Geology

The geology for the ESR watershed dates back to the Phanerozoic eon which is roughly 250 million years ago. Within the Phanerozoic eon there are two eras in which the geology of the study area has been classified to, the Mesozoic and Cenozoic era. The entire geological portion of the study area excluding the Turtle Mountains has been classified as belonging to the Mesozoic era. Within the study area this portion of the land is also referred to as the Boissevain Formation. The remaining geological portion of the study area, the Turtle Mountains, falls into the Cenozoic era. By sampling these and other geological features it helps in determining the types of geology present and can determine age of its formation.

Mesozoic formations usually encompass sandstones, red siltstone, gypsum, bentonite and various types of shales. Within these formations petroleum is one product that can be extracted, as seen by the number of oil wells in the study area. The Boissevain Formation of sandstone and shale is up to 140 feet thick; however most of it is not exposed.

Cenozoic formations are limited to the Turtle Mountain area which is mainly encompassed of fine sandy and silty shales reaching a depth of at least 480 feet thick. There is minimal exposure in the mountains with some outcrops in ravines on lower slopes and in road cuts. Bedrock found under the Turtle Mountains is buried deeply by glacial Lake Souris deposits and in some areas there is drift over 400 feet thick making an uneven surface with lakes and swampy sections.

The geology of the East Souris River watershed consists of a bedrock formed by Cretaceous and Tertiary aged sediments (approximately 55-80 million years before present) overlain by unconsolidated deposits laid down prior to, during, and following Pleistocene glaciation.

The oldest bedrock sediments consist of Cretaceous shales and siltstones of the Riding Mountain Formation. These include the soft bentonitic shales of the Millwood Member (forming the lower part of the Riding Mountain Formation), the siliceous shales and minor bentonites of the Odanah Member which overlies the Millwood, and the soft bentonitic shales and siltstones of the Coulter Member which overlies the Odanah Member near Turtle Mountain. In the southern and eastern parts of the watershed, sediments comprising the Riding Mountain Formation are overlain by younger bedrock deposits which form the Turtle Mountain upland. The oldest of these is the Boissevain Formation of Cretaceous age, consisting of greenish-grey sandstones and shales. The Boissevain Formation is overlain by the Turtle Mountain Formation formed by sandstones, siltstones and shales with minor coal.

The bedrock is overlain by much younger unconsolidated sediments which, with some exceptions, were laid down during a series of glacial advances and retreats over the past 2 million years. Throughout most of the area surficial deposits consist of glacial till of varying thickness. Tills are poorly sorted mixtures of clay, silt, sand and gravel derived from materials that the glaciers moved over then deposited as the ice melted and retreated. Sand and gravel deposits are locally associated with the tills, either as sand and gravel lenses found at depth within the tills or as sand and gravel deposits found at ground surface. These deposits often represent stagnation areas where the advance or retreat of the glaciers stalled for a period of time and deposited water sorted sediments. South of the Souris River, the tills are overlain by clays, silts and sands which were deposited into a large ice-marginal lake formed near the end of the last glaciation, named Lake Hind.

There are at least two buried valleys mapped within the watershed area. These features are formed by river erosion cutting incised valleys into the underlying bedrock deposits followed by the infilling of these valleys by sediments, generally tills and sand/gravel of Pleistocene age but in some areas the basal sediments in the valleys may be Tertiary in age. The largest of these features is the Medora-Waskada buried valley. Sand and gravel deposits in the infill materials in this valley form an important local

aquifer. A second buried valley has been identified in the Turtle Mountain area, traversing to the north before disappearing near Whitewater Lake. Sand and gravel aquifers have not been identified in this feature.

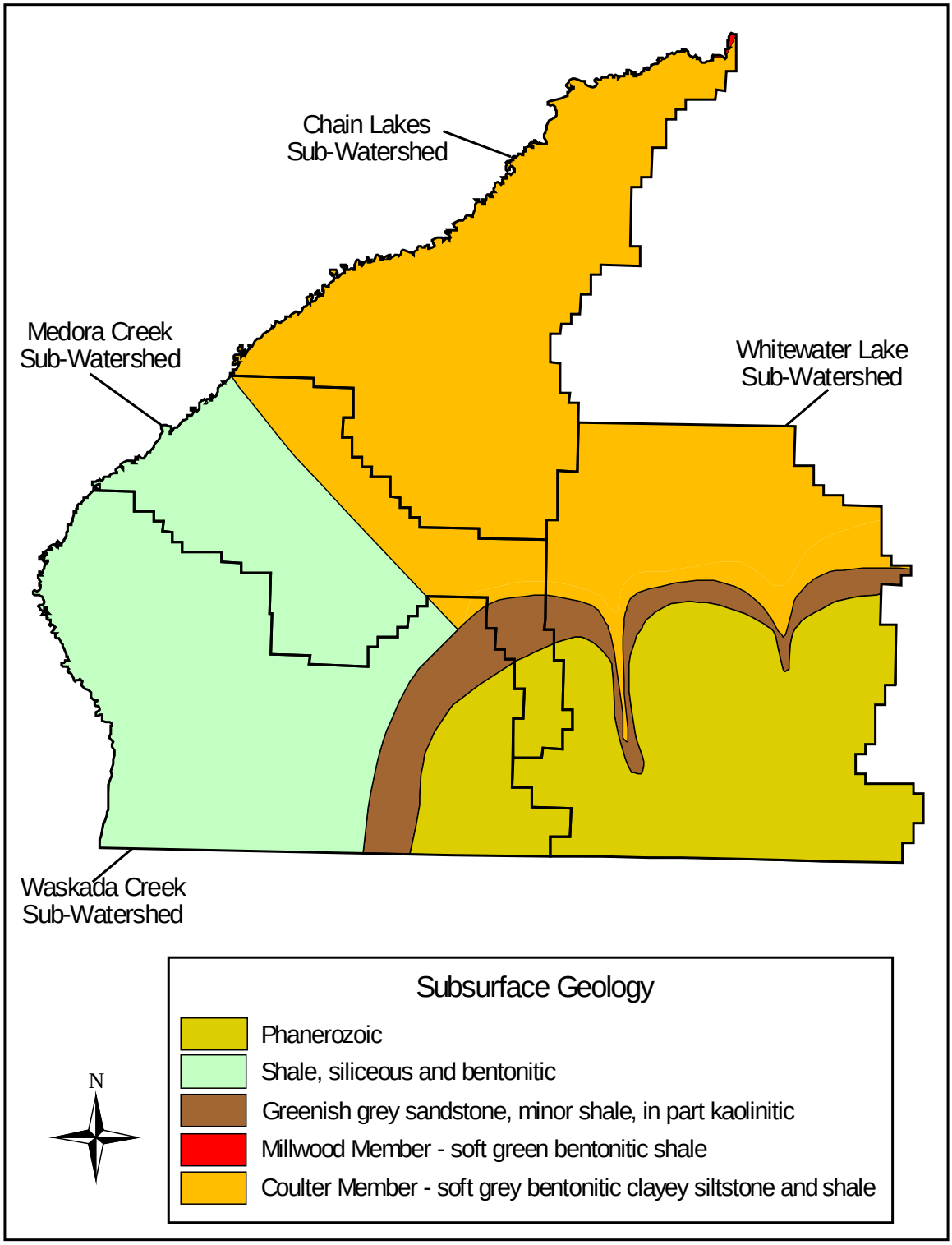

Figure 27. Subsurface Geology within the East Souris River IWMP study area.