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Dept. of Community Development
Pacific County, Long Beach, WA

To: Pacific County Shoreline Critical Areas Citizen Committee

From: Dick Sheldon
Willapa Resources

The Peninsula, from the north Long Beach city limits to the tip of Leadbetter Point is solely dependent upon an isolated "island" aquifer for its only potable water source. This aquifer is a finite resource entirely dependent upon rainfall for its existence and replenishment. The comprehensive plan's Peninsula development guidelines incorporates this geologic feature into its North Peninsula plan. However, past County Commissions have refused to declare this aquifer a sole source, thus leaving it vulnerable in lacking the legal protection that this designation would afford.

In the mid 80's under Commissioner Dan'l Markham, the Peninsula Flood Control District was formed to take over the defunct cranberry drainage district ditches lying outside of County's legal jurisdiction. I was on both its formations board and its following board of directors. Its operational policy was strictly excess water removal or flood control, firmly against dropping the normal water table as in a drainage district. The flood control board had the autonomy to operate the district, set fees and select and plan projects. With a change of County Commissioners these powers were taken away and administration was given to the Public Works Department. The flood control district became a drainage district and the flood board changed to advisory only to the Public Works Department. This is the present status. The County Commission then proposed making Public Works the lead agency in administering their own environmental permits, but from opposition, this did not take place.

The following page 30 and page 31 are from the 167 page 1995 report Ground-Water Flow and Water Quality in the Sand Aquifer of Long Beach Peninsula Washington by US Geological Survey, Report 95-4026 prepared for Pacific County Dept. of Community Development and WA Dept. of Ecology. The process of saltwater intrusion is well documented. Take particular note of the 40' to 1' ratio in salt water rise by the draining of each foot of fresh water from the top of the island aquifer lens.

Boundaries

The external boundaries of the freshwater ground-water system in the Long Beach Peninsula are similar to the boundaries of a homogeneous "island" ground-water flow system that can be defined by some physical principles (fig. 12). In this system, the freshwater "floats" on saltwater as a lens-shaped body. This relation occurs because the density of freshwater (1.000) is slightly less than the density of seawater (1.025).

In an island ground-water flow system, the higher the water table is above sea level, the thicker is the freshwater lens. This relation is known as the Ghyben-Herzberg principle, named after the two scientists who first discovered it. The Ghyben-Herzberg principle states that at any particular location, for every 1 ft of altitude the water table is above sea level, fresh ground water will extend 40 ft below sea level. For example, if the water table at a given site is 5 ft above sea level, the freshwater-saltwater interface is theoretically at 200 ft below sea level. The thickness of the freshwater body is, therefore, 205 ft at that site. The principle also implies that if the water table is lowered 1 ft, the interface will rise 40 ft, thereby reducing the total thickness of the freshwater lens by 41 ft.

In addition to the relative densities of freshwater and seawater, the position of the interface at any one time is also affected by the seasonal position of the water table, the hydraulic characteristics of the aquifer, recharge-discharge relations within the aquifer, and tides. The interface is not sharp, but rather is a diffusion zone in which the chloride and salt concentration of the freshwater gradually increases with distance from the freshwater body until it reaches the concentration of the surrounding saltwater body. This zone may be narrow or broad, depending on the above-mentioned factors.

The upper external boundary of the ground-water system in the Long Beach Peninsula is the water table. The water table is a dynamic boundary whose vertical position fluctuates over time. All the possible flow conditions can occur at the water-table boundary; recharge occurs from percolation of rainfall, discharge occurs by evapotranspiration, and no-flow occurs in areas with no recharge or discharge, where ground water flows parallel to the water table. The flow condition that occurs at a particular location of the water table is dependent on the complex interaction among the flow conditions at all the boundaries of the ground-water system.

The lateral and lower external boundaries of the freshwater ground-water system in the Long Beach Peninsula mostly coincide with the interface between freshwater and saltwater as described in the Ghyben-Herzberg principle and shown on figure 12. Thus, the thickness of the ground-water system is dependent on the height of the water table above sea level (altitude). During the winter, the maximum altitude of the water table is about 15 ft, and therefore the maximum thickness of the ground-water system would be about 600 ft. During the fall, ground-water levels decline and the maximum thickness would decrease to about 400 ft. Three wells on the peninsula appear to have penetrated the diffusion zone of the freshwater-saltwater interface. A water sample collected in 1968 from a 164-ft well (well 95) had a chloride concentration of 566 mg/L (Tracy, 1978, table 6) and a water sample collected in July 1982 from a nearby 235-foot well (well 98) had a chloride concentration of 250 mg/L. Well 14, which was abandoned immediately after drilling, encountered saltwater at a depth of about 250 ft (Economic and Engineering Services, Inc., written commun., October 19, 1983). The typical chloride concentration of seawater is about 19,000 mg/L and the average chloride concentration of the shallow freshwater aquifer in 1992 was about 18 mg/L.

The saltwater bodies outside of the fresh ground-water lens are the Pacific Ocean on the western side of the peninsula and Willapa Bay on the eastern and northern sides. The lower boundary is probably a combination of saltwater from the Pacific Ocean and Willapa Bay. The flow of fresh ground water will be mostly parallel to this boundary (fig. 12), but some water can move in both directions across the interface.

In two areas, the external boundary of the ground-water system of the peninsula does not coincide with the freshwater-saltwater interface. A no-flow boundary exists at the southern lateral boundary, which is the contact between the unconsolidated deposits and bedrock (fig. 7). In the southern part of the peninsula, where bedrock is shallow and less than the depth prescribed by the Ghyben-Herzberg principle, the lower boundary of the ground-water system is the contact with bedrock rather than the freshwater-saltwater interface.

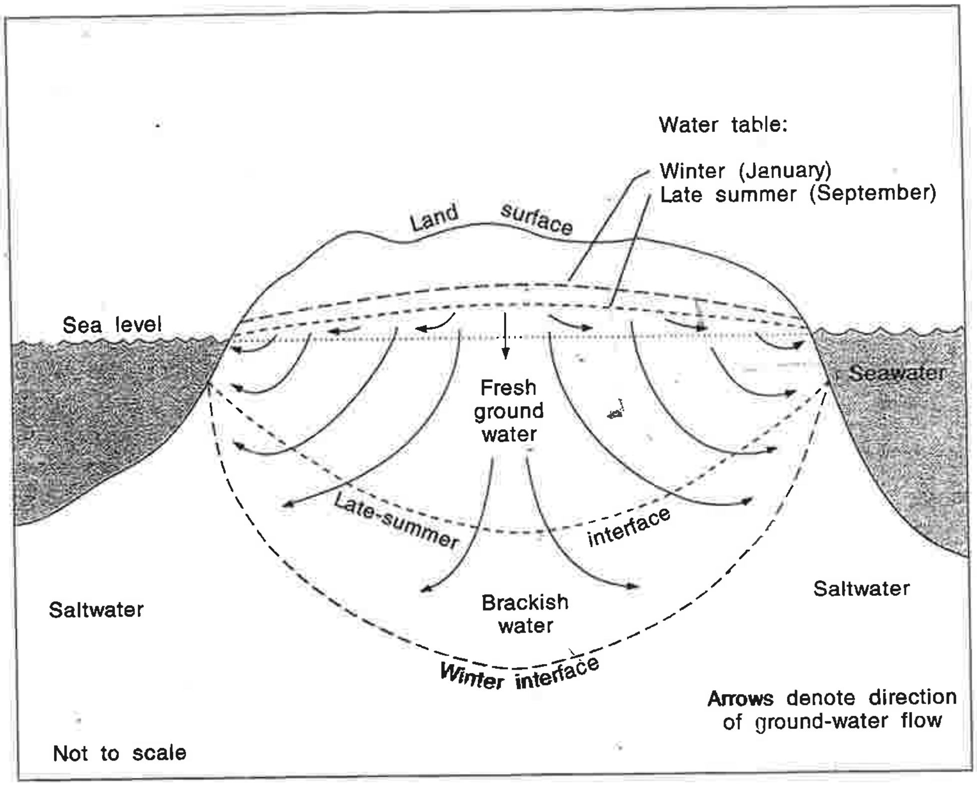

Figure 12.--Generalized flow pattern of a homogeneous island aquifer.

Many surface-water bodies, including lakes, marshes, and drainage channels, form boundaries with the ground-water system. In most areas, the permeability of the material between the surface-water body and the aquifer is sufficient to allow water to flow across the boundary. Such boundaries can be either recharge or discharge boundaries; the flow condition is dependent on the relative altitudes of the surface-water body and nearby water levels in the aquifer.

The ground-water system in the Long Beach Peninsula consists of a sand aquifer with some local lenses of silt or clay (fig. 13) that may act as confining beds. The silt or clay lenses are interspersed throughout the body of sand and the available information is not sufficient to determine if the lenses may connect to form a continuous confining bed across the entire peninsula. Near Cranberry Road, the lithologic information from several well logs and an aquifer test made on a 235-foot well (well 98) indicate that a local confining bed probably exists between altitudes of about -120 to -210 ft. In the northern part of the peninsula, lithologic data indicate that a confining bed might exist between altitudes of about -230 to -280 ft.

The biggest impact and threat to this aquifer has been and remains the refusal of County authorities to incorporate this condition into planning and operational procedures. Close behind is the WA Dept. of Ecology's complacency in this practice. The foregoing study was made for and in possession of these entities for over twenty years. However, massive drainage projects continued.

Example: Pacific County issued on-site sewage permits that were far below state standards for over 15 years until citizen pressure on WA State Dept. of Health forced the County into compliance. This resulted in hundreds of Peninsula septic systems flooded by winter water tables. The County's solution was to lower the winter water table by 4' or 5' thru massive drainage projects. Using the Ghyben-Herzberg principal of 40' to 1', this 5' of water drained in winter =205' of brackish water rise when added to the yearly 4' to 5' natural summer ground water drop at 40' to 1' another 164' to 205' of salt intrusion equals 400' upward travel of the salt or brackish water into our Peninsula's island aquifer. This example is not isolated on the North Peninsula. It takes 50 to 100 years for the brackish condition to change back to fresh once this lens is violated.

The majority of the Peninsula's major land speculation has required some drainage to develop. In some cases, nearly all of it depended on lowering groundwater levels or filling. If not at first, then later when septics began failing as an emergency matter. County approved development in wetlands with filling and drainage, almost always toward Willapa Bay, has not only imperiled our aquifer by drainage but passing on this tainted water into Willapa Estuary is a constant threat to bay water quality and its shellfish industry. These artificial drainages are among the most polluted entering west Willapa Bay.

In the mid 1970's a Peninsula sewage system was considered. The accompanying study concluded that two alternatives existed for its operation. First that the aquifer could not support the amount of water required to create flows of sewage disposed off site into the ocean. Using the aquifer as a supply would necessitate a massive drain field or series of fields to reinject the water back into the Peninsula's aquifer to keep the balance. The second was to bring offsite water from outside the Peninsula like a dam on Bear River to be the supply. The existing drain fields of all North Peninsula on site systems now function as a recharge as in the first option. A peninsula straw vote voted the sewer idea down.

My suggestion is to first, incorporate the Peninsula water study into the critical area documents. Second, make it mandatory for any substantial off peninsula drainage to address its potential impact on both the aquifer and its receiving waters. This includes County projects. Third, population control by not artificially creating buildable properties by draining or filling our natural dunal swales be made a policy. It presently exists through large lot sizes, but use of mitigation banking credits definitely erode this concept as found in the Peninsula's

Comprehensive Plan. Despite Dept. of Ecology's preferred mitigation banking option. Finally, officially declare the North Peninsula Aquifer a Sole Source Aquifer under the protection of law.

Respectfully Submitted,

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CC: Pacific County Planning Commission
Pacific County Board of Commissioners
Futurewize