Drainfield to Surface Water Setback Distance Subcommittee Progress Report

Idaho Department of Environmental Quality

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1. Executive Summary

The Drainfield to Surface Water Setback Distance Subcommittee was tasked to evaluate the established horizontal setback distances required of individual septic (onsite) drainfields from surface water. The setback committee, composed of multiple stakeholder representatives, engineering consultants, health district personnel, and DEQ representatives, pursued identification of pertinent wastewater constituents that could impact surface water quality if discharged too closely. The subcommittee identified 4 classes of wastewater constituents for evaluation: nitrates, phosphorus, pathogens, and Emerging Constituents of Concern. The subcommittee divided into focus groups to investigate applicable peer reviewed literature that addressed each of these constituents. The focus groups reviewed the literature, discussed the findings and generated summary reports documenting their efforts. The summary findings are presented in the body of this report, while each focus group's full findings are provided in the associated Appendices.

The subcommittee concluded that available research on Emerging Contaminants of Concern was inadequate to address subsurface sewage discharge concerns. This area of study is relatively new and currently focused on community wastewater treatment plant discharges to surface water.

The subcommittee concluded that Nitrate's impact was adequately addressed through implementing the Nutrient – Pathogen (NP) Studies and the Technical Guidance Manual's (TGM) Total Nitrogen Reduction Policy. Nitrogen reducing technologies are currently permitted for onsite wastewater treatment, and are thoroughly documented in the TGM. These technologies use the nitrification-denitrification process to convert the ammonia, urea and other nitrogen bearing chemicals to nitrogen gas. The nitrogen gas then escapes into the atmosphere. Additionally, nitrogen is not the limiting nutrient in fresh surface waters.

The subcommittee concluded that Pathogens could potentially contaminate surface water. Pathogens were the constituent that established the current drainfield to surface water setbacks during the 1985 negotiated rule making. Currently, based upon more recent studies, the focus group recommended that the subcommittee accept a minimum effective soil depth of 2 feet (24 inches) of a fine textured, unsaturated soil beneath the drainfield. These unsaturated, fine grained soils have been found suitable for filtering bacterial and viral pathogens from the wastewater, thereby safeguarding the state's ground and surface water resources.

The subcommittee concluded that Phosphorus was the contaminant of greatest concern when considering onsite wastewater discharges impacting surface water. Phosphorus is typically the limiting nutrient in fresh surface waters. Furthermore, phosphorus is a solid and can not be converted to a gas like nitrogen. The soils beneath the site's drainfield have a finite phosphorus adsorption capacity. Some soils have greater phosphorus adsorption capacity than others, with drainfield lifetimes spanning from just a few years to many decades, depending upon the abundance of adsorption sites, and wastewater being pressure dosed to the drainfields. What remains unknown is how the loss of this capacity can be remedied once the soils become saturated with phosphorus. At that point phosphorus will leach into the ground water and adjacent surface water. Preferably, phosphorus would be captured and physically removed from the site to truly protect adjacent surface water.

Current phosphorous reducing wastewater treatment technologies remove phosphorus by capturing it in a media and then removing the media from the site. The subcommittee investigated technologies marketed for phosphorous removal. These technologies all require periodic maintenance which includes media replacement. The subcommittee believes that the current authorities identified in the rules are inadequate to ensure homeowners will properly maintain these technologies and replace expended media when required.

As mentioned above, the site's soils will provide a variable capacity to capture phosphorus. Unfortunately, this capacity is limited and once consumed it is not possible to remediate the site. A technology that the subcommittee all agreed should be required for phosphorus sequestration in the drainfield soils is pressurized dosing. Timed pressurized dosing of drainfields, whether accomplished with shallow low pressure dosing systems or drip dispersal systems, deliver the wastewater to the soils in finite quantities, so that the wastewater flows through the soils in an unsaturated state. This is critical for phosphorus adsorption in the soil.

In order to assess soil's ability to adsorb phosphorus, the subcommittee modeled a select few Idaho soils. DEQ developed a prototype software tool that could be used to evaluate proposed building sites for their efficacy in sequestering phosphorus and subsequently protecting adjacent surface waters. The Idaho soils selected to develop this model were the only soils with the necessary data. The available data supported only a preliminary modeling effort because the soil data was representative of the soil's top few feet. More detailed model development will require more soil data covering a greater soil depth and soil variety. While the model exhibits potential, the limiting factor is the soil's capacity to sequester phosphorus, around which many question remain unanswered. Specifically, what will happen to the adjacent surface water once that capacity is exceeded, and how will a homeowner replace a system that will require virgin soils?

Permitting is the issue that the subcommittee determined was the most problematic. Many questions arose concerning how system maintenance and replacement would be assured and by whom. The subcommittee concluded that the current rules do not adequately support permitting systems that exhibit a finite life. The many outstanding pending issues associated with systems seeking reduced setbacks to surface water are closely related to the permitting limitations.

Various methods of documenting necessary changes were also discussed. Five possible courses of action were identified, although no claim is made that these are exclusively the only possible avenues. The 5 possible courses of action include; (1) do nothing, (2) continue studying the problem, (3) document changes in the TGM, (4) document changes in the TGM and rule, and (5) document changes in the rule alone. Each course of action has associated benefits and detriments. An attempt was made to list these attributes, but no claim is made of completeness.

In summary, the subcommittee established that the current setbacks listed in rule are appropriate for standard, gravity dosed drainfields. Pressurized wastewater dispersal was identified as a requirement if setbacks are to be reduced. Soil analysis must also continue to adequately characterize the site's soils and allow software development to be completed. Permitting and enforcement are not adequate to oversee technologies and drainfields with a limited useful life.

2. Introduction

In 2008, DEQ initiated a negotiated rule making effort to address perceived deficiencies in the current version of the Individual/Subsurface Sewage Disposal (SSD) Rules (IDAPA 58.01.03). During the negotiated rule making, stakeholders requested that drainfield to surface water setback distances be opened for negotiation. DEQ had not investigated this aspect of the rules and was not prepared to discuss changes at that time. The proposed rules presented to the 2009 legislative session did not make it out of committee and were rejected by joint resolution.

In the March 17, 2009, Technical Guidance Committee (TGC) meeting presentations were made addressing DEQ concerns and possible drainfield alterations that could possibly warrant a surface water setback reduction. Stakeholders present at the meeting requested that the TGC establish a subcommittee to investigate whether Idaho's setbacks to surface water were appropriate and could possibly be reduced. The TGC authorized this subcommittee at that time.

Subsequent to the TGC's subcommittee authorization, DEQ issued a letter to potential subcommittee members identifying the task. This 23 September 2009 letter states:

> "The purpose of this subcommittee is to evaluate subsurface sewage system drainfield separation distances from surface water and develop recommendations for appropriate separation distances for drainfields to these surface waters."

The Subcommittee discussed this task and approaches for evaluating drainfield setbacks from surface water. The intent of the SSD Rules was reviewed. The SSD rules (IDAPA 58.01.03.004.01) state:

> "The Board, in order to protect the health, safety, and environment of the people of the state of Idaho establishes these rules governing the design, construction, siting and abandonment of individual and subsurface sewage disposal systems. These rules are intended to insure that blackwastes and wastewater generated in the state of Idaho are safely contained and treated and that blackwaste and wastewater contained in or discharged from each system:
>
> **a.** Are not accessible to insects, rodents, or other wild or domestic animals;
>
> **b.** Are not accessible to individuals;
>
> **c.** Do not give rise to a public nuisance due to odor or unsightly appearance;
>
> **d.** Do not injure or interfere with existing or potential beneficial uses of the waters of the State."

The following goal statement resulted from discussions of the SSD Rule intent and the task requested of the subcommittee.

GOAL STATEMENT:

> Evaluate the appropriateness of Idaho's current drainfield setback distance requirement to surface waster and, if appropriate, make pertinent recommendations to the Technical Guidance Committee and the Department of Environmental Quality addressing new separation distance requirements for inclusion in either the Technical Guidance Manual or the Individual/Subsurface Sewage Disposal Rules (IDAPA 58.01.03).

The history and status of the SSD Rules were presented at the first subcommittee meeting. Prior to 1985, the SSD Rules required 300 feet between a drainfield and surface water. Permit applicants could request a variance from the SSD Rules if they sought a lesser setback. Health Districts (HD) were authorized to grant variances on a case by case basis, but in no instance could the setback be reduced below 100 feet. Additionally, if local ordinance required a greater setback, the HD had to comply with the more restrictive ordinance.

It was during the 1985 negotiated rule making that the drainfield setbacks to surface water were modified to our current distances. Simultaneously, the wastewater flows from homes were reduced to a new baseline. Flow baseline was established at 250 gallons per day (GPD) for a 3 bedroom home and allowed to fluctuate ±50 GPD for each bedroom above or below the baseline. Prior to the 1985 SSD rule change, drainfields were sized based on wastewater flows of 100 GPD per bedroom.

The 1985 Rule revision retained the surface water setback for drainfields in sandy soils at 300 feet, but reduced the setback for drainfields in loamy soils to 200 feet. Furthermore, setbacks for drainfields in silty soils were reduced to 100 feet. All of these setbacks are from permanent or intermittent surface waters. Soil types were labeled A, B, and C to correspond with the sandy, loamy and silty soils. The current setbacks are presented in the Table 1.

Table 1. Drainfield to surface water setback distances.

Surface Water Feature of Interest	Soil Type		
	A	B	C
Permanent or Intermittent Surface Water other than Irrigation Canals & Ditches	300	200	100
Temporary Surface Water and Irrigation Canals and Ditches	50	50	50

The terms permanent, intermittent, and temporary are used to describe surface waters. These terms are defined in the SSD Rules and are provided here in Table 2.

Idaho's neighboring states have established setback distances. Subcommittee members volunteered to contact various states to determine what their surface water setback distance is and how they arrived at the value.

Washington, Oregon, California, Utah, Arizona, Colorado, New Mexico, and North Carolina all have a set separation distance of 100 feet between a drainfield and surface waters. None of these states were able to provide definitive information supporting the predominant use of 100 foot setbacks. Utah and Arizona believed that this distance was established by the US Public Health

Service and documented in Publication 526. The subcommittee has not been able to substantiate this.

Table 2. Definitions of Permanent, Intermittent, and Temporary Surface Waters.

Term	Definition (IDAPA 58.01.03.003.34)
Surface Water	Any waters of the State which flow or are contained in natural or man-made depressions in the earth's surface. This includes, but is not limited to, lakes, streams, canals, and ditches. (10-1-90)
Permanent Surface Water	A permanent surface water exists continuously for a period of more than six (6) months a year. (10-1-90)
Intermittent Surface Water	An intermittent surface water exists continuously for a period of more than two (2) months but not more than six (6) months a year. (10-1-90)
Temporary Surface Water	A temporary surface water exists continuously for a period of less than two (2) months a year. (10-1-90)

Wisconsin has established a 50 foot setback to surface water. Minnesota also has a 50 foot setback to surface water for domestic drainfields, but they are currently pursuing increasing that separation distance to 200 feet. Massachusetts has set 200 feet as a minimum setback to streams supplying drinking water, and 400 feet to drinking water reservoirs.

The subcommittee discussed the lack of supporting information that established the 100 foot setback. It was decided that a scientifically based setback should be sought, based upon site and source attributes. Based on this concept, the subcommittee developed a set of attributes that could be assessed to evaluate a drainfield setback distance. These variables include soil, ground water, system, and wastewater attributes. Table 3 presents the variables that were deemed important for answering this question.

Table 3. Site and Source Attributes

Soil Type	Mass of Soil	% Gravel in Soil	Surface Water Type
Soil's linear loading rate	Depth to Ground Water	Particle size distribution	Surface Water Condition (TMDL?)
Concentration of amorphous Iron	Concentration of amorphous Aluminum	Residual soil phosphorus concentration	Ground Water Gradient
Hydraulic conductivity	Aquifer Dispersivity	Vadose Zone thickness	Distribution Method
Calcium concentration	Soil pH	Soil Bulk Density	Wastewater volume

The number of potential pollutants in a single family's wastewater stream is daunting. The subcommittee discussed which constituents in the wastewater stream were potentially detrimental to the environment, human health, and surface waters. The subcommittee identified 4 categories of wastewater constituents that were labeled "Constituents of Concern" to investigate further. These 4 Constituents of Concern are addressed in Section 3.

3. Constituents of Concern

Early in the subcommittee's meetings, discussions occurred to identify which wastewater constituents would be of greatest concern when discharged in close proximity to surface waters. Various chemicals and biological constituents were appraised. These constituents were all classified under the term "Constituents of Concern".

The identified constituents of concern included nitrates, pathogens, phosphorus and emerging contaminants of concern (Pharmaceuticals and Personal Care Products (PPCP) and Endocrine Disrupting Chemicals (EDC)). Peer reviewed articles from various scientific technical journals and reports were collected and shared with the subcommittee members. It soon became apparent that the amount of information was overwhelming. A suggestion was made to create focus groups to investigate each constituent of concern. Four focus groups were created, each responsible for reviewing and assessing the information on their specific constituent.

Summary statements addressing each focus group's preliminary findings appear below. Each focus group's summary can be found in the appendices of this report.

3.1 Nitrate

Nitrate's impact on ground water is currently evaluated through a Nutrient – Pathogen (N-P) Study for all Large Soil Absorption System (LSAS) projects where flows exceed 2500 GPD and, in certain Health Districts, for projects where flows are less than 2500 GPD but the development is in an area of concern. The goal of these N-P studies is to evaluate whether the proposed development may significantly degrade ground water. The basis for evaluation is the Ground Water Quality Rule's primary constituent standard for nitrate of 10 mg/L (IDAPA 58.01.11.200.01.a). An N-P study that indicates an unacceptably large impact to ground water may occur provides justification to require that wastewater be treated to secondary wastewater quality standards or limit the density of development. There are multiple technologies currently on the market in Idaho that reduce nitrate in their effluent. These technologies use biology to convert inorganic and organic forms of nitrogen (urea, ammonia, nitrite and nitrate) into molecular nitrogen (N_2) which escapes into the atmosphere. This is not an atmospheric contaminant since approximately 78% of the atmosphere is composed of nitrogen gas (N_2). This process is referred to as nitrification-denitrification and is part of the nitrogen cycle.

Additionally, nitrate is not the limiting nutrient in Idaho's fresh surface water. The current controls used to limit the discharge of nitrate to ground water has been found to be sufficient in controlling the degradation to Idaho's ground and surface water resources from onsite septic systems.

The subcommittee has determined that nitrates, once processed adequately, should not significantly influence the decision whether or not to reduce surface water setback distances for individual drainfields. The focus group's summary findings are presented in Appendix A.

3.2 Emerging Contaminants of Concern

The emerging contaminants of concern include pharmaceuticals and personal care products (PPCP), many of which may disrupt biology's endocrine system, and other endocrine disrupting chemicals (EDC). These chemicals have structures with functional groups that mimic biology controlling hormones, which allow these chemicals to effectively influence biological processes when present in minute concentrations. The discovery of these chemicals occurred in association with wastewater treatment plant's discharges to surface water. Fish, amphibians and other aquatic life proved susceptible to the low doses present in the treatment plant's discharges. Additional concern has been raised due to the widespread use of antibiotics and their subsequent discharge in low doses to the environment. It is feared that pathogenic organisms will develop resistance to antibiotics through their exposure to these low doses. We may already see the impact of this exposure in the growing number of infections from methicillin-resistant staphylococcus aureus (MRSA).

This is a new frontier in environmental studies. The information currently available has predominantly focused upon surface water and the impact of wastewater treatment plants. The subcommittee found little information on the soil's ability to treat these chemicals. Consequently, the subcommittee decided that sufficient, pertinent information does not yet exist to evaluate whether these emerging contaminants of concern are impacting our surface waters from drainfields. The focus group's summary findings are presented in Appendix B.

3.3 Pathogens

Pathogen transport to both ground and surface waters has been an area of study for decades. The current Rule specified separation distances were established based upon studies of pathogen transport from drainfields (see Appendix C). These studies identified the potential for both bacterial and viral pathogen transport under saturated flow conditions. Saturated flow conditions exist in non-pressurized drainfields which constitute the vast majority of installed drainfields.

The focus group did discover that unsaturated flow conditions, through soils of a suitably fine texture and depth, typically provide an acceptable environment capable of significantly reducing pathogens. This discovery lead the focus group to recommend that drainfields be pressurized in order to be considered for reduced setbacks to surface water. This technological application, coupled with a minimum effective soil depth of 2 feet (24 inches), composed of a suitably textured soil, should prove sufficient to reduce pathogens in the wastewater stream. The focus group's findings are presented in Appendix C.

3.4 Phosphorus

Phosphorus is a solid non-metal present in all living cells. It is an indispensible biological nutrient used in cell wall construction, DNA, RNA and the cell's energy processes. Phosphorus is typically the limiting nutrient in fresh surface water for aquatic growth. Limiting nutrients are depleted first, limiting the growth of aquatic plants and algae. Phosphorus sources that increase phosphorus concentrations above the background level can contribute to excess aquatic plant growth and blue-green algae blooms. Blue-green algae generate toxins that can sicken and potentially kill animals and humans that may consume it. These algae blooms are a major reason for beach closures.

In addition to human waste, phosphorus is present in many household items such as toothpaste, matches, and detergents as well as pesticides and fertilizers. Because phosphorus is a solid at earth's temperature and pressure, there are no biological processes that convert its form for easy disposal as in the case of nitrogen. Many of the phosphorus containing compounds settle out of the sewage stream in the septic tank, but many are also suspended in the remaining clarified effluent that is discharged to the drainfield. Currently Idaho estimates that the average concentration of phosphorus in septic system's clarified effluent is approximately 9 mg/L (9 parts per million [ppm]).

Since phosphorus is a solid, the subcommittee focused on evaluating the soil's ability to retain phosphorus. Other avenues briefly discussed were emerging technologies that claim to effectively sequester phosphorus. These technologies will be discussed in Section 5.

Soil particles adsorb phosphorus onto their surfaces. The soil's ability to do this is influenced by:

- The amount of fine soil particles,
- The soil's pH,
- The soil's oxidation-reduction (redox) state,
- Various wastewater attributes, and
- The abundance of various metal cations present in the soil, specifically iron (Fe), aluminum (Al) and calcium (Ca).

The reason phosphorus is sequestered by these metal ions is due to phosphorus being present in a highly oxidized state, namely as phosphate. Phosphate (PO_4^{-3}) has a large negative charge, which is attracted to the metal ions positive charge; Ferric iron (Fe^{+3}), Ferrous iron (Fe^{+2}), Aluminum (Al^{+3}), and Calcium (Ca^{+2}). Studies of soil phosphorus adsorption indicate that soils are capable of removing 23% to 99% of applied phosphorus for a limited period of time. The duration of phosphorus adsorption determines the lifetime associated with the drainfield.

Based on this physicochemical process, the subcommittee undertook efforts to model how well various soils would sequester phosphorus. The modeling efforts are presented in Section 4, and a summary of the focus group's findings are presented in Appendix D.

4. Modeling

The subcommittee decided to model phosphorus transport through the soil media between the drainfield and adjacent surface water. This required modeling wastewater flow vertically through the vadose zone's unsaturated soil and horizontally through the saturated aquifer. This section will describe these modeling efforts.

In order to evaluate the impact a drainfield's phosphorus discharge may have on adjacent surface water the effluent's phosphorus concentration must be established. The subcommittee accepted the phosphorus concentration currently used for Nutrient – Pathogen (N-P) studies; 9 mg-P/L (9 ppm). This value is the midrange of the US EPA published range of phosphorus concentrations in their *Onsite Wastewater Treatment Systems Manual* (EPA/625/R-00/008). The reported range is 6 mg/L to 12 mg/L when the water usage is assumed to be 60 gallons per day per person (GPD/capita). These data can be found in the referenced manual in Table 3-7 on page 3-11.

Wastewater flow through the vadose zone is a very difficult phenomena to model. Gravity is not the dominant force moving water in unsaturated soils; the dominant forces are cohesion and adhesion. Cohesive forces exist between water molecules and are what cause water drops to bead. Adhesive forces exist between the water molecules and a surface. Adhesion is what causes water to climb up a straw. These forces combine to yield the common phenomenon known as capillary action. Capillary action allows water to move in all directions in the soil. Since capillary action takes place only in unsaturated flow conditions, the subcommittee agreed that pressurized effluent dispersal should be required for any drainfield that is proposing to remove phosphorus. Another advantage that capillary action provides is that it allows a thin layer of effluent to flow over the soil particles, maximizing the contact between the constituents in the effluent and the Al and Fe on the soil particle's surface.

Since the soil and effluent will be in intimate contact, modeling soil phosphorus adsorption is best accomplished using a thermodynamic model. A thermodynamic model can link the applied phosphorus to the soil's available Al and Fe so that an accounting can be maintained; yielding not only a total mass of phosphorus the soil can remove, but also a time beyond which no more phosphorus can be extracted from the effluent.

The subcommittee sought a technical means, based on applicable science, to determine setback distances from surface water. DEQ is developing a spreadsheet tool, the Onsite Setback Determination Modeling (OSDM) Tool, that shows promise. Still in development, this tool takes into account effluent quality, drainfield attributes, and both aquifer characteristics and ground water quality to calculate an appropriate setback distance from surface water. Since phosphorus has been determined to be the main constituent of concern, OSDM attempts to model soil-phosphorus chemistry in the vadose zone and phosphorus transport in the underlying aquifer.

Removal of phosphorus in the vadose zone, and phosphorus dilution in the ground water are the two stages that are modeled. The first stage of the model predicts how much phosphorus can be 'sorbed' – that is, 'fixed' or bound to the soil – until the phosphorus sorption capacity of the soils below the drainfield are used up. At this point, phosphorus starts to discharge below the drainfield to ground water. The higher the phosphorus fixing capacity of the soil, the longer the site can be utilized.

Development of the vadose zone thermodynamic model is based on limited Idaho soils' information. The data were only available for a few soils that fit into the Subsurface Sewage Disposal Rule soil types B and C (Logan = C-1, Declo = B1 & B-2, Greenleaf, Palouse, Santa and Threebear = B-2). Idaho's sandy soils, designated type A in Rule and the TGM, have not been evaluated.

See Appendix E for further explanation of modeling soil phosphorus sorption in the vadose zone.

The second stage of the model predicts the extent ground water and drainfield percolate will mix. Mixing provides percolate dilution which reduces the phosphorus concentration in ground water. Phosphorus dilution increases in the ground water the further the phosphorus travels from the drainfield. At some point from the drainfield this percolate / ground water mixing will dilute the phosphorus concentration to an acceptably low level, which is yet to be set by regulatory authority, and this distance would be the setback distance required to surface water. An alternative method is to establish the compliance boundary at the surface water boundary, thereby establishing an acceptable phosphorus concentration as that value which will not contribute to surface water degradation. This value will be established by DEQ using the receiving surface water's water quality criteria. The model could then be run to determine the allowable phosphorus discharge concentration at the site's distance to surface water. See Appendix F for further explanation of how percolate / ground water mixing phenomena are modeled.

Finally, these modeling stages and accompanying calculation tools are being put together in a user-friendly spreadsheet to assist qualified professionals in evaluating appropriate setback distances to surface water. These calculations will also be provided graphically. See Appendix G for actual figures of model information entry and results sheets, as well as other notes on the construction of the model.

5. Technology

During these activities the subcommittee became aware of technologies being developed to sequester phosphorus. The subcommittee briefly looked at the state of development of these technologies and determined that only one was mature enough to seriously consider. This technology is pressurized effluent dispersal. The various forms of pressure dispersal will be presented below.

The other technologies under development or entering the commercial market are all expendable media filters. Each of these technologies uses an adsorption media to capture the liquid borne phosphorus. In all instances, the media's finite number of adsorption sites effectively limits the amount of phosphorus that can be captured. Once this capacity is reached the media needs to be replaced. These technologies will be presented in greater detail below.

5.1 Pressurized Drainfields

Pressurized effluent dispersal has been used for decades; most frequently as low pressure dosed system, but more recently using drip dispersal systems. The benefits of using these technologies and the differences of each will be presented below.

5.1.1 Low Pressure, Time Dosed Drainfield

A low pressure dosed drainfield is the simplest pressurized drainfield configuration. The drainfield is typically composed of small diameter pressure pipes that have drilled orifices. The effluent is pressure dosed on a timed schedule to evenly spread the effluent throughout the drainfield. This even distribution of a known volume of effluent increases the likelihood that the soils will be maintained in an unsaturated state. Another method of pressure dosing a drainfield is on demand; on demand dosing does not rely on a regular schedule but rather doses effluent whenever the volume arrives at the system. Demand dosing has an increased potential to saturate the soils, hindering the site's ability to sequester phosphorus. Consequently, demand dosed drainfields should not be allowed where phosphorus sorption is a prime reason for pressurizing the drainfield.

A low pressure, time dosed drainfield should also be placed as high in the soil as practical. This provides the maximum amount of soil for phosphorus sorption. Furthermore, shallow drainfields encourage the effluent to rise in the soil due to capillary forces (adsorption and cohesion). This allows the effluent to transpire through the plant leaves, leaving the phosphorus on the soil's surface or incorporated into the plant.

5.1.2 Drip Dispersal Field

Drip dispersal is the second pressurized drainfield configuration. This pressurized soil dispersal configuration differs from the shallow, low pressure drainfield in 3 significant ways:

- The drip tubing is placed directly in the root zone, as high as practical in the soil column,
- The drip dispersal system can be placed in existing planted areas allowing plant's quick access to the effluent by already established trees and shrubs, and
- The drip dispersal area is significantly smaller than a corresponding drainfield.

Drip tubing placed in the root zone is even higher in the soil column than low pressure dosed drainfields. This placement allows the effluent to evaporate more easily from the soil's surface. It also provides more vertical separation beneath the dispersal area and the underlying limiting layer.

Plant uptake of water and nutrients in the effluent occurs very quickly after installation of a drip system into an area that has established plants. Plants readily evapotranspire the provided water and incorporate much of the available nitrogen and phosphorus; though some plants are dormant in the winter.

While the first 2 differences described in the bullet list above are beneficial for phosphorus sequestration and pathogen removal, the 3rd difference limits the volume of available soil for phosphorus adsorption. This occurs because the drip lines are often placed on a 2 foot on center grid over the required dispersal area, while a pressurized drainfield must have an additional 3 feet of virgin soil on either side of the trench and the trench bottom area must equal the dispersal area. This makes drainfields configured with trenches typically 3 times larger than drip dispersal fields. In defense of the drip dispersal configuration, the drip field can be expanded if the longevity of the field is reduced due to limited adsorption sites. Additional zones can be added to the drip field which will provide additional soil adsorption sites. Although, this expansion will increase the system cost.

Finally, claims have been made that plant uptake will also remove phosphorus. While it is true that plants consume phosphorus, it must be noted that plant's needs are small compared to the mass of phosphorus being discharged to the soil. Additionally, and because phosphorus is a solid, the removal of phosphorus by plants will only occur when and if the owner removes the cut grasses, raked leaves, and trimmed branches from the property. If the grass clippings are mulched, or the leaves composted, the phosphorus is still present and capable of leaching into the soils and adjacent surface water.

5.2 Expendable Media Unit Processes

The subcommittee became aware of the following 3 technologies specifically developed for the onsite / decentralized wastewater market. All 3 technologies have undergone various amounts of testing and have entered the onsite wastewater market, but none are currently approved for use in Idaho.

5.2.1 PhosRID™

PhosRID is a proprietary media filtration system developed and marketed by Lombardo Associates, Inc. of Newton, MA. This system is a passive system, not requiring mechanical pumping or aeration to remove the phosphorus. The sorption media is typically placed following the treatment and consists of the PhosRID media followed by a PhosRID filter. PhosRID removes phosphorus by supplying a ready source of reduced iron that sorbs the phosphorus and then filtration media that captures the iron phosphorus material. RID stands for "Reductive Iron Dissolution". A quick scan of the brochure's data indicates that from a system installed and tested at Massachusetts Septic System Test Center (MASSTC) the total phosphorus (TP) present in the system's influent was 5.7 mg/L with a standard deviation (stdev) of ±2.6 mg/L. The same table reports that the effluent from the PhosRID system yielded 0.4 mg/L with a stdev of ±0.3 mg/L, resulting in 86% phosphorus removal rate. Similarly, 3 single family dwelling installations monitored in Nantucket, MA, yielded a reduction of approximately 99% from the influent phosphorus concentrations.

Pio Lombardo, via direct communication with the subcommittee chair, claims that the PhosRID system has been sized to provide a lifetime of service without having to replace the media or filter. Mr. Lombardo did not provide a duration for the lifetime of his system. The Lombardo Associates brochure is provided in Appendix H.

5.2.2 Phosphex™

Phosphex is a patented process of the University of Waterloo, Waterloo, Ontario, Canada. This process recycles a steel industry byproduct that contains large amounts of metal oxides to adsorb phosphorus. The process media is also mixed with limestone which increases the pH of the effluent stream and enhances the "precipitation and immobilization of dissolved phosphorous (ie. phosphates). The raised pH of the water also simultaneously destroys any water borne pathogens, viruses, and bacteria."

The literature claims that Phosphex will remain active with little maintenance from 8 to 15 years. Phosphex requires that the effluent be pretreated to reduce the biological oxygen demand (BOD) in the media. The spent media is reportedly a non-hazardous waste that can be used in the construction industry as an aggregate material.

A Phosphex component was also subjected to evaluation at MASSTC with associated published test data. Phosphex literature can be found in Appendix I.

5.2.3 PhosRock™ (Polonite)

PhosRock is composed of a natural mineral called polonite which is a calcium silicate mineral. Polonite, when exposed to sewage, dissolves, allowing the calcium to bind with phosphorus. The solution becomes very basic, attaining a pH of 12. The high pH effectively disinfects the effluent. Unfortunately, it has the potential to kill plants also, unless the effluent is neutralized. This will add another system expense, especially in Idaho's southern regions where soils are already very alkaline and do not have the natural ability to neutralize this potentially caustic effluent. Based on typical application media sizing (500 kg replaceable bags), and typical flows from a 3 bedroom, single family residence, an onsite system using Phosphex could provide effective phosphorus removal for 1 to 2 years before the media would need to be replaced.

PhosRock is marketed in the U.S. by Green Tech Global, Inc. located in Fayetteville, AR. The spent media, sludge from filtration and sedimentation can be used as agricultural phosphorus fertilizers and soil amendments. See provided literature in Appendix J.

6. Permitting

Under the current permitting structure, and in light of the enforcement limitations in the current Rules, the subcommittee does not believe it feasible to permit systems using expendable media filters without changing the current SSD Rules. This position is held because of the experience with the current permitting scheme associated with the Extended Treatment Package Systems (ETPS). ETPS are complex treatment systems that generate secondary quality effluent for discharge to the subsurface in areas of concern. These areas of concern may include, but are not necessarily limited to sites with:

- Thin soil over bedrock,
- Shallow ground water,
- Degraded ground water, or
- Other site specific constraints that do not allow permitting a standard septic system.

Problems experienced with homeowners that have ETPSs include, but are not necessarily limited to:

- Owners refuse to maintain the system in violation of their installation permit,
- Owners refuse to pay their contractually obligated annual fees to the operations and maintenance entity or service provider, and
- Owners shutting off the electricity to the aerobic treatment units to save electricity or reduce noise.

There is one attribute that all phosphorus treatment technologies share with the soil; a limited capacity to sequester phosphorus. Even though some soils may be able to function for decades, the final wastewater system state is phosphorus saturation. At saturation, the media and the soil cannot hold any more phosphorus. If the onsite wastewater system uses a phosphorus media filter, the media may simply be replaced, but, if the site relies upon the soils alone to filter the phosphorus, at saturation there may not be any other place to install a new drainfield.

This raises some serious questions:

- How will the regulatory agency ensure that a homeowner replaces the expendable media when required or refurbishes drainfields when they become saturated with phosphorus?
- What action is possible after the soils beneath the drainfield become saturated with phosphorus?
- How will the regulatory agency know when the media filter or drainfield have reached the end of their useful life?

The subcommittee believes that the regulatory agencies currently do not have adequate authority under current regulations to accomplish these tasks. This lack of regulatory authority jeopardizes the agency's ability to protect human health and the environment when it comes to permitting these expendable media filters, and drainfields installed in close proximity to surface waters.

During the 12 August 2010 meeting, the US EPA's *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems* (EPA 832-B-03-001, March 2003) was briefly discussed. The 5 management models were briefly presented. It was posed that one of these management models might possibly providing a structure under which onsite systems containing these expendable media components could be permitted. The 5 management levels are:

- "Management Model 1 – "Homeowner Awareness" specifies appropriate program elements and activities where treatment systems are owned and operated by individual property owners in areas of low environmental sensitivity. This program is adequate where treatment technologies are limited to conventional systems that require little owner attention. To help ensure that timely maintenance is performed, the regulatory authority mails maintenance reminders to owners at appropriate intervals."
- "Management Model 2 – "Maintenance Contracts" specifies program elements and activities where more complex designs are employed to enhance the capacity of conventional systems to accept and treat wastewater. Because of treatment complexity, contracts with qualified technicians are needed to ensure proper and timely maintenance."
- "Management Model 3 – "Operating Permits" specifies program elements and activities where sustained performance of treatment systems is critical to protect public health and water quality. Limited-term operating permits are issued to the owner and are renewable for another term if the owner demonstrates that the system is in compliance with the terms and conditions of the permit. Performance-based designs may be incorporated into programs with management controls at this level."
- "Management Model 4 – "Responsible Management Entity (RME) Operations and Maintenance" specifies program elements and activities where frequent and highly reliable operation and maintenance of decentralized systems is required to ensure water resource protection in sensitive environments. Under this model, the operating permit is issued to an RME instead of the property owner to provide the needed assurance that the appropriate maintenance is performed."
- "Management Model 5 – "RME Ownership" specifies that program elements and activities for treatment systems are owned, operated, and maintained by the RME, which removes the property owner from responsibility for the system. This program is analogous to central sewerage and provides the greatest assurance of system performance in the most sensitive of environments."

Currently, Idaho's regulatory structure does not adhere to any of these management models, but it most nearly approaches the second management model. The subcommittee discussed permitting system structures and the attributes necessary to implement these alternative permitting systems. A flowchart diagramming such a system was even developed to assure all steps and possibilities were addressed during the discussion. This report does not include this flowchart because the flowchart conveys an unrealistic impression that the subcommittee was sure of this course of action when in fact many questions still remain unanswered.

7. Pending Issues

Issues that the subcommittee identified as integral to whether drainfield setbacks could be reduced, and if reductions are authorized how might this be accomplished, fit into the following 4 categories and associated topics:

- Regulatory: Permitting, Monitoring & Reporting, and Enforcement
- Site Evaluation & System Design: Modeling, and Compliance Boundary Constraints
- Homeowner: System life, Operations & Maintenance, and Replacement expense
- Markets: Realtor disclosure, Builder acceptance, and end of life property valuation

7.1 Regulatory

The main regulatory concern is whether or not drainfields can be safely permitted in close proximity to surface water and still protect that surface water from degradation. The limited amount of soils data available increases the risk of incurring surface water degradation if systems are permitted concurrently with data collection; a kind of learn as you go approach. This also raises a question about the type of permit that is applicable. Since the soil has limited ability to adsorb phosphorus, is an installation permit appropriate or is a more restrictive operating permit more applicable? A simple installation permit grants a vested right for the homeowner to discharge their wastewater to the subsurface for as long as the residence is occupied; an operating permit has a time limit associated with it and therefore does not grant a vested right. If operating permits are authorized, what authorities will be applicable to ensure the system performs as required to safeguard the state surface water resource and public health?

Coupled with the life of the drainfield is a question about how to monitor the onsite system's performance, and remaining drainfield adsorption capacity. How will soil phosphorus saturation be determined and who will have access to the property to monitor the system's status? After the system's capacity is reached what method of wastewater disposal will the homeowner use? Will system monitoring to determine the system's remaining capacity be the obligation of the regulator, a service provider, or the homeowner? Will the homeowner be qualified to perform the necessary servicing and monitoring? Who will report the system's status? Will the state wait until surface water exhibits significant degradation before initiating enforcement action? What are the acceptable methods of enforcement?

Since the technology and the native soils have limited capacity to sorb phosphorus, implying a finite lifetime that the system will be capable of sequestering phosphorus, how will the state "encourage" homeowners to replace saturated media or install new drainfields? Will the site have adequate area to install a third drainfield? Isn't this just delaying the inevitable failure of the onsite system and risking surface water degradation in the future?

7.2 Site Evaluation & System Design

Many of the site and system issues are also regulatory in nature, but the consultant or engineer would use them to evaluate the site and design an appropriate system. Compliance boundaries and the associated phosphorus concentration is the main unknown at this time. It was proposed that this will have to be accomplished on a case by case basis since it relies upon the water quality of the adjacent surface water. Others felt that it would be more easily addressed if default values were generated and only those sites that did not comply with predefined conditions be required to undergo modeling. There is merit in this last suggestion, but with the limited amount of available Idaho soils data there is increased risk of surface water degradation by establishing criteria without supporting scientific data. Couldn't the current rule established setback distances and system configurations be used as the default values?

Site evaluation and system design typically establishes a 'lifetime' during which the system is expected to be in compliance with the permit and rule. Considering that the soils have a limited adsorption capacity, what is an acceptable lifetime for a residential drainfield? Is it 30 years per drainfield as many member of the subcommittee felt was appropriate? Does the permit require that both drainfields be installed before wastewater can be discharged to the environment? This has merit, even though it would cost more than a typical installation. The system would last years longer and the homeowner would not incur remobilization expense to install the second drainfield. Additionally, inflation costs would be saved when the entire system is installed at the initial mobilization. But what could the homeowner do once the system lifetime expired?

7.3 Homeowner

Many of the homeowner concerns may be handled through outreach, to educate the homeowner on the limitations associated with systems designed to sequester phosphorus. This information would help homeowners make informed decisions. One concern with this scenario is that it may not be the same homeowner in the home when the drainfield lifetime expires. This could be addressed through an operating permit, which would require permit transfer when the property changed ownership.

Additional concerns that may also be overcome by adequate education involve system periodic maintenance requirements, and associated expenses. These are concerns for homeowners who may find themselves on tight budgets. Ultimately, this should not be any different than residents living in the city and incurring periodic sewer bills. The main issue for the homeowner revolves around systems that rely totally upon the soil's adsorption capacity. What are these homeowners to do when their drainfield's capacity it reached? Will homeowners experience precipitous property devaluation?

7.4 Market

Concerns were voiced about how the realtors, builders, and lenders may view possible proposed changes to drainfield's surface water setback distances. While it was generally accepted that the builders and realtors would embrace this proposal, they may balk at the increased building costs incurred to perform site evaluations. Design and construction of site specific wastewater systems will also be more expensive than most complex systems. The associated increase in construction costs may be offset by opening up many lakefront lots that command a premium price. Additional concern that the realtor associations may not be fully aware of include their obligation to fully divulge information to prospective buyers. If onsite systems are approved for phosphorus sequestration in close proximity to surface water a key point that will need to be disclosed to prospective buyers is the amount of drainfield life remaining. This also raises concerns about how the mortgage industry may respond to these situations.

Lenders may impose financing restrictions on properties where the wastewater system has a limited useful life. Lenders may only offer shorter term loans on these properties. This may be especially problematic if a new buyer is seeking financing and the remaining expected life of the site's wastewater system exceeds the financing term offered by the lender. It is highly unlikely that a fully informed lender would not discount a property's value under this condition.

8. Possible Courses of Action

There are several possible courses of action that can be pursued at this juncture. Due to the varying positions that currently exist among the subcommittee members, the following section will attempt to present these possible avenues, list some benefits, and detriments of each listed course of action. What appears below is a partial listing of possible avenues, and associated benefits and detriments; no claim is made of completeness.

- Maintain the current set of Rules and the Technical Guidance Manual as is.

This particular direction would not change how we have been doing business. A perceived benefit to this course of action is that our current requirements and restrictions are known. The main detriment is that stakeholders and property owners who believe that they should be allowed to build on affected property may feel slighted and ignored and seek a legislative solution.

- Continue investigation and development of software tools?

This particular direction would not necessarily retain the current status quo, but could be implemented with any other chosen course of action. A definite benefit would be additional information collected over time that would help establish a more thorough assessment of Idaho's soils. Currently, Idaho does not have any data addressing sandy soils. The 6 soils that the subcommittee has data on are classified as Sandy loam (B-1), loam (B-2), silt loam (B-2), and silty clay loam (C-1).

It must be made clear that this classification system is not refined enough to address all soils in Idaho. There are many soils in Idaho that would be classified as a B-1, but may have significantly different amounts of available amorphous Fe and Al, and effective soil depths, all of which impact a drainfield's sorption capacities. Consequently, it should be recommended, regardless of the selected course of action, that soil samples be collected from the test pit horizons and analyzed to quantify the actual available amorphous Fe and Al.

This particular direction does not exclude other courses of action. Benefits would include collecting data that would help refine the model. A detriment to pursuing this action alone is a perceived delay in establishing alternative setback distances, which could result in stakeholders and property owners seeking a legislative solution.

- Leave the Rule unchanged but modify the TGM?

This particular direction would document all necessary changes in the TGM. The guidance manual could provide a section detailing minimum system design and construction requirements. This would be a benefit for the installers and consultants because they are already familiar with this document, and this type of information is best distributed to the stakeholders in guidance. Additionally, future changes would be reviewed and approved through the TGC which would provide quicker response than if it required negotiated rule making and legislative approval. A detriment associated with this course of action is that one can not enforce effectively from a guidance manual. In fact, DEQ is prohibited from enforcing guidance.

One of the benefits to leaving the Rule alone is that it addresses standard, gravity dosed septic systems, which are still permitted extensively around the state at suitable sites. The subcommittee concluded that the current rule established setbacks are appropriate for these types of systems and do not need to be changed.

- Modify both the TGM and the Rule?

Some of the detriments and benefits of changing the TGM are presented under the immediately preceding heading.

Modifying rule could provide needed updates. Stakeholders and regulators could benefit from clear definitions for bedroom, module, and other terms used in the rule and TGM. Regulatory structures paralleling those proposed by the US EPA's *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems* (EPA 832-B-03-001, March 2003) could provide a more conducive permitting system that addresses the needs of systems that require periodic maintenance and media replacement. Detriments to pursuing rule changes include the time and effort expended by state agencies with no assurance that the resulting product will be accepted by the legislature. Additionally, DEQ believes that there is no value in pursuing negotiated rule making without participation from **<u>all</u>** stakeholders; that includes realtor associations, building contractors, equipment distributors, installers, consultants and regulatory agencies.

- Modify the Rule alone?

Modifying only the rule poses many disadvantages, mainly because the TGM provides design and construction clarification that the stakeholders have become familiar with. Additionally, the TGM's authority over advanced treatment technology review and approval is provided by rule (IDAPA 58.01.03.004.07 through .004.10). Restricting modifications to rule alone would severely restrict the expediency provided by the TGC to review and approve new technologies, which are being developed at an ever increasing pace.

9. The Appendices

Appendices are provided under separate cover in the file "Progress Report – Appendices – 10Mar2011.doc"