Maine Geological Survey
DEPARTMENT OF CONSERVATION
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Title: Iron and Nitrates in Bedrock Well Water - Cumberland County, Maine

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Contents: 9 page report and 2 maps

IRON & NITRATES IN BEDROCK WELL WATER
CUMBERLAND COUNTY, MAINE

1979
Maine Geological Survey
Hydrogeology Division*

ABSTRACT

Routine water analyses of municipal and private water supplies by the Department of Human Services (DHS) has resulted in the accumulation of a considerable amount of water quality data. The Maine Geological Survey, Hydrogeology Division, acquired from DHS all original 1969-1974 water analysis data sheets after they were microfilmed for permanent storage. Of more than 55,000 test records, some 2000 are for bedrock wells in Cumberland County. This investigation is an attempt to find useful correlations between recorded water quality parameters of Cumberland County bedrock wells and the inherent natural and cultural factors.

METHODOLOGY

A base map of Cumberland County was constructed at a scale of 1:125,000. Water quality data from the DHS records was then located geographically on mylar overlays by cross-reference with other well data on file, and by field inventory. Additional overlays showing cultural land use, bedrock geology, and surficial geology were constructed and studied in conjunction with the water data for possible interrelationships. Descriptions of the procedures used to investigate nitrates and iron follow.

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*Work was initiated by a proposal, Quality Of Ground Water In Bedrock Aquifers, Cumberland County, Maine, submitted by W.B.Caswell in 1978, and was to include investigations of iron, nitrates, chlorides, and hardness. Work was begun by S.Ludwig and continued by D.E.Lewis (who authored this report).

IRON

For purposes of convenience and comparison, the county was divided into 3 sections based on bedrock geology.[1] These sections are shown in figure 1 and include:

1. South Coastal section: phyllite, schist, and quartzite plus two-mica gneiss. Felsic metavolcanics and metasandstone. This section bordered on north by the Nonesuch fault.
2. Western/Coastal Plain section: calc-silicate and biotite granulite, plus metalimestone and metapelite. Bounded on south by Nonesuch fault; on north by contact with Sebago granite.
3. Sebago section: granite batholith.

Results of data compilation are shown in Table 1. A value of 0.3 milligrams per liter (mg/l) of iron was considered a significant level as it is the maximum value recommended for drinking supplies under EPA guidelines. The study reveals that highest iron levels were located in the south coastal section (1) where 52% of the wells yielded water with iron content in excess of 0.3 mg/l. In comparison, water from wells in the Western/Coastal Plain section (2) contained lesser amounts of iron with 20.6% of the wells above the accepted limit. Well water samples from the Sebago section (3) contained least amounts of iron; only 15.6% of the well water

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[1] Data from Preliminary Bedrock and Brittle Fracture Map of the Portland 2° Quadrangle, A. Hussey, Maine Geological Survey, 1978. Also, Geologic Map and Cross Sections of the Orrs Island 7 1/2' Quadrangle and Adjacent Area, A. Hussey, Maine Geological Survey, 1971.

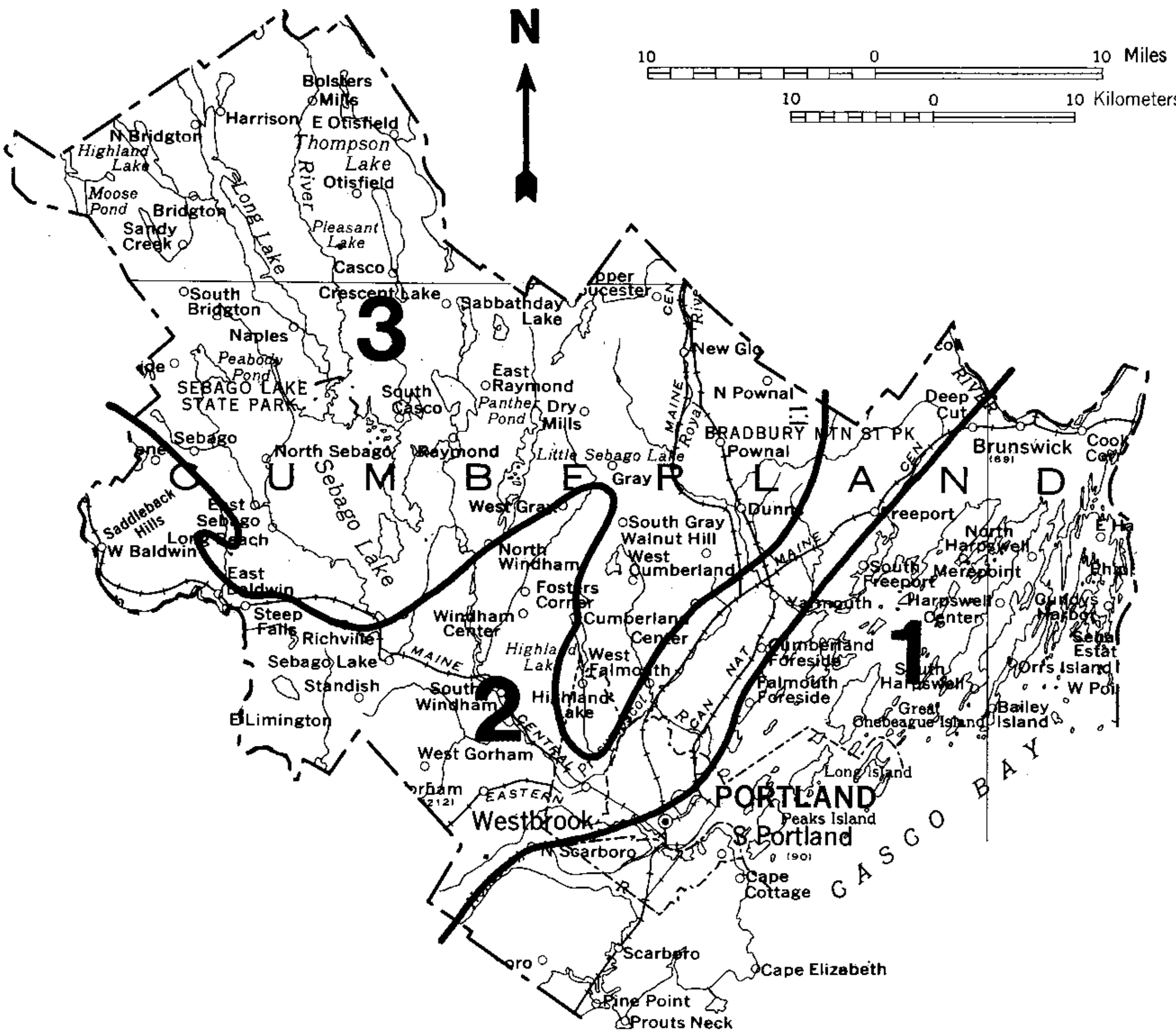

FIGURE 1

Figure showing Cumberland County
and sections used in iron analysis.

samples exceeded the limit.

Of special interest, the Orrs Island region (extreme eastern Cumberland County) displayed consistently high iron values. In particular, 88% of wells in a rusty weathering unit of the Cape Elizabeth Formation contained iron in amounts greater than 0.3 mg/l, and 70% of the samples from a bordering non-rusty unit of the same Formation exceeded the limit. In contrast, only 31.5% of wells in an outcrop of the Cape Elizabeth Formation on the mainland (Scarboro area) exceeded the limit. This Orrs Island to mainland discrepancy in iron content was not observed in the neighboring Cushing Formation, which demonstrated a more equitable ratio 35.7% : 38.71%.

	Total wells	Number of wells with iron > 0.3 mg/l	Percentage
South Coastal	252	132	52
Western & Coastal Plain	321	66	20.6
Sebago section	596	93	15.6
totals	1169	291	24.89

TABLE 1

Table showing iron data in bedrock well water, Cumberland County, Maine. (Data Period 1969-1974).

NITRATES

For ease of analysis, the county was divided in two sections based on agricultural and residential land use intensity.[2] The arbitrary boundary shown in figure 2 separates the high density agricultural/residential COASTAL area from the less intensely used INLAND area.

The study involved the determination of the percentage of wells in each land use type (agricultural, residential, neither) yielding well water samples with nitrates in excess of 3.0 mg/l. Although the maximum recommended EPA level for nitrates in drinking water is 10 mg/l, only six of the 1259 total wells in the test area exceeded this limit. Therefore, a lower arbitrary value (3.0 mg/l) was chosen to facilitate the analysis.[3]

As shown in table 2, sixty six of these wells (5.2%) yielded water with nitrate levels greater than 3.0 mg/l. For comparison purposes, background data was determined (see table 3) by considering only non-agricultural/non-residential areas. In these areas only 4.4% of wells delivered water with nitrate concentrations above 3.0 mg/l.

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[2] Data from Land Use and Cover map 1973-75, Portland, Maine; New Hampshire, USGS. Open file 76-042-1, land use series

[3] Results of drinking water tests by DHS routinely show specific nitrate values greater than 1.0 mg/l; lesser values are indicated as a check (✓). Therefore, not all test values were available for study.

FIGURE 2

Figure showing Cumberland County as divided for nitrate analysis.

Next, the residential plots were inspected (see table 4); of the 716 wells included, 4.89% delivered water with greater than 3.0 mg/l nitrates. This result compares closely with the background data mentioned above. Of interest, the residential plots in the COASTAL area exhibited approximately twice as many greater than 3.0 mg/l values as did the INLAND residential plots (e.g. 6.91% vs 3.13%), and may have some connection with land use intensity.

Inspection of agricultural plots revealed a total of 181 wells (see table 5); 8.29% of these wells yielded water with nitrates above the 3.0 mg/l level. These data indicate that bedrock wells in agricultural plots of Cumberland County are likely to exhibit higher nitrate levels than water from bedrock wells in non-agricultural areas.

Interestingly, of the total (1259) wells observed, only 6 exceeded the EPA 10 mg/l maximum value. Four of these were associated with residential plots; one with agricultural land; and one on neither type of land use.

	Total wells	Number of wells with nitrates >3.0 mg/l	Percentage
COASTAL	691	44	6.37
INLAND	568	22	3.87
totals	1259	66	5.24

TABLE 2

Table showing nitrate data in bedrock well water samples, Cumberland County, Maine.

	Total wells outside agri/ resid. plots	# wells outside with nitrates >3.0mg/l	Percentage
COASTAL	199	8	4.02
INLAND	163	8	4.91
totals	362	16	4.42

TABLE 3

Table showing nitrate data in bedrock well water taken from non-agricultural/ non-residential plots, Cumberland County, Maine.

	Total wells in residential plots	Number of wells with nitrates >3.0 mg/l	Percentage
COASTAL	333	23	6.91
INLAND	383	12	3.13
totals	716	35	4.89

TABLE 4

Table showing nitrate data in bedrock well water samples from residential plots, Cumberland County, Maine. (Data period 1969-74).

	Total wells in agricultural plots	Number of wells with nitrates >3.0 mg/l	Percentage
COASTAL	159	13	8.18
INLAND	22	2	9.09
totals	181	15	8.29

TABLE 5

Table showing nitrate data in bedrock well water samples from agricultural plots, Cumberland County, Maine.

Cumberland County
IRON
in
GROUNDWATER SOURCES

Values in parts per million
Scale 1: 125,000

BY
DAVID E. LEWIS & SCHUYLER LUDWIG

1979

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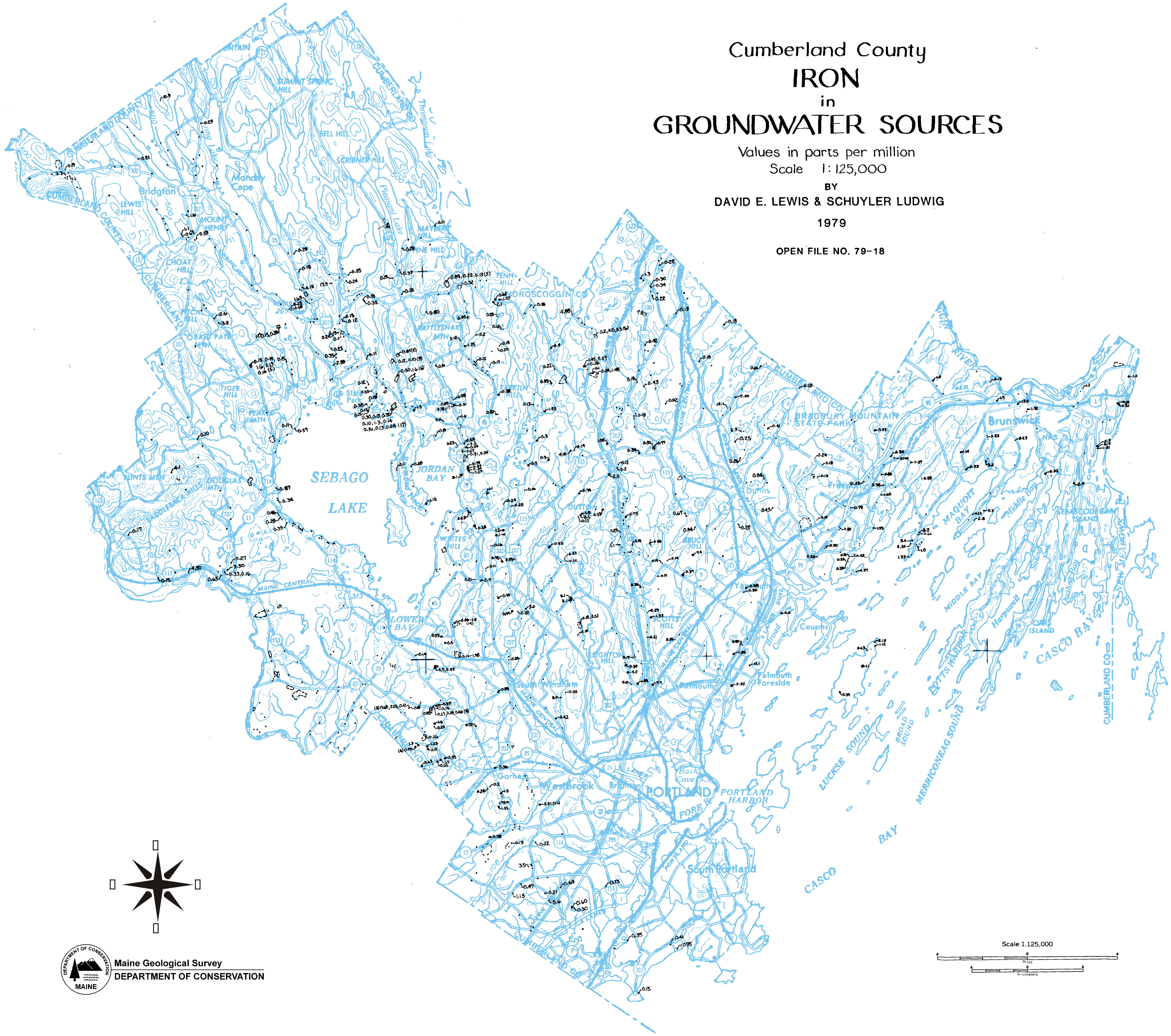

Scale 1:125,000
Miles
Kilometers

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Cumberland County
NITRATES
in
GROUNDWATER SOURCES

Values in parts per million

Scale 1: 125,000

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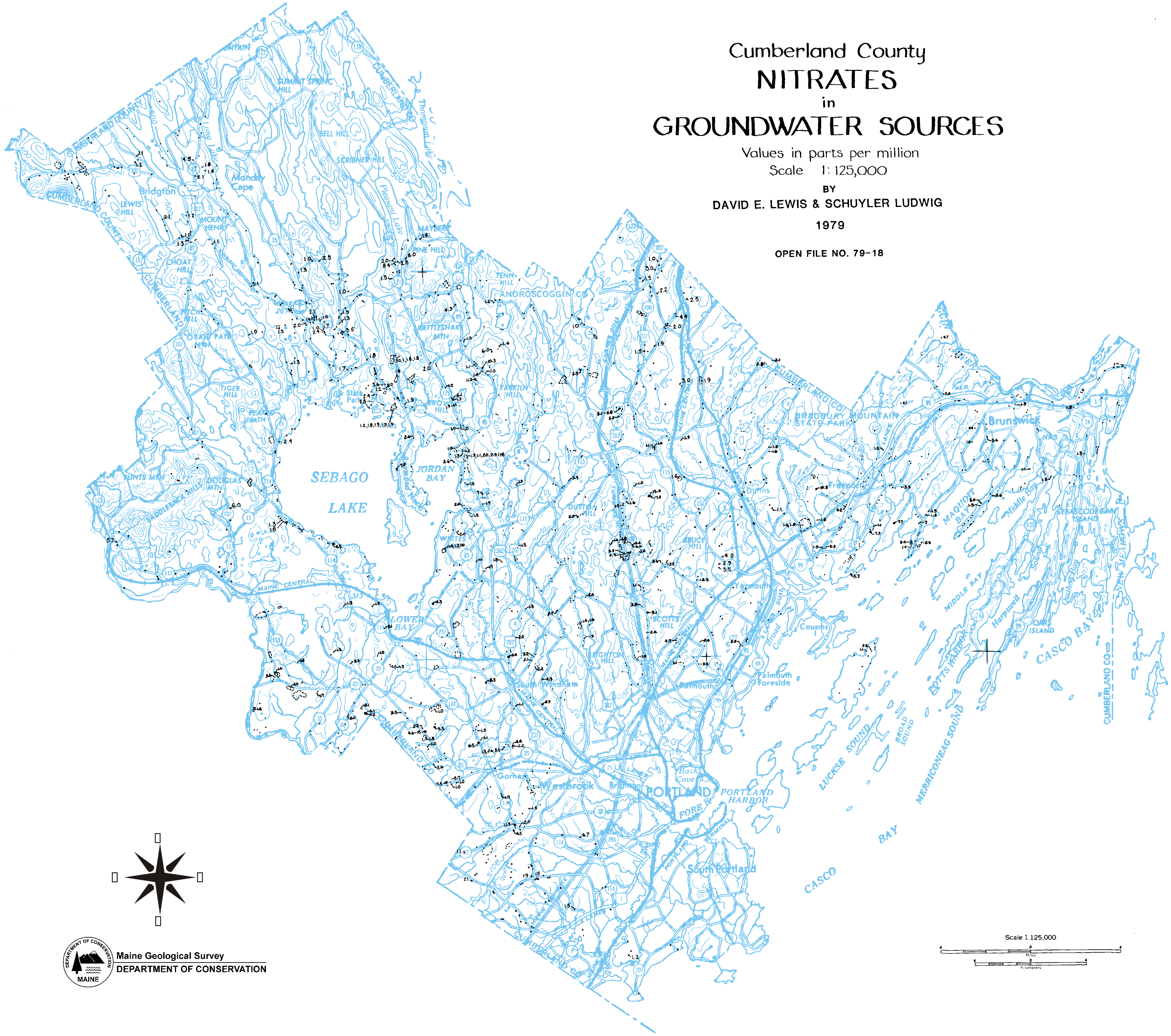

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