

Appendix E: HUC8 Watershed Loads and Reductions

Chapter 6 includes a strategy for nutrient reduction which calls for achieving nutrient reductions within the 8-digit hydrologic unit code (HUC8) major watersheds which will cumulatively achieve the downstream goals and Mississippi River nitrogen milestone. The watershed restoration and protection strategy (WRAPS) for each major watershed includes such elements as timelines, interim milestones, and responsible governmental units for achieving the needed pollutant reductions. The WRAPS and associated local water management plan (e.g., One Watershed One Plan) should be developed to not only have the goal of protecting and restoring water resources within the watershed, but to also contribute to nutrient reductions needed for downstream waters (in-state and out-of-state).

A set of HUC8 nutrient reduction targets is provided in this appendix as a guide to provide an estimate of the magnitude of individual HUC8 reductions which will collectively reach NRS goals and milestones (Table E-1). One approach in this appendix is based on reducing a common percentage of SPARROW-modeled loads for each HUC8 watershed outlet in the major basin (i.e. 20 percent for the Mississippi nitrogen milestone reduction for each HUC8 in the Mississippi Basin). This approach, as shown in Table E-2, includes loads from all sources and takes into consideration recent progress as documented in Chapter 4. If other watershed monitoring and modeling is available (e.g., calibrated HSPF watershed model), the major basin reduction needs in Table E-1 could instead be applied to the modeled existing condition load to estimate the needed HUC8 load reduction.

Table E-1. Summary of new reductions needed

| Major Basin | Phosphorus | | | Nitrogen | | |
|-------------------|----------------|---------------------------|----------------------------|--------------------------|---------------------------|----------------------------|
| | Goal Reduction | Recent Progress Reduction | Remaining Reduction Needed | Goal/Milestone Reduction | Recent Progress Reduction | Remaining Reduction Needed |
| Mississippi River | 45% | 33% | 12% | 20% | 0% | 20% |
| Lake Winnipeg | 10% | 4.3% | 5.7% | 13% | 0% | 13% |

A different approach provided in this appendix is based on estimated HUC8 watershed nutrient reduction needs from cropland sources only. Table E-3 shows estimates for HUC8 load reductions that would collectively achieve the cropland nutrient reduction goals and milestones. The BMP adoption targets are predicted to be sufficient to meet environmental milestones and goals for nitrogen and phosphorus loading, if adopted on the suitable acres as described in Chapter 5. The cropland load

reduction approximations are summarized from the NBMP tool and the phosphorus analysis, which considers the amount of land that is suitable and available for the various agricultural BMPs in each watershed. Individual HUC8 watershed modeling and planning should be used along with information in the NRS to determine the best scenario for HUC8 nutrient reductions and the associated BMP adoption to achieve both local and downstream milestones and goals.

In addition to these watershed nutrient reduction guidelines and scenarios, TMDLs will inform watershed and point source reductions needed to address specific water body impairments. In cases where downstream TMDLs require large reductions, interim implementation targets consistent with these reduction targets may be considered, but in all cases TMDLs are applicable and this NRS is not intended to supersede any regulatory requirements. Of particular importance are the reductions needed for those HUC8s that drain to lakes with approved TMDLs such as Lake St. Croix and in the future Lake Pepin. Chapter 2 of the NRS summarizes key eutrophication-impaired lakes with large watersheds in Minnesota that are in need of phosphorus load reductions to meet water quality standards.

Table E-2. SPARROW modeled loads at HUC8 outlets from all sources to collectively achieve goals and nitrogen milestone when each watershed in the major basin is reduced by the same percentage according to Table E-1.

Note: The reduction targets in this table indicate the general magnitude of reductions needed. Additional monitoring and modeling information should be used determine watershed reduction goal planning.

| HUC8 Number | HUC8 Name | Basin | Major Basin | Phosphorus | | Nitrogen | |
|-------------|----------------------------------|-------------------|-------------|-----------------------------|----------------------------------|-----------------------------|----------------------------------|
| | | | | Load ^a (MT/year) | Reduction (MT/year) ^b | Load ^a (MT/year) | Reduction (MT/year) ^b |
| 07080102 | Upper Wapsipinicon River | Cedar | Mississippi | 2.8 | 0.3 | 80.4 | 16.1 |
| 07080201 | Cedar River | Cedar | Mississippi | 169.3 | 20.3 | 4,660.9 | 932.2 |
| 07080202 | Shell Rock River | Cedar | Mississippi | 57.6 | 6.9 | 1,359.4 | 271.9 |
| 07080203 | Winnebago River | Cedar | Mississippi | 12.2 | 1.5 | 817.5 | 163.5 |
| 07100001 | Des Moines River - Headwaters | Des Moines | Mississippi | 199.3 | 23.9 | 3,709.3 | 741.9 |
| 07100002 | Lower Des Moines River | Des Moines | Mississippi | 19.2 | 2.3 | 246.0 | 49.2 |
| 07100003 | East Fork Des Moines River | Des Moines | Mississippi | 32.1 | 3.9 | 552.1 | 110.4 |
| 10170202 | Upper Big Sioux River | Missouri | Mississippi | 6.9 | 0.8 | 124.4 | 24.9 |
| 10170203 | Lower Big Sioux River | Missouri | Mississippi | 83.6 | 10.0 | 1,504.5 | 300.9 |
| 10170204 | Rock River | Missouri | Mississippi | 147.6 | 17.7 | 2,655.4 | 531.1 |
| 10230003 | Little Sioux River | Missouri | Mississippi | 51.4 | 6.2 | 924.2 | 184.8 |
| 07010101 | Mississippi River - Headwaters | Upper Mississippi | Mississippi | 15.7 | 1.9 | 181.3 | 36.3 |
| 07010102 | Leech Lake River | Upper Mississippi | Mississippi | 7.2 | 0.9 | 79.4 | 15.9 |
| 07010103 | Mississippi River - Grand Rapids | Upper Mississippi | Mississippi | 123.2 | 14.8 | 982.1 | 196.4 |

| HUC8 Number | HUC8 Name | Basin | Major Basin | Phosphorus | | Nitrogen | |
|-------------|---|-------------------|-------------|--------------------------------|-------------------------------------|--------------------------------|-------------------------------------|
| | | | | Load ^a (MT/year) | Reduction (MT/year) ^b | Load ^a (MT/year) | Reduction (MT/year) ^b |
| 07010104 | Mississippi River - Brainerd | Upper Mississippi | Mississippi | 111.7 | 13.4 | 1,611.4 | 322.3 |
| 07010105 | Pine River | Upper Mississippi | Mississippi | 6.0 | 0.7 | 89.3 | 17.9 |
| 07010106 | Crow Wing River | Upper Mississippi | Mississippi | 53.9 | 6.5 | 905.2 | 181.0 |
| 07010107 | Redeye River | Upper Mississippi | Mississippi | 39.9 | 4.8 | 806.7 | 161.3 |
| 07010108 | Long Prairie River | Upper Mississippi | Mississippi | 52.6 | 6.3 | 733.6 | 146.7 |
| 07010201 | Mississippi River - Sartell | Upper Mississippi | Mississippi | 115.1 | 13.8 | 1,847.7 | 369.5 |
| 07010202 | Sauk River | Upper Mississippi | Mississippi | 149.8 | 18.0 | 2,076.6 | 415.3 |
| 07010203 | Mississippi River - St. Cloud | Upper Mississippi | Mississippi | 106.0 | 12.7 | 1,783.7 | 356.7 |
| 07010204 | North Fork Crow River | Upper Mississippi | Mississippi | 173.3 | 20.8 | 3,287.1 | 657.4 |
| 07010205 | South Fork Crow River | Upper Mississippi | Mississippi | 296.0 | 35.5 | 5,811.2 | 1162.2 |
| 07010206 | Mississippi River - Twin Cities | Upper Mississippi | Mississippi | 291.5 | 35.0 | 5,108.6 | 1021.7 |
| 07010207 | Rum River | Upper Mississippi | Mississippi | 103.4 | 12.4 | 1,647.2 | 329.4 |
| 07020001 | Minnesota River - Headwaters | Minnesota | Mississippi | 42.0 | 5.0 | 512.9 | 102.6 |
| 07020002 | Pomme de Terre River | Minnesota | Mississippi | 135.2 | 16.2 | 1,643.4 | 328.7 |
| 07020003 | Lac Qui Parle River | Minnesota | Mississippi | 117.3 | 14.1 | 1,705.0 | 341.0 |
| 07020004 | Minnesota River - Yellow Medicine River | Minnesota | Mississippi | 435.7 | 52.3 | 6,910.6 | 1382.1 |
| 07020005 | Chippewa River | Minnesota | Mississippi | 234.4 | 28.1 | 3,882.9 | 776.6 |
| 07020006 | Redwood River | Minnesota | Mississippi | 199.3 | 23.9 | 1,998.5 | 399.7 |
| 07020007 | Minnesota River - Mankato | Minnesota | Mississippi | 299.4 | 35.9 | 8,245.0 | 1649.0 |
| 07020008 | Cottonwood River | Minnesota | Mississippi | 261.0 | 31.3 | 5,305.0 | 1061.0 |
| 07020009 | Blue Earth River | Minnesota | Mississippi | 376.5 | 45.2 | 8,022.1 | 1604.4 |
| 07020010 | Watonwan River | Minnesota | Mississippi | 192.0 | 23.0 | 4,176.2 | 835.2 |
| 07020011 | Le Sueur River | Minnesota | Mississippi | 351.8 | 42.2 | 7,067.9 | 1413.6 |
| 07020012 | Lower Minnesota River | Minnesota | Mississippi | 338.4 | 40.6 | 9,249.1 | 1849.8 |
| 07030001 | Upper St. Croix River | St. Croix | Mississippi | 19.5 | 2.3 | 377.6 | 75.5 |
| 07030003 | Kettle River | St. Croix | Mississippi | 53.2 | 6.4 | 777.3 | 155.5 |
| 07030004 | Snake River | St. Croix | Mississippi | 63.5 | 7.6 | 911.2 | 182.2 |
| 07030005 | Lower St. Croix River | St. Croix | Mississippi | 66.9 | 8.0 | 1,428.8 | 285.8 |
| 07040001 | Mississippi River - Lake Pepin | Lower Mississippi | Mississippi | 97.1 | 11.7 | 1,735.4 | 347.1 |
| 07040002 | Cannon River | Lower Mississippi | Mississippi | 248.0 | 29.8 | 6,265.3 | 1253.1 |

| HUC8 Number | HUC8 Name | Basin | Major Basin | Phosphorus | | Nitrogen | |
|-------------|---|-------------------|-------------|--------------------------------|-------------------------------------|--------------------------------|-------------------------------------|
| | | | | Load ^a (MT/year) | Reduction (MT/year) ^b | Load ^a (MT/year) | Reduction (MT/year) ^b |
| 07040003 | Mississippi River - Winona | Lower Mississippi | Mississippi | 161.0 | 19.3 | 1,744.0 | 348.8 |
| 07040004 | Zumbro River | Lower Mississippi | Mississippi | 314.6 | 37.8 | 5,575.3 | 1115.1 |
| 07040006 | Mississippi River - La Crescent | Lower Mississippi | Mississippi | 30.0 | 3.6 | 412.4 | 82.5 |
| 07040008 | Root River | Lower Mississippi | Mississippi | 322.5 | 38.7 | 5,821.4 | 1164.3 |
| 07060001 | Mississippi River - Reno | Lower Mississippi | Mississippi | 30.5 | 3.7 | 404.7 | 80.9 |
| 07060002 | Upper Iowa River | Lower Mississippi | Mississippi | 25.1 | 3.0 | 677.7 | 135.5 |
| 09020101 | Bois de Sioux River | Red | Winnipeg | 35.2 | 2.1 | 471.8 | 47.2 |
| 09020102 | Mustinka River | Red | Winnipeg | 155.7 | 9.3 | 1,653.3 | 165.3 |
| 09020103 | Otter Tail River | Red | Winnipeg | 116.7 | 7.0 | 1,569.1 | 156.9 |
| 09020104 | Upper Red River of the North | Red | Winnipeg | 69.6 | 4.2 | 684.8 | 68.5 |
| 09020106 | Buffalo River | Red | Winnipeg | 98.8 | 5.9 | 1,687.3 | 168.7 |
| 09020107 | Red River of the North - Marsh River | Red | Winnipeg | 27.9 | 1.7 | 552.9 | 55.3 |
| 09020108 | Wild Rice River | Red | Winnipeg | 104.9 | 6.3 | 2,214.1 | 221.4 |
| 09020301 | Red River of the North - Sandhill River | Red | Winnipeg | 39.0 | 2.3 | 963.0 | 96.3 |
| 09020302 | Upper/Lower Red Lake | Red | Winnipeg | 2.4 | 0.1 | 21.6 | 2.2 |
| 09020303 | Red Lake River | Red | Winnipeg | 86.2 | 5.2 | 1,689.6 | 169.0 |
| 09020304 | Thief River | Red | Winnipeg | 14.3 | 0.9 | 255.4 | 25.5 |
| 09020305 | Clearwater River | Red | Winnipeg | 53.0 | 3.2 | 964.3 | 96.4 |
| 09020306 | Red River of the North - Grand Marais Creek | Red | Winnipeg | 47.9 | 2.9 | 809.4 | 80.9 |
| 09020309 | Snake River | Red | Winnipeg | 43.2 | 2.6 | 1,079.4 | 107.9 |
| 09020311 | Red River of the North - Tamarac River | Red | Winnipeg | 44.3 | 2.7 | 1,160.2 | 116.0 |
| 09020312 | Two Rivers | Red | Winnipeg | 79.0 | 4.7 | 1,532.1 | 153.2 |
| 09020314 | Roseau River | Red | Winnipeg | 54.7 | 3.3 | 1,033.6 | 103.4 |

a. Load delivered to HUC8 outlet derived from SPARROW, results reflect point source update. Note that these loads are higher than the loads delivered to De Soto (state line) due to attenuation.

b. Load reduction is proportional based on Major Basin reduction milestones, at the HUC8 outlet (Table E-1).

Table E-3. HUC8 loading results and reductions from new agricultural BMPs.

BMP adoption scenarios are based on the levels of adoption described Chapter 5. Total loads are at HUC8 outlets. The cropland load reduction indicates the general magnitude of reductions needed from cropland to collectively achieve goals and nitrogen milestone. Additional monitoring and modeling information where available and appropriate should be used to complete a watershed-specific nutrient reduction planning process.

| HUC8 Number | HUC8 Name | Basin | Major Basin | Phosphorus | | Nitrogen | |
|-------------|----------------------------------|-------------------|-------------|-----------------------------|--|-----------------------------|--|
| | | | | Load ^a (MT/year) | Cropland Load Reduction (MT/year) ^b | Load ^a (MT/year) | Cropland Load Reduction (MT/year) ^b |
| 07080102 | Upper Wapsipinicon River | Cedar | Mississippi | 2.8 | 0.2 | 80.4 | 7.4 |
| 07080201 | Cedar River | Cedar | Mississippi | 169.3 | 12.7 | 4,660.9 | 435.2 |
| 07080202 | Shell Rock River | Cedar | Mississippi | 57.6 | 3.1 | 1,359.4 | 123.4 |
| 07080203 | Winnebago River | Cedar | Mississippi | 12.2 | 1.6 | 817.5 | 31.7 |
| 07100001 | Des Moines River - Headwaters | Des Moines | Mississippi | 199.3 | 20.7 | 3,709.3 | 581.4 |
| 07100002 | Lower Des Moines River | Des Moines | Mississippi | 19.2 | 2.4 | 246.0 | 52.7 |
| 07100003 | East Fork Des Moines River | Des Moines | Mississippi | 32.1 | 4.2 | 552.1 | 123.0 |
| 10170202 | Upper Big Sioux River | Missouri | Mississippi | 6.9 | 1.5 | 124.4 | 13.8 |
| 10170203 | Lower Big Sioux River | Missouri | Mississippi | 83.6 | 8.7 | 1,504.5 | 171.0 |
| 10170204 | Rock River | Missouri | Mississippi | 147.6 | 13.7 | 2,655.4 | 304.9 |
| 10230003 | Little Sioux River | Missouri | Mississippi | 51.4 | 5.5 | 924.2 | 139.4 |
| 07010101 | Mississippi River - Headwaters | Upper Mississippi | Mississippi | 15.7 | 1.0 | 181.3 | -- |
| 07010102 | Leech Lake River | Upper Mississippi | Mississippi | 7.2 | 0.3 | 79.4 | -- |
| 07010103 | Mississippi River - Grand Rapids | Upper Mississippi | Mississippi | 123.2 | 1.3 | 982.1 | 33.6 |
| 07010104 | Mississippi River - Brainerd | Upper Mississippi | Mississippi | 111.7 | 4.6 | 1,611.4 | 139.6 |
| 07010105 | Pine River | Upper Mississippi | Mississippi | 6.0 | 0.1 | 89.3 | -- |
| 07010106 | Crow Wing River | Upper Mississippi | Mississippi | 53.9 | 2.3 | 905.2 | -- |
| 07010107 | Redeye River | Upper Mississippi | Mississippi | 39.9 | 3.1 | 806.7 | 125.0 |
| 07010108 | Long Prairie River | Upper Mississippi | Mississippi | 52.6 | 3.8 | 733.6 | 129.7 |
| 07010201 | Mississippi River - Sartell | Upper Mississippi | Mississippi | 115.1 | 9.1 | 1,847.7 | 121.7 |
| 07010202 | Sauk River | Upper Mississippi | Mississippi | 149.8 | 17.4 | 2,076.6 | 144.9 |
| 07010203 | Mississippi River - St. Cloud | Upper Mississippi | Mississippi | 106.0 | 6.9 | 1,783.7 | 219.7 |
| 07010204 | North Fork Crow River | Upper Mississippi | Mississippi | 173.3 | 17.7 | 3,287.1 | 480.7 |
| 07010205 | South Fork Crow River | Upper Mississippi | Mississippi | 296.0 | 33.9 | 5,811.2 | 682.8 |
| 07010206 | Mississippi River - Twin Cities | Upper Mississippi | Mississippi | 291.5 | 13.5 | 5,108.6 | 288.6 |
| 07010207 | Rum River | Upper | Mississippi | 103.4 | 6.3 | 1,647.2 | 122.2 |

| HUC8 Number | HUC8 Name | Basin | Major Basin | Phosphorus | | Nitrogen | |
|-------------|---|-------------------|-------------|--------------------------------|---|--------------------------------|---|
| | | | | Load ^a (MT/year) | Cropland Load Reduction (MT/year) ^b | Load ^a (MT/year) | Cropland Load Reduction (MT/year) ^b |
| | | Mississippi | | | | | |
| 07020001 | Minnesota River - Headwaters | Minnesota | Mississippi | 42.0 | 3.1 | 512.9 | 109.3 |
| 07020002 | Pomme de Terre River | Minnesota | Mississippi | 135.2 | 15.7 | 1,643.4 | 280.7 |
| 07020003 | Lac Qui Parle River | Minnesota | Mississippi | 117.3 | 12.5 | 1,705.0 | 408.1 |
| 07020004 | Minnesota River - Yellow Medicine River | Minnesota | Mississippi | 435.7 | 47.0 | 6,910.6 | 1,038.4 |
| 07020005 | Chippewa River | Minnesota | Mississippi | 234.4 | 22.5 | 3,882.9 | 572.1 |
| 07020006 | Redwood River | Minnesota | Mississippi | 199.3 | 12.5 | 1,998.5 | 334.2 |
| 07020007 | Minnesota River - Mankato | Minnesota | Mississippi | 299.4 | 32.5 | 8,245.0 | 790.7 |
| 07020008 | Cottonwood River | Minnesota | Mississippi | 261.0 | 24.6 | 5,305.0 | 691.0 |
| 07020009 | Blue Earth River | Minnesota | Mississippi | 376.5 | 52.8 | 8,022.1 | 976.8 |
| 07020010 | Watonwan River | Minnesota | Mississippi | 192.0 | 22.7 | 4,176.2 | 649.4 |
| 07020011 | Le Sueur River | Minnesota | Mississippi | 351.8 | 50.9 | 7,067.9 | 897.2 |
| 07020012 | Lower Minnesota River | Minnesota | Mississippi | 338.4 | 25.5 | 9,249.1 | 1,023.4 |
| 07030001 | Upper St. Croix River | St. Croix | Mississippi | 19.5 | 0.8 | 377.6 | 77.9 |
| 07030003 | Kettle River | St. Croix | Mississippi | 53.2 | 1.1 | 777.3 | 96.2 |
| 07030004 | Snake River | St. Croix | Mississippi | 63.5 | 3.2 | 911.2 | 27.7 |
| 07030005 | Lower St. Croix River | St. Croix | Mississippi | 66.9 | 2.9 | 1,428.8 | 134.6 |
| 07040001 | Mississippi River - Lake Pepin | Lower Mississippi | Mississippi | 97.1 | 4.9 | 1,735.4 | 209.5 |
| 07040002 | Cannon River | Lower Mississippi | Mississippi | 248.0 | 20.3 | 6,265.3 | 743.1 |
| 07040003 | Mississippi River - Winona | Lower Mississippi | Mississippi | 161.0 | 9.8 | 1,744.0 | 340.6 |
| 07040004 | Zumbro River | Lower Mississippi | Mississippi | 314.6 | 37.7 | 5,575.3 | 982.0 |
| 07040006 | Mississippi River - La Crescent | Lower Mississippi | Mississippi | 30.0 | 0.5 | 412.4 | 26.8 |
| 07040008 | Root River | Lower Mississippi | Mississippi | 322.5 | 33.1 | 5,821.4 | 913.6 |
| 07060001 | Mississippi River - Reno | Lower Mississippi | Mississippi | 30.5 | 0.9 | 404.7 | 67.4 |
| 07060002 | Upper Iowa River | Lower Mississippi | Mississippi | 25.1 | 3.3 | 677.7 | 143.1 |
| 09020101 | Bois de Sioux River | Red | Winnipeg | 35.2 | 1.2 | 471.8 | 32.1 |
| 09020102 | Mustinka River | Red | Winnipeg | 155.7 | 3.6 | 1,653.3 | 54.6 |
| 09020103 | Otter Tail River | Red | Winnipeg | 116.7 | 2.6 | 1,569.1 | 158.2 |
| 09020104 | Upper Red River of the North | Red | Winnipeg | 69.6 | 2.9 | 684.8 | 21.7 |
| 09020106 | Buffalo River | Red | Winnipeg | 98.8 | 3.2 | 1,687.3 | 82.0 |
| 09020107 | Red River of the North - Marsh River | Red | Winnipeg | 27.9 | 1.1 | 552.9 | 13.2 |
| 09020108 | Wild Rice River | Red | Winnipeg | 104.9 | 3.7 | 2,214.1 | 70.7 |

| HUC8 Number | HUC8 Name | Basin | Major Basin | Phosphorus | | Nitrogen | |
|-------------|---|-------|-------------|--------------------------------|---|--------------------------------|---|
| | | | | Load ^a (MT/year) | Cropland Load Reduction (MT/year) ^b | Load ^a (MT/year) | Cropland Load Reduction (MT/year) ^b |
| 09020301 | Red River of the North - Sandhill River | Red | Winnipeg | 39.0 | 1.5 | 963.0 | 34.2 |
| 09020302 | Upper/Lower Red Lake | Red | Winnipeg | 2.4 | 0.1 | 21.6 | |
| 09020303 | Red Lake River | Red | Winnipeg | 86.2 | 2.9 | 1,689.6 | 40.6 |
| 09020304 | Thief River | Red | Winnipeg | 14.3 | 0.4 | 255.4 | 19.9 |
| 09020305 | Clearwater River | Red | Winnipeg | 53.0 | 1.4 | 964.3 | 65.7 |
| 09020306 | Red River of the North - Grand Marais Creek | Red | Winnipeg | 47.9 | 2.1 | 809.4 | 19.4 |
| 09020309 | Snake River | Red | Winnipeg | 43.2 | 1.6 | 1,079.4 | 90.1 |
| 09020311 | Red River of the North - Tamarac River | Red | Winnipeg | 44.3 | 1.9 | 1,160.2 | 29.5 |
| 09020312 | Two Rivers | Red | Winnipeg | 79.0 | 2.4 | 1,532.1 | 23.4 |
| 09020314 | Roseau River | Red | Winnipeg | 54.7 | 1.3 | 1,033.6 | -- |

a. Load delivered to HUC8 outlet derived from SPARROW, results reflect point source update. Note that these loads are higher than the loads delivered to De Soto (state line) due to attenuation.

b. Load reduction is from new agricultural BMPs, as summarized in Chapter 5, at the HUC8 outlet.