OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER
1562 W. First Ave., Columbus 12, Ohio

OHIO WATER PLAN INVENTORY
1962

SANDUSKY RIVER BASIN
(Upper portion)

UNDERGROUND WATER RESOURCES

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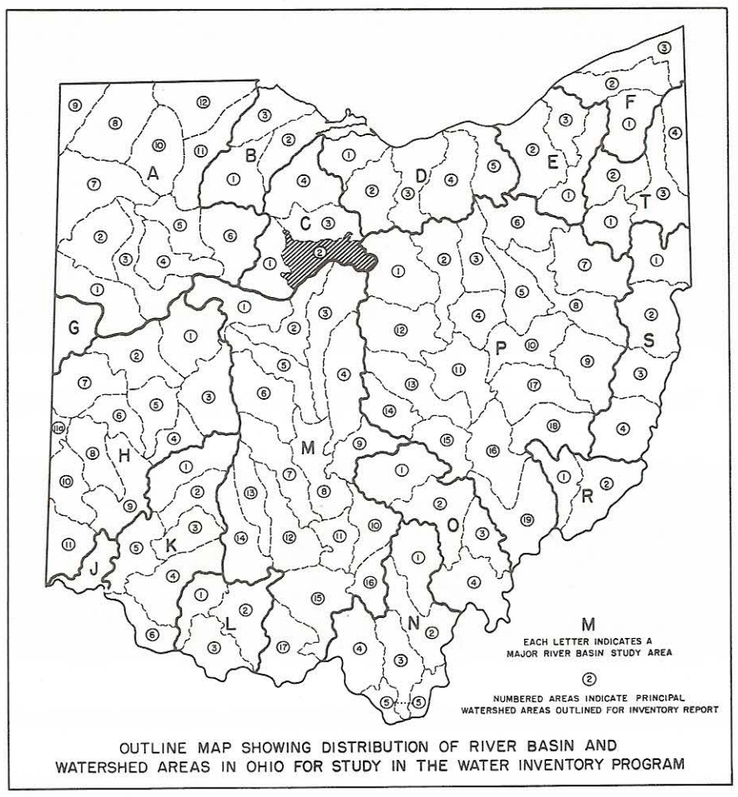


OUTLINE MAP SHOWING DISTRIBUTION OF RIVER BASIN AND WATERSHED AREAS IN OHIO FOR STUDY IN THE WATER INVENTORY PROGRAM

FILE INDEX
C-2

GENERALIZED STRATIGRAPHIC SEQUENCE OF THE ROCKS
IN THE UPPER PORTION OF THE SANDUSKY RIVER BASIN

System or Series		Group or Formation	Character of Material	Water-bearing Characteristics
Quaternary	Recent		Clay, silt and alluvium deposited on flood plains of the principal streams.	Generally a poor source of water due to the predominance of fine material.
Quaternary	Pleistocene		Relatively thick morainal deposits consisting of discontinuous sand or gravel layers interbedded in clay till.	Adequate supplies for farm or domestic use are usually available. Limited industrial supplies can be developed in isolated areas.
Quaternary	Pleistocene		Till, composed largely of clay with widely scattered lenses of sand or gravel.	Generally not a source of ground water although, locally, sand or gravel lenses yield small domestic supplies.
Mississippian		Berea	Thin-bedded to massive sandstone with some layers of sandy shale.	Farm or domestic supplies readily available. Wells seldom yield over 50 gallons per minute in the basin.
Mississippian		Bedford	Soft, argillaceous shale.	Not a dependable source of ground water.
Devonian		Ohio	Hard, carbonaceous shale grading from massive to thinly laminated shale.	
Devonian		Olentangy	Soft argillaceous shale.	
Devonian		Delaware	Thin-bedded limestone with some thin shale layers.	Formation generally supplies less than 5 gallons per minute.
Devonian		Columbus	Massive, rather pure limestone.	Good ground-water source for farm, domestic, and limited industrial supplies. Water is sometimes charged with hydrogen sulfide.
Silurian		Bass Islands	Brown or gray massive to thin-bedded dolomites.	Dependable water source over large areas.
Silurian		Niagara	Brown to blue-gray crystalline dolomite.	Dependable water source. May be highly mineralized.

The occurrence of underground water in a given area is governed by the local geology or, more specifically, by the kinds of rocks found beneath the surface. The water-bearing properties of a particular rock formation depend upon its physical structure or the amount of open space, within the formation, capable of storing water. Openings exist in practically all rocks in the form of fractures, bedding planes, solution channels, and in the spaces between individual grains or fragments of rocks. The quantity of water available to wells is governed by the size, shape, and number of open spaces and the degree in which they are interconnected.

There are two major divisions of rocks in the basin: (1) The glacial deposits lie at or near the ground surface and are loose, unconsolidated formations of clay, silt, sand, and gravel. They either occur as a heterogeneous mixture known as glacial till, or in well sorted, stratified layers. (2) The bedrock formations beneath the glacial material comprise consolidated sedimentary layers of limestone, dolomite, shale, and sandstone. The geologic formations in the basin area and their water-bearing characteristics are described in the generalized stratigraphic sequence.

A blanket of glacial material covers the entire basin and ranges from 10 to over 100 feet thick. Glacial moraines in the north-central portion of the basin average over 50 feet in thickness and contain frequent lenses or stringers of sand and gravel. Sand and gravel wells in Holmes, Liberty, and Sandusky townships, Crawford County, are drilled to depths of 30 to 90 feet and normally yield adequate farm or domestic supplies (10 to 20 gallons per minute).

Rather extensive sand and gravel layers, interbedded with clay, are present in an area immediately east of Bucyrus and south of the Sandusky River. Wells in the area, drilled to depths of 30 to 60 feet, commonly supply 25 to 50 gallons per minute. Although yields of over 100 gallons per minute have been reported, test drilling and controlled pumping tests are needed in order to fully define the ground-water potential of this aquifer.

Progressively younger bedrock formations occur near the surface from west to east across the basin. The cross section A-A' shows the approximate dip of the bedrock and illustrates the character of the glacial material.

The bedrock in the western half of the basin consists of limestone and dolomite. The amount of water found in these rocks depends upon the size and number of water-storing cracks and crevices. Furthermore, since the fracture pattern of the rock can rarely be detected from surface conditions and varies considerably from one location to the next, a rather wide range in potential yield can be expected from wells developed in limestone or dolomite. For this reason, extensive test drilling is often necessary in order to locate suitable industrial or municipal well sites. Yields of up to 300 gallons per minute can be expected from bedrock wells in this part of the basin at depths of 150 to 250 feet. Farm or domestic supplies are readily available at depths of 50 to 125 feet.

Devonian and Mississippian shales are the uppermost bedrock strata in the central portion of the basin. In areas where the glacial material is thin or predominantly clay, wells must be drilled into the underlying bedrock. Shale is unfavorable for developing reliable ground-water supplies because of its low permeability and it is often necessary to supplement drilled wells with a cistern or dug well. Yields of 2 to 5 gallons per minute are sometimes available from the upper weathered portion of the rock. Deep wells into the limestone beneath the shale are likely to produce highly mineralized water.

The Berea sandstone is the primary water-bearing formation in the eastern part of the basin. Sandstone wells average around 15 gallons per minute at depths of 50 to 150 feet. Glacial material, ranging from 10 to 90 feet in thickness, covers the Berea sandstone. Locally, where the glacial deposits are thick, limited supplies are available from sand and gravel. A few sandstone wells in the basin have reported yields of over 50 gallons per minute.

Drilling reports for approximately 1200 water wells in the basin are on file at the Ohio Division of Water. Locations of 159 typical wells are shown on the map.

QUALITY OF UNDERGROUND WATER

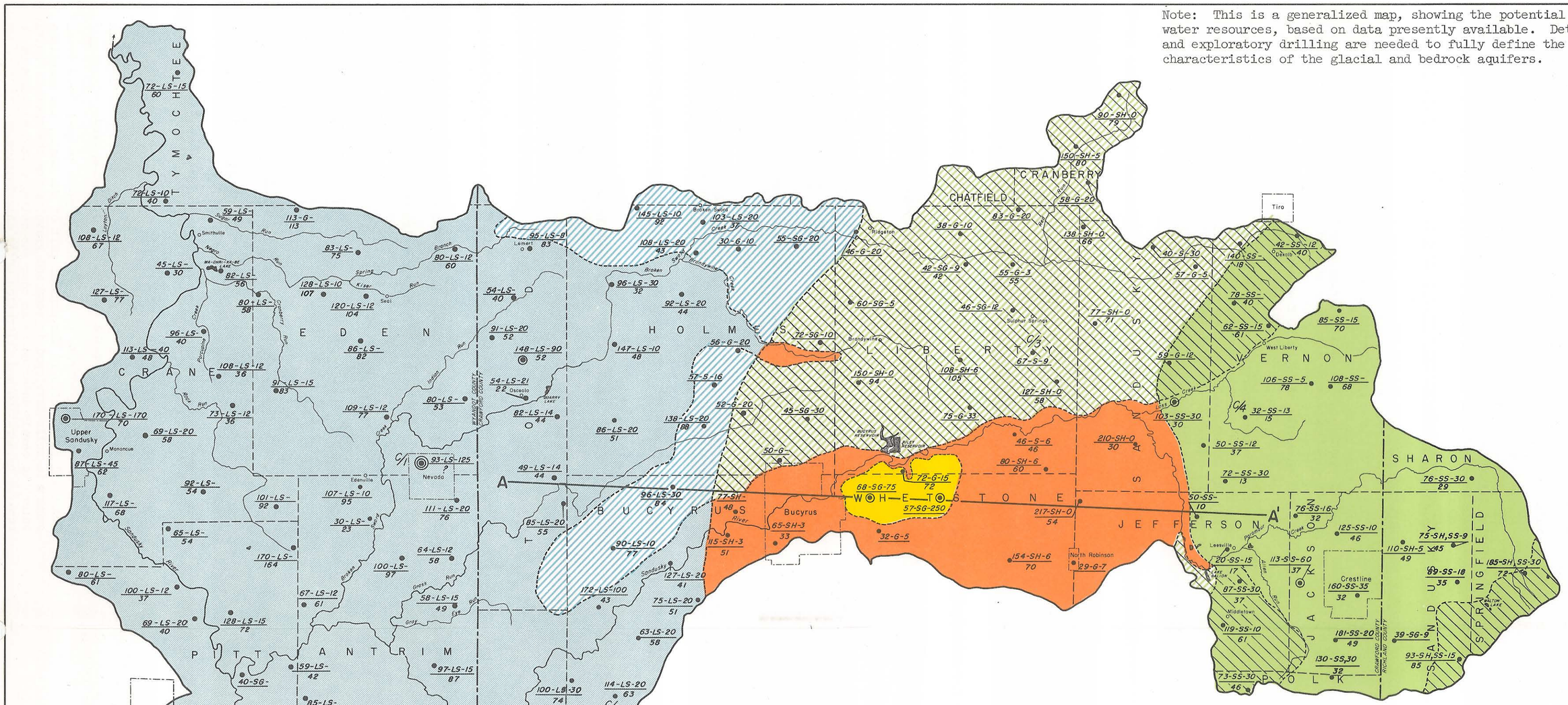
Partial analyses of water samples from four wells in the basin are shown in the following table. These wells are developed in limestone, sand, and sandstone. Analyses were made by the Ohio Department of Health and the Quality of Water Branch, U.S. Geological Survey.

Well number	C-1	C-2	C-3	C-4
Depth (ft.)	93	114	67	32
Water-bearing formation	Limestone	Limestone	Sand	Sandstone
	Parts per million			
Iron (Fe)	2.3	3.7	2.1	.47
Chloride (Cl)	3.0	2.5	2.5	12.
Dissolved solids	675.	796.	415.	445.
Total hardness	540.	630.	336.	391.
pH	7.75	6.9	7.3	7.2

All samples contain iron in excess of 0.3 parts per million (ppm). On exposure to air, iron oxide forms a precipitate, which is likely to cause "red water" and stain laundry or plumbing fixtures. Water having a total hardness in excess of 150 ppm, such as these samples, would normally require softening before being used.

Hydrogen sulfide is a common occurrence in water from limestone and shale wells in the central part of the basin, and sometimes occurs in wells developed in sand and gravel above the shale. "Sulfur water" is easily detected by an odor resembling rotten eggs and can be removed by aeration and filtration or by chlorination.

Note: This is a generalized map, showing the potential underground-water resources, based on data presently available. Detailed studies and exploratory drilling are needed to fully define the hydrologic characteristics of the glacial and bedrock aquifers.



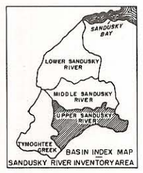
EXPLANATION OF SYMBOLS

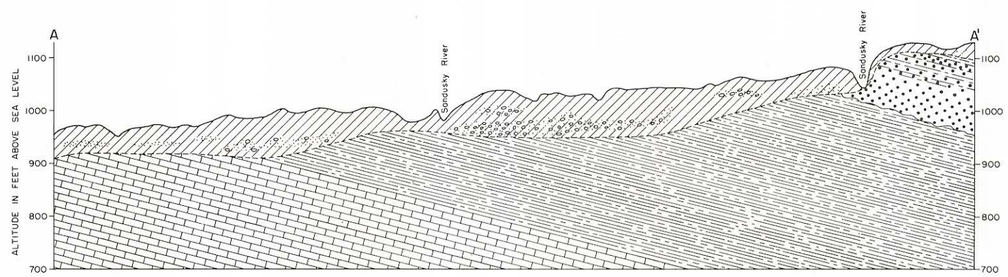
- Domestic well
- Industrial well
- Municipal well

SS	Sandstone
LS	Limestone
SH	Shale
S	Sand
G	Gravel

C/2 Chemical analysis in text.

Total depth (Ft.) - Water-bearing formation - Yield (gpm)
Depth to bedrock (Ft.)





GEOLOGIC CROSS SECTION SHOWING CHARACTER OF GLACIAL AND BEDROCK FORMATIONS

MAP OF THE UPPER PORTION OF THE SANDUSKY RIVER BASIN SHOWING AVAILABILITY OF UNDERGROUND WATER

PUBLISHED BY - STATE OF OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER

SCALE IN MILES

LEGEND

AREAS IN WHICH YIELDS OF 100 TO 500 GALLONS PER MINUTE CAN BE DEVELOPED

Limestone, covered with an average of 60 feet of glacial till, supplies as much as 300 gallons per minute at depths of 150 to 250 feet.

Adequate farm or domestic supplies from sand and gravel layers in the glacial material at depths of 30 to 90 feet. Larger yields available from the underlying limestone.

AREAS IN WHICH YIELDS OF 25 TO 100 GALLONS PER MINUTE CAN BE DEVELOPED

Relatively thick sand and gravel layers beneath 20 to 50 feet of clay till. Yields of over 100 gallons per minute have been noted.

AREAS IN WHICH YIELDS OF 5 TO 25 GALLONS PER MINUTE CAN BE DEVELOPED

Berea sandstone, covered with 10 to 50 feet of glacial till, may yield 50 gallons per minute or more. Sandstone wells average 15 gallons per minute.

Glacial moraine deposits, underlain by Berea sandstone, yield adequate farm and domestic supplies. Similar yields available from underlying bedrock at depths of up to 175 feet.

Glacial moraine deposits, underlain by shale, yield adequate farm and domestic supplies. Little or no water available from the bedrock.

AREAS IN WHICH YIELDS OF LESS THAN 5 GALLONS PER MINUTE CAN BE DEVELOPED

Thin to thick glacial drift composed predominantly of clay and overlying shale. Limited supplies are sometimes developed in the upper weathered portion of the bedrock. Cisterns and dug wells are common.