



Draft Spokane County Critical Aquifer Recharge Areas Review Technical Memorandum #4

Prepared for: Spokane County Division of Utilities 1026 West Broadway Avenue Spokane, WA 99260

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Acronyms

CARA critical aquifer recharge area

gpd gallons per day

HDR HDR Engineering, Inc.

IDEQ Idaho Department of Environmental Quality
MDEQ Montana Department of Environmental Quality

N-P nutrient-pathogen

PAZ Phosphorus analysis zone SCC Spokane County Code TMDL total maximum daily load

UGA urban growth area

WDOE Washington Department of Ecology WDOH Washington Department of Health



Introduction

Study Objectives and Approach

The objective of this study is to review, and if necessary, recommend updates to the critical aquifer recharge area (CARA) wastewater disposal standards for non-residential uses and activities outside the urban growth areas (UGA) boundary (Spokane County Code (SCC) 11.20.075). HDR Engineering, Inc. (HDR) is working with Spokane County to review the current standard and to evaluate the need for standard revisions. An important component of this project is stakeholder participation, which includes a series of meetings and document review. Stakeholder engagement is being supported by Sarah Hubbard-Gray of Hubbard Gray Consulting.

This study involves an assessment of non-residential sanitary wastewater loadings to soils (typically through septic system drainfields) that are protective of groundwater in susceptible aquifer areas outside the UGA boundary. Understanding loadings that are protective of groundwater in this sensitive area allows for recommendations for revised standards. In addition, surface water protection associated with groundwater-to-surface-water discharge will be considered in this analysis. Acceptable constituent loadings to soil that lead to loadings to groundwater are dependent upon several factors, including wastewater constituent type, soil hydraulic and adsorption properties, groundwater properties, surface water properties, hydraulic loadings, and effluent attenuation factors.

To meet project objectives, the following tasks are being conducted:

- a. Define area of study.
- b. Define non-residential uses.
- c. Define non-residential sanitary wastewater characteristics.
- d. Define environmental/resource properties for the area of study.
- e. Define groundwater quality criteria.
- f. Analyze the aquifer mixing zone.
- g. Determine soil loadings.
- h. Determine sanitary wastewater loadings.
- i. Develop a predictive model.

Four technical memoranda (drafts and finals) are being developed during the study, that describe the above listed tasks and findings, along with supporting documentation:

- i. Technical Memorandum # 1 Introduction of regulations and description of current standards and summary of tasks a through d (listed above).
- ii. Technical Memorandum # 2 Documentation for task e.
- iii. Technical Memorandum # 3 Documentation for tasks f through h.
- iv. Technical Memorandum # 4 Documentation for task i.

This document, *Technical Memorandum #4*, presents the following information:

- An approach to implementing the findings of the preceding memoranda.
- Recommended updates.



Overview

The Technical Memoranda #1, #2, and #3 include definitions of the study area, non-residential uses, non-residential sanitary wastewater characteristics, environmental/resource properties for the area of study, and groundwater quality criteria. The Technical Memoranda #1, #2, and #3 also include information about analyzing the aquifer mixing zone, determining soil loadings, and determining sanitary wastewater loadings. In other words, a review of the regulations, the process and characteristics of sanitary wastewater entering an on-site treatment system from a non-residential use and flowing through the soil and groundwater were investigated. A literature review was performed to determine the characteristics. Analytical methods were examined to calculate the impact to groundwater.

These reviews led to an understanding of groundwater loading analyses. Acceptable constituent loadings to soil are dependent upon several factors, including wastewater constituent type, soil hydraulic and adsorption properties, hydraulic loadings, and effluent attenuation factors. Groundwater and surface water properties are also important; however, both the results of the analyses and comments from stakeholders cautioned that incorporating too many complexities into a revised standard will very challenging and difficult to implement into policy. Attributes that the method should address were identified as part of the stakeholder survey, during the CARA Review Committee meetings, and from example applications of the methods. Based on findings during the progression of the study, key attributes that were identified from the stakeholder reviews to consider in selecting a method include:

- The update must be scientifically based.
- The update must be protective of water resources and water quality, especially the groundwater.
- The process should be straightforward and concise for applicants and the County to use.
 Application of the process should provide consistent and equitable evaluation of projects County-wide.
- While the process should include the same evaluation methodology for all applicants, it should also include additional options for supplementary evaluations to provide flexibility for unique situations that may be justified with detailed supporting information.
- The update should be consistent in application.

A tiered modeling process (levels 1 through 3) for assessing potential impacts to groundwater and surface water is proposed as part of the standard revisions, where level 1 involves evaluations for nitrogen, phosphorus, and hydraulic loadings based on a few simple input parameters and assumed default values (yet based on science). If necessary, the applicant can then conduct a level 2 analysis using more site specific information, or the applicant may choose to conduct a level 3 analysis that involves a detailed site specific study.

This Technical Memorandum, #4, provides a summary predictive model that is recommended as part of an update to the CARA wastewater disposal standards for non-residential uses and activities outside the UGA boundary. An approach is proposed that addresses the identified challenges while still being based on the science of the analytical methods reviewed in the earlier Technical Memoranda. The proposed approach integrates hydraulic, nitrogen, and phosphorus loadings into one analysis requiring limited inputs by the user and straightforward results for the County's review. Additionally this proposed approach is consistent with CARA requirements for other counties in Washington.



This project approach of combining the findings and discussions about the policy and regulations, science and data, and stakeholder input that led to the key points and recommended update is summarized by **Figure 1**. The intent of the recommended update is for an applicant to demonstrate that a proposed on-site subsurface sewage disposal system complies with the policies and regulations governing such systems and is protective of water resources and water quality, particularly CARAs.

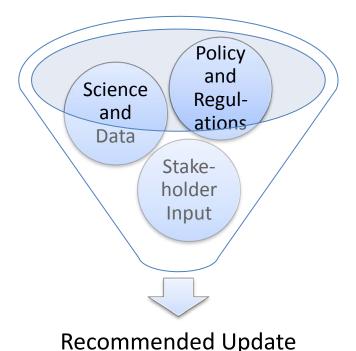


Figure 1. Process for Developing Recommended Updates to CARA Sanitary Wastewater Standards for Non-Residential Uses for Outside the Urban Growth Area

Overview of Recommended Process

For county approval of a non-residential on-site sanitary wastewater discharge outside the UGA in moderate and high CARA sensitive areas, an application process including use of a spreadsheet tool is recommended. Most applicants would have the software (Microsoft Excel) and familiarity with spreadsheets to use this tool. This CARA Spreadsheet includes basic project inputs. The applicant would need to determine these inputs either based on the guidance provided as part of the CARA Spreadsheet instructions or based on existing requirements. The CARA Spreadsheet performs some calculations and provides an assessment of the proposal.

A completed CARA Spreadsheet and application package would be submitted to the County for review. The County may accept or deny the application package. A CARA Spreadsheet that indicates a positive assessment does not ensure acceptance. The County may deny an application based on other information in the application package or because unreasonable input values were used in the CARA Spreadsheet.



While many projects are anticipated to be met with the requirements in the CARA Spreadsheet, additional options are provided for those that do not. Three levels of analysis are proposed:

- Level 1 CARA Spreadsheet or base level analysis with key input values.
- Level 2 Mid-level analysis allowing for modifications to County selected input values to the CARA Spreadsheet requiring scientific documentation.
- Level 3 Detailed study or high level analysis for complicated sites and/or projects providing a means to demonstrate a feasible and protective approach for wastewater disposal.

For those projects that result in a negative assessment, the next step is for the applicant to make appropriate adjustments or to justify changes in spreadsheet input parameters. Adjustments may include reducing the wastewater volume be reducing the size of the project and/or volume of water used or by changing the size of the drainfield area. In considering changes to the spreadsheet input parameters, detailed supporting information is needed to justify these modifications. For example, based on the project type and specific equipment and processes that will be employed, the designer may provide supporting information to use a lower wastewater nitrogen or phosphorus concentration. Finally for projects resulting in a negative assessment with adjustments and modifications, the designer may elect to perform a detailed study (level 3). The detail study could include, for example, evaluation of groundwater parameters and implementation of a groundwater mixing zone analysis. This iterative process of options is shown in **Figure 2**.

The Recommended Process with Options for Meeting CARA is shown in a flow chart in **Figure 3**. Again, the process is to complete the CARA Spreadsheet, if the assessment is negative, then perform adjustments and/or provide detailed supporting information for a modified CARA Spreadsheet. If adjustments and modifications do not result in a positive assessment, then the applicant may undertake a detailed study or accept restriction of wastewater discharges to soils for the parcel. A proposal for the approach of the detailed study should be submitted for discussion and review with the County prior to study initiation. The objective of the proposal review is to minimize the risk of investing in a detailed study and still not having a feasible on-site septic system that meets CARA requirements.

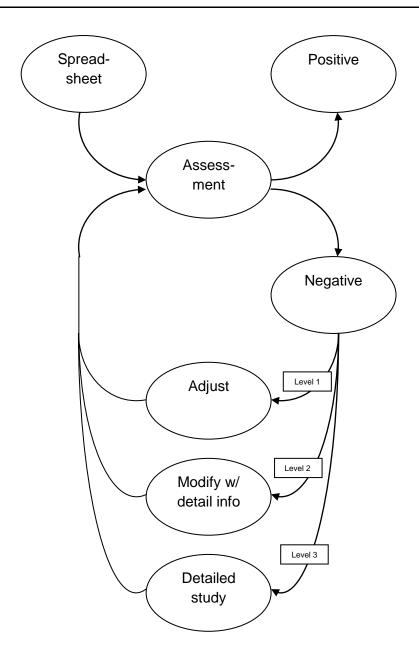


Figure 2. General Overview of Recommended Process with Options for Meeting CARA

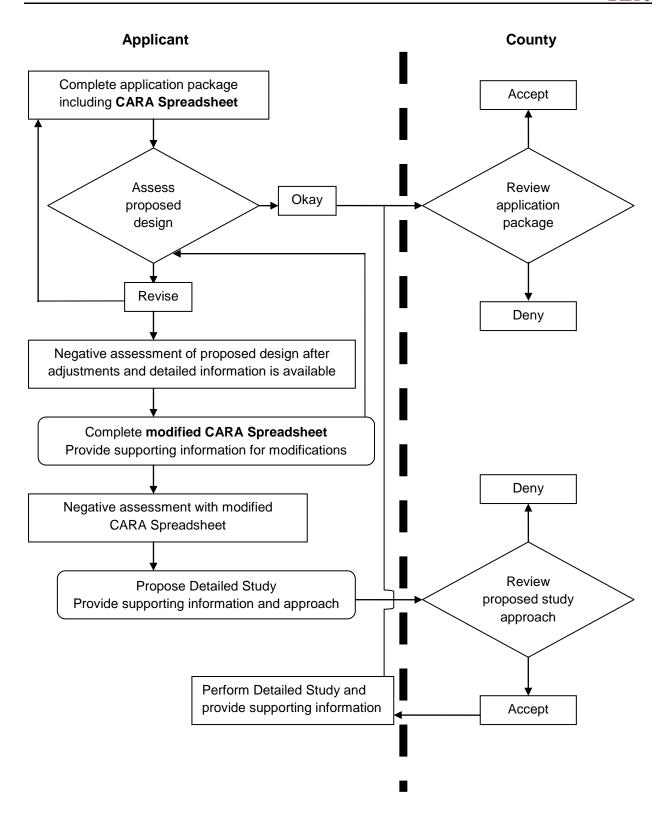


Figure 3. Flow Diagram of Recommended Process with Options for Meeting CARA

Proposed Approach

The applicant for a non-residential use on a property outside the UGA boundary would complete a Spokane County application for a sanitary system. All applications must include a completed CARA Spreadsheet (Attachment A). This application is separate from requirements of Chapter 246-272A WAC, which requires approval of all on-site sewage systems from either the Spokane Regional Health District or from the Washington State (**Figure 4**).

Spokane Regional Health District Systems ≤ 3,499 gallons/day

Washington State Department of Health
Systems from 3,500 to 100,000 gallons/day
Approves tank system design

Washington State Department of Ecology
Wastewater facilities
Systems > 100,000 gallons/day
Systems with groundwater connection to surface water
All industrial wastewater, combined stormwater,
and evaporative lagoons (WAC 246-727 A, B, and C)

Figure 4. Division of Regulatory Authority for On-Site Septic Systems

The input values that must be documented and provided by the applicant include (see Attachment A for spreadsheet):

- Facility or project type, size, and description.
- Parcel lot size.
- Location.
- Soil type (select from a menu of 1 to 7).
- Recharge (Use Map A [Attachment B]).
- Wastewater volume.
- Drainfield area.
- Depth to groundwater (Use Map B [Attachment C]).

The information in CARA Spreadsheet provides the County information about three items: hydraulics, nitrate, and phosphorus. If the assessment at the bottom of CARA Spreadsheet shows a positive assessment, the sanitary system would be considered by the County for approval. If the assessment is negative, the County recommends the applicant consider adjustments to meet the requirements of CARA Spreadsheet and/or provide additional documentation specific to the site and proposal, or accept restrictions to wastewater discharge to soils. The options for additional documentation are shown below. For phosphorus, if the project is located outside of areas near surface waters as identified in the Phosphorus Analysis Zone (PAZ) map, the CARA Spreadsheet indicates that the phosphorus assessment is not applicable (N/A).



Additional Documentation – CARA Spreadsheet plus Modifications

The applicant may elect to request and provide supporting information for specific modifications of one or more of the County input values. County input values most likely to be requested to modify based on site specific information are recharge, depth to groundwater, and/or nitrogen or phosphorus concentration in wastewater. Submittal requirements would include CARA Spreadsheet, modified CARA Spreadsheet with the revised site specific data, and a report documenting the source, selection, and background information for the revised site specific data.

Additional Documentation – CARA Spreadsheet plus Detailed Study

The applicant may elect to request and provide supporting information including calculations for a detailed study with specific evaluation of the site. Submittal requirements would include CARA Spreadsheet, Nitrate Mixing Zone and/or Phosphorus Breakthrough Worksheets, and a report documenting the source, selection, background, and calculations. The document should include a full report following the requirements of WAC 246-272B including a hydrogeologic report, mixing analysis, and additional supporting documentation and calculations for review. The minimum outline for the report is shown in Attachment D.

Description of the CARA Spreadsheet

The CARA Spreadsheet includes 'Input Values' specific to the proposed project and County selected values. These values are used in calculations for assessment: hydraulic loading, nitrate concentrations, and phosphorus sorption. The bottom of the CARA Spreadsheet provides an assessment of the inputs.

Input Values

The 'Input Values' provide specific information about the proposed project.

- Parcel lot size. The lot size is the area of the parcel for the facility as recorded by the County assessor. If there are multiple facilities on the parcel, then the wastewater volume is the sum of the flow from all of the facilities. No distinction is being made for the location of the facility and on-site septic system on the lot.
- Location: The location is used with the PAZ map which determines if phosphorus analysis is required. [The PAZ map is a work in progress that the County is currently developing.]
- Recharge value. The rate of recharge is the amount of inches per year of rainfall that infiltrate into the ground surface. The County is considering a process for developing a county-wide map of recharge and anticipates including that map with a CARA standard revision. Attachment B provides as an example map based on the SHADI analysis approach of using the PRISM annual precipitation data and the equation 0.67 * Annual Precipitation 7.25 (inches) (Spokane County, unknown; PRISM, 2013). This map is currently being updated to reflect more site specific information including soil type.
- Wastewater volume. The wastewater volume is the rate of wastewater flow anticipated from the facility. Standard references should be cited such as the Department of Ecology, Criteria for Sewage Works Design, Publication No. 98-37 WQ and Wastewater Engineering: Treatment and Reuse by Metcalf & Eddy. If additional supporting information for the calculation of the wastewater volume is available, it should be provided as part of the application package.



- Drainfield area. The minimum drainfield area should be based on WAC 246-272A-0234 design requirements--soil dispersal components for drainfield area (subsurface soil absorption system) requirements and standard references.
- Depth from Drainfield to Groundwater. The depth from the drainfield to groundwater may
 be selected from the Depth to Water map from SHADI analysis. If additional supporting
 information is available, such a local well driller log, this value may be used and the
 supporting information provided as part of the application package. This value should be
 from the lowest point in the drainfield to the upper-most aquifer.
- Soil type. Soil type is soil textural classifications ranging from gravels, coarse sands, medium sands, fine sands, silts, loams, and clays. The texture, structure, compaction and other soil characteristics should be determined using normal field and/or laboratory procedures such as particle size analysis. Soil type is required by WAC 246-272A and the permit application for an on-site septic system (Figure 4).

County Values

The County has selected representative values for Spokane County for multiple parameters. These values should not be changed for the CARA Spreadsheet. If there is supporting information to change these values, an additional modified CARA Spreadsheet may be submitted as part of the application package.

- Total nitrogen concentration in wastewater. This is the concentration of total nitrogen in
 the effluent measured at the end of the pipe before it enters the drainfield. While the
 concentration of nitrogen varies in effluent, the County has selected a representative
 value (Technical Memorandum #1; DEQ, 2002; EPA, 1980; UW, 1978). The value
 assumes 100-percent conversion of all nitrogen forms to nitrate; nitrate measured as
 nitrogen. The CARA Spreadsheet uses a value of 45 mg/L nitrate-N.
- Total phosphorus concentration in wastewater. This is the concentration of total
 phosphorus in the effluent measured at the end of the pipe before it enters the drainfield.
 While the concentration of phosphorus varies in effluent, the County has selected a
 representative value (Technical Memorandum #1; MDEQ, 2009; EPA, 2002, Lombardo,
 2006, Lowe, et.al, 2007). The CARA Spreadsheet uses a value of 10.6 mg/L.
- Soil denitrification. Denitrification in the soil can reduce the amount of nitrates that reach
 groundwater. The amount of denitrification is difficult to quantify and depends on several
 variables including soil carbon, soil moisture, soil temperature, and soil pH. In general, a
 coarse well drained soil will have less denitrification than a fine poorly drained soil. The
 CARA Spreadsheet uses a value of 10% denitrification (WDOH, 2011).
- Nitrate concentration in precipitation. Precipitation in Washington State contains a small amount of nitrates from both natural and man-made sources (WDOH, 2011). The CARA Spreadsheet uses a value of 0.24 mg/L.
- Soil weight. The CARA Spreadsheet uses a typical soil weight of 100 lb/ft³ (Merritt, et.al, 1996).
- Phosphorus adsorption capacity of soil. The adsorption capacity is the soil's ability to sorb phosphorus. This capacity varies with through the soil column (HDR, 2007). The CARA Spreadsheets uses depth varying values from 200 to 20 mg/Kg.

Assessment

The assessment portion of the CARA Spreadsheet includes comparison of the calculations from the proposed project with assessment of hydraulic loading, nitrate, and phosphorus.



- Hydraulic loading. The hydraulic loading checks that the drainfield area is greater than the required minimum drainfield area based on sizing criteria established in WAC 246-272A.
- Nitrate. This is a check that the total nitrogen concentration from the drainfield and the parcel is less than 10 mg/L nitrate-N. This value is the groundwater quality standard (Technical Memorandum #2). This is the value in soil water at the top of the upper-most aquifer (this value does not include groundwater mixing).
- Phosphorus. This is a check that there is phosphorus sorptive capacity for 20 years in
 the soil column below the drainfield to the upper-most aquifer. A 20-year breakthrough
 is used based on the assumption that the non-residential parcel would likely be
 incorporated into the UGA over the 20-year period (would be sewered into a centralized
 treatment system) and/or that the typical drain field life is 20 years requiring the drain
 field to be moved to a different location on the parcel. Phosphorus breakthrough is only
 considered for those areas within the PAZ.

Instructions for Completing the CARA Spreadsheet

The following instructions provide guidance on completing the required CARA Spreadsheet as part of an application to Spokane County for an on-site septic system for sanitary wastewater for non-residential uses that are outside the UGA in areas of moderate to high CARA (Attachment A). These instructions would be provided as part of CARA Spreadsheet (Attachment A). The CARA Spreadsheet provides important information to Spokane County for review of the proposed on-site septic system and to the applicant designing the system. Inputs to the CARA Spreadsheet should be documented and provided to the County in a technical memorandum as part of the application package. In addition to the CARA Spreadsheet, the applicant may perform and provide supporting information for adjustments, a modified CARA Spreadsheet (level 2), or a detailed study (level 3).

Input Values

Provide information including the project name, address or location, name of individual who completed the CARA Spreadsheet and data completed. Provide information about the proposed facility or project, its type, size, and a general description.

- Parcel lot size. Enter the land area for the facility and on-site septic system. Include a map of the parcel.
- Recharge value. Select the recharge value based on the County provide recharge map.
- Wastewater volume. Enter the wastewater flow rate based on the facility type, standard references, and additional supporting information. (A table of reference values such as included in Technical Memorandum #1 will be included as part of the instructions.)
- Drainfield area. Enter the area.
- Depth from Drainfield to Groundwater. Enter the depth from drainfield to groundwater based on the County provided depth map or a local well log.
- Soil type. Select the soil type from the dropdown menu in the spreadsheet. Refer to WAC 246-272A-0220 soil and site evaluation for procedures on classifying the soil type.

Assessment

The assessment portion of the CARA Spreadsheet includes comparison of the calculations from the proposed project to assess hydraulic loading, nitrate, and phosphorus.



• If the result of any of the assessments is 'No', then requirements are not met. Adjustments along with other options, see Recommended Process discussion, should be examined.

Discussion

This proposed approach, requiring a completed CARA Spreadsheet, is based on scientific data and analyses, is protective of sensitive groundwater and surface water, provide a consistent review method for the County and should provide a relatively straightforward submittal for the applicant. The proposed approach includes two options for additional documentation which provides an adaptable approach for site specific conditions and/or specific project proposals. These options provide a means for an applicant to work with the County beyond CARA Spreadsheet; however, the additional documentation does require the applicant to provide more information for the County's review to support deviations from the CARA Spreadsheet.

Nitrate concentration less than standard at the groundwater interface was selected as protective of groundwater quality. Selection of a nitrate-N concentration of 10 mg/L is based on the drinking water quality standard. A phosphorus breakthrough of 20 years or greater in PAZ areas was selected a protective of surface water. Selection of 20 years for phosphorus is based on a weight of evidence approach, the importance of controlling phosphorus to protect water quality as demonstrated in the scientific literature and further exhibited by the Spokane River TMDL, the consideration that the general design life of on-site septic system is 20 years (EPA, 1999, MDEP, 2013), and probability that the majority of these on-site septic systems are on the UGA fringe and may be connected to sewer systems in 20 years.

Examples

The following examples illustrate the completion and results of CARA Spreadsheet for several project scenarios. The values are meant to be representative but not exclusive of potential non-residential type projects.

Project A

- Parcel lot size.
 - o 5-acre
- Location.
 - Not within a PAZ
- Recharge (Use Map A [Attachment A]).
 - 4 inches/year based on location
- Wastewater volume (Use provided references or similar.)
 - o 400 gpd
- Drainfield area.
 - o 700 square-feet
- Depth to groundwater (User Map B [Attachment B]).
 - 50 feet based on location
- Soil type (select from a menu of 1 to 7).
 - Type 4, fine sands

Assessment

Δ

Hydraulic loading: Okay

- Nitrate: Okay at 8.8 mg/L
- Phosphorus: N/A outside of a PAZ

Project B

- Parcel lot size.
 - o 5-acre
- Location.
 - Not within a PAZ
- Recharge (Use Map A [Attachment A]).
 - 4 inches/year based on location
- Wastewater volume (Use provided references or similar.)
 - o 1,000 gpd
- Drainfield area.
 - o 1,700 square-feet
- Depth to groundwater (User Map B [Attachment B]).
 - o 150 feet based on location
- Soil type (select from a menu of 1 to 7).
 - Type 4, fine sands

Assessment

- Hydraulic loading: Okay
- Nitrate: Revise Revise at 16.4 mg/L. Go to level 2 and evaluate alternative options such as (nitrogen treatment and modified County value for nitrogen concentration, parcel lot size increase, project location, wastewater volume, alternative wastewater disposal, etc.). If still exceeding criteria, go to level 3 to include groundwater evaluation and detailed study or accept wastewater disposal restrictions on parcel.
- Phosphorus: N/A outside of a PAZ

Project C

- Parcel lot size.
 - o 5-acre
- Location.
 - o Within a PAZ
- Recharge (Use Map A [Attachment A]).
 - 4 inches/year based on location
- Wastewater volume (Use provided references or similar.)
 - o 400 gpd
- Drainfield area.
 - o 900 square-feet
- Depth to groundwater (User Map B [Attachment B]).
 - o 150 feet based on location
- Soil type (select from a menu of 1 to 7).
 - Type 4, fine sands

Assessment

- Hydraulic loading: Okay
- Nitrate: Okay at 8.8 mg/L

Phosphorus: Okay at 20.7 years

Project D

- Parcel lot size.
 - o 9-acre
- Location.
 - Within a PAZ
- Recharge (Use Map A [Attachment A]).
 - 4 inches/year based on location
- Wastewater volume (User provided references or similar.)
 - o 800 gpd
- Drainfield area.
 - o 1,700 square-feet
- Depth to groundwater (Use Map B [Attachment B]).
 - o 150 feet based on location
- Soil type (select from a menu of 1 to 7).
 - o Type 4, fine sands

Assessment

- Hydraulic loading: Okay
- Nitrate: Okay at 9.5 mg/L
- Phosphorus: Revise at 9.8 years. Go to level 2 and evaluate alternative options such as (phosphorus treatment and modified County value for phosphorus concentration, drainfield size increase, project location, wastewater volume, alternative wastewater disposal, etc.). If still exceeding criteria, go to level 3 to include groundwater/surface water evaluation and detailed study or accept wastewater disposal restrictions on parcel.

Project E

- Parcel lot size.
 - o 10-acre
- Location.
 - Not within a PAZ
- Recharge (Use Map A [Attachment A]).
 - 4 inches/year based on location
- Wastewater volume (User provided references or similar.)
 - o 900 gpd
- Drainfield area.
 - o 1,550 square-feet
- Depth to groundwater (Use Map B [Attachment B]).
 - 200 feet based on location
- Soil type (select from a menu of 1 to 7).
 - o Type 4, fine sands

Assessment

- Hydraulic loading: Okay
- Nitrate: Okay at 9.6 mg/L
- Phosphorus: N/A outside of a PAZ

Project F

- Parcel lot size.
 - o 10-acre
- Location.
 - Not within a PAZ
- Recharge (Use Map A [Attachment A]).
 - 4 inches/year based on location
- Wastewater volume (Use provided references or similar.)
 - o 9,000 gpd
- Drainfield area.
 - o 15,050 square-feet
- Depth to groundwater (Use Map B [Attachment B]).
 - o 200 feet based on location
- Soil type (select from a menu of 1 to 7).
 - Type 4, fine sands

Assessment

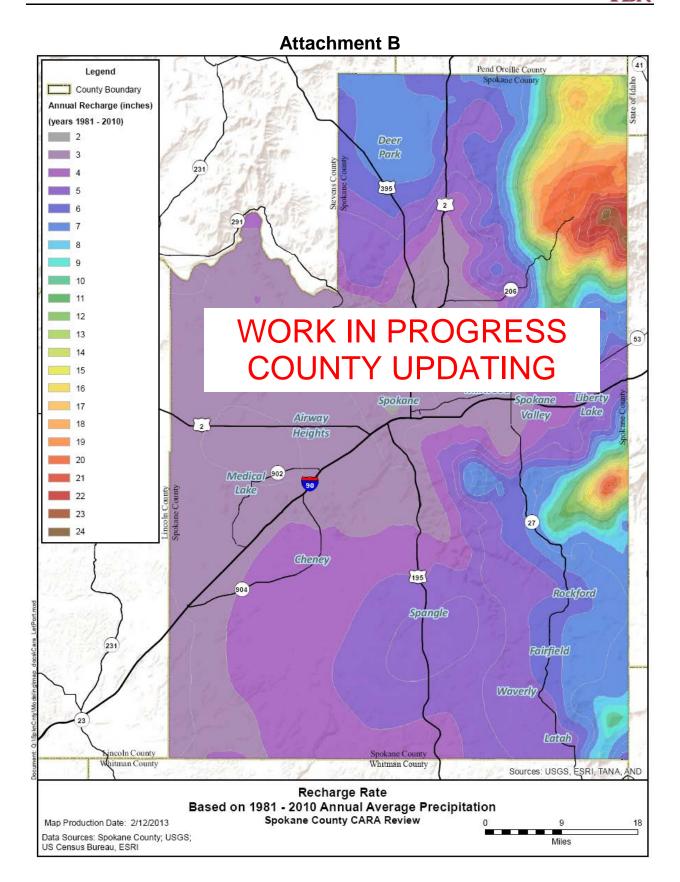
- Hydraulic loading: Okay
- Nitrate: Revise Revise at 30.5 mg/L. Go to level 2 and evaluate alternative options such as (nitrogen treatment and modified County value for nitrogen concentration, parcel lot size increase, project location, wastewater volume, alternative wastewater disposal, etc.). If still exceeding criteria, go to level 3 to include groundwater evaluation and detailed study or accept wastewater disposal restrictions on parcel
- Phosphorus: N/A outside of a PAZ

References

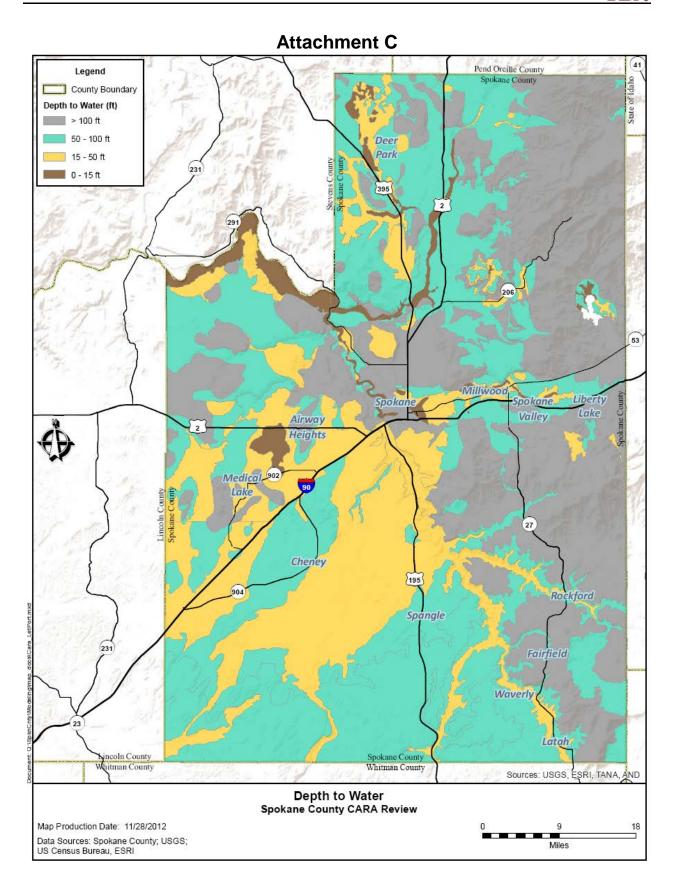
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Attachment A

	A	llac	nmeni	I A		
	ON-SITE S	SEPTIO	SYSTEM	ANALYSI	S	
Instructions:	Enter inform	nation i	nto areas s	haded gre	en. Red values must be updated.	
Project name:						
Address:						
Completed by and Date:						
Facility type, size and description:						
Input Values		Sign	Values	Units	Instructions	
Parcel lot size		A _P	5	acre	Site specific 1 acre = 43,560 ft ²	
Location (within PAZ?)		PAZ	No	unitless	Use PAZ map and project location	
Recharge		R	4	in/yr	Use recharge Map	
Wastewater volume		Vw	500	gpd	Use table or provide basis	
Drainfield area		\mathbf{A}_{D}	900	ft ²	Primary drainfield area	
Depth from drainfield to groundwater		В	100	ft	Site Specific information or use Map	
Soil Type	Type 4 - Fine	sands	s, loamy fine	unitless	Use Drop Menu and WAC 246-272A-022	
County Values		Sign	Values	Units	Notes	
Total nitrogen concentration in wastewater		N _W	45.0	mg/l	Default	
Total phosphorus concentration in wastewater		Р	10.6	mg/L	Default	
Soil denitrification		d	0.1	unitless	Default	
Nitrate concentration in precipitation		N_R	0.24	mg/l as N	Default	
Soil weight		S _W	100	lb/ft ³	Default	
Phosphorus adsorption capacity of soil	for P _{a1}	P _{a1}	200	mg/Kg	0 to 3 below drainfield	
Phosphorus adsorption capacity of soil for P _{a2}		P _{a2}	150	mg/Kg	3 to 13 below drainfield	
Phosphorus adsorption capacity of soil for Pa3		P _{a3}	50	mg/Kg	13 to 50 below drainfield	
Phosphorus adsorption capacity of soil	for P _{a4}	P _{a4}	20	mg/Kg	> 50 below drainfield	
Hydraulic Output Values		Sign	Values	Units	Notes	
Hydraulic loading		D _H	0.6	gal/ft²/day		
Minimum drainfield area		A_D	833	ft ²		
Nitrate Output Values		Sign	Values	Units	Notes	
Volume of recharge over parcel		V_P	1,488	gpd	A _P * R * conversion	
Total infiltration (drainfield & parcel)	Total infiltration (drainfield & parcel)		1,988	gpd	$V_W + V_P$	
Total Nitrogen concentration from drainfield & parcel		N_{ip}	10.3	mg/l as N	$((V_P * N_R + V_W * N_W) * (1 - d)) / (V_P + V_W)$	
Phosphorus Output Values		Sign	Values	Units	Notes	
Total phosphorus load		Pt	40.4	lbs/yr	V _W / 200	
Depth P _{a1}		DP _{a1}	3	ft		
Depth P _{a2}		DP _{a2}	10	ft		
Depth P _{a3}		DP _{a3}	37	ft		
Depth P _{a4}		DP _{a4}	50	ft		
Soil weight under drainfield for W ₁		W ₁	270,000	lbs	L * W * DP _{a1} * S _W	
Soil weight under drainfield for W ₂		W_2	900,000	lbs	L * W * DP _{a2} * S _W	
Soil weight under drainfield for W ₃		W ₃	3,330,000	lbs	L * W * DP _{a3} * S _W	
Soil weight under drainfield for W ₄		W_4	4,500,000	lbs	L * W * DP _{a4} * S _W	
Phosphorus adsorption in soil column		Ps	446	lbs	W ₁ *Pa ₁ +W ₂ *Pa ₂ +W ₃ *Pa ₃ +W ₄ *Pa ₄ *conv.	
Breakthrough time of phosphorus to groundwater B		BT_GW	11.0	yrs	P _s /P _t	
Assessment			Values	Units	Instructions	
Hydraulic loading			Okay	unitless	If No, review input values	
					L	
Nitrate			Revise	unitless	If No, review input values	







Attachment D (Level 3 Information Outline)

Project Information

- Date of application
- Name and address of the property owner and the applicant at the head of each page of submission
- · Name, signature and stamp of the designer

Parcel Information

- Parcel number and if available, the address of the site
- Size of the parcel
- A dimensioned site plan
- General topography and/or slope
- Drainage characteristics
- Designated areas for the proposed initial system and the reserve area

Effluent Information

- System operating capacity and design flow;
- Source of sewage, for example, residence, restaurant, or other type of business
 - Characteristics of sewage: flow, concentration of nitrate, and concentration of phosphorus

Soils Information

- Soil type
- The soil and site evaluation as specified under WAC 246-272A-0220
- The location of all soil logs and other soil tests for the OSS
- The depth of the soil dispersal component, the vertical separation, and depth of cover material

If a mixing or groundwater analysis is included:

Groundwater Information

- Hydraulic conductivity source
- Hydraulic gradient
- Depth to groundwater
- Distance to surface water
- Background constituent concentrations