TECHNICAL NOTES

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IDAHO NUTRIENT TRANSPORT RISK ASSESSMENT (INTRA)
A Water Quality Risk Assessment Tool for Conservation Planning

The Idaho Nutrient Transport Risk Assessment (INTRA) uses a limited number of landform, site and management characteristics to determine the probability of off-site transport of nutrients (primarily nitrogen and phosphorus). The purpose of the Risk Assessment is to provide planners with a tool to evaluate the various landforms and management practices for potential risk of nutrient movement to surface and ground water. The assessment tool is used during the planning process to determine if surface and/or ground water quality concerns exist. The tool is similar to the risk assessment within ONEPLAN, but is modified to use with conservation management units, not individual fields. The tool was field-tested in both northern and southern Idaho in a number of different landuse-operation scenarios. The tool provides recommendations to assist the planner in selecting appropriate conservation practices that address individual and multiple risk factors to protect or enhance water quality. These mitigating practices are required in order to meet quality criteria for nutrients and organics in surface and ground water if the final risk level is greater than LOW. A brief summary of nutrient movement in agricultural systems, primarily phosphorus and nitrogen, follows. For a more detailed description, refer to *Idaho Water Quality Technical Notes No. 4 and 5*.

Summary of Nutrient Movement in Agricultural Systems

Phosphorus

Phosphorus movement in runoff occurs as particulate P and dissolved P. Particulate P is attached to mineral and organic sediment as it moves with the runoff. Dissolved P is in the water solution. In general, particulate P is the major portion (75-90%) of the P transported in runoff from cultivated land. Dissolved P makes up a larger portion of the total P in runoff from non-cultivated lands such as pastures and fields with reduced tillage.

As runoff moves from the landscape toward surface water, phosphorus may become more bioavailable by the sorption and desorption processes, and by the preferential transport of clay-sized material as sediment moves over the landscape (enrichment). The interaction between the particulate and dissolved P in the runoff is very dynamic and the mechanism of transport is complex. Additionally, dissolved P can move laterally towards surface water bodies as subsurface flow, or downwards, as the soil reaches P saturation. Therefore, it is difficult to predict the transformation and ultimate fate of P as it moves through the landscape (Sharpley et al. 2003).

Nitrogen

Nitrogen is one of the most dynamic and mobile nutrients in the plant-soil-air continuum, with many pathways for loss. There is a large reservoir of N in soil, but most of this is in the organic form. It is estimated that only 2-3% of organic N is mineralized annually. The mineralized form of N (nitrate and ammonium) is readily available for uptake by plants. The N cycle is both spatially and temporally variable within agricultural systems. Variability of soil properties impacts nitrogen movement and loss within agricultural operations, including soil organic matter, residual nitrate, crop residue amount, crop yield variability, and changes in soil chemical and physical properties across the field. The primary loss mechanism of nitrogen in agricultural systems is leaching of nitrate below the root zone. However, losses of nitrogen to the air and by overland flow also occur.

Management plays a critical role in reducing N loss to the environment, and management is the dominant factor influencing long-term nitrate leaching (Shaffer and Delgado 2002). Soil, climate, watershed and aquifer characteristics must also be taken into account in order to minimize nitrate leaching. Loss of nitrate from agricultural systems can range from 0 - 60% of N applied (Meisinger and Delgado 2002). Leaching loss is dependent on the concentration of N in soil solution and the volume of water leached. Over-irrigation can lead to nitrate leaching, especially with shallow rooted crops. Effective management is therefore aimed at reducing transport through proper irrigation water management, and optimizing N application amounts and timing in concert with crop uptake. Crop type and cultivation are also important considerations.

The Idaho Nutrient Transport Risk Assessment: Risk Factors

The main factors influencing nutrient movement in agricultural systems can be separated into transport, source and management factors. Transport factors include the mechanisms by which nutrients move within the landscape. These are rainfall, irrigation, erosion and runoff, and deep percolation. Factors which influence the source and amount of nutrients available for transport include soil nutrient content and form of nutrient applied. Management factors include the method of application, timing and placement in the landscape as influenced by the management of application equipment and tillage.

When the factors of the assessment are analyzed, it will be apparent when an individual factor (or factors) is influencing the assessment disproportionately. These identified factors are the basis for planning corrective soil and water conservation practices and management techniques.

The soil, hydrology, climate and land management site characteristics that have a major influence on nutrient availability, retention, management and movement are listed below. The number in parentheses after each factor is the relative weighting factor.

- Soil test P (available phosphorus in soil laboratory test units relative to the 0-12” soil layer *Phosphorus Threshold* per Idaho Nutrient Management Practice Standard 590) (1.0)
- P fertilizer application rates (in pounds available phosphate per acre) (0.75)
- P fertilizer application methods (0.5)
- Organic P source application rates (in pounds available phosphates per acre) (1.0)

- Organic P source application methods (0.75)
- N fertilizer application rate (1.0)
- N application timing (1.00 if non-irrigated, 0.75 if irrigated)
- N fertilizer application method (0.75)
- Irrigation runoff index (0.5)
- Runoff class (0.5)
- Runoff conservation practices (-1.0)
- Sheet and rill and/or irrigation-induced soil erosion (in tons per acre per year) (1.0)
- Distance to the nearest receiving water body (1.0)
- Irrigation index (for deep percolation) (1.5)
- Leaching index (0.5 irrigated, 1.5 not irrigated)
- Water table depth, geologic features, and hydrologic group (1.00 if irrigated, 1.5 if non-irrigated)

Field-specific data for the site characteristics selected for this version of the Risk Assessment (Table 1) are readily available at the conservation management unit level. Some analytical testing of the soil and organic material is required to determine the rating levels. This soil and organic material analysis is considered essential as a basis for the assessment.

The factors (described below) used in the assessment are rated as VERY LOW, LOW, MEDIUM, HIGH, or VERY HIGH (and some use CRITICAL) by determining the range for each category. The sum of the site characteristic rankings provides an index for surface water quality (Table 2) and an index for ground water quality (Table 3).

Soil P Test

A soil sample (0-12”) from the site is necessary to assess the relative level of "plant available P" in the surface layer of the soil. The plant available P is the level customarily given in a soil test analysis by the Cooperative Extension Service or commercial soil test laboratories. The Assessment uses ranges of soil test P. The Olsen (bicarbonate), Bray I, or Morgan (sodium acetate) soil test P methods are required by the NRCS Idaho Nutrient Management Standard depending upon the soil pH. The soil test level for "plant available P" does not ascertain the total P in the surface soil. Rather, it gives an indication of the relative amount of total P that may be present because of the general relationship between the forms of P (organic, adsorbed, and labile P) and the solution P available for plant uptake. If a soil test P result is above the phosphorus threshold as identified in the Idaho Nutrient Management Standard (590), the rating automatically defaults to CRITICAL.

P Fertilizer Application Rate

The P fertilizer application rate is the amount, in pounds per acre (lbs/ac), of commercial phosphate fertilizer (P_20_5) applied to the soil. This phosphate fertilizer does not include phosphorus from organic sources that are recorded in Organic P Sources Application Rate.

P Fertilizer Application Method

The manner in which P fertilizer is applied to the soil affects potential P movement. Incorporation implies that the fertilizer P is buried below the soil surface. If fertilizer is surface applied on a field with surface runoff (natural or from irrigation) and there is no incorporation, it is considered a significant risk and therefore the rating automatically defaults to CRITICAL.

Organic P Source Application Rate
The organic P application rate is the amount, in pounds per acre (lbs/ac), of potential phosphate (P_20_5) contained in the manure and applied to the soil. This organic phosphate source does not include phosphorus from fertilizer sources that are recorded in P Fertilizer Application Rate.

Organic P Source Application Method
The manner in which organic P material is applied to the soil can determine potential P movement. Incorporation implies that the organic P material is buried below the soil surface. If manure is surface applied on a field with surface runoff (natural or from irrigation) and there is no incorporation, it is considered to be a discharge and a violation of existing regulations. Because of this, the rating automatically defaults to CRITICAL.

Runoff Class and Irrigation Runoff Index

Runoff Class: The runoff class of the site is used to determine the risk of runoff from storm events. One method to determine the runoff class is based on the soil permeability and the percent slope of the site (USDA-NRCS Soil Survey Manual, Agricultural Handbook 18, 1993). The matrix relating soil permeability class and slope (Table 4) provides the appropriate value category. This information is available in the SSURGO soils database (physical properties report).

Runoff Index: The irrigation runoff index of the site is used for irrigated lands. For sprinkler irrigated lands, the runoff index is simply based on a user supplied assessment of whether or not runoff (overland flow) exists and, if so, whether or not it leaves the field. For surface irrigated lands, the runoff index is based on the typical percent of the irrigation set time that runoff from the furrow/field occurs; the user enters whether it is more or less than 50%.

Runoff Conservation Practices
Runoff conservation practices include any conservation practices which serve to reduce runoff and the movement of soil, thereby reducing potential for dissolved and particulate phosphorus movement across the landscape toward a receiving water body. Credit (negative point value) is applied depending on the number of conservation practices implemented, so multiple practices receive greater credit than a single practice. Also, runoff conservation practices that filter or trap nutrients (such as buffers, borders, filter strips, and grassed waterways) receive greater credit than those that simply reduce runoff. Certain practices (e.g., tail-water recovery systems with sediment basins) eliminate runoff and sediment loss from the field.

Soil Erosion (Total Water-Induced Soil Erosion)
Soil erosion is defined as the loss of soil along the slope or unsheltered distance caused by the processes of water and wind. Soil erosion is estimated from erosion prediction models including the Revised Universal Soil Loss Equation (RUSLE/RUSLE2) for water erosion from non-irrigated lands (and sprinkler irrigated lands if runoff exists) and the Surface Irrigation Soil Loss equation (SISL) for water erosion from surface irrigated lands. The Wind Erosion Equation (WEQ) is <u>not</u> used in this assessment. The value category is given in tons of soil loss per acre per year (ton/ac/yr). These soil loss prediction models <u>do not</u> predict sediment delivery rates from the end of a field to a water body. The prediction models are used in this assessment to

indicate the potential for sediment and attached nutrient movement across the slope or unsheltered distance toward surface waters.

Distance to Nearest Receiving Water Body
The distance to the nearest receiving water body is the distance in feet between the edge of the field and the nearest receiving water. This is typically a ditch, canal, waterway, drain, etc. – *any water body or water way which has connection (perennial or ephemeral) with a stream, river, pond or lake*. The closer the distance, the greater the likelihood nutrients lost from the field will reach the receiving water body.

Leaching Index
Deep percolation is dependent on numerous factors, including climate and soil type. The leaching index is based on the Nitrogen Leaching Index (Czymmek et al. 2003, Williams and Kissel 1991) which is essentially a water percolation index based on soil water storage. Slight modifications were made to some of the percolation index equations to adjust for low precipitation zones found in areas of Idaho. Total annual precipitation for specific locations is determined from local climate station data, as is winter precipitation. The percolation index is based on precipitation and hydrologic soil group. A seasonal index is calculated as the ratio of winter precipitation to annual precipitation. The leaching index is then calculated as the product of the percolation index and seasonal index. For irrigated lands, the leaching index is low if the irrigation index is low. If not, then the leaching index is based on amount of winter precipitation.

Irrigation Index
Managing irrigation water will minimize nutrient losses from leaching and surface runoff. Potential system application efficiency and irrigation water management have significant impacts on actual water movement through the root zone. Five different factors are used in the irrigation index to determine the potential for irrigation water to transport nutrients to ground water. The irrigation system is the primary rating factor, and the other variables modify that rating based on the level of management for each. These additional factors are water control and measurement, irrigation scheduling and soil moisture monitoring, use of pre- and/or post-season irrigation, and soil condition index (SCI).

N Application Index
Crop nitrogen requirement is determined based on crop yield and University of Idaho fertilizer recommendations. The nitrogen application rate is the percent nitrogen applied compared to the total crop nitrogen requirement according to the fertilizer guides prior to any credits or debits for previous crop and residual nitrogen.

N Application Timing
Timing of N application directly influences potential transport due to the high mobility of nitrate in soils. The appropriate timing of N application is complicated by the soil processes of nitrification, volitization, and mobilization, which affect N plant availability. Split applications of N throughout the growing season better match crop growth requirements, reducing the likelihood of loss. Fall application in most instances has the greatest potential for loss prior to the planting season; additional N applications are often required to meet crop demand when losses occur.

Water Table Depth/Soil Type
Soils can stop or slow nutrient movement depending on their chemical and physical characteristics. Depth of soils, depth to water tables and limiting layers such as hard pans will influence rooting depth, nitrogen movement, and leaching potential. Fine textured soils (Hydrologic Group D) have a lower potential for leaching due to reduced permeability and high water holding capacity, while coarse textured soils (Hydrologic Group A) have a higher likelihood of nitrate leaching due to low water holding capacity and the rapid infiltration and movement of water through the profile.

If a water table is present within five feet of the surface, the potential for ground water contamination is high regardless of the soil type.

Using the Idaho Nutrient Transport Risk Assessment

The Assessment applies on Cropland, Hayland, and Pasture where nutrients are applied. Use of the Risk Assessment for planning should begin during the initial field visit and interview with the producer. However, some of the information needed for the factors will be obtained from other planning tools (for instance, SISL or RUSLE2, soils database, etc.). **A field data sheet is provided in the spreadsheet, but required calculations and look-up information is performed by the spreadsheet, so entering information from the field data sheet into the spreadsheet (or taking the computer to the field) is required**. Steps for using the assessment tool are:

1) An assessment is developed for each land use, conservation management unit, or cropping system.

   Example: An operation includes 3 cropping systems or conservation management units:

   1. Hay in rotation with row crops and cereals, where commercial fertilizer is applied.
   2. Hay in rotation with row crops and cereals where animal waste is applied in addition to commercial fertilizer.
   3. Pasture where commercial fertilizer is applied.

   An assessment is required for each system/management unit.

2) Identify the critical crop in each system. The critical crop is the crop in which the highest potential for off-site transport of nutrients exists. For example, a rotation being evaluated includes winter wheat, spring barley and summer fallow. All the nitrogen for winter wheat is applied in the fall prior to planting the crop. The critical crop is winter wheat. The assessment is made using information which relates to the winter wheat crop.

3) The planner must obtain the following information from the producer.
   1. Typical rotation.
   2. For the critical crop:

a) Soil test data using the appropriate analysis method (Olson, Bray or Sodium Acetate). Note: If no soil test has been done in the last 5 years, the input value is automatically a VERY HIGH.
b) Phosphorus fertilizer application rate (lbs/ac/yr).
c) Phosphorus fertilizer application method.
d) Organic phosphorus application rate (lbs/ac/yr). Note: If the producer can not provide this information, the input value is automatically a VERY HIGH.
e) Organic phosphorus fertilizer application method.
f) Nitrogen application rate (% of Crop Requirement) requires 2 factors. The actual lbs/ac/yr of Nitrogen applied and the target yield. The program uses these 2 values to generate the rating.
g) Nitrogen fertilizer application method.
h) Runoff Index (Surface Irrigated). This value is qualitative. The planner determines the input by asking the producer whether water runs off less than or more than 50% of the set time.
i) Runoff Index (Sprinkler Irrigated). This value is qualitative. The planner determines the input with on site observation and/or asking the producer. Does water move across the field surface during irrigation? Does water leave the field via overland flow?

4) Other Information: Factors like hydrologic soil group, average field slope, permeability, soil erosion, and distance to surface waters are required and should be representative of the cropping scenario/conservation management unit being evaluated.

Requirements for Meeting Quality Criteria

- Quality Criteria is met when an overall rating of LOW is obtained. No mitigating practices are required.
- Quality Criteria is not met when an overall rating of MEDIUM or greater is obtained. Mitigating practices are required. If <u>all</u> possible mitigating practices have already been implemented, then Quality Criteria are considered met. <u>This must be documented in the plan.</u>

Identification of Mitigating Practices

The rating for each site characteristic (factor) is displayed on the Assessment Report. If any site characteristic has a MEDIUM or higher rating, then mitigating practices are required. Mitigating practices are not required for any site characteristic which has a rating of LOW, however "Recommended" practices might be suggested. "Recommended" and "Required" practices are identified on the report in the column titled "Mitigating Practices".

References

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Table 1. Idaho Nutrient Transport Risk Assessment for Planning (Field Sheet). The weighting for each factor is incorporated into the point value.

Surface Water Quality							
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 1	Medium 2	High 4	Very High 8	Critical 10	
Soil Test P (ppm) Olsen Method 0 – 12”	< 8	8 - 15	16 - 25	26 - 35	36 – 40 (or no soil test)	> 40	
Soil Test P (ppm) Bray Method 0 – 12”	< 10	10 - 20	21 - 40	41 - 50	51- 60 (or no soil test)	> 60	
Soil Test P (ppm) Morgan Method (NaOAc) 0 – 12”	< 1.0	1.0 – 2.0	2.1 – 4.0	4.1 – 5.0	5.1- 6.0 (or no soil test)	> 6.0	
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 0.75	Medium 1.5	High 3	Very High 6	Critical	
Phosphorus Fertilizer Application Rate (lbs/ac P_2O_5)	0	< 60	60 - 150	151- 300	> 300		
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 0.5	Medium 1.0	High 2	Very High 4	Critical 10	
Phosphorus Fertilizer Application Method	None applied	Placed with planter (banded) or injected > 2" or plowed	Incorporated > 3" by disking or chiseling, etc.	Chemigated, or incorporated < 3" by harrowing, etc.	Surface applied, no incorporation	Surface applied on a field with surface runoff (natural or from irrigation) and no incorporation	
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 1	Medium 2	High 4	Very High 8	Critical	
Organic Phosphorus Application Rate (lbs/ac P_2O_5)	0	< 40	40 - 100	101 – 200	> 200 (or unknown)		

Site Characteristic	Rating and Point Value						SELECTED RATING
	Very Low 0	Low 0.75	Medium 1.5	High 3	Very High 6	Critical 10	
Organic Phosphorus Application Method	None applied	Placed with planter (banded) or injected > 2" or plowed	Incorporated > 3" by disking or chiseling, etc.	Chemigated, or incorporated < 3" by harrowing, etc.	Surface applied, no incorporation	Surface applied on a field with surface runoff (natural or from irrigation) and no incorporation	
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 1	Medium 2	High 4	Very High 8	Critical	
Nitrogen Application Rate (% of Crop Requirement)	< 40	40 - 60	60 - 100	100 - 120	> 120		
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 0.75	Medium 1.5	High 3	Very High 6	Critical 10	
Nitrogen Fertilizer Application Method (prior to critical runoff period)	None applied	Placed with planter (banded) or injected > 2" or plowed	Incorporated > 3" by disking or chiseling, etc.	Chemigated, or incorporated < 3" by harrowing, etc.	Surface applied, no incorporation	Surface applied on a field with surface runoff (natural or from irrigation) and no incorporation	
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 0.5	Medium 1.0	High 2	Very High 4	Critical	
Runoff Index (Surface Irrigated)	No runoff occurs	-----	Water runs off the field less than 50% of the set time	-----	Water runs off the field 50% or more of the set time		
Runoff (Sprinkler Irrigated)	No runoff occurs	Water moves across the surface but not off the field	-----	Runoff leaves the field	----		
Runoff Class	Negligible	Very low or low	Medium	High	Very High		

Site Characteristic	Rating and Point Value						SELECTED RATING
	Very Low 0	Low -1	Medium -2	High -4	Very High -8	Critical	
Runoff BMPs (Only applies if runoff occurs)	No conservation practices	One or two on-field conservation practices that reduces runoff	Multiple conservation practices that reduce runoff or trap nutrients	Multiple conservation practices that reduce runoff and trap/filter pollutants	Conservation practice(s) that eliminates runoff		
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 1	Medium 2	High 4	Very High 8	Critical	
Average Total Soil Erosion due to Water (tons/ac/year)	< 1 ton/acre	1 - 5 tons/acre	5 - 10 tons/acre	10 - 15 tons/acre	> 15 tons/acre		
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 1	Medium 2	High 4	Very High 8	Critical	
Distance to Surface Water	> 2640 feet (> 0.5 mile)	2640 - 1320 feet	1319 - 600 feet	599 - 200 feet	< 200 feet		
TOTAL POINTS FOR SURFACE WATER QUALITY (Less than 12 is a LOW rating)							

Ground Water Quality							
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 1	Medium 2	High 4	Very High 8	Critical	
Nitrogen Application Rate (% of Crop Requirement)	< 40	40 - 60	60 - 100	100 - 120	> 120		
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
Irrigated> **Not Irrigated>**	Very Low 0 0	Low 0.75 1	Medium 1.5 2	High 3 4	Very High 6 8	Critical	
Nitrogen Application Timing	None applied	Nitrogen applied in several applications during the primary growing season, the first application no greater than 30 days of start of primary growing season	Majority of nitrogen is applied within 30 days of, or during, the primary growing season. Nitrogen applied outside this time frame is less than 50 lbs and is applied with a nitrification inhibitor or when soil temperatures are less than 50 deg. F.	Nitrogen is applied as a single application within 90 days of the primary growing season OR a split application is made which does not meet the conditions described for LOW or MEDIUM.	Nitrogen is applied as a single application more than 90 days prior to the primary growing season.		

Site Characteristic	Rating and Point Value						SELECTED RATING
	Very Low 0	Low 1.5	Medium 3	High 6	Very High 12	Critical	
Irrigation Index	> 79	70 - 79	60 - 69	50-59	< 50		

This index requires information on the irrigation system type, water measurement and distribution, irrigation scheduling, SCI, and whether pre or post season irrigation is used. Circle the most appropriate selection in each category.

Irrigation System	**Irrigation Scheduling**	**Water Control and Measurement**
Surface - Graded Border	Use a set irrigation schedule each year	
Surface - Level Border (Basin)	Irrigation based on visual observation of crop stress	Poor - no water measurement AND poor control of water due to inadequate water control structures throughout the conveyance system
Surface - Graded Furrow or Corrugates	Soil moisture by NRCS feel method	
Surface - Surge	Check book scheduling, irrigation scheduler, etc.	
Surface - Controlled with contour ditch, turnouts, canvas dams, etc.	Irrigation scheduling via pan evaporation of atmometer in field	Fair - manually recorded water measurement at delivery point to farm AND poor control of water due to inadequate control structures throughout the conveyance system
Surface - Uncontrolled (wild flood, no control with turnouts, etc.)	Irrigation scheduling via regional weather network (e.g. AgriMet)	
Sprinkler - Big gun or boom	Soil moisture monitoring using Gypsum blocks, moisture probes, etc.	
Sprinkler - Periodic Move (hand line or wheel line)	Continuous measurement of soil moisture, water applied, and ET	Average - manual recordings somewhere in the system OR good control of water with effective water control structures throughout the conveyance system
Sprinkler - Solid set		
Sprinkler - Center pivot	**Pre/Post Irrigation**	
Sprinkler - Lateral/linear move	Pre- and post-season irrigations based on standard run time	Good - manual recordings somewhere in the system AND good control of water with effective water control structures throughout the conveyance system
Micro Irrigation - Sprays and Bubblers	Pre-season OR post-season irrigations based on standard run time	
Micro Irrigation - Tubing or tape w/ integrated or punched-in emitters	Pre- and post-season irrigations based on soil moisture assessment	
	Pre- OR post-season irrigations based on soil moisture assessment	Excellent - Continuous recording water measurement device(s) AND good control of water with effective water control structures throughout the conveyance system
	No irrigation outside crop growing season	

Site Characteristic	Rating and Point Value						SELECTED RATING
Irrigated> **Not Irrigated>**	Very Low 0 0	Low 0.5 1.5	Medium 1.0 3	High 2 6	Very High 4 12	Critical	
Leaching Index (Irrigated) (applies only if Irrigation Index > LOW)	< 9	9 - 12	13 - 16	17 - 20	> 20		
Leaching Index (Not Irrigated)	0	0 – 2	2 – 5	5 – 10	>10		
Site Characteristic	**Rating and Point Value**						**SELECTED RATING**
	Very Low 0	Low 1	Medium 2	High 4	Very High 8	Critical	
Water Table/Geologic Feature Depth and Soil Type	Water table or geologic feature > 5 feet from surface, Hydrologic Group D	Water table or geologic feature > 5 feet from surface, Hydrologic Group C	Water table or geologic feature > 5 feet from surface, Hydrologic Groups A, B	Water table or geologic feature < 5 feet to surface, Hydrologic Groups C, D	Water table or geologic feature < 5 feet to surface, Hydrologic Groups A, B		
TOTAL POINTS FOR GROUND WATER QUALITY (Less than 9 is a LOW rating)							

Table 2. Surface Water Quality Nutrient Transport Risk Assessment Index rating and sit e vulnerability.

Surface Water Risk Assessment Rating	Total	Site Vulnerability Chart
LOW	< 12	Low potential for nutrient loss if current farming practices are maintained.
MEDIUM	12 - 20	Medium potential for nutrient loss. Some remediation measures should be undertaken to minimize the probability of nutrient loss.
HIGH	21 - 40	High potential for nutrient loss and adverse effects on surface and/or ground waters. Soil and water conservation measures and phosphorus management plans are needed to reduce the probability of nutrient loss.
VERY HIGH	> 40	Very high potential for nutrient loss and adverse effects on surface and/or ground waters. All necessary soil and water conservation measures and a nutrient management plan must be implemented to minimize nutrient loss.

Table 3. Ground Water Quality Nutrient Transport Risk Assessment Index rating and sit e vulnerability.

Ground Water Risk Assessment Index Rating	Total	Site Vulnerability Chart
LOW	< 9	Low potential for nutrient loss if current farming practices are maintained.
MEDIUM	9 - 16	Medium potential for nutrient loss. Some remediation measures should be undertaken to minimize the probability of loss.
HIGH	16 - 25	High potential for nutrient loss and adverse effects on ground water. Soil and water conservation measures and nutrient management plans are needed to reduce the probability of loss.
VERY HIGH	>25	Very high potential for nutrient loss and adverse effects on ground water. All necessary soil and water conservation measures and a nutrient management plan must be implemented to minimize loss.

Table 4. The surface RUNOFF CLASS site characteristic determined from the relationship of the soil permeability class and field slope. Adapted from NRCS Soil Survey Manual (1993) Table 3-10.

Slope (%)	Soil Permeability Class [1] *(in/hr)*				
	Very Rapid *(>20.00 in/hr)*	Moderately Rapid and Rapid *(2.00 – 20.00)*	Moderately Slow and Moderate *(0.20 – 2.00)*	Slow *(0.06 - 0.20)*	Very Slow *(< 0.06 in/hr)*
	Runoff Class [3]				
Concave [2]	N	N	N	N	N
< 1	N	N	N	L	M
1 - 5	N	VL	L	M	H
5 - 10	VL	L	M	H	VH
10 - 20	VL	L	M	H	VH
> 20	L	M	H	VH	VH

[1] Permeability class of the least permeable layer within the upper 39 inches (one meter) of the soil profile. Permeability classes for specific soils can be obtained from a published soil survey or from local USDA-NRCS field offices (soils database).
[2] Area from which no or very little water escapes by overland flow.
[3] RUNOFF CLASS: N = negligible, VL = very low, L = low, M = medium, H = high, VH = very high.

ATTACHMENT 1: Example for Conservation Planning

Benchmark condition is sprinkler irrigated potato-sugarbeet-winter wheat in southeast Idaho with manure application.

Site Characteristic and Ranking	Factor Weighting X Rating Value
Soil P test is 35 ppm using an Olsen Test =HIGH	1.0 x 4 = 4.0
P fertilizer application rate is 50 lbs/ac P_2O_5 =LOW	0.75 x 1 = 0.75
P fertilizer application method is placed with planter =LOW	0.5 x 1 = 0.5
Organic P source application rate is 210 lbs/ac =VERY HIGH	1.0 x 8 = 8.0
Organic P source application method is incorporated less than 3 inches by harrowing, etc. =HIGH	0.75 x 4 = 3.0
N fertilizer application rate is 80% of crop requirement prior to debits/credits =MEDIUM	1.0 x 2 = 2.0
N fertilizer application method is broadcast and incorporated greater than 3” =LOW	0.75 x 1 = 0.75
N fertilizer application timing is single application in spring, > 30 days prior to growing season =HIGH	0.75 x 4 = 3
Irrigation Runoff Index for sprinkler irrigated, no runoff occurs but overland flow within field does occur. = LOW	0.5 x 1 = .5
Runoff class from Table 3 is Medium =MEDIUM	0.5 x 2 = 1.0
No runoff conservation practices in place =VERY LOW	1.0 x 0 = 0

Soil erosion is 7.5 tons/ac/yr = MEDIUM	1.0 x 2 = 2.0
Distance to nearest receiving water body is 300 feet =HIGH	1.0 x 4 = 4.0
Irrigation Index calculated at 68 for center pivot with visual observation of crop stress, pre-season irrigation and average control of water =MEDIUM	1.5 x 2 = 3
Leaching Index for Pocatello =LOW	0.75 x 1 = 0.75
Water table/soils for Hydrologic Group C with no water table or geologic feature within 5 feet =LOW	1.0 x 1 = 1.0
Total Points for Surface Water Quality	**26.5**
Total Points for Ground Water Quality	**9.75**

Ranking for Surface Water - the site has a **HIGH** potential for nutrient loss and adverse effects on surface waters.

Ranking for Ground Water – the site has a **MEDIUM** potential for nutrient loss and impact to ground water.

Using the individual site characteristics, identify some factors of concern and management options that could be used to reduce this site vulnerability (mitigation):

Soil P Test – The soil P test was HIGH. Remember that the soil test level for "available P" does not ascertain the total P in the surface soil. It does, however, give an indication of the amount of total P that may be present because of the general relationship between the forms of P and the solution P available for crop uptake. Research has conclusively shown that the higher the soil test P level of a site, the proportionately higher the potential P loss will be from that site. Therefore the long-term goal should be to conduct a comprehensive soil testing program on the entire farm and implement nutrient management on individual fields using ONEPLAN. Estimates should be made to determine the time required to deplete the soil P to optimum levels.

Organic P Source Application Rate – The organic P source application rate was > 200 lbs/ac, falling in the VERY HIGH category. This particular site characteristic is especially important. Here we have a management unit with a soil test P level that is already high and very high rates of organic P are being applied. Considering the long-term management options discussed under

Soil P Test, the organic P application rate should either be reduced to crop P uptake or less, or no organic P should be applied ntil the soil P is depleted back to an optimal level. The ONEPLAN nutrient management program can help identify fields with lower soil P test and lower risk assessment values where the organic material could be applied.

Organic P Source Application Method – The organic P source application method was incorporated less than 3 inches with a harrow, etc. putting it in the HIGH category. Remember that the manner in which organic P material is applied to the soil can determine potential P movement. Since the organic P was only minimally incorporated, the organic P would still have a substantial surface exposure. Mechanical incorporation reduces the amount of nutrients in the thin mixing zone at the soil surface and/or on crop residue or foliage, thus reducing the interaction with and transfer of nutrients to runoff water. With incorporation, other environmental losses may also be reduced, and nutrient management may be improved. However, mechanical incorporation with tillage may reduce soil-protecting crop residue and increase erosion. Incorporated material may be subject to downward movement. Leaching losses may be increased, and the relative importance of the different loss pathways needs to be considered. The organic P material should be injected or plowed greater than 2 inches if possible, and applied immediately before the crop is planted.

Runoff Conservation Practices – No runoff practices are currently in place, so level of use is VERY LOW. Implementing irrigation water management and use of surface roughening (dam-dike) and buffers would help reduce runoff and sediment loss. (see Soil Erosion).

Soil Erosion – The soil erosion rate was 7.5 tons/ac/yr (MEDIUM category). Prediction models are used in the assessment to indicate a movement of soil, thus potential for sediment and attached phosphorus movement across the slope or unsheltered distance and to a water body. Conservation measures such as residue management or reduced tillage should be considered as a way to reduce erosion. In addition, other conservation measures like field borders or buffers should be considered as a means to mitigate off-site transport and improve the quality of runoff leaving the field.

Irrigation Index – Despite the use of a center pivot system, the irrigation index rated MEDIUM because of pre-season irrigation practices and a low level of irrigation scheduling. Following appropriate irrigation water management techniques could significantly improve efficient use of water and reduce the potential for leaching losses.

Nitrogen Application Timing – Applying nitrogen as a single application more than 30 days prior to the start of the growing season increases the risk of loss during spring. Apply the nitrogen closer to the growing season and consider splitting applications for better crop use efficiency.