WATER QUALITY ISSUES IN THE GULF ISLANDS

The subdued topography (local relief ranges from 100-350 m) of the Gulf Islands lends to the presence of few freshwater lakes. As a result, residents on the islands rely on fractured-bedrock aquifers as a primary source of potable water. Seasonal precipitation fluctuations, along with increased water demand from population growth and development have contributed to saltwater intrusion, increased numbers of abandoned wells, and significant declines in water quality during summer months.

TYPES OF AQUIFERS IN THE GULF ISLANDS

An aquifer is a body of rock or sediment that yields useful amounts of water. In the Gulf Islands, two types of aquifers exist: sand and gravel layers and fractured-bedrock (Figure 1). Fractured-bedrock aquifers provide the primary source of freshwater for the majority of island residents. Fractures in bedrock located below the water table are filled with water and are tapped by wells. The density of fractures and proximity to major faults determine the water yield from individual wells.

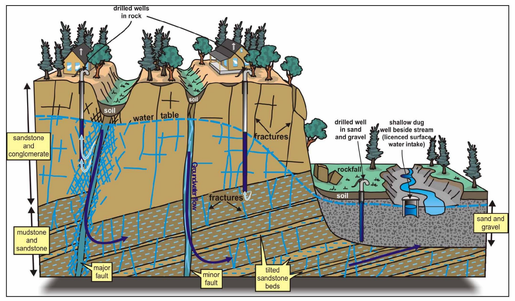


Figure 1. Ground water fills cracks and pores below the water table.

Geology in the Gulf Islands is dominated by inter-layered sandstone and mudstone formations. Mudstone formations are more densely fractured than sandstone and have a greater ground water storage capacity.

Figure 2 illustrates a cliff exposure where thin-bedded mudstone and sandstone beds (mudstone-dominant formation) lie between sandstone layers . Water from the surface flows down the fracture that cuts these rocks. Where the fracture crosses the mudstone-dominant beds, the water spreads out into the many fractures. The fracturing gives the mudstone a greater water storage capacity to act as an aquifer than the sandstone.

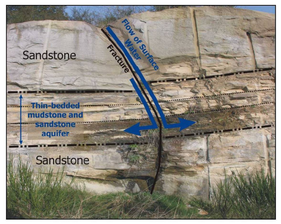


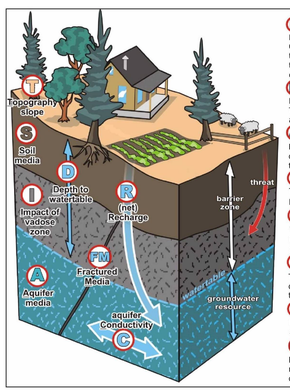
Figure 2. An example of a mudstone aquifer in the Gulf Islands.

THE SUSCEPTIBILITY OF GROUND WATER TO CONTAMINATION

There is a need to translate scientific understanding of ground water resources for decision-makers across all levels of government so that they can address the impacts of future development on the ground water in the Gulf Islands. These maps serve this purpose.

Ground water susceptibility maps illustrate the potential for subsurface aquifers to be contaminated and are based on the environmental characteristics of a landscape that facilitate or impede contamination.

This ground water susceptibility map is based on the DRASTIC methodology (Aller *et al.*, 1987). "DRASTIC" is an acronym for the 7 parameters that influence the susceptibility of ground water to surface contamination (Figure 3). The DRASTIC methodology has a limitation when applied to fractured bedrock aquifers. Therefore, the DRASTIC methodology was modified to include an eighth parameter - Fractured Media (FM). This 8-parameter assessment tool is referred to as DRASTIC-FM (Journeay *et al.*, 2004). This map characterizes the contamination potential within a geologic setting and defines areas that are more susceptible than others. This type of assessment does not consider the properties or characteristics of contaminants.



Depth to water table
Represents the thickness of the layer of geologic material above the water table. Ground water is more vulnerable to contamination where the water table is near to the surface, and therefore the barrier zone of soil or rock above the water table is thin. In this case, there is little capacity for natural filtration of contaminants before reaching the water table.

(Net) Recharge
Reflects the amount of water that percolates from the surface to the water table. The greater the flow of water, the more likely that contaminants will "hitch a ride" and contaminate the groundwater below the water table.

Aquifer media
Reflects the character of the ground water flow system. Path length and travel time of ground water within an aquifer determine how quickly a contaminant will spread through an aquifer.

Soil media
The effectiveness of a soil to act as a barrier to surface contaminants depends on its physical properties. Thin, permeable soils are ineffective barriers.

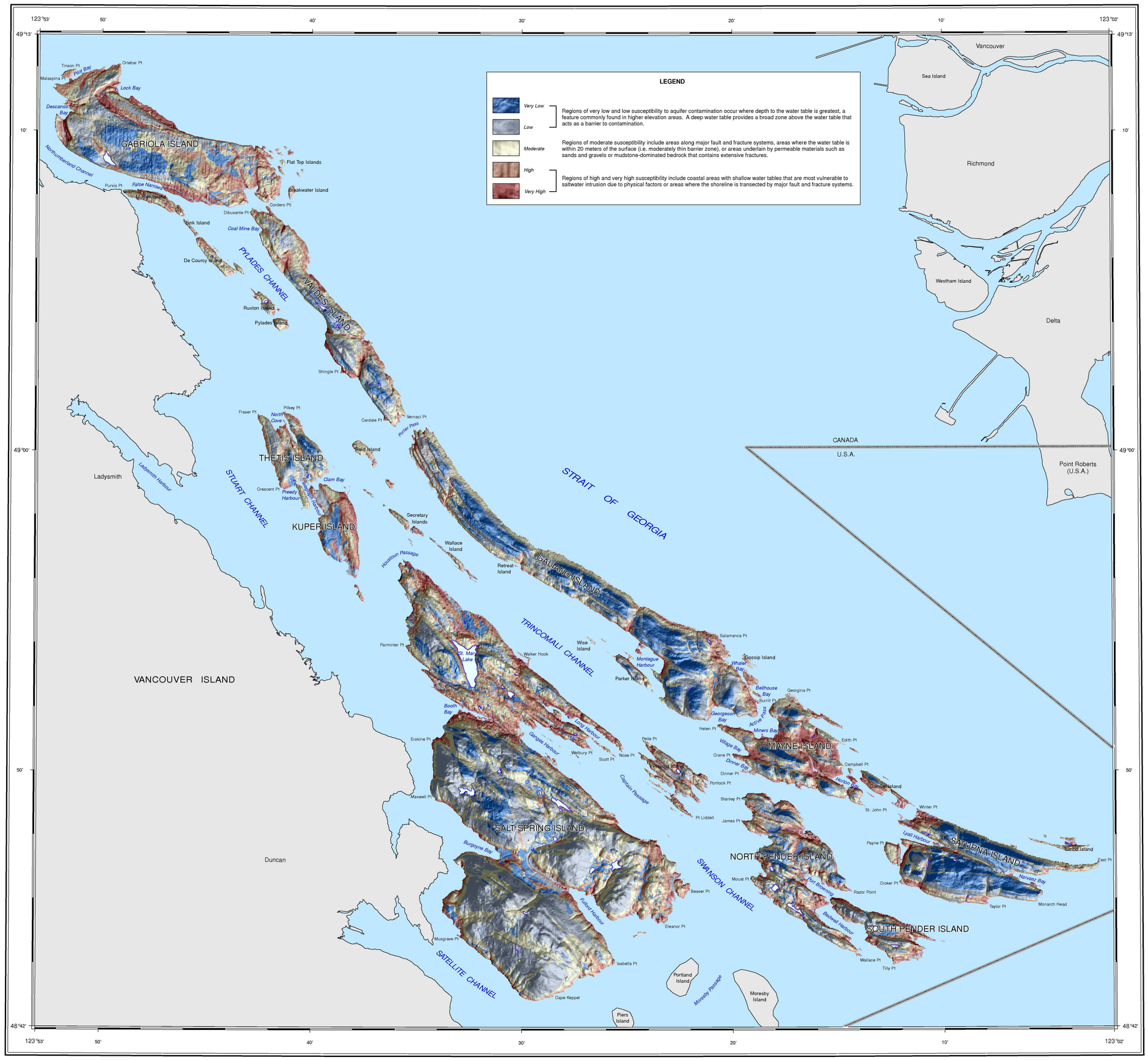
Topography slope
The slope of the land and changes in the slope can influence the proportion of rainfall that stays on the surface as runoff versus how much infiltrates into the soil. Flatter ground at the base of steeper slopes can be important areas of water infiltration.

Impact of vadose zone
The texture of the partly saturated soil and rock above the water table (vadose zone) determines how quickly water, and therefore contaminants, can infiltrate downwards to the water table.

Aquifer Conductivity
Reflects the rate of ground water flow in an aquifer. Rapid ground water flow in an aquifer allows the rapid spread of a contaminant.

Fractured Media
Reflects the characteristics of complex fractured bedrock aquifers that influence the rate and character of ground water flow (transmissivity) and, hence, potential mobility of contaminants.

Figure 3. The parameters that affect ground water susceptibility and are included in the DRASTIC-FM methodology.



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Journeay, J.M., Denny, S., Allen, D.M., Forster, C., Turner, R., and Wei, M.
2004: Integrated Groundwater Resource Assessment of Fractured Bedrock Aquifers in the Gulf Islands, B.C.; in Proceedings, 57th Canadian Geotechnical Conference - 5th Joint IAH-CNC-CGS Conference, Quebec.

Compilation by S. Denny, J.M. Journeay (Geological Survey of Canada) and D.M. Allen (Simon Fraser University)

Digital cartography by M. Ceh, Geological Survey of Canada

Digital base map from data compiled by Geomatics Canada and Washington State Department of Transportation, modified by Geological Survey of Canada

Magnetic declination 2006, 18°22'E, decreasing 12.0' annually. Readings vary from 18°32'E in the northwest to 18°11'E in the southeast corner of the map.

Digital elevation model derived from Geomatics Canada data sets. Shaded relief image generated using an illumination source with a southeast azimuth and altitude 45° above the horizon.

OPEN FILE 5333

SUSCEPTIBILITY OF GROUND WATER TO CONTAMINATION

SOUTHERN GULF ISLANDS

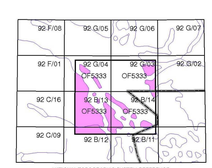
BRITISH COLUMBIA

Scale: 1:100 000/Échelle 1/100 000

kilometres 2 0 2 4 6 8 kilometres

Universal Transverse Mercator Projection
North American Datum 1983

Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983



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