FINAL DRAFT

Protecting Critical Water Resources in Dunes City, Oregon
Standards for Septic Systems and their Effluents, including Phosphorus and Nitrogen, and Regulation of Phosphate Containing Products

(Photograph by Bob Anderson)

Background Information Document

And

Draft Ordinance

September 14, 2006

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INTRODUCTION

On March 9, 2006, Dunes City, Oregon, adopted a Septic System Maintenance ordinance “to ensure that all onsite wastewater disposal systems, also known as sewage disposal systems or septic systems, are operated in a safe, healthful and environmentally responsible manner.”[1] The Septic System Maintenance ordinance requires homeowners in Dunes City to provide updated maps of the location of their onsite wastewater disposal systems and to regularly evaluate the integrity of their onsite wastewater disposal systems.

On May 11, 2006, Dunes City adopted an ordinance imposing a moratorium on land development prohibiting the acceptance of applications for partitions, subdivisions and planned

[1] Dunes City, Ordinance number 173, Septic System Maintenance. http://www.dunescity.com/ord173_2nd_read_final.pdf

unit developments.[2] The moratorium found that “subsurface disposal system effluents contain nitrates and phosphorus that eventually migrate into groundwater and surface water sources, providing nutrients that enrich phytoplankton populations … nutrients are also introduced into surface waters through erosion and run-off [and] both Woahink and Siltcoos Lakes have experienced episodes of rapid growth of phytoplankton populations (algae bloom) in recent years.”[3]

The moratorium granted an exemption for “development that demonstrates through site specific soil testing, development of phosphorus adsorption isotherms, and computations performed by an Oregon registered Professional Engineer that detectable levels of phosphorus in the soil from the proposed drainfield locations … will not occur for at least 100-years after installation of the system.”[4]

The moratorium incorporated by reference findings stating that:

> “Residents and commercial businesses exclusively use subsurface waste disposal systems for waste treatment. Dunes City has no septic design criteria, installation standards or ordinances of its own. It generally defers to the standards or criteria set by Lane County or the State of Oregon that do not reflect best practices for the highly permeable soils and nearness of the lakes and wetlands. Higher standards and criteria are needed to reduce nutrient flows to ground waters, wetlands and the lakes. ... Numerous recent advances in the efficiency of subsurface systems in removal of detrimental nutrients bring acceptable standards within reach of an adequate set of ordinances.”[5]
>
> “Dunes City lacks an ordinance addressing the prohibition of fertilizer use containing phosphorus within its minimal 50-foot riparian overlay zone or within it's 1000 foot sensitive zone. And the use of these fertilizers in such close proximity to lakes, streams, and wetlands is very likely a significant source of detrimental nutrient loading to these water bodies..”[6]

In these findings presented here, we discuss the basis for *An Ordinance to Protect Critical Water Resources in Dunes City I – Minimizing phosphorus releases from septic systems*, which is given at the end of this document. In these findings, we first lay out the approaches necessary to maintain the integrity of the water supply for Dunes City. Based on these arguments, we then propose an ordinance to establish standards for reducing nutrient flows to lakes in Dunes City.

The findings and ordinance were drafted with major contributions by Dr. Mark Chernaik - an environmental scientist with fifteen years of experience helping communities solve environmental problems. In preparing the findings and ordinance, Dr. Chernaik solicited and received input and feedback from the following experts:

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[2] Dunes City, Ordinance number 181, Moratorium on Development. http://www.dunescity.com/ord181.pdf
[3] Ibid., at Paragraphs C and E.
[4] Ibid., at Section 2c.
[5] Ibid., at Exhibit A, paragraph 45.
[6] Ibid., at Exhibit A, paragraph 56.

- Dr. Carl Etnier, Project Scientist, Stone Environmental Inc., Montpelier, Vermont, and principal author of the June 2005 publication "Micro-Scale Evaluation of Phosphorus Management: Alternative Wastewater Systems Evaluation;"

- Dr. Anish Jantrania, Technical Services Engineer, Virginia Department of Health, Division of Onsite Sewage and Water Services, Richmond, Virginia, and co-author of the 2006 book "Advanced Onsite Wastewater Systems Technologies;"

- Mark Repasky, Professional Engineer and President, Wastewater Technologies Inc., Tallahassee, Florida;

- Pio Lombardo, Professional Engineer and President, Lombardo Associates, Inc., Newton, Massachusetts, and author of the April 2006 publication "Phosphorus Geochemistry in Septic Tanks, Soil Absorption Systems, and Groundwater;"

- Michael Kucinski, Section Supervisor, Roseburg, Oregon Department of Environmental Quality, Onsite Wastewater Management Program;

- Denise Kalakay, Water Quality Specialist, Lane County Council of Governments, Eugene, Oregon.

1. Consequences of lake over eutrophication

Lake over eutrophication can cause human death and illness through exposure to pathogenic microbes that proliferate in eutrophic conditions.[7] Cryptosporidium and Plesiomonas shigelloides are pathogens that proliferate in lakes experiencing over eutrophication.[8] Cryptosporidium oocysts are highly resistant to common disinfectants, such as chlorine, and survive for months. Over eutrophication of coastal dune lakes near to Dunes City has forced the Oregon Department of Human Services to issue public health advisories against exposure to water from these lakes.[9]

Lake over eutrophication causes chemical and microbial changes in water quality that can impart to water an obnoxious and unpalatable taste and odor.[10]

Lake over eutrophication causes overgrowth of pathogenic microbes that can reduce or eliminate recreational uses of lakes. Overgrowth of pathogenic microbes caused by over eutrophication has forced the Oregon Department of Human Services to advise closure of several coastal dune

[7] Oregon Department of Human Services "Blue-Green Algae Health Concerns in Oregon." http://oregon.gov/DHS/ph/envtox/docs/bgahealthconcernsfaq.pdf
[8] U.S. EPA "Safe Drinking Water - Guidance for people with severely weakened immune systems." http://www.epa.gov/OGWDW/crypto.html; U.S. Food and Drug Administration "Plesiomonas shigelloides." http://www.cfsan.fda.gov/~mow/chap18.html
[9] Oregon Department of Human Services "Tenmile Lakes Toxic Microcystis Bloom." http://oregon.gov/DHS/ph/envtox/tenml.shtml
[10] Davies, J.M. et al. (2004) "Origins and implications of drinking water odours in lakes and reservoirs of British Columbia, Canada." *Water Research*, 38(7):1900-10, page 1900.

lakes to recreational use.[11] Lake over eutrophication also reduces aesthetic values by increasing turbidity and causing discoloration.[12]

2. Status of lakes in Dunes City

More than a thousand people use water from lakes in Dunes City for domestic purposes, including for drinking. Tens of thousands of people visit lakes in Dunes City each year to go swimming, enjoy water sports, fishing and boating and to enjoy their beauty. Algal blooms, obnoxious and unpalatable taste and odor, increased turbidity, and discoloration have been detected during the summer in recent years in lakes in Dunes City, particularly Lake Woahink.[13, 14, 15] Cryptosporidium and Plesiomonas shigelloides have recently infected individuals consuming water from homes that take their water from lakes in Dunes City.[16]

Several studies of conditions at Lake Woahink dating back to the mid-1960s reveal a lake that is in a precarious state.

According to a study published by researchers from Portland State University, the trophic state of Lake Woahink had declined from the late-1960's to the early-1990's:

> "This paper discusses evidence suggesting that the study lakes have become more biologically productive (eutropic), apparently as a result of human activities, and provides additional limnological information about each lake. … Increases in the rate of phytoplankton primary productivity, densities of selected zooplankton species, sedimentation rate, sedimentary vanadium, and numbers of Cyclotella stelligera frustules all indicate that Lake Woahink has undergone significant change relative to its presettlement condition. The primary productivity measurements made in 1992 average 1.5 times larger than the maximum rates measured during 1970-1972 (Table 2). A comparison of data from 1991 and Malick (1970) for the total density of four zooplankton species … showed that the lowest 1991 density (15,300 m3) was almost twice as large as the highest 1968-1969 density (8,200 m3)."[17]

However, this same 1996 study failed to detect changes in Lake Woahink beyond perturbations in the relative composition, not total abundance, of lake microbes:

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[11] Oregon Department of Human Services (October 2002) "Potential recreational hazard at Mercer Lake." http://www.oregon.gov/DHS/ph/envtox/ma102002.shtml

[12] Environment Canada (2001) "Nutrients in the Canadian environment," page 13. http://dsp-psd.pwgsc.gc.ca/Collection/EN1-11-97E.pdf

[13] Dr. Doug. Larson, a limnologist studying these lakes for over thirty years, reported observing 'toxic' blue-green algae in Siltcoos Lake in his fly-overs in 1991. He reported to residents of Dunes City at the City Hall, January 28, 2006, and stated, in part, "... Anybody that takes their drinking water should be very concerned."

[14] Testimony of Susie Navetta before the Dunes City Council, February 20, 2006; Testimony of Mark Chandler before the Dunes City Council, March 2, 2006.

[15] Testimony of Gerald Wasserburg before the Dunes City Council, March 2, 2006.

[16] Testimonies of Holly H. Martin and Miffy Honda to the Dunes City Council

[17] Dagget et al. (1996) "Eutrophication of Mercer, Munsel, and Woahink Lakes, Oregon," Northwest Science, 70(special issue 2):28-38

> "The presence of Cyclotella stelligera in Woahink was cited by Johnson et al. (1985) as partial justification for assigning the lake to oligotrophy, yet the relative numbers of frustules from this species, already the most abundant taxon in Woahink sediments, increased by over a third between the lower strata and the 2 cm depth …, the same period of time that the lake has been apparently undergoing cultural eutrophication. The increase in the relative abundance of C. stelligera as this lake underwent enrichment may be an early indicator of eutrophication. …. Data for chlorophyll a and *dissolved oxygen show no apparent change over time* (Daggett 1994) suggesting that there was a greater shift in species composition than in total primary productivity."[18]

A more recent study published in 2001 by researchers with the Center for Lakes and Reservoirs, Portland State University, noted additional and more serious symptoms of over eutrophication in Lake Woahink evident by 2000 that were not evident in 1994:

> "*Dissolved oxygen concentrations in the hypolimnion of Woahink Lake were generally lower than in previous years* (Figure 16). The lowest concentration measured just prior to turnover was 4 mg/L. Lower concentrations were measured in the hypolimnion when turnover occurred later."[19]

According to a 1999 study by the U.S. Forest Service, Siuslaw National Forest:

> "Eutrophication of Woahink and Siltcoos Lakes is particularly alarming since development continues with neither area wide sewage nor water treatment facilities in this area. Currently, several housing developments around Woahink and Siltcoos lakes rely on small private water treatment facilities of varying size and effectiveness that draw their water from the lakes. Simultaneously, the condition of septic tanks around the lake varies based on age and type. Thorough site evaluations take place by Lane County officials for the installation of new septic systems which must account for soil type and proximity to the lake, but a 1972 survey of septic tanks found that 26% of all tanks within 100 feet of the lake were performing unsatisfactorily (Lane County, 1978). Where systems had failed, sewage was coming to the ground surface very near the lake and in winter almost certainly drained there. …
>
> "If nutrient levels continue to increase relatively unchecked by State or County officials, problems such as those in Tenmile Lake south of this watershed will begin to take place. In Tenmile Lake, toxic algal blooms (Microcystis) have made water unsafe for drinking or recreation during certain times of year with uncertainty of its long-term effects on public safety and the viability of local tourism."[20]

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[18] Ibid.

[19] Systma and Haag (2001) "Oregon Lake Watch 2000 Final Report," Portland State University, at page 17. http://www.clr.pdx.edu/publications/files/clw_report_2000.pdf

[20] U.S. Forest Service/Siuslaw National Forest (1999) "Coastal lakes watershed analysis,"at pages 48-49.

3. The role of nutrients in lake over eutrophication

Lake over eutrophication is one of the most well studied ecological phenomena. Excess input of nutrients, especially phosphorus, but also nitrogen, is always the cause of lake over eutrophication.[21]

3.1. The role of phosphorus

Beginning in 1968, the Experimental Lakes Area Research Unit (ELA) of the University of Manitoba has conducted extensive studies on the role of nutrients as the cause of lake over eutrophication. These studies have dramatically confirmed that phosphorus is the key nutrient that causes lake over eutrophication. According to the ELA:

> "Using small, natural lakes as experimental systems, scientists at the ELA were able to add various combinations of nutrients and determine which of the major plant nutrients (carbon, nitrogen, phosphorus) was the key to controlling cultural eutrophication in lakes. Over a number of years, seven different ELA lakes (227, 304, 302, 261, 226, 303, 230) were experimentally fertilized in various ways. Two of these lakes (227 and 226) were particularly important in demonstrating that phosphorus was the key nutrient for the control of eutrophication.
>
> "Studies of gas exchange and internal mixing in ELA lake 227 during the early 1970's clearly demonstrated that algae in lakes were able to obtain sufficient carbon dioxide, via diffusion from the atmosphere to the lake water, to support eutrophic blooms. Other studies in the same lake demonstrated that certain blue green 'algae' (Cyanophytes or Cyanobacteria) were able to 'fix' nitrogen that had diffused naturally into the lake from the air, thereby making the nitrogen available for supporting algal growth.
>
> "ELA Lake 226 was the site of a visually spectacular experiment. The lake was divided into two approximately equal portions using a plastic divider curtain. Carbon and nitrogen were added to one half of the lake, while carbon, nitrogen and phosphorus were added to the other half. For eight consecutive years, the side receiving phosphorus developed eutrophic algal blooms, while the side receiving only carbon and nitrogen did not. However, after only two years, this experiment convinced even the skeptics that phosphorus is the key nutrient. A multi-billion dollar phosphate control program was soon instituted within the St. Lawrence Great Lakes Basin. Legislation to control phosphates in sewage, and to remove phosphates from laundry detergents, was part of this program."[22]

Depicted on the following page is an aerial photo of divided lake showing over eutrophication in response to added phosphorus. The upper portion of the lake received added carbon and nitrogen and remained clear; the lower portion of the lake received added carbon, nitrogen and phosphorus and experienced an algal bloom.

[21] Carpenter, S. (2005) "Regime Shifts in Lake Ecosystems: Pattern and Variation."
[22] Experimental Lakes Area Research Unit of the University of Manitoba, Eutrophication (Nutrient Pollution). http://www.umanitoba.ca/institutes/fisheries/eutro.html

The trophic state of a lake follows a sigmoidal dependence on phosphorus levels, meaning that as a lake becomes more eutrophied, relatively small additional inputs of phosphorus can cause a very large shift in the lake's trophic state.[23] In certain cases, when a lake is in a mesotrophic state (approaching the midpoint), a small increase in phosphorus loading can abruptly shift a lake to a eutrophic state.

3.2. The role of nitrogen

Excess nitrogen can also encourage lake over eutrophication. According to a 2005 report of the UK Centre for Ecology & Hydrology:

> "Phosphorus is traditionally regarded as the primary nutrient controlling lake productivity. This belief is derived, first of all, from correlations, across a large number of lakes, between phosphorus concentration, usually expressed as total phosphorus, and phytoplankton abundance, usually measured as the concentration of chlorophyll a. A second reason for the focus on phosphorus rather than nitrogen (or carbon) is that the history of eutrophication of lakes … is related to an increase in the availability of phosphorus rather than nitrogen. A third reason for the focus on phosphorus derives from seminal whole–lake experiments on Canadian shield lakes which demonstrated that, in these, phosphorus was the prime limiting nutrient.
>
> "Nevertheless, while it is true that phosphorus is usually the main limiting nutrient in freshwaters, other resources may also be limiting on occasion. ... Furthermore, after decades of anthropogenic P loading and associated eutrophication it is likely that the number of lakes limited by nitrogen has increased. These, in addition to the lakes which might be naturally nitrogen limited, such as those with naturally high P levels, or where

[23] Srinivasu, P.D.N. (2004) "Regime shifts in eutrophied lakes: a mathematical study." *Ecological Modelling*, 179:115-130, at page 4. http://www.ictp.trieste.it/~eee/files/wp19.pdf

denitrification rates are high, suggests that the role of nitrogen in driving over eutrophication in lakes needs to be reviewed.

"Nitrogen is the primary or co–limiting nutrient for phytoplankton production in some lakes in North America. …. N–limitation does not appear to be confined to eutrophic lakes, and has been reported in mesotrophic lakes and in oligotrophic lakes for periods during the late summer in North America. Even where lakes are not predominately N–limited, the N–limitation of phytoplankton can occur even for short periods. …

"As a result of the fixation activities of cyanobacteria it is argued that P–limitation should prevail and any N–limitation should be short lived (Schindler, 1977; Howarth et al.,1999). Nevertheless, Maberly et al. (2002) suggested that the lack of escape from nitrogen–limitation in the relatively unproductive upland lakes they studied may have resulted from environmental factors that were not favourable for cyanobacteria such as low concentrations of P, low pH and high loss rates through flushing.

"Although phosphorus is the main resource that limits phytoplankton growth in many lakes, there is growing evidence that suggests that in certain types of lakes, both upland and lowland, nitrogen may be the primary–limiting or co–limiting nutrient. Some cyanobacteria can fix nitrogen and so, potentially, escape from nitrogen–limitation. This may not be the only mechanism for their dominance in productive lakes with relatively low concentrations of nitrogen but there is a danger that increased phosphorus concentrations, resulting from eutrophication, may lead to greater frequency of nitrogen–limitation, furthering cyanobacterial blooms, some of which may be toxic. In upland lakes where conditions tend not to be favourable for cyanobacteria, nitrogen limitation may be frequent and the lakes accordingly sensitive to changes in nitrogen availability. Overall, it is desirable that N–reduction is carried out hand in hand with P–reduction measures (van der Molen et al., 1998)."[24]

3.3. Irreversibility of lake over eutrophication

Numerous case studies show that lake over eutrophication is often irreversible.[25] After a lake reaches a eutrophic state, decreased oxygen levels in the hypolimnium cause lake sediments to release more phosphorus. Under these conditions, the lake's sediments act as a reservoir of continued phosphorus input into the lake's waters, establishing a dynamic that locks-in eutrophic conditions.[26] Therefore, additional release of phosphorus could result in the irreversible over eutrophication of lakes in Dunes City and the loss of the vital public benefits they provide.

4. Use of fertilizer and input of phosphorus to lakes in Dunes City

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[24] UK Centre for Ecology & Hydrology (2005) "Deriving practical guidance on the importance of nitrogen in freshwater eutrophication." http://194.247.95.101/Resource/Doc/26350/0014464.pdf

[25] Carpenter, S. (2005) "Regime Shifts in Lake Ecosystems: Pattern and Variation." Chapter 2. Regime Shifts in Lakes.

[26] Janssen, M.A. & Carpenter, S.R. (1999) "Managing the Resilience of Lakes: A multi-agent modeling approach." *Conservation Ecology* 3(2): 15. http://www.ecologyandsociety.org/vol3/iss2/art15/

A report of the U.S. Forest Service, Siuslaw National Forest states:

> "An additional source of nutrients to Woahink Lake is the runoff from lawns and driveways that lead directly into Woahink Lake. Sediment and fertilizer laden runoff from these areas are high in phosphorus and nitrogen and are key components of the eutophication now observed. Education and increased awareness of private shore owners is very important to limiting this nutrient source."[27]

A recent study of the U.S. Geological Survey in Wisconsin analyzes in more detail the contribution lawn maintenance makes to the release of phosphorus to lakes:

> "The annual phosphorus load from the nearshore area of Lauderdale Lakes may be greater than the 430 pounds previously estimated. Using a revised median concentration of 2.3 mg/L for surface runoff from an estimated 220 acres of developed shoreline (67 percent of shoreline) within 200 feet from the edge of water, annual total phosphorus load from residential lawns could be as much as 370 pounds (assuming all of the phosphorus reaches the lake). If a delivery of 50 percent of the load is assumed, and the total surface-water load is recomputed using the surface runoff values from the previous study, the total annual surfacewater load from the nearshore drainage area would be 620 pounds, which represents 60 percent of the total annual phosphorus input from all sources."[28]

This study also concluded that: "Runoff from lawn sites with nonphosphorus fertilizer applications had a median total phosphorus concentration that was similar to that of unfertilized sites, an indication that nonphosphorus fertilizer use may be an effective, low-cost practice for reducing phosphorus in runoff."[29]

5. Soil phosphorus levels and plant growth

According to the Oregon Extension Service:

> "Healthy turf does not show a growth or color response to phosphorus. Contrary to the popular notion expressed in many newspapers, magazines and garden books, phosphorus does not enhance root growth of grasses unless it is added to deficient turf. Since the vast majority of lawn soils contain adequate P, supplement applications are usually wasteful.
>
> "Phosphorus is best applied only when soil tests indicate it is low. In all regions of Oregon, a soil test level above 20 ppm indicates that P is adequate and does not need to be applied."[30]

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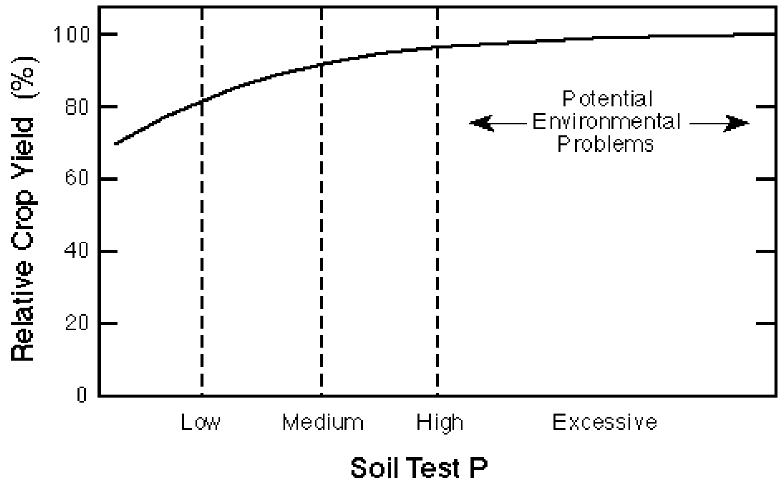
[27] U.S. Forest Service/Siuslaw National Forest (1999) "Coastal lakes watershed analysis,"at pages 48-49
[28] U.S. Geological Survey (2002) "Effects of Lawn Fertilizer on Nutrient Concentration in Runoff from Lakeshore Lawns, Lauderdale Lakes, Wisconsin." USGS Water-Resources Investigations Report 02–4130. http://wi.water.usgs.gov/pubs/wrir-02-4130/wrir-02-4130.pdf
[29] Ibid.
[30] Oregon State University Extension Service (2005) "Fertilizing Lawns." http://extension.oregonstate.edu/catalog/pdf/ec/ec1278.pdf

This is in accord with the Extension Services of other states that have examined the relationship between soil phosphorus levels and healthy plant growth. A publication of the University of Minnesota Extension Service depicts the following response of plants to soil phosphorus.[31]



According to this publication:

> "Soil test levels are measured in a laboratory by either the Bray or Olsen procedure. The Bray procedure is usually used when soil pH is less than 7.4. The Olsen procedure is used when soil pH is 7.4 or higher. The soil test values for phosphorus which correspond to the relative levels are listed [below]:[32]

	Procedure	
	Bray	Olsen
	- - - - - - - - ppm	- - - - - - -
very low	0-5	0-3
low	6-10	4-7
medium	11-15	8-11
high	16-20	12-15
very high	21+	16+

According to the Oregon Extension Service: "On the Oregon Coast, soils range from fine sand to subsoil clays and have a pH in the range of 5.5 (∀ 0.5)."[33] The PH should be determined in order to choose the appropriate analytical method. Therefore, soils in Dunes City should be

[31] University of Minnesota Extension Service (1998) "Agronomic and Environmental Management of Phosphorus." http://www.extension.umn.edu/distribution/cropsystems/DC6797.html
[32] Ibid.
[33] Oregon State University Extension Service (2004) "Practical Lawn Establishment and Renovation." http://extension.oregonstate.edu/catalog/pdf/ec/ec1550.pdf

considered to have medium phosphorus levels if the Bray procedure shows phosphorus levels between 11-15 ppm or 8-11 ppm by the Olsen procedure. Even at these medium soil phosphorus levels, grass growth should be at >80% of levels occurring with abundant soil phosphorus levels.

Moreover, the external addition of phosphate-containing fertilizer is not the only option of insuring that soils contain adequate levels of phosphorus. Best management practices, such as returning grass clippings to a lawn by use of a mulching mower, returns phosphorus to soil, further reducing the need for any use of phosphate fertilizer. Lawn clippings contain about 0.13 pounds phosphorus per 1000 square feet, making them excellent natural fertilizer.[34]

The draft ordinance presented in Section 12 presumes that the use of phosphate fertilizer is not necessary in Dunes City. However, the draft ordinance allows homeowners in Dunes City to still use phosphate fertilizer by performing soil tests on their property that show that their soil is deficient in phosphorus.

Homeowners can collect soil from their property by following a simple procedure.[35] Homeowners can then bring or send soil samples to a laboratory for analysis of phosphorus by the Bray or Olsen procedure, whichever is appropriate. Excluding the cost of shipping, the cost of soil testing for phosphorus is minimal. The Central Analytical Laboratory at Oregon State University charges seven dollars per sample for testing soil phosphorus levels.[36]

Under the ordinance, a test showing that soil deficient in phosphorus is not a license for a homeowner to apply any amount of phosphate fertilizer. Instead, the application of phosphate fertilizer must "not exceed rates recommended by the Oregon State University Extension service for application to a particular plant species." This rate will depend on the level of phosphorus found in a soil test. For example, if a homeowner found soil phosphorus levels of 12 ppm, then an application of only 0.5 pounds of phosphate (as P_2O_5) per 1000 ft^2 of lawn would be necessary.[37]

6. Septic systems and input of nutrients to lakes in Dunes City

Like carbon, phosphorus and nitrogen are essential building blocks of life. Phosphorus is a key element of DNA, and nitrogen is a key element of protein. The human body contains about 1% phosphorus. Phosphorus and nitrogen are in all the foods we eat and, hence, in the wastes people generate. As a result, onsite wastewater systems inevitably receive substantial amounts of these chemical elements.

[34] Minnesota Department of Agriculture (2005) "Phosphorus in Lawns, Landscapes, and Lakes: An Informative Guide on Phosphorus." http://www.mda.state.mn.us/appd/ace/phosphorusguide.pdf

[35] University of Minnesota Extension Service "Lawn Soil Testing." http://www.extension.umn.edu/info-u/plants/BG468.html

[36] Central Analytical Laboratory Oregon State University Soil Test Price List http://cropandsoil.oregonstate.edu/Services/Plntanal/CAL/price.htm

[37] University of Minnesota Extension Service "Soil Test Interpretations and Fertilizer Management for Lawns, Turf, Gardens, and Landscape Plants Established Lawns and Turf." http://www.extension.umn.edu/distribution/horticulture/components/1731-22.html

6.1. Capacity of conventional septic systems to remove nutrients

Conventional septic tanks have little capacity to remove phosphorus. According to a recent review:

> "Organic wastes in the septic tank are partially digested under anaerobic conditions by microorganisms in the tank, which typically reduce biological oxygen demand (BOD) in the effluent by 30 to 50% (US EPA 2002). Nitrogen and phosphorus compounds are also transformed in the septic tank via microbially mediated processes. *Most of the* nitrogen and *phosphorus that enters the tank* in organic molecules from feces, urine, and food waste *is converted to mineralized forms*: organic nitrogen (urea) to ammonia and *organic phosphorus to soluble orthophosphate*. …. *Orthophosphate is the most bioavailable and mobile form of phosphorus; therefore, conversion to orthophosphate in the septic tank has implications for subsequent steps in the wastewater treatment process.*
>
> "*Septic tanks were not developed to remove phosphorus from wastewater*. Cantor and Knox (1986) conclude that septic tanks are not highly efficient in phosphorus removal. The amount of phosphorus removed from the wastewater stream is a function of sludge accumulation in the interval between tank pumpouts. When a septic tank is pumped out, the phosphorus contained in the septage (the sludge, scum, and volume of wastewater in the tank) is removed from the wastewater treatment system. ….
>
> "*In a summary of Scandinavian and US sources, Refsgaard and Etnier (1998) found 3 to 5% phosphorus sequestration in septic tanks.* A recent estimate of phosphorus-removal efficiency of a conventional septic tank was developed by the Ventura Regional Sanitation District (2001) in a demonstration study of several advanced onsite sewage dispersal systems. …. The mean influent phosphorus concentration for the duration of the test period was 3.2 mg/L … The mean effluent phosphorus concentration was 2.9 mg/L, a 9% reduction in total phosphorus. The ranges in phosphorus concentration were 2.3 to 4.5 mg/L and [only] 2.0 to 3.3 mg/L for influent and effluent, respectively. *Despite substantial overlap in the ranges, these data suggest marginal phosphorus removal during normal system operation.*"[38]

Conventional septic tanks are not much better at removing nitrogen. According to a recent report of the Washington State Department of Health:

> "Removal of nitrogen from wastewater is a complex process, even for large wastewater treatment plants. Quality control of nitrogen removal processes from individual onsite wastewater systems is even more difficult to manage. Treatment systems that are most commonly used are relatively efficient in the removal of biological oxygen demand (BOD) and total suspended solids (TSS) from wastewater, but provide less than optimal removal of nitrogen (10-30 %). Most of the nitrogen is released as nitrate (NO_3^-), which

[38] Etnier, C.D., et al. (2005) "Micro-Scale Evaluation of Phosphorus Management: Alternative Wastewater Systems Evaluation." Project No. WU-HT-03-22. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by Stone Environmental, Inc., Montpelier, VT, at page 2-35. http://www.ndwrcdp.org/userfiles/WUHT0322.pdf

> is highly mobile in the soil water. In a conventional septic tank and drainfield system organic nitrogen in household wastes is transformed into ammonia products in the anaerobic conditions of the septic tank (ammonification). When these products exit the septic tank and encounter the aerobic conditions in the drainfield, the ammonia products are biochemically transformed primarily into nitrates (nitrification). These two steps, ammonification and nitrification, occur naturally in conventional systems."[39]

According to this same report:

> "A typical family of four using a conventional septic system can be expected to generate 20 to 50 pounds of nitrogen per year. Ten to thirty percent of this nitrogen is trapped in the septic tank as part of the sludge/scum accumulation in the tank. The nitrogen remaining in the liquid waste is transformed to nitrate when the wastewater leaves the anaerobic conditions of the septic tank and percolates through the aerobic environment of the soil portions of the drainfield. Although there is some potential for denitrification as the wastewater moves through the soil, the majority of the nitrogen produced by the family remains as nitrate loading to the soil. Drainfields installed 2-3 feet deep in soils where there is little organic matter, are relatively inefficient at removing nitrogen."[40]
>
> "Untreated domestic wastewater typically contains 20 to 85 mg/L Total-N."[41]

Because conventional on-site wastewater treatment systems are not designed to remove phosphorus or nitrogen, the use of these systems in lakeshore communities can make up the locally dominant pathway for entry of nutrients to a lake.

6.2. Nutrient limits under Oregon law applicable to septic systems

The primary function of onsite wastewater treatment systems is to protect public health by minimizing human exposure to pathogenic bacteria, of which fecal coliform is an indicator.

The Oregon Department of Environmental Quality (DEQ) has enacted an extensive rule that applies to onsite wastewater treatment systems throughout the state.[42] Under this rule, new, conventional onsite wastewater treatment systems must be designed to comply with 'Treatment Standard 1,' which includes the following numerical limits only:

- A 30-day average of less than 20 mg/L of biochemical oxygen demand (BOD); and
- A 20 mg/L of total suspended solids (TSS)

Thus, there are no limits under existing Oregon law that limit the release of nutrients from new, conventional onsite wastewater treatment systems.

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[39] Washington Department of Health (June 2005) "Report to the Puget Sound Action Team: Nitrogen Reducing Technologies for Onsite Wastewater Treatment Systems."
http://www.psat.wa.gov/Publications/hood_canal/n_reducing_technologies.pdf
[40] Ibid., at page 8.
[41] Ibid., at page A-15.
[42] Oregon Administrative Rules for Onsite Wastewater Treatment Systems, OAR Chapter 340, Division 071

Also under this DEQ rule, some new onsite wastewater treatment systems that include a recirculating sand filter or alternative treatment technology, must be designed to comply with "Treatment Standard 2," which includes the following numerical limits only.

- A 30-day average of less than 20 mg/L of biochemical oxygen demand (BOD);
- A 20 mg/L of total suspended solids (TSS);
- A 30-day geometric mean of less than 400 fecal coliform per 100 milliliters; and
- A 30-day average of 30 mg/L of Total Nitrogen (TN)

Although Treatment Standard 2 includes a limit on levels of nitrogen some onsite wastewater treatment systems may release, it does not include a limit on phosphorus. Furthermore, because Treatment Standard 2 is restricted to onsite wastewater treatment systems that include a recirculating sand filter or alternative treatment technology, the limit on nitrogen levels might have minimal application to Dunes City. We are unaware of any onsite wastewater treatment systems in Dunes City, existing or planned, that would include a recirculating sand filter or alternative treatment technology.[43]

Moreover, as discussed above, typical levels of total nitrogen in septic tank influent range from 20-85 mg/L. So, the 30 mg/L numerical limit for nitrogen in the DEQ rule, in the rare instance it does apply, does not require a substantial reduction, if any, in the amount of nitrogen released by an onsite wastewater treatment system. Rather, it seems that the purpose of the numerical limit for nitrogen in the DEQ rule is to insure that when developers and homeowners install a new onsite wastewater treatment systems that includes a recirculating sand filter or alternative treatment technology, these systems do not increase nitrogen output over what a conventional septic system releases.

7. Removing nutrients from septic systems

There are several options for removing nutrients from on-site wastewater treatment systems. What follows is a discussion of the efficacy and cost-effectiveness of these options.

7.1. Removal of phosphorus via source reduction

7.1.1. Diversion of blackwater

Toilet wastewater (often referred to as blackwater) contributes a substantial fraction of phosphorus to onsite wastewater treatment systems. According to the 2005 NDWRCDP Research Project Report:

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[43] Under the DEQ rule, 'alternative treatment technology' is defined as 'an alternative system,' which in turn is defined as a system 'for use in lieu of the standard subsurface system.' OAR 340-071-0100 – Definitions. If developers and homeowners use the post-septic tank treatment technologies for the removal of phosphorus described in Section 7.2 of this report, then DEQ would likely consider these devices to be 'add-on treatment units' rather than alternative treatment technology.

"removing blackwater from domestic wastewater reduces phosphorus by 75%."[44]

A number of composting toilets with proven track records are commercially available, including the Clivus Multrum composting toilet,[45] the EcoTech Carousel composting toilet system,[46] and the Sun-Mar composting toilet.[47] The total estimated life-cycle cost of a composting toilet ranges from $1600-$6400.[48]

Another option for the diversion of blackwater is the installation of a zero-discharge water recycling system. An example of this technology is the Equaris Infinity Water Recycling System that uses a closed-loop system that eliminates the discharge of phosphorus and other pollutants typically found in septic tank effluent.[49] However, this option is relatively expensive. According to the 2005 NDWRCDP Research Project Report, the system costs $35,000, plus $3,000-5,000 for installation, and entails operating and maintenance costs of $400-500 per year.[50]

7.1.2. Diversion of phosphorus in detergents

Banning the use of high-phosphate detergents is a simple, cost-effective means of lowering phosphorus levels in onsite wastewater treatment system effluent. In addition to normal human wastes, high-phosphate cleaning compounds and detergents are a considerable source of phosphorus contribution to onsite wastewater treatment systems. Many people assume incorrectly that Oregon law prohibits the sale of high-phosphate automatic dishwasher detergent (ADD). However, Oregon law only prohibits the sale of high-phosphate laundry detergent. According to the NDWRCDP Research Project Report:

> "In the early 1970s, when phosphorus limits for laundry detergent were set, automatic dishwashers were relatively uncommon and there was not a perceived need to severely limit or ban phosphorus in dishwashing detergents. Now that dishwashers are common in many homes, efforts are underway in several states to ban phosphorus in dishwashing detergents as well ..."[51]

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[44] Etnier, C.D., et al. (2005) "Micro-Scale Evaluation of Phosphorus Management: Alternative Wastewater Systems Evaluation." Project No. WU-HT-03-22. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by Stone Environmental, Inc., Montpelier, VT, at page 2-8. http://www.ndwrcdp.org/userfiles/WUHT0322.pdf
[45] See: http://www.clivusmultrum.com/projects/residential/index.html
[46] See: http://www.ecological-engineering.com/carousel.html
[47] See: http://www.sun-mar.com
[48] Ibid, at page 2-11.
[49] Equaris Total Household Water Recycling and Wastewater Treatment Systems. http://www.alascanofmn.com/default.asp?Page=Disinfection
[50] Etnier, C.D., et al. (2005) "Micro-Scale Evaluation of Phosphorus Management: Alternative Wastewater Systems Evaluation." Project No. WU-HT-03-22. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by Stone Environmental, Inc., Montpelier, VT, at page A-45. http://www.ndwrcdp.org/userfiles/WUHT0322.pdf
[51] Etnier, C.D., et al. (2005) "Micro-Scale Evaluation of Phosphorus Management: Alternative Wastewater Systems Evaluation. Project No. WU-HT-03-22. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by Stone Environmental, Inc., Montpelier, VT, at page 2-2. http://www.ndwrcdp.org/userfiles/WUHT0322.pdf

Automatic dishwashers (ADWs) are common in existing homes in Dunes City. Virtually every new home in Dunes City is expected to have an ADW. Thus, prohibiting the use of high-phosphate ADD would have an immediate and substantial, beneficial impact on phosphorus levels in on-site wastewater treatment system effluent. According to the NDWRCDP Research Project Report:

> "Restrictions on the phosphorus content of dishwashing detergent similar to those for laundry detergent, limiting phosphorus content to 0.5% or less by weight, would result in an average wastewater influent phosphorus reduction of 23% (0.61 g/day) ...."[52]

Low-phosphate ADD performs just as well as high-phosphate ADD but at little additional cost. A recent analysis of policy options for reducing phosphorus loading in Lake Champlain stated the following:

> "This policy option suggests amending the statutes in Vermont and New York to reduce the P content of all household cleansers to less than 0.5 percent elemental P. ....
>
> "Seventh Generation, Inc. has commissioned independent laboratories to test the effectiveness of phosphate-free ADDs in soft and hard water. The results show that phosphate-free ADDs, both powder and gel, performed as well as phosphate ADDs. Seventh Generation uses sodium citrate and sodium carbonate (washing soda) in its ADD powder and a polycarboxylate in its gel.
>
> "This analysis estimates that there are 5.5 tablespoons of ADD used per wash [and] that the current price differential between P and non-P ADDs will move towards zero as non-P ADDs become the norm rather than the exception, which affects the cost-effectiveness of this policy option. ….
>
> "Currently, phosphate-free ADDs are approximately 15 percent more expensive to consumers than commercial phosphate ADDs. … Assuming that it is not more expensive to produce phosphate-free ADD products, economic forces should result in no additional cost to consumers from this policy.... If the current price differential is maintained … it will cost $8.65 per year for each household with an ADW .... Even under this scenario, they found a ban on P in ADDs to be much more cost-effective than many other options. If the ultimate price differential were to become zero, as we assume, the cost-effectiveness of this policy option would be very high."[53]

In September 2002, Shuster Laboratoriesm a leading independent consumer products testing, quality assurance and R&D firm, compared the performance of several phosphate-free ADDs with the performance of conventional, high-phosphate ADDs, including Procter & Gamble's Cascade™. Shuster Laboratories found that phosphate-free ADDs were just as effective as conventional, high-phosphate ADDs in: 1) removing coffee and tea stains; and 2) preventing filming and spotting.

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[52] Ibid.,at page 2-2.
[53] Winsten, J.R. (2004) "Policy Options for Reducing Phosphorus Loading in Lake Champlain."

Lists, by brand name, of automatic dishwasher detergents and the amount of phosphorus they contain, are readily available.[54]

7.2. Removal of phosphorus via post-septic tank treatment technologies

In 2003, the National Decentralized Water Resources Capacity Development Project commissioned a comprehensive survey of technologies and policy options for controlling the release of phoshorous from on-site wastewater treatment systems. The survey culminated in a report released in June 2005 titled "Micro-Scale Evaluation of Phosphorus Management: Alternative Wastewater Systems Evaluation" (2005 NDWRCDP Research Project Report). More recently, the Massachusetts Alternative Septic System Test Center (MASSTC) evaluated the performance of several phosphorus removal technologies. MASSTC presented its findings in a report titled "Evaluation of Methods to Control Phosphorus in Areas Served by Onsite Septic Systems"(June 2006 MASSTC Report).

The MASSTC report presents the issues quite clearly. The Executive Summary states:

> "Phosphorus presents a unique challenge to watershed managers where residences are served by onsite septic systems to the dearth of available treatment technologies and the role that phosphorus plays in the over eutrophication of freshwater ecosystems. …
>
> "Three technologies were directly tested for their ability to remove phosphorus. A Waterloo Biofilter ™, that demonstrated efficacy in removing nitrogen in previous testing, was modified with a small experimental module of hematite-coated wood chips. The modification exhibited only limited increase in phosphorus removal (~29%) compared with this system without the experimental module (~11%). Phosphex™, a patented upflow filter following a recirculating sand filter and containing basic oxygen furnace slag exhibited > 99% total phosphorus (TP) removal, however the discharge pH was > 11, which precludes discharge to the groundwater under the Massachusetts Department of Environmental Protection regulations. Attempts to buffer the pH of this unit were unsuccessful with the exception of a short period following its passage through peat. PhosRid™, a treatment system with a unique configuration that manipulates the valence state of iron to optimize its combination with phosphorus removed > 99% TP following passage through a final sand filter. This system continues to undergo research and development at MASSTC and has proceeded to the Pilot Approval stage in the Commonwealth of Massachusetts."

It is evident that the phosphate is of first importance and that significant efforts are underway toward developing systems capable of delivering final outflow with total phosphorus less than 1 milligram per liter. While there do not appear to be currently approved systems capable of this performance criterion, it is reasonable to expect that in the next few years they will be available. Some possible contenders are discussed below.

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[54] Missoula Valley Water Quality District "Automatic Dishwasher Detergents." http://www.co.missoula.mt.us/wq/Nutrients/automatic_dishwasher_detergents.htm

7.2.1. Packed-bed filters containing an iron-rich media

According to the 2006 MASSTC Report, a packed-bed filter containing iron-rich media called the PhosRID™ system (Lombardo Associates, Inc.)[55] appears to a promising system:

> "PhosRID is a treatment process for phosphorus that proceeds from the work of Robertson (2000) and others based on a process called **r**eductive **i**ron **d**issolution (RID). Tn this passive process, an iron (Fe[III]) rich porous media is placed in direct contact with unoxidized sewage, such as effluent of a septic tank. …
>
> "At first glance, it may appear that the PhosRID strategy for removing phosphorus is much like the standard addition of ferric chloride ($FeCl_3$) or alum to precipitate the phosphorus. The difference, however is that the iron-rich porous media (containing for instance ferric hydroxide – $Fe(OH)_3$) is slowly dissolved by the sewage under reducing conditions in the septic tank effluent and is utilized for phosphorus adsorption as it is produced. Thus the wastewater stream itself 'triggers' the release of the phosphorus treatment, reducing the need for accurately dosing amounts of other precipitants such as ferric chloride or alum. Another difference between simple alum addition and the RID is that the deposition of the iron-phosphorus compounds takes the form of secondary mineral grains and grain coatings as opposed to a low density flocculant that increases the sludge production (Robertson, 2000).
>
> "As configured at MASSTC, the PhosRID system was undergoing continuing development. …
>
> "During the initial three months, the total phosphorus reductions as measured just after the RID media showed significant reductions (Figure 3-12). However following this initial period, reductions in phosphorus do not appear significant.
>
> "This contrasts with the reductions in total phosphorus following the sand filter element of the system (figure 3-13). During those periods when concurrent samples were taken, total phosphorus levels were generally below our detection limit of 0.5 mg/L.
>
> "Data suggest that this technology has potential to remove phosphorus to levels below 0.5 mg/L. However, significant design features must be determined. The proponent of this technology [Lomardo Associates] has been conducting significant research and developm,ent efforts at MASSTC and continues to do so as of March, 2006."[56]

7.2.2. Packed-bed filters containing lightweight expandable clay aggregate

Examples of lightweight expandable clay aggregate include: Filtralite® (Optiroc Group AB)[57] and Utelite® (Utelite Corporation).[58] According to the NDWRCDP Research Project Report:

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[55] For more details, see: http://www.lombardoassociates.com/phosrid.shtml

[56] Massachusetts Septic System Testing Center (June 2006) "Evaluation of Methods to Control Phosphorus in Areas Served by Onsite Septic Systems." at pages 18-21.

[57] For more details, see: http://www.filtralite.com/arch/_img/177293.pdf

> "Lightweight aggregates (LWAs) are a sort of clay 'popcorn' with high surface area and are often used in horticulture. Some are specially manufactured to increase their phosphorus-sorption capability. It can be used as a medium in packed-bed filters of various designs. …. Filtralite is specially manufactured to increase its phosphorus-sorption capability. It can be used as a medium in packed-bed filters of various designs. One type is composed of 62% SiO_2, 18% Al_2O_3, 7% FeO_3, and less than 5% each of K_2O, MgO, CaO, and Na_2O. …
>
> "For 12 constructed wetland systems using LWAs, average removal is 79%-98% (Jenssen et al. 2004). Over time, the manufacturer has changed the 'recipe' to increase the phosphorus-removal capabilities. Removal percentage is over 95% in all 10 facilities that use blackwater, and they are built from 1991 to 2000. Effluent phosphorus concentrations range from 0.05 to 0.6 mg/L. .... A study in the Florida Keys found that the LWA tested in phase II had the highest phosphorus removal of any method tested, averaging 94% with a mean effluent concentration of 0.53 mg/L (Ayres Associates 2000).

A special version of Filtralite® (Filtralite-P) is designed specifically for phosphorus removal.[59] Performance data of an onsite wastewater treatment system using Filtralite® installed in Florida showed treated effluent had phosphorus levels averaging 0.53 mg/L.[60]

Filtralite® has a substantial cross-capacity to remove nitrogen, removing on average 40% of nitrogen in septic tank effluent.[61]

7.3. Removal of nitrogen via post-septic tank treatment technologies

The most promising post-septic tank treatment technologies that have been tested for the removal of phosphorus from onsite wastewater treatment systems are two types of trickling filters: 1) the Waterloo Biofilter™; and 2) the Nitrex Filter™. These technologies were recently evaluated by the Washington State Department of Health.[62]

7.3.1. The Waterloo Biofilter™

According to the Washington Department of Health:

> "[The Waterloo Biofilter™] averaged 62% removal of total nitrogen with an average total nitrogen effluent of 14 mg/l over the 13-month testing period. Earlier testing of this

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[58] For more details, see: http://www.utelite.com/
[59] Filtralite P. http://www.filtralite.com/arch/_img/176569.pdf
[60] Ayres Associates (2000) "Florida Keys Onsite Wastewater Nutrient Reduction Systems Demonstration Project Phase II Addendum." http://www.doh.state.fl.us/environment/ostds/zip/keysnutrientdemoph2.zip
[61] Ibid.
[62] Washington Department of Health (June 2005) "Report to the Puget Sound Action Team: Nitrogen Reducing Technologies for Onsite Wastewater Treatment Systems."
http://www.psat.wa.gov/Publications/hood_canal/n_reducing_technologies.pdf

> product in a single pass mode demonstrated that it could produce a 20-40% TN reduction."[63]

Unfortunately, the Waterloo Biofilter™ has only limited cross-capacity to remove phosphorus. According to the MASSTC report:

> "The modified Waterloo Biofilter removed an average of 29% (median 27%) of total phosphorus (Figure 3-5) over the period tested. This compares with 11% removal of total phosphorus observed in the standard un-modified Waterloo Biofilter in 1999-2001. While the modification demonstrated some success, the effluent mean concentration of 4.2 mg/L total phosphorus still exceeds levels generally considered necessary to prevent undesirable environmental consequences."[64]

7.3.2. The Nitrex Filter™

According to the Washington Department of Health:

> "The Nitrex™ is a proprietary trickling biofilter developed at the University of Waterloo in Ontario, Canada. Nitrex™ is designed for denitrification and requires a nitrification process prior to the unit. The nitrification unit can be either a public domain process like a lined sand filter or there are a variety of proprietary products that would serve the same purpose. The unit is filled with a proprietary wood byproduct mixture that promotes nitrogen removal. Wastewater containing nitrate, such as nitrified wastewater is applied to the surface of the Nitrex filter. As the wastewater moves through the organic medium, microbial reduction of the nitrate nitrogen (denitrification) occurs. The bed must remain submerged for this to occur due to the anaerobic nature of this reaction. Typically the units are singlepass and do not require pumping.
>
> "Results of testing have been encouraging, with reductions to levels of 2 mg/l reported (Rich, 2003). Unpublished testing data from the Massachusetts Septic System Testing Center (MASSTC) indicate slightly higher results (average of 5.4 mg/l; median of 4.2 mg/l) but still very good results (Heufelder, personal communication 2005)."

Unfortunately, the Nitrex Filter™ has no significant cross-capacity to remove phosphorus. Evaluation of the Nitrex Filter™ at installations in Oregon, Montana, Massachusetts and Rhode Island showed no significant removal of phosphorus.[65]

7.4. Using post-septic tank treatment technologies in Dunes City

Although the post-septic tank treatment technologies have the best performance in terms of removing phosphorus and nitrogen, respectively, these technologies are still developmental in

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[63] Ibid., at page A-45.
[64] Massachusetts Septic System Testing Center (June 2006) "Evaluation of Methods to Control Phosphorus in Areas Served by Onsite Septic Systems."
[65] Lombardo Associates (October 2005) "Supporting Information on Nitrex™ Nitrogen Removal Treatment System."

nature. They are not available off-the-shelf. DEQ has not approved for general use either post-septic tank treatment technologies for the removal of phosphorus or nitrogen. There is serious interest in such systems and the Oregon DEQ Technology Review Committee, which reviews applications for approval of add-on control technologies, is considering such possibilities for approval of add-on control technologies.[66]

For now, developers or homeowners considering the installation of these post-septic tank treatment technologies for the removal of phosphorus or nitrogen can do so only by applying for and receiving a Water Pollution Control Facilities (WPCF) permit.

Under the DEQ rule for onsite wastewater treatment systems:

> "The criteria and standards for design and construction in this division and OAR chapter 340, division 073 apply to all onsite systems.
>
> "(a) For onsite systems subject to WPCF onsite permits, the department may allow variations of the criteria, standards, and technologies in this division and OAR chapter 340, division 073 based on adequate documentation of successful operation of the proposed technology or design. The system designer must demonstrate the performance of new processes, treatment systems, and technologies in accordance with OAR chapter 340, division 052."[67]

The DEQ rule specifies the process of applying for a WPCF permit, including a fee schedule.[68] Information required in the application includes "adequate documentation of successful operation" of the add-on treatment unit.

8. Release of nutrients from failing septic systems

Conventional on-site wastewater treatment systems, even recently installed systems do not remove phosphorus and remove little nitrogen. If only new construction in Dunes City controlled nutrients from their septic systems, then this may not prevent over eutrophication of lakes in Dunes if existing systems continue to release nutrients at their present rate.

Homeowners with failing systems are already obligated by state law to repair their systems. Repair of a failing on-site wastewater treatment system usually requires replacement of the septic tank and several or more other components of the system. Thus, homeowners with failing systems are in a position similar to that of a developer installing a new system in regard to the opportunity of installing options for removing phosphorus and reducing nitrate levels.

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[66] In a meeting of the Oregon DEQ Technology Review Committee serious interest was expressed in Phosphorus removal systems (letter to Lombardo Associates of 26 July from Michael Kucinski, DEQ Interim Onsite Wastewater Management Program Coordinator).
[67] OAR Chapter 340, Division 071, section 0130(19).
[68] OAR Chapter 340, Division 071, section 0162.

Requiring persons with failing on-site wastewater treatment systems to comply with the performance standard for new systems means that, over time, all onsite wastewater treatment systems in Dunes City would better control the release of nutrients as older systems are replaced.

9. Monitoring of nutrient levels in treated septic system effluent

Monitoring of phosphorus levels in treated effluent is necessary to ensure that phosphorus control options are functioning properly. Therefore, new and repaired systems must have sampling ports with access from the ground surface for the purpose of providing access to treated effluent. Under the draft ordinance, a regular schedule of tests for phosphorus and nitrogen in septic system effluent are to be conducted by property owners.

10. Comparable legislation of other states

It is important for Dunes City to take advantage of the efforts other jurisdictions have made to protect lakes by controlling the release of nutrients. These efforts provide examples that Dunes City may follow.

10.1. Legislation restricting the use of phosphate fertilizer

Under Minnesota law:

> "(a) A person may not apply a fertilizer containing the plant nutrient phosphorus to turf statewide, except under conditions listed in paragraph (b).
>
> "(b) Paragraph (a) does not apply when:
>
> "(1) a tissue, soil, or other test by a laboratory or method approved by the commissioner and performed within the last three years indicates that the level of available phosphorus in the soil is insufficient to support healthy turf growth;
>
> "(2) the property owner or an agent of the property owner is first establishing turf via seed or sod procedures, and only during the first growing season; or
>
> "(3) the fertilizer containing the plant food phosphorus is used on a golf course under the direction of a person licensed, certified, or approved by an organization with an ongoing training program approved by the commissioner.
>
> "(c) Applications of phosphorus fertilizer authorized under paragraph (b) must not exceed rates recommended by the University of Minnesota and approved by the commissioner."[69]

[69] Minnesota Statutes, Chapter 18C, Fertilize, Soil Amendment and Plant Amendment Law, Section 60 - Phosphorus turf fertilizer use restrictions. http://www.revisor.leg.state.mn.us/stats/18C/60.html

The Minnesota Legislature enacted this law in 2004 after 23 cities and counties had enacted similar ordinances restricting the use of phosphorus-containing fertilizers for the purpose of preventing over eutrophication of surface waters.[70]

Dunes City should consider a restriction on the use of phosphate fertilizer as provided by this Minnesota state law.

Other local governments across the country have enacted ordinances restricting the use of phosphorus-containing fertilizers. In 2004, Dane County, Wisconsin (home to Wisconsin's capital city, Madison) enacted an ordinance restricting the use of phosphorus containing fertilizer for the purpose of protecting lakes within the county.[71] This law is substantially the same law as that enacted by the State of Minnesota.

In Oregon, on February 21, 2006, the City Council of Lake Oswego adopted the goal to consider a phosphorus free fertilizer ordinance.[72] Commenting on the forthcoming effort to restrict the use of phosphorus-containing fertilizer, Lake Oswegeo Mayor Judie Hammerstad said, "This is a human action causing pollution and it can be altered. It's part of the stewardship of clean water."[73]

10.2. Legislation prohibiting the use of phosphorus containing detergents

On March 27, 2006, Governor Christine Gregoire signed into law a bill passed by large majorities of both houses of the Washington State Legislature prohibiting the sale and use of phosphorus-containing dishwasher detergents. The law states:

> "A person may not sell or distribute for sale a dishwashing detergent that contains 0.5 percent or more phosphorus by weight: (i) Commencing July 1, 2008, in counties with populations, as determined by office of financial management population estimates: (A) Greater than one hundred eighty thousand and less than two hundred twenty thousand; and (B) Greater than three hundred ninety thousand and less than six hundred fifty thousand; (ii) Commencing July 1, 2010, throughout the state."[74]

Dunes City should consider a prohibition on phosphorus-containing dishwasher detergent as provided in this Washington State law.

10.3. Legislation regulating the release of phosphorus from septic systems

Under Chapter 7080 (Individual Sewage Treatment Systems) of the Minnesota Rules

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[70] Minnesota Department of Agriculture: Local units of government with ordinances restricting the use or sale of phosphorus in lawn fertilizer. http://www.mda.state.mn.us/appd/ace/lawnlugphos.htm

[71] Dane County Code, Chapter 80, Establishing Regulations for Lawn Fertilizer Application and Sale. http://www.co.dane.wi.us/pdfdocs/ordinances/ord080.pdf

[72] Lake Oswego City Council Goals, 2006-2007. http://www.ci.oswego.or.us/council/Goals.htm

[73] The Oregonian (April 19, 2006). http://www.oregonlive.com/printer/printer.ssf?/base/news/1145415334226550.xml&coll=7

[74] Engrossed House Bill 2322, 59th Legislature, 2006 Regular Session. http://www.leg.wa.gov/pub/billinfo/2005-06/Pdf/Bills/House%20Passed%20Legislature/2322.PL.pdf

"Section 7080.0179 – Performance ... Subpart 2 – Performance systems. … C. Groundwater and surface water protection. ….

"(3) *If the system is located on a lot which adjoins a lake*, the sewage effluent/groundwater plume shall:

"(a) have a total phosphorus concentration of 1 mg/l or less 50 feet or greater from the soil treatment area; or

"(b) have concentrations of total phosphorus less than 1 mg/l above background concentrations 50 feet or greater from the soil treatment area."[75]

It is unclear how pertinent this Minnesota state law is to the problem of phosphorus releases from onsite wastewater systems in Dunes City. Correspondence with staff of the Minnesota Pollution Control Agency indicates that lakeshore homeowners with onsite wastewater treatment systems in Minnesota rely on the capacity of local soils to sequester phosphorus,[76] a situation that may not pertain to Dunes City.

11. The authority of Dunes City to regulate the use of fertilizer

The Oregon Revised Statutes (ORS) contain a chapter on the regulation of feeds, fertilizers, and seeds.[77] There are no provisions of this Chapter that would preempt local governments from further regulating the use of fertilizers.

Another chapter of the ORS regulates pesticides.[78] This Chapter contains the following provision (ORS 634.057) explicitly preempting local governments from further regulating the use of *pesticides*:

> "No city, town, county or other political subdivision of this state shall adopt or enforce any ordinance, rule or regulation regarding pesticide sale or use, including but not limited to: (1) Labeling; (2) Registration; (3) Notification of use; (4) Advertising and marketing; (5) Distribution; (6) Applicator training and certification; (7) Licensing; (8) Transportation; (9) Packaging; (10) Storage; (11) Disclosure of confidential information; or (12) Product composition."[79]

Although most fertilizers are not pesticides, some fertilizers contain pesticides (for example, Scott's Weed & Feed). The question arises: Would ORS 634.057 preempt Dunes City from banning the use of phosphorus-containing fertilizer?

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[75] Minnesota Rules 7080.0179 Subpart 2C(3). http://www.revisor.leg.state.mn.us/arule/7080/0179.html
[76] Mark Wespetal, Minnesota Pollution Control Agency. Personal communication.
[77] ORS Chapter 633 — Grades, Standards and Labels for Feeds, Fertilizers and Seeds. http://www.leg.state.or.us/ors/633.html
[78] ORS Chapter 634 — Pesticide Control. http://www.leg.state.or.us/ors/634.html
[79] ORS 634.057 – State preemption of local pesticide regulation.

To answer this question, it is instructive to look at developments in Wisconsin. As discussed above, in 2004, Dane County, Wisconsin enacted an ordinance restricting the use of phosphorus containing fertilizer for the purpose of protecting lakes within the county. Wisconsin has a state law preempting local regulation of pesticide use that is nearly identical to Oregon's law that preempts local regulation of pesticide use. The manufacturers of Weed & Feed went to court seeking to overturn the Dane County ordinance on the basis that Wisconsin state law preempts it.

The case first went to the United States District Court for the Western District of Wisconsin, where, on June 13, 2005, a federal district judge upheld the Dane County ordinance on the following grounds:

> "For their preemption argument, plaintiffs place primary emphasis on their contention that state laws regulating pesticides preempt the city and county ordinances, insofar as those ordinances attempt to regulate fertilizer products that are combined with pesticides. Therefore, I will begin with that contention, anomalous as it may seem to begin a federal question lawsuit with a discussion of a state law question.
>
> "Wis. Stat. § 94.64(1)(e) defines pesticides as including fertilizers that are combined with an herbicide, insecticide or any kind of pesticide. Wis. Stat. § 94.701 forbids the state's political subdivisions from prohibiting the use of pesticides or otherwise regulating their use. Relying on these statutes and the purpose behind them, which was to enact uniform pesticide rules on a matter of statewide concern, plaintiffs argue that defendants lack the authority to enact ordinances that attempt to regulate the sale or use of any fertilizer that contains a pesticide (referred to as "mixed fertilizers" in the ordinances).
>
> "Plaintiffs are attacking a straw man of their own construction. Nothing in the challenged ordinances says anything about pesticide composition, use or sale. The ordinances are directed only to the composition, use and sale of the fertilizers with which the pesticides are mixed. The city and county do not allow lawn fertilizers that contain phosphorus, but neither government has attempted to restrict the nature or composition of the pesticides with which a fertilizer product is combined. So long as those pesticides meet state law requirements, manufacturers can mix them with phosphorus-free fertilizer and meet the city's and county's restrictions.
>
> "It is irrelevant to the legality of the ordinances that the state refers to these mixed fertilizer-pesticide products as "pesticides" for the purpose of its regulations. It does so to insure that manufacturers do not try to evade any of the pesticide regulations by mixing their pesticides with fertilizers, not because it is regulating the fertilizer portion of the mixture.
>
> "The city and county would be barred from enacting regulations on fertilizer use and sale if the legislature had expressly withdrawn defendants' power to regulate fertilizer use or sales or if the challenged ordinances conflicted logically with any state legislation, defeated its purpose or went against its spirit. …. *Plaintiffs have identified no action by the legislature to take away the authority of local units of government to regulate*

> *fertilizer use* or shown any logical conflict between the local ordinances and any state legislation."[80]

The manufacturers of Weed & Feed appealed the decision to the U.S. Court of Appeals for the Seventh Circuit, where, on December 23, 2005, a unanimous, three-judge panel affirmed the lower court ruling on the following grounds:

> "This appeal arises from a suit by producers and suppliers of "weed and feed" products against the City of Madison and the county (Dane) in which Madison is located. Weed and feed products are lawn-care products each granule of which contains both a herbicide and a substance, such as phosphorus, that fertilizes. ...
>
> "To comply with the ordinances, the plaintiffs have had to reconstitute their weed and feed products to eliminate the phosphorus. Invoking a variety of federal and state legal theories, their suit seeks a declaration that the ordinances are invalid. The defendants moved for summary judgment, which was granted. The only claim pressed in this appeal is that the ordinances are preempted by a Wisconsin state statute that, with irrelevant exceptions, forbids a city or county to "prohibit the use of or otherwise regulate pesticides." Wis. Stat. § 94.701(3)(a).
>
> "The statutory definition of pesticides embraces herbicides, see Wis. Stat. § 94.67(25), and a regulation defines pesticide to include "a pesticide-fertilizer mixture." Wis. Admin. Code ATCP (Agriculture, Trade, and Consumer Protection) § 29.01(28). Therefore, the plaintiffs argue, their weed and feed products are pesticides, which Madison and Dane County may not regulate by specifying that the products are not to contain phosphorus, even though phosphorus is a fertilizer rather than a pesticide and there is no state preemption of local regulation of fertilizers.
>
> "Yet the plaintiffs themselves quote the provision of the Wisconsin statute that defines "fertilizer" to include "mixed fertilizers," in turn defined as any combination of "a fertilizer material and any other substance," Wis. Stat. § 94.64(1)(e), (l). And a regulation, parallel to the one that defines "pesticide" to include "a pesticide-fertilizer mixture," defines "combination products containing fertilizer" to include "a fertilizer-pesticide combination," Wis. Admin. Code ATCP §§ 40.02(3), (8), (11)—and, lest there be any doubt, adds that " 'weed and feed' products are fertilizer-pesticide combinations." Wis. Admin. Code ATCP § 40.02(11) Note. So it seems that a weed and feed product is both a pesticide, which only the state can regulate, and a fertilizer, which local government can regulate. (For further confirmation that weed and feed products are both pesticides and fertilizers, see Wis. Admin. Code ATCP § 40.02(29).) How can this be?
>
> "The answer is that the dual definition is necessary to avoid creating a regulatory loophole. If "pesticide" were not defined to include a mixed pesticide-fertilizer product, then a manufacturer of a pesticide might be able to get out from under regulation by

[80] *Croplife America v. City of Madison*, Docket No. 04-C-0949-C (W.D. Wis. 2005) http://www.beyondpesticides.org/documents/P_WeedandFeedBan_6-14-05.pdf (emphasis added)

mixing his pesticide with a fertilizer. And if “fertilizer” were not defined to include a mixed pesticide-fertilizer product, then a manufacturer of fertilizer might be able to get out from under regulation by mixing his fertilizer with a pesticide. *The definition of both “pesticide” and “fertilizer” as including a mixture of the two preserves both state regulation of pesticides and local regulation of fertilizers. The state regulates the pesticide components of the mixed products, local government the fertilizer components*.

“Suppose a weed and feed product sold in Wisconsin contained atrazine, a herbicide, as well as phosphorus, a fertilizer. And suppose the state wanted to ban atrazine and Madison wanted to ban phosphorus. The definition of “pesticide” as including a pesticide mixed with a fertilizer would empower the state to ban atrazine in the product, and the definition of “fertilizer” as including a fertilizer mixed with a pesticide would empower Madison to ban phosphorus in the product because there is no state preemption of local fertilizer regulation. If “pesticide” were defined to exclude mixtures, the state would be helpless to deal with atrazine in a weed and feed product, while if “fertilizer” were defined to exclude mixtures, the city could not deal with the phosphorus in the product because (assuming “pesticide” was defined to include mixtures) the product would just be a pesticide, and not also a fertilizer, and so the city and county would be preempted.

“The plaintiffs complain that unless local regulation is preempted, they cannot sell a weed and feed product in Dane County without reconstituting the product to replace phosphorus with some other fertilizer. They have presented no evidence, however, that such reconstitution is infeasible, or even that it is costly. Indeed, they are selling the reconstituted product in Dane County. No doubt they prefer phosphorus to whatever they have substituted for it in the reconstituted product, or else they would have made the substitution voluntarily. But if phosphorus is indeed a pollutant with serious consequences for lakes (which the plaintiffs have made no effort to confute, although they have made some effort to downplay the polluting effect of their products, as by contending that “the waste from one adult goose contributes 13.76 ounces of phosphorus runoff per year or 68 times more than a typical lawn,” though one might suppose that this would depend on where the goose spent his year), the plaintiffs will not be heard to complain. *The defendants point out, without contradiction, that it makes practical sense to allow local regulation of phosphorus because the effects differ from county to county depending on the number and importance of a county’s lakes and other bodies of water,* not to mention the number of geese and other contributors to phosphorus pollution.

“So our interpretation of the statute, which is the natural interpretation as a semantic matter and has the further virtue of closing a regulatory loophole, cannot be rejected on the ground that it produces absurd or unreasonable results, which the Wisconsin legislature is unlikely to have intended. Compare Public Citizen v. U.S. Dept. of Justice, 491 U.S. 440, 453-55 (1989); Green v. Bock Laundry Machine Co., 490 U.S. 504, 527 (1989) (Scalia, J., concurring). Quite the contrary, it produces sensible results. See Krzalic v. Republic Title Co., 314 F.3d 875, 879-80 (7th Cir. 2002); United States v. Hilario, 218 F.3d 19, 23 (1st Cir. 2000).”[81]

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[81] *Croplife America v. City of Madison*, Docket num. 05-3033, December 2005 (7th Cir. 2006). http://www.vlex.us/generic/descarga/19472931,A_35,Q_,17.pdf (emphasis added).

These opinions are from other jurisdictions and are not binding on courts in Oregon. However, a court in Oregon would look to these opinions as guidance if the authority of Dunes City to regulate phosphate fertilizer use were challenged.

12. Draft Ordinance

Based on the extensive arguments presented above, we propose the following ordinance:

The City of Dunes City Finds:

A. Lakes in Dunes City provide essential benefits to the residents of Dunes City, including a source of drinking water;

B. Lakes in Dunes City are beginning to show early signs of over eutrophication. Both Woahink and Siltcoos Lakes have experienced episodes of rapid phytoplankton population growth (algae blooms) in recent years;

C. The residents of Dunes City depend on the use of onsite wastewater treatment systems to dispose of household liquid wastes. Conventional onsite wastewater treatment systems are not designed to remove phosphorus. Effluent from these systems contains phosphorus that migrates into groundwater and into lakes in Dunes City;

D. Use of phosphate fertilizer adds a substantial amount of phosphorus to lakes in Dunes City

E. The use of high-phosphate detergents makes a substantial contribution to the overall phosphorus levels of onsite wastewater treatment system effluent. Low-phosphate detergents perform just as well as high-phosphate detergents at little additional cost;

F. Tested and validated means of removing phosphorus from onsite wastewater treatment system effluent should become commercially available in the near future;

G. If no action were taken, further release of phosphorus into lakes in Dunes City would cause water quality deterioration to accelerate, potentially leading to their irreversible over eutrophication and loss of vital public benefits;

H. The Background Information Document submitted by the Moratorium Support Committee to the Dunes City Council on September 14, 2006, is hereby incorporated by reference as an aid in the implementation of this ordinance.

1. Definitions

(a) "Fertilizer" means a substance containing one or more recognized plant nutrients that is used for its plant nutrient content and designed for use or claimed to have value in promoting plant growth. Fertilizer does not include animal and vegetable manures that are not manipulated, marl, lime, and limestone.

(b) "Turf" means non-crop land planted in closely mowed, managed grasses, including, but not limited to, residential and commercial residential property, private golf courses, and property owned by federal, state, or local units of government, including parks, recreation areas, and public golf courses. Turf does not mean pasture, hayland, hay, turf grown on turf farms, or any other form of agricultural production.

(c) The terms "person," "onsite wastewater treatment system," "failing system," and "existing system," shall have the same meaning as these terms are defined in Division 071, Chapter 340, of the Oregon Administrative Rules.

(d) "New system" means any onsite wastewater treatment system installed after the enactment date of this ordinance.

(e) "Repaired system" means any failing system that is repaired after the enactment date of this ordinance.

(f) "Treated effluent" means liquid emanating from a device or system installed with an onsite wastewater treatment system for the purpose of removing phosphorus from septic tank effluent.

(g) "Composite sample" means a sample prepared by combining a series of individual, discrete samples over known time or flow intervals.

(h) "Automatic dishwashing detergent" means any cleaning agent specifically designed for use in automatic dishwashers;

(i) "Cleaning agent" means a laundry detergent, dishwashing compound, automatic dishwashing detergent, household cleaner, metal cleaner, degreasing compound, commercial cleaner, industrial cleaner, phosphate compound, or other substance that is intended to be used for cleaning purposes;

(j) "Nonphosphorus automatic dishwasher detergent" means any automatic dishwashing detergent containing no more than 0.5 % phosphorus.

2. Restrictions on the use of phosphate fertilizer

(a) A person may not apply a fertilizer containing phosphorus to lawn or garden plants except under conditions listed in subsection (b).

(b) Subsection (a) does not apply when:

(1) A residential property owner or an agent of the property owner conducts a soil test (by a laboratory or method approved by the Oregon Department of Environmental Quality) indicating

that the level of available phosphorus in the soil is insufficient to support healthy plant growth; or

(2) A residential property owner or an agent of the property owner is first establishing turf via seed or sod procedures, and only during the first growing season.

(c) Results of soil tests conducted pursuant to subsection (b) shall be submitted to Dunes City prior to application of phosphorus fertilizer by a residential property owner or an agent of the property owner.

(d) Applications of phosphorus fertilizer authorized under subsection (b) must not exceed rates recommended by the Oregon State University Extension Service publication EC 1278 "Fertilizing Home Lawns."

3. Prohibition of the use of phosphorus-containing cleaning agents

(a) After the commencement date of this ordinance, no person may use any cleaning agent that contains more than 0.5 % phosphorus by weight.

4. Consumer and Retailer Information

(a) Each year the City Council shall provide residents of Dunes City with a list, by brand name, of the most common fertilizers that contain and do not contain phosphorus.

(b) The City Council shall contact the managers of retail stores in Dunes City and its proximate environs to: a) inform such stores about the prohibition on the use of high-phosphate dishwasher detergents in Dunes City; and b) request that such stores post signs, labels or other markings that clearly distinguishes brands of fertilizers that contain and do not contain phosphorus.

(c) The City Council shall provide residents of Dunes City with a list, by brand name, of automatic dishwasher detergents and the amount of phosphorus they contain.

(d) The City Council shall contact the managers of retail stores in Dunes City and its proximate environs to: a) inform such stores about the prohibition on the use of high-phosphate dishwasher detergents in Dunes City; and b) request that such stores post signs, labels or other markings that clearly distinguishes brands of phosphorus-containing automatic dishwasher detergents from non-phosphorus automatic dishwasher detergents.

5. Performance standard for onsite wastewater treatment systems

(a) All onsite wastewater treatment systems must by evaluated by a registered inspector according to Dunes City Ordinance 173 including the requirement for submission of an evaluation report.

(b) Any person installing a new onsite wastewater treatment system after the enactment of this ordinance shall insure that the system include:

(1) Sampling ports to monitor system effluent (see Appendix for Specific Design Standards)

(2) Two outflow connections from the septic tank (see Appendix for Specific Design Standards)

(c) Any person installing a new onsite wastewater treatment system after the enactment of this ordinance shall insure that the level of nitrogen in treated effluent does not exceed 30 milligrams per liter (mg/L).

(d) Subsequent to DEQ approval under OAR Division 340 Chapter 71 of an add-on treatment unit for greater than 95% removal of phosphorus from septic tank effluent, any person installing a new onsite wastewater treatment system shall insure that the level of phosphorus in treated effluent does not exceed 1.0 mg/L.

(e) Any person repairing a failing onsite wastewater treatment system after the enactment of this ordinance shall insure, in addition to making the repairs required by OAR 340-071-0215, that the repaired system complies with subsections (a), (b), (c) and (d) above. Homeowners who would suffer excessive economic hardship from the difference in cost of repairing a system such that it complies with the performance standard, and the cost of repairing the system without regard to the performance standard for nitrogen and phosphorus, should make application to Dunes City, which, after assessing the particular need, will seek funding from outside sources to alleviate the cost difference.

6. Determination of compliance

Any person required to comply with the performance standards in Section 6 of this ordinance shall demonstrate compliance by:

(a) Attaching to the permit application required by OAR 340-071-0160 or OAR 340-071-0162 an additional Exhibit prepared by an Oregon registered Professional Engineer describing how the design of the new or repaired onsite wastewater treatment system would result in phosphorus and nitrogen levels that comply with the performance standard. A copy of the additional Exhibit shall be submitted to Dunes City.

(b) Measuring the levels of total phosphorus and total nitrogen in a 24-hour, composite sample of treated effluent at the following intervals coinciding with the anniversary dates of the installation or repair of systems:

(1) Six months after installation or repair of the system;

(2) Twelve months after installation or repair of the system;

(3) Every three years after installation or repair of the system; and

(4) If a sampling result shows a violation of the performance standard, effluent must be resampled within sixty days. If the resampling result also shows a violation of the perfomance standard, the homeowner shall submit to Dunes City within sixty days a plan indicating the measures necessary to improve the system such that it complies with the performance standard.

(c) Homeowners are allowed a period of three months to conduct measurements required by subsections (c)(1)-(3).

(d) Monitoring data collected in accordance with subsection (b) shall be reported to Dunes City.

7. Penalties

(a) Any person who knowingly uses a fertilizer in violation of Section 2 of this ordinance shall be subject to a fine of not more than $500.

(b) Any person who knowingly uses a cleaning agent in violation of Section 3 of this ordinance shall be subject to a fine of not more than $100.

(c) Any person who installs a new of repaired system not designed to comply with the performance standard of Section 5 of this ordinance shall be subject to a fine of $15,000, or an amount equal to the cost of improving the performance of an existing systems in Dunes City such that it complies with the performance standard.

(d) Any person who fails to monitor phosphorus or nitrogen levels of treated effluent as required by Section 6(b) of this ordinance shall be subject to a fine not to exceed $250. Each calendar date on which a violation occurs constitutes a separate violation until the property is in compliance with the requirements of this ordinance.

8. Severability

If any provision of this Act, or the application thereof to any person or circumstance, is held invalid, the invalidity shall not affect other provisions or applications of this Act, which can be given effect without regard to the invalid provision or application and, to this end, the provisions of this Act are severable.