Sources of Nitrate and the Regulatory Environment

Groundwater quality in Washington is regulated by the federal Safe Drinking Water Act and Clean Water Act, the state Water Pollution Control Act and Water Resources Act and the State Department of Health's authorizing statute.

While we have attempted to make this document as readable as possible, this section contains in-depth discussion of scientific and regulatory topics. As a result, clarity of language may suffer.

Safe Drinking Water Act

The EPA has broad authority, under Section 1421 of the Safe Drinking Water Act, 42 U.S.C. 300g-1(b)(1)(A), (B), to establish national primary drinking water standards, "if the Administrator determines that . . . the contaminant may have an adverse effect on the health of persons;" "is known to occur . . . in public water systems with a frequency and at levels of public health concern;" or there is "a meaningful opportunity for health risk reduction for persons served by public water systems."

> For each contaminant that the Administrator determines to regulate under subparagraph (B), the Administrator shall publish maximum contaminant level goals and promulgate, by rule, national primary drinking water regulations under this subsection. 42 U.S.C. 300g-1(b)(1)(E)

EPA sets legal limits on over 90 contaminants in drinking water. The legal limit for a contaminant reflects the level that protects human health and that water systems can achieve using the best available technology. EPA rules also set water testing schedules and methods that water systems must follow

The EPA set the maximum contaminant level for nitrate, nitrite and total nitrate and nitrite in 40 CFR § 141.62:

Contaminant	MCL (mg/l)
(7) Nitrate	10 (as Nitrogen)
(8) Nitrite	1 (as Nitrogen)
(9) Total Nitrate and Nitrite	10 (as Nitrogen)

EPA may approve states to assume primary enforcement authority under the Safe Drinking Water Act. "States are responsible for reviewing, establishing, and revising water quality standards." "States may develop water quality standards more stringent than required" by federal regulations 40 CFR § 131.4 (a). DOE has adopted Chapter 173-200 WAC, *Water quality standards for groundwaters of the State of Washington*. Washington's drinking water quality standard for nitrate is 10 milligrams per liter (mg/L), or 10 parts per million (ppm). State law requires public water systems to sample for many contaminants, including nitrate, on a regular basis. Public water systems with nitrate levels over 10 ppm must notify the people who receive water from them.

DOE's groundwater regulations, WAC 173-200, implement Washington's Water Pollution Control Act, Ch. 90.48 RCW, and Water Resources Act of 1971, Ch. 90.54 RCW. The goal of the regulations is to maintain the highest quality of the state's groundwaters and protect existing and future beneficial uses of the groundwater through the reduction or elimination of the discharge of contaminants to the state's groundwaters. The regulations set groundwater quality standards that, together with the state's technology-based treatment requirements, seek to protect the environment, human health and existing and future beneficial uses of groundwaters. The regulations apply to all groundwaters of the state that occur in a saturated zone or stratum beneath the surface of land or below a surface water body. They do not apply to:

(a) contaminant concentrations found in saturated soils where those contaminants are chemicals or nutrients that have been applied at agronomic rates for agricultural purposes if those contaminants will not cause pollution of any groundwaters below the root zone;

(b) contaminant concentrations found in saturated soils where those contaminants are constituents that have been applied at approved rates and under approved methods of land treatment if those contaminants will not cause pollution of any groundwaters below the root zone; or

(c) clean up actions approved by the Department under the Model Toxics Control Act, ch. 70.105D RCW, or approved by the United States Environmental Protection Agency under the Comprehensive Environmental Response Compensation and Liability Act, 42 U.S.C. 9601 et seq., WAC 173-200-010.

WAC 173-200-040 (2) establishes "groundwater concentrations" that groundwaters of the state may not exceed. Nitrate concentrations in groundwater may not exceed 10 mg/L. WAC 173-200-040 (2) (Table 1).

> No person shall engage in any activity that violates or causes the violation of [ch. 173-200 WAC]." WAC 173-200-100 (2).

Violations of maximum concentrations may be addressed by enforcement "through all legal, equitable, and other methods available to the department including, but not limited to: issuance of state waste discharge permits, other departmental permits, regulatory orders, court actions, review and approval of plans and specifications, evaluation of compliance with all known, available, and reasonable methods of prevention, control, and treatment of a waste prior to discharge, and pursuit of memoranda of understanding between the department and other regulatory agencies." WAC 173-200-100 (3).

If DOE determines that a potential to pollute the groundwater exists, it may request a permit holder or responsible person to prepare and submit a groundwater quality evaluation program for its approval. Each evaluation program must be based on soil and hydrogeologic characteristics and be capable of assessing impacts on groundwater at the "point of compliance." The evaluation program approved by DOE may include (a) groundwater monitoring for a specific activity; (b) groundwater monitoring at selected sites for a group of activities; (c) monitoring of the vadose zone; (d) evaluation and monitoring of effluent quality; (e) evaluation within a treatment process; or (f) evaluation of management practices. WAC 173-200-080 (2). The "point of compliance" is the location where the "enforcement limit," is "measured and shall not be exceeded." WAC 173-200- 060 (1). The "enforcement limit" is established in accordance with WAC 173-200-050.

When drinking water in private wells contains or is likely to contain a contaminant that may present an imminent and substantial endangerment, such as nitrate, EPA may take an emergency action under the SDWA, Section 1431. EPA must first determine that the state and local

authorities have not taken action to protect the health of such persons. An emergency action pursuant to SDWA Section 1431 may include any order that may be necessary to protect the health of persons, including ordering the collection of samples to investigate the sources of the contamination. In addition, where appropriate, EPA may issue orders to require the provision of alternative water supplies. EPA may also judicially enforce its orders, through action seeking civil penalties for each day of such violation. If violation of EPA's orders is "wilfull," EPA may seek criminal penalties of fines or imprisonment for not more than three years. 42 U.S.C. § 300g-2(b). Citizens may also seek protection of underground sources of drinking water, under 42 USC 300j-8, so as to mandate EPA regulatory or litigative action.

The EPA may also designate sole source drinking water aquifers under Section 1427 of the Safe Drinking Water Act, 42 U.S.C. 300h.

Clean Water Act

The Clean Water Act, 33 U.S.C. §1251 et seq., establishes the basic structure for regulating discharges of pollutants into the waters of the United States. Under the Clean Water Act, states develop water quality standards to protect waters of the U.S. EPA approves those standards. The standards are comprised of: criteria, designated uses and antidegredation. Those standards are used to establish effluent limits in NPDES permit. If standards are not being attained in a water body, then the states must add the water body to their §303(d) impaired water body list and develop total maximum daily loads, "TMDLs," for the water body. These TMDL's should set forth an implementation plan for ultimately achieving water quality standards in the impaired water body. The Clean Water Act makes it unlawful to discharge any pollutant from a point source into waters of the U.S., unless a National Pollutant Discharge Elimination System (NPDES) permit is obtained (33 U.S.C. 1342) NPDES permitting authority has been delegated to the DOE. (33 U.S.C. 1342 (b)).

The DOE is the primary agency in Washington State responsible for the protection of both ground and surface water quality. DOE's Water Quality Program operates primarily pursuant to the Water Pollution Control Act, Chapter 90.48 RCW. The Act makes it "unlawful for any person to throw, drain, run, or otherwise discharge into any of the waters of this state, or to cause, permit or suffer to be thrown, run, drained, allowed to seep or otherwise discharged into such

waters any organic or inorganic matter that shall cause or tend to cause pollution of such waters." (RCW 90.48.080)

DOE may implement measures to protect both ground and surface waters from pollutants, and has established regulations for the protection of ground and surface water quality, permitting of discharging activities, and financing of water quality protection activities. This regulation lists numerical limits for specific contaminants ("water quality criteria") that apply to all groundwaters in the state. These criteria are used when evaluating the performance of permitted discharge activities (such as sprayfields and holding ponds), implemented best management practices, or when conducting clean-up activities at historical or current waste sites.

DOE's water quality standards incorporate an "antidegradation policy," an otherwise existing part of state water quality law (WAC 173-200-030). This policy forbids degradation which would harm existing or future beneficial uses of groundwater (drinking water, irrigation and support of wildlife habitat). The standards provide numeric values which must not be exceeded to protect the beneficial use of drinking water. Washington's water quality standards are enforceable through DOE's actions. Washington's Water Pollution Control Act authorizes DOE to "bring any appropriate action, in law or equity, including action for injunctive relief . . . as may be necessary to carry out the provisions" of that Act (RCW 90.48.037), including its prohibition of the discharge of organic or inorganic matter that may cause pollution of ground or surface water. (RCW 90.48.080).

DOE's water quality standards apply to both point source activities and nonpoint source activities. Point source activities are activities where a source of pollution can be readily distinguished, such as the industrial discharge of waste onto or into the ground. State law requires point sources to operate under permits that set conditions for discharges. These permits may be issued to a specific entity with conditions designed to protect water quality.

A "point source" is "any discernible, confined, and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture." (WAC 273-226-030 (21))

"Nonpoint sources" are more diffuse in nature. They often consist of many small pollutant sources that have a cumulative effect, like highway runoff, on-site septic systems in developed

areas, and application of pesticides or nutrients in both agricultural and urban areas. Some nonpoint sources are managed through the development of siting and design standards.

DOE's permits describe penalty provisions which may be put into effect if discharge limitations (or other conditions specified in the permit) are not met. DOE has the enforcement discretion to impose those penalties.

"General permits" may be issued to a group of entities with common discharge characteristics and conditions. (WAC 273-226-020) Permits issued under Chapter 273-226 WAC are designed to satisfy the requirements for discharge permits under Sections 307 and 402(b) of the federal Water Pollution Control Act (33 U.S.C. §1251) and the state law governing water pollution control (Ch. 90.48 RCW). (WAC 273-226-020). If eligible, a point source must obtain general permit coverage before discharging to surface or ground waters or the point source may be found to be in violation of state or federal law for discharging without a permit. General permits have been issued to industries and municipalities for treated discharges into surface waters such as Sulphur Creek Wasteway or the Yakima River.

General permits establish standards for management. The standards apply to all underground waters in the saturated zone (generally at or below the water table), but do not apply in the root zone of saturated soils where agricultural pesticides and nutrients have been applied at agronomic rates for agricultural purposes and pollution does not occur below the root zone. (WAC 173.200.010(3)(a))

General permits are issued for fixed terms not exceeding five years from the effective date. Point source facility operators must apply to the DOE for coverage under a general permit. (WAC 227-226) All permittees covered under a general permit must submit a new application for coverage under a general permit or an application for an individual permit at least 90 days prior to the expiration date of the general permit under which the permittee is covered. When a permittee has made timely and sufficient application for the renewal of coverage under a general permit, an expiring general permit remains in effect and enforceable until the application has been denied, a replacement permit has been issued by the DOE, or the expired general permit has been terminated by the DOE. Coverage under an expired general permit for permittees who fail to submit a timely and sufficient application shall expire on the expiration date of the general permit. (WAC 173-226-200)

A general permit may be modified, revoked and reissued, or terminated, during its term if information is obtained by DOE which indicates that cumulative effects on the environment from dischargers covered under the general permit are unacceptable. (WAC 173-226-230 (1)(d)) DOE may require any discharger to apply for and obtain an individual permit, or to apply for and obtain coverage under another more specific general permit. Also, any interested person may petition the DOE to require a discharger authorized by a general permit to apply for and obtain an individual permit. (WAC 173-226-240 (2), (3))

DOE may revoke, or "terminate coverage under" a general permit where terms or conditions of the general permit are violated, conditions change such that either temporary or permanent reduction or elimination of permitted discharges is required, or DOE determines that the permitted activity endangers human health, safety, or the environment, or contributes to water or sediment quality standards violations. (WAC 173-226-240 (1) (a), (c), and (d))

Currently, the permit framework is reactive, a permit is not required unless there is or was a documented discharge to surface waters. The permitting process now requires a facility to submit a complete Nutrient Management Plan with the permit application. The Nutrient Management Plan is approved by DOE and becomes the facility's effluent limitation. After a facility is permitted, it must submit an updated Nutrient Management Plan if it wants to make changes to its operation.

Under §303(d) of the Clean Water Act, states are required to develop lists of impaired waters. These are waters for which technology-based regulations and other required controls are not stringent enough to meet the water quality standards set by the state. The law requires that states establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDL) for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards. A TMDL is generally administered by establishing limits on the discharge of pollutant materials otherwise permitted under the NPDES program—a program that relates to discharges to surface water only.

State Department of Health

DOH is authorized to adopt regulations "to protect public health." (RCW 43.20.050(2)) These may include rules for Group A public water systems, as necessary, to assure safe and reliable public drinking water and to protect the public health. Those rules set requirements regarding: (i)

The design and construction of public water system facilities, including proper sizing of pipes and storage for the number and type of customers; (ii) Drinking water quality standards, monitoring requirements, and laboratory certification requirements; (iii) Public water system management and reporting requirements; (iv) Public water system planning and emergency response requirements; (v) Public water system operation and maintenance requirements; (vi) Water quality, reliability, and management of existing but inadequate public water systems; and (vii) Quality standards for the source or supply, or both source and supply, of water for bottled water plants.

DOH requires that nitrate levels (concentrations) (as N) in Group A public water systems not exceed the maximum contaminant level ("MCL") of 10 mg/L, and that nitrite levels (concentrations) not exceed the MCL of 1 mg/L. WAC 246-290-310(3) (Table 4). The requirements for Group B public water systems are the same. WAC 246-291-170 (2)(b) Nitrate and nitrite are "primary inorganic contaminants" and the MCL for nitrate and nitrite are "primary MCLs." When primary MCLs are exceeded by a public water system the water purveyor must "determine the cause of the contamination" and "take action as directed by the Department of Health." WAC 246-290-320(1)(b)(iii).

DOH is also sets rules for Group B public water systems, as defined in RCW 70.119A.020. These rules establish minimum requirements for the initial design and construction of a public water system and "rules and standards for prevention, control, and abatement of health hazards and nuisances related to the disposal of human and animal excreta and animal remains." RCW 42.30.050 (2) (b), (c)

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) (Pub. L. No. 94-590, 90 Stat 2795, 42 U.S.C. §§6901-6987, 9001-9010) contains both regulatory standards and remedial provisions to achieve goals of conservation, reducing waste disposal, and minimizing the present and future threat to human health and the environment. RCRA provides a comprehensive national regulatory structure for the management of nonhazardous solid wastes (subtitle D, 42 U.S.C. §§ 6941/y-6949a) and hazardous solid wastes (subtitle C, 42 U.S.C. §§ 6921/y-6939b). "Solid waste" is defined as "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous

material resulting from industrial, commercial, mining, and agricultural operations, and from community activities . . . ." 42 U.S.C. §6903(27)

Materials are discarded if they are either abandoned or recycled or are inherently waste-like. 40 C.F.R. § 261.2. Materials are "disposed" if they are discharged, deposited, injected, dumped, spilled, leaked or otherwise placed into or on land or water such that it may enter into the environment or be emitted into the air or discharged into any waters, including groundwaters 42 U.S.C. §6903(3). Agricultural wastes, including manures, crop residues, or commercial chemical fertilizers applied to the soil in amounts greater that can be used as fertilizers or soil conditioners may be the disposal of solid waste.

Irrigated Agriculture

There are 360,906 acres of crops in Yakima County. 96,459 (27 percent) of those acres are located within the GWMA (WSDA 2017b). In 2015, irrigated agriculture within the GWMA occupied 55 percent of the total land area within the GWMA boundaries (175,161 acres). (WSDA 2017b).

Most crops grown in the GWMA have the potential for positive nitrogen loading under some management practices. WSDA 2015 crop data shows that there is a large and diverse number of crops grown in the GWMA. The top 15 crops by acreage represent 96 percent of the irrigated agricultural land within the GWMA. Each crop has a unique cultivation practice.

Anecdotal information provided by members of the GWMA's Irrigated Agriculture Working Group indicates that growers do not want to over-irrigate and have disincentives to over-applying commercial fertilizers.

The native organic matter content of lower Yakima soils is around one percent but when these soils have a history of organic inputs such as manure, there can be an increase in organic matter levels of two to three percent. In general, organic matter in soils can mineralize to provide between 20 and 65 lbs N per one percent organic matter for crop utilization.

Nitrogen from organic matter becomes available for crop uptake as well as losses including leaching below the crop root zone with water.

The South Yakima Conservation District completed a Deep Soil Sampling project for the Irrigated Agriculture Work Group. The sampling data from the project, including 163 samples taken in spring and fall have been assembled by Yakima County Public Services.

a. Crops Supporting Livestock Operations

A significant portion of irrigated agricultural acreage within the GWMA (31,790 acres or 32 percent) is dedicated to crops and land uses (corn, triticale, pasture, and alfalfa) that support dairy or other livestock operations. The majority of manure and compost applications observed by representatives of the WSDA during interviews with farmers and crop consultants were taking place on crops intended for animal feed.

Triticale is "double-cropped" (two crops in one growing year). Triticale is planted in the fall (September-October) and harvested in the spring (April-May). Silage corn is seeded immediately afterward and harvested in late summer or fall (August-September).

Alfalfa is also planted. Alfalfa is a complex perennial crop. It removes large quantities of nutrients from the soil (Pacific Northwest Extension Publication PNW0611). It can meet most of its nitrogen needs from the atmosphere through nitrogen fixation, but is dependent both on the presence of rhizobia bacteria in the soil and on whether or not supplemental nitrogen is added. Alfalfa is considered a "lazy" plant and will use nitrogen from other sources such as manure or commercial fertilizer if given the chance. The practice of nitrogen supplementation on alfalfa does occur within the GWMA. However, agricultural practices used for perennial crops like alfalfa and pasture remove the majority of the plant residue from the field during harvest (hay/silage) or through grazing.

Based on a DOE survey during 1998-2003, 29 percent of the irrigated acres in the Granger drainage and 12 percent in the Sulphur drainage were owned by dairies (Laurie Crowe, South Yakima Conservation District, personal communication, February 2004) and there were 20, 24, 2, and 0 dairies in Granger, Sulphur, Spring and Snipes drainages, respectively. (RSJB 2009).

WSDA's regulations implementing the Dairy Nutrient Management Act, Ch. 16-611 WAC, require dairy producers to maintain records to demonstrate that applications of nutrients to crop land are within acceptable agronomic rates. Soil analysis should include annual postharvest soil nitrate nitrogen analysis; triennial soil analysis that includes organic matter; pH, ammonium nitrogen;

phosphorus, potassium; and electrical conductivity. Nutrient analysis is required for all sources of organic and inorganic nutrients including, but not limited to, manure and commercial fertilizer supplied for crop uptake. Manure and other organic sources of nutrients must be analyzed annually for organic nitrogen, ammonia nitrogen, and phosphorus. There is no equivalent requirement for non-dairy agricultural producers.

Nutrient application records should include field identification and year of application, crop grown in each field where the application occurred, crop nutrient needs based on expected crop yield, nutrient sources available from residual soil nitrogen including contributions from soil organic matter, previous legume crop, and previous organic nutrients applied, date of applications, method of application, nutrient sources, nutrient analysis, amount of nitrogen and phosphorus applied and available for each source, total amount of nitrogen and phosphorus applied to each field each year; and the weather conditions twenty-four hours prior to and at time of application.

b. Tree Fruit and Vegetable Crops

The other main crops in the region are tree fruit, grapes (both juice and wine), hops, wheat, mint, and asparagus. The orchard and vineyard crops, e.g., apples, grapes, cherries, pears, peaches/nectarines are permanent crops.

Fertilizers

Fertilizers available within the GWMA include commercial fertilizer, manure, or compost. There is no current measured data regarding the distribution of the amounts of these three nitrogen sources within the GWMA. WSDA interviews with farmers and crop consultants indicate that the most commonly used product is commercial fertilizer. The only exceptions were silage corn and triticale, where more acres were fertilized with manure than with commercial fertilizer. The only crops where growers or crop consultants reported use of all three fertilizer products were hops and triticale.

Bulk commercial fertilizer distributors are required by RCW 15.54.275 to be licensed. They are also required by RCW 15.54.362 to report the number of net tons of fertilizer distributed within the state during six-month periods (January to June, July to December) (annual report permitted if less than 100 tons). 220,909 tons (200,406,000 kg) of commercial fertilizer was purchased in Washington State in 2011. As the statute does not require that the report be subdivided by county,

region or groundwater management area, there is no specific information with which to evaluate the amount of commercial fertilizer sold within the GWMA. "Bulk fertilizer" is commercial fertilizer distributed in a nonpackage form such as tote bags, tanks, trailers, spreader trucks, and railcars. Fertilizers are required to meet the nutrient value guaranteed by the fertilizer manufacturer. There is no requirement that agricultural producers be licensed to apply commercial or any other fertilizer. Unmanipulated animal and vegetable manures, organic waste-derived materials and biosolids are not commercial fertilizer. WAC 16-200-701.

Chemigation procedures are described by regulations of the Department of Agriculture. Ch. 16-202 WAC. Chemigation" is the application of any substance a pesticide, plant or crop protectant, or system maintenance compound applied with irrigation water. WAC 16-202-1002 (17). All pesticide laws apply to chemigation. Pesticides cannot be applied with an open surface, gravity irrigation system unless allowed by the product label.

The Director of the Department of Agriculture may adopt regulations for the appropriate use and disposal of commercial fertilizers for the protection of groundwater. RCW 15.54.800. Although "deep percolation" ("the movement of water downward through the soil profile below a plant's effective rooting zone") is defined by WSDA regulations, WAC 16-202-1002 (23), the regulations do not specifically prohibit deep percolation.

Fertilizer application timing can affect nitrogen availability for plant uptake and resultant leaching of excess nitrogen. For instance, synthetic fertilizers are formulated to release a specific amount of nutrients at a specific rate over a select period of time. Nitrogen from compost or manure would be released over a much longer period of time at a much lower rate. Crop fertilizers (manure, compost, and synthetic fertilizer) also react differently at the point of application. Compost or manure also contain components with soil health improvement properties.

Generally, crop fertilizer application choices are affected by several parameters including fertilizer type, crop nitrogen needs, application recommendations, expected crop pricing, and anticipated yields. They also may be influenced by recommendations from crop consultants and fertilizer guides, historical practices, and practices of other growers in the community. This variability, in combination with effects of fertilizer types used, irrigation type and practices, and nutrient application timing, soil type and organic matter content, soil nutrient content, manure nutrient content, handling, and storage before application, organic carbon cycling and

mineralization, and fertilizer fixing in alfalfa will all affect whether or not any fertilizer application represents a nitrogen loading risk. (Alfalfa will resort to fixing nitrogen (i.e., create its own nitrogen by pulling it out of the air) only if there is insufficient nitrogen already in the soil. If there is sufficient nitrogen in the soil, it will utilize the soil nitrogen first.)

Generally speaking, fertilizers of any type should be applied only at an "agronomic rate," that is, the rate of application of nutrients to supply crop or plant nutrient needs to achieve realistic yields, while at the same time minimizing the movements of nutrients to surface and ground waters. Cf. WAC 16-611-010.

Further information should be developed about the use of each of the three fertilization materials, as well as information about application timing and specific application site characterization prior to application.

a. Crops Supporting Livestock Operations

Annual crops such as silage corn, triticale (for silage) and wheat use both commercial nitrogen and manure throughout the GWMA. Generally, the nitrogen application for this corn/triticale cropping system is split - one in the fall and one in the spring. Corn (silage and grain) use fairly even amounts of commercial nitrogen and manure on most of the acreage.

b. Tree Fruit and Vegetable Crops

High nutrient applications or application of multiple nutrient sources may be used on permanent tree fruit and vegetable crops to improve soil health and maximize fruit production. Producers of crops intended for human consumption may be reluctant to make manure and compost application because of concerns about pathogen transfer, reducing fertilization options.

c. Organic Fertilizers: Cover Crops, Manure and Compost

Cover crops can fix nitrogen within the soil, if plowed into the soil onsite. The variety of cover crop and number of years of integration of cover-crops into the soil can affect overall nitrogen concentrations in the soil.

Manure from dairy and livestock operations within the GWMA is a widely-used source of organic fertilizer for irrigated crops within the GWMA. While total volume of manure production can be calculated, as a function of total animals, no public records are currently maintained from

which to analyze whether, in gross (minus exportation of such materials), the application of such volume on available irrigated acreage within the GWMA equates to an agronomic rate in-gross. Some pre-application site-specific soil characterization is practiced, so as to accomplish specific site application at an agronomic rate.

Manure contains two primary forms of nitrogen: ammonium and organic nitrogen. Organic nitrogen is nearly immobile. It becomes mobile, and available to crops as fertilizer, through mineralization, the process by which soil microbes decompose organic nitrogen into ammonium. The rate of mineralization varies with soil temperature, soil moisture, and the amount of oxygen in the soil. After mineralization, microorganisms within the soil convert ammonium into nitrate. This process, called nitrification, occurs most rapidly when the soil is warm, moist, and well-aerated.

Although livestock wastes contain low concentrations of nitrogen relative to inorganic fertilizer, it is difficult to estimate nitrogen loading to soil, air and water from manure application without sufficient analysis of nitrogen content in these waste streams. These are subject to some nitrogen loss to air and soil under natural conditions.

The Dairy Nutrient Management Act requires that manure transfer records, including imports or exports, be maintained by dairies that transfer ownership of manure to others. These records should include date of manure transfer; amount of nutrients transferred, the name of the persons supplying and receiving the nutrients, and a nutrient analysis of manure transferred. Irrigation water management records should include field identification and the total amount of irrigation water applied to each field each year.

d. Synthetic Fertilizers

There is no public record of the total amount of synthetic fertilizers sold or used within the GWMA. Anecdotal evidence suggests that the form of synthetic fertilizers has shifted, generally, from dry, granulated fertilizers to liquid fertilizers capable of simultaneous application with irrigation water ("fertigation").

Crop consultants or agronomists, either academic or mercantile (G.S. Long, Co., D & M Chemical, Bleyhl's, Wilbur-Ellis, Simplot, Crop Production Services, Husch and Husch) are used by the majority of commercial farms operating within the GWMA. There are only a few companies that do this type of work. These consultants are not usually farmers. They create prescriptions for

pesticide and fertilizer applications across multiple crops on many different farms. Mercantile crop consultants have economic incentives to recommend larger applications of fertilizers. Agronomists without such incentives could review and evaluate such recommendations for farmers.

There are no federal, state or local regulations specifically pertaining to the application of nitrogen-based fertilizer to agricultural crops, so long as they are applied at an agronomic rate.

Water Applications

Irrigation practices can affect both amounts and rates of nitrogen leaching and the potential for increased nitrogen concentrations in irrigation return flows (which relocate nitrogen applied through fertilizer).

The irrigation water nitrogen input is unique to each commodity. The average N concentration of high flow (late spring) and low flow (late summer) conditions of the Yakima River at Kiona during the 2012 irrigation season was 0.809 mg N/L. (USGS 2013)

Irrigated agriculture is mapped statewide by WSDA, including the area within the GWMA. There is no current measured data regarding the distribution of the three general irrigation methods (sprinkler, drip, macro/rill) within the GWMA. Interviews with farmers and crop consultants indicate that sprinkler irrigation was used on 61 percent of the total irrigated acreage in the GWMA, drip irrigation (including drip, micro sprinkler, drip/sprinkler, and combinations) was used on 23 percent of the acreage. Macro, or rill, irrigation was used on 15 percent of the acreage.

Silage corn and triticale cultivation is almost all irrigated with sprinkler or center pivot irrigation systems. Triticale cultivation rarely occurs on rill irrigated fields.

Any improperly decommissioned wells beneath livestock operations, including crop fields onto which waste is applied, could provide a direct conduit for contaminants to reach the groundwater.

There are no federal, state or local regulations specifically pertaining to the application of irrigation water to agricultural crops. State water law generally precludes wasting water.

Livestock Operations/CAFOs and Groundwater Quality Regulation

a. Dairy Operations

The WSDA's Nitrogen Availability Assessment (WSDA 2017b) reported that USDA's 2012 estimate of dairy operations was 99,532 milk cows on 97 farms (USDA NASS 2014) in Yakima County. The majority, or near total of these, are thought to be located within the GWMA. According to WSDA, dairy farms are increasing in size while the number of farms is decreasing.

Manure and other animal wastes supply nutrients to crops because they contain nitrogen and other elements essential to plant growth, and that the recycling of animal nutrients to increase soil fertility and crop yield is a historic practice. Manures are recommended over commercial fertilizers where there is a desire to build the soil profile by increasing and diversifying soil organisms, increasing moisture holding capacity, and reducing the need for inputs. Manure is a "dairy nutrient" under Washington State's Dairy Nutrient Management Act. Ch. 90.64 RCW "'Dairy nutrient' means any organic waste produced by dairy cows or a dairy farm operation." RCW 90.64.010 (11)

Livestock operations have the potential to release nitrate, chloride, sulfate, and bacteria to surface or groundwater. (Harter, et al., 2002; Harter et al., 2012. Whether groundwater contamination occurs depends on contaminant characteristics, management practices, meteorological conditions, soil types, geological conditions, and groundwater characteristics. (Viers et al., 2012) Contaminant sources can be animal holding areas, manure storage impoundments (either lagoons or settling ponds/basins), and manure applications to cropland. (Harter et al 2002).

The national statistical average of manure production of milk cows (in 2000) was 15.24 tons per animal unit of manure excreted per year. The national statistical average of nitrogen per ton of manure excreted is 10.69 pounds of nitrogen per ton. (Kellog, et al., 2000). The formulas used by the EPA to calculate animal manure production, nitrogen production and losses due to volatilization or denitrification (EPA, 2012c, attributable to WSDA) in the Yakima Valley are as follows:

> Annual manure production is calculated using the following formula: [((# of milking cows)*1.4*108) + ((# of dry cows)*1.4*51) + ((# of heifers)*0.97*56) + ((# of calves *0.33*83)]*365/2000 (WSDA 2010)
>
> Nitrogen production is calculated using the following formula: [((# of milking cows)*1.4*.71) + ((# of dry cows)*1.4*.3) + ((# of heifers)*0.97*.27) + ((# of calves *0.33*.42)]*365/2000 (WSDA 2010)

> Losses due to volatilization or denitrification during storage are estimated at 35 percent. This does not include application losses.

The effects of livestock operations on groundwater quality are addressed through the Clean Water Act's regulations and Washington's Dairy Nutrient Management Act. DOE has authority under Washington's Water Pollution Control Act to enforce the Clean Water Act. Voluntary financial and technical assistance programs are available from the National Resource Conservation Service to eligible landowners and agricultural producers to help them manage natural resources in a sustainable manner.

Washington's Dairy Nutrient Management Act (DNMA) (Ch. 90.64 RCW) authorizes WSDA to "determine if a dairy-related water quality problem requires immediate corrective action under the Washington state water pollution control laws, chapter 90.48 RCW, or the Washington state water quality standards adopted under chapter 90.48 RCW." (RCW 90.64.050 (1)(d)). and to "help maintain a healthy agricultural business climate." Dairies that are licensed to sell Grade A milk and who generate large quantities of animal waste that can pollute surface water and ground water must have an "approved" Nutrient Management Plan (DNMP) on site within six months after licensing. DNMP's must be implemented within two years after licensing. (RCW 90.64.026 (7)) The purpose of such plan is to prevent the discharge of livestock nutrients to surface and ground waters of the state.

The DNMA authorizes local conservation districts to "provide technical assistance to dairy producers in developing and implementing a dairy nutrient management plan;" and to "review, approve, and certify dairy nutrient management plans that meet the minimum standards." (RCW 90.64.070 (1)(d),(e)) An employee of the South Yakima Conservation District often writes the DNMP. "Approved" means the local conservation district has determined that the facility's plan to manage nutrients meets all the elements identified on a checklist established by the Washington Conservation Commission. Certified means the local conservation district has determined all plan elements are in place and implemented as described in the plan. To be certified, both the dairy operator and an authorized representative of the local conservation district must sign the plan. Dairies whose NPDES permits require dairy nutrient management plans need not be otherwise "certified." "Farm Plans," developed and approved by local conservation districts for farmers, must include "livestock nutrient management measures." RCW 89.08.560. Local conservation districts

also provide dairies with technical assistance and planning services with which to implement nutrient management plans.

Local Conservation Districts are authorized to provide dairies and other farms with technical assistance and planning services (RCW 89.08.560) and are required to approve and certify all NMPs. "Farm Plans" developed by conservation districts for farmers must include "livestock nutrient management measures" RCW 89.08.560. The South Yakima Conservation District (SYCD) often writes the NMPs for dairy farms and later certifies them.

The primary goal of an NMP is to protect water quality from dairy nutrient discharges. The required elements of an NMP specified by the State Conservation Commission include the collection, storage, transfer and application of manure, waste feed and litter, and any potentially contaminated runoff at the site. Plans should focus on management of nitrogen, and phosphorus as well as preventing bacteria and other pollutants, such as sediment, from reaching surface or ground water. Excess nutrients must be exported off site.

The elements of a dairy nutrient management plan may include methods and technologies of the nature prescribed by the Natural Resources Conservation Service, a department of the U.S. Department of Agriculture RCW 90.64.026(3).

Nutrient management plans are required to be maintained on the farm for review by WSDA inspectors. The DNMA requires that all dairies be inspected for implementation of their nutrient management plans and to ensure protection of waters of the state. Most dairies keep their NMP and associated sampling data on location.

WSDA's regulations implementing the DNMA are published at chapter 16-611 WAC. WAC 16-611-010 defines "agronomic rate" as "the application of nutrients to supply crop or plant nutrient needs to achieve realistic yields and minimize the movements of nutrients to surface and ground waters." The same section defines "Nutrient" as "any product or combination of products used to supply crops with plant nutrients including, but not limited to, manure or commercial fertilizer." The phrase "transfer of manure" is defined as "the transfer of manure, litter or process waste water to other persons when the receiving facility is in direct control of application acreage, rate or time, and transfer rate and time.

Dairy producers must maintain records to demonstrate that applications of nutrients to crop land are within acceptable agronomic rates. Those records should demonstrate that applications of nutrients to the land were within acceptable agronomic rates. Soil analysis should include annual postharvest soil nitrate nitrogen analysis; triennial soil analysis that includes organic matter; pH, ammonium nitrogen; phosphorus, potassium; and electrical conductivity. Nutrient analysis is required for all sources of organic and inorganic nutrients including, but not limited to, manure and commercial fertilizer supplied for crop uptake. Manure and other organic sources of nutrients must be analyzed annually for organic nitrogen, ammonia nitrogen, and phosphorus.

Nutrient application records should include field identification and year of application, crop grown in each field where the application occurred, crop nutrient needs based on expected crop yield, nutrient sources available from residual soil nitrogen including contributions from soil organic matter, previous legume crop, and previous organic nutrients applied, date of applications, method of application, nutrient sources, nutrient analysis, amount of nitrogen and phosphorus applied and available for each source, total amount of nitrogen and phosphorus applied to each field each year; and the weather conditions twenty-four hours prior to and at time of application. Manure transfer records, including imports or exports should include date of manure transfer, amount of nutrients transferred, the name of the person supplying and receiving the nutrients, and a nutrient analysis of manure transferred. Irrigation water management records should include field identification and the total amount of irrigation water applied to each field each year.

The GWMA's Livestock/CAFO Working Group found consensus that DNMPs are important tools for managing nitrate concentrations in groundwater within the GWMA but was unable to reach consensus whether alternative or additional regulatory approaches should be implemented.

b. Concentrated Animal Feeding Operations

The Clean Water Act's regulations (40 CFR, Part 122) define dairies with 750 or more animals and feedlots with 1,000 or more animals as Large Concentrated Animal Feeding Operations (CAFO). Large CAFOs are defined as point sources of water pollution if they can or do discharge to surface waters, becoming subject to the National Pollutant Discharge Elimination System (NPDES) requirement for permit. However, unlike other point sources that have continuous or regular discharges to surface waters, CAFOs are not considered to automatically have

a surface water discharge. Consequently, they may be required to obtain an NPDES CAFO permit only if they have a discharge or potential to discharge. The DOE administers the CAFO permit, decides when a facility is required to apply for a permit, approves the nutrient management plan that is required under the permit and is responsible for enforcing the permit.

In Washington, the NPDES permit program, including the CAFO permit, is the responsibility of the DOE. On February 3, 2017, the DOE announced its reissuance of a new CAFO NPDES and a new State Waste Discharge (SWD) General Permit. These permits became effective on March 3, 2017, and expire March 2, 2022. They were reissued as two separate permits, the CAFO SWD General Permit (state permit) and the CAFO NPDES and SWD General Permit (combined permit). The state and combined permits regulate the discharge of pollutants such as manure, litter, or process wastewater from CAFOs into waters of the state. The state permit conditionally authorizes discharges to groundwater only. The combined permit conditionally authorizes discharges to surface and groundwater, including agricultural stormwater. Coverage under a general permit will be available to facilities that meet the definition of a CAFO and that have a discharge or that voluntarily apply for permit coverage.

The CAFO permit requires large-scale livestock operations in Washington to implement specific practices to better protect groundwater, rivers, lakes and marine waters from manure pollution. Discharges conditionally authorized by the CAFO permit must not cause or contribute to a violation of water quality standards.

The DOE has the authority to decide when a facility is required to apply for a permit, approves the nutrient management plan that is required under the permit and is responsible for enforcing the permit. DOE issued a CAFO General permit in 2006 that covered five of the 69 dairies in Yakima County. None of the 11 small or medium sized dairies in the county were considered CAFOs and were not covered by the prior CAFO permit.

The permittee is prohibited from discharging manure, litter, feed, process wastewater, other organic by-products, or water that has come into contact with manure, litter, feed, process wastewater, or other organic by-products, to surface waters of the state from the production area except when:

> 1. Precipitation events cause an overflow of manure, litter, feed, process wastewater, or other organic by-product management and storage facilities which are designed,

> constructed, operated, and maintained to contain all manure, litter, feed, process wastewater, and other organic by-products including the contaminated runoff and direct precipitation from a 25-year, 24-hour rainfall event for the location of the facility and still have lagoon design freeboard;
>
> And,
>
> 2. The production area is operated in accordance with the applicable inspection, maintenance, recordkeeping, and reporting requirements of this permit.

Also, a permittee is prohibited by the permit from discharging manure, litter, feed, process wastewater, or other organic by-products from their land application fields, unless the discharge is generated only by precipitation, not caused by human activities during the precipitation, and the permittee is otherwise in compliance with the permit. The permit establishes production area runoff controls, including the requirement that the permittee must keep manure, litter, and process wastewater from being tracked out onto public roadways. If manure, litter, process wastewater, or other sources of pollutants are tracked out onto public roadways, the permittee must clean-up the material tracked onto the roadway.

The permit establishes conditions related to solid manure, litter, and feed storage, composting facilities, above and below-ground infrastructure, diversion of clean water, prevention of direct contact between animals and water, handling of chemicals, management of dead animals, sampling and analysis of manure, litter, process wastewater, and other organic by-products, and soil sampling.

The permittee must land-apply manure, litter, process wastewater, or other organic by-products in accordance with their yearly field nutrient budgets and at the appropriate rates and times. If the permittee generates more manure, litter, process wastewater, or other organic by-products than the land application fields available to the permittee can appropriately utilize according to their yearly field nutrient budgets, the permittee must find other avenues of appropriately utilizing the excess manure, litter, process wastewater, or other organic by-products e.g., export, composting. The permittee's staff must have sufficient training to be able to land apply in accordance with the yearly field nutrient budgets and at appropriate rates and times to comply with permit conditions.

The permittee must manage the application irrigation water so that the amount of water applied from precipitation and irrigation does not exceed the water holding capacity in the top two feet of soil, thereby preventing the downward movement of nitrate.

The permittee must use field discharge management practices on their land-application fields to limit discharge of manure, litter, process wastewater, and other organic by-products to down-gradient surface waters or to conduits to surface or ground water.

The permittee is permitted to "export" manure, i.e., to relinquish control of how the manure is used. When exporting manure, the permittee must provide the most recent manure, litter, process wastewater, or other organic by-product nutrient analysis to the recipient as part of export. The permittee must keep records of its manure exports.

The GWMA's Livestock/CAFO Working Group found consensus that the DOE's reissued CAFO permits are an affirmative action in addressing groundwater nitrate concentrations within the GWMA, but did not find consensus whether the conditions contained in the reissued CAFO permits are overly, satisfactorily, or insufficiently restrictive.

The elements of a NMP must include methods and technologies of the nature prescribed by the Natural Resources Conservation Service (NRCS), a department of the U.S. Department of Agriculture. RCW 90.64.026(3).

NRCS provides technical assistance to farmers and other private landowners and managers. NRCS has six mission goals: high quality, productive soils, clean and abundant water, healthy plant and animal communities, clean air, an adequate energy supply, and working farms and ranchlands.

NRCS helps landowners develop conservation plans and provides advice on the design, layout, construction, management, operation, maintenance, and evaluation of recommended, voluntary conservation practices. NRCS activities include farmland protection, upstream flood prevention, emergency watershed protection, urban conservation, and local community projects designed to improve social, economic, and environmental conditions. NRCS conducts soil surveys, conservation needs assessments, and the National Resources Inventory to provide a basis for resource conservation planning activities.

NRCS conservation practice standards contain information on why and where the practice is applied, and sets forth the minimum quality criteria that must be met during the use of that practice.

State conservation practice standards are available through the Field Office Technical Guide (FOTG). NRCS believes that nutrient management for the protection of groundwater, although different on each farm, is best accomplished through best management practices beginning with those stated in Standards 590, 449 and 313.

Ch. 90.64 RCW does not require that the best management practices recommended by the NRCS be followed. Nutrient Management Plans are required to be maintained on the farm for review by inspectors. The DNMA requires that all dairies be inspected for implementation of their Nutrient Management Plans and to ensure protection of waters of the state. Most dairies keep their NMP and associated sampling data on location.

The DNMA does not authorize the WSDA to compel nutrient management consistent with NMPs. Representatives of the WSDA state that most "enforcement" is accomplished through the "soft enforcement" efforts that the Department accomplishes through its administrative activities under its Dairy Nutrient Management Program.

Although "farm plans" are not subject to disclosure under Washington's public records law, (RCW 42.56.270 (17)), plans, records, and reports obtained by state and local agencies from dairies, animal feeding operations, and concentrated animal feeding operations not required to apply for a NPDES permit are disclosable under Washington's public records law (Ch. 42.56 RCW), but only in ranges that provide meaningful information to the public while ensuring confidentiality of business information regarding: (1) number of animals; (2) volume of livestock nutrients generated; (3) number of acres covered by the plan or used for land application of livestock nutrients; (4) livestock nutrients transferred to other persons; and (5) crop yields. The ranges of the information required to be disclosed by the public disclosure law (Ch. 42.56 RCW) are set forth in the WSDA's rules implementing that law and Ch. 90.64 RCW, WAC 16-06-210 (29).

c. Waste Storage Facilities (Lagoons)

Liquid manure stored in lagoons can be a source of nitrate and other contaminants. Contents of lagoons often consist of liquid manure (including urine), rainfall and snowmelt, any other liquid corral runoff, and process water from feeding pens and milking areas. Design, construction and management of lagoons are all very important for the protection of groundwater. In studying dairy, beef, and swine lagoons, researchers found substantial variation in the

composition of solids, liquids and dissolved constituents and leakage rates causing a wide variation in the potential to impact groundwater quality. (Ham 2002, Harter et al., 2012a,)

The distinction between a lagoon, a settling basin, a settling pond, or a pond can be hard to clarify. Different professionals use different terms for different manure storage impoundments, and different impoundments may be used for different purposes at different times of year. Producers may mix manure and water in additional ponds before land application.

Different industry experts classify impoundments based on different criteria and experience. In addition, there are a wide variety of different construction techniques and operational techniques for settling ponds and basins. Some are earthen impoundments that are drained and cleaned as needed. Some ponds are concrete lined, engineered basins, which would make using permeabilities for a clay lined impoundment inappropriate.

Lagoon nitrogen concentration depends on farm practices and unit operations on site. Operational differences are often related to whether a dairy uses a flush or scrape system to clean barns, the type of solids separation systems utilized and whether irrigation water is mixed with liquid manure for land application, and potential seasonal effects.

Under the 2017 CAFO permit, the permittee must have adequate storage space for the manure, litter, process wastewater, feed, and any other sources of pollutants on-site during the storage period for the area where the CAFO is located. Lagoons and other liquid storage structures built, expanded, or having major refurbishment e.g., complete emptying and re-compaction to restore the earthen liner done after the issuance of this permit must achieve a permeability of $1x10^{-6}$ cm/s without consideration for manure sealing and there must be a minimum of two feet of vertical separation between the bottom of the lagoon (measured from the outside of the earthen liner) and the water table, including seasonal high water table. Lagoons must be inspected, maintained as to structure and volume, and permanently decommissioned when closed.

d. Animal Holding Areas or Corrals

Animal holding areas or corrals at animal feeding operations are typically unvegetated areas that include pens, freestalls, corrals, and resting and feeding areas. Some areas have extensive concrete and other areas are dominated primarily with a flooring or surface of unlined and compacted soil that can be susceptible to leaching or runoff to contaminant areas. If properly

constructed and maintained, concrete floor surfaces can contain wastes and minimize leaching. Corral surfaces become compacted with use and become dense enough to slow down the downward movement of water and pollutants. Manure accumulating on the surface mixes with the soil layer and forms a low-permeability interface layer that further reduces the permeability of corral and pen surfaces. (Harter et al., 2012a) Nitrogen loading from corrals and pens at dairy and feedlot facilities is governed by engineered sloping, soil type, dairy or feedlot age, unsaturated zone thickness, stocking rate, rainfall, and evapotranspiration rates. In some situations, increased short-term leaching in corrals may occur due to cracking during seasonal weather events.

e. Pens and Composting Areas

There are 2,632 acres within the GWMA identified by WSDA as pens or composting areas. (1,597 acres Dairy CAFO, 499 acres Nondairy CAFO, 536 acres compost). The nitrogen loading rates of pens vary depending upon number and size of stock contained within them and the management of those pens. Nitrogen leaching potential in pens and compost areas is mitigated by low annual precipitation and management of the amount of manures in those pens. Beef cattle feedlots and dairies have different number of animals per-lot. The majority of pens that have been identified as non-dairy CAFOs are most likely dedicated to raising or housing dairy support animals (calves and heifers). However, individual pens may hold calves during one time period and after those animals are moved out, heifers and adult cows may be moved into that same corral or pen.

Management practices are required on the site of dairy CAFO pens, such as maintaining an intact layer between the cattle and the underlying ground to inhibit leaching through the surface of the pen, changes in precipitation and evapotranspiration from season to season, and animal density rates

"Composting," which as a term may refer to a category of activities rather than a specific practice or technology, may occur in windrows, composting in bags, spreading material out over a concrete pad or large surface area to dry, turning frequency, potential moisture additions to material that has dried out. Composting reduces the weight of the basic material. Composted waste can be desired by organic growers as a source of additive to soil structure, soil density, nutrient and weed defoliant.

WSDA, although it does not regulate dairy waste composting, reports that a number of dairies compost their manure on site. 30% to 40% of that composted material is exported out of

Yakima Valley. Limiting factors are the costs of processing and loading. Generally, liquids are applied close to dairies, solids can be transported mid-range and compost may be moved further, due to weight reduction.

f. Buildings Housing Animals

Animals may spend time in freestall barns, milking parlors or loafing sheds. These facilities are built with concrete floors and are cleaned multiple times a day. Potential leaching from these types of buildings, even anticipating cracks in concrete floors that could provide a pathway to leaching, is much smaller than potential from pens and lagoons.

g. Administration and Enforcement

The WSDA's regulations implementing the DNMA are published at chapter 16-611 WAC. WAC 16-611-010 defines "agronomic rate" as "the application of nutrients to supply crop or plant nutrient needs to achieve realistic yields and minimize the movements of nutrients to surface and ground waters."

The WSDA's mission under the DNMA is to "protect water quality from livestock nutrient discharges" and to "help maintain a healthy agricultural business climate." The DNMA does not authorize the WSDA to compel nutrient management consistent with dairy nutrient management plans, Washington's Water Pollution Control Act authorizes the DOE to "bring any appropriate action, in law or equity, including action for injunctive relief . . . as may be necessary to carry out the provisions of that Act (RCW 90.48.037), including its prohibition of the discharge of organic or inorganic matter that may cause pollution of ground or surface water. (RCW 90.48.080)

The WSDA encourages compliance by providing technical assistance as a first step as required by RCW 43.05, but when that is not successful the WSDA has authority under both RCW 90.64 and RCW 90.48 and has informal (warning letters and notices of correction) and formal (civil penalties and orders) enforcement tools available.

In 2013-2014, WSDA issued 17 notices of correction, one order, and 11 notices of penalty for discharges of pollutants to surface waters, statewide, as well as 122 warning letters and 27 notices of correction for potential to pollute. WSDA usually begins with informal enforcement, using warning letters and notices of correction, then proceeding to formal enforcement through civil penalty or administrative order. Most penalties include a settlement process including

reduction in penalty, requirements to adopt specific management practices, to abstain from discharge and collection of entire penalty in the event of non-performance.

Washington's Water Pollution Control Act authorizes the DOE to "bring any appropriate action, in law or equity, including action for injunctive relief . . . as may be necessary to carry out the provisions of that Act (RCW 90.48.037), including its prohibition of the discharge of organic or inorganic matter that may cause pollution of ground or surface water. (RCW 90.48.080)

DOE and WSDA signed a Memorandum of Understanding (MOU) in 2003 to guide coordination and cooperation between the two agencies for dairies, CAFOs and other animal feeding operations. A key element of the MOU is that WSDA inspectors must provide field inspections and technical assistance to DOE for CAFO and other AFO related water quality activities. The two agencies continue to coordinate on livestock and manure related complaints and in implementing the CAFO permit. An updated MOU was signed in 2009. The MOU can be found at

http://agr.wa.gov/FP/Pubs/docs/MOUAgricultureEcology2011Final.pdf

Under the MOU, DOE is responsible to EPA for Clean Water Act compliance for AFOs and CAFOs. DOE maintains authority under Ch. 90.48 RCW to take compliance actions on any livestock operations where human health or environmental damage has or may occur due to potential or actual discharges, for pasture or rangeland based operations, for manure spreading operations when it is determined the manure was not applied by a dairy, for non-dairy AFOs, CAFOs and permitted CAFOs, and ultimately for permitted dairies. Where compliance actions are against non-permitted dairies, DOE recognizes WSDA as lead. Where DOE is involved in investigations and compliance actions against non-permitted dairies, DOE will discuss the compliance actions with WSDA to ensure that timely compliance actions are sufficient to protect human health and the environment. DOE is responsible for the approval of best management practices used to show compliance with water quality standards. DOE must provide available monitoring data and trend analysis for livestock related pollutants to WSDA upon request. DOE's TMDL process must involve WSDA as a stakeholder if livestock issues are anticipated.

The DOE/WSDA MOU requires that both agencies provide the other all livestock related records that either may possess as necessary to fulfill state and federal requirements for livestock

under the Clean Water Act (MOU ¶ C.2), and that the two agencies will coordinate in response to public disclosure requests for AFOs, CAFOs and dairies. (MOU ¶ C.4)

WSDA is responsible for implementing Ch. 90.64 RCW and is required to follow Ch. 43.05 RCW. WSDA is responsible for inspections and may initiate compliance actions on permitted dairies, but must notify DOE if there is a discharge to waters of the state and provide a Recommendation for Enforcement. WSDA is responsible for inspections, complaint response and warning letters for all non-dairy permitted CAFOs. DOE is responsible for complaint response for non-dairy AFOs and CAFOs but WSDA may respond for initial complaint response if resources are available and may write warning letters. WSDA must coordinate, but seldom becomes involved with DOE when compliance actions beyond warning letters are necessary for non-dairy AFOs and CAFOs or permitted CAFOs. WSDA must enter complaint inspections and warning letters on non-permitted AFOs and CAFOs into DOE's PARIS database.

NRCS offers voluntary financial and technical assistance programs to eligible landowners and agricultural producers to help them manage natural resources in a sustainable manner. Those under contract with NRCS to participate in voluntary programs must adhere to relevant standards for funded projects. Current financial assistance programs in Washington State include:

- Agricultural Management Assistance (AMA): helps agricultural producers use conservation to manage risk and solve natural resource issues through natural resources conservation.
- Conservation Stewardship Program (CSP): helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns.
- Environmental Quality Incentives Program (EQIP): provides financial and technical assistance to agricultural producers in order to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation or improved or created wildlife habitat.

Washington's Right to Farm Law

Washington State's right to farm law, RCW 7.48.300-320, was first enacted in 1979, with the purpose of protecting agricultural activities conducted on farm and forest lands from lawsuits sounding in nuisance. As a consequence, "agricultural activities conducted on farmland and forest practices, if consistent with good agricultural and forest practices and established prior to surrounding nonagricultural and nonforestry activities, are presumed to be reasonable and shall not be found to constitute a nuisance." RCW 7.48.305 (1) The defense does not apply however if "the activity or practice has a substantial adverse effect on public health and safety." "Agricultural activities and forest practices undertaken in conformity with all applicable laws and rules are presumed to be good agricultural and forest practices not adversely affecting the public health and safety." RCW 7.48.305 (2) In 2005, Washington's right to farm law was amended to provide for full recovery of costs of litigation in the defense of nuisance suits where the right to farm law was a successful defense. RCW 7.48.315

Residential, Commercial, Industrial and Municipal Groundwater Quality Regulation

Residential and non-residential Onsite Sewage Systems (OSS) are present throughout the Lower Yakima Valley Ground Water Management Area (LYV GWMA) outside of those areas served by municipal sewage collection and treatment systems. Outside of the municipal sewage systems, OSS provide some level of sewage treatment and disposal for both residential and non-residential activities. Residential OSS are especially common in and near the urban growth boundaries of many of the valley's municipalities. Non-residential OSS are scattered throughout the project area serving a variety of public and private entities. OSS comprise one of the several potential sources contributing nitrate-N to the underlying shallow alluvial groundwater system.

Non-agricultural sources of potential contamination of groundwater within the GWMA boundaries include the following:

a. Residential Onsite Sewage Systems (ROSS)

Residential Onsite Sewage Systems (OSS) are present throughout the Lower Yakima Valley Ground Water Management Area (LYV GWMA) outside of those areas served by municipal sewage collection and treatment systems. Residential OSS are especially common in and near the urban growth boundaries of many of the valley's municipalities. Non-residential OSS are also scattered

throughout the project area serving a variety and public and private entities. OSS comprise one of the several potential sources contributing nitrate-N to the underlying shallow alluvial groundwater system.

"Septage" is "the mixture of solid wastes, scum, sludge and liquids pumped from within septic tanks, pump chambers, holding tanks and other OSS components." WAC 246-271A-0010 The total nitrogen content of septage generated in the GWMA varies under individual circumstances. An area-wide average is not available.

WAC 246-272A-0270 provides that the owner of an OSS is responsible for its operation, monitoring, maintaining, repairing, altering or expanding an OSS. The owner must also assure that an evaluation of a simple gravity septic system's components happens at least once every three years and that an evaluation of all other systems occurs every year. The solids and scum must be pumped from the septic system by an approved pumper generally every three to five years or whenever necessary. (EPA 2002) The septic system must not be covered by structures or impervious material. Surface drainage must be trained away from the septic system. The soil above the drain field should not be compacted by vehicles or livestock. Information about the septic system should be disclosed to any future buyer of the property.

There are 6,044 residential households within the GWMA that discharge wastewater to an onsite sewage system. Nitrogen in residential wastewater is mainly generated from human body wastes and food materials from kitchen sinks and dishwashers. The amount of nitrogen present in the wastewater is typically expressed as a concentration in milligrams per liter (mg/L) and/or as a mass loading in grams/person/day.

The highest density of OSS is within and near urban growth areas associated with municipalities. Specifically:

- The highest density of OSS are found on the east and north side of Sunnyside where OSS density ranges from 80 to 100 OSS per section.
- West of Sunnyside near Outlook where OSS density approaches 80 OSS per section.
- In the Zillah to Buena area where density approaches 80 OSS per section.
- Slightly lower OSS density is found south of Grandview, Sunnyside, and Mabton where the OSS range from 50 to 70 per section.

Density of 1-10 ROSS per section are considered to be low density, 11-40 ROSS per section is considered medium density, and over 40 ROSS per section are considered to be high density by the EPA.

The frequency of septic tank pumping in each ROSS in the GWMA is unknown. In a survey conducted by Yakima County, without statistical sampling methodology, 82 percent of 458 surveys collected indicated that they had had their "septic tank pumped recently."

Wastewater discharged to a ROSS is subject to several biological processes including nitrification and denitrification. These processes can take place depending on the environmental conditions and occur most effectively when the soil is unsaturated because the wastewater is forced to percolate over the soil particle surfaces where treatment can take place and air is able to diffuse through the soil. Whether these processes occur and their effectiveness in treatment depends on the physical characteristics of the soil and the environmental conditions of the soil through which the wastewater percolates. Wastewater parameters, such as levels of nitrogen, are removed to varying degrees. Under good conditions (and proper operation and management), organic or ammonia nitrogen is readily and rapidly nitrified biochemically in aerobic soil and some biochemical denitrification can occur in the soil, but without plant uptake, 60 to 90 percent of the nitrate enters the groundwater. Under anaerobic soil conditions, nitrification will not occur, but the positively charged ammonium ion is retained in the soil by adsorption onto the soil particles. The ammonium may be held until aerobic soil conditions return allowing nitrification to occur. (EPA 2002) Within the GWMA, moderate denitrification occurs about three months a year and poor denitrification occurs about three months (soil saturated and no warmth). These factors determine that the total denitrification average in the GWMA is in the range of 10 to 13 percent.

Conventional ROSS technology relies on primary treatment (settling) for solids and organic reduction prior to dispersion to the ground. Innovative ROSS technologies combine the primary treatment with biological treatment to achieve a higher level of treatment. The biological processes promote the removal of nitrogen from wastewater through the multi-step bacterial conversion of ammonia and organic nitrogen to nitrates (nitrification) and the reduction of nitrates to gaseous nitrogen (denitrification). The optimum nitrogen removal of properly operating conventional ROSS technology is up to 20 percent. The projected nitrogen removal of properly operating innovative ROSS technology could be up to 50 percent.

The predominant soil types underlying the ROSS drain fields located within the GWMA are characterized as silt loams that are porous and have a well-developed structure. The estimated depth to groundwater is equal to or greater than 10 feet at approximately 90 percent of the ROSS locations. It is reasonable to assume that the environmental conditions underlying the drain fields are conducive to some level of denitrification.

The location, design, installation, operation, maintenance, and monitoring of OSS is regulated by Chapter 246-272A WAC. The chapter is intended to coordinate with other statutes and rules for the design of OSS under Chapter 18.210 RCW and Chapter 196-33 WAC.

A local board of health must apply to the state DOH to approve local regulations. They must be at least as stringent as the regulations of the state department WAC 246-272A-0015 (9), (10).

The minimum liquid volume for a septic tank serving a single-family residence containing three or fewer bedrooms is 900 gallons. A septic tank serving a single-family residence containing four bedrooms may be 1,000 gallons. Each bedroom after that requires an additional 250 gallons of septic capacity. The actual size of each ROSS within the GWMA is unknown. Permitting for septic systems is done by the Yakima Health District. That agency is also authorized by WAC 246-272A-0015 (5) to "develop a written plan that will provide guidance to the local jurisdiction regarding development and management activities for all OSS within the jurisdiction." The elements of the plan are listed in the WAC.

The local health officer may require the owner of a failing OSS located within 200 feet of a public sewer service to hook up to that system WAC 246-272A-0025. Design specifications for OSS tanks are located at WAC 246-272C.

The amount of land necessary for the installation of an onsite sewage (septic) tank varies depending upon soil type. Table X in WAC 246-272A-0320 establishes the minimums. Table V in WAC 246- 272A-0220 describes the soil types.

TABLE X (WAC 246-272A-0320)

Minimum Land Area Requirement
Single-Family Residence or Unit Volume of Sewage

Type of Water Supply	Soil Type (defined by WAC 246-272A-0220)					
	1	2	3	4	5	6
Public	0.5 acre	12,500 sq. ft.	15,000 sq. ft.	18,000 sq. ft.	20,000 sq. ft.	22,000 sq. ft.
	2.5 acres					
Individual, on each lot	1.0 acre	1 acre	1 acre	1 acre	2 acres	2 acres
	2.5 acres					

TABLE V (WAC 246-272A-220)

Soil Type	Soil Textural Classifications
1	Gravelly and very gravelly coarse sands, all extremely gravelly soils excluding soil types 5 and 6, all soil types with greater than or equal to 90% rock fragments.
2	Coarse sands.
3	Medium sands, loamy coarse sands, loamy medium sands.
4	Fine sands, loamy fine sands, sandy loams, loams.
5	Very fine sands, loamy very fine sands; or silt loams, sandy clay loams, clay loams and silty clay loams with a moderate or strong structure (excluding platy structure).
6	Other silt loams, sandy clay loams, clay loams, silty clay loams.

7 Unsuitable for treatment or dispersal	Sandy clay, clay, silty clay, strongly cemented or firm soils, soil with a moderate or strong platy structure, any soil with a massive structure, any soil with appreciable amounts of expanding clays.

b. Large Onsite Sewer Systems (LOSS)

A LOSS is a septic system serving multiple residences or nonresidential establishments serving twenty or more people per day or having a design volume over 3,500 gallons. Washington State Department of Health records show that there are two LOSS located within the GWMA. One is located outside of Zillah with a design capacity of 5,000 gallons. The second LOSS site is located outside of Granger with a design capacity of 4,850 gallons. Annual reports for LOSS are submitted to the DOH.

Regulations for large on-site sewage (septic) systems (LOSS) are found at WAC 264-272B. LOSS are inventoried with the Department of Ecology as UIC wells (WAC 173-218-040) under a memorandum agreement between DOE and DOH.

c. Commercial Onsite Sewer Systems (COSS)

A COSS is a septic system used for employees working at agricultural or other businesses that operate year-round and are not classified as a LOSS by the DOH. The most likely locations of these facilities within the GWMA are wineries, schools, agriculture packing lines, small businesses (stores, fire stations), agricultural business offices and maintenance buildings, churches, and confined animal feeding operations (CAFOs).

d. Biosolids

Biosolids are a nutrient rich soil amendment derived from public waste treatment plant septage. Septage is a class of biosolids that comes from septic tanks, treatment works and similar systems receiving domestic wastes. WAC 173-308-050. Biosolids are produced by treating sewage sludge to meet certain quality standards that allow it to be applied to the land for beneficial use.

The DOE's biosolid program is administered independently of other agencies, but coordinated with health districts. Land application of biosolids requires pre-approval of application rates that are based upon agronomic crop requirements. Permittees receive coverage under a statewide general permit. Permit coverage is mandated for those who produce and/or land apply biosolids. The DOE's regulatory program incorporates site specific approvals with specific testing and analysis procedures, development of land application plans that prescribe

specific practices and prohibitions, and a review and approval process for land application of the wastewater solids. Land application may only occur on permitted sites with pre-established buffers and setbacks. Application rates require advance approval based on pre-plant soil tests, evaluation of crop type and yield estimates, soil types, use of irrigation. Intermittent post-harvest tests are also conducted. Permittees receive coverage under a statewide general permit. Permit coverage is mandated for those who produce and/or land apply biosolids. The DOE's regulatory program incorporates site specific approvals with specific testing and analysis procedures, development of land application plans that prescribe specific practices and prohibitions, and a review and approval process for land application of the wastewater solids. Land application may only occur on permitted sites with pre-established buffers and setbacks. Application rates require advance approval. Intermittent post-harvest tests are also conducted. The single site approved for land application of biosolids within the GWMA is Natural Selection Farms, 6800 Emerald Road, Sunnyside. Yakima County also receives some biosolids and County landfills.

e. Residential Lawn Fertilizers

Residential lawns exist primarily within towns or urban growth areas within the GWMA. Anecdotal evidence indicates that not all residents fertilize their lawn regularly, and some do not fertilize their lawns at all. Rough estimates are necessary to evaluate how much nitrogen is applied within the GWMA to residential lawns. Nitrate accumulation in the groundwater is not just a matter of nitrogen application rates but also water application rates. While not everyone fertilizes regularly, overwatering occurs at municipal properties, including residences, schools and businesses, particularly if they water daily. Both can have an effect on the loading of even a small amount of nitrogen. Higher population density areas can have a higher percentage of lawn area and the associated potential for more fertilization and overwatering that could be a factor in N loading.

There are no known laws or regulations regarding homeowner maintenance of residential lawns. There are also no known laws or regulations regarding municipal maintenance of parks or grounds.

f. "Hobby Farms"

The term "hobby farm" is intended to mean a land, which may or may not contain a residence, other than lawns, upon which minimialist agriculture is maintained without the intention of profit. It may contribute nitrogen within the GWMA area. These land uses are on parcels of

land less than 10 acres that are not included in the WSDA's crop inventory. Nitrogen contributions on these parcels may come from individual gardens, pastures, pets, and other animals. Co-location of septic drain fields and hobby farming operations, particularly animal farming operations, may cause drain field failure and reduction of denitrification potential.

There are no known laws or regulations regarding maintenance of animals or herbaceous material on "hobby farms."

Underground Injection Wells

Most UIC's in Yakima County are road based and county-owned, put in place to receive surface water runoff from county roads.

Part C of the Federal Safe Drinking Water Act (SDWA), 42 U.S.C. §300h-3, regulates underground injection wells (UIC). Washington's UIC program is administered by the Department of Ecology. Its UIC regulations are found at WAC 173-218. The program is approved by the EPA pursuant to SDWA §1422, 40 CFR !47.2400. The program regulates the injection of fluids underground for storage, enhanced recovery, and disposal to prevent the contamination of underground sources of drinking water. The regulations establish a non-endangerment standard designed to ensure that injected fluids do not cause or contribute to the movement of a contaminant into an underground source of drinking water if the presenceof that contaminant may cause or contribute to the exceedance of a drinking water standard ("MCL") or otherwise adversely affect the health of persons. (40 CFR 144.12, WAC 173-18-080)