02.04.14 – RULES GOVERNING DAIRY BYPRODUCT

000. LEGAL AUTHORITY.
This chapter is adopted under the legal authority of Title 37, Chapters 3, 4, and 6, Idaho Code. (3-31-22)

001. SCOPE.
These rules govern the Department's review, approval, and enforcement of dairy environmental management plans. (3-31-22)

002. -- 003. (RESERVED)

004. INCORPORATION BY REFERENCE.
The following documents are incorporated by reference into this chapter. (3-31-22)

~~**01. Natural Resources Conservation Service Agricultural Waste Management Field Handbook Appendix 10D (Appendix 10D) (1997 Edition) (USDA, NRCS)**. This document is available online at https://agri.idaho.gov/main/wp-content/uploads/2017/08/nrcs_10d_1997.pdf.~~ (3-31-22)

02. Nutrient Management Standard (NMS). The 1999 publication by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Idaho Conservation Practice Standard, Nutrient Management Code 590, available online at https://agri.idaho.gov/main/wp-content/uploads/2017/08/nutrient_Management_code_590.pdf. (3-31-22)

~~**03. Natural Resources Conservation Service (NRCS) Idaho Conservation Practice Standard Waste Storage Facility Code 313 December 2004**. This document is available online at https://agri.idaho.gov/main/wp-content/uploads/2017/10/nrcs_313_Dec_2004.pdf. (3-31-22)~~

~~**04. American Society of Agricultural and Biological Engineers Specification ASAE EP393.3 Manure Storages February 2004**. This document is part of a copyrighted publication and is available for viewing at the ISDA offices or a copy may be purchased online at http://www.asabe.org/. (3-31-22)~~

~~**05. Natural Resources Conservation Service (NRCS) Web Soil Survey Database**. This document is available online at https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. (3-31-22)~~

~~**06. Natural Resources Conservation Service (NRCS) Part 630, Hydrology National Engineering Handbook, Chapter 7, (Hydrologic Soil Groups), January 2009**. This document is available online at https://www.wcc.nrcs.usda.gov/ftpref/wntsc/H&H/NEHhydrology/ch7.pdf. (3-31-22)~~

Commented [DSL1]: Move to NMP rule

07. The Phosphorus Site Index: A Systematic Approach to Assess the Risk of Nonpoint Source Pollution of Idaho Waters by Agricultural Phosphorus, 2017. This document is available online at https://agri.idaho.gov/main/wp-content/uploads/2018/12/Phosphorus-Site-Index-reference-2017-revised.pdf.(3-31-22)

005. -- 009. (RESERVED)

010. DEFINITIONS.
The following definitions apply in the interpretation and enforcement of this chapter: (3-31-22)

~~**01. Approved Laboratory**. A soil testing laboratory that meets the requirements and performance standards of the North American Proficiency Testing Program under the auspices of the Soil Science Society of America.~~ (3-31-22)

Commented [DSL2]: Move to NMP rule

~~**02. Certified Soil Sampler**. An individual qualified and approved by the Department to collect soil samples according to the 1997 University of Idaho Soil Sampling protocols or other method as approved by the~~

~~Department.~~ (3-31-22)

03. **Dairy Animal**. Milking cows, sheep or goats. (3-31-22)

04. **Dairy Byproduct**. Solids and liquids associated with dairy animal rearing and milk production including, but not limited to, manure, manure compost, process water, bedding, spilled feed, and feed leachate. (3-31-22)

05. **Dairy Environmental Management System**. The areas and structures within a dairy farm where dairy byproducts are collected, stored, treated, or applied to land. These areas and structures may include corrals, feeding areas, collection systems, conveyance systems, storage ponds, treatment lagoons, and evaporative ponds and land application areas, but do not include pastures as defined in these rules. (3-31-22)

06. **Dairy Farm**. The land owned or operated by a person as an integral component of a Department-permitted grade A or manufacture grade facility where one (1) or more milking cows, sheep, or goats are kept, and from which all or a portion of the milk produced thereon is delivered, sold or offered for sale for human consumption. A dairy farm does not include those lands that contain non-dairy animals provided a physical separation exists from lands owned or operated by the dairy, byproducts remain separate, and dairy animals are not comingled with non-dairy animals. (3-31-22)

~~**07.** **Dairy Storage and Containment Facilities**. The areas and structures within a dairy farm where dairy byproducts are collected, stored, or treated in conformance with engineering standards and specifications published by the USDA Natural Resources Conservation Service or by the ASABE, or other equally protective criteria approved by the Director. These areas may include corrals, feeding areas, collection systems, conveyance systems, storage ponds, treatment lagoons, evaporative ponds, and compost areas, but do not include pastures as defined in these Rules. (3-31-22)~~

~~**08.** **Inspector**. A qualified, trained person employed by the Department to perform dairy farm inspections. (3-31-22~~)

09. **Land Application**. Mechanical spreading on, or incorporating into the soil mantle, dairy byproduct as a soil amendment for agricultural use of nutrients and for other beneficial purposes. Land application does not include pasturing animals as defined in these rules. (3-31-22)

~~**10.** **Modification or Modified**. Structural changes and alterations to the dairy storage and containment facility that would require increased storage or containment capacity or the function of the facility. (3-31-22)~~

11. **Pasture, Pasturing, and Pastured**. For purposes of these rules, a pasture is an irrigated or dryland field with forage plant growth covering a minimum of fifty percent (50%) of the field. Pasturing and pastured is dairy animals and other animals owned, leased, or otherwise under the control of the producer, grazing in the same dairy farm pasture. Pastures are not considered part of a dairy storage and containment facility. (3-31-22)

12. **Permit**. A permit issued by the Department allowing the sale of Grade A milk or manufacture grade milk. (3-31-22)

13. **Phosphorus Site Index**. A method to evaluate the relative potential for off-site movement of phosphorus from a field or pasture based upon risk factors relating to surface transport, phosphorus loss potential and nutrient management practices. (3-31-22)

14. **Producer**. The person who owns or operates a permitted dairy farm. (3-31-22)

011. **ABBREVIATIONS.**

~~**01.** **ASABE**. American Society of Agricultural and Biological Engineers. (3-31-22)~~

02. **IPDES**. Idaho Pollutant Distribution Elimination System. (3-31-22)

03. **NMS**. Nutrient Management Standard (3-31-22)

04. **NRCS**. Natural Resources Conservation Service. (3-31-22)

~~**05.** **USDA**. United States Department of Agriculture. (3-31-22)~~

012. -- 029. (RESERVED)

030. DAIRY ENVIRONMENTAL MANAGEMENT PLAN APPROVAL.

01. **Dairy Storage and Containment Facility Criteria**. (3-31-22)

a. Dairy storage and containment facilities shall be constructed to meet a minimum of one hundred eighty (180) days of holding capacity. Construction, operation and maintenance shall be in accordance with IDAPA 02.04.30, Rules Governing Environmental and Nutrient Management.~~.~~ ~~Process water containment structures that are utilized as the secondary or final storage for effluent shall have a minimum two (2) vertical feet of freeboard. Process water and containment structures that are not the secondary or final storage for effluent shall have a minimum one (1) vertical feet of freeboard. (3-31-22)~~

~~**b.** Earthen dairy storage and containment facilities less than ten (10) vertical feet high with a maximum high water line of eight (8) vertical feet shall have a top embankment width of at least eight (8) feet. The combined embankment slopes must be at least five (5) horizontal to one (1) vertical, and shall not exceed two (2) horizontal to one (1) vertical slope. Earthen dairy storage and containment facilities greater than ten (10) vertical feet from the naturally occurring ground level shall meet the NRCS Idaho Conservation Practice Standard Waste Storage Facility Code 313 December 2004 embankment requirements. (3-31-22)~~

~~**c.** The inside bottom of the dairy storage and containment facility shall be a minimum of two (2) feet above the high water table, bed rock, gravel, or permeable soils. For an earthen dairy storage and containment facility, a soil liner shall be installed such that the specific discharge rate of the containment structure meet 1 x 10-6 cm3/cm2/sec or less. Concrete or synthetic liners must be constructed to ASAE and Appendix 10D specifications. (3-31-22)~~

~~**d.** Storage areas for dairy byproduct, including compost and solid manure storage areas, shall be appropriately protected to prevent run on, run off, and contamination of ground and surface water. (3-31-22)~~

~~**e.** Dairy environmental management systems shall be maintained in a condition that allows the producer to regularly inspect the integrity of the systems. (3-31-22)~~

02. **Dairy Nutrient Management Plan (DNMP)**. Each dairy farm shall have a dairy nutrient management plan that is approved by the Department~~. The DNMP shall~~ that covers the dairy farm site and other land owned and operated by the dairy farm ~~owner or operator~~ to which dairy byproducts are land applied. In addition to the ~~R~~requirements ~~to comply with the provisions of a DNMP~~ set forth in IDAPA 02.04.30, Rules Governing Environmental and Nutrient Management, a DNMP must also include the following: (3-31-22)

~~**a.** Producer annual soil tests shall be conducted as set forth in IDAPA 02.04.30, "Rules Governing Environmental and Nutrient Management," and tested by an approved laboratory. (3-31-22)~~

~~**b.** Regulatory soil tests will be conducted at frequencies sufficient to provide assurance of compliance with Section 031 and with IDAPA 02.04.30, "Rules Governing Environmental and Nutrient Management." (3-31-22)~~

~~**c.** Accurate DNMP records shall be maintained. These records shall include at a minimum: (3-31-22)~~

~~i. Annual soil analysis; (3-31-22)~~

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ii. Date and amount of dairy byproduct and commercial fertilizer applied to individual dairy owned or operated fields; (3-31-22)

iii. Date(s) of exported dairy byproduct, number of acres applied, amount of dairy byproduct exported, and to whom dairy byproduct was exported; and (3-31-22)

iv. Actual crop yields on dairy owned or operated fields. (3-31-22)

v. A nitrogen management plan worksheet shall be completed for all fields and pastures receiving land application of nutrients. (3-31-22)

d. Pasturing. All pastures utilized for grazing of dairy animals, and other animals grazing within the same pasture, shall be incorporated in to the DNMP and subject to the following requirements: (3-31-22)

i. Soil testing pursuant to IDAPA 02.04.30, Rules Governing Environmental and Nutrient Management.the NMS and this section. (3-31-22)

ii. Surface water access. If pastured animals have access to surface water within a pasture, the producer may be required to implement one (1) or more NRCS conservation practice standards to minimize adverse impact on surface water quality. (3-31-22)

iii. Land application. If land application occurs within a pasture, annual soil tests shall be conducted. (3-31-22)

iv. Confinement areas. Confinement areas shall not be considered part of a pasture. (3-31-22)

e. IPDES Permits. Dairy farms governed by the IPDES program are not required to submit a DNMP to the Department. (3-31-22)

031. PHOSPHORUS MANAGEMENT.
Dairy farms shall utilize either Phosphorus Indexing (Section 031.01) or the Phosphorus Threshold (Section 031.02) to manage nutrient application. (3-31-22)

01. Phosphorus Indexing. The dairy farm shall utilize phosphorus site indexing (PSI) for each field where dairy byproducts and/or commercial fertilizers are land applied and for each pasture utilized for grazing, in accordance with the 2017 Idaho Phosphorus Site Index Standards. The PSI shall be calculated by a Nutrient Management Planner, certified by the Department, and be included as a component of the DNMP in the dairy farm's Environmental Management Plan. It shall be the dairy farm's responsibility to provide updated information, including annual soil test results, to the Nutrient Management Planner for calculation of the PSI on all fields and pastures on an annual basis. Failure to abide by the nutrient application and management provisions of a field or pasture's PSI risk classification in the DNMP shall constitute a non-compliance and the producer may be penalized as provided in these rules. (3-31-22)

a. Notwithstanding anything to the contrary in the 2017 Idaho Phosphorus Site Index Standards, no land application of phosphorus shall be permitted on any fields or pastures that possess a soil phosphorus level exceeding three hundred (300) parts per million, as determined by the required annual soil test (via Olsen method). Further, the dairy farm shall not receive BMP Coefficient credit for implementing any best management practice designed to reduce phosphorus loss on fields exceeding three hundred (300) parts per million, via Olsen method. (3-31-22)

b. The Department may award zero (0) or partial BMP Coefficient credit when a dairy farm implements a best management practice designed to reduce phosphorus loss from fields that does not fully conform to NRCS standards or the standards set forth in the 2017 Idaho Phosphorus Site Index Standards BMP definition section. (3-31-22)

02. Phosphorus Threshold. If the regulatory or producer soil tests reveal that phosphorus thresholds on fields and pastures have exceeded the levels established in the NMS, the producer shall only apply phosphorus at the appropriate phosphorus crop uptake rate. Subsequent regulatory soil test(s) on fields and pastures that were identified as exceeding the phosphorus threshold will be conducted. If two (2) out of three (3) tests reveal the phosphorus index continues to trend upward, the producer will be penalized as provided in these rules. These tests shall be taken in the top one (1) foot of soil. (3-31-22)

032. -- 039. (RESERVED)

040. INSPECTIONS.
Each dairy farm shall be inspected at intervals sufficient to determine that dairy byproducts and process water have been managed to prevent an unauthorized discharge, unauthorized release, or contamination of surface and ground water. (3-31-22)

041. -- 049. (RESERVED)

050. COMPLIANCE SCHEDULES.

01. Non-Compliance or Unauthorized Release Violations. Appropriate corrective actions will be identified and informally scheduled when items of non-compliance or unauthorized release violations are identified. The Director may develop a formal compliance schedule in the following cases: (3-31-22)

a. Failure to complete corrective actions within thirty (30) days; or (3-31-22)

b. Corrective actions require significant capital investment; or (3-31-22)

c. Informal schedules have not been followed. (3-31-22)

02. Re-Inspection. Re-inspection of the dairy farm will be conducted as appropriate, to ensure compliance. An unauthorized release violation shall be corrected immediately, when at all possible. (3-31-22)

051. -- 059. (RESERVED)

060. UNAUTHORIZED DISCHARGES AND UNAUTHORIZED RELEASES -- PENALTIES.
Non-compliance with requirements for dairy environmental systems, the NMS, and DNMP shall be addressed through corrective actions and compliance schedules pursuant to these rules. (3-31-22)

061. -- 999. (RESERVED)

02.04.14 – RULES GOVERNING DAIRY BYPRODUCT

000. LEGAL AUTHORITY.
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001. SCOPE.
These rules govern the Department's review, approval, and enforcement of dairy environmental management plans. (3-31-22)

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004. INCORPORATION BY REFERENCE.
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02. Nutrient Management Standard (NMS). The 1999 publication by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Idaho Conservation Practice Standard, Nutrient Management Code 590, available online at https://agri.idaho.gov/main/wp-content/uploads/2017/08/nutrient_Management_code_590.pdf. (3-31-22)

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07. The Phosphorus Site Index: A Systematic Approach to Assess the Risk of Nonpoint Source Pollution of Idaho Waters by Agricultural Phosphorus, 2017. This document is available online at https://agri.idaho.gov/main/wp-content/uploads/2018/12/Phosphorus-Site-Index-reference-2017-revised.pdf. (3-31-22)

005. -- 009. (RESERVED)

010. DEFINITIONS.
In addition to Section 37-604, Idaho Code, t~~T~~he following definitions apply in the interpretation and enforcement of this chapter: (3-31-22)

~~**01. Approved Laboratory**. A soil testing laboratory that meets the requirements and performance standards of the North American Proficiency Testing Program under the auspices of the Soil Science Society of America.~~ (3-31-22)

Commented [DSL1]: Move to NMP rule

Commented [JS2]: I know I suggested striking this language in other chapters. Over the last several months, people have asked that we keep this language where appropriate and I am fine with this. While people should always go to statute first, this little bit here is helpful.

Commented [DSL3]: Move to NMP rule

02. Certified Soil Sampler. An individual qualified and approved by the Department to collect soil samples according to the 1997 University of Idaho Soil Sampling protocols or other method as approved by the Department. (3-31-22)

03. Dairy Animal. Milking cows, sheep or goats. (3-31-22)

04. Dairy Byproduct. Solids and liquids associated with dairy animal rearing and milk production including, but not limited to, manure, manure compost, process water, bedding, spilled feed, and feed leachate. (3-31-22)

Commented [JS4]: IC 37-604(4)

05. Dairy Environmental Management System. The areas and structures within a dairy farm where dairy byproducts are collected, stored, treated, or applied to land. These areas and structures may include corrals, feeding areas, collection systems, conveyance systems, storage ponds, treatment lagoons, and evaporative ponds and land application areas, but do not include pastures as defined in these rules. (3-31-22)

Commented [JS5]: 37-604(6)

06. Dairy Farm. The land owned or operated by a person as an integral component of a Department-permitted grade A or manufacture grade facility where one (1) or more milking cows, sheep, or goats are kept, and from which all or a portion of the milk produced thereon is delivered, sold or offered for sale for human consumption. A dairy farm does not include those lands that contain non-dairy animals provided a physical separation exists from lands owned or operated by the dairy, byproducts remain separate, and dairy animals are not comingled with non-dairy animals. (3-31-22)

Commented [JS6]: 37-604(5)

07. Dairy Storage and Containment Facilities. The areas and structures within a dairy farm where dairy byproducts are collected, stored, or treated in conformance with engineering standards and specifications published by the USDA Natural Resources Conservation Service or by the ASABE, or other equally protective criteria approved by the Director. These areas may include corrals, feeding areas, collection systems, conveyance systems, storage ponds, treatment lagoons, evaporative ponds, and compost areas, but do not include pastures as defined in these Rules. (3-31-22)

08. Inspector. A qualified, trained person employed by the Department to perform dairy farm inspections. (3-31-22)

09. Land Application. Mechanical spreading on, or incorporating into the soil mantle, dairy byproduct as a soil amendment for agricultural use of nutrients and for other beneficial purposes. Land application does not include pasturing animals as defined in these rules. (3-31-22)

Commented [JS7]: 37-604(9)

10. Modification or Modified. Structural changes and alterations to the dairy storage and containment facility that would require increased storage or containment capacity or the function of the facility. (3-31-22)

11. Pasture, Pasturing, and Pastured. For purposes of these rules, a pasture is an irrigated or dryland field with forage plant growth covering a minimum of fifty percent (50%) of the field. Pasturing and pastured is dairy animals and other animals owned, leased, or otherwise under the control of the producer, grazing in the same dairy farm pasture. Pastures are not considered part of a dairy storage and containment facility. (3-31-22)

12. Permit. A permit issued by the Department allowing the sale of Grade A milk or manufacture grade milk. (3-31-22)

13. Phosphorus Site Index. A method to evaluate the relative potential for off-site movement of phosphorus from a field or pasture based upon risk factors relating to surface transport, phosphorus loss potential and nutrient management practices. (3-31-22)

14. Producer. The person who owns or operates a permitted dairy farm. (3-31-22)

011. ABBREVIATIONS.

~~**01.** **ASABE**. American Society of Agricultural and Biological Engineers. (3-31-22)~~

02. **IPDES**. Idaho Pollutant Distribution Elimination System. (3-31-22)

03. **NMS**. Nutrient Management Standard (3-31-22)

04. **NRCS**. Natural Resources Conservation Service. (3-31-22)

~~**05.** **USDA**. United States Department of Agriculture. (3-31-22)~~

012. -- 029. (RESERVED)

030. DAIRY ENVIRONMENTAL MANAGEMENT PLAN APPROVAL.

01. Dairy Storage and Containment Facility Criteria. (3-31-22)

a. Dairy storage and containment facilities shall be constructed to meet a minimum of one hundred eighty (180) days of holding capacity. Construction, operation and maintenance shall be in accordance with IDAPA 02.04.30, Rules Governing Environmental and Nutrient Management.~~. Process water containment structures that are utilized as the secondary or final storage for effluent shall have a minimum two (2) vertical feet of freeboard. Process water and containment structures that are not the secondary or final storage for effluent shall have a minimum one (1) vertical feet of freeboard. (3-31-22)~~

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~~**b.** Earthen dairy storage and containment facilities less than ten (10) vertical feet high with a maximum high water line of eight (8) vertical feet shall have a top embankment width of at least eight (8) feet. The combined embankment slopes must be at least five (5) horizontal to one (1) vertical, and shall not exceed two (2) horizontal to one (1) vertical slope. Earthen dairy storage and containment facilities greater than ten (10) vertical feet from the naturally occurring ground level shall meet the NRCS Idaho Conservation Practice Standard Waste Storage Facility Code 313 December 2004 embankment requirements. (3-31-22)~~

~~**c.** The inside bottom of the dairy storage and containment facility shall be a minimum of two (2) feet above the high water table, bed rock, gravel, or permeable soils. For an earthen dairy storage and containment facility, a soil liner shall be installed such that the specific discharge rate of the containment structure meet 1 x 10-6 cm3/cm2/sec or less. Concrete or synthetic liners must be constructed to ASAE and Appendix 10D specifications. (3-31-22)~~

~~**d.** Storage areas for dairy byproduct, including compost and solid manure storage areas, shall be appropriately protected to prevent run on, run off, and contamination of ground and surface water. (3-31-22)~~

~~**e.** Dairy environmental management systems shall be maintained in a condition that allows the producer to regularly inspect the integrity of the systems. (3-31-22)~~

02. Dairy Nutrient Management Plan (DNMP). Each dairy farm shall have a dairy nutrient management plan that is approved by the Department~~. The DNMP shall~~ that covers the dairy farm site and other land owned and operated by the dairy farm ~~owner or operator~~ to which dairy byproducts are land applied. In addition to the ~~R~~requirements ~~to comply with the provisions of a DNMP~~ set forth in IDAPA 02.04.30, Rules Governing Environmental and Nutrient Management, a DNMP must also include the following: (3-31-22)

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~~**a.** Producer annual soil tests shall be conducted as set forth in IDAPA 02.04.30, "Rules Governing Environmental and Nutrient Management," and tested by an approved laboratory. (3-31-22)~~

~~**b.** Regulatory soil tests will be conducted at frequencies sufficient to provide assurance of compliance with Section 031 and with IDAPA 02.04.30, "Rules Governing Environmental and Nutrient Management." (3-31-22)~~

~~c. Accurate DNMP records shall be maintained. These records shall include at a minimum: (3-31-22)~~

~~i. Annual soil analysis; (3-31-22)~~

~~ii. Date and amount of dairy byproduct and commercial fertilizer applied to individual dairy owned or operated fields; (3-31-22)~~

~~iii. Date(s) of exported dairy byproduct, number of acres applied, amount of dairy byproduct exported, and to whom dairy byproduct was exported; and (3-31-22)~~

~~iv. Actual crop yields on dairy owned or operated fields. (3-31-22)~~

v. A nitrogen management plan worksheet shall be completed for all fields and pastures receiving land application of nutrients. ~~(3-31-22)~~

d. Pasturing. All pastures utilized for grazing of dairy animals, and other animals grazing within the same pasture, shall be incorporated in to the DNMP and subject to the following requirements: (3-31-22)

i. Soil testing pursuant to IDAPA 02.04.30, Rules Governing Environmental and Nutrient Management.~~the NMS and this section~~. (3-31-22)

ii. Surface water access. If pastured animals have access to surface water within a pasture, the producer may be required to implement one (1) or more NRCS conservation practice standards to minimize adverse impact on surface water quality. (3-31-22)

iii. Land application. If land application occurs within a pasture, annual soil tests shall be conducted. (3-31-22)

iv. Confinement areas. Confinement areas shall not be considered part of a pasture. (3-31-22)

~~e. IPDES Permits. Dairy farms governed by the IPDES program are not required to submit a DNMP to the Department.~~ (3-31-22)

031. PHOSPHORUS MANAGEMENT.
Dairy farms shall utilize either Phosphorus Indexing (Section 031.01) or the Phosphorus Threshold (Section 031.02) to manage nutrient application. (3-31-22)

01. Phosphorus Indexing. The dairy farm shall utilize phosphorus site indexing (PSI) for each field where dairy byproducts and/or commercial fertilizers are land applied and for each pasture utilized for grazing, in accordance with the 2017 Idaho Phosphorus Site Index Standards. The PSI shall be calculated by a Nutrient Management Planner, certified by the Department, and be included as a component of the DNMP in the dairy farm's Environmental Management Plan. It shall be the dairy farm's responsibility to provide updated information, including annual soil test results, to the Nutrient Management Planner for calculation of the PSI on all fields and pastures on an annual basis. Failure to abide by the nutrient application and management provisions of a field or pasture's PSI risk classification in the DNMP shall constitute a non-compliance and the producer may be penalized as provided in these rules. (3-31-22)

a. Notwithstanding anything to the contrary in the 2017 Idaho Phosphorus Site Index Standards, no land application of phosphorus shall be permitted on any fields or pastures that possess a soil phosphorus level exceeding three hundred (300) parts per million, as determined by the required annual soil test (via Olsen method). Further, the dairy farm shall not receive BMP Coefficient credit for implementing any best management practice designed to reduce phosphorus loss on fields exceeding three hundred (300) parts per million, via Olsen method. (3-31-22)

b. The Department may award zero (0) or partial BMP Coefficient credit when a dairy farm implements a best management practice designed to reduce phosphorus loss from fields that does not fully conform to NRCS standards or the standards set forth in the 2017 Idaho Phosphorus Site Index Standards BMP definition section. (3-31-22)

02. Phosphorus Threshold. If the regulatory or producer soil tests reveal that phosphorus thresholds on fields and pastures have exceeded the levels established in the NMS, the producer shall only apply phosphorus at the appropriate phosphorus crop uptake rate. Subsequent regulatory soil test(s) on fields and pastures that were identified as exceeding the phosphorus threshold will be conducted. If two (2) out of three (3) tests reveal the phosphorus index continues to trend upward, the producer will be penalized as provided in these rules. These tests shall be taken in the top one (1) foot of soil. (3-31-22)

032. -- 039. (RESERVED)

040. INSPECTIONS.

Each dairy farm shall be inspected at intervals sufficient to determine that dairy byproducts and process water have been managed to prevent an unauthorized discharge, unauthorized release, or contamination of surface and ground water. (3-31-22)

041. -- 049. (RESERVED)

050. COMPLIANCE SCHEDULES.

01. Non-Compliance or Unauthorized Release Violations. Appropriate corrective actions will be identified and informally scheduled when items of non-compliance or unauthorized release violations are identified. The Director may develop a formal compliance schedule in the following cases: (3-31-22)

a. Failure to complete corrective actions within thirty (30) days; or (3-31-22)

b. Corrective actions require significant capital investment; or (3-31-22)

c. Informal schedules have not been followed. (3-31-22)

02. Re-Inspection. Re-inspection of the dairy farm will be conducted as appropriate, to ensure compliance. An unauthorized release violation shall be corrected immediately, when at all possible. (3-31-22)

051. -- 059. (RESERVED)

060. UNAUTHORIZED DISCHARGES AND UNAUTHORIZED RELEASES -- PENALTIES.

Non-compliance with requirements for dairy environmental systems, the NMS, and DNMP shall be addressed through corrective actions and compliance schedules pursuant to these rules. (3-31-22)

061. -- 999. (RESERVED)

02.04.23 – RULES GOVERNING COMMERCIAL LIVESTOCK TRUCK WASHING FACILITIES

000. LEGAL AUTHORITY.
This chapter is adopted under the legal authority of Sections 22-103(15) and 22-110, Idaho Code. (3-31-22)

001. TITLE AND SCOPE.

01. Title. The title of this chapter is IDAPA 02.04.23, "Rules Governing Commercial Livestock Truck Washing Facilities." (3-31-22)

02. Scope. These rules govern the permitting, construction, and management of commercial livestock truck washing facilities. (3-31-22)

002. WRITTEN INTERPRETATIONS.
There are no written interpretations of these rules. (3-31-22)

003. ADMINISTRATIVE APPEAL.
Persons may be entitled to appeal agency actions authorized under these rules pursuant to Title 67, Chapter 52, Idaho Code. (3-31-22)

004. INCORPORATION BY REFERENCE.
Copies of these documents may be obtained from the Idaho State Department of Agriculture central office and the State Law Library. (3-31-22)

01. The 1997 United States Department of Agriculture Natural Resources Conservation Service Agricultural Waste Management Field Handbook, Appendix 10 D. (3-31-22)

02. The 2000 American Society of Agricultural Engineers Standard EP393.3. (3-31-22)

03. The 1999 Publication by the United States Department Of Agriculture, Natural Resource Conservation Service, Conservation Practice Standard, Nutrient Management Code 590. (3-31-22)

005. ADDRESS, OFFICE HOURS, TELEPHONE, FAX NUMBERS, WEB ADDRESS.
The Idaho State Department of Agriculture central office is located at 2270 Old Penitentiary Road, Boise, ID 83712-8298. The office is open from 8 a.m. to 5 p.m., except Saturday, Sunday, and legal holidays. The mailing address is PO Box 7249, Boise, Idaho 83707. The phone number is (208) 332-8500 and the fax number is (208) 334-2170. The Department web address is https://agri.idaho.gov/. (3-31-22)

006. IDAHO PUBLIC RECORDS ACT.
These rules are public records available for inspection and copying at the central office of ISDA and the State Law Library. (3-31-22)

007. -- 009. (RESERVED)

010. DEFINITIONS.
The following definitions apply in the interpretation and enforcement of this chapter. (3-31-22)

01. Commercial Livestock Truck Washing Facilities. Livestock truck washing facilities that charge a fee to wash livestock trucks and trailers, or those facilities where the process wastewater is not regulated pursuant IDAPA 02.04.14 "Rules Governing Dairy WasteByproduct," or 02.04.15 "Rules of the Department of Agriculture Governing Beef Cattle Animal Feeding Operations." (3-31-22)

02. Compost. A biologically stable material derived from the biological decomposition of organic

Commented [DSL1]: All language pertaining to construction of lagoons or maintaining an NMP is being moved to the NMP rule.

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Commented [DSL2]: Disparity on regulatory oversight...should this be addressed? Would it be enforceable at that point? Is there a penalty provision for this rule?

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~~matter.~~ (3-31-22)

~~**03. Discharge**. Release of process wastewater or manure from a commercial livestock truck washing facility to waters of the state.~~ (3-31-22)

~~**04. Land Application**. The spreading on, or incorporation of manure or process wastewater into the soil. (3-31-22)~~

05. Livestock. Bovidae, ovidae, suidae, and equidae. (3-31-22)

06. Livestock Truck Washing Facilities. Those facilities utilized primarily for washing and cleaning trucks and trailers that haul livestock. (3-31-22)

~~**07. Modified**. Structural or management changes, or alterations to the livestock truck washing facility which would require increased storage or containment capacity or such changes, which would alter the function of the wastewater storage or containment facility.~~ (3-31-22)

~~**08. Non-Compliance**. A practice or condition that causes an unauthorized discharge or a practice or condition that if left uncorrected will cause an unauthorized discharge.~~ (3-31-22)

~~**09. Non-Land Application Season**. The portion of the year during which land application is not allowed pursuant to an approved NMP.~~ (3-31-22)

~~**10. Nutrient Management Plan**. A plan prepared in conformance with the nutrient management standard or other equally protective standard for managing the amount, source, placement, form, and timing of the land application of nutrients or soil amendments. (3-31-22)~~

~~**11. Operate**. Washing or cleaning livestock trucks. (3-31-22)~~

~~**12. Operator**. The person who has power or authority to manage, or direct, or has financial control of a commercial livestock truck washing facility.~~ (3-31-22)

13. Process Wastewater. Any water generated on a commercial livestock truck washing facility that comes into contact with manure, compost, bedding, or feed. (3-31-22)

14. Runoff. Any precipitation that comes into contact with manure, compost, bedding, or feed on a commercial livestock truck washing facility. (3-31-22)

15. Unauthorized Discharge. A discharge of process wastewater or manure from a commercial livestock truck washing facility to surface waters of the state that is not authorized under an IPDES permit. ~~by~~ a ~~National Pollutant Discharge Elimination System permit issued by the United States Environmental Protection Agency~~. (3-31-22)

~~**16. Wastewater Storage and Containment Facility**. That portion of a CLTWF where manure or process wastewater is stored or collected. This includes, but is not limited to, waste collection systems, waste conveyance systems, waste storage ponds, waste treatment lagoons and evaporative ponds. (3-31-22)~~

17. Waters of the State. All surface and ground water located within the boundaries of the state or boundary streams, rivers and lakes except for private waters as defined in Title 42, Chapter 2, Idaho Code. (3-31-22)

011. ABBREVIATIONS.

01. CLTWF. Commercial Livestock Truck Washing Facility. (3-31-22)

~~**02. FEMA**. Federal Emergency Management Agency. (3-31-22)~~

Commented [DSL3]: Don't need both definitions with "Unauthorized discharge" listed below.

Commented [DSL4]: Relocate to NMP

Commented [DSL5]: Red Tape Reduction

Commented [JS6]: Consider striking as already defined in IC22-4904(14):

(14) "Process wastewater" means liquid containing beef cattle manure, process-generated wastewater and any pre-cipitation which comes into direct contact with livestock manure and facility products or byproducts.

Commented [DSL7R6]: IC 22-49 is not the authorizing statute for this rule.

Commented [JS8]: Consider striking as already defined in 22-4904(15):

(15) "Unauthorized discharge" means a discharge of process wastewater or livestock manure to state surface waters that does not meet the requirements of this chapter or water quality standards.

Commented [JS9]: Consider striking as already defined in 22-4904(17):

"Waters of the state" means all accumulations of water, surface and underground, natural and artificial, public and private, or parts thereof which are wholly or partially within, which flow through or border upon the state.

03. **ISDA**. Idaho State Department of Agriculture. (3-31-22)

04. **NMP**. Nutrient Management Plan. (3-31-22)

05. **NPDESIPDES**. National Idaho Pollutant Discharge Elimination System. (3-31-22)

06. **NRCS**. Natural Resources Conservation Service. (3-31-22)

07. **USDA**. United States Department of Agriculture. (3-31-22)

012. APPLICABILITY.

These rules apply to all CLTWF. (3-31-22)

Commented [JS10]: Not necessary. Already outlined in Scope.

013. -- 049. (RESERVED)

050. INSPECTIONS.

In order to ascertain compliance with this chapter,The the Director shall have reasonable access to all CLTWF facility or record: (3-31-22)

Commented [JS11]: More concise.

01. **Inspect Facilities**. Inspect any facility or land application site listed in the CLTWF's NMP. (3-31-22)

02. **Inspect Records**. Inspect, review, or copy any CLTWF's records deemed necessary, during normal business hours. (3-31-22)

051. -- 099. (RESERVED)

100. PERMIT REQUIRED.

No person shall construct or operate a CLTWF without first obtaining a permit to do so from the Director. (3-31-22)

101. APPLICATION FOR PERMIT.

Applications for permits submitted to the Director shall contain the following:contain information as required ISDA on a form required and supplied by the IDSA.approved by the Administrator. (3-31-22)

Commented [JS12]: Presuming this permit is on a form supplied by the Department. If so, further presuming this information is on there. No need to spell it out in rule after rule granting authority to need a permit when the Department is the one coming up with the application.

01. **Name, Telephone Number, and Address**. The name, telephone number, and address of the owner and operator of the CLTWF. (3-31-22)

02. **Physical Address**. The physical address of the CLTWF. (3-31-22)

03. **Scaled Vicinity Map With Site Location**. A detailed sketch of the proposed or existing CLTWF site location, on an aerial photograph if available, which includes the following: (3-31-22)

a. The location of all homes, schools, churches, etc. within a one (1) mile radius of the proposed CLTWF; and (3-31-22)

b. Private and community domestic water wells, irrigation wells, existing monitoring wells, and existing injection wells as documented by Idaho Department of Water Resources or other sources, which are with in a one (1) mile radius of the proposed or existing CLTWF; and (3-31-22)

c. Irrigation canals, irrigation laterals, rivers, streams, springs, lakes, reservoirs, and designated wetlands, which are within a one (1) mile radius of the proposed CLTWF; and (3-31-22)

d. Location of all land application sites; and (3-31-22)

e. FEMA flood zones or other appropriate flood data for the CLTWF site and all land application sites. (3-31-22)

~~**04.** **Scaled Site Plan**. A site plan showing all buildings, process wastewater and manure storage areas, piping, and roadways. (3-31-22)~~

~~**05.** **Land Application System**. A detailed description of the current or proposed management practices and methods used to make land application including: (3-31-22)~~

~~**a.** Timing, frequency, and duration of practices. (3-31-22)~~

~~**b.** Proximity of land application sites to residential and public use areas. (3-31-22)~~

~~**06.** **Nutrient Management Plan**. A NMP for all land where manure or process wastewater from the CLTWF is land applied. (3-31-22)~~

102. -- 109. (RESERVED)

110. DURATION OF PERMIT.

Permits issued pursuant to this chapter are valid for a period of two (2) years. (3-31-22)

Commented [DSL13]: Is this necessary….should a permit ever expire if routine inspections are kept current?

111. RENEWAL OF PERMIT.

The operator of a CLTWF shall submit an application to renew the permit to the Director for approval ninety (90) days prior to the expiration of the existing permit. (3-31-22)

112. -- 119. (RESERVED)

120. REVOCATION OF PERMIT.

The Director may revoke the permit of any CLTWF that violates any of the provisions of this Chapter. (3-31-22)

121. -- 199. (RESERVED)

200. UNAUTHORIZED DISCHARGES.

Commented [DSL14]: Need to address 'runoff' here?

Unauthorized discharges of manure or process wastewater from CLTWF or land application sites owned or controlled by a CLTWF are prohibited. CLTWF operators shall notify the Director within twenty-four (24) hours of learning of a discharge, (3-31-22)

201. -- 209. (RESERVED)

~~**210. NOTIFICATION OF DISCHARGE.**~~

~~Within twenty-four (24) hours of learning of a discharge, the operator of a CLTWF shall verbally notify the Director of such a discharge. (3-31-22)~~

~~**211. WRITTEN NOTIFICATION.**~~

Commented [DSL15]: RTR

~~If the ISDA has not begun a discharge investigation within five (5) days of the verbal notification to the director, the operator shall submit a written report to the Director which includes: (3-31-22)~~

~~**01.** **A Description of the Discharge**. A description of the flow path to the receiving water body; and (3-31-22)~~

~~**02.** **Flow Rate**. An estimation of the flow rate and volume discharged; and (3-31-22)~~

~~**03.** **Dates and Time**. The period of discharge, including dates and times, and if not already corrected, the anticipated time the discharge is expected to continue; and (3-31-22)~~

~~**04.** **Steps Taken**. Steps taken to reduce, eliminate, and prevent recurrence of the discharge. (3-31-22)~~

212. -- 299. (RESERVED)

300. WASTEWATER STORAGE AND CONTAINMENT FACILITIES.
All CLTWF shall have wastewater storage and containment facilities designed, constructed, operated, and maintained pursuant to IDAPA 02.04.30, Rules Governing Environmental and Nutrient Management. ~~sufficient to contain:~~ (3-31-22)

~~**01. Process Wastewater**. All process wastewater generated on the CLTWF during the non-land application season; and (3-31-22)~~

~~**02. Rainfall**. The runoff from a twenty-five (25) year, twenty-four (24) hour rainfall event; and (3-31-22)~~

~~**03. Winter Precipitation**. Either three (3) inches of runoff from the accumulation of winter precipitation or the amount of runoff from the accumulation of precipitation from a one-in-five (1 in 5) year winter. (3-31-22)~~

301. -- 309. (RESERVED)

~~310. Construction Requirements.~~
~~All CLTWF shall have wastewater storage and containment facilities designed and constructed in accordance with the engineering standards and specifications contained in the Natural Resources Conservation Service Agricultural Waste Management Field Handbook, Appendix 10D or the American Society of Agricultural Engineers Standard EP393.3, or other equally protective standards approved by the Director. (3-31-22)~~

311. -- 319. (RESERVED)

320. SUBSTANCES ENTERING WASTEWATER STORAGE AND CONTAINMENT FACILITIES.
Only manure and process wastewater from the operation of the CLTWF shall be allowed to enter wastewater storage and containment facilities. The disposal of any other materials into a wastewater storage and containment facility, including, but not limited to oil, grease, heavy metals, chlorinated solvents, and human waste is prohibited. (3-31-22)

321. -- 329. (RESERVED)

330. NUTRIENT MANAGEMENT.
Each CLTWF shall ~~submit, to the Director for approval,~~ have an NMP that conforms to ~~the nutrient management standard~~ IDAPA 02.04.30, Rules Governing Environmental and Nutrient Management. (3-31-22)

~~**01. Odor**. Each NMP shall address odors generated on the CLTWF, and land application sites. Odors shall not be generated in excess of odors normally associated with livestock production in Idaho. (3-31-22)~~

~~**02. Land Application**. Each NMP shall include all land to which manure or process wastewater from the CLTWF is land applied. (3-31-22)~~

~~**03. Duty of Operator**. It shall be the duty of the operator of a CLTWF to ensure that the NMP, for any land included in the NMP, is implemented. (3-31-22)~~

~~**04. Implementation of NMP**. Failure to implement and abide by an approved NMP is a violation of this chapter. (3-31-22)~~

331. -- 359. (RESERVED)

~~**360. NEW CLTWF.**~~
~~Any new CLTWF shall submit a NMP to the Director for approval with its application for a permit to operate a CLTWF. The Director responds to or approves such NMP within sixty (60) days of submission. (3-31-22)~~

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Commented [DSL16]: Move to NMP rule
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Commented [DSL17]: RTR

361. -- 999. (RESERVED)

Idaho State Department of Agriculture
02.04.23 Rules Governing Commercial Truck Wash
May 9th, 2023, 1:00 p.m.
Lloyd Knight, Dr. Scott Leibsle, Chanel Tewalt, Hosts/Facilitators

Present:

Martha Walbey, ISDA; Dallas Burkhalter, Office of Attorney General – ISDA; Mitchell Vermeer, ISDA. Emily Courter, ISDA.

AGENDA ITEMS

WELCOME:

Lloyd Knight started the meeting at 1:06 pm by teleconference. Mr. Knight introduced himself and stated the rule they would be going over, 02.04.23, regarding Commercial Truck Washes.

Mr. Knight discussed the house rules and stated, that comments would be accepted till May 23rd, 2023.

Mr. Knight then turned the meeting over to Dr. Scott Leibsle to present the strawman.

Dr. Leibsle read the rule and started to explain the basic layout of the first draft strawman that has been posted to the ISDA website.

Dr. Leibsle stated the proposed changes indicate strictly red tape reduction removal of redundant antiquated or otherwise outdated language and additional changes within the rule are to better organize and simplify the language for any department rule related to environmental management of a livestock facility. Dr. Leibsle continued, "the goal is to remove any common language that pertains to nutrient management plans, soil sampler's certification or nutrient management plan certification". Dr. Leibsle added, "all of that will be removed from all of the specific program rules and relocated to a single location, which is, the nutrient management and environmental rule that will be negotiated on tomorrow on 5/10/2023". He continued by stating "No changes have been made to the language and will just be moved".

Dr. Leibsle finished the summary of the rule and any changes that had been made.

No additional comments were added to the meeting.

Lloyd Knight ended meeting at 1:16 p.m.

IDAHO IDA
dairymen's association

June 29, 2023

Deputy Director Lloyd Knight
Rules Review Officer,

Mr. Knight

The Idaho Dairymen's Association is submitting comments on two rules that are currently open for negotiated rulemaking: 02.04.114—Rules Governing Dairy Byproduct, and 02.04.30—Rules Governing Environmental and Nutrient Management.

After reviewing these rules, it came to our attention that the rules have not been sufficiently updated to reflect recent changes to the Dairy Environmental Control Act, namely Idaho Code 37-606(2). The changes that we are proposing are technical in nature, with the goal of making the rules conform to Idaho Code. Please see attached for a redlined word document that details sections of the rules that we believe should be revised to conform to the statute.

Please do not hesitate to contact us if you need further clarification.

Sincerely,

Bob Naerebout
Government Affairs Director
Idaho Dairymen's Association

195 River Vista Place
Twin Falls, Idaho 83301
208.736.1953
www.idahodairymens.org

June 29, 2023

Deputy Director Lloyd Knight
Rules Review Officer,

Mr. Knight

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Sincerely,

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Government Affairs Director
Idaho Dairymen's Association

195 River Vista Place
Twin Falls, Idaho 83301
208.736.1953
www.idahodairymens.org

Idaho State Department of Agriculture
02.04.14 Rules Governing Dairy Byproduct
May 24, 2023, 8:30 a.m.
Lloyd Knight, Dr. Scott Leibsle, Hosts/Facilitators

Present: Dallas Burkhalter, Office of Attorney General – ISDA; Mitch Vermeer, ISDA; Bob Naerebout, Idaho Dairymen's Association; Marv Patten, Milk Producers of Idaho; Will Tiedemann, Idaho Conservation League; Katie Van Vliet, Idaho Dairymen's Association; Roland Wood, NPK Planning; April Leytem, ARS; Emily Courter, ISDA.

AGENDA ITEMS

WELCOME:

Mr. Knight started the second meeting at 8:34 am via teleconference and audio recorded the meeting. He opened the meeting by going over housekeeping rules and introducing participants. Mr. Knight recapped the first meeting and started going over definitions, which were displayed via teleconference. Mr. Knight shared that a comment was submitted to ISDA from Mr. Naerebout to review. Mr. Knight also asked the attendees if there was anything else that needed to be reviewed in the meeting.

No one in the group commented.

Mr. Knight turned the meeting over to Dr. Leibsle.

Dr. Leibsle started by referencing the definition discussions that were had with DFM and the duplications between statue and rule. Dr. Leibsle indicated that statute will take precedence and went over what has been struck from the rule. He continued to list the definitions that would be retained. He discussed the interpretation that was given to ISDA by DFM. Dr. Leibsle asked the group if anyone had any questions.

No comments were made.

Dr. Leibsle discussed the proposal Mr. Wood made last meeting about dammer diking. Dr. Leibsle stated he approached ARS about the topic of best management practices and requested an analysis. Dr. Leibsle read and displayed an email that was received from Dave Bjorneberg from ARS. Dr. Leibsle added that a study had been sent along with the email and displayed it for everyone to review via teleconference. Dr. Leibsle also suggested to the group that if a third meeting is necessary to continue to review the given information, that is something they can do. Dr. Leibsle introduced April Leytem from ARS and stated she could help with any questions the group might have.

Mr. Naerebout had a question for Ms. Leytem regarding how it would impact the others.

Ms. Leytem responded and went over the original Index and how it was created. Ms. Leytem went over where they thought they could incorporate the information and went over dammer diking and its potential as a best management practice for run offs.

Dr. Leibsle referenced the formula and the risk rating for phosphorus loss or transport and the best management practices based on the table results. Dr. Leibsle asked the group if anyone had any questions.

Mr. Patten spoke to wanting table 8 to read, dammer dike or berm. Instead of it saying dike or berm.

Dr. Leibsle referenced research based out of Alabama that spoke to dammer diking as not a best management practice, however indicated where it might be able to go.

Mr. Naerebout spoke to the study and ARS findings and why dammer diking was not originally added.

Mr. Patten indicated that he would like the language there to give people the option.

Ms. Leytem spoke to each situation being different, causing different outcomes based on the slope and field conditions. She mentioned how the language of the rule could be referenced and found.

Dr. Leibsle asked the group if there were any other questions on Mr. Wood's proposal.

Mr. Knight mentioned that it was a good time to go over Mr. Naerebout proposal that was submitted.

Dr. Leibsle agreed and mentioned that a third meeting could be scheduled if the group thought it was needed.

Mr. Wood indicated he would like to see some studies on phosphate levels when it comes to dammer diking and or runoff.

Dr. Leibsle mentioned the submission from Mr. Naerebout and asked him to clarify how this document has been amended.

Mr. Naerebout spoke to how there is nothing in rule or statue on how to adjust the index and spoke to the verbiage he submitted as a rough draft that possibly could be used.

Dr. Leibsle read the proposed amendment submitted by Mr. Naerebout and asked Mr. Naerebout to speak to it.

Mr. Naerebout mentioned that this is another avenue.

Mr. Patten asked Mr. Naerebout to clarify the number of years in question on the proposed amendment.

Mr. Naerebout indicated the years were correct.

Mr. Knight asked Mr. Naerebout where he would like this verbiage to go.

Mr. Naerebout stated that he was open to wherever everyone thought best.

Mr. Knight mentioned where he thought it might go.

Dr. Leibsle indicated he thought the verbiage could go under the phosphorous indexing and by adding the letter "c".

Ms. Leytem mentioned she would recommend removing the verbiage regarding current or less than ten years. She spoke to research being done in the 1970's and 1980's and how that research is still relevant today. She added how research funding works and how she thought it should read.

Mr. Knight asked Mr. Naerebout if he had any thoughts.

Mr. Naerebout indicated he understood and mentioned that the amendment was just a rough draft and wanted to have something as a starting point.

Ms. Leytem mentioned to remove the verbiage that states, "by three scientists from accredited Idaho research institutions". Ms. Leytem didn't think its worth limiting.

Mr. Naerebout asked Ms. Leytem about researchers from out of state and if they would be as knowledgeable in Idaho's climate, soil, and crops and if that makes a difference.

Ms. Leytem indicated it did not and added there are several regions that are similar enough to the conditions we have, that we would not want to discredit those findings.

Mr. Naerebout asked Ms. Leytem how she would word the amendment to reflect "those that are relevant to Idaho".

Ms. Leytem mentioned adding "relevant to our climate, soil, cropping systems and irrigation."

Mr. Naerebout agreed.

Dr. Leibsle added the verbiage to the document Mr. Naerebout submitted and the changes were displayed for the group via teleconference.

Dr. Leibsle asked the group for any other comments.

No comments were made.

Dr. Leibsle stated a 3rd negotiated rule meeting may be possible, if necessary, and wanted to make sure everyone had the opportunity to go over the submitted documents.

Mr. Knight mentioned another meeting and that he will set it up if need be.

Dr. Leibsle concluded by summarizing the proposed changes and what was discussed. Dr. Leibsle asked the group to please submit comments.

Mr. Knight mentioned June 30th as the comment deadline and mentioned he would send out an email to schedule another meeting to finalize.

Dr. Leibsle asked Mr. Vermeer to bring a phosphorus index report on where we could implement changes and where we could acknowledge the change on inspections.

Mr. Naerebout asked Ms. Leytem to mention what they had been communicating about regarding the verbiage of the amendment.

Ms. Leytem mentioned removing other verbiage in the amendment that was shown via teleconference.

Dr. Leibsle changed how it was worded.

Mr. Naerebout asked Mr. Burkhalter if they could amend an ARS document.

Mr. Burkhalter indicated he did not believe we had the authority to change an ARS document unless ISDA took over the document.

Ms. Leytem indicated she was not sure how that would happen.

Mr. Naerebout mentioned that we would not want to infringe on the authors.

Ms. Leytem mentioned using possible modifications and by whom modified it.

Mr. Naerebout mentioned adding notes to the rule.

Mr. Burkhalter stated that ISDA would want to investigate it.

Mr. Knight added that it is important to consider the options and to get it correct, legally and wants to mull it over and discuss more. Mr. Knight mentioned he would set up a third meeting to discuss and wanted to give everyone another opportunity to submit comments until June 30th, 2023.

Mr. Knight asked Mr. Tiedemann if he had anything to discuss.

Mr. Tiedemann indicated he did not.

Mr. Knight ended the meeting at 9:31 am.

Idaho State Department of Agriculture
02.04.14 Rules Governing Dairy Byproduct
May 24, 2023, 8:30 a.m.
Lloyd Knight, Dr. Scott Leibsle, Hosts/Facilitators

Present: Dallas Burkhalter, Office of Attorney General – ISDA; Mitch Vermeer, ISDA; Bob Naerebout, Idaho Dairymen's Association; Marv Patten, Milk Producers of Idaho; Will Tiedemann, Idaho Conservation League; Katie Van Vliet, Idaho Dairymen's Association; Roland Wood, NPK Planning; April Leytem, ARS; Emily Courter, ISDA.

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Mr. Patten asked Mr. Naerebout to clarify the number of years in question on the proposed amendment.

Mr. Naerebout indicated the years were correct.

Mr. Knight asked Mr. Naerebout where he would like this verbiage to go.

Mr. Naerebout stated that he was open to wherever everyone thought best.

Mr. Knight mentioned where he thought it might go.

Dr. Leibsle indicated he thought the verbiage could go under the phosphorous indexing and by adding the letter “c”.

Ms. Leytem mentioned she would recommend removing the verbiage regarding current or less than ten years. She spoke to research being done in the 1970’s and 1980’s and how that research is still relevant today. She added how research funding works and how she thought it should read.

Mr. Knight asked Mr. Naerebout if he had any thoughts.

Mr. Naerebout indicated he understood and mentioned that the amendment was just a rough draft and wanted to have something as a starting point.

Ms. Leytem mentioned to remove the verbiage that states, “by three scientists from accredited Idaho research institutions”. Ms. Leytem didn’t think its worth limiting.

Mr. Naerebout asked Ms. Leytem about researchers from out of state and if they would be as knowledgeable in Idaho’s climate, soil, and crops and if that makes a difference.

Ms. Leytem indicated it did not and added there are several regions that are similar enough to the conditions we have, that we would not want to discredit those findings.

Mr. Naerebout asked Ms. Leytem how she would word the amendment to reflect “those that are relevant to Idaho”.

Ms. Leytem mentioned adding “relevant to our climate, soil, cropping systems and irrigation.”

Mr. Naerebout agreed.

Dr. Leibsle added the verbiage to the document Mr. Naerebout submitted and the changes were displayed for the group via teleconference.

Dr. Leibsle asked the group for any other comments.

No comments were made.

Dr. Leibsle stated a 3rd negotiated rule meeting may be possible, if necessary, and wanted to make sure everyone had the opportunity to go over the submitted documents.

Mr. Knight mentioned another meeting and that he will set it up if need be.

Dr. Leibsle concluded by summarizing the proposed changes and what was discussed. Dr. Leibsle asked the group to please submit comments.

Mr. Knight mentioned June 30th as the comment deadline and mentioned he would send out an email to schedule another meeting to finalize.

Dr. Leibsle asked Mr. Vermeer to bring a phosphorus index report on where we could implement changes and where we could acknowledge the change on inspections.

Mr. Naerebout asked Ms. Leytem to mention what they had been communicating about regarding the verbiage of the amendment.

Ms. Leytem mentioned removing other verbiage in the amendment that was shown via teleconference.

Dr. Leibsle changed how it was worded.

Mr. Naerebout asked Mr. Burkhalter if they could amend an ARS document.

Mr. Burkhalter indicated he did not believe we had the authority to change an ARS document unless ISDA took over the document.

Ms. Leytem indicated she was not sure how that would happen.

Mr. Naerebout mentioned that we would not want to infringe on the authors.

Ms. Leytem mentioned using possible modifications and by whom modified it.

Mr. Naerebout mentioned adding notes to the rule.

Mr. Burkhalter stated that ISDA would want to investigate it.

Mr. Knight added that it is important to consider the options and to get it correct, legally and wants to mull it over and discuss more. Mr. Knight mentioned he would set up a third meeting to discuss and wanted to give everyone another opportunity to submit comments until June 30th, 2023.

Mr. Knight asked Mr. Tiedemann if he had anything to discuss.

Mr. Tiedemann indicated he did not.

Mr. Knight ended the meeting at 9:31 am.

Idaho State Department of Agriculture
02.04.14 Rules Governing Dairy Byproduct
May 10, 2023, 8:30 a.m.
Lloyd Knight, Dr. Scott Leibsle, Hosts/Facilitators

Present: Chanel Tewalt, ISDA; Dallas Burkhalter, Office of Attorney General – ISDA; Mitch Vermeer, ISDA; Bob Naerebout, Idaho Dairymen's Association; Marv Patten, Milk Producers of Idaho; Russ Hendricks, Farm Bureau; Will Tiedemann, Idaho Conservation League; Josh Scholer, DFM; Katie Van Vliet, Idaho Dairymen's Association; Johnathan Oppenheimer, Idaho Conservation League; Kyle Wilmot, ISDA; Roland Wood, NPK Planning; Scott Campbell, Office of Attorney General.

AGENDA ITEMS

WELCOME:

Mr. Knight started the meeting at 8:33am via teleconference and audio recorded the meeting. He introduced himself as well as welcomed everyone that joined and went over housekeeping rules.

Mr. Knight handed the meeting over to Dr. Leibsle to start his summary of changes.

Dr. Leibsle went over how the rule was negotiated for red tape reduction two years ago and stated the reason they are reopening it, is because the rest of the environmental rules are being opened and this is to reorganize the language related to environmental management and to put things in consistent language in one rule. Specifically, those construction and facility requirements for waste management structures like lagoon construction specifications, soil sampling requirements, soil sampler certification requirements and NMP requirements. Dr. Leibsle reiterated that ISDA has made no substantive change to the rules, but that the strikethroughs represent the reorganization of sections in the nutrient management rule.

Dr. Leibsle stated there was a request to amend one of the incorporations by reference documents, specifically the phosphorus site index document. The request was to add a Best Management Practice (BMP) on page 19, which lists BMPs that dairy producers can implement to reduce their risk rating for phosphorus. Dr. Leibsle asked Mr. Patten to speak to this specific issue, and Mr. Patten deferred to Roland Wood.

Mr. Wood stated that it is important to save water and prevent nutrients and silt moving to the lower ends of the fields. Mr. Wood questioned, why put up a dike or a berm if you have a wastewater problem at the bottom of a field, why not put in a dam or diking and leave the water and nutrients where they need to be?. Mr. Wood referenced the documentation he provided that showed how it helps keep the nutrients in place.

Dr. Leibsle asked Mr. Wood to explain how a dam and diking works in these scenarios and how the conservation process works.

Mr. Wood stated it is a piece of farm equipment that is used with a cultivator, and it is applied during the final cultivation and leaves depressions in the furrow to where water will not run, if there is any silt and keeps the water where it needs to be. Mr. Wood indicated he had also sent ISDA a previously published article.

Dr Leibsle asked the group if anyone else had any questions for Mr. Wood about dam or diking or phosphorus runoff conservation practice.

No one had questions.

Dr Leibsle then asked Mr. Wood about the list of BMPs for phosphorus indexing and Dr. Leibsle stated, if we are adding dam or diking to the list of best management practices, what is being proposed as far as reduction coefficient of the phosphorus risk rating.

Mr. Wood stated he thought it should be more like a berm at the bottom of the field and based upon the slope.

Dr. Leibsle asked Mr. Naerebout to add information about dike or berm reduction coefficient. He added that dike or berms are already on the list and wanted clarification.

Mr. Wood responded with, that is how it states it now, but it does not qualify as a dam or dike.

Dr. Leibsle opened it up to the group.

Mr. Naerebout stated he thought ARS should have a say in what the coefficient would be.

Mr. Wood stated he thought it was a good idea and had brought this up before 2017.

Dr. Leibsle stated he would reach out to April Leytem and Dave Bjorenberg at ARS for feedback to discuss at the next meeting. Dr Leibsle then opened the discussion up to the floor for any more comments or concerns.

Mr. Knight stated he wanted to go through all the steps to make sure we are processing this correctly.

Dr. Leibsle indicated that the documents shown and the authors of those documents, should be involved in this and communicated with.

Mr. Knight indicated we would likely need an updated document.

Dr. Leibsle agreed and asked if there were any other questions about Mr. Wood's proposal.

Mr. Oppenheimer stated he wanted to learn more about it and more about the calculations and the differences in the documents.

Dr. Leibsle indicated he would like to get one of the authors from ARS to attend the next meeting and would look for clarification and report to the group during the next meeting. Dr. Leibsle asked the group if there were any other questions.

There were no other questions.

Dr. Leibsle talked about how the soil sampling language would be removed from the dairy byproduct rule and moved to the NMP rule. He asked if anyone had questions on definitions.

No one had questions.

Dr. Leibsle summarized the transposing of the nutrient management rule and asked the group if they wanted to keep anything in the rule.

Mr. Patten indicated that the original reason the ten-foot rule on waste containment structures was to help improve the waste containment system.

Dr. Leibsle confirmed that the language could remain in place.

Mr. Knight asked if Mr. Naerebout had any questions.

Mr. Naerebout indicated he did not.

Dr. Leibsle stated that no changes have been made to the phosphorus management section of the rule. He stated this concluded the list of changes and opened the floor to any comments or questions and referenced the website.

Mr. Knight asked to see the definitions via teleconference for the benefit of the group.

Dr. Leibsle indicated the definitions are not in statute or slightly different and showed the group.

Mr. Knight asked Dr. Leibsle a question about the definitions.

Mr. Naerebout asked would it be beneficial for somewhere in this rule to add where we got this process from and to clarify the process.

Dr. Leibsle showed the document in reference and pointed out the information and science behind it and asked Mr. Naerebout to clarify.

Mr. Naerebout stated that there should be clarity for constituents and said there should be something to clarify how to add a new practice.

Mr. Knight thought that any practices that should be added or removed to the document, should be removed by ARS.

Mr. Naerebout stated there should be some direction pointing to the best management practices and following the correct processes.

Mr. Knight agreed with Mr. Naerebout.

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Dr. Leibsle stated he would work on this and have it ready for the next meeting and wants it to be specific to the phosphorus indexing and discuss "dammer diking" with ARS.

Mr. Naerebout agreed.

Marv Patten asked if the 180-day limitation moved over to the nutrient management standard. He wanted to know and indicated it would be different.

Dr. Leibsle confirmed that language still remained in the dairy byproduct rule and was not removed.

No further questions were offered.

Dr. Leibsle thanked the group for attending and stated the next meeting would be in two weeks and turned the meeting over to Mr. Knight.

Mr. Knight thanked the group and asked to please submit comments and referred to the website and the link for the next meeting and closed the meeting.

Meeting concluded at 9:16 am.

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The Phosphorus Site Index:

A Systematic Approach to Assess the Risk of Nonpoint Source Pollution of Idaho Waters by Agricultural Phosphorus

Dr. April Leytem
Research Soil Scientist
USDA- ARS

Dr. David Bjorneberg
Supervisory Agricultural Engineer
USDA-ARS

Dr. David Tarkalson
Research System Agronomist
USDA-ARS

2017

Updated 2023

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INTRODUCTION

Why is phosphorus a concern for Idaho?

Water quality in Idaho has been negatively impacted by the inputs of nutrients from both point and nonpoint sources. The two nutrients of greatest concern are nitrogen (N) and phosphorus (P). Efforts to reduce nutrient enrichment of ground and surface waters have become a high priority for state and federal agencies and a matter of considerable importance to all nutrient users and nutrient generators in the state. Two actions in particular highlight the importance of this issue in Idaho:

- Total Maximum Daily Load (TMDL) Program: Section 303(d) of the Federal Clean Water Act (CWA) of 1972 requires states to develop a list of water bodies that need pollution reduction beyond that achievable with existing control measures. These water bodies are referred to as "Water Quality Limited" and are compiled by each state on a "303(d) list". States are required to develop a "total maximum daily load (TMDL)" for a number of pollutants, including nutrients for these "water quality limited" waters. A TMDL is defined as "the level of pollution or pollutant load below which a water body will meet water quality standards and thereby allow use goals such as drinking water supply, swimming and fishing, or shellfish harvesting". In ID, approximately 36% of streams were identified as not meeting water quality standards. The TMDL for the upper and middle Snake River was set at 0.075 mg total P L^{-1}.

- Idaho Statute Title 37 Chapter 4 Section 37-40, passed in 1999 requires that all dairy farms shall have a nutrient management plan approved by the Idaho State Department of Agriculture. The nutrient management plan shall cover the dairy farm site and other land owned and operated by the dairy farm owner or operator. Nutrient management plans submitted to the department by the dairy farm shall include the names and addresses of each recipient of that dairy farm's livestock waste, the number of acres to which the livestock waste is applied and the amount of such livestock waste received by each recipient. The information provided in this subsection shall be available to the county in which the dairy farm, or the land upon which the livestock waste is applied, is located. If livestock waste is converted to compost before it leaves the dairy farm, only the first recipient of the compost must be listed in the nutrient management plan as a recipient of livestock waste from the dairy farm. Existing dairy farms were required to submit a nutrient management plan to the department on or before July 1, 2001, and plans are required to be updated every 5 years.

What is a Phosphorus Site Index?

In the early 1990's the U.S. Department of Agriculture (USDA) began to develop assessment tools for areas with water quality problems. While some models such as the Universal Soil Loss Equation (USLE) for erosion, and Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) for ground water pollution, were already being used to screen watersheds for potential agricultural impacts on water quality, there was no model considered suitable for the field-scale assessment of the potential movement of P from soil to water. A group of scientists from universities and governmental agencies met in 1990 to discuss the potential movement of P from soil to water, and later formed a national work group (PICT: Phosphorus Index Core Team) to more formally address this problem. Members of the PICT soon realized that despite the many scientists conducting independent research on soil P, there was a lack of integrated research that could be used to develop the field scale assessment tool for P needed by USDA. Consequently, the first priority of PICT was a simple, field-based, planning tool that could integrate through a multi-parameter matrix, the soil properties, hydrology, and agricultural management practices within a defined geographic area, and thus to assess, in a relative way, the risk for P movement from soil to water. The initial goals of the PICT team were:

- *To develop an easily used field rating system (the* ***Phosphorus Site Index****) for Cooperative Extension, Natural Resource Conservation Service (NRCS) technical staff, crop consultants, farmers or others that rates soils according to the potential for P loss to surface waters*

- *To relate the P Site Index to the sensitivity of receiving waters to eutrophication.* This is a vital task because soil P is only an environmental concern if a transport process exists that can carry particulate or soluble P to surface waters where eutrophication is limited by P.

- *To facilitate adaptation of the P Site Index to site specific situations.* The variability in soils, crops, climates and surface waters makes it essential that each state or region modify the parameters and interpretation given in the original P Index to best fit local conditions.

- *To develop agricultural management practices that will minimize the buildup of soil P to excessive levels and the transport of P from soils to sensitive water bodies.*

The *P Site Index* is designed to provide a systematic assessment of the risks of P loss from soils, but does not attempt to estimate the actual quantity of P lost in runoff. Knowledge of this risk not only allows us to design best management practices (BMPs) that can reduce agricultural P losses to surface waters, but to more effectively prioritize the locations where their implementation will have the greatest water quality benefits.

It has long been known that P loss depends on not only the amount of P in or added to a soil but the transport processes that control soil and water movement from fields to waterways. Therefore, when assessing the risk of P loss from soil to water, it is important that we not focus strictly on measures of P, such as agronomic soil test P value. Rather a much broader, multi-disciplinary approach is needed; one that recognizes that P loss will vary among watersheds and soils, due to the rate and type of soil amendments used, and due to the wide diversity in soils, crop management practices, topography, and hydrology. At a minimum, any risk assessment process for soil P shall include the following:

- Characteristics of the P source (fertilizer, manure, biosolids) that influence its solubility and thus the potential for movement or retention of P once the source has been applied to a soil.
- The concentration and bioavailability of P in soils susceptible to loss by erosion.
- The potential for soluble P release from soils into surface runoff or subsurface drainage.
- The effect of other factors, such as hydrology, topography, soil, crop, and P source management practices, on the potential for P movement from soil to water.
- Any "channel processes" occurring in streams, field ditches, etc. that mitigate or enhance P transport into surface waters.
- The sensitivity of surface waters to P and the proximity of these waters to agricultural soils.

In summary, when resources are limited, it is critical to target areas where the interaction of P source, P management, and P transport processes result in the most serious risk of losses of P to surface and shallow ground waters. This is the fundamental goal of the *P Site Index*.

Phosphorus Site Index

The *P Site Index* has two separate components (Table 1). Part A characterizes the risk of P loss based on site-specific soil properties and hydrologic considerations. Part B characterizes the risk of P loss based on site-specific past and current nutrient management practices that affect the concentration of P in the soil (soil test P) and the potential for P loss due to management of inorganic (fertilizer) and organic (manures, composts, etc.) P sources. Parts A and B are summarized below, followed by a detailed discussion and descriptions of each component of the two parts. Generalized interpretations of the *P Site Index* values are given in Table 2.

Part A: Phosphorus Loss Potential Due to Site and Transport Characteristics

Surface transport mechanisms, i.e. soil erosion and runoff are generally the main mechanisms by which P is exported from agricultural fields to receiving waters. In some areas, leaching of P can also be a significant method of P export, especially in areas with artificial subsurface drainage (e.g. tiles, mole drains) high water tables, or shallow soils overlying basalt. Therefore, the considerations of the methods of P transport factors affecting these transport mechanisms are critical to an understanding of P losses from watersheds. Part A includes the following four factors: (i) soil erodibility; (ii) soil surface runoff index; (iii) leaching potential; and (iv) distance from edge of field to surface water.

Part B: Phosphorus Loss Potential Due to P Source and Management Practices

Phosphorus losses are also related to the amount and forms of P at a site which can potentially be transported to ground or surface waters. The main sources of P at any site that must be considered in assessing the risk of P loss are (i) soil P (particulate and dissolved), a reflection of natural soil properties and past management practices: and (ii) P inputs such as inorganic fertilizers and organic P sources (manures, composts, biosolids). Also of importance are the management practices used for all P inputs, such as the rate, method, and timing of fertilizer and manure applications, as these factors will influence whether or not P sources will have negative impacts on water quality. Part B includes the following three factors: (i) soil test P value; (ii) P applications rate; and (iii) P application method.

Table 1. The *Phosphorus Site Index* proposed for use in Idaho

Part A: Phosphorus loss potential due to site and transport characteristics

Characteristics	**Phosphorus Loss Rating**					**Field Value**
Soil Erodibility	Very Low **0**	Low **1**	Medium **2**	High **4**	Very High **8**	
Soil Surface Runoff Index – Surface Irrigated	No Runoff **0**	Water runs off less than 50% of the irrigation set time **4**		Water runs off more than 50% of the irrigation set time **8**		
Soil Surface Runoff Index – Sprinkler or Non-Irrigated	Very Low **0**	Low **1**	Medium **2**	High **4**	Very High **8**	
Leaching Potential	Low **1**		Medium **2**	High **4**		
Distance from Edge of Field to Surface Water	> 2,640’ **0**		200-2,640’ **2**	< 200’ **8**		

Part B: Phosphorus loss potential due to P source and management practices.

Characteristics	**Phosphorus Loss Rating**					**Field Value**
	Very Low	Low	Medium	High	Very High	
Soil Test P value	**0.05** x [Olsen Soil Test P (ppm)] **0.025** x Bray Soil Test P (ppm)]					
P Application Rate (lbs P_2O_5 applied per acre)	No Application **0**	< 60 **1**	60 – 150 **2**	151 – 300 **4**	>300 **8**	
P Application Method	None Applied **0**	Incorporated within 2 days or injected/banded below surface at least 3” **1**	Incorporated within 7 days of application **2**	Incorporated > 7 days or no incorporation when applied between February 16 and December 15 **4**	Application between December 16 and February 15 **8**	

Table 2. Generalized interpretations of the *P Site Index*.

***P Site Index* Value**	**Generalized Interpretation of the *P Site Index* Value**
< 75	**LOW** potential for P movement from this site given current management practices and site characteristics. There is a low probability of an adverse impact to surface waters from P losses from this site. Nitrogen-based nutrient management planning is satisfactory for this site. Soil P levels and P loss potential may increase in the future due to N-based nutrient management planning.
75 - 150	**MEDIUM** potential for P movement from this site given current management practices and site characteristics. Phosphorus applications shall be limited to the amount expected to be removed from the field by crop harvest (crop uptake) or soil test-based P application recommendations. Testing of manure P prior to application is required.
151 – 225	**HIGH** potential for P movement from this site given the current management practices and site characteristics. Phosphorus applications shall be limited to 50% of crop P uptake. Testing of manure P prior to application is required.
> 225	**VERY HIGH** potential for P movement from this site given current management practices and site characteristics. No P shall be applied to this site.

Usage of the Idaho *Phosphorus Site Index*

The Phosphorus Site Index is a risk assessment tool to help determine the potential for off-site transport of phosphorus from agricultural fields. It is intended to be used as an integral and interactive part of the nutrient management plan to help guide applications of manure and fertilizers to minimize potential P losses from agricultural fields, and to identify fields that may require additional management to reduce P losses even when P applications are not planned. The PSI is also a valuable educational tool to assist producers in recognizing high risk areas, allowing them to focus conservation practices where they would be of most value.

A PSI rating shall be done for each field. Fields that do not receive manure and fertilizer shall only be assessed once until there is a planned application of P. The PSI shall be calculated prior to P application for each field using the planned management and P application rate along with current soil test P results. The risk rating will determine whether or not the P application on the field is allowable, given the current management. For example, if the risk assessment was completed with inputs for the field source factors (soil test P, planned P application rates, and planned application method and timing) and the field received a low rating, then application and management can continue according to plan. If, however, the risk rating is in a medium category, P application will be limited to crop uptake. If the risk rating is in a higher category, BMPs will need to be implemented on the field in order to reduce the potential for P loss, and/or the P application rates must be limited or prohibited in order to reduce the risk of P losses from the field. Producers can receive full credit for maximum of two (2) BPMs per field at any given time. In addition, testing of manure prior to application will be required for fields having a risk rating above low.

When a perennial crop such as alfalfa is part of the rotation, or when allowable manure application rates are below a reasonable application rate (<10 tons/acre for manure and <5 tons/acre for composted manure) then a producer may be allowed to apply up to a four year application rate at one time with no further application over the remainder of the time period that the nutrients have been allocated to. For example, a field with a medium rating beginning a four-year rotation of alfalfa could apply a maximum of four times the annual excepted crop P uptake rate in the first year with no additional P application for the next three years; or a field with a high rating beginning a four-year rotation of alfalfa could apply a maximum of two times the annual expected crop P uptake rate in the first year, and the following three years of alfalfa could receive no additional P.

<u>Phosphorus Site Index:</u>
Part A: Phosphorus Loss Potential Due to Site and Transport Characteristics

Soil Erosion

Phosphorus is strongly sorbed by soils, therefore erosion of soil materials dominates the movement of particulate P in landscapes (Bjorneberg et al., 2002; Leytem and Westermann, 2003). Up to 90% of the P transported from surface irrigated crops is transported with eroded sediment (Berg and Carter, 1980). In contrast to rainfall, irrigation is a managed event. Runoff and soil erosion should be minimal from properly managed sprinkler irrigation or drip irrigation. Water flowing over soil during surface irrigation will detach and transport sediment. Annual soil loss from furrow irrigated fields can range from less than 1 to greater than 100 tons per acre (Berg and Carter, 1980; Koluvek et al., 1993). Typically, greater than 90% of the P in surface irrigation runoff from clean-tilled row-crop fields is transported with eroded sediment. Conversely, when erosion is minimal from crops such as alfalfa and pasture, greater than 90% of the total P is dissolved in the runoff water (Berg and Carter, 1980). Total P concentration in surface irrigation runoff correlates directly with sediment concentration (Fitzsimmons et al., 1972, Westermann et al., 2001). Dissolved reactive P concentration in surface irrigation runoff, on the other hand, correlates with soil test P concentration, but not with sediment concentration (Westermann et al., 2001). During detachment and movement of sediment in runoff, the finer-sized fractions of source material are preferentially eroded. Thus, the P content and reactivity of eroded particulate material is usually greater than the source soil (Carter et al., 1974; Sharpley et al., 1985). Therefore, to minimize P loss in the landscape, it is essential to control soil erosion. Particulate P movement in the landscape is a complex function of rainfall, irrigation, soil properties affecting infiltration and runoff of irrigation/rainfall/snowmelt, and soil management factors affecting erosion. Numerous management practices that minimize P loss by erosion are available including filter strips, contour tillage, cover crops, use of polyacrylamide and impoundments or small reservoirs.

Soil erosion can be estimated from erosion prediction models such as the Universal Soil Loss Equation (USLE) or the Revised Universal Soil Loss Equation (RUSLE) for water erosion and Wind Erosion Equation (WEQ) for wind erosion. However, neither USLE nor RUSLE can accurately predict irrigation erosion. Therefore, the potential for soil erosion is based on the erodibility of the soil along with the predominant slope of the field. While this factor does not predict sediment transport and delivery to a water body, it does indicate the potential for sediment and attached P movement across the slope or unsheltered distance toward a water body.

For the *Phosphorous Site Index*, the potential for soil erosion loss is determined by the erodibility of the soil (K_w factor) along with the slope of the field Table 3.

Table 3. Soil erodibility factor

Kw factor - surface mineral layer Whole Soil	Slope Gradients				
	< 2%	2 – 5%	5 – 10%	10 – 15%	> 15%
<= 0.10 Very low erodibility	Very Low	Very Low	Very Low	Very Low	Low
0.11 – 0.20 Low erodibility	Very Low	Very Low	Very Low	Low	Medium
0.21 – 0.32 Moderate erodibility	Very Low	Low	Low	Medium	High
0.33 – 0.43 High erodibility	Low	Low	Medium	High	Very High
0.44 – 0.64 Very high erodibility	Low	Medium	High	Very High	Very High

All factors shall be determined by using the NRCS soil survey data (Web Soil Survey) with field verification of the predominant slope in the field. **The soil erodibility value will range from very low to very high and shall be assigned a value of 0 (very low) to 8 (very high) and used in the calculation of the *P Site Index* (Table 1).**

Runoff Index

Dissolved P (DP) is another important source of P that is transported in surface runoff. Dissolved P exists mainly in the form of orthophosphate, which is available immediately for uptake by algae and other aquatic plants. The first step in the movement of DP in runoff is the desorption, dissolution, and extraction of P from soils, crop residues, and surface applied fertilizer and manure (Sharpley et al., 1994). These processes occur as irrigation water, rainfall, or snowmelt water interacts with a thin layer of surface soil (0.04 to 0.12 in) before leaving the field as runoff or leaching downward in the soil profile (Sharpley, 1995). The soil test P content of surface soils has been found to be directly related to DP concentrations in runoff. Field studies have shown that P losses by surface runoff are greater when soil test P values are above the agronomic optimum range (Turner et al., 2004). Laboratory research has also shown that soils with high agronomic soil test P values are more likely to have high concentrations of soluble, desorbable, and bioavailable P (Paulter and sims, 2000; Sibbensen and Sharpley, 1997; Sims, 1998b). In furrow irrigation runoff, even soil with low soil test P can have high runoff DP concentrations (Westermann et al., 2001).

For the *P Site Index*, soil runoff index is determined differently for surface irrigated vs sprinkler irrigated or fields with no irrigation. For surface irrigated fields use Table 4, for sprinkler irrigated or non-irrigated fields use Table 5.

Table 4. Runoff index for surface irrigated fields:

Criteria	Value
Fields with no runoff	0
Fields with water running off less than 50% of the irrigation set time	4
Fields with water running off 50% or more of the irrigation set time	8

Table 5. Runoff index for sprinkler or non-irrigated fields.

Hydrologic Soil Group	Slope Gradients				
	< 2%	2 – 5%	5 – 10%	10 – 15%	> 15%
A: Low Runoff Potential	Very Low	Very Low	Low	Medium	High
B: Moderately Low Runoff Potential	Very Low	Low	Medium	High	High
C: Moderately High Runoff Potential	Very Low	Medium	Medium	High	Very High
D, A/D, B/D, C/D: High Runoff Potential	Low	Medium	High	Very High	Very High

All factors shall be determined by using the NRCS soil survey data (Web Soil Survey) with field verification of the predominant slope in the field. The final runoff index calculated for fields that have implemented reservoir tillage using a dammer diker will be reduced one (1) risk level. (i.e. – from high to medium)

Leaching Potential

While surface transport processes are the major contributing factors in P transport from soil to water in most cases, leaching of P can contribute significant amounts of P to surface waters in some situations, such as in areas where there is relatively flat topography, high water tables, shallow soils over basalt and any artificial drainage system (e.g. ditches, subsurface drains). While P leaching is typically considered to be small there is potential for significant movement of P through the soil profile when soil P values increase to very high or excessive values due to long-term over-fertilization or manuring (Sims et al., 1998). Whether this leached P will reach surface waters depends on the depth to which it has leached and the hydrology of the site in question. In flat areas with shallow groundwater levels, P loss by leaching through soils contributes significantly to the phosphorus loads of streams (Culley et al., 1983; Heathwaite & Dils, 2000). Soils that are poorly drained with high water tables have a higher possibility of P loss than soils that are well drained with deep water tables. Also soils that are shallow (<24”) overlying basalt have a higher possibility of P loss than deeper soils. It is common in poorly drained soils to have water tables rise to the soil surface during the winter and spring months, during this time there is the potential for release of P into these drainage waters which can then be carried to nearby streams via subsurface flow. When soils are wet (during spring and late fall) or during time periods when irrigation exceeds ET, shallow soils can potentially leach P into the underlying basalt which can then be carried to surface waters (i.e. springs).

For the *P Site Index*, leaching potential shall be based on a USDA-NRCS categorization scheme based on the soil hydrologic group, predominant slope, saturated hydraulic conductivity, depth to high water table (HWT) and depth to bedrock Table 6. This information shall be determined through site inspection and the NRCS Web Soil Survey.

Table 6. Leaching potential.

Soil Leaching Potential	Hydrologic Group A	Hydrologic Group B	Hydrologic Group C	Hydrologic Group D
Low	NA	NA	NA	All **<u>except</u>**: • Apparent HWT • Depth to bedrock < 24”
Medium	• Slope > 6% • No apparent HWT and Depth to bedrock > 24”	• Slope > 6% or slope ≤ 6% with K_{sat} < 0.24 in/hr • No apparent HWT and Depth to bedrock > 24”	All **<u>except</u>**: • Apparent HWT • Depth to bedrock < 24”	NA
High	• Slope < 6% • Apparent HWT or Depth to bedrock < 24”	• Slope < 6% with K_{sat} > 0.24 in/hr • Apparent HWT or Depth to bedrock < 24”	• Apparent HWT • Depth to bedrock < 24”	• Apparent HWT • Depth to bedrock < 24”

High Water Table (HWT) is defined as a saturated layer < 24” from the surface anytime during the year.

Distance from Edge of Field to Surface Water

Another factor that affects the risk of P transport from soils to surface waters is the distance between the P source (i.e., the field) and the receiving waters. In some areas, the nearest water body may be a mile or more from the field being evaluated with no connectivity between the field and surface water; in these cases, even high levels of soil P may have low risk for nonpoint source pollution since the potential for transport to the water body is low. On the other hand, fields that are directly connected to surface water, such as surface irrigated fields with tailwater ditches, directly convey runoff water to surface water bodies through the return flow system. In these cases, even fields with low soil P can convey a large amount of both particulate and soluble P to surface waters.

The *P Site Index* shall take into account the distance from field edge to the nearest surface water body or other conveyance system connected to surface water (tailwater ditches, return flow ditches, laterals (Table 7).

Table 7. Distance from edge of field to surface water

Distance From Edge of Field to Surface Water	Value
> 2,640’ (0.5 mile)	0
200’ to 2,640’	2
< 200’	8

Best Management Practices for Reducing Transport Losses of P

There are several best management practices (BMPs) that can reduce the transport and loss of P from agricultural fields. In many situations, a combination of management practices is more effective than one BMP alone. To account for the effect of BMPs on the off-site transport of P from agricultural fields, a reduction in the overall transport factor is applied with varying BMPs that could be implemented on farm.

Contour farming, i.e. planting across the slope instead of up and down the hill can reduce soil erosion significantly. It is estimated that contour farming can reduce sediment loss by 20 to 50% depending on the slope of the field (Wischmeier and Smith, 1978). Keeping soil surfaces covered through cover or green manure crops can reduce losses of P by reducing erosion losses, however in some cases soluble P is either not affected or can increase. Sharpley and Smith (1991) reported reductions in total P losses of 54 to 66% with the use of cover crops while soluble P was reduced by 0 to 63%. The use of perennial crops such as alfalfa will also reduce the amount of sediment and therefore P leaving the field.

The installation of a dike or a berm that captures runoff from the field will prevent the loss of both soluble and total P. The effectiveness will depend on the holding capacity of the retention area. The use of drip irrigation vs. surface irrigation can significantly reduce the amount of runoff and therefore P that is transported off site. Mchugh et al. (2008) reported a 90% reduction in total P loss from fields with subsurface drip irrigation vs. furrow irrigation. Vegetative filter strips can trap sediment thereby reducing the offsite transport of P. Abu-Zreig et al. (2003) found that filter strips removed 31 to 89% of total P with filter length being the predominant factor affecting filter strip efficacy. The use of polyacrylamide (PAM) with irrigation has been shown to reduce losses of P from both furrow and sprinkler irrigated fields. Applying PAM with irrigation water or directly to furrow soil reduced soil erosion more than 90% on research plots (Lentz et al. 1992, Sojka and Lentz 1997, Trout et al. 1995). A conservative estimate for production fields is 50% to 80% reduction in soil loss. By reducing soil erosion, PAM treatment also reduced total P concentrations in runoff water (Lentz et al. 1998) but had little impact on dissolved P concentrations (Bjorneberg and Lentz, 2005). When used with sprinkler irrigation PAM has been shown to reduce P losses by 30%, but the effectiveness of PAM is minimal after three irrigations (Bjorneberg et al., 2000). Conservation tillage can also reduce soil erodibility and increase residue in furrows, both of which reduce soil loss to irrigation return flow (Carter and Berg 1991).

Sediment ponds remove suspended material from water by reducing flow velocity to allow particles to settle. Sediment ponds also remove nutrients associated with sediment particles. A large pond removed 65% to 75% of the sediment and 25% to 33% of the total P that entered the pond (Brown et al. 1981). A smaller percentage of total P was removed because only the P associated with sediment was removed and a large portion of the total P flowing into the pond was dissolved. Average total P concentrations significantly decreased by 13 to 42% in five ponds with 2 to 15 hour retention times, while dissolved P concentrations only decreased 7 to 16% in thee of the five ponds (Bjorneberg et al., 2015). Dissolved P concentration may actually be greater in pond outflow than pond inflow because P may continue to desorb from sediment as water flows through the pond. Implementing sediment control practices on an 800 ha (2,000 ac) irrigation tract in the Columbia Basin of Washington reduced P discharges by 50% (King et al. 1982). Tailwater recovery systems that capture runoff from furrow irrigated fields and pump it back for re-use as irrigation water should eliminate the loss of P from the system during the irrigation system, provided that no water leaves the field.

The reduction in transport factor due to the implementation of BMPs is listed in Table 8. For each BMP implemented, the transport factor shall be reduced by the amounts listed in the tables. Combinations of BMPs will reduce the transport factor sequentially, for example if you had a score of 36 and you implemented contour farming and a sediment basin your score would then be:

$$36 - (0.2 \times 36) = 28.8 - (0.6 \times 28.8) = \mathbf{11.5}$$

Table 8. Management practices to reduce the loss of P from fields.

Management Practice[1]	BMP Coefficient
Contour Farming	0.20
Cover & Green Manure Crop	0.30
Dike or Berm	0.40 or 0.80
Drip Irrigation	0.80
Filter Strip[3]	0.35
PAM - Furrow Irrigation	0.60
PAM – Sprinkler Irrigation	0.30
Residue Management/Conservation Tillage[4]	0.30
Sediment Basin	0.30
Tailwater Recovery & Pumpback Systems[2]	0.80
Established Perennial Crop[5]	0.50

[1]BMPs designed by NRCS can receive full credit; otherwise the BMPs must meet the requirements set out in the BMP definition section.

Phosphorus Site Index

Part A: Phosphorus Loss Potential Due to Site and Transport Characteristics

Sample Calculation

Part A: Phosphorus Loss Potential Due to Site and Transport Characteristics

Calculation of the Total Site and Transport Value for Part A of the P Site Index

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Once the values for soil erodibility, soil surface runoff, leaching potential and distance from edge of field to surface water have been obtained, these values shall be added together to obtain a total site and transport value (sum for Part A).

EXAMPLE:

A field located in the Magic Valley with a Portneuf silt loam soil, 1.5% slope, that is surface irrigated with water running off of the field >50% of the irrigation set time. Hydrologic soil group C, K_w factor for erosion is 0.43, K_{sat} 0.2 to 0.6 in/hr, depth to water table > 80". The surface irrigation runoff flows directly into the return flow system.

Soil Erodibility
Using Table 3, a K_w factor of 0.43 with a slope of < 2% puts this in the "Low" category, with a value of **1** (Table 1).

Soil Surface Runoff
This field is surface irrigated with runoff >50% of the set time, which is a value of **8** (Table 1).

Leaching Potential
This soil is in Hydrologic Group C without a high water table and is not a shallow soil, which is a medium risk (Table 6) with a value of **2** (Table 1).

Distance from edge of field to surface water
Since the runoff from this field flows directly into the return flow system the distance from edge of field to surface water is 0' which would be a value of **8** (Table 1).

All of the field values in Part A are then added together to obtain the Total Site Transport Value

1 + 8 + 2 + 8 = 19

**If this site had a tailwater recovery and pumpback system the transport value would be reduced by 80%*

19 – (19 x 0.8) = 3.8

Sum of Part A = 3.8

Phosphorus Site Index

Part B: Phosphorus Loss Potential Due to P Source and Management Practices

Soil Test Phosphorus

Phosphorus exists in many forms in the soil, both inorganic and organic. Major inorganic forms are soluble, adsorbed, precipitated and minerals containing Al, Ca, and Fe. Each "pool" of soil P has a characteristic reactivity and potential for movement in either soluble or particulate forms. Iron and aluminum oxides, prevalent in most soils, strongly adsorb P under acidic conditions; under alkaline conditions, adsorption and precipitation are fostered by the presence of free calcium ions and calcium carbonate (Leytem and Westermann, 2003). Microorganisms and plant uptake can immobilize inorganic P by incorporation into biomass. Conversely, as organic materials decompose, soluble P can be released and made available for transport. How much P exists in each of these pools is determined by soil type, mineralogy, microbial activity, cropping, and fertilization practices (with both inorganic and organic sources of P).

Past and present research has demonstrated that there is a positive relationship between soil test P and dissolved P in surface runoff; that is, as soil test P increases, dissolved P in runoff also increases (Westermann et al., 2001; Turner et al., 2004). However, this relationship varies with soil type, cropping system and nature of the runoff episode. In addition to impacting P levels in surface waters, soil test P has also been found to affect P loss in drainage waters (Heckrath et al., 1995; Sims et al, 1998). Thus, as soils are fertilized to levels exceeding the soil test P values considered optimum for plant growth, the potential for P to be released to soil solution and transported by surface runoff, leaching, subsurface movement and even groundwater increases. Therefore, it is important to include a measure of the current soil test P values in any risk assessment tool for P.

For the *P Site Index,* soil test P values are expressed in ppm of either Olsen or Bray P. Olsen P is the most common (and appropriate) soil test for Idaho's calcareous soils. However certain regions of the state with lower soil pH (<7.4) may also use the Bray method for determination of soil test P.

P Site Index Value For Table 1 = 0.05 x Olsen Soil Test P (ppm), or

P Site Index Value For Table 1 = 0.025 x Bray Soil Test P (ppm)

Phosphorus Application Rate

The addition of fertilizer P or organic P to a field will usually increase the amount of P available for transport to surface waters. The potential for P loss when fertilizers, manures, or other P sources are applied is influenced by the rate, timing, and method of application and by the form of the P source (e.g. organic vs. inorganic). These factors also interact with others, such as the timing and duration of subsequent irrigation, rainfall or snowmelt and the type of soil cover present (vegetation, crop residues, etc.; Sharpley et al., 1993). Past research has established a clear relationship between the rate of fertilizer P applied and the amount of P transported in runoff (Baker and Laflen, 1982; Romkens and Nelson, 1974). These studies showed a linear relationship between the amount of P added as superphosphate fertilizer and P loss in runoff. Using manure as the source of P, Westerman et al. (1983) also demonstrated a direct relationship between the quality of runoff water and the application of manure. Therefore, it is important that the amount of P added to a site is accounted for in any risk assessment for nonpoint source pollution by P.

The P application rate is the amount of P in pounds P_2O_5 per acre that is applied to the crop. The amount of P in manures shall be determined either by sample submission for testing by a certified laboratory or calculated using Table 10.

Table 9. Phosphorus application rate. Corresponding value to be included in the *P Site Index (Table 1).*

P Application Rate (lbs P_2O_5 applied per acre)	Value
No Application	0
< 60	1
60 - 150	2
151 - 300	4
> 300	8

Table 10. Phosphorus concentration of dairy manure

Dairy Manure Type	%P_2O_5 on a wet basis
Solid stacked	0.57
Composted	0.69
Lagoon liquid	0.03
Slurry	0.30

Phosphorus Application Method

Directly related to the amount of fertilizer and organic P sources applied to a field is the method and timing of the application. Baker and Laflen (1982) determined that the dissolved P concentrations of runoff from areas receiving broadcast fertilizer P average 100 times more than from areas where comparable rates were applied 5cm below the soil surface. Muller et al (1984) showed that incorporation of dairy manure reduced total P losses in runoff five-fold compared to areas with broadcast applications. Surface applications of fertilizers and manures decrease the potential interaction of P with the soil, and therefore increase the availability of P for runoff from the site. When fertilizers and manures are incorporated into the soil, the soil is better able to absorb the added P and thus decrease the likelihood of P loss. It is particularly important that fertilizers and manures are not surface applied during times when there is no plant growth, when the soil is frozen, during or shortly before periods of irrigation, intense storms or times of the year when fields are generally flooded due to snowmelt. The major portion of annual P loss in runoff generally results from one or two intense transport periods. If P applications are made during any of these high risk times, the percentage of applied P lost would be higher than if applications are made when runoff probabilities are lower (Edwards et al., 1992). Also, the time between application of P and the first runoff even is important. Westerman and Overcash (1980) applied manure to plots and simulated rainfall at intervals ranging from one to three days following manure application. Total P concentrations in the runoff were reduced by 90% by delaying the first runoff event for three days. In order to manage manure and fertilizers to decrease potential for P transport off-site, they must be either applied below the surface or incorporated into the soil within a short period of time and also be applied shortly before the growing season when available P can be utilized by the plant.

For the *P site Index*: To determine the field value for application methods of P sources, information about the time of year and method of application must be obtained from the nutrient user and assigned values using Table 11.

Table 11. Values of P application methods for inclusion in *P Site Index (Table 1).*

P Application Method	Value
None applied	0
Incorporated within 2 day or injected/banded below surface at least 2”	1
Incorporated within 7 days of application	2
Incorporated >7 days or no incorporation when applied between February 16 and December 15	4
Application between December 16 and February 15	8

The Phosphorus Site Index

Part B: Phosphorus Loss Potential Due to P Source and Management Practices

Sample Calculation

Part B: Phosphorus Loss Potential Due to P Source and Management Practices

Calculation of the Total P Source and Management Value for Part B of the P Site Index

Once the values for soil test P, P application rate and P application method have been obtained, these values shall be added together to obtain a total P source and management practice value (sum for Part B).

EXAMPLE:
The field described for calculation of Part A has an Olsen soil test P value of 80 and solid manure is applied at 50 tons/acre in October and is not incorporated.

Soil Test P value
Olsen P of 80 x 0.05 = **4**

P Application Rate
50 tons/acre = (50 x 2,000 x (0.57/100)) = 570, this would be a value of **8**

P Application Method
Surface applied between Feb 16 and Dec 15 and not incorporated, this is a value of **4**

All of the field values in Part B are then added together to obtain the Total P Source and Management Value

4 + 8 + 4 = 16

Sum of Part B = 16

The Phosphorus Site Index

Calculation and Interpretation of the Overall P Loss Rating for a Site

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To find the overall *P Loss Rating* for a site (the final *P Site Index Value*), multiply the total site and transport value from Part A by the total management and source value from Part B as follows:

***P Site Index* = [Sum of Part A] x [Sum of Part B]**

Sum of Part A = 19

Sum of Part B = 16

***P Site Index* = 19 x 16 or 304**

A *P Site Index* value of **304** is classified as **Very High (See Tables 2 or 12)**

*If a tailwater recover with a pumpback system was used as a BMP then the P Site Index value would be

Sum of Part A = 3.8

Sum of Part B = 16

***P Site Index* = 3.8 x 16 or 61**

A *P Site Index* value of **61** is classified as **Low (See Tables 2 or 12)**

<u>Interpretation of the *P Site Index* Value</u>

Compare the *P Site Index* value calculated as show above with the ranges given in Table 12 for Low, Medium, High, or Very High risk of P loss. **It is important to remember that a P Site Index value is an indication of the degree of risk of P loss, not a quantitative prediction of the actual amount of P lost from a given field.** Fields in the "Low" category are expected to have a lower potential for P losses than fields in the "Medium P loss rating category, while fields in the "Medium P loss rating category are expected to have a relatively lower potential for P loss than fields in the "High" P loss rating category, and so on. The numeric values used in Table 12 to separate the various P loss categories are based on the best professional judgement of the individuals involved in the development of the *P Site Index* using data from fields and farms in Idaho where field evaluations were conducted in 2017.

Table 12. Interpretation of the *Phosphorus Site Index* Value

***P Site Index* Value**	**Generalized Interpretation of the *P Site Index* Value**
< 75	**LOW** potential for P movement from this site given current management practices and site characteristics. There is a low probability of an adverse impact to surface waters from P losses from this site. Nitrogen-based nutrient management planning is satisfactory for this site. Soil P levels and P loss potential may increase in the future due to N-based nutrient management planning.
75 - 150	**MEDIUM** potential for P movement from this site given current management practices and site characteristics. Phosphorus applications shall be limited to the amount expected to be removed from the field by crop harvest (crop uptake) or soil test-based P application recommendations. Testing of manure P prior to application is required.
151 – 225	**HIGH** potential for P movement from this site given the current management practices and site characteristics. Phosphorus applications shall be limited to 50% of crop P uptake. Testing of manure P prior to application is required.
> 225	**VERY HIGH** potential for P movement from this site given current management practices and site characteristics. No P shall be applied to this site.

Best Management Practice Definitions

Contour Farming. Farming sloping land in such a way that planting is done on the contour (perpendicular to the slope direction). This practice would apply to fields having a slope of 2% or greater. When converting from surface to sprinkler irrigation, this can be as simple as planting across the direction of the surface water flow. For other more complex settings, the maximum row grade shall not exceed half of the downslope grade up to a maximum of 4%. The minimum ridge height shall be 2 inches for row spacing greater than 10 inches and 1 inch for row spacing less than 10 inches.

Cover & Green Manure Crop. A cover and/or green manure crop is a close-growing crop primarily for seasonal protection and soil improvement. This practice reduces erosion by protecting the soil surface. Cover crops must be established (have vegetative cover over a minimum of 30% of the soil) by November 1 and must be maintained to within 30 days prior to planting the following crop. There shall be a minimum of 2 to 3 plants per square foot (about 100,000 plants/acre).

Dike or Berm. This practice applies to non-surface irrigated fields only and is comprised of an embankment to retain water on the field. The dike or berm must be engineered to retain runoff from a 25 year 24 hour storm event (0.8 BMP coefficient) or from 1 inch of runoff from the field (0.4 BMP coefficient).

Drip Irrigation. The credit for implementing this practice only applies when switching from surface irrigation to drip irrigation. A drip irrigation system shall be comprised of an irrigation system with orifices, emitters or perforated pipe that applies water directly to the root zone or soil surface. This practice efficiently applies water to the soil surface with low probability of runoff, as determined using the calculation in Table 5.

Filter Strip. A filter strip is a strip of permanent herbaceous dense vegetation in an area where runoff occurs. A filter strip can only be used on fields having < 10% slope. Ideally they are perpendicular to the flow of water and the runoff from the source area is such that flow through the strip is in the form of sheet runoff. Channeling of water through a filter strip will severely reduce its effectiveness. Filter strips must be a minimum of 20 feet in length. If the length of the field contributing runoff to the filter strip is greater than 1000 feet, then the minimum filter strip width shall be 50 feet. They must be irrigated and maintained so that there is a minimum of 75% vegetative cover. The seeding rate shall be sufficient to ensure that the plant spacing does not exceed 4 inches (about 16-18 plants per square foot).

Polyacrylamide (PAM). PAM is an organic polymer that stabilizes the soil surface when applied with irrigation water. This practice can increase infiltration and reduce soil erosion. The PAM must be a soluble anionic polyacrylamide. Standards for proper implementation of this BMP shall follow the NRCS Conservation Practice Standard "Anionic Polyacrylamide (PAM) Application" (450-CPS-1).

Residue Management/Conservation Tillage. is any method of soil cultivation that leaves the previous year crop residue cover on the soil surface (such as corn stock or wheat stubble).. Conservation tillage must result in crop residue remaining on at least 30% of the soil surface. This practice reduces soil erosion by protecting the soil surface.

Sediment Basin. A basin or pond constructed to collect and retain sediment. This practice slows the velocity of flowing water which allows sediment to settle in the basin. Sediment basin size must be at least 500 cubic feet per acre of drainage area (20,000 ft^3 for 40 acre field or 20 ft x 200 ft x 5 ft). The length-to-width ratio shall be 2 to 1 or greater with a minimum depth of 3 feet. Sediment basins must be cleaned on an annual basis or more frequently.

Tailwater Recovery & Pumpback Systems. This practice applies to surface irrigated fields only. Design standards and management must follow the ASABE Engineering Practice Standard 408.3 "Surface Irrigation Runoff Reuse Systems". Irrigation runoff reuse systems have four basic components: 1) runoff collection and conveyance channels (tailwater ditches, drains), 2) storage reservoir (tailwater pit, pond, sump), 3) pumping plant (reuse, return, pumpback pump), and 4) delivery pipe (return, pumpback pipe). Runoff from irrigated fields is intercepted by a system of open channels or pipelines and conveyed by gravity to a storage reservoir or pumping plant. Capacity of the channels and pipelines shall be sufficient to convey the maximum expected runoff rate from irrigation. Also, the collection system must be able to safely convey or bypass runoff from precipitation. Reuse systems designed to capture 50% of the application volume will usually capture a large percentage of the total irrigation runoff.

Established Perennial Crop. This is a crop that is grown for more than one year. Perennial crop is considered to be "established" the season after it was seeded.

References

Abu-Zreig, M., R. Rudra, H.R. Whiteley, M.N. Lalonde, and N.K. Kaushik. 2003. Phosphorus removal in vegetated filter strips. J. Environ. Qual. 32:613-619

Baker, J.L., and J.M. Laflen. 1982. Effect of crop residue and fertilizer management on soluble nutrient runoff losses. Trans. ASAE 25:344-348.

Berg, R.D., and D.L. Carter. 1980. Furrow erosion and sediment losses on irrigated cropland. Journal of Soil and Water Conservation 35:267-270.

Bjorneberg, D.L. and Aase, J.K. and Westermann, D.T. (2000) Controlling sprinkler irrigation runoff, erosion, and phosphorus loss with straw and polyacrylamide. Transactions of the ASAE. 43(6):1545-1551.

Bjorneberg, D.L., D.T. Westermann, and J.K. Aase.2002. Nutrient losses in surface irrigation runoff. J. Soil Water Cons. 57:524-529.

Brown, M.I, JA. Bondurant, and C.E. Brockway. 1981. Ponding surface drainage water for sediment and phosphorus removal. Transactions of the ASAF 24:1478- 1481.

Carter, D.L., and R .D. Berg. 1991. Crop sequences and conservation tillage to control irrigation furrow erosion and increase farmer income. Journal of Soil and Water Conservation 46:139-142.

Carter, D.L., M.J. Brown, C.W. Robbins, and JA. Bondurant. 1974. Phosphorus associated with sediments in irrigation and drainage waters for two large tracts in southern Idaho. Journal of Environmental Quality 3:287-291.

Culley, J.L.B., Bolton, E.F. & Bernyk, V. 1983. Suspended solids and phosphorus loads from a clay soil: I. Plot studies. Journal of Environmental Quality, 12, 493–498.

Edwards, D.R., T.C. Daniel, and O. Marbun. 1992. Determination of best timing for poultry waste disposal: A modeling approach. Wat Res. Bul. 28:487-494.

Fitzsimmons, D.W., G.C. Lewis, D.V. Naylor, and J.R. Busch. 1972.Nitrogen, phosphorous and other inorganic materials in waters in a gravity-irrigated area. Transactions of the ASAE 15:292-295.

Heckrath, G., P.C. Brooks, P.R. Poulton, and K.W. T. Gouliding. 1995. Phosphorus leaching from soils containing different phosphorus concentrations in the Broadbalk experiment. J. Environ. Qual. 24:904-910.

Heathwaite, A.L. & Dils, R.M. 2000. Characterising phosphorus loss in surface and subsurface hydrological pathways. Science of the Total Environment, 251–252, 523–538.

King, LG., B.L. McNeal, F.A. Ziari, S.C. Matulich, and JP Law. 1982. On-farm improvements to reduce sediment and nutrients in irrigation return flow. Washington State University completion report for Grant No. R-805527 from the R .S. Kerr Environmental Research Laboratory. U.S. Environmental Protection Agency, Ada, OK. 193 pp.

Koluvek, P.K., K.K. Tanji, and T.J. Trout. 1993. Overview of soil erosion from irrigation. Journal of Irrigation and Drainage Engineering 119:929-946.

Lentz, R .D., I. Shainberg, R .E. Sojka, and D.L. Carter. 1992. Preventing irrigation furrow erosion with snail applications of polymers Soil Science Society of America Journal 56:1926-1932.

Lentz, R.D., R.E. Sojka, and C.W. Robbins 1998. Reducing phosphorus losses from surface-irrigated fields Emerging polyacrylamide technology. Journal of Environmental Quality 27:305-312.

Leytem, A.B. and Westermann, D.T. (2003) Phosphate sorption by Pacific Northwest calcareous soils. Soil Sci. 168:368-375.

Mchugh, A.D., S. Bhattarai, G. Lotz, and D.J. Midmore. 2008. Effects of subsurface drip irrigation rates and furrow irrigation for cotton grown on a vertisol on off-site movement of sediments, nutrients and pesticides. Agron. Sustain. Dev. 28:507-519.

Mueller, D.H., R.C. Wendt, and T.C. Daniel. 1984. Phosphorus losses as affected by tillage and manure application. Soil Sci. Soc. Am. J. 48:901-905.

Pautler, M.C., and J.T. Sims. 2000. Relationships between soil test phosphorus, soluble phosphorus, and phosphorus saturation in Delaware soils. Soil Sci. Soc.Am. J. 64:765-773.

Romkens, J.M. and D.W. Nelson. 1974. Phosphorus relationships in runoff from fertilized soils. J. Environ. Qual. 3:10-13.

Sharpley, A.N. 1985. The selective erosion of plant nutrients in runoff. Soil Science Society of America Journal 49:1527-1534.

Sharpley, A.N. 1995. Identifying sites vulnerable to phosphorus loss in agricultural runoff. J. Environ. Qual. 24:947-951.

Sharpley, A.N., S.C. Chapra, R. Wedepohl, J.T. Sims, T.C. Daniel, and K.R. Reddy. 1994. Managing agricultural phosphours for the protection of surface waters: Issues and options. J. Environ. Qual. 23:437-451.

Sharpley, A.N. and S.J. Smith. 1991. Effect of cover crop on surface water quality. p. 41-49, *In* Cover Crop for Clean Water. W.L. Hargrov (Ed.) Soil and Water Conservation Society, Iowa, USA.

Sibbesen, E. and A.N. Sharpley. 1997. Setting and justifying upper critical limits of r phosphorus in soils. p. 151-176. *In* H. Tunney et al. (eds) Phosphorus loss from soil to water. CAB International, London.

Sims, J.T. 1998. Phosphorus and soil testing: Innovations for water quality protection. Comm. Soil Sci. Plant Anal. 29:1471-1489.

Sims, J.T., R.R. Simard, and B.C. Joern. 1998. Phosphorus losses in agricultural drainage: Historical perspectives and current research. J. Environ. Qual. 27:277-293.

Sojka, R .E., and R .D. Lentz. 1997. Reducing furrow irrigation erosion with polyacrylamide (PAM). Journal of Production Agriculture 10:47-52.

Trout, T.I, R .E. Sojka, and R .D. Lentz. 1995. Polyacrylamide effect on furrow erosion and infiltration. Transactions of the ASAF 38:761-765.

Turner, B.L., M.A. Kay, and D.T. Westermann. 2004. Phosphorous in surface runoff from calcareous arable soils of the semiarid Western United States. J. Environ. Qual. 33:1589-1946.

Westermann, D.T., D.L. Bjorneberg, J.K. Aase, and C.W. Robbins. 2001. Phosphorus losses in furrow irrigation runoff. Journal of Environmental Quality 30:1009-1015.

Westerman, P.W., T.L. Donnely, and M.R. Overcash. 1983. Erosion of soil and poultry manure – a laboratory study. Trans ASAE 26:1070-1078.

Westerman, P.W. and M.R. Overcash. 1980. Shor-term attenuation of runoff pollution potential for land-applied swine and poultry manure. P. 289-292. In R.J. Smith et al. (eds.) Livestock waste – A renewable resource. Prox. 4th Int. Symp on Livestock Wastes, Amarillo TX, 15-17 Apr. ASAE, St. Joseph, MI.

Wischmeier, W.H. and D.D. Smith. 1978. Predicting rainfall erosion losses – A guide to conservation planning. USDA

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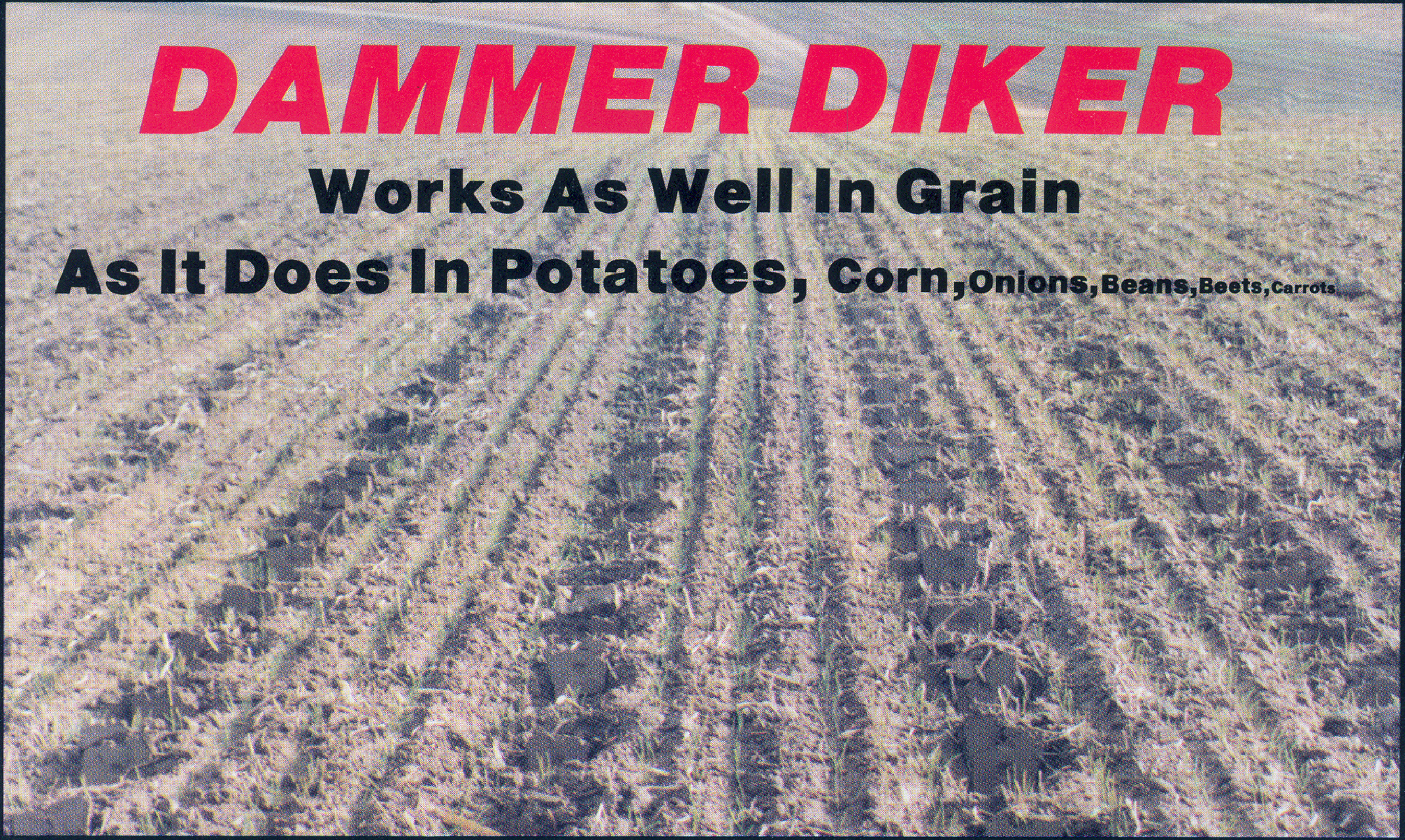

Winter wheat - seeded with the ***Dammer Diker*** drill or planted with conventional drills and diked with the ***Dammer Diker*** before germination insures good stand and no water runoff.

The ***Dammer Diker*** stops runoff cold. Snow melt is contained on the slopes for crop use.

Up to 7,500 mini-reservoirs per acre leave the field in perfect condition for better aeration and increased production.

Each year 17 million tons of top soil are eroded from Washington's Palouse Basin. The ***"Dammer Diker"*** is the ultimate in conservation tillage. Shanks penetrate deep to fracture hard pan layers and the mini-reservoirs left by the ***Dammer Diker*** stop runoff cold.

This 14 ft. pull-type ***Dammer Diker*** is ripping 15" deep and diking the stubble field to conserve precious moisture. These small reservoirs insure that next year's crop has maximum available soil moisture. Research shows that one additional inch of moisture can produce 7 or more bushels of grain per acre.

This 32′ folding ***Dammer Diker*** is capable of turning large acreages of erodable top soil into a waffled, sponge-like surface that can absorb up to 60% more moisture than open undiked fields. Properly diked fields seldom show any signs of runoff.

A ***Dammer Diker*** with an air seeder can be used behind conventionally planted grain. A small amount of seed is placed in the reservoirs to insure 100% stand. This process will stop water movement in the fields and improve crop production. This concept works well in CRP seeding and is probably the only proven conservation tillage machine for small grain crops.

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DOES THE DAMMER DIKER REALLY STOP RUNOFF?

"We call it Reservoir Tillage," says Tom Longley, University of Idaho-Aberdeen Station. "It stops runoff cold. Where we lost 10% to 60% of the water from conventional tillage, there was no runoff with reservoir tillage. It increased spring wheat yields 9.5%, potatoes 22%, and corn 31%."

Farm Journal, April 1985

DOES THE DAMMER DIKER INCREASE THE INFILTRATION RATE OF THE SOIL?

"They do something drastic to the soil," says R.J. Hanks, soils physicist, Utah State University. "You get more infiltration than you can computer. The hydraulic properties of the soil are changed. In our trials, reservoir tillage reduced runoff almost entirely. We had to apply 4 to 5 inches of water per hour under a center pivot to get it to run off. Conventionally-tilled fields lost 66% of the water applied."

Farm Journal, April 1985

DOES THE DAMMER DIKER INCREASE YIELD?

We couldn't afford to farm without something like the Dammer Diker," says Brent Schulthies, who, with Brent Hartley, Clyde Bybee, and Robert, Loren, and Duane Munn, developed Sunheaven Farms in the rolling Horse Heaven Hills, Benton County, Washington. Then he adds simply, "It saved us. Pumping costs have skyrocketed. But we've survived because of the tremendous increases in y8ields. Also, the Dammer Diker saves us time in the field. We pull it as fast as we can go, and it's easier to pull then the older, three-sided diking machine we had."

The New Farm, Nov/Dec 1985

"Our big problem for years has been water runoff," says Mile Svoboda, who grows 1,300 acres of dry-land corn and milo on tight clay soils near Bennington, Oklahoma. The answer to his water management problems is a "Dammer Diker" machine, which both subsoils and punches gallon-sized holes, or reservoirs, into row middles for water retention. "We get enough rain, but it tends to fall in 2- or 3-inch downpours. Normally, the soil holds only half an inch of that, but with the holes, we're keeping it all." That translates into more vigorous crops, more consistency across the field, and a 10-bushel-per-acre yield increase, Svoboda says. He no longer sees muddy runoff from his fields, which \shows he was losing topsoil with conventional tillage.

The New Farm, Nov/Dec 1985

Kansas farmer Ed Winger tried the Dammer Diker for the first time last year on 250 acres of irrigated corn and decided to buy a 12-row unit, which he used on 750 acres this year. Winger says he hasn't had time to measure yields, but "you can see the difference in the height of the corn and the grain in the bins."

The New Farm, Nov/Dec 1985

DOES THE DAMMER DIKER SAVE WATER?

"We put 9,600 acres of dryland what under pivot irrigation in 1976. We pump inland from 11 to 17 miles and over 1,000 feet of lift. The Dammer Diker saves us from $7.00 to $20.00 per acre in water costs alone. We pump less water and get a yield increase to boot.

"In addition, we find that the ability to combine several cultivation processes in one pass with the Dammer Diker saves us from one to two passes through the field.

"Our machines pay for themselves on every 500 acres of use, in water savings alone."

Duane Munn
Sun Heaven Farms
Benton County, WA

DOES THE DAMMER DIKER IMPROVE CROP QUALITY?

Balcome & Moe, Inc. Pasco, WA

Dammer Diker Comparison – Potatoes – Farm Unit 54 – Plot Size 1.5 Acres

	With Dammer Diker	*%*	*Regular*
70 Count	89 lbs	35%	66 lbs
80 Count	96 lbs	85%	52 lbs
90 Count	133 lbs	5%	127 lbs
100 Count	220 lbs	14%	193 lbs
Total	83,050 lbs	9%	76,980 lbs

23% more cartons of 70, 80, 90, &100 count
57% more cartons of 70 & 80 count
30% more cartons of 70, 80, and 90 Count
9% Increase in Total Yields

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FAX (509) 582-5282

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Tri-Cities, WA 99302
(800) 627-9099
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From: Lloyd Knight
To: Denise Lauerman
Cc: Dr. Scott Leibsle
Subject: FW: Reservoir tillage in Idaho P Index
Date: Wednesday, May 24, 2023 3:04:01 PM
Attachments: Impact Reservoir Tillage Runoff Quality Quantity.pdf
image001.png

Denise -

Please post the email and the attachment as a comment from Dave Bjorneberg for the Dairy By-Product Rule…

Thanks.

Lloyd B. Knight
Deputy Director
Idaho State Department of Agriculture
Office: (208)332-8615
Cell: (208)859-4173

From: Dr. Scott Leibsle <Scott.Leibsle@ISDA.IDAHO.GOV>
Sent: Wednesday, May 24, 2023 8:46 AM
To: Lloyd Knight <Lloyd.Knight@ISDA.IDAHO.GOV>
Subject: FW: Reservoir tillage in Idaho P Index

IDAHO AGRICULTURE

Scott R. Leibsle DVM, DABVP
State Veterinarian/Administrator – Animal Industries
Idaho State Department of Agriculture – Boise, ID
scott.leibsle@isda.idaho.gov
(O) 208.332.8540

From: Bjorneberg, Dave - REE-ARS <dave.bjorneberg@usda.gov>
Sent: Tuesday, May 23, 2023 4:58 PM
To: Dr. Scott Leibsle <Scott.Leibsle@ISDA.IDAHO.GOV>
Cc: Mitchell Vermeer <Mitchell.Vermeer@ISDA.IDAHO.GOV>
Subject: Reservoir tillage in Idaho P Index

Scott,
I probably will not be at the meeting tomorrow. Here are some comments that you can share with the group.

Reservoir tillage was not included in the initial Idaho Phosphorus Index because there was no peer-reviewed literature documenting impacts on water quality. Research shows that reservoir tillage reduces runoff, however, these studies only measured runoff from small plots within a field. These runoff values indicate how much water is flowing from a small area within a field, but not how much leaves the field. It is difficult to translate these results into a reduction in risk of phosphorus loss from a field.

I have since found one study from Alabama that included water quality (publication attached). They measured runoff for 15 rainfall events and two irrigations over two years. Reservoir tillage significantly decreased runoff but did not significantly change sediment or phosphorus concentrations or loads (Tables 1 and 3).

If stakeholders feel strongly that reservoir tillage should be included as a best management practice, I think the most appropriate method is to reduce the Soil Surface Runoff Index – Sprinkler or Non-irrigated since reservoir tillage primarily impacts runoff. The value from Table 5 could be reduced one level (e.g. High to Medium) if reservoir tillage is used. This would add another level of complexity to the index because all other practices are applied to the overall Site Transport Value.

Let me know how the group wants to proceed. We can help draft language if the index needs to be revised.

Dave Bjorneberg, P.E., Ph.D.
Research Leader
USDA Agricultural Research Service
Northwest Irrigation & Soils Research Lab
3793 N 3600 E
Kimberly, ID 83341-5076
208-423-6521 desk
208-420-3894 cell

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IMPACT OF RESERVOIR TILLAGE ON RUNOFF QUALITY AND QUANTITY

E. W. Rochester, D. T. Hill, K. H. Yoo

ABSTRACT. *The effects of reservoir tillage on runoff and water quality were studied under two levels of soil compaction in the production of cotton. A wide frame tractive vehicle was used during plot establishment and during all farm operations to provide the desired soil compactions. LEPA (Low Energy Precision Application) irrigation was used to apply supplemental water as required. Runoff quantity was monitored with flumes and runoff samples were taken using Coshocton-type runoff samplers. Thirteen runoff events were monitored and analyzed over a two-year period for the replicated, four-treatment study. Reservoir tillage decreased runoff and total discharges of organic nitrogen and phosphate. Differences in concentrations of water quality parameters (total solids, ammonium, total kjeldahl nitrogen, nitrate, phosphate, and COD) were not statistically significant. Although not statistically different, total runoff and total discharge of water quality parameters (except phosphate) were lower for the low compacted treatments compared to the high compacted treatments.* ***Keywords.** Runoff, Water quality, Tillage system, Pollution control.*

Furrow diking and reservoir tillage are methods of modifying the soil surface and near surface to increase water storage and to improve water use efficiency in cropping systems. Furrow diking and reservoir tillage are different in the way that water storage is achieved. Furrow diking generally refers to the building of dikes across the furrow while reservoir tillage generally refers to the formation of surface depressions. The first machine capable of making dikes was developed in 1931 (Lyle and Dixon, 1977). Interest in this and other early machines was limited. In 1975, a furrow diking machine was developed for use in the High Plains of Texas for dryland crops (Lyle and Dixon, 1977). Interest in the concept increased when substantial yield increases were reported for cotton and sorghum (Clark and Hudspeth, 1976). The furrow diking machine is also used in conjunction with LEPA (Low Energy Precision Application) irrigation (Lyle and Bordovsky, 1981; Bordovsky et al., 1992). And recently, furrow diking has been used in reduced tillage in the production of cotton (Clark et al., 1991).

An early reservoir tillage machine was developed in 1980 in Idaho (Wiser, undated) with the objective of holding water on the soil where it fell. This machine formed reservoirs at the surface of the soil profile. Yield increases have also been documented with the use of this concept (Longley, 1984). In the late 1980s, a research effort was initiated to evaluate the value of reservoir tillage in a high-intensity rainfall area (Hackwell et al., 1991). This study included production systems with and without reservoirs on highly compacted and on uncompacted soils. In the first year of the study, 1989, a series of LEPA irrigation applications was used to characterize the potential water savings of reservoir tillage. Runoff was decreased by the use of reservoirs for both levels of compaction. The decrease, however, was much greater for the highly compacted soils. After the first year, we expanded the study to include chemical analyses of the surface runoff and continued the study through two additional growing seasons. The objective of this study was to determine the effect of reservoir tillage in a high-intensity rainfall area on surface runoff quantity and quality under varying soil compaction levels.

EXPERIMENTAL PROCEDURES

In 1989, 12 experimental plots were established at the E. V. Smith Research Center, Alabama Agricultural Experiment Station, Shorter, Alabama. Details of plot design and construction have been presented (Hackwell et al., 1991) and are summarized here. The plots were constructed between previously prepared traffic lanes (Monroe and Taylor, 1989) to accommodate a Wide Framed Tractive Vehicle (WFTV) (Monroe and Burt, 1989). All field operations were conducted with this vehicle, thus eliminating any unwanted traffic in the plots.

The 6.0-m-wide plots were designed to accommodate eight rows of crop with a 0.76-m row spacing. The plots were initially 29.0 m long, but were reduced in subsequent years to 24.4 m to better accommodate the field equipment. Surface water flow into and out of the plots was eliminated by the use of vertical steel strips which extended approximately 150 mm above the soil surface. Each plot was equipped with a 180-mm HS flume, model N-1 Coshocton-type runoff sampler and collector tank. Two CR10 dataloggers (Campbell Scientific, Inc., Logan, Utah) were used in conjunction with potentiometers to monitor and record flow at 1-min increments. Runoff samples were collected manually from the collecting tank after each

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The authors are **Eugene W. Rochester**, ***ASAE Member Engineer***, Associate Professor, **David T. Hill**, ***ASAE Member Engineer***, Professor, and **Kyung H. Yoo**, ***ASAE Member Engineer***, Associate Professor, Dept. of Agricultural Engineering, Alabama Agricultural Experiment Station, Auburn University, Ala.

runoff event. Collected samples were transported to the laboratory for analysis. Samples were stored at 3° C and analyzed within one week of collection.

Water quality parameters of total solids (TS), total ortho-phosphate (T-PO_4), ammonium nitrogen (NH_4-N), and chemical oxygen demand (COD) were analyzed according to procedures outlined in *Standard Methods for the Examination of Water and Wastewater* (APHA, 1989). Nitrate nitrogen (NO_3-N) was analyzed by the DeVarda's alloy method. Total Kjeldahl nitrogen (TKN) was analyzed according to the micro-Kjeldahl technique of AOAC (1984). Runoff water quality analyses were performed after the collected runoff samples were completely mixed.

The above parameters (TS, T-PO_4, NH_4-N, and TKN) are of major concern in surface water runoff and are known to cause various health or pollutional problems. The U.S. Public Health Service has established a drinking water standard of 10 mg/L for NO_3-N as the upper health limit. COD levels over about 500 mg-O_2/L pose serious problems when runoff reaches surface water streams and TS levels of more than 10 g/L (1%) signal a serious erosion event. Excessive phosphorus levels (i.e., > 10 mg-P/L) cause serious algal blooms in surface water impoundments. All of these parameters, taken as a whole, can be used to determine processes occurring in the soil and during runoff events. However, the most important use of these data will be in an analysis of variance for the two-year study to determine if and what significant differences exist between the factors of compaction and tillage.

The soil is a Bassfield sandy loam (Typic Hapludult, 67% sand, 18% silt, 15% clay, 1.2% organic matter). Prior to initiation of tests in 1989, the top 200 mm of soil profile was extensively tilled to minimize compaction and then recompacted using a double-wheeled compactor according to treatment needs. A hardpan was left undisturbed in the 200- to 300-mm profile range. This modified soil profile was left undisturbed during the three-year test period except for surface preparations during planting. Soil compaction was quantified annually utilizing a hydraulically operated cone penetrometer to determine the cone index of the soil profiles in the different treatments. Plot slope is 0.2% in the direction of the traffic lanes and rows.

In addition to natural rainfall, supplemental irrigation was applied as needed according to soil moisture tension obtained from resistance-type sensors and from gravimetric soil-moisture sampling. A traveling LEPA irrigation system was used to apply water to each of the seven inside furrows of the eight-row cropping system with depth of application controlled by travel speed. Volume of water applied by irrigation was monitored using a mainline flowmeter. Volume applied by rainfall was monitored by on-site tipping bucket and total volume rain gages.

The experiment included four treatments, each having three replications arranged in a randomized complete block design as follows: 1) high compaction without reservoirs; 2) high compaction with reservoirs; 3) low compaction without reservoirs; and 4) low compaction with reservoirs. At planting, all plots were disked and cultivated twice to form a seed bed. Cotton (*Gossypium hirsutim* L.) was planted at a seeding rate of 20 seeds/m. Reservoirs were then created (in the appropriate treatments) in each of the seven inside furrows using commercially available equipment (Dammer Diker manufactured by Ag Engineering and Development Co., Tri-Cities, Wash.). The reservoirs were an average of 250 mm deep and spaced at 600-mm intervals along the furrow. A late season water-holding volume ranged from 2.9 to 4.6 L per reservoir (5.6 to 9.0 mm effective storage depth).

All plots received the same commercial fertilizer applications based upon soil tests and recommendations from the Auburn University Soil Test Laboratory. Applications during the 1989 growing season included a common broadcast of 44 kg-N/ha and 44 kg-P/ha incorporated with a field cultivator on 18 May (planting) followed by a broadcast on 27 July of 95 kg-N/ha as NH_4NO_3. In the 1990 growing season, 27 kg-N/ha and 81 kg-P/ha were broadcast and incorporated at planting (24 April) followed by a broadcast application of 101 kg-N/ha as NH_4NO_3 on 6 June, 43 days after planting. In the final cropping year (1991), 99 kg-N/ha was applied as NH_4NO_3 on 13 June, 21 days after planting.

At season end, plots were hand-harvested and yields measured. After harvest, the soil surface was tilled and winter wheat planted as a ground cover.

Results and Discussion

Water quality and quantity data were collected for 17 events over the two-year study period (table 1). These events represent most of the runoff events that occurred during the growing seasons, and included two events after harvest, and two events prior to planting for 1990 and 1991, respectively. Two irrigation events, one in each year, resulted in runoff as noted by footnote 1. All reported events occurred in the months May through November.

Runoff

Runoff, as a percentage of water applied, varied to a maximum of approximately 30%. Runoff from plots with reservoirs was significantly (denotes statistically significant differences at the 0.05 level or better) reduced compared to plots without reservoirs. Average runoff percentage over both compacted and uncompacted treatments for events which occurred during the crop growing period were 7.0 and 4.0% for treatments without and with reservoirs, respectively. Differences between the two treatments were more pronounced for events with high percentage runoff, such as events 5 and 15. These high runoff events were caused by high intensity storms of 75 and 70 mm/h, and total applications of 39 and 34 mm, respectively. Other runoff events with higher application totals, such as events 9 and 12 (51 mm and 86 mm, respectively), had lower runoff percentages because of lower application intensities (28 and 40 mm/h, respectively). Reservoirs had a more pronounced effect on runoff percentage for the highly compacted soils than with the uncompacted soils. Reservoirs reduced total runoff from 8.5 to 3.7% for the compacted soils as compared to a reduction of 7.0 to 4.0% for the uncompacted soils.

Total Solids

Total solids (TS) measures all dissolved and suspended solids, including fixed (mineral) and volatile (organic matter). Concentration of TS in the runoff varied from approximately 0.1-4.3 g/L (table 1) and averaged

1.6 g/L for the 13 cropping-season events. Differences between treatments were not significant. Computed on a mass per unit area basis (table 1), trends, although not statistically significant, indicated slightly lower amounts of TS discharged for plots with reservoirs compared to nonreservoir plots. Events 5 and 14 produced the most losses. Event 5 was a high-intensity rainfall, while event 14 was an irrigation applied immediately after installing the reservoirs during a time in which the surface soil was loose.

NITROGEN

The three forms of N (NH_4-N, organic nitrogen (ON-N), and NO_3-N) represent the most mobile forms and, also, NO_3-N poses the greatest health hazard in drinking water. Highest average concentration of NO_3-N was 23.8 mg/L (event 14, table 2). Runoff event 14 occurred just four days after a broadcast application of NH_4NO_3 at a rate of 99 kg N/ha. Differences in NO_3-N concentrations of the runoff were not significant between treatments. Average concentration of NO_3-N over all treatments was 3.5 mg/L.

Total discharge of NO_3-N (table 2) on a unit area basis again demonstrated the sharp impact of the first runoff event after the N application (event 14) with an average discharge over all treatments of 0.3 kg N/ha. Differences in discharge values were not significant between treatments.

NH_4-N demonstrated trends similar to NO_3-N (table 2) with average peak concentrations and total discharge occurring at event 14 (21.8 mg/L and 1.0 kg/ha). Differences between treatments were not significant, but total discharge of NH_4-N was lower for events 5, a high runoff event, and 14, the event just after a N application.

Table 1. Average runoff and total solids concentrations and losses*

Event†	Days After Planting	Rain or Irr.	Runoff		Total Solids Conc.		Total Solids Loss	
			WR‡	NR	WR	NR	WR	NR
	(d)	(mm)			(g/L)		(kg/ha)	
	(1990)							
1	15	31	0.00	0.00	0.7	0.7	0.0	0.0
2	23	17	0.01	0.01	1.4	1.2	0.7	0.6
3	59	13	0.03	0.05	1.8	2.2	3.4	6.7
4	75	26	0.06	0.41	1.1	1.3	3.9	30.9
5	78	39	1.10	2.20	1.8	1.7	117.2	199.9
6	117	18	0.06	0.08	2.9	1.8	10.2	8.1
7	125	33	0.04	0.11	1.5	1.4	3.8	8.7
8	129	19	0.13	0.15	0.6	1.3	4.6	11.4
9	138	51	0.29	0.43	3.2	1.8	54.0	46.2
10	181	18	0.01	0.00	2.0	3.0	0.8	0.3
11	199	35	0.04	0.06	0.4	1.4	0.9	4.4
	(1991)							
12	−55	86	0.83	1.15	1.0	1.3	55.9	96.7
13	−4	33	0.03	0.05	0.4	1.2	0.8	4.0
14	25	63	0.57	0.81	4.3	3.8	162.3	202.4
15	80	34	0.53	1.06	0.5	0.6	18.7	42.5
16	83	17	0.18	0.27	0.3	0.7	3.9	12.6
17	124	51	0.12	0.10	0.1	0.2	0.4	1.2
Average§			0.22a	0.39b	1.7a	1.5a	34.0a	41.0a

* Values are averages of three replications and two levels of compaction.
† All events are rainfall except for irrigation event 7.
‡ WR = with reservoirs, NR = no reservoirs.
§ Averages within each variable followed by different letters are significantly different at the 0.05 level.
Averages exclude events 10, 11, 12, 13 which did not occur during the growing season.
Averages are based upon individual replications and may differ from averages of table data.

Table 2. Average NH_4-N, NO_3-N, and ON-N concentrations and losses*

Event	Days After Planting	NH_4-N Conc.		NH_4-N Loss		NO_3-N Conc.		NO_3-N Loss		ON-N Conc.		ON-N Loss	
		WR†	NR	WR	NR	WR	NR	WR	NR	WR	NR	WR	NR
	(d)	(mg/L)		(kg/ha)		(mg/L)		(kg/ha)		(mg/L)		(kg/ha)	
	(1990)												
1	15	0.1	0.2	0.00	0.00	0.72	1.06	0.00	0.00	2.38	1.03	0.00	0.00
2	23	1.1	0.5	0.00	0.00	0.00	0.50	0.00	0.00	7.19	6.07	0.00	0.00
3	59	0.6	1.1	0.00	0.00	0.81	0.33	0.00	0.00	3.26	5.45	0.01	0.02
4	75	2.9	1.8	0.01	0.04	2.91	1.46	0.01	0.03	5.12	4.82	0.02	0.12
5	78	2.3	2.4	0.15	0.28	2.10	1.69	0.14	0.20	8.26	7.07	0.54	0.84
6	117	0.8	1.1	0.00	0.00	0.45	1.35	0.00	0.01	6.37	6.37	0.02	0.03
7	125	1.8	0.9	0.00	0.01	1.25	1.03	0.00	0.01	5.03	4.70	0.01	0.03
8	129	0.4	0.8	0.00	0.01	0.95	2.04	0.01	0.02	3.24	3.96	0.02	0.04
9	138	1.4	0.7	0.02	0.02	1.99	0.83	0.03	0.02	8.69	5.68	0.15	0.14
10	181	1.3	1.2	0.00	0.00	0.88	0.41	0.00	0.00	5.60	7.94	0.00	0.00
11	199	1.0	1.2	0.00	0.00	1.25	0.41	0.00	0.00	1.75	4.33	0.00	0.01
	(1991)												
12	−55	0.1	0.1	0.01	0.01	0.37	0.30	0.02	0.02	3.10	3.27	0.17	0.25
13	−4	0.4	0.5	0.00	0.00	0.44	1.57	0.00	0.01	2.05	4.25	0.00	0.01
14	25	22.6	21.1	0.85	1.14	26.83	20.80	1.02	1.02	6.32	5.65	0.24	0.30
15	80	0.4	0.6	0.01	0.04	2.55	5.20	0.14	0.26	1.49	1.91	0.05	0.14
16	83	0.5	0.8	0.01	0.01	2.23	2.01	0.03	0.04	1.47	2.54	0.02	0.05
17	124	0.5	0.3	0.00	0.00	0.25	0.53	0.00	0.00	0.54	1.75	0.00	0.01
Average‡		3.1a	2.6a	0.09a	0.11a	3.85a	3.11a	0.12a	0.13a	5.23a	4.56a	0.09a	0.14b

* Values are averages of three replications and two levels of compaction.
† WR = with reservoirs, NR = no reservoirs.
‡ Averages within each variable followed by different letters are significantly different at the 0.05 level.
Averages exclude events 10, 11, 12, 13 which did not occur during the growing season.
Averages are based upon individual replications and may differ from averages of table data.

Concentrations of ON-N showed no significant differences between treatments (table 2) with an average concentration of 4.9 mg/L. Total discharge of ON-N, however, was significantly different between treatments. Event averages were 0.14 and 0.09 kg/ha, for without and with reservoirs, respectively. Highest discharge of ON-N occurred in event 5, the runoff event with a high rainfall intensity.

The TKN reflects the combination of ON-N and NH_4-N. Concentration differences were not significant between treatments and averaged 7.7 mg/L. Peak discharges occurred during events 5 and 14 for similar reasons as previously discussed for other N parameters.

PHOSPHORUS

Because P tends to be adsorbed onto soil particles, less movement in the aqueous phase would be expected with more movement associated with erosion. Therefore, lower erosion would affect the movement of P more than N. Concentrations of PO_4-P (table 3, mean = 4.0 mg/L) appear to be unaffected by reservoir tillage. Total losses (table 3) of PO_4-P through runoff were decreased by the addition of reservoirs from 0.08 to 0.04 kg/L. The PO_4-P losses closely track losses of TS (table 1) with the exception of event 14. No superfluous events were associated with event 14, therefore no explanation can be given for PO_4-P not tracking TS data.

COD

The importance of COD is in measuring the reduced organic matter contained in the runoff. It has long been recognized as an important parameter in measuring pollution based on oxygen demand. Neither concentration nor total discharge of COD were significantly different between the two reservoir tillage treatments. Mean values of 101 mg/L and 2.3 kg/ha were obtained (table 3).

SUMMARY AND CONCLUSIONS

The effects of reservoir tillage on runoff quantity and water quality parameters were studied in the production of cotton. A wide frame tractive vehicle was used during plot establishment and during all farm operations to provide two levels of soil compaction in the replicated treatments. LEPA irrigation was used to apply supplemental water as required. Runoff quantity was monitored with flumes and runoff samples taken using Coshocton-type samplers.

The experiment included four treatments: 1) low compaction without reservoirs, 2) low compaction with reservoirs, 3) high compaction without reservoirs, and 4) high compaction with reservoirs. In these discussions, the combined results of low and high compaction are presented for simplicity and clarity, as differences between compaction treatments were generally not statistically significant. Seventeen runoff events were monitored and analyzed during the study period. Thirteen of the events occurred during the growing season and were used to determine effects of reservoir tillage on quantity and quality of runoff.

Reservoir tillage decreased runoff and total mass discharges of ON-N and PO_4-P as compared to similar plots without reservoirs. This decrease was as expected because reservoirs impede flow and, since these two parameters are more closely associated with the non-soluble phase, their discharge was reduced. Differences in concentrations of water quality parameters (TS, NH_4-N, ON-N, NO_3-N, PO_4-P, and COD) were not statistically significant. Although there are no statistical differences in the concentration of water quality parameters for reservoir tillage compared to no reservoir tillage, there is a significant improvement in pollution control due to the reduction in runoff quantity. As a result, total mass discharge of pollutants was less for the plots with reservoir tillage. Although the primary use of reservoir tillage will not likely be pollution abatement, this benefit will accompany its use as a crop cultural practice and will benefit the environment significantly.

Table 3. Average PO_4-P and COD concentrations and losses*

Event	Days After Planting	PO_4-P Conc.		PO_4-P Loss		COD Conc.		COD Loss	
		WR†	NR	WR	NR	WR	NR	WR	NR
	(d)	(mg/L)		(kg/ha)		(mg/L)		(kg/ha)	
	(1990)								
1	15	2.86	2.06	0.00	0.00	36.5	33.3	0.0	0.0
2	23	4.75	6.80	0.00	0.00	121.2	70.2	0.1	0.0
3	59	4.40	6.71	0.01	0.02	67.0	66.3	0.1	0.2
4	75	4.56	4.48	0.02	0.11	73.6	67.8	0.3	1.6
5	78	5.30	5.61	0.34	0.67	134.4	119.9	8.7	14.2
6	117	5.34	5.15	0.02	0.02	129.2	128.8	0.5	0.6
7	125	5.06	4.49	0.01	0.03	116.0	103.9	0.3	0.7
8	129	1.29	4.08	0.01	0.04	44.0	76.0	0.3	0.7
9	138	7.50	4.51	0.13	0.11	346.7	197.3	6.0	5.0
10	181	5.39	6.97	0.00	0.00	157.8	257.8	0.1	0.0
11	199	1.65	3.46	0.00	0.01	20.9	96.5	0.1	0.3
	(1991)								
12	-55	2.34	2.76	0.13	0.21	40.5	54.9	2.2	4.2
13	-4	1.28	1.49	0.00	0.00	28.7	66.5	0.1	0.2
14	25	1.62	1.72	0.06	0.09	160.0	127.6	6.0	6.9
15	80	1.10	1.67	0.04	0.12	24.2	43.6	0.9	3.1
16	83	1.04	1.58	0.01	0.03	11.3	24.2	0.1	0.4
17	124	0.39	0.82	0.00	0.01	19.5	41.3	0.2	0.3
Average‡		4.04a	4.03a	0.06a	0.10a	113.2a	88.0a	2.0a	2.5a

* Values are averages of three replications and two levels of compaction.
† WR = with reservoirs, NR = no reservoirs.
‡ Averages are based upon individual replications and may differ from averages of table data.
Averages exclude events 10, 11, 12, 13 which did not occur during the growing season.
Treatment differences for phosphate and COD are not significant.
Averages within each variable followed by different letters are significantly different at the 0.05 level.

REFERENCES

AOAC. 1984. *Official Methods of Analysis.* New York: Assoc. of Official Analytical Chemists.

APHA. 1989. 17th Ed. *Standard Methods for the Examination of Water and Wastewater.* Washington, D.C.: American Public Health Association.

Bordovsky, J. P., W. M. Lyle, R. J. Lascano and D. R. Upchurch. 1992. Cotton irrigation management with LEPA systems. *Transactions of the ASAE* 35(3):879-884.

Clark, R. N. and E. B. Hudspeth, Jr. 1976. Runoff control for summer crop production in the southern plains. ASAE Paper No. 76-2008. St. Joseph, Mich.: ASAE.

Clark, L. E., H. T. Wiedemann, C. J. Gerard and J. R. Martin. 1991. A reduced tillage system with furrow diking for cotton production. *Transactions of the ASAE* 34(4):1597-1603.

Hackwell, S. G., E. W. Rochester, K. H. Yoo, E. C. Burt and G. E. Monroe. 1991. Impact of reservoir tillage on water intake and soil erosion. *Transactions of the ASAE* 34(2):436-442.

Longley, T. S. 1984. Reservoir tillage for center pivot irrigation. ASAE Paper PNR84-209. St. Joseph, Mich.: ASAE.

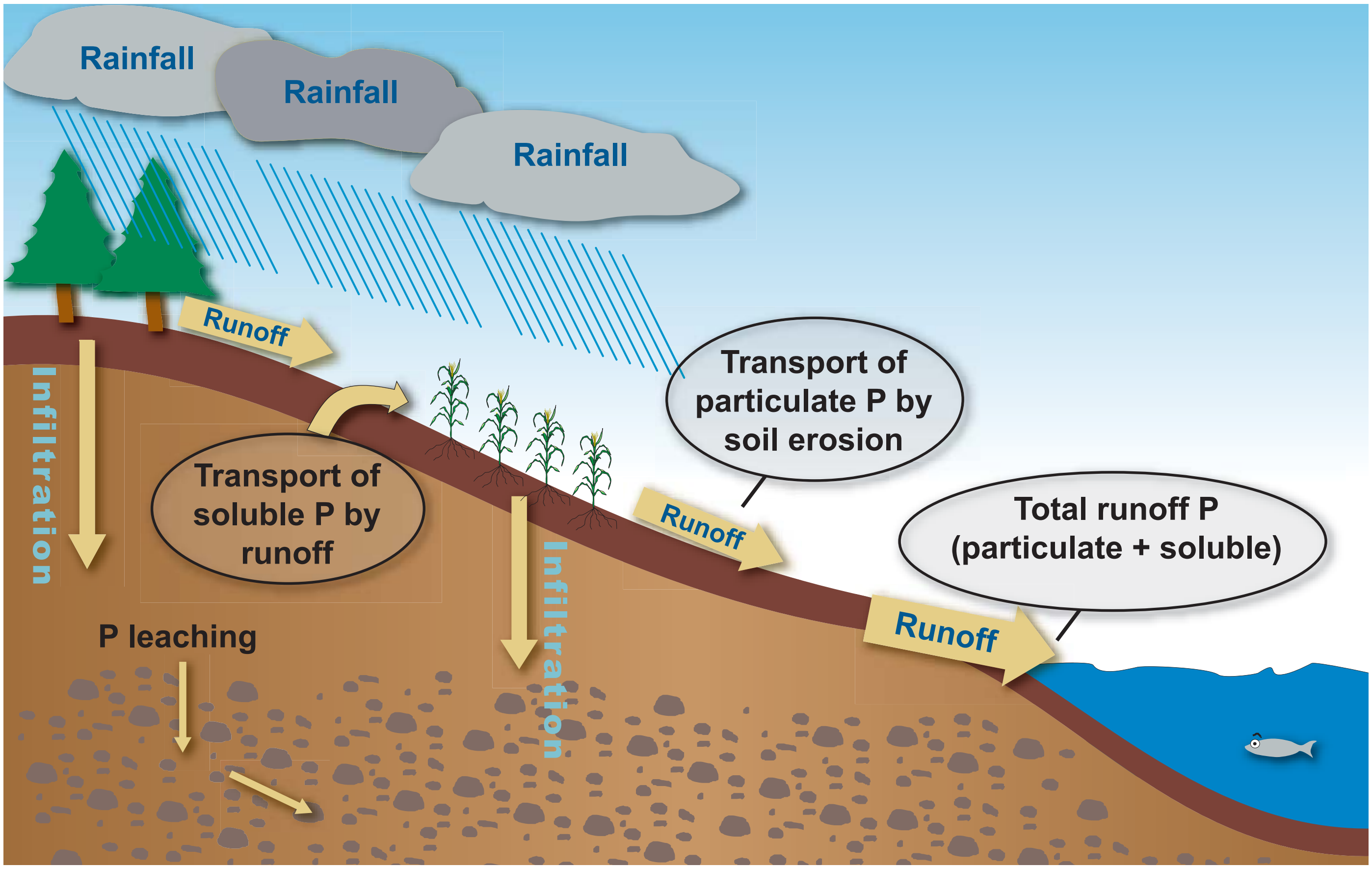
Lyle, W. M. and J. P. Bordovsky. 1981. Low energy precision application (LEPA) irrigation system. *Transactions of the ASAE* 24(5):1241-1245.

Lyle, W. M. and D. R. Dixon. 1977. Basin tillage for rainfall retention. *Transactions of the ASAE* 20(6):1013-1017, 1021.

Monroe, G. E. and E. C. Burt. 1989. Wide frame tractive vehicle for controlled traffic research. *Applied Engineering in Agriculture* 5(1):40-43.

Monroe, G. E. and J. H. Taylor. 1989. Traffic lanes for controlled traffic cropping systems. *J. of Agric. Eng. Res.* 44(1):23-31.

Wiser, T. B. Undated. Story of reservoir tillage. In *The Reservoir Tillage Handbook.* Tri-Cities, Wash.: Ag. Engineering & Development Company Inc.



Phosphorus Movement from Land to Water

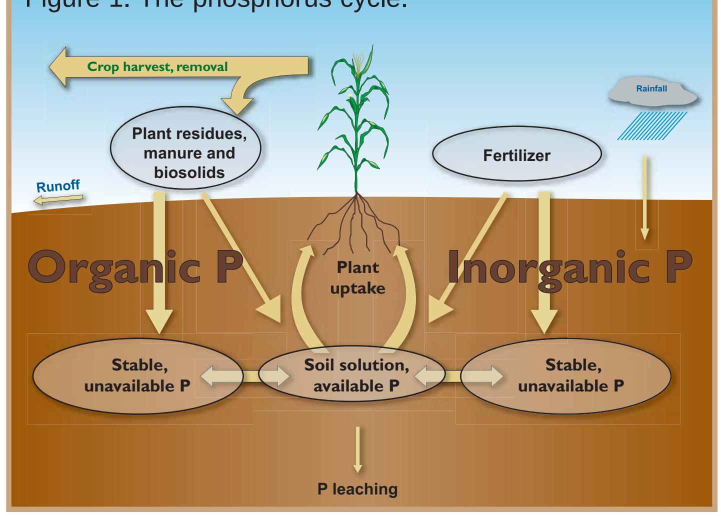
Phosphorus (P) is a naturally occurring element found in soil, water and all living organisms. In soil, P plays a critical role in the health of many crops and is one of 16 essential elements for plant growth. In water, additions of P to lakes and streams can impair water quality by stimulating excessive growth of algae and aquatic vegetation. The result can be a reduction in the recreational value of the water body along with the potential for additional consequences such as fish kills and reduced drinking water quality.

Movement of P across landscapes is a process that requires both a **source** of P and a mechanism for **transport** of P. Soil, vegetation, fertilizer, manure, other soil amendments, and municipal and industrial discharges are all sources of P. Water runoff and soil erosion are forces that transport P from land to water. Understanding the source and transport processes that control P movement is important for the development of sound nutrient management strategies that minimize the impacts of P on water quality.

The Phosphorus Cycle

Phosphorus, like most nutrients, moves through a cycle of interactions from soil to plant to animal (Fig. 1). The P cycle consists of a complex relationship of chemical and biological reactions that control its availability. Soil P originates from the weathering of minerals and from the additions of P-containing materials previously mentioned. Removal of P from soil occurs by crop uptake and harvest, erosion, runoff, and, occasionally, leaching (water movement through soils). The majority of P is located in the topsoil as a mixture of inorganic (mineral) and organic materials. Both forms of P are important sources for plant growth, but their availabilities are controlled by soil characteristics and environmental conditions. While soils generally contain a significant amount of P, most of it is strongly bound to soil particles by a process known as "fixation", and is unavailable for plant use.

Figure 1. The phosphorus cycle.



Phosphorus Sources

Where is phosphorus coming from?

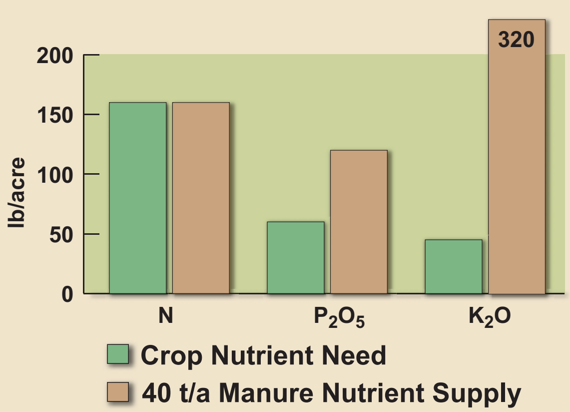
Soil - Phosphorus occurs naturally in the soil and is often supplemented with various inputs. Supplementation is needed because of the rapid rate at which P is "fixed" to soil particles. Over the course of time, however, P applications in excess of removal will elevate soil P to levels above the range needed for optimum crop growth. In general, soils with excessive levels of P have a higher potential for P losses to surface waters.

Plants - Native and agricultural vegetation can be a source of P. Researchers have found that alfalfa, grasses, crop residues, and forest litter contribute P in spring runoff. Plants release P when tissue is ruptured due to freezing and thawing. During rainfall or thawing events, plant-derived P can be dissolved into runoff water.

Fertilizers - Crop fertilization is the greatest use of P in agriculture. Many native soils were naturally low in P and required supplemental P additions to increase yields. The long-term use of manufactured fertilizers, along with other P inputs, has increased the P content of many soils to levels exceeding those needed for crop growth. In general, as soil P content increases, the potential for P loss in runoff and erosion increases.

Manure - Land application of manure to cropland recycles valuable soil nutrients needed for plant growth. Manure additions also improve many of the physical properties of soil resulting in an improved seedbed for crop growth. Unfortunately, manure applications can also lead to a build-up of soil P. Manure is often applied at rates to meet the nitrogen (N) need of corn. While the crop-available N and P contents of dairy and other animal manures are about equal, the corn need for N is three to five times greater than the P need (Fig. 2). Consequentially, the application of manure at rates to meet the N need of corn results in P applications that exceed crop P removal. The result is a build-up of P in cropland soils. Long-term manure applications have elevated the P level of many soils above the range necessary for optimum crop growth. This trend is common in areas where concentrated livestock operations are found.

Figure 2. Nitrogen-based manure application strategy for corn.



Livestock Feed - As it relates to manure, livestock feed can be a significant source of P on farms. Farm animals need adequate protein, energy, and nutrients in their feed in order to meet their nutritional needs, but dietary rations often contain excess nutrients, particularly P. Dietary P intake is directly related to the P content of manure. The higher the dietary P levels, the higher the concentration of P in the manure (Table 1). Excess dietary P accelerates the build-up of soil P and increases the potential for P losses from manured fields.

Table 1. Annual phosphorus fed to and excreted by a lactating cow.

Dietary P Level	Supplemental P	Fecal P
(%)	- - - - - - - lb/cow/year	- - - - - - -
0.35*	0	42
0.38*	5.5	47
0.48	23	65
0.55	36	78

*Dietary P levels of 0.35 and 0.38 are within the ranges recommended by the National Research Council (NRC) for dairy cattle feed.

Industrial and Municipal Waste - Water discharged into lakes and streams from industrial and municipal wastewater treatment facilities is an obvious source of pollution, and often a source of P. Storm water runoff from streets, driveways, parking lots, roofs, and lawns is an additional source of P entering surface waters. Biosolids, such as sewage sludge, are produced from the separation of liquid and solid waste at municipal waste water treatment plants. These P-rich solids are applied to nearby agricultural land as a nutrient resource similar to manure. The potential for the build-up of soil P levels to excessively high levels exists with multiple years of biosolid applications to the same fields.

Phosphorus Transport

How does phosphorus move?

Runoff and Erosion - The main transport mechanism for delivery of P to lakes and streams is runoff and erosion from the surrounding land (*see cover illustration*). Runoff and erosion are similar and interrelated processes. Runoff is the movement of water across the land's surface. Erosion occurs when runoff or rainfall dislodges soil particles and moves them with water from their place of origin to be deposited elsewhere. As runoff from rainfall or snowmelt

Point and Nonpoint Source Pollution in Agricultural and Urban Areas

Point Source Pollution: Identifiable pollution discharge sources, such as pipe emissions.

Nonpoint Source (or Runoff) Pollution: Diffuse, hard-to-identify pollution sources transported by runoff and erosion from a widespread land area.

One may be tempted to associate point source pollution with urban and industrial activities and nonpoint sources with agricultural activities. While this is often true, the opposite occurs as well. In urban areas, rainfall and the resulting runoff picks up sediment and pollutants as it travels across construction sites, lawns, parking lots, and streets. This runoff becomes a nonpoint source of pollution. In an agricultural setting, manure, fertilizer, pesticide, etc. spilled into or near a waterway from a storage facility is an example of an agricultural point source of pollution.

Municipal and industrial point source pollution has been greatly reduced over the past decades due to strict regulation, management, and investment in capital improvements by industries and municipalities. The success in reducing point sources of pollution and the substantial costs involved with further reduction of point sources of P is focusing public attention on the reduction of nonpoint (runoff) sources of pollution to further improve water quality.

Urban watersheds are few relative to agricultural watersheds in Wisconsin. Many of the state's watersheds contain both urban and agricultural areas. While the impact of nonpoint source pollution in urban landscapes can be locally significant, it often pales in comparison to agricultural P contributions due to large differences in acreage of the two land uses. As a consequence, the focus of many water quality protection programs has been to reduce nonpoint source pollution from the largest overall land use affecting it – agriculture.

travels along the landscape, the water interacts with the topsoil and any materials on the soil surface. During this process P can be added to the runoff water from soil, plant material, manure, and other soil amendments. Runoff water can contain P in both soluble (dissolved) and particulate (suspended) forms. Particulate-P is bound to the eroded soil and organic particles carried in the runoff. The majority of P lost from agricultural land is in the particulate form. Researchers estimate that particulate-P makes up 60 to 90% total P losses from cropland. The relationship between the soluble-P and particulate-P proportion of the total P contained in runoff varies as a function of erosion rates (Fig. 3). As erosion rates increase, the particulate-P fraction of runoff increases while the soluble-P fraction decreases significantly.

While particulate-P makes up the majority of the P transported in runoff from cropland, P in this form is not immediately available to algae and aquatic weeds in lakes and streams. However, the soluble-P portion of runoff can immediately stimulate the growth of algae and aquatic vegetation. Eroded sediment that reaches a lake will eventually settle to the bottom where it can act as a reservoir of P - awaiting future release (Fig. 4). The release of P from bottom sediments is a complex process that is dependant upon numerous factors. Biological activity can gradually release soluble-P from bottom sediment and organic matter. This soluble-P may diffuse into the lake water or it may become bound to the surfaces of lake bottom particles before it can reach the overlying water.

It is important to note that even small P additions to lakes and streams can have a big impact on water quality. The amount of P necessary to cause water quality problems is very small compared to the amount of P required for crops or the amounts contained in manure and fertilizer-P applications. Surface water concentrations of P as

Figure 3. Effect of erosion rate on the content of soluble P and particulate P in runoff.

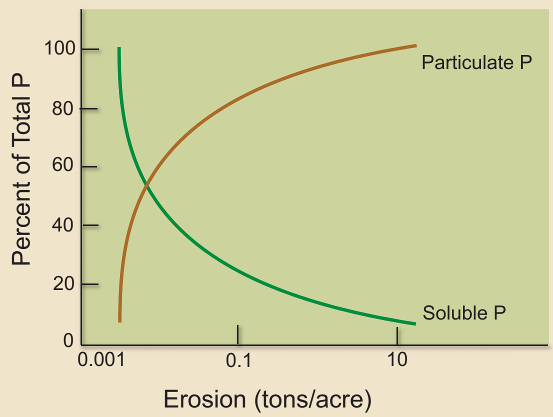
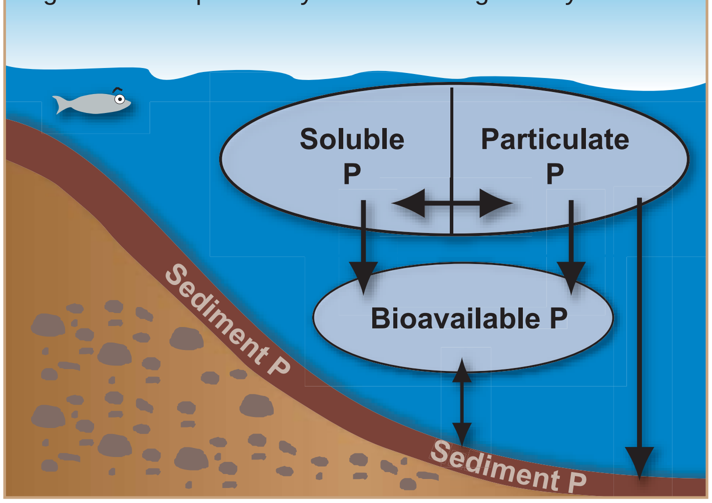


Figure 4. Phosphorus dynamics withing a body of water.



low as 0.01 ppm have been shown to impair water quality. These values are ten times lower than the P concentrations required in soil water for plant growth - typically 0.2 to 0.3 ppm. Comparing these concentrations illustrates the importance of limiting any amount of P loss from the land to water.

Leaching - In addition to runoff and erosion, another way P can move is by water infiltration through soil to groundwater, a process called leaching. Groundwater flow has been documented as a P transport mechanism to surface waters, but only under specific and usually rare conditions. *Remember P is tightly bound to soil particles.* Conditions that may result in P leaching include sites with high water tables, soils that are extremely high in P (i.e. P has saturated the soil's adsorption capacity), and/or sandy, highly permeable soils. Groundwater contributions of P are all in the soluble or dissolved form. In Wisconsin, current evidence suggests that P additions to surface waters from groundwater are negligible.

Relationship between Phosphorus Source and Transport

Phosphorus that reaches a lake or stream often originates from small areas within a watershed. One study found that less than 10% of the area within the agricultural watersheds they investigated was responsible for 90% of the P contained in runoff. Source-areas vary in location and magnitude of P contribution due to weather conditions such as the intensity and length of rainfall, as well as land characteristics such as soil moisture, soil erodability, soil water storage capacity, topography, etc. Not all areas that would be obvious P sources have a means to transport P to surface water. On the other hand, not all areas with high potential for P transport have a significant source of P. The many factors influencing P movement from the landscape makes it challenging to identify areas prone to losing P.

The Phosphorus Index

Various landscape assessment tools have been developed over the years to identify sites requiring improved management in order to minimize environmental risk. The Phosphorus Index (PI) is one tool that calculates the risk of P loss from individual fields and provides management recommendations to reduce those losses. The PI evaluates both P source and transport factors in its determination of P loss potential. With the identification of critical areas where both source and transport factors coincide, appropriate management practices can be applied to reduce P losses.

A PI has been developed for Wisconsin and work continues to improve the model. The latest information can be found at **http://wpindex.soils.wisc.edu.**

Summary

In order for P, and other soil nutrients, to be added to lakes and steams, there must be both a **source** of P and a mechanism for **transport** of P to water.

Sources of P include fields with high levels of soil P, or a history of manure, biosolids, or fertilizer applications. Transport of P occurs through runoff, erosion, and, occasionally, leaching.

To minimize P losses, it is critical to identify landscape areas where source and transport factors coincide.

Authors: Angela M. Ebeling, Soil Science Outreach Specialist; Larry G. Bundy, Professor of Soil Science; Scott J. Sturgul, Nutrient Management Specialist. Nutrient and Pest Management (NPM) Program, University of Wisconsin-Madison and University of Wisconsin-Extension. **Publication, production and design:** Roger W. Schmidt, Senior Informaiton Processing Consultant, NPM Program.

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Nutrient Management Plans (NMP) are to help prevent phosphorus from entering surface water.

Dikes/Berms are ways to prevent water moving from agriculture fields to surface waterways. I have not been able to find in the NMP program outlining where the dikes/berms are to be located.

There are some draw backs of a dike/berm at the bottom of a field.

1. Cost to install
2. Poor use of top soil
3. Maintain and keep weeds under control
4. Creates a tail water pond that decreasing the number of acres in field
5. Creates breeding ground for mosquitoes

The shortage of ground water and surface water are factors all agriculture is facing today. The cost of power to pump ground water and pressurize surface water is also increasing each year.

The cost of commercial fertilizer and the cost of applying manure to crop land is also going up.

Growers and dairymen are going to do whatever is best to save costs in their operation.

Dammer Diking need more credit in phosphate indexing in the NMPs. I have seen it work in the many years since it has become an agriculture practice.

A dike in a furrow of a row crop slows, if not prevents, runoff from a field. It keeps water and crop nutrients, commercial or organic, where the plants can use them. The greater the slope the greater the value of dammer diking.

I have attached two articles of information and links to from Ag Engineering, a manufacture of dammer dikers:

NC State Extension, information is in Slow Water Flow

University of Wisconsin Madison, information is in the Summary

Ag Engineering website, dammerdiker.com

Both studies talk about phosphorus moving with soil and water. The information from Ag Engineering gives great inside into how dammer diking works and its value.