TECHNICAL NOTE

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EXECUTIVE SUMMARY

Protection or restoration of a specific water resource to meet the water quality standards for its designated use(s) is often accomplished by the implementation of a properly formulated and implemented watershed (hydrologic unit) management program.

If-protection or restoration is to be effective, the watershed management strategy must address the following issues:

A. The water resource (lake, stream or aquifer) being threatened or impacted by poor water quality and its designated use (M&I water, fishery, irrigation, contact recreation, etc.).

B. The problem(s) resulting from impaired water quality (loss of aquatic habitat, hazard to health, loss of recreation values, etc. and the severity of the problems).

C. Contaminant(s) in the water resource causing the water quality impairment.

D. The source(s) of the contaminant(s) causing the impaired water quality (agricultural & nonagricultural, point and non-point).

E. The total contaminant load into the water resource (from all sources).

F. The cause-effect relationship between amount of contaminant and intensity of the problem.

G. Reduction of the contaminant load must be achieved to reach an acceptable level of water quality.

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PROJECT PLANNING FOR WATER QUALITY CONCERNS

PURPOSE

1. Provide concepts that will aid NRCS Planners to inventory, analyze, plan, assess, and appraise soil and water resources to help state and local sponsors meet water quality goals. These concepts are intended to compliment other existing NRCS guidance documents.

2. Provide guidance in using the NRCS planning process to develop project plans to solve problems caused by impaired water quality in a cost efficient and time efficient manner.

I. INTRODUCTION

Water quality and quantity are inseparable. Just as quality and quantity are inseparable, water cannot be separated from the basic resources of soil and air. These resources interact with plants and animals to determine the healthiness of our environment. Assistance provided by NRCS may concentrate on water quality as the primary resource of concern of sponsoring groups, but it is to be done within the concept of building a system to ensure total resource management.

To effectively assist our clients in their efforts to reduce problems resulting from impaired water quality, NRCS and our planning and implementation partners must identify and evaluate all potential sources of pollution including point sources and nonagricultural sources. Alternative solutions should effectively address all major (significant) sources of pollution.

When dealing with water quality initiatives, NRCS must recognize that there are numerous local, state, and federal agencies, political entities, and interest groups which have a vested interest in water quality. NRCS must develop partnerships with these groups to effectively maximize reduction in all significant pollution sources.

The management of waters of the United States is a function of state governments. Each state regulates water use and water quality within its boundary under the overall guidance of the U.S. Environmental Protection Agency. Each state has a designated State Water Quality Management Agency (SWQMA). This agency is responsible for establishing and maintaining water quality standards and assigning designated uses for the water supplies within the state. Any proposed action that may modify water quality is subject to review and approval by the SWQMA. NRCS must develop a working relationship with the SWQMA and other resource agencies and include them in NRCS project planning and implementation efforts.

II. OVERVIEW

Impaired water quality can be associated with one or more specific contaminants present in the water at concentrations that are high enough to cause objectionable conditions. Contaminants enter the water supply either directly through precipitation and atmospheric dry fall, or in solution or suspension through surface or groundwater inflows. In some cases, contaminants accumulate in sediments and may be recycled to overlying waters.

Restoration of the water resource can often be accomplished by the implementation of a properly formulated and implemented watershed management program (see Section VI). However, in some cases water resources can not be restored, but the rate of degradation can be slowed.

If restoration is to be effective or the rate of degradation slowed, the watershed management program must address the following issues:

A. What is the specific problem(s) and/or potential problem(s) resulting from impaired water quality?

B. Which contaminant in the water resource is the principal contributor to the problem?

C. What are the sources of the contaminant?

D. What is the loading rates into the water resource of each source of the contaminant?

E. What is the cause-effect relationship between amount of pollution and intensity of the problem?

F. How much reduction of the contaminant must be achieved to reach an acceptable water quality? In other words, how much contaminant input can be tolerated without causing objectionable water quality?

G. Which pollutant sources are controllable (can be affected by project action), and which must be classified uncontrollable?

1. For the controllable sources:

   a. What management practices/control measures are available and what are their effects?

   b. Which practices are practical in the project, given site, institutional or other constraints?

   c. What are the performance characteristics, and costs of each practice?

   d. What is the comprehensive management system that will provide the degree of reduction in pollutant load desired, and at what cost?

2. For the uncontrollable sources:

   a. Document significance and role of pollutants from these sources..

   b. Do not forget that these sources exist and include them in evaluation procedures as appropriate.

III. WATER QUALITY RESOURCE DATA

Planners should take full advantage of all existing resource data. Much of the basic information on the quality of existing water resources may be obtained from or through the U.S. Geologic Survey (USGS), Environmental Protection Agency (EPA) and the State Water Quality Management Agency (SWQMA). Other potential sources of information include the U.S. Forest Service (USFS), Tennessee Valley Authority (TVA), Army Corp of Engineers (COE), Agricultural Research Service (ARS), and Councils of Government (COGs).

Under provisions of the Clean Water Act of 1987, which is an amendment of the Federal Water Pollution Control Act of 1972, Section 319, each State Water Quality Management Agency (SWQMA) has prepared and submitted to the Environmental Protection Agency a State Water Quality Assessment Report. This report defines the water quality standard and designated uses of each water body within the State. The report also identifies water quality impairments or threatened impairments, which water quality parameters exceed the standard, and probable source(s) of pollution.

Each SWQMA has also prepared a State Non-point Source Pollution Management Plan which describes the strategies that the agency plans to implement to mitigate impairment of water quality caused by non-point sources of pollution. The Non-point Source Pollution Management Plan identifies water bodies that have been determined as high priority for protection and/or enhancement. While these reports vary in content between states, it is important that the planning team consider these reports as an important information source for water quality planning efforts.

IV. PREREQUISITES FOR EFFECTIVE WATER QUALITY PLANNING

A. An established working relationship with water quality, water resource, and other natural resource agencies and interested organizations within the state.

B. A working knowledge of the State's Water Quality Assessment Report and Non-point Source Pollution Management Plan.

C. Knowledge of and ability to access existing water quality data and needed water quality technical expertise in and outside of NRCS.

D. A good working knowledge of NRCS Planning Procedures and Policy, and the ability to discern the proper level of planning intensity.

E. The ability to assemble a planning team of qualified planners and appropriate technical experts.

V. KEYS TO SUCCESSFUL AND EFFICIENT PLANNING

A. SPONSOR COMMITMENT TO SOLUTION OF AN IDENTIFIED WATER QUALITY PROBLEM - Local sponsor(s) must have a strong commitment to resolve their water quality problems. If a commitment does not exist, delay planning until it does!

B. PROBLEM DEFINITION - Water quality problem(s) must be defined in terms of damages and/or impacts resulting from impaired water quality, who or what is being impacted, how and by how much. A well defined water quality problem will focus the planning effort towards identification of the pollutant(s) and sources of pollutant(s) causing the problem and solutions to bring about the reduction of pollutant loading.

Water quality problems may be actual (existing) problems, or potential problems expected to develop, if appropriate actions are not taken. If the problem definition is to be expressed in terms of potential problems, care should be taken to realistically estimate the cause and effect relationships defining the potential problem.

C. UTILIZATION OF EXISTING DATA - Locate, evaluate and utilize appropriate resource data from all sources. It is cost effective, efficient and technically sound to utilize existing data if it is perceived to be accurate and is accepted by the appropriate technical experts. Time used identifying and evaluating existing resource data can pay big benefits by reducing expensive duplication of efforts.

D. PROJECT MANAGEMENT - It is critical that a qualified person who fully understands the planning process and who can effectively work with various disciplines inside and outside the agency be designated team leader. The team leader must have assigned responsibility for the project and must be provided with all the needed authorities and resources to manage the project. Every effort must be made to allow the planning process to happen without it being confined or influenced by the criteria of a specific program authority.

E. PLANNING TEAM - The planning team should consist of NRCS and non-NRCS technical specialists with the necessary expertise to effectively evaluate existing resource conditions and to make recommendations for the resolution of resource problems. The combination of disciplines needed on a planning team will vary with the resource condition(s) and/or concern(s). When dealing with water quality issues it is important to involve technical specialists from appropriate state and federal entities either as team members or to serve in a review capacity.

F. COOPERATION AND COORDINATION - An effective and efficient planning effort requires successful interaction between the sponsor(s), the planning team, and other appropriate local, state and federal agency and interest group representatives. Agreement among these entities (consensus building) is critical to establishing credibility. Credibility is critical to acceptance and implementation of recommended solutions.

G. The PLAN OF WORK (POW) The sponsor(s) and planning team will need to develop a detailed POW so that all planning team members and supporting technical advisors understand the scope and intensity of their assignments, the procedures to be used to accomplish their assignments, and when their assignments will be completed.

The POW is a dynamic planning tool which may be modified as needed. Minor changes made in the POW must be approved by the team leader, major changes in the POW must be approved by the planning team (consensus). All team members must be kept informed of all changes in the POW.

The detailed POW will be finalized after the sponsor(s) and planning team have identified and determined the usability of all appropriate existing data.

H. PLAN TO PLAN EFFICIENTLY - Every activity identified in the POW must be essential to the planning effort and performed only at an intensity needed to effectively achieve the objective(s). Consider utilizing statistical acceptable sampling techniques and water quality models. Water quality models make planning possible in many cases.

I. RISK ASSESSMENT - The acceptance of some risk and uncertainty in the utilization of "limited data" is acceptable. The same is true in utilization of promising new technologies even though not fully field tested. The sponsor, planning team and technical specialists must evaluate the risk and uncertainty of the above actions and reach a consensus that the advantages out weigh the disadvantages and proceed accordingly. Make sure that consensus decisions are properly documented and displayed.

J. EVALUATE THE WHOLE PROBLEM - Evaluate all potential causes and/or sources of the problem(s). Evaluate non-agricultural as well as agricultural related sources to the problem(s). In order to develop cause and effect relationships between the problem(s) and the cause of the problem(s) all causes and/or sources of the problem must be considered.

K. CLEARLY ESTABLISH CAUSE AND EFFECT RELATIONSHIPS - Define realistic changes to the "future without" conditions to meet the sponsor's goal(s). Describe monetary and non-monetary effects of each potential solution as appropriate. The cause and effect relationship determination is essential to the planning process. The justification of a project hinges on whether watershed controls can impact the water resource. Establishing the cause and effect relationship may require expertise not normally found on the water resource planning staff.

L. DEVELOP COST EFFECTIVE SOLUTIONS - Consider non structural, structural, management, informational and educational activities or combinations of the above to achieve cost effective acceptable solution(s). Look beyond just USDA programs for potential implementation.

M. ESTABLISH A REALISTIC FUTURE WITHOUT PROJECT CONDITION - Utilize all the knowledge and expertise available to forecast the future conditions without the project. To over estimate or under estimate future without project conditions will result in inaccurate measurement of effects of alternative solutions. For example, If future condition without project predicts that livestock producers will go out of business due to enforcement of regulations, we may over estimate project benefits because we have under estimated the ability of producers to do what is necessary to stay in business.

N. ASK FOR ASSISTANCE AND/OR COLLABORATIVE SUPPORT - Technology is rapidly evolving in the water quality arena. There are numerous tools and techniques available to assist in evaluating water quality, identifying sources of pollution, quantifying pollutant loading, evaluating effects of applied practices, etc. Request water quality planning assistance and or collaborative support early in the planning process. National Specialists and/or non-NRCS Water Quality Specialists can contribute to the planning process. Their involvement in the process may save a lot of time in the planning effort and will facilitate review and concurrence of the plan.

O. DOCUMENTATION

A reviewable record of the planning process should be developed and maintained. A case file for the project should be established at the beginning of the planning effort. The case file should include all pertinent information developed.

It is essential to include a record of all decisions made by the interdisciplinary team, other agencies, and the public concerning the scope and intensity of studies, procedures used and the evaluation of the results of the studies. It is recommended that letters of concurrence be obtained from other agencies and special interest groups which are involved in the planning effort.

VI. INTEGRATION OF WATER QUALITY CONSIDERATIONS INTO THE 9 - STEPS OF PLANNING

The NRCS National Planning Procedures Handbook provides policy guidance for all planning activities. The 9 steps of planning as defined in the National Planning Procedures Handbook will serve as an outline in discussing the process for water quality planning, implementation and follow-up.

Step 1 - Problem Identification

Some of the problems relating to poor water quality are health hazards, loss of fish and wildlife values, increased cost of treating water for domestic and industrial uses, loss of recreational values, and reduced esthetic values just to name a few. Look to other local, state and federal entities to help identify and quantify the magnitude of these problems.

A water quality problem exists when a designated use of water is impaired by one or more contaminants that exceed water quality standards or criteria. Designated uses of surface and ground water are established by the State Water Quality Management Agency in coordination with the Environmental Protection Agency.

Designated uses of surface water are normally established by stream segment or waterbody, and relate directly to water quality standards for that designated use. Water quality problems exist because the quality of the stream or waterbody is not suitable for its intended use.

The State's Water Quality Assessment Report (Section 319 report) provides the opportunity for states to declare stream segments or waterbodies unsuitable for their intended use(s). In some instances where watersheds are suspected of having water quality problems, but no state declaration has been made, water quality monitoring data should be checked. The measured values for critical parameters should be compared to water quality standards and criteria, and note taken where the actual quality is poorer than that needed for designated use of the water supply.

Sources of monitoring data are the USGS WATSTORE System and EPA's STORET System. Both computer systems offer historic surface and ground water data from throughout the United States, and can be accessed by NRCS personnel.

WATSTORE data is limited to that data collected by USGS or by other agencies under the quality assurance and quality control of USGS. STORET contains most all data in WATSTORE as well as data from many other sources. Since there has been limited quality control by EPA of the data residing in STORET, care should always be exercised in using data from this source.

In addition to the federal data bases, there are other sources of data that reside in published reports or in open files available for use. This data as with STORET, must be evaluated in light of quality control used in collecting the information.

In special situations, it may be desirable to collect site specific water quality data through a monitoring program. These monitoring programs should be designed by appropriate technical specialists to insure the gathered data is representative of the watershed water quality.

In some cases, biological indicators in a water body may be used to determine water quality problems. A stream or lake's biological community is susceptible to even small changes in certain parameters, such as dissolved oxygen and some nutrients, so the trend in the composition of the biological community is an indication of the trend in overall water quality. Biological assessments are often as expensive as other forms of water quality monitoring.

Another tool available for identifying water quality problems is the USDA-NRCS, "Water Quality Indicators Guide". The Indicators Guide provides indirect evidence of water quality impairment. The Indicators Guide provides the opportunity for an interdisciplinary team through observations of a watershed as a whole, specific stream segments, and fields contributing to the stream segments, to begin to isolate water quality problems and to establish a sense of the most critical water quality problems in an area.

The Indicators Guide provides the mechanism for looking at water quality problems of sediment, nutrients, pesticides and animal waste. It is most effective where problems exist from sediment and animal waste and least effective with pesticides. The Indicators Guide should be used to support water quality problem determinations by other sources, but the procedure is not of the technical quality to substitute for these other determinations.

Step 2 - Identify Objectives for Project

Sponsor(s), with the assistance of the planning team, establish the desired future with project condition(s). The plan development process will result in alternative solutions to achieve the desired future condition in the most effective and cost efficient manner, considering total resource management.

Example Objective: Restore Lake Potowatomee to body contact recreation and

Class A warm water fisheries standards as defined by the State Water Quality Management Agency. This will be accomplished by reducing nitrogen loading by 40%.

Step 3 - Inventory Resources

The first step in accomplishing the resources inventory is to identify and evaluate the applicability of existing resource information.

The next step is to establish an inventory process that will provide the additional data needed to complete the analysis of water quality conditions in the project area. The planning team needs to define the scope and intensity of the inventories, the techniques for data collection, what data is needed, how the data will be displayed, what water quality technology (tools/models) will be utilized to analyze the data, who will complete the inventories and when.

A carefully designed and implemented inventorying process, developed by the appropriate disciplines, will increase the efficiency of the inventory process and will provide adequate data for analysis. Some simplifying assumptions may be made through consensus of the team and other appropriate technical experts.

Complete the data collection effort utilizing the most cost effective and efficient methods. Utilize statistical sampling techniques, photo interpretation, GIS, available data bases, rapid bioassessments, soil tests, and other information sources and techniques to provide the desired information at an acceptable level of accuracy.

Inventory all the potential sources of pollution that may be contributing to impaired water quality. Agriculture related and non-agriculture related point and non-point pollution sources should be included. This will probably require involving water resource specialists from outside NRCS.

Identifying and Quantifying Sources of Pollution

As previously mentioned, the "Water Quality Indicators Guide" can be used to confirm water quality problems, and to identify contributing areas within a watershed. Use of this or similar tools may also point to contributing land uses. In any case, some level of inventory of the watershed is required. The inventory should be adequate to generalize sources of water quality pollutants, their magnitude, and their opportunity to contribute to the identified water quality problems.

Complete inventory of the watershed may be required in some cases (see discussion of water quality models below); however, in most instances some sampling strategy should be employed to reduce the amount of inventory required. The inventory should be adequate to generalize sources of water quality pollutants, their magnitude, and their opportunity to contribute to the identified water quality problem(s).

Water quality models are tools which, when properly utilized, are useful in evaluating the resource data collected within a hydrologic unit to quantify rates of loading to a system of various kinds of pollutants. Each water quality model is designed to provide a specific product and requires a unique resource data set. It is essential to know in the data collection process what water quality models are to be utilized in data analysis so that the appropriate data sets will be available for analysis.

It is important to know the effectiveness of the data analysis tool to be used, when they can be used, and the data required for their use. Assistance from a Water Quality Specialist and/or Environmental Engineer can help in selecting the appropriate water quality model to be utilized in each specific study.

There are currently several hydrologic unit (watershed) scale models readily available to NRCS modelers to aid in identifying and quantifying sources of pollution. Of these, SWRRB-WQ and AGNPS have been evaluated by NRCS.

AGNPS is a storm event model that simulates surface hydrology, and the movement of sediment, nitrogen, phosphorus, and organic material. Input data is provided on a cell by cell basis, with the size of cell ranging up to 40 acres.

SWRRB-WQ is a continuous simulation model using daily rainfall. SWRRB-WQ simulates the movement of sediment, nutrients, and pesticides to surface water, and the movement of nutrients and pesticides to ground water.

Both SWRRB-WQ and AGNPS have use in project planning for water quality purposes, but in their present form their utility is limited to relatively small watersheds or where the land use is spatially uniform. AGNPS, due to its cell configuration, is ideally suited to areas of varying land use, but model input requires a field by field inventory of the entire watershed. SWRRBWQ, on the other hand, requires much less data than AGNPS, but must combine unlike land uses into zones, and does not readily reflect subtle changes in water quality due to conservation application.

The future interface of a geographical information system with AGNPS or SWRRBWQ will greatly reduce the time required to use these models and will improve their utility. The discussion that follows will focus on the use of field scale models in project planning. The intent is to describe a technique that makes a prudent use of models without sacrificing the intent of streamlining the planning process. In addition, the process described is not intended to be an oversimplification of a complex process. The examples and appendix material are provided to illustrate that tools are available to aid the project planner.

SEDIMENT:

Sediment as a result of erosion from sheet and rill, concentrated flow, and gullies has long been quantified in water resources planning. As a general rule, sediment still remains the largest water quality pollutant.

Sediment yield at a point is normally estimated by using erosion models such as the USLE, and multiplying the erosion by a "delivery ratio". This procedure results in an average annual sediment yield to a point, and is adequate where detailed sediment yield has not been acquired. To address sediment attached pollutants such as nutrients and pesticides, a more detailed evaluation of sediment yield is needed.

Sediment yield to an edge of field can be estimated using current modeling technology such as CREAMS, GLEAMS, and EPIC. These models should not be used on every field, but the erosion and sediment yield' from fields with typical land use, crop rotations, soil, and management can be simulated with the results expanded to the watershed. Sediment yields at the edge of fields can be routed to the problem area by the use of sediment delivery ratio as would be done with USLE values.

Sediment Delivery Ratios should be determined by a Sedimentation Geologist or other specialist familiar with the models used and sediment delivery technology. For example, CREAMS considers the effect of agrading and degrading channels (concentrated flow areas and receiving channels) within a field, EPIC does not. This information is critical in assigning sediment delivery ratios.

Field scale water quality models are not the only tools to provide sediment yield data, but generally will provide the best relationships between agriculture and resulting sedimentation at the edge of field. In addition, field scale models can also provide information to address other water quality problems such as excess nutrients and pesticides.

Other tools that could provide sediment yield data are special studies and research projects by universities and other natural resource agencies in or near the watershed. Sediment yields from stream banks and gullies are usually estimated separately from erosion from sheet and rill and concentrated flow areas. Erosion from stream banks and gullies have a higher delivery ratio than sheet and rill erosion. Specialists in gully erosion should estimate these values on a case by case basis.

NUTRIENTS:

The nutrients, nitrogen and phosphorous, behave differently in the soil and water environment and will be discussed separately.

Phosphorous (P) is typically found tightly bound to soil particles, in soluble (dissolved) form, or in a form loosely attached to soil. The latter is available to become soluble in changing conditions of pH and temperature. An exception is the phosphorus associated with oxidizing organic soils which is beyond the scope of this technical note. In the soluble form, phosphorous moves with water, and in the attached form moves with detached soil particles (sediment).

Many studies have looked at P movement with varying cropping systems, soils, and climate. The results of these studies are highly variable. However, general conclusions can be summarized into the form of simplified tools that would be applicable nation wide and may be further modified for the southern states. Normally, phosphorous is a surface water concern. Percolating waters in the soil profile may move dissolved P downward, but the dissolved P becomes readily bound to soil attachment sites lower in the soil profile.

Some general relationships concerning manure application used as a source of phosphorus can be made. Runoff from fields receiving heavy applications of manure has a higher concentration of dissolved P than does runoff from sites with no manure, even when manure is incorporated into the soil profile. Runoff from pasture sites receiving poultry litter tend to be higher in all forms of P than from sites not receiving litter (runoff, particularly from rainfall near the time of litter application, floats a portion of the litter off the land surface).

Nitrogen (N) is normally found in the nitrate, ammonium, or organic form in the soil. Only nitrate is readily available to move with water because it does not bond to soil particles. Nitrate is considered the major nitrogen related water quality pollutant in both surface and ground water because of its mobility. Ammonium and organic nitrogen forms attached to eroding soil particles do provide pollution potential as well, but at a lesser level.

As with phosphorous, the research and evaluation of nitrogen movement with varying cropping systems, soil, and management, has produced results with enough consistency to establish some general tools such as NLEAP. The more complex tools will require modification for field use. Generally, nitrates move downward in the soil profile (the proportion of nitrate in surface runoff is normally much less than that moving below the root zone) unless intercepted in farm drains or stopped by some form of soil or geologic barrier.

Manure applications, if incorporated, offer little hazard in surface runoff, unless the runoff moves soil particles with attached nitrogen forms. With many solid, liquid, and slurry manure applications, nitrogen is primarily in the form of ammonium or one of the organic forms. Ammonium readily volatilizes, so if the applied waste is not immediately incorporated, much of the available N is lost into the atmosphere. Unincorporated manure is, to a certain extent, available to move with surface flows. As organic wastes mineralize, they produce ammonia nitrogen forms that along with existing ammonium can be oxidized to the more water mobile nitrates.

The use of field scale water quality models such as NLEAP, CREAMS, GLEAMS, and EPIC can be used to simulate nutrient movement under typical soils and cropping systems. The use of these models provides an indication of the amount and timing of nitrogen and phosphorous movement, and an indication of the form of the nutrient (dissolved, attached to soil, etc.). The model used, the number of situations to be simulated, and the length of the simulation period are all vital decisions that should be made by the appropriate technical specialists and planning team. Generally, a limited number of fields can be used to represent typical watershed conditions.

Nutrient budgets, along with water budgets, are tools to identify and quantify movement of nutrients with surface runoff and percolating waters. Excess nutrients available during periods of surface runoff and deep percolation may move with drainage waters leaving the site. It is a safe assumption that with adequate drainage, as much nitrate is leached as is denitrified in a saturated root zone. This assumption will allow the conversion of excess nitrogen to a ground water pollutant if one assumes all nitrates moving downward below the root zone will eventually reach ground water. Unless information is otherwise available, assume phosphorous does not move downward with percolating waters. Water budgets and nutrient budgets are normally site specific.

Localized studies should be consulted to quantify typical concentrations of N and P in runoff waters, and the water budget can supply average values of runoff amounts. Use of a water quality model such as CREAMS on some typical fields will also provide some guidance as to the magnitude of N and P in surface runoff and percolating waters.

ANIMAL WASTES:

The pollution potential of animal waste can be categorized by its various constituents. For the purpose of this discussion, only organic loading (expressed as oxygen demand), nutrients in the form of nitrogen and phosphorous, and pathogens expressed as fecal coliforms and/or fecal streptococci, will be discussed.

For confined animal systems, considerable research has been conducted on waste characteristics for various animals under different conditions. Tabular values of characteristics are available in the Agricultural Waste Management Field Handbook (AWMFH). Loadings to streams can be calculated by estimating the percent of animal waste mismanaged, multiplying that value by appropriate waste characteristics, and estimating delivery ratios based on site specific circumstances.

Factors that impact manure delivery include change in grades, vegetation that filter or retard flows, and distance from streams. Generally, livestock facilities located a minimum of 1/4 to 1/2 mile from a live stream with no direct connection to the stream, will have little opportunity to pollute.

Considerations should be given to the contribution of runoff from areas with manure, such as holding pens, dry lots, and feedlots to overall water quality problems resulting from animal waste. Runoff volumes by month can be computed by multiplying coefficients from Figures 10.C-1 through l0.C-26 in the AWMFH times average monthly rainfall.

The concentration of manure in the runoff water is not as easy to estimate, but some aids are available to look at specific characteristics. Tables in the AWMFH provide concentrations of pollutants in runoff water from swine lots and beef/dairy feedlots.

Work done by Young and others summarized in, "An Evaluation System to Rate Feedlot Pollution Potential", ARM-NC-17, April 1982, also provides tools to estimate phosphorus and organic loadings in feed lot runoff. Figures 1 and 2 can be used to calculate concentrations of phosphorus and chemical oxygen demand as related to manure pack.

Percent manure pack is a function of animal density in the lot and is also related to the time the animals spend in the lot. One hundred animal units (an animal unit is the equivalent of a 1,000 pound animal - a 1,400 lb. milk cow is equivalent to 1.4 animal units) per acre is equal to an animal unit density (AUD) of 100. The AUD should be adjusted for the average percent of time each day the animals occupy the lot. To be conservative, do not use an adjusted AUD of less than 25 percent of the value calculated by the number of animal units per acre.

Biochemical Oxygen Demand (BOD) is directly related to Chemical Oxygen Demand (COD). Use a COD/BOD ratio of 4.5 to relate the values in Figure 2 to BOD. Runoff from agricultural lands receiving livestock waste has the potential to be a major source of pollution as well.

Definitive studies of runoff from specific sites receiving manure have been made over the years, but as with the quality of runoff from fields without manure, the quality of runoff is very site specific and unpredictable outside of general relationships. Table 1 and 2, copied from "Animal Waste Utilization on Cropland and Pastureland", USDA-SEA, EPA NO. EPA-600/2-79-150, October 1979, provide approximation of runoff from fields with manure. Table 1 and 2 can be used in areas where local studies are not available. Assume values are edge of field, and apply a delivery ratio to assess impact at the area of water quality impairment.

Bacterial contamination of waters are also a major concern. Uses of water for contact recreation require water with very limited bacterial contamination, usually expressed as number of fecal coliform per 100 ml of water. Tables 3 and 4 from "Evaluating Coliform Concentrations in Runoff From Various Animal Waste Management Systems", Dr. James Moore and others, Oregon State University, Special Report 817, January 1988, provides a summary of some of the research values describing bacterial counts. Table 3 shows agricultural manure concentrations, and Table 4 summarizes previous studies that measure indicator organisms from agricultural fields.

Special Report 817 documents a water quality model, MWASTE, which tracks bacterial numbers with time for various wastes under various management strategies of storage and land application. This tool also tracks nitrogen and phosphorus in the waste management system.

Edge of field or instream fecal coliform counts must be adjusted by a delivery ratio to determine their impact at the point of the water quality impairment. Fecal coliform counts in a problem stream segment are more likely to be a product of a nearby operation rather than one far away. Figure 3 is an idealized representation of e. coli survival in the Tangipahoa River, but is fairly representative of the shape of die off curves found in Special Report 817 and elsewhere. For the purpose of computing delivery of bacteria, use Figure 3 if better local data is not available.

PESTICIDES:

As with nutrients, the most desirable technique for quantifying pesticide contributions to surface or ground water would be special studies in the watershed of interest where pesticides in surface runoff and percolating waters have been actually measured. Short of the ideal, would be modeling of typical fields where pesticides have been used. Field scale models previously mentioned, CREAMS, GLEAMS, and EPIC, all have pesticide components. Simulations for sediment yields and nutrient determinations could also provide pesticide information.

Use of soil-pesticide interaction rating proposed in 1988 also provides a tool for qualitatively judging whether current pesticides in use are compatible with the soils to which they are being applied. The model NPURG is a computerized version of the soil-pesticide interaction rating system. Use of the soil-pesticide interaction system in a watershed would be a time consuming effort, but should be used for typical soils and cropping systems that are critical to controlling pesticide pollution. A copy of a brief description of the soil-pesticide interaction rating system and a page from the NRCS pesticide data base showing assigned ratings for surface loss potential and leaching potential are attached as Attachment 1 in the Appendix.

GROUND WATER SENSITIVITY:

Current regulatory agency focus is changing somewhat from surface waters to ground water aquifers. A discussion of water quality tools would not be complete without a discussion of three tools used to identify vulnerable aquifers and potential problems with agricultural activities.

DRASTIC is an EPA model used to classify broad areas such as watersheds and counties for aquifer vulnerability. DRASTIC looks at such factors as depth to water table, soils, and topography to assign a numerical vulnerability to an aquifer. When the vulnerability rating is shown on a map for a county or watershed, areas of most vulnerability can become evident.

SEEPPAGE is an NRCS tool with many of the features of DRASTIC, but is intended for a more site specific look at vulnerability and pollution risk. SEEPPAGE, like DRASTIC, uses commonly available information to assign a rating value to sites. Provisions in SEEPPAGE permit assigning a weighting value so that both concentrated sources of potential pollution (a lagoon for example) and dispersed sources (fertilized fields) can be evaluated for their impact on an aquifer.

DRASTIC lends itself readily to watershed analyses, but as with all models, intensive data collection efforts may be needed. SEEPAGE, on the other hand, lends itself to the "typical field" style of analysis already discussed.

In addition to DRASTIC and SEEPPAGE, FARM*A*SYST, is available to assess and prioritize ground water problems and sensitivity.

Step 4 - Analyze Resource Data

The resource data analysis process must:

1 - look at all potential sources of pollution that may be impacting on the impaired water quality (show the estimated present and projected future pollution load from each source),

2 - support and/or redefine and quantify the water quality problem(s) (evaluate monetary and non-monetary values of the damages or loss of values resulting from impaired water quality - this very often requires input and agreement from all planning team members and the sponsors),

3 - clearly describe the cause and effect relationships of water quality within the project area. Identify how much reduction in the pollution load will be required to achieve the desired objective(s) (required pollution reduction may be a judgement call of the interdisciplinary team if existing data is limited),

4 - achieve consensus of planning team members, and other water quality specialists (particularly the State Water Quality Management Agency) on the amount of pollution reduction needed to meet water quality standards for the intended uses and to meet the objectives of the sponsor(s).

Step 5 - Formulate Alternative Solutions

Address all point and non-point sources of pollution, agricultural and non-agricultural, causing water quality impairment.

Alternatives should contain compatible components: land treatment, management, regulatory, informational/educational, non-structural and structural practices and/or activities.

As alternative solutions are being developed, it may be necessary to refine or reexamine inventory data. All alternatives may not address the same aspects of the identified problem. As each alternative solution is being formulated, the components of that alternative should be examined for cost effectiveness in solving the problem.

Step 6 - Evaluation of Alternative Solutions

Evaluate effects of each alternative solution on pollutant load reduction and achievement of the sponsor's water quality objective(s). Costs, benefits and effects of implementing each alternative need to be displayed in a manner that will allow the sponsor to make effective decisions.

The model(s)(analysis tool) chosen in step 4 to analyze resource data should also be used as an effective tool for alternative evaluation. This approach is valid, and will be appropriate for nutrients, sediment, and pesticides. Delivery ratios for a treatment alternative from edge of field to the critical stream segment or water body would be similar to those used in evaluating the sources of the pollutant(s). Without modeling information the change in sediments, nutrients, and pesticides delivered offsite should be based on assumptions prepared and agreed to by an interdisciplinary team. The Conservation Practice Physical Effects document in the local Field Office Technical Guide can provide some indication of the impact of individual conservation practices.

The impact of collecting and correctly managing agricultural wastes is somewhat more straight forward. Properly designed and managed waste systems will eliminate the discharge of nutrients, organic materials and bacteria. Although careful consideration should be exercised in doing so, the amount of waste improperly managed in the present can be reduced by the percentage of wastes to be properly handled in the future.

If, for example, 75 percent of the waste not properly handled in the present situation is to be correctly managed with a treatment alternative, credit could be given to a 75 percent reduction in the problem. Caution should be taken to assume the waste management systems are uniformly applied, i.e., if all the application is for livestock operations remote from the problem, and the closest problem operations are left as-is, the impact on the problem could be drastically reduced.

Step 7 - Alternative Selection

The planning team has a responsibility to provide the sponsors and/or decision- makers with enough information to make an informed decision.

The information provided must display existing conditions, estimated future without project action conditions, projected future with project condition for each of the alternatives developed and evaluated. Costs, benefits and effects of each alternative should be displayed so that it is easy for the sponsors to make a comparative analysis.

The team must make every effort to insure that the sponsors are fully informed and are confident in the information they have been provided. Having the sponsors involved in and fully informed of the planning process from start to finish will help establish a high level of confidence. Having other water quality and natural resource agency specialists involved in the planning process as team members and/or as consultants adds a great deal of credibility to the planning effort. A well maintained project file containing documentation that effectively records all planning and administrative activities, decisions and data related to the project is not only good project planning procedure, it is also useful in building sponsor confidence.

Record the sponsor decisions and prepare a plan document.

Step 8 - Implementation

NRCS should be committed to assist the sponsors implement their water quality management plan even if no financial assistance is to be provided through NRCS administered programs. Every reasonable effort should be made to assist the sponsor(s) to seek the necessary technical and financial resources needed to achieve their water quality objectives.

When the Water Quality Management Plan has been developed it may be appropriate to establish a team of resource specialists (NRCS and non-NRCS representation) to assist the sponsor(s) develop and apply a strategy which will lead to the successful implementation of the plan and achievement of the sponsor(s) water quality objectives. This kind of help is often needed by small rural and/or limited resource communities.

Step 9 - Monitoring and Evaluation

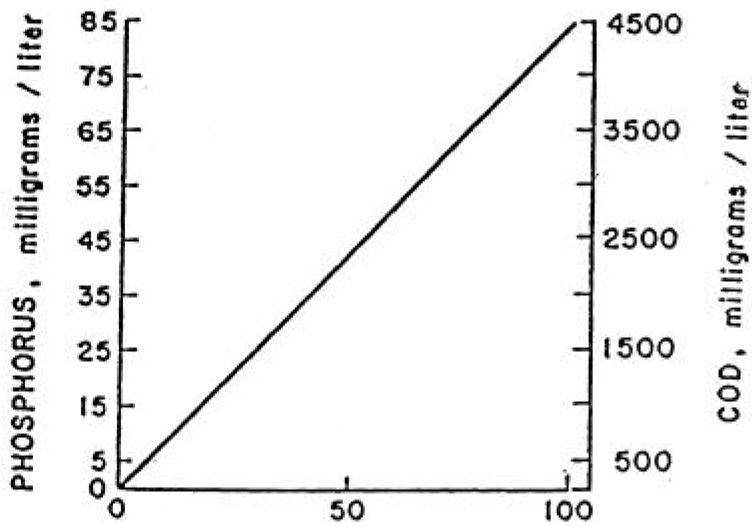
The planning process is not complete until it can be documented that the water quality objectives of the sponsor(s) have been achieved. If monitoring and evaluation identifies that the objectives are not going to be met as a result of changing circumstances or as a result of short comings in the planning process, a reiteration of part of the plan process may be necessary to redefine the more appropriate solutions.

Water quality planning to address non-point source pollution sources is relatively new and we must be able to learn from each effort we make in order to become more proficient. We can learn a great deal from our successes and our failures.

A monitoring and evaluation plan should be part of and a continuation of the Water Quality Management Plan.

APPENDIX

Figure 2 Concentration of COD and P in feedlot runoff versus percent manure pack.



PERCENT :MANURE PACK

FIGURE 3

E. Coli Survival in Tangipahoa River

Southern Louisiana

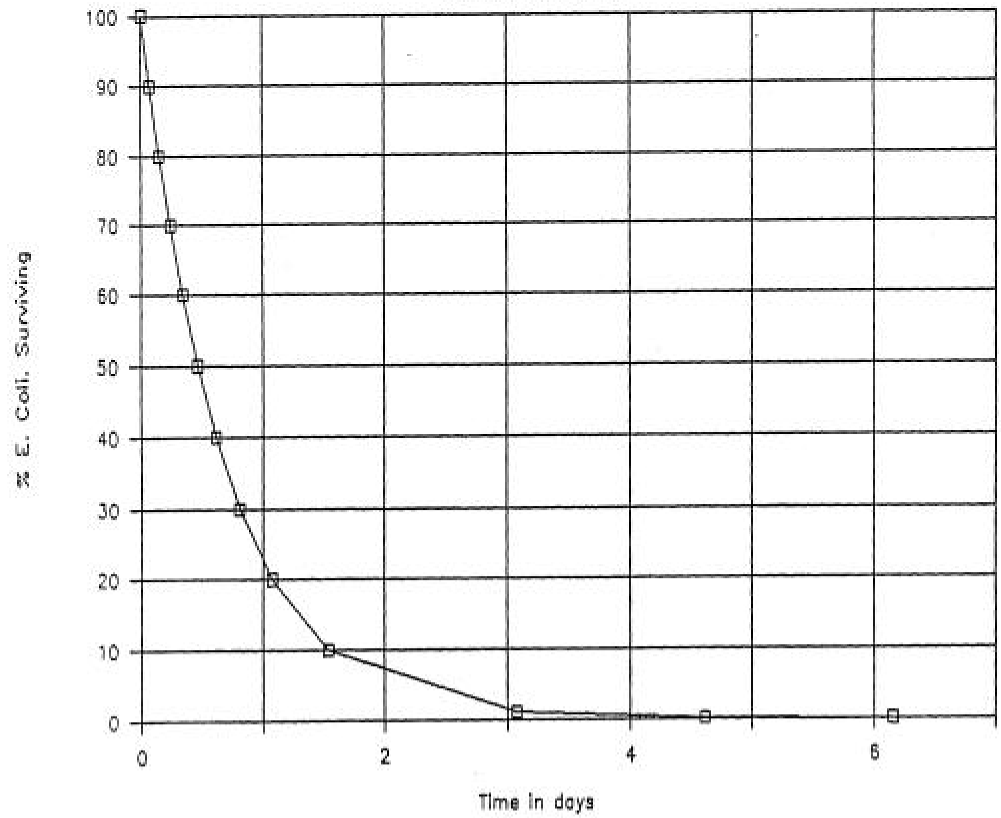


Table 1 - Increase in dissolved nitrogen transported in annual runoff from land receiving livestock or poultry manure surface-applied at agronomic rates[1]

Land Resource Area	Grass	Small grain with or without conservation		Row crop with or without conservation		Rough plow with or without conservation	
52	< 1.8	<2.7	< 2.7	< . 9	< .9	< 2.2	< 2.2
53	< 1.9	<2.7	< 2.7	< .9	< .9	< 2.2	< 2.2
54	< 1.8	<2.7	< 2.7	< .9	<.9	< 2.2	< 2.2
55	< 1.8	<2.7	< 2.7	< -9	< .9	< 2.1	< 2.2
56	6.9	5.9	7.9	2.9	3.5	4.5	5.4
57	< 3.8	<3-3	3.3	1.2	1.8	1.9	2.8
58	< 1.8	<2.7	< 2.7	< .9	< .9	< 2.2	< 2.2
59	< 1.8	<2.7	< 2.7	< .9	< .9	< 2.2	< 2.2
60	< 3.0	<3.1	3.1	1.1	1.4	2.0	2.6
61	< 1.8	<2.7	< 2.7	< .9	< .9	< 2.2	< 2.2
62	(2)	-	-	-	-	-	-
63	4.8	4.4	6.0	2.1	2.7	3.6	4.6
64	< 1.8	<2.7	< 2.7	< .9	< .9	< 2.2	< 2.2
65	< 1.8	<2.7	< 2.7	< .9	< .9	< 2.2	< 2.2
66	< 2.2	<2.8	2.8	.9	1.0	2.1	3.0
67	< 1.8	<2.7	< 2.7	< .9	< .9	< 2.2	< 2.2
68	< 1.8	<2.7	< 2.7	< .9	< .9	< 2.2	< 2.2
69	< 1.8	<2.7	< 2.7	< .9	< .9	< 2.2	< 2.2
70	< 1.8	<2.7	2.7	.9	1.1	2.2	2.8
71	< 2.2	<2.8	2.8	.9	1.5	2.1	3.4
72	< 2.0	<2.8	2.8	.9	1.2	2.1	3.0
73	< 2.0	<2.8	2.8	.9	1.8	2.1	4.3
74	< 2.0	<2.8	2.8	.9	2.3	2.1	5.6
75	< 2.2	<2.8	2.8	.9	2.4	2.1	5.5
76	- 10.2	13.9	16.1	5.1	5.8 1	2.4	13.9
77	2.4	3.6	5.2	1.6	2.o	4.1	5.2
78	4.1	6.0	7-6	2.4	2.9	6.1	7-4
79	< 1.8	<2.7	2-7	.9	1.2	2.2	3.0
80	5.7	8.5	10.4	3.2	3.8	8.2	9.5
81	4.1	6.0	7.6	2.4	2.9	6.1	7.4
82	5.7	8.5	10.4	3.2	3.8	8.2	9.5
83	7.6	11.2	13.1	4.1	4.7	10.4	11.9
84	7.8	2.8	4.1,	7.1	2.2	3.1	5.6
85	16.3	11.1	16.4	18.5	5.8	6.4	14.7
86	18.4	12.9	19.1	21.3	6.6	7.2	16.9
87	20.6	14.7	21.8	24.0	7-5	8.1	19.1
88		-	-				
89	-	-					
90	< 3.8	< 3.3	3.0	1.2	1.8	1.9	2.8
91	< 3.8	< 3.3	3.0	1.2	1.2	1.9	1.9
92	-	-					
93							

94	-	-						
95	< 3.4	< 3.2	3.2	1.1	2.6		1.9	4.4
96	< 1.8	< 2.7	< 2.7	< .9	< .9	<	2.2	< 2.2
97	< 3.0	< 3.1	3.1	1.1	2.8		2.0	5.1
98	< 3.0	< 3.1	3.1	1.1	2.6		2.0	5.0
99	10.9	11.0	13.1	4.5	5.2		8.5	9.7
100	< 2.4	< 2.9	2.9	1.0	2.4		2.1	5.2
101	< 2.8	< 3.0	3.0	1.0	2.4		2.0	4.6
102	< 3.8	< 3-3	3.3	1.2	2.2		1.9	3.3

(See footnotes at end of table.)

103	<	3.8	<	3.3	3.3	1.2	2.4	1.9	3.7
104		8.9		8.2	10.4	3.7	4.4	6.3	7.5
105	<	3.4	<	3.2	3.2	1.1	2.5	1.9	4.2
106	<	2.2	<	2.8	2.8	.9	2.5	2.1	5.7
107	<	2.6	<	3.0	3.0	1.0	2.3	2.0	4.7
108	<	2.8	<	3.0	3.0	1.0	2-4	2.0	4.6
109		7.2		9.1	11.1	3.6	4.2	9.2	9.7
110		7.8		9.3	11.0	3.6	4.2	7.9	9.1
111		9.0		11.3	13.6	4.4	5.1	10.1	11.6
112		11.1		16.4	18.5	5.8	6.4	14.7	16.3
113		12.2		16.7	18.9	6.0	6.6	14.5	16.0
114		14.3		19.5	21.7	6.9	7.5	16.7	18.2
115		3.1		4.2	7.2	2.3	3.2	5.6	7.7'
116		10.9		16.1	18.3	5.7	6.4	14.5	16.3
117		-		-	-	-	-		
115		20.1		29.7	31.9	10.0	10.6	25.4	27.1
119		-		-	-	-	-		
120		10.2		13.9	16.1	5.1	5.8	12.4	13.9
121		10.2		13.9	16.1	5.1	5.8	12.4	13.9
122		5.7		8.5	12.0	3.8	4.9	9.5	12.4
123		15.3		22.6	25.1	7.8	8.5	19.9	21.7
124		6.3		8.6	10.6	3.4	3-9	8.1	9.4
125									
126		6.9		8.8	10.8	3.5	4.1	8.0	9.3
127		-		-	-	-	-	-	
128 N3		4.2		6.3	9.6	3.0	4.0	7.6	10-2
1285		8.7		12.8	17-2	5.4	6.6	13.7	16.9
129		10.3		15.3	19-6	6.1	7.5	15.6	19.1
130		-		-	-	-	-	-	
131 N		16.4		24.3	26.5	8.3	8.9	21.0	22.8
1315		29.1		43-1	45.5	14-2	14.9	36-2	37.9
132		23.6		34.9	37-4	11.7	12.3	29.7	31.4
133		7.2		10-6	14.7	4.6	5.8	11-7	14.7
134 N		12.5		18.5	21.0	6.6	7-2	16.7	18.4
1345		21.6		31.9	34.4	10.7	11.5	27.3	29.3
135		29.1		43.1	45-5	14.2	14.9	36-2	37.9
136 N		2.8		4.1	7.1	2.2	3.1	5.6	7.8
1365		8.7		12.8	17.2	5.4	6.6	13.7	16.9
137		< 1.8		< 2.7	2.7	.9	2.2	2.2	5.6
138		10.3		15.3	19.6	6.1	7.5	15.6	19.1
139		4.9		6.2	7.9	2.6	3.1	5.9	7.2
140		6.2		6.6	8.4	2.9	3.5	5.6	6.8
141		9.4		9.5	11.6	4.0	4-7	7.5	9.7
142		15.7		13.4	15.7	5.7	6.6	8.9	10.2
143		-		-	-	-	-	-	
144		< 3.0		< 3.1	3.1	1.1	1.5	2.0	2.8
145		3.7		4.3	7.5	2.5	3.4	5.4	7.5
146		15.3		13.1	15.7	5.7	6.6	8.9	10.2
147		< 2.2		< 2.8	2.8	.9	2.4	2.1	5.5
148		6.9		8.8	10.8	3.5	4.1	8.0	9.3

(Sec footnotes at end of table.)

149	8.2	11.1	13.4	4.3	4.9	10.3	11.8
150 w	11.1	16.4	18.5	5.8	6.4	14. -.'	16.3
150 E	29.1	43.1	45.5	14.2	14.9	36.'	37.9
151	-	-	-	-	-	-	-
152	29.1	43.1	45.5	14.2	14-9	36.	37.9
153	14.4	21.3	23.7	7.4	8.1	18.9	20.6
154	2.8	4.1	10.1	3.2	5.0	8.0	12.8
155	13.6	20.2	25.1	7.8	9.3	19.9	23.6
156	-	-	-	-	-	-	-

I Values esticmted from tables 17 and Is.

ù It is not @ble to cstinatc values for mountain. swamp, and f@ resons or those with erratic dimate.

3 North. N; South, S;

E; Weg. W. respectively. within Land Rewurot Amas-

TABLE 2 .-Increase in dissolved PbosPhorus transported in offilual ruii(!fl ron, la d receirirkiz livestock or poulir), manure surface-appli,-,f at @icroiit)tpiic raft's,

52 < .6 < .8 < .8< .3 <.3< .3 <
53 < .6 < .8 < .8< .3 <.3< .3 <
54 < .6 <.8 < .8 < .3 <.3< .3 <
55 < .6 < .8 < .8< .3 <.3< .3 <.3
56 1.8 1.4 1.9 .6 .8 .8 .9
57 <i.o <.8 .8 .3 .4 .3

58	< .6	< .8	< .8	< -3	< .3	< .3	<
59	< .6	< .8	< .8	< .3	< .3	< .3	<
60	< .8	< .8	.8	.3	.4	.3	.4
61	< .6	< .8	.8	.3	.3	.3	.5
62	(1)	-	-	-			
63	1.3	1.1	1.5	.5	.6	.6	.8
64	< .6	< .8	< .9	< .3	< .3	< .3	< .3
65	< .6	< .8	< .8	< .3	< .3	< .3	< .3
66	< .6	< .8	.8	.3	.4	.3	.3
67	< .6	< .8	< .8	< .3	< .3	< .3	< .3
68	< .6	< .8	< .8	< .3	< .3	< .3	< .3
69	< .6	< .8	< .8	< .3	< .3	< .3	< .3
70	< .6	< .8	.8	.3	.4	.3	.4
71	< .6	< .8	.8	.3	.4	.3	.5
72	< .6	< .8	.8	.3	.4	.3	.5
73	< .6	< -8	.8	.3	.6	.3	.6
74	< .6	< .8	.8	.3	.8	.3	.8
75	< .6	< .8	.8	.3	.7	.3	.8
76	3.0	3.9	4.5	1.6	1.8	1.9	2.1
77	.7	1.0	1.5	.5	.7	.6	.8
78	1.2	1.7	2-2	-8	.9	.9	1.1
79	< .6	< .8	.8	.3	.4	.3	.5
50	1.7	2.4	2.9	1.1	1.2	1.2	1.4
81	1.2	1.7	2.2	.8	.9	.9	1.1
82	1.7	2.4	2.9	1.1	1-2	1.2	1.4
83	2.3	3.2	3.7	1.3	1.5	1.5	1.8

84	.8	1.2	2.0	.7	1.0	.8	1.2
85	3.3	4.6	5.3	1.9	2.1	2.2	2.4
86	3.8	5.4	6.0	2.2	2.4	2.5	2.7
87	4.4	6.2	6.8	2.4	2.6	2.8	3.1
88	-	-	-	-	-		
89	-	-	-	-			

90	<1.0	<	.8		.8	.3	.4	-3	.5
91	<i.o	<	.8		.8	.3	< -3	.3	< .3.
92			-		-	-	-		
93									
94	-		-		-	-			
95	< .9	<	.8		.8	.3	.6	.3	.7
96	< .6	<	.8	< .8	< .3	< .3	< .3	< .3	
97	< .8	<	.8		.8	.3	.7	.3	.8
98	< .8	<	.8		.8	.3	.7	.3	.8
99	3.0		2.8		3.4	1.2	1.3	1.4	1.5
100	< .7	<	.8		.8	.3	.7	.3	.8
101	< .8	<	.8		.8	.3	.6	.3	.7

(See footnotes at cnd of tabk.)

102	<1.0	<	8			3		3	6	
103	<1.0	<	8			3		3	6	
104	2.4		2.1	2.6		.9	1.0	1.0	1.2	
105	<	.9	<	.8	.8		.2	.6	.3	.7
106	<	.6	<	.8	.8		.3	.7	.3	.9
107	<	.7	<	.8	.8		.3	.6	.3	.7
108	<	.8	<	.8	.8		.3	.6	.3	.7
109	2.1		2.:5	3.0		1.1	1.3	1.3	1.5	
110	2.2		2.5	3.0		1.0	1.2	1.2	1.4	
111	2.6		3.1	.3.7		1.3	1.5	1.5	1.8	
112	3.3		4.6	5.3		1.9	2.1	2.2	2.4	
113	3.6		4.7	5.3		1.9	2.1	2.2	2.4	
114	4.2		5.4	6.1		2.2	2.3	2.5	2.7	
115	.9		1.2	2.0		.7	1.0	.8	1.2	
116	3.2		4.6	5.2		1.8	2.1	2.2	2.4	
117	-		-	-		-	-			
115	6.0		8.4	9.0		3.2	3.5	3.8	4.0	
119	-		-	-		-	-			
120	3.0		3.9	4.5		1.6	1.8	1.9	2.1	
121	3.0		3.9	4.5		1.6	1.8	1.9	2.1	
122	1.7		2.4	3.4		1.2	1.6	1.4	1.8	
123	4.6		6.4	7.1		2.6	2.8	3.0	3.2	
124	1.8		2.4	3.0		1.1	1.2	1.2	1.4	
125	-		-	-		-	-	-		
126	2.0		2.4	3.0		1.0	1.2	1.2	1.4	
127	-		-	-		-	-			
128 N3	1.3		1.8	2.7		1.0	1.3	1.1	1.5	
1295	2.6		3.6	4.9		1.7	2.2	2-0	2.5	
129	3.1		4.3	5.6		2.0	2.4	2.3	2.8	
130	-		-	-		-	-			
131 N	4.9		6.9	7.5		2.7	2.9	3.1	3.4	
1315	8.7		12.2	12.9		4.6	4.8	5-4	5.6	
132	7.0		9.9	10.6		3.8	4.0	4.4	4.7	
133	2.1		3.0	4.2		1.5	1.9	1.7	2.2	
134 N	3.7		5.3	6.0		2.1	2.4	2.5	2.7	
1345	6.4		9.0	9.7		3.5	3.7	4.1	4.3	
135	8.7		12.2	12-9		4.6	4.8	5.4	5.6	
136 N	.8		1.2	2.0		.7	1.0	.8	1.2	
1365	2.6		3.6	4.9		1.7	2.2	2.0	2.5	
137	< .6		< .8	.8		.3	.7	.3	. .8	
138	3.1		4.3	5.6		2.0	2.4	2.3	2.8	
139	1.4		1.7	2.2		.8	.9	.9	1.1	
140	1.7		1.7	2.2		.8	.9	.9	1.1	
141	2.6		2.5	3.0		1.0	1.2	1.2	1.4	
142	4.2		3.3	3.8		1.3	1.5	1.5	1.7	
143	-		-	-		-	-			
144	< .8		< .8	.8		.3	.4	.3	.4	
145	1.0		1.2	2.0		.7	1.0	.8	1.2	
146	4.1		3.2	3.8		1.3	1.5	1.5	1.7	

147	< .6		< .8	.8		.3	.7	.3	.8
148	2.0		2.4	3.0		1.0	1.2	1.2	1.4

TAi3Lr- 2 -Increase in dissolved PbOsphorus tratl"rtcd in aiiiiii I r
receii-it@iz lii,e.Tiork or poultry manure ,wrface-applied at @icrotiottlit. rate.@i-@Ctintinucd

Land Rcsourcc Area

Snwll Grass tion

grain Row ert)p iz(vi@ch pkv%-

with or without %%ith or %%ithout %%ith or -Aithout

conscr%-ation con-@r%,ation

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149	2.4	3.1	3.7	1.3	1.5	1.5	1.8
150 w	3.3	4.6	5.3	1.9	2.1	2.2	2.4
150 E	8.7	12.2	12.9	4.6	4.8	5.4	5.6
151							
152	8.7	12.2	12.9	4.6	4.8	5.4	5.6
153	4.3	6.0	6.7	2-4	2.6	2.8	3.1
154	.8	1.2	2.9	1.0	1.6	1.2	1.9
155	4.1	5.7	7.1	2.5	3.0	3.0	3.5
156	-	-	-	-	-		

i Valucs @ted frogn tabks 17 md I&
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Soil-puticide in
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loss potential and mg I
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Pesticides a"

ATTACHMENT 1

11-1 Soil-Pesticide Interaction IZatiilgs

Introduction

ra@ hel determine the potential for @cide Ims
tion below the root zone when

Soil and @cide

Soils are tO POtentW for pesticide loss @ surface runoff and fi-om leaching. soils v "Nes are a le to the states fim the

@ w@ -

location as 5 data at Ames, lowgl The gate @ @d get

these tables fi-om @ snd te to the field @y those "M tables tbat are t to m& individual:field @ce- ne tamen @t senes,

the @ 1082 @tial and lea@g poten@ ne @ @ce potential are ranked as highs intem@te

9to @tial fOr loss tO surface runoff and leaching' The Mac'de tables am in section 1-5. Pes6cide Data Base. In this @on @ is a Usto-f pesticide properties that include the loss potential and leac ng potential for each pesticide- The @ce loss potential is as @ev Inedi@,or The leaching potential is
or total uw-

The field ofrace staff ehould determine the water resource (e.g. ground water or surface water quality), then adect the appropriate procedure. The ve procedure de es the potential loss of a cide when used an a parti@ mi

Procedure

Both the pesticide @ and the @ rnk @ used to determine the tential for pesticide loss into s runoff or to leaching. Follow these steppso:

Potential Pesticides Lm to Lea

IL- @d the leaclag potential fOr the soil @es from the son ranldng tables

2. Determine the pesticide leaching Potential fiom the Pe-sticide Pz'OPerties in Section 1-5, Pesticide Data Base.

S. Use these ratings with the Poientialpesficide &So to kaching ma@ (fig. 1) to determine potential 1-3.

ranked as @ge,, imedi@

Which p@dure to use:

Surface runoff.-

L 11/2d the

S. Use these ra@ vath the p

surface mwff (fig. 2) to

ATTACHMENT 1 cont.

Using the Ma@: The inte@tionOf the soil leaching potential and the pesticide leaching potential gives the overall leaching pc)tential- a potential 1, 2, or S. For example, the @ded -potential S" below was from a soil with intermediate soil "ching potential and a pesticide with a small leaching potential

1. Potential pesticide loss to leaching matrix

Soil leaching potential	Pe@cide leaching potentig Is	Medium	Small	Total use
High	Potential I	POtentW 1	Potential 2	Potentig 3
Inter=ediatg	Potential I	PotentW 2:		potential 3
Nornl*nal	Potential 2	Potential 3	Potential3	Potentha 3

Im potential for the the @es from

thies If tU @ ma@ unit has a slope @,or law than

2%.   the   Ion potential by one @ Le. ,.#
to nom;n MI   Wmediate

2. De e the pesbade   low potentud fi-om

the Pesticide in Section 1-5. Pftdcide Mta B@

pe .8@ Im to
e Potential is.

Figure 2. P &s$ to surface ff

Soil surface P@cide suxface 1068 p DtentW
loss potential

@e Medium snmu

Eugh Potential I Potential I i Potentia 2

]Intermediate Potential 1 Potentua 2 Potential 3

Nomi@ Potential 2 1 Potential 3 Potentha 3

General Cons ns.- 7le introduction of the -Pesticide 'Data Base, l@l to I-5-5 should be read and understoodl The method of application should be considered. Yftp in mind that: (1) Foliar applications can result in only a small Pc)rtiOn Of a Pesticide reaching the soil surface where it can be sutdect to loss. (2) Pesticides applied in a band below. the @aoe or incorporated into the 60il may have a lower loss to @ace runoff but a higher lostj to leaching than estimated by this technique. Take @ into consideration when these methods of application are @ @nsult locally developed guidelines or the manufacwm.

The pesticide data base lists the solubility in water, half-life in @. and sOrption index. These factors were used in estimating the surface loss and

2.4-D ACM

Trade name(s): ne (mixture @th 2,4.D @ne @t)
MAnufact@e): Ferments
U@ lherbicide: lawnsomhardsgrain&,Tice.
com, sorghum
Formulation type(e): aqueous solution Application m@(a): target weed fobar spray
Solubility in water (mall): 890 19-If life in soil(days): 20 I SoU sorption index @l-. 20 @ Rof ow @75-7 Surface lo" pote-ti&L- SMALL potenti&L- MMIUM

ATTACHMENT 1 cont.

2,4-DB =R

Trade name(e): Butymc Ester
Man@ct@e)- Rhone-Poulenc
Use: berbicide: alfalfabirdrfoottrefail
Formv"tion @(s): emulgifiable
@ntrate
Application models): target wered fo@

spray
Solubility in water (mg/1): 50 E @ Hfe in noil(days): 10 E Soil @on index
@'): 1000 E CA. Rof
U" pote-tl-l- NEDIM

po SMALL

2,44D E= OR O@LTJBLE AMINE SALT

Trade Aqua @ W@e. T"& name(@. Butyrw, R"cue (mixture

EM mm adublo "U)
SA Farm@ Pouknc. Union
@enc Cwbide
berbicide: Urn
d @. fmp Wines
Formulation @(@. granules, Famulatioan @(s).- aqueous
emul4ifig%)Ao conoen@ @ons
Application mo&(s). granules applied to Ap@tion inode(s): weed
f@
- water mdam; weed foliar @y vm
Solubility in water @.- 60 E Sol@ty in water @. 200000

14alf life in soil(days): 10   Half lif-0 In oofl(days).- 10 E
SoU sorption index   1000 E   Sa @on I'nAev 20 E
CJL   Reference: 7   CA.   ce:
8   lo"   po   - NMIL7M   Surfaoo @ potenti&L' SMALL

T,em@ingpotenfs*mli   SMALL   lAa@ pote@- MEDRUM

2,4-D   SOI.UBLE   SALT

@de niLme(a).- W@
@ufacturer(s): Rh@Poulenc
Use: berbicide: la@looncroplands,@ns,

COM lico,
vegetablej6 @mm
Form@tion typo(s): aqueous solution
Application mode(e).- target weed f@

spray
Solubility in water (m@. 300000
TT&lf]life in *oil (days): 20
SoU sorption index @l.- log
C.& Reference: "M-6
Surface Ions potenti&L- -WEDTLTM
@ching potaint;ml. IMIM

2,4-DB SOLUBLE FIODIUM OR

340PA SOLUBLE SODRUM SALT

@de   (s): Fruitone CPA

Man   6).   Poulenc
U@   @   @ator

le

Formulatioon type(s): aqueous solution
Application m@s): crop plant vm
Solubility in water @): 200000
&&Iif4s in soil(days): 10 E
Soil @on index MM'): 20 E
CA. Re(
Surface lose poterst; ml- SMALL
I"@gp*tentiial- IM@

A se@on of f'@ and mwrds fmm the USDA.@ I p pm@ V@,on LO.
by R.D. Wa@pe. Surfam lo" and @t" by Sa &lion Se@.

E@ 0-ate v@; p@le error is 2X to 3X for Half W and SX to 5X for UnbE* and
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