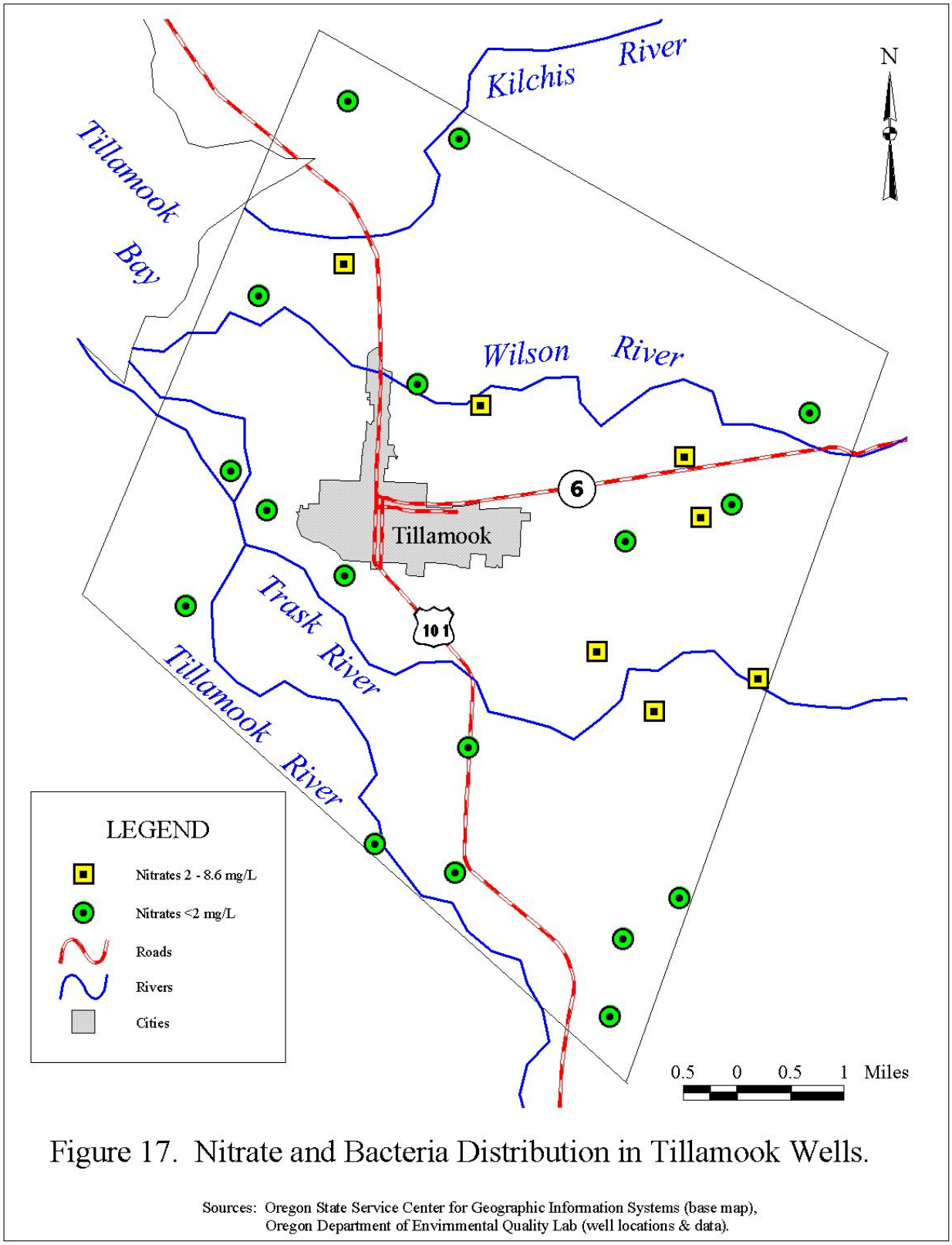

Figure 17. Nitrate and Bacteria Distribution in Tillamook Wells.

Sources: Oregon State Service Center for Geographic Information Systems (base map),
Oregon Department of Envirnmental Quality Lab (well locations & data).

Table 4. Tillamook Groundwater Study (November 1997).

Contaminant	No. of Wells Detected out of 24 wells	Average* Concentration (mg/L)	Maximum Concentration (mg/L)	Detection Limit (mg/L)	NPDW MCL** (mg/L)	Number of Wells Over MCL
Nitrate	16	1.28	8.60	0.02	10	0
Bacteria	1	12 CFU/0.1 L	280 CFU/0.1 L	2 CFU/0.1 L	1 positive per month	1
Antimony	16	0.0038	0.0069	0.0030	0.006	5
Lead	4	0.0064	0.0114	0.0030	0.015	0
Barium	25	0.00713	0.05270	0.00010	2	0
Chromium	18	0.00118	0.00582	0.00020	0.1	0
Copper	24	0.03907	0.46500	0.00030	1.3	0
Nickel	24	0.00143	0.00643	0.00040	0.1	0

*Average concentration calculated for wells with detectable contaminant levels and may include multiple samples.
**NPDW MCL = National Primary Drinking Water Maximum Contaminant Level (mg/L = milligrams per liter = parts per million)

Table 5. Tillamook Groundwater Study (April 1998).

Contaminant	No. of Wells Detected out of 24 wells	Maximum Concentration (mg/L)	Detection Limit (mg/L)	NPDW MCL** (mg/L)	Number of Wells Over MCL
Bacteria	0	0	2 CFU/0.1 L	1 positive per month	0
Ethylbenzene	1	0.0007	0.0005	0.7	0
Lead	3	0.0221	0.0030	0.015	1
Antimony	1	0.0039	0.0030	0. 006	0
Barium	5	0.07190	0.00010	2	0
Cadmium	1	0.00013	0.00010	0.005	0
Chromium	4	0.00045	0.00020	0.1	0
Copper	5	0.52000	0.00030	1.3	0
Nickel	4	0.00182	0.00020	0.1	0

*Average concentration calculated for wells with detectable contaminant levels and may include multiple samples.
**NPDW MCL = National Primary Drinking Water Maximum Contaminant Level (mg/L = milligrams per liter = parts per million)

Overall Status of North Coast Basin Groundwater

Nitrate

North Coast Basin studies have found areas with nitrate in the groundwater. Nitrate levels above 2 mg/L indicate anthropogenic activities have adversely affected the groundwater. Nitrate sources include dispersed non-point sources such as agricultural activities and on-site septic systems, and point sources generating nutrient rich waste products.

Some Public Water Systems (PWS) in the region have reported nitrate levels between 2 to 10 mg/L. A few PWS in the Clatsop Plains area have reported nitrate levels above the MCL (10

mg/L). For domestic wells sampled as part of a real estate transaction, two percent of the wells have nitrate above the MCL.

In local area studies, elevated nitrate was found in the Clatsop Plains area. Nitrate was above the MCL in four wells out of a network of 36 wells (11%). Three of these wells were in the Gearhart area. This area has no centralized sewage collection and treatment system. Area residents use on-site septic systems for sewage disposal.

In the Tillamook area, a large majority of wells sampled (18 out of 25 = 72%) had nitrate levels less than 2 mg/L. None of the remaining wells had nitrate levels exceeding the drinking water standard of 10 mg/L. The groundwater sampled in this study represents deeper groundwater zones used for domestic drinking water, and does not indicate shallow, near surface groundwater quality, more susceptible to contamination from anthropogenic activities. To monitor the shallow groundwater, permission from owners of shallow wells would have to be obtained, or new monitoring wells would have to be installed.

Bacteria

Positive groundwater bacteria detections may indicate contamination from non-point sources including on-site septic systems, or point sources including facilities handling or disposing septage or manure. Bacteria from well water may indicate poor well construction and maintenance practices, rather than an area wide aquifer problem.

On a regional scale, the domestic well real estate transaction data collected throughout the North Coast Basin counties showed 88 tests out of 924 were positive for bacteria.

In the Clatsop Plains area, widespread bacterial contamination is present. Local studies show bacteria present in 30% to 66% of the wells sampled. Bacteria prevalent in Clatsop Plains area water wells is likely due to poor well construction and maintenance practices. The presence of bacteria had no apparent correlation with well depth. Bacteria was present in the shallowest well (11.5 feet deep monitoring well), and in one of the deepest wells (100 foot irrigation well).

In the Tillamook area study, groundwater sampled from deeper water zones used for domestic drinking water showed only one well testing positive for bacteria. Resampling results for this well were negative for bacteria.

Toxics – Pesticides

In the Clatsop Plains area studies, groundwater samples were analyzed for pesticides using screening analytical methods with reporting limits generally higher than 0.001 mg/L. The reporting limit for 1,2-dibromomethane (EDB) was 0.0005 mg/L. This is higher than the MCL of 0.00005 mg/L. At these levels, pesticides were generally not detected. One pesticide, atrazine, was detected in one well at a concentration above the drinking water standard. The well location is near the Warrenton Landfill. Resources were unavailable to conduct confirmational resampling. Another pesticide, pentachlorophenol, was detected in one location in a monitoring well, but was not found when the well was re-sampled in the fall.

In the Tillamook area, no pesticides were detected using analytical methods with reporting limits generally higher than 0.001 mg/L.

Toxics – Volatile Organic Compounds

Some Public Water Systems (PWS) in the region have reported detections of volatile organic compounds (VOCs). Two PWS wells have detected VOCs above the MCL.

In the Clatsop Plains area, VOCs were generally not detected in groundwater. Low levels of toluene, chloroform, and dimethylbenzene were detected in one to two wells at concentrations below the MCLs, but were not detected when wells were re-sampled.

In the Tillamook area, VOCs were not present except for one trace detection of ethylbenzene.

Toxics - Metals

Some Public Water Systems in the region have reported elevated metal levels. Three PWS wells have detected lead above the drinking water action level. These systems are in Columbia County.

In the Clatsop Plains area studies, several metals were detected in groundwater samples from one sampling event, but were not detected when the wells were re-sampled. Lead was detected above the drinking water action level (0.015 mg/L) in 11 of 35 wells (31%) on initial sampling in spring 1996. Lead was present in only one well when the network was re-sampled six months later in fall 1996. The resampled lead level was below the MCL. Low levels of arsenic, copper, cadmium, chromium, and barium were also detected in the spring sampling event, but were not present above detection levels when re-sampled.

In the Tillamook area, lead was found exceeding drinking water action levels in one well that was sampled in spring 1998, but was not detected when sampled initially in the previous fall. Antimony was initially detected and exceeded the drinking water standard of 0.006 mg/L in five out of 25 wells (20%) in fall 1997, but concentrations were not confirmed on re-sampling in spring 1998.

POLLUTANT SOURCES

Overview

Various state and federal programs regulate pollution sources in Oregon. Point sources are confined or discrete pollution sources where contaminants can enter into public waters (OAR 340-040-0010(14)). Nonpoint source are diffuse or unconfined pollution sources (OAR 340-040-0010(12)). The state and federal regulatory goal is to prevent or minimize adverse impacts to groundwater quality from ground surface activities. Several types of point sources in the North Coast Basin are discussed below.

Waste Dischargers

The DEQ regulates waste discharges through permits. Permit types include:

- National Pollutant Discharge Elimination System (NPDES) - These permits must meet Federal Water Pollution Control Act requirements and procedures (OAR 340-045-0010(9)). NPDES permits generally cover all discharges, whether direct or indirect, to surface waters of the United States. NPDES permits cover direct discharges into a river or stream, or indirect discharges into a drain or ditch conveying wastewater to a river or stream, and may also cover discharges to land.

- Water Pollution Control Facilities (WPCF) - These permits regulate disposal system construction and operation with no discharge to navigable waters (340-045-0010(12)). State requirements and procedures (OAR 340-045 or OAR 340-071) distinguish these facilities from those discharging to navigable waters. DEQ issues WPCF permits for discharges not covered by an NPDES permit. WPCF permitted facilities may discharge wastewater onto land through irrigation, into drain fields, or into lagoons and holding ponds.

NPDES and WPCF permitted facilities discharge a variety of wastewater including sewage, pulp and paper waste, food processing waste, smelting/refining waste, cooling water, industrial storm water, mining waste, municipal wastewater, and others.

The DEQ has regional offices in various locations around the state. The Northwest Region (NWR) manages permits within the North Coast Basin. Information on NPDES and WPCF permits is available on-line at http://www.deq.state.or.us/wq/SISData/FacilityHomenew.asp. Figure 18 shows the locations of 198 facilities permitted in the North Coast Basin. Eight of these facilities are major permits handling potentially high pollutant loads or serving a large number of people. Many facilities have more than one permit record associated with them. The database has 473 records associated with the198 facilities.

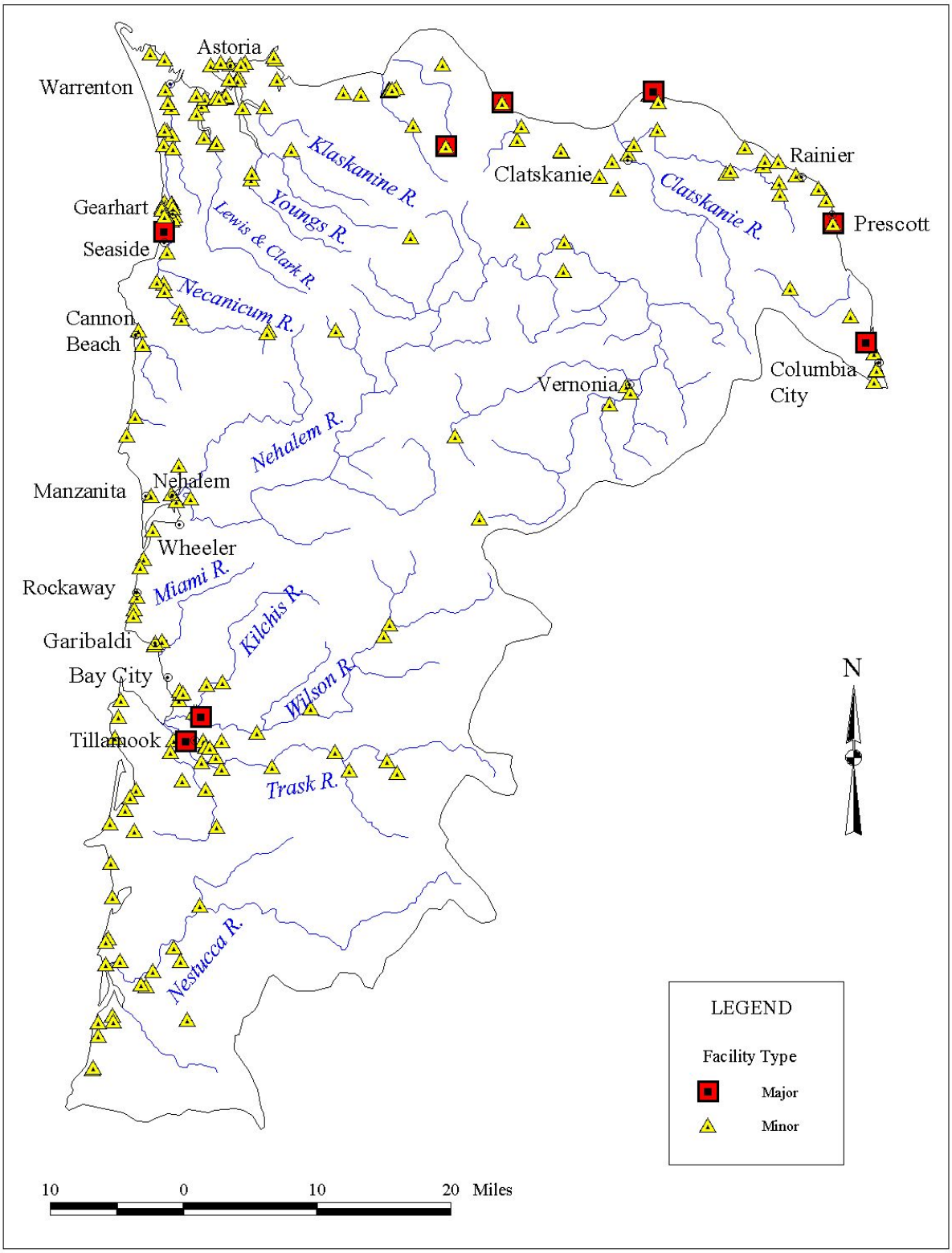

Figure 18. Locations of Permitted Waste Discharge Facilities, North Coast Basin, Oregon.

Underground Injection Control (UIC)

The DEQ Underground Injection Control (UIC) program regulates subsurface waste injection to protect groundwater quality. A UIC system includes structures or activities placing or discharging fluids into the subsurface. Examples of UICs include drywells, sumps, septic system drain fields above a certain service or design size, and other wells used for injection purposes. In the not too distant past, businesses routinely disposed of waste fluids in UICs. Considering that only several ounces of gasoline can contaminate a million gallons of drinking water, UICs hold great potential for being the source of much groundwater contamination.

The DEQ maintains a database of known UIC systems which is available at http://www.deq.state.or.us/wq/groundwa/UIChome.htm. The current database shows 271 injection systems at 51 facilities in the North Coast Basin. Figure 19 is a map of the North Coast Basin showing the locations of all individual UIC injection systems having available latitude/longitude coordinates information.

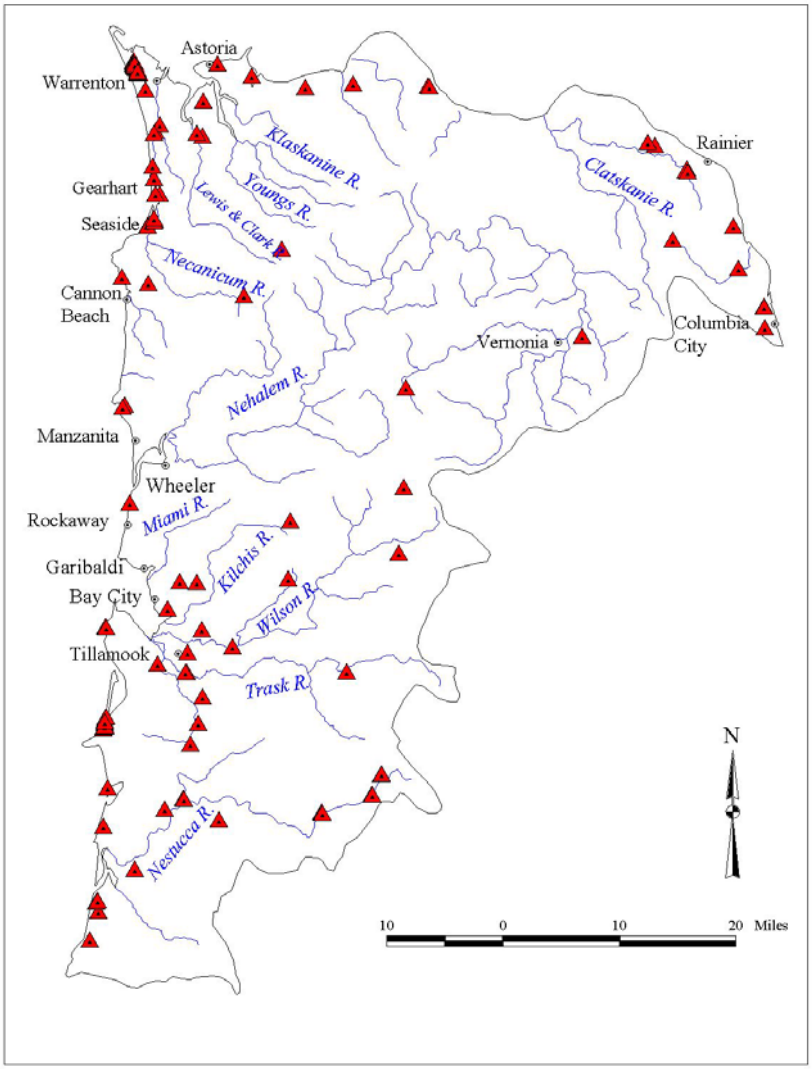

Figure 19. Underground Injection Systems in the North Coast Basin.

Confined Animal Feeding Operations (CAFOs)

The Oregon Department of Agriculture (ODA), in conjunction with DEQ, reviews applications and issues wastewater permits for Confined Animal Feeding Operations (CAFOs). This includes reviewing animal waste management system plans and specifications for animal waste control facilities. The types of CAFO facilities include the following:

- Production areas such as animal confinement areas;
- Manure storage areas such as lagoons, runoff ponds, storage sheds, stockpiles, and liquid impoundments; and
- Waste containment areas such as settling basins.

The waste management systems may also include land application areas. Without proper waste containment and processing systems, CAFOs can concentrate and introduce nitrate and bacterial contamination into underlying groundwater aquifers. Figure 20 shows the locations of the 198 permitted CAFOs in the North Coast Basin.

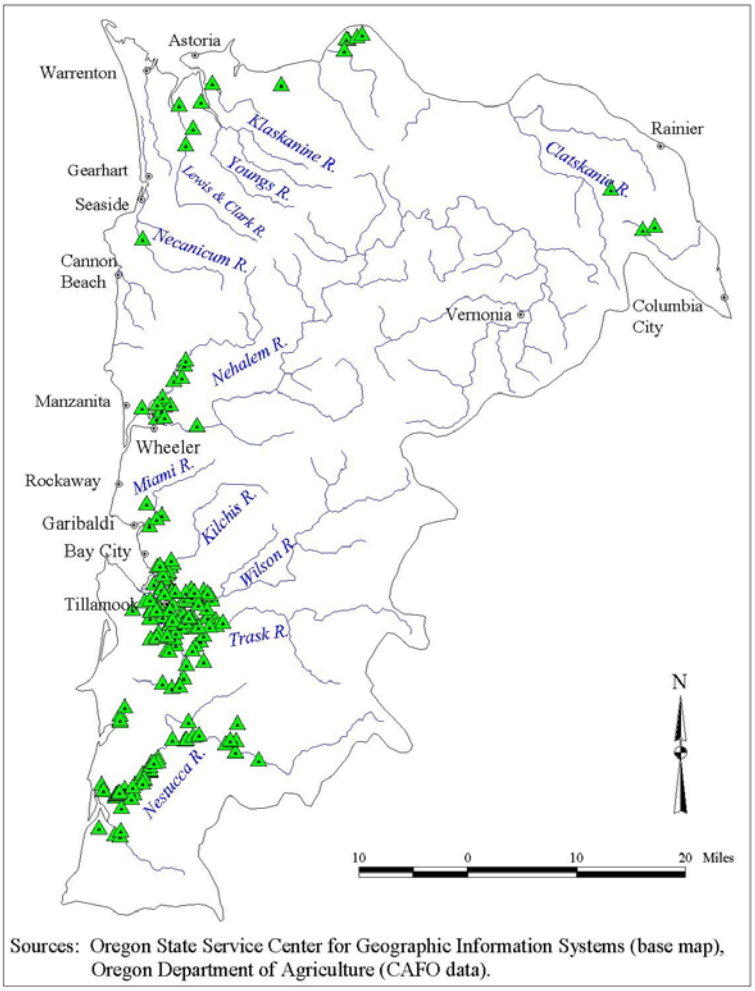

Figure 20. Confined Animal Feeding Operations in the North Coast Basin.

Hazardous Substance Release Sites

The DEQ maintains a list of known hazardous substance release sites in the Environmental Cleanup Site Information (ECSI) database. Information on specific sites is available through on-line queries at http://www.deq.state.or.us/wmc/ECSI/ecsiquery.htm. Currently (2/18/04), the database shows 84 sites in the North Coast Basin. Figure 21 shows all 84 sites, and distinguishes them, according to the following four site types:

1. Administrative action (11 sites).
2. Further investigation or cleanup underway (7 sites).
3. No further action (20 sites).
4. Further investigation or cleanup recommended (46 sites).

Many of the sites are very close to each other, causing some symbols to overlap and hide others.

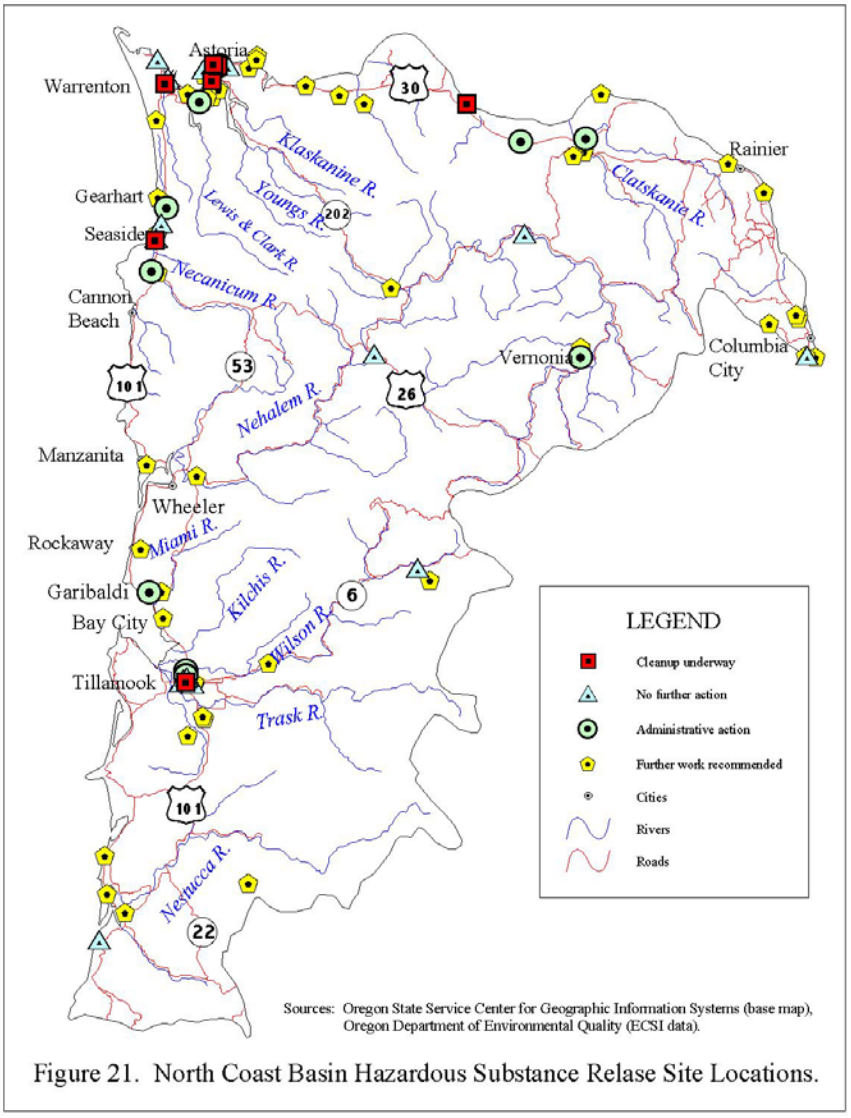

Figure 21. North Coast Basin Hazardous Substance Relase Site Locations.

Underground Storage Tanks (USTs) and Leaking Underground Storage Tanks (LUSTs)

The DEQ Underground Storage Tank (UST) program regulates tanks storing petroleum or certain hazardous substances, and regulates tank release cleanups, including home heating oil tanks. The DEQ maintains the UST List for regulated underground storage tank facilities in Oregon. This list is available on-line at: http://www.deq.state.or.us/wmc/tank/ustfaclist.htm . The UST program also maintains a database of Leaking Underground Storage Tanks (LUST) where releases from tanks have been reported. This database is available on-line at: http://www.deq.state.or.us/wmc/tank/LustPublicLookup.asp. Underground storage tank leaks can lead to widespread aquifer contamination.

The database, updated 10/23/01, has 322 records on file for LUST sites in the North Coast Basin. Active sites account for 92 of these sites, while the remaining 230 sites are closed. Active sites are those with continuing cleanup activities, or where compliance with cleanup standards has not yet been demonstrated. The closed sites are those where cleanup and cost recovery is complete. Figure 22 shows all active and closed LUST sites in the North Coast Basin.

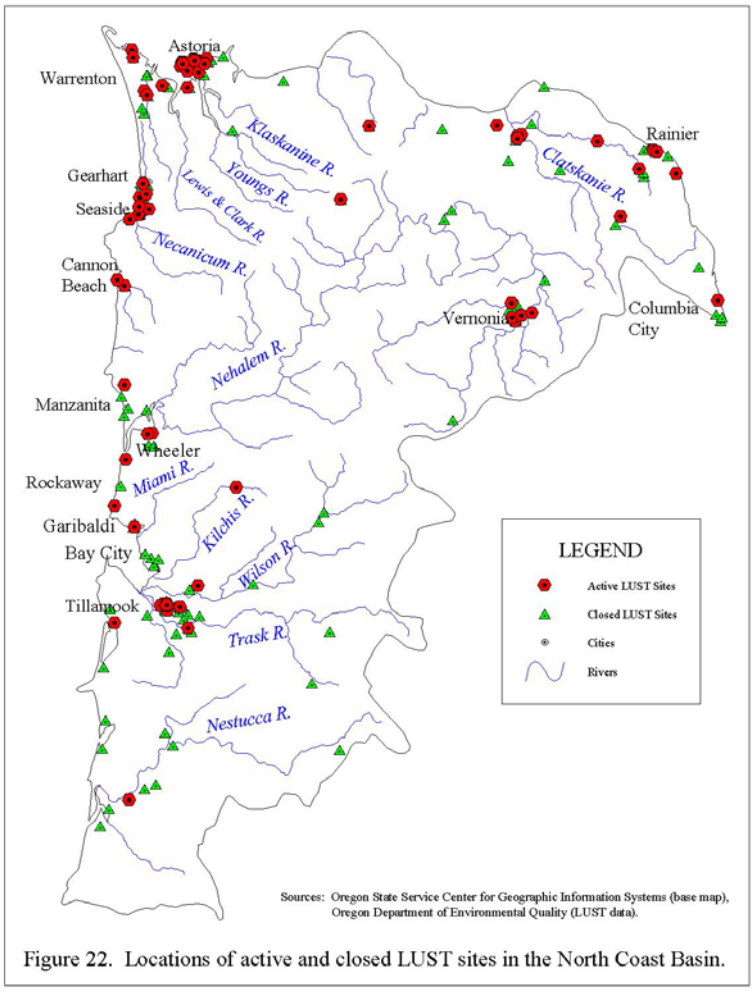

Figure 22. Locations of active and closed LUST sites in the North Coast Basin.

Solid Waste Facilities

The DEQ has collected groundwater, surface water, and leachate monitoring data at three landfills in the North Coast Basin. These are the Astoria, Warrenton, and Tillamook Landfills, shown on Figure 9. Each of these landfills has a Solid Waste Closure Permit. The DEQ Northwest Region Solid Waste Section has information about the landfill status, monitoring results, and annual reports.

Astoria Landfill (1987 – 1996).
Summary

Solid Waste Closure Permit Number 118 regulates activities at the Astoria Landfill. The DEQ collected and analyzed surface and groundwater samples at the Astoria Landfill 10 times between 1987 and 1996.

The Astoria Landfill is completed in highly weathered sandstone and siltstone of the Astoria Formation. This formation does not readily transmit water, making groundwater sample collection difficult and time consuming.

Data from the DEQ's sampling are available in LASAR through the internet at: http://www.deq.state.or.us/wq/lasar/EventLocatorCriteria.htm and can be retrieved using Astoria Landfill as the sampling event name.

Results

A review of monitoring data from all three monitoring wells and all three surface water sites yielded the following:

- Bacteria was present in all surface water sites.
- Several metals were present at some sites. Arsenic and chromium were present above drinking water standards at MW-2, and chromium was present above drinking water standards at MW-3.
- Nitrates were present at all sites, but levels did not exceed drinking water standards.
- No volatile organic compounds were detected at any of the sites.

The shallow aquifer underlying the landfill has low permeability and transmissivity. No surface water sites have had detections of either arsenic or chromium. These factors suggest the landfill poses no significant threat to downgradient beneficial uses.

Warrenton Landfill (1980 – 1996).

The City of Warrenton acquired the landfill in July 1977. The landfill closed in Fall 1985. Following landfill capping, a soccer field, parking lot, and concession area were built at the site. The DEQ collected and analyzed groundwater samples from three monitoring wells at the Warrenton Landfill 13 times between 1980 and 1996. The DEQ also collected groundwater samples from the landfill monitoring network as part of the 1996 Clatsop Plains Groundwater

study. Solid Waste Closure Permit Number 120 regulates activities at the Warrenton Landfill. The permit requires continued periodic monitoring and split sampling with the DEQ Lab. The DEQ analyzed samples in October 2002 as a split sampling event.

The shallow aquifer underlying the Warrenton Landfill is composed of beach sand. This material is highly permeable and transmissive. Water level data from the three monitoring wells around the landfill show the groundwater flow direction is to the northeast, with a gradient of 1.25 feet in 1,000 feet (1:800, Sprecher, 2002).

Data from DEQ's sampling are available in LASAR through the internet at: http://www.deq.state.or.us/wq/lasar/EventLocatorCriteria.htm and can be retrieved using Warrenton Landfill as the sampling event name.

Results

A review of monitoring data from all three monitoring wells yielded the following:

- MW-1 (upgradient): Nitrate, barium, and two volatile organic compounds (VOCs) were detected, all below drinking water standards. Atrazine was detected above the drinking water standard. Bacteria was detected above the drinking water standard.
- MW-2 (downgradient): Nitrate, arsenic, barium, selenium, and one VOC were detected, all below drinking water standards.
- MW-3 (downgradient): Nitrate, arsenic, barium, chromium, and lead were detected, all below drinking water standards. Bacteria was detected above the drinking water standard.

The presence of atrazine in the upgradient well, next to the road bordering the landfill's west side, is attributed to roadside maintenance activities. The area immediately downgradient of the landfill is a wetland, with wildlife habitat. Monitoring data show the only adverse impact to downgradient groundwater quality is bacteria. Although the shallow aquifer underlying the landfill is permeable and transmissive, bacteria in the groundwater is not expected to adversely impact the downgradient receptors.

Tillamook Landfill (1980 – 2000).
Summary

During the late 1940s the Tillamook Landfill was operated as an open burning dump. To meet RCRA standards the dump was converted to a sanitary landfill in 1980. The landfill was closed in 1982. In 1986 the landfill was expanded with two new cells. A third cell was prepared in 1987 but never used. The third cell was closed in Fall 1990. That year the site became a transfer station. Solid waste is now trucked to the Coffin Butte landfill, north of Corvallis, Oregon.

The Tillamook Landfill is constructed in highly weathered fine-grained sandstone and siltstone of the Astoria Formation. The soils overlying the aquifer have a permeability coefficient of approximately $3x10^{-6}$ ft/sec. (CES, 1992). The aquifer underlying the landfill transmits groundwater very slowly, on the order of 0.01 feet/day (McFarland, 1983).

Solid Waste Closure Permit Number 148 regulates activities at the Tillamook Landfill. The DEQ collected and analyzed surface and groundwater samples from the Tillamook Landfill between 1980 and 2000. Over this time period the DEQ sampled various combinations of 15 wells, 11 surface sites, five lysimeters, a leachate sump, and a cistern. Data from DEQ's sampling are available in LASAR through the internet at: http://www.deq.state.or.us/wq/lasar/EventLocatorCriteria.htm, and can be retrieved using Tillamook Landfill as the sampling event name.

Results

A review of monitoring data from one surface site, five monitoring wells, and the leachate sump, yielded the following:

- Bacteria was present in the leachate sump and surface water sites.
- Metals were present in all sites, but below MCLs.
- Nitrates were present at all sites, but none exceeded drinking water standards.
- Volatile organic compounds were present in the sump, but below MCLs.

The combination of poorly permeable and low transmissive aquifer materials, and low levels of constituents in the groundwater underlying the landfill, suggest adverse impacts to downgradient beneficial uses are not likely.