|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **BMP** | **Basic Cost Parameters Accounted for in Assessment** | **2021$ Annual Cost per Hectare[[1]](#footnote-1)** | | **Nitrate Reduction (%)[[2]](#footnote-2)** | Comments |
|  |  |  | *IA* | *MN* |  |  |
| **In-field** | Multipurpose contour prairie strip[[3]](#footnote-3) | Site preparation; seed mix (high diversity w/forbs); planting; mowing for establishment; periodic mowing/ burning for management; monitoring. | $77 | $69 | nd |  |
| Contour buffer strip | Site preparation; seed mix (usually 1 or 2 different species); planting; mowing for establishment; periodic mowing for management; monitoring. | $72 | $67 | 90 ± 20 | Includes multi-purpose contour prairie strips. For these practices, the nitrate reduction efficiency is large, but only applicable to the nitrate in surface runoff and the very shallow subsurface flow in root zone. No subsurface drainage is treated. |
| Cover crop[[4]](#footnote-4) | Seed (usually cereal rye or mix); planting (aerial or broadcast); termination (herbicide or mechanical); monitoring. | $180 | $173 | 31 ± 29 | Assumes winter cereal rye (Secale cereale). |
| Grass waterway[[5]](#footnote-5) | Site preparation (including land grading and outlet stabilization); erosion control during establishment; seed mix (high diversity with forbs); maintenance; monitoring. | $230 | $232 | nd | There is no expected nutrient reduction benefit from grassed waterways, but they are a complementary practice to other BMPs and may be required to install alongside other nutrient-reduction BMPs. Users can calculate costs for grassed waterways. |
| **Field margin** | Vegetative filter strip | Site preparation; seed mix (usually low diversity mix); planting; mowing for establishment; periodic mowing/ burning for management; monitoring. | $101 | $99 | nd |  |
| Nitrogen bioreactor[[6]](#footnote-6) | Engineering design; excavation; tile pipe, wood chips, and control gate purchase; installation and yearly adjustment/ maintenance; site surface planting; seed mix (usually 1-2 species); annual groundskeeping,  replacement costs at end of practice life; monitoring. | $5,451  (per BMP) | $5,451  (per BMP) | 43 ± 21 | Assumes a woodchip bioreactor that routes drainage water and nitrate through a buried trench filled with woodchips. |
| Nutrient Removal Wetlands[[7]](#footnote-7) | Engineering design; site planning, engineering, and preparation; excavation and soil movement; tile redirection; installation of structures; planting; seed costs for wetland; seed costs for buffer; mowing buffer for establishment; mowing buffer for management; monitoring. | $4,066 | $4,076 | 52 | Assumes targeted placement for nutrient reduction purposes. |
| Farm pond[[8]](#footnote-8) | Engineering design; dam building and general excavation; spillway piping; pond sealer; embankment conservation cover planting; seed mix (usually 1-2 species); annual grounds keeping, monitoring. | $2,912 | $2,912 | nd | Assumes targeted placement for nutrient reduction purposes. No evidence of nitrate reduction, but possible phosphorus reduction. |
| **Riparian** | Multi-species Buffer | Site preparation; tree and shrub nursery stock; grass seed mix (high diversity); planting trees and grass; mowing for establishment; periodic mowing/ burning for management; monitoring. | $193 | $210 | 91 ± 20 | Similar to contour buffer strips, the nitrate reduction efficiency is large, but only applicable to nitrate in surface runoff and the very shallow subsurface flow in the root zone. No subsurface drainage is treated. |
| Vegetative | Site preparation; grass seed mix (usually low diversity mix); planting; mowing for establishment; periodic mowing/ burning for management; monitoring. | $101 | $99 | nd |  |
| Saturated Buffers[[9]](#footnote-9) | Engineering design; site preparation; seed mix (usually similar to vegetative or riparian buffer strips); planting; mowing. Excavation for tile drainage pipes; control structure purchase and installation; connection tile pipe; control gate yearly maintenance; monitoring. | $887  (per BMP) | $887  (per BMP) | 50 ± 13 | Divert fraction of tile drainage into riparian buffer to remove nitrate through denitrification. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Bioreactor |  |  |  |  |  |  |
|  | Year cost incurred |  |  |  |  |  |  |
| Bioreactor Design |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| *Land prep* |  |  |  |  |  |  |  |
| Trenching (backhoeing) |  |  |  |  |  |  |  |
| Tillage |  |  |  |  |  |  |  |
| Herbicide & Application |  |  |  |  |  |  |  |
| Planting grass cover |  |  |  |  |  |  |  |
| Prairie Seed |  |  |  |  |  |  |  |
| Seed Drilling |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| *Installation* |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Geotextile Fabric Liner |  |  |  |  |  |  |  |
| Control Structures |  |  |  |  |  |  |  |
| Connection Pipe/Tile |  |  |  |  |  |  |  |
| Woodships (with transport) |  |  |  |  |  |  |  |
| Cultipacking |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| *Maintenance* |  |  |  |  |  |  |  |
| Mow, rake, bale, move |  |  |  |  |  |  |  |
| OR |  |  |  |  |  |  |  |
| Burn |  |  |  |  |  |  |  |
| Mowing |  |  |  |  |  |  |  |
| General operating costs |  |  |  |  |  |  |  |
| Adjust Control Gates |  |  |  |  |  |  |  |
| Replace Control Gates |  |  |  |  |  |  |  |
| Replace Woodchips (with transport) |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| *Acquisition* |  |  |  |  |  |  |  |
| Land rent |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

1. All costs have been calculated using standard discounted cash flow analysis and annualized over a 20-year period using a real 2% discount rate. Rounded to nearest dollar. Opportunity costs where relevant and indirect costs not considered here. [↑](#footnote-ref-1)
2. Nitrogen reduction practices and their potential impact on N-load reduction from the IA NRS. Adapted from Lawrence and Benning (2019). [↑](#footnote-ref-2)
3. Prairie strip costs being modeled represent a CP 43 prairie strip economy mix. Burning is assumed to be the primary long-term management. [↑](#footnote-ref-3)
4. Cover crop was winter cereal rye (Secale cereal L.), planted with aerial seeding, and chemically terminated. Costs can vary depending on species or mix being planted and choice of planting and termination. Assumed that cover crops do not have an effect on cash crop yield. [↑](#footnote-ref-4)
5. Costs for grassed waterway assumes grading and outlet stabilization; cost could be considerably less than presented if these actions are not required. Tall fescue is the grass choice; costs of seed may vary depending on species. [↑](#footnote-ref-5)
6. Costs of nutrient removal wetlands can vary considerably depending on overall scale, engineering design needs, initial site conditions, and amount of earth and rock moving required. [↑](#footnote-ref-6)
7. The cost of a bioreactor depends upon the drainage area being treated and the scale of trench. This assessment assumes a 20-hectare drainage area and two control structures. [↑](#footnote-ref-7)
8. The cost of saturated buffers is based on 305 meters of connecting tile to route drainage from 12.15 hectares and one control structure. Assumes a carbon source is present. [↑](#footnote-ref-8)
9. Assumes pond is an embankment style pond, 2.1-meter depth capacity. Pond sealant not considered; if needed would add ~$700 per year to cost. [↑](#footnote-ref-9)