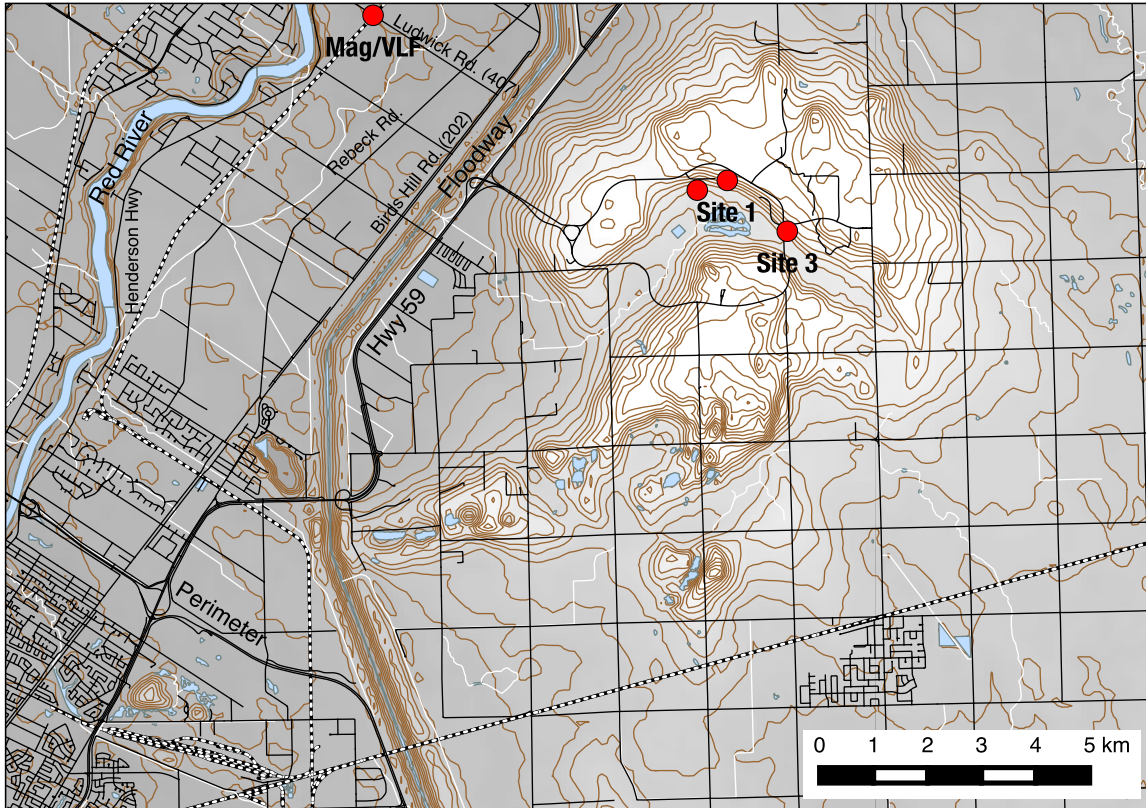


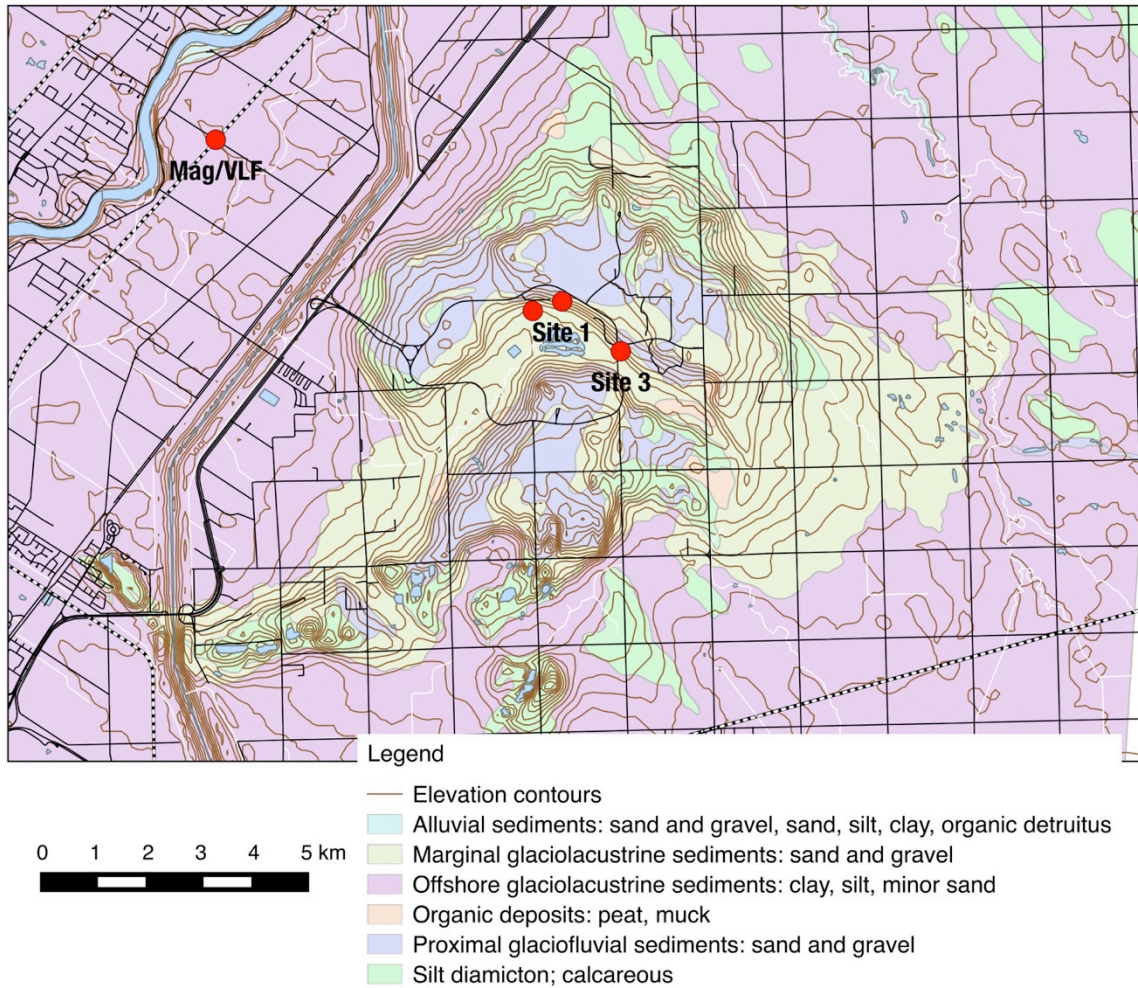
University of Manitoba: Geophysics Field School
2015 Birds Hill Project
 General Background

Manitoba Digital Elevation Model (2 m contours, lighter colour is higher elevation)



Birds Hill is one of the few areas of high ground in the vicinity of Winnipeg: an esker/delta complex just northeast of the city. We will undertake a series of geophysical surveys within Birds Hill Provincial Park, in order to gain familiarity with a range of instrumentation as well as to examine the near-surface physical properties of its constituent glaciofluvial sediments. We will be working at three sites within the park (red dots above), each of which will be assigned to a different student group. As Birds Hill does not offer a good magnetic or VLF target, we will perform those surveys across a railway line outside of the park (red dot marked “Mag/VLF”, above).

Site	Description	UTM zone 14N: X,Y (m)
1	Overlook	651950, 5542850
2	North beach	651390, 5542780
3	Festival Drive	653090, 5541960
Mag/VLF	Ludwick Road	645380, 5545890



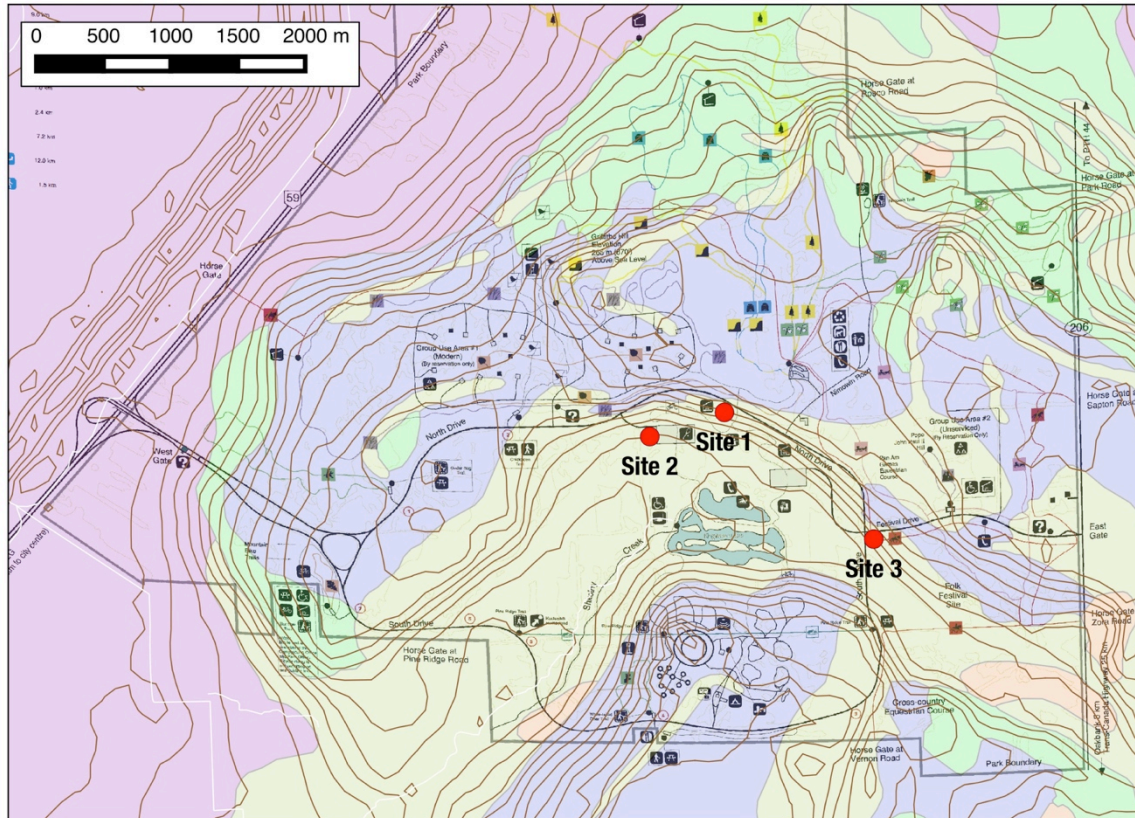
The map above shows the surface geology of the Birds Hill area. Our three Birds Hill sites will be on glaciofluvial and glaciolacustrine sediments consisting primarily of sand and gravel. The properties of these sediments are significantly different from the clays found elsewhere in the Red River valley; in particular, the Birds Hill sediments are resistive enough to make ground-penetrating radar possible.

The map on the next page shows the park infrastructure and field sites in more detail. From Provincial Highway 59 (the continuation of Lagimodière Blvd.), the park is accessed via the west gate, and all three sites are accessed from North Drive. The three sites are:

Site 1: Overlook, just off of North Drive.

Site 2: Field west of West Beach parking lot.

Site 3: Field SE of intersection between North/South Drive and Festival Drive.



For the Birds Hill field projects, your groups are currently planned to be (subject to change):

Group	Site	Members
1	1	Amandeep Dhatt
		Adekola Ishola
		Kevin Ramlakhan
		Easton Sato
2	2	Jason Cornick
		Shehryar Gill
		Steve Kachapilly
		Qaisar Naseem
		Yana Tyomkin
3	3	Neil Clark
		Chad Delaney
		Gafaar Ibikunle
		Harsimran Mann
		Tony Ulom

These groups will be different for later projects (Selkirk, Virden, etc.). The schedule for the Birds Hill project is on the next page.

Day	Time	Group 1	Group 2	Group 3
Tue., April 28	AM	Seismic	EM31/EM profiler	GPR & TEM
	PM	GPR & TEM	Seismic	EM31/EM profiler
	Eve.	<i>Analysis</i>	<i>Analysis</i>	<i>Analysis</i>
Wed., April 29	AM	EM31/EM profiler	GPR & TEM	Seismic
	PM	Gravity/Elevation	DC Resistivity	Mag-VLF
	Eve.	<i>Analysis</i>	<i>Analysis</i>	<i>Analysis</i>
Thu., April 30	AM	Mag-VLF	Gravity/Elevation	DC Resistivity
	PM	DC Resistivity	Mag-VLF	Gravity/Elevation
	Eve.	<i>Analysis</i>	<i>Analysis</i>	<i>Analysis</i>

Geology of Birds Hill (from Ian Ferguson's notes):

Figure 1 provides a schematic illustration of the geological structure surrounding the Birds Hill area. The structure includes a surface layer of unconsolidated sediments of Quaternary geological age that is between 15 and 50 m thick over much of the area. The surface sediments overlie around 100 m of Ordovician age sedimentary rocks that form the easternmost part of the Williston Basin, a sub-basin of the Western Canada Sedimentary Basin. The sedimentary rocks overlie Precambrian rocks of the Archean age that make up the rest of the Earth's crust. The crust is around 40 km thick in this region.

subprovince, a volcano-plutonic belt.. The subprovince immediately to the south is the Winnipeg River subprovince which is characterized by abundant granitic and related rocks. The Bird River subprovince is characterized by the presence of greenstone belts containing volcanic rocks, and in some locations, strongly magnetic iron-rich rocks. The Selkirk Greenstone Belt is an elliptical-shaped feature located in the Bird River subprovince a few kilometres to the northwest of the Birds Hill sites (Figure 4). This greenstone belt has a strong magnetic and gravity anomaly and drilling has revealed the presence of iron-rich rocks and mineralization (Gowan et al. 2009).

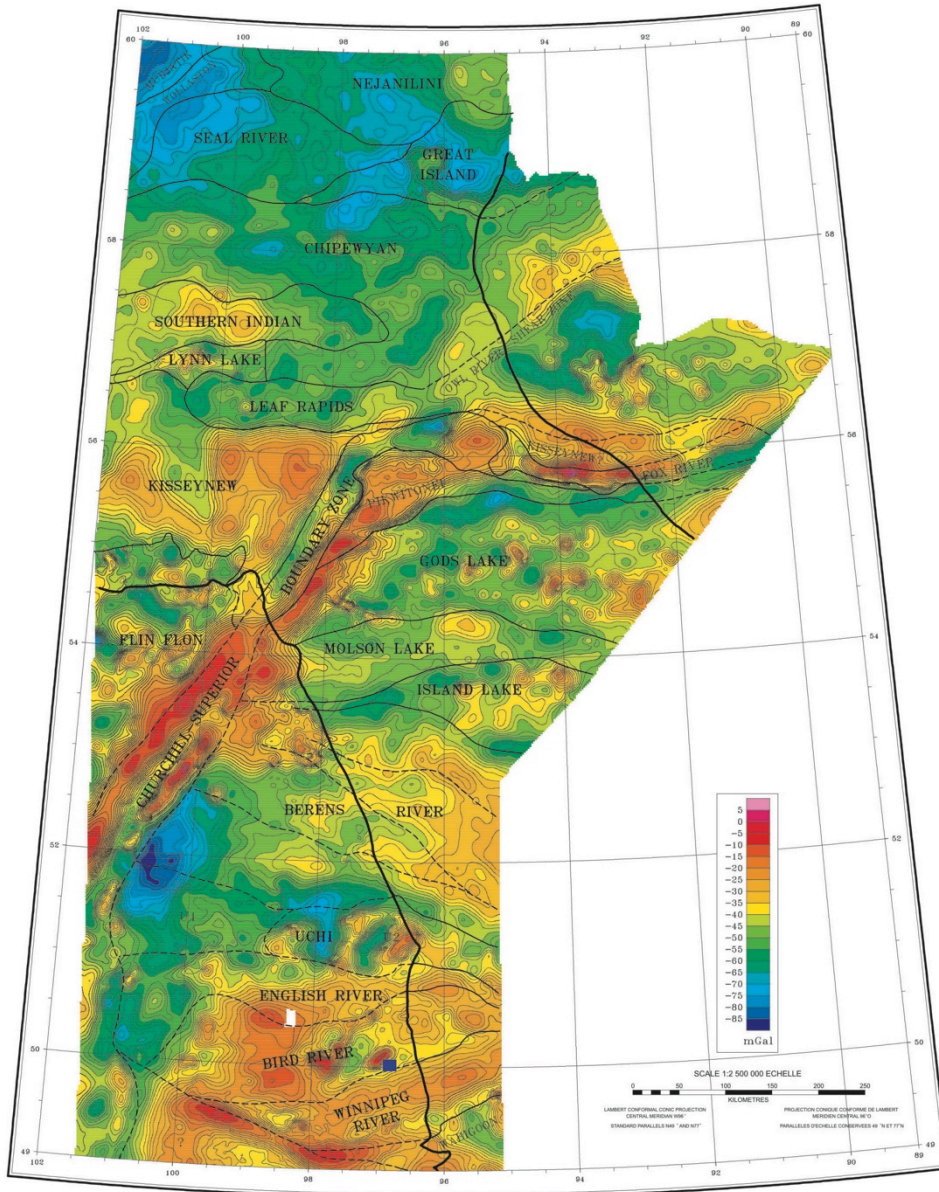


Figure 2. Bouguer gravity map of Manitoba showing location of Precambrian subprovinces (modified from Pilkington & Thomas 2001). Blue square shows the Birds Hill study area on the southeast flank of the Selkirk Greenstone Belt gravity anomaly.

Paleozoic Geology

The sequence of Palaeozoic sedimentary basin rocks at Birds Hill consists of Ordovician-aged shale and sandstone of the Winnipeg Formation underlying Ordovician-aged dolomitic limestone and dolostone of the Red River Formation (Figure 3; Bezys and McCabe 1996). In the area of Birds Hill the Winnipeg Formation is approximately 25 m thick and the Red River Formation is approximately 100 m thick.

The sedimentary rocks contain important aquifers (e.g., Render 1971). The Upper Carbonate aquifer occurs in the top 15 m to 30 m of the Red River Formation in the Winnipeg area (Figure 4). A minor aquifer called the Lower Carbonate Aquifer occurs in the lower part of the Red River Formation. The Winnipeg Formation contains a 6 to 12 m thick Upper Sandstone Aquifer and a 3 m thick Lower Sandstone Aquifer. The salinity of the water in both the carbonate aquifer and the sandstone aquifer decreases rapidly to the east of Winnipeg as the recharge zones of the aquifers is approached. In the area of Birds Hill, the salinity of the carbonate aquifer is around 0.4 g/L compared with salinity values of up to 2 g/L in the Winnipeg area (Hyde et al. 1997). In the area of Birds Hill the salinity of the sandstone aquifer is ~3 g/L compared with salinity values of up to 10 g/L in the Winnipeg area (Ferguson et al. 2007).

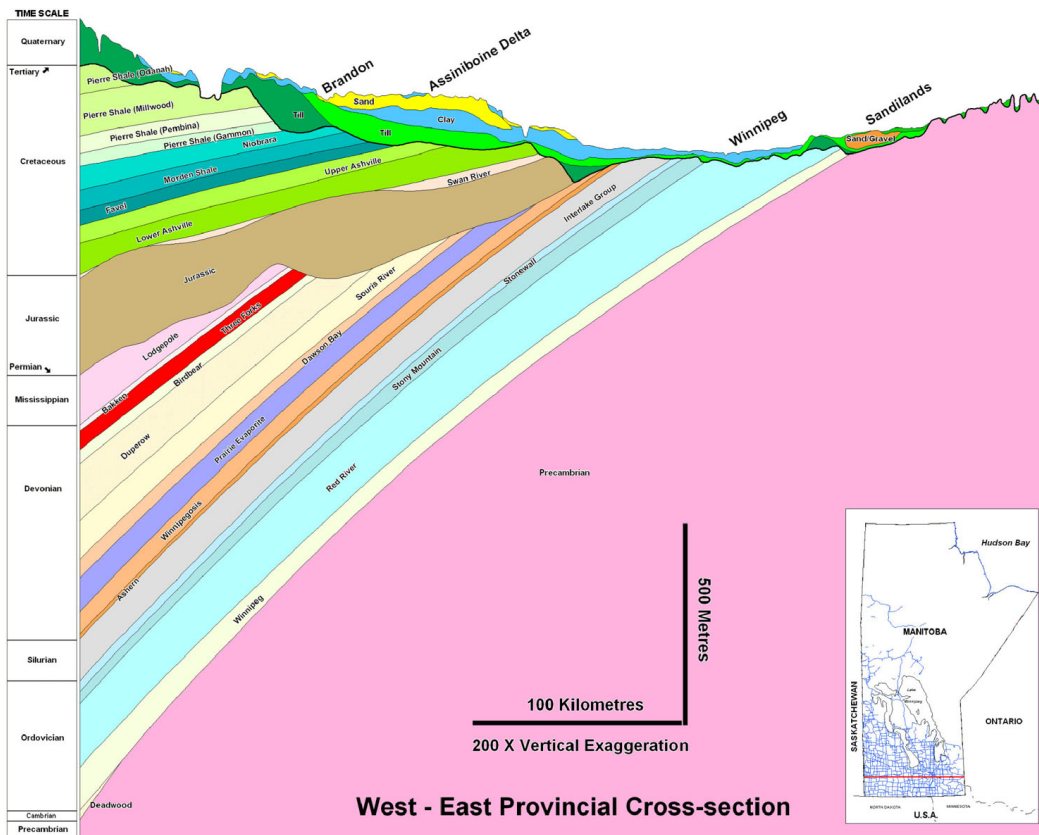


Figure 3. Simplified east-west cross-section of geological units in southern Manitoba (Manitoba Geological Survey, accessed on 02/11/2011, http://www.manitoba.ca/iem/mrd/geo/3dmodel/cross_section_large.html)

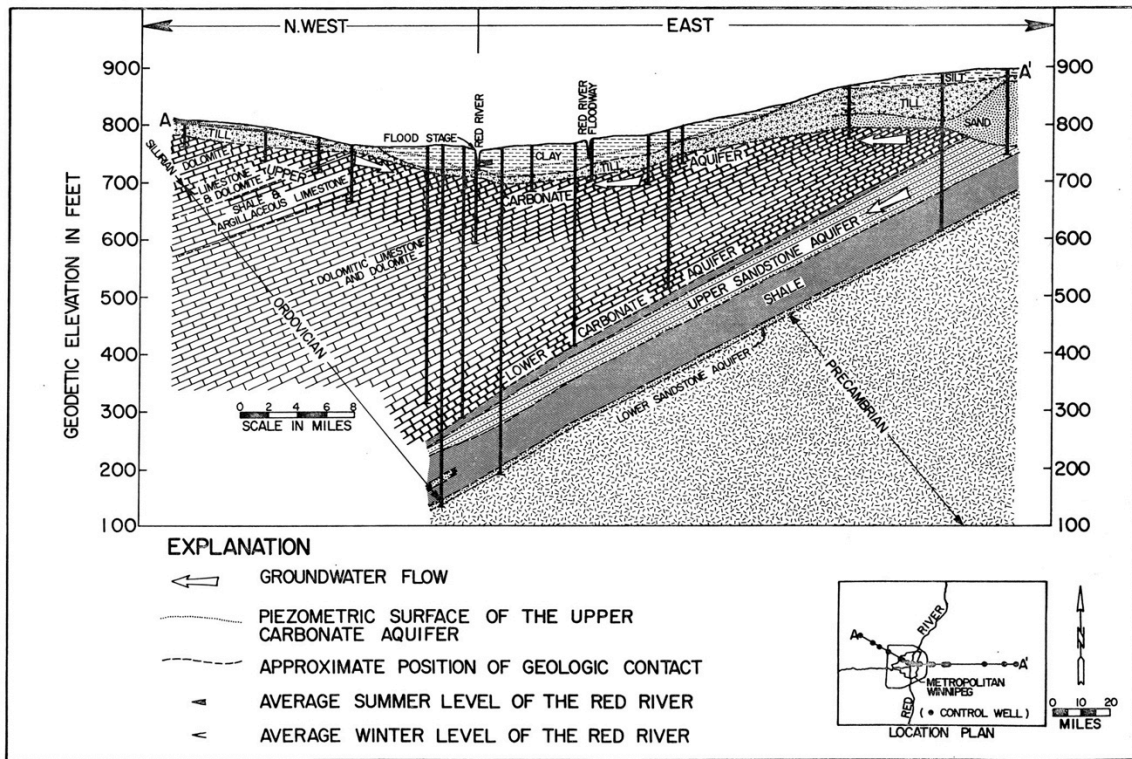


Figure 4. Geological cross-section of the Winnipeg region (Baracos & Render 1984).

Quaternary Geology

Figure 5 shows the surficial geology in the Winnipeg area. The area is dominated by clay-rich offshore glaciolacustrine deposits (with thickness varying from 1 to 20 m thick). In the Winnipeg area these deposits overlie a basal till units that is typically 2 to 4 m thick (Figure 6). The clay units are overlain by a layer of interbedded silt and silty clay that is typically 0.5 to 4.5 m thick.

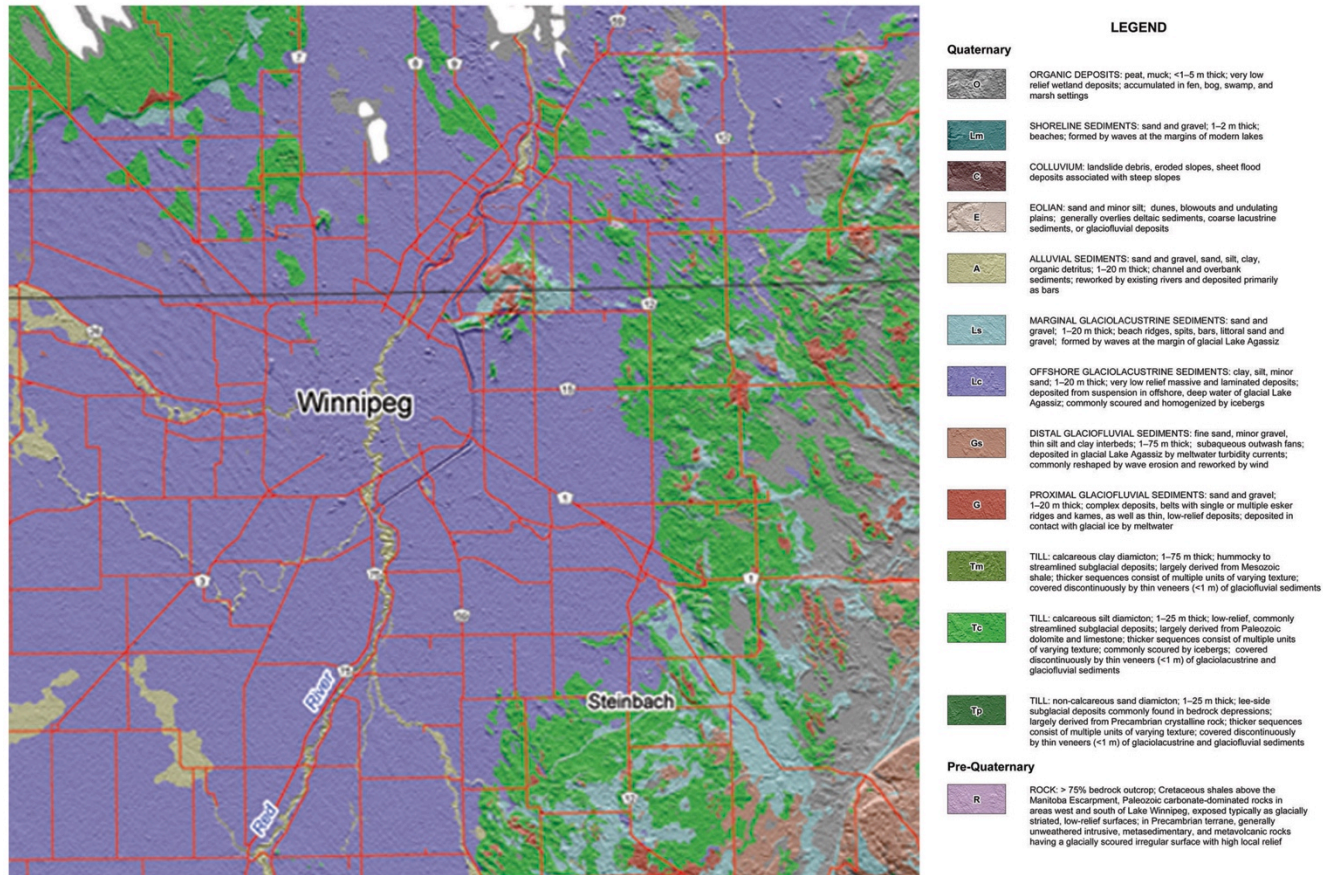


Figure 5. Surficial geological map of southern Manitoba (modified from Matile & Keller 2004).

The proximal sand and gravel rich glaciofluvial deposits in Birds Hill contrast with the surrounding clay deposits. Birds Hill is a Quaternary esker-glaciolacustrine complex that formed 11,000 to 12,000 years ago from the interaction of the Red River glacial ice lobe and glacial Lake Agassiz (Matile, 1984). The lobe was part of a Pleistocene glacier that advanced from the northwest. As the glacier retreated, melt water flowed through gaps in the glacier and deposited sand and gravel to form the esker complex. After further retreat, Lake Agassiz submerged the esker, depositing basal silt and clay in the area surrounding the esker. Icebergs that broke off of the glacier produced scours as they dragged along the bottom of the lake. As the water level of Lake Agassiz dropped, wind and wave action eroded the esker. The eroded sand and gravel deposited as beach ridges and spits at five major strandline levels (Figure 8). The total thickness of Quaternary deposits in the Birds Hill area ranges from 5 to over 40 m.

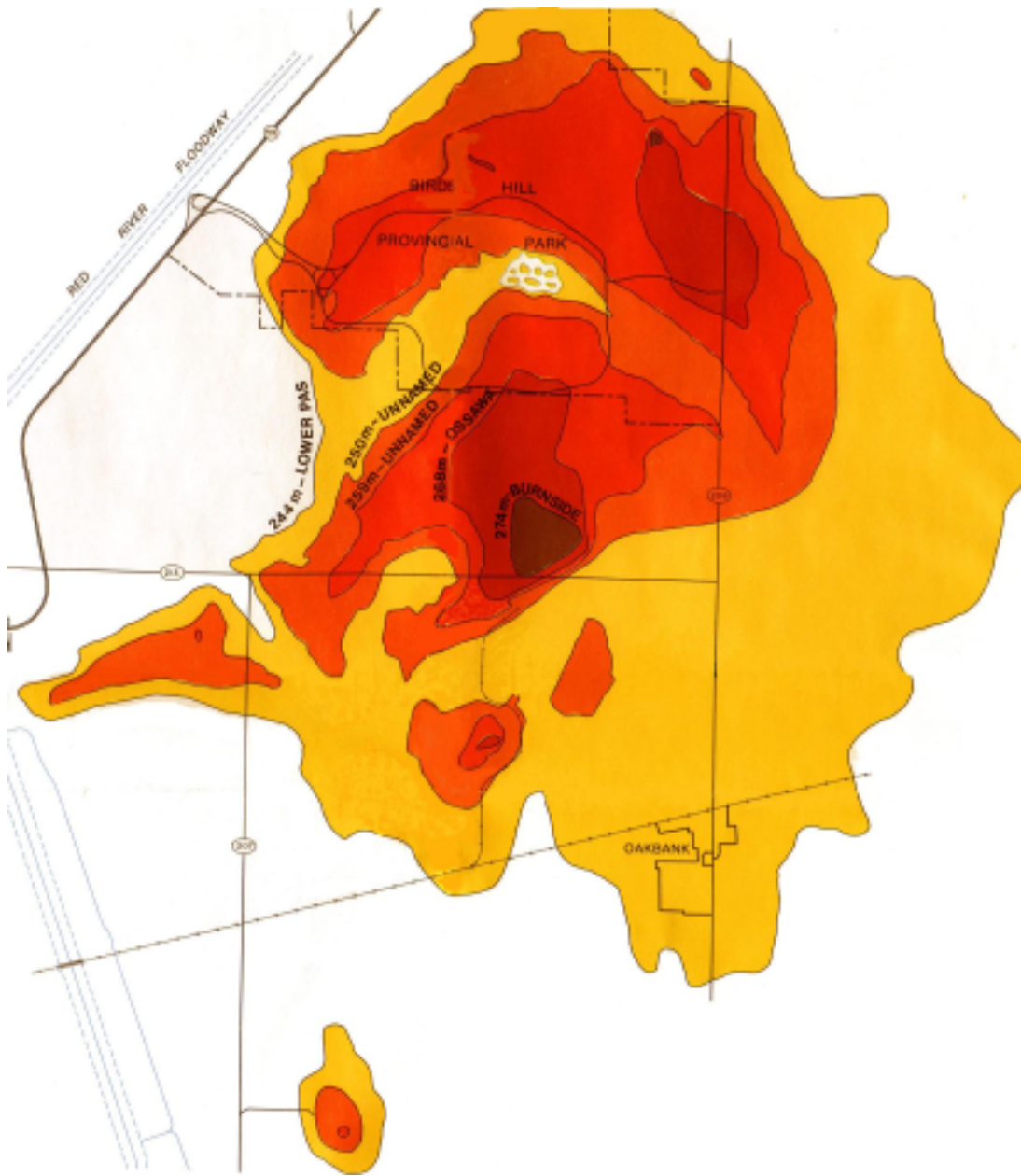


Figure 6. Major strandlines on the Birds Hill esker complex. Strandline levels are in metres above sea level (Matile, 1984).

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