University of Wisconsin

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

Summary Statement

of facilities for

UNDERGROUND STORAGE OF LIQUID PETROLEUM PRODUCTS

in

Wisconsin

by

George F. Hanson

State Geologist

March, 1960

GENERAL GEOLOGY

The geologic structure of Wisconsin is essentially very simple. Gently dipping sedimentary rocks of Paleozoic age outcrop in a horseshoe pattern around a "shield" of Precambrian crystalline rocks which occupies the north-central part of the state (Fig. 1).

The entire state is covered with glacial deposits of Pleistocene age with the exception of the southwest quarter, commonly called the "Driftless Area". The glacial deposits vary considerably in thickness and obscure exposures of the underlying bedrock.

The Paleozoic sediments are principally dolomites and sandstones. Shale may occur subordinately within these formations but the Maquoketa shale is the only formation in which shale predominates.

PERMEABLE RESERVOIRS

In order for a permeable reservoir to be suitable for underground storage of liquid petroleum gas (LPG) it is necessary that an impermeable caprock be present and that there be adequate structural closure to localize the product stored.

The sedimentary section of Wisconsin has been extensively penetrated by water wells. The Maquoketa shale is the only formation which is impermeable enough to form a caprock but, although saline waters occur in some of the formations below the Maquoketa, no structural traps are known, or indicated, that would serve to confine petroleum products.

MINES AND NATURAL CAVERNS

There are numerous zinc and lead mines in the southwest part of the state. These are shallow and seldom exceed 200 feet in depth. The host rock is dolomite or limestone which may be fractured, creviced and highly altered in the mineralized zones.

Iron mines in northern Wisconsin extend to as much as 4000 feet in depth.

Caves are found principally in the "Driftless Area" of southwest Wisconsin. They are small and lie at shallow depths.

Problems of sealing caves or mines in the carbonate formations would be serious. The extensive workings of the iron mines would not only present problems of sealing, but danger from rock-bursts and caving would also be present.

EXCAVATED CHAMBERS

Sandstone

Friable sandstone of Upper Cambrian age outcrops along the bluffs of the Mississippi and its tributaries in western Wisconsin. It has been mined by room and pillar methods at Bayview and Maiden Rock. The United Petroleum Gas Company of Minneapolis has been experimenting, for several years, to develop storage facilities for LPG in these workings. Chambers are excavated in the walls, fitted with concrete bulkheads and sprayed with a sealing compound. The work is still in the experimental stage and no commercial storage has been developed to date.

Shale

The Maquoketa formation, of Upper Ordovician age, is a dolomitic shale which is overlain by the Niagara dolomite, of Silurian age, and underlain by the Galena dolomite of Middle Ordovician age. The Neda, an oolitic iron-formation, may be present locally between the Niagara and the Maquoketa. With the exception of a few small outliers in southwestern Wisconsin the Maquoketa is present only along the eastern margin of the state. (Fig. 2). The shale outcrops in a band parallel to, and some 15-35 miles west of, the Lake Michigan shoreline. It dips gently towards the east at from 15 to 35 feet per mile. The thickness varies from about 150 to 500 feet. (Fig. 3). Surface exposures are rare due to the blanket of glacial deposits.

Storage of LPG in this formation, at pressures of 110 to 120 pounds per square inch and at temperatures of 52-56°F., has been successfully demonstrated at Kankakee and Eola in Illinois. Another large scale project is currently under construction at Middleton, Ohio, in a formation that is geologically similar to the Maquoketa.

The geographic distribution of the Maquoketa shale in Wisconsin coincides closely with the present pipeline distribution (Fig. 4) and with the most highly industrialized areas. It is believed that excavated chambers in this formation offer the most promising facilities for underground storage of petroleum products in Wisconsin, due both to geologic and economic considerations.

More detailed information on specific areas may be obtained from the Wisconsin Geological Survey, Science Hall, University of Wisconsin, Madison. Numerous well logs and samples are on file at the survey offices where they may be examined by qualified personnel.

Figure 1

MAP OF WISCONSIN SHOWING BEDROCK GEOLOGY AFTER BEAN

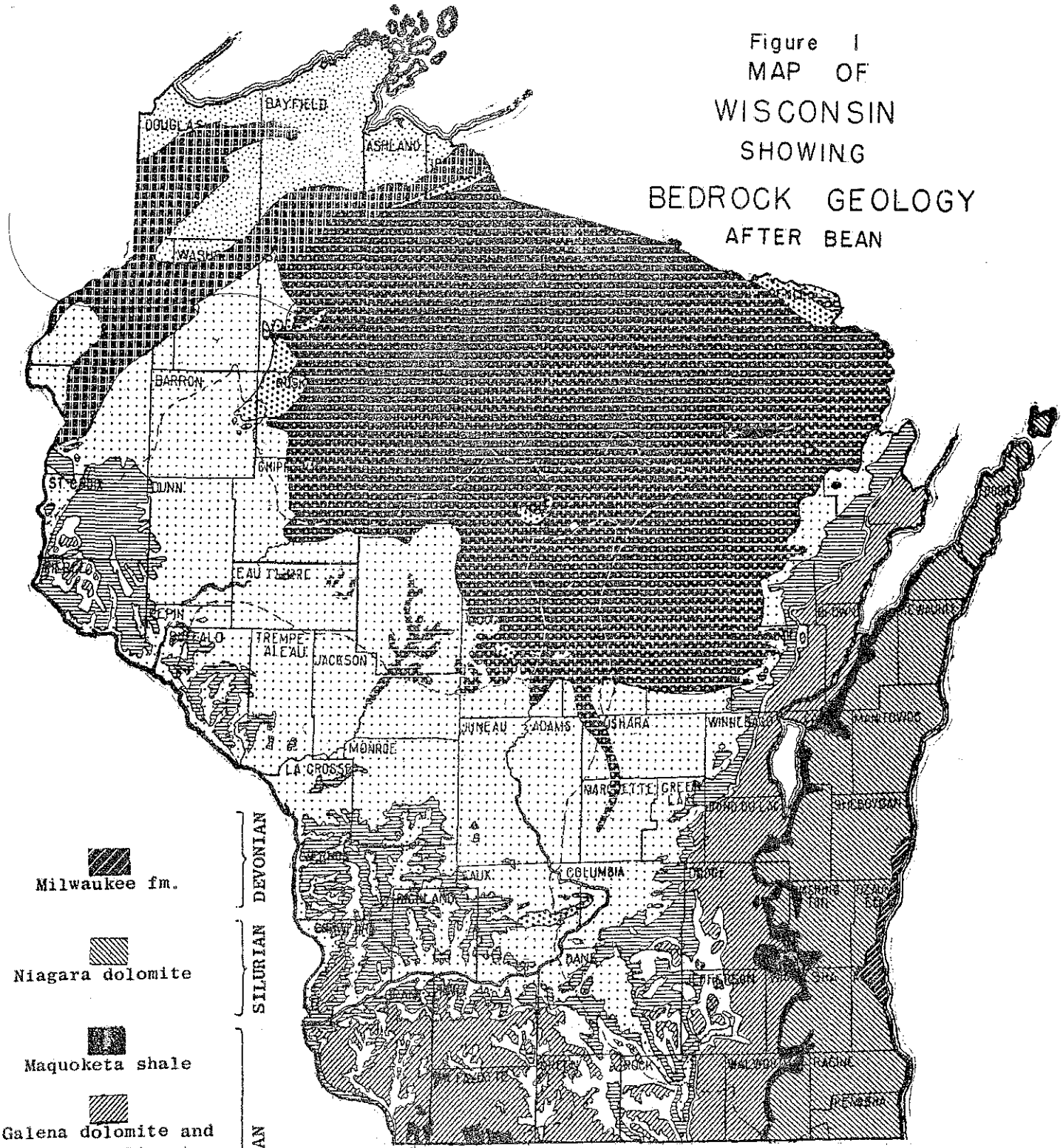
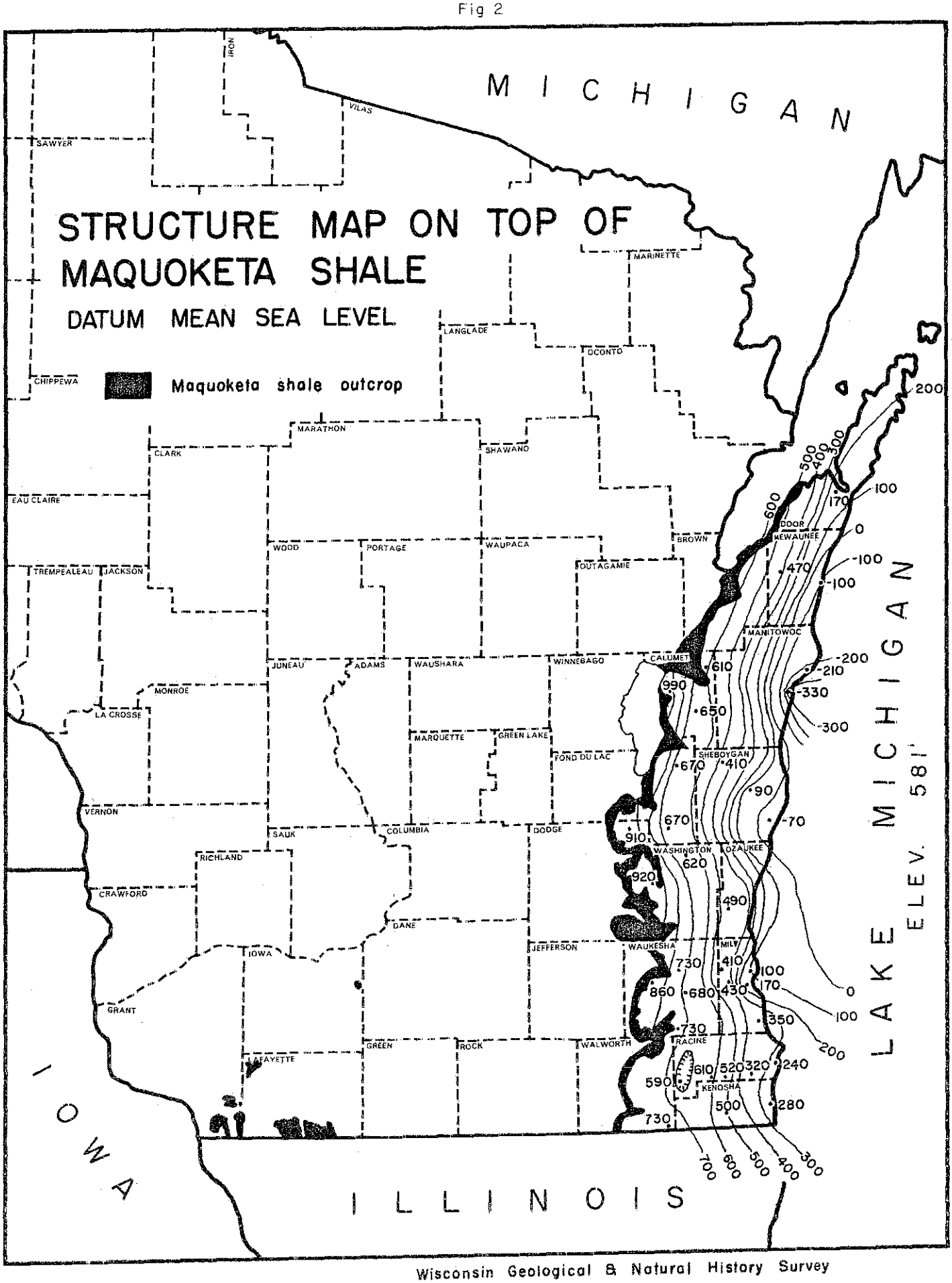
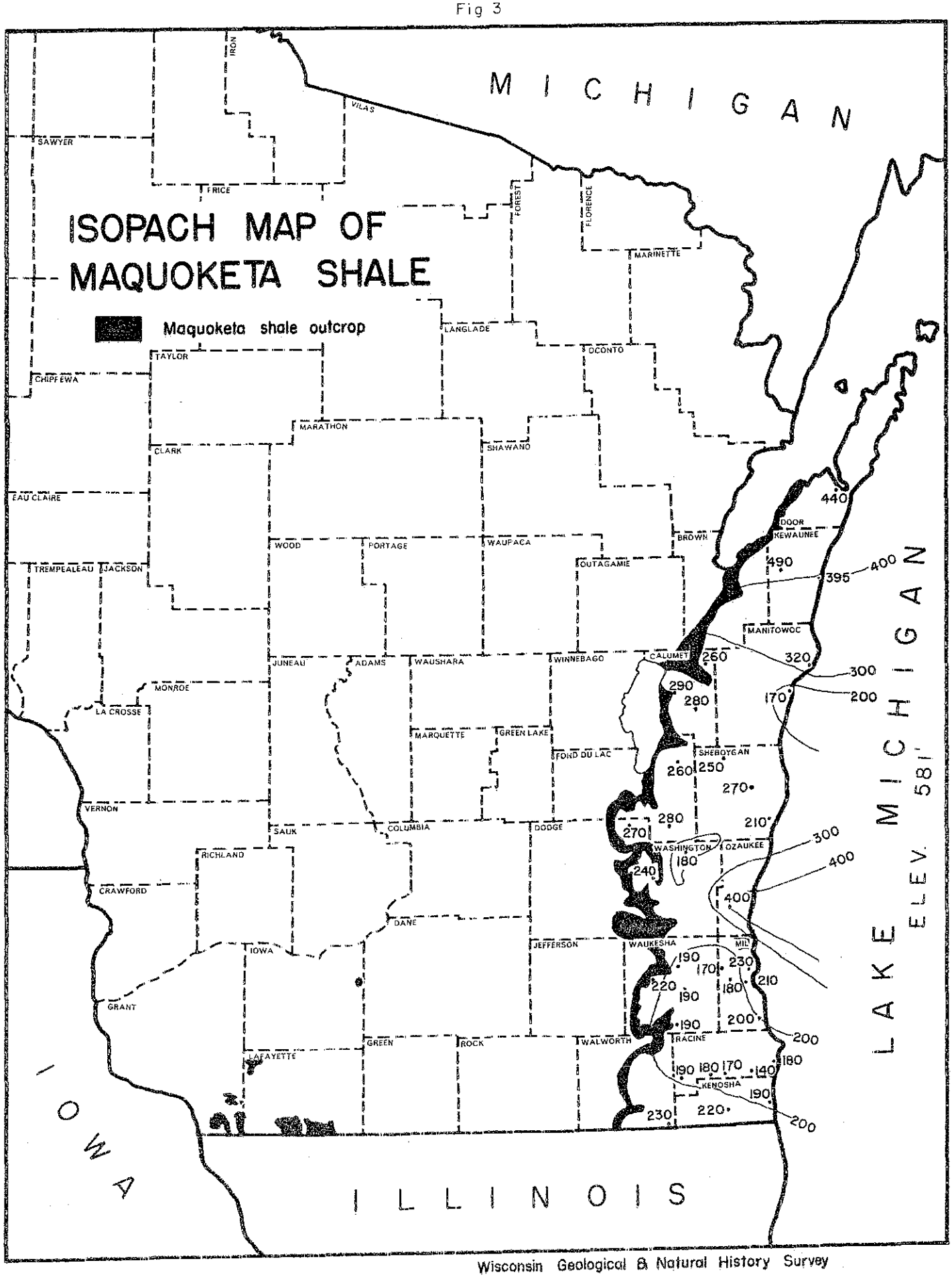


Fig 2



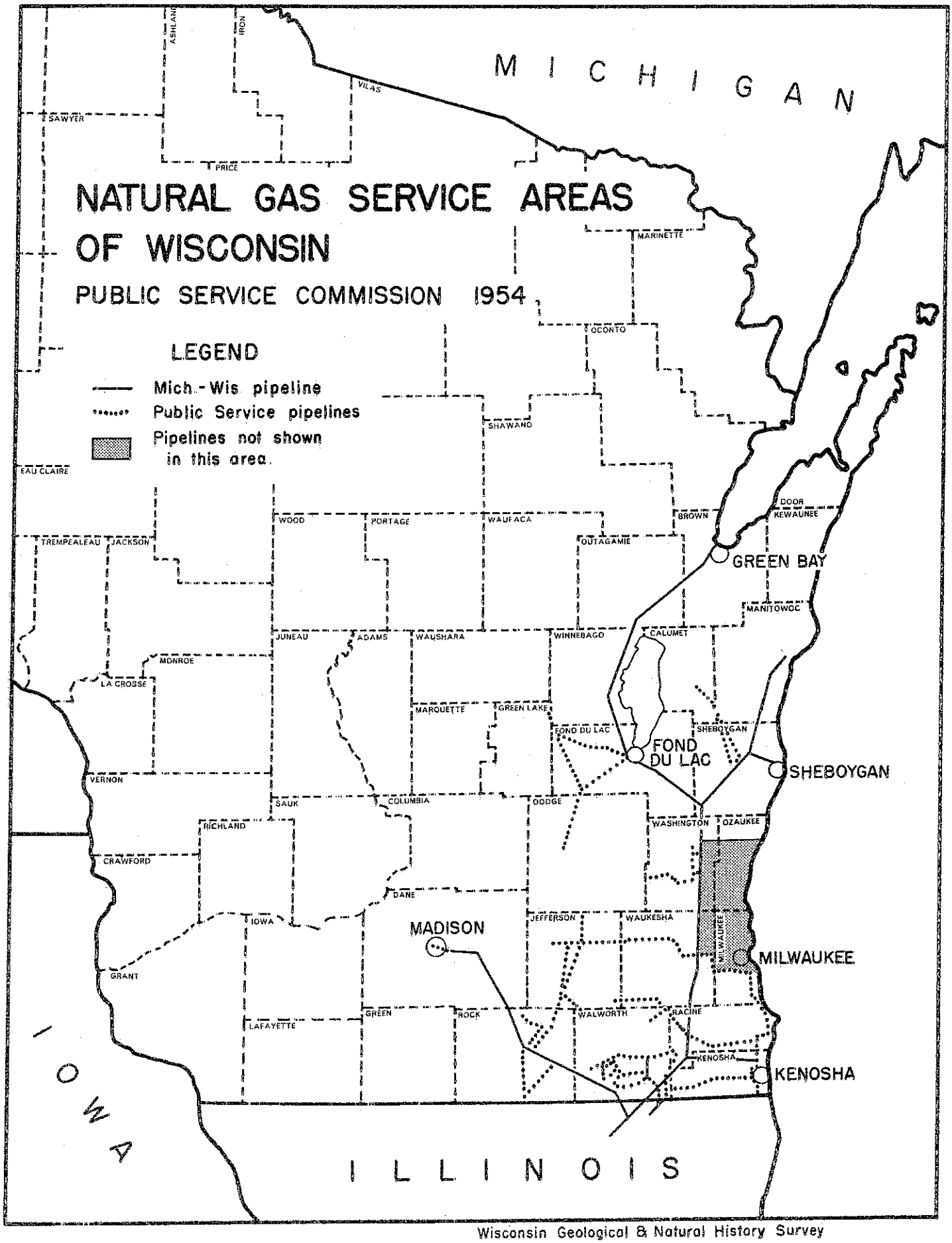
Wisconsin Geological & Natural History Survey

Fig 3



Wisconsin Geological & Natural History Survey

Fig 4



Wisconsin Geological & Natural History Survey