CHIPPEWA/LUCE/MACKINAC CONSERVATION DISTRICT
2847 ASHMUN STREET SAULT STE. MARIE, MI 49783
906-635-1278 CLMCD@MACD.ORG WWW.CLMCD.ORG
"Our mission is to assist with land use and management through education, community projects and services."

Request for Bids
Chippewa/Luce/Mackinac Conservation District (CLMCD)
Waishkey River Watershed Farmland Runoff Reduction Project
Bid Period Open: January 19th, 2026 to February 13th, 2026
Bid Opening: February 13th, 2026 at 9:01am

Waishkey River Watershed Farmland Runoff Reduction Project Site #2 – Heavy Use Area Protection & Earth Work

CLMCD invites qualified contractors to provide bids for Site #2 for an early summer 2026 installation.

1. SUMMARY

Professional contractors with experience and expertise in earth work, drainage management, from the Natural Resources Conservation Service (NRCS) are invited to submit a competitive bid for work associated with Waishkey River Watershed Farmland Runoff Reduction Project. The project site is located on South Maple Road, less than three miles from I-75 Exit 386. Contractors will need to comply fully with NRCS standards. This project includes the installation of the following;

- 250 ft French drain
- 17,500 ft² 22A Aggregate heavy use area protection (HUAP)
- ~2,000 ft. of light land leveling

Installers will need to have a high degree of flexibility and communication. Installers will need to have the ability to meet with CLMCD to complete the project and be able to provide itemized invoices. The Request for Bids does not constitute a contract for services performed or to be performed. Following the selection of the successful contractor, CLMCD and the contractor will negotiate a contract including a full scope of services. If there are any questions, contact Mr. Mike McCarthy at 906-635-1278 mike.mccarthy@macd.org or Mrs. Madeline Drent CLMCD Watershed Technician at 906-748-0837 madeline.drent@macd.org.

The contractors' services will consist of providing all necessary labor, equipment and materials for the completion of this project in accordance with the anticipated scope of service specifications in Section 2.

2. ANTICIPATED SCOPE

Four horses and one mini-pony reside on this property. The owner overwinters the animals in the 17,500 ft² paddock, which has begun to wash away during the spring melt and has become a threat to the nearby stream. An aggregate HUAP will reinforce this paddock and direct water away from the stream and barn. This area will need to be sloped accordingly by the selected contractor. Within the HUAP, a 20'x20' manure storage bin is scheduled for construction in the

southeast corner. Finally, the landowner had previous grading along the stream bank that needs re-graded to allow water to flow into the stream without being trapped. Light grading this area to remove piled soil will need to be completed. Approx. 2,000 feet of stream is affected.

3. SCHEDULE FOR COMPLETION

CLMCD is expecting to have the project completed by July 2026.

- Contractors should purchase materials and begin installation as soon as permitted. *If the contractor is not able to meet the timelines, the contractor bid should provide a timeline of their own to be considered.*
    - **Pre-construction meeting is required with CLMCD and landowner.**
- March - July 2026 – Contractor should complete the given project to NRCS standards provided by CLMCD. Finished project will be inspected for quality and quantity upon completion by CLMCD. Invoice should be submitted to CLMCD itemized by project within 30 days of completion.

Any bidder will be given the option to see the project area with CLMCD project staff before the bidding period ends. Bidders can request a to see the project area by contacting Madeline Drent, Watersheds Technician at 906-748-0837 or by email at madeline.drent@macd.org. **Site visits are highly recommended to fully understand the project.**

4. SUBMITTAL REQUIREMENTS

Please submit one electronic copy of your bid in .PDF format no later than **9:00 AM EST** on **February 13th, 2026** to Mr. Mike McCarthy at clmcd@macd.org

In the interest of fairness to all bidders and to facilitate timely review, any bids received after the scheduled receipt time stated above will be rejected and not reviewed. All bids received on time become the property of the CLMCD and will not be returned.

In compliance with CLMCD policy, all bids will be opened on February 13th, 2026 at 9:01 am. The bid will be opened by a CLMCD Staff member, analyzed and brought to the CLMCD Board for approval. All contractors may be present for the bid opening.

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5. What to Submit

To facilitate review of the bids, the bidders are requested to organize the bid package as follows:

- 1-2 page 8.5" x 11" letter sized paper with company's name, address, telephone number, and email.
- Brief paragraph providing experience for the type of project being bid on and using 3rd party standards, specifically NRCS standards.
- Bid price for the project with a breakdown showing the price of each component. See below for an example
- A timeline of when the project will be complete
- Date bid was submitted
- Signature of bidder.

Itemized List Example

Values shown here are fictional and not expectations for real pricings.

Item	Quantity	Price	Cost
Fence Posts	200	$12	$2400.00
Labor - hours	45	$32	$1440.00
High Tensile Wire	2	$200	$400.00
Strainer	10	$5	$50.00
		Total Cost	$4290.00

Attached: Map of Project Area, NRCS HUAP Standard, NRCS Subsurface Drain Standard, NRCS Streambank Stabilization Standard

This request for bid does not commit CLMCD to enter into agreement, to pay any costs incurred in the preparation of a proposal in response to this request or in subsequent negotiations, or to procure a contract for the project. CLMCD will require the selected bidder, if any, to participate in negotiations and to absorb such cost, technical and/or other revisions to the proposals as may result from negotiations. CLMCD reserves the right to perform all or some of the scope items listed herein with its own work force.

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

HEAVY USE AREA PROTECTION

CODE 561

(sf)

DEFINITION

Stabilization or protection of an intensively used area.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce soil erosion
- Provide a stable, noneroding surface for areas frequently used by animals, people, or vehicles
- Protect or improve water quality

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where a frequently or intensively used area requires relocation or treatment to address one or more resource concerns.

CRITERIA

General Criteria Applicable to All Purposes

Installation and operation of heavy use area must comply with all Federal, State, Tribal, and local laws, rules and regulations.

Design load

Base the design load on the type and frequency of traffic (vehicular, animal, or human) anticipated on the heavy use area.

Foundation

Evaluate the site foundation to ensure that the presumptive bearing capacity of the soil meets the intended design load and frequency of use for the anticipated climate conditions. Prepare the foundation by removal and disposal of materials that are not adequate to support the design loads.

Use a base course of gravel, crushed stone, other suitable material, geotextile, or a combination of materials on all sites that need increased load-bearing strength, drainage, separation of material, and soil reinforcement. Refer to NRCS Technical Note (Title 210), Agricultural and Biological Engineering (AEN), Technical Note 4, “Earth and Aggregate Surfacing Design Guide,” and MI-165 Construction Specification, Geotextiles.

Surface treatment

Select a surface treatment that is stable and appropriate to the purpose of the heavy use area. Use concrete, bituminous concrete pavement, cementitious materials, mulches, aggregates, geotextiles, or a combination of materials to prevent punching or rutting failure in a heavy use area. Surface treatments must meet the following requirements according to the material used.

Concrete

Design concrete structures and slabs-on-ground in accordance with NRCS National Engineering Manual (NEM) (Title 210), Part 536, “Structural Engineering.”

- Use American Concrete Institute (ACI) 360, Design of Slabs-on-Ground, when subject to distributed stationary loads, light vehicular traffic, or infrequent use of heavy trucks or agricultural equipment in accordance with ACI Guide for the Design and Construction of Parking Lots (ACI 330R).
- Where the specific yield strength of reinforcement (f_y) does not exceed 60,000 lbs/in^2 use ACI Building Code Requirments for Reinforced Concrete (ACI 318)
- Design slabs-on-ground subject to regular or frequent heavy truck or heavy agricultural equipment traffic in accordance with ACI Guide to Design of Slabs-on-Ground (ACI 360R).
- Where it is necessary to limit the permeability of the concrete, Design liquid-tight slabs in accordance with ACI, Environmental Engineering Concrete Structures, Slabs-on-Soil (ACI 350, Appendix H).

Bituminous concrete pavement

Refer to the American Association of State Highway and Transportation Officials (AASHTO) “Guide for Design of Pavement Structures” or the applicable State highway department’s specification for design criteria for bituminous concrete paving.

In lieu of a site-specific design for areas that will be subject to light use, pave with a minimum of 4 inches of compacted bituminous concrete over a subgrade of at least 4 inches of well-compacted gravel. Use bituminous concrete mixtures commonly used for road paving in the area.

Other cementitious materials

Cementitious materials such as soil cement, agricultural lime, roller-compacted concrete, and coal combustion byproducts (flue gas desulphurization sludge and fly ash) can be used to provide a durable, stable surfacing material. Where coal combustion by-products are used, consult with the Michigan Department of Environment, Great Lakes & Energy regarding conditions of use and permit requirements.

Based on the properties of the surface material, develop a site-specific mix design with compressive strengths necessary for the expected use and loading on the heavy use area. Select materials that are nontoxic and that have chemical properties that are compatible with the intended use.

Aggregate

Design aggregate surfaces for expected wear and intended use. In lieu of a site-specific design for areas that will be subject to light nonvehicular use, install a minimum combined thickness for aggregate surfacing and base course of 6 inches for animals and 4 inches for other applications.

For other applications, use NRCS Technical Note (Title 210), AEN, Technical Note 4, “Earth and Aggregate Surfacing Design Guide,” or other appropriate methodology to design aggregate thickness.

Mulches

Use a minimum layer thickness of 6 inches for materials such as limestone screenings, cinders, tanbark, bark mulch, brick chips, or shredded rubber. Mulches are not recommended for livestock or vehicular applications.

Vegetation

Use vegetative measures only on areas where traffic can be managed so the vegetative cover can be maintained. Select grass species or other plant materials that are wear resistant, have fast recovery from heavy use, and are suitable to the site. Establish the vegetation in accordance with the criteria in NRCS Conservation Practice Standard (CPS) Critical Area Planting (Code 342) or the appropriate State reference.

For heavy use areas managed as vegetated lots, provide an adequate number of lots in the system to allow the vegetation to be sustained by moving the animals. Establish a rotation that ensures the vegetated lot will be used only when vegetation has had time to recover between animal activities.

Other
Other materials can be used for surface treatment if they will serve the intended purpose and design life.

Drainage
Include provisions in the design for surface and subsurface drainage, as needed. Design positive grade in the planned direction of flow. Fill low areas that may contribute to subgrade instability or ground water contamination.

Diversion of clean water
To the extent possible, prevent surface water from entering the heavy use area. Refer to NRCS CPSs Diversion (Code 362), Underground Outlet (Code 620), Roofs and Covers (Code 367), Roof Runoff Structure (Code 558), or other appropriate CPSs for drainage control. Include provisions for disposal of runoff without causing erosion or water quality impairments.

Stabilization and erosion control
Stabilize all areas disturbed by construction as soon as possible after construction. Refer to the criteria in NRCS CPS Critical Area Planting (Code 342) for establishment of vegetation. If vegetation is not appropriate for the site, use the criteria in NRCS CPS Mulching (Code 484) to stabilize the disturbed area.

Water quality
If there is the potential for ground water contamination from the heavy use area, select another site.

For heavy use areas with surface water quality concerns, relocate the site or make provisions to collect, store, treat, or utilize contaminated surface runoff from the heavy use area. Include provisions to address runoff without causing erosion or water quality impairment. Use NRCS CPS's Waste Transfer (Code 634), Vegetated Treatment Area (Code 635), Critical Area Planting (Code 342), Fence (Code 382), Prescribed Grazing (Code 528), Filter Strip (Code 393), Access Control (Code 472), or other similar CPSs as supporting practices, when needed.

Recreation
Address accessibility requirements for new construction and when existing facilities are being altered. The Americans with Disabilities Act of 1990 (ADA) requires recreation areas that are used by the public to be accessible to people with disabilities.

Additional Criteria for Livestock Heavy Use Areas
Utilize other practices to collect, store, utilize or treat manure and contaminated runoff where nutrient rich runoff will cause a resource concern to waters of the state.

Determine the animal yard area (square feet/head) for a planned heavy use area using state guidance or base the heavy use area on future farm goals and objective. Minimizing the heavy use area size whenever possible.

CONSIDERATIONS

Heavy use areas can have a significant impact on adjoining land uses. These impacts can be environmental, visual, and cultural. Select a treatment that is compatible with adjoining areas. Consider such things as proximity to neighbors and the land use where the stabilization will take place.

Vegetated heavy use areas may need additional materials such as geogrids or other reinforcing techniques or planned periods of rest and recovery to ensure that vegetative stabilization will succeed. Re-evaluate the size of the area to allow plant recovery periods. Include plans to re-vegetate areas as needed.

Consider the safety of the users during the design. Avoid slippery surfaces, sharp corners, or surfaces and structures that might entrap users.

For heavy use areas used by animals, avoid the use of angular aggregates that might injure livestock. When concrete is used for livestock imprint or texture concrete to provide traction in wet or freezing conditions.

Paving or otherwise reducing the permeability of the heavily used area can reduce infiltration and increase surface runoff. Depending on the size of the heavy use area, this can have an impact on the water budget of the surrounding area. Consider the effects to ground and surface water.

To reduce the negative water quality impact of heavy use areas, consider locating them as far as possible from water bodies or water courses. In some cases, this may require relocating the heavily used area rather than just armoring an area that is already in use. Discharge from a heavy use area to waters of the state is not permitted. Where moving the heavy use site cannot be achieved to obtain a suitable distance to surface waters, then runoff must be prevented, treated, or stored. A roof structure may be considered to prevent direct precipitation on the heavy use area surface from creating polluted runoff.

To the extent possible, maintain a 2-foot separation distance between the bottom of the surface material and the seasonal high water table or bedrock.

To reduce the potential for air quality problems from particulate matter associated with a heavy use area, consider the use of NRCS CPSs Windbreak/Shelterbelt Establishment (Code 380), Herbaceous Wind Barriers (Code 603), Dust Control from Animal Activity on Open Lot Surfaces (Code 375), or Dust Control on Unpaved Roads and Surfaces (Code 373) to control dust from heavy use areas.

Consider ways to reduce the size of the heavy use area as much as possible. This may require changes in how the livestock are managed but in the long run may result in less maintenance and a more efficient operation.

Consider a concrete or other durable surface for areas that require frequent scraping.

Where muddy sites hinder vehicle movement or movement of livestock consider using NRCS CPS Access Road (560), or Trails and Walkways (575).

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for installing the practice according to this standard. As a minimum, include—

- A plan view showing the location and extent of the practice. Include the location and distances to adjacent features and known utilities.
- Typical sections showing the type and required thickness of paving or stabilization materials.
- A grading plan, as needed.
- Where appropriate, plans for required structural details.
- Methods and materials used to stabilize areas disturbed by construction.
- Construction specifications with site-specific installation requirements.
- Vegetative establishment specifications, as applicable.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance (O&M) plan and review it with the operator prior to practice installation. The minimum requirements to be addressed in the O&M plan are—

- Periodic inspections—annually and immediately following significant rainfall events.
- Prompt repair or replacement of damaged components, especially surfaces that are subjected to

wear or erosion.

- Requirements for the regular removal and management of manure, as needed, for livestock heavy use areas.
- Restricted uses, as needed, to protect the stand and to allow vegetative recovery for vegetated heavy use areas.

REFERENCES

American Concrete Institute. 2010. Guide to Design of Slabs-on-Ground. ACI 360R-10. Farmington Hills, MI.

American Concrete Institute. 2008. Guide for the Design and Construction of Concrete Parking Lots. ACI 330R-08. Farmington Hills, MI.

American Concrete Institute. 2006. Code Requirements for Environmental Concrete Structures. ACI 350-06, Appendix H, Slabs on Soil. Farmington Hills, MI.

American Concrete Institue. 2019. Building Code Requirements for STructural Concrete. ACI 318-19. Farmington Hills, MI.

American Association of State Highway and Transportation Officials. 1993. AASHTO Guide for Design of Pavement Structures. Washington, D.C.

Korcak, R.F. 1998. Agricultural Uses of Coal Combustion Byproducts. *In* R.J. Wright, et al. (eds.). Agricultural Uses of Municipal, Animal, and Industrial Byproducts. USDA-ARS, Conservation Research Report 44, pp. 103-119.

USDA NRCS. 2017. Technical Note (Title 210) Agricultural and Biological Engineering, Agricultural Engineering Technical Note 4, Earth and Aggregate Surfacing Design Guide. Washington, D.C. https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=41362.wba

USDA NRCS. 2017. National Engineering Manual (Title 210), Part 536, Structural Engineering. Washington D.C https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=41175.wba

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

STREAMBANK AND SHORELINE PROTECTION

CODE 580

(ft)

DEFINITION

Treatment(s) used to stabilize and protect banks of streams or constructed channels and shorelines of lakes, reservoirs, or estuaries.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Prevent the loss of land or damage to land uses or facilities adjacent to the banks of streams or constructed channels and shorelines of lakes, reservoirs, or estuaries. This includes the protection of known historical, archaeological, and traditional cultural properties.
- Maintain the flow capacity of streams or channels.
- Reduce the offsite or downstream effects of sediment resulting from bank erosion.
- Improve or enhance the stream corridor or shoreline for fish and wildlife habitat, aesthetics, or recreation.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to streambanks of natural or constructed channels and shorelines of lakes, reservoirs, or estuaries susceptible to erosion. It does not apply to erosion problems on main ocean fronts, beaches, or similar areas of complexity. It does not apply to erosion problems created by wave action on the open and unprotected shores of the Great Lakes.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct this practice to comply with all Federal, State, Tribal and local laws, rules, and regulations. The landowner must obtain all necessary permissions from regulatory agencies, or document that no permits are required. The landowner and/or contractor is responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

Assess unstable streambank or shoreline sites in enough detail to identify the causes contributing to the instability. The assessment should provide details necessary for design of the treatments and convey reasonable confidence that the treatments will perform adequately for the design life of the measure. If the failure mechanism for a streambank is a result of the degradation or removal of riparian vegetation, if possible, implement stream corridor restoration, along with bank treatment.

Causes of instability include—

- Livestock access;
- Watershed alterations resulting in significant modifications of discharge or sediment production;

- In-channel modifications such as gravel mining;
- Head cutting;
- Water level fluctuations; and
- Boat-generated waves.

Design streambank and shoreline treatments that are compatible with—

- Existing bank or shoreline materials;
- Planned improvements or improvements installed by others;
- Water chemistry;
- Channel or lake hydraulics; and
- Slope characteristics above and below the water line.

Avoid adverse effects on—

- Endangered, threatened, and candidate species and their habitats;
- Archaeological, historical, structural, and traditional cultural properties; and
- Existing wetland functions and values.

Design treatments that result in stable slopes based on the bank or shoreline materials and the type of measure proposed. Account for anticipated ice action, wave action, and fluctuating water levels. Ensure that installations are protected from overbank flows from upslope runoff and flooding. Include internal drainage where bank seepage is a problem. Use geotextiles, designed filters, or bedding to prevent piping or erosion of material from behind the treatment. Anchor end sections into existing treatments or existing stable areas.

Revegetate all areas disturbed during construction in accordance with NRCS Conservation Practice Standard (CPS) Critical Area Planting (Code 342). If climatic conditions preclude the use of vegetation, use NRCS CPS Mulching (Code 484) to install inorganic cover materials such as gravel. Protect the area from livestock and human traffic until the site is fully stabilized.

Additional Criteria for Streambanks

Assess stream segments to be protected using the Stream Classified System (Rosgen, 1996) or a Channel Evolution Model (Simon, 1989 or Schumm, et al., 1984). Evaluate incised segments or segments that contain the 5-year return period (20 percent probability) or greater flows for further degradation or aggradation.

Do not realign the channel without an assessment of upstream and downstream fluvial geomorphology that evaluates the impacts of the proposed alignment. Determine the current and future discharge-sediment regime using an assessment of the watershed upstream of the proposed channel alignment.

Do not install bank protection treatment in channel systems undergoing rapid and extensive changes in bottom grade and/or alignment unless designing the treatments to control or accommodate the changes. Construct bank treatment to a depth at or below the anticipated lowest depth of streambed scour.

Stabilize toe erosion by treatments that redirect the stream flow away from the toe or by structural treatments that armor the toe. Where toe protection alone is inadequate to stabilize the bank, shape the upper bank to a stable slope and establish vegetation, or stabilize with structural or soil bioengineering treatments.

To the extent possible, retain or replace habitat-forming elements that provide cover, food, pools, and water turbulence. This includes stumps, fallen trees, debris, and sediment bars. Only remove these

stream habitat elements when they cause unacceptable bank erosion, flow restriction, or damage to structures.

Design treatments to remain functional and stable for the design flow and sustainable for higher flow conditions. Evaluate the effects of changes to flow levels compared with the preinstallation flow levels, for low and high flow conditions. Ensure treatments do not limit stream flow access to the floodplain. Do not design treatments that result in negative offsite impacts such as increased channel or bank erosion downstream.

Design the top elevation structural treatments to the elevation of the 5-year return period (20 percent probability) peak discharge or bankfull discharge whichever is lower in elevation. Implement other measures to ensure stability when structural measures do not extend to the top of the bank. Design structural measures to be stable based on conditions with flow depth at the top of bank as a minimum.

Prevent undercutting by scour where structural measures are used for bank or toe protection. Provide protection from erosion at both the upstream and downstream ends of structural measures.

Additional Criteria for Shorelines

For the design of structural treatments, evaluate the site characteristics below the waterline for a minimum of 50 feet horizontally from the shoreline measured at the design water surface. Base the height of the protection on the design water surface plus the computed wave height and freeboard. Use mean high tide as the design water surface in tidal areas. Limit revetments, bulkheads, or groins to no higher than 3 feet above mean high tide, or mean high water in nontidal areas. Key-in structural shoreline protective treatments to a depth that prevents scour during low water.

When using vegetation as the protective treatment, include a temporary breakwater during establishment when wave run-up could damage the vegetation.

Additional Criteria for Stream Corridor Improvement

Establish stream corridor vegetative components as necessary for ecosystem function and stability. The appropriate composition of vegetative components is a key element in preventing excess long-term channel migration in reestablished stream corridors. Establish vegetation on channel banks and associated areas according to NRCS CPS Critical Area Planting (Code 342).

Design treatments to achieve habitat and population objectives for fish and wildlife species or communities of concern as determined by a site-specific assessment or management plan. Establish objectives on the survival and reproductive needs of populations and communities, including habitat diversity, habitat linkages, daily and seasonal habitat ranges, limiting factors, and native plant communities. Develop the requirements for the type, amount, and distribution of vegetation using the requirements of the fish and wildlife species or communities of concern.

Design treatments to meet aesthetic objectives as determined by a site-specific assessment or management plan. Establish aesthetic objectives based on human needs, including visual quality, noise control, and microclimate control. Use construction materials, grading practices, and other site development elements compatible with adjacent land uses.

CONSIDERATIONS

When designing protective treatments, consider changes that may occur in the watershed hydrology and sedimentation over the design life of the treatments.

Incorporate debris removed from the channel or streambank into the treatment design when it is compatible with the intended purpose to improve benefits for fish, wildlife, and aquatic systems.

Use construction materials, grading practices, vegetation, and other site development elements that minimize visual impacts and maintain or complement existing landscape uses such as pedestrian paths, climate controls, buffers, etc. Avoid excessive disturbance and compaction of the site during installation.

Use vegetative species that are native and/or compatible with local ecosystems. Avoid introduced species that could become nuisances. Consider species that have multiple values such as those suited for biomass, nuts, fruit, browse, nesting, aesthetics, and tolerance to locally used herbicides. Avoid species that may be alternate hosts to disease or undesirable pests. Consider species diversity to avoid loss of function due to species-specific pests.

Select plant materials that provide habitat requirements for desirable wildlife and pollinators. The addition of native forbs and legumes to grass mixes will increase the value of plantings for both wildlife and pollinators. Consider and refer to NRCS CPS Wetland Wildlife Habitat Management (Code 644).

Use treatments that promote beneficial sediment deposition and the filtering of sediment and sediment-attached and dissolved substances.

Maintain or improve fish and wildlife habitat by including treatments that provide aquatic habitat in the treatment design and that may lower or moderate water temperature and improve water quality.

Stabilize side channel inlets and outlets, and outlets of tributary streams from erosion.

Maximize adjacent wetland functions and values with the project design to the extent practicable.

To maintain plant community integrity, exclude livestock during establishment of vegetative treatments and apply appropriate grazing practices after establishment.

Control wildlife during establishment of vegetative treatments. Use temporary and local population control methods with caution and within applicable regulations.

When appropriate, consider establishing a buffer strip and/or diversion at the top of the bank or shoreline protection zone to help maintain and protect installed treatments, improve their function, filter out sediments, nutrients, and pollutants from runoff, and provide additional wildlife habitat.

Consider safety hazards to boaters, swimmers, or people using the shoreline or streambank when designing treatments. Place warning signs as necessary.

Consider installing self-sustaining or minimal maintenance treatments.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard. Include provisions to minimize erosion and sediment production during construction and provisions necessary to comply with conditions of any environmental agreements, biological opinions, or other terms of applicable permits. At a minimum, include—

- A plan view of the layout of the streambank and shoreline protection.
- Typical profiles and cross sections of the streambank and shoreline protection.
- Structural drawings adequate to describe the construction requirements.
- Requirements for vegetative establishment and mulching, as needed.
- Safety features.
- Site-specific construction and material requirements.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator.

At a minimum, include—

- Instructions for operating and maintaining the system to ensure it functions properly.
- Periodic inspections and prompt repair or replacement of damaged components.
- Periodic inspections and prompt repair of erosion.
- Instructions for maintaining healthy vegetation, when required.
- Instructions for controlling undesirable vegetation.

REFERENCES

USDA NRCS. 1996. National Engineering Handbook (Title 210), Part 650, Chapter 16, Streambank and Shoreline Protection. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2008. National Engineering Handbook (Title 210), Part 654, Stream Restoration Design. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2010. National Engineering Handbook (Title 210), Part 653, Stream Corridor Restoration: Principles, Processes, and Practices. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2017. National Engineering Manual (Title 210). Washington, D.C. https://directives.sc.egov.usda.gov/

Rosgen, 1996. Applied River Morphology. Wildland Hydrology, Colorado.

Schumm, Harvey and Watson, 1984. Incised Channels: Morphology, Dynamics and Control. Water Resources Publications, Littleton, Colorado.

Simon, 1989. A model of channel response in distributed alluvial channels. Earth Surface Processes and Landforms 14(1): 11-26.

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

SUBSURFACE DRAIN

CODE 606

(ft)

DEFINITION

A conduit, or system of conduits, installed beneath the ground surface to manage soil water conditions.

PURPOSE

Use this practice to accomplish one or more of the following purposes:

- Remove or distribute soil water
- Remove salts and other contaminants from the soil profile
- Mitigate degraded plant health and vigor and undesirable plant productivity due to saturated soil, ponding, and flooding
- Mitigate degraded animal health productivity due to saturated soil, ponding, and flooding

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where a shallow water table exists or where a subsurface drainage system can mitigate one or more of the following adverse conditions caused by excessive soil moisture:

- Poor health, vigor, and productivity of plants
- Poor field trafficability
- Accumulation of salts in the root zone
- Health risk and livestock stress due to pests
- Adverse soil conditions around farmsteads, structures, and roadways

This practice also applies to water distribution through subsurface drain pipe for utilization or treatment.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct this practice to comply with all applicable Federal, State, Tribal, and local laws and regulations. The landowner must obtain all necessary permissions from regulatory agencies or document that no permits are required. The landowner or contractor is responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

If wetlands are present, complete an appropriate wetland determination per established procedures. Avoid adverse effects of the drainage system on the ecology and hydrology of the site and on adjacent lands, especially potential or delineated wetlands, existing easements, and wildlife habitat.

Capacity

Base design capacity on the following, as applicable:

- Recommendations from the State drainage guide
- Application of a locally proven drainage coefficient for the acreage drained
- The yield of ground water based on the expected deep percolation of irrigation water from the overlying fields, including leaching requirement
- Comparison of the site to other similar sites with known subsurface drain yields
- Measurement of the rate of subsurface flow at the site during a period of adverse weather and ground water conditions
- Application of Darcy's law to lateral or artesian subsurface flow
- Contributions from surface inlets based on hydrologic analysis or flow measurements
- Drain inlet opening size versus drain intake rate

Size
Compute the drain size by applying Manning's formula, using roughness coefficients recommended by the manufacturer of the conduit or coefficients adopted by the regulating authority. Base the size on the maximum design flow rate and compute using one of the following:

- The hydraulic grade line parallel to the bottom grade of the subsurface drain with the conduit flowing full at design flow (normal condition, no internal pressure)
- Conduit flowing partly full where a steep grade or other conditions require excess capacity
- Conduit flowing under internal pressure with hydraulic grade line set by site conditions, which differs from the bottom grade of the subsurface drain

All subsurface drains must have a nominal diameter that equals or exceeds 3 inches.

Internal hydraulic pressure
Drains are normally designed to flow with no internal pressure, and the flow is normally classified as open channel. Maintain the design internal pressure of drains at or below the limits recommended by the manufacturer of the conduit.

Horizontal alignment
Accomplish a change in horizontal direction of the subsurface drain by one of the following methods:

- The use of manufactured fittings
- The use of junction boxes or manholes
- A gradual curve of the drain trench on a radius in accordance with the limitations of the installation equipment and the recommendations of the pipe manufacturer while maintaining grade

Location, depth, and spacing
Base the location, depth, and spacing of the subsurface drain on site conditions including soils, plants, topography, ground water conditions, crops, land use, outlets, saline or sodic conditions, and proximity to wetlands.

The minimum depth of cover over subsurface drains may exclude sections of conduit near the outlet or through minor depressions, providing these sections of conduit are not subject to damage by frost action or equipment travel.

In mineral soils, provide a minimum depth of cover over subsurface drains of 2 feet.

In organic soils, provide a minimum depth of cover after initial subsidence of 3 feet. If water control structures are installed and managed to limit oxidation and subsidence of the soil, the minimum depth of cover may be reduced to 2.5 feet.

For flexible conduits, base maximum burial depth on the manufacturer's recommendations for the site conditions or on a site-specific engineering design consistent with methods in NRCS National Engineering Handbook (NEH) (Title 210), Part 636, Chapter 52, "Structural Design of Flexible Conduits."

For computation of maximum allowable loads on subsurface drains of all materials, use the trench and bedding conditions specified and the compressive strength of the conduit. Base the design load on the conduit from a combination of embedment, backfill, and live loads.

Base live loads on the maximum equipment or vehicle wheel loads. Equipment loads on the conduit may be neglected when the depth of cover exceeds 6 feet.

Minimum velocity and grade
In areas where sedimentation of fine sands and silts is not a hazard, design the minimum grade based on site conditions and velocity of not less than 0.5 feet per second. If a sedimentation potential exists, use a velocity of not less than 1.4 feet per second to establish the minimum grade. Otherwise, include provisions for preventing sedimentation by use of filters or by collecting and periodically removing sediment from installed traps, or by periodically cleaning the lines with high-pressure jetting systems or cleaning solutions. Prior to using high-pressure jetting systems, verify that the jetting system will not damage the pipe or the pipe embedment.

Maximum velocity
Limit the maximum velocity in a perforated corrugated plastic drainage pipe under open channel flow to 12 feet per second unless further restricted by the manufacturer's recommendation.

Limit the maximum design velocities in open-joint pipe (clay or concrete) to those given in table 1 if protective measures are not installed. Refer to NRCS 210-NEH, Section 16, Chapter 4, "Subsurface Drainage."

Table 1. Maximum Flow Velocities by Soil Texture

Soil Texture	Velocity (ft/s)
Sand and sandy loam	3.5
Silt and silt loam	5.0
Silty clay loam	6.0
Clay and clay loam	7.0
Coarse sand or gravel	9.0

Protective measures for high velocities in open-joint pipe may include the following, as appropriate:

- Bed the conduit in a sand and gravel envelope that is filter-compatible with the joint openings and surrounding soil
- Wrap the joints with nonwoven geotextile

Releases from water control structures must not cause flow velocities in perforated or open-joint drains to exceed allowable velocities in table 1, unless protective measures are installed.

Thrust control
Follow pipe manufacturer's recommendations for thrust control or anchoring where the following conditions exist:

- Axial forces that tend to move the pipe down steep slopes
- Thrust forces from abrupt changes in pipeline grade or horizontal alignment that exceed soil-bearing strength
- Reductions in pipe size

In the absence of manufacturer's data, design thrust blocks in accordance with NRCS 210-NEH-636-52.

Outlets
Provide drainage outlets adequate for the quantity and quality of water to be discharged.

Avoid submerged outlets unless intermittent submerged outlets are designed for protection from root clogging. For discharge to streams or channels, locate the outlet invert above the elevation of normal flow and at least 1 foot above the channel bottom.

For outlets into sumps, locate the discharge elevation above the elevation at which pumping is initiated.

Protect outlets against erosion and undermining of the conduit, entry of tree roots, damaging periods of submergence, and entry of rodents or other animals into the subsurface drain.

Use a continuous section of rigid pipe, without open joints or perforations and with stiffness necessary to withstand expected loads at the outlet end of the drain line. Table 2 shows minimum lengths for the outlet section of the conduit. Unsupported single-wall corrugated plastic pipe is not suitable for the section that outlets into a ditch or channel.

Table 2. Minimum Length of Outlet Pipe Sections

Pipe Diameter (in)	Minimum Section Length (ft)
8 and smaller	10
10 to 12	12
15 to 18	16
Larger than 18	20

The use and installation of outlet pipe must conform to the following requirements:

- If burning vegetation on the outlet ditch bank is likely to create a fire hazard, select fireproof material for the pipe
- Bury at least two-thirds of the rigid outlet pipe section in the ditch bank and project the cantilever section past the toe of the ditch side slope; or protect the side slope from erosion below the outlet pipe
- If ice or floating debris may damage the outlet pipe, protect the pipe by recessing the cantilevered part of the pipe to protect it from the current of flow in the ditch or channel
- Headwalls used for subsurface drain outlets must be adequate in strength and design to avoid washouts and other failures

For outlets into sumps, locate the discharge elevation above the elevation at which pumping is initiated.

Protection from biological and mineral clogging
Drains in certain soils are subject to clogging of perforations by bacterial action in association with ferrous iron, manganese, or sulfides. Iron ochre can clog drain openings and seal manufactured (fabric) filters. Manganese deposits and sulfides can clog drain openings.

Where bacterial activity is expected to lead to clogging of drains, provide access points for cleaning the drain lines.

Where possible, outlet individual drains to an open ditch to isolate localized areas of contamination and to limit the translocation of contamination throughout the system.

Protection from root clogging
Problems may occur where drains are near perennial vegetation. Drain clogging may result from root penetration by water-loving trees, such as willow, cottonwood, elm, and soft maple, and some shrubs, grasses, and deep-rooted perennial crops growing near subsurface drains. Refer to the USDA PLANTS Database website as a preliminary planning tool for obtaining vegetation properties and qualities information.

Use one or more of the following steps to reduce the incidence of root intrusion:

- Install a continuous section of nonperforated pipe or tubing with sealed joints through the root zone
- Remove water-loving trees for a distance of at least 100 feet on each side of the drain and locate drains a distance of 50 feet or more from noncrop tree species
- Provide for intermittent submergence of the drain to limit rooting depth by installing a structure for water control that allows for raising the elevation of the drain outlet (e.g., an inline weir with adjustable crest)

Utilize the intermittent submergence option only when the raised elevation of the drain outlet will not adversely impact the performance of the land use supported by the subsurface drain, and where the raised elevation will not adversely impact flooding on neighboring properties.

Water quality
Do not connect septic systems to the subsurface drainage system, nor allow animal waste to be directly introduced into the subsurface drainage system.

Materials
Subsurface drains include flexible conduits of plastic, bituminized fiber, or metal; rigid conduits of vitrified clay or concrete; or other materials of acceptable quality.

The conduit must meet strength and durability requirements for the site. All conduits must meet or exceed the minimum requirements of the appropriate and current specifications published by the American Society for Testing and Materials (ASTM), American Association of State Highway Transportation Officials (AASHTO), or the American Water Works Association (AWWA).

Conduit foundation
If soft or yielding foundation conditions are encountered, stabilize the conduit foundation and protect the area from settlement. The following methods are acceptable foundation treatments:

- Remove the unstable material and provide stable bedding of granular envelope or filter material.
- Provide continuous cradle support for the conduit through the unstable section.
- Bridge unstable areas using long sections of a conduit having adequate strength and stiffness to ensure satisfactory subsurface drain performance.
- Place conduit on a flat, treated plank. This method must not be used for flexible conduits (e.g., plastic pipe) without proper bedding between the plank and conduit.
- Use bedding to avoid laying the pipe on rock, rocky soil, or extremely hard soil.

Conduit Placement and bedding
Placement and bedding requirements apply to both trenching and plow-type installations.

Place the conduit on a firm foundation to ensure proper alignment.

The conduits must not be placed on exposed rock, stones greater than 1.5 inches for conduits 6 inches or larger in diameter, or stones greater than three-fourths of an inch for conduits less than 6 inches in diameter. Where site conditions do not meet this requirement, the trench must be over-excavated a minimum of 6 inches and refilled to grade with suitable bedding material. For trench installations where a sand-gravel envelope or compacted bedding is not specified, the conduit embedment must be suitable backfill. Soil excavated from the trench may be used for backfill as long as it contains no hard objects larger than the specified stone sizes above. Place initial backfill to a minimum of 3 inches above the conduit. Compact backfill to a density similar to the surrounding soil material. Mound the backfill over the trench to provide material for settling.

If installation will be below a water table or where unstable soils are present, special equipment, installation procedures, or bedding materials may be needed. These special requirements may also be

necessary to prevent soil movement into the drain or plugging of the envelope if installation will be made in materials such as soil slurries.

For the installation of corrugated plastic pipe with diameter of 8 inches or less, specify one of the following bedding methods:

- Provide a shaped groove with an angle of support of 90 degrees or greater in the bottom of the trench for tubing support and alignment
- Provide a sand-gravel envelope, at least 3 inches thick, for support
- Provide compacted embedment material beside and to 3 inches above the conduit

For the installation of corrugated plastic pipe with diameter larger than 8 inches, the same bedding requirements apply except that a semicircular or trapezoidal groove shaped to fit the conduit with a support angle of 120 degrees will be used rather than a V-shaped groove.

For rigid conduits installed in a trench, the same requirements apply except that a groove or notch is not required.

Filter envelopes and materials
Design filters around conduits, as needed, to enhance water entry and stabilize the structure of the surrounding soil material. Determine the need for a filter by the characteristics of the surrounding soil material, site conditions, and the velocity of flow in the conduit. Use a suitable filter if any of the following conditions exist:

- Local experience with soil site conditions indicates a need
- Soil materials surrounding the conduit are dispersed clays, silts with a plasticity index less than 7, or fine sands with a plasticity index less than 7
- The soil is subject to cracking by desiccation
- The method of installation may result in inadequate consolidation between the conduit and backfill material

Design the sand or sand-gravel filter gradation in accordance with NRCS 210-NEH, Part 633, Chapter 26, “Gradation Design of Sand and Gravel Filters.”

Specified filter material must completely encase the conduit such that all openings are covered with at least 3 inches of filter material, except where the top of the conduit and side filter material will be covered by a sheet of plastic or similar impervious material to reduce the quantity of filter material required. In all cases, the resulting flow path through the filter material must be a minimum of 3 inches in length.

Use geotextile filter materials with the effective opening size, strength, durability, and permeability to prevent soil movement into the drain throughout the expected life of the system. Where the silt content in the soil exceeds 40 percent, ensure the geotextile filter material will not clog during its design life.

Hydraulic envelopes and materials
Use an envelope around subsurface drains, as needed, to improve flow conditions in the area immediately adjacent to the drain.

Materials used for envelopes must not contain materials that will cause an accumulation of sediment in the conduit or render the envelope unsuitable for bedding of the conduit.

Envelope materials must consist of sand-gravel, organic, or similar material. Use an envelope gradation such that 100 percent of sand-gravel passes a 1.5-inch sieve, not more than 30 percent passes a number 60 sieve, and not more than 5 percent passes a number 200 sieve.

Organic or other compressible envelope materials must not be used below the centerline of flexible conduits. If organic or other compressible materials are used they must be of a type that will not readily decompose within the expected lifespan of the practice.

Refer to NRCS 210-NEH, Part 650, Chapter 14, “Water Management (Drainage),” for more complete definitions of envelopes (e.g., hydraulic envelope, filter envelope, and bedding).

Auxiliary structures and protection
The capacity of any structure installed in the drain line must be no less than that of the line or lines feeding into or through the structure.

Structures for water table management, with provisions to elevate the outlet and allow submergence of the upstream drain, must meet applicable design criteria in NRCS Conservation Practice Standard (CPS) Structure for Water Control (Code 587). Mark buried boxes with surface evidence or referenced to fixed aboveground markings or structures.

Underground outlets connected to the subsurface drainage system must meet the applicable provision of NRCS CPS Underground Outlet (Code 620). Design the capacity of the surface water inlet to be no greater than the maximum design flow in the downstream drain line or lines. Install sediment traps if sediment might pose a problem.

Specify pressure relief wells as needed to allow excess flow to escape the conduit and flow over the ground surface. Use pressure relief wells where there is a stable outlet for the flow from the relief well. Cover the relief well with a grate or other appropriate means to prevent accidental entry of machines, animals, humans, and debris. Design the subsurface drain system to have a positive hydraulic grade to the relief well flow line. Base the relief well system capacity on the flow from the drainage system and other site conditions. Capacity must be adequate to lower the water head to the desired level. Relief wells must not be less than 4 inches in diameter.

Junction boxes, manholes, catch basins, and sediment traps must be accessible for maintenance. Provide a clear opening of not less than 2 feet in diameter or 2 feet by 2 feet square.

Protect the drain system against turbulence created near outlets, surface inlets, or similar structures. Use continuous nonperforated or closed-joint pipe in drain lines adjoining the structure where excessive velocities will occur.

As an alternative to manufactured fittings, install a junction box where three or more lines join or if two lines join at different elevations. Use a solid cover if the junction box is buried. The junction box should have a minimum of 1.5 feet of soil cover. Protect buried boxes from traffic.

If not connected to a structure, close the upper end of each subsurface drain line with a tight-fitting cap or plug of the same material as the conduit, or other durable materials.

Use watertight conduits designed to withstand the expected loads where subsurface drains cross under irrigation canals, ditches, or other structures.

CONSIDERATIONS

When planning, designing, and installing this practice, consider—

- Protection of shallow drains, auxiliary structures, and outlets from damage due to freezing and thawing
- Proper surface drainage to reduce the required capacity of the subsurface drainage system
- Designs that can incorporate drainage water management practices (or facilitate future incorporation of drainage water management) to reduce nutrient loading of receiving waters, including downstream drinking water sources.

- Drainage laterals oriented along elevation contours to improve the effectiveness of drainage water management structures
- The effects of drainage systems on runoff volume, seepage, and the availability of soil water needed for plant growth
- Confirmation of soil survey information with site investigation, including augering and shallow excavations to identify soil profile hydraulic characteristics, soil texture layering, water table depth, etc
- Maximizing wetland functions and values to the extent practicable
- Subsoiling or ripping of soils with contrasting texture layers to improve internal drainage. Where this treatment is needed use NRCS CPS Deep Tillage (Code 324)
- Installations in a dry soil profile to minimize problems of trench stability, conduit alignment, and soil movement into the drain
- The effects to surface water quality
- Using measures to reduce the risk of drain water contamination from surface applications of manure (e.g., temporary flow-blocking devices)
- Using NRCS CPSs Drainage Water Management (Code 554), Constructed Wetland (Code 656), Saturated Buffer (Code 604), or Denitrifying Bioreactor (Code 605) in conjunction with this standard where removal of nitrate nitrogen in subsurface drainage is needed
- Including a tailwater reuse system that conforms to NRCS CPS Irrigation and Drainage Tailwater Recovery (Code 447) in conjunction with this standard where excess soil water will be reused for irrigation
- The potential existence of a hazardous atmosphere in junction boxes or manholes

PLANS AND SPECIFICATIONS

Prepare plans and specifications for installing subsurface drains according to the applicable criteria that describe the requirements for implementing the practice to achieve its intended purpose.

At a minimum, plans and specifications must include, as applicable—

- Location and plan view of the drainage system
- Conduit lengths, grades, spacing, sizes, and type of materials
- Requirements and typical cross sections or details for the subsurface drain, filter, envelope, and bedding
- Structure locations, dimensions, and elevations
- Outlet locations, elevations, and protection required
- Location of utilities and notification requirements
- Construction specifications describing site-specific installation requirements of the subsurface drain

OPERATION AND MAINTENANCE

Provide an operation and maintenance (O&M) plan with specific instructions for operating and maintaining the system to ensure proper function as designed. At a minimum, the O&M plan must address—

- Necessary periodic inspection and prompt repair of system components (e.g., structures for water control, underground outlets, vents, drain outlets, trash, and rodent guards)
- Winterization protection from freezing conditions (if applicable) for drainage systems in cold climates
- Protection requirements during manure applications (if applicable)

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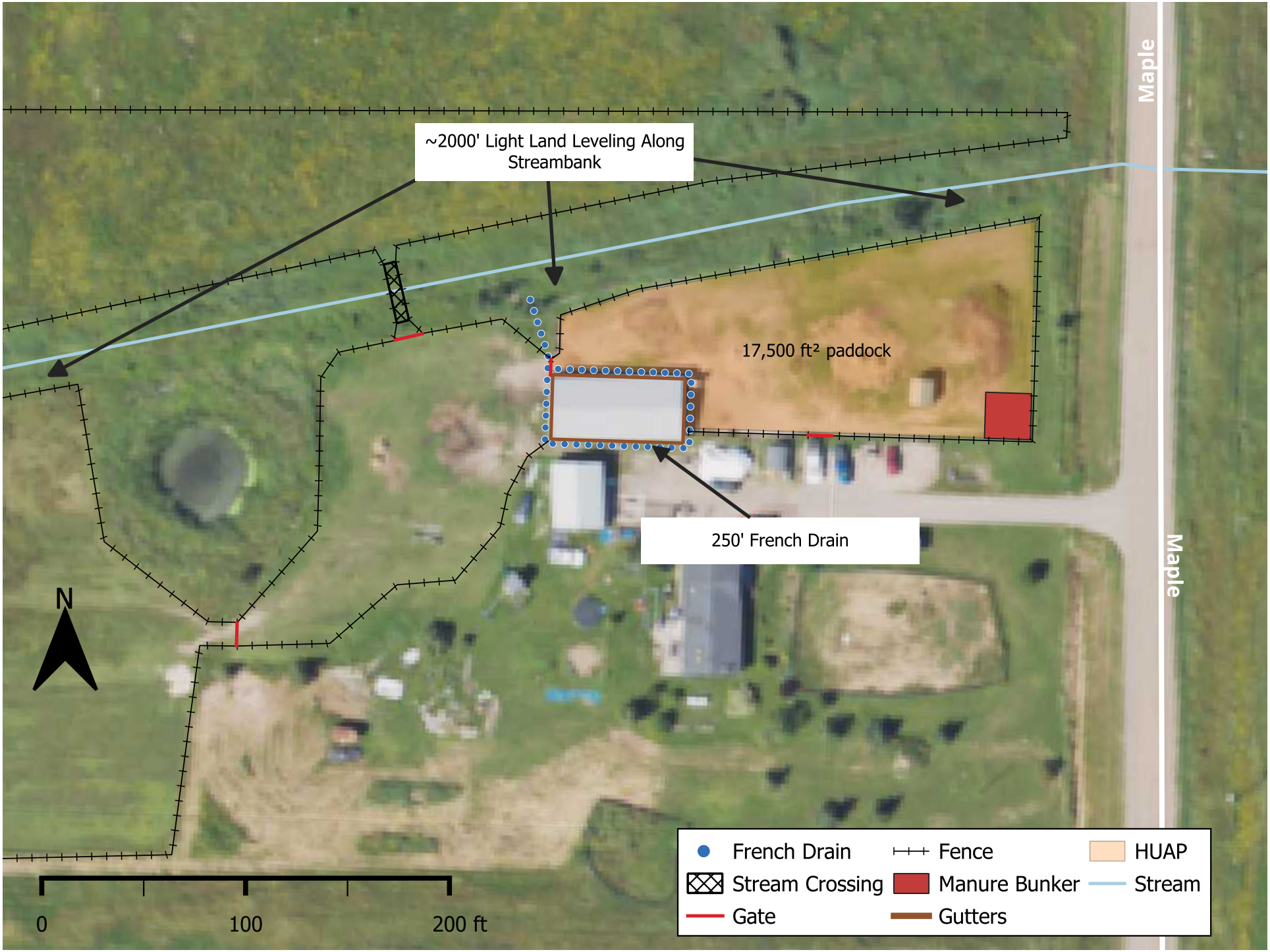
~2000' Light Land Leveling Along Streambank
17,500 ft² paddock
250' French Drain
Maple
Maple
N
0
100
200 ft
French Drain
Fence
HUAP
Stream Crossing
Manure Bunker
Stream
Gate
Gutters