APPENDIX A: DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

Definitions

1987 Corps of Engineers Wetland Delineation Manual: The federal delineation manual, dated January 1987, used in the CWA, Section 404 Regulatory Program for the identification and delineation of *wetlands*. The manual requires evidence of *wetland* vegetation, soils, and hydrology in order to determine that an area is a *wetland* (https://www.nwp.usace.army.mil/Portals/24/docs/regulatory/jurisdiction/Wetland_Delineation_Manual.pdf). There are different procedures for conducting onsite delineations, by collecting field data, and offsite determinations, from aerial and *mine site* photos.
2007 Alaska Regional Supplement to the Corps Wetland Delineation Manual: The federal regional guidebook to identifying *wetlands* in Alaska (http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/reg_supp/erdc-el_tr- 07-24.pdf).
Affecting: Any impact that reduces the quality and/or quantity of *anadromous* or impaired waters. Effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components.
Anadromous: Referring to a fish or fish species that spends portions of its life cycle in both fresh and salt waters, entering fresh water from the sea to spawn. In Alaska, examples of *anadromous* fish species include *anadromous* forms of Pacific trout and salmon of the genus *Oncorhynchus*, Arctic char, Dolly Varden, smelts, and sturgeon.
Ancillary features: Features within the *mine site* providing support to the primary activities or operation of an organization, system, etc. *Ancillary features* include airstrips, camps, roads, etc.
At any time: Areas of *wetland disturbance* and/or length of *stream diversion or relocation* can never exceed the limits (unless waived) of the RGP during any point (this includes during a single day), until such time as they are *successfully reclaimed*.
Best Management Practices (BMPs): techniques and strategies designed to prevent or *minimize* pollution, protect natural resources, and promote sustainable practices.
Diversion: A stream channel *diversion* is considered a temporary feature for the purposes of this RGP, with the intent of moving the stream back to its approximate original location. A *diversion* may only be in place for the 5-year term of this RGP and must be reclaimed before the RGP expires on October 31, 2030.
Dredge and fill material: The term *dredged material* means material that is excavated or *dredged* from *waters of the United States*. Any addition, including redeposit other than incidental fallback, of material, including excavated material, into *waters of the United*

States which is incidental to any activity, including mechanized land clearing, ditching, channelization, or other excavation. The term *fill* material means material placed into *waters of the U.S.* that has the effect of either replacing any portion of a *water of the U.S.* with dry land or changing the bottom elevation of any portion of a waterbody. Examples of "*fill material*" include rock, sand, soil, clay, plastics, construction debris, wood chips, overburden from mining or other excavation activities, and materials used to create any structure or infrastructure in *waters of the U.S.* The placement of overburden, slurry, tailings, or similar mining-related materials is included in the definition of "discharge of *fill material*" regulated under Section 404 of the CWA (Final Definition of Fill, 2002).
Erosion: Dispersal of soil particles, sediment, or gravel by wind or water. For the purpose of this RGP, *dredge and fill material* must not show signs of *erosion*, beyond the *mine site* and into *waters of the U.S.* Indicators of excess *erosion* include rills, gullying, head cutting, caving, block slippage, material sloughing, mudflows etc.
Floodplain: The lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year. For the purposes of this RGP, *floodplains* and *riparian areas* are used interchangeably.
Functions: The physical, chemical, and biological processes that occur in ecosystems. *Wetland functions* include water quality improvement, floodwater storage, fish and wildlife habitat, aesthetics, pollution attenuation, and biological productivity. Stream *functions* include moderating stream temperatures, filtering sediment and pollutants from surface runoff, slowing flood waters, buffering storm runoff, and reducing peak flows during rain events. Healthy rivers provide aid in natural flood control by absorbing excess rainwater and reducing flood risks downstream, *erosion* reduction, improved water quality by pollution reduction and maintaining healthier environments downstream. Streams play a critical role in nutrient cycling and supporting diverse ecosystems and fish and wildlife habitat.
High flow: Refers to periods when a river or stream carries more water than usual, often due to heavy rainfall or snowmelt.
Impervious surface: A surface where water cannot infiltrate to groundwater. Examples of "*impervious surfaces*" would include roads, buildings, housing developments, parking lots, etc.
Independent utilities: A test to determine what constitutes a *single and complete* project in the USACE Regulatory program. A project is considered to have *independent utility* if it would be constructed absent the construction of other projects in the project area.

Portions of a multi-phase project that depend upon other phases of the project do not have *independent utility*. Phases of a project that would be constructed even if the other phases were not built can be considered as separate *single and complete* projects with *independent utility*.
Mechanical placer mining: The removal of gold or other precious materials from alluvial gravels using mechanized equipment.
Mine Site: All features of a mining operation authorized under "Section I. Activities Covered by the Permit." Each *mine site* encompasses all *ancillary features* and *mined areas*.
Mined areas: The portions of *WOTUS*, including *wetlands*, that have been physically altered or disturbed through mining activities for the extraction of gold or other precious materials. This includes land that has been mechanically cleared, excavated, trenched, etc., resulting in changes to the landscape, soil composition, and natural features in order to access and extract gold and other precious materials.
Minimization: Measures to reduce impacts to *waters of the U.S.*, including *wetlands*. Examples include but are not limited to constructing a drainage ditch around the mine operation to collect and redirect overland flow away from the mine operation; stockpiling organic overburden separately from inorganic overburden for use in *reclamation*; constructing settling ponds to collect sediment laden water within the *mine site*; and using an old creek channel for a stream *relocation*.
Minimization Plan: 33 CFR 325.1 (d)(7) A descriptive statement that explains how an applicant plans to avoid and *minimize* impacts to *waters of the U.S.*
Navigable Waters: Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) *Navigable waters of the U.S.* are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce (https://www.poa.usace.army.mil/Missions/Regulatory/Navigable-Waters-of-Alaska/). A determination of navigability, once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions or events which impede or destroy navigable capacity (33 CFR Part 329.4).
Non-notifying: A *non-notifying* RGP 8 is an activity that does not require a pre-construction notification (PCN) to the U.S. Army Corps of Engineers (USACE). To proceed with a *non-notifying* RGP 8, the project proponent/applicant must operate solely on federally managed lands and *affect* no more than 10 acres of *WOTUS* during the life of this RGP.
Ordinary high water mark (OHWM): The line on the shore established by the fluctuations of water, and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that

consider the characteristics of the surrounding areas (33 CFR 328.3(e) and RGL 05-05).
Reclamation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of mimicking natural/historic aquatic *functions* of a natural/undisturbed site found within the same watershed.
Relocation: A stream channel *relocation* is a permanent (i.e., more than 5 years) realignment including creation of a *stable* bank, stream bed, and *floodplain* connectivity that is similar with respect to upstream and downstream conditions.
Revegetation: Activities that include, but are not limited to, natural *revegetation*, and use of locally available materials, including native seeds, dormant woody cuttings, transplanting, or other methods.
Riparian Areas: *Riparian areas* are the areas bordering rivers and other bodies of surface water. They include the *floodplain* as well as the *riparian* buffers adjacent to the *floodplain*. For the purposes of this RGP, *floodplains* and *riparian areas* are used interchangeably.
Rolling Footprint: Also known as concurrent or phased *reclamation*, involves *reclaiming* parts of a *mine site* while mining operations are still ongoing.
Single and Complete: For non-linear projects, the term "*single and complete project*" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A *single and complete* non-linear project must have independent utility (see definition of "independent utility"). *Single and complete* non-linear projects may not be "piecemealed" to avoid the limits in a general permit authorization.
Stable: Not likely to give way or overturn; firmly fixed.
Successful reclamation/Successfully reclaimed: The point at which all previously mined waters of the United States (WOTUS) have been reclaimed such that temporary impacts are fully reclaimed to pre-construction conditions and there is no loss of *WOTUS*, including *wetlands*, beyond the authorized permanent impacts for *ancillary features*, such as roads, airstrips, etc. *Reclamation* must result in *stable* landforms that are hydrologically functional and demonstrate re-establishment of appropriate stream and/or *wetland* characteristics consistent with the requirements of General Conditions 5–11, as well as any special conditions required during authorization. *Wetlands* are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Final *reclamation* shall not be considered completely successful until written approval is issued by USACE, confirming that the site meets the definition of "*successfully reclaimed*."

Uplands: There is no regulatory definition of *uplands*, except that they do not satisfy *wetland* criteria. An *upland* is missing at least one of these criteria: hydrophytic vegetation, hydric soils, or *wetland* hydrology during the growing season of a typical year. On *mine sites*, *uplands* may include old tailings, camps, roads or airstrips. These areas may have been *wetlands* that were filled under a prior GP or before the CWA. *Mine sites* may also include naturally occurring *upland* areas that do not satisfy *wetland* criteria.
Vegetated buffer: Areas of natural, existing or established vegetation that protect the water quality of neighboring areas and waterbodies during construction. Buffer zones provide an area where stormwater can permeate the soil and replenish the groundwater (WES, 2008). They also slow the flow of stormwater, which helps to filter sediment, decrease soil erosion and prevent streambank collapse.
Waters of the United States (WOTUS): Include all waters listed at 33 CFR Part 328.3. For the purposes of this RGP, this includes *wetlands* and perennial (year-round) and intermittent (seasonal) streams that have a downstream connection to *navigable waters*.
Wetland: An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3(b)).
Wetland disturbance: Area of disturbance in *wetlands*, measured dimensionally, for example: "x" cubic yards into "x" acres of *WOTUS*. The *wetland disturbance* includes all activities and mine features constructed by placing/redistributing *fill* into *wetlands*. See Section I, "Activities covered by the permit."

APPENDIX B: BEST MANAGEMENT PRACTICES (BMPs) DURING MINE SITE PLANNING AND OPERATION

The BMPs presented in this document are intended to provide general guidance for effective planning and operation of disturbed areas, including wetlands and aquatic resources. However, not all BMPs will be appropriate or effective for every mine site or operational context. Site-specific conditions, such as hydrology, soil type, topography, vegetation, climate, and equipment limitations, must be carefully considered during project planning. Successful planning and operation require site-specific design of structures and features, and thoughtful placement of materials. An adaptive management approach, where outcomes are regularly monitored and practices are adjusted as needed, is critical to address evolving conditions and ensure long-term reclamation success. Compliance with all applicable federal, state, and local regulations remains the responsibility of the operator.

The purpose of these BMPs is to assist and guide miners in identifying and implementing ways to minimize adverse environmental impacts, particularly to water quality, aquatic resources, and downstream habitats, by promoting site-specific, practicable techniques for controlling runoff, stabilizing disturbed areas, and managing sediment discharges during and after mining operations in order to support compliance with the terms and conditions of this RGP. The information below is not an exhaustive list of available techniques. BMPs referenced in this document may be known by different common names depending on regional practices, agency guidance, or local industry terminology. While the basic functions and principles of these BMPs remain consistent, users should be aware that alternative names may be used in different contexts or guidance materials.

Mine Site Planning: Having a solid mine plan before starting the permitting process is critical to the financial, regulatory, and environmental success of any placer mining operation.

- Winter trails or traveling when the ground is frozen can minimize impacts to wetlands and other aquatic resources, especially when moving heavy machinery.
- Wash all machinery prior to transport to the site to control the spread of invasive species.
- Utilize proper wildlife timing for all mining related activities so that wildlife, such as migratory birds and fish are not harmed by mining activities.
    - For migratory bird windows, please see the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool (https://ipac.ecosphere.fws.gov/).
    - For timing recommendations for land disturbance and vegetation clearing, please see the USFWS's recommendations (https://www.fws.gov/media/timing-recommendations-land-disturbance-vegetation-clearingpdf).
- For construction of roads or airstrips borrow material should be taken from upland sources whenever feasible. Please see General Condition 18 above.
- If roads must be placed within waters of the United States (WOTUS), create conditions to maintain hydrology and avoid road washout, such as properly sized

culverts or properly designed low-water stream crossings.
  - For more information on culvert designs, please see the USFWS's Culvert Design Guidelines (https://www.fws.gov/alaska-culvert-design-guidelines).
- Exploration should be conducted to provide valuable information on the lateral and vertical extent of a deposit; gold grades within that deposit; and how much overburden must be removed to reach the pay. This information can be used to avoid and minimize impacts to WOTUS for areas that are not economically viable to be mined.
- When creating a site plan place mine camps, staging areas, and stockpiles, etc., in adjacent uplands, whenever possible.
  - However, the overburden stripped off before mining and the tailings produced during operations should be stockpiled and staged at or near where they would be needed during reclamation, making it easier and less expensive to level, shape, and contour the rock and gravel ahead of covering with organic material that would encourage native vegetation regrowth.
- Early in the planning and exploration process, assess the mine areas for features that could aid in reclamation actions. This includes features such as vegetation borrow sites to assist with revegetating areas or for bioengineered bank stabilization; vegetative mats that can be stripped from areas to be mined to reclaim wetlands, streambanks, and riparian areas; historic upland tailings stockpiles that could provide materials to aid in reclamation; mine site geometry; etc.
  - Ensure borrow sites, vegetative mats, etc., are located in authorized areas and are approved for use by the land managing agency.
  - Use bioengineering to the maximum extent practicable. Bioengineering may include willow layering and transplanting for erosion control. Use what is available on site. Salvage, stabilize, and revegetate with timeliness in mind using phases and seasonal development strategies.
    - Collect cuttings in winter and early spring to use in reclamation activities.
    - Plan to stabilize and revegetate disturbed areas with local, native plants within the same season, as practicable.
- Consider conducting reclamation concurrently with active mining activities (rolling footprint or phased reclamation).
- Plan to create benches and terraces on steep slopes to minimize potential impacts from erosion into adjacent WOTUS.
- Design the mine plan to capture and control sheet flow to minimize erosion and capture sediments.
  - For example: ditches and berms around the mine site leading to settling ponds.
- A series of multiple settling ponds allowing sediment (dirt) to settle out of the water prior to reuse would help lower the quantity and improve the quality of water leaving the mine site. These ponds should be designed to slow the flow of water; the longer the water stays within the pond system, the more opportunity the sediment would have to settle out. The length of the pond system determines the

travel and settling time, and the pond depth determines how much sediment the pond can hold.

- Berms, including any pond walls, dikes, dams, and similar water retention structures should be constructed in a manner such that water is not reasonably expected to overtop and/or compromise the structures.

Construction Sequence: Good site planning and preservation of mature vegetation are imperative for reclamation and controlling runoff water both during and after mining activities. Properly planning and staging major earth disturbing activities can also dramatically decrease the costs of control measures. In addition, the details about the control measures used during construction would provide Permittees with a written record to support these decisions in terms of the placement and design of the on-site control measures, and it would give potential inspectors a way of verifying that the control measures were attempted should failure occur.

Mine Site Operation and Management: Once a robust mine plan has been established, the mine site should be constructed to manage the water and overburden and tailings in a manner that satisfies the terms and conditions of this RGP.

- To help stabilize and control erosion and runoff in the disturbed areas, many features planned for above can be used to control, direct, and guide water at the mine site.
    - Mine site conditions may vary from an operator's plans so adaptive management (see General Condition 11 above) may be needed as the operation progresses (i.e., changes to grading, berms and ditches, location of trenches, etc.).
- Slash piles, i.e., accumulations of natural woody debris (limbs, tops, and smaller pieces) left behind after mechanized land clearing/ stripping of site, may be quickly placed in locations where changes are needed to address immediate runoff/erosion concerns.
- Stockpiled and any other disturbed material should have erosion and sediment BMPs around them to preclude reentry into any WOTUS, which includes wetlands.
    - Approved siltation control measures include, but are not limited to, silt fences, fiber rolls, waddles, coir logs, sediment traps, ditches, berms and settling ponds.
- Steep slopes are especially susceptible to erosion and, where steep slopes would be disturbed on the mining site, applicable practices to minimize erosion from steep slopes include, but are not limited to, reducing continuous length of slope with terracing and benching, reducing slope steepness, roughening slope surfaces (e.g., track walking), and temporary or permanent stabilization.
    - Additionally, operators can use interceptor dikes and swales, grass-lined channels, pipe slope drains, subsurface drains, and/or check dams (See Figure 1. Rock check dams) to divert concentrated flows of runoff water away from disturbed portions of the slope. These measures would minimize the amount of runoff flowing across the face of the slope and decrease the erosion of that slope.

Figure 1: Rock check dams in a roadside ditch.
From Mile High Flood District (2024).

- Locate fuel storage areas on state mining claims at least 100 feet from natural occurring water bodies. The Bureau of Land Management (BLM) strongly recommends storing fuel outside of the 100-year floodplain on federal claims.
- Equipment should be inspected regularly for leaks. If leaks are found, the equipment should be repaired immediately to prevent fuel, oil, hydraulic fluid, or any other hazardous material from entering an aquatic resource.
- Refuel equipment away from aquatic resources.
- Increasing the vegetated buffer width, especially on steeper slopes or near sensitive water bodies, can significantly improve the effectiveness of the vegetated buffer.
- Design vegetated buffers to be wider in erosion-prone or hydrologically sensitive areas.

To minimize the impacts of erosion around aquatic resources, these tools may be used:

- Control water volume and velocity to minimize soil erosion and material discharges.
- Control water discharges, including both peak flowrates and total water volume, to minimize channel and streambank erosion and scour in the immediate vicinity of discharge points.
- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes outside the mining area.
- Minimize sediment discharges from the site. The design, installation, and maintenance of erosion and sediment controls should address factors such as the amount, frequency, intensity, duration of precipitation; the nature of resulting water runoff; and soil characteristics, including the range of soil particle sizes expected to be present on the site.
- Dissipate water runoff into open vegetated swales and natural depressions to reduce in stream impacts of erosive flows.
- Stabilize all disturbed areas of the site to minimize erosion and sedimentation and the resulting discharge of material. A Permittee should ensure that existing vegetation is preserved, and a natural buffer is maintained wherever possible, and disturbed portions of the site are stabilized. A Permittee should avoid using

impervious surfaces, such as concrete, for stabilization. Applicable stabilization control measures include, but are not limited to:
  - Temporary and permanent seeding;
  - Sodding;
  - Mulching;
  - Rolled erosion control product;
  - Compost blanket;
  - Soil application of Polyacrylamide (PAM).
- Include the following control measures to handle water and total water volume discharges as they apply to the site:
  - Divert water around the site so that it does not flow onto the project site and cause erosion of exposed soils (diverting water around the site can be an effective measure as long as it does not cause flooding and/or erosion offsite);
  - Slow down or contain water that may collect and concentrate within a site and cause erosion of exposed soils;
  - Avoid placement of structural control measures in active floodplains to the degree technologically and economically practicable and achievable;
  - Place velocity dissipation devices (e.g., check dams [See Figure 1. Rock check dams], sediment traps, or riprap) along the length of any conveyance channel (of erodible materials) to provide a non-erosive flow velocity. Also place velocity dissipation devices where discharges from the conveyance channel or structure join a water course to prevent erosion and to protect the channel embankment, outlet, adjacent stream bank slopes, and downstream waters; and
  - Install permanent water management controls, where practical, so that they are functional prior to construction of site improvements (e.g., impervious surfaces).
- Install appropriate protection measures (e.g. filter berms, perimeter controls, temporary diversion dikes, etc.) to minimize the discharge of sediment prior to entry into inlets located on site or immediately downstream of the site.
- Install appropriate protection measures (e.g. velocity dissipation devices) to minimize the discharge of sediment prior to entry into the water body for water bodies located on site or immediately downstream of the site.

Vegetated Buffers

- Areas of natural or established vegetation that help protect water quality during construction.
- Slow runoff, filter sediment, reduce erosion, and prevent streambank collapse.
- Design vegetated buffers to be broader in erosion-prone or hydrologically sensitive areas.
- Most effective along floodplains, wetlands, streambanks, and unstable slopes.
- May be required by local regulations or permits near sensitive waters (e.g., impaired or exceptional waters).

Soil Stabilization and Erosion Control

- Use biodegradable netting (e.g., jute, sisal, coir) in erosion control products.
- Avoid plastic-based netting; if used, ensure it is wildlife-safe with loose-weave designs.
- Promptly remove temporary erosion controls like silt fences when no longer needed.
- Clearly mark areas of disturbance and no-disturbance to protect surrounding vegetation and sensitive features.
- Preserve existing vegetation and stabilize disturbed soils as soon as practicable.
- Stabilization methods include seeding (temporary/permanent), mulching, geotextiles, and sod.

Phasing and Exposure Minimization

- Minimize the duration of soil exposure by phasing construction activities.
- Limit the area disturbed at one time (e.g., clear/mine 5 acres of a 10-acre site, then reclaim before clearing the remainder of the site).

Sediment Control Measures

- Install sediment controls on all down-slope and side-slope perimeters of disturbed areas.
- Design and maintain controls appropriate to the site (e.g., buffer strips, silt fences).

Interception Berms and Ditches

- Construct berms or swales across slopes to intercept and divert runoff.
- Route water to stable outlets or basins; include check dams (See Figure 1. Rock check dams) on steep slopes.
- Ensure positive drainage to prevent ponding.

Check Dams (See Figure 1. Rock check dams)

- Used in diversions and site ditches to reduce water velocity and channel erosion.
- Remove trapped sediment before dam removal.

Sediment Traps

- Small basins that allow sediment to settle from runoff before it exits the site.
- Located at site discharge points or in drainageways.

Spring Thaw and Site Stabilization

- Stabilize disturbed soils, slopes, ditches, and stockpiles before spring thaw.
- Implement erosion controls in advance where runoff is expected.

General Erosion and Runoff Management

- Control water volume and velocity to minimize erosion and discharges.
- Minimize exposure and disturbance of steep slopes.
- Design erosion controls based on site conditions (soil, rainfall, runoff patterns).
- Divert offsite water around construction areas (without causing offsite impacts).
- Slow or contain onsite water to prevent erosion.
- Avoid structural controls in floodplains where feasible.

- Install velocity dissipation devices (e.g., check dams [See Figure 1. Rock check dams], riprap) in channels.
- Install permanent controls early when possible.
- Divert concentrated flows away from slopes using dikes, drains, swales, etc.

Stabilization Methods

- Use seeding, sodding, mulching, compost blankets, erosion control products.
- Apply gravel base early in areas to be paved.
- Avoid impervious materials for stabilization.

Inlet and Waterbody Protection

- Install sediment controls (e.g., filter berms, diversion dikes) near inlets and waterbodies.
- Use velocity dissipation at discharge points into nearby waters.

  - **NOTE:** Please see Appendix D for Stream BMPs.

APPENDIX C: WETLAND RECLAMATION BEST MANAGEMENT PRACTICES (BMPs)

The BMPs presented in this document are intended to provide general guidance for effective reclamation of disturbed areas, including wetlands and aquatic features. However, not all BMPs will be appropriate or effective for every mine site or operational context. Site-specific conditions, such as hydrology, soil type, topography, vegetation, climate, and equipment limitations, must be carefully considered during project planning. Successful reclamation requires proper planning, site-specific design of structures and features, and thoughtful placement of materials. An adaptive management approach, where outcomes are regularly monitored and practices are adjusted as needed, is critical to address evolving conditions and ensure long-term reclamation success. Compliance with all applicable federal, state, and local regulations remains the responsibility of the operator.

As with during operations, water management is crucial for the wetland reclamation success of a project. Wetlands need to be kept wet, and water managed to reduce erosion. In other words, water needs to be managed to maintain desired water levels and flow regimes in reclaimed wetland areas. Many BMPs/structures mentioned above may be used or left in place to help manage water in reclaimed areas.

Using Media Lunas in Wetland Reclamation (Léger, A., et al., 2023) at Placer Mine Sites

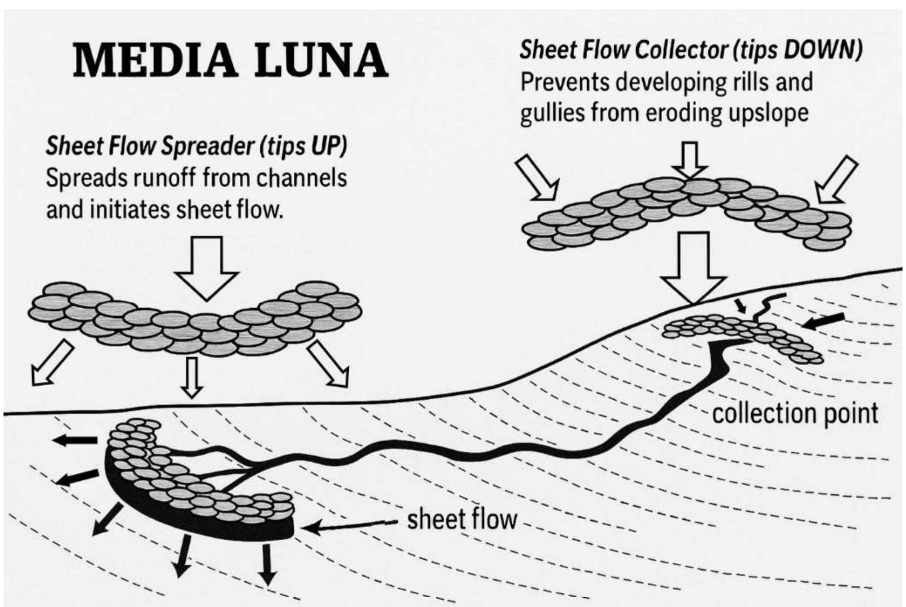

Figure 2: Media Luna Diagram. From USACE (2025)

Uses of Media Lunas in Wetland Reclamation:

- Media Lunas: Crescent-shaped rock structures designed to slow down water flow, spread runoff, and encourage sediment deposition.
    - Tips up media luna is a sheet flow spreader used on relatively flat ground to disperse erosive channelized flow and reestablish sheet flow to spread water across a site.

- Tips down media luna prevent erosion (i.e. rills/gullies) by collecting sheet flow and creating a transition from sheet flow to channel flow.

- Slow and Spread Water: Install *tips-up* media lunas on gentle slopes to spread runoff and encourage surface saturation, which is ideal for wetland reclamation.
- Retain Moisture in Depressions: Place around recontoured pits or swales to help hold seasonal water and promote wetland vegetation.
- Support Sediment Deposition: Slow flow allows fine sediments to settle, creating better soil conditions for native plant growth.
- Protect Vegetation: Use with vegetative plugs or mats behind the structure to retain moisture and reduce erosion.
- Stabilize Drainage Paths: Helps prevent new rills or gullies from forming on reclaimed floodplains or benches.

Uses of Log Spreaders in Wetland Reclamation:

- Log spreaders, also known as flow spreaders, are wetland reclamation "control feature[s] that slow water flow and spread it evenly along a wide outlet, allowing it to infiltrate naturally into the ground. Built with durable materials and proper grading, it turns concentrated runoff into gentle sheet flow," enhancing wetland reclamation and protecting the surrounding environment (Philadelphia Water Logs LLC, 2025).
  - Helps capture and distribute water more evenly across floodplains and wetlands.
  - Traps small woody debris and leaf litter.

Figure 3: An example of log spreaders. From NatureBid (2022).

- Water Dispersion and Flow Spreading
  - Help distribute water more evenly across recontoured floodplains and wetlands.
  - Reduce concentrated flow paths that can cause erosion or gully formation.
  - By spreading flow, they encourage sheet flow across vegetated areas,

promoting wetland hydrology.

- Sediment and Nutrient Retention
  - Logs slow water velocity, which allows sediments and organic material to settle behind the structure. This supports soil development, nutrient cycling, and vegetation establishment.
- Habitat Enhancement
  - Logs create microhabitats, such as pools and riffles, which benefit amphibians, invertebrates, and fish (where appropriate).
  - Promote diverse vegetation by holding moisture and fostering different hydrologic zones.
- Support for Vegetative Establishment
  - The slowed, spread-out water helps maintain saturated soil conditions, essential for the reestablishment of hydrophytic plants in wetlands.
- Design Considerations:
  - Proper anchoring is critical to prevent flotation or washout during high flows (e.g., buried logs, cross bracing).
  - Spacing should reflect slope and hydrology: closer spacing on steeper slopes or where erosion is a concern.
  - Use native or untreated wood to avoid chemical leaching and maintain ecological compatibility.
  - Logs can be placed perpendicular or angled to flow depending on the desired effect (e.g., spreading vs. deflecting).
- Other options:
  - Rock Mulch Rundowns: Channels lined with rocks to safely convey water down slopes, reducing gully formation.
  - Brush Weirs: Structures made from branches and vegetation placed across gullies to slow water flow and trap sediment.

Use of organic overburden is another crucial factor in successful wetland reclamation. Proper stripping and stockpiling techniques would help ensure healthy organics to reclaim a site with, proper stockpiling is required by the RGP. Organic soils are rich in nutrients and microbial communities essential for re-establishing wetland vegetation. They help retain moisture and improve soil structure in reclaimed areas.

- If surrounding reclamation site conditions lack good topsoil supplies (possibly the result of historically mined sites), settling pond fines can be used to supplement soil to help promote revegetation.

Properly designed shallow ponds have been a major focus for placer mining reclamation activities and have shown success, but diversity of wetlands is important and the RGP requires all material to be used for reclamation to minimize impacts and reclaim the site to a similar state as before mining operations.

However, ponds, pits, and other disturbed areas do not always need to be completely backfilled. In certain locations these areas may be recontoured below grade to form low-lying floodplains, pockets, depressions, catchment basins, and/or swales that can help capture/collect and retain water, encouraging wetland reclamation. Likewise, to help these areas collect water, adjacent areas should be graded to slope towards these aquatic features.

Key points for pit/pond reclamation:

- Backfill and recontour pit and pond edges into gentle, low-relief landforms (e.g., swales, pockets, and depressions) that blend into the surrounding terrain.
- Design the reclaimed surface to mimic a natural floodplain, especially near stream channels. Broad, flat, and slightly undulating surfaces are ideal.
- Grade surrounding disturbed ground to slope slightly toward the pockets or swales (about 1-2% slope), so runoff or seepage would collect naturally in low areas.
- Avoid steep slopes or sharp berms around depressions. Keep transitions soft and natural-looking to help vegetation establish and reduce erosion.
- Place woody debris or root wads in low spots to create habitat increase roughness and retain moisture longer.
- Leave some small, excavated features partially intact if they are already holding water or staying moist. These features can develop into marshes or sedge meadows (i.e., wetlands) over time.
- Monitor water retention and vegetation. Adjust grading as needed if water is not collecting as planned or if surfaces are drying out too fast.
- Ensure pond bottoms are below the low water table.
- Ensure marsh areas are below the high-water table and, generally, near the low water table.

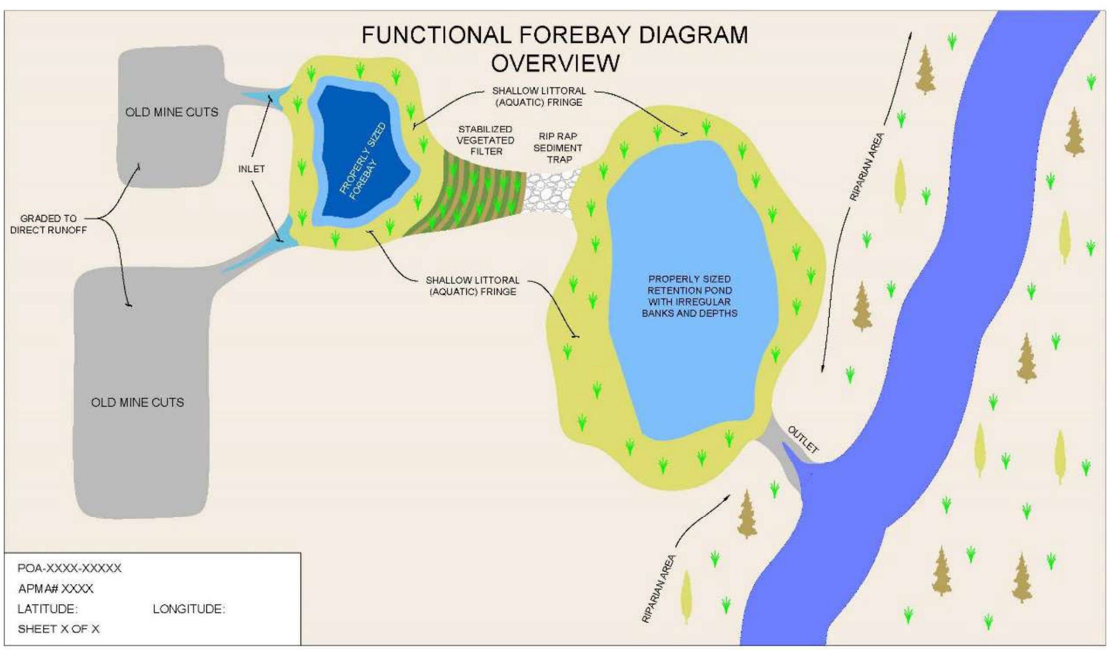

Figure 4: An example of a functional forebay diagram overview plan. From USACE (2025).

Forebays are often found near runoff water ponds, dams, or mining reclamation sites to help manage water quality and prevent erosion. They often consist of a smaller ponded area that is designed to catch sediment. Then it drains/flows into or over a shallow, partially vegetated, stabilized area before then draining into another larger ponded location before return water enters a stream. See example diagrams (Figure 4 & 5).

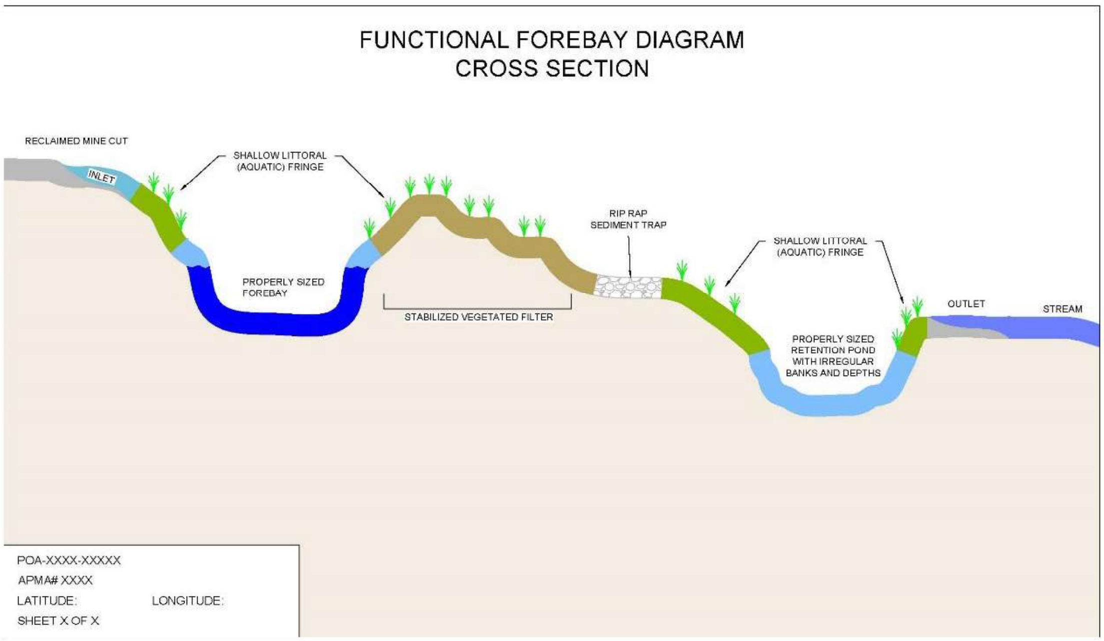

Figure 5: An example of a functional forebay diagram cross section plan. From USACE (2025).

Transplant wings should be positioned perpendicular to the stream flow to reduce flow velocities and encourage deposition. Transplant wings extend from the toe of the streambank and tie into the adjacent hillslope in order to encourage reestablishment of riparian zones. The width of transplant wings and brush bars is typically around 10 to 20 feet.

- For more information, please see the BLM’s March 2023 Stream Design and Reclamation Guide for Interior Alaska: Technical Report 65, page 92.

Brush bars are a mix of live and dead cuttings placed on the edge of the streambank perpendicular to the flood flow. Their purpose is the same as transplant wings, to slow flood velocities and encourage deposition. Brush bars are not as robust as transplant wings but are a good substitute on sites where transplants are not plentiful or as a way to augment transplant wings. Another benefit is that brush bars can be installed by hand and do not require the use of heavy equipment. Over time, the brush bars will grow and expand, providing a method for revegetating the riparian zones.

- For more information, please see the BLM’s March 2023 Stream Design and Reclamation Guide for Interior Alaska: Technical Report 65, page 93.

Vegetative mats are typically a section of sod composed of native wetland plants (like sedges, mosses, grasses, and rushes), containing intact roots, shoots, and often organic-rich soil, harvested from a healthy donor area (before disturbance or next areas to be disturbed) and reapplied to a reclamation site. It is essentially a living piece of wetland or riparian vegetation moved and replanted to quickly reclaim ecological function.

<u>Key points for vegetative mats:</u>

- Scout the area first to identify healthy, undisturbed wetland or riparian vegetation (sedge meadows, mossy areas, grassy mats). Look for spots with thick root mats and organic-rich soil, ideally before disturbance.
- Use a flat or smooth-edged bucket and avoid sharp teeth, if possible, as they can tear the vegetation. If only a toothed bucket is available, modify the digging technique to minimize root shredding (e.g., shallow skimming instead of deep digging).
- Start by cutting small sections. Lower the bucket and tilt slightly forward, then gently push to slice just beneath the root zone (about four (4) to six (6) inches deep). Aim for chunks about two (2) to three (3) feet wide and as long as manageable (approximately four (4) to six (6) feet). This makes them easier to transport and replant.
- Lift slowly and carefully. Curl the bucket back gently to lift the mat without breaking it apart. Keep the mat horizontal to avoid losing soil or breaking up root mass.
- Stack vegetation-side up. If storing, place the mat in a shaded, moist location, stacked no more than two (2) to three (3) mats deep. Lightly spray with water if needed to keep roots moist, especially during hot/dry periods.
- Label or flag mats if harvesting from different vegetation types (e.g., sedge-dominant vs moss-dominant) to match site conditions during replanting.
- Replant as soon as possible. Place the vegetative mat directly on reclaimed surfaces, press in with bucket or by hand, and tuck soil around edges to ensure good contact and prevent drying out.

Vegetative plugs are smaller than vegetative mats and often contain only one plant species. Plugs should be harvested from a healthy donor community before disturbance with hand tools and/ or excavators. Plugs are particularly well suited for planting in wetlands, constructing grass rolls or being divided into sprigs. Sprigs are the smallest transplant unit, consisting of a single shoot with roots.

<u>Key Point for Plugs:</u>

- Dig a plug with a shovel. A plug may range from two (2) to ten (10) inches in diameter. It is important to include as many roots and as much soil as possible with each plug. Plant plugs so that the new soil level matches the soil level of the donor site. If the planting site is dry, the plug should be planted in the center of a small depression that will catch and retain water. The soil around the plug should be pressed firmly into place.

  - **NOTE:** Please see Appendix D for Stream BMPs.

APPENDIX D: STREAM CHANNEL MANAGEMENT

The BMPs presented in this document are intended to provide general guidance for effective reclamation of disturbed areas, including wetlands and aquatic features. However, not all BMPs will be appropriate or effective for every mine site or operational context. Site-specific conditions, such as hydrology, soil type, topography, vegetation, climate, and equipment limitations, must be carefully considered during project planning. Successful reclamation requires proper planning, site-specific design of structures and features, and thoughtful placement of materials. An adaptive management approach, where outcomes are regularly monitored and practices are adjusted as needed, is critical to address evolving conditions and ensure long-term reclamation success. Compliance with all applicable federal, state, and local regulations remains the responsibility of the operator.

Slope is one of the most important factors in stream reclamation because it directly influences flow energy. Higher slopes increase water velocity and erosion potential, making energy management a critical design goal. Energy can be dissipated by increasing friction and roughness within the channel. Using natural materials and features that slow flow and reduce scour. Stream reclamation designs should prioritize simplicity and be tailored to the specific characteristics of the stream; understanding the river's seasonal flow stages is essential, especially during the construction period. Structural treatments can be either permeable or impermeable. Permeable structures, such as logs, rot wads, or brush bundles, allow water to pass through while reducing velocity and encouraging sediment deposition. In contrast, impermeable structures like rock vanes redirect flow away from vulnerable banks. Where a stream exhibits vertical instability or headcutting, grade control measures should be implemented first, as stabilizing these features is fundamental to the overall success and sustainability of the reclamation effort.

Prevent Entrenchment and Avoid Rosgen F/G Stream Types: Where floodplains are connected to a river and periodically inundated, interactions of land, water, and biology support natural functions that benefit river ecosystems and people. Unless otherwise approved by USACE on case-by-case circumstances, no final stream reclamation should resemble Rosgen F or G stream types.

- Entrenchment refers to the degree to which a river channel is vertically confined within its valley. It is a measure of how easily a river can access its floodplain during high flows.
    - F and G stream types are associated with gorge or canyon valley types and are typically not associated with placer mine sites located in valleys. G and F stream types often lead to prolonged instability and unsuccessful reclamation.
- Avoid deep, narrow, incised channels that lack floodplain connectivity.
    - Construct inset floodplains within confined valleys to allow overbank flow during high water.
    - Incorporate media lunas and log spreaders on adjacent floodplain areas to diffuse and spread high flows, promoting floodplain connectivity.
    - Avoid steep valley walls and entrenched alignments typical of Rosgen F or G types unless natural site conditions require it and USACE has approved it.

- Toe slope stabilization involves reinforcing the base (toe) of an eroded or steep streambank to prevent further vertical and lateral incision. It can use rock or other natural materials (e.g., logs, root wads, rock toes, vegetated lifts) placed along the lower portion of the bank. This technique integrates well with other methods like live stakes, vegetative mats, and boulder cross vanes.

Figure 6: An example of toe slope stabilization. From ERDC's Streambank Erosion and Protection course (2022).

- Promotes Bank Layback:
    - Stabilizing the toe may help provide a firm foundation to reshape the upper banks at a gentler slope, reducing their angle (e.g., from 1:1 to 3:1 or flatter) as water erodes portions above the stabilized toe.
    - This gradual grading mimics natural floodplain profiles and creates benches or terraces.
- Encourage Overbank Flow:
    - As banks become shallower, high flows can more easily overtop the channel, reactivating the floodplain during peak events.
    - Overbank flow supports wetland regeneration, sediment deposition, and energy dissipation.

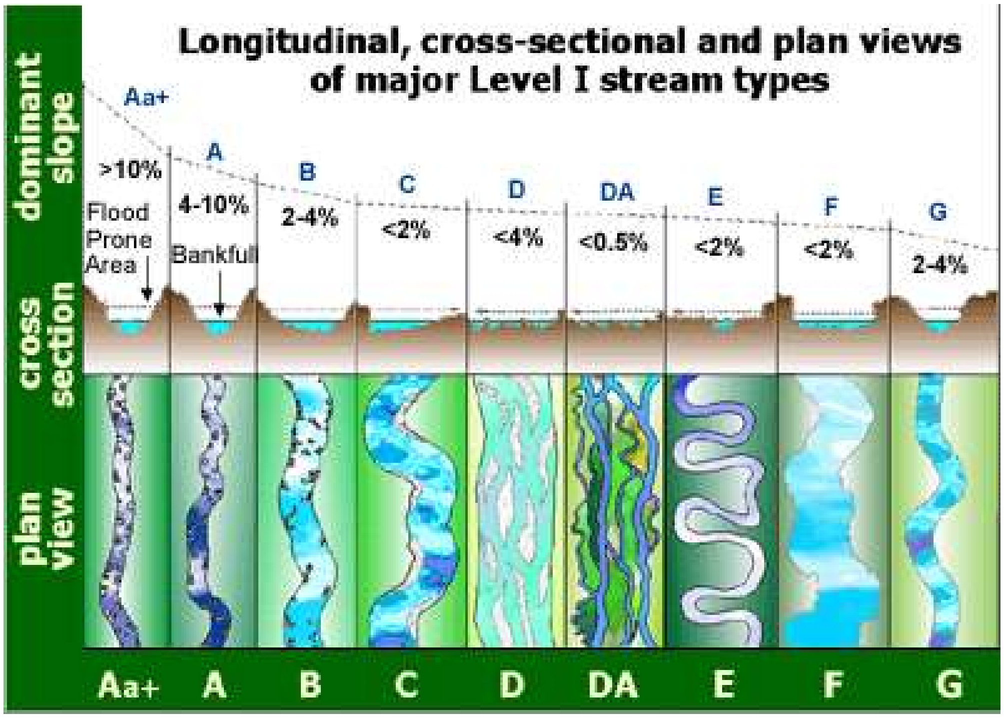

Figure 7: This diagram compares the longitudinal (as seen from the side), cross-sectional (bank to bank), and plan (as seen from above) views of each of the nine major stream types in the Level I classification of Rosgen stream types. From Rosgen, D.L. (1998).

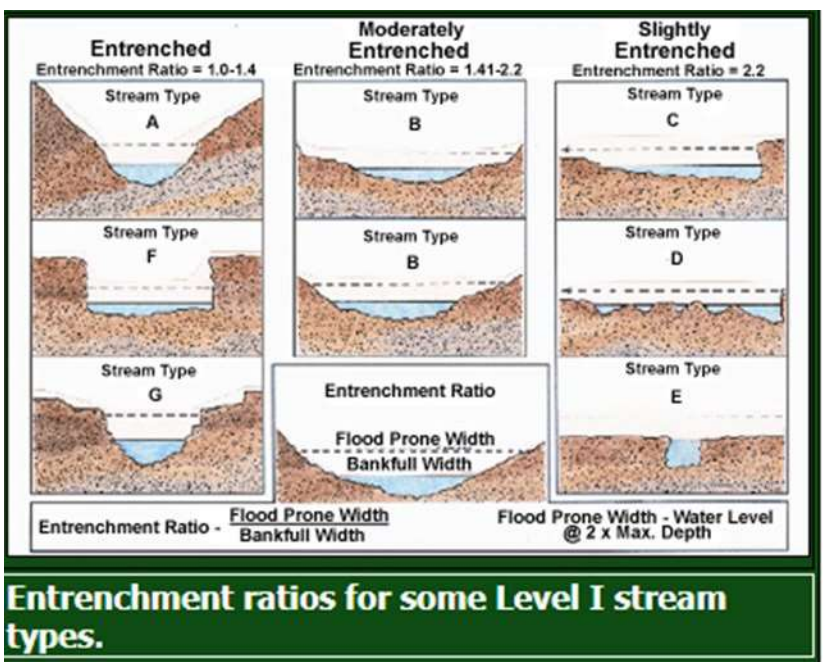

Figure 8: The entrenchment ratio measures how flood-prone the stream is based on how high the channel is. A high ratio (>2.2) indicates slightly entrenched rivers, or rivers that easily flood. A low ratio (1-1.4) indicates highly entrenched streams, or streams that would have trouble escaping their banks. From Rosgen (1994).

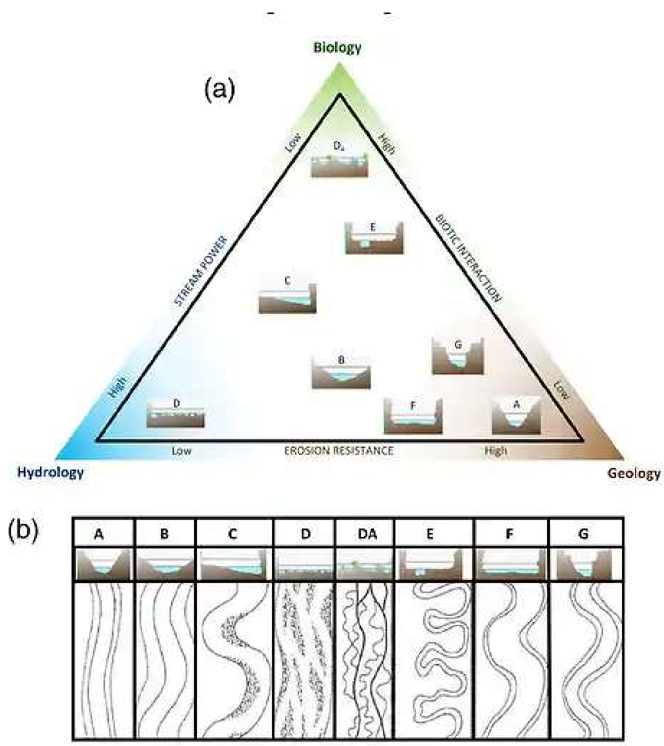

FIGURE 6 (a) Stream evolution triangle with example classification system (Rosgen, 1996); (b) Rosgen Stream Classification System (modified from Rosgen, 1996) [Colour figure can be viewed at wileyonlinelibrary.com]

Figure 9: The Stream Evolution Triangle (SET) represents the relative influences of geology (erosion resistance), hydrology (stream power), and biology (biotic interaction). From Castro and Thorne (2019).

Bedform Diversity: Diverse stream beds dissipate stream energy, contribute to channel stability, and provide a suite of habitats needed by many fish species.

- Promote hydraulic complexity and aquatic habitat.
  - Construct riffle-pool or step-pool sequences using a mix of gravels, cobbles, boulders, and logs placed irregularly to break up uniformity.
  - Use root wads, woody debris, and boulder clusters to create microhabitats and flow variation.
  - Mimic natural stream substrate heterogeneity. Do not grade streambeds smooth or uniform.
  - Where feasible, install log weirs or cross-vanes to concentrate flow in riffles and maintain pool depth.
- To remain in compliance with this permit the stream bed should contain variations in bed materials, such as gravel, sand, rocks, logs, root balls/wads and boulders, as well as different patterns and shapes of sediment deposition. Substrate may not appear uniform or organized while creating riffle/step-pool sequences or other in-stream structures.

Stream Sinuosity (K ≥ 1): Sinuosity serves as a key indicator of river health, behavior, and the interactions between water and landforms, with implications for ecology, hydrology, and human activities. Stream channel sinuosity (K) is calculated by dividing the length of the selected stream channel (Ls) by the straight-line distance between the end points of the selected channel reach (Lv). Unless otherwise approved by USACE on case-by-case circumstances, no stream relocation or diversion will result in channelization.

- Prevent channelization and ensure natural meander development.
  - Design reclaimed channels with sinuosity greater than (≥) 1.0.
  - Layout channels using topographic maps and pre-disturbance alignments to guide natural meanders.
  - Use woody debris or flow deflectors to promote channel curvature and reduce straight-line flows.

Figure 10: Sinuosity of a stream. From Rosgen (1998).

Riparian Vegetation Establishment: Riparian vegetation improves functions for water quality and channel stability of streams. The requirement is the re-establishment of a 35-foot wide, vegetated riparian area above the ordinary high water mark (OHWM), adjacent to the stream channel, unless otherwise approved by USACE on case-by-case circumstances.

- **NOTE:** OHWM is the USACE's jurisdictional limit under Section 404 of the CWA. See the Wetlands Regulatory Assistance Program (WRAP) National Ordinary High Water Mark Field Delineation Manual for Rivers and Streams Final Version (January 2025), https://erdc-library.erdc.dren.mil/items/76c61f8f-6d75-4a35-aaf3-39aa64918afb.

- Stabilize banks and support channel functions.

    - Harvest vegetative mats before mining and transplant post-mining along the OHWM to jumpstart revegetation.
    - Apply native seed mixes and dormant woody cuttings (e.g., willow stakes) on streambanks and riparian zones.
    - Use biodegradable erosion control blankets to retain moisture and promote seedling growth.
    - Plant in rows perpendicular to the flow to reduce shear stress and trap sediments.
        - Make sure to leave small paths/tracks to allow for adaptive management need be.
    - Establish a minimum 35-foot vegetated buffer above OHWM and monitor plant coverage over three (3) to five (5) seasons:
        - By the end of three (3) growing seasons, riparian areas should have 30% live native plant cover.
        - By the end of five (5) growing seasons, riparian areas should have 70% live native plant cover.
- As stated in Appendix B, transplant wings and brush bars are tools that should be considered for in-stream reclamation as well.
- Transplant wings should be positioned perpendicular to the stream flow to reduce flow velocities and encourage deposition. Transplant wings extend from the toe of the streambank and tie into the adjacent hillslope in order to encourage reestablishment of riparian zones. The width of transplant wings and brush bars is typically around 10 to 20 feet.
    - For more information, please see the BLM's March 2023 Stream Design and Reclamation Guide for Interior Alaska: Technical Report 65, page 92.
- Brush bars are a mix of live and dead cuttings placed on the edge of the streambank perpendicular to the flood flow. Their purpose is the same as transplant wings, to slow flood velocities and encourage deposition. Brush bars are not as robust as transplant wings but are a good substitute on sites where transplants are not plentiful or as a way to augment transplant wings. Another benefit is that brush bars can be installed by hand and do not require the use of heavy equipment. Over time, the brush bars will grow and expand, providing a method for revegetating the riparian zones.
    - For more information, please see the BLM's March 2023 Stream Design and Reclamation Guide for Interior Alaska: Technical Report 65, page 93.

Velocity Dissipation and Grade Control: Place velocity dissipation devices (e.g., check dams (See Figure 1. Rock check dams), boulder cross veins, riffle pool complexes, or other grade control structures) along the length of any conveyance channel to provide a non-erosive flow velocity dissipator. Also place velocity dissipation devices where flows from the conveyance channel join a water course to prevent erosion and to protect the channel embankment, outlet, adjacent stream bank, and downstream waters.

- Prevent erosion and reduce channel incision.
    - Install rock check dams (See Figure 1. Rock check dams), media lunas, or natural log grade controls at intervals based on slope and flow rate.
    - Build boulder cross-vanes or constructed riffles to create energy dissipation

zones and mimic natural steps.

- Use step-pool sequences in steeper reaches to prevent headcutting and maintain grade.
- Place spreader logs or rock aprons at channel junctions and outfalls to dissipate flow and protect embankments.
- Ensure grade control structures are embedded below the streambed to prevent undercutting.

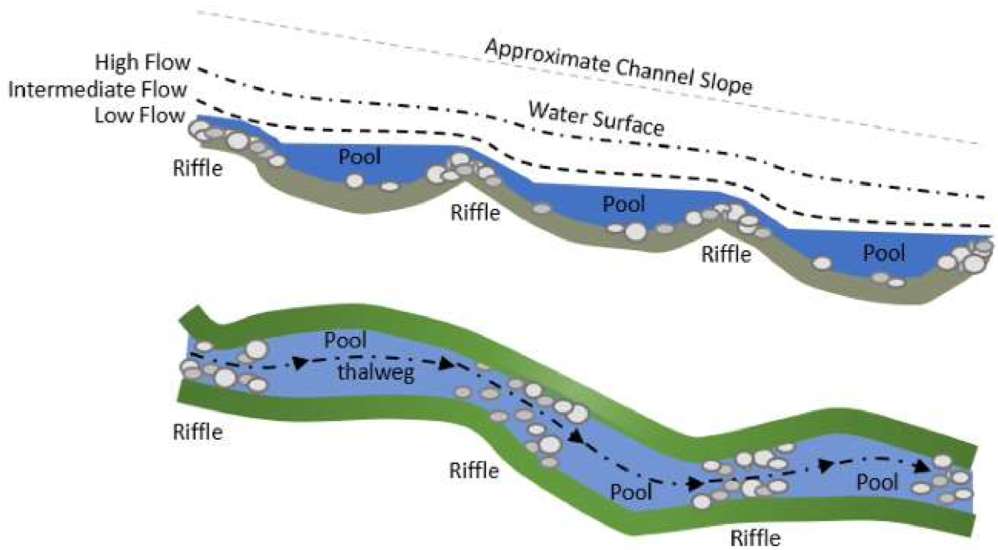

Figure 11: Diagram of a riffle-pool sequence. Adapted from Dunne & Leopold (1978).

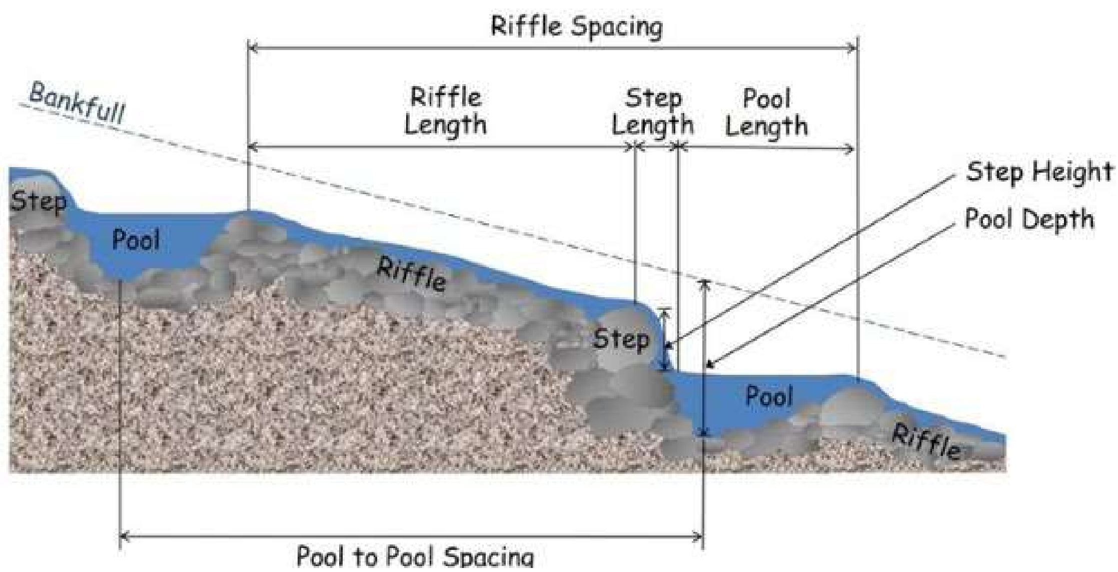

Figure 12: Additional diagram of a riffle-pool sequence. Adapted from Thompson, D.M. (2018).

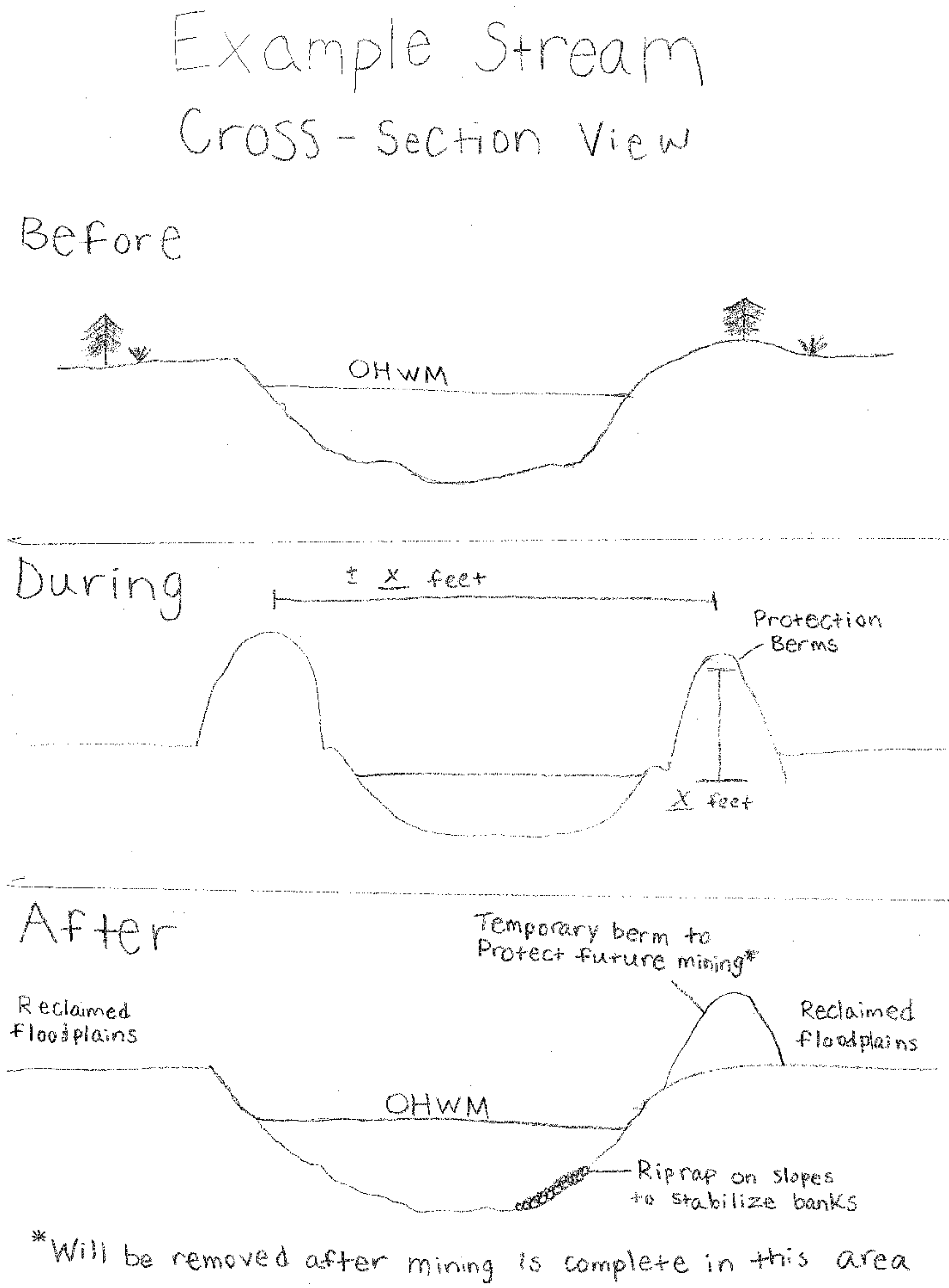

Figure 13: Example drawing of a cross-section view of a stream. From USACE (2025).

Monitoring & Adaptive Management

- Track plant survival with annual monitoring reports and supplement if vegetation fails to meet standards.
- Inspect grade controls during spring melt and after storm events; repair or adjust structures as needed.
- **Submit the annual report to USACE by December 31 of each calendar year!**

Key points for stream management:

- Prevent vertical incision and entrenchment.
- Reconnect floodplains and restore overbank flow.
- Promote channel stability and bedform diversity.
- Maintain stream sinuosity and reduce erosion.
- Reestablish native riparian vegetation.

    - **NOTE:** To obtain information on appropriate BMP techniques based on the site's fluvial landscape, please contact a local BLM office (https://www.blm.gov/office/alaska-state-office), or refer to the BLM Stream Design and Reclamation Guide for Interior Alaska (Harmon, W., M. Varner, E. Lamb, and D. McLeod, 2023), commonly referred to as BLM Technical Report 65.

References

Alaska Department of Transportation and Public Facilities. (2004). Chapter 16: Erosion and Sediment Control. In *Alaska Highway Drainage Manual*. ADOT&PF.

BLM. (Bureau of Land Management). (2022). Alaska Open File Report 169: Assessment of the impact of snow management on shallow geothermal resources on Alaska's North Slope. https://www.blm.gov/sites/default/files/docs/202205/Library_Alaska_OpenFileReport169.pdf.

BLM. (2023). Alaska stream reclamation: A guide for practitioners (Tech Series 1.0). https://www.blm.gov/sites/default/files/docs/202303/BLM_AK_Stream_Reclamation_Brochure_TechSeries_1_0.pdf.

Castro, J. M., & Thorne, C. R. (2019). The stream evolution triangle: Integrating Geology, Hydrology, and biology. *River Research and Applications*, *35*(4), 315–326. https://doi.org/10.1002/rra.3421.

Corps of Engineers Wetlands Delineation Manual. (1987). The Laboratory.

Criteria manual volume 3. MHFD. (2010, November). https://www.mhfd.org/criteria-manual-volume-3#docaccess-be5f5274bc8bf12777c922e95dcd9aa83d067676ae767b40b5e3a3acedb48a5c.

David, G., Fritz, K., Nadeau, T.-L., Topping, B., Allen, A., Trier, P., Kichefski, S., James, L., Wohl, E., & Hamill, D. (2025). *National Ordinary High Water Mark Field Delineation Manual for Rivers and Streams: Final Version*. https://doi.org/10.21079/11681/49526.

Dunne, T., & Leopold, L. B. (1978). Water in environmental planning. *The Journal of Wildlife Management*, *44*(1), 302. https://doi.org/10.2307/3808399.

Durst, J. D., & Ferguson, J. M. (2000). Buffer strip function and design. Alaska Department of Fish and Game, Habitat and Restoration Division. 19 pp. https://forestry.alaska.gov/Assets/pdfs/forestpractices/1LitBufferDesign8-7-00.pdf.

Environmental Protection Agency (EPA). (2021). Stormwater Best Management Practice, Vegetated Buffers. https://www.epa.gov/npdes.

Farming & Wildlife Advisory Group South West. (2022). *NatureBid Auction Measure Specification: Flow Spreaders*. NatureBid.

Geist, M., & Alaska Center for Conservation Science, University of Alaska Anchorage. (2024). Historic mining footprint (Version 1.0). UAA. https://accscatalog.uaa.alaska.edu/dataset/historic-mining-footprint.

Haring, C. (2012, November 21). *Systems approach to stream bed and Bank Erosion Control Training*. Engineer Research and Development Center (ERDC). https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/476713/systems-approach-to-stream-bed-and-bank-erosion-control-training/.

Harman, W., M. Varner, E. Lamb, and D. McLeod. (2023). Stream Design and

Reclamation Guide for Interior Alaska. Bureau of Land Management. BLM Technical Report 65.

Hruby, T. (2013). Update on wetland buffers: The state of the science, Final report, October 2013. Washington State Department of Ecology Publication #13-06-11. https://www.ecy.wa.gov/publications/documents/130611.pdf.

Kennedy, B. W., & Langley, D. E. (2007). Assessment of hydrology, water quality, and trace elements in selected placer-mined creeks in the Birch Creek watershed near Central, Alaska, 2001–05 (U.S. Geological Survey Scientific Investigations Report No. 20075124). 50 pages. https://pubs.usgs.gov/sir/2007/5124/pdf/sir20075124.pdf.

Léger, A., M., Ossana, L., and Sittig-Guglielmo, J. (2023). "Reversing Erosion on Semi-Arid Grassland Ranches: A 10-Year Analysis." *CART*. Retrieved from https://www.fws.gov/project/reversing-erosion-grassland-ranches.

Madison, R.J. (1981). Effects of placer mining on hydrologic systems in Alaska; status of knowledge. U.S. Geological Survey Open-File Report 81-217, 25 p. Retrieved from https://pubs.usgs.gov/of/1981/0217/report.pdf.

Philadelphia Water Logs LLC. (2025, September 25). *Level spreader: Philadelphia water logs: Stormwater Management Company*. Level Spreader. https://phlwaterlogs.com/level-spreaders/.

Rosgen, D.L. (1994). A classification of natural rivers. Catena, Vol. 22, 169-199. Elsevier Science, B.V. Amsterdam.

Rosgen, (1996), Applied River Morphology, Wildland Hydrology, Pagosa Springs, CO.

Rosgen, D. (1998). The reference reach: A blueprint for natural channel design. *Engineering Approaches to Ecosystem Restoration*, 1009–1016. https://doi.org/10.1061/40382(1998)166.

Thompson, D. M. (2018). Pool–riffle sequences. *Reference Module in Earth Systems and Environmental Sciences*. https://doi.org/10.1016/b978-0-12-409548-9.11029-2.

Thompson, D. M., & MacVicar, B. J. (2022). Pool-riffle. *Treatise on Geomorphology*, 587–608. https://doi.org/10.1016/b978-0-12-409548-9.12087-1.

USGS. (U.S. Geological Survey). (1999). Geospatial analysis of streamflow data in the North Fork of the Flathead River, Montana and British Columbia (Open-File Report 99-328). https://pubs.usgs.gov/of/1999/0328/report.pdf.

Weber, P. (1986). Downstream effects of placer mining in the Birch Creek Basin, Alaska, Technical Report No. 86-7. Alaska Department of Fish and Game, Division of Habitat. https://www.adfg.alaska.gov/static/home/library/pdfs/habitat/86_07.pdf.

Wright, S. J., & Hunt, P. (2008). *A revegetation manual for Alaska*. Alaska Plant Materials Center, Division of Agriculture, Alaska Dept. of Natural Resources.

United States Army Corps of Engineers. (1987, October 29). *Placer mining.* Memorandum for Record.