708 – Sediment Traps & Basins

708.05 Rock Horseshoe

Definition:

A rock horseshoe is a sediment control measure that causes deposition of soil particles by creating a temporary pool of water behind a berm (often times horseshoe or arc shaped) of riprap faced with INDOT CA No. 8 aggregate that ties into an earth berm. A flat area upstream is needed to maximize pooling volume.

The temporary rock horseshoe is a measure that allows for the withdrawal from below the surface of the water column.

Exhibit 708.05-A.
Source: Deckard Engineering

Purpose:

- To minimize sediment entry to existing or newly constructed/installed culverts, pipes, or storm water inlets where a temporary pool of water can be created that does not cause flooding of adjacent properties or cause damaging by-pass flows.
- To minimize sediment discharges from temporary sediment basins (708.02) implemented on construction sites when practices that withdraw from the top of the water column are not feasible or are inhibited/prohibited by freezing conditions. It is a temporary dewatering device that functions by causing sediment-laden stormwater to pool allowing retention time for the settling of suspended soil particles.

Specifications:

Location:
A temporary rock horseshoe can be implemented upstream of culverts, pipes, stormwater inlets, temporary sediment basin outlets or at permanent stormwater basin outlet structures (when floating outlet practices are not feasible). When used for protection of culverts, pipes, or storm water inlets the following cautions should be reviewed/considered:

- Height of berm causes flooding of adjacent properties.
- Height of berm causes by-pass flows that cause additional damage or erosion.
- This practice is most effective where sufficient pooling area is available or constructed.

Note: Rock horseshoes cannot be implemented within water resources such as streams or channels without appropriate permitting.

Contributing Drainage Area:
5 acres maximum (for larger watersheds: designed by a qualified individual/professional engineer; larger drainage areas may be accommodated but require additional design considerations).

Structure Life:
Typically, less than 2 years but can be modified/designed for long term/post-construction use.

Discharge Capacity:
- For culverts, pipes, or inlet applications the rock horseshoe shall be designed for a 2-year frequency, 24-hour duration storm event.
- For sediment basin applications the rock horseshoe shall meet discharge requirements for sediment basins.

Rock Horseshoe Spillway Design:
When used for temporary sediment control for culverts, pipes, and storm water inlets the discharge capacity and weir height:
- Maximum watershed: 5 acres or by design.
- Maximum crest height: 5 feet and 1 foot below the berm or embankment the rock horseshoe is tying into.
- Minimum height: A suggested minimum 2 feet above the bottom culvert elevation.

When used as a dewatering device for the Temporary Sediment Basin (708.02) the design capacity and weir height:
- The rock horseshoe shall meet discharge requirements for sediment basins.
- The crest elevation should be same as the top elevation of the dewatering zone.
- Weir length/flow depth: Flow over the weir for a 2-year frequency, 24-hour duration storm event should be below the emergency spillway and at a velocity that will not displace the riprap.
- Minimum height: A suggested 2 feet above the bottom orifice or outlet structure elevation.

Recommendations for all rock horseshoe structures or by design:
- Top width (riprap) (of horseshoe spillway): 2 feet minimum (riprap part of horseshoe).
- Rock horseshoe bottom width: a minimum of 10 feet wide.
- Spillway crest: by design.

- Spillway spacing from inlet: 1 foot minimum from toe of the berm back slope to inlet or culvert invert (sufficient distance to minimize horseshoe aggregate from entering into inlet).
- Front slope of horseshoe (pooling side): 2:1 or flatter.
- Back slope of horseshoe (inlet side): 2:1 or flatter.
- Pooling side face of horseshoe: Is covered with facing stone 1 foot thick of INDOT CA No. 8 aggregate (refer to Appendix D).
- Horseshoe termination ends: Extend aggregate horseshoe up the embankment to prevent flow around end points. The horseshoe ends need to be a minimum of 6 inches higher than the spillway crest.
- Embankment side protection:
    - Where embankment slope is to grade stabilize with seeding and mulching and prevent or divert sediment-laden run-off from entering into the backside of the horseshoe from the embankment area.
    - For unstabilized (rough and not to final grade) embankment situations: To prevent inflows of sediment-laden run-off from entry behind the rock horseshoe utilize control options such as: diversion berms, Silt Fence (709.02), Tubular Sediment Control (709.07), or aggregate wrap arounds.
- Outlet apron to culvert or structure inlet: Stabilize the flow path from the toe of the horseshoe to the inlet with riprap 1 foot thick (minimum) with the top of riprap being flush with the invert/opening.

Materials:

- Riprap berm and apron: INDOT Revetment or Uniform A riprap (refer to Appendix D).
- Facing Stone (pooling side face of berm): INDOT CA No. 8. aggregate (refer to Appendix D). The purpose of this aggregate is to cause flow reduction that results in the detention or pooling of run-off to allow for sediment deposition to occur.
- Geotextile: To be located under all aggregate areas (refer to Appendix C).

Typical Installation:

Location and Layout:

- Locate the rock horseshoe upstream of culvert inlet or stormwater basin outlet structure. Caution: Do not install rock horseshoes in front of culverts within water resources without appropriate permitting.
- Install rock horseshoe at least 1 foot (minimum) from toe of horseshoe back slope to inlet/culvert or by design.
- Rock horseshoe is required to wrap around the inlet to protect to fit the location characteristics. The shape (may not always be horseshoe shaped) depends on if the inlet to be protected is in a straight bank area, corner bank area or channel outlet area.
- Prevent sediment-laden run-off from flowing into the back-side area of the rock horseshoe.
- When used as a sediment basin dewatering device: When a rock horseshoe is required to be replaced with the Floating Outlet (708.03); the rock horseshoe is to be installed with basin construction and kept offline until needed. If the basin requires draining to activate the dewatering device the following procedure shall be followed: Drain any water from the dewatering zone, refer to Water Pumping (713.02), without discharging sediment and remove any sediment deposits that prevents installation and function of the device.

Construction:

(1) If horseshoe location is on undisturbed or unexcavated area such as for the protection of an existing culvert inlet then clear, grub and strip all vegetation and root mat from horseshoe location in front of inlet structure (pipe or basin outlet structure).
(2) Over excavate in front of inlet to allow for installation of the inlet apron to be installed flush with the invert of the inlet resulting in no obstruction of inlet function.
(3) Install geotextile fabric on smoothed debris free soil surface to cover the area of the horseshoe berm and line the inlet apron excavation.
(4) Outlet apron to culvert or structure inlet: Place INDOT revetment or uniform A riprap (refer to Appendix D) such that rock is flush with the invert of the inlet. Rock shall not obstruct, block, or enter inlet. This apron in when used with permanent culverts or stormwater outlets can be substituted for the planned permanent inlet scour protection pad.
(5) Place a berm of INDOT Revetment or Uniform A riprap (refer to Appendix D) to wrap around the inlet area to the design height. Weir should be level and have a consistent top width. Riprap will form a uniform front and back slope. The toe of the backslope shall not be closer than 1 foot to the inlet or culvert or by design (sufficient distance is required to minimize horseshoe aggregate from entering into inlet). There shall be no area between the berm and the inlet that is not lined with riprap.
(6) Cover upstream face of the riprap berm with a 1-foot-thick layer of INDOT CA No. 8 aggregate.
(7) Prevent sediment entry from behind the rock horseshoe.
    a. Stabilize with seeding and mulching or aggregate covering the embankment area behind the horseshoe.
    b. For unstabilized embankment with active construction: To prevent inflows of sediment-laden runoff from entry behind the rock horseshoe utilize control options such as: diversion berms, Silt Fence (709.02), Tubular Sediment Control (709.07) or aggregate wrap arounds.
(8) When the rock horseshoe is required to be replaced with the Floating Outlet (708.03); the rock horseshoe is to be installed with basin construction and kept offline until needed. Construction procedures are needed that allow for the rock horseshoe to be brought online that require the minimal use of heavy machinery and equipment that can be difficult to use during periods of inclement weather and difficult wet soil conditions. If the basin requires draining to activate the dewatering device the following procedure shall be followed: Drain any water from the dewatering zone (refer to Water Pumping (713.02), without discharging sediment and remove any sediment deposits that prevents installation and function of the device.

Typical Maintenance:

- Inspect prior to anticipated significant rain events and restore any practice element as needed to maintain practice function.
- At a minimum inspect within 24 hours of a rain event.
- Check behind the horseshoe to ensure that the embankment is not eroding, or sediment laden run-off is entering behind the measure. Stabilize eroding embankment area and/or install control measures to prevent inflow of sediment-laden run-off with installation of sediment control measures that wrap around behind the horseshoe or divert run-off from entering behind the horseshoe measure.

- Sediment basin dewatering device application: Replace facing stone, INDOT CA No. 8 aggregate, if the basin dewatering zone does not dewater (drain) within the required time period (typically 48-72 hours) following a stormwater run-off event.
- Culvert/pipe protection application: Replace facing stone INDOT CA No. 8 aggregate if pooling area does not dewater (drain) within 48-72 hours following a stormwater run-off event.
- Check spillway (central part of horseshoe) for stone displacement and restore. Remove displaced stones from inlet areas. Ensure that no horseshoe aggregate enter the structure to be protected.
- Ensure that pooled run-off does not flow around the ends of the horseshoe structure. Maintain aggregate terminating ends of horseshoe to be sufficiently higher than the spillway to prevent flow around the ends of the horseshoe.
- Remove sediment when it has accumulated to one-half the design volume of the sediment storage zone and/or one-third the height of the spillway.
- Ensure that sediment laden run-off enters the pooling area as far away from the horseshoe measure as possible for the most effective sediment trapping performance of the measure.
- When the contributing drainage area has been permanently stabilized, remove, and properly dispose of all sediment and construction material and stabilize any resulting disturbances.
- When permanent stormwater basins have been modified to function as a temporary sediment basin and the contributing watershed has been permanently stabilized, remove sediment from the pooling area to meet the basin design requirements, remove all temporary dewatering devices, or features and make functional all required permanent outlet features.

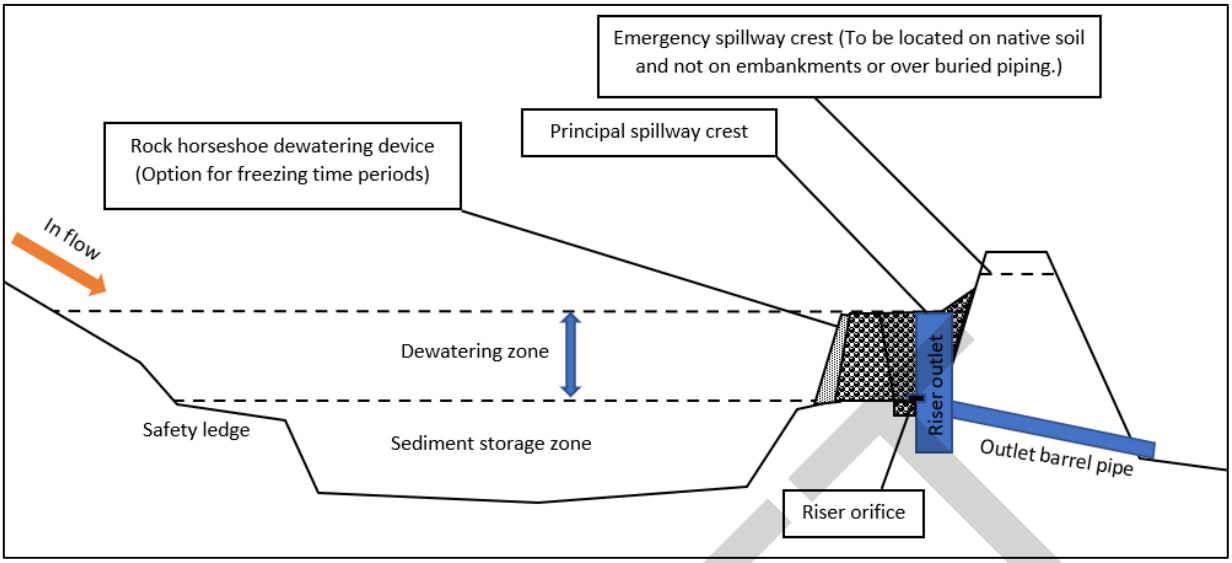


Exhibit 708.05-B. Typical sediment basin components when using the rock horseshoe dewatering device during freezing time periods. Note the dewatering zone height is limited to the feasible rock horseshoe height. This drawing is intended to represent how the practice fits into the sediment basin practice and not intended to be a design drawing.
Source: IDEM file

Exhibit 708.05-C. Rock horseshoe has been installed to protect a newly installed culvert inlet on a road project for function as a temporary trap. Notice the embankment has been stabilized with seeding and mulching and the horseshoe extends up the bank to form a spillway to the pipe inlet.
Source: IDEM

Exhibit 708.05-D. During the construction period a rock horseshoe has been installed to protect the permanent concrete outlet structure of a dry stormwater basin. Notice that the horseshoe has been wrapped around the backside of the outlet structure to prevent sediment entry from behind the horseshoe practice from the unstabilized embankment.
Source: IDEM

Exhibit 708.05-E. A rock horseshoe has been installed around a permanent riser structure of a stormwater basin that has been modified to function as a sediment basin.
Source: IDEM

Exhibit 708.05-F

Temporary Rock Horseshoe
Sediment Basin Dewatering Device
Design Data Sheet

Computed by: _____ Date: _____

Project Name: _____ Basin: _____

Location: _____

Latitude: _____ Longitude: _____

Emergency spillway crest: _____ elevation (feet)

Horseshoe spillway berm height: _____ elevation (feet)

Floor of sediment basin or wet pool elevation: _____ feet

Effective height of berm: _____ feet (measurable/constructed height for inspection)
(Spillway must be a minimum of one (1) foot below the emergency spillway crest)

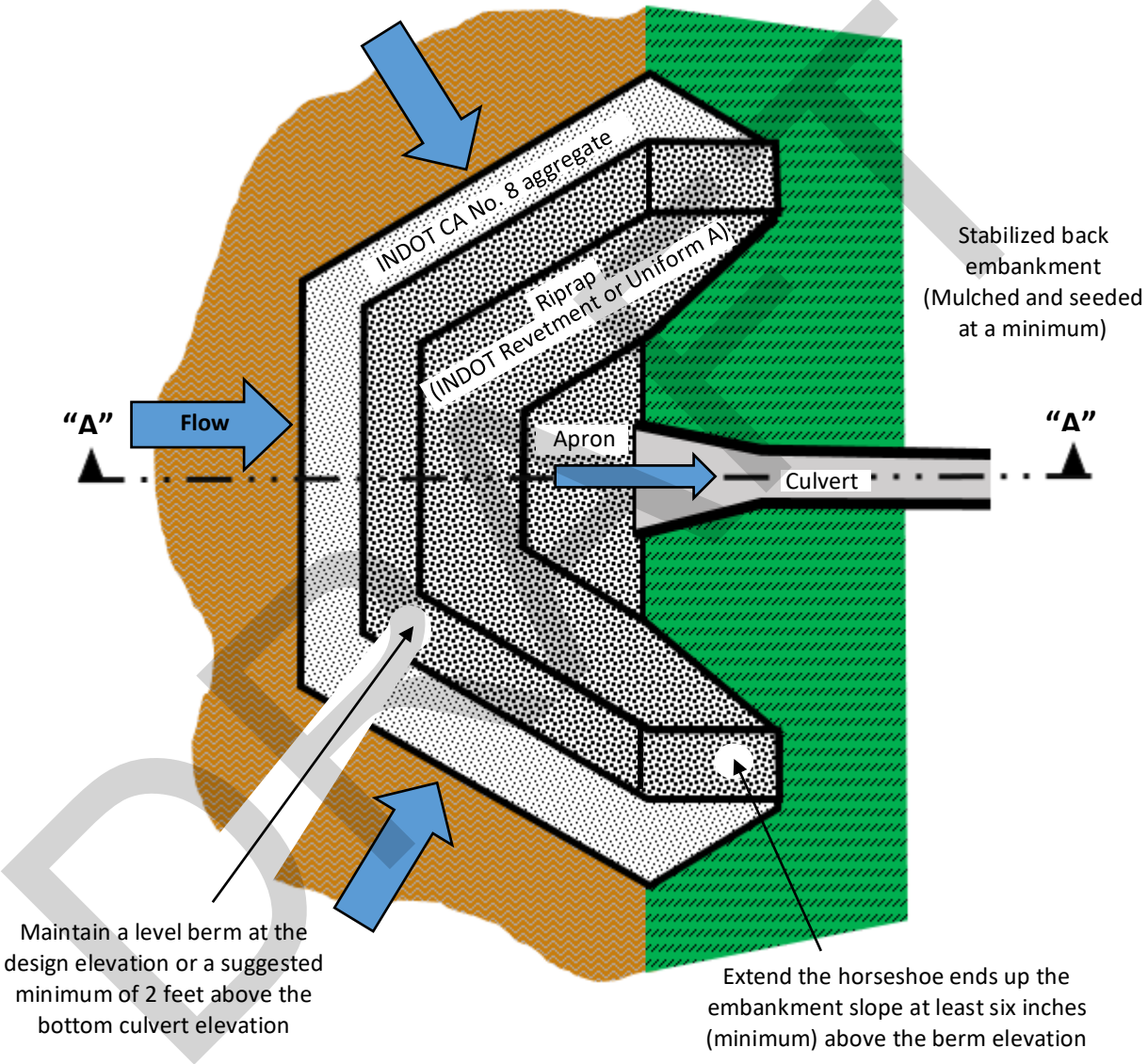
Bottom width of berm (minimum of 10 feet): _____ feet

Toe of berm spacing from inlet (minimum of one (1) foot): _____ feet

Note: If the rock horseshoe dewatering device is to be implemented in a sediment basin that requires a change of dewatering devices to account for freezing conditions, then provide provisions that describe how this change over is to occur. Provisions must allow the rock horseshoe to be installed or brought online in such a way that requires the minimal use of heavy machinery and equipment that can likely be difficult to use during periods of inclement weather and difficult wet soil conditions.

Exhibit 708.05-G

TEMPORARY ROCK HORSESHOE
CULVERT, PIPE, INLET PROTECTION
TYPICAL PRACTICE DIAGRAM
PLAN VIEW
(NOT TO SCALE)



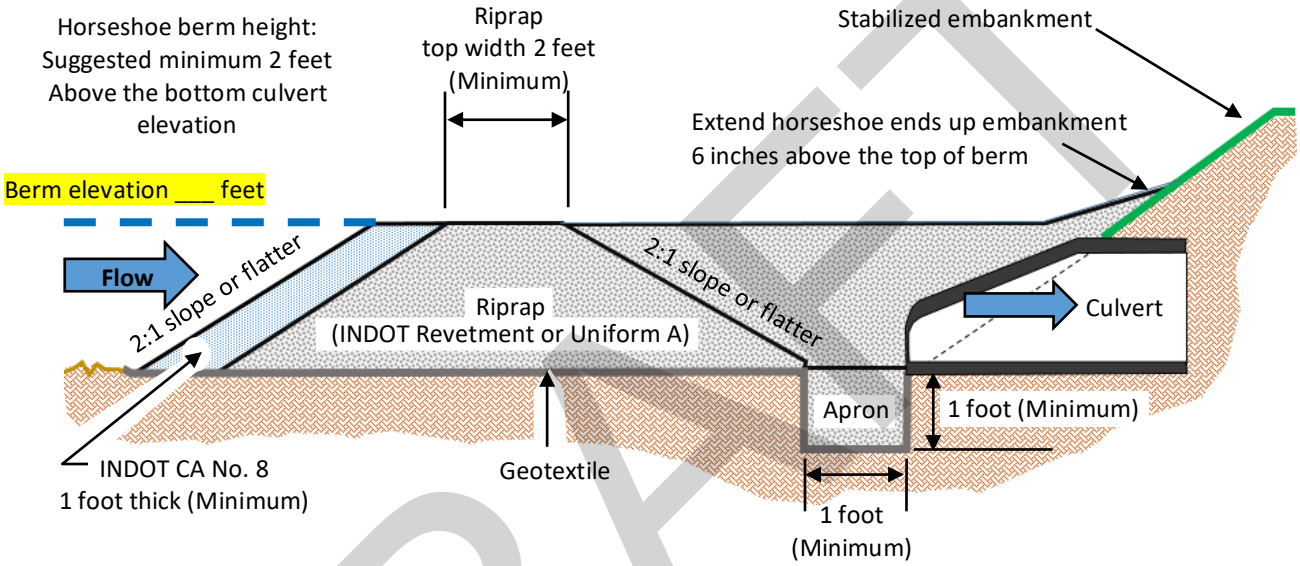
NOTES:

- For unstabilized embankment situations: To prevent inflows of sediment-laden run-off from entry behind the rock horseshoe utilize control options such as: diversion berms, silt fence, tubular sediment control, or horseshoe aggregate wrap rounds.
- The illustrations in this exhibit are not intended to serve as construction drawings. The diagrams/drawings are to be used to communicate the concepts for implementation of this control measure.

Source: IDEM File

Exhibit 708.05-H

TEMPORARY ROCK HORSESHOE
CULVERT, PIPE, INLET PROTECTION
TYPICAL PRACTICE DIAGRAM
SECTION "A" PROFILE VIEW
(NOT TO SCALE)



NOTES:

- Horseshoe spillway crest height: Suggested minimum 2 feet above the bottom culvert elevation.
- For unstabilized embankment situations: To prevent inflows of sediment-laden run-off from entry behind the rock horseshoe utilize control options such as: diversion berms, silt fence, tubular sediment control, or horseshoe aggregate wrap rounds.
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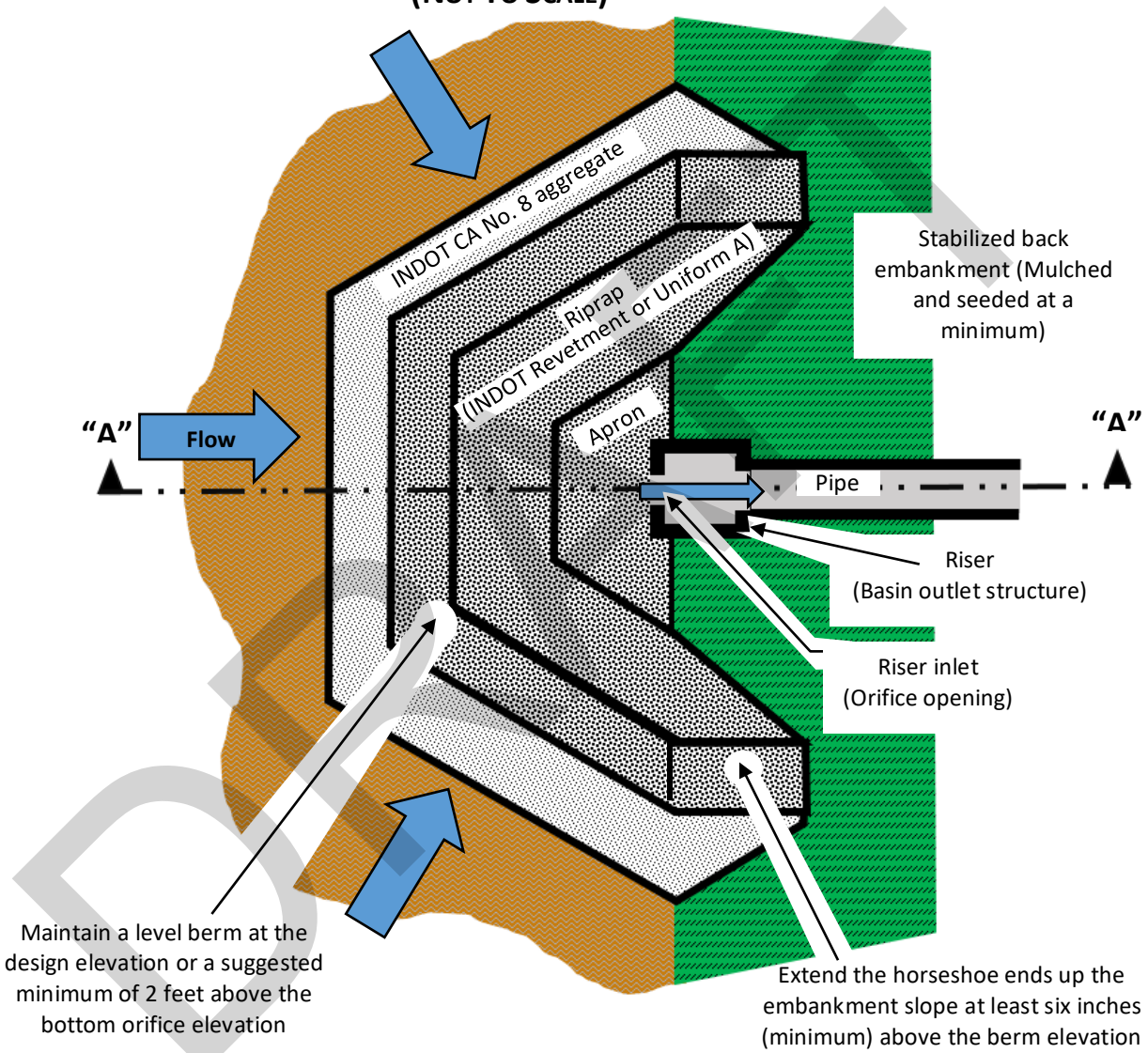
Source: IDEM File

Exhibit 708.05-I

TEMPORARY ROCK HORSESHOE
SEDIMENT BASIN DEWATERING DEVICE
TYPICAL PRACTICE DIAGRAM
PLAN VIEW
(NOT TO SCALE)



NOTES:

- Replace Rock Horseshoe with Floating Outlet Dewatering Device (708.03) as soon as freezing conditions are not likely.
- Horseshoe berm height: corresponds to the top of dewatering zone.
- For unstabilized embankment situations: To prevent inflows of sediment-laden run-off from entry behind the rock horseshoe utilize control options such as: diversion berms, silt fence, tubular sediment control, or horseshoe aggregate wrap rounds.
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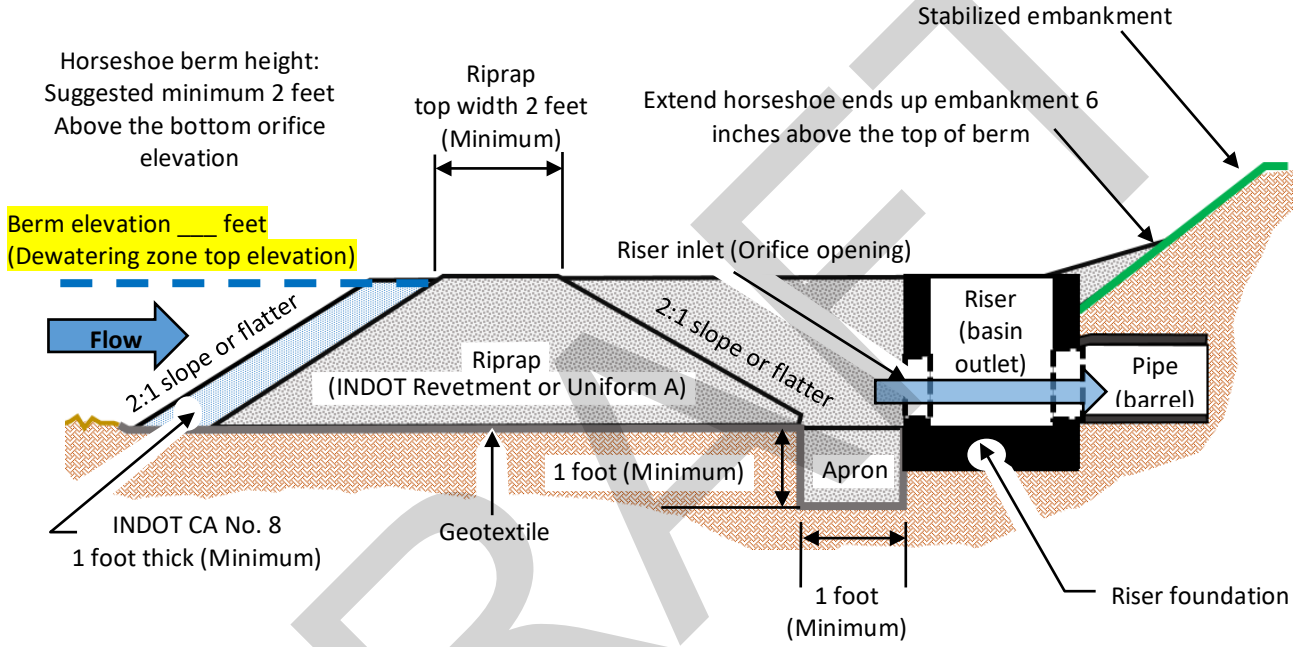
Exhibit 708.05-J

TEMPORARY ROCK HORSESHOE
SEDIMENT BASIN DEWATERING DEVICE
TYPICAL PRACTICE DIAGRAM
SECTION "A" PROFILE VIEW
(NOT TO SCALE)



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Source: IDEM File