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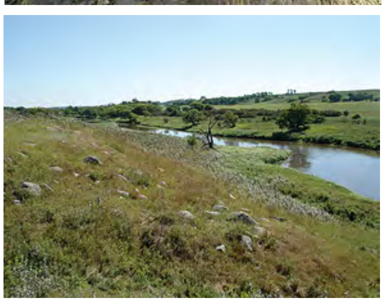
Riparian Complex Ecological Sites of North Dakota

A Pictorial Guide of Riparian Complex Ecological Sites Common in North Dakota



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The following is a pictorial guide of the valleys, streams and plant communities common in riparian complex ecological sites in North Dakota. The figures and diagrams included in this guide provide a detailed view of valley and stream types. Additionally, vegetation communities will be represented by photos. This guide is intended to aid in the interpretation of riparian ecological site descriptions and assist in the identification of riparian complex ecological sites when developing management plans for riparian ecosystems.

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Riparian Complex Ecological Site

A riparian complex is the ecosystem associated with a stream, consisting of multiple surfaces, each supporting a unique plant community (Figure 1). A riparian complex ecological site is a-unit of land with a unique set of biotic and abiotic factors that is capable of producing a distinct riparian complex and plant communities. While upland ecological sites in North Dakota are influenced primarily by soil properties, topography, climate, fire and grazing patterns, riparian complex ecological sites are largely influenced by stream hydrology.

The formation of surfaces and plant communities within a riparian complex is a direct result of geomorphological and hydrological processes. The primary factors that influence the riparian complex include valley type, stream type, stream gradient, channel substrates, fluvial surfaces, and vegetation patterns.

These factors vary across North Dakota due to differences in geology, soils, water, climate and topography. Areas that have similar geology, soils, water, climate and topography have been categorized by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as Major Land Resource Areas (MLRA).

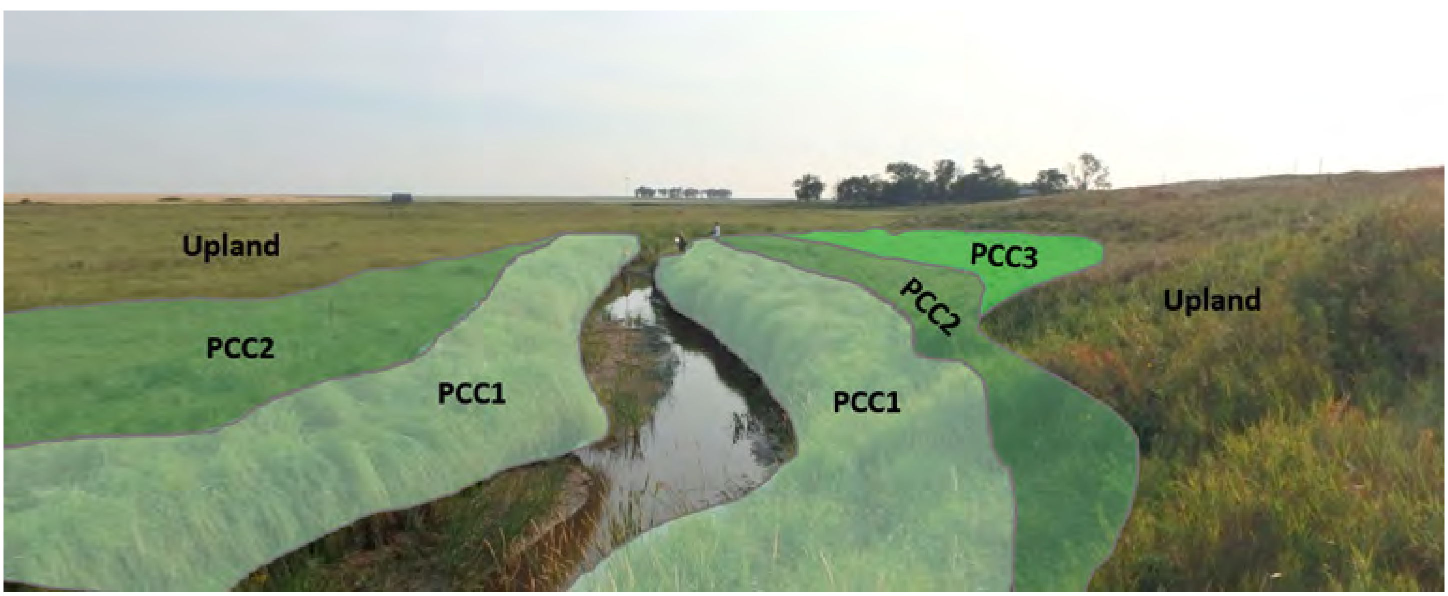


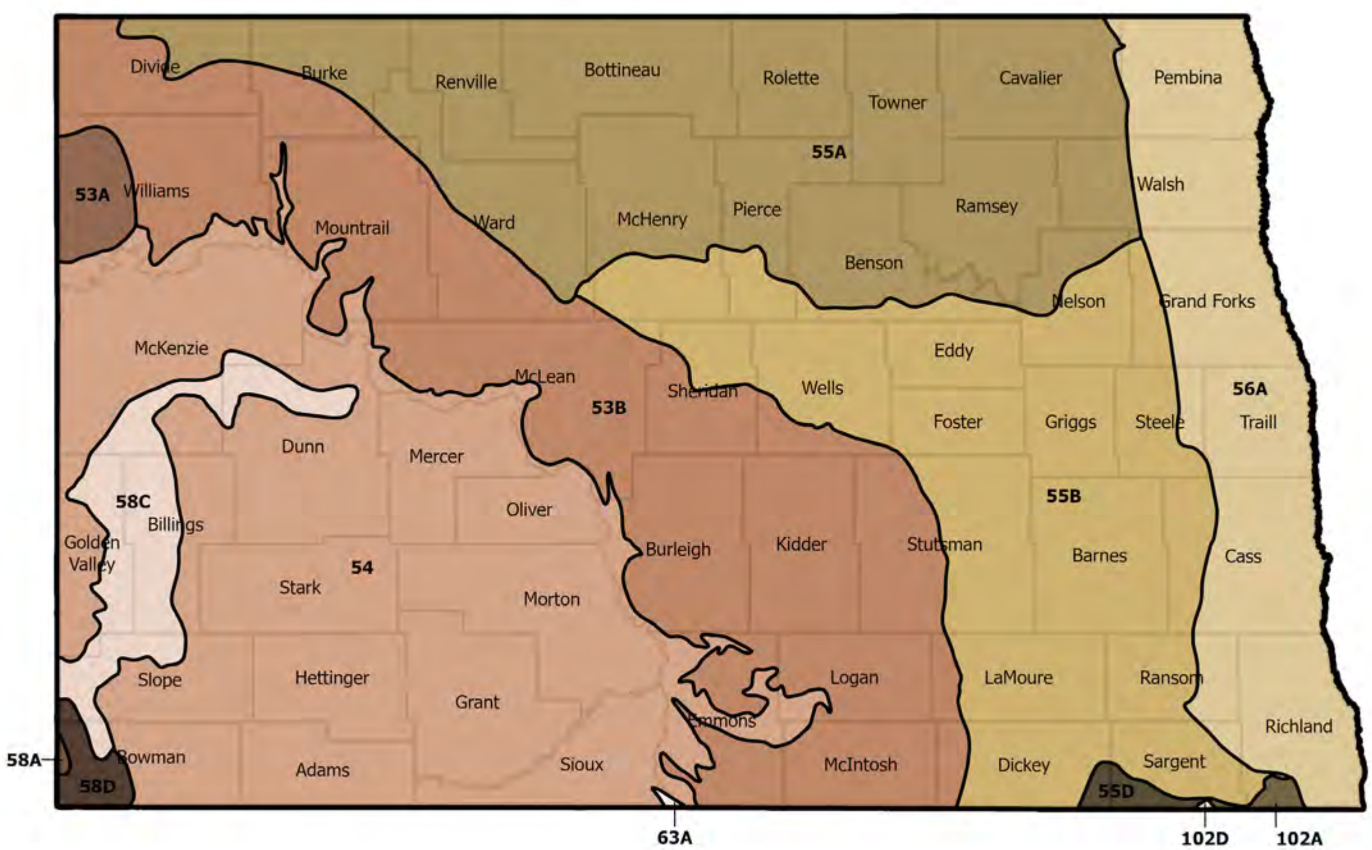
Figure 1. An example of a riparian complex in North Dakota showing multiple surfaces and plant communities (PCCs; Meehan & O'Brien 2020).

Major Land Resource Areas

Major land resource areas are geographic regions characterized by soil patterns, climate, water resources and land uses. MLRA regions are important in statewide agricultural planning and have value in interstate, regional and national planning. The NRCS has defined 278 MLRAs, each defined by a descriptive geographic name and a number.

Eight MLRAs represent the majority of North Dakota (Figure 2). Each MLRA may support multiple riparian complex ecological sites due to this broad pattern of soils, vegetation and water resources. A stream or river may have multiple ecological sites if it crosses more than one MLRA.

Figure 2. Major land resource areas of North Dakota.



Riparian Site Dynamics

Riparian ecosystems are highly dynamic. As a result of the fluvial activity in these ecological sites, the plant communities shift in response to the influences of erosion, deposition and water table on a fluvial surface.

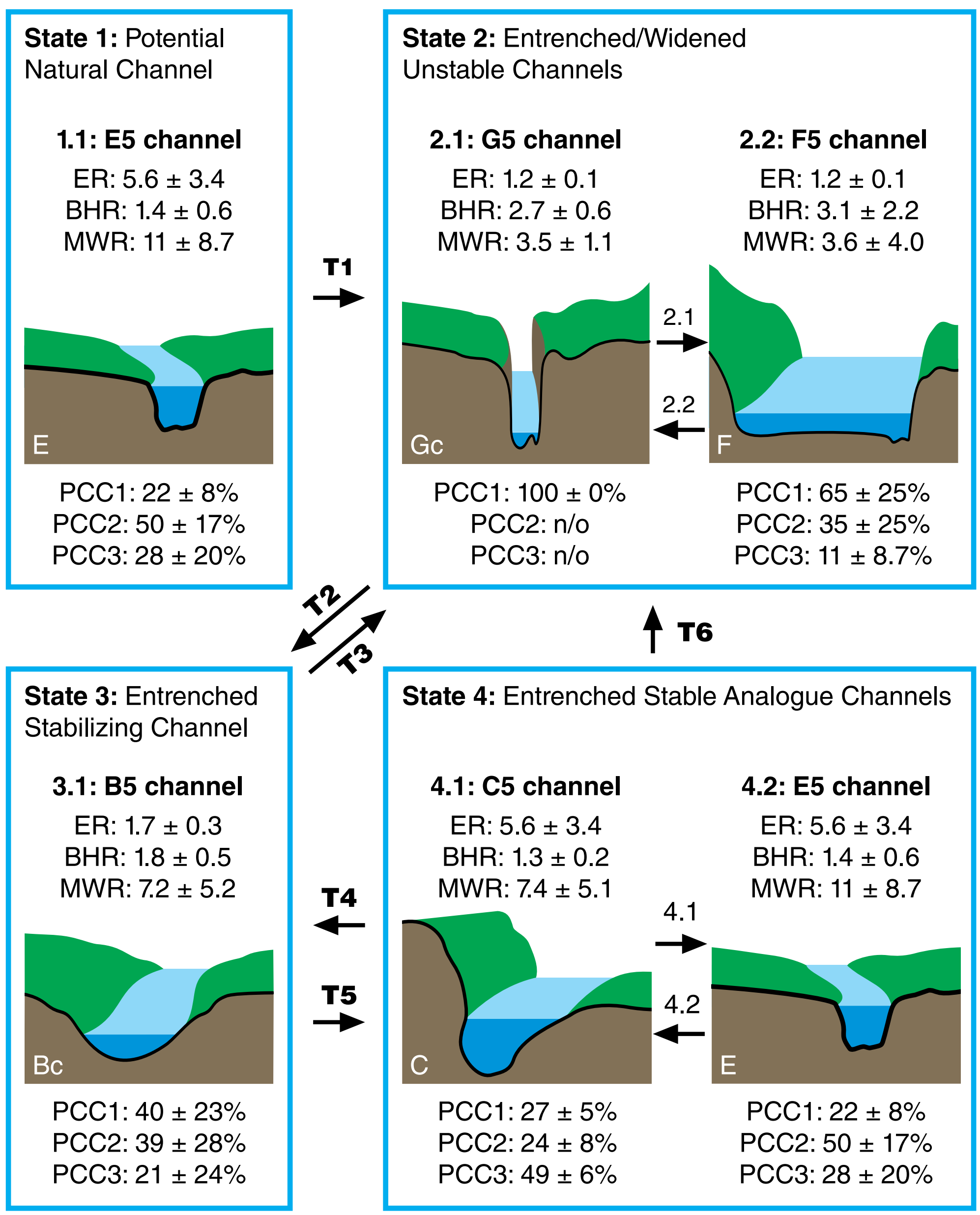
Fluvial surfaces are the flood plains and terraces associated with a stream. Stream stability, which is linked to geomorphology, changes in response to shifts in climate, vegetation, or management.

Each land site's ecological dynamics are presented through a state-and-transition model (STM). Riparian complex ESDs describe the stream types, fluvial surfaces, plant communities and the site's responses to disturbances. Figure 3 depicts a riparian complex STM for a perennial stream in MLRA 54, located in the southwest region of North Dakota.

Prior to European settlement, the primary disturbances impacting the stream channel, fluvial surfaces and riparian vegetation communities were hydrology, climate, fire, beaver activity and grazing by free-roaming herbivores. Historically, beaver populations were widespread and their activities had a large influence on riparian systems. The decline in beaver populations degraded streams and altered vegetation in riparian areas. Additionally, prolonged periods of drought and heavy grazing by herbivores can result in the loss of bank-stabilizing riparian vegetation. When followed by a flood event, this loss of vegetation often resulted in entrenchment of the stream channel and a change in stream type. Entrenchment reduces the size of the floodplain and lowers the position of the water table within the watershed.

Ecological site descriptions (ESD) provide a consistent framework for classifying and describing range and forest land soils and vegetation. Land is organized into categories based on shared capabilities and responses to management activities or disturbances.

Figure 3. State-and-transition model for a riparian complex ecological site.



The STM depicts the current understanding of the ecological dynamics of the site. The STM, along with the ecological dynamics narratives, identifies and describes the different stream states, phases, thresholds, transitional pathways and drivers that may occur on a site. The STM describes the fluvial surfaces and plant community components and their relationship to the stream type in each state and phase. Understanding these dynamics helps land managers and owners predict how a riparian complex will respond to changes in management and various disturbance regimes such as drought, overgrazing, fire and grazing exclusion.

The stream type(s) in State 1 are referred to as the reference state or the potential natural channel(s). The reference state represents the stream channel and plant community components that would have occupied the site under the historic disturbance regime. This stream type is suited to transport the energy, water, and sediments supplied by the watershed, and promote the plant community components that provide stability to the system.

The potential natural channels, fluvial features and plant community components of the reference state are described based upon data collected from sites determined to be representative of historic conditions. Additional information is gathered from historical documents and other sources that describe the stream, streamflow and plant community components prior to settlement, when the natural disturbance regime would have occurred.

Since settlement, these sites have been subjected to numerous disturbances, such as changes in land use, removal of beaver, unmanaged grazing, or the removal of grazing within watersheds and floodplains. These changes have altered riparian plant communities, leaving streams vulnerable to entrenchment and altering the stream and riparian plant communities.

Additionally, non-native species such as Kentucky bluegrass, smooth bromegrass, reed canary grass, saltcedar, buckthorn and Russian olive have invaded sites and negatively impacted stream stability. Many stream systems have been subjected to direct hydrologic alterations from the development of infrastructure, livestock grazing, crop and forage production, and energy development. Stream reaches have been modified by channel straightening, agricultural drainage, bridge design, concrete crossings and dam construction.

Disturbances to potential natural channels can result in stream entrenchment and floodplain abandonment. When this occurs, a threshold has been crossed to State 2, which consists of the unstable channels. These unstable channels are highly erosive and have no floodplain.

Once entrenchment has occurred, recovering the potential natural channel is nearly impossible without a major investment of time and money for restoration. The stream may stabilize within the new valley formed by entrenchment, forming a smaller, restricted floodplain.

As the stream starts to stabilize and develop a deeper channel and new floodplain within the restricted floodplain, it crosses a threshold into State 3, the stabilizing state. This state occurs when the channel is in a state of building resistance and resilience. Management of stabilizing channels should include practices that promote floodplain development through the establishment of riparian plant communities.

As the stream continues to stabilize and the floodplain expands, it crosses a threshold into State 4, the stable analogue state, which consists of stable channels with restricted floodplains and plant community components due to past entrenchment. If these streams are not managed properly, they will transition back to State 2, where they become further entrenched.

Stabilizing stream channel within a valley formed by entrenchment in North Dakota. (PC Miranda Meehan).

Using the Riparian Complex Ecological Site Guide

The information in the riparian complex ecological site descriptions (RCESDs) should be used to implement direct management, restoration efforts, and monitoring to determine if these efforts are achieving the desired outcomes. The intention of this guide is to help land managers interpret the information in the RCESDs and identify the current state of riparian complexes.

To set management objectives, it is important to know the current state of the stream area being managed. Stable stream types typically allow current management to continue; however, if the stream type is unstable or at risk of becoming unstable, then changes in management may be required.

In addition to guiding management, the information in RCESDs can be utilized in riparian restoration efforts to determine stream and floodplain dimensions and select the appropriate species for riparian plantings.

Monitoring stream morphology and riparian plant communities is critical to determine if changes in management are needed or if management objectives are being achieved. Changes in the stream's bank height ratio or width and depth are early indicators of potential changes in stream type. Shifts in the size and number of plant communities within a riparian complex are often indicative of changes in stream type.

The greenline plant community, the community that occurs adjacent to the stream channel, is critical for bank stabilization. Monitoring changes in species composition and ground cover within the greenline is important. When the greenline has elevated levels of upland plant species and bare ground, it is at risk for increased erosion and transitioning to an unstable stream type.

The extent of riparian complex ecological sites is dictated by streamflow and valley type; thus, the ability to distinguish the different streamflow and valley type classifications is required to ensure you are utilizing the correct RCESD. RCESDs for North Dakota are available in Section II of the "NRCS Field Office Technical Guide" (FOTG), which can be accessed at https://efotg.sc.egov.usda.gov/.

Streamflow

Knowing the type of streamflow for the stream reach that is being managed is critical when utilizing this guide. The concepts in this guide are best suited for intermittent and perennial streams with defined channels that are capable of transferring water, sediment and nutrients, and support the development of riparian plant communities.

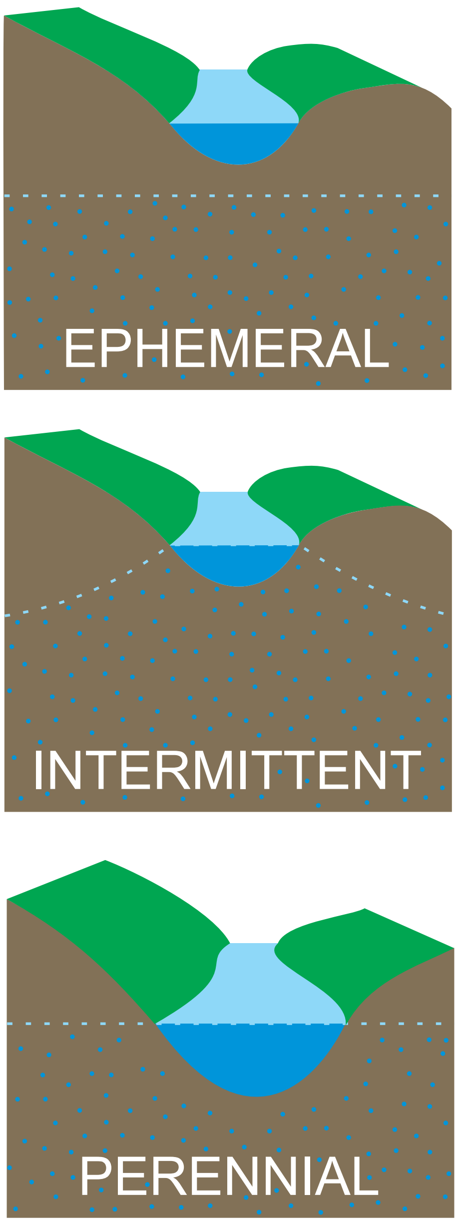
There are three types of streamflow: ephemeral, intermittent and perennial. Streamflow is dictated by the channel's position in relation to the water table (Figure 4).

Ephemeral streams only flow in direct response to precipitation, with water only being transported during and immediately after precipitation events. An ephemeral stream generally does not have a well-defined channel and may not support riparian vegetation. The bed of an ephemeral stream is always above the water table. Ephemeral streams tend to function more like upland sites than riparian sites.

Intermittent streams have a channel that only contains water for a portion of the year, typically in the spring and early summer when runoff from snowmelt and precipitation provides flow. Due to the inconsistent flow, the stream channel may or may not be well-defined. The position of the stream channel in relation to the water table fluctuates throughout the year. Intermittent streams often have decreased or no active stream flow in the late summer and fall.

Perennial streams have defined channels that contain water throughout the year, given normal precipitation. The bed of the stream channel is below the water table, with groundwater providing the base flow level of the stream.

Figure 4. Streamflow as related to the water table.



Stream with ephemeral flow. This site functions as an upland site and supports an upland plant community. (Miranda Meehan, NDSU)

Stream with intermittent flow. (Miranda Meehan, NDSU)

Stream in western North Dakota with perennial flow. (Miranda Meehan, NDSU)

Stream with ephemeral flow.
(Miranda Meehan, NDSU)

Stream with intermittent flow with no active flow due to lowered water table.
(Miranda Meehan, NDSU)

Stream in eastern North Dakota with perennial flow. (Miranda Meehan, NDSU)

Valley Type

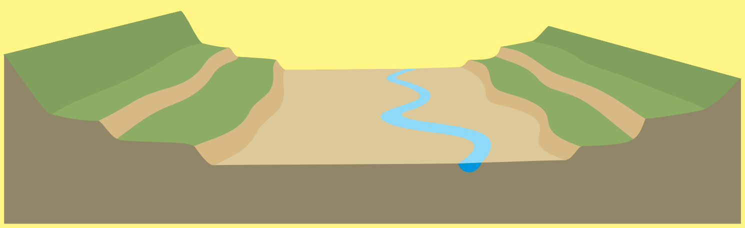
Each valley type has a unique landform that is the product of historical fluvial and geological processes, such as deposition, erosion, and geologic material. The valley type influences the type of stream channel and disturbance response; only certain stream types are supported by each valley type. Within the valley, the stream's behavior is controlled by the valley's width, slope, parent material and vegetation. The two most common valley types documented in North Dakota are alluvial and lacustrine.

Alluvial Valley Type

The alluvial valley is described as a broad U-shaped structure with a gentle down-valley relief that has a well-developed flood plain and numerous glacial and alluvial terraces. Active alluvial terraces support riparian vegetation, whereas abandoned terraces are no longer connected to the stream or water table and are inhabited by upland plants.

This is the most prevalent valley type across North Dakota due to past glaciation and the erodibility of the soils. The majority of the streams in North Dakota are in alluvial valleys, examples include the Little Missouri River and James River. The alluvial valley type supports stream types B, C, D, E, F and G (see Figure 5).

Alluvial Valley

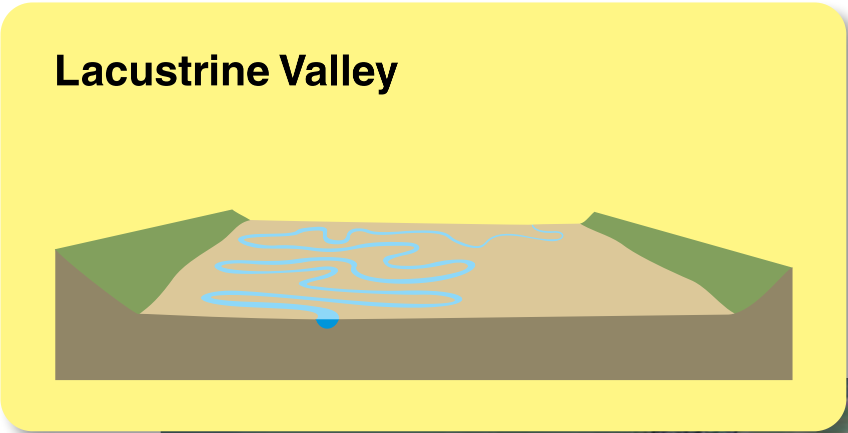


Stream in an alluvial valley type with multiple terraces. (Miranda Meehan, NDSU)

Lacustrine Valley Type

The lacustrine valley forms in old lake beds and is described as a very wide valley with gentle slopes. The lacustrine material that forms this valley can be from recent lakes or glacial lakes, such as Lake Agassiz.

The streams in this valley tend to have expansive floodplains that are frequently flooded and have many wetlands and oxbows. Many streams in the Red River Valley of eastern North Dakota belong to this valley type. The lacustrine valley type is able to support stream types B, C, D, E, F and G (See Figure 5).

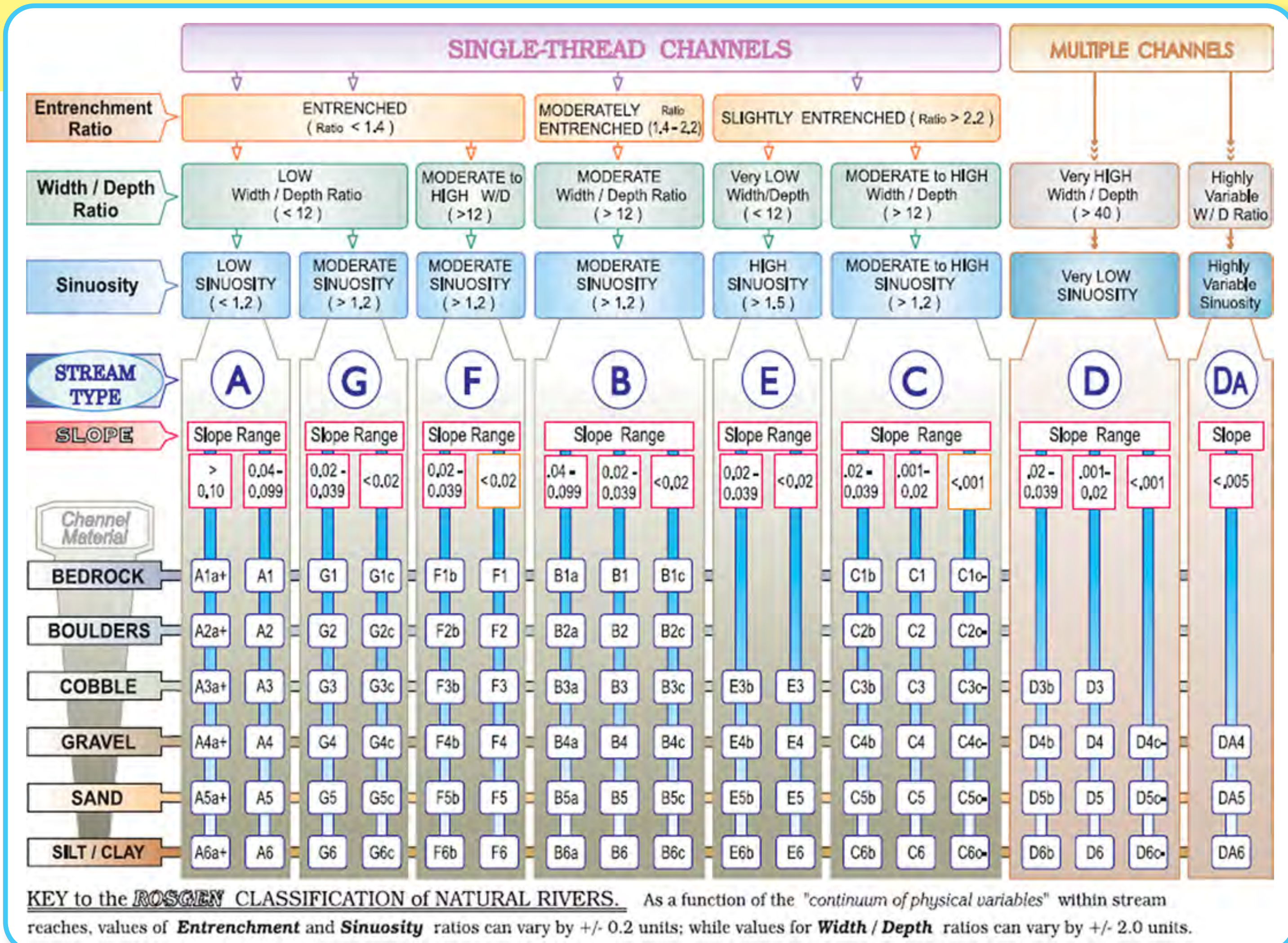


Stream within lacustrine valley with broad floodplain and oxbow wetlands. (Vern Whitten, Vern Whitten Photography)

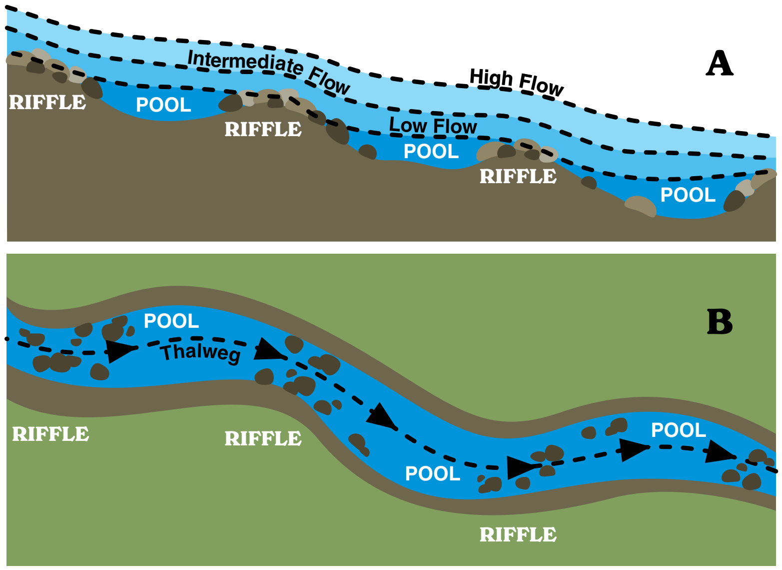
Stream Type

Stream type is based primarily on the shape of the stream channel and sinuosity. Stream types can be defined further based on the slope of the channel and channel bed material. Rosgen (1985; 1994) developed a stream classification system based on these major variables that has been adapted by the Natural Resources Conservation Service and the U.S. Forest Service for the assessment of riparian complex ecological sites. Rosgen's stream classification system allows natural resource managers to predict a stream's behavior and compare data from one reach with that from similar reaches by grouping similar streams.

Figure 5. Key to the Rosgen Classification of Natural Rivers



Stream Profile



The specific measurements required to determine stream type are entrenchment ratio, width/depth ratio, and sinuosity. These measurements must be taken at a riffle within the reach being assessed. Riffles are located at the tail of a pool and are the shallowest portions of the stream.

To ensure measurements are accurate, identifying the bankfull elevation of the stream correctly is important. Bankfull elevation is the point where the stream leaves the channel and enters its floodplain.

Common indicators used to identify the bankfull elevation are the floodplain surface, vegetation line and top of bars. Bars are features formed when the stream deposits material. The bankfull flow is the channel-forming flow and occurs, on average, every 1.5 years.

Bankfull elevation can be identified as the top of the floodplain, as depicted in this figure. The yellow lines highlight the extent of the bankfull elevation. Often, a change in plant community occurs at the bankfull elevation. (Miranda Meehan, NDSU)

Bankfull elevation can be identified by the top of bars and depositional features. The yellow lines highlight the extent of the bankfull elevation. (Jeff Printz, NRCS)

Entrenchment Ratio

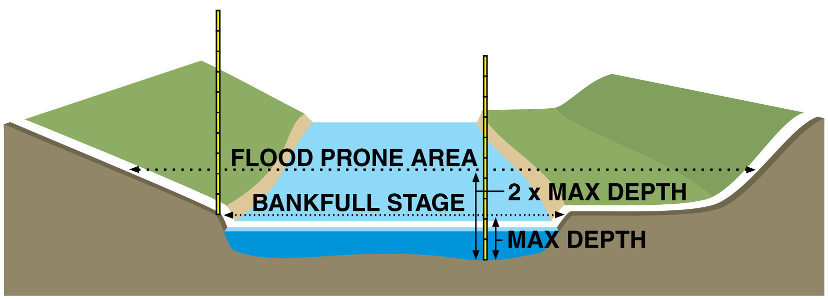
The entrenchment ratio is a measure of the stream's ability to access its floodplain. A low entrenchment ratio indicates the stream is no longer connected to the floodplain, whereas a high entrenchment ratio indicates the stream has a well-developed floodplain that the stream is able to access on a regular basis (during bankfull events, which occur every 1.5 years in North Dakota). A stream with a high entrenchment ratio is able to access the floodplain during a flood, which helps reduce the energy of flood waters and reduce bank erosion, promoting channel stability.

Entrenchment ratio = flood prone width ÷ bankfull width, where flood prone width is the width of the floodplain at an elevation of twice the maximum channel depth.

Width to Depth Ratio

The width-to-depth ratio is a measure of the stream's ability to transport water and sediment. When a stream has a high width-to-depth ratio, it cannot transport sediment, and deposition occurs.

Width to depth ratio = bankfull width ÷ average bankfull depth



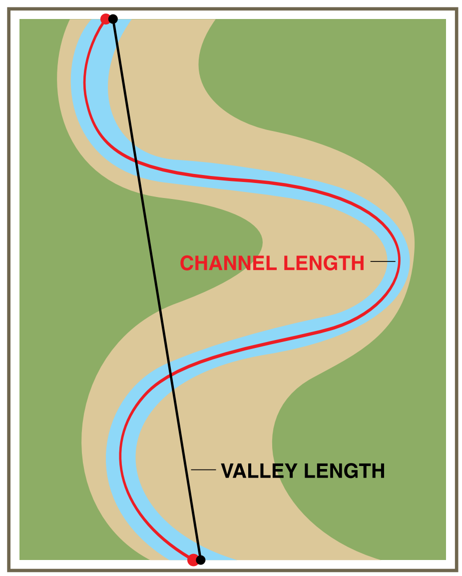
Sinuosity

Sinuosity measures how much the stream is able to move within the floodplain or simply how much the stream curves. Under natural conditions, North Dakota streams typically have high sinuosity of 1.5 or greater.

Sinuosity = channel length ÷ valley length

Channel Bed Material

Channel bed material is denoted by a number one through six following the stream type. In North Dakota, the channel material of most streams is silts/clays (denoted by a 6) or sands (denoted by a 5). *For example, an E channel with silt/clay as the channel material is an E6 stream.*



(Miranda Meehan, NDSU)

Example

Bankfull width = 11.3 feet

Flood prone width = 38.42 feet

Mean depth = 2.8 feet

Channel length = 4,775 feet

Valley length = 2,999 feet

Entrenchment ratio = 38.42 ÷ 11.3

Entrenchment ratio = 3.4

Width to depth ratio = 11.3 ÷ 2.8

Width to depth ratio = 4.03

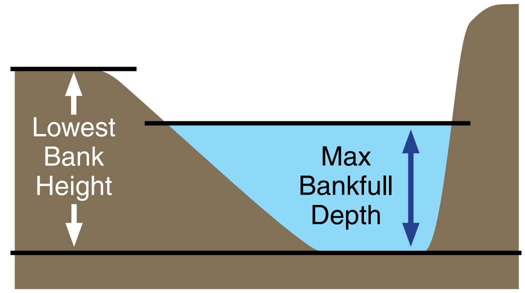
Sinuosity = 4,775 ÷ 2,999

Sinuosity = 1.6

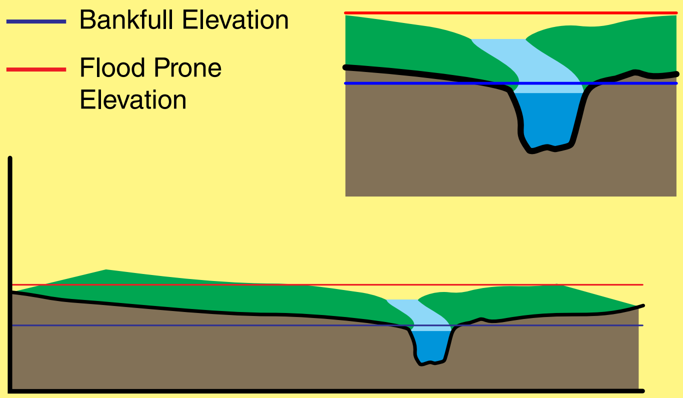
Bank Height Ratio

While not part of the Rosgen's stream classification system, bank height ratio (BHR) is another metric used to assess a stream's ability to access its floodplain. Bank height ratio responds quickly to disturbance and can be an indicator that a stream is at-risk of transitioning to an unstable state. Bank height ratio is broken into stability groups where: stable is ≤ 1, moderately unstable is 1.1 – 1.3, unstable is 1.3 – 1.5, or highly unstable > 1.5.

Bank height ratio = lowest bank height ÷ bankfull height.



E Streams



The E stream type is the most stable stream type and the potential natural channel for many streams in North Dakota. E channels are slightly entrenched (entrenchment ratio > 2.2), have a narrow and deep channel (width/depth ratio <12), and moderate to high sinuosity (> 1.5).

These streams typically have a large floodplain unless floodplain development is restricted by the valley. This happens when an E stream develops in a former F stream type or other confined valleys. An E stream is able to access the floodplain easily during bankfull flood events.

The water table associated with this stream type is elevated, supporting the expansion of highly productive riparian plant communities. A healthy riparian plant community is required to maintain a stable E stream.

Disturbances that alter streambank vegetation that result in the replacement of deep-rooted riparian plant species by shallow-rooted upland species, can destabilize streambanks and increase sediment loads. These changes make the stream at risk of transitioning to a less stable or unstable stream type.

E streams are narrow and deep like this perennial reach. (Jeff Printz, NRCS)

E streams have well-developed floodplains such as the one associated with this intermittent reach. (Jeff Printz, NRCS)

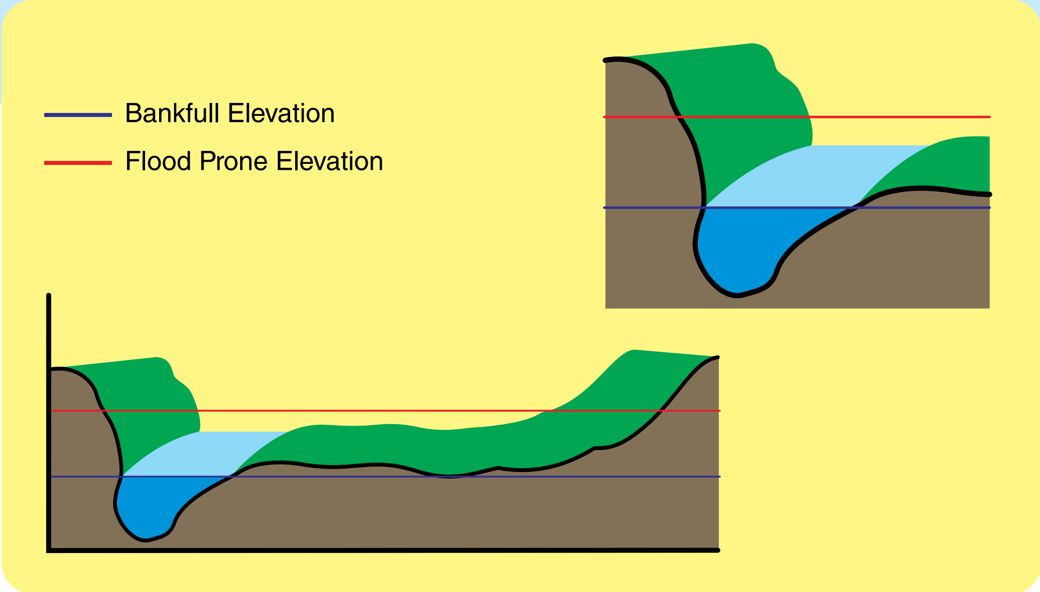
Intermittent E channel in western North Dakota. This channel is narrow and deep, enabling it to transport its sediment load. (Benjamin Menapace)

C Streams

The C stream type is characterized by active lateral movement, with material being removed from outer bends (cut banks) and deposited on inner bends (point bars). C channels are slightly entrenched (entrenchment ratio > 2.2), have a moderate to high width-to-depth ratio (>12) and moderate to high sinuosity (> 1.2).

The C channel is the potential natural channel for some streams in North Dakota that have sand as the dominant channel material. Due to the active lateral movement of C streams, they have a high sediment supply unless streambanks are well-vegetated. These streams typically have a well-defined floodplain with numerous fluvial features (terraces) as a result of deposition during flood events. Each of these features supports a different plant community, the composition of which is dictated by the depth to the water table.

A healthy riparian plant community is required to maintain a stable C stream or facilitate the transition to a more stable E channel (if that is the potential natural channel for the site). A healthy greenline plant community traps sediments, aiding in floodplain development. Disturbances that alter streambank vegetation, such as the replacement of deep-rooted riparian plant species by shallow-rooted upland species, can destabilize streambanks and alter sediment loads. These changes make the stream at risk of transitioning to a less stable or unstable stream type.



C channels are characterized by point bar formation as a result of deposition on the inner bends. Note the point bar formation on the perennial stream in western North Dakota. (Miranda Meehan, NDSU)

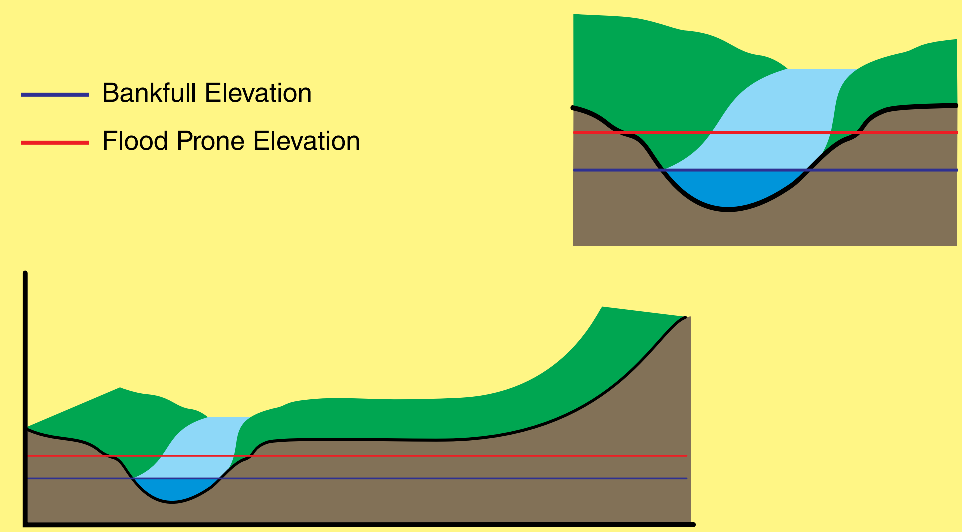
As the floodplain develops, point bars are stabilized by riparian vegetation, as seen along this reach of a perennial stream in eastern North Dakota. (Miranda Meehan, NDSU)

C stream type along a reach of an intermittent stream in western North Dakota. (Jeff Printz, NRCS)

B Streams

The B stream type is characterized as having a parabolic shape and is the most widely documented channel in North Dakota to date. This channel is categorized as stabilizing in the riparian systems of the Great Plains, acting as a transitional state between unstable and stable channels. B channels are moderately entrenched (entrenchment ratio of 1.4-to-2.2), with a moderate width-to-depth ratio (> 12) and moderate to high sinuosity (> 1.2).

In North Dakota, the B channel has a shallow slope and channel bed materials consisting of silt and clay (denoted by a 6) or sand (denoted by a 5). This stream is indicative of past disturbance because it is a stabilizing channel that is associated with the early stages of floodplain development. These streams typically have a very narrow floodplain consisting of early successional riparian species. Due to its stabilizing nature, this stream is considered at-risk of destabilization. Thus, management has a significant influence on the trajectory of B channels, promoting stability or causing it to return to an unstable state.



B streams have a parabolic or U-shape, as seen on this intermittent stream. This stream has a poorly developed riparian plant community and is at-risk of becoming unstable. (Benjamin Menapace)

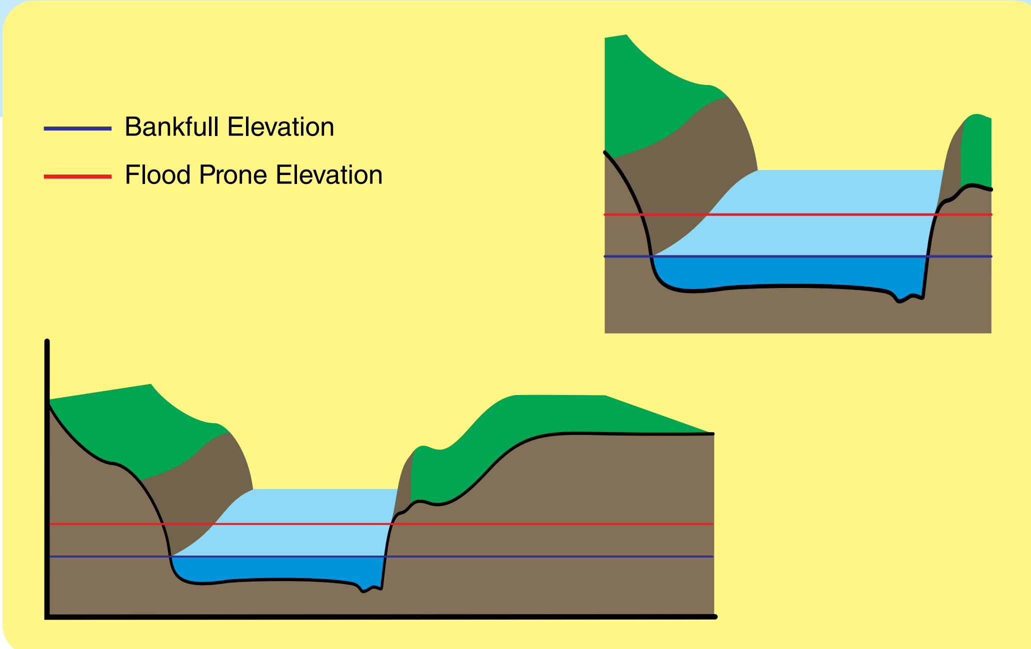
The floodplains of B streams are narrow, like those associated with this reach of a perennial stream in eastern North Dakota. (Miranda Meehan, NDSU)

Floodplain plant communities associated with B streams often are inhabited by early successional plants, as seen along this reach of an intermittent stream. (Benjamin Menapace)

F Streams

The F stream type is an unstable channel that is shaped like a trough with a wide, flat bottom and vertical sides. F channels are entrenched (entrenchment ratio <1.4) and do not have an active floodplain. These streams are wide and shallow (width-to-depth ratio > 12) and relatively straight (sinuosity is >1.2) when compared with the potential natural channels.

In North Dakota, the channel material of this stream is silt and clay (denoted by a 6) or sands (denoted by a 5). The stream is unable to access the floodplain, which causes the streambanks to experience increased force during flood events, leading to an increase in erosion, sediment loads and channel widening. However, this process is required to facilitate floodplain development and the transition to a stable B, C, or E channel.

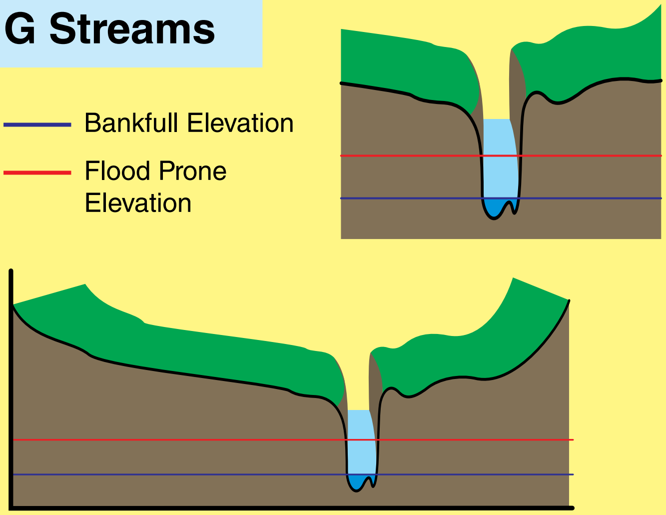


F streams are trough-shaped and wide, with a flat bottom and nearly vertical sides, as seen in this intermittent stream in western North Dakota. (Jeff Printz, NRCS)

F streams are shallow as a result of the high width-to-depth ratio, with perennial reaches having little to no flow during dry periods. (Miranda Meehan, NDSU)

F channels do not leave the channel during flood events and have no floodplain. (Miranda Meehan, NDSU)

G Streams



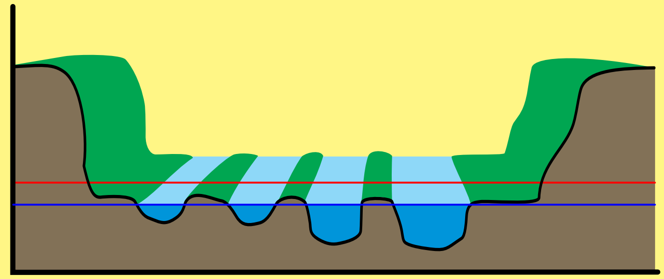
The G stream type is highly unstable with a gully like channel that is narrow and very deep (width-to-depth ratio <12). G channels are entrenched (entrenchment ratio <1.4), having lost connection to the floodplain due to down-cutting. Down-cutting is often a response to changes in grade and increased erosion and/or sediment loads.

These streams are relatively straight (sinuosity is >1.2) when compared with the potential natural channels, decreasing sinuosity, and increasing the speed and force of floodwaters.

Because the stream is unable to access the floodplain, the increased force leads to increased erosion of the streambank, sediment loads, and channel down-cutting and widening. The high instability of this channel in North Dakota is increased by the erodibility of silts/clays and sands channel material. As a result, these streams often quickly transition to F or B streams.

G streams are gully- or trench-shaped, being narrow and deep with no floodplain. The streambanks are unstable and actively eroding. (Miranda Meehan)

D Streams



The D stream type is characterized as having multiple channels and commonly called a braided stream. D channels are common on streams with high sediment loads such as the Upper Missouri River and Platte River. However, D streams are typically considered an unstable channel type and result from increased erosion within a watershed. D streams have a very high WDR (>40) and very low sinuosity.

D streams are wide and shallow with multiple channels and high sediment loads. This is a D stream reach on the Little Missouri River in western North Dakota. (Miranda Meehan)

Riparian Plant Community Components

Riparian complex ecological sites consist of numerous plant communities called plant community components (PCC). Each PCC is associated with a different fluvial surface and supports a distinct arrangement of plant functional groups and species. PCCs are assigned a number based on their location relative to the stream, with PCC1 occurring nearest to the stream. Riparian complex sites across North Dakota typically support two to five PCCs, though three is the most common. The PCCs associated with a site and the percentage of each are a function of the stream type. PCCs dominated by riparian species are associated with stream types B, C and E, and are often absent at sites with stream type G or F (see STM in Figure 3).

The species and functional group composition of PCCs varies depending on MLRA, valley type, flooding frequency, depth to water table, and dominant channel material. Reference Table 1 to determine what types of plants are expected to occur in different PCCs in relation to streamflow based on their wetland indicator status. Wetland indicator status groups plants by the frequency in which they are present in wetlands. The groups are obligate (>99%), facultative wetland (67-99%), facultative (34-66%), facultative upland (1-33%), and upland (<1%).

Riparian plant communities and channel geomorphology are reciprocally linked. A change in stream type can influence PCCs, and a change in PCC composition or size can influence stream type. This is especially true of changes within the PCC1 and greenline plant community, which is located at the water's edge at the bankfull elevation or slightly higher. The presence of riparian species in the greenline community is maintained by seasonal flows and the local water table. When stream entrenchment results in a loss of hydrologic connectivity with the stream's water table, that floodplain feature and PCC are no longer part of the riparian complex and become a terrace ecological site, which supports upland plant species.

Considerable scouring occurs in the floodplain closest to the stream on an annual basis as part of seasonal flooding, so the plants in this community are adapted to this frequent disturbance and function to protect and stabilize banks. Riparian plants have many growing points, enabling them to produce many stems and deep roots that help stabilize stream banks.

Table 1. Expected PCC in relation to streamflow.

Plant Community Component (PCC)	Perennial	Intermittent
PCC1	Obligate wetland sedges	Obligate and facultative wetland grasses and sedges
PCC2	Obligate and facultative wetland grasses and sedges	Facultative and facultative upland grasses
PCC3	Facultative and facultative upland grasses	Facultative and facultative upland grasses

Stream with a well-defined greenline plant community consisting of deep-rooted riparian species. (Jeff Printz, NRCS)

The greenline plant community (PCC1) is subject to damage by natural forces that include extreme flooding and drought, and anthropogenic actions, including channel modification (bridges, crossings, straightening), improper grazing management, and crop production. Extreme or long-term drought can cause an increase in the presence of upland plants with shallower roots within the riparian area, which can reduce stability over time. Overgrazing tends to facilitate the invasion of Kentucky bluegrass, a shallow-rooted upland species; however, the absence of grazing within the northern Great Plains makes sites susceptible to invasion by smooth brome, another shallow-rooted upland species.

Replacement of the native plant community by shallow-rooted upland species that are not capable of protecting and stabilizing banks results in the formation of tensile cracks, bank sloughing, and accelerated lateral channel movement (unstable state). In the unstable channel phases, PCC1 is restricted with high amounts of bare ground and often comprised of early successional plants. The stream is subject to extreme bank erosion.

Tensile cracks on streambank where riparian species have been replaced by Kentucky bluegrass. (Miranda Meehan, NDSU)

Bank sloughing along stream reach where riparian species have been replaced by smooth bromegrass, resulting in widening of stream channel. (Miranda Meehan, NDSU)

Glossary

Abandoned terrace: A terrace that is no longer connected to the stream or water table and is inhabited by upland plants.

Alluvial valley: A broad valley with gentle down-valley relief that has a well-developed floodplain and numerous glacial and alluvial terraces. Considered broader than a floodplain.

At-risk: A site that is in a stable state but could cross the threshold and become unstable due to degradation.

Bankfull elevation: The elevation where the stream leaves the channel and enters its floodplain.

Bankfull flow: The channel-forming flow, which occurs, on average, every 1.5 years. The flow velocity at which natural channel maintenance is the most effective, occurring on average every 1.5 years. Creates the shape of the channels.

Base flow: The portion of stream flow that results from groundwater seepage/discharge. Does not experience extreme annual fluxes of water quantities.

Bed: The bottom of the stream channel. The bed of an ephemeral stream is always above the water table, whereas the bed of a perennial stream is below the water table.

Channel: The portion of the stream where transportation of water and sediment occurs within the streambanks.

Channel substrate: The materials (sand, silt, clay, and rock) that form the channel bed.

Climate: The long-term weather conditions in a specific region, including precipitation, temperature and wind.

Deposition: The process of soil and sediments dropping out of the water column and being left behind when the flow is no longer sufficient to transport them. A point bar is an example of a depositional feature.

Disturbance: A change in conditions that causes a change in ecosystem processes, such as fire or heavy grazing.

Drought: A prolonged time without precipitation or receiving below-average precipitation.

Ecological site description: A detailed description of a unit of land with a unique set of biotic and abiotic factors that determine its potential to support different plant communities and respond to disturbance and management.

Entrenchment: The process of a stream becoming laterally contained as it vertically erodes into the valley floor, lowering the water table.

Entrenchment ratio: Flood prone width (at the elevation twice the maximum channel depth) divided by bankfull width. A measure of the stream's ability to access its floodplain. A low entrenchment ratio indicates the stream has incised, whereas a high entrenchment ratio indicates the stream has a well-developed floodplain.

Ephemeral stream: Streams that flow only during or immediately after periods of precipitation. Flow for short periods, generally less than 30 days per year. The bed of an ephemeral stream is always above the water table.

Erosion: A natural process that wears away land surfaces by the action of ice, water and wind.

Floodplain: The land adjacent to an active stream, constructed of sediment from stream overflow during moderate flow events. The floodplain aids in dissipating energy during high-flow events.

Flood prone: Defined as two times the maximum bankfull depth. This elevation often is associated with the 50-year floodplain.

Fluvial activity: Any behavior related to the stream, such as flooding.

Fluvial surfaces: The floodplains and terraces associated with a stream.

Geology: The parent materials, structures and processes that create the landscape.

Geomorphology: The topography, or relief of an area (land form).

Grazing: The consumption of plant biomass by herbivores.

Greenline: Occurs within the bankfull elevation (or slightly higher) and is maintained by seasonal flows and a local water table. The greenline plant community is critical for bank stabilization.

Herbivore: An animal that consumes vegetation for food.

Hydrology: The way water moves and interacts with the landscape.

Hydrologic processes: Processes that influence hydrology and flow, such as relief, climate, precipitation, evaporation, infiltration and ground water.

Intermittent stream: Channels that flow only during a portion of the year, typically in the spring, and then flow decreases and/or stops in late summer and fall. The position of the stream channel in the relation to the water table fluctuates throughout the year.

Major land resource area: This is a broad geographic area that is characterized by a particular pattern of geology, soils, climate, water resources, vegetation and land use.

Management objective: A goal or objective that is desired to be achieved through management of rangeland resources.

Monitoring: The process of observing and recording data.

Lacustrine valley: A valley that formed within an old lakebed. This valley type is described as a very wide valley with gentle slopes.

Lateral movement: The ability of streams, particularly C stream types, to erode at their banks and move laterally (meander) within their valley.

Parent material: The material (primary minerals) that formed soil through pedogenesis.

Perennial stream: A stream that has defined channels that contain water throughout the year, given normal precipitation. The bed of the stream channel is below the water table, with ground water providing the base flow level of the stream.

Plant community: An assemblage of plants that occur and interact with each other within a similar area, such as an ecological site or fluvial surface.

Plant community component: Plant communities that have different species based on flooding frequency, depth to water table and channel materials.

Point bar: An alluvium feature, created by deposition of sediments from slow moving water located on the inside of a stream bend of a meandering stream.

Potential natural channel: Describes the stream channel and plant community components that would have occupied the site historically.

Precipitation: The condensation of water vapors that fall to Earth's surface as rain, sleet, snow or hail.

Reference state: The state that is believed to have occupied the site historically, prior to European settlement.

Restoration: Actions taken to return a site to a pristine and/or more desirable condition.

Riffle: Shallowest portion of a stream located at the tail of a pool.

Riparian complex: The ecosystem associated with a stream and consisting of multiple surfaces, each of which supports a unique plant community.

Riparian complex ecological site: A unit of land with a unique set of biotic and abiotic factors that is capable of producing a distinct riparian complex and plant communities.

Riparian ecosystem: A highly dynamic and continuously changing ecosystem that exists at the interface of upland and aquatic zones.

Riparian vegetation: Vegetation that is hydrophilic, or water-loving, and aids in bank stabilization.

Sinuosity: A measurement of how much a stream curves (meanders); it is calculated as the length of the stream channel divided by the length of the valley it occupies**.**

Soil: A combination of mineral and organic material that formed on the surface of the Earth through weathering. Soil serves as a medium for plant growth.

Stability: The resistance of a site to change states.

State: A site that is resistant to change; its possible pathways for change are described in the state-and-transition model.

State-and-transition model: A diagram that predicts how an ecological site will change in response to various disturbance regimes.

Stream gradient: The change in elevation of a stream channel over a given distance.

Stream morphology: Channel characteristics that define the stream type, such as the dimensions and pattern on which the stream has developed.

Stream reach: A portion of a stream that is uninterrupted, or under similar management and state.

Stream type: Streams are categorized into eight different stream types based on their morphological characteristics, which give insight to how they may behave.

Streamflow: Characteristic of a stream that describes how regularly water flows through the channel, based on the water table's relationship with the stream bed.

Terrace: Former floodplain that has been disconnected from the adjacent stream as a result of channel incision.

Threshold: A critical point in space and time between two states that is defined by a minimum disturbance. When crossed, a site will transition into a different state, and substantial energy and time will be required to revert back to a stable state.

Transition: A change in the state of a site that is triggered by natural and/or anthropogenic disturbances.

Topography: The physical landscape created by natural and man-made features.

Unstable channels: Channels that are highly erosive and entrenched with no or a limited floodplain.

Uplands: Lands that are influenced minimally by hydrology because of their elevated relationship to the water table.

Upland plant species: Plants that thrive in low soil moisture environments, not found in wetlands or the greenline plant communities of stable channels.

Utilization: Refers to the use of vegetation, primarily by herbivores, through consumption and trampling.

Valley: A drainage basin that has been shaped by erosional and depositional processes.

Valley type: A classification of valleys based on their formation and landform that influences what suite of stream types can be found within them.

Water table: The level where the soil is completely saturated with water.

Watershed: The entire drainage basin that supplies water to a stream.

Width-to-depth ratio: The bankfull width divided by average bankfull depth.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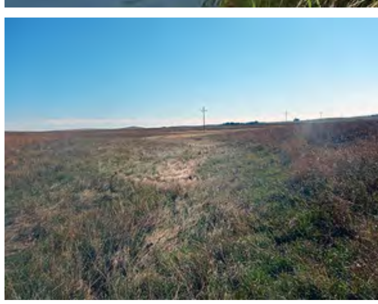

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