

**TABLE I – Mitigation Effectiveness Guide - Reducing Pesticide Impacts on Water Quality**

Note: Pest Management (595) requires environmental risk evaluation and appropriate mitigation for all identified resource concerns. This table identifies management techniques and conservation practices that have the potential to mitigate pesticide impacts on water quality. Not all techniques will be applicable to a given situation. Relative effectiveness ratings by pesticide loss pathway are “no effect” (blank), “slight effect” (+/-), “moderate effect” (++/--), and “significant effect” (+++/---). The table also identifies how the techniques function. Effectiveness of any mitigation technique can be highly variable based on site conditions and how it is designed. Therefore, with guidance provided by the table, site-specific selection and design of mitigation techniques that are appropriate for identified resource concerns is left to the professional judgement of the conservation planner.

| Pest Management Mitigation Techniques   | Pesticide Loss Pathways |                        |                        | Function   |
|---|-------------------------|------------------------|------------------------|--|
|   | Leaching                | Solution Runoff        | Adsorbed Runoff        |  |
| <b>Management Techniques <sup>1/</sup></b>  |                         |                        |                        |  |
| Application Timing  | +++                     | +++                    | +++                    | Reduces exposure potential - delaying application when significant rainfall events are forecast can reduce pesticide transport to ground and surface water, application when conditions are optimal can reduce the amount of pesticide applied, also delaying application when wind speed is not in accordance with label requirements can reduce pesticide drift to surface water |
| Formulations/Adjuvants  | ++                      | ++                     | +                      | Reduces exposure potential – formulations and/or adjuvants that increase efficacy allow lower application rates  |
| Lower Application Rates   | +++                     | +++                    | +++                    | Reduces exposure potential - use lowest effective rate   |
| Partial Treatment   | +++                     | +++                    | +++                    | Reduces exposure potential - spot treatment, banding and directed spraying reduce amount of pesticide applied  |
| Pesticide Label Environmental Hazard Warnings and BMPs  | Required <sup>2/</sup>  | Required <sup>2/</sup> | Required <sup>2/</sup> | Reduces exposure potential - label guidance must be carefully followed for pesticide applications near water bodies and on soils that are intrinsically vulnerable to erosion, runoff, or leaching   |
| Scouting and Integrated Pest Management (IPM) Thresholds  | +++                     | +++                    | +++                    | Reduces exposure potential - reduces the amount of pesticide applied   |
| Set-backs   | +                       | ++                     | +                      | Reduces exposure potential - reduced application area reduces amount of pesticide applied, can also reduce inadvertent pesticide application and drift to surface water  |
| Soil Incorporation – mechanical or irrigation   | ---                     | +++                    | +++                    | Reduces exposure potential for surface losses, but increases exposure potential for leaching losses  |
| Substitution – <ul style="list-style-type: none"> <li>▪ Alternative pesticides</li> <li>▪ Cultural controls</li> <li>▪ Biological controls</li> </ul> | +++                     | +++                    | +++                    | Reduces hazard potential - use alternative pesticides with low environmental risk, substituting cultural (including burning and mechanical controls) and biological controls can reduce the need for pesticides  |
| <b>Conservation Practices <sup>3/</sup></b>   |                         |                        |                        |  |
| Agrichemical Mixing Center (Interim)  | +++                     | +++                    | +++                    | Reduces the potential for point source pesticide contamination   |
| Alley Cropping (311)  | +                       | +                      | ++                     | Increases infiltration and uptake of subsurface water, reduces soil erosion, can provide habitat for beneficial insects which can reduce the need for pesticides, also can reduce pesticide drift to surface water   |

**TABLE I - (continued)**

| Mitigation Technique                               | Pesticide Loss Pathways |                 |                 | Function  |
|--|-------------------------|-----------------|-----------------|---|
|  | Leaching                | Solution Runoff | Adsorbed Runoff |   |
| Anionic Polyacrylamide (PAM) Erosion Control (450) | -                       | +               | +++             | Increases infiltration and deep percolation, reduces soil erosion   |
| Bedding (310)                                      | +                       | +               | +               | Increases surface infiltration and aerobic pesticide degradation in the rootzone  |
| Brush Management (314)                             | +++                     | +++             | +++             | Using non-chemical brush control often reduces the need for pesticides, pesticide use requires environmental risk analysis and appropriate mitigation - see Pest Management (595)   |
| Conservation Cover (327)                           | +++                     | +++             | +++             | Retiring land from annual crop production often reduces the need for pesticides, builds soil organic matter   |
| Constructed Wetland (656)                          | +                       | +               | ++              | Captures pesticide residues and facilitates their degradation   |
| Conservation Crop Rotation (328)                   | ++                      | ++              | ++              | Reduces the need for pesticides by breaking pest lifecycles   |
| Contour Buffer Strips (332)                        |                         | ++              | ++              | Increases infiltration, reduces soil erosion  |
| Contour Farming (330)                              | -                       | +               | +               | Increases infiltration and deep percolation, reduces soil erosion   |
| Contour Orchard and Other Fruit Area (Ac.) (331)   | -                       | +               | +               | Increases infiltration and deep percolation, reduces soil erosion   |
| Contour Stripcropping (585)                        |                         | ++              | ++              | Increases infiltration, reduces soil erosion  |
| Cover Crop (340)                                   | +                       | +               | ++              | Increases infiltration, reduces soil erosion, builds soil organic matter  |
| Cross Wind Ridges (589A)                           |                         |                 | (+)<br>4/       | Reduces wind erosion and adsorbed pesticide deposition in surface water   |
| Cross Wind Stripcropping (589B)                    |                         |                 | (++)<br>4/      | Reduces wind erosion and adsorbed pesticide deposition in surface water, traps adsorbed pesticides  |
| Cross Wind Trap Strips (589C)                      |                         |                 | (++)<br>4/      | Reduces wind erosion and adsorbed pesticide deposition in surface water, traps adsorbed pesticides  |
| Deep Tillage (324)                                 | -                       | +               | +               | Increases infiltration and deep percolation   |
| Dike (356)   | ++/--                   | ++              | ++              | Reduces exposure potential - excludes outside water (++) leaching) or captures pesticide residues and facilitates their degradation (-- leaching)   |
| Diversion (362)                                    | +                       | +               | +               | Reduces exposure potential - water is diverted  |
| Drainage Water Management (554)                    | ++/--                   | ++              | ++              | Seasonal saturation may reduce the need for pesticides, drainage reduces storm water runoff, drainage increases infiltration and aerobic pesticide degradation in the rootzone during the growing season (++) leaching), seasonal saturation may bring the water table in contact with pesticide residues from the previous growing season (-- leaching)                            |
| Field Border (386)                                 |                         | +               | ++              | Increases infiltration and traps adsorbed pesticides, often reduces application area resulting in less pesticide applied, can provide habitat for beneficial insects which reduces the need for pesticides, can provide habitat to congregate pests which can result in reduced pesticide application, also can reduce inadvertent pesticide application and drift to surface water |

**TABLE I - (continued)**

| Mitigation Technique                            | Pesticide Loss Pathways |                 |                 | Function  |
|---|-------------------------|-----------------|-----------------|---|
|   | Leaching                | Solution Runoff | Adsorbed Runoff |   |
| Filter Strip (393)                              |                         | ++              | +++             | Increases infiltration and traps adsorbed pesticides, often reduces application area resulting in less pesticide applied, can provide habitat for beneficial insects which reduces the need for pesticides, can provide habitat to congregate pests which can result in reduced pesticide application, also can reduce inadvertent pesticide application and drift to surface water |
| Floodwater Diversion (400)                      | +                       | +               | +               | Reduces exposure potential - floodwater is diverted   |
| Forage Harvest Management (511)                 | ++                      | ++              | ++              | Reduces exposure potential - timely harvesting reduces the need for pesticides  |
| Forest Stand Improvement (666)                  | ++                      | ++              | ++              | Reduces the potential for pest damage and the need for pesticides   |
| Grade Stabilization Structure (410)             |                         |                 | ++              | Traps adsorbed pesticides   |
| Grassed Waterway (412)                          |                         | +               | ++              | Increases infiltration and traps adsorbed pesticides (should be applied with Filter Strips at the outlet and on each side of the waterway)  |
| Grazing Land Mechanical Treatment (548)         | -                       | +               | +               | Increases infiltration and deep percolation   |
| Hedgerow Planting (442)                         |                         |                 | (+)<br>4/       | Reduces adsorbed pesticide deposition in surface water, also can reduce inadvertent pesticide application and drift to surface water  |
| Herbaceous Wind Barriers (603)                  |                         |                 | (+)<br>4/       | Reduces wind erosion, traps adsorbed pesticides, can provide habitat for beneficial insects which reduces the need for pesticides, can provide habitat to congregate pests which can result in reduced pesticide application, also can reduce pesticide drift to surface water  |
| Hillside Ditch (423)                            | +                       | +               | +               | Reduces exposure potential - water is diverted  |
| Irrigation Land Leveling (464)                  | ++                      | +               | ++              | Reduces exposure potential - uniform surface reduces pesticide transport to ground and surface water  |
| Irrigation System, Microirrigation (441)        | ++                      | +++             | +++             | Reduces exposure potential - efficient and uniform irrigation reduces pesticide transport to ground and surface water   |
| Irrigation System, Sprinkler (442)              | ++                      | ++              | ++              | Reduces exposure potential - efficient and uniform irrigation reduces pesticide transport to ground and surface water   |
| Irrigation System, Surface and Subsurface (443) | +                       | +               | +               | Reduces exposure potential - efficient and uniform irrigation reduces pesticide transport to ground and surface water   |
| Irrigation System Tail Water Recovery (447)     |                         | +++             | +++             | Captures pesticide residues and facilitates their degradation   |
| Irrigation Water Management (449)               | +++                     | +++             | +++             | Reduces exposure potential - water is applied at rates that minimize pesticide transport to ground and surface water, promotes healthy plants which can better tolerate pests   |
| Land Smoothing (466)                            | +                       | +               | +               | Reduces exposure potential - uniform surface reduces pesticide transport to ground and surface water  |

**TABLE I - (continued)**

| Mitigation Technique                              | Pesticide Loss Pathways |                 |                 | Function   |
|---|-------------------------|-----------------|-----------------|--|
|   | Leaching                | Solution Runoff | Adsorbed Runoff |  |
| Mole Drain (482)                                  | +                       | +               | +               | Increases infiltration and aerobic pesticide degradation in the rootzone<br>*Note – avoid direct outlets to surface water  |
| Mulching (484)                                    | +                       | +/-             | +/-             | Often reduces the need for pesticides, natural mulches increase infiltration and reduce soil erosion (+ solution and adsorbed runoff), artificial mulches may increase runoff and erosion (- solution and adsorbed runoff) |
| Nutrient Management (590)                         | ++                      | ++              | ++              | Promotes healthy plants which can better tolerate pests  |
| Pasture and Hay Planting (512)                    | ++                      | ++              | ++              | Retiring land from annual crop production often reduces the need for pesticides, builds soil organic matter  |
| Precision Land Forming (462)                      | ++                      | +               | ++              | Reduces exposure potential - uniform surface reduces pesticide transport to ground and surface water   |
| Prescribed Burning (338)                          | ++                      | ++              | ++              | Often reduces the need for pesticides  |
| Prescribed Grazing (528A)                         | ++                      | ++              | ++              | Improves plant health and reduces the need for pesticides  |
| Range Planting (550)                              | ++                      | ++              | ++              | Increases infiltration and uptake of subsurface water, reduces soil erosion, builds soil organic matter  |
| Recreation Area Improvement (562)                 | ++                      | ++              | ++              | Increases infiltration and uptake of subsurface water, reduces soil erosion, builds soil organic matter  |
| Residue Management, No-till and Strip-Till (329A) | +                       | ++              | +++             | Increases infiltration, reduces soil erosion, builds soil organic matter   |
| Residue Management, Mulch-Till (329B)             | +                       | ++              | +++             | Increases infiltration, reduces soil erosion, builds soil organic matter   |
| Residue Management, Ridge Till (329C)             | +                       | ++              | +++             | Increases infiltration, reduces soil erosion, builds soil organic matter   |
| Residue Management, Seasonal (344)                | +                       | +               | +               | Increases infiltration, reduces soil erosion, builds soil organic matter   |
| Riparian Forest Buffer (391)                      | +                       | +++             | +++             | Increases infiltration and uptake of subsurface water, traps sediment, builds soil organic matter  |
| Riparian Herbaceous Cover (390)                   | +                       | ++              | ++              | Increases infiltration, traps sediment, builds soil organic matter   |
| Row Arrangement (557)                             | -                       | +               | +               | Increases infiltration and deep percolation, reduces soil erosion  |
| Sediment Basin (350)                              |                         |                 | ++              | Captures pesticide residues and facilitates their degradation  |
| Stripcropping, Field (586)                        |                         | +               | +               | Increases infiltration, reduces soil erosion   |
| Structure For Water Control (587)                 | -                       | ++              | +++             | Captures pesticide residues and facilitates their degradation, increases infiltration and deep percolation   |
| Subsurface Drainage (606)                         | +                       | ++              | ++              | Increases infiltration and aerobic pesticide degradation in the rootzone<br>*Note – avoid direct outlets to surface water  |
| Surface Drainage, Field Ditch (607)               | +                       | +               | +               | Increases infiltration and aerobic pesticide degradation in the rootzone   |
| Surface Roughening (609)                          |                         |                 | (+)<br>4/       | Reduces wind erosion and adsorbed pesticide deposition in surface water  |

**TABLE I - (continued)**

| Mitigation Technique                      | Pesticide Loss Pathways |                 |                 | Function   |
|---|-------------------------|-----------------|-----------------|--|
|   | Leaching                | Solution Runoff | Adsorbed Runoff |  |
| Terrace (600)                             | --                      | ++              | +++             | Increases infiltration and deep percolation, reduces soil erosion  |
| Tree and Shrub Establishment (612)        | +++                     | +++             | +++             | Retiring land from annual crop production often reduces the need for pesticides, increases infiltration and uptake of subsurface water, builds soil organic matter |
| Vegetative Barriers (601)                 |                         |                 | ++              | Reduces soil erosion, traps sediment, increases infiltration   |
| Waste Storage Facility (313)              | +                       | ++              | ++              | Captures pesticide residues  |
| Waste Treatment Lagoon (359)              |                         | +++             | +++             | Captures pesticide residues and facilitates their degradation  |
| Waste Utilization (633)                   | ++                      | ++              | ++              | Increases soil organic matter  |
| Water and Sediment Control Basin (638)    | -                       | ++              | +++             | Captures pesticide residues and facilitates their degradation, increases infiltration and deep percolation   |
| Waterspreading (640)                      | -                       | +               | +               | Increases infiltration and deep percolation  |
| Well Decommissioning (351)                | +++                     |                 |                 | Eliminates point source contamination  |
| Wetland Creation (Ac.) (658)              | +                       | +               | +               | Captures pesticide residues and facilitates their degradation  |
| Wetland Enhancement (Ac.) (659)           | +                       | +               | +               | Captures pesticide residues and facilitates their degradation  |
| Wetland Restoration (Ac.) (657)           | +                       | +               | +               | Captures pesticide residues and facilitates their degradation  |
| Windbreak/Shelterbelt Establishment (380) |                         |                 | (++)<br>4/      | Reduces wind erosion, reduces adsorbed pesticide deposition in surface water, traps adsorbed pesticides, also can reduce pesticide drift                           |
| Windbreak/Shelterbelt Renovation (650)    |                         |                 | (++)<br>4/      | Reduces wind erosion, reduces adsorbed pesticide deposition in surface water, traps adsorbed pesticides, also can reduce pesticide drift                           |

<sup>1/</sup> Additional information on pest management mitigation techniques can be obtained from Extension pest management publications, pest management consultants and pesticide labels.

<sup>2/</sup> The pesticide label is the law - all pesticide label specifications must be carefully followed, including required mitigation. Additional mitigation may be needed to meet NRCS pest management requirements for identified resource concerns.

<sup>3/</sup> Details regarding the effects of Conservation Practices on ground and surface water contamination by pesticides are contained in the Conservation Practice Physical Effects matrix found in the National Handbook of Conservation Practices.

<sup>4/</sup> Mitigation applies to adsorbed pesticide losses being carried to surface water by wind.

*TABLE I Mitigation Effectiveness Guide - Reducing Pesticide Impacts on Water Quality* is based on available research specific to the technique, related research, and the NWCC Pest Management Team's best professional judgement. The ratings are relative index values as opposed to absolute values, much like the Conservation Practice Physical Effects (CPPE) matrix. They are intended to help planners choose the best combination of techniques for their identified resource concerns. The ratings are based on the relative *potential* for a technique to provide mitigation. The technique has to be specifically designed, implemented and maintained for the mitigation potential to be realized. Varying site conditions can result in a great deal of variation in actual mitigation effectiveness, but our relative index values indicate which techniques will generally provide more or less mitigation under a given set of conditions. Our general rule of thumb is that '+'s generally have the potential to reduce losses by 10 -15%., ++'s have the potential to reduce losses by about 25% and +++'s have the potential to reduce losses by about 50%.

The original matrix was developed by the EPA-sanctioned Aquatic Dialogue Group and published by SETAC. The original reference is: *Aquatic Dialogue Group: Pesticide Risk Assessment and Mitigation*, Baker JL, Barefoot AC, Beasley LE, Burns LA, Caulkins PP, Clark JE, Feulner RL, Giesy JP, Graney RL, Griggs RH, Jacoby HM, Laskowski DA, Maciorowski AF, Mihaich EM, Nelson Jr HP, Parrish PR, Siefert RE, Solomon KR, van der Schalie WH, editors. 1994. *Society of Environmental Toxicology and Chemistry, Pensacola, FL., pages 99-111 and Table 4-2*. They provided ranges of effectiveness for various mitigation techniques. With their permission, we expanded their work for the NEDC *Nutrient and Pest Management Considerations in Conservation Planning* course materials. Richard Aycock from Louisiana was the first to put a mitigation matrix into an NRCS Pest Management (595) standard, based in large part on Table 6.2 (pages 67 - 68), and Table, 6.4 (pages 71 - 72) in *Module 6, Part C-Integrating Nutrient and Pest Management with Other Conservation Practices* in our *Nutrient and Pest Management Considerations in Conservation Planning* course materials. Table 1 was built from the Louisiana matrix by adding additional management techniques and conservation practices. If you have any questions, please contact the NWCC Pest Management Team.