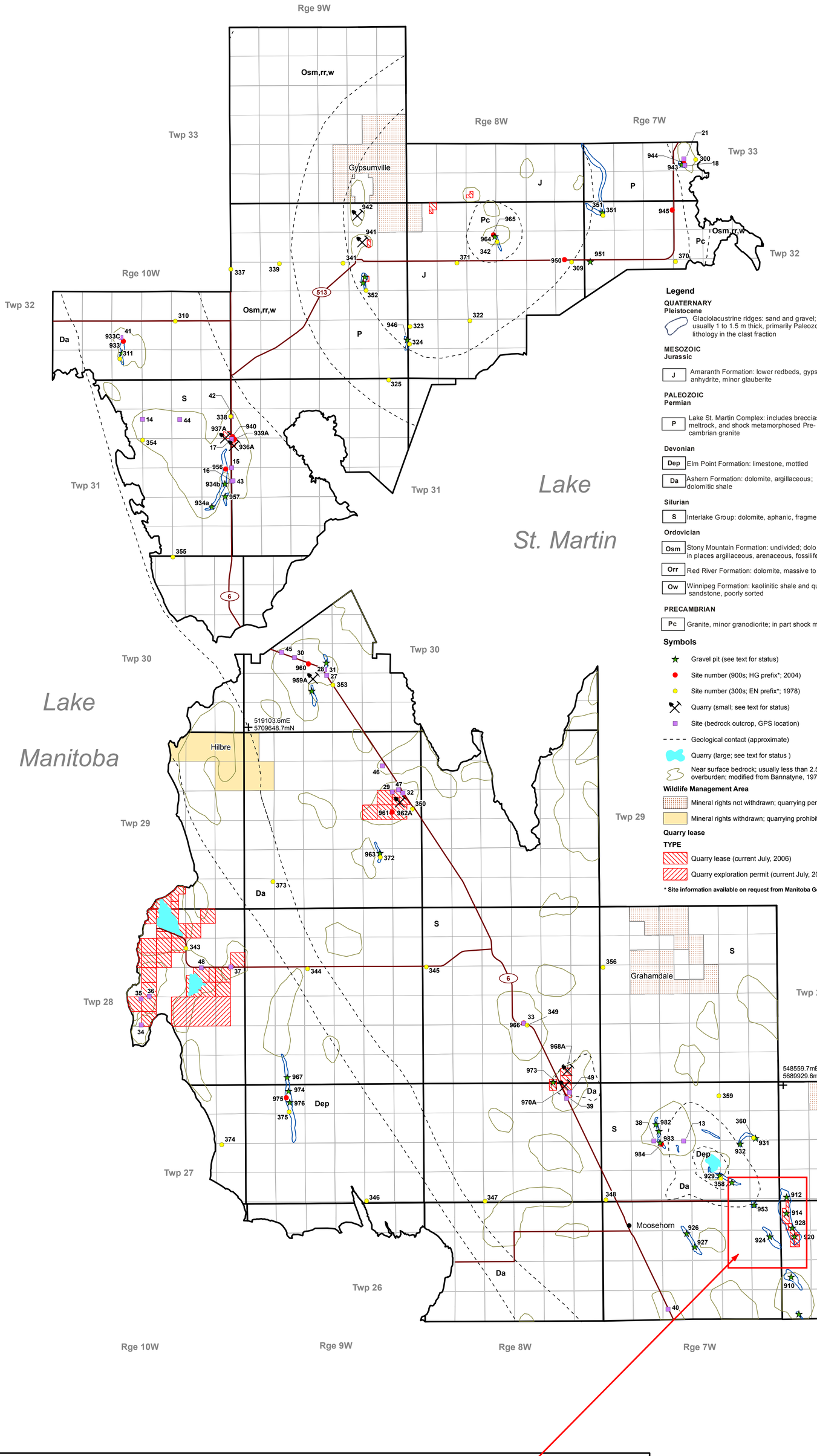
Aggregate resources in the Rural Municipality of Grahamdale, Manitoba



Introduction
An aggregate inventory of the Rural Municipality (R.M.) of Grahamdale was carried out in the summer of 2004 to provide information to the Western Interlake Planning District. The R.M. was recently added to the district and a development plan for the municipality will be included as part of the five-year review of the planning district development plans. The aggregate information is also used for resource management within the Manitoba Geological Survey and is available to other government departments and outside clients on request.

The R.M. is located in the Manitoba Interlake area, adjacent to the northern portion of Lake Manitoba. The municipality covers 28 townships between Twp. 23 to 33 in Rge. 4 to 10, W1st Mer. and is located on NTS sheets 62I13, 62J16, 62O1, 2, 7, 8, 9, 10, 15, 16 and 62P4.

Previous work
The bedrock of the municipality has been reported on by many authors, most notably Norris et al. (1982) for the Devonian strata and Bannatyne (1975, 1988) who studied the bedrock formations from an economic perspective, as sources of high-calcium limestone and high-purity dolomite. The bedrock geology, areas of near-surface bedrock and quarry locations in the municipality are included on the 1:250 000-scale maps that accompany Bannatyne?s report on dolomite resources of southern Manitoba (Bannatyne, 1988). Descriptions of some of the quarries in the municipality are found in mineral inventory cards on file with MGS (Bannatyne, 1988) and in two fieldtrip guidebooks (McCabe and Barchyn, 1982; Bezys and Bamburak, 2004). C. Jones (1986) studied the aggregate potential of selected bedrock formations in Manitoba; two of the quarries sampled in this study are situated within this municipality.

The quaternary geology of the area is shown on a recent 1:500 000-scale compilation map (Matile and Keller, 2004a). Individual 1:250 000-scale maps, used to produce this compilation, were published in November 2004 (Matile and Keller, 2004b, c, d, e). The northern part of the municipality (Twp. 26 to 33) is included on a 1:100 000-scale quaternary geology map of the Gypsumville area (Nielsen and Matile, 1984). The map includes delineations of near-surface bedrock and gravel deposits as well as pit and quarry locations. Young (1984) mapped the sand and gravel of the southern portion of the municipality and discussed the deposits. Nielsen (1982, 1989) reported on till stratigraphy exposed in backhoe testpits, which were part of a drift prospecting study in the Interlake area.

Geology

Bedrock geology
The municipality is underlain primarily by Paleozoic rocks of Silurian and Devonian age. However, within the Lake St. Martin crater area, rocks of Precambrian, Ordovician, Permian and Jurassic age occur. The geologic contacts on the map and the formation descriptions in the legend have been taken from Bannatyne, 1988.

The geology and possible origin of the Lake St. Martin crater is described by McCabe and Bannatyne (1970). The crater was probably formed by a meteorite impact in late Permian times, although it may have been the result of a volcanic explosion or a combination of both events. The structure consists of an outer uplifted rim of Precambrian and Paleozoic strata and an inner ring of gneissic rocks surrounded by rocks of the Permian St. Martin series. The gneissic rocks and the St. Martin series show strong shock metamorphism. Gypsum beds that maybe correlative to the Jurassic Amaranth Formation were deposited later within the crater. These gypsum deposits are described in Bannatyne (1959). Precambrian rock of the outer rim is exposed in the wall of a gravel pit in SW ¬, Sec. 10, Twp. 33, Rge. 7, W 1st Mer.; the gneisses of the inner core are less well exposed at the base of a gravel pit in NE-28-32-8-W1; and the gypsum beds are very well exposed in quarries in 26-33-9-W1, 35-33-9-W1 and 2-33-9-W1. Gypsum from this area was quarried from 1910 until the 1980s. Currently there is no extraction but there are several quarry leases for gypsum in good standing on these deposits.

Silurian rocks underlie the eastern part of the municipality. McCabe and Barchyn (1982) note that the rocks are primarily ?micritic to intraclastic and stromatolitic dolomites with scattered fossil-fragmental interbeds?interrupted by a number of thin sandy argillaceous marker beds?. Several authors (McCabe and Barchyn, 1982; Bannatyne, 1988; Bezys and Bamburak, 2004) have commented on the relative uniformity of the Silurian strata and the difficulty in correlating formations from north to south in Manitoba. However, the Silurian rocks exposed in the quarries along Highway (Hwy.) 6 in the map area can clearly be assigned to the Cedar Lake Formation (Bannatyne, 1988), which forms part of the Silurian Interlake Group. McCabe and Barchyn (1982) described the Cedar Lake Formation as ?dolomite, white to pale yellowish brown, microcrystalline dense sublithographic, thin bedded, in part stromatolitic; porous biostromal interbeds, possibly biothermal at top of unit?. The Cedar Lake Formation quarry at Hilbre (SW-24-29-9-W1) produces high-purity dolomite used for dolomitic lime production (Bannatyne, 1982).

The Devonian Elk Point Group strata underlie the western part of the municipality. The Elk Point Group consists of the basal Ashern Formation and the overlying Winnipegosis Formation. The Ashern Formation is composed of brick red to greyish orange dolomite, with some interbeds of green or red shale. Brecciated fragments in the lower Ashern beds are from the underlying Silurian strata. Iron sulphide is disseminated through the beds (Norris et al., 1982).

The Elm Point Formation is a facies equivalent of all or part of the Lower Member of the Winnipegosis Formation (Norris et al., 1982). Through most of its extent, the Lower Member of the Winnipegosis Formation is dolomite; however, the Elm Point Formation is primarily high-calcium limestone or partially dolomitized limestones. In the R.M. of Grahamdale, the Elm Point Formation has been quarried since 1913 for high-calcium limestone. The Spearhill, Steeprock and Faulkner quarries have been the three major sources. Bannatyne (1975) describes the physical properties of the bedrock in each of the quarries and provides the results of a chemical analysis of samples from each of the quarries. The Spearhill quarry is in a topographic high formed by an outlier of Elm Point Formation limestone overlying Ashern Formation dolomite. The quarry is depleted of limestone and has been partially rehabilitated; the Whitetail and Walleye Association has a clubhouse on the quarry site. The huge quarry at Steeprock stopped production in the 1980s; there are tentative plans to transfer the land to the R.M. of Grahamdale and turn the quarry into a heritage site. The Faulkner quarry is still active and is owned and operated by Graymont Western Canada Inc. The plant adjacent to the quarry produces lime and dolime using raw material from the Faulkner and Hilbre quarries in the municipality (J. Bamburak, pers. comm., 2006).

Surficial geology

There has been very little work done on the surficial geology of the municipality. The northern part of the municipality was mapped at a 1:100 000 scale (Nielsen and Matile, 1984) and the till stratigraphy was described by Nielsen (1989). The surficial sediments are primarily till, organics and bedrock outcrop; there are minor amounts of clay and gravel deposits related to glacial Lake Agassiz. The widespread occurrences of bedrock outcrop indicate surficial sediments are generally thin over most of the area. Striations on bedrock pavement and the orientation of flutes and drumlinoid ridges indicate that the last glacial ice flow to affect the municipality was from the northwest. Nielsen (1989) reports a two till sequence. Both are silty, carbonate-rich tills, reflecting the underlying bedrock. The lower Inwood till contains 84.2% carbonate pebbles and the upper Komarno till contains 85.9% carbonate clasts. The major distinguishing factor in the field is the relative hardness of the till; the Inwood till is an overcompacted basal till while the overlying Komarno till is softer. South of the R.M. of Grahamdale, the Komarno till often contains lake clay inclusions indicating it was deposited by ice flowing into glacial Lake Agassiz. There are few areas of clay in the municipality and the presence of glacial Lake Agassiz is primarily indicated by beach ridge deposits and areas of iceberg scour.

Aggregate inventory

Aggregate resources

In the R.M. of Grahamdale aggregate is produced from quarries in Paleozoic bedrock and pits in Quaternary sand and gravel deposits. The provincial crown owns the vast majority of the aggregate resources, although there are some deposits where the gravel is privately owned.

Quarries

There are twelve large quarries in the municipality. The locations are shown on Inset 1. For ease of discussion, the quarries are referred to by names assigned to them on the mineral inventory cards on file with MGS. Five of the quarries were opened to produce industrial minerals: Spearhill, Steeprock and Faulkner for high-calcium limestone and the two near Gypsumville for gypsum. These have been discussed in the bedrock section above. The remaining seven were opened to produce aggregate. They all are located very close to Hwy. 6 and in fact, except for one, they were opened in the late 1960s to the early 70s to provide the material to build the highway.

While the Spearhill quarry is depleted of high-calcium limestone and rock is no longer being blasted, there is a great deal of broken rock within the quarry. Small amounts of the bedrock are being removed annually under casual permit for local aggregate use.

The Mulvihill, Hilbre and the three Fairford quarries all occur in the Silurian Cedar Lake Formation. The rock is primarily a dense crystalline dolomite and was the major source of aggregate for Hwy. 6. Samples from the Mulvihill and FairfordN2 quarries were submitted for standard aggregate tests and chemical analysis; the results are presented in Jones (1986). The two GrahamdaleS quarries are in an outlier of the Devonian Ashern Formation, also a dolomite. The Hilbre and GrahamdaleS2 quarries are active producers of aggregate. Mulvihill, GrahamdaleS1 and FairfordN2 are flooded and have not been used recently. FairfordSE and FairfordN1 appear to have been inactive for a very long time.

All of the aggregate quarries, except FairfordSE, are held under quarry lease, most of them for aggregate production. The Hilbre quarry is held under two leases, one by an aggregate company and one by Graymont, which produces dolime at their Faulkner plant. The Hilbre quarry was a past producer of high-purity dolomite and production was resumed in 2002 (J. Bamburak, pers. comm., 2006). Graymont also holds the quarry lease over the inactive GrahamdaleS1 quarry.

Sand and gravel pits

Sand and gravel reserves in the municipality are located in beach deposits formed along the shores of glacial Lake Agassiz. They are scattered throughout the area although most occur in the Spearhill vicinity. Most of the deposits have been mined in the past and many are either depleted entirely or have only pebbly sand reserves left. Many of the active pits are nearing depletion and recent activity consists of minor amounts of material being removed for local use. In addition, the deposits were not very thick to begin with as most of the pits, including the depleted ones, are only 1 to 1.5 m deep. The gravel deposits in 24-24-6-W1 and 25-24-6-W1 were backhoe tested in 1998 (Groom, unpublished data, 1998) as part of a study of aggregate resources in Wildlife Management Areas; the deepest hole showed 1.4 m of gravel. The pit in NW-24-24-6-W1 is less than 1 m deep, yet it has been mined regularly for gravel. All of the gravel in these deposits has a high-carbonate lithology, reflecting the composition of the till they were derived from.

There is one large gravel deposit with high quality reserves remaining in the municipality. It is in 30-26-6-W1, 31-26-6-W1, 7-27-6-W1 and 18-27-6-W1. The deposit has been an aggregate source for over 20 years as pits are shown in it on Nielsen and Matile?s map (Nielsen and Matile, 1984). The deposit is now almost one continuous pit with areas of depletion, stockpile areas and active working faces. Pit depths in the active areas are 1.5 to 2.5 m. The gravel is sandy fine pebble gravel with a maximum grain size of 5 to 8 cm. The pebbles are about 80% carbonates and the only deleterious factors are some weathered Precambrian clasts and carbonate encrustation. Except for the north end, where gravel is extracted under casual quarry permit, there are quarry leases covering all of the deposit. There appears to be a substantial amount of reserves remaining. Total depth of the deposit is not known. At the south end of the deposit, there is a very old pit that is 4 to 5 m deep, yet the active pit adjacent to it is 2 m deep, as are the other active pits. Backhoe testing would be required to know what reserves lie below the current pit floors.

There is an active pit in the beach ridge in NE-25-26-7-W1. The pit is 2.5 to 3 m deep and the material exposed is pebbly sand, although shallow exposures further along the deposit indicate that there may be gravel beds remaining in the deposit. The aggregate in this deposit is privately owned. The gravel in SW-10-33-7-W1 was deposited along a bedrock high. The bedrock knob stands 10 m above the surrounding terrain and is known locally as ?the big hill?. The bedrock is Precambrian and is part of the outer rim of the Lake St. Martin crater. The gravel in the deposit is near depletion but there are reserves of sand and pebbly sand. In 2004, the pit operator said the sand is too fine for his purposes but not fine enough for VMA (void matrix additive) sand. He also said the beach deposits in 7-33-7-W1 and 18-33-7-W1 are nearly depleted of gravel, with mainly sand remaining. These deposits were inaccessible in 2004 due to high water.

Economic considerations

Quarries in the Paleozoic formations produce good quality crushed aggregate and there is an abundance of near-surface bedrock suitable for future quarry sites. However, the complete range of granular sizes cannot be easily (or economically) produced from crushing. Sand and granule-size material from sand and gravel sources are often blended with crushed bedrock to meet the required grain-size specifications for some end uses. Therefore, while the municipality has a large volume of potential crushed bedrock resources, there is a scarcity of aggregate in certain sizes. In addition, most of the beach ridges are near depletion and the remaining large deposit is under quarry lease, so there is a shortage of material available to the small operator.

Acknowledgments

J. Bamburak is thanked for providing information on the industrial mineral aspects of the limestone and dolomite strata.

References

Bannatyne, B.B. 1959: Gypsum-anhydrite deposits of Manitoba; Manitoba Department of Mines and Natural Resources, Mines Branch, Publication 58-2, 46 p.

Bannatyne, B.B. 1975: High-calcium limestone deposits of Manitoba; Manitoba Department of Mines, Resources and Environmental Management, Mineral Resources Division, Exploration and Geological Survey Branch, Publication 75-1, 103 p.

Bannatyne, B.B. 1988: Dolomite resources of southern Manitoba; Manitoba Energy and Mines, Geological Services, Economic Geology Report ER85-1, 39 p. plus 4 maps at scale 1:250 000.

Bezys, R.K. and Bamburak, J.D. 2004: Lower to middle Paleozoic stratigraphy of southwestern Manitoba; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, May 25?28, 2004, Fieldtrip Guidebook WCSB/TGI 11, 72 p.

Jones, C.W. 1986: The aggregate potential of selected Paleozoic and Precambrian rocks in Manitoba; Manitoba Energy and Mines, Mines Branch, Aggregate Report AR86-1, 13 p.

Matile, G.L.D. and Keller, G.R. 2004a: Surficial geology of southern Manitoba (south of 53ø); Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map Series, SG-SMB, scale 1:500 000.

Matile, G.L.D. and Keller, G.R. 2004b: Surficial geology of the Selkirk map sheet (NTS 62I), Manitoba; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map Series, SG-62I, scale 1:250 000.

Matile, G.L.D. and Keller, G.R. 2004c: Surficial geology of the Neepawa map sheet (NTS 62J), Manitoba; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map Series, SG-62J, scale 1:250 000.

Matile, G.L.D. and Keller, G.R. 2004d: Surficial geology of the Dauphin Lake map sheet (NTS 62O), Manitoba; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map Series, SG-62O, scale 1:250 000.

Matile, G.L.D. and Keller, G.R. 2004e: Surficial geology of the Hecla map sheet (NTS 62P), Manitoba; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map Series, SG-62P, scale 1:250 000.

McCabe, H.R. and Bannatyne, B.B. 1970: Lake St. Martin crypto-explosion crater and geology of the surrounding area; Manitoba Department of Mines and Natural Resources, Mines Branch, Geological Paper 3/70, 79 p.

McCabe, H.R. and Barchyn, D. 1982: Paleozoic stratigraphy of southwestern Manitoba; Geological Survey of Canada, Geological Association of Canada-Mineralogical Association of Canada, Joint Annual Meeting 1982, Winnipeg, Manitoba, Fieldtrip Guidebook Trip 10, May 17?19, 1982, 47 p.

Nielsen, E. 1982: Mineral deposit studies in Phanerozoic rocks of southern Manitoba; in Report of Activities 1982, Manitoba Energy and Mines, Mineral Resources Division, p. 64?67.

Nielsen, E. 1989: Quaternary stratigraphy and overburden geochemistry in the Phanerozoic terrane of southern Manitoba; Manitoba Energy and Mines, Geological Services, Geological Paper GP87-1, 78 p.

Nielsen, E. and Matile, G. 1984: Quaternary geology of the Gypsumville area; Manitoba Energy and Mines, Map AR84-3, scale 1:100 000.

Norris, A.W., Uyeno, T.T. and McCabe, H.R. 1982: Devonian rocks of the Lake Winnipegosis-Lake Manitoba outcrop belt, Manitoba; Geological Survey of Canada, Memoir 392, 280 p.

Young R.V. 1984: Aggregate resource inventory of the southern portion of the Local Government District of Grahamdale; in Report of Field Activities 1984, Manitoba Energy and Mines, Mineral Resources, p. 167-168.

Geology by:
H.D. Groom

Cartography by:
B.K. Lenton

Copies of this map can be obtained from:
Manitoba Industry, Economic Development and Mines
Manitoba Geological Survey, Publication Sales
360-1395 Ellice Avenue
Winnipeg, Manitoba
R3G 3P2
Canada
Phone: (204) 945-4154
Toll-free: 1-800-223-5215
E-mail: minesinfo@gov.mb.ca

Suggested reference:
Groom, H. D. 2006:
Aggregate resources in the Rural Municipality of Grahamdale, Manitoba; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Geoscientific Map, Map2006-1, scale 1:100 000.

Published by:
Manitoba Industry, Economic Development and Mines
Manitoba Geological Survey, 2006

Printed: 2006

Universal Transverse Mercator
North American Datum 1983
Zone 14