This value includes distributary paleochannels on abandoned delta lobes.
	Pediment Slope	PEDIMENT	PD	A pediment is a low-angle slope formed by surficial erosional processes such as lateral planation by streams, sheetflood erosion, and rillwash erosion. Classic pediments are formed on bedrock and associated with the foot of mountain belts. Sometimes they have a thin mantle of mostly fluvial erosional debris. In Minnesota, Late Quaternary erosion surfaces developed on till, such as the Iowan Erosion Surface (Ruhe, 1969; Hallberg et al. 1978) are similar to pediments, but formed by a combination of periglacial and eolian erosional processes. Pediments are common along the Rock River Valley.
	Peninsula	PENIN	PE	
	Plain	PLAIN	P	This value usually is used in conjunction with, but is not limited to, **Outwash**, **Glaciolacustrine**, and glacial ice **Landscape**s. **Exposed Lake Bed** is used for exposed lake or glacial lake basins of intermediate or smaller size.
	Raised (Radial) Bog	RAD_BOG	RB	A raised bog is a bog with an elevated convex central area due to peat accumulation, the central area of which is largely dependent upon rainwater. See Heinselman (1963, 1970), Glaser et al. (1981), Wright and Glaser (1983), Minnesota Department of Natural Resources and Eng (1980).
	Rapids, Nickpoint, Cascade, or Falls	RAPIDS	RP	
	Ribbed Fen	RIB_FEN	RF	Ribbed fen is used loosely for both fens and bogs that exhibit a pattern of alternating, more or less parallel, low peat ridges and hollows that are oriented perpendicular to water movement. See Heinselman (1963, 1970), Glaser et al. (1981), Wright and Glaser (1983), and Eng (1980).
	River Channel, Active	RIVER	R	
	Riverine Lake	RIV_LAKE	RL	
	Rock Basin	ROCK_BAS	RS	This value is used in **Bedrock Terrain**s. Rock basin is a type

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				of glacial erosional landform with examples that range over many orders of magnitude in size. It consists of a basin scoured by glacial ice that is usually elongated in, and sub-parallel to, the direction of glacial ice flow, but often in relationship to bedrock lithologic and structural characteristics.
	Rock Drumlins (Whale-backs)	ROCK_DRU	RD	This value is used in **Bedrock Terrain**s. The rock drumlin is an elongated, streamlined bedrock hill at the scale of tens to hundreds of meters that is largely shaped by glacial erosion. Rock drumlins also can have a thin veneer of glacial drift over the streamlined bedrock core. Rock drumlins have a 'whaleback' form with a steeper upglacier end and a tapering downglacier end. They tend to occur more often in association with crystalline (igneous, metamorphic) rocks, and can be influenced by joint patterns.
	Rogen Moraine	ROG_MOR	RM	Rogen Moraine is a glacial ridge of intermediate to large scale that is transverse to the predominent direction of glacial ice flow that forms, often in multiple congruent ridges, at some distance behind the ice front. Rogen Moraines tend to be broadly arcuate and slightly concave in the upglacier direction, but their surface can have drumlinized or fluted elements that are longitudinal to ice flow.
	Roche Moutonnée	ROCHE	RH	This value is used in **Bedrock Terrain**s. Roche moutonnée is an elongated bedrock remnant shaped by glacial erosion with a steep short slope in the down-flow direction, and a shallow longer slope in the up-flow direction.
	Sand Sheet	SHEET	ES	
	Spit	SP	SP	Spit
	Standing Water, Reservoir	RESERVOIR	LR	
	Summit	SUMMIT	S	See Ruhe (1969). In the code, this value is applied to **Bedrock Terrain**s and erosional terrains only and primarily consists of summit slopes.
	Terrace	TERRACE	T	
	Terrace, High, Undifferentiated	H_TERRACE	HT	This value is mapped where multiple high terraces, or high and low terraces, are present, but reasonably can not be differentiated at the 1:24,000 scale of mapping.
	Tunnel Valley	TUN_VAL	TV	Valley carved by a stream flowing at the ice/land surface contact.
	"V"-Shaped Valley	V_VALLEY	V	This value consists of low-order valleys that have a "v" shape;

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				little or no floodplain area; and, generally steep valley walls. Such valleys are often incised into the surrounding landscape, and may consist of the channel itself.
	Wave-Cut Platform	WAVE_CUT	WC	
CODE NO. 8 LANDFORM GEOGRAPHIC OR INFORMAL IDENTIFIER (LNDFRM_ID8)				This code consists of geographic or commonly used name for a **Landform**. It is to be added as needed.
	No Distinction made	NO_DIST	*	
CODE NO. 9 LANDFORM SUBDIVISION (LDFRM_SUB9)				
	No Distinction Made	NO_DIST	*	
	Depression, Ice-Block Ribs	DEP_RIBS	P	This code is used for slightly positive ribs, showing a rectangular pattern, within a rectangular ice block depression.
	Depression, Rectangular Ice-Block	DEP_RECT	R	This code is used for rectangular ice block depressions reflecting surface ice with little to moderate subsequent modifications.
	Floodplain, Island-Braided Channels	FL_IB_CHANNEL	B	This code is used to distinguish distinct braid channels within an Island-Braided Floodplain.
	Floodplain, Island-Braided Island	FL_IB_ISLAND	I	This code is used to distinguish distinct islands within an Island-Braided Floodplain.
	Pond	POND	PN	This code is used for a pond, or other small standing body of water. The code is generally used for smaller water bodies, often only partially filling a larger part of a landform basin.
CODE NO. 10 STREAM VALLEY ORDER (VLLY_ORD10)				Streams are ordered using the Strahler method (Strahler, 1964)
	Not Relevant or No Distinction	NO_DIST	*	

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Made			
	1	1	1	
	2	2	2	
	3	3	3	
	Etc.	Etc.	Etc.	
CODE NO. 11 SURFACE CHARACTERISTICS AND MODIFICATIONS (SURFACE11)				*This code consists surface characteristics and modifications within a* ***Landform*** *or* ***Landscape*** *that are penecontemporaneous with, or post-date the development of the* ***Landform*** *or* ***Landscape****.*
	Not Present or No Distinction Made	NO_DIST	*	
	Boulder or Cobble Lag	BOULDER	R	
	Braided Channel Pattern	BRAID	B	
	Braided Channel Pattern with Shallow, Natural Standing Water	BRAID_MARSH	BM	
	Inundated Channel	INUNDATED	W	This code refers to recognizable channel landforms that are inundated with intermittently or permanently flowing water, such as a crevasse splay channel. It is used in the Upper Mississippi Valley where such landforms tend to be large.
	Island Braided Pattern	ISLAND_BR	IB	
	Dendritic Channel Pattern	DENDR	DD	
	Meandering Channel Pattern	MEANDER	S	
	Flood Scour Channel Pattern	FL_SCOUR	F	
	Distributary Pattern	DISTRIB	D	
	Pitted	PITTED	P	
	Wave or Current Modified, Subaerial	WAVE_AERIAL	WA	
	Wave or Current Modified, Submerged	WAVE_SUBMERGE	WS	This code usually refers to submerged **Islands**, **Wave-Cut Platforms,** and **Ice-Block Kame Terraces.**
	Water Modified	WATER_MOD	T	
	Water Modified, Marsh	WAT_MOD_MAR	TM	
	Wind Modified	WIND_MOD	N	
	Linear, Reticulated, or Orbicular Patterns	RIP_ICE	I	Pertains to patterns recognized on the Glacial Lake Agassiz plain. See Mollard (1983).

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Standing Water, Natural, Shallow	MARSH	MA	This value is used for areas with intermittent or permanent shallow water usually marked with a marsh symbol on USGS topographic maps. Larger areas are often mapped as **Peatland**s. This value is differentiated from **Standing Water, Natural** (lakes) by having relatively shallow water and subaerial vegetation.
CODE NO. 12 COLLAPSED LANDSCAPE OR LANDFORM (COLLAPSD12)				This code refers to a **Landform** or **Landscape** that had a core of glacial ice that subsequently melted and "let down" the overlying material.
	No Distinction Made	NO_DIST	*	
	Not Collapsed	NO_COLL	N	
	Collapsed	COLLAPSE	C	
CODE NO. 13 ERODED LANDSCAPE OR LANDFORM (ERODED13)				This code refers primarily to soil erosion that post-dates landform or landscape development.
	Not Present or No Distinction Made	NO_DIST	*	
	Eroded	ERODED	E	This value is used for areas of mappable size at a scale of 1:24,000 that show field, air photo, or soil mapping evidence of being eroded. The value may include relatively steep **Hillslopes.**
	Erosion Complex	EROSION_C	EC	This value is used for areas characterized by either intricately interfingered, or very small discontinuous areas, of eroded and non-eroded areas that individually are of unmappable size at a scale of 1:24,000, based on field, air photo, or soil mapping evidence.
	Iowan Erosion Surface	IOWAN	O	See Hallberg et al. (1978). Soil erosion that formed the Iowan Erosion Surface formed a **Landscape** of one or more erosional "steps" on interfluves in specific parts of the state.

MATERIAL AND MATERIAL SEQUENCE FIELD CODES

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
CODE NO. 14 POST-GLACIAL LITHOSTRATIGRAPHIC UNIT (PSTGLACU14)				This code is to be used when sufficient information is available to informally or formally name post-glacial fluvial, lacustrine, peatland, and eolian formations.
	No Distinction Made	NO_DIST	*	
CODE NO. 15 TEXTURE AND TEXTURE SEQUENCE OF NEAR-SURFACE MATERIAL (TEXTURE15)				This code only applies to the upper 2 m of material, including any **Overlying Deposits.** Two systems are represented, a general one that differentiates by fine, coarse and peat/organic muck textures, and a more specific one that differentiates by USDA NRCS soil textures. Only one of these systems can be used for each **Landform** or **Landscape**, depending on the amount and reliability of subsurface information available.
General	Variable at this Scale, or No Distinction Made	NO_DIST	*	
	Peat or Organic Muck	P	P	
	Fine	F	F	This value includes silt and finer material. It may include loam and clay loam, depending on the region being mapped.
	Thinly Bedded Fines	Y	Y	
	Fine over Peat	F/P	FP	
	Coarse	CO	CO	This value includes sandy loam and coarser material. It may include loam and clay loam, depending on the region being mapped.
	Peat or Organic Muck over Fine	P/F	PF	
	Peat or Organic Muck over Coarse	P/CO	PC	
	Peat or Organic Muck over Interstratified Coarse and Fine	P/INTR_C&F	PQ	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Interstratified Peat or Organic Muck and Fines	INTR_P&F	IPF	
	Discontinuous Peat or Organic Muck over Fine	DIS_P/F	PFN	
	Discontinuous Peat or Organic Muck over Coarse	DIS_P/CO	PCR	
	Fine over Coarse	F/CO	FC	
	Fine over Interstratified Coarse and Fine	F/INTR_C&F	FQ	
	Coarse over Fine	CO/F	CF	
USDA NRCS	Clay	CY	CY	
	Silty Clay	SICY	SIC	
	Silty Clay Loam	SICYL	SICL	
	Silt Loam	SIL	SIL	
	Silt	SI	SI	
	Loam	L	L	
	Clay Loam	CYL	CL	
	Sandy Clay Loam	SACYL	SCL	
	Sandy Loam	SAL	SL	
	Loamy Sand	LSA	LS	
	Sand	SA	S	
	Gravel	G	G	
	Cobble	COB	B	
	Peat or Organic Muck over Clay to Silt Loam	P/CY-SIL	P/C-SIL	
	Peat or Organic Muck over Silty Clay	P/SICY	P/SIC	
	Peat or Organic Muck over Silty Clay and Sandy Gravel	P/SICY&SAG	P/SICG	
	Peat or Organic Muck over Silty Clay Loam over Clay Loam	P/SICYL/CYL	P/SICL/CL	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Peat or Organic Muck to Silty Clay Loam over Sandy Loam to Sand	P-SICYL/SAL-SA	P-SICL/SL-S	
	Peat or Organic Muck over Clay Loam to Sandy Loam	P/CYL-SAL	P/CL-SL	
	Peat or Organic Muck over Clay Loam to Loamy Sand	P/CYL-LSA	P/CL-LS	
	Peat or Organic Muck over Silty Clay Loam to Sandy Loam over Sand and Gravel	P/SICYL-SAL/SA&G	P/SICL-SL/S&G	
	Peat or Organic Muck over Silt Loam over Loam	P/SIL/L	P/SIL/L	
	Peat or Organic Muck over Silt Loam to Sand	P/SIL-SA	P/SIL-S	
	Peat or Organic Muck over Silt Loam over Loam to Sandy Loam	P/SIL/L-SAL	P/SIL/L-SL	
	Peat or Organic Muck over Silt Loam over Sandy Loam to Sand	P/SIL/SAL-SA	P/SIL/SL-S	
	Peat or Organic Muck over Silt over Sandy Loam	P/SI/SAL	P/SI/SL	
	Peat or Organic Muck to Silt over Sandy Loam to Sand	P-SI/SAL-SA	P-SI/SL-S	
	Peat or Organic Muck to Silt over Sandy Loam to Sand and Gravel	P-SI/SAL-SA&G	P-SI/SL-S&G	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Peat or Organic Muck to Silt over Loamy Sand	P-SI/LSA	P-SI/LS	
	Peat or Organic Muck to Silt over Loamy Sand to Sand and Gravel	P-SI/LSA-SA&G	P-SI/LS-S&G	
	Peat or Organic Muck to Silt over Sand and Gravel	P-SI/SA&G	P-SI/S&G	
	Peat or Organic Muck over Loam	P/L	P/L	
	Peat or Organic Muck over Loam to Loamy Sand	P/L-LSA	P/L-LS	
	Peat or Organic Muck over Loam to Sand	P/L-SA	P/L-S	
	Peat or Organic Muck over Sandy Loam	P/SAL	P/SL	
	Peat or Organic Muck over Sandy Loam to Clay Loam	P/SAL-CYL	P/SL-CL	
	Peat or Organic Muck over Sandy Loam to Sand	P/SAL-SA	P/SL-S	
	Peat or Organic Muck over Loamy Sand over Loam	P/LSA/L	P/LS/L	
	Peat or Organic Muck over Loamy Sand	P/LSA	P/LS	
	Peat or Organic Muck over Loamy Sand over Sand and Gravel	P/LSA/SA&G	P/LS/S&G	
	Peat or Organic Muck over Loamy Sand to Sand	P/LSA-SA	P/LS-S	
	Peat or Organic Muck over Loamy Sand to	P/LSA-SA&G	P/LS-S&G	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Sand and Gravel			
	Peat or Organic Muck over Sand to Sandy Loam	P/SA-SAL	P/S-SL	
	Peat or Organic Muck over Sand over Loam to Clay Loam	P/SA/L-CYL	P/S/L-CL	
	Peat or Organic Muck over Sand	P/SA	P/S	
	Peat or Organic Muck over Sandy Gravel	P/SAG	P/SG	
	Interstratified Peat or Organic Muck and Sand	INTR_P&SA	IPS	
	Clay over Loam to Clay Loam	CY/L-CYL	C/L-CL	
	Clay to Sandy Loam over Loam to Clay Loam	CY-SAL/L-CYL	C-SL/L-CL	
	Clay Loam to Sandy Loam	CYL-SAL	CL-SL	
	Clay Loam to Sandy Loam over Sand	CYL-SAL/SA	CL-SL/S	
	Clay Loam to Loamy Sand	CYL-LSA	CL-LS	
	Silty Clay to Coarse	SICY-CO	SIC-C	
	Silty Clay and Sandy Gravel	SICY&SAG	SIC&SG	
	Silty Clay Loam and Sand	SICYL&SA	SICL&S	
	Silty Clay Loam over Clay Loam	SICYL/CYL	SICL/CL	
	Silty Clay Loam over Clay Loam to Loam	SICYL/CYL-L	SICL/CL-L	
	Silty Clay Loam to Sandy Loam	SICYL-SAL	SICL-SL	
	Silty Clay Loam to Sandy Loam over Peat or Organic	SICYL-SAL/P/SA&G	SICL-SL/P/S&G	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Muck over Sand and Gravel			
	Silty Clay Loam to Sandy Loam over Sand	SICYL-SAL/SA	SICL-SL/S	
	Silty Clay Loam to Sandy Loam over Sand and Gravel	SICYL-SAL/SA&G	SICL-SL/S&G	
	Silty Clay Loam to Loamy Sand	SICYL-LSA	SICL-LS	
	Silty Clay Loam and Sandy Loam over Sand	SICYL-SAL/SA	SICL-SL/S	
	Silty Clay Loam to Sand	SICYL-SA	SICL-S	
	Silt Loam to Silty Clay Loam	SIL-SICYL	SIL-SICL	
	Silt Loam to Silty Clay Loam over Clay Loam	SIL-SICYL/CYL	SIL-SICL/CL	
	Silt Loam to Loam	SIL-L	SIL-L	
	Silt Loam over Loam	SIL/L	SIL/L	
	Silt Loam over Loam to Sandy Loam	SIL/L-SAL	SIL/L-SL	
	Silt Loam over Loam to Loamy Sand over Sand	SIL/L-LSA/SA	SIL/L-LS/S	
	Silt Loam over Sandy Loam	SIL/SAL	SIL/SL	
	Silt Loam over Sandy Loam over Sandy Gravel	SIL/SAL/SAG	SIL/SL/SG	
	Silt Loam over Sandy Loam to Sand	SIL/SAL-S	SIL/SL-S	
	Silt Loam over Sand	SIL/SA	SIL/S	
	Loam to Clay Loam	L-CYL	L-CL	
	Loam to Silt Loam over Sand	L-SIL/SA	L-SIL/S	
	Loam to Sandy Loam	L-SAL	L-SL	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Loam to Sandy Loam over Sand and Gravel	L-SAL/SA&G	L-SL/S&G	
	Loam to Loamy Sand	L-LSA	L-LS	
	Loam to Loamy Sand over Sand	L-LSA/SA	L-LS/S	
	Loam to Sand	L-SA	L-S	
	Loam to Sand and Gravel	L-SA&G	L-S&G	
	Loam over Clay Loam to Loam	L/CYL-L	L/CL-L	
	Loam over Sand	L/SA	L/S	
	Sandy Loam over Sand and Gravel	SAL/SA&G	SL/S&G	
	Sandy Loam over Gravelly Sand	SAL/GS	SL/GS	
	Sandy Loam over Sandy Clay Loam	SAL/SACYL	SL/SCL	
	Sandy Loam to Clay Loam	SAL-CYL	SL-CL	
	Sandy Loam over Sand	SAL/SA	SL/S	
	Sandy Loam over Sand and Gravel	SAL/S&G	SL/S&G	
	Sandy Loam over Gravelly Sand	SAL/GSA	SL/GS	
	Sandy Loam over Gravel	SAL/G	SL/G	
	Sandy Loam to Loamy Sand over Gravelly Sand	SAL-LSA/GSA	SL-LS/GS	
	Sandy Loam to Sand	SAL-SA	SL-S	
	Sandy Loam to Sand and Gravel	SAL-SA&G	SL-S&G	
	Sandy Loam to Sand and Gravel over Sandy Loam to Loamy Sand	SAL-SA&G/SAL-LSA	SL-S&G/SL-LS	
	Loamy Sand over Loam	LSA/L	LS/L	
	Loamy Sand over Sand and Gravel	LSA/SA&G	LS/S&G	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Loamy Sand over Gravelly Sand	LSA/GSA	LS/GS	
	Loamy Sand to Sand	LSA-SA	LS-S	
	Loamy Sand to Sand and Gravel	LSA-SA&G	LS-S&G	
	Sand to Sandy Loam	SA-SAL	S-SL	
	Sand to Sandy Loam over Clay Loam	SA-SAL/CYL	S-SL/CL	
	Sand to Sandy Loam over Loam to Clay Loam	SA-SAL/L-CYL	S-SL/L-CL	
	Sand over Sandy Clay Loam	SA/SACYL	S/SCL	
	Sand and Gravel	SA&G	S&G	
	Sandy Gravel	SAG	SG	
	Gravelly Sand	GSA	GSA	
	Etc.	Etc.	Etc.	Texture sequences can be added as necessary, separating the two texture map symbols by a backslash.
CODE NO. 16 DIAMICTON TEXTURE (DIAMICTN16)				Unsorted sediment ranging from clay to boulders deposited in very active environments. This code applies to uppermost lithologic value(s).
	No Distinction Made	NO_DIST	*	
	Diamicton Texture Not Present or Uncommon	NO_DIA	O	
	Diamicton Texture	DIA	D	
CODE NO. 17 THICKNESS OF NEAR-SURFACE MATERIAL OVER BEDROCK OR GLACIAL DRIFT (THICKNSS17)				Use this code includes any thickness of material of **Overlying Deposits** in Code No. 18 in addition to the remaining underlying unconsolidated mostly non-glacial Quaternary materials. Thicknesses for some **Valley Margin** LsSA values consider the thickest part of these wedge-shaped landforms.
	No Distinction Made	NO_DIST	*	
	Not Present or <1m Thick, Laterally	ZERO	><	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Discontinuous			
	>2m Thick, Laterally Continuous	>2M	>>	
	<2m Thick, Laterally Continuous	<2M	<<	
	<2m, >1m Thick, Laterally Continuous	<2>1M	<>	
	>1m Thick, Laterally Continuous	>1M	>	
	<1m Thick, Laterally Continuous	<1M	<	
CODE NO. 18 OVERLYING DEPOSITS (OVERLDEP18)				"Overlying" refers to material usually <2m thick that was deposited on a **Landform** or **Landscape** sometime after the principal landform- or landscape-sediment assemblage developed. This deposit is not genetically related to the landform. Values under this code are applicable to any **Landform** or **Landscape**.
	Not Present	NO_PRES	N	
	No Distinction Made	NO_DIST	*	
	Type "O" Overbank Deposits	OVERO	O	This value is used where relatively very light tonal contrasts on aerial photography of valley areas are interpreted as overbank deposits that are likely to include, or field evidence indicates, deposition of significant post-settlement alluvium. Here "significant" means a sufficient thickness to obscure prehistoric cultural deposits. In plowed areas this typically means >0.27 m thick. In unplowed areas, it may be thinner. If not otherwise noted, presence is implied with **Floodplain Type "W"**.
	Type "A" Overbank Deposits	OVERA	A	This value is used where relatively light tonal contrasts on aerial photography of valley areas are interpreted as overbank deposits. They may or may not include significant post-settlement alluvium.
	Sheetflood Deposits, Undifferentiated	SHEET	S	
	Hillslope Colluvium; Biomantle	HILL_COLLUV	H	This value is usually applied to upland landscapes. It includes the range of recognizable products from the combination of upland hillslope erosional, depositional, and soil evolution processes. See Johnson (1990).
	Loess	LOESS	L	
	Glaciolacustrine	GLA_LK	GL	Thick (>2m) **Glaciolacustrine** sediment mantles may occur in some **Outwash** or other depressional settings, and could have been interpreted as a

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
				Glaciolacustrine Plain, except for the dominant geologic process that shaped the landform.
	Outwash	OUTWASH	OU	Thick (>2m) **Outwash** mantles may occur in some **Glaciolacustrine** or other depressional settings, and could have been interpreted as an **Outwash Plain**, except for the dominant geologic process that shaped the landform.
	Eolian Sand Sheet, Discontinuous	EOL_SAND	E;	Discontinuous dunes and/or sheet sand.
	Wetland	WET_LAC	W	This value is for organic wetland deposits, with or without interbedded lacustrine or glaciolacustrine deposits, and is usually associated with **Depression**s.
	Till	TILL	T	Till, undifferentiated
CODE NO. 19 BURIED SOILS (BURSOIL19)				Documented or interpreted **Buried Soil**(s) are present, including consideration of **Overlying Deposits**. As used here, **Buried Soil** definition may include thick cumulic soils. The definition of **Buried Soil** does not have the depth limitations imposed by the USDA NRCS definition of **Buried Soil**.
	No Distinction Made	NO_DIST	*	
	Buried Soil(s) Not Present or Uncommon	NO_BUR_SOL	O	
	Buried Soil(s) Commonly Present	BUR_SOL	B	
CODE NO. 20 BASEMENT MATERIAL (BASEMENT20)				Basement Material as used in Mn/Model is the material immediately underlying the oldest sediment that is old enough to host buried cultural deposits. Depth to basement material can be highly variable.
	Not Exposed Within 2m of Ground Surface, or No Distinction Made	NO_DIST	*	
	Bedrock, Undifferentiated	BEDROCK	B	
	Thin Glacial Drift over Bedrock	DRIFT_BED	GB	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Bedrock or Glacial Drift, Undifferentiated	BEDR_GLAC	K	
	Bedrock, Igneous	IGNEOUS	IG	
	Bedrock, Metamorphic	METAM	M	
	Bedrock, Sedimentary	SEDIM	S	
	Bedrock, Carbonate	CARBONATE	SC	
	Glacial Drift, Undifferentiated	GLACIAL	G	
	Glaciolacustrine Deposits	GLA_LAKE	L	
	Glaciofluvial Deposits	OUTWASH	O	
	Till	TILL	T	
	Thin Glaciofluvial over Glacial Drift or Bedrock	OUT_DRIFT	OK	
CODE NO. 21 BASEMENT MATERIAL IDENTIFIER (BSMNT_ID21)				This code consists of the lithology or lithostratigraphic name of the material underlying the material of interest. It is to be developed as needed.
	No Distinction Made	NO_DIST	*	
	Sherack Formation	SHERACK	S	
	Sherack and Poplar River Formations	SHERACK_POPLAR	SP	
	Cromwell Formation	CROM	CR	
	Duluth Complex	DULUTH	DC	
	Ely Greenstone	ELY_GRE	EG	
	Banded Iron Fm.	IRON	FE	
	Giants Range Granite	GIANTS	GI	
	North Shore Volcanic Group	NS_VOLCAN	NS	
	Rove Fm.	ROVE	RO	
	Saganaga Granite	SAGANAGA	SG	
	Trommald Fm.	TROMMALD	TR	
	Vermillion Granite	VERMILLION	VG	

TEMPORAL FIELD CODES

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
CODE NO. 22 STAGE OR SUBSTAGE OF LANDFORM-SEDIMENT ASSEMBLAGE (STG_LFSA22)				This code consists of the primary stage or substage of a **Landform**. It ignores minor younger surface modifications. See text regarding stage definitions. Additional temporal sequences can be added as necessary, separating the two stage or substage symbols by a hyphen. The radiocarbon years below are only approximate.
	No Distinction Made	NO_DIST	*	
	Pre-Wisconsin	PRE_WISC	P	~ >50,000 C^{14} yrs. B.P.
	Wisconsin, Undifferentiated	WISC	W	~50,000-10,000 C^{14} yrs. B.P.
	Late Wisconsin	L_WISC	LW	~25,000-10,000 C^{14} yrs. B.P.
	Late Wisconsin to Holocene	L_WISC-HOL	LW-H	~25,000-0 C^{14} yrs. B.P.
	Late Wisconsin to Early Holocene	L_WISC-E_HOL	LW-E	~25,000-7,500 C^{14} yrs. B.P.
	Late Wisconsin to Late Holocene	L_WISC-L_HOL	LW-L	~25,000-2500 C^{14} yrs. B.P.
	Late Wisconsin to Historic	L_WISC-HIST	LW-S	~25,000-0 C^{14} yrs. B.P.
	Holocene, Undifferentiated	HOL_UNDIFF	U	This code may or may not include all the substages of the Holocene.
	Holocene	HOL	H	This code includes the Historic substage. ~10,000-200 C^{14} yrs. B.P.
	Holocene to Historic	HOL-HIST	H-S	~10,000-0 C^{14} yrs. B.P.
	Early Holocene	E_HOL	E	~10,000-7,500 C^{14} yrs. B.P.
	Early to Middle Holocene	E_HOL-M_HOL	E-M	~10,000-3,500 C^{14} yrs. B.P.
	Early to Late Holocene	E_HOL-L_HOL	E-L	~10,000-200 C^{14} yrs. B.P.
	Early Holocene to Historic	E-HOL-HIST	E-S	~10,000-0 C^{14} yrs. B.P.
	Middle Holocene	M_HOL	M	~7,500-3,500 C^{14} yrs. B.P.
	Middle to Late Holocene	M_HOL-L_HOL	M-L	~7,500-200 C^{14} yrs. B.P.
	Middle Holocene to Historic	M_HOL-HIST	M-S	~7,500-0 C^{14} yrs. B.P.
	Late Holocene	L_HOL	L	~3,500-200 C^{14} yrs. B.P.
	Late Holocene to Historic	L_HOL-HIST	L-S	~3,500-0 C^{14} yrs. B.P.

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Historic	HIST	S	~200-0 C^{14} yrs. B.P.
CODE NO. 23 STAGE OF OVERLYING DEPOSITS (STGOVRDP23)				This code consists of the stage of deposition of **Overlying Deposits** of Code No. 18. See text regarding stage definitions. Additional temporal sequences can be added as necessary, separating the two stage or substage symbols by a hyphen.
	Not Relevant or No Distinction Made	NO_DIST	*	
	Pre-Wisconsinan	PRE_WISC	P	
	Wisconsinan, Undifferentiated	WISC	W	
	Late Wisconsinan	L_WISC	LW	
	Late Wisconsinan to Holocene	L_WISC-HOL	LW-H	
	Late Wisconsinan to Early Holocene	L_WISC-E_HOL	LW-E	
	Late Wisconsinan to Historic	L_WISC-HIST	LW-S	
	Holocene, Undifferentiated	HOL_UNDIFF	U	This code may or may not include all the substages of the Holocene.
	Holocene	HOL	H	This code includes the Historic substage.
	Early Holocene	E_HOL	E	
	Early to Middle Holocene	E_HOL-M_HOL	E-M	
	Early to Late Holocene	E_HOL-L_HOL	E-L	
	Early Holocene to Historic	E-HOL-HIST	E-S	
	Middle Holocene	M_HOL	M	
	Middle to Late Holocene	M_HOL-L_HOL	M-L	
	Middle Holocene to Historic	M_HOL-HIST	M-S	
	Late Holocene	L_HOL	L	
	Late Holocene to Historic	L_HOL-HIST	L-S	
	Historic	HIST	S	

Code Number and Title	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
CODE NO. 24 GLACIAL LAKE OR GLACIAL ICE PHASE (GLACPHAS24)				This code consists of recognized glacial ice and lake phases for the stratigraphically highest basement material
	No Distinction Made	NO_DIST	*	
Glacial Lake Phase				
	Cass	CASS	CS	
	Emerson	EMER	EM	
	Lockhart	LOCK	LO	
	Moorhead	MOOR	MO	
	Nipigon	NIPI	NI	
Glacial Ice Phase				
	Automba	AUTO	AU	
	Culver	CULV	CU	
	Duluth	DULU	DU	
	Hewitt	HEWI	HE	
	Itasca	ITAS	IT	
	Nickerson	NICK	NI	
	Pine City	PINE	PI	
	Split Rock	SPLI	SP	
	St. Croix	STCR	ST	
	St. Croix - Automba	STCR_AUTO	ST-AU	Superior lobe tills possibly representing both the Automba and St. Croix phases and that are either indistinguishable from each other, or are found in an interspersed mosaic pattern that is too fine to distinguish at the current mapping scale.

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
CODE NO. 25 RELATIVE AGE OF GEOMORPHIC UNIT WITHIN A LANDFORM DEFINED BY CODE 7 (AGE_INLF25)				Most commonly refers to **Terraces** or **Wave-Cut Platforms**. A **Paleochannel**'s relative age refers to its associated **Terrace**'s relative age and not to the cross-cutting relations among these channels.
	No Distinction Made	NO_DIST	*	
	Youngest	YOUNG	1	
	Next to Youngest	YOUNG+1	2	
	Second Next to Youngest	YOUNG+2	3	
	Third Next to Youngest	YOUNG+3	4	
	Fourth Next to Youngest	YOUNG+4	5	
	Etc.	Etc.	Etc.	
CODE NO. 26 RELATIVE AGE OF GEOMORPHIC UNIT WITHIN A LANDFORM SUBDIVISION AS DEFINED IN CODE 9 (AGE_INSB26)				
	No Distinction Made	NO_DIST	*	
	Youngest	YOUNG	1	
	Next to Youngest	YOUNG+1	2	
	Second Next to Youngest	YOUNG+2	3	
	Third Next to Youngest	YOUNG+3	4	
	Fourth Next to Youngest	YOUNG+4	5	
	Etc.	Etc.	Etc.	

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
CODE NO. 27 RELATIVE AGE OF LANDFORM-SEDIMENT ASSEMBLAGE TO OTHER LANDSCAPE- OR LANDFORM-SEDIMENT ASSEMBLAGES (RLAGELSA27)				
	No Distinction Made	NO_DIST	*	
	Overlying, Crosscutting or Interfingering with Active Ice LsSA	A_ACT_ICE	I	
	Overlying, Crosscutting or Interfingering with Stagnant Ice LsSA	A_STAG_ICE	S	
	Overlying, Crosscutting or Interfingering with Ice Contact LsSA	A_ICE_CONT	N	
	Overlying, Crosscutting or Interfingering with Pediment LsSA	A_PEDIMENT	P	
	Overlying, Crosscutting or Interfingering with Glaciofluvial LsSA	A_OUTWASH	O	
	Overlying, Crosscutting or Interfingering with	A_CAT_FLOOD	C	

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
	Catastrophic Flood LsSA			
	Overlying, Crosscutting or Interfingering with Glaciolacustrine LsSA	A_GLAC_LAC	A	
	Overlying, Crosscutting or Interfingering with Paleo-Valley LsSA	A_PALEO_VAL	Y	
	Overlying, Crosscutting or Interfingering with Peatland LsSA	A_PEAT	B	
	Overlying, Crosscutting or Interfingering with Valley Terrace LsSA	A_VAL_TERR	V	
	Overlying, Crosscutting or Interfingering with Floodplain LsSA	A_FLOOD	F	
	Overlying, Crosscutting or Interfingering with Valley Margin LsSA	A_VAL_MARG	M	
	Overlying, Crosscutting or Interfingering with Eolian LsSA	A_EOLIAN	E	
	Overlying, Crosscutting or Interfingering with Lacustrine LsSA	A_LAKE	L	
	Overlying, Crosscutting or Interfingering with [LfSA as necessary]	Etc.	Etc.	

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
CODE NO. 28 GEOCHRONOLOGY OF LfSA: LESS THAN OR EQUAL TO (GEOCHNLT28)				This code consists of a number interpreted from one or more radiocarbon ages, in uncorrected radiocarbon years before present, for a **Landform-Sediment Assemblage**. The code will continue to be developed and refined as more radiocarbon ages become available. The Map Code has dropped the "ten's" off the years to abbreviate for mapping.
	No Distinction Made	NO_DIST	*	
	12,000 B.P.	12000	1200	
CODE NO. 29 GEOCHRONOLOGY OF LfSA: GREATER THAN OR EQUAL TO (GEOCHNGT29)				This code consists of a number interpreted from one or more radiocarbon ages, in uncorrected radiocarbon years before present, for a **Landform-Sediment Assemblage**. The code will continue to be developed and refined as more radiocarbon ages become available. The Map Code has dropped the "ten's" off the years to abbreviate for mapping.
	No Distinction Made	NO_DIST	*	
	Present	0	0	
CODE NO. 30 GEOCHRONOLOGY OF OVERLYING DEPOSITS: LESS THAN OR EQUAL TO (O_CHRNLT30)				This code consists of a number interpreted from one or more radiocarbon ages, in uncorrected radiocarbon years before present, for **Overlying Deposits**. The code will continue to be developed and refined as more radiocarbon ages become available. The Map Code has dropped the "ten's" off the years to abbreviate for mapping.
	No Distinction Made	NO_DIST	*	
	12,000	12000	1200	
CODE NO. 31 GEOCHRONOLOGY OF OVERLYING DEPOSITS GREATER THAN OR				This code consists of a number interpreted from one or more radiocarbon ages, in uncorrected radiocarbon years before present, for **Overlying Deposits**. The code will continue to be developed and refined as more radiocarbon ages become available. The Map Code has dropped the "ten's" off the years to abbreviate for mapping.

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
EQUAL TO (O_CHRNGT31)				
	No Distinction Made Present	NO_DIST 0	* 0	
CODE NO. 32 GEOCHRONOLOGY OF BASEMENT MATERIAL: LESS THAN OR EQUAL TO (BSMCHRLT32)				This code consists of a number interpreted from one or more radiocarbon ages, in uncorrected radiocarbon years before present, for **Basement Material**. The code will continue to be developed and refined as more radiocarbon ages become available. **Basement Material** may have the same **Geochronology** as the LfSA **Geochronology** if the B**asement Material** is part of the LfSA. The Map Code has dropped the "ten's" off the years to abbreviate for mapping.
	No Distinction Made	NO_DIST	*	
CODE NO. 33 GEOCHRONOLOGY OF BASEMENT MATERIAL: GREATER THAN OR EQUAL TO (BSMCHRGT33)				This code consists of a number interpreted from one or more radiocarbon ages, in uncorrected radiocarbon years before present, for **Basement Material**. The code will continue to be developed and refined as more radiocarbon ages become available. The **Basement Material** may have the same **Geochronology** as the LfSA **Geochronology** if the **Basement Material** is part of the LfSA. The Map Code has dropped the "ten's" off the years to abbreviate for mapping.
	No Distinction Made 12,000	NO_DIST 12000	* 1200	
CODES 34-37 LANDFORM SEDIMENT				

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
ASSEMBLAGE GEOLOGIC AGE RANKINGS AT DEPTH				
Geologic Age of Surface (AGE_0M)				Whether the age of the LfSA surface falls within or without the recognized time span that Pre-Contact peoples lived in Minnesota (i.e., 12,500-200 B.P.).
	Outside the valid time span	0		
	Within the valid time span	1		
Geologic Age from Surface to 1 meter depth (AGE_0_1M)				Whether the age of the LfSA from the surface to one meter below the surface falls within or without the recognized time span that Pre-Contact peoples lived in Minnesota (i.e., 12,500-200 B.P.).
	Outside the valid time span	0		
	Within the valid time span	1		
Geologic Age from 1 meter to 2 meter depth (AGE_1_2M)				Whether the age of the LfSA from one meter below the surface to two meters below the surface falls within or without the recognized time span that Pre-Contact peoples lived in Minnesota (i.e., 12,500-200 B.P.).
	Outside the valid time span	0		
	Within the valid time span	1		
Geologic Age from 2 meter to 5 meter depth (AGE_2_5M)				Whether the age of the LfSA from two meters below the surface to five meters below the surface falls within or without the recognized time span that Pre-Contact peoples lived in Minnesota (i.e., 12,500-200 B.P.).
	Outside the valid time span	0		
	Within the valid time span	1		
CODES 38-41 LANDFORM SEDIMENT ASSEMBLAGE DEPOSITIONAL				

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
ENVIRONMENT RANKINGS AT DEPTH				
Post-Depositional Environment at LfSA Surface (P_DEPO_0M)				Whether the land surface has been disturbed such that in situ prehistoric cultural deposits would or would not have been preserved. Does not consider plowed surfaces.
	Disturbed	0		
	Undisturbed	1		
Depositional Environment from 0 to 1 Meter Depth (DEPO_0_1M)				Estimate of the degree to which the energy conditions and other factors would have affected landscape suitability for occupation and preservation of prehistoric cultural deposits.
	Unsuitable	0		
	Low suitability	1		
	Moderate suitability	2		
	High suitability	3		
Depositional Environment from 1 to 2 Meter Depth (DEPO_1_2M)				Estimate of the degree to which the energy conditions and other factors would have affected landscape suitability for occupation and preservation of prehistoric cultural deposits.
	Unsuitable	0		
	Low suitability	1		
	Moderate suitability	2		
	High suitability	3		
Depositional Environment from 2 to 5 Meter Depth (DEPO_2_5M)				Estimate of the degree to which the energy conditions and other factors would have affected landscape suitability for occupation and preservation of prehistoric cultural deposits.
	Unsuitable	0		
	Low suitability	1		
	Moderate suitability	2		
	High suitability	3		
CODES 42-45 LANDSCAPE SUITABILITY				

Code Number and Title (GIS FIELD)	Value	GIS Code Symbol	Map or Code-String Symbol	Comments
RANKINGS AT DEPTH				
Landscape Suitability Rating at Surface (LSR_0M)				Suitability of the landscape surface to contain prehistoric cultural deposits. A product of surface geologic age (AGE_0M) and post-depositional environment (P_DEPO_0M)
	Unsuitable	0		
	Low suitability	1		
Landscape Suitability Rating at 0 to 1 Meter Depth (LSR_0_1M)				Suitability of the 0-1 meter depth to contain prehistoric cultural deposits. A product of surface geologic age (AGE_0_1M) and depositional environment (DEPO_0_1M)
	Unsuitable	0		
	Low suitability	1		
	Moderate suitability	2		
	High suitability	3		
Landscape Suitability Rating at 1 to 2 Meter Depth (LSR_1_2M)				Suitability of the 1-2 meter depth to contain prehistoric cultural deposits. A product of surface geologic age (AGE_1_2M) and depositional environment (DEPO_1_2M)
	Unsuitable	0		
	Low suitability	1		
	Moderate suitability	2		
	High suitability	3		
Landscape Suitability Rating at 2 to 5 Meter Depth (LSR_2_5M)				Suitability of the 2-5 meter depth to contain prehistoric cultural deposits. A product of surface geologic age (AGE_2_5M) and depositional environment (DEPO_2_5M)
	Unsuitable	0		
	Low suitability	1		
	Moderate suitability	2		
	High suitability	3		

REFERENCES CITED

Bluemle, J.P. 1967. Geology and Ground Water Resources of Traill County. *County Ground Water Studies 10*. North Dakota Geological Survey Bulletin 49, Part 1 - Geology, 34 p.

Eng, M.T. 1980. Surficial geology, Koochiching County, Minnesota. Minnesota Department of Natural Resources, Division of Minerals, 1:126,720

Glaser, P.H., Wheeler, G.A., Gorham, E., and Wright, H.E., Jr. 1981. The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms. *Journal of Ecology* 69: 575-599.

Hallberg, G.R., Fenton, T.E., Miller, G.A., and Luteneggar, A.J. 1978. Trip 2 - The Iowan Erosion Surface: An Old Story, and Important Lesson, and Some New Wrinkles. *42nd Annual Tri-State Geological Field Conference Guidebook*. Iowa Geological Survey, pp. 2-1 - 2-94.

Heinselman, M.L. 1963. Forest Sites, Bog Processes, and Peatland Types in the Glacial lake Agassiz Region, Minnesota. Ecological Monographs 33: 327-372.

Heinselman, M.L. 1970. Landscape Evolution, Peatland Types, and the Environment in the Lake Agassiz Peatlands Natural Area, Minnesota. Ecological Monographs 40: 235-260.

Hudak, C.M., and Hajic, E.R. 1999. Landscape Suitability Models For Geologically Buried Pre-Contact Cultural Resources, pp. 12-1 - 12-283 + Appendix E. In *A High Probability Predictive Model of Precontact Archaeological Site Location for the State of Minnesota*. Minnesota Department of Transportation CD-ROM report and GIS ArcView database.

Johnson, D.L. 1990. Biomantle Evolution and the Redistribution of Soil Materials and Artifacts. *Soil Science*, 149: 84-102.

Kehew, A.E. 1982. Catastrophic Flood Hypothesis of the Origin of the Souris Spillway, Saskatchewan and North Dakota. Geological Society of America Bulletin 93: 1051-1058.

Kemmis, T.J. 1991. Glacial Landforms, Sedimentology and Depositional Environments of the Des Moines Lobe, Northern Iowa: University of Iowa Department of Geology, Iowa City, unpublished Ph.D. thesis, 393 p.

Meyer, G.N. and Patterson, C.J. 1997. Surficial Geology of the Anoka 30 X 60 Minute Quadrangle, Minnesota. Minnesota Geological Survey, 1:100,000.

Minnesota Department of Natural Resources. 1984. Inventory of peat resources, an area of Beltrami and Lake of the Woods counties, Minnesota. Minnesota Department of Natural Resources, 64 p.

Mollard, J.D. 1983. The Origin of Reticulate and Orbicular Patterns on the Floor of Lake Agassiz. In, J.T. Teller and L. Clayton (eds.), Glacial Lake Agassiz. Geological Association of Canada Special paper 26: 355-375.

Patterson, C.J. 1992. Surficial Geology, Plate 3. In, G.N. Meyer and L. Swanson (eds.), Geologic Atlas of Ramsey County, Minnesota: Minnesota Geological Survey County Atlas Series C-7, scale 1:48,000.

Patterson, C.J. 1994 Tunnel-Valley Fans of the St. Croix Moraine, East-Central Minnesota, USA, in Formations and Deformations of Glacial Deposits, edited by W.P. Warren and D.G. Croot, Balkema, Rotterdam, pp. 69-87.

Ruhe, R.V. 1969. Quaternary landscapes in Iowa. Iowa State University Press, 255 p.

Strahler, A.N. 1964. Quantitative Geomorphology of Drainage Basins and Channel Networks. In, V.T. Chow (eds), Handbook of Applied Hydrology, New York, McGraw-Hill, Section 4-11.

Wright, H.E. 1972. Physiography of Minnesota. In, P.K. Sims and G.B. Morcy (eds.), Geology of Minnesota: A Centennial Volume. St. Paul, Minnesota Geological Survey, pp. 561-577.

Wright, H.E. 1973 Tunnel Valleys, Glacial Surges, and Subglacial Hydrology of the Superior Lobe, Minnesota, In GSA Memoir, no. 136, The Wisconsian Stage, Geological Society of America, Denver, Colorado, pp. 251-276,

Wright, H.E., and Glaser, P.H. 1983. Postglacial Peatlands of the Lake Agassiz Plain, Northern Minnesota. In, J.T. Teller and L. Clayton (eds.), Glacial Lake Agassiz, Geological Association of Canada Special Paper 26: 375-390.