United States Department of Agriculture

Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD

OPEN CHANNEL

Code 582

(Ft.)

INITIAL REVIEW – Comments and Responses

Drafted technical standard text (as sent for Initial Review) is in black and blue fonts. National minimum requirements are in black font; Wisconsin specific criteria is denoted with blue font.

Comments are in red, preceded by comment number (**C#**). To find a specific comment number, search for that number using “Ctrl + F” (Windows) or “Command + F” (Mac).

Responses to comments are in green italics.

Changes to standard text are in tracked changes.

General Comments

C4: I do not have any constructive comments for this standard. It appears that Streambank Protection will be a practice of the past. If the design requirements of this Standard become final, projects will be limited to areas of public land, easements, and special interest groups with grant dollars that can afford private engineering firms to complete designs. The average landowner/producer will not be able to afford design/construction costs to address the resource concerns within their stream corridor.

RESPONSE: CPS 580 Streambank and Shoreline Protection will continue to be applied to address site specific bank instability and protect near channel infrastructure. This standard incorporates referral criteria that initiates additional investigations and analysis to ensure appropriate application of treatment alternatives when streambank protection is proposed over long distances.

When this revised standard is applied, the level of analysis effort may increase compared to past projects; however, for projects that do not increase flood levels and do not involve restoring a stream to a new alignment or completely different condition, the level of effort should be similar.

C38: There is variability with NRCS engineers and Techs as to whether projects qualify, design modifications and adaptability to conditions not addressed through Rosgen adherence. As with any water project there are many variables to consider not addressed within a manual that can impact a projects' success and longevity.

RESPONSE: The standard provides criteria for planning and implementation of treatment alternatives. Variability among conservation engineers and technicians will be addressed through comprehensive training. Note that the standard has limited reference to Rosgen method.

DEFINITION

An open channel is a natural or artificial channel in which water flows with a free surface.

C18: Do you mean continuous water flow here?

RESPONSE: The standard applies to perennial, intermittent and ephemeral channels.

PURPOSE

Construct, improve, or restore an open channel to convey water required for flood prevention, drainage, wildlife habitat protection or enhancement, or other authorized water management purpose.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to the construction of open channels or modifications of existing streams or, (ditches with drainage areas exceeding one (1) mi^2 (1.6 km^2)). This standard does not apply to Natural Resources Conservation Service (NRCS) Conservation Practice Standards (CPSs) Codes 362, Diversions; 412, Grassed Waterways; 388, Irrigation Field Ditches; 607, Surface Drain, Field Ditch; or 320, Irrigation Canal or Lateral.

C19: I'm trying to discern how this relates to dry runs in the Northwest. Pierce and St Croix counties have many dry run type channels with large drainage areas and only periodic flows through well defined and often eroding cross sections. If the slope is under 1% out of bank flow works well for modifications under the 412 standard.

By "modifying existing streams or ditches" are you specifying constant base flow?

RESPONSE: The standard applies to perennial, intermittent and ephemeral channels. Diversions, Surface Drain Field Ditches, Irrigation Ditches, and Grassed Waterways are specific types of open channels with characteristics that warrant their own practice standards.

This practice applies in stream restoration to modify aadjust the channel cross-section, improveconstruct an inset floodplain connectivity, or increase planform sinuosity.

C46: Normally streams are trying to improve sinuosity on their own. They just can't connect to the floodplain, which is where 580 comes into play. What is the ideal sinuosity? Is there a metric for the size of stream, upper reaches, middle reaches, lower reaches? Are we moving the stream to achieve a certain slope or sinuosity? "How streams are supposed to look and function are ideals that vary from one person to another." (NEH part 654).

RESPONSE: We can apply the Open Channel standard to re-establish meanders in straightened streams using references reaches or historic imagery.

Treatment designs are evaluated using established procedures. The standard does not identify specific metrics, but instead incorporates referral criteria that will initiate additional investigations and analysis to ensure appropriate application of treatment alternatives. The standard identifies and references established procedures such as technical manuals and handbooks (for example, sinuosity is addressed by reference to NEH 654.1200 in the stream restoration guidelines below). Variability among conservation engineers and technicians will be addressed through comprehensive training.

CPS 580 Streambank and Shoreline Protection is intended to provide stabilization measures to banks. This standard could complement that work by defining what is needed for excavation. Therefore, we see this standard being used for floodplain reconnection.

It is used often in combination with other practices such as Streambank and Shoreline Protection (Code 580), Channel Bed Stabilization (Code 584), and Stream Habitat Improvement and Management (Code 395). See **Additional Criteria for Stream Restoration**.

C6: In what scenarios will this standard be used? States on projects where the cross section is adjusted but that's very broad. Will it be for projects where you are creating a new channel? Or in conjunction with the 580 standard? Only on certain sized projects?

RESPONSE: The standard will primarily be used to construct or modify channels to achieve a water management objective or restore alluvial channel functions.

The standard does not identify specific metrics, but instead incorporates referral criteria that will initiate additional investigations and analysis to ensure appropriate application of treatment alternatives. The standard identifies and references established procedures such as technical manuals and handbooks.

C47: "used in combination with 580, 584, and 395"…so this practice can stand alone or be used in conjunction with other practices besides those previously mentioned? More clearly defining the definition, purpose, and conditions where this practice applies would be helpful. Does this standard only apply to shaping and vegetating streambanks when the channel geometry and alignment is modified, or does this include the use of riprap on the banks?

RESPONSE: Yes, this practice can be stand alone or used in conjunction with other practices. The standard does not provide criteria for implementing rock riprap protection on the banks; refer to 580.

The standard does not identify specific metrics, but instead incorporates referral criteria that will initiate additional investigations and analysis to ensure appropriate application of treatment alternatives. The standard identifies and references established procedures such as technical manuals and handbooks.

~~This standard does not apply to open channels with watersheds greater than 390 square miles under NRCS programs. Refer to the Wisconsin NRCS supplement to the National Engineering Manual, Part 503.71.~~

C7 // C48 // C29: Where did 390 square miles come from? **//** Please remove this statement. Stream standards should not refer to the agreement between Army Corps and NRCS defining jurisdiction for dams. **//** Although I would agree that this practice should not be used on large watersheds, this statement appears to be NRCS policy so why is it included in the standard? Could you clarify this statement specifically "under NRCS Programs"? In addition, the current Wisconsin Supplement says this: "SUBPART E – PROHIBITED TECHNICAL ASSISTANCE § WI 503.71 Prohibited Activities • Employees shall not provide technical assistance to: » Install new drive-in covered storage tanks or transfer channels. » Modify for continued use existing drive-in, covered storage tanks or transfer channels that cannot reasonably be expected to operate in accordance with the current version of the ASABE EP470 procedures. » Install waste management systems that will transfer the waste stream via a drive-in covered storage tanks or channels. » Partners or other technical service providers who support the installation or continued use of an unsafe system as determined by a review of the safety assessment prepared by the designer."

*RESPONSE: This is NRCS national policy and applies to projects **under NRCS programs**. This paragraph will be moved to an NRCS policy document.*

CRITERIA

C1: Formatting question: The 580 standard says "General Criteria Applicable to All Purposes" after the Criteria title. Is that needed here?

RESPONSE: Federal format cannot be edited in this section.

Design and install this practice in accordance with all Federal, State, and local laws and regulations. The landowner must obtain all regulatory permits to implement the practice. The landowner and contractor are responsible for locating all buried utilities within the work limits, including drainage tile and other structural measures.

C49: We will have to be in close contact with our DNR water regs contact before planning to make sure that they are on board with stream manipulation.

RESPONSE: Agreed. Permitting is required under Ch. NR 30, Wis. Adm. Code for all navigable waters in the State of Wisconsin.

C71: After “obtain all regulatory permits to implement the practice” add “…or must attest and certify that no permits are required.”

RESPONSE: DNR, ACOE and County zoning should be consulted to determine whether Ch. NR 30 permitting is required. If no permit is required, then documentation should be included in the project file.

The landowner is responsible for ~~addressing pollutant~~removing hazardous materials or point source pollution~~s~~ (e.g. septic ~~systems~~discharge) within the work limits and attaining regulatory compliance prior to the open channel construction.

C30: Consider rephrasing to “point source pollution”

RESPONSE: Language clarified.

C50: Does this include nutrients from crop fields? How are pollutants and point sources to be addressed? How is this to be assessed? Who specifically is this regulatory compliance referring to? (DNR, NR151, septic systems, etc)?

RESPONSE: No. Nutrient runoff from cropland is considered non-point pollution.

Point source pollution is well understood and is broad enough to cover multiple scenarios. DNR is the regulatory agency responsible for discharges of pollutants to Waters of the State. The standard places this requirement on the landowner and does not include prescriptive procedures in addressing the consultation with DNR.

Ensure that channel modifications do not increase the Base Flood Elevation (100-year) adopted into floodplain zoning ordinances, including (a) Special Flood Hazard Areas (SFHA) on FEMA flood insurance maps (FIRM), (b) dam breach inundation maps, and (c) floodplain storage maps. Maps and supporting data can be provided by the local zoning administrator or DNR Surface Water Data Viewer. The FEMA Map Service Center website only provides FIRM maps and models.

C5: If a hydraulic and hydrologic analysis is required, who will conduct it - NRCS staff or an outside contractor? If an outside contractor, who pays for it? I doubt most landowners would be willing to pay for these on top of their project cost share – which means a significant decrease in program participation. More and more County Zoning Administrators are requiring H & H’s for stream projects so this analysis and associated cost should be factored into the other standards under review.

RESPONSE: If an H&H analysis is required, then a landowner may need to hire and pay for a private consultant as part of their cost share. NRCS may be able to assist in the development of H&H analysis. Modelling skills will be addressed through comprehensive training.

C8: What documentation is required?

RESPONSE: The results of an H&H analysis will be incorporated into the design and documented in the project file.

C51: This is a potential problem for some counties. What if the local Zoning office requires HEC-RAS modeling for any modification? (Even reductions in the Base Flood Elevation) Per some County

Floodplain Zoning Ordinances, a Hydraulic and Hydrologic (H&H) Study is required for any change within the floodplain. H&H Studies cost approximately $10,000 for a structure like a bridge. The H&H Study involves modeling in HEC-RAS. If the structure is determined to increase the flood level, flood easements are required for each affected property and these easements must be recorded on the deed. A Conditional Letter of Map Revision (CLOMR) must be issued from FEMA ($6,500 for a bridge) with a Letter of Map Revision following construction (LOMR) issued from FEMA ($8,000 for a bridge). I'm not sure if Zoning will see stream modifications under this standard as requiring the same things as a bridge but if they do this is a huge additional expense and requires much more work. Some areas do not have a defined BFE (Base Flood Elevation) so when an H&H Study is required it also requires an additional study to determine the BFE which costs approximately an additional $10,000 to complete (beyond the $10,000 for the H&H). These additional costs, if required, will price most landowners out of any stream modification/manipulation projects. This will drive landowners to "fix" their issues on their own, by dumping concrete chunks and other waste debris in the streams. Also, private engineering firms are often 6 months out or longer for completing a HEC-RAS model.

RESPONSE: LOMRs and CLOMRs are required for projects with an established FIS within an AE zone. Projects within an unmapped stream reach may require a No-Rise determination for compliance with a County Floodplain Ordinance. The level of effort and associated cost is variable and site specific. The additional costs and time may prevent some landowners from participating in NRCS cost share programs.

C52: In almost all cases, simple "shaping" within the open channel or cross-section does not add any fill to the cross-sectional area and usually reconnects the stream to the floodplain. Is there any way to make these types of modifications exempt from floodplain modelling? In addition, where rock is used, if planned cross-sectional areas have no net increase in fill or do not increase the Base Flood Elevation, can these modifications be exempt from floodplain modelling?

RESPONSE: Professional judgement dictates the level of analysis required for modified channels. In most cases, excavation without filling, would not impact the floodplain. Compliance with County Floodplain Ordinances is required. Counties, in consultation with DNR, will determine the level of detail required for compliance.

Use NRCS Engineering Technical Releases (TR), 210-25, Design of Open Channels; NRCS National Engineering Handbook (NEH), Part 653, Stream Corridor Restoration: Principles, Processes, and Practices; and NRCS NEH, Part 654, Stream Restoration Design, as applicable in surveys, planning, site investigations, and design of channel work.

Do not modify the horizontal or vertical alignment of a channel to the extent of endangering the stability of the channel or its laterals.

Capacity. Determine the capacity for open channels according to procedures applicable to the purposes of the channel and according to related engineering standards and guidelines in approved references and handbooks. Designs must consider low flows, average flows, frequent storm flows, and high (infrequent) storm flows.

C20: Does this mean that the Cyprus Creek Equation could be used for capacity?

RESPONSE: The Cyprus Creek Equation could be used to estimate the bankfulll discharge, but it more applicable to channels designed for managed flows such as CPS 607, Surface Drainage, Main and Lateral Field Ditches in flat watersheds.

Estimate stream flows using the USGS Flood Frequency Characteristics of Wisconsin Streams or hydrologic models such as NRCS WinTR-20, WinTR-55, or USACOE HEC-HMS.

C39: Consider reevaluation of the flood frequency, duration, and extremes as evidenced by the events beyond 100 year levels of recent occurrence. Climatic projections would tend to indicate a probability and continuance of this trend of events.

RESPONSE: NRCS utilizes NOAA Atlas14 rainfall depths. The NOAA Atlas14 is currently being updated to include rainfall measurements from 2010-2020. These data will include the recent occurrences of extreme events in Wisconsin.

Determine the water surface profile or hydraulic grade line for design flow using guidelines for hydraulic design in NRCS TR-210-25 and/or NRCS NEH, Part 654. Select a Manning's n value for the condition representing an aged channel. Base the selection on the expected vegetation and other factors such as the level of maintenance prescribed in the operation and maintenance plan. Establish the required flow capacity by considering volume-duration removal rates, peak flow, or a combination of the two, as determined by the topography, purpose of the channel, desired level of protection, and economic feasibility.

C21: Is the "required flow capacity" referring to the consideration of the Cyprus Creek Equation Q as a minimum channel capacity and out of bank flow of the peak flow while considering capacity based on stability?

RESPONSE: The Cyprus Creek Equation is more applicable to CPS 607, Surface Drainage, Field Ditch. This standard does not apply to CPS 607.

Design conditions cannot result in flood impacts to adjacent properties without addressing through the appropriate authorities. Refer to the USACE HEC-RAS model for development of water surface profiles., when non-uniform, unsteady, or gradually varied flow make it difficult to evaluate floodwater impacts

C9: Will HEC-RAS modeling be required for all watershed sizes?

RESPONSE: It is a reference, but not a requirement. HEC-RAS is a tool to evaluate the flow impact of a constructed or modified channel on adjacent properties. The software is free and in the public domain and largely used in the water resource field.

Compliance with County Floodplain Ordinances is required. Counties, in consultation with DNR, will determine the level of detail required for compliance.

C22: It appears that HEC-RAS is required for all open channel designs is that the intent? Otherwise tie HEC RAS to evaluations of flood impacts when pertinent.

RESPONSE: HEC-RAS is referenced in the design of constructed or modified channels where the floodwater surfaces are necessary to evaluate the impacts on adjacent properties or drainage systems. Compliance with County Floodplain Ordinances is required. Counties, in consultation with DNR, will determine the level of detail required for compliance.

C53: Other models should be able to be used as long as we are able to show the elevations that the water surface will be at pre and post project.

RESPONSE: Alternate methods such as an "At a Station" Manning's equation analysis may be sufficient. Compliance with County Floodplain Ordinances is required. Counties, in consultation with DNR, will determine the level of detail required for compliance.

Cross section. Determine the required channel cross section and grade by the plan objectives, the design capacity, the channel materials, the vegetative establishment program, and the requirements for operation and maintenance. As necessary, provide a minimum depth to allow adequate outlets for subsurface drains, tributary ditches, or streams. In urban areas, consider the design impacts on high-value developments.

Channel stability. A stable channel has the following characteristics:

- The channel neither aggrades nor degrades beyond tolerable limits

- The channel banks do not erode to the extent that an appreciable change in channel cross-section results

  C68: I would encourage clarification here on what "appreciable change" means. In general, I would strongly recommend encouraging reasonable stream adjustment and lateral migration within an acceptable erodible stream corridor so that these streams can be more resilient to a changing climate. If "appreciable change" is interpreted by a reader as any lateral migration, I would find that highly problematic.

  RESPONSE: Federal language cannot be edited in this section.

- Excessive sediment bars do not develop
- Gullies do not form or enlarge because of the entry of uncontrolled surface flow to the channel.

Design all channel construction and modification (including clearing and snagging) to result in a stable channel with reasonable maintenance costs. Use vegetation, riprap, revetments, linings, structures, or other measures if necessary to ensure stability.

Use the methods in NRCS TR-210-25 and/or NRCS NEH, Part 654 to determine the stability of proposed channel improvements.

Bankfull flow is the discharge that fills a channel to an elevation where flow begins to spill onto the active floodplain. Bankfull flow can be identified by field indicators in alluvial channels that have adjusted to hydrologic conditions and sediment delivery. Over the long term, bankfull flow typically completes the most work in transporting sediment relative to the magnitude and frequency of other flows. Bankfull flow has a typical recurrence interval range of 1 to 3 years on an annualized frequency curve, with a predominance of values in the 1.2 to 1.8-year range, although exceptions may include urban areas, wetland streams, or settings influenced by colluvium or glacial features.

C10: How many cross sections will be required to represent bankfull flow conditions? A certain number per linear foot? Each outside bend and sections in between?

RESPONSE: The text does not identify specific metrics, but instead incorporates referral criteria that will initiate additional investigations and analysis to ensure appropriate application of treatment alternatives. The text identifies and references established procedures such as technical manuals and handbooks.

C23: This bank full definition seems out of place here.

RESPONSE: This is the first occurrence of "bankfull flow" in the national text, so a more thorough definition was added here.

Channels must be stable under conditions existing immediately after construction (as-built condition) and under conditions existing during effective design life (aged condition).

C54: What is "effective design life"?

RESPONSE: Effective design life can be defined as the expected period of performance of the stable channel at its designated capacity without major repairs. Effective design life is variable and is dependent upon stable conditions within the watershed.

Determine channel stability for discharges under the following conditions:

- As-built condition.—Bank-full flow, design discharge, or 10-year frequency flow, whichever is smallest, but not less than 50 percent of design discharge.

  C24: In most cases the Cyprus Creek Equation design discharge Q would be the smallest discharge flow here. The bank full and Cyprus Creek Q's would always be lower than the ten year event in my opinion. Can you define one minimum required design discharge for stability determinations as the bank-full for the sake of clarity in the as built condition? I understand the desire for flexibly but clarity is lacking here, my comment may not make sense due to lack of clarity and confusion on my part!

RESPONSE: An attempt will be made to clarify this section below. The Cyprus Creek Equation is applicable to CPS 607, Surface Drainage, Field Ditch. This standard does not apply to CPS 607. An evaluation of a range of flows is prudent as it allows the designer to evaluate multiple hydraulic conditions (i.e. depth of flow, velocity, shear stress, cross-sectional capacity, etc.).

- The designer may increase the allowable as-built velocity (regardless of type of stability analysis) in the newly constructed channel by a maximum of 20 percent if—
  - The soils at the site in which the channel is to be constructed are suitable for rapid establishment and support of erosion-controlling vegetation.
  - Species of erosion-controlling vegetation adapted to the area and proven methods of establishment are known.
  - The channel design includes detailed plans for establishing vegetation on the channel side slopes.
- Aged condition.—Bank-full flow or design discharge, whichever is larger, except that it is not necessary to check stability for discharge greater than the 100-year frequency.

C25: Ten year minimum would be nice here the high flood plain would be good for stability.

RESPONSE: An evaluation of a range of flows is prudent as it allows the designer to evaluate multiple hydraulic conditions (i.e. depth of flow, velocity, shear stress, cross-sectional capacity, etc.).

Stability checks that are flow related are not required if the velocity is 2 ft/s (0.6 m/s) or less.

A stability check under the as-built condition evaluates velocity and shear stress ~~under~~in the channel for an unvegetated ~~new channel~~ condition~~s~~. A stability check under the aged condition evaluates capacity of the channel~~, velocity, and shear stress under~~ for the well-established, vegetat~~ive~~ed condition~~s~~.

C26: Does this contradict the guidance in ["As-built condition" bullet above]? Why not just specify bank full flow under ["As-built condition" bullet]?

RESPONSE: Language adjusted to clarify this section. An evaluation of a range of flows is prudent as it allows the designer to evaluate multiple hydraulic conditions (i.e. depth of flow, velocity, shear stress, cross-sectional capacity, etc.).

C40: Evaluation of channel stability beyond bankfull and near or >100 year level would be questionable at best. Recent and past failure of channel modifications under former normal extremes and recent history would suggest over engineering or overbuilding channel modifications.

RESPONSE: An evaluation of a range of flows is prudent as it allows the designer to evaluate multiple hydraulic conditions (i.e. depth of flow, velocity, shear stress, cross-sectional capacity, etc.).

C55: Are stability checks modeled, artificially filled, or checked after/during each flow event? If they are checks over a period of time and storm events, how does this effect cost share payments? Does the stability check need to take place at both velocity points (bench and top of bank)?

RESPONSE: Language adjusted to clarify this section. An evaluation of a range of flows is prudent as it allows the designer to evaluate multiple hydraulic conditions (i.e. depth of flow, velocity, shear stress, cross-sectional capacity, etc.).

~~Evaluate alluvial channels for stability for all flows from bankfull up to the 100-year flood.~~

C27: Does this replace the need for [“Aged condition” bullet]?

RESPONSE: Statement removed and previous language clarified.

For newly constructed channels in fine-grained soils and sands, determine the Manning’s n values according to procedures in Chapter 6 of NRCS TR-210-25. Use caution selecting values greater than 0.25. In channels modified by clearing and snagging, determine the Manning’s n value according to the expected channel condition following completion of the work. Guidance is also available in NRCS NEH, Part 654.

Refer to USGS Water Supply Paper 2339, “Guide for Selecting Manning’s Roughness Coefficients for Natural Channels and Flood Plains,” or NRCS NEH, Part 654.0609(c). In straight, uniformly shaped channels, where vegetation plays only a minor role in resistance to flow, Manning’s n can be estimated using the Strickler formula.

C56: Add: “Appurtenant structures. For granular beds and in the absence of bedforms, the Manning (Strickler) coefficient can be estimated by: $n = 1/K = (0.04 – 0.047) \times d_{90}^{1/6}$, where d_{90} is the 90% grain diameter of the bed material (90% is finer)”

RESPONSE: The standard identifies and references established procedures such as technical manuals and handbooks. The Strickler formula is only a reference and it speaks for itself.

Appurtenant structures. Include all structures required for proper functioning of the channel and its laterals, as well as travel ways for operation and maintenance. Minimize the erosion or degradation from inlets and structures needed for entry of surface and subsurface flow into channels. Provide necessary floodgates, water-level-control devices, bays used in connection with pumping plants and any other appurtenances essential to the functioning of the channels. If needed, use protective structures or treatment at junctions between channels, to ensure stability at these critical locations.

Evaluate the effect of channel work on existing culverts, bridges, buried cables, pipelines, irrigation flumes, inlet structures, surface drainage systems, and subsurface drainage systems.

Assure that culverts and bridges modified or added as part of a channel project meet reasonable standards for the type of structure and have a minimum capacity equal to the design discharge or state agency design requirements, whichever is greater. Increase the capacity of culverts and bridges above the design discharge as necessary to assure the channel and associated floodway meet design capacity.

In natural channels, evaluate the effect of the grade control structure on channel and bank stability. Determine backwater effects and the effects of modification of sediment transport through the reach.

Disposal of spoil. Dispose of spoil material from clearing, grubbing, and channel excavation in a manner that will—

- Not modify flows or cause channel instability when the discharge is greater than the bank-full flow.
- Provide for the free flow of water between the channel and floodplain unless the presences of continuous dikes establish the basis for the valley routing and water surface profile.
- Not hinder the development of travel ways for maintenance.
- Leave the right-of-way in the best condition for the project purposes and adjacent land uses.
- Direct water accumulating on or behind spoil areas to protected outlets.
- Maintain or improve the visual quality of the site to the extent feasible.

Vegetation of channel. Establish vegetation on all channel slopes, berms, spoil, and other disturbed areas according to CPS Codes 342, Critical Area Planting; or 580, Streambank and Shoreline Protection.

Cultural resources. Consider existence of cultural resources in the project area and any project impacts on such resources. Consider conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.

Additional Criteria for Stream Restoration

Conduct a site assessment to describe the watershed dynamics, identify impairments in the stream, develop integrated solutions, and assess the potential consequences of restoration activities. At minimum, incorporate the following information ~~regarding the existing conditions assessment~~ into the design report. Refer to WI NRCS Supplements to the NEH, Part 650, Chapter 16 for assessment tools.

C17: Seems like a monumental task. It's not clear to me at what scale the assessment is to take place: 1) conduct a site assessment, 2) assess the existing stream (as in the geomorphic assessment guidance). The longitudinal extent of key impact and restoration factors often will be outside (upstream) the project reach. Perhaps hard to prescribe the amount of effort to conduct an adequate assessment, but seems what is being asked may often be beyond the expertise available and time typically allotted. Are some of these tasks sequential and are they well prioritized, with my limited understanding I am not certain which activities are mandatory and not?

RESPONSE: The level of effort required will vary by project and risk. The appropriate level and extent of assessment is detailed in the NEH, Part 650, Chapter 16 document. We expect that all the assessment items be considered. If it is a relatively small project with low risk, the level of effort may just involve a qualitative description.

- Landowner's objectives for stream restoration, ~~available bandwidth for restoration work~~channel migration zone, available materials for bed and bank treatments, earthfill borrow and excavation spoil locations, existing and desired riparian land use, willingness to carry out maintenance activities, and special conditions.

  C2 // C57 // C69: What is bandwidth? Is that the stream corridor? // [Is bandwidth] referring to potential adjacent landowner interest? Might potential scope, or prospects be a better term? Please explain. // I'm not exactly sure what is meant by this but perhaps this is where you could list the landowner's willingness to allow the stream to migrate within a delineated erodible stream corridor. This could then guide design decisions.

  RESPONSE: Added clarification. We agree that the landowner's willingness to allow the stream to migrate should be asked at the start of a project.

- Geomorphic assessment of the existing stream which includes the following factors:
  - Past, present, future land uses in the watershed.

    C58: Past may be useful. Future can be used if a plan is known. But, the future can't be predicted.

    RESPONSE: We agree that it may be difficult to predict future land uses, but if the site is on the edge of a city or there is a proposed CAFO, etc., it should be documented in the project.

  - Description of the geomorphic setting and valley type. Refer to NRCS NEH, Part 654, Table 11-1 and TR-25-3.
  - Rosgen stream classification at existing representative crossovers locations. Refer to NRCS NEH, Part 654.0305(e).

    C59: Is this for the current or planned/manipulated channel, or both?

    RESPONSE: This is for the existing channel; text clarified above. Design requirements are listed below.

  - Description of the bankfull channel's connection to a floodplain.
  - Channel evolutionary stage (i.e. down-cutting, widening, aggrading, or stable). Refer to NRCS NEH Part 654.0305(c). Include a direction of successional changes in channel

evolution and indications of past, present, and future direction. Refer to NRCS NEH, Part 654, Fig. 11-15.

C31: Add Chapter 11.

RESPONSE: Chapter 11 is titled "Rosgen Geomorphic Channel Design." We purposefully left out prescriptive assessment and design methods based on one ideology. There are several methods for each of the items listed in these additional requirements for stream restoration.

- Description of the type and cause of streambank instability. Determine the type of bank failures such as a shallow slip failure, cantilever failure, or rotational shear failure. Describe causes of erosion such as concentrated flow around debris or sediment bars, seepage and soil piping, or high flow velocities along weak soil stratigraphy.

C32: This is good, makes the designer think; enhance if necessary.

RESPONSE: Thank you!

- Measurements of planform sinuosity, meander wavelength, riffle spacing and width, deep pool proportions, and if applicable, the extent that the channel was artificially straightened.
- Sediment transport ~~impact~~ conditions as described in NRCS NEH, Part 654.1302-1305~~00~~.

C33: Chapter 13. Just 1300? May want to be more specific here.

RESPONSE: Chapter sections clarified above.

- ~~Physical c~~Constraints to ~~restoration~~project completion, i.e. property lines, bedrock outcroppings, infrastructure, threatened and endangered species, cultural resources.

C34: Add cultural resources.

RESPONSE: Good addition, thank you. Language adjusted to clarify this section.

- Historical meander patterns and lateral migration rates from aerial imagery.

C11: Will this be required for all size projects? (Example: a small restoration in 1 bend of a stream?) Will this be required for streams that don't have stream history?

RESPONSE: Meander patterns and rates should be investigated for even small projects. The level of investigation is not specified, so the planner can adjust accordingly.

- Log the soil profile from the top of high bank to a depth at least 2 feet below the channel bottom, or refusal, at representative locations or changes in soil type. Identify the location and elevation of observed seepage layers. Classify the bedload material using sieve analysis or pebble counts on the riffles and point bars.

C12: Are these visual inspections on vertical faced streambanks or soil digs? If soil digs, how many will be required and what will the criteria be? May face permitting problems (floodplain, Ch 30, etc.) to even do a soil dig near the site.

RESPONSE: The extent of the soils investigation depends on the scope of the project. soil profile could be investigated by inspecting existing cut banks along a channel. It could also be completed with a hand corer which would not require digging up a substantial amount of material that would require a permit.

C60: Often times the channel bottom is a rock layer 1'+ thick. We may need excavation equipment to get beneath that layer. This should be modified to "log the soil profile to the most restrictive layer or rock layer" The Central Sands region would be different because in some stretches there will be a hard-packed clay layer in the streambed that can easily be excavated with a bucket auger.

RESPONSE: The reviewer makes a good point; language clarified. If a refusal layer is present, typical hand soil coring equipment cannot break through. In that case, it is no longer soil, but relic stream or glacial sediment that is important to note for the assessment. Sediment does not need to be sampled below the refusal layer.

- Document the location, type, and extent of existing bank protection or restoration work. Describe channel stability and effectiveness of those measures on improving water quality and fish and wildlife habitat. Examine past stabilization or restoration measures for success or failure.

C42: Add to bullet "Analyze and examine past stabilization or restoration measures as to reason for success or failure."

RESPONSE: Good comment; text incorporated.

- Assess aquatic and riparian habitat types, variability, and disturbances. Compile data on existing aquatic organism populations and water quality data. Summarize the ecological improvement~~uplift~~ potential.

C13: Are the proper resources going to be available to complete this task? What data is being assessed? Will surface water data viewer be adequate or will a biologist be needed?

RESPONSE: The intensity of these assessments are left undefined and to the professional judgement and the experience of plan approver.

C43: Add to this bullet "Coordinate with the local fisheries biologist to evaluate pre-restoration biota and one year post restoration positive or negative changes."

RESPONSE: Monitoring data would be helpful to identify and document changes in biota; however, this effort is at the discretion of the plan approver.

C35: To what extend? Potential or Maximal Uplift? What tools can be used for calculating the ecological uplift? What quantifies the environmental gain of the project? I think you need more explanation of what you want here.

RESPONSE: This is supposed to be a qualitative effort. We do not intend that a specific tool be used to quantify ecological uplift.

C70: Not clear what exactly [ecological uplift potential] means. Suggest using more familiar terminology.

RESPONSE: Language clarified.

- Describe the livestock type, number, riparian grazing period, stream crossing locations.

- Describe the type and density of riparian vegetation and invasive species.

C44: Add to this bullet "Consider the removal of streambank destabilizing species such as box elder."

RESPONSE: This is a debatable issue. Bank erosion is caused by a variety of factors including fluvial entrainment, pore water pressure and gravity. Trees are often associated with erosion and localized scour, but are generally not the cause of the erosion. Because of these site-specific variables, we are leaving prescriptive approaches out of the *standard so that it is adaptable for a wide variety of stream conditions. The user of this standard can simply complete the task to describe the type and density.*

- List waterway designations: Areas of Special Natural Resource Interest (ASNRI), Outstanding Resource Waters (ORW), Exceptional Resource Waters (ERW), trout stream classification, type (cold or warm water, fish habitat) and characteristics such as targeted aquatic species.

C45: Add to this bullet "Prioritize a restoration by which the implementation of successful habitat improvement will provide an optimal habitat for targeted aquatic species, i.e., trout, threatened fish and mussels."

RESPONSE: Language added to reference targeted aquatic species as one characteristic. Our intent with including this language was to acknowledge that there may be some limitations on the type and how the work should be conducted. There may be motivations for restoration projects other than specific aquatic species (e.g., reducing sediment delivery, aesthetics, etc.).

C28: I don't see anyone in the field or area offices completing the site assessments for this practice. In my opinion agency personnel do not have the time for such complex evaluations. Is this standard intended for the private sector? I see a trend of removing design standards from the reach of field office and area office personnel by the continual increase in complexity and complications required in design procedures.

RESPONSE: The standard was not written to be used by any particular user group. It was laid out as representing the minimum due diligence required. We view stream restoration as a potentially major alteration of a public waterway. Such a profound change should require the practitioner to adhere to best practices that are described by the NRCS National Engineering Handbook 654 and other Federal guidelines.

The primary objectives of alluvial channel design are to: (1) maintain sediment transport continuity, (2) reconnect the bankfull channel to a floodplain, (3) match stream type (hydraulic proportions and features) to the geomorphic setting, and (4) restore the natural planform to the extent possible.

Refer to Rosgen Geomorphic Channel Design as described in NRCS NEH, Part 654.11 or alluvial channel design as described in NEH, Part 654.0900, or combinations thereof. Portions of the stream may require a threshold channel design, or streambank protection, to prevent lateral migration due to physical site constraints such as property lines and buildings. Use the allowable shear stress approach as described in NEH, Part 654.0804 or streambank protection criteria in Streambank and Shoreline Protection (Code 580).

At minimum, incorporate the following analyses into the design:

- Develop a water surface profile model of the existing and planned channel. ~~using the~~ Refer to a flow model such as USACE HEC-RAS ~~software~~. Evaluate the shear stress, flow depth, and velocity for all flows from bankfull up to the 100-year flood. Calibrate the bankfull flow to field indicators. Match proposed vegetation with the frequency and duration of various flood surfaces.

C14: To what extent is the use of HEC-RAS needed? Is a full stream assessment necessary or will a set number of feet up and down stream of project be satisfactory?

RESPONSE: We intend to have a full stream assessment as outlined above. The HEC-RAS model may be relatively coarse depending on the site, hydraulic structures present (e.g., bridges, culverts), and nearby structures. If there are potential impacts to others, State Admin. Code requires a HEC-RAS model as well. It is difficult to create a "one-size-fits-all" standard for hydraulic model guidelines within a succinct standard. Judgement needs to be exercised by an experienced professional engineer when developing a hydraulic model.

C36 // C61: Any other options or tools? // After "…using the USACE HEC-RAS software" add "…or software/applications that show the water surface, velocity and capacity at each stage."

RESPONSE: We added language to allow for other options.

- Design the cross-sectional geometry to match the dimensions of stable, natural channels in the same or similar geomorphic setting (e.g. bankfull width to depth ratios, floodpronelain width to bankfull width ratios).

- Evaluate the channel for sediment competence (*ability to move the largest particle made available to the channel)* at the riffle sections. Perform pebble counts or collect bar/riffle samples. Refer to NRCS NEH, Part 654.1102(c). Design the channel capacity, profile, and sinuosity to maintain the sediment transport capacity of the upstream and downstream channel reaches.

C62: There seems to be really specific criteria here. Contractors are going to have to be within say 0.1' of planned elevations for the planned channel to preform to the metrics laid out. There will need to be a hefty cost share hike in the cook book to account for these changes. Is this worth the cost? If riffle sections change or move slightly, might we create habitat opportunities for other aquatic species? Are we managing for all species?

RESPONSE: This standard does not specify tolerances for design grades. If a practitioner is planning to completely re-build a channel in a new location, some assurance needs to be provided and documented that they are responsibly designing the channel geometry. The potential to induce substantial changes in upstream incision or aggradation is high in these scenarios.

- Specify the location of artificial riffles if necessary to re-distribute grade and restore riffle-run-pool-glide sequences.

C15: Will riffle/pool sequence be determined based on a "representative stable section of stream" or determined using a formulaic approach?

RESPONSE: There is a wide variety of approaches, and we tried to make this standard non-prescriptive with respect to method. Either of the methods the reviewer mention could be used, but it is up to the practitioner to determine best method for the site.

- If newly excavated channels will re-occupy former channel beds, verify the presence of suitable bed material. Where riffles are needed to re-establish vertical stability, specify the locations and dimensions of riffles to restore appropriate geomorphic conditions. Design pool geometry based on reference reaches or other empirical data.

C63: What about using the Scour formula NRCS NEH Part 654, TS-14B to estimate scour holes if weirs are used to create a pool?

RESPONSE: We agree that estimating and laying out pools should be one part of the design process. We are attempting to avoid prescriptive design methods, and are leaving it to the designer to determine the appropriate methods based on the provided guidance documents.

- Where possible, design a stable planform indicative of historic or natural meander patterns, and incorporate variability within the channel as described in National Engineering Handbook, Part 654.1200.

C41: Difficult to formulate at what point in time the historic meander pattern is present considering the impact of bridges, culverts, changes in land use throughout a watershed or even a specific stream reach.

RESPONSE: Good observation by the reviewer; language clarified. The wording of "where possible" leaves this open to interpretation and the designer will have to use their best judgment on planform and variability.

- Conduct a soils or geologic investigation along the existing stream channel and planned alignment according to NRCS NEH, Part 631, Chapters 2 and 5 for Group B structures, or TR-25-3. Collect soil samples for index properties of bed and bank soils.

C16: Will soil testing be required?

RESPONSE: The soils investigation should qualitatively describe materials in the planned channel using hand boring equipment.

C64: Who conducts the geologic investigation--state geologist, [county staff, etc.]?

RESPONSE: The language has been adjusted to "soils investigation" so geologist not implied. We expect the practitioner to conduct the investigation.

- Investigate the thalweg for at least 150 feet downstream to anticipate advancing headcuts or knickpoints.

Additional Criteria for Conversion to Two-Stage Ditch

Agricultural drainage ditches are designed as threshold channels to resist movement. However, they often require sediment removal and bank repairs, particularly after large storm flows. These ditches can be converted to a two-stage ditch with a bench that functions as a floodplain, and a low flow (bankfull flow) channel to transport sediment and provide ecological benefits. Drainage benefits include increased ditch stability and reduced maintenance. Refer to NRCS NEH, Part 654.1000 for design. The typical cross section of a two-stage ditch is shown in Figure 1.

Determine the low flow channel capacity using the Cypress Creek equation in NRCS NEH Part 650.1403, regional curve method, or other accepted runoff method. The low flow channel typically carries between the 0.5 and 1-year frequency, 24-hour storm. It can be approximated in the ditch by the elevation of natural bench formations, or the start of sod-forming grasses.

Do not disturb the existing low flow channel. However, in cases where the existing low flow channel is over-widened with a sediment transport problem, evaluate the need to fill the low flow channel with compacted earthfill and excavate a channel with an appropriate cross-section.

C37: Or in the case in NE Wisconsin where the sediment deposits within the low flow channel and the creek creates its own meander outside the bank. This is common. In most cases we excavate within the low flow channel to restore the channel cross section. I would avoid filling within the low flow channel. Please consider this.

RESPONSE: The planner has the choice to excavate or fill. If there is a sedimentation problem, then excavated material will simply be replaced with more sediment and this would be considered maintenance.

Set the bench height at the top of the low flow channel. Use a total bench width between 2 and 4 times the top width of the low flow channel. Total bench width is preferred to be evenly split between the two sides, but can be distributed unevenly, or on one side only. Use one side only to avoid protected areas such as trees, wetlands, or cultural resources.

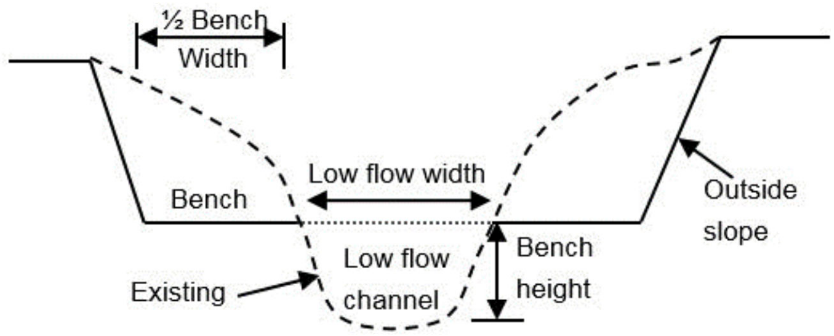

Figure 1. Typical two-sided two-stage ditch.

Use side slopes no steeper than those recommended in NRCS NEH, Part 650.1405, Fig. 14-14 and 14-15 which are based on the specific soils or geologic material in the ditch.

C3: There are recommended side slopes in the other standards. Should this match with those?

RESPONSE: This standard is intended to be unique.

Outlet drainage tile on a bench to provide a free outlet. Install rock riprap or other erosion protection method at tile outlets to protect the bench. Appropriate cover must be maintained according to WI NRCS CPS Subsurface Drainage (Code 606) and Underground Outlet (Code 620).

C65: Is Culvert Protection (MN TR-3) required to size this or can we just put any amount of rock around the outlet to stabilize it?

RESPONSE: MN Tr-3 is not needed in this application. The method for rock sizing for energy dissipated should be left to the designer.

Modify existing structures as necessary to fit the new ditch configuration.

Seed and mulch all bench and bank areas according to Critical Area Planting (Code 342) and Mulching (Code 484). Seed disturbed areas outside of top of bank within 15 days, or seed temporary cover if disturbed areas will be planted to a crop at a later time.

CONSIDERATIONS

Visual resource design. Carefully consider the visual design of channels in areas of high public visibility and those associated with recreation. The underlying criterion for all visual design is appropriateness. The shape and form of channels, excavated material, and plantings are to relate visually to their surroundings and to their function.

Fish and wildlife. This practice may influence important fish and wildlife habitats such as streams, creeks, riparian areas, floodplains, and wetlands. Evaluate aquatic organism passage concerns (e.g., velocity, depth, slope, air entrainment, screening, etc.) to enhance positive impacts and minimize negative impacts.

Select project location and construction methods that minimize the impacts to existing fish and wildlife habitat.

Include measures necessary to mitigate unavoidable losses to fish or wildlife habitat in the design. Maintain the quality of the landscape by both the location of channel works and plantings, as appropriate.

Vegetation. Stockpile topsoil for placement on disturbed areas to facilitate revegetation. Consider placement and selection of vegetation to improve fish and wildlife habitat and species diversity.

C66: Assuming temporary stockpiles can't be placed in the floodplain/shoreland, where should the stockpiles go?

RESPONSE: The reviewer poses a good question, but determining where the temporary stockpiles are placed is outside the scope of this standard. The answer varies by site.

Water quality. Consider the effects of—

- Erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that runoff carries.
- Short-term and construction-related effects of this practice on the quality of downstream watercourses.
- Wetlands and water-related wildlife habitats.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard.

As a minimum, include the following items:

- A plan view of the layout of the channel and appurtenant features; include horizontal curve layout data.
- Typical profiles and cross sections of the channel and flood plain, as needed.
- Profile view along the improved channel reach. Include the thalweg, top of high bank, bankfull elevation, lateral and vertical extent (top and bottom key) of revetments, bed and bank treatments, habitat components, soil logs, and seepage locations.
- Appurtenant features as needed
- Structural drawings, as needed
- Requirements for vegetative establishment and/or mulching, as needed
- Safety features
- Site-specific construction and material requirements
- Ingress and egress locations for construction equipment.
- Work limits --- extent of protection, ingress and egress locations for construction equipment, parking areas, borrow and spoil locations, areas of habitat requiring protection or avoidance (e.g. wetlands, regulated floodplains, riparian and upland areas, instream habitat), property lines, and buried/overhead utilities.
- Pollution control, e.g. staged construction, floating silt curtains, silt fences, erosion control wattles and logs.
- Grading plans showing existing and proposed 1-foot contours. Include cut and fill volumes.

C67: Does this include areas out of the floodplain where the spoil is being spread? Are benchmarks needed as well? What about locations of trees and designations whether they are staying or going?

RESPONSE: We agree that fill placement areas, control points, and tree salvage/removal areas should be part of the design plans.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator.

As a minimum, include the following items in the operation and maintenance plan:

- Periodic inspections of all structures, channel surfaces, safety components and significant appurtenances.
- Prompt repair or replacement of damaged components.
- Prompt removal of sediment when it reaches pre-determined elevations.
- Periodic removal of undesirable trees, brush, and invasive species.
- Maintenance of vegetative protection and immediate seeding or replanting of damaged areas, as needed.

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