# Design Memorandum

## Fourmile Canyon Creek Stream Restoration 30% Design

Wagonwheel Gap Road & Lee Hill Drive to Anne U White Trailhead



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## Project Location & Watershed Description

The Fourmile Canyon Creek restoration project is located north of the City of Boulder near the intersection of Lee Hill Drive and Wagonwheel Gap Road. The project begins approximately 1,100 feet downstream of Wagonwheel Gap Road and extends upstream to the Anne U White Trailhead. The total length of this project is approximately 1.4 miles.

The drainage area of Fourmile Canyon Creek at the downstream extents of the project is 7.19 square miles and at the confluence with Lion Point tributary, near Lion Point, is 4.92 square miles. The watershed elevation varies between 5700 feet at the downstream end of the project to 8500 feet at the headwaters, just upstream of Sunshine Canyon Drive. The mean annual precipitation for this portion of the watershed is approximately 21 inches per year.

Geology in the watershed consists mostly of granite, with some siltstone and sandstone. This watershed is comprised of alluvial valleys with ranging widths. Most of the soils in the watershed can be classified as loamy or sandy alluvium and are typically well-drained soils meaning that they have a high rate of infiltration.

Existing vegetation in this watershed falls within three categories: Overstory (trees), understory (shrubs), and ground cover (herbaceous). Existing overstory vegetation is generally comprised of Ponderosa Pine, Douglas Fir, Willow, and Cottonwood. Understory vegetation is generally comprised of Willow, Mountain Ninebark, and Chokecherry. Ground cover vegetation is generally comprised of a variety of grasses, brome, rushes, and sedges. A complete description of all existing vegetation is provided in Appendix A.

## Project Background

Fourmile Canyon Creek incurred significant damage during the September 2013 Flood. The flood and debris flow straightened the entire creek alignment, over widened the channel cross section, and modified the channel profile through the cutting and depositing of sediment. A heat map showing zones of erosion and deposition is provided in Appendix A. Aquatic and terrestrial habitat was severely impacted and/or destroyed and most riparian vegetation was removed by the flood.

This change in channel dimension (cross-section), pattern (planform), and profile (slope) has resulted in unstable channel conditions throughout the extents of this project. The resulting impact of these changes is a general inability of the existing channel to move water and sediment efficiently through the system without resulting in channel degradation, aggradation, and bank erosion.

Riparian and upland vegetation provides a substantial amount of natural earth stabilization for both the channel, floodplain, and valley. Much of this natural vegetation adjacent to Fourmile Canyon Creek was stripped during the flood event, which further reduced the overall stability of the existing stream system. Above average precipitation was received in the watershed, and along the Front Range of Colorado, during the summer of 2015. As a result, both natural and invasive vegetation has begun to grow back faster than expected. However, there is still a general lack of riparian vegetation in this system.

This project was derived from the adjacent Wagonwheel Gap Road project. Wagonwheel Gap Road was also severely damaged during the September 2013 Flood and Boulder County (County) secured funding

to do both the design and reconstruction of Wagonwheel Gap Road between Lee Hill Drive and the Anne U White Trailhead. The County decided to develop restoration plans for this section of Fourmile Canyon Creek for two reasons:

- 1. There is a high degree of interaction between the road and creek and making site-specific improvements only at locations where the road crosses the creek puts these isolated improvements at risk of failing due to adjacent, unaddressed, instabilities in the creek.
- 2. A post-flood watershed master plan was not completed for the Fourmile Canyon Creek watershed. However, the Fourmile Canyon Creek watershed experienced significant damage during the September 2013 Flood. As a result, the County did not have the appropriate planning documents to apply for watershed restoration grants.

Funding has not yet been secured for the construction of Fourmile Canyon Creek. Ideally it will be secured and construction can be completed at the same time as the reconstruction of Wagonwheel Gap Road. This would provide both a time and cost savings to the County.

## Goals & Objectives

The general philosophy towards restoring Fourmile Canyon Creek was to implement the principles of natural channel design. The definition of natural channel design is to establish the physical, chemical, and biological functions of the river system that are self-regulating and emulate the natural stable form within the constraints imposed by the larger landscape conditions (Wildland Hydrology, 2006). It is important to restore all components of a stream system that are required to make it sustainable, rather than just focusing on what is visible. A river system includes not only the river channel but also its related components, including adjacent floodplains, wetlands, and associated riparian and biological communities. Defining the natural, stable form of a river involves re-establishing a physical stability that integrates the processes responsible for creating and maintaining the dimension, pattern and profile of river channels.

A project kickoff meeting was held with the County on March 10<sup>th</sup>, 2015 to discuss project goals and objectives, which are in alignment with the definition of natural channel design, and consist of:

- Restoring the natural channel to the extent practical and within the current watershed setting
- Restoring aquatic and terrestrial habitat
- Restoring ecological connectivity
- Reducing flood risk
- Integrating the above restoration strategies with the adjacent Wagonwheel Gap Road project

#### Stream Assessments

Project reach assessments were performed over a period of ten days using protocols outlined in Watershed Assessment of River Stability and Sediment Supply (Wildland Hydrology, 2006) to quantify the degree of impairment for the existing creek system related to hydrologic, geomorphic, ecologic, and biologic conditions. Results of the assessment are provided in Appendix A.

General project reach assessments included:

• Initial site assessment to document existing conditions with field notes and photographs.

- A review of historical, pre- and post-flood aerial photography to evaluate changes in channel and floodplain conditions over time.
- A review of pre- and post-flood LiDAR data to evaluate changes in channel and floodplain conditions over time along with zones of channel erosion and deposition.
- Identification of vertical and lateral controls, such as roadways and utilities, in the vicinity of the project reach.
- Identification of flood debris.

Detailed project reach assessments consisted of the following:

- Hydrologic To evaluate flow regime and peak flow characteristics.
- Geomorphic To evaluate existing channel dimension, pattern, and profile characteristics including classification of existing and potential stream type.
- Ecologic To evaluate riparian and upland vegetation along with the identification of wetlands
- Biologic To evaluate quality of in-stream habitat, presence of fish species, and presence of macro invertebrates.
- Stability To evaluate vertical and lateral channel stability processes that are leading to erosion, deposition, and bank erosion.

Additionally, a tree survey was performed to identify large trees adjacent to the creek. The purpose of performing the survey was to identify large, well established, trees that would be ideal to save during the implementation of this restoration project. Both coniferous and deciduous trees were surveyed and classified in three different diameter classes: larger than 4 inches, larger than 8 inches, and larger than 12 inches.

Reference reach information was obtained, and used as a starting point, for developing design parameters for restoring impaired reaches. A reference reach is a stable stream that has adjusted to existing watershed conditions in such a way as to be self-maintaining. Reference reaches do not need to be pristine systems, rather, they need to have been stable over a long period of time and in a similar watershed setting as the project reach. All assessment information that is collected for the project reach is also collected for the Reference Reach. Then, both data sets are compared, and scaled design parameters are developed for use as a starting point for restoring stable channel geometry for the project reach. Reference reach information can be obtained from the following locations, in order of preference:

- 1. Immediately upstream or downstream of the project reach
- 2. In same watershed as the project reach
- 3. In the same hydrophysiographic region as the project reach

Reference reach assessment information was collected from the North Fork of North Elk Creek and the East Fork of the Arkansas River. Both of which are stable stream systems in a similar watershed settings as Fourmile Canyon Creek. This information was used to develop design parameters for restoring natural channel geomorphic, ecologic, and biologic conditions. Reference reach information is summarized in Appendix A.

In addition to collecting reference reach information, a pre-flood assessment of Fourmile Canyon Creek geometry was performed. This assessment was performed using pre-flood LiDAR and aerial

photographs to quantify stable planform geometry, channel width, and slope that existed prior to the September 2013 flood and was used as a reference during the design process. This assessment, along with reference reach information, is provided in Appendix A.

## Design Hydrology

Hydrologic analyses were performed to determine flood flows and bankfull flow for the project site.

#### Flood Flow Estimation

#### **USGS StreamStats**

The United States Geological Survey (USGS) StreamStats was used to calculate a range of peak flows that could be expected to occur in this watershed. This analysis estimates peak flows by using regression equations developed for different geographic areas. In this case, regression equations are available for both Mountain Regions and Plains Regions. Since portions of the Fourmile Canyon Creek watershed exist in both regions, an area-averaged peak flow was calculated. A summary of this analysis is provided in Appendix A and summarized in Table 1.

Danimana	Upstream of Lion Point (cfs)	Downstream of Lion Point (cfs)
Recurrence	DA=4.92 mi <sup>2</sup>	DA=7.19 mi <sup>2</sup>
2-year	60	75
5-year	140	183
10-year	210	284
25-year	345	476
50-year	464	646
100-year	630	885

Table 1: Summary of USGS StreamStats Analysis

Data from USGS StreamStats was used for reference when estimating bankfull flow for this watershed and comparison to Federal Emergency Management Agency (FEMA) regulatory 100-year flows.

#### **FEMA Regulatory Flows**

The effective FIS peak discharges were developed from the Flood Hazard Area Delineation study completed by Greenehorne and O'Mara in 1987. The peak discharge values not listed in the FIS report were obtained from the effective HEC-2 hydraulic model and used throughout the Fourmile Canyon Creek analysis. While the discharge values were evaluated approximately every 800 to 1,200 feet in the effective study, a summary of the effective values at the project upstream and downstream locations are shown in Table 2. The FEMA Flood Insurance Rate Map (FIRM) is provided in Appendix A for reference.

Peak Flow (cfs) Location 10-Year 50-year 100-Year 500-Year Upstream end of project 420 1,380 2,010 4,595 Downstream end of project 695 2,270 3,175 7,170

Table 2: Summary of FEMA Regulatory Flows

#### Bankfull Flow Estimation

Bankfull flow is a frequently occurring peak flow that occurs at a stage within the channel that corresponds to the incipient point of flooding. Bankfull flow is generally associated with a flood return period of 1-2 years and is generally responsible for moving the most sediment within the channel system over time. The role of the bankfull discharge in shaping the morphology of all alluvial channels is the fundamental principle behind natural channel design (Wildland Hydrology, 2006) and, therefore, needs to be estimated prior to beginning any design work. Estimations of bankfull flow, and bankfull cross section area, were made using the following methods:

- Regional curves developed for Central Colorado that provide a means to estimate bankfull flow.
- Field-based estimations that rely on presence of bankfull indicators and measurements of channel slope and cross section area. Bankfull stage indicators include:
  - The point at which the stream begins to spread out on the floodplain (requires knowledge of how the geomorphic floodplain should be configured)
  - Highest active depositional feature
  - Slope breaks in the channel bank/floodplain
  - o Change in particle size distribution
  - o Change in vegetation type
  - Staining of rocks
- Statistical analysis of gage data
- Comparison to the Elk Creek Reference Reach site

#### **Regional Curves**

Regional curves of Drainage Area vs. Cross Section Area and Drainage Area vs. Bankfull Flow were obtained for Central Colorado (Wildland Hydrology 2007) to estimate bankfull flow and bankfull channel cross section area. A summary of estimated bankfull flow and cross section area are provided in Table 3. Regional curves are provided in Appendix A. Note that there are two regional curves that represent different precipitation regimes. The high precipitation curve is valid for areas that receive between 18 to 40 inches of rainfall per year. The Fourmile Canyon Creek watershed within the extents of this project receives about 21 inches of rainfall per year so the high precipitation curve is valid for this watershed.

Table 3: Regional Curve Estimations of Bankfull Flow & Area

Location	Bankfull Flow (cfs)	Bankfull Cross Section Area (ft²)
Upstream of Lion Point (DA=4.92 mi2)	50-120	20-30
Downstream of Lion Point (DA=7.19 mi <sup>2</sup> )	60-130	25-35

#### **Field-Based Estimation**

In damaged stream systems bankfull indicators are difficult to identify, and in some cases may not be present. Furthermore, only two years have elapsed since the September 2013 flood which is at the upper limit for the return period on a typical bankfull flow event meaning that statistically very few bankfull flow events could have been experienced since the flood. As a result, bankfull features may not have had a significant amount of time to reestablish since the flood and may not be obvious within

impaired watersheds. Regardless of this, observed bankfull features were surveyed and estimations of bankfull flow and cross section area were made at several locations along Fourmile Canyon Creek. Collected survey measurements were compared against regional curves of Drainage Area vs. Cross Section Area and Drainage Area vs. Bankfull Flow for the Central Colorado Mountains, both of which are provided in Appendix A. There were three data points from the field survey that correlated fairly well with the regional curve data which confirmed applicability of the regional curve data to this project and further provided basis for determining the appropriate bankfull flow and bankfull cross section area as shown in Table 4.

Table 4: Field-Based Estimations of Bankfull Flow & Area

Location	Bankfull Flow (cfs)	Bankfull Cross Section Area (ft²)
Upstream of Lion Point (DA=4.92 mi2)	120	24
Downstream of Lion Point (DA=7.19 mi <sup>2</sup> )	130	28

#### **Statistical Analysis of Gage Data**

A statistical analysis of gage data was performed using the USGS PeakFQ software to calculate peak flows for the flood recurrences typically associated with the bankfull flow. This analysis was performed at gages in similar hydrophysiographic regions with a sufficient period of record to estimate the 1.25- to 2-year flow events. A total of ten gages were used to develop a regression equation of Drainage Area vs. Peak Flow. The results of the analysis were then applied to this project and are presented in Table 5. The regression analysis of the gage data, along with a comparison to the Central Colorado regional curve, is provided in Appendix A.

Table 5: Peak Flows Derived from Regression Analysis

Location	1.25-Year (cfs)	1.50-Year (cfs)	2-Year (cfs)
Upstream of Lion Point (DA=4.92 mi2)	101	114	129
Downstream of Lion Point (DA=7.19 mi <sup>2</sup> )	122	140	159

#### Comparison to Reference Reach Survey

Bankfull flow estimations were made during the reference reach survey performed at the North Fork of North Elk Creek. This reference reach was selected because it is in a similar hydrophysiographic region as Fourmile Canyon Creek. Both the drainage area (4.38 square miles) and annual precipitation (26 inches) of the reference reach site are similar to that of this project. Typical bankfull characteristics of the reference reach site are provided in Table 6 and are similar to what is predicted using the Central Colorado regional curves. Estimations of bankfull flow and bankfull cross section were plotted against the regional curves for Central Colorado and are provided in Appendix A.

Table 6: North Fork of North Elk Creek Typical Bankfull Characteristics

Location	Bankfull Flow (cfs)	Bankfull Cross Section Area (ft <sup>2</sup> )
North Fork of North Elk Creek	110	18.3

#### **Bankfull Flow Summary**

The selected bankfull flow and bankfull cross section area for the design of Fourmile Canyon Creek are provided in Table 7.

Table 7: Selected Bankfull Channel Flow & Cross Section Area

Location	Bankfull Flow (cfs)	Bankfull Cross Section Area (ft <sup>2</sup> )
Upstream of Lion Point (DA=4.92 mi2)	120	25
Downstream of Lion Point (DA=7.19 mi <sup>2</sup> )	130	27

Field-based estimations of bankfull flow are near the upper limit of what would be predicted by the Central Colorado regional curve while field-based estimations of bankfull cross section area are near the lower limit of what would be predicted by the Central Colorado regional curve. These findings were initially believed to be a result of working in a post-flood stream system that lacks clear bankfull indicators. However, the results of the reference reach survey performed at the North Fork of North Elk Creek compared similarly to the Central Colorado regional curve. Therefore, it is assumed that these results are characteristic of mountain streams that exist on the Front Range and that the field-based estimations of bankfull flow and bankfull cross section area are valid for this project. Additionally, the bankfull flows provided in Table 7 correspond to a flood recurrence between the 1.25- and 1.5-year flood events, which is common for bankfull flow.

## Natural Channel Design Approach

A toolbox methodology was employed for restoring Fourmile Canyon Creek which included:

- 1. Developing estimations of stable channel geometry obtained through reference reach surveys for application to the proposed design for Fourmile Canyon Creek design.
- 2. Developing hydraulic and sediment transport modeling to ensure long-term stability of the proposed design.

The approach towards restoring Fourmile Canyon Creek was to:

- Restore Fourmile Canyon Creek in the post-flood channel corridor, to the extent practical, in order to minimize earthwork and disturbance to vegetation that has become established since the 2013 Flood.
- Restore the natural channel dimension (cross section), pattern (planform), and profile (slope) to
  the extent practical to maximize stream stability at a lower cost, improve aquatic and terrestrial
  habitat, and optimize sediment transport and flood conveyance.
- Reconnect the channel to the adjacent floodplain to restore ecological connectivity and improve flood conveyance.
- Revegetate the channel and riparian zone with ecotypic plant species to restore habitat and ecological connectivity.
- Implement structure only where necessary to stabilize channel banks at risk of erosion, provide additional aquatic habitat, and protect adjacent roadway infrastructure.

The design of the proposed channel dimension, pattern, and profile were based on reference reach data previously described along with information obtained from the pre-flood assessment of Fourmile

Canyon Creek. Ideally, when restoring a stream system, there are no limitations on what modifications can be made to channel geometry. The intent is that if the channel geometry can be fully restored to a stable state structural stabilization may not be required. However, numerous constraints exist within the Fourmile Canyon Creek watershed that limit the ability to make changes to exiting channel geometry. These constraints include:

- Preserving existing, well-established trees
- Preserving existing, well-established vegetation
- Minimizing impact to existing and proposed roadway infrastructure
- Aligning the creek with existing and proposed roadway crossings
- Minimizing impact to private property and protecting homes
- A desire to restore the creek in the post-flood channel corridor to the extent practical

These constraints mostly impact the ability to add sinuosity to the stream and fully restore the need floodplain width. The result is a channel with higher than desirable channel slopes and narrower floodplain than needed. The resultant consequence is higher channel velocity, shear stress, and stream power. As a result, structure in the form of bank protection and in-stream features are added to mitigate against these variables. Structures were also added to improve stream complexity and aquatic habitat conditions. All structures consist of natural materials found within this watershed.

The following in-stream features were included in the restoration of Fourmile Canyon Creek:

- Log Vane Used in areas of sharp channel bends and potentially extreme hydraulic conditions to reduce near bank stress, channel bank erosion, and assist with turning the channel thalweg. Log vanes also provide aquatic habitat through the formation of scour pools and in-stream cover. These structures can be made with on-site material where available.
- Cross Vane Used in areas of sharp channel bends and potentially extreme hydraulic conditions
  to reduce near bank stress, channel bank erosion, and assist with turning the channel thalweg.
  Rock cross vanes were used instead of log vanes in confined areas which tend to have more
  extreme hydraulic conditions that could lead to logs becoming mobilized. These structure
  typically require imported boulders, but can be constructed with on-site material if available.
- Step-Pool Used in segments of steep channel slopes to transition channel grade, provide grade control, and allow for aquatic organism passage. These structures can be made with on-site material where available, but sometimes require imported materials be used.
- Rock Wings Incorporated into longer riffles to add thalweg complexity. These structures can be made with on-site material where available.
- Boulder Clusters Incorporated into longer riffles to add thalweg complexity and aquatic
  habitat. Boulder clusters were typically only used in long riffles leading into a bend with a cross
  vane structure where thalweg movement is not desirable. These structures can be made with
  on-site material where available.
- Converging Boulder Clusters Placed at the head of riffles where additional grade control would be beneficial. These features also provide in-stream complexity, and aquatic habitat. These structures can be made with on-site material where available.

The following bank protection features were included in the restoration of Fourmile Canyon Creek. Note that bank protection was not added in areas where channel bank erosion will likely not cause an

adverse impact to infrastructure and/or private residences. Additionally, channel bank protection was not added adjacent to steep geologic features and areas dominated by boulders and cobble due to the low risk of failure and potential challenges with construction.

- Boulder Bank Protection Used in confined corridors and tight channel bends close to infrastructure and private residences.
- Toe Wood Used in most places where bank protection is needed because of its proven
  effectiveness and benefit to in-stream habitat. This is also the most cost effective bank
  stabilization method compared to other options suitable for this watershed.
- Root Wads Used only in areas where sufficient room adjacent to the creek exists for construction and where channel bank materials are conducive to easy excavation.

The riffle-pool and step-pool sequence shown on the proposed plans is consistent with what was observed during reference reach surveys and assessment of pre-flood channel conditions. All riffle and pool locations are shown on the planset and are intended to be constructed with native, in-stream channel bed material only. In other words, the import of additional material is not required to construct these features. Pool locations are shown on both the inside and middle of channel bend to add complexity and based on in-stream structures being used adjacent to the pool.

Geomorphic floodplain benches were incorporated at different flood stages to improve stream function, aquatic and terrestrial habitat conditions, flood conveyance, and assist with ecologic restoration. Floodplain benches were incorporated adjacent to the low-flow channel and adjacent to the bankfull channel to the extent possible based on existing site constraints.

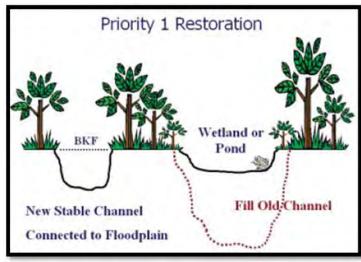
When restoring incised channels, such as most of Fourmile Canyon Creek, there are four different approaches (Priority 1 through Priority 4) for doing so as outlined in Stream Restoration – A Natural Channel Design Handbook (NC State University) and summarized below. This methodology is also further described, and referenced, in River Restoration & Natural Channel Design (Wildland Hydrology, 2013). All restoration approaches discussed below do not require import of fill material, and both Priority 1 and Priority 3 approaches do not require exporting material. The Priority 2 restoration approach may generate excess material that needs to be exported, however, in most instances the material can be disposed of on-site to fill the relic channel and/or avulsions that exist within the valley bottom. The Priority 4 restoration approach is to stabilize channel banks-in place. This method was not used in Fourmile Canyon Creek.

Earthwork is typically the most expensive component of a channel restoration project. As a result, the proposed channel profile and cross section were designed so that earthwork was minimized. Every attempt was made to balance earthwork quantities resulting from profile and cross section modifications. However, most of the proposed design was based on post-flood LiDAR information obtained in November 2014. As a result, there are associated inaccuracies with the use of LiDAR which could result in a difference in earthwork quantities compared to what is reported for this project.

#### Priority 1 – Establish Bankfull Stage at the Historical Floodplain Elevation

The objective of a Priority 1 project is to replace the incised channel with a new, stable stream at a higher elevation. This is accomplished by excavating a new channel with the appropriate dimension, pattern and profile (based on reference reach data) to fit the watershed and valley type. The bankfull

stage of the new channel is located at the ground surface of the original floodplain. The increase in streambed elevation also will raise the water table, in many cases restoring or enhancing wetland conditions in the floodplain. Surrounding land uses can limit the use of a Priority 1 approach if there are concerns about increased flooding or widening of the stream corridor. Most Priority 1 projects will result in higher flood stages above bankfull discharge in the immediate vicinity of the project and possibly downstream.



# Priority 2 – Create a New Floodplain and Pattern with Stream Bed Remaining at the Existing Elevation

The objective of a Priority 2 project is to create a new, stable stream and floodplain at the existing channel-bed elevation. This is accomplished by excavating a new floodplain and stream channel at the

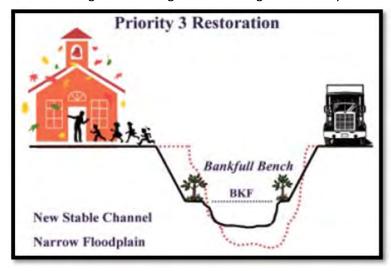


elevation of the existing incised stream. The new channel is designed with the appropriate dimension, pattern and profile (based on reference reach data) to fit the watershed. The bankfull stage of the new channel is located at the elevation of the newly excavated floodplain. Because the new floodplain is excavated at a lower elevation, Priority 2 projects do not increase—and may decrease—the potential for flooding.

#### Priority 3 – Widen the Floodplain at the Existing Bankfull Elevation

Priority 3 is similar to Priority 2 in its objective to widen the floodplain at the existing channel elevation to reduce shear stress. This is accomplished by excavating a floodplain bench on one or both sides of the existing stream channel at the elevation of the existing bankfull stage. The existing channel may be

modified to enhance its dimension and profile based on reference reach data. The bankfull stage of the new channel is located at the elevation of the newly widened floodplain. Priority 3 projects typically do not increase sinuosity to a large extent because of land constraints. These projects typically have little impact on flooding potential unless there are large changes in channel dimension.



## Reach Description

This section of Fourmile Canyon

Creek was subdivided into 10 reaches based on change in valley type, change stream type, and presence of road crossings. All reaches are defined on the plan set titled Fourmile Canyon Creek: 30% Stream Restoration Plans.

#### Reach 1

A Priority 2 restoration is recommended for this reach. Low-flow and bankfull geomorphic benches will be re-established along the existing channel alignment using material within the channel generated from expanding the channel section and excavating pools. The floodplain on the left bank of the channel can be widened to increase floodplain width. Flood impacts will likely be reduced by increasing channel cross section area, widening the floodplain, and reattaching the channel to the floodplain.

The major design constraint in this reach is the need to keep the channel in the existing alignment. The two properties adjacent to the reach may be bought-out in the future, but the status of this I s unknown. An alternative alignment was provided in the event that the property acquisition happens.

#### Reach 2

A Priority 1 restoration is recommended for this reach as much of the channel can be realigned to increase sinuosity. Low-flow and bankfull geomorphic benches will be re-established along the entire reach. Overall floodplain width is only constrained by the bottom width of the valley between the two eroded terrace banks. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

The only constraint to design in this reach is that the channel alignment is constrained by the bottom width of the valley between the two eroded terrace banks.

#### Reach 3

A Priority 1 restoration is recommended for this reach as much of the channel can be realigned to increase sinuosity. Low-flow and bankfull geomorphic benches will be re-established along the entire reach. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

The only constraint to design in this reach is that the channel alignment needs to cross Bow Mountain Road at a prescribed location identified in the Wagonwheel Gap Road reconstruction project.

#### Reach 4

The upstream and downstream portions of this reach will be realigned out of the existing channel alignment and will follow a Priority 1 restoration approach. Low-flow and bankfull geomorphic benches will be re-established along both reach segments. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

The constraint to design in these segments of Reach 4 are because of modifications that will be made to two roadway crossings identified in the Wagonwheel Gap Road reconstruction project that will require the channel to be realigned.

The remainder of Reach 4 between these two segments will follow a Priority 3 restoration approach in the existing channel alignment. Low-flow and bankfull geomorphic benches will be re-established along the entire reach. Flood impacts will likely be reduced by increasing channel cross section area and reattaching the channel to the floodplain.

Design constraints in this portion of Reach 4 are the need to preserve existing vegetation. A substantial amount of vegetation has rejuvenated during the summer of 2015 and there are numerous trees adjacent to the existing channel alignment. Both the vegetation and trees provide great channel bank stability, and for this reason should be preserved. Furthermore, adding additional sinuosity is limited by the adjacent road.

#### Reach 5

The upstream and downstream portions of this reach will be realigned out of the existing channel alignment and will follow a Priority 1 restoration approach. Low-flow and bankfull geomorphic benches will be re-established along both reach segments. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

The constraint to design in these segments of Reach 5 are because of modifications that will be made to two roadway crossings identified in the Wagonwheel Gap Road reconstruction project that will require the channel to be realigned.

The remainder of Reach 5 between these two segments will follow a Priority 3 restoration approach in the existing channel alignment. Low-flow and bankfull geomorphic benches will be re-established along the entire reach. Flood impacts will likely be reduced by increasing channel cross section area and reattaching the channel to the floodplain.

Design constraints in this portion of Reach 5 are the need to preserve existing vegetation. A substantial amount of vegetation has rejuvenated during the summer of 2015 and there are numerous trees

adjacent to the existing channel alignment. Both the vegetation and trees provide great channel bank stability, and for this reason should be preserved. Furthermore, adding additional sinuosity is limited by the adjacent homes.

#### Reach 6

The upstream portion of this reach will be realigned out of the existing channel alignment and will follow a Priority 1 restoration approach. Low-flow and bankfull geomorphic benches will be re-established along the entire reach segment. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

The constraint to design in this segment of Reach 6 is because of modifications that will be made to the upstream roadway crossings identified in the Wagonwheel Gap Road reconstruction project that will require the channel to be realigned.

The remainder of Reach 6 between will follow a Priority 3 restoration approach in the existing channel alignment. Low-flow and bankfull geomorphic benches will be re-established along the entire reach. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

Design constraints in this portion of Reach 6 are the need to preserve existing vegetation. A substantial amount of vegetation has rejuvenated during the summer of 2015 and there are numerous trees adjacent to the existing channel alignment. Both the vegetation and trees provide great channel bank stability, and for this reason should be preserved. Furthermore, adding additional sinuosity is limited by the adjacent road, home, and private driveway crossing.

#### Reach 7

Reach 7 between will follow a Priority 3 restoration approach in the existing channel alignment. Low-flow and bankfull geomorphic benches will be re-established along the entire reach. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

There are two design constraints in this reach. One is the need to preserve existing vegetation. A substantial amount of vegetation has rejuvenated during the summer of 2015 and there are numerous trees adjacent to the existing channel alignment. Both the vegetation and trees provide great channel bank stability, and for this reason should be preserved. The other design constraint is the narrow canyon that the existing channel alignment is in, which limits the opportunity to add sinuosity.

#### Reach 8

Reach 8 between will follow a Priority 3 restoration approach in the existing channel alignment. Low-flow and bankfull geomorphic benches will be re-established along the entire reach. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

There are two design constraints in this reach. One is the need to preserve existing vegetation. A substantial amount of vegetation has rejuvenated during the summer of 2015 and there are numerous trees adjacent to the existing channel alignment. Both the vegetation and trees provide great channel

bank stability, and for this reason should be preserved. The other design constraint is the narrow canyon that the existing channel alignment is in, which limits the opportunity to add sinuosity. The channel alignment is also constrained by the presence of private driveway crossings.

#### Reach 9

This reach will follow a Priority 1 restoration approach for the entire length. Low-flow and bankfull geomorphic benches will be re-established along both reach segments. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

The constraint to Reach 9 is that it needs to be completely realigned in a new location due to the Wagonwheel Gap Road reconstruction project.

#### Reach 10

The upstream and middle portions of this reach will be realigned out of the existing channel alignment and will follow a Priority 1 restoration approach. Low-flow and bankfull geomorphic benches will be reestablished along both reach segments. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

The constraint to design in these segments of Reach 10 are because of modifications that will be made to two roadway crossings identified in the Wagonwheel Gap Road reconstruction project that will require the channel to be realigned.

The remainder of Reach 10 will follow a Priority 3 restoration approach in the existing channel alignment. Low-flow and bankfull geomorphic benches will be re-established along the entire reach. Flood impacts will likely be reduced by increasing channel cross section area and re-attaching the channel to the floodplain.

Design constraints in this portion of Reach 4 are the need to preserve existing vegetation. A substantial amount of vegetation has rejuvenated during the summer of 2015 and there are numerous trees adjacent to the existing channel alignment. Both the vegetation and trees provide great channel bank stability, and for this reason should be preserved. Furthermore, adding additional sinuosity is limited by the adjacent road and the presence of private driveway crossings.

## Hydraulic Modeling

Hydraulic modeling was performed using HEC-RAS and normal depth calculations for the purposes of estimating:

- Flow velocities and shear stress
- Sizing boulders and engineered channel material
- Estimating scour depths
- Sizing culvert crossings

A summary of the above results is provided in Appendix A.

A detailed hydraulic model of the entire proposed design is being completed as a part of separate task order for the Conditional Letter of Map Revision (CLOMR) submittal.

### **Sediment Transport Modeling**

While information obtained during the reference reach and project reach survey largely influences the final restoration design, sediment transport modeling is performed to validate the design and ensure that the proposed project will remain stable under the anticipated sediment loading and hydrologic regime.

Two different types of sediment transport analyses were performed: competence analysis and capacity analysis. Sediment competence is determined by comparing the size of a particle that the channel can move compared to the material found in the streambed. A channel is considered competent if it can move the D84 size particle. The capacity analysis evaluates the ability of the creek to move the total volume of sediment coming into the system and reveals whether the system will have the tendency to aggrade or degrade. Both analyses were performed with the RIVERMorph® software using protocols outlined in Watershed Assessment of River Stability and Sediment Supply (Wildland Hydrology 2009). Suspended load and bed load information was obtained from regional curves developed for Central Colorado (Wildland Hydrology 2007).

Results of the sediment competence and capacity analysis are provided in Appendix A. The proposed design is competent and has the capacity to move the anticipated volume of sediment entering the system. The proposed channel section was designed with a small amount of excess capacity to account for additional, and unforeseen, sediment loading entering the stream system. This excess capacity will allow for the channel section to naturally adjust over time while preserving the needed capacity to move the expected sediment load. Without a slight amount of excess capacity, any increase in sediment loading could cause the channel to aggrade.

A sediment continuity analysis was performed to ensure that the proposed channel section in each of the ten design reaches has similar competence and capacity values. This ensures that sediment moves through each reach similarly. Drastically different competence and capacity values between design reaches can lead to channel aggradation and/or degradation.

## **Ecologic Restoration**

A custom wetland/riparian restoration design was developed for the restoration of Fourmile Canyon Creek. The design maximized the size of lower floodplain benches whenever possible. These benches were be designed to frequently flood during high flow events or be positioned low enough to consistently receive alluvial groundwater, which will provide the appropriate water regime to support a diverse and productive wetland and riparian system. The restored system will mimic the natural system that was lost or impaired during the flood event and is comprised of three vegetation "zones." These zones generally include channel edge (mainly herbaceous plants or emergent wetland), lower riparian (shrub-dominated, often wetlands, typically willow), and upper riparian (shrubs and trees--mainly willow and cottonwood but usually non-wetland). These habitats are essential for the health of any watershed and are mainly supported by high alluvial groundwater or regular overbank flooding. They provide key habitat for a myriad of wildlife species (including endangered species), serve as movement corridors to link areas of larger habitats, provide bank protection and overall channel stability, enhance water quality, reduce flooding in downstream areas, and promote groundwater recharge.

All of the wetland and riparian areas will be seeded and/or planted with plants native to the Fourmile Canyon Creek watershed, with a particular focus on plants sourced locally (local ecotypes). Introducing containerized plant material with living and robust root systems is the quickest way to stabilize each project and "jump start" the establishment of native plant communities. The use of local ecotypes ensures the presence of plant material that is adapted to the local environment while also avoiding the introduction of unknown genetics into the system.

## **Road Crossings**

Road crossings were designed by the Wagonwheel Gap Road design team and were largely focused on hydraulic conveyance and adjacent site constraints. However, aquatic organism passage was considered as a part of this project at each of these crossings. Modifications to each of the road crossings was made to ensure that adequate flow depth is maintained in all locations and that no habitat barriers exist upstream, downstream, or within any of the crossings. Additional design is being performed at all crossing locations as a part of the final Wagonwheel Gap Road design.

#### Reach Prioritization

The purpose of doing this was to identify segments of stream that could be constructed individually without having to construct all 1.4 miles of Fourmile Canyon Creek. This benefits Boulder County in the event that they are only able to obtain partial funding for construction. A reach prioritization was completed to identify reaches that should be given first priority should construction funding become available. In addition to this ranking, priority should be given to constructing upstream reaches first over downstream reaches. This helps reduce the risk of damage to reaches that are restored near the downstream end of the project extents when construction is being completed upstream.

A summary of this prioritization is provided in Table 8 and summarized in more detail in Appendix A. Reaches were prioritized using the criteria outlined below:

- Reach Condition Rating Overall reach condition assigned during the project reach assessment.
- Impact of Ongoing Erosion to Values-At-Risk The degree to which ongoing, and unaddressed, erosion could impact adjacent homes and infrastructure if mitigation measures aren't put in place.
- Required for Road Construction The requirement that a specific reach needs to be constructed as a part of Wagonwheel Gap Road construction.
- Accessibility/Ease of Construction Represents ease of access to a specific reach along with how
  easy the recommended restoration can be constructed.
- Amount of Private Property Coordination

Table 8: Reach Prioritization

Priority	Reach	Priority	Reach
1	Reach 3	7	Reach 8
2	Reach 10	8	Reach 4
3	Reach 5	8	Reach 1
4	Reach 9	10	Reach 2
5	Reach 6		
6	Reach 7		

### Opinion of Probable Construction Cost

Opinion of probable construction costs were based on an Association for the Advancement of Cost Engineering (AACE) International CLASS 3 Cost Estimate. Class 3 estimates are generally prepared to form the basis for budget authorization, appropriation, and/or funding. Typically engineering is from 10% to 40% complete, and would comprise a minimum of process flow diagrams, utility flow diagrams, preliminary piping and instrumentation diagrams, plot plan, developed layout drawings, and essentially complete engineered process and utility equipment lists. They are typically prepared to support full project funding requests, and become the first of the project phase "control estimates" against which all actual costs and resources will be monitored for variation to budget. Most Class 3 estimates involve more deterministic estimating methods than stochastic methods. Typical accuracy ranges for Class 3 estimates are from +/- 10% to 30% (sometimes higher), depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination.

The opinion of probable construction costs assume that some on-site material will be available for constructing channel features and in-stream structures. The availability of on-site material could impact the actual costs. Additionally, earthwork quantities were based on LiDAR information and actual quantities could differ significantly.

## **Next Steps**

The proposed design for Fourmile Canyon Creek is at the 30% design level. The intent of this plan set was to identify all major design components and provide sufficient detail for a contractor to begin construction. If this plan is carried forward into construction the design engineer will need to be on-site daily to ensure the plans are being interpreted correctly, make field-fit modifications, and make design modifications. It is recommended that the following tasks be completed prior to beginning construction:

- An erosion control plan will need to be prepared.
- A monitoring plan will need to be prepared that includes both implementation monitoring and effectiveness monitoring.
  - o Implementation monitoring is performed to determine if a project was constructed according to the design plans. Typically includes measurements/survey of:
    - Channel Geometry (dimension, pattern, profile)
    - Stream facet (width, depth, slope)
    - Structure location and layout
    - Vegetation density and type
  - Effectiveness monitoring is performed to determine the ecologic/biologic/geomorphic response of the restored system to compared to pre-project conditions. Typically includes measurements of:
    - Pertinent biologic indices
    - Pertinent water quality parameters
    - Channel bed load
    - Suspended load
    - Channel bank erosion rates
    - Change in Channel Geometry and Stream Facet over time

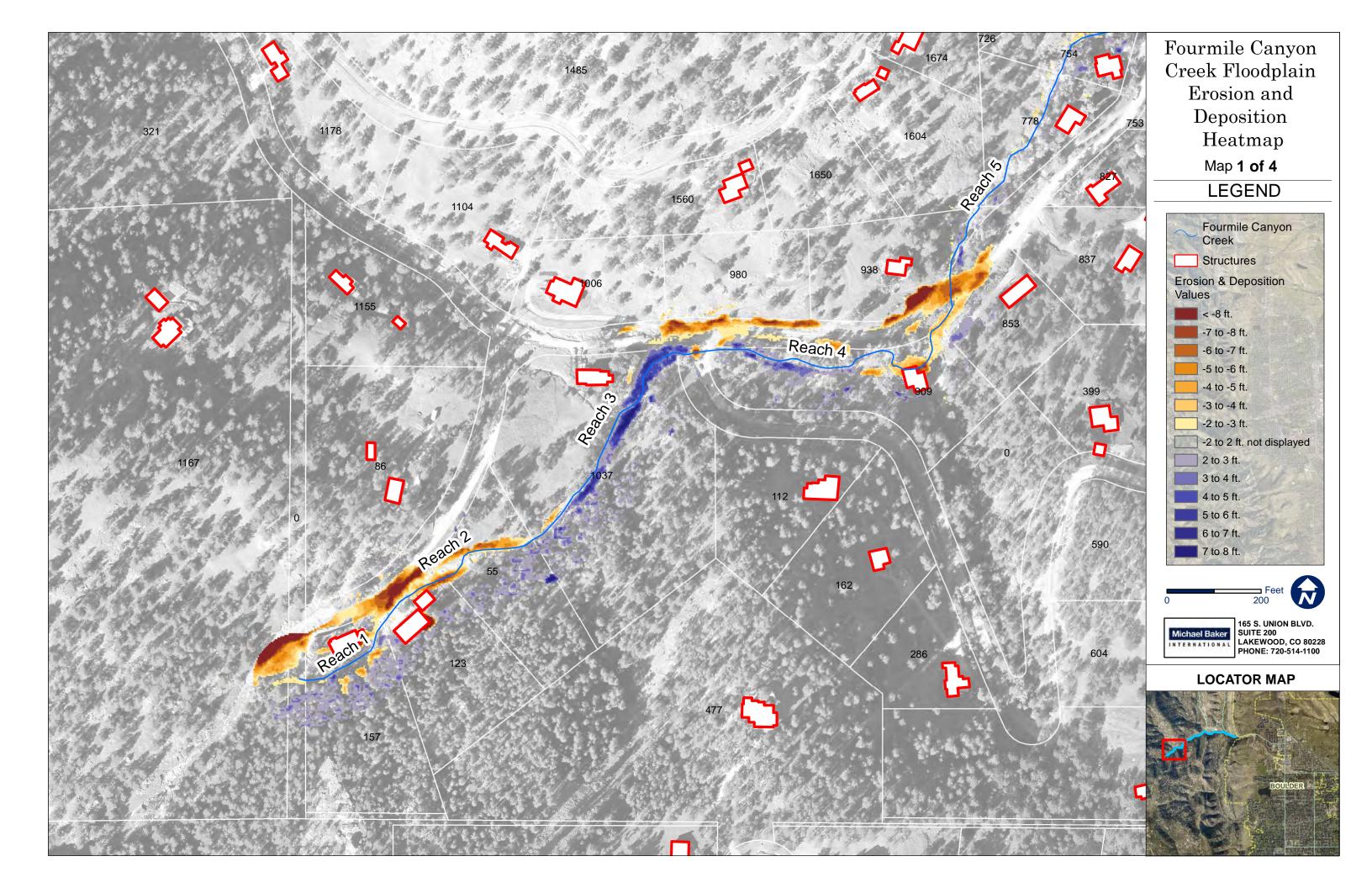
The following tasks will be completed as a part of the final design of the Wagonwheel Gap Road project:

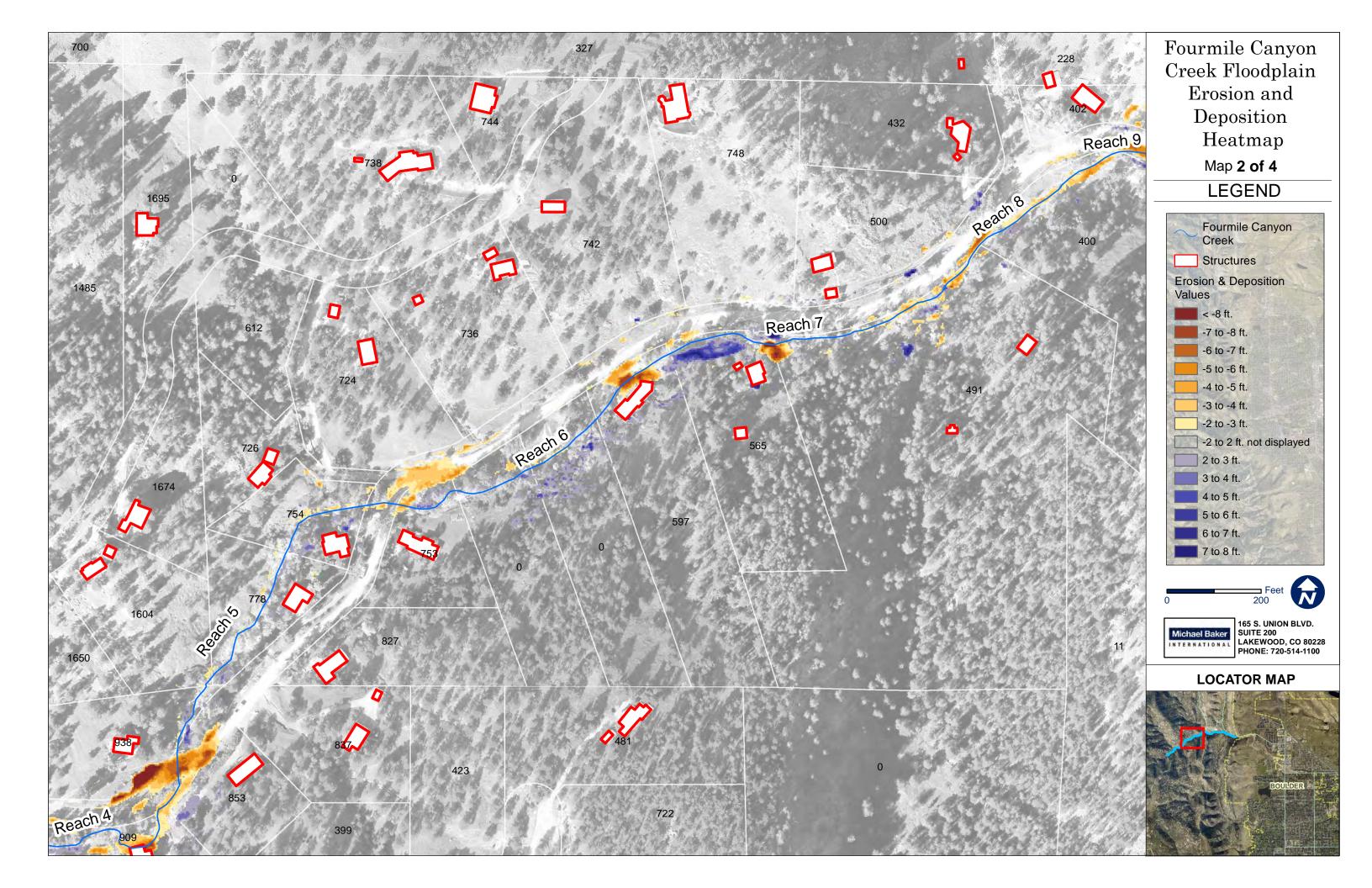
- Final hydraulic modeling and the completion, and submittal, of the CLOMR.
- Additional design for aquatic organism passage in and around all road crossings.
- Additional stream restoration design in locations where Fourmile Canyon Creek needs to be modified due to roadway impacts. These locations are shown on the plans.

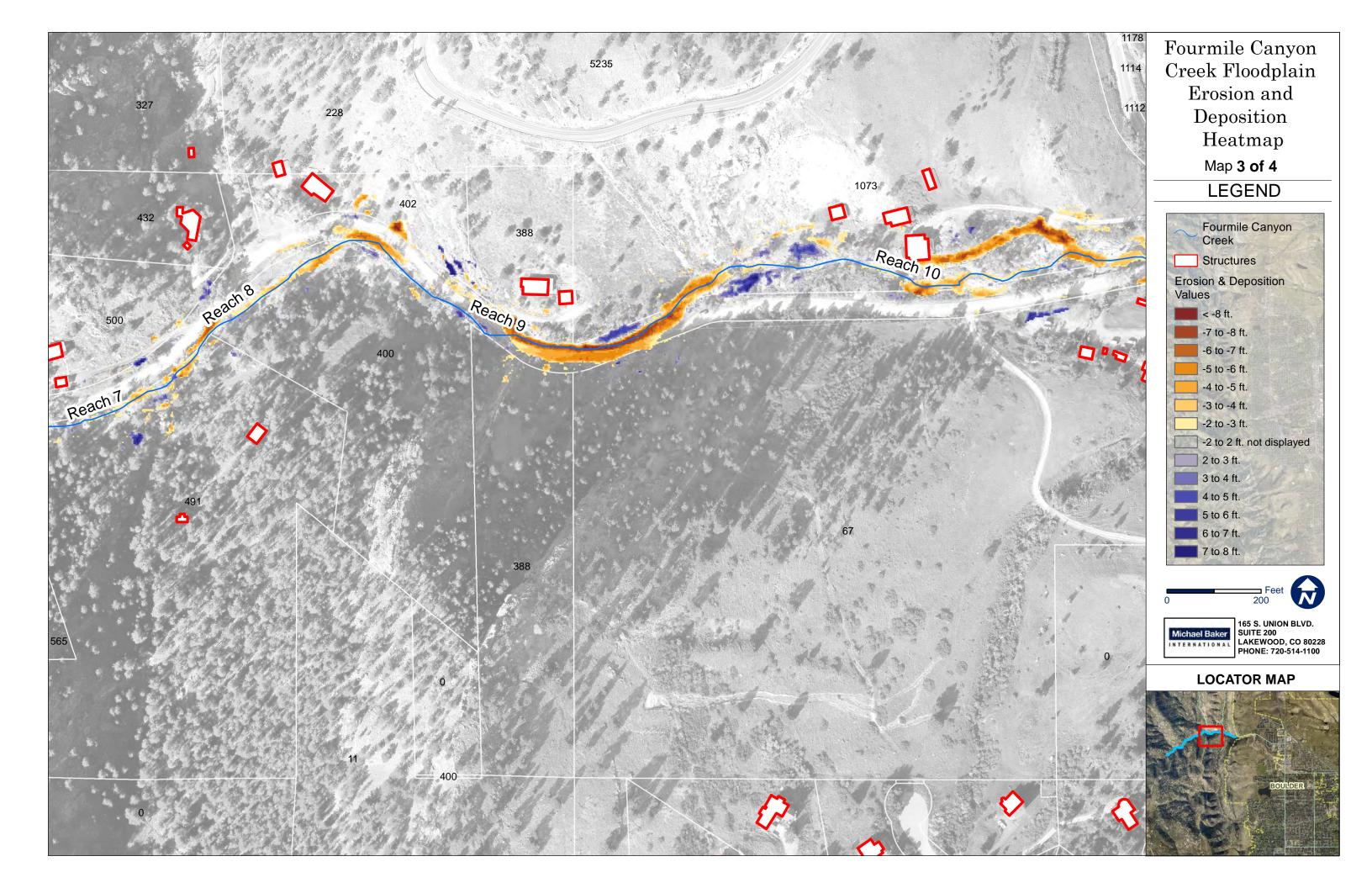
## Appendix A

- Project Reach Assessment
  - o Heat Map
  - o Assessment Data
- Reference Reach Data
  - o East Fork of Arkansas River
  - o North Fork of North Elk Creek
  - o Pre-Flood Assessment of Fourmile Canyon Creek
- USGS StreamStats Summary
- FEMA FIRM
- Regional Curves
- Statistical Analysis of USGS Gage Data
- Hydraulic Modeling Results
- Sediment Transport Modeling Results
- Reach Prioritization

## Project Reach Assessment









#### RIVERMORPH PFANKUCH SUMMARY

River Name: Reach 1 Reach Name: Assesments Survey Date: 05/13/2015

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#### Upper Bank

Landform Slope: 6
Mass Wasting: 9
Debris Jam Potential: 4
Vegetative Protection: 12

#### Lower Bank

Channel Capacity: 2
Bank Rock Content: 6
Obstructions to Flow: 2
Cutting: 6
Deposition: 8

#### Channel Bottom

Rock Angularity: 2
Brightness: 4
Consolidation of Particles: 4
Bottom Size Distribution: 8
Scouring and Deposition: 12
Aquatic Vegetation: 4

## Channel Stability Evaluation

Sediment Supply:
Stream Bed Stability:
W/D Condition:
Stream Type:
Rating - 93
Condition - Fair

Moderate
Stable
Normal
C4B

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	Fourmile Canyon Creek, Reach - Reach 1		
Basin:	Drainage Area: 2860.8 acres	4.47	mi <sup>2</sup>
Location:			
Twp.&Rge:	; Sec.&Qtr.: ;		
Cross-Sect	ion Monuments (Lat./Long.): 40.05944 Lat / 105.31997 Long	Date:	05/11/15
Observers:	Lucas Babbitt	Valley Type:	VIII(a)
	Bankfull WIDTH (W <sub>bkf</sub> )		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	17.36	ft
	<b>Bankfull DEPTH (<math>d_{bkf}</math>)</b> Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ( $d_{bkf}$ = A / $W_{bkf}$ ).	0.05	],
	Time Section (dbg = X / VV bg/).	0.95	]ft -
	Bankfull X-Section AREA (A <sub>bkf</sub> )  AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	16.56	ft <sup>2</sup>
		10.00	]'' ]
	Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> ) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	18.27	ft/ft
	Maximum DEPTH (d <sub>mbkf</sub> )  Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	1.79	ft
	WIDTH of Flood-Prone Area ( $W_{fpa}$ ) Twice maximum DEPTH, or (2 x d <sub>mbkf</sub> ) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	102.28	ft
	Entrenchment Ratio (ER)		]
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH ( $W_{\rm fpa}/W_{\rm bkf}$ ) (riffle section).	5.89	ft/ft
	Channel Materials (Particle Size Index ) D <sub>50</sub>		ĺ
	The $D_{50}$ particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	35.91	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.03649	ft/ft
	Channel SINUOSITY (k)		1
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.1	
	Stream Type  C 4b (See Figure 2-		

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	ream: Fourmile Canyon Creek					Location: Reach - Reach 1		
Ob	servers: Lucas Babbitt		Date:	05/11	/15	Valley Type: VIII Strea	m Type: C 4b	
		Riv	er Rea	ch Dir	nens	sion Summary Data1		
	Riffle Dimensions*' *** ***	Mean	Min	Max	i.	Riffle Dimensions & Dimensionless Ratios****		Max
*	Riffle Width (W <sub>bkf</sub> )	17.4	17.4	17.4		Riffle Cross-Sectional Area (A <sub>bkf</sub> ) (ft²)	16.56 16.56 1	_
** **	Mean Riffle Depth (d <sub>bkf</sub> )	0.95	0.95	0.95	•	Riffle Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	18.27 18.27 1	
Riffle Dimensions*	Maximum Riffle Depth (d <sub>max</sub> )	1.79	1.79	1.79	<u>.                                      </u>	Max Riffle Depth to Mean Riffle Depth (d <sub>max</sub> / d <sub>bkf</sub> )	1.884 1.884 1	_
nsic	Width of Flood-Prone Area (W <sub>fpa</sub> )	102	102	102		Entrenchment Ratio (W <sub>fpa</sub> / W <sub>bkf</sub> )	5.892 5.892 5	
ime	Riffle Inner Berm Width (W <sub>ib</sub> )	8.66	8.66	8.66	ft	Riffle Inner Berm Width to Riffle Width (W <sub>ib</sub> / W <sub>bkf</sub> )	0.499 0.499 0	
le D	Riffle Inner Berm Depth (d <sub>ib</sub> )	0.64	0.64	0.64	ft	Riffle Inner Berm Depth to Mean Depth (d <sub>ib</sub> / d <sub>bkf</sub> )	0.669 0.669 0	
R	Riffle Inner Berm Area (A <sub>ib</sub> )	5.5	5.5	5.5	ft <sup>2</sup>	Riffle Inner Berm Area to Riffle Area (A <sub>ib</sub> / A <sub>bkf</sub> )	0.332 0.332 0	0.332
	Riffle Inner Berm W/D Ratio (W <sub>ib</sub> / d <sub>ib</sub> )	13.6	13.6	13.6				
	Pool Dimensions*, **, *** Pool Width (W <sub>bkfp</sub> )	Mean 12.3	Min 12.3	Max 12.3	ft	Pool Dimensions & Dimensionless Ratios**** Pool Width to Riffle Width (W <sub>bkfp</sub> / W <sub>bkf</sub> )	Mean Min M	Max 0.706
* *	Mean Pool Depth (d <sub>bkfp</sub> )	1.27	1.27	1.27	-	Mean Pool Depth to Mean Riffle Depth (d <sub>bkfp</sub> / d <sub>bkf</sub> )	1.337 1.337 1	.337
* *	Pool Cross-Sectional Area (A <sub>bkfp</sub> )	15.6	15.6	15.6	•	Pool Area to Riffle Area (A <sub>bkfp</sub> / A <sub>bkf</sub> )	0.939 0.939 0	
ions	Maximum Pool Depth (d <sub>maxp</sub> )	1.8	1.8	1.8	ft	Max Pool Depth to Mean Riffle Depth (d <sub>maxp</sub> / d <sub>bkf</sub> )	1.895 1.895 1	
Dimensions*, **, ***	Pool Inner Berm Width (W <sub>ibp</sub> )	8.12	8.12	8.12	ft	Pool Inner Berm Width to Pool Width (W <sub>ibp</sub> / W <sub>bkfp</sub> )	0.663 0.663 0	
Din	Pool Inner Berm Depth (d <sub>ibo</sub> )	0.4	0.4	0.4	ft	Pool Inner Berm Depth to Pool Depth (d <sub>ibp</sub> / d <sub>bkfp</sub> )	0.314 0.314 0	).314
Pool	Pool Inner Berm Area (A <sub>ibp</sub> )	3.23	3.23	3.23	ft <sup>2</sup>	Pool Inner Berm Area to Pool Area (A <sub>ibp</sub> / A <sub>bkfp</sub> )	0.208 0.208 0	
"	Point Bar Slope (S <sub>pb</sub> )	0.282	0.282	: :	<del>!</del>	Pool Inner Berm Width/Depth Ratio (W <sub>ibp</sub> / d <sub>ibp</sub> )	#### #### #	
	Run Dimensions*	Mean	Min	May		Dun Dimonsionless Detice****		May
*	Run Width (W <sub>bkfr</sub> )	15.2		Max 15.2	ft	Run Dimensionless Ratios****  Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	Mean Min Model	Max ).877
sions*								).877
nensions*	Run Width (W <sub>bkfr</sub> )	15.2	15.2	15.2	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	0.877 0.877 0	).877 ).874
Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )	15.2 0.83	15.2 0.83	15.2 0.83	ft ft	Run Width to Riffle Width $(W_{bkfr} / W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr} / d_{bkf})$	0.877 0.877 0 0.874 0.874 0	).877 ).874 ).764
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )	15.2 0.83 12.7	15.2 0.83 12.7	15.2 0.83 12.7	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	0.877     0.877     0       0.874     0.874     0       0.764     0.764     0	).877 ).874 ).764
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )	15.2 0.83 12.7 2.21 18.4	15.2 0.83 12.7 2.21 18.4	15.2 0.83 12.7 2.21 18.4	ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )	0.877   0.877   0   0.874   0.874   0   0.764   0.764   0   2.326   2.326   2	0.877 0.874 0.764 2.326
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )	15.2 0.83 12.7 2.21	15.2 0.83 12.7 2.21 18.4 Min	15.2 0.83 12.7 2.21	ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****	0.877   0.877   0   0.874   0.874   0   0.764   0.764   0   2.326   2.326   2	0.877 0.874 0.764 2.326 Max
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )	15.2 0.83 12.7 2.21 18.4 Mean	15.2 0.83 12.7 2.21 18.4 Min	15.2 0.83 12.7 2.21 18.4 Max	ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )	0.877   0.877   0 0.874   0.874   0 0.764   0.764   0 2.326   2.326   2 Mean   Min   I	0.877 0.874 0.764 2.326 Max 1.139
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> /d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8	15.2 0.83 12.7 2.21 18.4 Min 19.8	15.2 0.83 12.7 2.21 18.4 Max 19.8	ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	0.877   0.877   0 0.874   0.874   0 0.764   0.764   0 2.326   2.326   2 Mean Min I 1.139   1.139   1 1.295   1.295   1	0.877 0.874 0.764 2.326 Max 1.139
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8	15.2 0.83 12.7 2.21 18.4 Min 19.8	15.2 0.83 12.7 2.21 18.4 Max 19.8	ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	0.877   0.877   0 0.874   0.874   0 0.764   0.764   0 2.326   2.326   2 Mean Min I 1.139   1.139   1 1.295   1.295   1 1.474   1.474   1	0.877 0.874 0.764 2.326 Max 1.139 1.295
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4	ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )	0.877   0.877   0 0.874   0.874   0 0.764   0.764   0 2.326   2.326   2   Mean   Min   N 1.139   1.139   1 1.295   1.295   1 1.474   1.474   1 1.874   1.874   1	0.877 0.874 0.764 2.326 Max 1.139 1.295
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23 24.4 1.78	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23 24.4 1.78	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4 1.78 16.1	ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )	0.877   0.877   0     0.874   0.874   0     0.764   0.764   0     2.326   2.326   2     Mean Min I     1.139   1.139   1     1.295   1.295   1     1.474   1.474   1     1.874   1.874   1     0.000   0.000   0	0.877 0.874 0.764 2.326 Max 1.139 1.295 1.474 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23 24.4 1.78 16.1	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23 24.4 1.78	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4 1.78 16.1	ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> /W <sub>bkfg</sub> )	0.877   0.877   0     0.874   0.874   0     0.764   0.764   0     2.326   2.326   2     Mean   Min   N     1.139   1.139   1     1.295   1.295   1     1.474   1.474   1     1.874   1.874   1     0.000   0.000   0     0.000   0.000   0	0.877 0.874 0.764 2.326 Max 1.139 1.295 1.474 1.874 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23 24.4 1.78 16.1	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23 24.4 1.78 16.1	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4 1.78 16.1 0	ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )	0.877   0.877   0     0.874   0.874   0     0.764   0.764   0     2.326   2.326   2     Mean Min I     1.139   1.139   1     1.295   1.295   1     1.474   1.474   1     1.874   1.874   1     0.000   0.000   0	0.877 0.874 0.764 2.326 Max 1.139 1.295 1.474 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23 24.4 1.78 16.1 0	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23 24.4 1.78 16.1 0	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4 1.78 16.1 0	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>lbg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>lbg</sub> / d <sub>bkfg</sub> )	0.877   0.877   0   0.874   0.874   0.874   0.764   0   0.764   0   0   0   0   0   0   0   0   0	0.877 0.874 0.764 2.326 Max 1.139 1.295 1.474 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>bg</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23 24.4 1.78 16.1 0	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23 24.4 1.78 16.1 0	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4 1.78 16.1 0 0 Max	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>bkfg</sub> / A <sub>bkfg</sub> )	0.877   0.877   0   0.874   0.874   0.874   0.764   0.764   0   0.764   0   0.764   0   0.764   0   0.764   0   0.764   0   0.764   0   0.764   0.76	0.877 0.874 0.764 2.326 MMax 1.139 1.295 1.474 0.000 0.000 0.000 Max
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23 24.4 1.78 16.1 0 0 Mean 0	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23 24.4 1.78 16.1 0 0 Min 0	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4 1.78 16.1 0 0 Max 0	ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / M <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	0.877   0.877   0   0.874   0.874   0.874   0.764   0   0.764   0   0.764   0   0   0   0   0   0   0   0   0	0.877 0.874 0.764 2.326 Max 1.139 1.295 1.474 0.000 0.000 0.000 0.000 Max 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23 24.4 1.78 16.1 0 0 Mean 0	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23 24.4 1.78 16.1 0 0 Min 0	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4 1.78 16.1 0 0 Max 0	ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	0.877   0.877   0     0.874   0.874   0     0.764   0.764   0     2.326   2.326   2	0.877 0.874 0.764 2.326 MMax 1.139 1.295 1.474 1.874 0.000 0.000 0.000 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23 24.4 1.78 16.1 0 0 0 Mean 0	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23 24.4 1.78 16.1 0 0 Min 0 0	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4 1.78 16.1 0 0 Max 0 0	ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / W <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )  Step Area to Riffle Area (A <sub>bkfs</sub> / A <sub>bkf</sub> )	0.877   0.877   0     0.874   0.874   0     0.764   0.764   0     2.326   2.326   2     Mean Min   1     1.139   1.139   1     1.295   1.295   1     1.474   1.474   1     1.874   1.874   1     0.000   0.000   0     0.000   0.000   0     0.000   0.000   0     0.000   0.000   0     0.000   0.000   0     0.000   0.000   0     0.000   0.000   0     0.000   0.000   0     0.000   0.000   0     0.000   0.000   0	0.877 0.874 0.764 2.326 Max 1.139 1.295 1.474 1.874 0.000 0.000 0.000 0.000 0.000 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	15.2 0.83 12.7 2.21 18.4 Mean 19.8 1.23 24.4 1.78 16.1 0 0 Mean 0	15.2 0.83 12.7 2.21 18.4 Min 19.8 1.23 24.4 1.78 16.1 0 0 Min 0	15.2 0.83 12.7 2.21 18.4 Max 19.8 1.23 24.4 1.78 16.1 0 0 Max 0 0	ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	0.877   0.877   0     0.874   0.874   0     0.764   0.764   0     2.326   2.326   2	0.877 0.874 0.764 2.326 Max 1.139 1.295 1.474 1.874 0.000 0.000 0.000 0.000 0.000 0.000

<sup>\*</sup>Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

<sup>\*\*</sup>Step-Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

<sup>\*\*\*</sup>Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

<sup>\*\*\*\*</sup>Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	Stream: Fourmile Canyon Creek Location: Reach - Reach 1															
Ob	Observers: Lucas Babbitt Date: 05/11/15 Valley Type: VIII Streat								m Type:	C 4b						
ics	River Reach Su					ch Sum	mary D	ata	.2		)					
lraul	Streamflow: Estimated Mean Velocity at Bankfull Sta					ge (u <sub>bkf</sub> )	)	5.	8	ft/sec	Estim	ation Me	ethod		U/U*	
Ě	Streamflow: Estimated	l Dischar	ge at B	ankfull	Stage (	Q <sub>bkf</sub> )		96.	09	cfs	Drain	age Area	a	4.	47	mi <sup>2</sup>
	Geometry		Mean	Min	Max			Dime	ension	ess Ge	eomet	ry Ratio	S	Mean	Min	Max
	Linear Wavelength (λ)		128	128	128	ft	Linear V	√avelen(	gth to F	Riffle W	idth (λ	/ W <sub>bkf</sub> )		7.373	7.373	7.373
	Stream Meander Leng	th (L <sub>m</sub> )	184	184	184	ft	Stream	Meande	r Lengt	h Ratio	(L <sub>m</sub> /'	N <sub>bkf</sub> )		#####	#####	####
tern	Radius of Curvature (F	₹ <sub>c</sub> )	34	33	36	ft	Radius	of Curva	ture to	Riffle V	Vidth (	R <sub>c</sub> / W <sub>bkf</sub>	)	1.959	1.901	2.074
I Paí	Belt Width (W <sub>blt</sub> )		23	23	23	ft	Meande	r Width	Ratio (	W <sub>blt</sub> / W	bkf)			1.325	1.325	1.325
Channel Pattern	Arc Length (L <sub>a</sub> )		0	0	0	ft	Arc Len	gth to Ri	ffle Wid	dth (L <sub>a</sub> /	W <sub>bkf</sub> )			0.000	0.000	0.000
Cha	Riffle Length (L <sub>r</sub> )		6.82	6.24	7.39	ft	Riffle Le	ngth to I	Riffle V	/idth (L	r / W <sub>bk</sub>	;)		0.393	0.359	0.426
	Individual Pool Length	(L <sub>p</sub> )	13.3	6.67	22.8	ft	Individua					` F	,	0.768	0.384	1.316
	Pool to Pool Spacing (	P <sub>s</sub> )	74.1	38.3	110	ft	Pool to I	Pool Spa	acing to	Riffle	Width	(P <sub>s</sub> /W <sub>bk</sub>	kf)	4.270	2.207	6.333
	Valley Slope (S <sub>val</sub> )	0.04	103	ft/ft	Averag	ge Wate	er Surface	e Slope (	(S)	0.0	3649	ft/ft	Sinuosity (	S <sub>val</sub> / S)		1.1
	Stream Length (SL)	23	3	ft	Valley	Length	(VL)	-		2	14	ft	Sinuosity (	SL / VL)		1.09
	Low Bank Height (LBH)		6.1 4.94	ft ft		Max De (d <sub>max</sub> )	pth	h start 1.67 ft Bank-Height Ratio (I end 1.69 ft (LBH / d <sub>max</sub> )						HR)		3.65 2.92
	Facet Slopes		Mean	Min	Max		Di	imensio	nless	Facet S	Slope	Ratios		Mean	Min	Max
	Riffle Slope (S <sub>rif</sub> )			0.041			Riffle Slo	ope to A	verage	Water	Surfa	ce Slope	(S <sub>rif</sub> / S)	1.424	1.129	1.719
Profile	Run Slope (S <sub>run</sub> )			0.088									(S <sub>run</sub> / S)		2.418	<del>:                                    </del>
	Pool Slope (S <sub>p</sub> )			0.008			Pool Slo								0.213	<del>'                                    </del>
Channel	Glide Slope (S <sub>g</sub> )		0.038	0.026	0.051	ft/ft	Glide Sl	ope to A	verage	Water	Surfa	ce Slope	(S <sub>g</sub> / S)	1.030	0.706	1.397
Spa Cha	Step Slope (S <sub>s</sub> )		0.000	0.000	0.000	ft/ft	Step Slo	pe to Av	verage	Water	Surfac	e Slope	(S <sub>s</sub> / S)	0.000	0.000	0.000
	Max Depths <sup>a</sup> Max Riffle Depth (d <sub>maxi</sub>	\	Mean	Min	Max	l <sub>44</sub>	May Diff			ss Dep			/d )	Mean	Min	Max
			1.73	1.72			Max Riff Max Rur							1.821		1.82
	Max Run Depth (d <sub>maxru</sub>		1.95		2.03	<u>.                                    </u>	Max Poo							•	1.968	
	Max Glide Depth (d <sub>maxp</sub>		1.55	2.26	1.88		Max Glid								2.379 1.126	
		g <i>)</i>				i	Max Ste									
	Max Step Depth (d <sub>maxs</sub> )		0	0	0	ft	IVIAX SIE	р Бериі			Dept	II (u <sub>maxs</sub> /	U <sub>bkf</sub> )	0	0	0
	0/ Silt/Clay:	Rea			fle <sup>c</sup>	i E	Bar	<u>                                    </u>		ach <sup>b</sup>	1	iffle <sup>c</sup>	Bar	Protru	ısion He	
als	% Silt/Clay % Sand	0.9			0 7	<u> </u>		D <sub>16</sub>		35	:	11.3	i			mm
Channel Materials	% Gravel	20. 47.				<u> </u>		D <sub>35</sub>		.91	1	7.89	1	<u> </u>		mm
Ĭ K	% Gravei	27.			7	<u> </u>		l .		.91 3.26		9.43 6.75	<u>i</u>	!		mm
anne	% Cobble % Boulder	1.9			27	<u>i</u>		D <sub>84</sub>			<u>!</u>		<u>i</u>	<u> </u>		mm
වි	% Boulder % Bedrock	1		<u> </u>	3 n	!		D <sub>95</sub>		9.07	1	)5.33 362	1	<u> </u>		mm
100	∏ /o Deulock	0.9	פנ	,	0	i		D <sub>100</sub>	Bea	rock	į	362	į	İ		mm

a Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

<sup>&</sup>lt;sup>b</sup> Composite sample of riffles and pools within the designated reach.

<sup>&</sup>lt;sup>c</sup> Active bed of a riffle.

<sup>&</sup>lt;sup>d</sup> Height of roughness feature above bed.

Worksheet 3-1. Riparian vegetation composition/density used for channel stability assessment.

	Riparian Vegetation								
Stre	eam: <b>Fourm</b>	nile Canyon Cro	eek	Location: Reach 1					
Obs	servers: Lucas	05/13/15							
spe	sting cies nposition: <b>See de</b>	escription		Potential species Same as existin composition: species	g native				
R	iparian cover categories	Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition				
1. Overstory	Canopy layer	5%	1%	Ponderosa pine (Pinus	100% 0% 0% 0% 0% 0%				
					100%				
2. Understory	Shrub layer		1%	Willow (Salix sp.)	100% 0% 0% 0% 0% 0%				
-					100%				
level	Herbaceous		30%	Reed canary grass (Phalaris Downy brome (Bromus Bluegrass (Poa sp.) White clover (Trifolium Dandelion (Taraxacum Common mullein	25% 15% 15% 15% 15% 15%				
3. Ground level	Leaf or needle litter		10%	Remarks: Condition, vigor and/or usage of existing reach:	100%				
	Bare ground		58%	Density and potentially some species impacted by 2013 flood					
	ed on crown closure. ed on basal area to s	surface area.	Column Total = 100%						

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

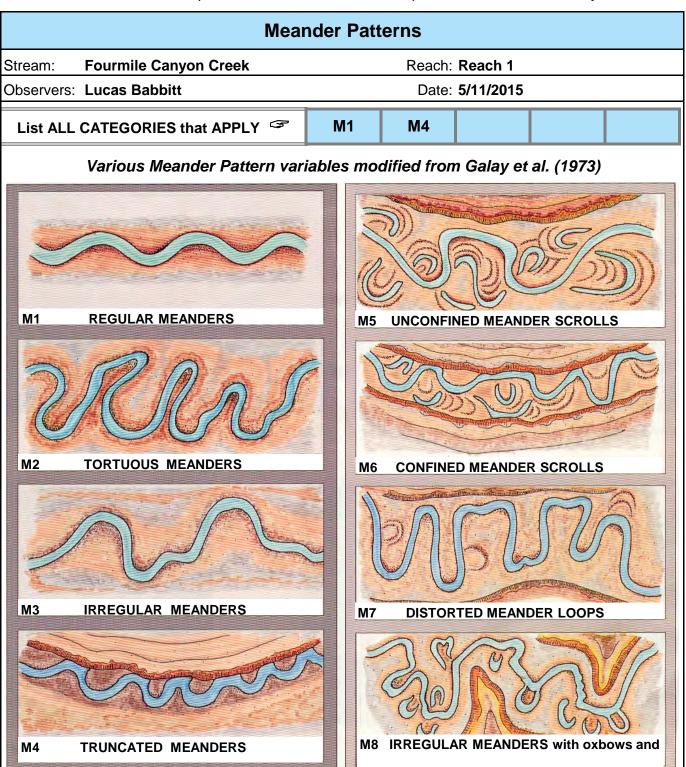
biological interpretations.						
FLOW REGIME						
Stream:	Fourmile Canyon Creek Location: Reach 1					
	Observers: Lucas Babbitt Date: 5/11/2015					
	List ALL COMBINATIONS that P 1 2 8					
APPLY						
General C	Category					
E	Ephemeral stream channels: Flows only in response to precipitation					
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.					
ı	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.					
Р	Perennial stream channels: Surface water persists yearlong.					
Specific Category						
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.					
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.					
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.					
4	Streamflow regulated by glacial melt.					
5	Ice flows/ice torrents from ice dam breaches.					
6	Alternating flow/backwater due to tidal influence.					
7	Regulated streamflow due to diversions, dam release, dewatering, etc.					
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.					
9	Rain-on-snow generated runoff.					

**Worksheet 3-3.** Stream order and stream size categories for stratification by stream type.

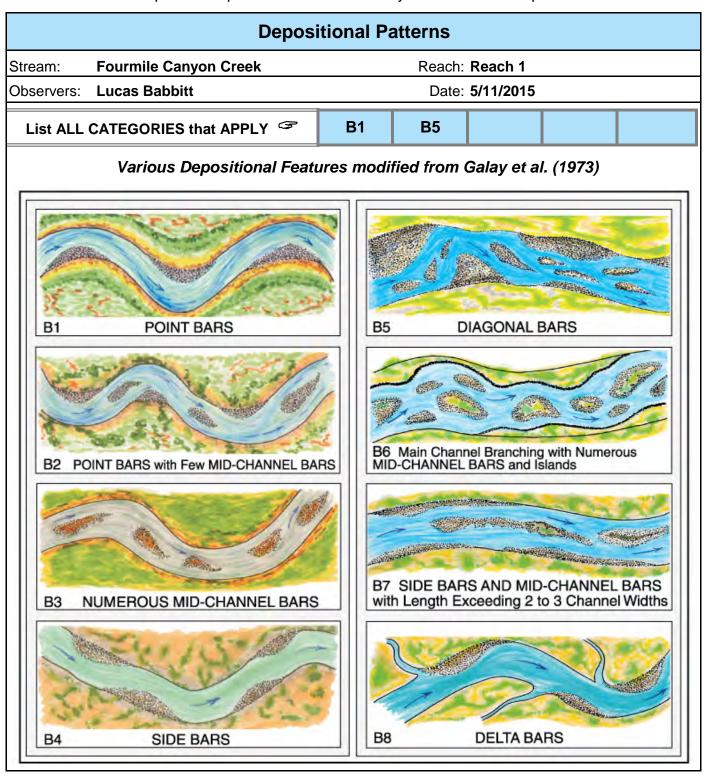
Stream Size and Order						
Stream: Fourmile Canyon Creek						
Location: Reach 1						
Observers: Lucas Babbitt						
Date:	5/11/2015					
Stream Size Category and Order S-4(2)						
Category		ZE: Bankfull dth	Check (✓) appropriate			
	meters	feet	category			
S-1	0.305	<1				
S-2	0.3 – 1.5	1 – 5				
S-3	1.5 – 4.6	5 – 15				
S-4	4.6 – 9	15 – 30	~			
S-5	9 – 15	30 – 50				
S-6	15 – 22.8	50 – 75				
S-7	22.8 - 30.5	75 – 100				
S-8	30.5 – 46	100 – 150				
S-9	46 – 76	150 – 250				
S-10	76 – 107	250 – 350				
S-11	107 – 150	350 – 500				
S-12	150 – 305	500 – 1000				
S-13	>305	>1000				
Stream Order						
Add categories in parenthesis for specific stream order of						

Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



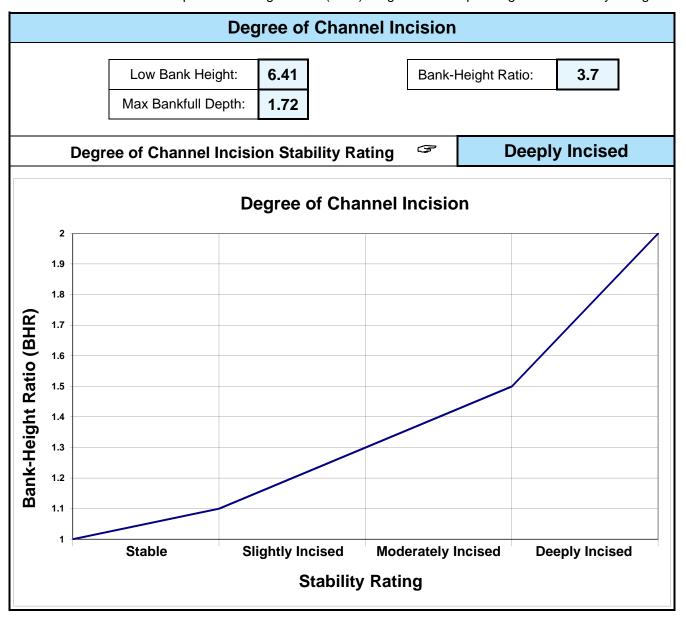
Worksheet 3-5. Depositional patterns used for stability assessment interpretations.



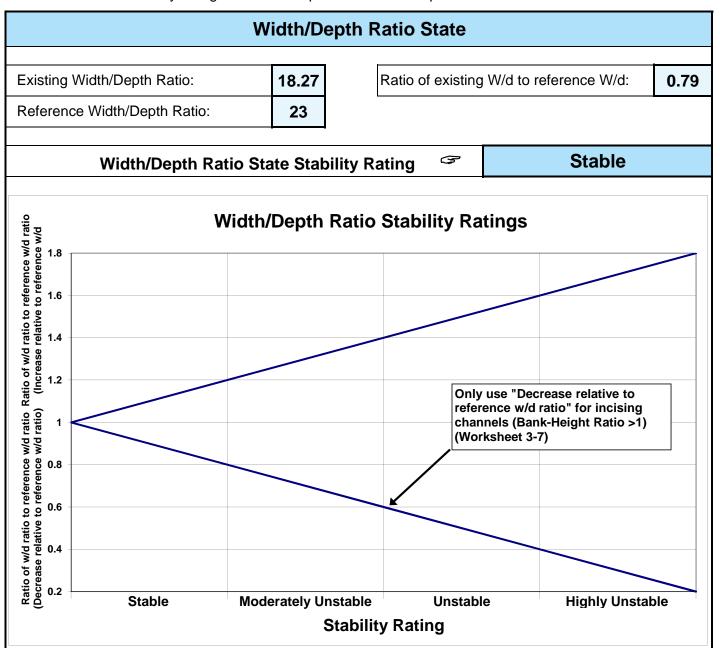
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

Channel Blockages							
Stream: Fourmile Canyon Creek Location: Reach 1							
Obser	Observers: Lucas Babbitt Date: 5/11/2015						
Description/extent		Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.					
D1	None	Minor amounts of small, floatable material.					
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.	•				
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.					
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.					
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.					
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.					
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.					
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.					
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.					
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	Y				

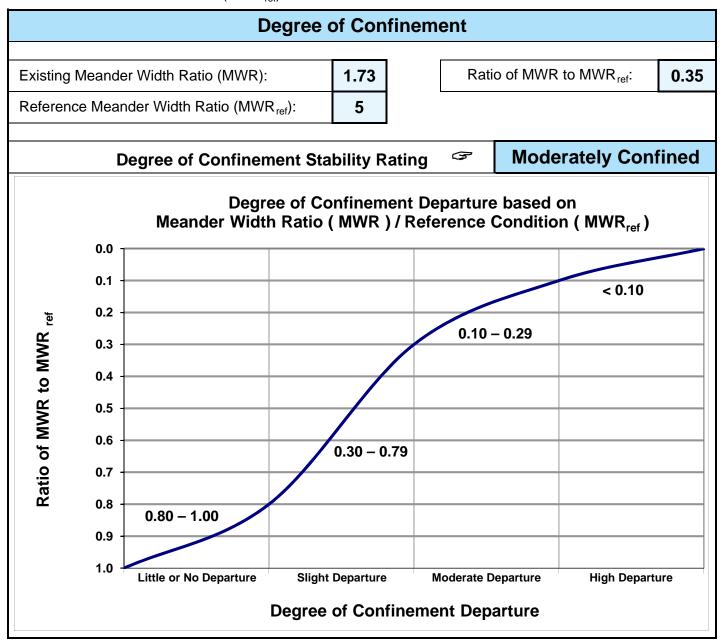
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	Stream Type:	C 4b				
Location:		Reach 1			Valley Type:	VIII				
Observers	s:	Lucas Bab	bitt		Date: <b>05/11/2015</b>					
Enter Re	equire	d Information	on for Existing Condition	on						
39.4	4	D 50	Median particle size of	riffle bed material (mn	า)					
0.0		<b>D</b> \$\hat{0}\$	Median particle size of	bar or sub-pavement	sample (mm	າ)				
0.85	i4	D <sub>max</sub>	Largest particle from b	oar sample (ft)	260.35	(mm)	304.8 mm/ft			
0.036	649	S	Existing bankfull water	surface slope (ft/ft)						
0.9	5	d	Existing bankfull mear	n depth (ft)						
1.6	5	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	vity of sediment						
Select th	пе Арр	ropriate Ec	quation and Calculate (	Critical Dimensionless	Shear Str	ess				
0.00	0	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>)</b> ^) -0.872			
6.60	0	$D_{\rm max}/D_{50}$	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>			
		τ*	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A			
Calculate	e Bank	full Mean D	epth Required for Entra	inment of Largest Par	ticle in Bar	Sample				
		d	Required bankfull mean	depth (ft) $d = \frac{\tau}{}$	$\frac{*(\gamma_s - 1)D_n}{S}$	use (use	D <sub>max</sub> in ft)			
Calculat	e Banl	kfull Water	Surface Slope Require				r Sample			
		s	Required bankfull water	surface slope (ft/ft) <b>S</b> =	$=\frac{\tau^*(\gamma_s-1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)			
		Check:	☐ Stable ☐ Aggradi	ng 🗹 Degrading						
Sedimen	nt Com	petence Us	sing Dimensional Shea	r Stress						
2.16	3		hear stress $\tau = \gamma dS$ (lbs/ft		dius, R, with	mean depth,	d )			
Shields	CO		d = existing depth, S = exis							
	268.1	Predicted I	largest moveable particle s	size (mm) at bankfull shea	ar stress τ (F	igure 3-11)				
3.181 2	co <b>2.078</b>	Predicted :	shear stress required to ini	tiate movement of measu	ıred $D_{\sf max}$ (mı	m) <b>(Figure 3</b>	-11)			
Shields	СО	Predicted i	mean depth required to init	tiate movement of measu	red $D_{\text{max}}$ (mr	n) <b>d</b> = 1	τ_			
	0.91		ted shear stress, $\gamma = 62.4$ ,			$\mathbf{d} = \frac{1}{2}$	<b>/S</b>			
Shields	CO		slope required to initiate m		<sub>max</sub> (mm)	$S = \frac{\tau}{1100}$				
0.0537	0.0351		ted shear stress, $\gamma = 62.4$ ,			γd				
		Check:	☐ Stable ☐ Aggradi	ng 🗹 Degrading						

**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type: C 4b
Location:	Reach 1	Valley Type: <b>VIII</b>
Observers:	Lucas Babbitt	Date: <b>05/11/2015</b>
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)
	eam Type at potential, $(C \rightarrow E)$ , ), $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	✓ Stable
(E→C),	(B→High W/d B), (C→High W/d C)	
(G <sub>c</sub>	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	☐ Unstable
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	☐ Highly Unstable

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Canyon Creek Stream Type: C 4b										
Location: Reach 1			Valley Ty	<sub>'pe:</sub> VIII						
Observers: Lucas Babbitt			Da	ate: <b>05/11/2015</b>						
Lateral stability criteria		Lateral Stability Categories								
(choose one stability category for each criterion 1–5)	Stable	Stanio i instanio i		Highly Unstable	Selected Points (from each row)					
W/d Ratio State 1 (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	2					
	(2)	(4)	(6)	(8)						
Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	В3	B5, B6, B7	4					
	(1)	(2)	(3)	(4)						
Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		1					
,	(1)		(3)							
Streambank Erosion: 4 Unit Rate (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07						
(Worksheet 3-13)	(2)	(4)	(6)	(8)						
Degree of Confinement 5 (MWR / MWR <sub>ref</sub> )	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	2					
(Worksheet 3-9)	(1)	(2)	(3)	(4)						
Total Points										
Lateral Stability Category Point Range										
Overall Lateral Stability Category (use total points and check stability rating)	Stable <10 ☑	Moderately Unstable 10 – 12 □	<i>Unstable</i> 13 – 21 □	Highly Unstable > 21 □						

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Stre	eam: Fourmile Can	yon Creek		Stream Type:	C 4b	
Loca	ation: Reach 1			Valley Type:	VIII	
Obs	ervers: Lucas Babbitt			Date:	05/11/2015	
	ertical Stability	Vertical Stabil	ity Categories fo	r Excess Deposition	n / Aggradation	Selected
sta	iteria (choose one ability category for ch criterion 1–6)	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	Points (from each row)
1	Sediment competence (Worksheet 3-14)	Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	2
		(2)	(4)	(6)	(8)	
	Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand	2
		(2)	(4)	(6)	(8)	
W/d Ratio State (Worksheet 3-8)		< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	2
		(2)	(4)	(6)	(8)	
4	Stream Succession States (Worksheet 3- 16)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{split} &(C \! \to \! High \ W\!/d \ C), \\ &(B \! \to \! High \ W\!/d \ B), \\ &(C \! \to \! F), \ (G_c \! \to \! F), \\ &(G \! \to \! F_b) \end{split} $	(C→D), (F→D)	2
		(2)	(4)	(6)	(8)	
5	Depositional Patterns (Worksheet	B1	B2, B4	B3, B5	B6, B7, B8	1
	3-5)	(1)	(2)	(3)	(4)	
l n	Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	4
		(1)	(2)	(3)	(4)	
					Total Points	13
		Vertical Stab		nt Range for Exce	ss Deposition /	
Ex Ag po	ertical Stability for ccess Deposition / ggradation (use total pints and check stability ting)	No Deposition < 15 ▽	Moderate Deposition 15 – 20 □	Excess Deposition 21 – 30	Aggradation > 30 □	

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream: Fourmile Canyon Creek Stream Type: C 4b									
Loc	cation: Reach 1			Valley Type:	VIII				
Ob	servers: Lucas Babbit	t		Date:	05/11/2015				
	ertical Stability	Vertical Stabil	ity Categories for	Channel Incision	n / Degradation	Selected			
Si	criteria (choose one tability category for ach criterion 1–5)	Not Incised	Slightly Incised	Moderately Incised	Degradation	Points (from each row)			
1	Sediment Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved	2			
		(2)	(4)	(6)	(8)				
2	Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	2			
		(2)	(4)	(6)	(8)				
3	Degree of Channel Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	8			
	(Worksheet 5-7)	(2)	(4)	(6)	(8)				
4	Stream Succession States (Worksheets 3-16 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$	2			
		(2)	(4)	(6)	(8)				
	Confinement (MWR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	2			
	(Worksheet 3-9)	(1)	(2)	(3)	(4)				
					Total Points	16			
		Vertical Stab	ility Category Poi Degra	nt Range for Cha Idation	nnel Incision /				
C D	Pertical Stability for Channel Incision/ Degradation (use total oints and check tability rating)	Not Incised < 12 □	Slightly Incised 12 – 18	Moderately Incised 19 – 27 □	Degradation > 27 □				

**Worksheet 3-20.** Channel enlargement prediction summary.

Stream: Fourmile Canyon Creek Stream Type: C 4b									
Lo	cation: Reach 1			Valley Type:	VIII				
Ob	servers: Lucas Babbitt			Date:	05/11/2015				
С	Channel Enlargement	Char	nel Enlargement	<b>Prediction Categ</b>	ories				
(c	Prediction Criteria choose one stability ategory for each criterion –4)	No Increase Slight Increase Increase		Extensive	Selected Points (from each row)				
1	Successional Stage Shift (Worksheet 3-16)	Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{l} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $	2			
		(2)	(4)	(6)	(8)				
2	Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	2			
		(2)	(4)	(6)	(8)				
3	Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	2			
	(Worksheet 3-18)	(2)	(4)	(6)	(8)				
4	Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation	4			
	(Worksheet 3-19)	(2)	(4)	(6)	(8)				
					Total Points	10			
Category Point Range									
P p	Channel Enlargement Prediction (use total oints and check stability ating)	No Increase < 11 ✓	Slight Increase 11 – 16	Moderate Increase 17 – 24	Extensive > 24 □				

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Str	eam: Fourmile Canyo	n Creek		Stream Type:	C 4b		
Lo	cation: Reach 1			Valley Type:	VIII		
Ob	servers:			Date:	05/11/2015		
P (d p	overall Sediment Supply rediction Criteria choose corresponding oints for each criterion –5)	Stability	y Rating	Points	Selected Points		
		Stable		1			
1	Lateral Stability	Mod. Unstal	ble	2	1		
<b>!</b> '	(Worksheet 3-17)	Unstable		3	•		
		Highly Unst	able	4			
	Vertical Stability	No Depositi	on	1			
2	<b>Excess Deposition or</b>	Mod. Depos	ition	2	1		
	Aggradation	Excess Dep	osition	3	•		
	(Worksheet 3-18)	Aggradation	1	4			
	Vertical Stability	Not Incised		1			
3	<b>Channel Incision or</b>	Slightly Inci	sed	2	2		
ľ	Degradation	Mod. Incise	d	3	2		
	(Worksheet 3-19)	Degradation	)	4			
	Channel Enlargement	No Increase	1	1			
4	Prediction (Worksheet	Slight Increase		2	1		
~	3-20)	Mod. Increa	se	3	•		
	0 20)	Extensive		4			
	Pfankuch Channel	Good: Stab	le	1			
5	Stability (Worksheet 3-	Fair: Mod. l	Jnstable	2	2		
ľ	10)						
	10)	Poor: Unsta	able	4			
				Total Points	7		
			Category P	oint Range			
R	overall Sediment Supply ating (use total points and check stability rating)	Low < 6 □	<i>Moderate</i> 6 – 10 ☑	<i>High</i> 11 – 15 □	Very High > 15 □		

Worksheet 3-22. Summary of stability condition categories.

	А	BCDEFGHIJK	LMNOPQRS	STUVWXYZ	AA AB AC AD AE AF A	GAH AI AJAK ALAM
1	Stream:	Fourmile Canyon Creek		Location: Reach 1		
2	Observers:	Lucas Babbitt	Date: 5/11/2015	Stream Type: C 4B	Valley Type: <b>\</b>	/III
3	Channel Dimension	Mean Bankfull 0.95 Bankfull W Depth (ft):	/idth 17.36 Cross-Secti	16 66	18.27 Entrench Ratio:	nment <b>5.89</b>
5	Channel Pattern	Kange.	10.00 - 10.00	1.90 - 2.07	1.32 - 1.32	Sinuosity: 1.1
7 8	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec): 5.8	Discharge (Q <sub>bkf</sub> ):	Estimation Method:	U/U^	Orainage Area (mi <sup>2</sup> ):
9		Check: ☑ Riffle/Pool ☐ Step/Po		Convergence/Divergence		
10	River Profile & Bed	Max Riffle Pool	Depth Ratio (max Riffle	Pool Pool-to- Ra	tio S	Slope
11 12	Features	Depth (ft): 1.79 1.8	to mean): 1.88	1.42 Pool Spacing: 74		Surrace:
13		Riparian Current Composition/D			rks: Condition, Vigor & Usaç	-
14		Vegetation See description		ng native speci Density a		
15		Flow P12 Stream Size	Meander	M1 M4 Depositional	B1 B5 Debris/C	1121111
16	_	Regime: 6 & Order:	Patterns:	Patterns:	Воскаде	es:
17	Level III Stream		Degree of Incision Dee		kuch Stability Rating	93 - Fair
18	Stability Indices		Stability Rating:		djective Rating):	
19 20		Width/depth Ratio (W/d): 18.27 Reference V Ratio (W/d <sub>ref</sub>	<sub>f</sub> ): 23 (W/d) / (	· · · · · · · · · · · · · · · · · · ·	Stability Rating:	Stable
21 22		Meander Width Ratio (MWR): Refe		of confinement MWR <sub>ref</sub> ):	MWR / MWR <sub>ref</sub> Stability Rating:	Stable
23	Bank Erosion	Length of Reach 0 Ann	ual Streambank Erosion R	tate: Curve Used:	Remarks:	
24	Summary	Studied (ft):	(tons/yr) <b>0</b> (	(tons/yr/ft)		
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity ☐ Insuffi	icient Capacity   🗆 Exce	ess Capacity Remar	ks:	
26 27	Entrainment/ Competence	Largest Particle from Bar Sample (mm):	au = 2.078	Existing Depth: 0.95 Require Depth:	ed <b>0.91</b> Existing Slope:	Required   ####   Slope:
28 29	Successional Stage Shift	c → c → -	<b>→</b>	Existing St State (Typ		ntial Stream e (Type):
30	Lateral Stability	Stable	table Unstable	☐ Highly Unstable	Remarks/causes:	
31	Vertical Stability (Aggradation)	▼ No Deposition □ Mod. Depo	osition 🔲 Ex. Deposition	n 🗖 Aggradation	Remarks/causes:	
32	Vertical Stability (Degradation)	☐ Not Incised ☑ Slightly Inc	cised Mod. Incised	☐ Degradation	Remarks/causes:	
33	Channel Enlargement	✓ No Increase ☐ Slight Increase	rease 🔲 Mod. Increase	e 🗆 Extensive	Remarks/causes:	
34 35	Sediment Supply (Channel Source)	-□ Low	☐ High ☐ Very	High Remarks/causes:		

#### RIVERMORPH PFANKUCH SUMMARY

River Name: Reach 2
Reach Name: Assesments
Survey Date: 05/13/2015

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## Upper Bank

Landform Slope: 8
Mass Wasting: 12
Debris Jam Potential: 6
Vegetative Protection: 12

### Lower Bank

Channel Capacity: 4
Bank Rock Content: 2
Obstructions to Flow: 8
Cutting: 12
Deposition: 16

#### Channel Bottom

Rock Angularity: 2
Brightness: 4
Consolidation of Particles: 4
Bottom Size Distribution: 12
Scouring and Deposition: 24
Aquatic Vegetation: 4

# Channel Stability Evaluation

Sediment Supply: High
Stream Bed Stability: Aggrading
W/D Condition: Very High
Stream Type: D4A

Stream Type: Rating - 130 Condition - Fair

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	Fourmile Canyon Creek, Reach - Reach 2		
Basin:	Drainage Area: 2860.8 acres	4.47	mi <sup>2</sup>
Location:			
Twp.&Rge:	; Sec.&Qtr.: ;		
Cross-Sect	ion Monuments (Lat./Long.): 40.05939 Lat / 105.3176 Long	Date:	05/11/15
Observers:	Lucas Babbitt	Valley Type:	VIII(b)
	Bankfull WIDTH (W <sub>bkf</sub> )		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	22.57	ft
	Bankfull DEPTH (d <sub>bkf</sub> )		1
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ( $d_{bkf} = A / W_{bkf}$ ).	0.71	ft
	Bankfull X-Section AREA (A <sub>bkf</sub> )		1
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	15.95	ft <sup>2</sup>
	Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )		1
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	31.79	ft/ft
	Maximum DEPTH (d <sub>mbkf</sub> )		1
	Maximum depth of the bankfull channel cross-section, or distance between the		
	bankfull stage and Thalweg elevations, in a riffle section.	1.42	ft
	WIDTH of Flood-Prone Area (W <sub>fpa</sub> )		
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area		
	WIDTH is determined in a riffle section.	34.39	ft
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH ( $W_{fpa}/W_{bkf}$ ) (riffle section).	1.52	f+/f+
	Time sectory.	1.32	ft/ft
	Channel Materials (Particle Size Index ) D <sub>50</sub>		
	The $D_{50}$ particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg		
	elevations.	23.19	mm
	Water Surface SLOPE (S)		1
	Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.04500	
		0.04583	ft/ft
	Channel SINUOSITY (k)		
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by		
	channel slope (VS / S).	1.16	
		-	]
	Stream D4a (See Figure 2-	14)	
	Type		

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	eam: Fourmile Canyon Creek					Location: Reach - Reach 2		
Ob	servers: Lucas Babbitt		Date:	05/11	/15	Valley Type: XIII Strea	m Type: <b>D</b>	4a
		Riv	er Rea	ch Dir	nens	sion Summary Data1		
	Riffle Dimensions*', ***, ***	Mean	Min	Max	i.	Riffle Dimensions & Dimensionless Ratios****		lin Max
* *	Riffle Width (W <sub>bkf</sub> )	22.6	22.6	22.6	1	Riffle Cross-Sectional Area (A <sub>bkf</sub> ) (ft²)		15.95
* * * *	Mean Riffle Depth (d <sub>bkf</sub> )	0.71	0.71	0.71	:	Riffle Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	<del>-</del>	.79 31.79
,suc	Maximum Riffle Depth (d <sub>max</sub> )	1.42	1.42	1.42	1	Max Riffle Depth to Mean Riffle Depth (d <sub>max</sub> / d <sub>bkf</sub> )		000 2.000
nsic	Width of Flood-Prone Area (W <sub>fpa</sub> )	34.4	34.4	34.4	ft	Entrenchment Ratio (W <sub>fpa</sub> / W <sub>bkf</sub> )		524 1.524
ime	Riffle Inner Berm Width (W <sub>ib</sub> )	0	0	0	ft	Riffle Inner Berm Width to Riffle Width (W <sub>ib</sub> / W <sub>bkf</sub> )	0.000 0.	0.000
Riffle Dimensions*,	Riffle Inner Berm Depth (d <sub>ib</sub> )	0	0	0	ft	Riffle Inner Berm Depth to Mean Depth (d <sub>ib</sub> / d <sub>bkf</sub> )	0.000 0.0	0.000
Riff	Riffle Inner Berm Area (A <sub>ib</sub> )	0	0	0	ft <sup>2</sup>	Riffle Inner Berm Area to Riffle Area (A <sub>ib</sub> / A <sub>bkf</sub> )	0.000 0.0	0.000
	Riffle Inner Berm W/D Ratio (W <sub>ib</sub> / d <sub>ib</sub> )	0	0	0				
	Pool Dimensions*' **' *** Pool Width (W <sub>bkfp</sub> )	Mean 28.4	Min 28.4	Max 28.4	ft	Pool Dimensions & Dimensionless Ratios****  Pool Width to Riffle Width (W <sub>bkfp</sub> / W <sub>bkf</sub> )		Min Max 257 1.257
* *	Mean Pool Depth (d <sub>bkfp</sub> )	0.55	0.55	0.55	<u> </u>	Mean Pool Depth to Mean Riffle Depth (d <sub>bkfp</sub> / d <sub>bkf</sub> )	1	775 0.775
Dimensions*, **, ***	Pool Cross-Sectional Area (A <sub>bkfp</sub> )	15.5	15.5	15.5	•	Pool Area to Riffle Area (A <sub>bkfp</sub> / A <sub>bkf</sub> )		973 0.973
ons	Maximum Pool Depth (d <sub>maxp</sub> )	1.15		<u> </u>	1	Max Pool Depth to Mean Riffle Depth (d <sub>maxp</sub> / d <sub>bkf</sub> )		620 1.620
ensi	Pool Inner Berm Width (W <sub>ibp</sub> )	0	0		ft	Pool Inner Berm Width to Pool Width (W <sub>ibp</sub> / W <sub>bkfp</sub> )		000 0.000
ğ	Pool Inner Berm Depth (d <sub>ibp</sub> )	0	0	0	ft	Pool Inner Berm Depth to Pool Depth (d <sub>ibp</sub> / d <sub>bkfp</sub> )		000 0.000
Pool	Pool Inner Berm Area (A <sub>ibp</sub> )	0	0	0	ft <sup>2</sup>	Pool Inner Berm Area to Pool Area (A <sub>ibp</sub> / A <sub>bkfp</sub> )		000 0.000
ا م	Point Bar Slope (S <sub>pb</sub> )		0.000			Pool Inner Berm Width/Depth Ratio (W <sub>ibp</sub> / d <sub>ibp</sub> )		000 0.000
	Tomic But Glope (Opb)	0.000	0.000	0.000	111/11	Tool filler Bellin Width/Beptil Ratio (Wipp/ Gipp)	0.000 0.	0.000
*-	Run Dimensions*	Mean 24	Min 24	Max 24	ft	Run Dimensionless Ratios****		Min Max
ions*	Run Width (W <sub>bkfr</sub> )	24	24	24	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	1.064 1.0	064 1.064
ensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )	0.99	24 0.99	24 0.99	ft	Run Width to Riffle Width ( $W_{bkfr} / W_{bkf}$ )  Mean Run Depth to Mean Riffle Depth ( $d_{bkfr} / d_{bkf}$ )	1.064 1.1 1.394 1.3	064 1.064 394 1.394
Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )	24 0.99 23.8	24 0.99 23.8	24 0.99 23.8	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	1.064 1.1 1.394 1.1 1.489 1.1	064     1.064       394     1.394       489     1.489
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )	24 0.99 23.8 1.58	24 0.99 23.8 1.58	24 0.99 23.8 1.58	ft ft	Run Width to Riffle Width ( $W_{bkfr} / W_{bkf}$ )  Mean Run Depth to Mean Riffle Depth ( $d_{bkfr} / d_{bkf}$ )	1.064 1.1 1.394 1.1 1.489 1.1	064 1.064 394 1.394
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )	24 0.99 23.8	24 0.99 23.8	24 0.99 23.8	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	1.064 1.1 1.394 1.1 1.489 1.1	064     1.064       394     1.394       489     1.489
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )	24 0.99 23.8 1.58 24.3	24 0.99 23.8 1.58 24.3	24 0.99 23.8 1.58 24.3	ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****	1.064 1.1 1.394 1.1 1.489 1.2 2.225 2.2 Mean M	064 1.064 394 1.394 489 1.489 225 2.225 //in Max
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9	24 0.99 23.8 1.58 24.3 Min 18.9	24 0.99 23.8 1.58 24.3 Max 18.9	ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	1.064 1.1 1.394 1.1 1.489 1.2 2.225 2.1 Mean M 0.838 0.0	064 1.064 394 1.394 489 1.489 225 2.225 Min Max 838 0.838
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9	24 0.99 23.8 1.58 24.3 Min 18.9	24 0.99 23.8 1.58 24.3 Max 18.9	ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	1.064 1.1 1.394 1.1 1.489 1.2 2.225 2.1  Mean N 0.838 0.1 1.451 1.1	064 1.064 394 1.394 489 1.489 225 2.225 1in Max 838 0.838 451 1.451
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03	24 0.99 23.8 1.58 24.3 Min 18.9 1.03	24 0.99 23.8 1.58 24.3 Max 18.9 1.03	ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )	1.064 1.1 1.394 1.1 1.489 1.2 2.225 2.1  Mean N 0.838 0.1 1.451 1.1 1.220 1.1	064   1.064 394   1.394 489   1.489 225   2.225 Min Max 838   0.838 451   1.451 220   1.220
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03 19.5	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5	24 0.99 23.8 1.58 24.3 Max 18.9 1.03 19.5 2.04	ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )	1.064 1.1 1.394 1.1 1.489 1.2 2.225 2.1  Mean N 0.838 0.1 1.451 1.1 1.220 1.1 2.873 2.6	064 1.064 394 1.394 489 1.489 225 2.225 1111 Max 838 0.838 451 1.451 220 1.220 873 2.873
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03 19.5 2.04	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5 2.04	24 0.99 23.8 1.58 24.3 Max 18.9 1.03 19.5 2.04	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )	1.064 1.1 1.394 1.1 1.489 1.1 2.225 2.1  Mean N 0.838 0.1 1.451 1.1 1.220 1.1 2.873 2.1 0.000 0.1	064 1.064 394 1.394 489 1.489 225 2.225 Min Max 838 0.838 451 1.451 220 1.220 873 2.873
Glide Dimensions* Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03 19.5 2.04 18.4	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5 2.04 18.4	24 0.99 23.8 1.58 24.3 Max 18.9 1.03 19.5 2.04 18.4	ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> /W <sub>bkfg</sub> )	Mean N 0.838 0.4 1.451 1.220 1.2873 2.873 2.6 0.000 0.	064 1.064 394 1.394 489 1.489 225 2.225 Min Max 838 0.838 451 1.451 220 1.220 873 2.873 000 0.000 000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>lbg</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03 19.5 2.04 18.4 0	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5 2.04 18.4 0	24 0.99 23.8 1.58 24.3 Max 18.9 1.03 19.5 2.04 18.4 0	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )	Mean N 0.838 0.4 1.220 1 2.873 2 0.000 0 0.000 0	064 1.064 394 1.394 489 1.489 225 2.225 Min Max 838 0.838 451 1.451 220 1.220 873 2.873 000 0.000 000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03 19.5 2.04 18.4	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5 2.04 18.4	24 0.99 23.8 1.58 24.3 Max 18.9 1.03 19.5 2.04 18.4 0	ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> /W <sub>bkfg</sub> )	Mean N 0.838 0.4 1.220 1 2.873 2 0.000 0 0.000 0	064 1.064 394 1.394 489 1.489 225 2.225 Min Max 838 0.838 451 1.451 220 1.220 873 2.873 000 0.000 000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>lbg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )	24 0.99 1.58 24.3 Mean 18.9 1.03 19.5 2.04 18.4 0	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5 2.04 18.4 0 0	24 0.99 1.58 24.3 Max 18.9 1.03 19.5 2.04 18.4 0 0	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>bkfg</sub> / A <sub>bkfg</sub> )	Mean N 0.838 0.4 1.220 1.2 2.873 2.4 0.000 0.4 0.000 0.4 Mean N	064   1.064 394   1.394 489   1.489 225   2.225 Min Max 838   0.838 451   1.451 220   1.220 873   2.873 000   0.000 000   0.000 000   0.000 000   0.000 Min Max
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03 19.5 2.04 18.4 0 0	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5 2.04 18.4 0 0	24 0.99 1.58 24.3 Max 18.9 1.03 19.5 2.04 18.4 0 0	ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / M <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	Mean N 0.838 0.4 1.451 1.220 1.2873 2.6 0.000 0.	064 1.064 394 1.394 489 1.489 225 2.225 Min Max 838 0.838 451 1.451 220 1.220 873 2.873 000 0.000 000 0.000 000 0.000 000 0.000 Min Max 000 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>bg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03 19.5 2.04 18.4 0 0 0 Mean 0	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5 2.04 18.4 0 0 0	24 0.99 1.58 24.3 Max 18.9 1.03 19.5 2.04 18.4 0 0 0 Max 0	ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	Mean N 0.838 0.0 1.451 1.220 1.1 2.873 2.1 0.000 0.0 0.000 0.0 Mean N 0.000 0.0 0.000 0.0 0.000 0.0 0.000 0.0	064   1.064 394   1.394 489   1.489 225   2.225 In Max 838   0.838 451   1.451 220   1.220 873   2.873 000   0.000 000   0.000 000   0.000 000   0.000 Min Max 000   0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )  Step Cross-Sectional Area (A <sub>bkfs</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03 19.5 2.04 0 0 0 Mean 0	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5 2.04 18.4 0 0 0	24 0.99 23.8 1.58 24.3 Max 18.9 1.03 19.5 2.04 0 0 0 Max 0 0	ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / W <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )  Step Area to Riffle Area (A <sub>bkfs</sub> / A <sub>bkf</sub> )	Mean N 0.838 0.4 1.451 1.4 2.873 2.4 0.000 0.4 0.000 0.4 0.000 0.4 0.000 0.4 0.000 0.4 0.000 0.4	064 1.064 394 1.394 489 1.489 225 2.225 Min Max 838 0.838 451 1.451 220 1.220 873 2.873 000 0.000 000 0.000 000 0.000 Min Max 000 0.000 000 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>bg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	24 0.99 23.8 1.58 24.3 Mean 18.9 1.03 19.5 2.04 18.4 0 0 0 Mean 0	24 0.99 23.8 1.58 24.3 Min 18.9 1.03 19.5 2.04 18.4 0 0 0	24 0.99 23.8 1.58 24.3 Max 18.9 1.03 19.5 2.04 0 0 0 Max 0 0	ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	Mean N 0.838 0.4 1.451 1.4 2.873 2.4 0.000 0.4 0.000 0.4 0.000 0.4 0.000 0.4 0.000 0.4 0.000 0.4	064   1.064 394   1.394 489   1.489 225   2.225 In Max 838   0.838 451   1.451 220   1.220 873   2.873 000   0.000 000   0.000 000   0.000 000   0.000 Min Max 000   0.000

<sup>\*</sup>Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

<sup>\*\*</sup>Step-Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

<sup>\*\*\*</sup>Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

<sup>\*\*\*\*</sup>Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	Stream: Fourmile Canyon Creek Location: Reach - Reach 2														
Ob	servers: Lucas Babbi	tt		Date:	05/11/	15		Valle	y Type:	XIII		Strea	n Type:	D4a	
S				Riv	er Reac	ch Sum	mary Da	ata	.2						
Hydraulics	Streamflow: Estimated	Mean Veloc	ty at Banl	vat Bankfull Stage (u <sub>bkf</sub> )  4.736 ft/sec Estimation Method			thod	i i	U/U*						
Ě	Streamflow: Estimated Discharge at Bankfull Stage			Q <sub>bkf</sub> )		75.5	39	cfs	Drainag	ge Area	ı	4.	47	mi <sup>2</sup>	
	Geometry	Mea	an Min	Max			Dimei	nsionl	ess Ge	ometry	Ratios		Mean	Min	Max
	Linear Wavelength (λ)	17		174	ft	Linear V	/aveleng						7.621		
	Stream Meander Lengtl	า (L <sub>m</sub> ) <b>18</b>	0 180	180	ft	Stream	Meander	Lengt	h Ratio	(L <sub>m</sub> /W	<sub>bkf</sub> )		7.975	7.975	7.975
tern	Radius of Curvature (Ro	.) 42	2 23	75	ft	Radius	of Curvat	ure to	Riffle V	Vidth (R	v / W <sub>bkf</sub> )		1.861	1.019	3.323
Pat	Belt Width (W <sub>blt</sub> )	3	23	43	ft	Meande	r Width F	Ratio (\	N <sub>blt</sub> / W	bkf)			1.551	1.019	1.905
Channel Pattern	Arc Length (L <sub>a</sub> )	0	0	0	ft	Arc Len	gth to Rif	fle Wid	dth (L <sub>a</sub> /	W <sub>bkf</sub> )			0.000	0.000	0.000
Cha	Riffle Length (L <sub>r</sub> )	10	1 4.72	14.4	ft	Riffle Le	ngth to R	Riffle W	/idth (L	r / W <sub>bkf</sub> )			0.447	0.209	0.638
	Individual Pool Length (	L <sub>p</sub> ) 12	9 10.5	15.1	ft	Individua	al Pool Le	ength t	to Riffle	: Width (	(L <sub>p</sub> / W <sub>b</sub>	<sub>kf</sub> )	0.570	0.464	0.669
	Pool to Pool Spacing (P	s) 15	6 95.5	216	ft	Pool to I	Pool Spa	cing to	Riffle	Width (F	P <sub>s</sub> /W <sub>bkf</sub>	:)	6.891	4.231	9.551
	Valley Slope (S <sub>val</sub> )	0.05333	ft/ft	Avera	ne Wate	r Surface	Slope (	S)	0.04	4583	ft/ft	Sinuosity (	S <sub>val</sub> / S)		1.16
	Stream Length (SL)	395	ft	<u> </u>	Length			- /			ft	Sinuosity (			1.06
	Low Bank Height	start 10	<b>3</b> ft		Max De	pth	start	1.66	ft			ht Ratio (B			6.22
	(LBH)	end <b>7.</b> 9			(d <sub>max</sub> )		-	1.66				H / d <sub>max</sub> )		end	4.81
	Facet Slopes	Mea	1	Max	1		imensior			•			Mean	Min	Max
	Riffle Slope (S <sub>rif</sub> )		30 0.035				ope to Av				<u> </u>	,		0.765	
lje Jije	Run Slope (S <sub>run</sub> )	-	0.051	<u>:                                    </u>	-		pe to Ave							1.114	
∏ F	Pool Slope (S <sub>p</sub> )		14 0.007				pe to Av							0.156	
Channel Profile	Glide Slope (S <sub>g</sub> )	0.0	0.042	0.088	ft/ft	Glide Sl	ope to Av	/erage	Water	Surface	Slope	(S <sub>g</sub> / S)	1.414	0.910	1.919
မြီ	Step Slope (S <sub>s</sub> )	0.0	0.000	0.000	ft/ft	Step Slo	pe to Av	erage	Water	Surface	Slope	(S <sub>s</sub> / S)	0.000	0.000	0.000
	Max Depths <sup>a</sup>	Mea		Max	la.	M D:66				th Ratio		/ -l . \	Mean	Min	Max
	Max Riffle Depth (d <sub>maxrif</sub>			1.6			le Depth							1.944	
	Max Run Depth (d <sub>maxrun</sub> )			2.23			Depth t							2.676	
	Max Pool Depth (d <sub>maxp</sub> )		3 1.38	1			ol Depth t							1.944	
	Max Glide Depth (d <sub>maxg</sub> )	1		<u> </u>			de Depth						<u>i                                      </u>	1.085	
	Max Step Depth (d <sub>maxs</sub> )	0	0	0	ft	Max Ste	p Depth	to iviea	an Rime	Depth	(a <sub>maxs</sub> /	O <sub>bkf</sub> )	0	0	0
		Reachb		fle <sup>c</sup>	E	Bar	- !		ich <sup>b</sup>	1	fle <sup>c</sup>	Bar	Protru	usion He	
SE SE	% Silt/Clay	0		0	1		D <sub>16</sub>		72	9.3		i	i		mm
Channel Materials	% Sand	18.1		11			D <sub>35</sub>		1.3	22		<u> </u>	<u> </u>		mm
Ma	% Gravel	53.33	<u> </u>	52	!		D <sub>50</sub>		.19	i	3	!	!		mm
lu ne	% Cobble	21.9	<u> </u>	24	i		D <sub>84</sub>		0.94	<u> </u>	0	i	i i		mm
မီ				3			D <sub>95</sub>		0.56	170		<u> </u>	<u> </u>		mm
	% Bedrock	0		0			D <sub>100</sub>	5′	12	36	62		İ		mm

<sup>&</sup>lt;sup>a</sup> Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

<sup>&</sup>lt;sup>b</sup> Composite sample of riffles and pools within the designated reach.

<sup>&</sup>lt;sup>c</sup> Active bed of a riffle.

<sup>&</sup>lt;sup>d</sup> Height of roughness feature above bed.

Worksheet 3-1. Riparian vegetation composition/density used for channel stability assessment.

			Riparian Ve	getation		
Stre	eam: <b>Fourm</b>	nile Canyon Cro	eek	Location: Reach 2		
Obs	servers: Lucas	Babbitt	Reference cimpacted reach Disturbed (impacted reach)			
spe	sting cies nposition: <b>See de</b>	escription		Potential species Same as existin composition: species	g native	
R	iparian cover categories	Percent aerial cover*	Percent of site coverage**	Species composition	Percent of total species composition	
1. Overstory	Canopy layer 25% 5%			Ponderosa pine (Pinus Douglas fir (Pseudotsuga	0% 0% 0% 0% 0% 0%	
2. Understory	Shrub layer		5%	Willow (Salix sp.) Mountain ninebark Lilac (Syringa	0% 0% 0% 0% 0% 0%	
					0% 0%	
evel	Herbaceous		80%	Downy brom (Bromus Bluegrass (Poa Sp.) Reed canarygrass (Phalaris White clover (Trifolium Dandelion (Taraxacum Common mullein	0% 0% 0% 0% 0%	
3. Ground level	Leaf or needle litter		5%	Remarks: Condition, vigor and/or usage of existing reach:	0%	
	Bare ground		5%	Density and potentially some species impacted by 2013 flood		
	ed on crown closure. ed on basal area to s	surface area.	Column Total = 100%			

Worksheet 3-14. Sediment competence calculation form to assess bed stability.

0.04583 S Existing bankfull water so 0.71 d Existing bankfull mean d	ffle bed material (mr ar or sub-pavement sample (ft) urface slope (ft/ft)	m)	05/11/2015				
Enter Required Information for Existing Condition  33.0 $D_{50}$ Median particle size of rif  0.0 $D_{50}$ Median particle size of background  0.781 $D_{max}$ Largest particle from bar  0.04583 S Existing bankfull water size  0.71 $d$ Existing bankfull mean $d$	ffle bed material (mr ar or sub-pavement sample (ft) urface slope (ft/ft)	n) sample (mm					
33.0 $D_{50}$ Median particle size of rife0.0 $D_{50}^{\uparrow}$ Median particle size of bard0.781 $D_{max}$ Largest particle from bard0.04583SExisting bankfull water states0.71 $d$ Existing bankfull mean d	ffle bed material (mr ar or sub-pavement sample (ft) urface slope (ft/ft)	sample (mm	1)				
<ul> <li>0.0 D          <sub>50</sub> Median particle size of bar one of the description of t</li></ul>	ar or sub-pavement sample (ft) urface slope (ft/ft)	sample (mm	1)				
<ul> <li>0.781 D<sub>max</sub> Largest particle from bar</li> <li>0.04583 S Existing bankfull water so</li> <li>0.71 d Existing bankfull mean d</li> </ul>	sample (ft) urface slope (ft/ft)	· `	1)				
0.04583SExisting bankfull water st0.71dExisting bankfull mean d	urface slope (ft/ft)	238.125	304.8				
0.71 d Existing bankfull mean d							
	anth (ft)	Existing bankfull water surface slope (ft/ft)					
1.65 $\gamma_s - \gamma/\gamma$ Immersed specific gravit	Existing bankfull mean depth (ft)						
	mmersed specific gravity of sediment						
Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress							
<b>0.00</b> $D_{50}/D_{50}^{\wedge}$ Range: 3-7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	) <sub>50</sub> ) -0.872			
7.22 $D_{\text{max}}/D_{50}$ Range: 1.3 – 3.0 Use EQUATION 2: $\tau^* = 0.0384 (D_{\text{max}}/D_{50})^{-1}$				<sub>50</sub> ) <sup>-0.887</sup>			
τ* Bankfull Dimensionless Shear Stress EQUATION USED: N/A							
Calculate Bankfull Mean Depth Required for Entrain	ment of Largest Par	ticle in Bar	Sample				
d Required bankfull mean de	pth (ft) $d = \frac{\tau}{2}$	$\frac{(*(\gamma_s-1)D_n)}{S}$	use (use	D <sub>max</sub> in ft)			
Calculate Bankfull Water Surface Slope Required	for Entrainment of	Largest Par	rticle in Baı	r Sample			
S Required bankfull water su	rface slope (ft/ft) S =	$=\frac{\mathcal{T}^*(\gamma_s-1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)			
Check: ☐ Stable ☐ Aggrading	Degrading						
Sediment Competence Using Dimensional Shear S	Stress						
2.031 Bankfull shear stress $\tau = \gamma dS$ (lbs/ft <sup>2</sup> ) ( $\gamma = 62.4$ , d = existing depth, S = existing	·	adius, R, with	mean depth,	d )			
Shields CO  163.1 255.9 Predicted largest moveable particle size		ar stress <b>τ (F</b>	igure 3-11)				
Shields CO 2.92 1.841 Predicted shear stress required to initial	Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)						
Shields CO Predicted mean depth required to initiat	e movement of measu	ured $D_{\sf max}$ (mr	n) d_ (	<u></u>			
<b>1.02 0.64</b> $\tau$ = predicted shear stress, $\gamma$ = 62.4, S =	existing slope		$\mathbf{d} = \frac{7}{2}$	<i>'</i> S			
	Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\mathbf{S} = \frac{\mathbf{T}}{\mathbf{T}}$						
<b>0.0659 0.0415</b> $\tau$ = predicted shear stress, $\gamma$ = 62.4, d =			$\gamma$ d				
Check: □ Stable □ Aggrading	Degrading						

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

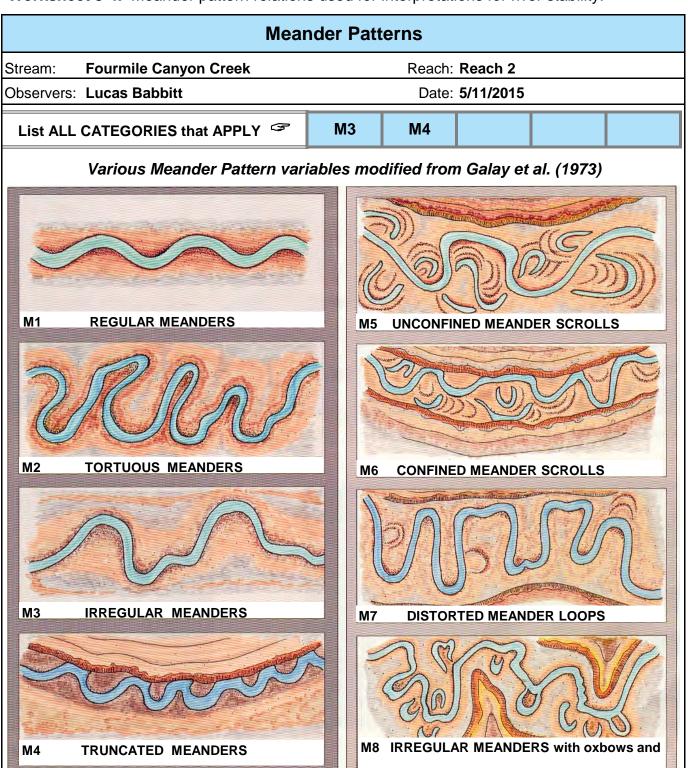
biological interpretations.					
	FLOW REGIME				
Stream:	Fourmile Canyon Creek Location: Reach 2				
	Lucas Babbitt Date: 5/11/2015				
	COMBINATIONS that P 1 2 8				
API	PLY				
General (	Category				
E Ephemeral stream channels: Flows only in response to precipitation					
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.				
ı	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.				
Р	Perennial stream channels: Surface water persists yearlong.				
Specific (	Category				
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.				
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.				
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.				
4	Streamflow regulated by glacial melt.				
5	Ice flows/ice torrents from ice dam breaches.				
6	Alternating flow/backwater due to tidal influence.				
7	Regulated streamflow due to diversions, dam release, dewatering, etc.				
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.				
9	Rain-on-snow generated runoff.				

Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

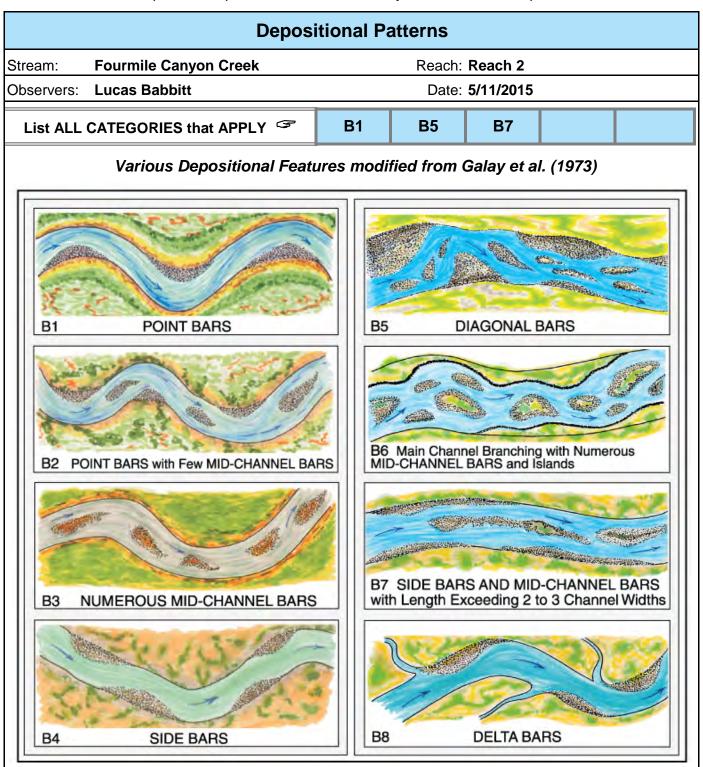
Stream Size and Order					
Stream:	Fourmile Cany	on Creek			
Location:	Location: Reach 2				
Observers:	Lucas Babbitt				
Date:	5/11/2015				
Stream Siz	Stream Size Category and Order S-4(2)				
STREAM SIZE: Bankfull Check (🗸) Category width appropriate					
	meters	feet	category		
S-1	0.305	<1			
S-2	0.3 – 1.5	1 – 5			
S-3	1.5 – 4.6	5 – 15			
S-4	4.6 – 9	15 – 30	>		
S-5	9 – 15	30 – 50			
S-6	15 – 22.8	50 – 75			
S-7	22.8 - 30.5	75 – 100			
S-8	30.5 – 46	100 – 150			
S-9	46 – 76	150 – 250			
S-10	76 – 107	250 – 350			
S-11	107 – 150	350 – 500			
S-12	150 – 305	500 – 1000			
S-13	>305	>1000			
	Strear	n Order			
Add categori	es in parenthesis	for specific strea	m order of		

Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



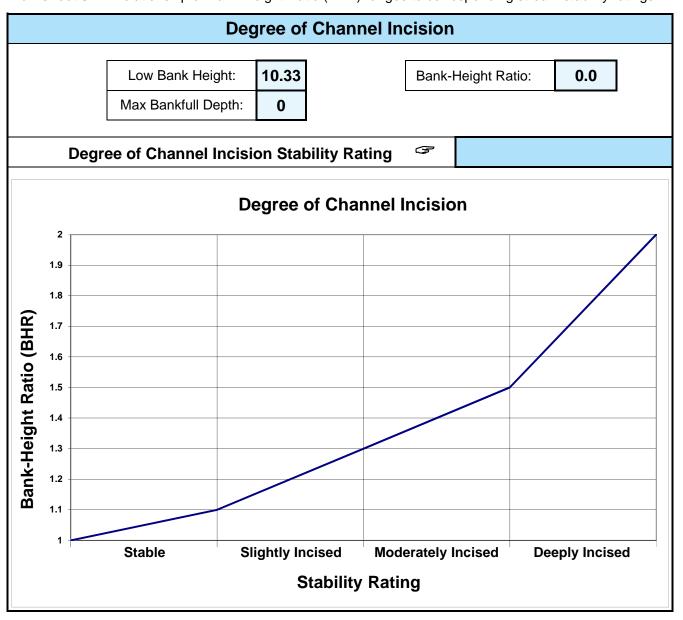
Worksheet 3-5. Depositional patterns used for stability assessment interpretations.



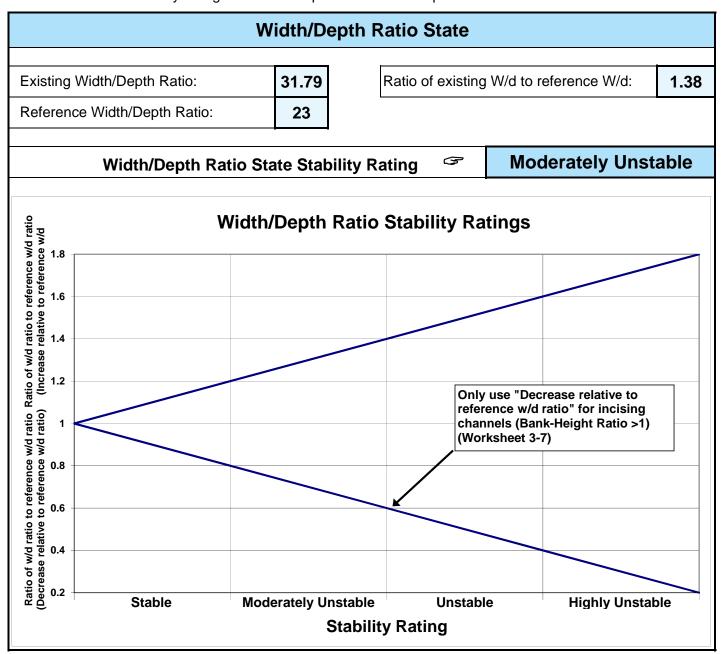
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

	Channel Blockages					
Stream	m: Fourmile C	anyon Creek Location: Reach 2				
Obser	rvers: Lucas Babl	bitt Date: 5/11/2015				
Desc	ription/extent	Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.	Check (√) all that apply			
D1	None	Minor amounts of small, floatable material.				
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.				
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.	~			
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.				
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.				
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.				
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.				
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.				
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.				
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.				

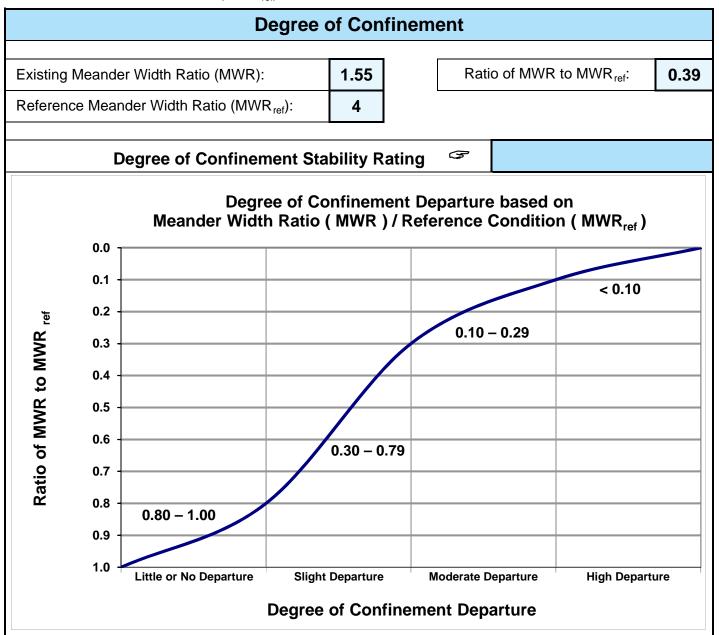
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type: <b>D4a</b>
Location:	Reach 2	Valley Type: <b>XIII</b>
Observers:	Lucas Babbitt	Date: <b>05/11/2015</b>
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)
	eam Type at potential, $(C \rightarrow E)$ , ), $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	☐ Stable
(E→C),	(B→High W/d B), (C→High W/d C)	
(G <sub>c</sub>	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	☐ Unstable
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	✓ Highly Unstable

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Canyor	Creek		Stream Ty	<sub>pe:</sub> <b>D4a</b>	
Location: Reach 2			Valley Ty	pe: XIII	
Observers: Lucas Babbitt			Da	ate: <b>05/11/2015</b>	
Lateral stability criteria		Lateral Stabilit	ty Categories		
(choose one stability category for each criterion 1–5)	Stable	Moderately Unstable	Unstable	Highly Unstable	Selected Points (from each row)
W/d Ratio State  1 (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	4
	(2)	(4)	(6)	(8)	
Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	В3	B5, B6, B7	4
	(1)	(2)	(3)	(4)	
Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		1
(WOINSHEEL 3-4)	(1)		(3)		
Streambank Erosion: 4 Unit Rate (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07	
(Worksheet 3-13)	(2)	(4)	(6)	(8)	
Degree of Confinement 5 (MWR / MWR <sub>ref</sub> )	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	
(Worksheet 3-9)	(1)	(2)	(3)	(4)	
				Total Points	9
	Late	eral Stability C	ategory Point Ra	ange	
Overall Lateral Stability Category (use total points and check stability rating)	<i>Stable</i> < 10 <b>▽</b>	Moderately Unstable 10 – 12 □	<i>Unstabl</i> e 13 – 21 □	Highly Unstable > 21 □	

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Str	eam: Fourmile Can	yon Creek		Stream Type:	D4a	
	cation: Reach 2			Valley Type:	XIII	
Ob	servers: Lucas Babbitt			Date:	05/11/2015	
٧	ertical Stability	Vertical Stabi	lity Categories fo	r Excess Deposition	on / Aggradation	Selected
S	riteria (choose one tability category for ach criterion 1–6)	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	Points (from each row)
1	Sediment competence (Worksheet 3-14)	Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	
	"	(2)	(4)	(6)	(8)	
2	Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand	
		(2)	(4)	(6)	(8)	
3	W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	4
		(2)	(4)	(6)	(8)	
4	Stream Succession States (Worksheet 3- 16)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{aligned} &(C \rightarrow High \ W/d \ C), \\ &(B \rightarrow High \ W/d \ B), \\ &(C \rightarrow F), \ (G_c \rightarrow F), \\ &(G \rightarrow F_b) \end{aligned} $	(C→D), (F→D)	
		(2)	(4)	(6)	(8)	
5	Depositional Patterns (Worksheet	B1	B2, B4	B3, B5	B6, B7, B8	1
	3-5)	(1)	(2)	(3)	(4)	
6	Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	1
		(1)	(2)	(3)	(4)	
Total Points				Total Points	6	
	Vertical Stability Category Point Range for Excess Deposition / Aggradation					
E A p	ertical Stability for xcess Deposition / ggradation (use total oints and check stability ating)	No Deposition < 15	Moderate Deposition 15 – 20 □	Excess Deposition 21 – 30	Aggradation > 30	

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream: Fourmile Ca	nyon Creek		Stream Type:	D4a	
Location: Reach 2			Valley Type:	XIII	
Observers: Lucas Babbi	tt		Date:	05/11/2015	
Vertical Stability	Vertical Stabil	ity Categories for	Channel Incision	n / Degradation	Selected
Criteria (choose one stability category for each criterion 1–5)	Not Incised	Slightly Incised	Moderately Incised	Degradation	Points (from each row)
Sediment 1 Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved	
	(2)	(4)	(6)	(8)	
Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	
	(2)	(4)	(6)	(8)	
Degree of Channel 3 Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	
(WOIKSHEEL 3-1)	(2)	(4)	(6)	(8)	
Stream Succession 4 States (Worksheets 3-16 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$	
	(2)	(4)	(6)	(8)	
Confinement 5 (MWR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	
(Worksheet 3-9)	(1)	(2)	(3)	(4)	
				Total Points	0
Vertical Stability Category Point Range for Channel Incision / Degradation					
Vertical Stability for Channel Incision/ Degradation (use total points and check stability rating)	Not Incised <12 □	Slightly Incised 12 – 18	Moderately Incised 19 – 27 □	Degradation > 27 □	

**Worksheet 3-20.** Channel enlargement prediction summary.

Str	Stream: Fourmile Canyon Creek Stream Type: D4a						
Lo	cation: Reach 2			Valley Type:	XIII		
Ob	servers: Lucas Babbitt			Date:	05/11/2015		
	Channel Enlargement	Char	Channel Enlargement Prediction Categories				
(d	Prediction Criteria choose one stability category for each criterion -4)	No Increase	Slight Increase	Moderate Increase	Extensive	Selected Points (from each row)	
1	Successional Stage Shift (Worksheet 3-16)	Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{c} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $		
		(2)	(4)	(6)	(8)		
2	Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	2	
		(2)	(4)	(6)	(8)		
3	Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation		
	(Worksheet 3-18)	(2)	(4)	(6)	(8)		
4	Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation		
	(Worksheet 3-19)	(2)	(4)	(6)	(8)		
Total Points 2					2		
Category Point Range							
P p	Channel Enlargement Prediction (use total points and check stability ating)	No Increase <11 □	Slight Increase 11 – 16	Moderate Increase 17 – 24	Extensive > 24 □		

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Str	eam: Fourmile Canyo	n Creek		Stream Type:	D4a	
Lo	cation: Reach 2			Valley Type:	XIII	
Ob	servers:			Date:	05/11/2015	
P (d p	verall Sediment Supply rediction Criteria choose corresponding oints for each criterion -5)	Stability Rating		Points	Selected Points	
		Stable		1		
1	Lateral Stability	Mod. Unstal	ble	2	1	
<b>!</b> '	(Worksheet 3-17)	Unstable		3	•	
		Highly Unst	able	4		
	Vertical Stability	No Depositi	on	1		
2	<b>Excess Deposition or</b>	Mod. Depos	ition	2		
	Aggradation	Excess Dep	osition	3		
	(Worksheet 3-18)	Aggradation	1	4		
	Vertical Stability	Not Incised		1		
3	<b>Channel Incision or</b>	Slightly Incised		2		
ľ	Degradation	Mod. Incise	Mod. Incised			
	(Worksheet 3-19)	Degradation	1	4		
	Channel Enlargement	No Increase		1		
4	Prediction (Worksheet	Slight Increa		2		
	3-20)	Mod. Increa	se	3		
	· /	Extensive		4		
	Pfankuch Channel	Good: Stab		1		
5	Stability (Worksheet 3-	Fair: Mod. (	Jnstable	2		
	10)	Poor: Unsta	ahlo	4		
		Poor. Orista	able	4		
	Total Points 1					
	Category Point Range					
R	everall Sediment Supply ating (use total points and check stability rating)	<i>Low</i> < 6 □	<i>Moderate</i> 6 – 10 □	<i>High</i> 11 – 15 □	Very High > 15 □	

Worksheet 3-22. Summary of stability condition categories.

	А	BCDEFGHIJK	L M N O P Q R	STUVWXY	Z AA AB AC AD AE AF	AGAH AI AJAKALAM
1	Stream:	Fourmile Canyon Creek		Location: Reach 2		
2	Observers:	Lucas Babbitt	Date: 5/11/2015	Stream Type: <b>D</b>		: XIII
3	Channel Dimension	Mean Bankfull 0.71 Bankfull \( \text{Depth (ft):} \)	77 57	1606	oth 31.79 Entrer Ratio:	nchment 1.52
5 6	Channel Pattern	Mean: λ/W <sub>bkf</sub> : <b>7.62 7.58 - 7.71</b>	L <sub>m</sub> /W <sub>bkf</sub> : 7.98 7.98 - 7.98	R <sub>c</sub> /W <sub>bkf</sub> : 1.86 1.02 - 3.32	MWR: <b>1.55</b> <b>1.02 - 1.91</b>	Sinuosity: 1.16
7	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec):	Discharge (Q <sub>bkf</sub> ):	75.539 Estimation Method:	U/U*	Drainage Area (mi²):
9		Check: ☐ Riffle/Pool ☐ Step/P		Convergence/Diverg		nes/Smooth Bed
10	River Profile & Bed	Max Riffle Pool	Depth Ratio (max Riffle		Ratio	Slope
11 12	Features	Bankfull 1.42 1.15 Depth (ft):	to mean): 2	2.09 Pool Spacing:	155.5 Valley: 0.053	; Surrace:
13		Riparian Current Composition			Remarks: Condition, Vigor & U	-
14		Vegetation See description		, , , , , , , , , , , , , , , , , , , ,	ty and potentially some	
15		Flow P12 Stream Size	S-4(2) Meander	M3 M4 Deposition	B1B6B/	c/Channel D3
16		Regime: 8 & Order:	Patterns:	Patterns:	Blocka	ages:
17	Level III Stream		Degree of Incision		Pfankuch Stability Rating	130 -
18	Stability Indices		Stability Rating:		& Adjective Rating):	
19		Width/depth 31.79 Reference		Depth Ratio State	1.38 W/d Ratio Sta	
20		Ratio (W/d): Ratio (W/d		(W/d <sub>ref</sub> ):	Stability Ratin	-
21 22		Ratio (MWR):	VR <sub>ref</sub> : 4 (MWR	e of confinement / MWR <sub>ref</sub> ):	0.3875 MWR / MWR / Stability Ratin	HIMNIV LINGTANIA
23	Bank Erosion		nual Streambank Erosion		ed: Remarks:	
24	Summary	Studied (ft): 0	(tons/yr) 0	(tons/yr/ft)		
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity ☐ Insu	fficient Capacity 🔲 Exc	cess Capacity Re	emarks: 	
26 27	Entrainment/ Competence	Largest Particle from <b>238.125</b> Bar Sample (mm):	$ au = 1.841  au^* = 0$		equired <b>0.64</b> Existing Slope:	#### Required Slope: ####
28	Successional Stage			Existin	ng Stream D4a Po	tential Stream
29	Shift		<b>—</b>	State (	(Type): D4a Sta	ate (Type):
30	Lateral Stability	Stable	stable Unstable	☐ Highly Unstable	Remarks/causes:	
31	Vertical Stability (Aggradation)	☐ No Deposition ☐ Mod. De	position 🔲 Ex. Depositi	on 🗌 Aggradation	Remarks/causes:	
32	Vertical Stability (Degradation)	☐ Not Incised ☐ Slightly I	Incised Mod. Incised	Degradation	Remarks/causes:	
33	Channel Enlargement	☐ No Increase ☐ Slight Inc	crease 🔲 Mod. Increas	se 🗆 Extensive	Remarks/causes:	
34 35	Sediment Supply (Channel Source)	Low   Moderat	te ☐ High ☐ Ver	y High Remarks/causes	:	

RIVERMORPH PFANKUCH SUMMARY River Name: Reach 3 Reach Name: Assesments Survey Date: 05/13/2015 Upper Bank Landform Slope: 6 Mass Wasting: Debris Jam Potential: Vegetative Protection: Lower Bank Channel Capacity: 2 4 Bank Rock Content: Obstructions to Flow: Cutting: Deposition: 8 Channel Bottom 2 4 Rock Angularity: Brightness: Consolidation of Particles: 4 8 Bottom Size Distribution: Scouring and Deposition: 12 Aquatic Vegetation:

Channel Stability Evaluation

Sediment Supply: Stream Bed Stability: Hi gh

W/D Condition: Normal Stream Type: F4B

Rating - 79 Condition - Good

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	Fourmile Canyon Creek, Reach - Reach 3		
Basin:	Drainage Area: 3148.8 acres	4.92	mi <sup>2</sup>
Location:			
Twp.&Rge:	; Sec.&Qtr.: ;		
Cross-Sect	ion Monuments (Lat./Long.): 40.05992 Lat / 105.31812 Long	Date	08/20/15
Observers:	Lucas Babbitt	Valley Type	: VIII(b)
	Bankfull WIDTH (W <sub>bkf</sub> )		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	20.86	ft
	Bankfull DEPTH (d <sub>bkf</sub> ) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ( $d_{bkf} = A / W_{bkf}$ ).	0.66	ft
	Bankfull X-Section AREA (A <sub>bkf</sub> )		
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	13.77	ft <sup>2</sup>
	Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )		
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	31.61	ft/ft
	Maximum DEPTH (d <sub>mbkf</sub> )		
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	1	ft
	WIDTH of Flood-Prone Area (W <sub>fpa</sub> )		
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	24.73	ft
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH ( $W_{fpa}/W_{bkf}$ ) (riffle section).	1.19	ft/ft
	Channel Materials (Particle Size Index ) D <sub>50</sub>		
	The $D_{50}$ particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg		
	elevations.	31.32	mm
	Water Surface SLOPE (S)		- 1
	Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient		
	at bankfull stage.	0.02886	ft/ft
	Channel SINUOSITY (k)		
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.25	
		1.23	<u> </u>
	Stream F 4b (See Figure 2-	.14)	
	Type (See Figure 2-	· <del></del> /	

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	ream: Fourmile Canyon Creek					Location: Reach - Reach 3							
Ob	servers: Lucas Babbitt		Date:	08/20	/15	Valley Type: XIII Strea	ım Type: <b>F 4b</b>						
		Riv	er Rea	ch Dir	mens	sion Summary Data1							
	Riffle Dimensions*, **, ***	Mean	Min	Max	i.	Riffle Dimensions & Dimensionless Ratios****	Mean Min	Max					
* *	Riffle Width (W <sub>bkf</sub> )	20.9	20.9	20.9		Riffle Cross-Sectional Area (A <sub>bkf</sub> ) (ft²)	13.77 13.77						
* * *	Mean Riffle Depth (d <sub>bkf</sub> )	0.66	0.66	0.66	_	Riffle Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	31.61 31.61						
suc*	Maximum Riffle Depth (d <sub>max</sub> )	1	1	1	ft	Max Riffle Depth to Mean Riffle Depth (d <sub>max</sub> / d <sub>bkf</sub> )	1.515 1.515						
Riffle Dimensions*	Width of Flood-Prone Area (W <sub>fpa</sub> )	24.7	24.7	24.7	<del>-</del>	Entrenchment Ratio (W <sub>fpa</sub> / W <sub>bkf</sub> )	1.186 1.186	1.186					
ime	Riffle Inner Berm Width (W <sub>ib</sub> )	14.2	14.2	14.2	ft	Riffle Inner Berm Width to Riffle Width (W <sub>ib</sub> / W <sub>bkf</sub> )	0.682 0.682						
le D	Riffle Inner Berm Depth (d <sub>ib</sub> )	0.13	0.13	0.13	ft	Riffle Inner Berm Depth to Mean Depth (d <sub>ib</sub> / d <sub>bkf</sub> ) 0.196 0.1							
R	Riffle Inner Berm Area (A <sub>ib</sub> )	1.84	1.84	1.84	ft <sup>2</sup>	Riffle Inner Berm Area to Riffle Area (A <sub>ib</sub> / A <sub>bkf</sub> )	0.134 0.134	0.134					
	Riffle Inner Berm W/D Ratio (W <sub>ib</sub> / d <sub>ib</sub> )	110	110	110									
	Pool Dimensions*' **' *** Pool Width (W <sub>bkfp</sub> )	Mean 15.6	Min 15.6	Max 15.6	ft	Pool Dimensions & Dimensionless Ratios****  Pool Width to Riffle Width (W <sub>bkfp</sub> / W <sub>bkf</sub> )	Mean Min	Max 0.748					
* *	Mean Pool Depth (d <sub>bkfp</sub> )	1.74	1.74	1.74	ft	Mean Pool Depth to Mean Riffle Depth (d <sub>bkfp</sub> / d <sub>bkf</sub> )	2.636 2.636	2.636					
* *	Pool Cross-Sectional Area (A <sub>bkfp</sub> )	27.2	27.2	27.2	ft	Pool Area to Riffle Area (A <sub>bkfp</sub> / A <sub>bkf</sub> )	1.972 1.972	1.972					
ions	Maximum Pool Depth (d <sub>maxp</sub> )	2.71	2.71	2.71	ft	Max Pool Depth to Mean Riffle Depth (d <sub>maxp</sub> / d <sub>bkf</sub> )	4.106 4.106	4.106					
Dimensions*, **, ***	Pool Inner Berm Width (W <sub>ibp</sub> )	0	0	0	ft	Pool Inner Berm Width to Pool Width (W <sub>ibp</sub> / W <sub>bkfp</sub> )	0.000 0.000	0.000					
Pi	Pool Inner Berm Depth (d <sub>ibp</sub> )	0	0	0	ft	Pool Inner Berm Depth to Pool Depth (d <sub>ibp</sub> / d <sub>bkfp</sub> )	0.000 0.000	0.000					
Pool	Pool Inner Berm Area (A <sub>ibp</sub> )	0	0	0	ft <sup>2</sup>	Pool Inner Berm Area to Pool Area (A <sub>ibp</sub> / A <sub>bkfp</sub> )	0.000 0.000	0.000					
$\  - \ $	Point Bar Slope (S <sub>pb</sub> )	0.000	0.000	0.000	ft/ft	Pool Inner Berm Width/Depth Ratio (W <sub>ibp</sub> / d <sub>ibp</sub> )	0.000 0.000	0.000					
	Run Dimensions*	Mean	Min	Max		Dun Dimonoionloso Detico****							
\( \script{\sinte\sint\sint\sint\sint\sint\sint\sint\sint							Mean Min	Max					
*s	Run Width (W <sub>bkfr</sub> )	12.2	Min 12.2	Max 12.2	ft	Run Dimensionless Ratios****  Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	Mean Min 0.587 0.587	Max 0.587					
sions*					•			0.587					
mensions*	Run Width (W <sub>bkfr</sub> )	12.2	12.2	12.2 1.72	•	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	0.587 0.587	0.587 2.606					
n Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )	12.2	12.2	12.2 1.72	ft ft	Run Width to Riffle Width ( $W_{bkfr} / W_{bkf}$ )  Mean Run Depth to Mean Riffle Depth ( $d_{bkfr} / d_{bkf}$ )	0.587     0.587       2.606     2.606	0.587 2.606 1.527					
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )	12.2 1.72 21	12.2 1.72 21 2.78	12.2 1.72 21	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	0.587     0.587       2.606     2.606       1.527     1.527	0.587 2.606 1.527					
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )	12.2 1.72 21 2.78 7.12	12.2 1.72 21 2.78 7.12	12.2 1.72 21 2.78 7.12	ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )	0.587 0.587 2.606 2.606 1.527 1.527 4.212 4.212	0.587 2.606 1.527 4.212					
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )	12.2 1.72 21 2.78	12.2 1.72 21 2.78	12.2 1.72 21 2.78 7.12 Max	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	0.587     0.587       2.606     2.606       1.527     1.527	0.587 2.606 1.527 4.212 Max					
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*	12.2 1.72 21 2.78 7.12 Mean	12.2 1.72 21 2.78 7.12 Min	12.2 1.72 21 2.78 7.12 Max	ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****	0.587 0.587 2.606 2.606 1.527 1.527 4.212 4.212  Mean Min	0.587 2.606 1.527 4.212 Max 0.000					
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0	12.2 1.72 21 2.78 7.12 Min 0	12.2 1.72 21 2.78 7.12 Max 0	ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	0.587 0.587 2.606 2.606 1.527 1.527 4.212 4.212  Mean Min 0.000 0.000	0.587 2.606 1.527 4.212 Max 0.000					
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0	12.2 1.72 21 2.78 7.12 Min 0	12.2 1.72 21 2.78 7.12 Max 0	ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	0.587   0.587   2.606   2.606   1.527   1.527   4.212   4.212   Mean   Min   0.000   0.000   0.000	0.587 2.606 1.527 4.212 Max 0.000 0.000					
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0	12.2 1.72 21 2.78 7.12 Min 0 0	12.2 1.72 21 2.78 7.12 Max 0 0	ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )	0.587   0.587	0.587 2.606 1.527 4.212 Max 0.000 0.000 0.000					
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0 0	12.2 1.72 21 2.78 7.12 Min 0 0	12.2 1.72 21 2.78 7.12 Max 0 0 0	ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )	0.587   0.587   2.606   2.606   1.527   1.527   4.212   4.212	0.587 2.606 1.527 4.212  Max 0.000 0.000 0.000 0.000					
Glide Dimensions* Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0 0	12.2 1.72 21 2.78 7.12 Min 0 0 0	12.2 1.72 21 2.78 7.12 Max 0 0 0	ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )	0.587   0.587	0.587 2.606 1.527 4.212  Max 0.000 0.000 0.000 0.000 0.000					
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0 0 0	12.2 1.72 21 2.78 7.12 Min 0 0 0 0	12.2 1.72 21 2.78 7.12 Max 0 0 0 0	ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> /W <sub>bkfg</sub> )	0.587   0.587	0.587 2.606 1.527 4.212  Max 0.000 0.000 0.000 0.000 0.000 0.000					
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Min 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Max 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>lbg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>lbg</sub> / d <sub>bkfg</sub> )	0.587   0.587     2.606   2.606     1.527   1.527     4.212	0.587 2.606 1.527 4.212  Max 0.000 0.000 0.000 0.000 0.000 0.000 0.000					
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0 0 0	12.2 1.72 21 2.78 7.12 Min 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Max 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )	0.587   0.587	0.587 2.606 1.527 4.212  Max 0.000 0.000 0.000 0.000 0.000 0.000 0.000 Max					
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Min 0 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Max 0 0 0 0 0 0 0 Max 0	ft ft ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>bkfg</sub> / A <sub>bkfg</sub> )	0.587   0.587     2.606   2.606     1.527   1.527     4.212	0.587 2.606 1.527 4.212  Max 0.000 0.000 0.000 0.000 0.000 0.000 0.000  0.000  Max 0.000					
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0 0 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Min 0 0 0 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Max 0 0 0 0 0 0 0 Max 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / M <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	0.587   0.587	0.587 2.606 1.527 4.212  Max 0.000 0.000 0.000 0.000 0.000 0.000  Max 0.000 0.000					
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0 0 0 0 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Min 0 0 0 0 0 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Max 0 0 0 0 0 0 0 0 0 0 0	ft  ft  ft  ft  ft  ft  ft  ft  ft  ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>lbg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>lbg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Step Depth to Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	0.587   0.587     2.606   2.606     1.527   1.527     4.212	0.587 2.606 1.527 4.212  Max 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000					
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )  Step Cross-Sectional Area (A <sub>bkfs</sub> )	12.2 1.72 21 2.78 7.12 Mean 0 0 0 0 0 0 0 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Min 0 0 0 0 0 0 0 0 0 0	12.2 1.72 21 2.78 7.12 Max 0 0 0 0 0 0 0 0 0 0 0 0	ft  ft  ft  ft  ft  ft  ft  ft  ft  ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / W <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )  Step Area to Riffle Area (A <sub>bkfs</sub> / A <sub>bkf</sub> )	0.587   0.587     2.606   2.606     1.527   1.527     4.212     4.212	0.587 2.606 1.527 4.212  Max 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000					

<sup>\*</sup>Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

<sup>\*\*</sup>Step-Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

<sup>\*\*\*</sup>Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

<sup>\*\*\*\*</sup>Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	Stream: Fourmile Canyon Creek Location: Reach - Reach 3															
Ob	Observers: Lucas Babbitt				Date: 08/20/15 Valley Type: XIII Stream							n Type:	F 4b			
S				Riv	er Reac	mary Data2				)						
Hydraulics	Streamflow: Estimated Mean Velocity			at Bankfull Stage (u <sub>bkf</sub> )			3.5	82	ft/sec	Estim	ation Me	thod	İ	U/U*		
Streamflow: Estimated Discharge at Ba			Bankfull Stage (Q <sub>bkf</sub> )				49.3	49.324 cfs Drainage Area				ı	4.	92	mi <sup>2</sup>	
	Geometry Mean				Min Max			Dimensionless Geometry Ratios					3	Mean	Min	Max
Channel Pattern	Linear Wavelength (λ)		244	121	367	ft	Linear V	√avelenç	gth to F	Riffle W	idth (λ	/ W <sub>bkf</sub> )		#####	5.801	####
	Stream Meander Lengt	th (L <sub>m</sub> )	154	154	154	ft	Stream	Meande	r Lengt	h Ratio	(L <sub>m</sub> /\	N <sub>bkf</sub> )		7.383	7.383	7.383
	Radius of Curvature (R	(c)	43	36	49	ft	Radius	of Curva	ture to	Riffle V	Vidth (	R <sub>c</sub> / W <sub>bkf</sub>		2.061	1.726	2.349
	Belt Width (W <sub>blt</sub> )	i	23	23	23	ft	Meande	r Width I	Ratio (\	W <sub>blt</sub> / W	bkf)			1.103	1.103	1.103
nne	Arc Length (L <sub>a</sub> )		0	0	0	ft	Arc Len	gth to Ri	ffle Wid	dth (L <sub>a</sub> /	W <sub>bkf</sub> )			0.000	0.000	0.000
Cha	Riffle Length (L <sub>r</sub> )	Riffle Length (L <sub>r</sub> ) 19.8			2.8 26.8 ft Riffle Length to					/idth (L	r/W <sub>bki</sub>	;)		0.948	0.612	1.284
	Individual Pool Length	(L <sub>p</sub> )	10.4	2.5	16.3	ft	Individua	al Pool L	ength	to Riffle	Width	n (L <sub>p</sub> / W <sub>I</sub>	okf)	0.500	0.120	0.781
	Pool to Pool Spacing (P <sub>s</sub> ) 355			355	355	ft	Pool to Pool Spacing to Riffle Width (P <sub>s</sub> / W <sub>bkf</sub> )						į)	#####	#####	####
	Valley Slope (S <sub>val</sub> )	0.03	36	ft/ft	Averac	ne Wate	r Surface	e Slope (	S)	0.02	2886	ft/ft	Sinuosity (	S <sub>val</sub> / S)		1.25
	Stream Length (SL)	579		ft	`	Length			/		57	ft	Sinuosity (			1.04
	Low Bank Height	start	6.01	ft		Max De	oth	start	1.2	ft	В	ank-Hei	ht Ratio (B	HR)	start	5.01
	(LBH)	i	4.17			(d <sub>max</sub> )			1.65	i e		(LBH / d <sub>max</sub> )				2.53
	Facet Slopes	-	Mean	Min	Max	<u> </u>		imensio			•		(0, (0)	Mean	Min	Max
	Riffle Slope (S <sub>rif</sub> )	-		0.041			Riffle Slo						,		1.430	
ofile	Run Slope (S <sub>run</sub> )	-		0.053			Run Slo							3.241		
Channel Profile	Pool Slope (S <sub>p</sub> )			0.008								e Slope	•	1	0.273	
anne	Glide Slope (S <sub>g</sub> )			0.003				•				ce Slope	. 5	0.363		·
ືຮີ	Step Slope (S <sub>s</sub> )	<u>i_</u>	i	0.000		ft/ft	Step Slo	<u> </u>				•	(S <sub>s</sub> / S)	<u> </u>	0.000	i
	Max Depths <sup>a</sup> Max Riffle Depth (d <sub>maxri</sub>		Mean 0.73	Min 0.7	Max 0.75	ft	Max Riff	Dimen le Depth					/ dhirt)	Mean	Min 1.061	Max 1.14
	Max Run Depth (d <sub>maxrur</sub>		0.92		1.1										1.121	
				· · · · · · · · · · · · · · · · · · ·				In Depth to Mean Riffle Depth $(d_{maxrun} / d_{bkf})$ ol Depth to Mean Riffle Depth $(d_{maxp} / d_{bkf})$							0.985	
	Max Glide Depth (d <sub>maxo</sub>		0.77		1.04		Max Glid								0.742	
1	Max Step Depth (d <sub>maxs</sub> )		0	0.43		i .								0	0.172	0
	% Silt/Clay	Reac 0.9			fle <sup>c</sup> )	<u>E</u>	Bar	D <sub>16</sub>		ich <sup>b</sup> 24	1	iffle <sup>c</sup> 7.36	Bar	Protru	ısion He	
als	% Sand	23.7			-	<u> </u>		1		.36	<u>.                                      </u>		İ	i i		mm
Channel Materials	% Gravel	44.56		6.93 55.45		i i				2.36 26.69 1.32 47.04		<u> </u>			mm	
∭ Se ∏	% Cobble	30.69		37.62		} 					<u> </u>		} 			mm
ann	% Boulder	0		0		<u>i</u> !				8.99     114.82       53.34     164.14			<u> </u>	! !		mm
ြင်	% Bedrock	0				: !					<u>.                                      </u>		<u> </u>	} }		mm
	70 Deditook		0				D <sub>100</sub> 256 256						İ			

a Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

<sup>&</sup>lt;sup>b</sup> Composite sample of riffles and pools within the designated reach.

<sup>&</sup>lt;sup>c</sup> Active bed of a riffle.

<sup>&</sup>lt;sup>d</sup> Height of roughness feature above bed.

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

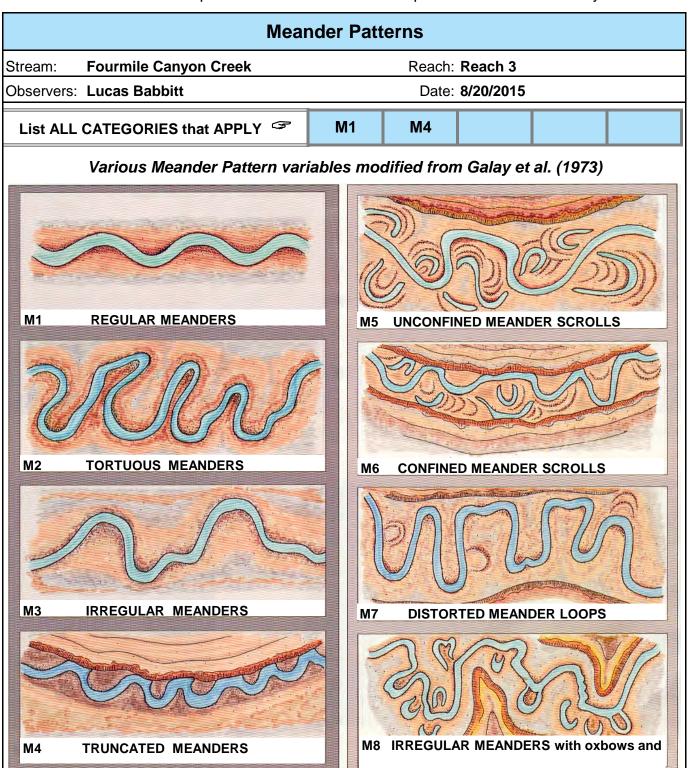
olological ilit	terpretations.						
FLOW REGIME							
Stream:	Fourmile Canyon Creek Location: Reach 3						
Observers:	Lucas Babbitt Date: 8/20/2015						
List ALL	COMBINATIONS that P 1 2 8						
API	PLY						
General C	Category						
E	Ephemeral stream channels: Flows only in response to precipitation						
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.						
ı	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.						
Р	Perennial stream channels: Surface water persists yearlong.						
Specific (	Category						
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.						
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.						
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.						
4	Streamflow regulated by glacial melt.						
5	Ice flows/ice torrents from ice dam breaches.						
6	Alternating flow/backwater due to tidal influence.						
7	Regulated streamflow due to diversions, dam release, dewatering, etc.						
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.						
9	Rain-on-snow generated runoff.						

Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

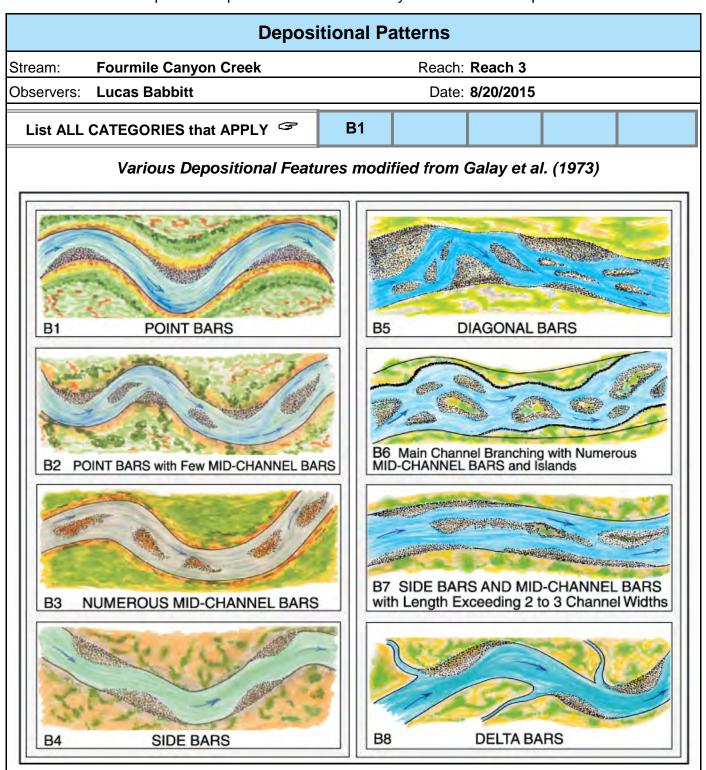
	Stream Size and Order					
Stream:	Fourmile Cany	on Creek				
Location:	Reach 3					
Observers:	Lucas Babbitt					
Date:	8/20/2015					
Stream Siz	e Category and	l Order 🤝	S-4(2)			
Category		ZE: Bankfull dth	Check (✓) appropriate			
	meters	feet	category			
S-1	0.305	<1				
S-2	0.3 – 1.5	1 – 5				
S-3	1.5 – 4.6	5 – 15				
S-4	4.6 – 9	15 – 30	>			
S-5	9 – 15	30 – 50				
S-6	15 – 22.8	50 – 75				
S-7	22.8 - 30.5	75 – 100				
S-8	30.5 – 46	100 – 150				
S-9	46 – 76	150 – 250				
S-10	76 – 107	250 – 350				
S-11	107 – 150	350 – 500				
S-12	150 – 305	500 – 1000				
S-13	>305	>1000				
Stream Order						
Add categories in parenthesis for specific stream order of						

Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



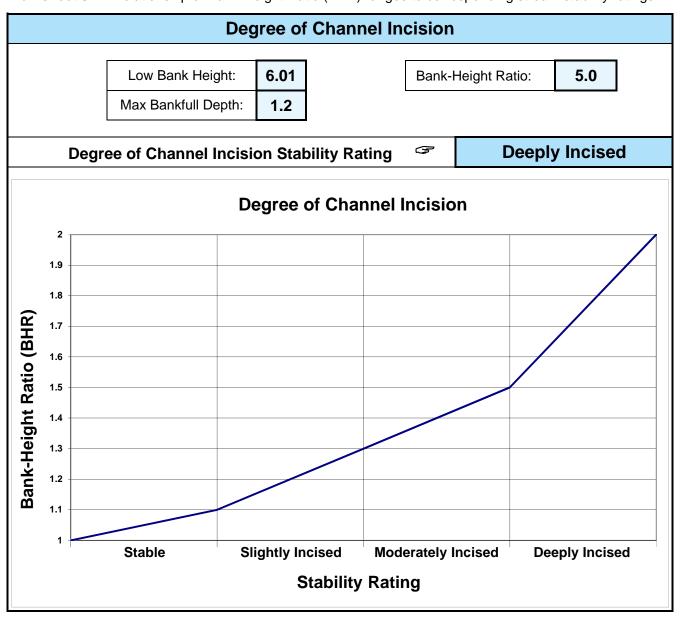
Worksheet 3-5. Depositional patterns used for stability assessment interpretations.



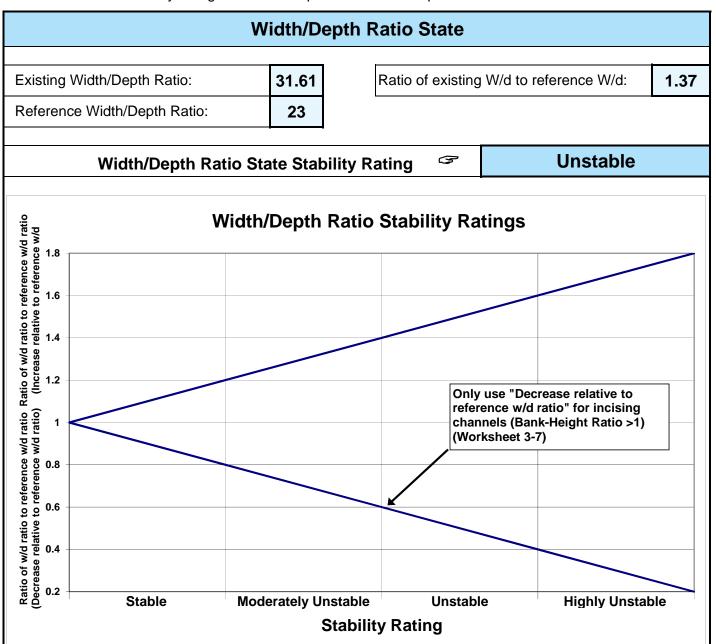
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

	Channel Blockages					
Stream		anyon Creek Location: Reach 3				
Obser	rvers: Lucas Babl	bitt Date: 8/20/2015				
Desc	ription/extent	Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.	Check (√) all that apply			
D1	None	Minor amounts of small, floatable material.				
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.	•			
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.				
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.				
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.				
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.				
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.				
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.				
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.				
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	Y			

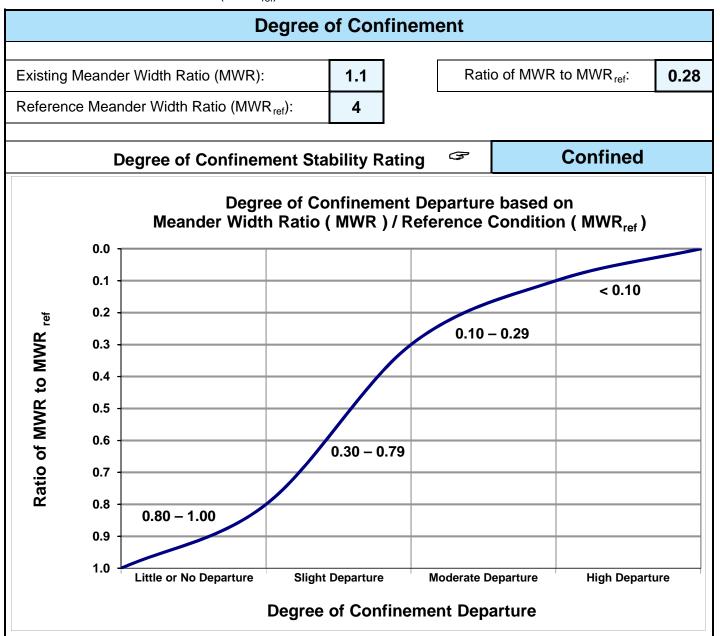
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	Stream Type:	F 4b	
Location	:	Reach 3			Valley Type:	XIII	
Observe	rs:	Lucas Bab	bitt		Date:	08/20/2015	<b>i</b>
Enter R	equire	d Information	on for Existing Conditi	on			
47	.0	D 50	Median particle size of	f riffle bed material (mm	n)		
0.	0	<b>D</b> ^	Median particle size of	f bar or sub-pavement	sample (mm	n)	
0.7	08	D <sub>max</sub>	Largest particle from b	oar sample (ft)	215.9	(mm)	304.8 mm/ft
0.02	886	S	Existing bankfull water	r surface slope (ft/ft)			
0.6	66	d	Existing bankfull mear	n depth (ft)			
1.6	65	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	vity of sediment			
Select t	he App	ropriate Ec	quation and Calculate (	Critical Dimensionless	Shear Str	ess	
0.0	00	$D_{50}/D_{50}^{\wedge}$	Range: 3-7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>L</b>	<b>)</b> ^) -0.872
4.5	59	$D_{\rm max}/D_{50}$	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>
		τ*	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A
Calcula	te Bank	full Mean D	epth Required for Entra	inment of Largest Part	ticle in Bar	Sample	
		d	Required bankfull mean	depth (ft) $d = \frac{\tau}{}$	$rac{*(\gamma_{ m s}-1)D_{ m m}}{{\sf S}}$	max — (use	D <sub>max</sub> in ft)
Calcula	ite Ban	kfull Water	Surface Slope Require				r Sample
		S	Required bankfull water	surface slope (ft/ft) <b>\$</b> =	$=\frac{\tau^*(\gamma_s-1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)
		Check:	☐ Stable ☑ Aggradi	ing   Degrading			
Sedime	nt Com	petence U	sing Dimensional Shea	r Stress			
1.1	89		hear stress $\tau = \gamma dS$ (lbs/ft	•	dius, R, with	mean depth,	d)
Shields	СО		d = existing depth, S = exis				
93.34	172.6	Predicted I	largest moveable particle s	size (mm) at bankfull shea	ar stress τ (F	igure 3-11)	
Shields <b>2.658</b>	co <b>1.611</b>	Predicted :	shear stress required to ini	itiate movement of measu	ured $D_{max}$ (m	m) <b>(Figure 3</b>	-11)
Shields	СО	Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm)					
1.48	0.89	•	Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted shear stress}, \ \gamma = 62.4, \ S = \text{existing slope}$				
Shields	СО	Predicted	slope required to initiate m	ovement of measured D <sub>r</sub>	<sub>nax</sub> (mm)	$S = \frac{\tau}{}$	
0.0645	0.0391	$\tau$ = predict	ted shear stress, $\gamma = 62.4$ ,	d = existing depth		$\gamma$ d	
		Check:	☐ Stable ☑ Aggradi	ing   Degrading			

**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type: <b>F 4b</b>
Location:	Reach 3	Valley Type: <b>XIII</b>
Observers:	Lucas Babbitt	Date: 08/20/2015
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)
	eam Type at potential, $(C \rightarrow E)$ , $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	☐ Stable
(E→C),	(B→High W/d B), (C→High W/d C)	
(G	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	✓ Unstable
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	☐ Highly Unstable

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Canyon Creek Stream Type: F 4b							
Location: Reach 3	Location: Reach 3 Valley Type: XIII						
Observers: Lucas Babbitt Date: 08/20/2015							
Lateral stability criteria		Lateral Stabilit	ty Categories				
(choose one stability category for each criterion 1–5)	Stable	Moderately Unstable	Unstable	Highly Unstable	Selected Points (from each row)		
W/d Ratio State  1 (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	6		
,	(2)	(4)	(6)	(8)			
Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	В3	B5, B6, B7	1		
	(1)	(2)	(3)	(4)			
Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		1		
,	(1)		(3)				
Streambank Erosion: 4 Unit Rate (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07			
(Worksheet 3-13)	(2)	(4)	(6)	(8)			
Degree of Confinement 5 (MWR / MWR <sub>ref</sub> )	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	3		
(Worksheet 3-9)	(1)	(2)	(3)	(4)			
Total Points							
Lateral Stability Category Point Range							
Overall Lateral Stability Category (use total points and check stability rating)	Stable <10 □	Moderately Unstable 10 – 12 ✓	<i>Unstable</i> 13 – 21 □	Highly Unstable > 21 □			

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Stream: Fourmile Canyon Creek Stream Type: F 4b							
Location: Reach 3 Valley Type: XIII							
Observers: Lucas Babbitt Date: 08/20/2015							
Vertical Stability	Vertical Stabi	lity Categories fo	r Excess Deposition	n / Aggradation	Selected		
Criteria (choose one stability category for each criterion 1–6)	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	Points (from each row)		
Sediment 1 competence (Worksheet 3-14)	Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	6		
	(2)	(4)	(6)	(8)			
Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand			
	(2)	(4)	(6)	(8)			
W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	6		
	(2)	(4)	(6)	(8)			
Stream Succession 4 States (Worksheet 3- 16)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{split} &(C \! \to \! High \ W\!/d \ C), \\ &(B \! \to \! High \ W\!/d \ B), \\ &(C \! \to \! F), \ (G_c \! \to \! F), \\ &(G \! \to \! F_b) \end{split} $	(C→D), (F→D)	6		
	(2)	(4)	(6)	(8)			
Depositional 5 Patterns (Worksheet	B1	B2, B4	B3, B5	B6, B7, B8	1		
3-5)	(1)	(2)	(3)	(4)			
Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	4		
•	(1)	(2)	(3)	(4)			
				Total Points	23		
	Vertical Stab		nt Range for Exce	ss Deposition /			
Vertical Stability for Excess Deposition / Aggradation (use total points and check stability rating)	No Deposition < 15	Moderate Deposition 15 – 20 □	Excess Deposition 21 – 30	Aggradation > 30 □			

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream: Fourmile Canyon Creek Stream Type: F 4b						
Location: Reach 3 Valley Type: XIII						
Observers: Lucas Babbi	tt		Date:	08/20/2015		
Vertical Stability	Vertical Stabil	ity Categories for	Channel Incision	n / Degradation	Selected	
Criteria (choose one stability category for each criterion 1–5)	Not Incised	Slightly Incised	Moderately Incised	Degradation	Points (from each row)	
Sediment 1 Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved	2	
	(2)	(4)	(6)	(8)		
Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load		
	(2)	(4)	(6)	(8)		
Degree of Channel 3 Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	8	
(WOINSHEET 3-1)	(2)	(4)	(6)	(8)		
Stream Succession 4 States (Worksheets 3-16 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$	2	
	(2)	(4)	(6)	(8)		
Confinement 5 (MWR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 - 0.79	0.10 - 0.29	< 0.10	3	
(Worksheet 3-9)	(1)	(2)	(3)	(4)		
	Total Points					
Vertical Stability Category Point Range for Channel Incision / Degradation						
Vertical Stability for Channel Incision/ Degradation (use total points and check stability rating)	Not Incised < 12 □	Slightly Incised 12 – 18 ✓	Moderately Incised 19 – 27 □	Degradation > 27 □		

**Worksheet 3-20.** Channel enlargement prediction summary.

Stream: Fourmile Canyon Creek Stream Type: F 4b						
Lo	cation: Reach 3			Valley Type:	XIII	
Observers: Lucas Babbitt Date: 08/20/2015						
С	Channel Enlargement	Char	nel Enlargement	<b>Prediction Categ</b>	ories	
(d	Prediction Criteria choose one stability ategory for each criterion –4)	No Increase	Slight Increase	Moderate Increase	Extensive	Selected Points (from each row)
1	Successional Stage Shift (Worksheet 3-16)	Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{c} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $	8
		(2)	(4)	(6)	(8)	
2	Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	4
		(2)	(4)	(6)	(8)	
3	Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	6
	(Worksheet 3-18)	(2)	(4)	(6)	(8)	
4	Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation	4
	(Worksheet 3-19)	(2)	(4)	(6)	(8)	
	Total Points					
	Category Point Range					
P p	Channel Enlargement Prediction (use total oints and check stability ating)	No Increase < 11	Slight Increase 11 – 16	Moderate Increase 17 – 24 ☑	Extensive > 24 □	

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Str	Stream: Fourmile Canyon Creek Stream Type:					
Loc	cation: Reach 3	Valley Type:	XIII			
Ob	Observers: Date:					
Overall Sediment Supply Prediction Criteria (choose corresponding points for each criterion 1–5)		Stability Rating		Points	Selected Points	
		Stable		1		
1	Lateral Stability	Mod. Unstal	ble	2	2	
Ι'	(Worksheet 3-17)	Unstable		3	2	
		Highly Unst	able	4		
	Vertical Stability	No Depositi	on	1		
2	<b>Excess Deposition or</b>	Mod. Depos	ition	2	3	
-	Aggradation	Excess Dep	osition	3	3	
	(Worksheet 3-18)	Aggradation	1	4		
	Vertical Stability	Not Incised		1		
3	<b>Channel Incision or</b>	Slightly Inci	sed	2	2	
١	Degradation	Mod. Incise	d	3	2	
	(Worksheet 3-19)	Degradation	1	4		
	Channel Enlargement	No Increase	)	1		
4	Prediction (Worksheet	Slight Increa		2	3	
	3-20)	Mod. Increa	se	3	· ·	
	<i></i>	Extensive		4		
	Pfankuch Channel	Good: Stab		1		
5	Stability (Worksheet 3-	Fair: Mod. (	Jnstable	2	2	
	10)				_	
		Poor: Unsta	able	4		
				Total Points	12	
			Category P	oint Range		
R	overall Sediment Supply ating (use total points and check stability rating)	<i>Low</i> < 6 □	<i>Moderate</i> 6 – 10 □	<i>High</i> 11 – 15 <b>▽</b>	Very High > 15 □	

Worksheet 3-22. Summary of stability condition categories.

	А	BCDEFGHIJK	L M N O P Q R	STUVWXYZ	AA AB AC AD AE AF	AGAH AI AJAK ALAM
1	Stream:	Fourmile Canyon Creek		Location: Reach 3		
2	Observers:	Lucas Babbitt	Date: 8/20/2015	Stream Type: F 4B	Valley Type:	XIII
3	Channel Dimension	Mean Bankfull 0.66 Bankfull (ft)	70 X6	19 77	31.61 Entrend Ratio:	chment 1.19
5 6	Channel Pattern	Mean: λ/W <sub>bkf</sub> : 11.7 5.80 - 17.59		R <sub>c</sub> /W <sub>bkf</sub> : 2.06 M	WR: <b>1.1</b> 1.10 - 1.10	Sinuosity: 1.25
7	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec):  3.58	Discharge (Q <sub>bkf</sub> ):	49.324 Estimation Method:		Drainage Area (mi²):
9		Check: ☐ Riffle/Pool ☐ Step/F		Convergence/Divergence		nes/Smooth Bed
10	River Profile & Bed	Max Riffle Pool	Depth Ratio (max Riffle		tio	Slope
11 12	Features	Bankfull 1 2.71 Depth (ft):	to mean): 1.52	Spacing:		Surrace:
13		Riparian Current Composition			rks: Condition, Vigor & Us	-
14		Vegetation See description		ting native speci Density a		
15		Flow P12 Stream Size	S-4(2) Meander	M1 M4 Depositional	R1 I	Channel D2 D10
16		Regime: 8 & Order:	Patterns:	Patterns:	Blocka	ges:
17	Level III Stream	Degree of Incision 5.01	Degree of Incision De		kuch Stability Rating	79 -
18	Stability Indices	(Bank-Height Ratio):	Stability Rating:	(Numeric & Ac	djective Rating):	
19 20		Width/depth Ratio (W/d): 31.61 Reference		Depth Ratio State (W/d <sub>ref</sub> ):	Stability Rating	g: Unstable
21 22				e of confinement / MWR <sub>ref</sub> ):	75 MWR / MWR <sub>re</sub> Stability Rating	I INSTANIA I
23	Bank Erosion	Length of Reach 0 Ar	nnual Streambank Erosion	Rate: Curve Used:	Remarks:	
24	Summary	Studied (ft):	(tons/yr) <b>0</b>	(tons/yr/ft)		
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity ☐ Insu	ufficient Capacity 🔲 Exc	cess Capacity Remar	ks:	
26 27	Entrainment/ Competence	Largest Particle from <b>215.9</b> Bar Sample (mm):	$ au = 1.611  ag{7}= 0$	Existing Depth: 0.66 Require Depth:	ed <b>0.89</b> Existing Slope:	#### Required Slope: ####
28 29	Successional Stage Shift	<b>→ →</b>	<b>→ →</b>	Existing St	E // D	ential Stream ite (Type):
30	Lateral Stability	☐ Stable ☑ Mod. Un	nstable 🗀 Unstable	☐ Highly Unstable	Remarks/causes:	
31	Vertical Stability (Aggradation)	☐ No Deposition ☐ Mod. De	eposition 🔽 Ex. Depositi	on 🗌 Aggradation	Remarks/causes:	
32	Vertical Stability (Degradation)	☐ Not Incised ☑ Slightly	Incised Mod. Incised	Degradation	Remarks/causes:	
33	Channel Enlargement	☐ No Increase ☐ Slight In	ocrease 🔽 Mod. Increas	se 🗆 Extensive	Remarks/causes:	
34 35	Sediment Supply (Channel Source)	Low Modera	te ☑ High ☐ Ver	y High Remarks/causes:		

RIVERMORPH PFANKUCH SUMMARY River Name: Reach 4 Reach Name: Assesments Survey Date: 05/13/2015 Upper Bank Landform Slope: 6 Mass Wasting: Debris Jam Potential: Vegetative Protection: Lower Bank Channel Capacity: Bank Rock Content: Obstructions to Flow: Cutting: Deposition: Channel Bottom 2 4 Rock Angularity: Brightness: Consolidation of Particles: 4 8 Bottom Size Distribution: Scouring and Deposition: 12 Aquatic Vegetation: Channel Stability Evaluation Sediment Supply: Stream Bed Stability: Hi gh W/D Condition:

**B4** 

Stream Type:

Rating - 80 Condition - Fair

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfull VELOCITY & DISCHARGE Estimates							
Stream: Fourmile Canyon Creek Location:			Location:	Reach - F	Reach 4			
Date:	5/13/2015 Str	eam Type:	B4	Valley	туре:		VIII	
Observers:	Lucas Babbitt			HUC:				
	INPUT VARIA	BLES			OUTP	UT VARI	ABLES	
	e Cross-Sectional AREA	28.04	A <sub>bkf</sub> (ft <sup>2</sup> )	Bankfull I	Riffle Mear	DEPTH	1.13	d <sub>bkf</sub> (ft)
Bankfull	Riffle WIDTH	24.71	W <sub>bkf</sub> (ft)		d PERMIM 2 * d <sub>bkf</sub> ) + V		25.46	W <sub>p</sub>
D <sub>84</sub>	at Riffle	82.57	Dia.	D <sub>84</sub>	<sub>4</sub> (mm) / 30	4.8	0.27	<b>D</b> <sub>84</sub> (ft)
Bankt	full SLOPE	0.0352	S <sub>bkf</sub> (ft / ft)	Hyd	raulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	1.10	R (ft)
Gravitation	nal Acceleration	32.2	g (ft / sec <sup>2</sup> )	F	tive Rough R(ft) / D <sub>84</sub> (ft	)	4.06	R / D <sub>84</sub>
Drair	nage Area	4.9	DA (mi²)		near Veloci u* = (gRS) <sup>½</sup>		1.117	u* (ft/sec)
	ESTIMATIO	N METHO	DS			kfull OCITY		kfull IARGE
1. Friction Factor	Relative <i>u</i> =	= [ 2.83 + 5.6	6 * Log { R	/D <sub>84</sub> }] u*	7.01	ft / sec	196.69	cfs
	Coefficient: a) Manning	g's <i>n</i> from Frict = 1.49*R <sup>2/3</sup> *S		0.062	4.80	ft / sec	134.54	cfs
2. Roughness b) Manning's	Coefficient: n from Stream Type (	Fig. 2-20)	u = 1.49* n =	R <sup>2/3</sup> *S <sup>1/2</sup> /n 0.062	4.80	ft / sec	134.54	cfs
, ,	n from Jarrett (USGS)		n = 0.39	R <sup>2/3</sup> *S <sup>1/2</sup> /n *S <sup>0.38</sup> *R <sup>-0.16</sup>	2.76	ft / sec	77.45	cfs
roughness, cobb	on is applicable to steep, ste le- and boulder-dominated A2, A3, B1, B2, B3, C2 & E3	stream systems;		0.108				
	<mark>ods (Hey, Darcy-Weisl</mark> sbach (Leopold, Wo				7.23	ft / sec	202.83	cfs
3. Other Metho Chezy C	ods (Hey, Darcy-Weisl	oach, Chezy (	C, etc.)		0.00	ft / sec	0.00	cfs
4. Continuity E Return Period fo	quations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	year	0.00	ft / sec	0.00	cfs
4. Continuity E	equations: b) USG	S Gage Data	u = Q / A		0.00	ft / sec	0.00	cfs
	on Height Options for							
Option 1. feat	For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.							
	Option 2. For <b>boulder-dominated</b> channels: Measure 100 " <b>protrusion heights</b> " of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.							
	pedrock-dominated char nel bed elevation. Substi						s or uplifted surf	aces above
	og-influenced channels: on upstream side if embed							ight of the

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	ream: Fourmile Canyon Creek					Location: Reach - Reach 4		
Ob	servers: Lucas Babbitt		Date:	08/20	/15	Valley Type: <b>XIII</b> Strea	m Type: <b>B</b>	4
		Rive	er Rea	ch Dir	nens	sion Summary Data1		
	Riffle Dimensions*' *** ***	Mean	Min	Max	i	Riffle Dimensions & Dimensionless Ratios****		lin Max
*	Riffle Width (W <sub>bkf</sub> )	12.4	0	24.7	_	Riffle Cross-Sectional Area (A <sub>bkf</sub> ) (ft <sup>2</sup> )		00 28.04
* *	Mean Riffle Depth (d <sub>bkf</sub> )	0.57	0	1.13	ft	Riffle Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	10.93 0.	00 21.87
ns*	Maximum Riffle Depth (d <sub>max</sub> )	0.86	0	1.71	ft	Max Riffle Depth to Mean Riffle Depth (d <sub>max</sub> / d <sub>bkf</sub> )	0.757 0.0	000 1.513
	Width of Flood-Prone Area (W <sub>fpa</sub> )	23.3	0	46.6	ft	Entrenchment Ratio (W <sub>fpa</sub> / W <sub>bkf</sub> )	0.944 0.0	000 1.887
me	Riffle Inner Berm Width (W <sub>ib</sub> )	0	0	0	ft	Riffle Inner Berm Width to Riffle Width (W <sub>ib</sub> / W <sub>bkf</sub> )	0.000 0.0	0.000
Riffle Dimensions*, **, ***	Riffle Inner Berm Depth (d <sub>ib</sub> )	0	0	0	ft	Riffle Inner Berm Depth to Mean Depth $(d_{ib} / d_{bkf})$	0.000 0.0	0.000
Riff	Riffle Inner Berm Area (A <sub>ib</sub> )	0	0	0	ft <sup>2</sup>	Riffle Inner Berm Area to Riffle Area (A <sub>ib</sub> / A <sub>bkf</sub> )	0.000 0.0	0.000
	Riffle Inner Berm W/D Ratio (W <sub>ib</sub> / d <sub>ib</sub> )	0	0	0				
	Pool Dimensions*' **' ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean M	lin Max
	Pool Width (W <sub>bkfp</sub> )	9.77	9.77	9.77	ft	Pool Width to Riffle Width (W <sub>bkfp</sub> / W <sub>bkf</sub> )		790 0.790
* *	Mean Pool Depth (d <sub>bkfp</sub> )	1.02	1.02	1.02	ft	Mean Pool Depth to Mean Riffle Depth (d <sub>bkfp</sub> / d <sub>bkf</sub> )	1.789 1.7	789 1.789
*    *s	Pool Cross-Sectional Area (A <sub>bkfp</sub> )	10	10	10	ft	Pool Area to Riffle Area (A <sub>bkfp</sub> / A <sub>bkf</sub> )	0.714 0.7	714 0.714
ion	Maximum Pool Depth (d <sub>maxp</sub> )	1.56	1.56	1.56	ft	Max Pool Depth to Mean Riffle Depth (d <sub>maxp</sub> / d <sub>bkf</sub> )	2.737 2.7	737 2.737
len:	Pool Inner Berm Width (W <sub>ibp</sub> )	0	0	0	ft	Pool Inner Berm Width to Pool Width (W <sub>ibp</sub> / W <sub>bkfp</sub> )	0.000 0.0	0.000
Din	Pool Inner Berm Depth (d <sub>ibp</sub> )	0	0	0	ft	Pool Inner Berm Depth to Pool Depth (d <sub>ibp</sub> / d <sub>bkfp</sub> )	0.000 0.0	0.000
Pool Dimensions*, **, ***	Pool Inner Berm Area (A <sub>ibp</sub> )	0	0	0	ft <sup>2</sup>	Pool Inner Berm Area to Pool Area (A <sub>ibp</sub> / A <sub>bkfp</sub> )	0.000 0.0	000.000
	Point Bar Slope (S <sub>pb</sub> )	0.000	0.000	0.000	ft/ft	Pool Inner Berm Width/Depth Ratio (W <sub>ibp</sub> / d <sub>ibp</sub> )	0.000 0.0	0.000
	Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios****	Mean M	lin Max
<u>*</u>	Run Width (W <sub>bkfr</sub> )	24.7			ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )		999 1.999
sion	Mean Run Depth (d <sub>bkfr</sub> )	1.13	1.13	1.13	ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )	1.982 1.9	982 1.982
nen	Run Cross-Sectional Area (A <sub>bkfr</sub> )	28	28	28	ft	Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )	2.000 2.0	000 2.000
Run Dimensions*	Maximum Run Depth (d <sub>maxr</sub> )	1.71	1.71	1.71	ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )	3.000 3.0	000 3.000
<b>B</b>	Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )	21.9	21.9	21.9	ft			
	Glide Dimensions*	Mean	Min	Max		Glide Dimensions & Dimensionless Ratios****	Mean N	lin Max
	Glide Width (W <sub>bkfg</sub> )	0	0		ft	Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )		0.000
*	Mean Glide Depth (d <sub>bkfg</sub> )	0	0	0	ft	Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	0.000 0.0	0.000
ions	Glide Cross-Sectional Area (A <sub>bkfg</sub> )	0	0	0	ft	Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )	0.000 0.0	0.000
ens	Maximum Glide Depth (d <sub>maxg</sub> )	0	0	0	ft	Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )	0.000 0.0	0.000
Ei	Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )	0	0	0	ft/ft	Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )	0.000 0.0	0.000
Glide Dimensions*	Glide Inner Berm Width (W <sub>ibg</sub> )	0	0	0	ft	Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> /W <sub>bkfg</sub> )	0.000 0.0	0.000
ဗ	Glide Inner Berm Depth (d <sub>ibg</sub> )	0	0	0	ft	Glide Inner Berm Depth to Glide Depth (d <sub>ibg</sub> / d <sub>bkfg</sub> )	0.000 0.0	0.000
	Glide Inner Berm Area (A <sub>ibg</sub> )	0	0	0	ft <sup>2</sup>	Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )	0.000 0.0	0.000
	Step Dimensions**	Mean	Min	Max		Step Dimensionless Ratios****	Mean M	lin Max
	Step Width (W <sub>bkfs</sub> )	0	0	0	ft	Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )		0.000
*_	Mean Step Depth (d <sub>bkfs</sub> )	0	0	0	ft	Mean Step Depth to Riffle Depth (d <sub>bkfs</sub> / d <sub>bkf</sub> )	0.000 0.0	0.000
Step**	Step Cross-Sectional Area (A <sub>bkfs</sub> )	0	0	0	ft	Step Area to Riffle Area (A <sub>bkfs</sub> / A <sub>bkf</sub> )	0.000 0.0	0.000
	Maximum Step Depth (d <sub>maxs</sub> )	0	0	0	ft	Max Step Depth to Mean Riffle Depth (d <sub>maxs</sub> / d <sub>bkf</sub> )	0.000 0.0	0.000
	Step Width/Depth Ratio (W <sub>bkfs</sub> / d <sub>bkfs</sub> )	0	0	0				
	-Pool system (i.e., C, E, F stream types) bed feature							

<sup>\*</sup>Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

<sup>\*\*</sup>Step-Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

<sup>\*\*\*</sup>Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

<sup>\*\*\*\*</sup>Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

	ream: Fourmile Cany						cation:	Reach	- Rea	ch 4				
Ob	servers: Lucas Babbitt				08/20/				y Type:	XIII	Strear	n Type:	B 4	
lics		L		Riv	er Reac	h Sumi	mary D	ata	.2					
Hydraulics	Streamflow: Estimated Me	ean Velocity	at Bank	full Sta	ge (u <sub>bkf</sub> )		4.7	98	ft/sec	Estimation Me	thod			
£	Streamflow: Estimated Di	ischarge at B	ankfull	Stage (	Q <sub>bkf</sub> )		134.	536	cfs	Drainage Area	1	4.	92	mi <sup>2</sup>
	Geometry	Mean	Min	Max			Dime	nsionl	ess Ge	ometry Ratios	3	Mean	Min	Max
	Linear Wavelength (λ)	116	98	151	ft	Linear W	/avelenç	gth to F	Riffle W	idth (λ / W <sub>bkf</sub> )		9.385	7.929	####
	Stream Meander Length	(L <sub>m</sub> ) 118	118	118	ft	Stream I	Meande	r Lengt	h Ratio	$(L_m/W_{bkf})$		9.547	9.547	9.547
terr	Radius of Curvature (R <sub>c</sub> )	44	7	115	ft	Radius o	of Curva	ture to	Riffle V	Vidth (R <sub>c</sub> / W <sub>bkf</sub>		3.560	0.566	9.304
Pat	Belt Width (W <sub>blt</sub> )	18	13	23	ft	Meande	r Width I	Ratio (\	N <sub>blt</sub> / W	bkf)		1.456	1.052	1.861
Channel Pattern	Arc Length (L <sub>a</sub> )	0	0	0	ft	Arc Leng	gth to Ri	ffle Wid	dth (L <sub>a</sub> /	W <sub>bkf</sub> )		0.000	0.000	0.000
Cha	Riffle Length (L <sub>r</sub> )	0	0	0	ft	Riffle Le	ngth to F	Riffle W	/idth (L	r / W <sub>bkf</sub> )		0.000	0.000	0.000
	Individual Pool Length (L <sub>p</sub>	o) <b>0</b>	0	0	ft	Individua	al Pool L	ength	to Riffle	Width (L <sub>p</sub> / W <sub>t</sub>	okf)	0.000	0.000	0.000
	Pool to Pool Spacing (P <sub>s</sub> )	0	0	0	ft	Pool to F	Pool Spa	cing to	Riffle	Width (P <sub>s</sub> / W <sub>bk</sub>	<sub>f</sub> )	0.000	0.000	0.000
	Valley Slope (S <sub>val</sub> )	0.033	ft/ft	Averag	ge Wate	r Surface	Slope (	(S)	0.03	3521 ft/ft	Sinuosity (	S <sub>val</sub> / S)		1.07
	Stream Length (SL)	481	ft	Valley	Length	(VL)			4	<b>35</b> ft	Sinuosity (	SL / VL)		1.11
	Low Bank Height	start 0	ft		Max Dep	oth	start	0	ft	Bank-Hei	ht Ratio (B	HR)	start	
	(LBH)	end 0	ft		(d <sub>max</sub> )		end		ft	l	H / d <sub>max</sub> )		end	
	Riffle Slope (S <sub>rif</sub> )	Mean	Min 0.000	Max	ft/ft					Slope Ratios Surface Slope	(S <sub>ee</sub> / S)	Mean	Min 0.000	Max 0 000
a	Run Slope (S <sub>run</sub> )		0.000				•	•		Surface Slope (			0.000	
	Pool Slope (S <sub>p</sub> )		0.000							Surface Slope			0.000	
Channel Profile	Glide Slope (S <sub>0</sub> )		0.000				•			Surface Slope	· F /	1	0.000	
hanr	Step Slope (S <sub>s</sub> )		0.000							Surface Slope		1	0.000	
5	Max Depths <sup>a</sup>	Mean	Min	Max	1.4.1					th Ratios	(-3)	Mean	Min	Max
	Max Riffle Depth (d <sub>maxrif</sub> )	0	0	1	ft	Max Riff				e Depth (d <sub>maxrif</sub>	/ d <sub>bkf</sub> )	0	0	0
	Max Run Depth (d <sub>maxrun</sub> )	0	0	0	ft	Max Rur	n Depth	to Mea	n Riffle	Depth (d <sub>maxrun</sub>	/ d <sub>bkf</sub> )	0	0	0
	Max Pool Depth (d <sub>maxp</sub> )	0	0	0	ft	Max Poo	ol Depth	to Mea	ın Riffle	Depth (d <sub>maxp</sub> /	d <sub>bkf</sub> )	0	0	0
	Max Glide Depth (d <sub>maxg</sub> )	0	0	0	ft	Max Glic	de Depth	to Me	an Riffl	e Depth (d <sub>maxg</sub>	/ d <sub>bkf</sub> )	0	0	0
	Max Step Depth (d <sub>maxs</sub> )	0	0	0	ft	Max Ste	p Depth	to Mea	an Riffle	Depth (d <sub>maxs</sub> /	d <sub>bkf</sub> )	0	0	0
		Reach <sup>b</sup>	Rif	fle <sup>c</sup>	В	Bar		Rea	ıch <sup>b</sup>	Riffle <sup>c</sup>	Bar	Protru	ısion He	eiaht <sup>d</sup>
s	% Silt/Clay	2.68		1	! ! !		D <sub>16</sub>		96	4		! ! !		mm
Fial	% Sand	11.61	1	1	į		D <sub>35</sub>	28	.03	17.8	i ! !	i i		mm
Mate	% Gravel	55.35	6	67 D <sub>50</sub> 41.94 28.58					! ! ! !		mm			
lue	% Cobble	29.47	2	1	<u> </u> 		D <sub>84</sub>	10	1.7	82.57				mm
Channel Materials	% Boulder	0.89	(	)			D <sub>95</sub>	156	5.07	128		i !		mm
	% Bedrock	0	(	)			D <sub>100</sub>	361	.99	180		! !		mm

<sup>&</sup>lt;sup>a</sup> Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

<sup>&</sup>lt;sup>b</sup> Composite sample of riffles and pools within the designated reach.

<sup>&</sup>lt;sup>c</sup> Active bed of a riffle. 

<sup>d</sup> Height of roughness feature above bed.

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

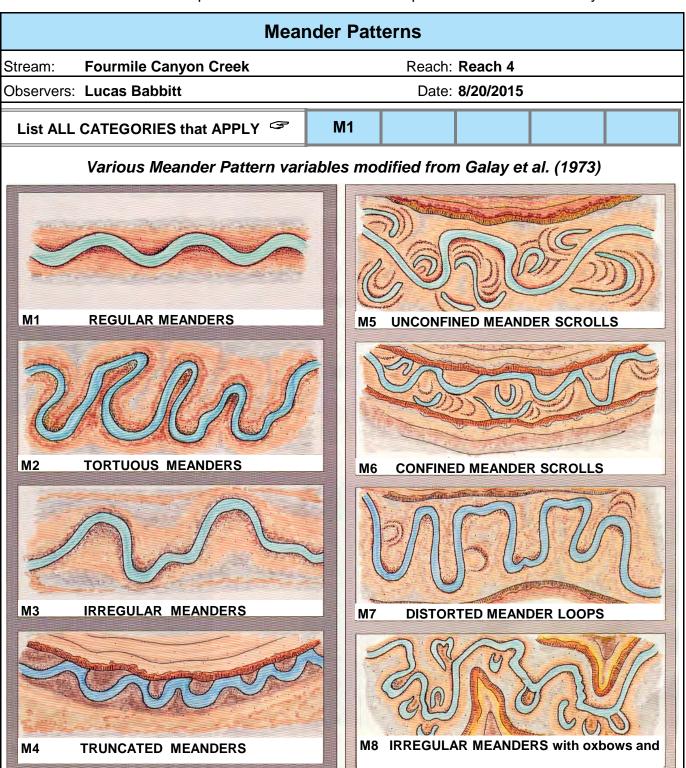
olological ilit	terpretations.								
	FLOW REGIME								
Stream:	Fourmile Canyon Creek Location: Reach 4								
Observers:	Observers: Lucas Babbitt Date: 8/20/2015								
List ALL	List ALL COMBINATIONS that P 1 2 8								
API	PLY								
General C	Category								
E	Ephemeral stream channels: Flows only in response to precipitation								
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.								
ı	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.								
Р	Perennial stream channels: Surface water persists yearlong.								
Specific (	Category								
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.								
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.								
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.								
4	Streamflow regulated by glacial melt.								
5	Ice flows/ice torrents from ice dam breaches.								
6	Alternating flow/backwater due to tidal influence.								
7	Regulated streamflow due to diversions, dam release, dewatering, etc.								
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.								
9	Rain-on-snow generated runoff.								

Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

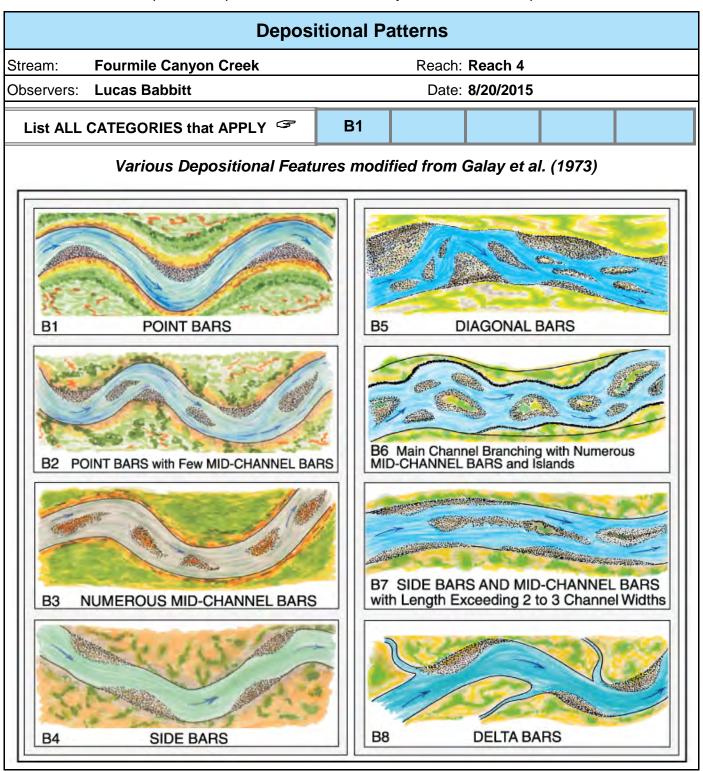
	Stream Size and Order						
Stream:	Stream: Fourmile Canyon Creek						
Location:	Reach 4						
Observers:	Lucas Babbitt						
Date:	8/20/2015						
Stream Siz	e Category and	l Order 🤝	S-4(2)				
Category		ZE: Bankfull dth	Check (✓) appropriate				
	meters	feet	category				
S-1	0.305	<1					
S-2	0.3 – 1.5	1 – 5					
S-3	1.5 – 4.6	5 – 15					
S-4	4.6 – 9	15 – 30	>				
S-5	9 – 15	30 – 50					
S-6	15 – 22.8	50 – 75					
S-7	22.8 - 30.5	75 – 100					
S-8	30.5 – 46	100 – 150					
S-9	46 – 76	150 – 250					
S-10	76 – 107	250 – 350					
S-11	107 – 150	350 – 500					
S-12	150 – 305	500 – 1000					
S-13	>305	>1000					
	Strear	n Order					
Add categories in parenthesis for specific stream order of							

Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



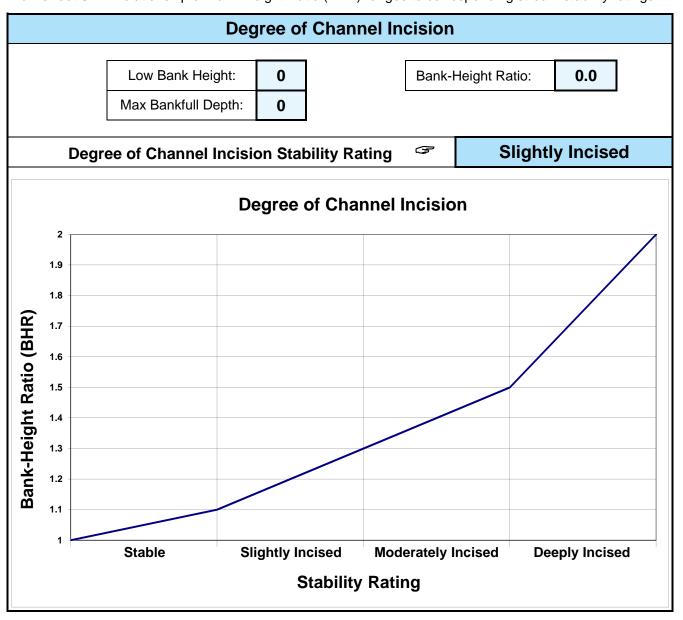
Worksheet 3-5. Depositional patterns used for stability assessment interpretations.



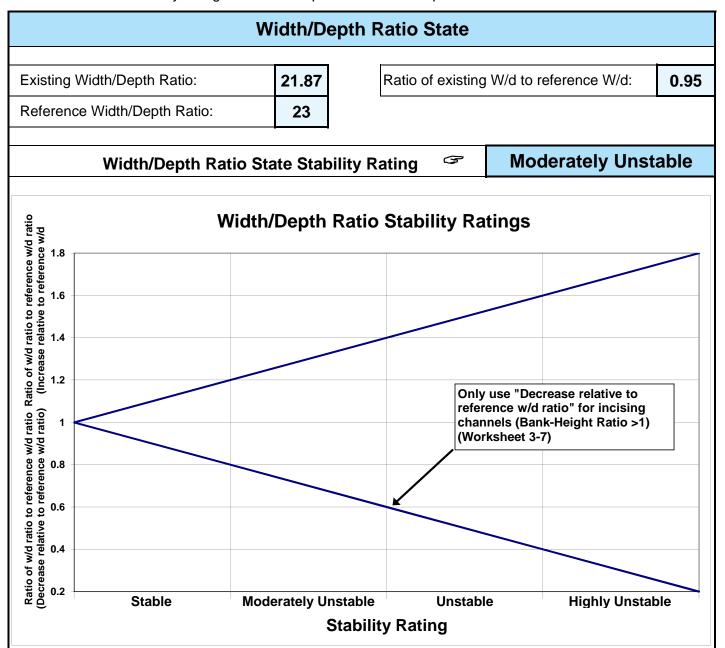
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

	Channel Blockages							
Stream	Stream: Fourmile Canyon Creek Location: Reach 4							
Obser	rvers: Lucas Bab	bitt Date: 8/20/2015						
Desc	ription/extent	Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.	Check (√) all that apply					
D1	D1 None Minor amounts of small, floatable material.							
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.	V					
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.						
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.						
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.						
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.						
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.						
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.						
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.						
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	Y					

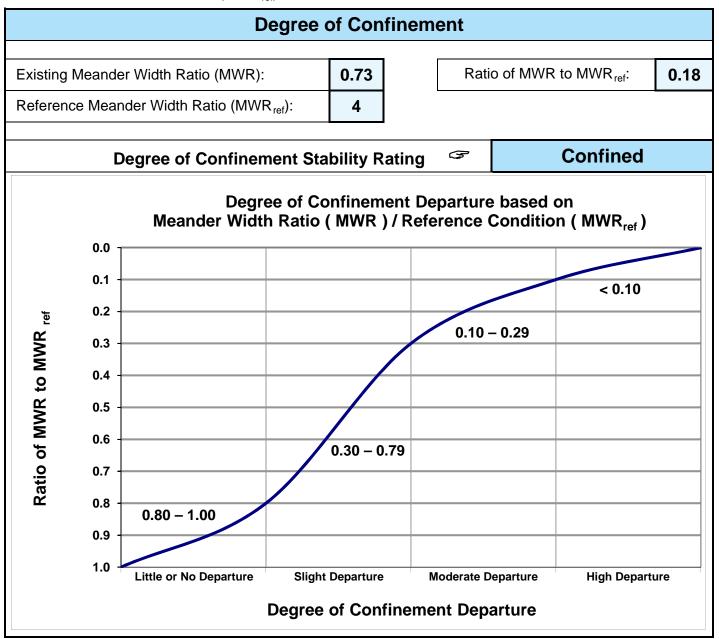
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	5	Stream Type:	B 4		
Location	:	Reach 4			Valley Type:	XIII		
Observe	rs:	Lucas Bab	bitt		Date:	08/20/2015	<b>i</b>	
Enter R	Enter Required Information for Existing Condition							
28	.6	D 50	Median particle size o	f riffle bed material (mn	า)			
0.	0	D 50	Median particle size o	f bar or sub-pavement	sample (mm	1)		
0.4	58	D <sub>max</sub>	Largest particle from b	oar sample (ft)	139.7	(mm)	304.8 mm/ft	
0.03	521	S	Existing bankfull wate	r surface slope (ft/ft)				
1.1	13	d	Existing bankfull mear	n depth (ft)				
1.6	<b>6</b> 5	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	avity of sediment				
Select t	he App	ropriate Ed	quation and Calculate (	Critical Dimensionless	Shear Str	ess		
0.0	00	$D_{50}/D_{50}^{\wedge}$	Range: 3-7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>)</b> ^) -0.872	
4.8	39	D <sub>max</sub> /D <sub>50</sub>	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 ( <i>D</i> <sub>max</sub> / <i>D</i>	<sub>50</sub> ) <sup>-0.887</sup>	
τ* Bankfull Dimensionless Shear Stress EQUATION USED:				N/A				
Calculat	te Bank	full Mean D	epth Required for Entra	ainment of Largest Par	ticle in Bar	Sample		
		d	Required bankfull mean	depth (ft) $d = \frac{\tau}{\tau}$	$rac{*(\gamma_{ m s}-1)D_{ m m}}{{\sf S}}$	use (use	D <sub>max</sub> in ft)	
Calcula	te Banl	kfull Water	Surface Slope Require	ed for Entrainment of	Largest Pa	rticle in Ba	r Sample	
		S	Required bankfull water	surface slope (ft/ft) <b>S</b> =	$=\frac{\tau^*(\gamma_s-1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)	
		Check:	Stable □ Aggrad	ing   Degrading				
Sedime	nt Com	petence U	sing Dimensional Shea	ar Stress				
2.4	83		hear stress $\tau = \gamma dS$ (lbs/ft	•	dius, R, with	mean depth,	d)	
Shields	СО		d = existing depth, S = exis	-				
201.1	296.7	Predicted I	largest moveable particle s	size (mm) at bankfull shea	ar stress τ (F	igure 3-11)		
1.75	co <b>0.891</b>	Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)						
Shields	CO	Predicted	mean depth required to ini	tiate movement of measu	red D <sub>max</sub> (mr	n) <b>d</b> – .	$\overline{ au}$	
0.80	0.41	•	ted shear stress, $\gamma$ = 62.4,	<u> </u>		$\mathbf{d} = \frac{1}{2}$	γS	
Shields	CO		slope required to initiate m		<sub>max</sub> (mm)	$S = \frac{\tau}{111}$		
0.0248	0.0126		ted shear stress, $\gamma = 62.4$ ,			γd		
		Check:	✓ Stable	ing   Degrading				

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	Fourmile Canyon Creek, Reach - Reach 4		
Basin:	Drainage Area: 3148.8 acres	4.92	mi <sup>2</sup>
Location:			
Twp.&Rge:	; Sec.&Qtr.: ;		
Cross-Sect	ion Monuments (Lat./Long.): 40.06097 Lat / 105.31683 Long	Date	08/20/15
Observers:	Lucas Babbitt	Valley Type	: VIII(b)
	Bankfull WIDTH (W <sub>bkf</sub> )		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	24.71	ft
	Bankfull DEPTH (d <sub>bkf</sub> )		1
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ( $d_{bkf} = A / W_{bkf}$ ).	1.13	ft
	Bankfull X-Section AREA (A <sub>bkf</sub> )		1
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	28.04	ft <sup>2</sup>
	Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )		1
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	21.87	ft/ft
	Maximum DEPTH (d <sub>mbkf</sub> )		1
	Maximum depth of the bankfull channel cross-section, or distance between the		
	bankfull stage and Thalweg elevations, in a riffle section.	1.71	ft
	WIDTH of Flood-Prone Area (W <sub>fpa</sub> )		
	Twice maximum DEPTH, or (2 x $d_{mbkf}$ ) = the stage/elevation at which flood-prone area		
	WIDTH is determined in a riffle section.	46.63	ft
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W <sub>fpa</sub> / W <sub>bkf</sub> )	4.00	6. (6.
	(riffle section).	1.89	_ft/ft
	Channel Materials (Particle Size Index ) D <sub>50</sub>		
	The D <sub>50</sub> particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg		
	elevations.	41.94	mm
	Weter Surface SLODE (S)		- 1
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient		
	at bankfull stage.	0.03521	ft/ft
	Channel SINUOSITY (k)		1
	Sinuosity is an index of channel pattern, determined from a ratio of stream length		
	divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.07	
		1.07	
	Stream   B 4   (See Figure 2-	14)	
	Type (See Figure 2-	• • • )	

**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type: <b>B 4</b>
Location:	Reach 4	Valley Type: <b>XIII</b>
Observers:	Lucas Babbitt	Date: 08/20/2015
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)
	eam Type at potential, $(C \rightarrow E)$ , ), $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	☐ Stable
(E→C),	(B→High W/d B), (C→High W/d C)	✓ Moderately Unstable
(G <sub>c</sub>	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	☐ Unstable
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	☐ Highly Unstable

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Canyon Creek Stream Type: B 4								
Location: Reach 4 Valley Type: XIII								
Observers: Lucas Babbitt Date: 08/20/2015								
Lateral sta	bility criteria		Lateral Stabilit	ty Categories				
(choose one	(choose one stability category for each criterion 1–5)		Moderately Unstable	Unstable	Highly Unstable	Selected Points (from each row)		
W/d Rati 1 (Worksh		< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	4		
,	,	(2)	(4)	(6)	(8)			
	Depositional Patterns (Worksheet 3-5)		B4, B8	В3	B5, B6, B7	1		
,	•	(1)	(2)	(3)	(4)			
Meander (Worksh	Patterns eet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		1		
,	,	(1)		(3)				
4 Unit Rate	ank Erosion: e (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07			
(Worksh	eet 3-13)	(2)	(4)	(6)	(8)			
5 (MWR/M		> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	3		
(Workshe	eet 3-9)	(1)	(2)	(3)	(4)			
Total Points								
Lateral Stability Category Point Range								
Category (ı	eral Stability use total points stability rating)	<i>Stable</i> < 10 <b>▽</b>	Moderately Unstable 10 – 12 □	<i>Unstable</i> 13 – 21 □	Highly Unstable > 21 □			

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Stream: Fou	Stream: Fourmile Canyon Creek Stream Type: B 4					
Location: Rea	ch 4			Valley Type:	XIII	
Observers: Luc	as Babbit	t		Date:	08/20/2015	
Vertical Stabili	ty	Vertical Stabi	lity Categories fo	r Excess Deposition	n / Aggradation	Selected
Criteria (choos stability categor each criterion 1	ry for	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	Points (from each row)
Sediment 1 competence (Worksheet		Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	
		(2)	(4)	(6)	(8)	
Sediment Ca 2 (POWERSEI		Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand	
		(2)	(4)	(6)	(8)	
3 W/d Ratio St (Worksheet		< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	4
		(2)	(4)	(6)	(8)	
Stream Succ 4 States (Work 16)		Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{split} &(C \! \to \! High \ W\!/d \ C), \\ &(B \! \to \! High \ W\!/d \ B), \\ &(C \! \to \! F), \ (G_c \! \to \! F), \\ &(G \! \to \! F_b) \end{split} $	(C→D), (F→D)	
		(2)	(4)	(6)	(8)	
Depositiona 5 Patterns (We		B1	B2, B4	B3, B5	B6, B7, B8	1
3-5)		(1)	(2)	(3)	(4)	
6 Debris / Blo	_	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	4
		(1)	(2)	(3)	(4)	
	Total Points					
		Vertical Stab		nt Range for Exce	ss Deposition /	
Vertical Stabili Excess Depos Aggradation (u points and chec rating)	ition / ise total	No Deposition < 15 □	Moderate Deposition 15 – 20 □	Excess Deposition 21 – 30	Aggradation > 30 □	

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream: Fourmile Canyon Creek Stream Type: B 4								
Location: Reach 4	Location: Reach 4 Valley Type: XIII							
Observers: Lucas Babbitt Date: 08/20/2015								
Vertical Stability	Vertical Stabi	ity Categories for	Channel Incision	n / Degradation	Selected			
Criteria (choose one stability category for each criterion 1–5)	Not Incised	Slightly Incised	Moderately Incised	Degradation	Points (from each row)			
Sediment 1 Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved				
	(2)	(4)	(6)	(8)				
Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load				
	(2)	(4)	(6)	(8)				
Degree of Channel 3 Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	4			
(WOIRSHEEL 3-1)	(2)	(4)	(6)	(8)				
Stream Succession 4 States (Worksheets 3-16 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$				
	(2)	(4)	(6)	(8)				
Confinement 5 (MWR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 – 0.79	0.10 - 0.29	< 0.10	3			
(Worksheet 3-9)	(1)	(2)	(3)	(4)				
Total Points								
Vertical Stability Category Point Range for Channel Incision / Degradation								
Vertical Stability for Channel Incision/ Degradation (use total points and check stability rating)	Not Incised < 12 □	Slightly Incised 12 – 18	Moderately Incised 19 – 27 □	Degradation > 27 □				

**Worksheet 3-20.** Channel enlargement prediction summary.

Stream: Fourmile Canyon Creek Stream Type: B 4						
Lo	cation: Reach 4			Valley Type:	XIII	
Observers: Lucas Babbitt Date: 08/20/2015						
	Channel Enlargement	Char	nnel Enlargement	<b>Prediction Categ</b>	ories	
(d	Prediction Criteria choose one stability ategory for each criterion -4)	No Increase	Slight Increase	Moderate Increase	Extensive	Selected Points (from each row)
1	Successional Stage Shift (Worksheet 3-16)	Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{c} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $	
		(2)	(4)	(6)	(8)	
2	Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	2
		(2)	(4)	(6)	(8)	
3	Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	
	(Worksheet 3-18)	(2)	(4)	(6)	(8)	
4	Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation	
	(Worksheet 3-19)	(2)	(4)	(6)	(8)	
					Total Points	2
	Category Point Range					
P p	Channel Enlargement Prediction (use total points and check stability ating)	No Increase < 11	Slight Increase 11 – 16	Moderate Increase 17 – 24	Extensive > 24 □	

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Stream: Fourmile Canyon Creek				Stream Type:	B 4
Location: Reach 4 Valley				Valley Type:	XIII
Observers:				Date:	08/20/2015
Overall Sediment Supply Prediction Criteria (choose corresponding points for each criterion 1–5)		Stability Rating		Points	Selected Points
1	Lateral Stability (Worksheet 3-17)	Stable		1	
		Mod. Unstable		2	1
		Unstable		3	
		Highly Unstable		4	
2	Vertical Stability	No Deposition		1	
	Excess Deposition or Aggradation	Mod. Deposition		2	
		Excess Deposition		3	
	(Worksheet 3-18)	Aggradation		4	
3	Vertical Stability	Not Incised		1	
	Channel Incision or Degradation (Worksheet 3-19)	Slightly Incised		2	
		Mod. Incised		3	
		Degradation		4	
4	Channel Enlargement Prediction (Worksheet 3-20)	No Increase		1	
		Slight Increase		2	
		Mod. Increase		3	
		Extensive		4	
5	Pfankuch Channel Stability (Worksheet 3- 10)	Good: Stable		1	
		Fair: Mod. Unstable		2	
		Poor: Unstable		4	
Total Points					1
		Category Point Range			
Overall Sediment Supply Rating (use total points and check stability rating)		<i>Low</i> < 6 □	<i>Moderate</i> 6 – 10 □	<i>High</i> 11 – 15 □	Very High > 15 □

Worksheet 3-22. Summary of stability condition categories.

	Α	BCDEFGHIJK	L M N O P Q R	STUVWXYZ	AA AB AC AD AE AF	AGAH AI AJAKALAM
1	Stream:	Fourmile Canyon Creek		Location: Reach 4		
2	Observers:	Lucas Babbitt	Date: 8/20/2015	Stream Type: <b>B 4</b>	Valley Type:	XIII
3	Channel Dimension	Mean Bankfull 1.13 Bankfull \( \text{Depth (ft):} \)	2/1 /1	20 1/1	Ratio:	chment 1.89
5 6	Channel Pattern	Mean: λ/W <sub>bkf</sub> : <b>4.69</b> Range: 3.97 - 6.11	L <sub>m</sub> /W <sub>bkf</sub> : 4.78 4.78	R <sub>c</sub> /W <sub>bkf</sub> : 1.78 M	WR: <b>0.73</b> <b>0.53 - 0.93</b>	Sinuosity: 1.07
7	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec):	Discharge (Q <sub>bkf</sub> ):	34.536 Estimation Method:		Drainage Area (mi <sup>2</sup> ):
9		Check: ☐ Riffle/Pool ☐ Step/P		☐ Convergence/Divergence		nes/Smooth Bed
10	River Profile & Bed	Max Riffle Pool	Depth Ratio (max Riffle		tio	Slope
11 12	Features	Bankfull 1.71 1.56	to mean): 1.51	Spacing:	vanoy.	Surrace:
13		Riparian Current Composition			rks: Condition, Vigor & Us	-
14		Vegetation See description		ing native speci Density ar		
15		Flow P12 Stream Size	S-4(2) Meander	M1 Depositional	<b>B</b> 1	Channel D2 D10
16		Regime: 8 & Order:	Patterns:	Patterns:	Blocka	ges:
17	Level III Stream		Degree of Incision Slig		kuch Stability Rating	80 -
18	Stability Indices		Stability Rating:	(Numeric & Ac	djective Rating):	
19		Width/depth 31.61 Reference		Depth Ratio State	W/d Ratio Stat	
20		Ratio (W/d): Ratio (W/d		(W/d <sub>ref</sub> ):	Stability Rating	
21 22				of confinement <b>0.18</b> / MWR <sub>ref</sub> ):	MWR / MWR <sub>re</sub> Stability Rating	-
23	Bank Erosion		nual Streambank Erosion	Rate: Curve Used:	Remarks:	
24	Summary	Studied (ft): 0	(tons/yr) 0	(tons/yr/ft)		
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity ☐ Insu	fficient Capacity 🔲 Exc	ess Capacity Remar	ks:	
26 27	Entrainment/ Competence	Largest Particle from 139.7 Bar Sample (mm):	$ au=$ 0.891 $ au^*=$ 0	Existing Depth: 0 Require Depth:	ed <b>0.41</b> Existing Slope:	#### Required Slope: ####
28	Successional Stage			Existing St	ream B4 Pot	ential Stream
29	Shift		<b>—</b>	State (Type	e): Sta	ite (Type):
30	Lateral Stability	Stable	stable 🗖 Unstable	☐ Highly Unstable	Remarks/causes:	
31	Vertical Stability (Aggradation)	☐ No Deposition ☐ Mod. De	position 🔲 Ex. Deposition	on 🗌 Aggradation	Remarks/causes:	
32	Vertical Stability (Degradation)	☐ Not Incised ☐ Slightly I	Incised Mod. Incised	☐ Degradation	Remarks/causes:	
33	Channel Enlargement	☐ No Increase ☐ Slight Inc	crease 🗌 Mod. Increas	e 🗆 Extensive	Remarks/causes:	
34 35	Sediment Supply (Channel Source)	Low   Moderat	te ☐ High ☐ Very	/ High Remarks/causes:	-	

RIVERMORPH PFANKUCH SUMMARY River Name: Reach 5 Reach Name: Assesments Survey Date: 05/13/2015 Upper Bank Landform Slope: 6 Mass Wasting: Debris Jam Potential: Vegetative Protection: Lower Bank 3 4 Channel Capacity: Bank Rock Content: Obstructions to Flow: Cutting: Deposition: 12 12 Channel Bottom 2 4 Rock Angularity: Brightness: Consolidation of Particles: 4 Bottom Size Distribution: 12 Scouring and Deposition: 12 Aquatic Vegetation: 4 Channel Stability Evaluation Sediment Supply: Stream Bed Stability: Hi gh

W/D Condition: Stream Type: Rating - 96

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

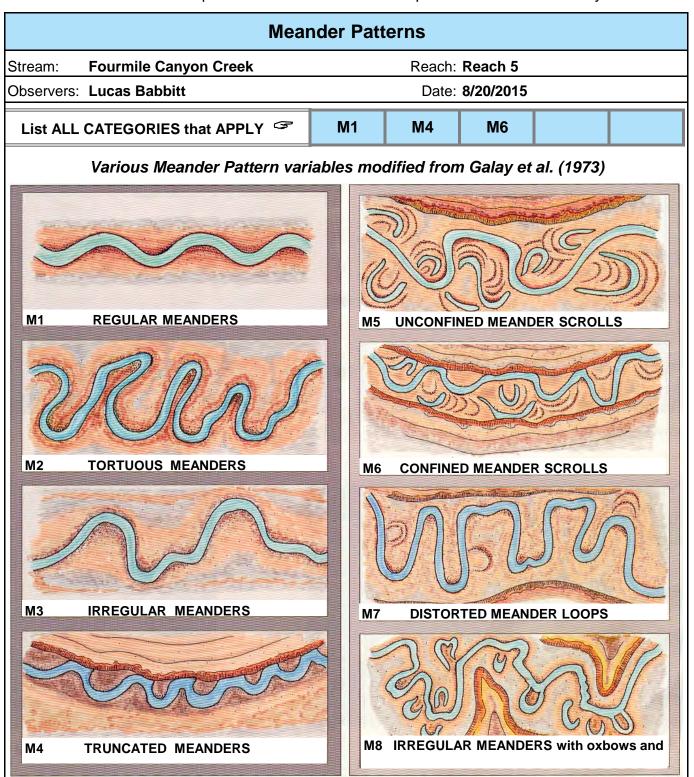
	torprotations.										
	FLOW REGIME										
Stream:	Fourmile Canyon Creek Location: Reach 5										
Observers:	Observers: Lucas Babbitt Date: 8/20/2015										
List ALL	List ALL COMBINATIONS that P 1 2 8										
API	APPLY										
General (	Category										
E	Ephemeral stream channels: Flows only in response to precipitation										
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.										
I	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.										
Р	Perennial stream channels: Surface water persists yearlong.										
Specific (	Category										
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.										
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.										
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.										
4	Streamflow regulated by glacial melt.										
5	Ice flows/ice torrents from ice dam breaches.										
6	Alternating flow/backwater due to tidal influence.										
7	Regulated streamflow due to diversions, dam release, dewatering, etc.										
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.										
9	Rain-on-snow generated runoff.										

Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

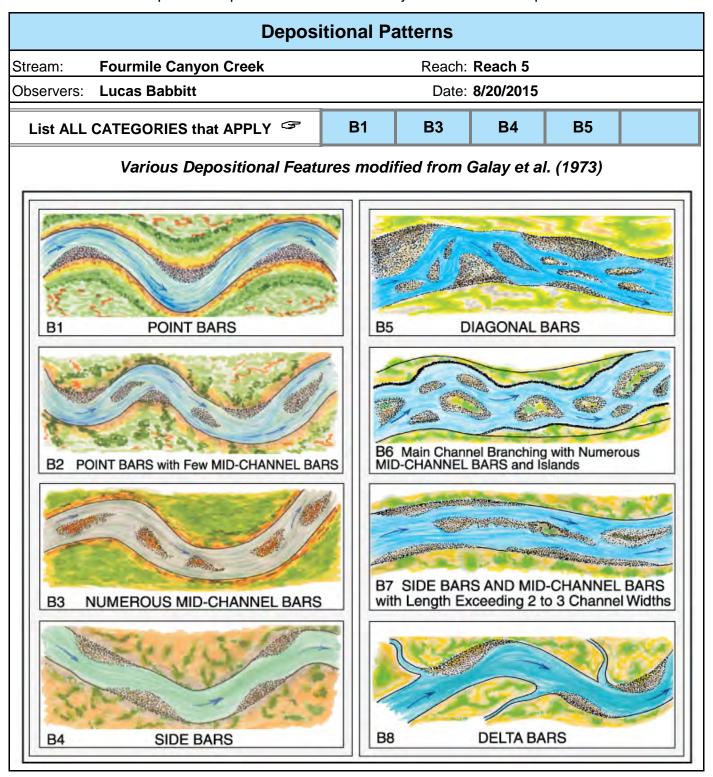
Stream Size and Order							
Stream: Fourmile Canyon Creek							
Location:	Reach 5						
Observers:	Lucas Babbitt						
Date:	8/20/2015						
Stream Siz	e Category and	l Order 🤝	S-4(2)				
STREAM SIZE: Bankfull Check (✓) Category width check (✓)							
	meters	feet	category				
S-1	0.305	<1					
S-2	0.3 – 1.5	1 – 5					
S-3	1.5 – 4.6	5 – 15					
S-4	4.6 – 9	15 – 30	>				
S-5	9 – 15	30 – 50					
S-6	15 – 22.8	50 – 75					
S-7	22.8 – 30.5	75 – 100					
S-8	30.5 – 46	100 – 150					
S-9	46 – 76	150 – 250					
S-10	76 – 107	250 – 350					
S-11	107 – 150	350 – 500					
S-12	150 – 305	500 – 1000					
S-13	>305	>1000					
	Strear	n Order					
Add categorie	as in naranthasis	for enacific etras	m order of				

Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



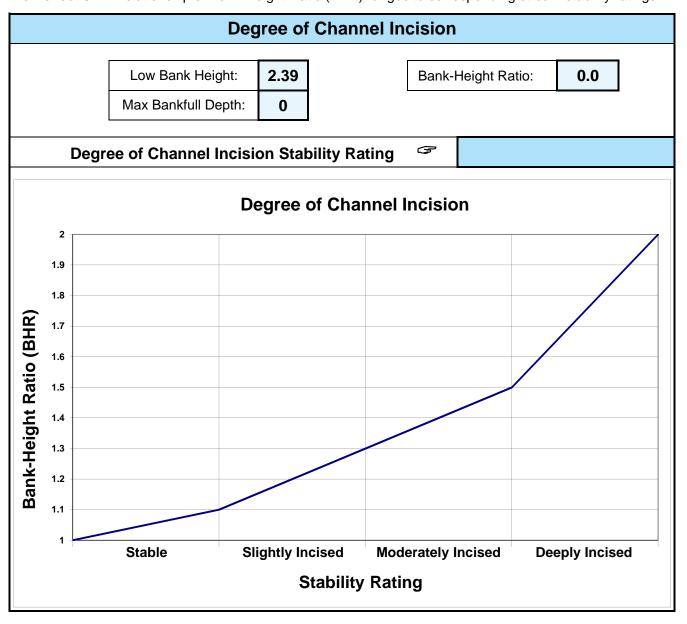
Worksheet 3-5. Depositional patterns used for stability assessment interpretations.



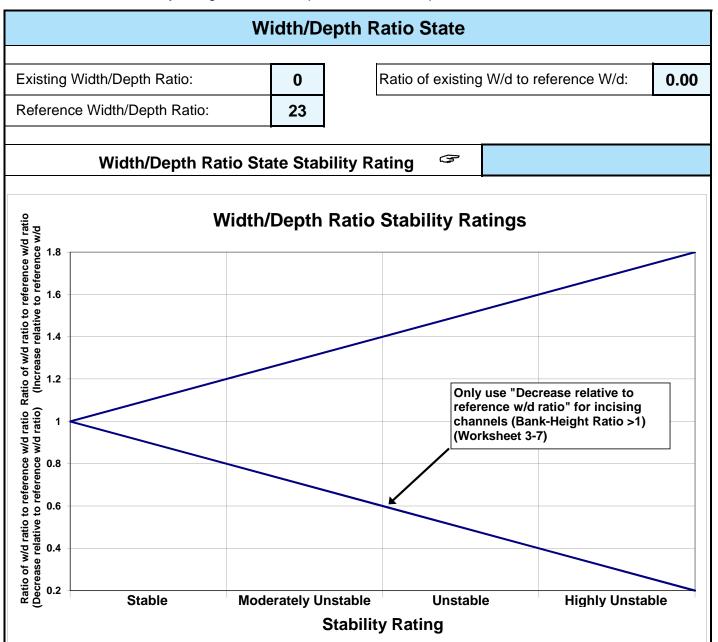
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

		Channel Blockages				
Stream	m: Fourmile C	anyon Creek Location: Reach 5				
Observers: Lucas Babbitt Date: 8/20/2015  Materials that upon placement into the active channel or flood-						
Desc	ription/extent	Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.	Check (√) all that apply			
D1	None	Minor amounts of small, floatable material.				
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.				
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.	~			
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.				
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.				
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.				
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.				
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.				
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.				
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	Y			

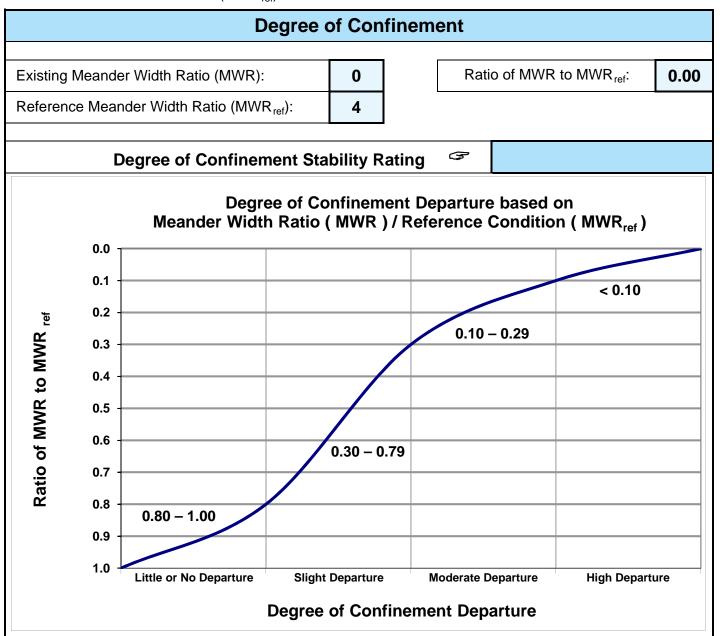
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type:
Location:	Reach 5	Valley Type: <b>VIII</b>
Observers:	Lucas Babbitt	Date: 08/20/2015
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)
	eam Type at potential, $(C \rightarrow E)$ , ), $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	☐ Stable
(E→C),	(B→High W/d B), (C→High W/d C)	
(G <sub>c</sub>	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	☐ Unstable
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	☐ Highly Unstable

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Canyor	Creek		Stream Ty	pe:	
Location: Reach 5			Valley Ty	<sub>pe:</sub> VIII	
Observers: Lucas Babbitt			Da	ate: <b>08/20/2015</b>	
Lateral stability criteria		Lateral Stabilit	ty Categories		
(choose one stability category for each criterion 1–5)	Stable	Moderately Unstable	Unstable	Highly Unstable	Selected Points (from each row)
W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	
,	(2)	(4)	(6)	(8)	
Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	В3	B5, B6, B7	4
,	(1)	(2)	(3)	(4)	
Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		3
,	(1)		(3)		
Streambank Erosion: 4 Unit Rate (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07	
(Worksheet 3-13)	(2)	(4)	(6)	(8)	
Degree of Confinement 5 (MWR / MWR <sub>ref</sub> )	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	
(Worksheet 3-9)	(1)	(2)	(3)	(4)	
				Total Points	7
	Late	eral Stability C	ategory Point Ra	ange	
Overall Lateral Stability Category (use total points and check stability rating)	Stable <10 ☑	Moderately Unstable 10 – 12 □	<i>Unstable</i> 13 – 21 □	Highly Unstable > 21 □	

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Stream: Fourmile Car	yon Creek		Stream Type:		
Location: Reach 5			Valley Type:	VIII	
Observers: Lucas Babbit	t		Date:	08/20/2015	
Vertical Stability	Vertical Stabi	lity Categories fo	r Excess Deposition	n / Aggradation	Selected
Criteria (choose one stability category for each criterion 1–6)	No Deposition	No Deposition Moderate Excess Deposition Deposit		Aggradation	Points (from each row)
Sediment 1 competence (Worksheet 3-14)	Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	
	(2)	(4)	(6)	(8)	
Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand	
	(2)	(4)	(6)	(8)	
W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	
	(2)	(4)	(6)	(8)	
Stream Succession 4 States (Worksheet 3- 16)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{array}{c} (C {\rightarrow} High \ W/d \ C), \\ (B {\rightarrow} High \ W/d \ B), \\ (C {\rightarrow} F), \ (G_c {\rightarrow} F), \\ (G {\rightarrow} F_b) \end{array} $	(C→D), (F→D)	
	(2)	(4)	(6)	(8)	
Depositional 5 Patterns (Worksheet	B1	B2, B4	B3, B5	B6, B7, B8	1
3-5)	(1)	(2)	(3)	(4)	
Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	4
	(1)	(2)	(3)	(4)	
				Total Points	5
	Vertical Stab		nt Range for Exce	ss Deposition /	
Vertical Stability for Excess Deposition / Aggradation (use total points and check stability rating)	No Deposition < 15	Moderate Deposition 15 – 20 □	Excess Deposition 21 – 30	Aggradation > 30 □	

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream: Fourmile	Canyon Creek		Stream Type:		
Location: Reach 5			Valley Type:	VIII	
Observers: Lucas Ba	bbitt		Date:	08/20/2015	
Vertical Stability	Vertical Stabi	lity Categories for	r Channel Incisio	n / Degradation	Selected
Criteria (choose one stability category for each criterion 1–5)		Slightly Incised	Moderately Incised	Degradation	Points (from each row)
Sediment 1 Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved	
	(2)	(4)	(6)	(8)	
Sediment Capaci (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	
	(2)	(4)	(6)	(8)	
Degree of Chann 3 Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	
(WOIKSHEEL 3-7)	(2)	(4)	(6)	(8)	
Stream Successi 4 States (Workshee 3-16 and 3-7)	indicate incision	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$	
	(2)	(4)	(6)	(8)	
Confinement 5 (MWR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	
(Worksheet 3-9)	(1)	(2)	(3)	(4)	
				Total Points	0
	Vertical Stab	ility Category Poi Degra	nt Range for Cha Idation	nnel Incision /	
Vertical Stability for Channel Incision/ Degradation (use to points and check stability rating)	Not Incided	Slightly Incised 12 – 18	Moderately Incised 19 – 27 □	Degradation > 27 □	

**Worksheet 3-20.** Channel enlargement prediction summary.

Str	ream: Fourmile Canyo	on Creek		Stream Type:		
Lo	cation: Reach 5			Valley Type:	VIII	
Ob	servers: Lucas Babbitt			Date:	08/20/2015	
Channel Enlargement		Char	nnel Enlargement	<b>Prediction Categ</b>	ories	
(d	Prediction Criteria choose one stability ategory for each criterion -4)	No Increase	Slight Increase	Moderate Increase	Extensive	Selected Points (from each row)
Successional Stage Shift (Worksheet 3-16)		Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{c} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $	
		(2)	(4)	(6)	(8)	
2	Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	2
		(2)	(4)	(6)	(8)	
3	Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	
	(Worksheet 3-18)	(2)	(4)	(6)	(8)	
4	Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation	
	(Worksheet 3-19)	(2)	(4)	(6)	(8)	
					Total Points	2
Category Point Range						
P p	Channel Enlargement Prediction (use total points and check stability ating)	No Increase < 11	Slight Increase 11 – 16	Moderate Increase 17 – 24	Extensive > 24 □	

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Str	eam: Fourmile Canyo	n Creek		Stream Type:	
Lo	cation: Reach 5			Valley Type:	VIII
Ob	08/20/2015				
P (d p	verall Sediment Supply rediction Criteria choose corresponding oints for each criterion –5)	Stability	/ Rating	Points	Selected Points
		Stable		1	
1	Lateral Stability	Mod. Unstal	ble	2	1
<b>!</b> '	(Worksheet 3-17)	Unstable		3	•
		Highly Unst	able	4	
	Vertical Stability	No Depositi	on	1	
2	Excess Deposition or	Mod. Depos	ition	2	
	Aggradation	Excess Dep	osition	3	
	(Worksheet 3-18)	Aggradation	1	4	
	Vertical Stability	Not Incised		1	
3	<b>Channel Incision or</b>	Slightly Inci	sed	2	
ľ	Degradation	Mod. Incise	d	3	
	(Worksheet 3-19)	Degradation	1	4	
	Channel Enlargement	No Increase		1	
4	Prediction (Worksheet	Slight Increa	ase	2	
	3-20)	Mod. Increa	se	3	
	<i></i>	Extensive		4	
	Pfankuch Channel	Good: Stab		1	
5	Stability (Worksheet 3-	Fair: Mod. (	Jnstable	2	
	10)				
	-,	Poor: Unsta	able	4	
	_			Total Points	1
			Category P	oint Range	
R	overall Sediment Supply ating (use total points and check stability rating)	Low < 6	<i>Moderate</i> 6 – 10 □	High 11 – 15	Very High > 15

Worksheet 3-22. Summary of stability condition categories.

	А	BCDEFGH	I J K	L M N	O P Q R	STUV	/ W X	Y Z AA A	BACADA	AE AF	AGAH AI	AJ AK AL AM
1	Stream:	Fourmile Canyon Cr	eek				: Reach	5				
2	Observers:	Lucas Babbitt			8/20/2015		m Type:			Type:		
3	Channel Dimension	Mean Bankfull Depth (ft):	Bankfull (ft):		Cross-Sec	Λ	Width/D Ratio:	epth	0	Entrenc Ratio:	hment	
5 6	Channel Pattern	Mean: Range: λ/W <sub>bkf</sub> :		L <sub>m</sub> /W <sub>bkf</sub> :		R <sub>c</sub> /W <sub>bkf</sub> :		MWR:			Sinuosity	1.07
7	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec):	0	Bankfu Dischai	ll rge (Q <sub>bkf</sub> ):	(1)	stimation ethod:				Drainage Area (mi²	<b>4.92</b>
9		Check: Riffle/Pool	☐ Step/P	ool	Plane Bed	☐ Converg	ence/Dive	rgence	Dunes/A	Antidune	es/Smoot	h Bed
10	River Profile & Bed	Max Riffle	Pool	Depth Rati	o (may Riffle	e Pool	Pool-to	- Ratio		;	Slope	
11 12	Features	Bankfull <b>0</b> Depth (ft):	0	to mea	n):		Pool Spacin	g: 0	Valley:	0.058	Wat Surfa	0 1
13		I TOPOLION	Composition			nposition/Densit	-	Remarks: C		7	-	-
14		Vegetation See descr			Same as exis	ting native s						npacted by 20
15		Flow P12 Stream			Meander	M1 M4 M6	Deposit		4 B/1 B/1		Channel	D3 D10
16		Regime: 8 & Orde			Patterns:		Patterns	S:	t	Blockag	jes:	
17	Level III Stream	Degree of Incision		Degree of I				d Pfankuch				96 -
18	9	(Bank-Height Ratio):		Stability Ra		Donth Datia (		ic & Adjecti				
19 20		Ratio (W/d):	Reference Ratio (W/d	<sub>ref</sub> ):	(W/d) /	Depth Ratio ( ' (W/d <sub>ref</sub> ):		0.00	W/d Rat Stability	Rating	:	
21 22		Meander Width Ratio (MWR):		ference VR <sub>ref</sub> :		e of confinem / MWR <sub>ref</sub> ):	ent	0	MWR / I Stability			
23	Bank Erosion	Length of Reach 0	An	nual Strean	nbank Erosion	Rate:	Curve l	Jsed: F	emarks:			
24	Summary	Studied (ft):	0	(tons	s/yr) <b>0</b>	(tons/yr/ft)						
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity	□ Insu	fficient Cap	acity 🔲 Ex	cess Capacit	y	Remarks:				
26 27	Entrainment/ Competence	Largest Particle from Bar Sample (mm):	127	$\tau = 0.7$	'83 τ* <sub>=</sub> (	Existing Depth:		Required Depth:	0 Exis			quired ####
28	Successional Stage		_				Exis	ting Stream	1	Pote	ential Stre	am
29	Shift						Stat	e (Type):		Stat	e (Type):	
30	Lateral Stability	▼ Stable □	Mod. Un	stable [	Unstable	□ Hig	hly Unsta	bie	ırks/causes			
31	Vertical Stability (Aggradation)	☐ No Deposition ☐	Mod. De	position [	Ex. Depositi	on 🗆 Agg	gradation	Rema	irks/causes	:		
32	Vertical Stability (Degradation)	□ Not Incised □	Slightly I	ncised [	Mod. Incised	d Deg	gradation	Rema	irks/causes	:		
33	Channel Enlargement	☐ No Increase ☐	Slight Ind	crease [	Mod. Increa	se 🗆 Ext	ensive	Rema	rks/causes	:		
34 35	Sediment Supply (Channel Source)	-□ Low □	Moderat	e 📙 I	High ☐ Ver	y High Rema	arks/caus	es:				

## RIVERMORPH PFANKUCH SUMMARY

River Name: Reach 6 Reach Name: Assesments Survey Date: 05/13/2015 Upper Bank Landform Slope: 6 Mass Wasting: Debris Jam Potential: Vegetative Protection: Lower Bank Channel Capacity: Bank Rock Content: Obstructions to Flow: Cutting: Deposition: 12 12 Channel Bottom 2 4 Rock Angularity: Brightness: Consolidation of Particles: 4 12 Bottom Size Distribution: Scouring and Deposition: 18 Aquatic Vegetation: 4 Channel Stability Evaluation Sediment Supply: Stream Bed Stability: Hi gh W/D Condition:

C4

Stream Type:

Rating - 102 Condition - Fair

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	Fourmile Canyon Creek, Reach - Reach 6						
Basin:	Drainage Area: 3148.8 acres	4.92	mi <sup>2</sup>				
Location:							
Twp.&Rge:	; Sec.&Qtr.: ;						
Cross-Sect	ion Monuments (Lat./Long.): 40.06286 Lat / 105.31333 Long	Date:	08/20/15				
Observers:	Lucas Babbitt	Valley Type:	VIII(b)				
	Bankfull WIDTH (W <sub>bkf</sub> )		1				
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	13.58	ft				
	Bankfull DEPTH (d <sub>bkf</sub> )		1				
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a						
	riffle section ( $d_{bkf} = A / W_{bkf}$ ).	1.44	ft				
	Bankfull X-Section AREA (A <sub>bkf</sub> )						
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	19.55	ft <sup>2</sup>				
		19.55	]1t -				
	Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	0.40	c. /c.				
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	9.43	ft/ft				
	Maximum DEPTH (d <sub>mbkf</sub> )						
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	2.57	ft				
	WIDTH of Flood-Prone Area (W <sub>fpa</sub> )		]				
	Twice maximum DEPTH, or (2 x d <sub>mbkf</sub> ) = the stage/elevation at which flood-prone area	05.40					
	WIDTH is determined in a riffle section.	65.49	ft				
	Entrenchment Ratio (ER)						
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH ( $W_{fpa}/W_{bkf}$ ) (riffle section).	4.82	ft/ft				
		7.02	] 1011				
	Channel Materials (Particle Size Index ) $D_{50}$ The $D_{50}$ particle size index represents the mean diameter of channel materials, as						
	sampled from the channel surface, between the bankfull stage and Thalweg						
	elevations.	24.48	mm				
	Water Surface SLOPE (S)		1				
	Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel						
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.01969	ft/ft				
		0.3.000	J.~				
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length						
	divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by						
	channel slope (VS / S).	1.03					
	Stream (See Figure 2.44)						
	Stream C4 (See Figure 2-	14)					

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	ream: Fourmile Canyon Creek					Location: Reach - Reach 6			
Ob	servers: Lucas Babbitt		Date:	08/20	/15	Valley Type: XIII Strea	m Type:	C4	
		Rive	er Rea	ch Dir	nens	sion Summary Data1			
	Riffle Dimensions*' ***	Mean	Min	Max	i.	Riffle Dimensions & Dimensionless Ratios****	Mean	Min	Max
*	Riffle Width (W <sub>bkf</sub> )	6.79	0	13.6	_	Riffle Cross-Sectional Area (A <sub>bkf</sub> ) (ft <sup>2</sup> )		0.00	
* *	Mean Riffle Depth (d <sub>bkf</sub> )	0.72	0	1.44	ft	Riffle Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	4.72	0.00	9.43
ns*	Maximum Riffle Depth (d <sub>max</sub> )	1.29	0	2.57	ft	Max Riffle Depth to Mean Riffle Depth (d <sub>max</sub> / d <sub>bkf</sub> )	0.893	0.000	1.785
nsio	Width of Flood-Prone Area (W <sub>fpa</sub> )	32.8	0	65.5	ft	Entrenchment Ratio (W <sub>fpa</sub> / W <sub>bkf</sub> )	2.412	0.000	4.823
ine	Riffle Inner Berm Width (W <sub>ib</sub> )	2.99	0	5.99	ft	Riffle Inner Berm Width to Riffle Width (W <sub>ib</sub> / W <sub>bkf</sub> )	0.221	0.000	0.441
Riffle Dimensions*, **, ***	Riffle Inner Berm Depth (d <sub>ib</sub> )	0.23	0	0.46	ft	Riffle Inner Berm Depth to Mean Depth $(d_{ib} / d_{bkf})$	0.161	0.000	0.322
Riff	Riffle Inner Berm Area (A <sub>ib</sub> )	1.39	0	2.78	ft <sup>2</sup>	Riffle Inner Berm Area to Riffle Area $(A_{ib} / A_{bkf})$	0.071	0.000	0.142
	Riffle Inner Berm W/D Ratio (W <sub>ib</sub> / d <sub>ib</sub> )	6.45	0	12.9				İ	
	Pool Dimensions*' *** *** Pool Width (W <sub>bkfp</sub> )	Mean	Min 13.3	Max 13.3	ft	Pool Dimensions & Dimensionless Ratios****  Pool Width to Riffle Width (W <sub>bktp</sub> / W <sub>bkt</sub> )	Mean 1.956	Min 1.956	Max 1.956
* *	Mean Pool Depth (d <sub>bkfp</sub> )	1.53	1.53	1.53	_	Mean Pool Depth to Mean Riffle Depth (d <sub>bkfp</sub> / d <sub>bkf</sub> )	2.125		
	Pool Cross-Sectional Area (A <sub>bkfp</sub> )	20.4	20.4	20.4	_	Pool Area to Riffle Area (A <sub>bkfp</sub> / A <sub>bkf</sub> )	2.082	•	
Pool Dimensions*, **,	Maximum Pool Depth (d <sub>maxp</sub> )	2.4	2.4	2.4		Max Pool Depth to Mean Riffle Depth (d <sub>maxp</sub> / d <sub>bkl</sub> )	3.333		
ensi	Pool Inner Berm Width (W <sub>ibn</sub> )	6.4	6.4	6.4		Pool Inner Berm Width to Pool Width (W <sub>ibp</sub> / W <sub>bkfp</sub> )	0.482		
Dim	Pool Inner Berm Depth (d <sub>ibo</sub> )	0.28		0.28		Pool Inner Berm Depth to Pool Depth (d <sub>ibp</sub> / d <sub>bkfp</sub> )	0.183	-	
0	Pool Inner Berm Area (A <sub>ibp</sub> )	1.79	1.79	1.79		Pool Inner Berm Area to Pool Area (A <sub>ibo</sub> / A <sub>bkfp</sub> )	0.088	-	
╚	Point Bar Slope (S <sub>ob</sub> )		0.000		<u>.                                      </u>	Pool Inner Berm Width/Depth Ratio (W <sub>ibp</sub> / d <sub>ibp</sub> )	####		
							'		
				Max		Bun Dimonoionloso Botico****	Maan	Min	
*	Run Dimensions* Run Width (W <sub>bkfr</sub> )	Mean 12.9	Min 12.9	12.9	ft	Run Dimensionless Ratios****  Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	Mean 1.900	Min 1.900	Max 1.900
sions*			1	ı	-		1.900	1.900	1.900
nensions*	Run Width (W <sub>bkfr</sub> )	12.9	12.9	12.9	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	1 1	1.900 1.972	1.900 1.972
Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )	12.9	12.9 1.42	12.9 1.42	ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )	1.900 1.972 1.869	1.900 1.972 1.869	1.900 1.972 1.869
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )	12.9 1.42 18.3	12.9 1.42 18.3	12.9 1.42 18.3	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	1.900 1.972	1.900 1.972 1.869	1.900 1.972 1.869
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )	12.9 1.42 18.3 2.97 9.09	12.9 1.42 18.3 2.97 9.09	12.9 1.42 18.3 2.97 9.09	ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )	1.900 1.972 1.869 4.125	1.900 1.972 1.869 4.125	1.900 1.972 1.869 4.125
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )	12.9 1.42 18.3 2.97 9.09	12.9 1.42 18.3 2.97	12.9 1.42 18.3 2.97 9.09	ft ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	1.900 1.972 1.869	1.900 1.972 1.869 4.125 Min	1.900 1.972 1.869 4.125
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6	12.9 1.42 18.3 2.97 9.09	12.9 1.42 18.3 2.97 9.09 Max 17.6	ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****	1.900 1.972 1.869 4.125 Mean	1.900 1.972 1.869 4.125 Min 2.598	1.900 1.972 1.869 4.125 Max 2.598
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> /d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6	12.9 1.42 18.3 2.97 9.09 Min 17.6	12.9 1.42 18.3 2.97 9.09 Max 17.6	ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios*****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	1.900 1.972 1.869 4.125 Mean 2.598	1.900 1.972 1.869 4.125 Min 2.598 1.583	1.900 1.972 1.869 4.125 Max 2.598 1.583
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6	12.9 1.42 18.3 2.97 9.09 Min 17.6	12.9 1.42 18.3 2.97 9.09 Max 17.6	ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	1.900 1.972 1.869 4.125 Mean 2.598 1.583 2.049	1.900 1.972 1.869 4.125 Min 2.598 1.583 2.049	1.900 1.972 1.869 4.125 Max 2.598 1.583 2.049
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6 1.14	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14	12.9 1.42 18.3 2.97 9.09 Max 17.6 1.14	ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )	1.900 1.972 1.869 4.125 Mean 2.598	1.900 1.972 1.869 4.125 Min 2.598 1.583 2.049	1.900 1.972 1.869 4.125 Max 2.598 1.583 2.049
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6 1.14 20	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14 20 1.55	12.9 1.42 18.3 2.97 9.09 Max 17.6 1.14 20 1.55	ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )	1.900 1.972 1.869 4.125 Mean 2.598 1.583 2.049 2.153 0.000	1.900 1.972 1.869 4.125 Min 2.598 1.583 2.049 2.153	1.900 1.972 1.869 4.125 Max 2.598 1.583 2.049 2.153 0.000
Glide Dimensions* Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxe</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6 1.14 20 1.55	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14 20 1.55	12.9 1.42 18.3 2.97 9.09 Max 17.6 1.14 20 1.55 15.5	ft ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )	1.900 1.972 1.869 4.125 Mean 2.598 1.583 2.049	1.900 1.972 1.869 4.125 Min 2.598 1.583 2.049 2.153 0.000	1.900 1.972 1.869 4.125 Max 2.598 1.583 2.049 2.153 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6 1.14 20 1.55 15.5	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14 20 1.55 15.5	12.9 1.42 18.3 2.97 9.09 Max 17.6 1.14 20 1.55 15.5 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> /W <sub>bkfg</sub> )	1.900 1.972 1.869 4.125 Mean 2.598 1.583 2.049 2.153 0.000 0.000	1.900 1.972 1.869 4.125 Min 2.598 1.583 2.049 2.153 0.000 0.000	1.900 1.972 1.869 4.125 Max 2.598 1.583 2.049 2.153 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6 1.14 20 1.55 15.5 0 0	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14 20 1.55 0 0	12.9 1.42 18.3 2.97 9.09  Max 17.6 1.14 20 1.55 0 0 0	ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>tbg</sub> / d <sub>tbg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>tbg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>tbg</sub> / d <sub>bkfg</sub> )	Mean 2.598 1.583 2.049 2.153 0.000 0.000 0.000	1.900 1.972 1.869 4.125 Min 2.598 1.583 2.049 2.153 0.000 0.000	1.900 1.972 1.869 4.125 Max 2.598 1.583 2.049 2.153 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6 1.14 20 1.55 15.5 0	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14 20 1.55 15.5 0	12.9 1.42 18.3 2.97 9.09  Max 17.6 1.14 20 1.55 0 0 0 Max	ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>bg</sub> / d <sub>bg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>bg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>bg</sub> / d <sub>bkfg</sub> )	1.900 1.972 1.869 4.125 Mean 2.598 1.583 2.049 2.153 0.000 0.000	1.900 1.972 1.869 4.125 Min 2.598 1.583 2.049 2.153 0.000 0.000 0.000	1.900 1.972 1.869 4.125  Max 2.598 1.583 2.049 2.153 0.000 0.000 0.000 Max
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6 1.14 20 1.55 15.5 0 0 Mean	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14 20 1.55 0 0 0 Min	12.9 1.42 18.3 2.97 9.09 Max 17.6 1.14 20 1.55 0 0 0 Max 0	ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>bg</sub> / d <sub>bg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>bg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>bg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>bg</sub> / A <sub>bkfg</sub> )	1.900 1.972 1.869 4.125 Mean 2.598 1.583 2.049 2.153 0.000 0.000 0.000	Min 2.598 1.583 2.049 2.153 0.000 0.000 0.000	1.900 1.972 1.869 4.125  Max 2.598 1.583 2.049 2.153 0.000 0.000 0.000 Max 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )	12.9 1.42 18.3 2.97 9.09  Mean 17.6 1.14 20 1.55 0 0 0  Mean 0	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14 20 1.55 0 0 Min 0	12.9 1.42 18.3 2.97 9.09  Max 17.6 1.14 20 1.55 0 0 0  Max 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	1.900 1.972 1.869 4.125 Mean 2.598 1.583 2.049 2.153 0.000 0.000 0.000 Mean 0.000	1.900 1.972 1.869 4.125 Min 2.598 1.583 2.049 2.153 0.000 0.000 0.000 Min 0.000	1.900 1.972 1.869 4.125  Max 2.598 1.583 2.049 2.153 0.000 0.000  Max 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	12.9 1.42 18.3 2.97 9.09 Mean 17.6 1.14 20 1.55 15.5 0 0 0 Mean 0	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14 20 1.55 0 0 Min 0	12.9 1.42 18.3 2.97 9.09 Max 17.6 1.14 20 1.55 0 0 0 Max 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / M <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )  Mean Step Depth to Riffle Depth (d <sub>bkfs</sub> / d <sub>bkf</sub> )	1.900 1.972 1.869 4.125 Mean 2.598 1.583 2.049 2.153 0.000 0.000 0.000 Mean 0.000	1.900 1.972 1.869 4.125  Min 2.598 1.583 2.049 2.153 0.000 0.000  Min 0.000 0.000 0.000	1.900 1.972 1.869 4.125  Max 2.598 1.583 2.049 2.153 0.000 0.000 0.000  Max 0.000 0.000 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	12.9 1.42 18.3 2.97 9.09  Mean 17.6 1.14 20 1.55 0 0 0  Mean 0 0	12.9 1.42 18.3 2.97 9.09 Min 17.6 1.14 20 1.55 0 0 0 Min 0 0	12.9 1.42 18.3 2.97 9.09  Max 17.6 1.14 20 1.55 0 0  Max 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>lbg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )  Step Area to Riffle Area (A <sub>bkfs</sub> / A <sub>bkf</sub> )	1.900     1.972     1.869     4.125	1.900 1.972 1.869 4.125  Min 2.598 1.583 2.049 2.153 0.000 0.000  Min 0.000 0.000 0.000	1.900 1.972 1.869 4.125  Max 2.598 1.583 2.049 2.153 0.000 0.000 0.000  Max 0.000 0.000 0.000

<sup>\*</sup>Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

<sup>\*\*</sup>Step-Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

<sup>\*\*\*</sup>Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

<sup>\*\*\*\*</sup>Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	Stream: Fourmile Canyon Creek Location: Reach - Reach 6													
Ob	Observers: Lucas Babbitt Date: 08/20/15 Valley Type: XIII Stream						m Type:	C4						
S				Riv	er Read	ch Sum	mary D	ata	.2					
Hydraulics	Streamflow: Estimated Mea	n Velocity	at Bank	full Sta	ge (u <sub>bkf</sub> )	)	5.6	56	ft/sec	Estimation Me	ethod		U/U*	
¥	Streamflow: Estimated Discharge at Bankfull Stage (Q <sub>bkf</sub> )					110.	575	cfs	Drainage Are	a	4.	92	mi <sup>2</sup>	
	Geometry	Mean	Min	Max			Dime	nsion	less Ge	ometry Ratio	s	Mean	Min	Max
	Linear Wavelength (λ)	262	95	430	ft	Linear V	Vavelen	gth to F	Riffle W	idth (λ / W <sub>bkf</sub> )		#####	#####	####
Ш	Stream Meander Length (Ln	1 <b>57</b>	157	157	ft	Stream	Meande	r Leng	th Ratio	$(L_m/W_{bkf})$		#####	#####	####
tern	Radius of Curvature (R <sub>c</sub> )	58	26	98	ft	Radius	of Curva	ture to	Riffle V	Vidth (R <sub>c</sub> / W <sub>bkt</sub>	·)	8.542	3.829	####
Pat	Belt Width (W <sub>blt</sub> )	41	30	52	ft	Meande	r Width	Ratio (	W <sub>blt</sub> / W	bkf)		6.038	4.418	7.658
Channel Pattern	Arc Length (L <sub>a</sub> )	0	0	0	ft	Arc Len	gth to Ri	ffle Wi	dth (L <sub>a</sub> /	W <sub>bkf</sub> )		0.000	0.000	0.000
S S	Riffle Length (L <sub>r</sub> )	36.8	10.1	63.5	ft	Riffle Le	ength to l	Riffle V	Vidth (L	r / W <sub>bkf</sub> )		5.420	1.483	9.355
	Individual Pool Length (L <sub>p</sub> )	10.9	9.5	12.1	ft	Individu	al Pool L	ength	to Riffle	Width (L <sub>p</sub> / W	<sub>bkf</sub> )	1.604	1.399	1.784
	Pool to Pool Spacing (P <sub>s</sub> )	53.9	18.7	89.2	ft	Pool to	Pool Spa	acing to	Riffle \	Width (P <sub>s</sub> / W <sub>bl</sub>	kf)	7.943	2.756	####
	Valley Slope (S <sub>val</sub> )	0.021	ft/ft	Averag	ne Wate	er Surface	e Slone	(S)	0.0	1969 ft/ft	Sinuosity (	(S <sub>val</sub> / S)		1.03
	Stream Length (SL)	781	ft	1	Length		Осюро	(0)	1	41 ft	Sinuosity (	, ,		1.05
		art 4.08			Max De		start	1.62	<u> </u>	<u> </u>	ght Ratio (B	<u>'</u>		2.52
		nd <b>5.13</b>	ŧ		(d <sub>max</sub> )	ptii	ř	2.52	Ť		BH / d <sub>max</sub> )	111()		2.04
	Facet Slopes	Mean	Min	Max	ı					Slope Ratios		Mean	Min	Max
	Riffle Slope (S <sub>rif</sub> )	0.041	0.030	0.053	ft/ft	Riffle SI	ope to A	verage	Water	Surface Slope	(S <sub>rif</sub> / S)	2.103	1.523	2.683
file	Run Slope (S <sub>run</sub> )		0.137			Run Slo	pe to Av	erage	Water S	Surface Slope	(S <sub>run</sub> / S)		6.956	
Channel Profile	Pool Slope (S <sub>p</sub> )	_	0.006							Surface Slope			0.328	
nne	Glide Slope (S <sub>g</sub> )	0.026	0.019	0.033	ft/ft	Glide SI	ope to A	verage	Water	Surface Slope	e (S <sub>g</sub> / S)	1.314	0.955	1.672
Cha	Step Slope (S <sub>s</sub> )	0.000	0.000	0.000	ft/ft	Step Slo	pe to Av	/erage	Water	Surface Slope	(S <sub>s</sub> /S)	0.000	0.000	0.000
	Max Depths <sup>a</sup>	Mean	Min	Max	le.	M D:#				th Ratios	/ -l \	Mean	Min	Max
	Max Riffle Depth (d <sub>maxrif</sub> )	0.78	0.71	0.85						e Depth (d <sub>maxrit</sub>			0.986	1.18
	Max Run Depth (d <sub>maxrun</sub> )	1.19		1.29		ļ				Depth (d <sub>maxrun</sub>			1.417	
	Max Pool Depth (d <sub>maxp</sub> )	ı.	1.23	•						Depth (d <sub>maxp</sub>		1	1.708	
	Max Glide Depth (d <sub>maxg</sub> )	0.76		0.85	<u> </u>					e Depth (d <sub>maxg</sub>		<u>.                                    </u>	0.806	<u> </u>
	Max Step Depth (d <sub>maxs</sub> )	0	0	0	ft	Max Ste	p Depth	to Mea	an Riffle	e Depth (d <sub>maxs</sub> /	d <sub>bkf</sub> )	0	0	0
		Reach		fle <sup>c</sup>	E	Bar			ach <sup>b</sup>	Riffle <sup>c</sup>	Bar	Protru	usion He	!
sls	% Silt/Clay	0		0			D <sub>16</sub>		89	6.08	i	i		mm
Channel Materials	% Sand	17	1	3	:		D <sub>35</sub>		.64	20.4		<u> </u>		mm
∥ Ma	% Gravel	55		3			D <sub>50</sub>		.48	46.58				mm
	% Cobble	27		7	<u> </u>		D <sub>84</sub>		.29	128		<u> </u>		mm
Cha	% Boulder	1	<u> </u>	2			D <sub>95</sub>		5.33	180				mm
	% Bedrock	0		0			D <sub>100</sub>	36	1.99	511.99				mm

a Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

<sup>&</sup>lt;sup>b</sup> Composite sample of riffles and pools within the designated reach.

<sup>&</sup>lt;sup>c</sup> Active bed of a riffle. 
<sup>d</sup> Height of roughness feature above bed.

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

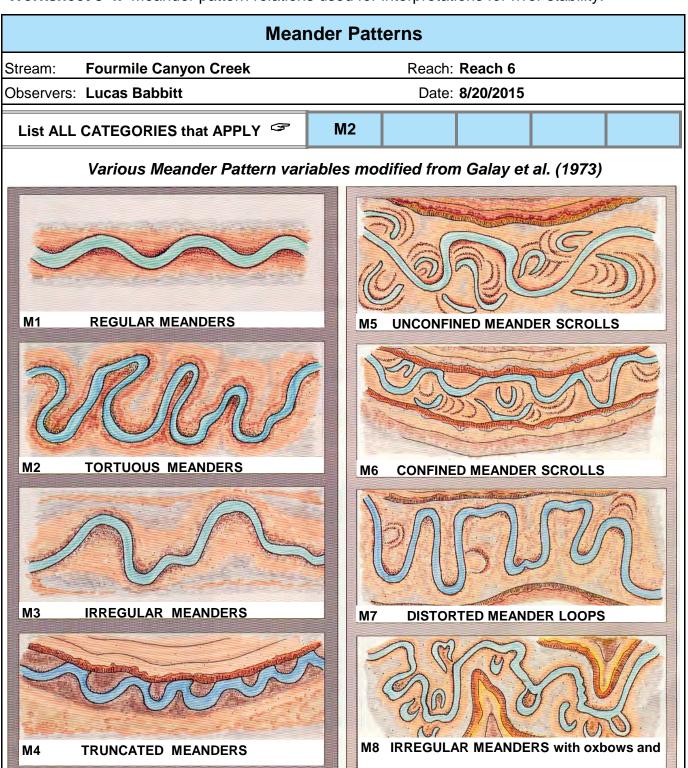
biological interpretations.										
FLOW REGIME										
Stream:	Fourmile Canyon Creek Location: Reach 6									
Observers: Lucas Babbitt Date: 8/20/2015										
List ALL COMBINATIONS that P 1 2 8										
APPLY										
General Category										
E	Ephemeral stream channels: Flows only in response to precipitation									
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.									
I	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.									
Р	Perennial stream channels: Surface water persists yearlong.									
Specific (	Category									
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.									
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.									
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.									
4	Streamflow regulated by glacial melt.									
5	Ice flows/ice torrents from ice dam breaches.									
6	Alternating flow/backwater due to tidal influence.									
7	Regulated streamflow due to diversions, dam release, dewatering, etc.									
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.									
9	Rain-on-snow generated runoff.									

Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

Stream Size and Order									
Stream: Fourmile Canyon Creek									
Location:	Location: Reach 6								
Observers:	Lucas Babbitt								
Date:	8/20/2015								
Stream Siz	e Category and	l Order 🤝	S-4(2)						
Category		ZE: Bankfull dth	Check (✓) appropriate						
	meters	feet	category						
S-1	0.305	<1							
S-2	0.3 – 1.5	1 – 5							
S-3	1.5 – 4.6	5 – 15							
S-4	4.6 – 9	15 – 30	>						
S-5	9 – 15	30 – 50							
S-6	15 – 22.8	50 – 75							
S-7	22.8 – 30.5	75 – 100							
S-8	30.5 – 46	100 – 150							
S-9	46 – 76	150 – 250							
S-10	76 – 107	250 – 350							
S-11	107 – 150	350 – 500							
S-12	150 – 305	500 – 1000							
S-13	>305	>1000							
	Stream Order								
Add categoric	Add categories in parenthesis for specific stream order of								

reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



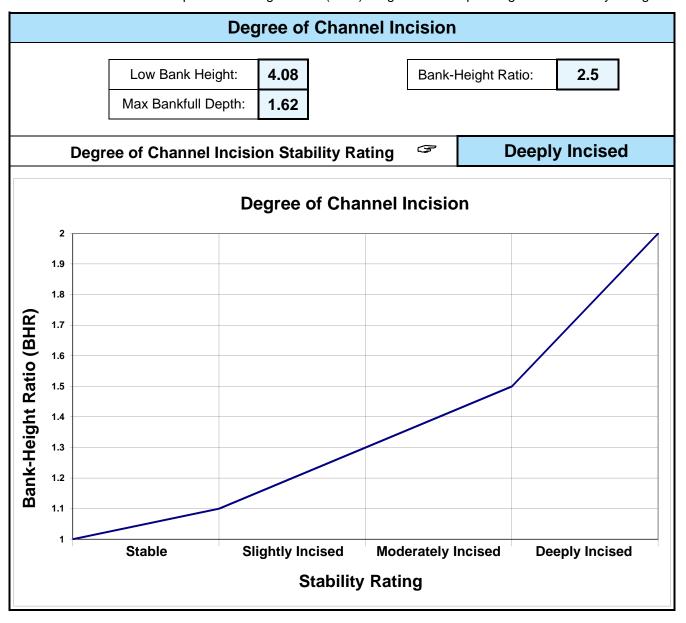
**Worksheet 3-5.** Depositional patterns used for stability assessment interpretations.

Depositional Patterns									
Stream: Fourmile Canyon Creek	Reach: Reach 6								
Observers: Lucas Babbitt	Date: 8/20/2015								
List ALL CATEGORIES that APPLY  B5 B7									
Various Depositional Features	modified from Galay et al. (1973)								
B1 POINT BARS  B5 DIAGONAL BARS									
B2 POINT BARS with Few MID-CHANNEL BARS	B6 Main Channel Branching with Numerous MID-CHANNEL BARS and Islands								
B3 NUMEROUS MID-CHANNEL BARS	B7 SIDE BARS AND MID-CHANNEL BARS with Length Exceeding 2 to 3 Channel Widths								
B4 SIDE BARS	B8 DELTA BARS								

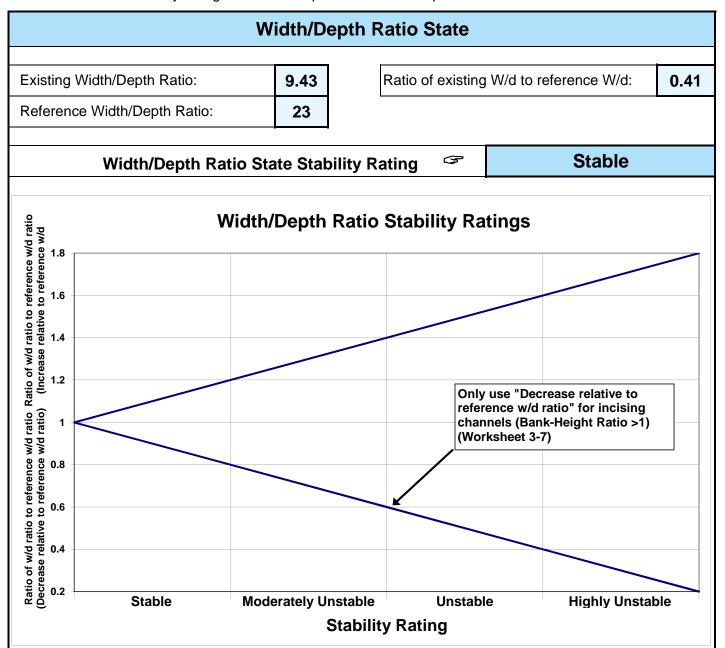
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

	Channel Blockages							
Stream		anyon Creek Location: Reach 6						
Obser	rvers: Lucas Babl	bitt Date: 8/20/2015						
Desc	ription/extent	Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.	Check (√) all that apply					
D1 None Minor amounts of small, floatable material.		Minor amounts of small, floatable material.						
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.						
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.						
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.	V					
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.						
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.						
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.						
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.						
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.						
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	Y					

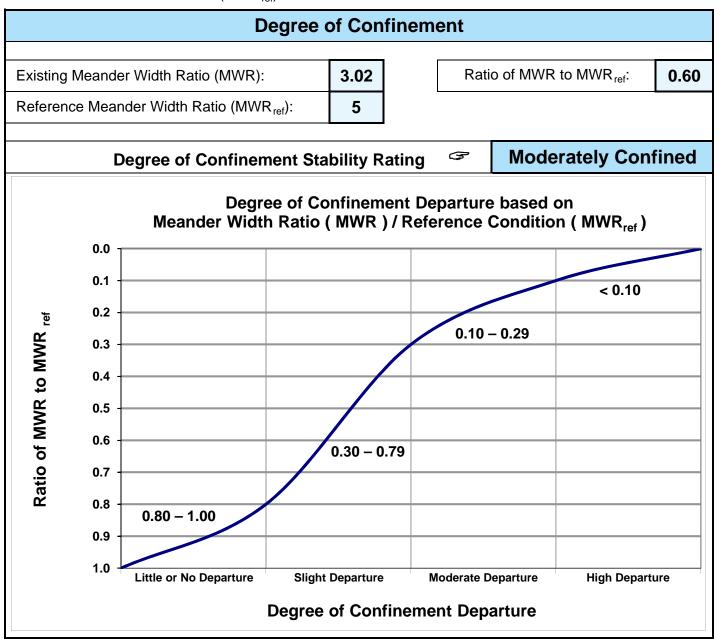
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	Stream Type:	C4		
Location:		Reach 6			Valley Type:	XIII		
Observe	rs:	Lucas Bab	bitt		Date:	08/20/2015		
Enter Required Information for Existing Condition								
46	.6	D 50	Median particle size of	riffle bed material (mn	n)			
0.0	0	D 50	Median particle size of	bar or sub-pavement	sample (mm	1)		
0.8	02	D <sub>max</sub>	Largest particle from b	oar sample (ft)	244.475	(mm)	304.8 mm/ft	
0.01	969	S	Existing bankfull water	surface slope (ft/ft)				
1.4	14	d	Existing bankfull mear	n depth (ft)				
1.6	<b>3</b> 5	$\gamma_s - \gamma / \gamma$	Immersed specific gra	vity of sediment				
Select t	he App	ropriate Ec	quation and Calculate (	Critical Dimensionless	Shear Stre	ess		
0.0	00	$D_{50}/D_{50}^{\wedge}$	Range: 3-7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	) -0.872	
5.2	25	D <sub>max</sub> /D <sub>50</sub>	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>	
		τ*	Bankfull Dimensionless	Shear Stress	EQUATIC	ON USED:	N/A	
Calculat	te Bank	full Mean D	epth Required for Entra	inment of Largest Par	ticle in Bar	Sample		
		d	Required bankfull mean	depth (ft) $d = \frac{\tau}{T}$	$\frac{*(\gamma_s-1)D_n}{S}$	use (use	D <sub>max</sub> in ft)	
Calcula	te Banl	kfull Water	Surface Slope Require	d for Entrainment of	Largest Par	rticle in Ba	r Sample	
		s	Required bankfull water	surface slope (ft/ft) <b>S</b> =	$=\frac{\tau^*(\gamma_s-1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)	
		Check:	☐ Stable ☑ Aggradi	ng   Degrading				
Sedime	nt Com	petence Us	sing Dimensional Shea	r Stress				
1.7	69		hear stress $\tau = \gamma dS$ (lbs/ft		dius, R, with	mean depth,	d)	
Shields	CO	•	d = existing depth, S = exis	-				
141.3	231.3	Predicted I	largest moveable particle s	ize (mm) at bankfull shea	ar stress τ (F	igure 3-11)		
Shields <b>2.995</b>	co <b>1.908</b>	Predicted :	shear stress required to ini	tiate movement of measu	ıred $D_{\sf max}$ (mı	m) (Figure 3	-11)	
Shields	СО	Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm)					τ	
2.44	1.55 $\tau$ = predicted shear stress, $\gamma$ = 62.4, S = existing slope					<i>y</i> S		
Shields	CO			required to initiate movement of measured $D_{\text{max}}$ (mm) $\mathbf{S} = \frac{\mathbf{T}}{\mathbf{T}}$				
0.0333	0.0212	•	ted shear stress, $\gamma = 62.4$ ,			γd		
<u></u>		Check:	☐ Stable ☑ Aggradi	ng   Degrading				

**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type: C4		
Location:	Reach 6	Valley Type: XIII		
Observers:	Lucas Babbitt	Date: 08/20/2015		
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)		
	eam Type at potential, $(C \rightarrow E)$ , ), $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	☐ Stable		
(E→C),	(B→High W/d B), (C→High W/d C)	✓ Moderately Unstable		
(G <sub>c</sub>	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	☐ Unstable		
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	☐ Highly Unstable		

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Canyon Creek Stream Type: C4								
Location: Reach 6 Valley Type: XIII								
Observers: Lucas Babbitt Date: 08/20/2015								
Lateral stability criteria		Lateral Stabilit	ty Categories					
(choose one stability category for each criterion 1–5)	Stable	Moderately Unstable	Unstable	Highly Unstable	Selected Points (from each row)			
W/d Ratio State 1 (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	2			
,	(2)	(4)	(6)	(8)				
Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	В3	B5, B6, B7	4			
,	(1)	(2)	(3)	(4)				
Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		3			
,	(1)		(3)					
Streambank Erosion: 4 Unit Rate (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07				
(Worksheet 3-13)	(2)	(4)	(6)	(8)				
Degree of Confinement 5 (MWR / MWR <sub>ref</sub> )	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	2			
(Worksheet 3-9)	(1)	(2)	(3)	(4)				
Total Points								
Lateral Stability Category Point Range								
Overall Lateral Stability Category (use total points and check stability rating)  Moderately Unstable Unstable Unstable 10 - 12								

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Stream: Fourmile Canyon Creek Stream Type: C4								
Location: Reach 6 Valley Type: XIII								
Observers: Lucas Babb	tt		Date:	08/20/2015				
Vertical Stability	Vertical Stabi	lity Categories fo	r Excess Deposition	on / Aggradation	Selected			
Criteria (choose one stability category for each criterion 1–6)	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	Points (from each row)			
Sediment 1 competence (Worksheet 3-14)	Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	6			
	(2)	(4)	(6)	(8)				
Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand	6			
	(2)	(4)	(6)	(8)				
W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	2			
	(2)	(4)	(6)	(8)				
Stream Succession 4 States (Worksheet 3 16)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{array}{c} (C \! \to \! High \ W\!/d \ C), \\ (B \! \to \! High \ W\!/d \ B), \\ (C \! \to \! F), (G_c \! \to \! F), \\ (G \! \to \! F_b) \end{array} $	(C→D), (F→D)	2			
	(2)	(4)	(6)	(8)				
Depositional 5 Patterns (Workshee	B1	B2, B4	B3, B5	B6, B7, B8	1			
3-5)	(1)	(2)	(3)	(4)				
Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	4			
	(1)	(2)	(3)	(4)				
Total Points								
Vertical Stability Category Point Range for Excess Deposition / Aggradation								
Vertical Stability for Excess Deposition / Aggradation   No Deposition   Aggradation    No Deposition   Aggradation    No Deposition   Aggradation    No Deposition   Aggradation    Aggradation    Aggradation    Aggradation    Aggradation    Aggradation    > 30    The position								

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream: Fourmile Canyon Creek Stream Type: C4								
Lo	Location: Reach 6 Valley Type: XIII							
Ob	Observers: Lucas Babbitt Date: 08/20/2015							
	ertical Stability	Vertical Stabil	ity Categories for	Channel Incision	n / Degradation	Selected		
S	Criteria (choose one stability category for each criterion 1–5)	Not Incised	Slightly Incised	Moderately Incised	Degradation	Points (from each row)		
1	Sediment Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved	2		
		(2)	(4)	(6)	(8)			
2	Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	2		
		(2)	(4)	(6)	(8)			
3	Degree of Channel Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	8		
	(Worksheet 9-1)	(2)	(4)	(6)	(8)			
4	Stream Succession States (Worksheets 3-16 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$	4		
		(2)	(4)	(6)	(8)			
5	Confinement (MWR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	2		
	(Worksheet 3-9)	(1)	(2)	(3)	(4)			
					Total Points	18		
Vertical Stability Category Point Range for Channel Incision / Degradation								
D p	Pertical Stability for Channel Incision/Degradation (use total points and check tability rating)	Not Incised < 12 □	Slightly Incised 12 – 18	Moderately Incised 19 – 27 □	Degradation > 27 □			

**Worksheet 3-20.** Channel enlargement prediction summary.

Str	Stream: Fourmile Canyon Creek Stream Type: C4						
Location: Reach 6 Valley Type: XIII							
Observers: Lucas Babbitt Date: 08/20/2015							
	Channel Enlargement	Char	nel Enlargement	<b>Prediction Categ</b>	ories		
(c	Prediction Criteria choose one stability ategory for each criterion –4)	No Increase	Slight Increase	Moderate Increase	Extensive	Selected Points (from each row)	
1	Successional Stage Shift (Worksheet 3-16)	Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{c} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $	2	
		(2)	(4)	(6)	(8)		
2	Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	4	
		(2)	(4)	(6)	(8)		
3	Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	6	
	(Worksheet 3-18)	(2)	(4)	(6)	(8)		
4	Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation	4	
	(Worksheet 3-19)	(2)	(4)	(6)	(8)		
	Total Points						
	Category Point Range						
P p	Channel Enlargement Prediction (use total oints and check stability ating)	No Increase < 11	Slight Increase 11 – 16 ✓	Moderate Increase 17 – 24 □	Extensive > 24 □		

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Stream: Fourmile Canyon Creek				Stream Type:	C4
Location: Reach 6 Valle				Valley Type:	XIII
Observers:				Date:	08/20/2015
Overall Sediment Supply Prediction Criteria (choose corresponding points for each criterion 1–5)		Stability Rating		Points	Selected Points
1	Lateral Stability (Worksheet 3-17)	Stable 1			
		Mod. Unstable		2	2
		Unstable		3	
		Highly Unstable		4	
2	Vertical Stability Excess Deposition or Aggradation (Worksheet 3-18)	No Deposition		1	3
		Mod. Deposition		2	
		Excess Deposition		3	
		Aggradation		4	
3	Vertical Stability Channel Incision or Degradation (Worksheet 3-19)	Not Incised		1	2
		Slightly Incised		2	
		Mod. Incised		3	
		Degradation		4	
4	Channel Enlargement Prediction (Worksheet 3-20)	No Increase		1	2
		Slight Increase		2	
		Mod. Increase		3	
		Extensive		4	
5	Pfankuch Channel Stability (Worksheet 3- 10)	Good: Stable		1	2
		Fair: Mod. Unstable		2	
		Poor: Unsta	able	4	
Total Points					11
L		Category Point Range			
Overall Sediment Supply Rating (use total points and check stability rating)		<i>Low</i> < 6 □	<i>Moderate</i> 6 – 10 □	<i>High</i> 11 – 15 <b>▽</b>	Very High > 15 □

Worksheet 3-22. Summary of stability condition categories.

	Α	BCDEFGHIJI	<pre></pre>	TUVWXYZ	AA AB AC AD AE AF	AGAH AI AJAKALAM
1	Stream:	Fourmile Canyon Creek		Location: Reach 6		
2	Observers:	Lucas Babbitt	Date: 8/20/2015	Stream Type: C4	Valley Type:	XIII
3	Channel Dimension	Depth (ft):	II Width t): Cross-Section Area (ft²):	19.55 Width/Depth Ratio:	9.43 Entren Ratio:	chment 4.82
5 6	Channel Pattern	Mean: λ/W <sub>bkf</sub> : <b>19.29 7.00 - 31.6</b> 0	b   11.56 - 11.56	1.91 - 7.22	WR: <b>3.02</b> <b>2.21 - 3.83</b>	Sinuosity: 1.03
7	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec): <b>5.6</b>	Discharge (Q <sub>bkf</sub> ):	575 Estimation Method:	U/U*	Drainage Area (mi²):
9			/Pool Plane Bed □	Convergence/Divergence		nes/Smooth Bed
10	River Profile & Bed	Max Riffle Pool	Depth Ratio (max Riffle	Pool Pool-to- Ra	tio	Slope
11 12	Features	Bankfull 2.57 2.4	to mean): 1.78	1.57 Pool Spacing: 53.		į Surrace:
13		Riparian Current Compositi			rks: Condition, Vigor & Us	•
14		Vegetation   See description	Same as existing	native speci Density a		
15		Flow P12 Stream Size	S-4(2) Meander	M2 Depositional	BAR/	/Channel D4 D10
16		Regime: 8 & Order:	Patterns:	Patterns:	Віоска	ges:
17	Level III Stream	Degree of Incision 2.52	Degree of Incision  Deepl		kuch Stability Rating	102 -
18	Stability Indices	(Bank-Height Ratio):	Stability Rating:		djective Rating):	40
19 20		Width/depth Ratio (W/d): 9.43 Reference Ratio (W/d)	//d <sub>ref</sub> ): 23 (W/d) / (W	· · · · · · · · · · · · · · · · · · ·	Stability Rating	g: Stable
21 22			leference 5 Degree of (MWR / M'	confinement WR <sub>ref</sub> ): <b>0.6</b>	MWR / MWR <sub>re</sub> Stability Rating	-
23	Bank Erosion	Length of Reach 0	Annual Streambank Erosion Rat	e: Curve Used:	Remarks:	
24	Summary	Studied (ft):	<b>0</b> (tons/yr) <b>0</b> (tons/yr)	ns/yr/ft)		
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity ☐ Ins	sufficient Capacity	s Capacity Remar	ks:	
26 27	Entrainment/ Competence	Largest Particle from <b>244.475</b> Bar Sample (mm):	$\sigma$ $\tau=$ 1.908 $\tau^*=$ 0	Existing Depth: 1.44 Require Depth:	ed 1.55 Existing Slope:	#### Required Slope: ####
28 29	Successional Stage Shift	<b>→</b> →	$\rightarrow$ $\rightarrow$	Existing St State (Typ		tential Stream ate (Type):
30	Lateral Stability	☐ Stable ☑ Mod. U	Instable Unstable		Remarks/causes:	по (туро).
31	Vertical Stability (Aggradation)	☐ No Deposition ☐ Mod. L	Deposition 🔽 Ex. Deposition	☐ Aggradation	Remarks/causes:	
32	Vertical Stability (Degradation)	☐ Not Incised ☑ Slightly	/ Incised	Degradation	Remarks/causes:	
33	Channel Enlargement	No Increase  ✓ Slight	Increase	☐ Extensive	Remarks/causes:	
34 35	Sediment Supply (Channel Source)	Low   Moder	rate 🖟 High 🗀 Very Hi	Remarks/causes:		

RIVERMORPH PFANKUCH SUMMARY River Name: Reach 7 Reach Name: Assesments Survey Date: 05/13/2015 Upper Bank 8 9 Landform Slope: Mass Wasting: Debris Jam Potential: Vegetative Protection: Lower Bank 3 4 Channel Capacity: Bank Rock Content: Obstructions to Flow: 1 Cutting: Deposition: 12 12 Channel Bottom 2 4 Rock Angularity: Brightness: Consolidation of Particles: 4 Bottom Size Distribution: 12 Scouring and Deposition: 18 Aquatic Vegetation: 4 Channel Stability Evaluation

Sediment Supply: Stream Bed Stability: Hi gh

W/D Condition:

Stream Type: F4B

Rating - 106 Condition - Good

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	Fourmile Canyon Creek, Reach - Reach 7				
Basin:	Drainage Area: 3148.8 acres	4.92	mi <sup>2</sup>		
Location:					
Twp.&Rge:	; Sec.&Qtr.: ;				
Cross-Sect	ion Monuments (Lat./Long.): 40.06375 Lat / 105.31125 Long	Date:	08/20/15		
Observers:	Lucas Babbitt	Valley Type:	VIII(b)		
	Bankfull WIDTH (W <sub>bkf</sub> ) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	16.58	ft		
	<b>Bankfull DEPTH (</b> $d_{bkf}$ <b>)</b> Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ( $d_{bkf} = A / W_{bkf}$ ).	1.33	ft		
	Bankfull X-Section AREA (A <sub>bkf</sub> )  AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	22	ft <sup>2</sup>		
	Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )  Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	12.47	ft/ft		
	<b>Maximum DEPTH (d</b> <sub>mbkf</sub> )  Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.				
	<b>WIDTH of Flood-Prone Area (W</b> <sub>fpa</sub> ) Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	22.84	ft		
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH ( $W_{fpa}/W_{bkf}$ ) (riffle section).	1.38	ft/ft		
	Channel Materials (Particle Size Index ) $D_{50}$ The $D_{50}$ particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	29.65	mm		
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.04992	ft/ft		
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.08			
	Stream Type  F 4b  (See Figure 2-	-14)			

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

	eam: Fourmile Canyon Creek					Location: Reach - Reach 7		
Observers: Lucas Babbitt Date: 08/20/15 Valley Type: XIII Stream Type:								
		Rive	er Rea	ch Dir	nens	sion Summary Data1		
	Riffle Dimensions*, **, ***	Mean	Min	Max	i.	Riffle Dimensions & Dimensionless Ratios****		Max
* *	Riffle Width (W <sub>bkf</sub> )	16.6	16.6	16.6		Riffle Cross-Sectional Area (A <sub>bkf</sub> ) (ft²)	22.00 22.00 2	
* * * .	Mean Riffle Depth (d <sub>bkf</sub> )	1.33	1.33	1.33	•	Riffle Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	12.47 12.47 1	
Riffle Dimensions*	Maximum Riffle Depth (d <sub>max</sub> )	2.34	2.34	2.34	<u> </u>	Max Riffle Depth to Mean Riffle Depth (d <sub>max</sub> / d <sub>bkf</sub> )	1.759 1.759 1	
ensi	Width of Flood-Prone Area (W <sub>fpa</sub> )	22.8	22.8	22.8	<del>:</del>	Entrenchment Ratio (W <sub>fpa</sub> / W <sub>bkf</sub> )	1.378 1.378 1	
Ë	Riffle Inner Berm Width (W <sub>ib</sub> )	0	0	<u> </u>	ft	Riffle Inner Berm Width to Riffle Width (W <sub>ib</sub> / W <sub>bkf</sub> )	0.000 0.000 0	
fle	Riffle Inner Berm Depth (d <sub>ib</sub> )	0	0	l	ft	Riffle Inner Berm Depth to Mean Depth (d <sub>ib</sub> / d <sub>bkf</sub> )	0.000 0.000 0	
	Riffle Inner Berm Area (A <sub>ib</sub> )	0	0	0	ft <sup>2</sup>	Riffle Inner Berm Area to Riffle Area (A <sub>ib</sub> / A <sub>bkf</sub> )	0.000 0.000 0	0.000
	Riffle Inner Berm W/D Ratio (W <sub>ib</sub> / d <sub>ib</sub> )	0	0	0				
	Pool Dimensions*' *** Pool Width (W <sub>bkfp</sub> )	Mean 13.8	Min 13.8	Max 13.8	ft	Pool Dimensions & Dimensionless Ratios****  Pool Width to Riffle Width (W <sub>bkfp</sub> / W <sub>bkf</sub> )	Mean Min	Max
* *	Mean Pool Depth (d <sub>bkfp</sub> )	1.27	1.27	1.27		Mean Pool Depth to Mean Riffle Depth (d <sub>bkfp</sub> / d <sub>bkf</sub> )	0.955 0.955 0	
*	Pool Cross-Sectional Area (A <sub>bkfp</sub> )	17.5	17.5	17.5	•	Pool Area to Riffle Area (A <sub>bkfp</sub> / A <sub>bkf</sub> )	0.796 0.796 0	
,suc	Maximum Pool Depth (d <sub>maxp</sub> )	2.19	2.19	2.19	+	Max Pool Depth to Mean Riffle Depth (d <sub>maxp</sub> / d <sub>bkf</sub> )	1.647 1.647 1	
nsic	Pool Inner Berm Width (W <sub>ibp</sub> )	9.62	9.62			Pool Inner Berm Width to Pool Width (W <sub>ibp</sub> / W <sub>bkfp</sub> )	0.696 0.696 0	
Dimensions*, **, ***	Pool Inner Berm Depth (d <sub>ibp</sub> )	1.05	<u> </u>	1.05	<u>.                                      </u>		0.827 0.827 0	
Pool [	Pool Inner Berm Area (A <sub>ibp</sub> )		! !	10.1	-	Pool Inner Berm Depth to Pool Depth (d <sub>ibp</sub> / d <sub>bkfp</sub> )  Pool Inner Berm Area to Pool Area (A <sub>ibp</sub> / A <sub>bkfp</sub> )	0.577 0.577 0	
•		10.1	10.1 0.000			Pool Inner Berm Width/Depth Ratio (W <sub>ibp</sub> / d <sub>ibp</sub> )		
	Point Bar Slope (S <sub>pb</sub> )	0.000	0.000	0.000	π/π	Poor inner berni widin/bepin kalio (w <sub>ibp</sub> / d <sub>ibp</sub> )	9.151 9.151 9	9.151
	Run Dimensions*	Mean	Min	May		Dun Dimensionless Detice****		B4
		1	Min	Max	i.e.	Run Dimensionless Ratios****		Max
ons*	Run Width (W <sub>bkfr</sub> )	0	0	0	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	0.000 0.000 0	0.000
ensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )	0	0	0	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )	0.000 0.000 0 0.000 0.000 0	0.000
Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )	0 0	0 0	0 0	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	0.000 0.000 C 0.000 0.000 C 0.000 0.000 C	0.000
un Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )	0 0 0	0 0 0	0 0 0	ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )	0.000 0.000 0 0.000 0.000 0	0.000
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )	0 0	0 0	0 0	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	0.000 0.000 C 0.000 0.000 C 0.000 0.000 C	0.000
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*	0 0 0 0 0 0 Mean	0 0 0 0 0	0 0 0 0 0 Max	ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****	0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0	0.000 0.000 0.000 0.000 Max
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )	0 0 0 0 0 0 Mean	0 0 0 0 0 Min 0	0 0 0 0 0 Max 0	ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0  Mean Min 0.000 0.000 0	0.000 0.000 0.000 0.000 Max 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )	0 0 0 0 0 0 Mean 0	0 0 0 0 0 Min 0	0 0 0 0 0 0 Max 0	ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 Mean Min 0.000 0.000 0	0.000 0.000 0.000 0.000 Max 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )	0 0 0 0 0 0 Mean 0	0 0 0 0 0 Min 0	0 0 0 0 0 Max 0	ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )	0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0  Mean Min 0.000 0.000 0 0.000 0.000 0	0.000 0.000 0.000 0.000 0.000 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )	0 0 0 0 0 0 Mean 0 0	0 0 0 0 0 0 Min 0 0	0 0 0 0 0 Max 0 0	ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )	0.000   0.000   0   0.000   0   0   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )	0 0 0 0 0 0 Mean 0 0 0	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 Max 0 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )	0.000   0.000   0   0.000   0.000   0   0.000   0.000   0   0.000   0.000   0   0.000   0.000   0   0.000   0.000   0   0.000   0.000   0   0.000   0.000   0   0.000   0.000   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000
Glide Dimensions* Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>lbg</sub> )	0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> / W <sub>bkfg</sub> )	0.000   0.000   0   0.000   0   0   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>ibg</sub> / d <sub>bkfg</sub> )	0.000   0.000   0   0.000   0   0   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>lbg</sub> )	0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> / W <sub>bkfg</sub> )	0.000   0.000   0   0.000   0   0   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>lbg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )	0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>bkfg</sub> / A <sub>bkfg</sub> )	0.000   0.000   0   0.000   0   0   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )	0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / M <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	0.000   0.000   0   0.000   0   0   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>lbg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfg</sub> )	0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>bkfg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	0.000   0.000   0   0.000   0   0   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 Max 1.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>bg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )  Step Cross-Sectional Area (A <sub>bkfs</sub> )	0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 16.6 1.33	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 16.6 1.33	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / M <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )  Step Depth to Riffle Depth (d <sub>bkfs</sub> / d <sub>bkf</sub> )	0.000   0.000   0   0.000   0   0   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.000 1.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>lbg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfg</sub> )	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>bkfg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	0.000   0.000   0   0.000   0   0   0	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1.000 1.000

<sup>\*</sup>Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

<sup>\*\*</sup>Step-Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

<sup>\*\*\*</sup>Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

<sup>\*\*\*\*</sup>Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	Stream: Fourmile Canyon Creek Location: Reach - Reach 7															
Ob	Observers: Lucas Babbitt				Date:	08/20/	15		Valle	y Type:	XIII		Strear	n Type:	F 4b	
cs	S				Rive	er Read	ch Sumi	mary D	ata	.2						
Hydraulics	Streamflow: Estimated Mean Velocity			t Bank	full Sta	ge (u <sub>bkf</sub> )	)	9.6	86	ft/sec	Estim	ation Me	thod		U/U*	
Ě	Streamflow: Estimated	Discharge	at Ba	nkfull S	Stage (	Q <sub>bkf</sub> )		213.	092	cfs	Drain	age Area	ı	4.	92	mi <sup>2</sup>
	Geometry	N	/lean	Min	Max			Dime	nsion	ess Ge	ometi	ry Ratios	•	Mean	Min	Max
	Linear Wavelength (λ)	_	135	135	135	ft	Linear W							8.142	8.142	8.142
	Stream Meander Lengt	th (L <sub>m</sub> ) 1	157	157	157	ft	Stream I	Meande	r Lengt	h Ratio	(L <sub>m</sub> / \	N <sub>bkf</sub> )		9.469	9.469	9.469
tern	Radius of Curvature (R	(c)	69	39	98	ft	Radius o	of Curva	ture to	Riffle V	Vidth (	R <sub>c</sub> / W <sub>bkf</sub> )		4.162	2.352	5.911
Channel Pattern	Belt Width (W <sub>blt</sub> )		16	16	16	ft	Meande	r Width I	Ratio (	W <sub>blt</sub> / W	bkf)			0.965	0.965	0.965
nne	Arc Length (L <sub>a</sub> )		0	0	0	ft	Arc Leng	gth to Ri	ffle Wi	dth (L <sub>a</sub> /	W <sub>bkf</sub> )			0.000	0.000	0.000
Cha	Riffle Length (L <sub>r</sub> )	4	12.7	42.7	42.7	ft	Riffle Le	ngth to F	Riffle V	/idth (L	r / W <sub>bkf</sub>	:)		2.572	2.572	2.572
	Individual Pool Length	(L <sub>p</sub> ) 8	3.72	8.4	9.03	ft	Individua	al Pool L	ength.	to Riffle	Width	n (L <sub>p</sub> / W <sub>t</sub>	<sub>kf</sub> )	0.526	0.507	0.545
	Pool to Pool Spacing (I	P <sub>s</sub> ) 4	41.1	27	55.2	ft	Pool to F	Pool Spa	acing to	Riffle \	Width	(P <sub>s</sub> /W <sub>bk</sub>	;)	2.481	1.630	3.331
	Valley Slope (S <sub>val</sub> )	0.056	6	ft/ft	Averac	ne Wate	r Surface	e Slope (	(S)	0.04	4992	ft/ft	Sinuosity (	S <sub>val</sub> / S)		1.08
	Stream Length (SL)	480	<u> </u>	ft		Length				1	62	ft	Sinuosity (			1.04
	Low Bank Height	start 3	<u></u>			Max De	pth	start	2.49	ft	В		ht Ratio (Bl			1.21
	(LBH)	end 4				(d <sub>max</sub> )		end	2.2	ft			H / d <sub>max</sub> )		end	2.01
	Facet Slopes		/lean	Min	Max	!		imensio			•			Mean	Min	Max
	Riffle Slope (S <sub>rif</sub> )		_		0.059		Riffle Slo						,		1.186	
Jile	Run Slope (S <sub>run</sub> )	-			0.309							e Slope (			2.406	<del></del>
Channel Profile	Pool Slope (S <sub>p</sub> )	_	-		0.002		1					e Slope			0.018	
auue	Glide Slope (S <sub>g</sub> )				0.027			•				ce Slope	. 9	0.531		<u> </u>
පී	Step Slope (S <sub>s</sub> )	0.	.000		0.000	ft/ft	Step Slo	<u> </u>					(S <sub>s</sub> /S)	0.000	0.000	0.000
	Max Depths <sup>a</sup> Max Riffle Depth (d <sub>maxri</sub>		Mean	Min	Max 0.87	ft	Max Riff			ss Dep			/ d)	Mean	Min 0.654	Max
	Max Run Depth (d <sub>maxru</sub>		0.87 1.01	0.87	1.26		Max Rur								0.647	
	Max Pool Depth (d <sub>maxru</sub>				1.66		Max Poo								1.113	<u> </u>
	Max Glide Depth (d <sub>maxp</sub> )			0.74			Max Glic							1	0.556	
1	Max Step Depth (d <sub>maxs</sub> )	!	0	0.74		ì	Max Ste								0.550	0.89
	Max Step Depth (u <sub>maxs</sub> )					II	IVIAX Ste	р Бериі			ь Бери	(u <sub>maxs</sub> )	U <sub>bkf</sub> )	0		
	% Silt/Clay	Reach 0	ı <sup>b</sup>	Riff	fle <sup>c</sup>	E	Bar	D !		ich <sup>b</sup>		iffle <sup>c</sup>	Bar	Protru	ısion He	
als	% Sand	18	i			i i		D <sub>16</sub>		71 6		2.48 3.53	İ			mm
Channel Materials	% Gravel	61	i	6		! !		D <sub>35</sub>		.65	!	3.53 45	 			mm
∭ W W	% Graver	18		2		! !		D <sub>50</sub>		.05 I.25	i	90	<u> </u>			mm
anne	% Cobble % Boulder	3	ļ			i i		D <sub>84</sub>		30	<u>.                                    </u>	19.86	i			<u> </u>
ີຣ໌	% Boulder % Bedrock	l				! !		1					<u> </u>			mm
	∏ /o Deulock	0		(	,	į		D <sub>100</sub>	อา	.98		180	i			mm

<sup>&</sup>lt;sup>a</sup> Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

<sup>&</sup>lt;sup>b</sup> Composite sample of riffles and pools within the designated reach.

<sup>&</sup>lt;sup>c</sup> Active bed of a riffle.

<sup>&</sup>lt;sup>d</sup> Height of roughness feature above bed.

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

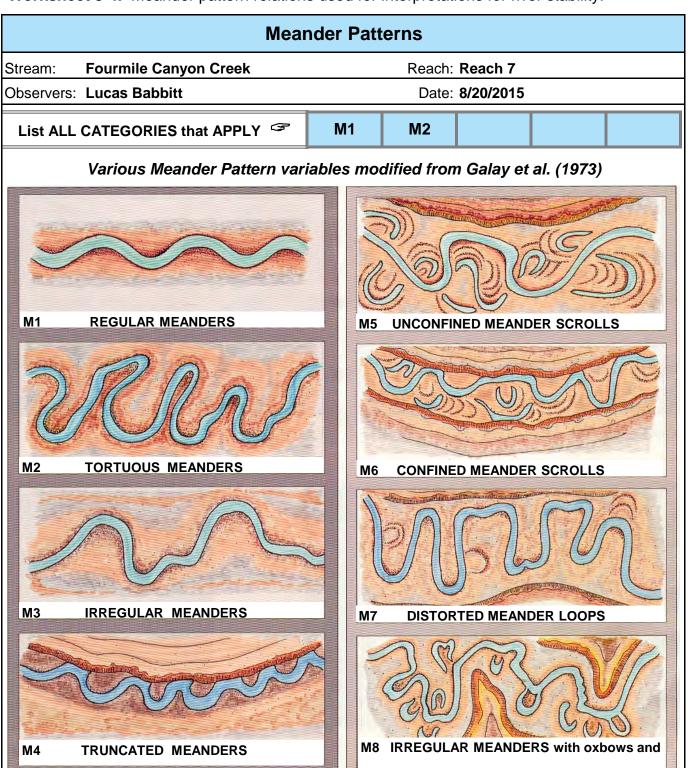
noiogidal interpretations.									
	FLOW REGIME								
Stream:	Fourmile Canyon Creek Location: Reach 7								
Observers: Lucas Babbitt Date: 8/20/2015									
List ALL COMBINATIONS that P 1 2 3									
API	APPLY								
General (	Category								
E	Ephemeral stream channels: Flows only in response to precipitation								
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.								
I	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.								
Р	Perennial stream channels: Surface water persists yearlong.								
Specific (	Category								
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.								
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.								
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.								
4	Streamflow regulated by glacial melt.								
5	Ice flows/ice torrents from ice dam breaches.								
6	Alternating flow/backwater due to tidal influence.								
7	Regulated streamflow due to diversions, dam release, dewatering, etc.								
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.								
9	Rain-on-snow generated runoff.								

Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

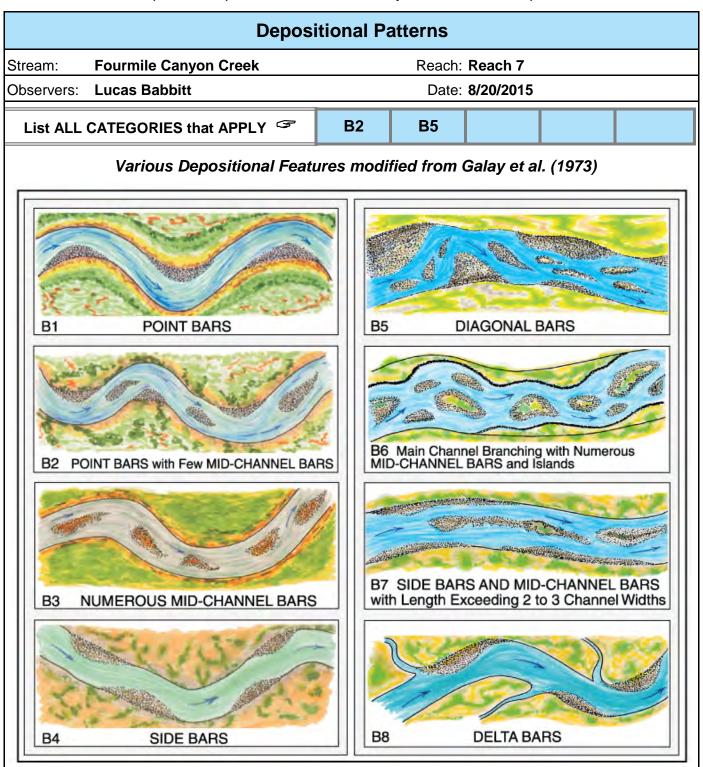
Stream Size and Order								
Stream: Fourmile Canyon Creek								
Location:	Location: Reach 7							
Observers:	Lucas Babbitt							
Date:	8/20/2015							
Stream Siz	e Category and	l Order 🤝	S-4(2)					
Category		ZE: Bankfull dth	Check (✓) appropriate					
	meters	feet	category					
S-1	0.305	<1						
S-2	0.3 – 1.5	1 – 5						
S-3	1.5 – 4.6	5 – 15						
S-4	4.6 – 9	15 – 30	>					
S-5	9 – 15	30 – 50						
S-6	15 – 22.8	50 – 75						
S-7	22.8 - 30.5	75 – 100						
S-8	30.5 – 46	100 – 150						
S-9	46 – 76	150 – 250						
S-10	76 – 107	250 – 350						
S-11	107 – 150	350 – 500						
S-12	150 – 305	500 – 1000						
S-13	>305	>1000						
	Strear	n Order						
Add categories in parenthesis for specific stream order of								

Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



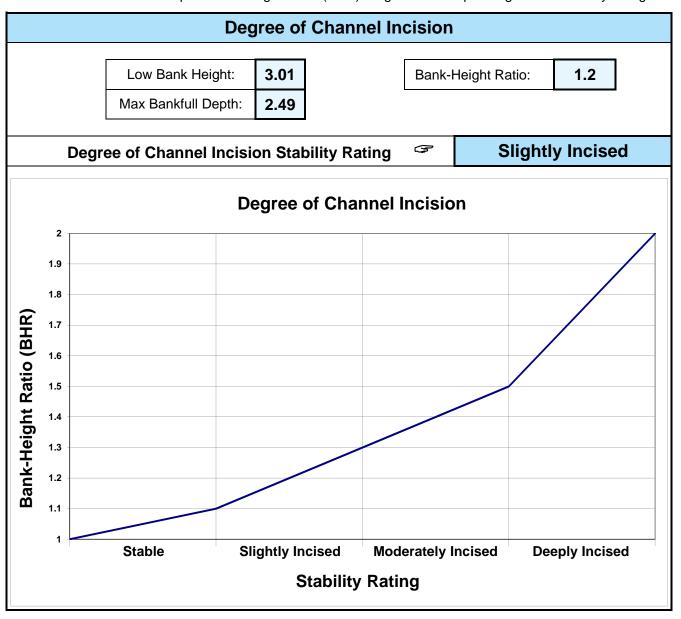
Worksheet 3-5. Depositional patterns used for stability assessment interpretations.



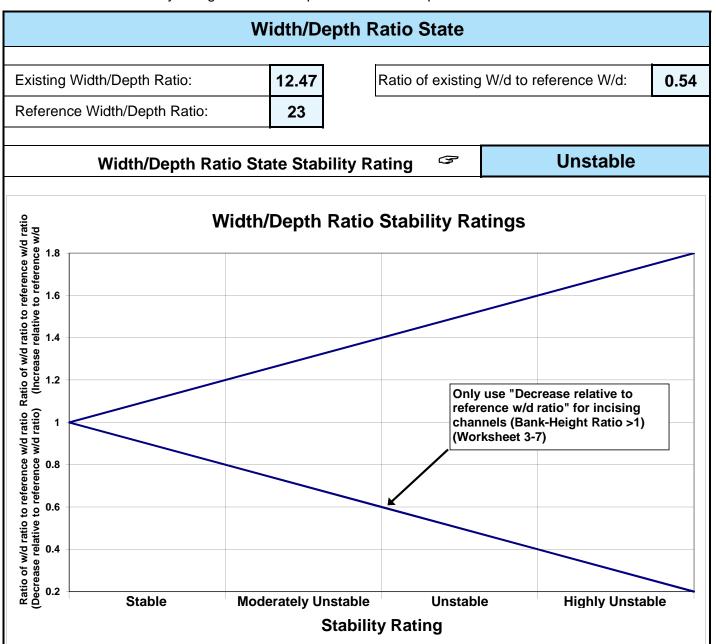
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

	Channel Blockages						
Stream	m: Fourmile C	anyon Creek Location: Reach 7					
Obser	rvers: Lucas Babl	bitt Date: 8/20/2015					
Desc	ription/extent	Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.					
D1	None	Minor amounts of small, floatable material.					
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.					
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.	~				
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.					
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.					
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.					
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.					
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.					
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.					
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	Y				

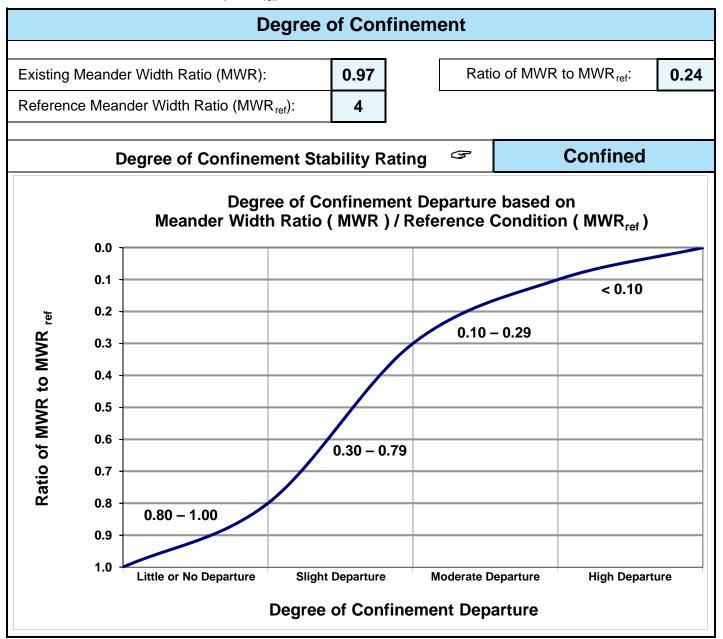
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	Stream Type:	F 4b	
Location	<b>1</b> :	Reach 7			Valley Type:	XIII	
Observe	ers:	Lucas Bab	bitt		Date:	08/20/2015	
Enter R	Require	d Information	on for Existing Conditi	on			
45	5.0	D 50	Median particle size o	f riffle bed material (mn	n)		
0.	.0	<b>D</b> \$\hat{\sigma}\$	Median particle size o	f bar or sub-pavement	sample (mm	ו)	
8.0	375	D <sub>max</sub>	Largest particle from b	oar sample (ft)	266.7	(mm)	304.8 mm/ft
0.04	1992	S	Existing bankfull wate	r surface slope (ft/ft)			
1.3	33	d	Existing bankfull mear	n depth (ft)			
1.0	65	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	vity of sediment			
Select	the App	ropriate Ed	quation and Calculate (	Critical Dimensionless	s Shear Str	ess	
0.0	00	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	) -0.872
5.9	93	D <sub>max</sub> /D <sub>50</sub>	Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384 (D_{\text{max}}/D_{50})$			
		τ*	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A
Calcula	ite Bank	full Mean D	epth Required for Entra	ninment of Largest Par	ticle in Bar	Sample	
		d	Required bankfull mean	depth (ft) $d = \frac{\tau}{\tau}$	$rac{*(\gamma_{ m s}-1)D_{ m m}}{{\sf S}}$	use (use	D <sub>max</sub> in ft)
Calcula	ate Ban	kfull Water	Surface Slope Require	ed for Entrainment of	Largest Pa	rticle in Ba	r Sample
		S	Required bankfull water	surface slope (ft/ft) <b>S</b> =	$=\frac{\tau^*(\gamma_s-1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)
		Check:	☐ Stable ☐ Aggrad	ing 🗹 Degrading			
Sedime	ent Com	petence Us	sing Dimensional Shea	ar Stress			
4.1	143		hear stress $\tau = \gamma dS$ (lbs/ft d = existing depth, S = exis	•	dius, R, with	mean depth,	d )
Shields	CO				ar stress τ /F	iaure 3-11\	
342.9 Shields							
3.255	2.147	Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)					
Shields	СО	Predicted i	mean depth required to ini	tiate movement of measu	red $D_{\rm max}$ (mr	$\mathbf{d} = \frac{1}{2}$	
1.05	0.69		ted shear stress, $\gamma = 62.4$ ,	<u> </u>		<u> </u>	<i>)</i> S
Shields <b>0.0392</b>	CO 0.0250		slope required to initiate m		<sub>max</sub> (mm)	$S = \frac{\tau}{2100}$	
0.0392	0.0259		ted shear stress, $\gamma = 62.4$ ,			γd	
		Check:	☐ Stable ☐ Aggradi	ing   ✓ Degrading			

**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type: <b>F 4b</b>			
Location:	Reach 7	Valley Type: <b>XIII</b>			
Observers:	Lucas Babbitt	Date: <b>08/20/2015</b>			
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)			
	eam Type at potential, $(C \rightarrow E)$ , $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	☐ Stable			
(E→C),	(B→High W/d B), (C→High W/d C)				
(G <sub>c</sub>	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	✓ Unstable			
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	☐ Highly Unstable			

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Canyon Creek Stream Type: F 4b								
Location: Reach 7			Valley Ty	<sub>'pe:</sub> XIII				
Observers: Lucas Babbitt Date: 08/20/2015								
Lateral stability criteria		Lateral Stabilit	ty Categories					
(choose one stability category for each criterion 1–5)	Stable	Moderately Unstable	Unstable	Highly Unstable	Selected Points (from each row)			
W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	6			
	(2)	(4)	(6)	(8)				
Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	В3	B5, B6, B7	4			
	(1)	(2)	(3)	(4)				
Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		3			
,	(1)		(3)					
Streambank Erosion: 4 Unit Rate (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07				
(Worksheet 3-13)	(2)	(4)	(6)	(8)				
Degree of Confinement 5 (MWR / MWR <sub>ref</sub> )	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	3			
(Worksheet 3-9)	(1)	(2)	(3)	(4)				
Total Points								
Lateral Stability Category Point Range								
Overall Lateral Stability Category (use total points and check stability rating)	Stable <10 □	Moderately Unstable 10 – 12 □	<i>Unstable</i> 13 – 21 <b>▽</b>	Highly Unstable > 21 □				

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Str	eam: Fourmile Can	yon Creek		Stream Type:	F 4b	
Loc	cation: Reach 7			Valley Type:	XIII	
Ob	servers: Lucas Babbitt			Date:	08/20/2015	
٧	ertical Stability	Vertical Stabil	Selected			
S	riteria (choose one tability category for ach criterion 1–6)	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	Points (from each row)
1	Sediment competence (Worksheet 3-14)	Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	2
		(2)	(4)	(6)	(8)	
2	Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand	2
		(2)	(4)	(6)	(8)	
3	W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	6
		(2)	(4)	(6)	(8)	
4	Stream Succession States (Worksheet 3- 16)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{split} &(C \! \to \! High \ W\!/d \ C), \\ &(B \! \to \! High \ W\!/d \ B), \\ &(C \! \to \! F), \ (G_c \! \to \! F), \\ &(G \! \to \! F_b) \end{split} $	(C→D), (F→D)	6
		(2)	(4)	(6)	(8)	
5	Depositional Patterns (Worksheet	B1	B2, B4	B3, B5	B6, B7, B8	1
	3-5)	(1)	(2)	(3)	(4)	
6	Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	4
		(1)	(2)	(3)	(4)	
Total Points						21
		Vertical Stab		nt Range for Exce	ss Deposition /	
E A p	ertical Stability for xcess Deposition / ggradation (use total oints and check stability ating)	No Deposition < 15 □	Moderate Deposition 15 – 20 □	Excess Deposition 21 – 30	Aggradation > 30 □	

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream: Fourmile Canyon Creek Stream Type: F 4b							
Location: Reach 7 Valley Type: XIII							
Observers: Lucas Babbitt Date: 08/20/2015							
Vertical Stability	Vertical Stabil	ity Categories for	Channel Incision	n / Degradation	Selected		
Criteria (choose one stability category for each criterion 1–5)	Not Incised	Slightly Incised	Moderately Incised	Degradation	Points (from each row)		
Sediment 1 Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved	8		
	(2)	(4)	(6)	(8)			
Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	8		
	(2)	(4)	(6)	(8)			
Degree of Channel 3 Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	4		
(WOIRSHEEL 3-1)	(2)	(4)	(6)	(8)			
Stream Succession 4 States (Worksheets 3-16 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$	8		
	(2)	(4)	(6)	(8)			
Confinement 5 (MWR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 – 0.79	0.10 - 0.29	< 0.10	3		
(Worksheet 3-9)	(1)	(2)	(3)	(4)			
				Total Points	31		
Vertical Stability Category Point Range for Channel Incision / Degradation							
Vertical Stability for Channel Incision/ Degradation (use total points and check stability rating)	Not Incised < 12 □	Slightly Incised 12 – 18	Moderately Incised 19 – 27 □	Degradation > 27 ☑			

**Worksheet 3-20.** Channel enlargement prediction summary.

Stream: Fourmile Canyon Creek Stream Type: F 4b							
Location: Reach 7 Valley Type: XIII							
Observers: Lucas Babbitt Date: 08/20/2015							
	hannel Enlargement	Char					
(c	rediction Criteria choose one stability ategory for each criterion –4)	No Increase	Slight Increase	Moderate Increase	Extensive	Selected Points (from each row)	
1	Successional Stage Shift (Worksheet 3-16)	Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{c} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $	8	
		(2)	(4)	(6)	(8)		
2	Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	6	
		(2)	(4)	(6)	(8)		
3	Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	6	
	(Worksheet 3-18)	(2)	(4)	(6)	(8)		
4	Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation	8	
	(Worksheet 3-19)	(2)	(4)	(6)			
					Total Points	28	
			Category P	oint Range			
P p	Channel Enlargement Prediction (use total oints and check stability ating)	No Increase < 11	Slight Increase 11 – 16	Moderate Increase 17 – 24	Extensive > 24 ✓		

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Str	F 4b						
Loc	cation: Reach 7			Valley Type:	XIII		
Ob	Observers: Date:						
P (d p	verall Sediment Supply rediction Criteria choose corresponding oints for each criterion -5)	Stability	y Rating	Points	Selected Points		
		Stable		1			
1	Lateral Stability	Mod. Unstal	ble	2	3		
l	(Worksheet 3-17)	Unstable		3	3		
		Highly Unst	able	4			
	Vertical Stability	No Depositi	on	1			
2	<b>Excess Deposition or</b>	Mod. Depos	ition	2	3		
_	Aggradation	Excess Dep	osition	3	3		
	(Worksheet 3-18)	Aggradation	1	4			
	Vertical Stability	Not Incised		1			
3	<b>Channel Incision or</b>	Slightly Inci	sed	2	4		
3	Degradation	Mod. Incise	d	3	4		
	(Worksheet 3-19)	Degradation	1	4			
	Channel Enlargement	No Increase	1	1			
4	Prediction (Worksheet	Slight Increa	ase	2	4		
	3-20)	Mod. Increa	se	3	-		
	0 20)	Extensive		4			
	Pfankuch Channel	Good: Stab	le	1			
5	Stability (Worksheet 3-	Fair: Mod. l	Unstable	2	4		
ľ	10)				-		
	10)	Poor: Unsta	able	4			
				Total Points	18		
			Category P	oint Range			
R	everall Sediment Supply ating (use total points and check stability rating)	<i>Low</i> < 6 □	<i>Moderate</i> 6 – 10 □	<i>High</i> 11 – 15 □	Very High > 15 ☑		

Worksheet 3-22. Summary of stability condition categories.

	А	BCDEFGHIJK	L M N O P Q R	S	AA AB AC AD AE AF	AGAH AI AJAKALAM
1	Stream:	Fourmile Canyon Creek		Location: Reach 7		
2	Observers:	Lucas Babbitt	Date: 8/20/2015	Stream Type: F 4E		: XIII
3	Channel Dimension	Mean Bankfull 1.33 Bankfull \ Depth (ft): (ft):	16 5X I	99	12.47 Entrer Ratio:	nchment 1.38
5	Channel Pattern	Mean: λ/W <sub>bkf</sub> : <b>8.14 8.14 - 8.14</b>	L <sub>m</sub> /W <sub>bkf</sub> : 9.47 9.47 - 9.47	R <sub>c</sub> /W <sub>bkf</sub> : 4.16 2.35 - 5.91	MWR: <b>0.97</b> <b>0.97 - 0.97</b>	Sinuosity: 1.08
7 8	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec): 9.686	Discharge (Q <sub>bkf</sub> ):	Estimation Method:	U/U*	Drainage Area (mi²):
9		Check: ☐ Riffle/Pool ☐ Step/P		☐ Convergence/Divergen		nes/Smooth Bed
10	River Profile & Bed	Max Riffle Pool	Depth Ratio (max Riffl		tatio	Slope
11 12	Features	Bankfull 2.34 2.19 Depth (ft):	to mean): 1.7	Spacing:	1.13 Valley: 0.05	i Surrace:
13		Riparian Current Composition			narks: Condition, Vigor & U	
14		Vegetation See description		ting native speci Density		
15		Flow P12 Stream Size	S-4(2) Meander	M1 M2 Depositional	B/B	/Channel D3 D10
16		Regime: 3 & Order:	Patterns:	Patterns:	Blocka	ages:
17	Level III Stream		Degree of Incision Sli		nkuch Stability Rating	106 -
18	Stability Indices		Stability Rating:	(Numeric & F	Adjective Rating):	1-
19 20		Width/depth Ratio (W/d): 12.47 Reference Ratio (W/d	ref): 23 (W/d)	(VV/d <sub>ref</sub> ):	W/d Ratio Sta Stability Ratin	g: <b>Unstable</b>
21 22				e of confinement / MWR <sub>ref</sub> ):	MWR / MWR Stability Ratin	i instania i
23	Bank Erosion	Length of Reach 0 An	nual Streambank Erosion	Rate: Curve Used:	Remarks:	
24	Summary	Studied (ft):	(tons/yr) <b>0</b>	(tons/yr/ft)		
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity ☐ Insuf	fficient Capacity 🔲 Ex	cess Capacity Rema	arks:	
26 27	Entrainment/ Competence	Largest Particle from 266.7 Bar Sample (mm):	$\tau = 2.147  \tau^* =$	0 Existing Depth: 0 Requirements		#### Required Slope: ####
28	Successional Stage			Existing 9	Stream F 4b	tential Stream
29	Shift		<b>→</b>	State (Ty		ate (Type):
30	Lateral Stability	□ Stable □ Mod. Uns	stable 🗸 Unstable	☐ Highly Unstable	Remarks/causes:	
31	Vertical Stability (Aggradation)	☐ No Deposition ☐ Mod. De	position 🔽 Ex. Deposit	ion 🗌 Aggradation	Remarks/causes:	
32	Vertical Stability (Degradation)	☐ Not Incised ☐ Slightly I	ncised Mod. Incised	d Degradation	Remarks/causes:	
33	Channel Enlargement	☐ No Increase ☐ Slight Inc	crease 🔲 Mod. Increa	se 🗹 Extensive	Remarks/causes:	
34 35	Sediment Supply (Channel Source)	Low   Moderat	re □ High <b>▽</b> Vel	y High Remarks/causes:		

RIVERMORPH PFANKUCH SUMMARY River Name: Reach 8 Reach Name: Assesments Survey Date: 05/13/2015 Upper Bank Landform Slope: 8 9 4 Mass Wasting: Debris Jam Potential: Vegetative Protection: Lower Bank Channel Capacity: Bank Rock Content: Obstructions to Flow: Cutting: Deposition: 12 Channel Bottom 2 4 Rock Angularity: Brightness: Consolidation of Particles: 4 8 Bottom Size Distribution: Scouring and Deposition: 12 Aquatic Vegetation: Channel Stability Evaluation Sediment Supply: Stream Bed Stability: Hi gh

C4B

W/D Condition: Stream Type:

Rating - 96 Condition - Fair

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bank	GE Esti	mates					
Stream: Fourmile Canyon	Location: Reach - Reach 8						
Date: Stre	eam Type:	B4	Valley	Туре:		??	
Observers:			HUC:				
INPUT VARIA	BLES			OUTP	UT VARIA	ABLES	
Bankfull Riffle Cross-Sectional AREA	24.20	A <sub>bkf</sub> (ft <sup>2</sup> )	Bankfull I	Riffle Mear	DEPTH	1.00	d <sub>bkf</sub> (ft)
Bankfull Riffle WIDTH	24.27	W <sub>bkf</sub> (ft)		d PERMIM 2 * d <sub>bkf</sub> ) + V		25.33	W <sub>p</sub> (ft)
D <sub>84</sub> at Riffle	90.00	Dia.	D <sub>84</sub>	, (mm) / 30	4.8	0.30	<b>D</b> <sub>84</sub> (ft)
Bankfull SLOPE	0.0459	S <sub>bkf</sub> (ft / ft)	Hyd	raulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	0.96	R (ft)
Gravitational Acceleration	32.2	g (ft / sec <sup>2</sup> )		tive Rough R(ft) / D <sub>84</sub> (ft		3.25	R / D <sub>84</sub>
Drainage Area	4.9	DA (mi <sup>2</sup> )		near Veloci u* = (gRS) <sup>½</sup>	•	1.191	u* (ft/sec)
ESTIMATIO	N METHO	DS			kfull OCITY		kfull IARGE
1. Friction Relative Factor Roughness u =	: [ 2.83 + 5.6	66 * Log { R	/D <sub>84</sub> }] u*	6.79	ft / sec	164.42	cfs
2. Roughness Coefficient: a) Manning	g's <i>n</i> from Frict = 1.49*R <sup>2/3</sup> *S		elative 0.062	4.98	ft / sec	120.61	cfs
2. Roughness Coefficient: b) Manning's <i>n</i> from Stream Type (I	Fig. 2-20)	u = 1.49* n =	R <sup>2/3</sup> *S <sup>1/2</sup> /n 0.062	4.98	ft / sec	120.61	cfs
2. Roughness Coefficient: c) Manning's n from Jarrett (USGS) Note: This equation is applicable to steep, ste		n = 0.39	R <sup>2/3</sup> *S <sup>1/2</sup> /n *S <sup>0.38</sup> *R <sup>-0.16</sup>	2.54	ft / sec	61.40	cfs
roughness, cobble- and boulder-dominated Stream Types A1, A2, A3, B1, B2, B3, C2 & E3	stream systems;		0.122				
3. Other Methods (Hey, Darcy-Weisk Darcy-Weisbach (Leopold, Wo				7.14	ft / sec	172.77	cfs
3. Other Methods (Hey, Darcy-Weisk Chezy C	oach, Chezy (	C, etc.)		0.00	ft / sec	0.00	cfs
4. Continuity Equations: a) Region Return Period for Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	year	0.00	ft / sec	0.00	cfs
4. Continuity Equations: b) USG	S Gage Data	u = Q / A		0.00	ft / sec	0.00	cfs
Protrusion Height Options for For sand-bed channels: Meas	-						
Option 1. feature. Substitute the D <sub>84</sub> sar	nd dune protrus	ion height in ft t	for the D <sub>84</sub> term	in method 1.			·
Option 2. For <b>boulder-dominated</b> chan the rock on that side. Substitution						e bed elevation	to the top of
Option 3. For <b>bedrock-dominated</b> chan channel bed elevation. Substit						s or uplifted surf	aces above
Option 4. For <b>log-influenced</b> channels: log on upstream side if embed							ight of the

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	Fourmile Canyon Creek, Reach - Reach 8		
Basin:	Drainage Area: 3148.8 acres	4.92	mi <sup>2</sup>
Location:			
Twp.&Rge:	Sec.&Qtr.:;		
Cross-Sect	tion Monuments (Lat./Long.): 40.06406 Lat / 105.30939 Long	Date:	08/20/15
Observers:	Lucas Babbitt	Valley Type:	VIII(b)
	Bankfull WIDTH (W <sub>bkf</sub> )		
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	20.91	ft
	Bankfull DEPTH (d <sub>bkf</sub> )		]
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ( $d_{bkf} = A / W_{bkf}$ ).	1.41	ft
	Bankfull X-Section AREA (A <sub>bkf</sub> )		
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	29.4	ft <sup>2</sup>
	Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )		
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	14.83	ft/ft
	Maximum DEPTH (d <sub>mbkf</sub> )		
	Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	2.49	ft
	WIDTH of Flood-Prone Area (W <sub>fpa</sub> )		
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	46.75	ft
	Entrenchment Ratio (ER)		1
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH ( $W_{\text{fpa}}/W_{\text{bkf}}$ ) (riffle section).	2.24	ft/ft
	Channel Materials (Particle Size Index ) D <sub>50</sub>		1
	The D <sub>50</sub> particle size index represents the mean diameter of channel materials, as		
	sampled from the channel surface, between the bankfull stage and Thalweg elevations.	29.65	mm
	W. (	20.00	J
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient		
	at bankfull stage.	0.04592	ft/ft
	Channel SINUOSITY (k)		
	Sinuosity is an index of channel pattern, determined from a ratio of stream length		
	divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.04	
			- 1
	Stream C 4b (See Figure 2-	14)	

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	ream: Fourmile Canyon Creek					Location: Reach - Reach 8		
Ob	servers: Lucas Babbitt		Date:	08/20	/15	Valley Type: XIII Strea	m Type: C 4b	
		Rive	er Rea	ch Dir	nens	sion Summary Data1		
	Riffle Dimensions*, **, ***	Mean	Min	Max	i.	Riffle Dimensions & Dimensionless Ratios****	Mean Min	Max
*	Riffle Width (W <sub>bkf</sub> )	21.9	19.5	24.3		Riffle Cross-Sectional Area (A <sub>bkf</sub> ) (ft²)	25.80 24.20	
* * * *	Mean Riffle Depth (d <sub>bkf</sub> )	1.21	1	1.41	•	Riffle Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	19.05 13.83	
,suc	Maximum Riffle Depth (d <sub>max</sub> )	2.16	1.93	2.39	<u>.                                      </u>	Max Riffle Depth to Mean Riffle Depth (d <sub>max</sub> / d <sub>bkf</sub> )	1.813 1.695	
Riffle Dimensions*,	Width of Flood-Prone Area (W <sub>fpa</sub> )	40.2	34.1	46.3	ft	Entrenchment Ratio (W <sub>fpa</sub> / W <sub>bkf</sub> )	1.890 1.406	2.373
ime	Riffle Inner Berm Width (W <sub>ib</sub> )	5.62	0	11.2	ft	Riffle Inner Berm Width to Riffle Width (W <sub>ib</sub> / W <sub>bkf</sub> )	0.288 0.000	0.576
ie D	Riffle Inner Berm Depth (d <sub>ib</sub> )	0.2	0	0.41	ft	Riffle Inner Berm Depth to Mean Depth (d <sub>ib</sub> / d <sub>bkf</sub> )	0.145 0.000	0.290
풀	Riffle Inner Berm Area (A <sub>ib</sub> )	2.29	0	4.59	ft <sup>2</sup>	Riffle Inner Berm Area to Riffle Area (A <sub>ib</sub> / A <sub>bkf</sub> )	0.084 0.000	0.167
	Riffle Inner Berm W/D Ratio (W <sub>ib</sub> / d <sub>ib</sub> )	13.8	0	27.5				
	Pool Dimensions*' **' *** Pool Width (W <sub>bkfp</sub> )	Mean	Min 16.8	Max 16.8	ft	Pool Dimensions & Dimensionless Ratios****  Pool Width to Riffle Width (W <sub>bkfp</sub> / W <sub>bkf</sub> )	Mean Min	Max 0.767
* *	Mean Pool Depth (d <sub>bkfp</sub> )	1.14		1.14	1	Mean Pool Depth to Mean Riffle Depth (d <sub>bkfp</sub> / d <sub>bkf</sub> )	0.942 0.942	
* *	Pool Cross-Sectional Area (A <sub>bkfp</sub> )	19.2	19.2	19.2		Pool Area to Riffle Area (A <sub>bkfp</sub> / A <sub>bkf</sub> )	0.744 0.744	
Dimensions*, **, ***	Maximum Pool Depth (d <sub>maxp</sub> )	1.85	1.85	1.85	<del>-</del>	Max Pool Depth to Mean Riffle Depth (d <sub>maxp</sub> / d <sub>bkf</sub> )	1.529 1.529	
ensi	Pool Inner Berm Width (W <sub>ihn</sub> )	13.3	13.3	13.3	-	Pool Inner Berm Width to Pool Width (W <sub>ibp</sub> / W <sub>bkfp</sub> )	0.793 0.793	
P i	Pool Inner Berm Depth (d <sub>ibp</sub> )	0.45		0.45	<u>.                                      </u>	Pool Inner Berm Depth to Pool Depth (d <sub>ibp</sub> / d <sub>bkfp</sub> )	0.395 0.395	
Pool	Pool Inner Berm Area (A <sub>ibn</sub> )	5.99	5.99	5.99	1	Pool Inner Berm Area to Pool Area (A <sub>ibp</sub> / A <sub>bkfp</sub> )	0.312 0.312	
<b> </b>	Point Bar Slope (S <sub>pb</sub> )		0.000			Pool Inner Berm Width/Depth Ratio (W <sub>ibp</sub> / d <sub>ibp</sub> )	#### ####	
	[ σ. σ. σ. σ. σ. σ. σ. σ. σ. σ. σ. σ. σ.	0.000	0.000	0.000	TOTE	The second of th		""""
*.	Run Width (W)	Mean	Min 24.3	Max	ft	Run Dimensionless Ratios****	Mean Min	Max
ions*	Run Width (W <sub>bkfr</sub> )	24.3	24.3	24.3	1	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	1.109 1.109	1.109
ensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )	24.3	24.3	24.3 1	ft	Run Width to Riffle Width ( $W_{bkfr} / W_{bkf}$ )  Mean Run Depth to Mean Riffle Depth ( $d_{bkfr} / d_{bkf}$ )	1.109 1.109 0.826 0.826	1.109 0.826
Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )	24.3 1 24.2	24.3 1 24.2	24.3 1 24.2	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	1.109     1.109       0.826     0.826       0.938     0.938	1.109 0.826 0.938
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )	24.3 1 24.2 1.93	24.3 1 24.2 1.93	24.3 1 24.2 1.93	ft ft	Run Width to Riffle Width ( $W_{bkfr} / W_{bkf}$ )  Mean Run Depth to Mean Riffle Depth ( $d_{bkfr} / d_{bkf}$ )	1.109 1.109 0.826 0.826	1.109 0.826 0.938
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )	24.3 1 24.2	24.3 1 24.2	24.3 1 24.2	ft ft	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$ Run Area to Riffle Area $(A_{bkfr}/A_{bkf})$	1.109     1.109       0.826     0.826       0.938     0.938	1.109 0.826 0.938
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*	24.3 1 24.2 1.93 24.3 Mean	24.3 1 24.2 1.93 24.3 Min	24.3 1 24.2 1.93 24.3 Max	ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****	1.109 1.109 0.826 0.826 0.938 0.938 1.595 1.595 Mean Min	1.109 0.826 0.938 1.595 Max
Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> /d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9	24.3 1 24.2 1.93 24.3 Min 22.9	24.3 1 24.2 1.93 24.3 Max 22.9	ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	1.109 1.109 0.826 0.826 0.938 0.938 1.595 1.595 Mean Min 1.044 1.044	1.109 0.826 0.938 1.595 Max 1.044
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9	24.3 1 24.2 1.93 24.3 Min 22.9	24.3 1 24.2 1.93 24.3 Max 22.9	ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	1.109 1.109 0.826 0.826 0.938 0.938 1.595 1.595  Mean Min 1.044 1.044 0.893 0.893	1.109 0.826 0.938 1.595 Max 1.044 0.893
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08	24.3 1 24.2 1.93 24.3 Min 22.9 1.08	24.3 1 24.2 1.93 24.3 Max 22.9 1.08	ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )	1.109 1.109 0.826 0.826 0.938 0.938 1.595 1.595  Mean Min 1.044 1.044 0.893 0.893 0.956 0.956	1.109 0.826 0.938 1.595 Max 1.044 0.893
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7	24.3 1 24.2 1.93 24.3 Max 22.9 1.08 24.7	ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )	1.109 1.109 0.826 0.826 0.938 0.938 1.595 1.595  Mean Min 1.044 1.044 0.893 0.893 0.956 0.956 1.496 1.496	1.109 0.826 0.938 1.595 Max 1.044 0.893 0.956
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7 1.81 21.2	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7 1.81 21.2	24.3 1 24.2 1.93 24.3 Max 22.9 1.08 24.7 1.81	ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )	1.109   1.109	1.109 0.826 0.938 1.595 Max 1.044 0.893 0.956 1.496
Glide Dimensions* Run Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7 1.81 21.2	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7 1.81 21.2	24.3 1 24.2 1.93 24.3 Max 22.9 1.08 24.7 1.81 21.2	ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> /W <sub>bkfg</sub> )	1.109   1.109	1.109 0.826 0.938 1.595 1.044 0.893 0.956 1.496 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7 1.81 21.2 0	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7 1.81 21.2 0	24.3 1 24.2 1.93 24.3 Max 22.9 1.08 24.7 1.81 21.2 0	ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>ibg</sub> / d <sub>bkfg</sub> )	1.109   1.109	1.109 0.826 0.938 1.595 Max 1.044 0.893 0.956 1.496 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7 1.81 21.2	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7 1.81 21.2	24.3 1 24.2 1.93 24.3 Max 22.9 1.08 24.7 1.81 21.2 0	ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> /W <sub>bkfg</sub> )	1.109   1.109	1.109 0.826 0.938 1.595 Max 1.044 0.893 0.956 1.496 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>bg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7 1.81 21.2 0 0 Mean	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7 1.81 21.2 0 0 Min	24.3 1 24.2 1.93 24.3 Max 22.9 1.08 24.7 1.81 21.2 0 0 Max	ft ft ft ft ft ft ft ft ft ft ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>bkfg</sub> / A <sub>bkfg</sub> )	1.109   1.109   0.826   0.826   0.938   0.938   1.595   1.595     1.044   1.044   1.044   1.044   1.044   1.046   1.496   1.496   1.496   1.496   0.000   0.	1.109 0.826 0.938 1.595  Max 1.044 0.893 0.956 1.496 0.000 0.000 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7 1.81 21.2 0 0 0 Mean 0	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7 1.81 21.2 0 0 0 Min 0	24.3 1 24.2 1.93 24.3 Max 22.9 1.08 24.7 1.81 21.2 0 0 Max 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Depth to Glide Width (W <sub>ibg</sub> / M <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	1.109   1.109	1.109 0.826 0.938 1.595 1.044 0.893 0.956 1.496 0.000 0.000 0.000 Max 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7 1.81 21.2 0 0 Mean 0	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7 1.81 21.2 0 0 Min 0 0	24.3 1 24.2 1.93 24.3  Max 22.9 1.08 24.7 1.81 21.2 0 0 Max 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	1.109   1.109   0.826   0.826   0.938   0.938   1.595   1.595	1.109 0.826 0.938 1.595  Max 1.044 0.893 0.956 0.000 0.000 0.000  Max 0.000 0.000
	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7 1.81 21.2 0 0 0 Mean 0 0	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7 1.81 21.2 0 0 Min 0 0	24.3 1 24.2 1.93 24.3  Max 22.9 1.08 24.7 1.81 21.2 0 0  Max 0 0  0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / W <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )  Step Area to Riffle Area (A <sub>bkfs</sub> / A <sub>bkf</sub> )	1.109   1.109	1.109 0.826 0.938 1.595  Max 1.044 0.893 0.956 1.496 0.000 0.000 0.000 0.000 0.000 0.000
Glide Dimensions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>lbg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	24.3 1 24.2 1.93 24.3 Mean 22.9 1.08 24.7 1.81 21.2 0 0 Mean 0	24.3 1 24.2 1.93 24.3 Min 22.9 1.08 24.7 1.81 21.2 0 0 Min 0 0	24.3 1 24.2 1.93 24.3  Max 22.9 1.08 24.7 1.81 21.2 0 0 Max 0 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )  Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	1.109   1.109   0.826   0.826   0.938   0.938   1.595   1.595	1.109 0.826 0.938 1.595 1.044 0.893 0.956 1.496 0.000 0.000 0.000 0.000 0.000

<sup>\*</sup>Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

<sup>\*\*</sup>Step-Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

<sup>\*\*\*</sup>Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

<sup>\*\*\*\*</sup>Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the mean riffle width value.

Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

	eam: Fourmile Can						cation:	Reach	ı - Rea	ch 8				
Ob	Observers: Lucas Babbitt Date: 08/20/15								у Туре:	XIII	Strea	m Type:	C 4b	
lics	River Reach Sun			h Sumi	mary D	ata	.2							
Hydraulics	Streamflow: Estimated M	lean Velocity	at Bank	full Sta	ge (u <sub>bkf</sub> )		4.9	84	ft/sec	Estimation Me	thod	<u> </u>	U/U*	
Ě	Streamflow: Estimated D	ischarge at I	Bankfull	Stage (	Q <sub>bkf</sub> )		120.	613	cfs	Drainage Area	a	4.	92	mi <sup>2</sup>
	Geometry	Mear	Min	Max			Dime	nsionl	ess Ge	eometry Ratio	<b>3</b>	Mean	Min	Max
	Linear Wavelength (λ)	351	351	351	ft	Linear V	/avelen	gth to F	Riffle W	idth $(\lambda / W_{bkf})$		#####	#####	####
	Stream Meander Length	(L <sub>m</sub> ) <b>256</b>	256	256	ft	Stream I	Meande	r Lengt	h Ratio	$(L_m/W_{bkf})$		#####	#####	####
tterr	Radius of Curvature (R <sub>c</sub> )	87	75	98	ft	Radius o	of Curva	ture to	Riffle V	Vidth (R <sub>c</sub> / W <sub>bkf</sub>	)	3.974	3.426	4.477
I Pa	Belt Width (W <sub>blt</sub> )	13	13	13	ft	Meande	r Width	Ratio (\	W <sub>blt</sub> / W	bkf)		0.594	0.594	0.594
Channel Pattern	Arc Length (L <sub>a</sub> )	0	0	0	ft	Arc Lenç	gth to Ri	ffle Wid	dth (L <sub>a</sub> /	W <sub>bkf</sub> )		0.000	0.000	0.000
ပြီ	Riffle Length (L <sub>r</sub> )	<mark>28.5</mark>	21	35.9	ft	Riffle Le	ngth to I	Riffle W	/idth (L	r / W <sub>bkf</sub> )		1.300	0.958	1.641
	Individual Pool Length (L	<sub>-p</sub> ) 11.9	2.66	30.2	ft	Individua	al Pool L	ength	to Riffle	Width (L <sub>p</sub> / W	okf)	0.543	0.122	1.381
	Pool to Pool Spacing (Ps	) <mark>36.3</mark>	13.4	70.9	ft	Pool to F	Pool Spa	acing to	Riffle	Width (P <sub>s</sub> / W <sub>bk</sub>	f)	1.656	0.613	3.238
	Valley Slope (S <sub>val</sub> )	0.043	ft/ft	Averag	ge Wate	r Surface	Slope (	(S)	0.04	4592 ft/ft	Sinuosity (	S <sub>val</sub> / S)		1.04
	Stream Length (SL)	520	ft	Valley	Length	(VL)			5	<b>05</b> ft	Sinuosity (	SL / VL)		1.03
	Low Bank Height	start 7	ft		Max Dep	oth	start	3.3	ft	Bank-Hei	ght Ratio (B	HR)	start	2.12
	(LBH)	end <b>4.76</b>			(d <sub>max</sub> )		<u>.</u>	1.46			sH / d <sub>max</sub> )		end	3.26
	Riffle Slope (S <sub>rif</sub> )	Mear	Min 0.025	Max 0.034	ft/ft					Slope Ratios Surface Slope	(S <sub>et</sub> / S)	Mean	Min 0.537	Max
a	Run Slope (S <sub>run</sub> )		0.161		<u>.                                    </u>					•			3.510	
rofij	Pool Slope (S <sub>p</sub> )		0.002		:		Run Slope to Average Water Surface Slope (S <sub>run</sub> / S)  Pool Slope to Average Water Surface Slope (S <sub>p</sub> / S)				0.050			
Channel Profile	Glide Slope (S <sub>a</sub> )		0.033	<u> </u>			de Slope to Average Water Surface Slope (S <sub>q</sub> / S)			0.728				
hanr	Step Slope (S <sub>s</sub> )		0.162				tep Slope to Average Water Surface Slope (S <sub>s</sub> /S)		1	3.523				
٥	Max Depths <sup>a</sup>	Mean		Max			Dimensionless Depth Ratios			Mean	Min	Max		
	Max Riffle Depth (d <sub>maxrif</sub> )	0.8	0.7	0.9	ft	Max Riffle Depth to Mean Riffle Depth (d <sub>maxrif</sub> / d <sub>bkf</sub> )			0.661	0.579	0.74			
	Max Run Depth (d <sub>maxrun</sub> )	1.2	1.2	1.2	ft	Max Rur	lax Run Depth to Mean Riffle Depth (d <sub>maxrun</sub> / d <sub>bkf</sub> )			0.992	0.992	0.99		
	Max Pool Depth (d <sub>maxp</sub> )	1.32	0.99	1.49	ft	Max Poo	ol Depth	to Mea	an Riffle	Depth (d <sub>maxp</sub> /	d <sub>bkf</sub> )	1.091	0.818	1.23
	Max Glide Depth (d <sub>maxg</sub> )	0.47	0.47	0.47	ft	Max Glid	de Depth	to Me	an Riffl	e Depth (d <sub>maxg</sub>	/ d <sub>bkf</sub> )	0.388	0.388	0.39
	Max Step Depth (d <sub>maxs</sub> )	0.88	0.41	1.33	ft	Max Ste	p Depth	to Mea	an Riffle	e Depth (d <sub>maxs</sub> /	d <sub>bkf</sub> )	0.727	0.339	1.1
		Reach <sup>b</sup>	Rif	fle <sup>c</sup>	В	Bar		Rea	ach <sup>b</sup>	Riffle <sup>c</sup>	Bar	Protru	ısion He	eight <sup>d</sup>
s	% Silt/Clay	0		0			D <sub>16</sub>		71	12.48		<u> </u>		mm
Channel Materials	% Sand	18		6			D <sub>35</sub>	1	6	33.53		i !		mm
Mate	% Gravel	61	6	55			D <sub>50</sub>	29	.65	45				mm
lue	% Cobble	18	2	29			D <sub>84</sub>	104	1.25	90		! !		mm
Shan	% Boulder	3		0			D <sub>95</sub>	18	80	119.86				mm
	% Bedrock	0		0			D <sub>100</sub>	511	1.98	180				mm

<sup>&</sup>lt;sup>a</sup> Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

<sup>&</sup>lt;sup>b</sup> Composite sample of riffles and pools within the designated reach.

<sup>&</sup>lt;sup>c</sup> Active bed of a riffle. 

<sup>d</sup> Height of roughness feature above bed.

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

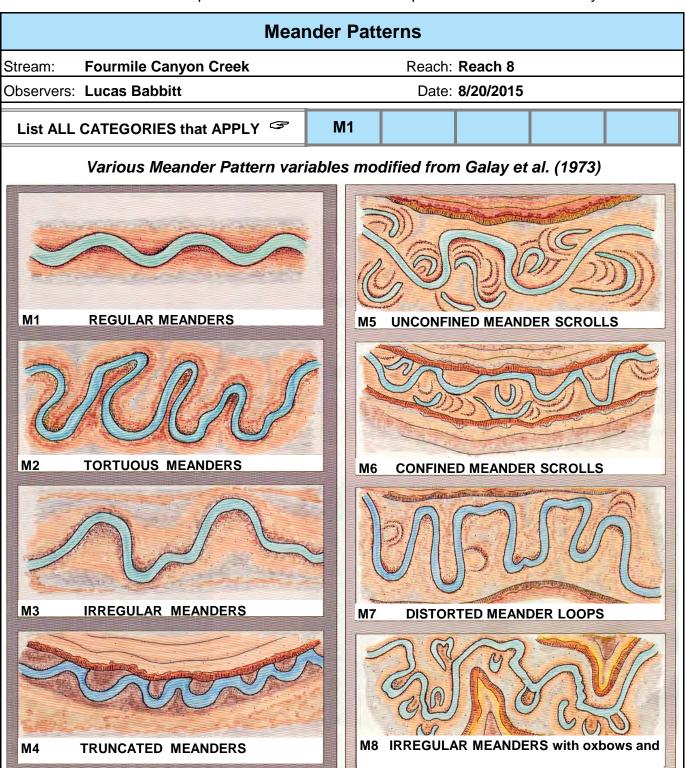
olological ilit	erpretations.									
FLOW REGIME										
Stream:	Fourmile Canyon Creek Location: Reach 8									
Observers:	Observers: Lucas Babbitt Date: 8/20/2015									
List ALL	List ALL COMBINATIONS that									
APPLY P 1 2 8										
General Category										
E	Ephemeral stream channels: Flows only in response to precipitation									
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.									
ı	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.									
Р	Perennial stream channels: Surface water persists yearlong.									
Specific (	Category									
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.									
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.									
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.									
4	Streamflow regulated by glacial melt.									
5	Ice flows/ice torrents from ice dam breaches.									
6	Alternating flow/backwater due to tidal influence.									
7	Regulated streamflow due to diversions, dam release, dewatering, etc.									
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.									
9	Rain-on-snow generated runoff.									

Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

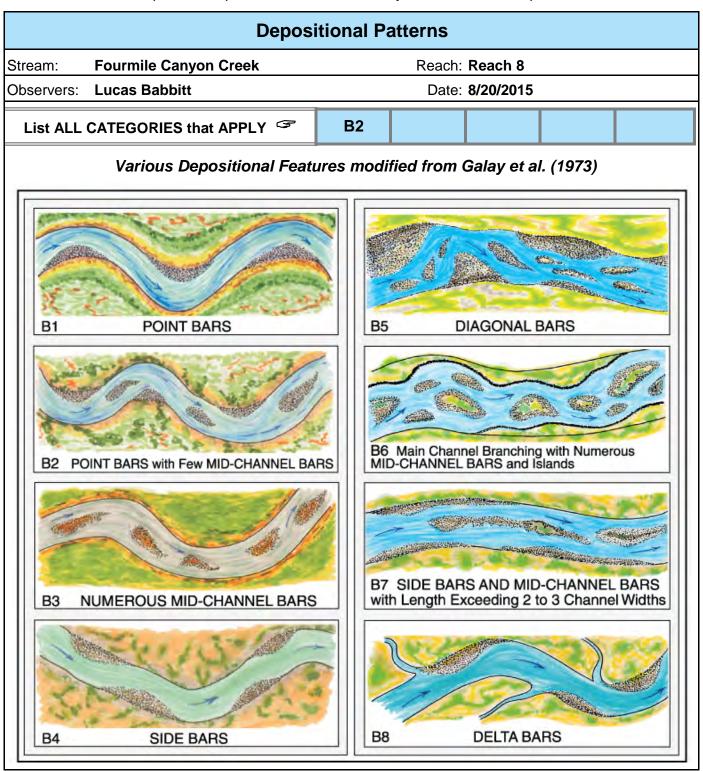
Stream Size and Order								
Stream: Fourmile Canyon Creek								
Location:	Reach 8							
Observers:	Lucas Babbitt							
Date:								
Stream Siz	e Category and	l Order 🤝	S-4(2)					
Category		ZE: Bankfull dth	Check (✓) appropriate					
	meters	feet	category					
S-1	0.305	<1						
S-2	0.3 – 1.5	1 – 5						
S-3	1.5 – 4.6	5 – 15						
S-4	4.6 – 9	15 – 30	~					
S-5	9 – 15	30 – 50						
S-6	15 – 22.8	50 – 75						
S-7	22.8 - 30.5	75 – 100						
S-8	30.5 – 46	100 – 150						
S-9	46 – 76	150 – 250						
S-10	76 – 107	250 – 350						
S-11	107 – 150	350 – 500						
S-12	150 – 305	500 – 1000						
S-13	>305	>1000						
	Strear	n Order						
Add categori	es in parenthesis	for specific strea	m order of					

Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



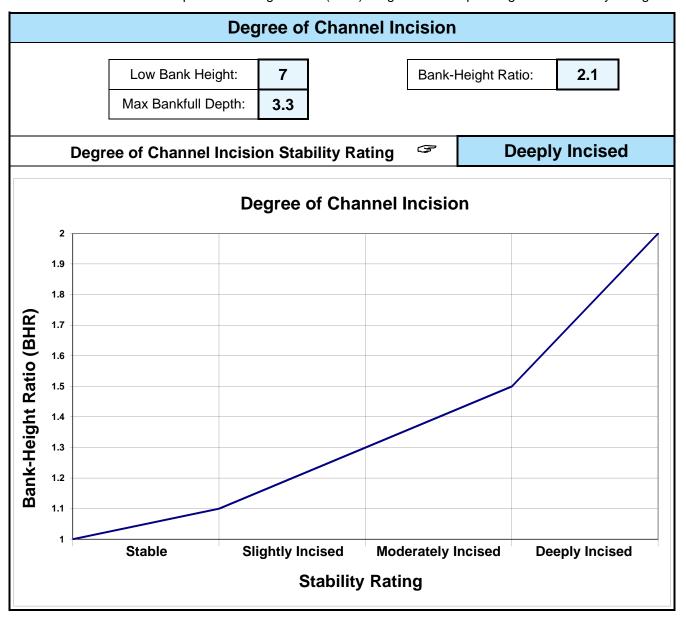
Worksheet 3-5. Depositional patterns used for stability assessment interpretations.



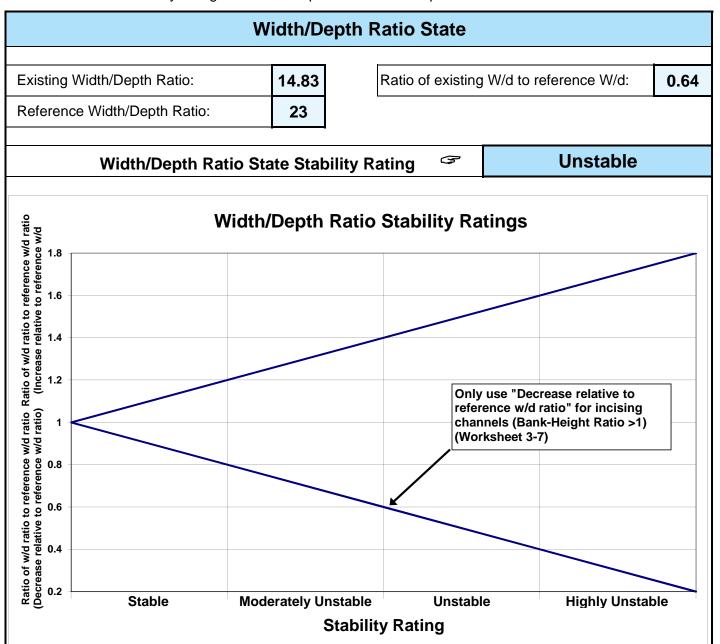
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

		Channel Blockages						
Strear	Stream: Fourmile Canyon Creek Location: Reach 8							
Obser	Observers: Lucas Babbitt Date: 8/20/2015							
Desc	ription/extent	Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.	Check (√) all that apply					
D1	None	Minor amounts of small, floatable material.						
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.						
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.	•					
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.						
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.						
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.						
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.						
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.						
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.						
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	V					

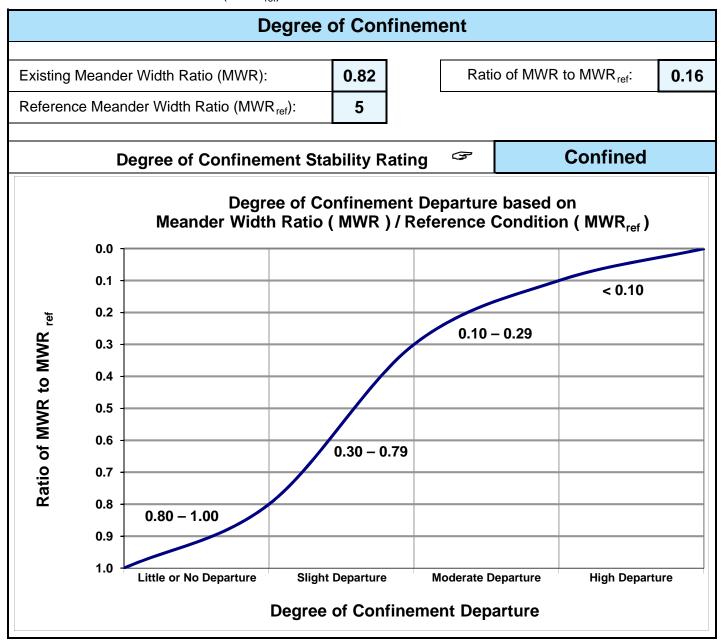
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



Worksheet 3-14. Sediment competence calculation form to assess bed stability.

0.750 $D_{\text{max}}$ Largest particle from bar s0.04592SExisting bankfull water sur1.18 $d$ Existing bankfull mean dep1.65 $\gamma_s - \gamma/\gamma$ Immersed specific gravitySelect the Appropriate Equation and Calculate Critic	ffle bed material (mm) ar or sub-pavement sample (mm) sample (ft)  228.6 (mm)  urface slope (ft/ft) epth (ft) y of sediment tical Dimensionless Shear Stress					
Enter Required Information for Existing Condition  45.0 $D_{50}$ Median particle size of riffle  0.0 $D_{50}$ Median particle size of bar  0.750 $D_{max}$ Largest particle from bar s  0.04592 S Existing bankfull water sur  1.18 $d$ Existing bankfull mean degree 1.65 $\gamma_s - \gamma/\gamma$ Immersed specific gravity  Select the Appropriate Equation and Calculate Critical	ffle bed material (mm)  ar or sub-pavement sample (mm)  sample (ft)  228.6 (mm)  urface slope (ft/ft)  epth (ft)  y of sediment  tical Dimensionless Shear Stress					
45.0 $D_{50}$ Median particle size of riffle $0.0$ $D_{50}^{\wedge}$ Median particle size of bar $0.750$ $D_{max}$ Largest particle from bar so $0.04592$ S Existing bankfull water sur $1.18$ d Existing bankfull mean department $1.65$ $\gamma_s$ - $\gamma/\gamma$ Immersed specific gravity Select the Appropriate Equation and Calculate Critical	ffle bed material (mm) ar or sub-pavement sample (mm) sample (ft)  228.6 (mm)  urface slope (ft/ft) epth (ft) y of sediment tical Dimensionless Shear Stress					
0.0 $D_{50}^{\circ}$ Median particle size of bar 0.750 $D_{max}$ Largest particle from bar s 0.04592 S Existing bankfull water sur 1.18 $d$ Existing bankfull mean department of $\gamma_s - \gamma/\gamma$ Immersed specific gravity Select the Appropriate Equation and Calculate Critic	ar or sub-pavement sample (mm)  sample (ft)  228.6 (mm)  urface slope (ft/ft)  epth (ft)  y of sediment  tical Dimensionless Shear Stress					
0.750 $D_{\text{max}}$ Largest particle from bar s0.04592SExisting bankfull water sur1.18 $d$ Existing bankfull mean deg1.65 $\gamma_s$ - $\gamma/\gamma$ Immersed specific gravitySelect the Appropriate Equation and Calculate Critic	r sample (ft)  228.6 (mm)  304.6 mm/f  urface slope (ft/ft)  epth (ft)  y of sediment  tical Dimensionless Shear Stress					
0.04592SExisting bankfull water sur1.18dExisting bankfull mean degree1.65 $\gamma_s - \gamma/\gamma$ Immersed specific gravitySelect the Appropriate Equation and Calculate Critic	urface slope (ft/ft) epth (ft) y of sediment tical Dimensionless Shear Stress					
1.18 $d$ Existing bankfull mean deposition of the second	epth (ft) y of sediment tical Dimensionless Shear Stress					
1.65 $\gamma_s$ - $\gamma/\gamma$ Immersed specific gravity  Select the Appropriate Equation and Calculate Critic	y of sediment tical Dimensionless Shear Stress					
Select the Appropriate Equation and Calculate Critic	tical Dimensionless Shear Stress					
<b>0.00</b> $D_{-0}/D_{-0}^{\wedge}$ Range: 3 – 7						
250, 250 Hanger 6	Use EQUATION 1: $\tau^* = 0.0834  (D_{50}/D_{50}^{^{^{^{^{^{^{^{^{^{^{^{^{^{^{^{^{^{^{$					
<b>5.08 D</b> <sub>max</sub> <b>/D</b> <sub>50</sub> Range: 1.3 – 3.0	Use EQUATION 2: $\tau^* = 0.0384 (D_{\text{max}}/D_{50})^{-0.88}$					
τ* Bankfull Dimensionless Shea	ear Stress EQUATION USED: N/A					
Calculate Bankfull Mean Depth Required for Entrainment	ment of Largest Particle in Bar Sample					
d Required bankfull mean dept	pth (ft) $d = \frac{\mathcal{T}^*(\gamma_s - 1)D_{\text{max}}}{S}$ (use $D_{\text{max}}$ in					
Calculate Bankfull Water Surface Slope Required fo	for Entrainment of Largest Particle in Bar Samp					
S Required bankfull water surfa	rface slope (ft/ft) $\mathbf{S} = \frac{\mathbf{T}^*(\gamma_s - 1)\mathbf{D}_{\text{max}}}{\mathbf{d}}$ (use $D_{\text{max}}$ in					
Check: ☐ Stable ☐ Aggrading I	✓ Degrading					
Sediment Competence Using Dimensional Shear St	Stress					
3.381	substitute hydraulic radius, R, with mean depth, d)					
$\gamma$ = 62.4, d = existing depth, S = existing s	g slope					
211.5 312.4	Predicted largest moveable particle size (mm) at bankfull shear stress τ (Figure 3-11)					
2.808 1.741 Predicted shear stress required to initiate	Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)					
Shields CO Predicted mean depth required to initiate	e movement of measured $D_{\text{max}}$ (mm) = existing slope $\mathbf{d} = \frac{\tau}{\gamma \mathbf{S}}$					
<b>0.98 0.61</b> $\tau$ = predicted shear stress, $\gamma$ = 62.4, S = 6 Shields CO Predicted slope required to initiate moven						
Shields CO Predicted slope required to initiate moven $\tau = 0.0381$ 0.0236 $\tau = 0.0381$ Predicted shear stress, $\gamma = 62.4$ , $\tau = 0.0381$	<b>5</b> = <del>−−−</del>					
Check: □ Stable □ Aggrading	- Oxiding depth					

**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type: C 4b
Location:	Reach 8	Valley Type: <b>XIII</b>
Observers:	Lucas Babbitt	Date: 08/20/2015
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)
	eam Type at potential, $(C \rightarrow E)$ , $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	☐ Stable
(E→C),	(B→High W/d B), (C→High W/d C)	
(G	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	Unstable
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	☐ Highly Unstable

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Canyon Creek Stream Type: C 4b										
Lo	cation: Reach 8			Valley Ty	<sub>'pe:</sub> XIII					
Ob	servers: Lucas Babbitt			Da	ate: <b>08/20/2015</b>					
L	ateral stability criteria									
(c	choose one stability ategory for each criterion -5)	Stable	Moderately Unstable	Unstable	Highly Unstable	Selected Points (from each row)				
1	W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	8				
	,	(2)	(4)	(6)	(8)					
2	Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	В3	B5, B6, B7	1				
	,	(1)	(2)	(3)	(4)					
3	Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		1				
	,	(1)		(3)						
4	Streambank Erosion: Unit Rate (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07					
	(Worksheet 3-13)	(2)	(4)	(6)	(8)					
5	1617	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	3				
	(Worksheet 3-9)	(1)	(2)	(3)	(4)					
	Total Points									
	Lateral Stability Category Point Range									
C	Overall Lateral Stability Category (use total points and check stability rating)	Stable <10 □	Moderately Unstable 10 – 12 □	<i>Unstable</i> 13 – 21 <b>▽</b>	Highly Unstable > 21 □					

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Str	eam: Fourmile Can	yon Creek		Stream Type:	C 4b		
Loc	cation: Reach 8			Valley Type:	XIII		
Ob	servers: Lucas Babbitt			Date:	08/20/2015		
٧	ertical Stability	Vertical Stabil	ity Categories fo	Selected			
Criteria (choose one stability category for each criterion 1–6)		No Deposition	Moderate Deposition	Aggradation		Points (from each row)	
Sediment 1 competence (Worksheet 3-14)		Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	2	
		(2)	(4)	(6)	(8)		
2	Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand	2	
		(2)	(4)	(6)	(8)		
3	W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	6	
		(2)	(4)	(6)	(8)		
4	Stream Succession States (Worksheet 3- 16)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{array}{c} (C {\rightarrow} High \ W/d \ C), \\ (B {\rightarrow} High \ W/d \ B), \\ (C {\rightarrow} F), \ (G_c {\rightarrow} F), \\ (G {\rightarrow} F_b) \end{array} $	(C→D), (F→D)	2	
		(2)	(4)	(6)	(8)		
5	Depositional Patterns (Worksheet	B1	B2, B4	B3, B5	B6, B7, B8	1	
	3-5)	(1)	(2)	(3)	(4)		
6	Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	4	
		(1)	(2)	(3)	(4)		
					Total Points	17	
		Vertical Stab		nt Range for Exce	ss Deposition /		
A p	ertical Stability for xcess Deposition / ggradation (use total oints and check stability ating)	No Deposition < 15 □	Moderate Deposition 15 – 20 ▽	Excess Deposition 21 – 30	Aggradation > 30 □		

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream: Fourmile Car	nyon Creek		Stream Type:	C 4b	
Location: Reach 8			Valley Type:	XIII	
Observers: Lucas Babbit	t		Date:	08/20/2015	
Vertical Stability	Vertical Stabil	ity Categories for	Channel Incision	n / Degradation	Selected
Criteria (choose one stability category for each criterion 1–5)	Not Incised	Slightly Incised	Moderately Incised	Degradation	Points (from each row)
Sediment 1 Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved	6
	(2)	(4)	(6)	(8)	
Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	6
	(2)	(4)	(6)	(8)	)
Degree of Channel 3 Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	8
(WOINSHEET 3-1)	(2)	(4)	(6)	(8)	
Stream Succession 4 States (Worksheets 3-16 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$	8
	(2)	(4)	(6)	(8)	
Confinement 5 (MWR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	3
(Worksheet 3-9)	(1)	(2)	(3)	(4)	
				Total Points	31
	Vertical Stab	lity Category Poi Degra	nt Range for Cha dation	nnel Incision /	
Vertical Stability for Channel Incision/ Degradation (use total points and check stability rating)	Not Incised < 12 □	Slightly Incised 12 – 18	Moderately Incised 19 – 27 □	Degradation > 27 ☑	

**Worksheet 3-20.** Channel enlargement prediction summary.

Stream: Fourmile Canyon Creek Stream Type: C 4b										
Lo	cation: Reach 8			Valley Type:	XIII					
Ob	servers: Lucas Babbitt			Date:	08/20/2015					
С	Channel Enlargement	Char	nel Enlargement	<b>Prediction Categ</b>	ories					
(d	Prediction Criteria choose one stability ategory for each criterion –4)	No Increase	Slight Increase	Moderate Increase	Extensive	Selected Points (from each row)				
1	Successional Stage Shift (Worksheet 3-16)	Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{l} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $	2				
		(2)	(4)	(6)	(8)	6				
2	Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	6				
		(2)	(4)	(6)	(8)					
3	Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	4				
	(Worksheet 3-18)	(2)	(4)	(6)	(8)					
4	Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation	8				
	(Worksheet 3-19)	(2)	(4)	(6)	(8)					
					Total Points	20				
	Category Point Range									
P p	Channel Enlargement Prediction (use total oints and check stability ating)	No Increase < 11	Slight Increase 11 – 16	Moderate Increase 17 – 24 ☑	Extensive > 24 □					

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Str	eam: Fourmile Canyo	n Creek		Stream Type:	C 4b	
Loc	cation: Reach 8			Valley Type:	XIII	
Ob	servers:			Date:	08/20/2015	
P (d p	verall Sediment Supply rediction Criteria choose corresponding oints for each criterion –5)	Stability	Stability Rating Points		Selected Points	
		Stable		1		
1	Lateral Stability	Mod. Unstal	ble	2	3	
Ι'	(Worksheet 3-17)	Unstable		3	3	
		Highly Unst	able	4	XIII 08/20/2015 Selected	
	Vertical Stability	No Depositi	on	1		
2	<b>Excess Deposition or</b>	Mod. Depos	ition	2	2	
-	Aggradation	Excess Dep	osition	3	2	
	(Worksheet 3-18)	Aggradation	1	4		
	Vertical Stability	Not Incised		1		
3	Channel Incision or Degradation	Slightly Inci	sed	2	4	
١		Mod. Incise	d	3		
	(Worksheet 3-19)	Degradation	1	4		
	Channel Enlargement	No Increase		1		
4	Prediction (Worksheet	Slight Increa		2	3	
	3-20)	Mod. Increa	se	3	3	
	<i></i>	Extensive		4		
	Pfankuch Channel	Good: Stab		1		
5	Stability (Worksheet 3-	Fair: Mod. (	Jnstable	2	2	
	10)				_	
		Poor: Unsta	able	4		
				Total Points	14	
			Category P	oint Range		
R	overall Sediment Supply ating (use total points and check stability rating)	<i>Low</i> < 6 □	<i>Moderate</i> 6 – 10 □	High 11 – 15 <b>▽</b>	> 15	

Worksheet 3-22. Summary of stability condition categories.

	А	BCDEFGHIJK	LMNOPQRS	TUVWXYZ	AA AB AC AD AE AF	AGAH AI AJAK ALAM
1	Stream:	Fourmile Canyon Creek		Location: Reach 8		
2	Observers:	Lucas Babbitt	Date: 8/20/2015	Stream Type: C 4B	Valley Type:	XIII
3	Channel Dimension	Mean Bankfull 1.41 Bankfull Depth (ft): (ft):	20 91	29.4 Width/Depth Ratio:	14.83 Entren Ratio:	chment 2.24
5 6	Channel Pattern	Mean: λ/W <sub>bkf</sub> : 16.79 Range: 16.79 - 16.79	12.24 - 12.24	3.59 - 4.69	WR: <b>0.62</b> <b>0.62 - 0.62</b>	Sinuosity: 1.04
7	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec):  4.98	Discharge (Q <sub>bkf</sub> ):	Estimation Method:	U/U*	Drainage Area (mi²):
9		Check: ☐ Riffle/Pool ☐ Step/P	ool Plane Bed	Convergence/Divergence		nes/Smooth Bed
10	River Profile & Bed	Max Riffle Pool	Depth Ratio (max Riffle	Pool Pool-to- Rat	io	Slope
11 12	Features	Bankfull 2.49 1.85	to mean): 1.77	1.62 Pool Spacing: 36.5		i Surrace:
13		Riparian Current Composition			ks: Condition, Vigor & Us	•
14		Vegetation   See description	Same as existing	native speci Density an		
15 16		Flow P 1 2 Stream Size Regime: 8 & Order:	S-4(2) Meander Patterns:	M1 Depositional Patterns:	B2 Debris	/Channel des: D3 D10
17	Level III Stream	Degree of Incision 2.12	Dograp of Indicion	Modified Diank	uch Stability Rating	
18	Stability Indices	(Bank-Height Ratio):	Stability Rating:		jective Rating):	96 -
19	·	Width/depth 13.37 Reference		th Ratio State 0.5	w/d Ratio Sta	te Unstable
20		Ratio (W/d): Ratio (W/d	d <sub>ref</sub> ): (W/d) / (W/	/d <sub>ref</sub> ):	Stability Rating	g: Offstable
21 22			ference VR <sub>ref</sub> : 5 Degree of (MWR / MV	confinement WR <sub>ref</sub> ):	MWR / MWR <sub>re</sub> Stability Rating	I INSTANIA I
23	Bank Erosion	Longth of Dooch	nnual Streambank Erosion Rat	<u> </u>	Remarks:	9.
24	Summary	Studied (ft):		ns/yr/ft)		
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity ☐ Insu	fficient Capacity	Capacity	(S:	
26 27	Entrainment/ Competence	Largest Particle from <b>228.6</b> Bar Sample (mm):	T - 1/41 T   U	Existing Depth: 1.18 Require Depth:	0.61 Existing Slope:	#### Required Slope: ####
28 29	Successional Stage Shift	<b>→ →</b>	<b>→ →</b>	Existing Str	(* 4n	tential Stream ate (Type):
30	Lateral Stability	□ Stable □ Mod. Un	stable 🔽 Unstable	☐ Highly Unstable	Remarks/causes:	
31	Vertical Stability (Aggradation)	☐ No Deposition ☑ Mod. De	position	☐ Aggradation	Remarks/causes:	
32	Vertical Stability (Degradation)	☐ Not Incised ☐ Slightly I	Incised	✓ Degradation	Remarks/causes:	
33	Channel Enlargement	☐ No Increase ☐ Slight Inc	crease Mod. Increase	☐ Extensive	Remarks/causes:	
34 35	Sediment Supply (Channel Source)	Low Moderat	te 💆 High 🗀 Very Hi	gh Remarks/causes:		

RIVERMORPH PFANKUCH SUMMARY River Name: Reach 9 Reach Name: Assesments Survey Date: 05/13/2015 Upper Bank 8 9 Landform Slope: Mass Wasting: Debris Jam Potential: Vegetative Protection: Lower Bank Channel Capacity: Bank Rock Content: 2 Obstructions to Flow: Cutting: Deposition: Channel Bottom 2 4 Rock Angularity: Brightness: Consolidation of Particles: 8 Bottom Size Distribution: Scouring and Deposition: 6 Aquatic Vegetation: Channel Stability Evaluation Sediment Supply: Stream Bed Stability: Hi gh W/D Condition:

E4B

Stream Type:

Rating - 75 Condition - Good

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	Fourmile Canyon Creek, Reach - Reach 9		
Basin:	Drainage Area: 4748.8 acres	7.42	mi <sup>2</sup>
Location:			
Twp.&Rge:	; Sec.&Qtr.: ;		
Cross-Sect	ion Monuments (Lat./Long.): 40.06497 Lat / 105.30794 Long	Date:	08/20/15
Observers:	Lucas Babbitt	Valley Type:	VIII(b)
	Bankfull WIDTH (W <sub>bkf</sub> ) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	12.15	] ft
			].,
	<b>Bankfull DEPTH (</b> $d_{bkf}$ <b>)</b> Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ( $d_{bkf} = A / W_{bkf}$ ).	1.48	ft
	Bankfull X-Section AREA (A <sub>bkf</sub> )  AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	17.98	ft <sup>2</sup>
	Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> ) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	8.21	ft/ft
	<b>Maximum DEPTH (d<sub>mbkf</sub>)</b> Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	2.3	ft
	WIDTH of Flood-Prone Area ( $W_{fpa}$ ) Twice maximum DEPTH, or (2 x d <sub>mbkf</sub> ) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	47.82	ft
	Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH ( $W_{\text{fpa}}/W_{\text{bkf}}$ ) (riffle section).	3.94	ft/ft
	Channel Materials (Particle Size Index ) $D_{50}$ The $D_{50}$ particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	39.22	mm
	Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.03451	_ft/ft
	Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	1.11	
	Stream E 4b (See Figure 2-	-14)	

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

	ream: Fourmile Canyon Creek					Location: Reach - Reach 9			
Ob	servers: Lucas Babbitt		Date:	08/20	/15	Valley Type: XIII Strea	m Type: <b>E</b>	E 4b	
		Riv	er Rea	ch Dir	nens	sion Summary Data1			
	Riffle Dimensions*' **' ***	Mean	Min	Max		Riffle Dimensions & Dimensionless Ratios****		Min	Max
*	Riffle Width (W <sub>bkf</sub> )	12.2	12.2	12.2	-	Riffle Cross-Sectional Area (A <sub>bkf</sub> ) (ft <sup>2</sup> )	17.98 1	7.98	17.98
* *	Mean Riffle Depth (d <sub>bkf</sub> )	1.48	1.48	1.48	ft	Riffle Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	8.21 8	3.21	8.21
ns*	Maximum Riffle Depth (d <sub>max</sub> )	2.3	2.3	2.3	ft	Max Riffle Depth to Mean Riffle Depth (d <sub>max</sub> / d <sub>bkf</sub> )	1.554 1	.554	1.554
	Width of Flood-Prone Area (W <sub>fpa</sub> )	47.8	47.8	47.8	ft	Entrenchment Ratio (W <sub>fpa</sub> / W <sub>bkf</sub> )	3.936 3	.936	3.936
me	Riffle Inner Berm Width (W <sub>ib</sub> )	0	0	0	ft	Riffle Inner Berm Width to Riffle Width (W <sub>ib</sub> / W <sub>bkf</sub> )	0.000 0	.000	0.000
Riffle Dimensions*, **, ***	Riffle Inner Berm Depth (d <sub>ib</sub> )	0	0	0	ft	Riffle Inner Berm Depth to Mean Depth $(d_{ib} / d_{bkf})$	0.000 0	.000	0.000
Riff	Riffle Inner Berm Area (A <sub>ib</sub> )	0	0	0	ft <sup>2</sup>	Riffle Inner Berm Area to Riffle Area (A <sub>ib</sub> / A <sub>bkf</sub> )	0.000 0	.000	0.000
	Riffle Inner Berm W/D Ratio (W <sub>ib</sub> / d <sub>ib</sub> )	0	0	0					
	Pool Dimensions*' **' ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean	Min	Max
	Pool Width (W <sub>bkfp</sub> )	13.2	13	13.3	ft	Pool Width to Riffle Width (W <sub>bkfp</sub> / W <sub>bkf</sub> )	1.082 1	i	
* *	Mean Pool Depth (d <sub>bkfp</sub> )	1.45	1.26	1.63	ft	Mean Pool Depth to Mean Riffle Depth (d <sub>bkfp</sub> / d <sub>bkf</sub> )	0.980 0	.851	1.101
*    *s	Pool Cross-Sectional Area (A <sub>bkfp</sub> )	19	16.4	21.7	ft	Pool Area to Riffle Area (A <sub>bkfp</sub> / A <sub>bkf</sub> )	1.058 0	.911	1.206
ion	Maximum Pool Depth (d <sub>maxp</sub> )	2.52	2.22	2.82	ft	Max Pool Depth to Mean Riffle Depth (d <sub>maxp</sub> / d <sub>bkf</sub> )	1.703 1	.500 °	1.905
len:	Pool Inner Berm Width (W <sub>ibp</sub> )	2.32	0	4.64	ft	Pool Inner Berm Width to Pool Width (W <sub>ibp</sub> / W <sub>bkfp</sub> )	0.175 0	.000	0.350
Din	Pool Inner Berm Depth (d <sub>ibp</sub> )	0.27	0	0.54	ft	Pool Inner Berm Depth to Pool Depth (d <sub>ibp</sub> / d <sub>bkfp</sub> )	0.166 0	.000	0.332
Pool Dimensions*, **, ***	Pool Inner Berm Area (A <sub>ibp</sub> )	1.25	0	2.51	ft <sup>2</sup>	Pool Inner Berm Area to Pool Area (A <sub>ibp</sub> / A <sub>bkfp</sub> )	0.058 0	.000	0.116
	Point Bar Slope (S <sub>pb</sub> )	0.000	0.000	0.000	ft/ft	Pool Inner Berm Width/Depth Ratio (W <sub>ibp</sub> / d <sub>ibp</sub> )	4.295 0	.000	8.590
	Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios****	Mean	Min	Max
*s	Run Width (W <sub>bkfr</sub> )	11.3		1	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	0.928 0		
sion	Mean Run Depth (d <sub>bkfr</sub> )	1.78	1.78	1.78	ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )	1.203 1	.203	1.203
~									
ll er	Run Cross-Sectional Area (A <sub>bkfr</sub> )	20.1	20.1	20.1	ft	Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )	1.116 1	.116	1.116
 ח Dimer	Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )	20.1	20.1	20.1 2.85	<del>                                     </del>	Run Area to Riffle Area $(A_{bkfr} / A_{bkf})$ Max Run Depth to Mean Riffle Depth $(d_{maxr} / d_{bkf})$			
Run Dimensions*		1		l	ft		1.116 1		
Run Dimer	Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )	2.85 6.34	2.85 6.34	2.85 6.34	ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )	1.116 1 1.926 1	.926	1.926
Run Dimer	Maximum Run Depth (d <sub>maxr</sub> )	2.85 6.34 Mean	2.85	2.85	ft ft		1.116 1 1.926 1	.926 Min	1.926 Max
	Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*	2.85 6.34 Mean 15.6	2.85 6.34 Min	2.85 6.34 Max 15.6	ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****	1.116 1 1.926 1 Mean 1.284 1	.926 Min .284	1.926 Max 1.284
	Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> )	2.85 6.34 Mean 15.6	2.85 6.34 Min 15.6	2.85 6.34 Max 15.6	ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	1.116 1 1.926 1 Mean 1.284 1 0.919 0	.926 / Min .284 /	Max 1.284 0.919
	Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )	2.85 6.34 Mean 15.6	2.85 6.34 Min 15.6 1.36 21.1	2.85 6.34 Max 15.6	ft ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	1.116 1 1.926 1 Mean 1.284 1	.926 Min .284 .919	Max 1.284 0.919
	Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )	2.85 6.34 Mean 15.6 1.36 21.1	2.85 6.34 Min 15.6 1.36 21.1	2.85 6.34 Max 15.6 1.36	ft ft ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )	1.116 1 1.926 1  Mean 1.284 1 0.919 0 1.176 1	.926 Min .284 .919 .176	Max 1.284 0.919 1.176
	Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )	2.85 6.34 Mean 15.6 1.36 21.1 2.58	2.85 6.34 Min 15.6 1.36 21.1 2.58	2.85 6.34 Max 15.6 1.36 21.1 2.58	ft ft ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )	Mean 1.284 1 0.919 0 1.176 1 1.743 1	.926 Min .284 .919 .176 .743	Max 1.284 0.919 1.176 1.743
Glide Dimensions*	Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )	2.85 6.34 Mean 15.6 1.36 21.1 2.58	2.85 6.34 Min 15.6 1.36 21.1 2.58 11.5	2.85 6.34 Max 15.6 1.36 21.1 2.58 11.5	ft ft ft ft ft ft ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )	Mean 1.284 1 0.919 0 1.176 1 1.743 1 0.000 0	.926 Min .284 .919 (.176 .743 .000 (	Max 1.284 0.919 1.176 1.743 0.000
	Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> ) Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> ) Glide Inner Berm Width (W <sub>ibg</sub> )	2.85 6.34 Mean 15.6 1.36 21.1 2.58 11.5	2.85 6.34 Min 15.6 1.36 21.1 2.58 11.5	2.85 6.34 Max 15.6 1.36 21.1 2.58 11.5	ft ft ft ft ft ft ft ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> /W <sub>bkfg</sub> )	Mean 1.284 1 0.919 0 1.743 1 0.000 0 0.000 0	.926 Min .284 .919 ( .176 .743 .000 (	Max 1.284 0.919 1.176 1.743 0.000 0.000
	Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> ) Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>lbg</sub> )	2.85 6.34  Mean 15.6 1.36 21.1 2.58 11.5 0 0	2.85 6.34 Min 15.6 1.36 21.1 2.58 11.5 0 0	2.85 6.34  Max 15.6 1.36 21.1 2.58 11.5 0 0	ft ft ft ft ft ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )	Mean 1.284 1 0.919 0 1.176 1 1.743 1 0.000 0 0.000 0 0.000 0	.926 Min .284 .919 .176 .743 .000 .000	Max 1.284 0.919 1.176 1.743 0.000 0.000 0.000
	Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )	2.85 6.34  Mean 15.6 1.36 21.1 2.58 11.5 0	2.85 6.34 Min 15.6 1.36 21.1 2.58 11.5 0	2.85 6.34 Max 15.6 1.36 21.1 2.58 11.5 0	ft ft ft ft ft ft/ft ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>ibg</sub> / d <sub>bkfg</sub> )	Mean 1.284 1 0.919 0 1.176 1 1.743 1 0.000 0 0.000 0 0.000 0	.926	Max 1.284 0.919 1.176 1.743 0.000 0.000 0.000 0.000
Glide Dimensions*	Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )	2.85 6.34  Mean 15.6 1.36 21.1 2.58 11.5 0 0 Mean	2.85 6.34 Min 15.6 1.36 21.1 2.58 11.5 0 0 Min	2.85 6.34 Max 15.6 1.36 21.1 2.58 11.5 0 0 Max	ft ft ft ft ft ft ft ft ft ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )	Mean 1.284 1 0.919 0 1.176 1 1.743 1 0.000 0 0.000 0 0.000 0 0.000 0	.926	Max 1.284 0.919 1.176 1.743 0.000 0.000 0.000 0.000 Max 0.982
Glide Dimensions*	Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**	2.85 6.34  Mean 15.6 1.36 21.1 2.58 11.5 0 0 Mean 11.9	2.85 6.34 Min 15.6 1.36 21.1 2.58 11.5 0 0 Min 11.9 1.63	2.85 6.34  Max 15.6 1.36 21.1 2.58 11.5 0 0 Max 11.9 1.63	ft ft ft ft ft ft ft ft ft ft ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> / W <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>lbg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	Mean 1.284 1 0.919 0 1.176 1 1.743 1 0.000 0 0.000 0 0.000 0 Mean 0.982 0 1.101 1	.926 Min .284 .919 .176 .743 .000 .000 .000 .000 .000 .000	Max 1.284 0.919 1.176 1.743 0.000 0.000 0.000 0.000 Max 0.982 1.101
	Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>ibg</sub> )  Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )  Step Cross-Sectional Area (A <sub>bkfs</sub> )	2.85 6.34  Mean 15.6 1.36 21.1 2.58 11.5 0 0  Mean 11.9 1.63	2.85 6.34 Min 15.6 1.36 21.1 2.58 11.5 0 0 Min 11.9 1.63	2.85 6.34 Max 15.6 1.36 21.1 2.58 11.5 0 0 Max 11.9 1.63	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> / W <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>lbg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>lbg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )  Mean Step Depth to Riffle Depth (d <sub>bkfs</sub> / d <sub>bkf</sub> )  Step Area to Riffle Area (A <sub>bkfs</sub> / A <sub>bkf</sub> )	Mean 1.284 1 0.919 0 1.176 1 1.743 1 0.000 0 0.000 0 0.000 0 0.000 0 1.101 1 1.081 1	.926	Max 1.284 0.919 1.176 1.743 0.000 0.000 0.000 0.000 0.000 1.101 1.081
Glide Dimensions*	Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )  Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )  Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Width (W <sub>ibg</sub> )  Glide Inner Berm Depth (d <sub>bg</sub> )  Glide Inner Berm Area (A <sub>bg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )	2.85 6.34  Mean 15.6 1.36 21.1 2.58 11.5 0 0 Mean 11.9 1.63	2.85 6.34 Min 15.6 1.36 21.1 2.58 11.5 0 0 Min 11.9 1.63 19.4 2.54	2.85 6.34  Max 15.6 1.36 21.1 2.58 11.5 0 0 Max 11.9 1.63 19.4 2.54	ft  ft  ft  ft  ft  ft  ft  ft  ft  ft	Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Step Depth to Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	Mean 1.284 1 0.919 0 1.176 1 1.743 1 0.000 0 0.000 0 0.000 0 Mean 0.982 0 1.101 1	.926	Max 1.284 0.919 1.176 1.743 0.000 0.000 0.000 0.000 0.000 1.101 1.081

<sup>\*</sup>Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

<sup>\*\*</sup>Step-Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

<sup>\*\*\*</sup>Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

<sup>\*\*\*\*</sup>Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	ream: Fourmile Ca	nyon Cr	eek				Lo	cation:	Reach	ı - Rea	ch 9					
Ob	servers: Lucas Babbi	itt			Date:	08/20/	15		Valle	y Type:	XIII		Strear	n Type:	E 4b	
cs					Riv	er Read	ch Sumi	mary D	ata	.2	)					
Hydraulics	Streamflow: Estimated	Mean Ve	locity a	at Bank	full Sta	ge (u <sub>bkf</sub> )		9.5	32	ft/sec	Estim	ation Me	thod	İ	U/U*	
Ě	Streamflow: Estimated Discharge at B			ankfull	Stage (	Q <sub>bkf</sub> )		171.	385	cfs	Draina	age Area	ı	7.	42	mi <sup>2</sup>
	Geometry	ı	Mean	Min	Max			Dime	nsionl	ess Ge	eometr	y Ratios	3	Mean	Min	Max
	Linear Wavelength (λ)		638	505	771	ft	Linear W					•		#####	#####	####
	Stream Meander Lengt	h (L <sub>m</sub> )	676	676	676	ft	Stream I	Meandei	r Lengt	h Ratio	(L <sub>m</sub> / V	V <sub>bkf</sub> )		#####	#####	####
tern	Radius of Curvature (R	c)	198	89	308	ft	Radius o	of Curvat	ture to	Riffle V	Vidth (F	R <sub>c</sub> / W <sub>bkf</sub> )		#####	7.325	####
Channel Pattern	Belt Width (W <sub>blt</sub> )		40	40	40	ft	Meande	r Width I	Ratio (\	W <sub>blt</sub> / W	bkf)			3.292	3.292	3.292
nne	Arc Length (L <sub>a</sub> )		0	0	0	ft	Arc Leng	gth to Rit	ffle Wid	dth (L <sub>a</sub> /	W <sub>bkf</sub> )			0.000	0.000	0.000
Cha	Riffle Length (L <sub>r</sub> )		38.7	7.62	72.2	ft	Riffle Le	ngth to F	Riffle W	/idth (L	r / W <sub>bkf</sub>	)		3.185	0.627	5.939
	Individual Pool Length	(L <sub>p</sub> )	11.8	4.23	28.4	ft	Individua	al Pool L	ength	to Riffle	Width	(L <sub>p</sub> /W <sub>t</sub>	okf)	0.974	0.348	2.333
	Pool to Pool Spacing (F	P <sub>s</sub> )	36.4	13.7	75.8	ft	Pool to F	Pool Spa	cing to	Riffle	Width	(P <sub>s</sub> /W <sub>bk</sub>	f)	2.992	1.125	6.235
	Valley Slope (S <sub>val</sub> )	0.04	7	ft/ft	Averac	ne Wate	r Surface	e Slope (	(S)	0.0	3451	ft/ft	Sinuosity (	S <sub>val</sub> / S)		1.11
	Stream Length (SL)	808	<u> </u>	ft	`	Length			,	1	89	ft	Sinuosity (			1.17
	Low Bank Height	start		ft	,	Max De	pth	start	2.2	ft	В		ht Ratio (Bl			1.95
	(LBH)	;	2.2	ft		(d <sub>max</sub> )		-	2.2	ł			H / d <sub>max</sub> )		end	1
	Facet Slopes	-	Mean	Min	Max	!		mensio			•			Mean	Min	Max
	Riffle Slope (S <sub>rif</sub> )	-		0.017			Riffle Slo					<u> </u>	,		0.492	
lie lie	Run Slope (S <sub>run</sub> )			0.048			Run Slo								1.383	
Channel Profile	Pool Slope (S <sub>p</sub> )			0.002			Pool Slo						•		0.053	
une	Glide Slope (S <sub>g</sub> )			0.002			Glide Slo	•					. 5	1	0.045	
ြင္မ	Step Slope (S <sub>s</sub> )	C	0.000	0.000	0.000	ft/ft	Step Slo	pe to Av	/erage	Water	Surfac	e Slope	(S <sub>s</sub> /S)	0.000	0.000	0.000
	Max Depths <sup>a</sup> Max Riffle Depth (d <sub>maxrii</sub>		Mean	Min	Max	<u></u>	Max Riff	Dimen:					/d )	Mean	Min	Max
			1.01	0.83	1.25		Max Rur								0.561	
	Max Run Depth (d <sub>maxrun</sub>						Max Poo								0.446	
	Max Pool Depth (d <sub>maxp</sub> )			1.06	1.07		Max Glic							1	0.716	=
	Max Glide Depth (d <sub>maxg</sub>	)	8.0	0.54										!	0.365	
	Max Step Depth (d <sub>maxs</sub> )		0	0	0	ft	Max Ste	p Deptn			Deptr	ı (ɑ <sub>maxs</sub> /	O <sub>bkf</sub> )	0	0	0
	D/ Silk/Clay	Reac	h <sup>b</sup>		fle <sup>c</sup>	E	Bar			ich <sup>b</sup>	R	iffle <sup>c</sup>	Bar	Protru	ısion He	
als	% Silt/Clay % Sand	0			) 	<u> </u>		D <sub>16</sub>		47	-	8		<u> </u>		mm
Channel Materials	% Sand	14 52	<u> </u>		<del>)</del>	<u> </u>		D <sub>35</sub>		.17	<u>.                                      </u>	5.29	1	<u> </u>		mm
∭ ₩ ₩	% Gravei	34	<u>i</u>		7	<u> </u>		D <sub>50</sub>		.22 7.73	<del></del>	5.61	<u> </u>	<u>.</u>		mm
anne			i		7	<u> </u>		D <sub>84</sub>			<u>.                                    </u>	6.36	<u> </u>	<u> </u>		mm
ဗိ	% Boulder	0				! !		D <sub>95</sub>		0.29	<del>                                     </del>	9.5	!	! !		mm
	% Bedrock	0	i		,	<u> </u>		D <sub>100</sub>	255	5.99	1	180				mm

<sup>&</sup>lt;sup>a</sup> Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

<sup>&</sup>lt;sup>b</sup> Composite sample of riffles and pools within the designated reach.

<sup>&</sup>lt;sup>c</sup> Active bed of a riffle.

<sup>&</sup>lt;sup>d</sup> Height of roughness feature above bed.

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

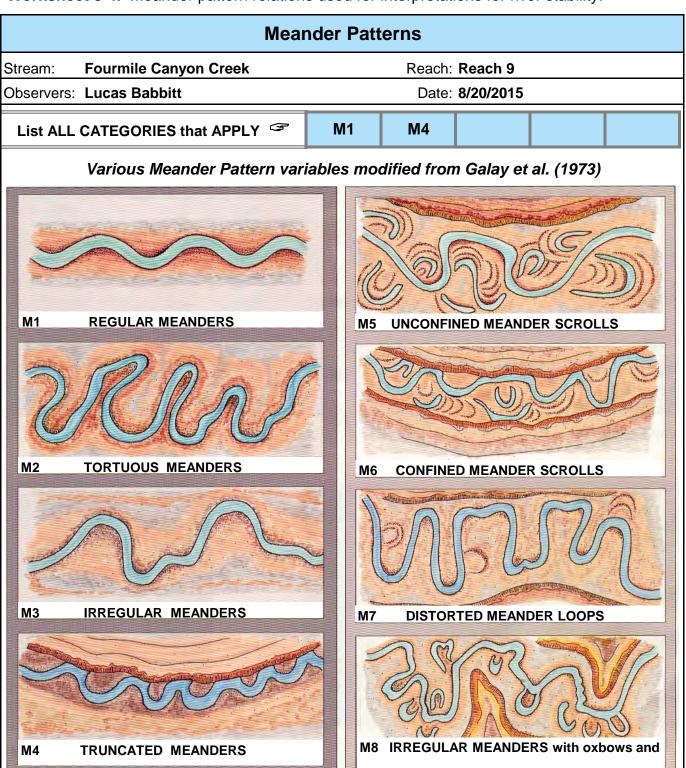
biological interpretations.										
FLOW REGIME										
Stream:	Fourmile Canyon Creek Location: Reach 9									
Observers:	Observers: Lucas Babbitt Date: 8/20/2015									
List ALL	List ALL COMBINATIONS that P 1 2 8									
API	APPLY									
General (	Category									
E	Ephemeral stream channels: Flows only in response to precipitation									
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.									
I	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.									
Р	Perennial stream channels: Surface water persists yearlong.									
Specific (	Category									
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.									
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.									
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.									
4	Streamflow regulated by glacial melt.									
5	Ice flows/ice torrents from ice dam breaches.									
6	Alternating flow/backwater due to tidal influence.									
7	Regulated streamflow due to diversions, dam release, dewatering, etc.									
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.									
9	Rain-on-snow generated runoff.									

Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

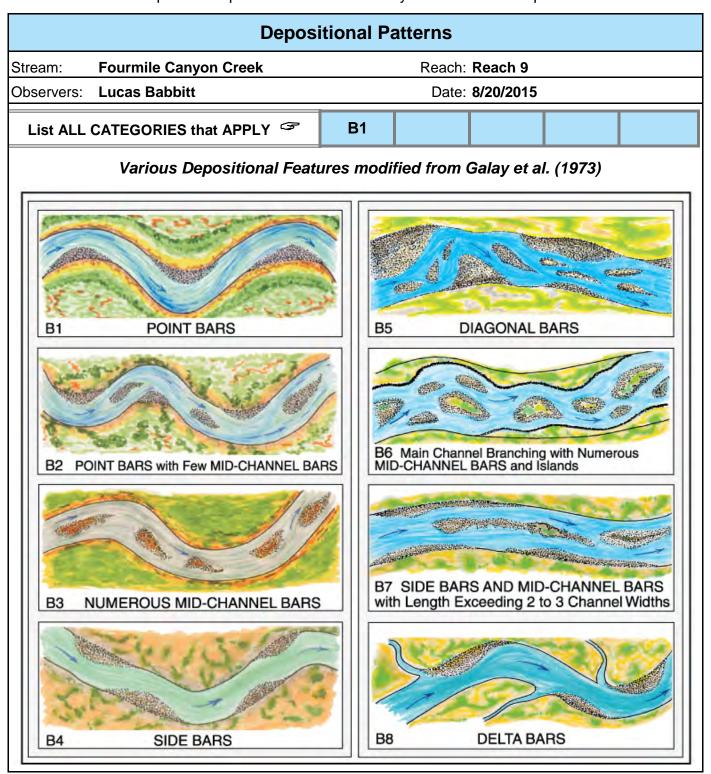
Stream Size and Order								
Stream:	Stream: Fourmile Canyon Creek							
Location: Reach 9								
Observers: Lucas Babbitt								
Date:	8/20/2015							
Stream Siz	e Category and	l Order 🤝	S-4(3)					
Category	Check (✓) appropriate							
	meters	feet	category					
S-1	0.305	<1						
S-2	0.3 – 1.5	1 – 5						
S-3	1.5 – 4.6	5 – 15						
S-4	4.6 – 9	15 – 30	~					
S-5	9 – 15	30 – 50						
S-6	15 – 22.8	50 – 75						
S-7	22.8 - 30.5	75 – 100						
S-8	30.5 – 46	100 – 150						
S-9	46 – 76	150 – 250						
S-10	76 – 107	250 – 350						
S-11	107 – 150	350 – 500						
S-12	150 – 305	500 – 1000						
S-13	>305	>1000						
	Strear	n Order						
Add categorie	as in naranthasis	for enacific etrasi	m order of					

Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



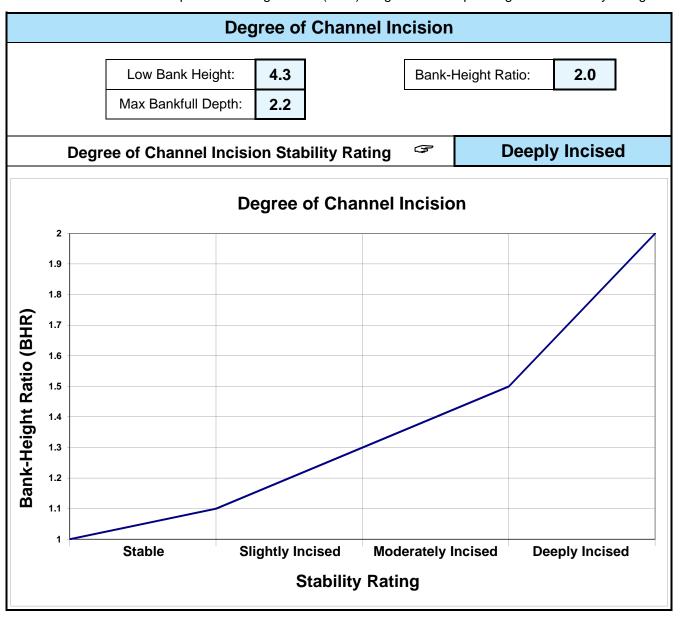
Worksheet 3-5. Depositional patterns used for stability assessment interpretations.



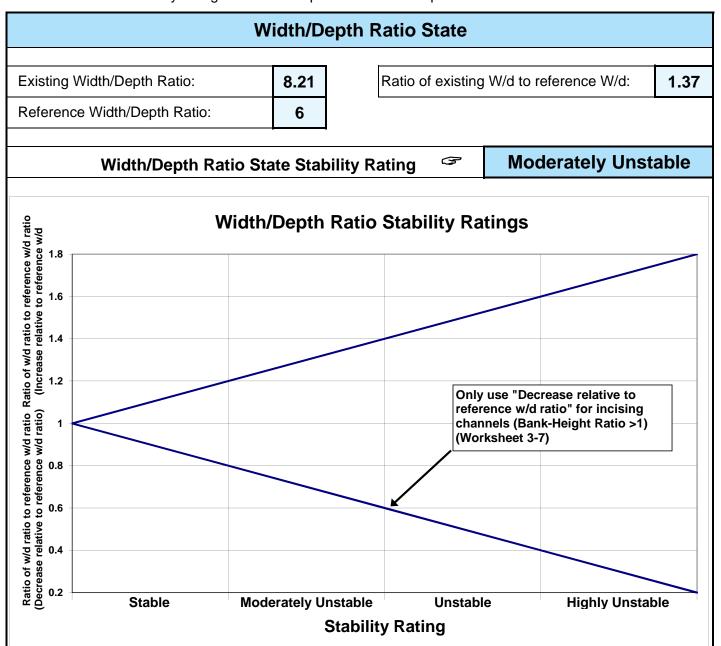
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

	Channel Blockages							
Stream		anyon Creek Location: Reach 9						
Obser	rvers: Lucas Babl	bitt Date: 8/20/2015						
Desc	ription/extent	Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.	Check (√) all that apply					
D1	None	Minor amounts of small, floatable material.	₹					
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.						
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.						
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.						
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.						
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.						
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.						
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.						
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.						
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	Y					

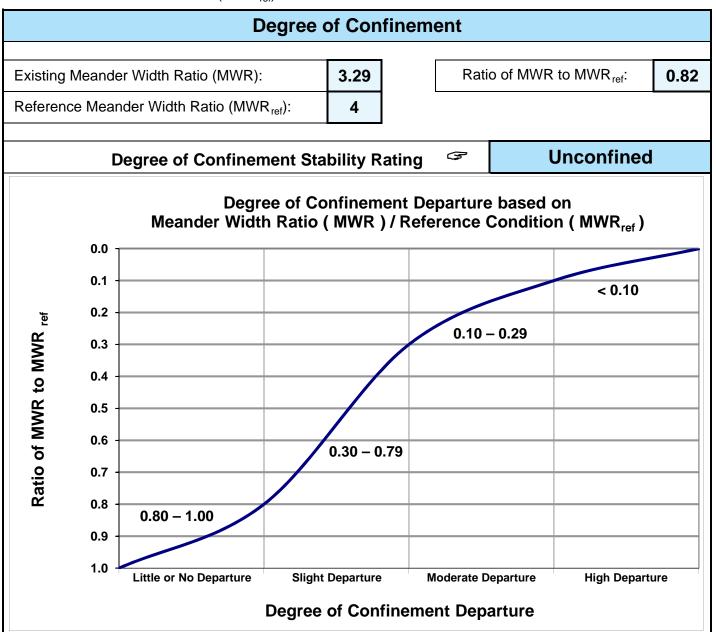
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	tream Type:	E 4b						
Location:		Reach 9		,	Valley Type:	XIII						
Observers:		Lucas Bab	bitt		Date:	08/20/2015						
Enter Rec	quire	Information	on for Existing Conditi	on								
35.6		D <sub>50</sub>	Median particle size o	f riffle bed material (mm	ffle bed material (mm)							
0.0		D 50	Median particle size o	f bar or sub-pavement s	ar or sub-pavement sample (mm)							
0.833	3	D <sub>max</sub>	Largest particle from l	oar sample (ft)	254	(mm)	304.8 mm/ft					
0.0345	51	S	Existing bankfull wate	r surface slope (ft/ft)								
1.48		d	Existing bankfull mea	n depth (ft)								
1.65		$\gamma_s - \gamma / \gamma$	$\gamma_s$ - $\gamma/\gamma$ Immersed specific gravity of sediment									
Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress												
0.00		$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>)</b> ^) -0.872					
7.13		$D_{\rm max}/D_{50}$	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 ( <i>D</i> <sub>max</sub> / <i>D</i>	<sub>50</sub> ) <sup>-0.887</sup>					
		$ au^*$	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A					
Calculate	Bank	full Mean D	Pepth Required for Entra	ainment of Largest Part	icle in Bar	Sample						
		d	Required bankfull mean	depth (ft) $d = \frac{\tau}{\tau}$	$rac{*(\gamma_{s}-1)D_{r}}{S}$	use (use	D <sub>max</sub> in ft)					
Calculate	Banl	kfull Water	Surface Slope Require	ed for Entrainment of I	Largest Pa	rticle in Ba	r Sample					
		s	Required bankfull water	surface slope (ft/ft) <b>\$</b> =	$\frac{\mathcal{T}^*(\gamma_s - 1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)					
		Check:	☐ Stable ☐ Aggrad	ing 🔽 Degrading								
Sediment	Com	petence Us	sing Dimensional Shea	ar Stress								
3.187	,		hear stress $\tau = \gamma dS$ (lbs/fi		dius, R, with	mean depth,	d)					
Shields	СО	•	d = existing depth, S = exis									
	56.6	Predicted I	largest moveable particle	size (mm) at bankfull shea	r stress τ (F	igure 3-11)						
	co 2. <b>01</b>	Predicted	shear stress required to in	itiate movement of measu	red $D_{max}$ (m	m) (Figure 3	-11)					
Shields	СО	Predicted i	mean depth required to ini	tiate movement of measu	red D <sub>max</sub> (mr	n) d	τ_					
	).93	•	ted shear stress, $\gamma$ = 62.4,	• •		$\mathbf{d} = \frac{1}{2}$	<b>yS</b>					
	CO		slope required to initiate m		<sub>nax</sub> (mm)	$S = \frac{\tau}{1100}$						
0.0336 0.	0218	·	ted shear stress, $\gamma = 62.4$ ,			γd						
		Check:	☐ Stable ☐ Aggrad	ing   ✓ Degrading								

**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type: <b>E 4b</b>
Location:	Reach 9	Valley Type: <b>XIII</b>
Observers:	Lucas Babbitt	Date: 08/20/2015
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)
	eam Type at potential, $(C \rightarrow E)$ , ), $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	☐ Stable
(E→C),	(B→High W/d B), (C→High W/d C)	✓ Moderately Unstable
(G <sub>c</sub>	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	☐ Unstable
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	☐ Highly Unstable

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Canyon	Creek		Stream Ty	<sub>'pe:</sub> <b>E 4b</b>							
Location: Reach 9			Valley Ty	<sub>'pe:</sub> XIII							
Observers: Lucas Babbitt			Da	ate: <b>08/20/2015</b>							
Lateral stability criteria		Lateral Stabilit	ty Categories								
(choose one stability category for each criterion 1–5)	Stable	Moderately Unstable	Unstable	Highly Unstable	Selected Points (from each row)						
W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	4						
,	(2)	(4)	(6)	(8)							
Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	В3	B5, B6, B7	1						
	(1)	(2)	(3)	(4)							
Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		1						
,	(1)		(3)								
Streambank Erosion: 4 Unit Rate (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07							
(Worksheet 3-13)	(2)	(4)	(6)	(8)							
Degree of Confinement 5 (MWR / MWR <sub>ref</sub> )	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	1						
(Worksheet 3-9)	(1)	(2)	(3)	(4)							
Total Points											
	Late	eral Stability C	ategory Point Ra	ange							
Overall Lateral Stability Category (use total points and check stability rating)	Stable <10 ☑	Moderately Unstable 10 – 12 □	<i>Unstable</i> 13 – 21 □	Highly Unstable > 21 □							

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Str	eam: Fourmile Can	yon Creek		Stream Type:	E 4b		
Loc	cation: Reach 9			Valley Type:	XIII		
Ob	servers: Lucas Babbitt	:		Date:	08/20/2015		
	ertical Stability	Vertical Stabi	ity Categories fo	r Excess Deposition	n / Aggradation	Selected	
St	riteria (choose one tability category for ach criterion 1–6)	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	Points (from each row)	
Sediment 1 competence (Worksheet 3-14)		Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	2	
		(2)	(4)	(6)	(8)		
2	Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand	2	
		(2)	(4)	(6)	(8)		
3	W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	4	
		(2)	(4)	(6)	(8)		
4	Stream Succession States (Worksheet 3- 16)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{array}{c} (C{\rightarrow}High\ W/d\ C),\\ (B{\rightarrow}High\ W/d\ B),\\ (C{\rightarrow}F),(G_c{\rightarrow}F),\\ (G{\rightarrow}F_b) \end{array} $	(C→D), (F→D)	2	
		(2)	(4)	(6)	(8)		
5	Depositional Patterns (Worksheet	B1	B2, B4	B3, B5	B6, B7, B8	1	
	3-5)	(1)	(2)	(3)	(4)		
6	Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	4	
		(1)	(2)	(3)	(4)		
					Total Points	15	
		Vertical Stab		nt Range for Exce	ss Deposition /		
E A p	ertical Stability for xcess Deposition / ggradation (use total oints and check stability ating)	No Deposition < 15	Moderate Deposition 15 – 20 ▽	Excess Deposition 21 – 30	Aggradation > 30 □		

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream: Fourmile Car	nyon Creek		Stream Type:	E 4b		
Location: Reach 9			Valley Type:	XIII		
Observers: Lucas Babbi	tt		Date:	08/20/2015		
Vertical Stability	Vertical Stabil	ity Categories for	Channel Incision	n / Degradation	Selected	
Criteria (choose one stability category for each criterion 1–5)	Not Incised	Slightly Incised	Moderately Incised	Degradation	Points (from each row)	
Sediment 1 Competence (Worksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved	6	
	(2)	(4)	(6)	(8)		
Sediment Capacity (POWERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	6	
	(2)	(4)	(6)	(8)		
Degree of Channel 3 Incision (BHR) (Worksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	8	
(WOIKSHEEL 3-1)	(2)	(4)	(6)	(8)		
Stream Succession 4 States (Worksheets 3-16 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$	4	
	(2)	(4)	(6)	(8)		
Confinement 5 (MWR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 - 0.79	0.10 - 0.29	< 0.10	1	
(Worksheet 3-9)	(1)	(2)	(3)	(4)		
				Total Points	25	
	Vertical Stab	ility Category Poi Degra	nt Range for Cha dation	nnel Incision /		
Vertical Stability for Channel Incision/ Degradation (use total points and check stability rating)	Not Incised <12 □	Slightly Incised 12 – 18	Moderately Incised 19 – 27 <b>▽</b>	Degradation > 27 □		

**Worksheet 3-20.** Channel enlargement prediction summary.

Stream: Fourmile Cany	on Creek		Stream Type:	E 4b		
Location: Reach 9			Valley Type:	XIII		
Observers: Lucas Babbitt			Date:	08/20/2015		
Channel Enlargement	Char	nel Enlargement	<b>Prediction Categ</b>	ories		
Prediction Criteria (choose one stability category for each criterion 1–4)	No Increase	Slight Increase	Moderate Increase	Extensive	Selected Points (from each row)	
Successional Stage Shift (Worksheet 3-16)	Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{c} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $	2	
	(2)	(4)	(6)	(8)		
Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	2	
	(2)	(4)	(6)	(8)		
Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	4	
(Worksheet 3-18)	(2)	(4)	(6)	(8)		
Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation	6	
(Worksheet 3-19)	(2)	(4)	(6)	(8)		
				Total Points	14	
		Category P	oint Range			
Channel Enlargement Prediction (use total points and check stability rating)	No Increase <11 □	Slight Increase 11 – 16 ✓	Moderate Increase 17 – 24	Extensive > 24 □		

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Str	eam: Fourmile Canyo	n Creek		Stream Type:	E 4b	
Loc	cation: Reach 9			Valley Type:	XIII	
Ob	servers:			Date:	08/20/2015	
P (d p	verall Sediment Supply rediction Criteria choose corresponding oints for each criterion –5)	Stability	/ Rating	Points	Selected Points	
		Stable		1		
1	Lateral Stability	Mod. Unstal	ble	2	1	
l	(Worksheet 3-17)	Unstable		3	•	
		Highly Unst	able	4		
	Vertical Stability	No Depositi	on	1		
2	<b>Excess Deposition or</b>	Mod. Depos	ition	2	2	
_	Aggradation	Excess Dep	osition	3	2	
	(Worksheet 3-18)	Aggradation	1	4		
	Vertical Stability	Not Incised		1		
3	<b>Channel Incision or</b>	Slightly Inci	sed	2	3	
3	Degradation	Mod. Incise	d	3	3	
	(Worksheet 3-19)	Degradation	1	4		
	Channel Enlargement	No Increase	No Increase 1			
4	Prediction (Worksheet	Slight Increa	2			
	3-20)	Mod. Increa	Mod. Increase 3			
	<b>0 20</b> )	Extensive		4		
	Pfankuch Channel	Good: Stab	le	1		
5	Stability (Worksheet 3-	Fair: Mod. l	Jnstable	2	2	
ľ	10)				-	
	10)	Poor: Unsta	able	4		
				Total Points	10	
			Category P	oint Range		
R	overall Sediment Supply ating (use total points and check stability rating)	Low Moderate < 6 6 − 10		<i>High</i> 11 – 15 □	Very High > 15 □	

**Worksheet 3-22.** Summary of stability condition categories.

	A	BCDEFGHI	ITJEKELEMENE	OPORS	TUV	WXYZ	AAIABIACIAD	AFIAFIAGA	AH AH AJIAKIAHA	
1	Stream:	Fourmile Canyon Cre			Location:		<u> </u>			
2	Observers:	Lucas Babbitt		8/20/2015		Type: <b>E 4B</b>	Valle	y Type: XIII		
3	Channel Dimension	Depth (ft):	Bankfull Width (ft):	Area (ft-):	17 98	Width/Depth Ratio:	8.21	Entrenchme Ratio:		
5 6	Channel Pattern	Range: 1.50		55.64 - 55.64	<sub>c</sub> /W <sub>bkf</sub> : <b>7.3</b>	16.3 33 - 25.35	/\//₽·	.29 - 3.29	uosity: <b>1.11</b>	
7	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec):	9.532 Bankful Dischar	l ge (Q <sub>bkf</sub> ): <b>171</b> .	225	imation thod:	U/U*		nage a (mi <sup>2</sup> ): <b>7.42</b>	
9		Check: Riffle/Pool [	Step/Pool 🗆	Plane Bed	Converger	nce/Divergend	e Dunes	/Antidunes/S		
10	River Profile & Bed	Max Riffle	Pool Depth Ratio	Riffle	Pool		atio	Slop	е	
11 12	Features	Bankfull 2.3 Depth (ft):	2.52 to mean	`	1.74	Spacing:	.35 Valley:	0.047	Water Surface: <b>0.03451</b>	
13		- Nparian	Composition/Density:	Potential Compos			arks: Condition, V			
14		Vegetation   See descrit	tpion	Same as existing	g native sp	eci Density a	nd potentially		ies impacted by 20	
15 16		Flow P12 Stream S Regime: 8 & Order:		Meander Patterns:		Depositional Patterns:	<b>B</b> 1	Debris/Cha Blockages:	nnel D1 D10	
17	Level III Stream	Degree of Incision	prop of Ingisian Degree of Ingisian				kuch Stability		75 -	
18	Stability Indices	(Bank-Height Ratio):	Stability Ra				djective Rating		75 -	
19	•	2.74	Reference W/d	K '	oth Ratio St	ate 1	37 W/d R	atio State	Moderately	
20		Ratio (W/d):	Ratio (W/d <sub>ref</sub> ):	(W/d) / (W	//d <sub>ref</sub> ):	•	Stabilit	y Rating:	Unstable	
21		Meander Width 3.5	Reference	Degree of confineme		nt 0.8	MWR / MWR <sub>ref</sub>		_	
22		Ratio (MVVR):	IVIVVR <sub>ref</sub> .	- (MWR/M			Stabilit	y Rating:	Unstable	
23	Bank Erosion	Length of Reach 0		nbank Erosion Rat		Curve Used:	Remarks:			
24	Summary	Studied (ft):	0 (tons	/yr) <b>0</b> (to	ons/yr/ft)					
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity	☐ Insufficient Capa	acity	s Capacity	Rema	rks: 			
26 27	Entrainment/ Competence	Largest Particle from Bar Sample (mm):	254 $\tau = 2.0$	01   τ*=   0	Existing Depth:	1.48 Requir		isting ###	Required ####	
28	Successional Stage					Existing S	troam	Potentia	al Stream	
29	Shift		• -	<b></b>	<b>-</b>	State (Typ		4b State (T	ype):	
30	Lateral Stability	☑ Stable □	Mod. Unstable	Unstable	☐ Highl	ly Unstable	Remarks/cause	es:		
31	Vertical Stability (Aggradation)	☐ No Deposition ☑	Mod. Deposition	Ex. Deposition	☐ Aggra	adation	Remarks/cause	es:		
32	Vertical Stability (Degradation)	□ Not Incised □	Slightly Incised	Mod. Incised	□ Degra	adation	Remarks/cause			
33	Channel Enlargement	□ No Increase 🔽	Slight Increase	Mod. Increase	☐ Exter	nsive	Remarks/cause	es:		
34 35	Sediment Supply (Channel Source)	- Low -	Moderate ☐ F	High ☐ Very H	ligh Remark	ks/causes:				

RIVERMORPH PFANKUCH SUMMARY River Name: Reach 10 Reach Name: Assesments Survey Date: 05/13/2015 Upper Bank Landform Slope: 9 4 Mass Wasting: Debris Jam Potential: Vegetative Protection: Lower Bank 3 4 Channel Capacity: Bank Rock Content: Obstructions to Flow: Cutting: Deposition: 12 12 Channel Bottom 2 4 Rock Angularity: Brightness: Consolidation of Particles: 4 8 Bottom Size Distribution: Scouring and Deposition: 24 Aquatic Vegetation: Channel Stability Evaluation Sediment Supply: Stream Bed Stability: Hi gh

**B4** 

W/D Condition: Stream Type:

Rating - 109 Condition - Poor

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bank	full VELC	DISCHAR	RGE Estimates						
Stream: Fourmile Canyon	Creek		Location:	Reach - F	Reach 10				
Date: Stre	eam Type:	C4	Valley	Туре:		??			
Observers:			HUC:						
INPUT VARIA	BLES			OUTPUT VARIABLES					
Bankfull Riffle Cross-Sectional AREA	23.06	A <sub>bkf</sub> (ft <sup>2</sup> )	Bankfull I	Riffle Mear	DEPTH	1.23	d <sub>bkf</sub> (ft)		
Bankfull Riffle WIDTH	18.69	W <sub>bkf</sub> (ft)		d PERMIM 2 * d <sub>bkf</sub> ) + V		20.10	W <sub>p</sub> (ft)		
D <sub>84</sub> at Riffle	90.00	Dia.	D <sub>84</sub>	, (mm) / 30	4.8	0.30	<b>D</b> <sub>84</sub> (ft)		
Bankfull SLOPE	0.0351	S <sub>bkf</sub> (ft / ft)	Hyd	raulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	1.15	R (ft)		
Gravitational Acceleration	32.2	g (ft / sec <sup>2</sup> )		tive Rough R(ft) / D <sub>84</sub> (ft		3.90	R / D <sub>84</sub>		
Drainage Area	7.4	DA (mi <sup>2</sup> )		near Veloci u* = (gRS) <sup>½</sup>	,	1.140	u* (ft/sec)		
ESTIMATIO	N METHO	DS		Ban VELC	kfull CITY		kfull IARGE		
1. Friction Relative Factor Roughness u =	= [ 2.83 + 5.6	66 * Log { R	/D <sub>84</sub> }] u*	7.02	ft / sec	161.96	cfs		
2. Roughness Coefficient: a) Manning	g's <i>n</i> from Fric = 1.49*R <sup>2/3</sup> *S		elative 0.055	5.55	ft / sec	128.01	cfs		
2. Roughness Coefficient: b) Manning's <i>n</i> from Stream Type (I	Fig. 2-20)	u = 1.49* n =	R <sup>2/3</sup> *S <sup>1/2</sup> / n 0.04	7.63	ft / sec	175.99	cfs		
2. Roughness Coefficient: c) Manning's n from Jarrett (USGS) Note: This equation is applicable to steep, ste		n = 0.39	R <sup>2/3</sup> *S <sup>1/2</sup> /n *S <sup>0.38</sup> *R <sup>-0.16</sup>	2.86	ft / sec	65.86	cfs		
roughness, cobble- and boulder-dominated Stream Types A1, A2, A3, B1, B2, B3, C2 & E3	stream systems;		0.107						
3. Other Methods (Hey, Darcy-Weisb Darcy-Weisbach (Leopold, Wo				7.53	ft / sec	173.71	cfs		
3. Other Methods (Hey, Darcy-Weisk Chezy C	oach, Chezy (	C, etc.)		0.00	ft / sec	0.00	cfs		
4. Continuity Equations: a) Region Return Period for Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	year	0.00	ft / sec	0.00	cfs		
4. Continuity Equations: b) USG	S Gage Data	u = Q / A		0.00	ft / sec	0.00	cfs		
Protrusion Height Options for For sand-bed channels: Meas									
Option 1. feature. Substitute the D <sub>84</sub> sar	nd dune protrus	ion height in ft t	for the D <sub>84</sub> term	in method 1.			·		
Option 2. For <b>boulder-dominated</b> chan the rock on that side. Substitution						bed elevation	to the top of		
Option 3. For <b>bedrock-dominated</b> chan channel bed elevation. Substit	nels: Measure tute the $D_{84}$ bed	100 <b>"protrusio</b> Irock protrusion	<b>n heights"</b> of r height in ft for	rock separations, steps, joints or uplifted surfaces above					
Option 4. For <b>log-influenced</b> channels: log on upstream side if embed							ight of the		

Worksheet 5-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	Fourmile Canyon Creek, Reach - Reach 10		
Basin:	Drainage Area: 4748.8 acres	7.42	mi <sup>2</sup>
Location:			
Twp.&Rge:	; Sec.&Qtr.: ;		
Cross-Sect	ion Monuments (Lat./Long.): 40.0645 Lat / 105.30531 Long	Date	08/20/15
Observers:	Lucas Babbitt	Valley Type:	: VIII(b)
	Bankfull WIDTH (W <sub>bkf</sub> )		1
	WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	24.93	ft
	Bankfull DEPTH (d <sub>bkf</sub> )		1
	Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a		
	riffle section ( $d_{bkf} = A / W_{bkf}$ ).	0.73	ft
	Bankfull X-Section AREA (A <sub>bkf</sub> )		1
	AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle		
	section.	18.11	ft <sup>2</sup>
	Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )		
	Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	34.15	ft/ft
	Maximum DEPTH (d <sub>mbkf</sub> )		1
	Maximum depth of the bankfull channel cross-section, or distance between the		
	bankfull stage and Thalweg elevations, in a riffle section.	1.7	ft
	WIDTH of Flood-Prone Area (W <sub>fpa</sub> )		
	Twice maximum DEPTH, or $(2 \times d_{mbkf})$ = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.		
	WIDTH IS determined in a fille section.	37.05	ft
	Entrenchment Ratio (ER)		
	The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH ( $W_{fpa}/W_{bkf}$ ) (riffle section).	1.49	ft/ft
		1.43	]10/10
	Channel Materials (Particle Size Index ) D <sub>50</sub>		
	The $D_{50}$ particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg		
	elevations.	29.65	mm
	Water Surface SLOPE (S)		1
	Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel		
	widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	0.00540	
	ar variation stage.	0.03512	_ft/ft
	Channel SINUOSITY (k)		
	Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by		
	channel slope (VS / S).	1.11	
			<u>.</u> 1
	Stream   B 4   (See Figure 2-	14)	
	Type		_

**Worksheet 5-4.** Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Str	eam: Fourmile Canyon Creek					Location: Reach - Reach 10		
Ob	servers: Lucas Babbitt		Date:	08/20	/15	Valley Type: XIII Strea	m Type: <b>B 4</b>	
		Rive	er Rea	ch Dir	nens	sion Summary Data1		
	Riffle Dimensions*' *** ***	Mean	Min	Max	i	Riffle Dimensions & Dimensionless Ratios****		lax
*	Riffle Width (W <sub>bkf</sub> )	21.8	18.7	24.9	ft	Riffle Cross-Sectional Area (A <sub>bkf</sub> ) (ft <sup>2</sup> )	20.59 18.11 23	3.06
* *	Mean Riffle Depth (d <sub>bkf</sub> )	0.98	0.73	1.23	ft	Riffle Width/Depth Ratio (W <sub>bkf</sub> / d <sub>bkf</sub> )	24.67 15.20 34	4.15
ns*	Maximum Riffle Depth (d <sub>max</sub> )	1.8	1.7	1.9	ft	Max Riffle Depth to Mean Riffle Depth (d <sub>max</sub> / d <sub>bkf</sub> )	1.937 1.545 2.3	329
	Width of Flood-Prone Area (W <sub>fpa</sub> )	36.3	35.6	37.1	ft	Entrenchment Ratio (W <sub>fpa</sub> / W <sub>bkf</sub> )	1.694 1.486 1.	902
me	Riffle Inner Berm Width (W <sub>ib</sub> )	6.22	0	12.4	ft	Riffle Inner Berm Width to Riffle Width (W <sub>ib</sub> / W <sub>bkf</sub> )	0.250 0.000 0.4	499
Riffle Dimensions*, **, ***	Riffle Inner Berm Depth (d <sub>ib</sub> )	0.22	0	0.45	ft	Riffle Inner Berm Depth to Mean Depth $(d_{ib} / d_{bkf})$	0.306 0.000 0.	612
Riff	Riffle Inner Berm Area (A <sub>ib</sub> )	2.78	0	5.55	ft <sup>2</sup>	Riffle Inner Berm Area to Riffle Area (A <sub>ib</sub> / A <sub>bkf</sub> )	0.154 0.000 0.3	307
	Riffle Inner Berm W/D Ratio (W <sub>ib</sub> / d <sub>ib</sub> )	13.9	0	27.9				
	Pool Dimensions*' **' ***	Mean	Min	Max		Pool Dimensions & Dimensionless Ratios****	Mean Min M	/lax
	Pool Width (W <sub>bkfp</sub> )	21	21	1	ft	Pool Width to Riffle Width (W <sub>bkfp</sub> / W <sub>bkf</sub> )	0.961 0.961 0.	$\overline{}$
* *	Mean Pool Depth (d <sub>bkfp</sub> )	1.11	1.11	1.11	ft	Mean Pool Depth to Mean Riffle Depth (d <sub>bkfp</sub> / d <sub>bkf</sub> )	1.133 1.133 1. <sup>1</sup>	133
* s	Pool Cross-Sectional Area (A <sub>bkfp</sub> )	23.2	23.2	23.2	ft	Pool Area to Riffle Area (A <sub>bkfp</sub> / A <sub>bkf</sub> )	1.126 1.126 1.	126
ion	Maximum Pool Depth (d <sub>maxp</sub> )	1.9	1.9	1.9	ft	Max Pool Depth to Mean Riffle Depth (d <sub>maxp</sub> / d <sub>bkf</sub> )	1.939 1.939 1.	939
Jen 8	Pool Inner Berm Width (W <sub>ibp</sub> )	12.7	12.7	12.7	ft	Pool Inner Berm Width to Pool Width (W <sub>ibp</sub> / W <sub>bkfp</sub> )	0.608 0.608 0.	608
Din	Pool Inner Berm Depth (d <sub>ibp</sub> )	0.75	0.75	0.75	ft	Pool Inner Berm Depth to Pool Depth (d <sub>ibp</sub> / d <sub>bkfp</sub> )	0.680 0.680 0.	680
Pool Dimensions*, **, ***	Pool Inner Berm Area (A <sub>ibp</sub> )	9.62	9.62	9.62	ft <sup>2</sup>	Pool Inner Berm Area to Pool Area (A <sub>ibp</sub> / A <sub>bkfp</sub> )	0.415 0.415 0.4	415
	Point Bar Slope (S <sub>pb</sub> )	0.000	0.000	0.000	ft/ft	Pool Inner Berm Width/Depth Ratio (W <sub>ibp</sub> / d <sub>ibp</sub> )	#### #### ##	###
	Run Dimensions*	Mean	Min	Max		Run Dimensionless Ratios****	Mean Min M	/lax
	Tuli Dilliciisions	Micuii		IVIUA		Ran Dinichsionicss Ratios		IIUA
*თ	Run Width (W <sub>bkfr</sub> )	18.7	18.7	18.7	ft	Run Width to Riffle Width (W <sub>bkfr</sub> / W <sub>bkf</sub> )	0.857 0.857 0.8	857
sions*	Run Width (W <sub>bkfr</sub> )  Mean Run Depth (d <sub>bkfr</sub> )	18.7	18.7 1.23	18.7 1.23	1	Run Width to Riffle Width $(W_{bkfr}/W_{bkf})$ Mean Run Depth to Mean Riffle Depth $(d_{bkfr}/d_{bkf})$	0.857 0.857 0.8 1.255 1.255 1.2	=
nensions*		!		1	ft			255
. Dimensions*	Mean Run Depth (d <sub>bkfr</sub> )	1.23	1.23	1.23	ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )	1.255 1.255 1.2	255 120
Run Dimensions*	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> )	1.23	1.23 23.1	1.23 23.1	ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )	1.255     1.255     1.       1.120     1.120     1.	255 120
Run Dimensions*	Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> /d <sub>bkfr</sub> )	1.23 23.1 1.9 15.2	1.23 23.1 1.9 15.2	1.23 23.1 1.9 15.2	ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )	1.255 1.255 1. 1.120 1.120 1. 1.939 1.939 1.	255 120 939
Run Dimensions*	Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )	1.23 23.1 1.9	1.23 23.1 1.9	1.23 23.1 1.9 15.2 Max	ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )	1.255 1.255 1. 1.120 1.120 1. 1.939 1.939 1.	255 120 939
	Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*	1.23 23.1 1.9 15.2 Mean	1.23 23.1 1.9 15.2 Min	1.23 23.1 1.9 15.2 Max 0	ft ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****	1.255 1.255 1. 1.120 1.120 1. 1.939 1.939 1. Mean Min M	255 120 939 Max 000
	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> )	1.23 23.1 1.9 15.2 Mean 0	1.23 23.1 1.9 15.2 Min 0	1.23 23.1 1.9 15.2 Max 0	ft ft ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )	1.255 1.255 1 1.120 1.120 1. 1.939 1.939 1  Mean Min M 0.000 0.000 0.	255 120 939 Max 000
	Mean Run Depth (d <sub>bkfr</sub> )  Run Cross-Sectional Area (A <sub>bkfr</sub> )  Maximum Run Depth (d <sub>maxr</sub> )  Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions*  Glide Width (W <sub>bkfg</sub> )  Mean Glide Depth (d <sub>bkfg</sub> )	1.23 23.1 1.9 15.2 Mean 0	1.23 23.1 1.9 15.2 Min 0	1.23 23.1 1.9 15.2 Max 0	ft ft ft ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	1.255 1.255 1. 1.120 1.120 1. 1.939 1.939 1.  Mean Min M 0.000 0.000 0. 0.000 0.000 0.	255 120 939 Max 000 000
	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> )	1.23 23.1 1.9 15.2 Mean 0 0	1.23 23.1 1.9 15.2 Min 0 0	1.23 23.1 1.9 15.2 Max 0 0	ft ft ft ft ft ft ft	Mean Run Depth to Mean Riffle Depth $(d_{bkfr} / d_{bkf})$ Run Area to Riffle Area $(A_{bkfr} / A_{bkf})$ Max Run Depth to Mean Riffle Depth $(d_{maxr} / d_{bkf})$ Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width $(W_{bkfg} / W_{bkf})$ Mean Glide Depth to Mean Riffle Depth $(d_{bkfg} / d_{bkf})$ Glide Area to Riffle Area $(A_{bkfg} / A_{bkf})$	1.255 1.255 1 1.120 1.120 1. 1.939 1.939 1  Mean Min M 0.000 0.000 0 0.000 0.000 0	255 120 939 Max 000 000
	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> )  Maximum Glide Depth (d <sub>maxg</sub> )	1.23 23.1 1.9 15.2 Mean 0 0	1.23 23.1 1.9 15.2 Min 0 0	1.23 23.1 1.9 15.2 Max 0 0	ft ft ft ft ft ft ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )	1.255   1.255   1.120   1.12	255 120 939 000 000 000
Glide Dimensions* Run Dimensions*	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> ) Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> )	1.23 23.1 1.9 15.2 Mean 0 0 0	1.23 23.1 1.9 15.2 Min 0 0 0	1.23 23.1 1.9 15.2 Max 0 0 0	ft ft ft ft ft ft ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )	1.255   1.255   1.120   1.12	255 120 939 Max 0000 0000 0000 0000
	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> ) Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> ) Glide Inner Berm Width (W <sub>ibg</sub> )	1.23 23.1 1.9 15.2 Mean 0 0 0 0	1.23 23.1 1.9 15.2 Min 0 0 0 0	1.23 23.1 1.9 15.2 Max 0 0 0 0	ft ft ft ft ft ft ft ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> /W <sub>bkfg</sub> )	1.255   1.255   1.120   1.12	255 120 939 Max 0000 0000 0000 0000 0000
	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> ) Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> ) Glide Inner Berm Width (W <sub>ibg</sub> ) Glide Inner Berm Depth (d <sub>lbg</sub> )	1.23 23.1 1.9 15.2 Mean 0 0 0 0 0	1.23 23.1 1.9 15.2 Min 0 0 0 0 0 0	1.23 23.1 1.9 15.2 Max 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / M <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>bg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )	1.255 1.255 1 1.120 1.120 1. 1.939 1.939 1  Mean Min M 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0	255 120 939 Max 0000 0000 0000 0000 0000
	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> ) Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> ) Glide Inner Berm Width (W <sub>ibg</sub> )	1.23 23.1 1.9 15.2 Mean 0 0 0 0	1.23 23.1 1.9 15.2 Min 0 0 0 0	1.23 23.1 1.9 15.2 Max 0 0 0 0	ft ft ft ft ft ft ft ft ft ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>lbg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>lbg</sub> / A <sub>bkfg</sub> )	1.255 1.255 1 1.120 1.120 1. 1.939 1.939 1  Mean Min M 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0	255 120 939 Max 0000 0000 0000 0000 0000
Glide Dimensions*	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> ) Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> ) Glide Inner Berm Width (W <sub>ibg</sub> ) Glide Inner Berm Depth (d <sub>lbg</sub> ) Glide Inner Berm Area (A <sub>lbg</sub> )	1.23 23.1 1.9 15.2 Mean 0 0 0 0 0 0	1.23 23.1 1.9 15.2 Min 0 0 0 0 0 0	1.23 23.1 1.9 15.2 Max 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / M <sub>bkfg</sub> )  Glide Inner Berm Depth to Glide Depth (d <sub>bg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )	1.255 1.255 1 1.120 1.120 1. 1.939 1.939 1  Mean Min M 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0	255 120 939 000 000 000 000 000 000 000 000 00
Glide Dimensions*	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> ) Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> ) Glide Inner Berm Width (W <sub>ibg</sub> ) Glide Inner Berm Depth (d <sub>ibg</sub> ) Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions**	1.23 23.1 1.9 15.2 Mean 0 0 0 0 0 0 0	1.23 23.1 1.9 15.2 Min 0 0 0 0 0 0 0 0 0 0 0 0	1.23 23.1 1.9 15.2 Max 0 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>lbg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )	1.255 1.255 1 1.120 1.120 1. 1.939 1.939 1  Mean Min M 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0	255 120 939 Max 0000 0000 0000 0000 0000 0000 0000
	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> ) Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> ) Glide Inner Berm Width (W <sub>ibg</sub> ) Glide Inner Berm Depth (d <sub>ibg</sub> ) Glide Inner Berm Area (A <sub>bg</sub> )  Step Dimensions**  Step Width (W <sub>bkfs</sub> ) Mean Step Depth (d <sub>bkfs</sub> )	1.23 23.1 1.9 15.2 Mean 0 0 0 0 0 0 0 0 0 0	1.23 23.1 1.9 15.2 Min 0 0 0 0 0 0 0 0 0	1.23 23.1 1.9 15.2 Max 0 0 0 0 0 0 0 0 0 0	ft ft ft ft ft ft ft ft ft ft ft ft ft f	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>lbg</sub> / d <sub>lbg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>lbg</sub> /W <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>lbg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfs</sub> / W <sub>bkf</sub> )  Mean Step Depth to Riffle Depth (d <sub>bkfs</sub> / d <sub>bkfg</sub> )	1.255   1.255   1.120   1.12	255 120 939 000 000 000 000 000 000 000 000 00
Glide Dimensions*	Mean Run Depth (d <sub>bkfr</sub> ) Run Cross-Sectional Area (A <sub>bkfr</sub> ) Maximum Run Depth (d <sub>maxr</sub> ) Run Width/Depth Ratio (W <sub>bkfr</sub> / d <sub>bkfr</sub> )  Glide Dimensions* Glide Width (W <sub>bkfg</sub> ) Mean Glide Depth (d <sub>bkfg</sub> ) Glide Cross-Sectional Area (A <sub>bkfg</sub> ) Maximum Glide Depth (d <sub>maxg</sub> ) Glide Width/Depth Ratio (W <sub>bkfg</sub> / d <sub>bkfg</sub> ) Glide Inner Berm Width (W <sub>ibg</sub> ) Glide Inner Berm Depth (d <sub>ibg</sub> ) Glide Inner Berm Area (A <sub>ibg</sub> )  Step Dimensions** Step Width (W <sub>bkfs</sub> )  Mean Step Depth (d <sub>bkfs</sub> )  Step Cross-Sectional Area (A <sub>bkfs</sub> )	1.23 23.1 1.9 15.2 Mean 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.23 23.1 1.9 15.2 Min 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.23 23.1 1.9 15.2 Max 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ft  ft  ft  ft  ft  ft  ft  ft  ft  ft	Mean Run Depth to Mean Riffle Depth (d <sub>bkfr</sub> / d <sub>bkf</sub> )  Run Area to Riffle Area (A <sub>bkfr</sub> / A <sub>bkf</sub> )  Max Run Depth to Mean Riffle Depth (d <sub>maxr</sub> / d <sub>bkf</sub> )  Glide Dimensions & Dimensionless Ratios****  Glide Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Glide Depth to Mean Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )  Glide Area to Riffle Area (A <sub>bkfg</sub> / A <sub>bkf</sub> )  Max Glide Depth to Mean Riffle Depth (d <sub>maxg</sub> / d <sub>bkf</sub> )  Glide Inner Berm Width/Depth Ratio (W <sub>ibg</sub> / d <sub>ibg</sub> )  Glide Inner Berm Width to Glide Width (W <sub>ibg</sub> / d <sub>bkfg</sub> )  Glide Inner Berm Area to Glide Area (A <sub>ibg</sub> / A <sub>bkfg</sub> )  Step Dimensionless Ratios****  Step Width to Riffle Width (W <sub>bkfg</sub> / W <sub>bkf</sub> )  Mean Step Depth to Riffle Depth (d <sub>bkfg</sub> / d <sub>bkf</sub> )	1.255 1.255 1 1.120 1.120 1. 1.939 1.939 1  Mean Min M 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0 0.000 0.000 0	255 120 939 000 000 000 000 000 000 000 000 00

<sup>\*</sup>Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

<sup>\*\*</sup>Step-Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

<sup>\*\*\*</sup>Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

<sup>\*\*\*\*</sup>Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

Worksheet 5-4. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

-	ream: Fourmile Car	-	reek					cation:				)				
Ob	servers: Lucas Babbi	tt				08/20/				у Туре:	XIII	)	Strear	n Type:	B 4	
ics			L		Riv	er Rea	ch Sum	mary D	ata	.2		J				
Hydraulics	Streamflow: Estimated	Mean V	elocity	ty at Bankfull Stage (u <sub>bkf</sub> )			)	4.9	ft/sec Estimation Method							
Ť	Streamflow: Estimated	Dischar	ge at B	ankfull	Stage (	(Q <sub>bkf</sub> )		89.	21	cfs	Drain	age Area	ı	7.	42	mi <sup>2</sup>
	Geometry Mean Min N						Dimensionless Geometry Ratios						Mean	Min	Max	
	Linear Wavelength (λ)		174	105	272	ft	Linear V	/avelen	gth to F	Riffle W	idth (λ	/ W <sub>bkf</sub> )		7.978	4.814	####
	Stream Meander Lengtl	h (L <sub>m</sub> )	218	164	302	ft	Stream	Meande	r Lengt	h Ratio	(L <sub>m</sub> /	W <sub>bkf</sub> )		9.995	7.519	####
tern	Radius of Curvature (R	;)	68	23	115	ft	Radius of Curvature to Riffle Width (R <sub>c</sub> / W <sub>bkf</sub> )						3.118	1.055	5.273	
Pa(	Belt Width (W <sub>blt</sub> )	ĺ	25	13	39	ft	Meander Width Ratio (W <sub>blt</sub> / W <sub>bkf</sub> )					1.146	0.596	1.788		
Channel Pattern	Arc Length (L <sub>a</sub> )		0	0	0	ft	Arc Leng	gth to Ri	ffle Wi	dth (L <sub>a</sub> /	W <sub>bkf</sub> )			0.000	0.000	0.000
Cha	Riffle Length (L <sub>r</sub> ) 45.1			30.5	54.5	ft	Riffle Le	ngth to I	Riffle V	/idth (L	r/W <sub>bk</sub>	f)		2.066	1.399	2.500
	Individual Pool Length (	0	0	0	ft	Individua	al Pool L	ength.	to Riffle	Widtl	h (L <sub>p</sub> / W <sub>t</sub>	okf)	0.000	0.000	0.000	
	Pool to Pool Spacing (P	P <sub>s</sub> )	0	0	0	ft	Pool to I	Pool Spa	acing to	Riffle	Width	(P <sub>s</sub> /W <sub>bk</sub>	<sub>f</sub> )	0.000	0.000	0.000
	Valley Slope (S <sub>val</sub> )	0.0	41	ft/ft	Avera	ge Wate	er Surface	Slope (	(S)	0.03	3512	ft/ft	Sinuosity (	S <sub>val</sub> / S)		1.11
	Stream Length (SL)	237	77	ft		Length				<u> </u>	158	ft	Sinuosity (		)	1.1
	Low Bank Height	start	6.46	ft		Max De	epth	start	6.11	ft	Е	Bank-Hei	ht Ratio (B			1.06
	(LBH)	end	6.1	ft		(d <sub>max</sub> )	·	end	2.03	ft			H / d <sub>max</sub> )		end	3
	Facet Slopes	1	Mean	Min	Max	10.10		mensio					(0, (0)	Mean	Min	Max
	Riffle Slope (S <sub>rif</sub> )	<u> </u>		0.010		-	<u> </u>					ce Slope	, ,		0.293	
Profile	Run Slope (S <sub>run</sub> )  Pool Slope (S <sub>D</sub> )				000 0.000 ft/ft Run Slope to Average Water Surface Slope (S <sub>run</sub> / S)				:	0.000	-					
	Glide Slope (S <sub>0</sub> )	<u> </u>			0.000 0.000 ft/ft Pool Slope to Average Water Surface Slope (S <sub>p</sub> / S)					1	0.000					
Channel					0.000       0.000       ft/ft       Glide Slope to Average Water Surface Slope $(S_g / S)$ 0.000       0.000       ft/ft       Step Slope to Average Water Surface Slope $(S_s / S)$					1	0.000					
ြင်	Step Slope (S <sub>s</sub> )	ļ				π/π	Step Sic						(S <sub>s</sub> /S)	i	0.000	
	Max Depths <sup>a</sup> Max Riffle Depth (d <sub>maxrif</sub>	)	Mean 0	Min 0	Max 0	ft	Max Riff			nless Depth Ratios  Mean Riffle Depth (d <sub>maxrif</sub> / d <sub>bkf</sub> )			Mean 0	Min 0	Max 0	
	Max Run Depth (d <sub>maxrun</sub> ,		0	0		ft	<u> </u>	· .			· ·	n (d <sub>maxrun</sub>		0	0	0
	Max Pool Depth (d <sub>maxp</sub> )	i I	0	0		ft	Max Poo							0	0	0
	Max Glide Depth (d <sub>maxq</sub> )	)	0	0		ft	Max Glid					•		0	0	0
1	Max Step Depth (d <sub>maxs</sub> )		0	0	0	ft	Max Ste	p Depth	to Mea	an Riffle	e Dept	h (d <sub>maxs</sub> /	d <sub>bkf</sub> )	0	0	0
	, L		. b		C				-	, b		Lees C		i	i	d
	% Silt/Clay	Read 0		1	fle <sup>c</sup> )		Bar	D <sub>16</sub>		ech <sup>b</sup> 71	1	iffle <sup>c</sup> 2.48	Bar	Protri	usion H	mm
rials	% Sand	18	3	(	<u> </u>			D <sub>35</sub>		6	<u>.                                      </u>	3.53				mm
	% Gravel	6	1	6	5	ļ		D <sub>50</sub>	29	.65		45	<u> </u>	!		mm
le N	% Cobble	18	3	2	9			D <sub>84</sub>	104	1.25		90				mm
Channel Materials	% Boulder	3		(	)			D <sub>95</sub>		80	1	19.86				mm
∥ੂਂ	% Bedrock	0		(		İ		D <sub>100</sub>		1.98	<del>!                                    </del>	180		<u> </u>		mm
	/Ii					1										

a Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

<sup>&</sup>lt;sup>b</sup> Composite sample of riffles and pools within the designated reach.

<sup>&</sup>lt;sup>c</sup> Active bed of a riffle.

<sup>&</sup>lt;sup>d</sup> Height of roughness feature above bed.

**Worksheet 3-2.** Flow regime variables that influence channel characteristics, sediment regime and biological interpretations.

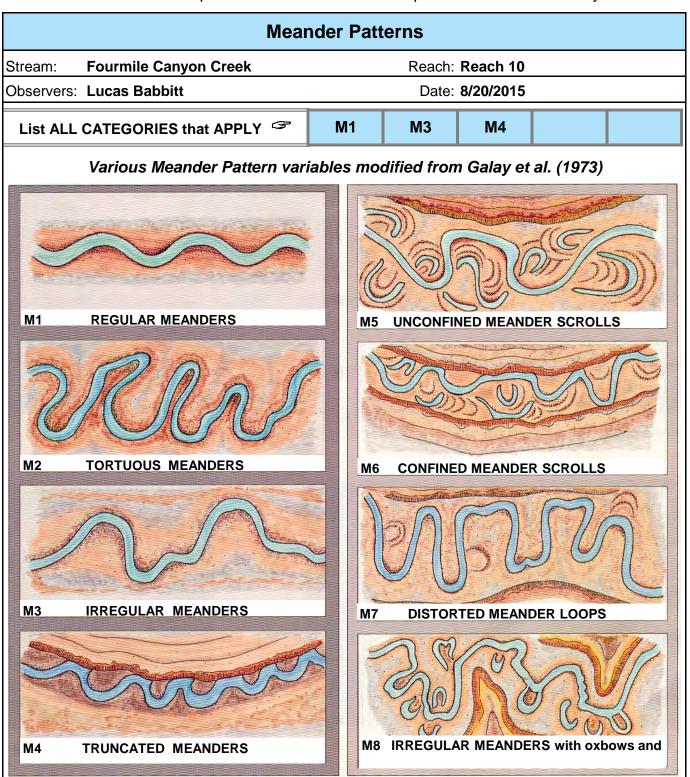
olological illi	erpretations.						
FLOW REGIME							
Stream:	Fourmile Canyon Creek Location: Reach 10						
Observers:	Observers: Lucas Babbitt Date: 8/20/2015						
	List ALL COMBINATIONS that P 1 2 8						
APPLY							
General C	Category						
E	Ephemeral stream channels: Flows only in response to precipitation						
S	Subterranean stream channel: Flows parallel to and near the surface for various seasons - a subsurface flow that follows the stream bed.						
I	Intermittent stream channel: Surface water flows discontinuously along its length. Often associated with sporadic and/or seasonal flows and also with Karst (limestone) geology where losing/gaining reaches create flows that disappear then reappear farther downstream.						
Р	Perennial stream channels: Surface water persists yearlong.						
Specific Category							
1	Seasonal variation in streamflow dominated primarily by snowmelt runoff.						
2	Seasonal variation in streamflow dominated primarily by stormflow runoff.						
3	Uniform stage and associated streamflow due to spring-fed condition, backwater, etc.						
4	Streamflow regulated by glacial melt.						
5	Ice flows/ice torrents from ice dam breaches.						
6	Alternating flow/backwater due to tidal influence.						
7	Regulated streamflow due to diversions, dam release, dewatering, etc.						
8	Altered due to development, such as urban streams, cut-over watersheds or vegetation conversions (forested to grassland) that change flow response to precipitation events.						
9	Rain-on-snow generated runoff.						

Worksheet 3-3. Stream order and stream size categories for stratification by stream type.

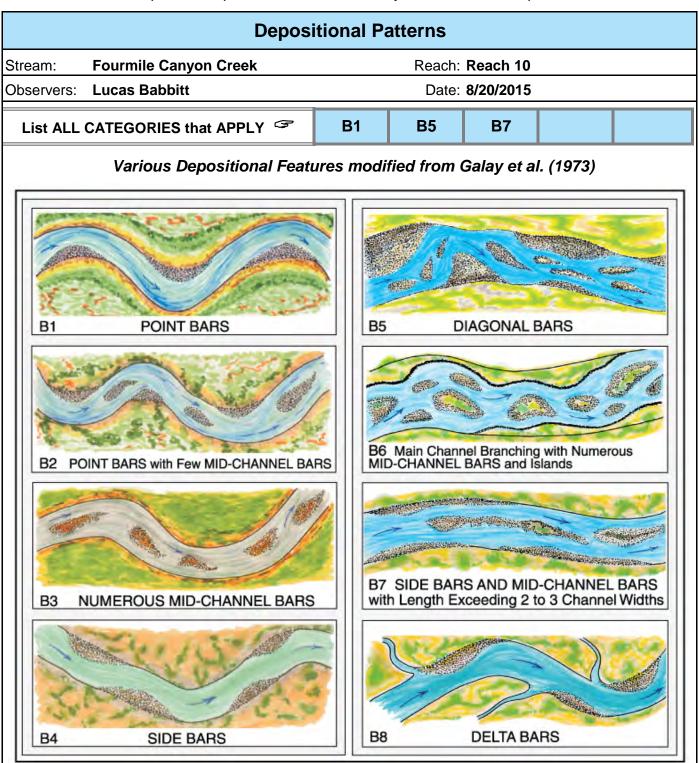
Stream Size and Order						
Stream: Fourmile Canyon Creek						
Location: Reach 10						
Observers: Lucas Babbitt						
Date: <b>8/20/2015</b>						
Stream Size Category and Order S-4(3)						
Category	STREAM SIZ	Check (✓) appropriate				
	meters	feet	category			
S-1	0.305	<1				
S-2	0.3 – 1.5	1 – 5				
S-3	1.5 – 4.6	5 – 15				
S-4	4.6 – 9	15 – 30	>			
S-5	9 – 15	30 – 50				
S-6	15 – 22.8	50 – 75				
S-7	22.8 – 30.5	75 – 100				
S-8	30.5 – 46	100 – 150				
S-9	46 – 76	150 – 250				
S-10	76 – 107	250 – 350				
S-11	107 – 150	350 – 500				
S-12	150 – 305	500 – 1000				
S-13	>305	>1000				
Stream Order						
Add categories in parenthesis for specific stream order of						

Add categories in parenthesis for specific stream order of reach. For example a third order stream with a bankfull width of 6.1 meters (20 feet) would be indexed as: S-4(3).

Worksheet 3-4. Meander pattern relations used for interpretations for river stability.



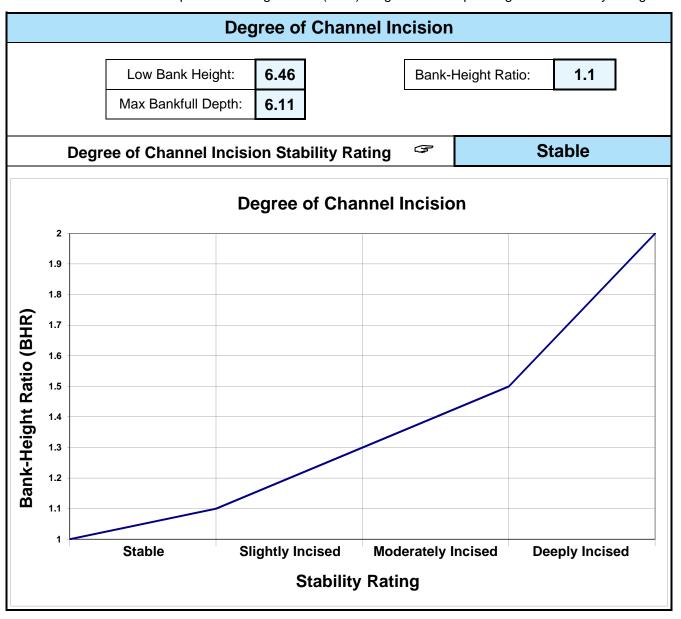
Worksheet 3-5. Depositional patterns used for stability assessment interpretations.



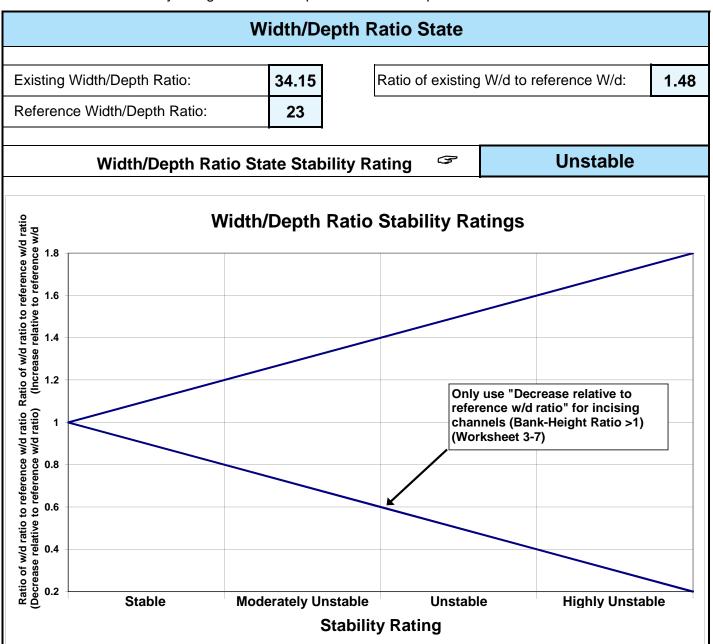
**Worksheet 3-6.** Various categories of in-channel debris, dams and channel blockages used to evaluate channel stability.

Channel Blockages							
Stream: Fourmile Canyon Creek Location: Reach 10							
Obser	Observers: Lucas Babbitt Date: 8/20/2015						
Description/extent		Materials that upon placement into the active channel or flood- prone area may cause adjustments in channel dimensions or conditions due to influences on the existing flow regime.					
D1	None	Minor amounts of small, floatable material.					
D2	Infrequent	Debris consists of small, easily moved, floatable material, e.g., leaves, needles, small limbs and twigs.					
D3	Moderate	Increasing frequency of small- to medium-sized material, such as large limbs, branches and small logs, that when accumulated, affect 10% or less of the active channel cross-section area.	~				
D4	Numerous	Significant build-up of medium- to large-sized materials, e.g., large limbs, branches, small logs or portions of trees that may occupy 10–30% of the active channel cross-section area.					
D5	Extensive	Debris "dams" of predominantly larger materials, e.g., branches, logs and trees, occupying 30–50% of the active channel cross-section area, often extending across the width of the active channel.					
D6	Dominating	Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section area. Such accumulations may divert water into the flood-prone areas and form fish migration barriers, even when flows are at less than bankfull.					
D7	Beaver dams: Few	An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams.					
D8	Beaver dams: Frequent	Frequency of dams is such that backwater conditions exist for channel reaches between structures where streamflow velocities are reduced and channel dimensions or conditions are influenced.					
D9	Beaver dams: Abandoned	Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments, such as bank erosion, lateral migration, avulsion, aggradation and degradation.					
D10	Human influences	Structures, facilities or materials related to land uses or development located within the flood-prone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures and various transportation encroachments that have an influence on the existing flow regime, such that significant channel adjustments occur.	Y				

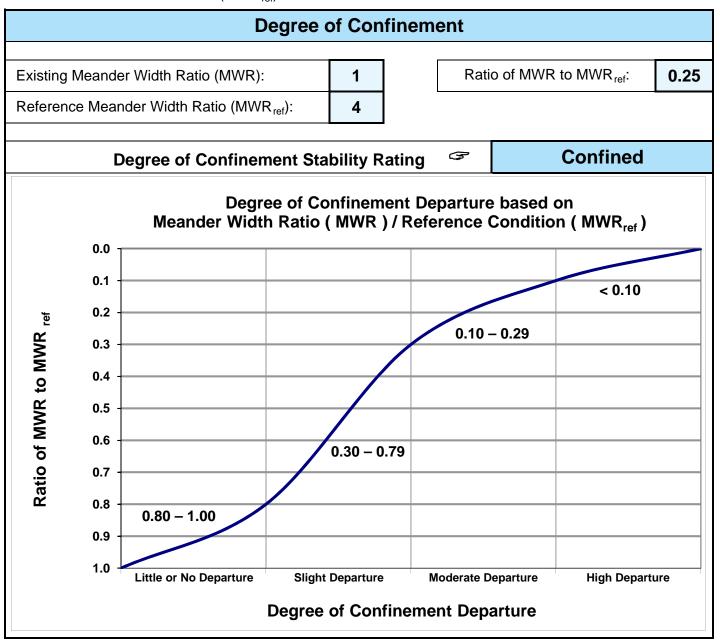
Worksheet 3-7. Relationship of Bank-Height Ratio (BHR) ranges to corresponding stream stability ratings.



Worksheet 3-8. Stability ratings based on departure of width/depth ratio from reference condition.



**Worksheet 3-9.** Degree of confinement based on Meander Width Ratio (MWR) divided by reference condition Meander Width Ratio (MWR<sub>ref</sub>).



Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:	Fourmile (	Canyon Creek	S	tream Type:	B 4	
Location:	Reach 10			Valley Type:	XIII	
Observers:	Lucas Bab	obitt		Date:	08/20/2015	1
Enter Requir	ed Information	on for Existing Condition	on			
45.0	D 50	Median particle size of	riffle bed material (mm	n)		
0.0	D 50	Median particle size of	bar or sub-pavement	sample (mm	1)	
0.583	D <sub>max</sub>	Largest particle from b	oar sample (ft)	177.8	(mm)	304.8 mm/ft
0.03512	S	Existing bankfull water	surface slope (ft/ft)			
0.73	d	Existing bankfull mear	n depth (ft)			
1.65	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	vity of sediment			
Select the A	opropriate Ed	quation and Calculate (	Critical Dimensionless	Shear Str	ess	
0.00	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	P <sub>50</sub> ) -0.872
3.95	$D_{\text{max}}/D_{50}$	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 ( <i>D</i> <sub>max</sub> / <i>D</i>	<sub>50</sub> ) <sup>-0.887</sup>
	τ*	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A
Calculate Ba	nkfull Mean D	Pepth Required for Entra	inment of Largest Part	icle in Bar	Sample	
	d	Required bankfull mean	depth (ft) $d = \frac{\tau}{T}$	$\frac{*(\gamma_s - 1)D_n}{S}$	use (use	D <sub>max</sub> in ft)
Calculate Ba	nkfull Water	Surface Slope Require	d for Entrainment of	Largest Pai	rticle in Ba	r Sample
	S	Required bankfull water	surface slope (ft/ft) <b>\$</b> =	$\frac{\mathcal{T}^*(\gamma_s-1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)
	Check:	☐ Stable ☐ Aggradi	ng 🗹 Degrading			
Sediment Co	mpetence U	sing Dimensional Shea	r Stress			
1.600		hear stress $\tau = \gamma ds$ (lbs/ft <sup>2</sup>		dius, R, with	mean depth,	d )
Shields CO		d = existing depth, S = exis	-			
127.2 214.	8 Predicted	largest moveable particle s	ize (mm) at bankfull shea	ar stress τ (F	igure 3-11)	
Shields CO 2.206 1.23	7 Predicted	shear stress required to ini	tiate movement of measu	ired $D_{\sf max}$ (mi	m) (Figure 3	-11)
Shields CO		mean depth required to init	iate movement of measu	red $D_{\sf max}$ (mr	$\mathbf{d} = \frac{1}{2}$	τ
1.01 0.56	t – prodio	ted shear stress, $\gamma = 62.4$ ,	• •		2 - 7	<i>y</i> S
Shields CO	_	slope required to initiate m		<sub>nax</sub> (mm)	$S = \frac{\tau}{2}$	
0.0484 0.027	t – prodio	ted shear stress, $\gamma = 62.4$ ,			γd	
	Check:	☐ Stable ☐ Aggradi	ng 🔽 Degrading			

**Worksheet 3-16.** Stability ratings for corresponding successional stage shifts of stream types. Check the appropriate stability rating.

Stream:	Fourmile Canyon Creek	Stream Type: <b>B 4</b>
Location:	Reach 10	Valley Type: <b>XIII</b>
Observers:	Lucas Babbitt	Date: 08/20/2015
Stream T	ype Stage Shifts (Figure 3-14)	Stability Rating (Check Appropriate Rating)
	eam Type at potential, $(C \rightarrow E)$ , $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	☐ Stable
(E→C),	(B→High W/d B), (C→High W/d C)	
(G	$_{c}\rightarrow$ F), (G $\rightarrow$ F <sub>b</sub> ), (F $\rightarrow$ D), (C $\rightarrow$ F)	✓ Unstable
(C→D)	, $(A \rightarrow G)$ , $(B \rightarrow G)$ , $(D \rightarrow G)$ , $(C \rightarrow G)$ , $(E \rightarrow G)$ , $(E \rightarrow A)$	☐ Highly Unstable

Worksheet 3-17. Lateral stability prediction summary.

Stream: Fourmile Cany	on Creek		Stream Ty	<sub>'pe:</sub> <b>B4</b>	
Location: Reach 10			Valley Ty	<sub>'pe:</sub> XIII	
Observers: Lucas Babbitt			Da	ate: <b>08/20/2015</b>	
Lateral stability criteria		Lateral Stabilit	ty Categories		
(choose one stability category for each criterion 1–5)	Stable	Moderately Unstable	Unstable	Highly Unstable	Selected Points (from each row)
W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	> 1.6	6
,	(2)	(4)	(6)	(8)	
Depositional Patterns (Worksheet 3-5)	B1, B2	B4, B8	В3	B5, B6, B7	4
	(1)	(2)	(3)	(4)	
Meander Patterns (Worksheet 3-4)	M1, M3, M4		M2, M5, M6, M7, M8		1
,	(1)		(3)		
Streambank Erosion: 4 Unit Rate (Tons/yr/ft)	< 0.006	0.006 - 0.04	0.041 - 0.07	> 0.07	
(Worksheet 3-13)	(2)	(4)	(6)	(8)	
Degree of Confinement 5 (MWR / MWR <sub>ref</sub> )	> 0.8	0.3 – 0.79	0.1 – 0.29	< 0.1	3
(Worksheet 3-9)	(1)	(2)	(3)	(4)	
				Total Points	14
	Lat	eral Stability C	ategory Point R	ange	
Overall Lateral Stability Category (use total points and check stability rating)	Stable <10 □	Moderately Unstable 10 – 12 □	<i>Unstable</i> 13 – 21 <b>▽</b>	Highly Unstable > 21 □	

**Worksheet 3-18.** Vertical stability prediction for excess deposition or aggradation.

Stream: Fourmile Can	yon Creek		Stream Type:	B 4	
Location: Reach 10			Valley Type:	XIII	
Observers: Lucas Babbit	t		Date:	08/20/2015	
Vertical Stability	Vertical Stabil	lity Categories fo	r Excess Deposition	n / Aggradation	Selected
Criteria (choose one stability category for each criterion 1–6)	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	Points (from each row)
Sediment 1 competence (Worksheet 3-14)	Sufficient depth and/or slope to transport largest size available	Trend toward insufficient depth and/or slope-slightly incompetent	Cannot move D <sub>35</sub> of bed material and/or D <sub>100</sub> of bar material	Cannot move D <sub>16</sub> of bed material and/or D <sub>100</sub> of bar or sub- pavement size	2
	(2)	(4)	(6)	(8)	
Sediment Capacity (POWERSED)	Sufficient capacity to transport annual load	Trend toward insufficient sediment capacity	Reduction up to 25% of annual sediment yield of bedload and/or suspended sand	Reduction over 25% of annual sediment yield for bedload and/or suspended sand	2
	(2)	(4)	(6)	(8)	
W/d Ratio State (Worksheet 3-8)	< 1.2	1.2 – 1.4	1.4 – 1.6	>1.6	6
	(2)	(4)	(6)	(8)	
Stream Succession 4 States (Worksheet 3- 16)	Current stream type at potential or does not indicate deposition/ aggradation	(E→C)	$ \begin{array}{c} (\text{C} {\rightarrow} \text{High W/d C}), \\ (\text{B} {\rightarrow} \text{High W/d B}), \\ (\text{C} {\rightarrow} \text{F}), (\text{G}_{\text{c}} {\rightarrow} \text{F}), \\ (\text{G} {\rightarrow} \text{F}_{\text{b}}) \end{array} $	$(C \rightarrow D)$ , $(F \rightarrow D)$	2
	(2)	(4)	(6)	(8)	
Depositional 5 Patterns (Worksheet	B1	B2, B4	B3, B5	B6, B7, B8	1
3-5)	(1)	(2)	(3)	(4)	
Debris / Blockages (Worksheet 3-6)	D1, D2, D3	D4, D7	D5, D8	D6, D9, D10	4
	(1)	(2)	(3)	(4)	
				Total Points	17
	Vertical Stab		nt Range for Exce adation	ss Deposition /	
Vertical Stability for Excess Deposition / Aggradation (use total points and check stability rating)	No Deposition < 15 □	Moderate Deposition 15 – 20 ☑	Excess Deposition 21 – 30	Aggradation > 30 □	

Worksheet 3-19. Vertical stability prediction for channel incision or degradation.

Stream	: Fourmile Can	yon Creek		Stream Type:	B 4	
Location	n: Reach 10			Valley Type:	XIII	
Observ	ers: Lucas Babbit	t		Date:	08/20/2015	
Vertic	cal Stability	Vertical Stabil	ity Categories for	Channel Incision	n / Degradation	Selected
stabili	ria (choose one ity category for criterion 1–5)	Not Incised	Slightly Incised	Moderately Incised	Degradation	Points (from each row)
1 Con	liment npetence rksheet 3-14)	Does not indicate excess competence	Trend to move larger sizes than $D_{100}$ of bar or > $D_{84}$ of bed	D <sub>100</sub> of bed moved	Particles much larger than $D_{100}$ of bed moved	6
		(2)	(4)	(6)	(8)	
Sed <sup>2</sup> (PO	liment Capacity WERSED)	Does not indicate excess capacity	Slight excess energy: up to 10% increase above reference	Excess energy sufficient to increase load up to 50% of annual load	Excess energy transporting more than 50% of annual load	6
		(2)	(4)	(6)	(8)	
3 Inci	gree of Channel sion (BHR) orksheet 3-7)	1.00 – 1.10	1.11 – 1.30	1.31 – 1.50	> 1.50	2
(	,	(2)	(4)	(6)	(8)	
4 Stat	eam Succession tes (Worksheets 6 and 3-7)	Does not indicate incision or degradation	If BHR > 1.1 and stream type has W/d between 5–10	If BHR > 1.1 and stream type has W/d less than 5	$(B\rightarrow G), (C\rightarrow G),$ $(E\rightarrow G), (D\rightarrow G),$ $(A\rightarrow G), (E\rightarrow A)$	8
		(2)	(4)	(6)	(8)	
5 (MW	nfinement VR / MWR <sub>ref</sub> )	0.80 – 1.00	0.30 – 0.79	0.10 – 0.29	< 0.10	3
(VVO	orksheet 3-9)	(1)	(2)	(3)	(4)	
					Total Points	25
		Vertical Stab	ility Category Poi Degra	nt Range for Cha dation	nnel Incision /	
Chan Degra points	cal Stability for nel Incision/ adation (use total s and check ity rating)	Not Incised < 12	Slightly Incised 12 – 18	Moderately Incised 19 – 27 <b>▽</b>	Degradation > 27 □	

**Worksheet 3-20.** Channel enlargement prediction summary.

Str	eam: Fourmile Canyo	on Creek		Stream Type:	B 4	
Lo	cation: Reach 10			Valley Type:	XIII	
Ob	servers: Lucas Babbitt			Date:	08/20/2015	
	hannel Enlargement	Char	nel Enlargement	<b>Prediction Categ</b>	ories	
(c	rediction Criteria choose one stability ategory for each criterion –4)	No Increase	Slight Increase	Moderate Increase	Extensive	Selected Points (from each row)
1	Successional Stage Shift (Worksheet 3-16)	Stream Type at Potential, $(C \rightarrow E)$ , $(F_b \rightarrow B)$ , $(G \rightarrow B)$ , $(F \rightarrow B_c)$ , $(F \rightarrow C)$ , $(D \rightarrow C)$	(B→High W/d B), (C→High W/d C), (E→C)	(G→F), (F→D)	$ \begin{array}{c} (C \rightarrow D), \ (A \rightarrow G), \\ (B \rightarrow G), \ (D \rightarrow G), \\ (C \rightarrow G), \ (E \rightarrow G), \\ (E \rightarrow A), \ (C \rightarrow F) \end{array} $	6
		(2)	(4)	(6)	(8)	
2	Lateral Stability (Worksheet 3-17)	Stable	Moderately Unstable	Unstable	Highly Unstable	6
		(2)	(4)	(6)	(8)	
3	Vertical Stability Excess Deposition or Aggradation	No Deposition	Moderate Deposition	Excess Deposition	Aggradation	4
	(Worksheet 3-18)	(2)	(4)	(6)	(8)	
4	Vertical Stability Channel Incision or Degradation	Not Incised	Slightly Incised	Moderately Incised	Degradation	6
	(Worksheet 3-19)	(2)	(4)	(6)	(8)	
					Total Points	22
			Category P	oint Range		
P p	channel Enlargement rediction (use total oints and check stability ating)	No Increase < 11	Slight Increase 11 – 16	Moderate Increase 17 – 24 ✓	Extensive > 24 □	

**Worksheet 3-21.** Overall sediment supply rating determined from individual stability rating categories.

Str	eam: Fourmile Canyo	n Creek		Stream Type:	B 4	
Loc	cation: Reach 10			Valley Type:	XIII	
Ob	servers:			Date:	08/20/2015	
P (d p	verall Sediment Supply rediction Criteria choose corresponding oints for each criterion –5)	Stability	y Rating	Points	Selected Points	
		Stable		1		
1	Lateral Stability	Mod. Unstal	ble	2	3	
l	(Worksheet 3-17)	Unstable		3	3	
		Highly Unst	able	4		
	Vertical Stability	No Depositi	on	1		
2	Excess Deposition or	Mod. Depos	ition	2	2	
_	Aggradation	Excess Dep	osition	3	_	
	(Worksheet 3-18)	Aggradation	1	4		
	Vertical Stability	Not Incised		1		
3	Channel Incision or	Slightly Inci		2	3	
ľ	Degradation	Mod. Incise	d	3	3	
	(Worksheet 3-19)	Degradation	•			
	Channel Enlargement	No Increase	)	1		
4	Prediction (Worksheet	Slight Increa		2	3	
•	3-20)	Mod. Increa	se	3	· ·	
	<i></i>	Extensive		4		
	Pfankuch Channel	Good: Stab		1		
5	Stability (Worksheet 3-	Fair: Mod. (	Jnstable	2	1	
	10)				•	
		Poor: Unsta	able	4		
				Total Points	12	
			Category P	oint Range		
R	overall Sediment Supply ating (use total points and check stability rating)	<i>Low</i> < 6 □	<i>Moderate</i> 6 – 10 □	High 11 – 15 ☑	Very High > 15 □	

Worksheet 3-22. Summary of stability condition categories.

	Α	BCDEFGHIJK	LMNOPQRS	TUVWXYZ	AA AB AC AD AE AF	AGAH AI AJAK ALAM
1	Stream:	Fourmile Canyon Creek		Location: Reach 10		
2	Observers:	Lucas Babbitt	Date: 8/20/2015	Stream Type: <b>B 4</b>	Valley Type:	XIII
3	Channel Dimension	Mean Bankfull 0.73 Bankfull \ Depth (ft): (ft):	2/1 (13 )	al Width/Depth Ratio:	34.15 Entren Ratio:	chment 1.49
5	Channel Pattern	Mean: λ/W <sub>bkf</sub> : <b>6.98 4.21 - 10.91</b>	6.58 - 12.11	W <sub>bkf</sub> : <b>2.73</b> M <b>0.92 - 4.61</b> M	WR: <b>1 0.52 - 1.56</b>	Sinuosity: 1.11
7	Streamflow	Bankfull Mean Velocity (ū <sub>bkf</sub> ) (ft/sec): 5.55 <sup>2</sup>	Discharge (Q <sub>bkf</sub> ):	Method:		Drainage Area (mi²): <b>7.42</b>
9		Check: ☐ Riffle/Pool ☐ Step/P	ool Plane Bed	Convergence/Divergence		nes/Smooth Bed
10	River Profile & Bed	Max Riffle Pool	Depth Ratio (max Riffle	Pool Pool-to- Ra	tio	Slope
11 12	Features	Bankfull 1.7 1.9	to mean): 2.33	1.71 Pool Spacing: 0	valley.	Surrace:
13		Riparian Current Composition/			rks: Condition, Vigor & Us	•
14		Vegetation   See description				species impacted by 20
15 16		Flow P 1 2 Stream Size Regime: 8 & Order:	S-4(3) Meander Patterns: M	Depositional Patterns:	B1 B5 B7 Debris	/Channel p3 D10 dges:
17	Level III Stream		Degree of Incision		kuch Stability Rating	109 -
18	Stability Indices	(Bank-Height Ratio):	Stability Rating:	(Numeric & Ac	djective Rating):	
19 20		Width/depth Ratio (W/d): 34.15 Reference Ratio (W/d)		th Ratio State (d <sub>ref</sub> ):	W/d Ratio Sta Stability Rating	IInstania I
21 22			Ference 4 Degree of (MWR / MV	confinement $NR_{ref}$ ):	MWR / MWR <sub>r</sub> Stability Rating	TINGTANIA I
23	Bank Erosion	Length of Reach 0 An	nual Streambank Erosion Rate	e: Curve Used:	Remarks:	-
24	Summary	Studied (ft):	(tons/yr) <b>0</b> (ton	s/yr/ft)		
25	Sediment Capacity (POWERSED)	☐ Sufficient Capacity ☐ Insuf	fficient Capacity	Capacity	ks:	
26 27	Entrainment/ Competence	Largest Particle from 177.8 Bar Sample (mm):	T — 1/3/  T   U	Existing Depth: 0.73 Require Depth:	<b>0.56</b> Existing Slope:	#### Required Slope: ####
28 29	Successional Stage Shift	<b>→</b> →	<b>→ →</b>	Existing St State (Type	B / I	tential Stream ate (Type):
30	Lateral Stability	☐ Stable ☐ Mod. Uns	stable 🔽 Unstable		Remarks/causes:	
31	Vertical Stability (Aggradation)	No Deposition    ✓ Mod. Deposition   ✓ Mod. Deposition	position 🗌 Ex. Deposition	☐ Aggradation	Remarks/causes:	
32	Vertical Stability (Degradation)	☐ Not Incised ☐ Slightly II	ncised Mod. Incised	Degradation	Remarks/causes:	
33	Channel Enlargement	☐ No Increase ☐ Slight Inc	crease Mod. Increase	☐ Extensive	Remarks/causes:	
34 35	Sediment Supply (Channel Source)	Low   Moderate	e 💆 High 🗀 Very Hi	gh Remarks/causes:		

### Reference Reach Data

		Entry Number & Variable	De	sign Reach Pool-1		n Reach ool-2		n Reach ool-3		n Reach Riffle	Assess	Flood sment of MCC	Bas	Design ed on rence	Arka Refe	Fork ansas rence V	Base	Design ed on ence	Cro Refe	of N. Elk eek rence
		Valley Type (I–XII)														•			V	<u>                                     </u>
		Valley Width (W <sub>val</sub> )		0.4/0.4	_	4/B4		1/B4		/B4				/B4		0-600 C3			0	O.L.
		Stream Type		C4/B4		4/B4 1.97		.97		•										3b
		Drainage Area, mi <sup>2</sup> (DA)		4.97				.97 20.0		.97 20.0				.97		9.9 75				1.4
	5 1	Bankfull Discharge, cfs (Q <sub>bkf</sub> )		120.0		20.0								20						0.0
	١,	Diffi - Mildel fe (M)	Mea		Mean:	21.5	Mean:	21.5	Mean:	21.5	Mean:	25.0	Mean:	24.2	Mean:	38.8	Mean:	19.5	Mean:	15.1
	ן ט	Riffle Width, ft (W <sub>bkf</sub> )	Min:	21.5	Min:	21.5	Min:	21.5	Min:	21.5	Min:	25.0	Min:	23.2	Min:	37.8	Min:	15.0	Min:	12.8
			Max		Max:	21.5	Max:	21.5	Max:	21.5	Мах:	25.0	Мах:	25.2	Max:	39.9 1.70	Max:	21.9	Max:	18.7 1.1
	١,,,	Diffic Macon Donath ft (d.)	Mea		Mean:	1.2	Mean:	1.2	Mean:	1.2	Mean:	1.08	Mean:	1.05	Mean:		Mean:	1.3	Mean:	
	′ '	Riffle Mean Depth, ft (d <sub>bkf</sub> )	Min:	1.2	Min:	1.2	Min:	1.2	Min:	1.2	Min:	1.08	Min:	1.00	Min:	1.51	Min:	1.2	Min:	0.8
			Max	1.2	Max:	1.2	Max:	1.2	Max:	1.2	Мах:	1.08	Max:	1.09	Max:	1.88	Max:	1.7 15.0	Max:	1.4 15.0
		Diffic Midth /Donth Datio (M. /d.)	Mea		Mean:	18.2	Mean:	18.2	Mean:	18.2	Mean:	23.1	Mean:	23.1	Mean:	23.1	Mean:		Mean:	
	° '	Riffle Width/Depth Ratio (W <sub>bkf</sub> /d <sub>bkf</sub> )	Min:	18.2	Min:	18.2	Min:	18.2	Min:	18.2	Min:	23.1	Min:	21.2	Min:	21.2	Min:	8.9	Min:	8.9
S			Max		Max:	18.2	Max:	18.2	Max:	18.2	Мах:	23.1	Мах:	25.1	Max:	25.1	Мах:	18.9	Мах:	18.9
<u>8</u>	١,,,	Diffic Course Continued August 62 (A)	Mea		Mean:	25.3	Mean:	25.3	Mean:	25.3	Mean:	28.0	Mean:	25.3	Mean:	66.0	Mean:	25.3	Mean:	15.9
Sus	9 1	Riffle Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkf</sub> )	Min:	25.3	Min:	25.3	Min:	25.3	Min:	25.3	Min:	28.0			Min:	57.0			Min:	10.8
Riffle Dimensions			Max		Max:	25.3	Max:	25.3	Мах:	25.3	Мах:	28.0	.,	4.70	Max:	75.1			Мах:	18.6
	۱.,	Diffic Manipular Double (d. )	Mea		Mean:	1.9	Mean:	1.9	Mean:	1.9	Mean:	2.00	Mean:	1.76	Mean:	2.79	Mean:	2.6	Mean:	2.1
I ∰	10 1	Riffle Maximum Depth (d <sub>max</sub> )	Min:	1.9	Min:	1.9	Min:	1.9	Min:	1.9	Min:	2.00	Min:	1.64	Min:	2.65	Min:	2.3	Min:	1.8
涩			Max		Max:	1.9	Max:	1.9	Max:	1.9	Мах:	2.00	Мах:	1.92	Max:	2.95	Max:	2.9	Мах:	2.5
		Riffle Maximum Depth to Riffle	Mea		Mean:	1.6	Mean:	1.6	Mean:	1.6	Mean:	1.852	Mean:	1.686	Mean:	1.686	Mean:	2.0	Mean:	2.0
	11	Mean Depth (d <sub>max</sub> /d <sub>bkf</sub> )	Min:	1.6	Min:	1.6	Min:	1.6	Min:	1.6	Min:	1.852	Min:	1.569	Min:	1.569	Min:	1.7	Min:	1.7
		, max sur,	Max		Max:	1.6	Max:	1.6	Мах:	1.6	Мах:	1.852	Мах:	1.834	Max:	1.834	Мах:	2.2	Мах:	2.2
	١ ١	Width of Flood-Prone Area at	Mea		Mean:	49.9	Mean:	49.9	Mean:	49.9	Mean:	100.0	Mean:	51.0	Mean:	280.7	Mean:		Mean:	59.3
	12	Elevation of 2 * d <sub>max</sub> , ft (W <sub>fpa</sub> )	Min:	22.8	Min:	22.8	Min:	22.8	Min:	22.8	Min:	100.0	Min:	35.0	Min:	220.0	Min:		Min:	46.4
			Max		Мах:	108.9	Мах:	108.9	Мах:	108.9	Мах:	100.0	Мах:	85.0	Мах:	320.0	Мах:		Мах:	79.4
			Mea		Mean:	2.3	Mean:	2.3	Mean:	2.3	Mean:	4.0	Mean:	2.1	Mean:	7.3	Mean:	0.0	Mean:	4.2
	13	Entrenchment Ratio (W <sub>fpa</sub> /W <sub>bkf</sub> )	Min:	1.1	Min:	1.1	Min:	1.1	Min:	1.1	Min:	4.0	Min:	1.5	Min:	5.5	Min:	0.0	Min:	2.5
			Max		Мах:	5.1	Мах:	5.1	Мах:	5.1	Мах:	4.0	Мах:	3.4	Мах:	8.5	Мах:	0.0	Мах:	6.2
			Mea		Mean:	9.5	Mean:	9.5	Mean:	9.5	Mean:	14.0	Mean:	13.4	Mean:	21.3	Mean:	13.0	Mean:	10.2
	14	Riffle Inner Berm Width, ft (W <sub>ib</sub> )	Min:	9.5	Min:	9.5	Min:	9.5	Min:	9.5	Min:	14.0	Min:	11.7	Min:	18.3	Min:	9.9	Min:	7.0
			Max		Мах:	9.5	Мах:	9.5	Мах:	9.5	Мах:	14.0	Мах:	14.2	Мах:	23.3	Мах:	15.4	Мах:	14.8
	۱ ۱	Riffle Inner Berm Width to Riffle	Mea		Mean:	0.4	Mean:	0.4	Mean:	0.4	Mean:	0.560	Mean:	0.552	Mean:	0.552	Mean:	0.7	Mean:	0.7
		Width (W <sub>ih</sub> /W <sub>hkf</sub> )	Min:	0.4	Min:	0.4	Min:	0.4	Min:	0.4	Min:	0.560	Min:	0.485	Min:	0.485	Min:	0.5	Min:	0.5
2		(IDBKI)	Max		Мах:	0.4	Мах:	0.4	Мах:	0.4	Мах:	0.560	Мах:	0.586	Мах:	0.586	Max:	0.8	Мах:	8.0
Berm Dimensions		Riffle Inner Berm Mean Depth, ft	Mea		Mean:	0.6	Mean:	0.6	Mean:	0.6	Mean:	0.45	Mean:	0.41	Mean:	0.66	Mean:	8.0	Mean:	0.7
ens	16	(d <sub>ib</sub> )	Min:	0.6	Min:	0.6	Min:	0.6	Min:	0.6	Min:	0.45	Min:	0.33	Min:	0.51	Min:	8.0	Min:	0.5
Ĕ		(∽ib)	Max		Мах:	0.6	Мах:	0.6	Мах:	0.6	Мах:	0.45	Мах:	0.46	Мах:	0.79	Мах:	0.9	Мах:	0.8
l D	,	Riffle Inner Berm Mean Depth to	Mea		Mean:	0.5	Mean:	0.5	Mean:	0.5	Mean:	0.417	Mean:	0.394	Mean:	0.394	Mean:	0.6	Mean:	0.6
err	17/	Riffle Mean Depth (d <sub>ib</sub> /d <sub>bkf</sub> )	Min:	0.5	Min:	0.5	Min:	0.5	Min:	0.5	Min:	0.417	Min:	0.320	Min:	0.320	Min:	0.6	Min:	0.6
E B	'	Time mean Depth (dip/dpki)	Max		Мах:	0.5	Мах:	0.5	Мах:	0.5	Мах:	0.417	Мах:	0.444	Мах:	0.444	Мах:	0.7	Мах:	0.7
e Inner		Riffle Inner Berm Width/Depth Ratio	Mea		Mean:	15.3	Mean:	15.3	Mean:	15.3	Mean:	31.1	Mean:	33.6	Mean:	33.6	Mean:	16.5	Mean:	16.5
e E	112	(M., /d., )	Min:	15.3	Min:	15.3	Min:	15.3	Min:	15.3	Min:	31.1	Min:	27.4	Min:	27.4	Min:	10.7	Min:	10.7

		Entry Number & Variable	_	n Reach ol-1	_	n Reach ol-2		n Reach ol-3	_	Reach	Asses	-Flood sment of WCC	Bas	t Design ed on erence	Ark	Fork ansas erence	Base	Design ed on rence	Cre	of N. Elk eek rence
Riffi		(w <sub>ib</sub> /u <sub>ib</sub> )	Мах:	15.3	Мах:	15.3	Мах:	15.3	Мах:	15.3	Мах:	31.1	Мах:	43.6	Мах:	43.6	Мах:	25.5	Мах:	25.5
≅			Mean:	5.9	Mean:	5.9	Mean:	5.9	Mean:	5.9	Mean:	6.3	Mean:	5.5	Mean:	14.0	Mean:	10.2	Mean:	6.6
	19	Riffle Inner Berm Cross-Sectional	Min:	5.9	Min:	5.9	Min:	5.9	Min:	5.9	Min:	6.3	Min:	4.7	Min:	11.4	Min:	8.6	Min:	3.7
		Area (A <sub>ib</sub> )	Max:	5.9	Мах:	5.9	Мах:	5.9	Мах:	5.9	Max:	6.3	Мах:	6.2	Мах:	18.4	Мах:	11.8	Мах:	8.6
		Riffle Inner Berm Cross-Sectional	Mean:	0.2	Mean:	0.2	Mean:	0.2	Mean:	0.2	Mean:	0.225	Mean:	0.216	Mean:	0.216	Mean:	0.4	Mean:	0.4
	20	Area to Riffle Cross-Sectional Area	Min:	0.2	Min:	0.2	Min:	0.2	Min:	0.2	Min:	0.225	Min:	0.187	Min:	0.187	Min:	0.3	Min:	0.3
		$(A_{ib}/A_{bkf})$	Max:	0.2	Мах:	0.2	Мах:	0.2	Мах:	0.2	Мах:	0.225	Мах:	0.245	Мах:	0.245	Мах:	0.5	Мах:	0.5
		( ID DRI)	Mean:	23.5	Mean:	23.5	Mean:	23.5	Mean:	23.5	Mean:	25.0	Mean:	21.7	Mean:	35.8	Mean:	14.2	Mean:	11.0
	21	Pool Width, ft (W <sub>bkfp</sub> )	Min:	23.5	Min:	23.5	Min:	23.5	Min:	23.5	Min:	25.0	Min:	19.1	Min:	31.5	Min:	14.2	Min:	11.0
		от от от от от от от от от от от от от о	Max:	23.5	Max:	23.5	Мах:	23.5	Мах:	23.5	Мах:	25.0	Мах:	24.3	Мах:	40.0	Мах:	14.2	Мах:	11.0
			Mean:	1.1	Mean:	1.1	Mean:	1.1	Mean:	1.1	Mean:	1.000	Mean:	0.897	Mean:	0.897	Mean:	0.7	Mean:	0.7
	22	Pool Width to Riffle Width	Min:	1.1	Min:	1.1	Min:	1.1	Min:	1.1	Min:	1.000	Min:	0.790	Min:	0.790	Min:	0.7	Min:	0.7
		(W <sub>bkfp</sub> /W <sub>bkf</sub> )	Max:	1.1	Max:	1.1	Max:	1.1	Мах:	1.1	Мах:	1.000	Мах:	1.004	Мах:	1.004	Мах:	0.7	Мах:	0.7
			Mean:	1.3	Mean:	1.5	Mean:	1.3	Mean:	1.3	Mean:	1.40	Mean:	1.29	Mean:	2.32	Mean:	1.3	Mean:	1.1
	23	Pool Mean Depth, ft (d <sub>bkfp</sub> )	Min:	1.3	Min:	1.5	Min:	1.3	Min:	1.3	Min:	1.40	Min:	1.26	Min:	2.27	Min:	1.3	Min:	1.1
		, , , bulby	Max:	1.3	Max:	1.5	Мах:	1.3	Мах:	1.3	Мах:	1.40	Мах:	1.32	Мах:	2.37	Мах:	1.3	Мах:	1.1
			Mean:	1.1	Mean:	1.3	Mean:	1.1	Mean:	1.1	Mean:	1.296	Mean:	1.234	Mean:	1.234	Mean:	1.0	Mean:	1.0
	24	Pool Mean Depth to Riffle Mean	Min:	1.1	Min:	1.3	Min:	1.1	Min:	1.1	Min:	1.296	Min:	1.207	Min:	1.207	Min:	1.0	Min:	1.0
		Depth (d <sub>bkfp</sub> /d <sub>bkf</sub> )	Max:	1.1	Мах:	1.3	Мах:	1.1	Мах:	1.1	Мах:	1.296	Мах:	1.261	Мах:	1.261	Мах:	1.0	Мах:	1.0
S			Mean:	18.1	Mean:	15.7	Mean:	18.1	Mean:	18.1	Mean:	17.9	Mean:	15.4	Mean:	15.4	Mean:	10.2	Mean:	10.2
Ϊ̈́	25	Pool Width/Depth Ratio (W <sub>bkfp</sub> /d <sub>bkfp</sub> )	Min:	18.1	Min:	15.7	Min:	18.1	Min:	18.1	Min:	17.9	Min:	13.3	Min:	13.3	Min:	10.2	Min:	10.2
eus		, , , , , , , , , , , , , , , , , , ,	Max:	18.1	Max:	15.7	Мах:	18.1	Мах:	18.1	Мах:	17.9	Max:	17.6	Max:	17.6	Мах:	10.2	Max:	10.2
Pool Dimensions			Mean:	31.0	Mean:	35.0	Mean:	29.9	Mean:	31.0	Mean:	35.0	Mean:	28.0	Mean:	83.2	Mean:	18.9	Mean:	11.9
ΙŞ	26	Pool Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkfp</sub> )	Min:	31.0	Min:	35.0	Min:	29.9	Min:	31.0	Min:	35.0	Min:	24.1	Min:	71.6	Min:	18.9	Min:	11.9
ĕ			Max:	31.0	Мах:	35.0	Мах:	29.9	Мах:	31.0	Мах:	35.0	Мах:	31.9	Мах:	94.7	Мах:	18.9	Мах:	11.9
			Mean:	1.2	Mean:	1.4	Mean:	1.2	Mean:	1.2	Mean:	1.250	Mean:	1,107	Mean:	1.107	Mean:	0.7	Mean:	0.7
	27	Pool Area to Riffle Area (A <sub>bkfp</sub> /A <sub>bkf</sub> )	Min:	1.2	Min:	1.4	Min:	1.2	Min:	1.2	Min:	1.250	Min:	0.954	Min:	0.954	Min:	0.7	Min:	0.7
		C BRID BRID	Max:	1.2	Мах:	1.4	Мах:	1.2	Мах:	1.2	Мах:	1.250	Мах:	1.261	Мах:	1.261	Мах:	0.7	Мах:	0.7
			Mean:	2.3	Mean:	2.6	Mean:	2.3	Mean:	2.3	Mean:	3.10	Mean:	2.73	Mean:	4.90	Mean:	3.0	Mean:	2.5
	28	Pool Maximum Depth (d <sub>maxp</sub> )	Min:	2.3	Min:	2.6	Min:	2.3	Min:	2.3	Min:	3.10	Min:	2.51	Min:	4.52	Min:	3.0	Min:	2.5
		, maxp	Max:	2.3	Мах:	2.6	Мах:	2.3	Мах:	2.3	Мах:	3.10	Мах:	2.93	Мах:	5.27	Мах:	3.0	Мах:	2.5
			Mean:	1.9	Mean:	2.2	Mean:	1.9	Mean:	1.9	Mean:	2.870	Mean:	2.606	Mean:	2.606	Mean:	2.3	Mean:	2.3
	29	Pool Maximum Depth to Riffle Mean	Min:	1.9	Min:	2.2	Min:	1.9	Min:	1.9	Min:	2.870	Min:	2.404	Min:	2.404	Min:	2.3	Min:	2.3
		Depth (d <sub>maxp</sub> /d <sub>bkf</sub> )	Max:	1.9	Max:	2.2	Max:	1.9	Мах:	1.9	Мах:	2.870	Max:	2.803	Мах:	2.803	Max:	2.3	Мах:	2.3
			Mean:	8.5	Mean:	8.6	Mean:	11.0	Mean:	8.5	Mean:		Mean:	33.300	Mean:	33.300	Mean:	5.6	Mean:	5.6
	30	Point Bar Slope (S <sub>pb</sub> )	Min:	8.5	Min:	8.6	Min:	11.0	Min:	8.5	Min:		Min:	28.600	Min:	28.600	Min:	10.0	Min:	10.0
			Max:	8.5	Мах:	8.6	Мах:	11.0	Мах:	8.5	Мах:		Мах:	38.000	Мах:	38.000	Мах:	2.5	Мах:	2.5
			Mean:	12.0	Mean:	10.8	Mean:	10.8	Mean:	12.0	Mean:	12.0	Mean:	11.5	Mean:	16.9	Mean:	7.3	Mean:	4.1
	31	Pool Inner Berm Width, ft (W <sub>ibp</sub> )	Min:	12.0	Min:	10.8	Min:	10.8	Min:	12.0	Min:	12.0	Min:	11.4	Min:	15.1	Min:	7.3	Min:	4.1
			Max:	12.0	Мах:	10.8	Мах:	10.8	Мах:	12.0	Мах:	12.0	Мах:	11.6	Мах:	18.8	Мах:	7.3	Мах:	4.1
		Daral Ingran Barrer W. III in Dari	Mean:	0.5	Mean:	0.5	Mean:	0.5	Mean:	0.5	Mean:	0.480	Mean:	0.530	Mean:	0.475	Mean:	0.5	Mean:	0.4
	32	Pool Inner Berm Width to Pool	Min:	0.5	Min:	0.5	Min:	0.5	Min:	0.5	Min:	0.480	Min:	0.524	Min:	0.470	Min:	0.5	Min:	0.4
		Width (W <sub>ibp</sub> /W <sub>bkfp</sub> )	Max:	0.5	Мах:	0.5	Мах:	0.5	Мах:	0.5	Мах:	0.480	Мах:	0.535	Мах:	0.480	Мах:	0.5	Мах:	0.4
ons		Baallanan Barra M. B. H. G.	Mean:	1.0	Mean:	1.0	Mean:	1.0	Mean:	1.0	Mean:	1.10	Mean:	1.05	Mean:	1.89	Mean:	0.4	Mean:	0.4
nsic	33	Pool Inner Berm Mean Depth, ft	Min:	1.0	Min:	1.0	Min:	1.0	Min:	1.0	Min:	1.10	Min:	0.92	Min:	1.68	Min:	0.4	Min:	0.4
erm Dimensions		(d <sub>ibp</sub> )	Max:	1.0	Мах:	1.0	Мах:	1.0	Мах:	1.0	Мах:	1.10	Мах:	1.19	Мах:	2.09	Мах:	0.4	Мах:	0.4
ä		2 11 2 14 2 11 2	Mean:	0.7	Mean:	0.7	Mean:	0.8	Mean:	0.7	Mean:	0.786	Mean:	0.815	Mean:	0.815	Mean:	0.3	Mean:	0.3
E	34	Pool Inner Berm Mean Depth to Pool	Min:	0.7	Min:	0.7	Min:	0.8	Min:	0.7	Min:	0.786	Min:	0.709	Min:	0.709	Min:	0.3	Min:	0.3
- m		Mean Denth Id., Id., 1																	1	

	Entry Number & Variable	_	n Reach ol-1		Reach	_	n Reach ol-3	_	n Reach Riffle		Flood sment of		t Design ed on		Fork Insas		Design ed on		of N. Elk eek
		FO	01-1	FO	01-2	FO	01-3	03	Killie	F۱	NCC	Refe	erence	Refe	rence	Refe	rence	Refe	rence
ă	Weari Deptil (dibp/dbkfp)	Мах:	0.7	Мах:	0.7	Мах:	0.8	Мах:	0.7	Мах:	0.786	Мах:	0.921	Мах:	0.921	Max:	0.3	Мах:	0.3
Pool Inner	Pool Inner Berm Width/Depth Ratio	Mean:	12.4	Mean:	10.6	Mean:	10.6	Mean:	12.4	Mean:	10.9	Mean:	9.2	Mean:	9.2	Mean:	11.1	Mean:	11.1
트	35 (W <sub>ibp</sub> /d <sub>ibp</sub> )	Min:	12.4	Min:	10.6	Min:	10.6	Min:	12.4	Min:	10.9	Min:	7.2	Min:	7.2	Min:	11.1	Min:	11.1
8	(vv ibp/ Gibp)	Max:	12.4	Мах:	10.6	Мах:	10.6	Мах:	12.4	Мах:	10.9	Мах:	11.2	Мах:	11.2	Max:	11.1	Мах:	11.1
1 "	Pool Inner Berm Cross-Sectional	Mean:	11.5	Mean:	11.0	Mean:	11.0	Mean:	11.5	Mean:	13.2	Mean:	10.8	Mean:	31.6	Mean:	2.4	Mean:	1.5
	Area (A <sub>ibp</sub> )	Min:	11.5	Min:	11.0	Min:	11.0	Min:	11.5	Min:	13.2	Min:	9.3	Min:	31.6	Min:	2.4	Min:	1.5
	Area (A <sub>bp</sub> )	Max:	11.5	Max:	11.0	Max:	11.0	Мах:	11.5	Мах:	13.2	Max:	12.4	Мах:	31.6	Мах:	2.4	Мах:	1.5
	Pool Inner Berm Cross-Sectional	Mean:	0.4	Mean:	0.3	Mean:	0.4	Mean:	0.4	Mean:	0.377	Mean:	0.387	Mean:	0.387	Mean:	0.1	Mean:	0.1
	37 Area to Pool Cross-Sectional Area	Min:	0.4	Min:	0.3	Min:	0.4	Min:	0.4	Min:	0.377	Min:	0.333	Min:	0.333	Min:	0.1	Min:	0.1
	$(A_{ibp}/A_{bkfp})$	Мах:	0.4	Мах:	0.3	Мах:	0.4	Мах:	0.4	Мах:	0.377	Мах:	0.441	Мах:	0.441	Мах:	0.1	Мах:	0.1
								Mean:		Mean:		Mean:	24.6	Mean:	40.5	Mean:	21.4	Mean:	16.5
	38 Run Width, ft (W <sub>bkfr</sub> )							Min:		Min:		Min:		Min:		Min:	14.4	Min:	11.1
								Мах:		Мах:		Мах:		Мах:		Мах:	34.2	Мах:	26.4
								Mean:	0.0	Mean:	0.000	Mean:	1.015	Mean:	1.015	Mean:	1.1	Mean:	1.1
	Run Width to Riffle Width							Min:	0.0	Min:	0.000	Min:		Min:		Min:	0.7	Min:	0.7
	(W <sub>bkfr</sub> /W <sub>bkf</sub> )							Мах:	0.0	Мах:	0.000	Мах:		Max:		Max:	1.8	Мах:	1.8
ŀ								Mean:		Mean:		Mean:	1.01	Mean:	1.82	Mean:	0.9	Mean:	0.8
	<b>40</b> Run Mean Depth, ft (d <sub>bkfr</sub> )							Min:		Min:		Min:		Min:		Min:	0.5	Min:	0.4
								Мах:		Max:		Мах:		Max:		Max:	1.4	Мах:	1.2
								Mean:	0.0	Mean:	0.000	Mean:	0.968	Mean:	0.968	Mean:	0.7	Mean:	0.7
	Run Mean Depth to Riffle Mean							Min:	0.0	Min:	0.000	Min:	0.300	Min:	0.300	Min:	0.4	Min:	0.4
ns l	Depth (d <sub>bkfr</sub> /d <sub>bkf</sub> )							Max:	0.0	Max:	0.000	Max:		Max:		Max:	1.1	Max:	1.1
Run Dimensions								Mean:	#DIV/0!	Mean:	#DIV/0!	Mean:	22.2	Mean:	22.2	Mean:	30.6	Mean:	30.6
e	<b>42</b> Run Width/Depth Ratio (W <sub>bkfr</sub> /d <sub>bkfr</sub> )							Min:	#DIV/0!	Min:	#DIV/0!	Min:	22.2	Min:	22.2	Min:	15.9	Min:	9.3
Ë	42 Kuli Wiutii, Deptii Katio (Wbkfr/ubkfr)							Max:	#DIV/0!	Max:		Max:		Мах:		мин. Мах:	10.8	Max:	
ו⊒								Mean:	#DIV/0:	Mean:	#DIV/0!	Mean:	24.9	Mean:	73.8	Mean:	17.0	Mean:	64.3 10.7
8	<b>43</b> Run Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkfr</sub> )							Min:		Min:		Min:	24.9	Min:	73.0	меап: Min:	17.0	Min:	7.9
	43 Run Cross-Sectional Area, It (A <sub>bkfr</sub> )																		
								Мах:		Max:	0.000	Мах:	0.000	Max:	0.000	Max:	21.1	Мах:	13.2
	44 Dun August Diffic August (A. /A.)							Mean:	0.0	Mean:	0.000	Mean:	0.982	Mean:	0.982	Mean:	0.7	Mean:	0.7
	<b>44</b> Run Area to Riffle Area (A <sub>bkfr</sub> /A <sub>bkf</sub> )							Min:	0.0	Min:	0.000	Min:		Min:		Min:	0.5	Min:	0.5
								Max:	0.0	Max:	0.000	Мах:		Max:		Max:	8.0	Мах:	0.8
	45 Dura Marrian Duri (1)							Mean:	2.2	Mean:	2.20	Mean:	1.89	Mean:	3.39	Mean:	2.0	Mean:	1.7
	<b>45</b> Run Maximum Depth (d <sub>maxr</sub> )							Min:	2.2	Min:	2.20	Min:		Min:		Min:	1.6	Min:	1.3
								Мах:	2.2	Max:	2.20	Мах:	4.005	Max:	4.000	Max:	2.6	Мах:	2.1
	Run Maximum Depth to Riffle Mean							Mean:	1.9	Mean:	2.037	Mean:	1.803	Mean:	1.803	Mean:	1.6	Mean:	1.6
	Depth (d <sub>maxr</sub> /d <sub>bkf</sub> )							Min:	1.9	Min:	2.037	Min:		Min:		Min:	1.2	Min:	1.2
								Max:	1.9	Max:	2.037	Мах:		Max:	4.5 =	Max:	2.0	Мах:	2.0
	[ <del>_</del>							Mean:		Mean:		Mean:	25.9	Mean:	42.7	Mean:	32.4	Mean:	25.0
	<b>47</b> Glide Width, ft (W <sub>bkfg</sub> )							Min:		Min:		Min:	23.8	Min:	39.3	Min:	32.4	Min:	25.0
								Мах:		Мах:		Мах:	27.9	Мах:	46.0	Мах:	32.4	Мах:	25.0
	Glide Width to Riffle Width							Mean:	0.0	Mean:	0.000	Mean:	1.070	Mean:	1.070	Mean:	1.7	Mean:	1.7
	48 (W <sub>bkfg</sub> /W <sub>bkf</sub> )							Min:	0.0	Min:	0.000	Min:	0.986	Min:	0.986	Min:	1.7	Min:	1.7
	, bulg bul/							Мах:	0.0	Мах:	0.000	Мах:	1.154	Мах:	1.154	Мах:	1.7	Мах:	1.7
								Mean:		Mean:		Mean:	0.93	Mean:	1.68	Mean:	0.5	Mean:	0.4
	<b>49</b> Glide Mean Depth, ft (d <sub>bkfg</sub> )							Min:		Min:		Min:	0.85	Min:	1.52	Min:	0.5	Min:	0.4
								Мах:		Мах:		Мах:	1.02	Мах:	1.84	Max:	0.5	Мах:	0.4
	Glide Mean Depth to Riffle Mean							Mean:	0.0	Mean:	0.000	Mean:	0.894	Mean:	0.894	Mean:	0.4	Mean:	0.4
S	50 Depth (d/d)							Min:	0.0	Min:	0.000	Min:	0.809	Min:	0.809	Min:	0.4	Min:	0.4

	Entry Number & Variable		Design Reach Pool-1	Design Reach Pool-2	Design Reach Pool-3	_	n Reach Riffle		-Flood sment of		t Design ed on		Fork ansas	Target Base	Design ed on		of N. Elk eek
			P001-1	P001-2	F001-3	03	Killle	FN	NCC	Refe	erence	Refe	rence	Refer	rence	Refer	rence
iö	Deptif (ubkfg/ubkf)	L				Мах:	0.0	Мах:	0.000	Мах:	0.979	Max:	0.979	Мах:	0.4	Мах:	0.4
Glide Dimensior						Mean:	#DIV/0!	Mean:	#DIV/0!	Mean:	25.4	Mean:	25.4	Mean:	62.4	Mean:	62.4
Ξ	<b>51</b> Glide Width/Depth Ratio (W <sub>bkfg</sub> /d <sub>bkfg</sub> )					Min:	#DIV/0!	Min:	#DIV/0!	Min:	25.0	Min:	25.0	Min:	62.4	Min:	62.4
e D		Ĺ				Max:	#DIV/0!	Мах:	#DIV/0!	Мах:	25.9	Мах:	25.9	Max:	62.4	Мах:	62.4
ΙË						Mean:		Mean:		Mean:	24.3	Mean:	72.2	Mean:	15.8	Mean:	9.9
ا	<b>52</b> Glide Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkfg</sub> )					Min:		Min:		Min:	20.1	Min:	59.6	Min:	15.8	Min:	9.9
		L				Мах:		Мах:		Мах:	28.6	Max:	84.8	Max:	15.8	Мах:	9.9
						Mean:	0.0	Mean:	0.000	Mean:	0.961	Mean:	0.961	Mean:	0.6	Mean:	0.6
	<b>53</b> Glide Area to Riffle Area (A <sub>bkfg</sub> /A <sub>bkf</sub> )					Min:	0.0	Min:	0.000	Min:	0.794	Min:	0.794	Min:	0.6	Min:	0.6
						Мах:	0.0	Мах:	0.000	Мах:	1.129	Max:	1.129	Max:	0.6	Мах:	0.6
						Mean:	1.6	Mean:	1.60	Mean:	1.26	Mean:	2.27	Mean:	2.0	Mean:	1.6
	<b>54</b> Glide Maximum Depth (d <sub>maxg</sub> )					Min:	1.6	Min:	1.60	Min:	1.19	Min:	2.14	Min:	2.0	Min:	1.6
		L				Мах:	1.6	Мах:	1.60	Мах:	1.34	Мах:	2.40	Мах:	2.0	Мах:	1.6
	Glide Maximum Depth to Riffle					Mean:	1.4	Mean:	1.481	Mean:	1.207	Mean:	1.207	Mean:	1.5	Mean:	1.5
	Mean Depth (d <sub>maxg</sub> /d <sub>bkf</sub> )					Min:	1.4	Min:	1.481	Min:	1.138	Min:	1.138	Min:	1.5	Min:	1.5
	Weari Deptil (umaxg/Ubkf)	Ĺ				Мах:	1.4	Мах:	1.481	Мах:	1.277	Мах:	1.277	Мах:	1.5	Мах:	1.5
		Ī				Mean:		Mean:		Mean:	14.9	Mean:	24.7	Mean:	6.0	Mean:	4.6
	<b>56</b> Glide Inner Berm Width, ft (W <sub>ibg</sub> )					Min:		Min:		Min:	13.7	Min:	20.8	Min:	6.0	Min:	4.6
						Мах:		Мах:		Мах:	16.1	Max:	28.6	Max:	6.0	Max:	4.6
	Clida Innar Barm Width to Clida	Ī				Mean:	#DIV/0!	Mean:	#DIV/0!	Mean:	0.575	Mean:	0.575	Mean:	0.2	Mean:	0.2
	Glide Inner Berm Width to Glide					Min:	#DIV/0!	Min:	#DIV/0!	Min:	0.528	Min:	0.528	Min:	0.2	Min:	0.2
S	Width (W <sub>ibg</sub> /W <sub>bkfg</sub> )					Мах:	#DIV/0!	Мах:	#DIV/0!	Мах:	0.622	Мах:	0.622	Мах:	0.2	Мах:	0.2
Glide Inner Berm Dimensions	Clida Impar Darm Maan Danth ft	Ī				Mean:		Mean:		Mean:	0.25	Mean:	0.43	Mean:	0.6	Mean:	0.5
nsi	Glide Inner Berm Mean Depth, ft					Min:		Min:		Min:	0.17	Min:	0.34	Min:	0.6	Min:	0.5
me.	(d <sub>ibg</sub> )					Мах:		Мах:		Мах:	0.32	Мах:	0.52	Max:	0.6	Мах:	0.5
١ä	Clida Impar Darra Maan Danth ta	Ī				Mean:	#DIV/0!	Mean:	#DIV/0!	Mean:	0.265	Mean:	0.265	Mean:	1.2	Mean:	1.2
ıξ	Glide Inner Berm Mean Depth to					Min:	#DIV/0!	Min:	#DIV/0!	Min:	0.185	Min:	0.185	Min:	1.2	Min:	1.2
ă	Glide Mean Depth (d <sub>ibg</sub> /d <sub>bkfg</sub> )					Мах:	#DIV/0!	Мах:	#DIV/0!	Мах:	0.345	Мах:	0.345	Max:	1.2	Мах:	1.2
nei	Clide Income Demon Middle / Demake Bekin	Ī				Mean:	#DIV/0!	Mean:	#DIV/0!	Mean:	61.9	Mean:	61.9	Mean:	9.3	Mean:	9.3
드	Glide Inner Berm Width/Depth Ratio					Min:	#DIV/0!	Min:	#DIV/0!	Min:	39.6	Min:	39.6	Min:	9.3	Min:	9.3
Ι <u>ĕ</u>	(W <sub>ibg</sub> /d <sub>ibg</sub> )					Мах:	#DIV/0!	Мах:	#DIV/0!	Мах:	84.2	Мах:	84.2	Max:	9.3	Мах:	9.3
9		ſ				Mean:		Mean:		Mean:	3.6	Mean:	10.3	Mean:	3.6	Mean:	2.3
	Glide Inner Berm Cross-Sectional					Min:		Min:		Min:	2.8	Min:	9.7	Min:	3.6	Min:	2.3
	Area (A <sub>ibg</sub> )					Мах:		Мах:		Мах:	4.5	Max:	10.9	Мах:	3.6	Мах:	2.3
	Clide Inner Perez Assatz Clide A	j				Mean:	#DIV/0!	Mean:	#DIV/0!	Mean:	0.149	Mean:	0.149	Mean:	0.2	Mean:	0.2
	Glide Inner Berm Area to Glide Area					Min:	#DIV/0!	Min:	#DIV/0!	Min:	0.115	Min:	0.115	Min:	0.2	Min:	0.2
	(A <sub>ibg</sub> /A <sub>bkfg</sub> )					Мах:	#DIV/0!	Мах:	#DIV/0!	Мах:	0.183	Мах:	0.183	Мах:	0.2	Мах:	0.2
		ļ				Mean:		Mean:		Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	<b>63</b> Step Width, ft (W <sub>bkfs</sub> )	J				Min:		Min:		Min:		Min:		Min:	0.0	Min:	0.0
						Max:		Мах:		Мах:		Max:		Мах:	0.0	Мах:	0.0
	C. WELL BITTER	j				Mean:	0.0	Mean:	0.000	Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	Step Width to Riffle Width					Min:	0.0	Min:	0.000	Min:		Min:		Min:	0.0	Min:	0.0
	(W <sub>bkfs</sub> /W <sub>bkf</sub> )					Мах:	0.0	Мах:	0.000	Мах:		Мах:		Мах:	0.0	Мах:	0.0
		ļ				Mean:		Mean:		Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	<b>65</b> Step Mean Depth, ft (d <sub>bkfs</sub> )					Min:		Min:		Min:	-	Min:		Min:	0.0	Min:	0.0
	. , , , , , , , ,					Max:		Мах:		Мах:		Max:		Мах:	0.0	Max:	0.0
		f				Mean:	0.0	Mean:	0.000	Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	Step Mean Depth to Riffle Mean					Min:	0.0	Min:		Min:		Min:		Min:	0.0	Min:	0.0
S	Denth (d/d)					ļ	<b></b>		0.000			1			0.0		<b></b>

		Design Reach	Design Reach	Design Reach	Desia	n Reach		-Flood	_	Design		Fork	_	Design		
	Entry Number & Variable	Pool-1	Pool-2	Pool-3	_	Riffle		sment of MCC		ed on erence		ansas rence		ed on rence	Cre Refer	_
21	Deptii (u <sub>bkfs</sub> /u <sub>bkf</sub> )				Мах:	0.0	Мах:	0.000	Max:	rence	Max:	rence	Max:	0.0	Max:	0.0
Step Dimension					Mean:	#DIV/0!	Mean:	#DIV/0!	Mean:		Mean:		Mean:	0.0	Mean:	0.0
Je l	<b>67</b> Step Width/Depth Ratio (W <sub>bkfs</sub> /d <sub>bkfs</sub> )				Min:	#DIV/0!	Min:	#DIV/0!	Min:		Min:		Min:	0.0	Min:	0.0
۱ä	Jep Width Depth Ratio (Wakis/ abkis/				Max:	#DIV/0!	Max:	#DIV/0!	Max:		Max:		Max:	0.0	Max:	0.0
g -					Mean:	#51470:	Mean:	#DIV/0:	Mean:	N/A	Mean:		Mean:	0.0	Mean:	0.0
Š	68 Step Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkfs</sub> )				Min:		Min:		Min:	IVA	Min:		Min:	0.0	Min:	0.0
	Step cross Sectional Area, it (Abas)				Max:		Max:		Max:		Max:		Max:	0.0	Max:	0.0
<b> </b> -					Mean:	0.0	Mean:	0.000	Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	69 Step Area to Riffle Area (A <sub>bkfs</sub> /A <sub>bkf</sub> )				Min:	0.0	Min:	0.000	Min:	14/71	Min:	1471	Min:	0.0	Min:	0.0
	Step / Hear to Mille / Hear (/ Bais/ MBRI)				Max:	0.0	Max:	0.000	Max:		Max:		Max:	0.0	Max:	0.0
1 6					Mean:	0.0	Mean:	0.000	Mean:	N/A	Mean:		Mean:	0.0	Mean:	0.0
1	<b>70</b> Step Maximum Depth (d <sub>maxs</sub> )				Min:		Min:		Min:	14/71	Min:		Min:	0.0	Min:	0.0
	Coop				Max:		Max:		Мах:		Max:		Max:	0.0	Мах:	0.0
					Mean:	0.0	Mean:	0.00	Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	Step Maximum Depth to Riffle Mean				Min:	0.0	Min:	0.00	Min:	,, .	Min:		Min:	0.0	Min:	0.0
	Depth (d <sub>maxs</sub> /d <sub>bkf</sub> )				Max:	0.0	Max:	0.00	Max:		Max:		Max:	0.0	Max:	0.0
					Mean:	143.0	Mean:	98.3	Mean:	291.3	Mean:	467.2	Mean:	72.6	Mean:	56.0
	<b>72</b> Linear Wavelength, ft (λ)				Min:	40.9	Min:	18.8	Min:	261.3	Min:	419.0	Min:	54.4	Min:	42.0
	- Emedi Wavelength, it (%)				Max:	595.2	Max:	278.3	Max:	309.6	Max:	496.6	Max:	99.8	Max:	77.0
-					Mean:	6.7	Mean:	3.933	Mean:	12.040	Mean:	12.040	Mean:	3.7	Mean:	3.7
	Linear Wavelength to Riffle Width				Min:	1.9	Min:	0.751	Min:	10.800	Min:	10.800	Min:	2.8	Min:	2.8
	$(\lambda/W_{bkf})$				Max:	27.7	Max:	11.133	Max:	12.800	Max:	12.800	Max:	5.1	Max:	5.1
					Mean:	149.0	Mean:	104.5	Mean:	331.4	Mean:	531.6	Mean:	84.2	Mean:	65.0
1	74 Stream Meander Length, ft (L <sub>m</sub> )				Min:	48.5	Min:		Min:	297.5	Min:	477.2	Min:	58.3	Min:	45.0
					Max:	611.2	Мах:	334.6	Мах:	365.3	Max:	585.9	Max:	103.7	Мах:	80.0
-					Mean:	6.9	Mean:	4.182	Mean:	13.700	Mean:	13.700	Mean:	4.3	Mean:	4.3
	75 Stream Meander Length Ratio				Min:	2.3	Min:	0.792	Min:	12.300	Min:	12.300	Min:	3.0	Min:	3.0
	(L <sub>m</sub> /W <sub>bkf</sub> )				Мах:	28.4	Max:	13.385	Мах:	15.100	Max:	15.100	Max:	5.3	Мах:	5.3
					Mean:	65.0	Mean:	65.0	Mean:	121.9	Mean:	195.6	Mean:	53.1	Mean:	41.0
1	76 Belt Width, ft (W <sub>blt</sub> )				Min:	0.0	Min:		Min:	97.0	Min:	155.6	Min:	38.9	Min:	30.0
	. , 500				Мах:	0.0	Max:	0.0	Мах:	171.8	Мах:	275.5	Мах:	71.3	Мах:	55.0
					Mean:	3.0	Mean:	2.600	Mean:	5.040	Mean:	5.040	Mean:	2.7	Mean:	2.7
	77 Meander Width Ratio (W <sub>blt</sub> /W <sub>bkf</sub> )				Min:	0.0	Min:	0.000	Min:	4.010	Min:	4.010	Min:	2.0	Min:	2.0
					Мах:	0.0	Мах:	0.000	Мах:	7.100	Мах:	7.100	Max:	3.7	Мах:	3.7
					Mean:	75.4	Mean:	58.2	Mean:	82.5	Mean:	132.4	Mean:	16.8	Mean:	13.0
	<b>78</b> Radius of Curvature, ft (R <sub>c</sub> )				Min:	10.0	Min:	3.7	Min:	53.2	Min:	85.4	Min:	5.2	Min:	4.0
					Мах:	300.0	Мах:	383.0	Мах:	109.2	Мах:	175.2	Max:	36.3	Мах:	28.0
٤	Padius of Currenture to Diffle Width				Mean:	3.5	Mean:	2.326	Mean:	3.412	Mean:	3.412	Mean:	0.9	Mean:	0.9
Pattern	Radius of Curvature to Riffle Width				Min:	0.5	Min:	0.148	Min:	2.200	Min:	2.200	Min:	0.3	Min:	0.3
Ра	$(R_c/W_{bkf})$				Max:	14.0	Max:	15.319	Мах:	4.516	Max:	4.516	Max:	1.9	Мах:	1.9
Channel					Mean:	44.2	Mean:	58.2	Mean:	87.4	Mean:	140.2	Mean:	33.7	Mean:	26.0
Jan	<b>80</b> Arc Length, ft (L <sub>a</sub> )				Min:	8.9	Min:	3.7	Min:	50.8	Min:	81.5	Min:	15.6	Min:	12.0
ਠ					Max:	136.2	Max:	383.0	Мах:	123.8	Мах:	198.6	Max:	59.6	Мах:	46.0
					Mean:	2.1	Mean:	2.326	Mean:	3.613	Mean:	3.613	Mean:	1.7	Mean:	1.7
	81 Arc Length to Riffle Width (L <sub>e</sub> /W <sub>bkf</sub> )				Min:	0.4	Min:	0.148	Min:	2.100	Min:	2.100	Min:	8.0	Min:	8.0
					Мах:	6.3	Max:	15.319	Мах:	5.119	Мах:	5.119	Max:	3.1	Мах:	3.1
					Mean:	60.7	Mean:	24.5	Mean:	75.0	Mean:	120.3	Mean:	21.7	Mean:	16.7
	<b>82</b> Riffle Length (L <sub>r</sub> ), ft				Min:	2.5	Min:	0.1	Min:	50.8	Min:	81.5	Min:	10.4	Min:	8.0

		Entry Number & Variable	Design Reach Pool-1	Design Reach Pool-2	Design Reach Pool-3	_	n Reach Riffle	Assess	Flood sment of		t Design sed on		Fork ansas		Design ed on		of N. Elk eek
	-		1 001-1	1 001-2	1 001-3				<b>NCC</b>	_	erence	_	erence	_	rence		rence
	L					Max:	290.3	Мах:	116.3	Max:	97.0	Мах:	155.6	Max:	40.3	Мах:	31.1
	١.,	• D:(()				Mean:	2.8	Mean:	0.982	Mean:	3.100	Mean:	3.100	Mean:	1.1	Mean:	1.1
	8	3 Riffle Length to Riffle Width (L/W <sub>bkf</sub> )				Min:	0.1	Min:	0.003	Min:	2.100	Min:	2.100	Min:	0.5	Min:	0.5
	H					Max:	13.5	Мах:	4.650	Мах:	4.010	Мах:	4.010	Max:	2.1	Max:	2.1
	١.	A Individual Deal Length # / L				Mean:	31.0	Mean:	40.7	Mean:	53.2	Mean:	85.4	Mean:	23.0	Mean:	17.8
	l °	4 Individual Pool Length, ft (L <sub>p</sub> )				Min: Max:	6.2 95.3	Min: Max:	2.6 268.1	Min: Max:	43.5 66.5	Min: Max:	69.8 106.7	Min: Max:	8.2 79.0	Min: Max:	6.4 61.0
	┡					Mean:	1.4	Mean:	1.628	Mean:	2.200	Mean:	2.200	Mean:	1.2	Mean:	1.2
	, g	5 Pool Length to Riffle Width (L <sub>p</sub> /W <sub>bkf</sub> )				Min:	0.3	Min:	0.104	Min:	1.800	Min:	1.800	Min:	0.4	Min:	0.4
	ľ	o Tool Length to Kime Width (Lp/ Wbki)				Max:	4.4	Max:	10.723	Max:	2.750	Max:	2.750	Мах:	4.1	Max:	4.1
	H					Mean:	74.7	Mean:	51.3	Mean:	153.1	Mean:	245.6	Mean:	57.4	Mean:	44.3
	86	6 Pool-to-Pool Spacing, ft (P <sub>s</sub> )				Min:	16.3	Min:	8.2	Min:	121.0	Min:	194.0	Min:	15.5	Min:	12.0
	ľ	• · · · · · · · · · · · · · · · · · · ·				Max:	328.8	Max:	189.8	Max:	181.4	Max:	291.0	Max:	114.5	Max:	88.3
	H					Mean:	3.5	Mean:	2.053	Mean:	6.330	Mean:	6.330	Mean:	2.9	Mean:	2.9
	87	Pool-to-Pool Spacing to Riffle Width				Min:	0.8	Min:	0.328	Min:	5.000	Min:	5.000	Min:	0.8	Min:	0.8
	ľ	(P <sub>s</sub> /W <sub>bkf</sub> )				Max:	15.3	Max:	7.591	Max:	7.500	Max:	7.500	Max:	5.9	Max:	5.9
	88	8 Stream Length (SL)					28.6		96.0	17,070			20.0				20.0
Slope	89	9 Valley Length (VL)				67	86.0	67	'86.0			30	0.00			30	00.0
and SI	9(	<b>0</b> Valley Slope (S <sub>val</sub> )				0.0	)442	0.0	0442	#0	DIV/0!	0	0114	#DI	IV/0!	0.0	0336
													1.14			SL/VL:	
Sinuosity	9	1 Sinuosity (k)				SL/VL:	1.07	SL/VL:	1.13	SL/VL:	S <sub>val</sub> /k	VS/S:	1.14	SL/VL:	S <sub>val</sub> /k	VS/S:	1.14
U,		2 Average Water Surface Slope (S)				0.0	1423	0.0	0397		OIV/O!	0.	0100		IV/0!	0.0	0294
						Mean:				Mean:		Mean:	305.000			Mean:	305.000
Ë	9:	<b>3</b> Floodplain Width, ft (W <sub>f</sub> )				Min:				Min:		Min:	210.000			Min:	210.000
ള						Мах:				Мах:		Мах:	400.000			Мах:	400.000
Floodplain		Floodplain Surface Depth Limit, ft				Mean:				Mean:		Mean:	2.0			Mean:	2.0
됴	94	4 (d <sub>f</sub> )				Min:				Min:		Min:	1.8			Min:	1.8
		` "				Мах:				Max:		Мах:	2.2			Мах:	2.2
a)	ĺ.,					Mean:				Mean:		Mean:	450.000			Mean:	450.000
ac	9	5 Low Terrace Width, ft (W <sub>lt</sub> )				Min:				Min:		Min:	290.000			Min:	290.000
Terrace	L					Max:				Мах:		Мах:	620.000			Max:	620.000
Low		Low Terrace Surface Depth Limit, ft				Mean:				Mean:		Mean:	5.6			Mean:	5.6
۲	90	6 (d <sub>lt</sub> )				Min:				Min:		Min:	5.3			Min:	5.3
-						Max:	40 500			Max:		Max:	6.0			Max:	6.0
Area	0.	7 Flood-Prone Area Width, ft (W <sub>fpa</sub> )				Mean:	42.500			Mean:		Mean:	450.000			Mean:	450.000
e A	9	i Hood-Frome Area Width, It (Wfpa)				Min: Max:				Min: Max:		Min: Max:	290.000 610.000			Min: Max:	290.000 610.000
Flood-Prone	$\vdash$					Mean:				Mean:		Mean:	5.6			Mean:	5.6
<u> </u>	98	Flood-Prone Area Surface Depth				Min:				Min:		Min:	5.3			Min:	5.3
윤	~	Limit, ft (d <sub>fpa</sub> )				Max:				Мах:		Max:	6.0			Max:	6.0
						Mean:				Mean:		Mean:	2.575			Mean:	0.000
_	90	9 Low Bank Height (LBH)				Min:				Min:		Min:	2.310			Min:	0.000
ision	٦	- Lott Bollik Height (LDH)				Max:				Max:		Max:	2.840			Max:	0.000
.03	_					wax.		L		wax.		wax.	2.070	<u> </u>		wax.	0.000

	Entry Number & Variable	Design Reach Pool-1	Design Reach Pool-2	Design Reach Pool-3	Design Reach US Riffle	Pre-Flood Assessment of FMCC	Bas	t Design sed on erence	Arka	Fork ansas rence	Target Design Based on Reference	Cr	of N. Elk reek erence
ı	Maximum Bankfull Depth (d <sub>max</sub> ) at				Mean:		Mean:		Mean:	2.6		Mean:	2.1
₽	100 Same Location as Low Bank Height				Min:		Min:		Min:	2.3		Min:	2.1
Degree	(LBH) Measurement				Мах:		Мах:		Мах:	2.8		Мах:	2.1
eg					Mean:		Mean:		Mean:	1.000		Mean:	0.000
	<b>101</b> Bank-Height Ratio (LBH/d <sub>max</sub> )				Min:		Min:		Min:	1.000		Min:	0.000
					Мах:		Мах:		Max:	1.000		Max:	0.000
					Mean:		Mean:	1.8	Mean:	3.3	2.0	Mean:	1.6
	102 Riffle Maximum Depth, ft (d <sub>max</sub> )				Min:		Min:	1.7	Min:	3.0	0.5	Min:	0.4
Dimensionless Ratios from Profile					Max:		Мах:	1.9	Мах:	3.4	2.5	Max:	2.0
٦ ا	103 Riffle Maximum Depth to Riffle				Mean:		Mean:	1.734	Mean:	1.734	1.505	Mean:	1.505
Ξ	Mean Depth (d <sub>max</sub> /d <sub>bkf</sub> )				Min:		Min:	1.617	Min:	1.617	0.355	Min:	0.355
f.	Wearr Deptir (u <sub>max</sub> /u <sub>bkt</sub> )				Мах:		Мах:	1.803	Мах:	1.803	1.897	Мах:	1.897
SO					Mean:		Mean:	2.7	Mean:	4.9	3.2	Mean:	2.6
ati	<b>104</b> Pool Maximum Depth, ft (d <sub>maxp</sub> )				Min:		Min:	2.4	Min:	4.2	2.2	Min:	1.8
SS					Max:		Мах:	2.9	Мах:	5.3	4.7	Max:	3.9
l se	Pool Maximum Depth to Riffle Mean				Mean:		Mean:	2.606	Mean:	2.606	2.467	Mean:	2.467
ē.	Depth (d <sub>maxp</sub> /d <sub>bkf</sub> )				Min:		Min:	2.255	Min:	2.255	1.682	Min:	1.682
ens	Deptif (u <sub>maxp</sub> /u <sub>bkf</sub> )				Max:		Мах:	2.793	Мах:	2.793	3.607	Max:	3.607
Ξ					Mean:		Mean:	1.9	Mean:	3.4	2.4	Mean:	1.9
	<b>106</b> Run Maximum Depth, ft (d <sub>maxr</sub> )				Min:		Min:	1.8	Min:	3.2	1.6	Min:	1.3
and					Мах:		Мах:	2.1	Мах:	3.7	3.2	Мах:	2.7
ıts	Run Maximum Depth to Riffle Mean				Mean:		Mean:	1.824	Mean:	1.824	1.813	Mean:	1.813
le l	Depth (d <sub>maxr</sub> /d <sub>bkf</sub> )				Min:		Min:	1.681	Min:	1.681	1.206	Min:	1.206
Measurements	Deptii (u <sub>maxi</sub> , u <sub>bkf</sub> )				Мах:		Мах:	1.963	Мах:	1.963	2.486	Мах:	2.486
ası					Mean:		Mean:	1.4	Mean:	2.5	2.1	Mean:	1.7
₽	<b>108</b> Glide Maximum Depth, ft (d <sub>maxg</sub> )				Min:		Min:	1.2	Min:	2.2	1.0	Min:	8.0
두					Max:		Мах:	1.5	Мах:	2.8	2.9	Мах:	2.4
Depth	Glide Maximum Depth to Riffle				Mean:		Mean:	1.309	Mean:	1.309	1.607	Mean:	1.607
Ĭ	Mean Depth (d <sub>maxq</sub> /d <sub>bkf</sub> )				Min:		Min:	1.149	Min:	1.149	0.757	Min:	0.757
×	Wearr Deptir (umaxg/ubkf)				Мах:		Мах:	1.473	Мах:	1.473	2.215	Max:	2.215
Feature Max					Mean:		Mean:	N/A	Mean:	N/A	0.0	Mean:	0.0
eati	110 Step Maximum Depth, ft (d <sub>maxs</sub> )				Min:		Min:		Min:		0.0	Min:	0.0
Ĭ,					Max:		Мах:		Мах:		0.0	Max:	0.0
Bed	Stop Maximum Donth to Piffle Moon				Mean:		Mean:	N/A	Mean:	N/A	0.000	Mean:	0.000
	Step Maximum Depth to Riffle Mean				Min:		Min:		Min:		0.000	Min:	0.000
	Depth (d <sub>maxs</sub> /d <sub>bkf</sub> )				Мах:		Мах:		Мах:		0.000	Max:	0.000

		Entry Number & Variable	_	n Reach ool-1	_	n Reach ol-2	_	n Reach ol-3	_	n Reach Riffle	Bas	Design ed on rence	Arka Refe	Fork ansas rence	Target Base Refer	d on	Elk C Refe	k of N. Creek rence
		'alley Type (I–XII)												V			V	/III
	2 V	'alley Width (W <sub>val</sub> )												-600				
		tream Type		4/B4		/B4		I/B4		4/B4		I/B4		23				3b
		Prainage Area, mi <sup>2</sup> (DA)		.19		.19		.19		.19		.19		9.9				.4
	<b>5</b> Ba	ankfull Discharge, cfs (Q <sub>bkf</sub> )	1	30	13	0.0	13	0.0	13	30.0	1	30	3	75			11	0.0
			Mean:	22.5	Mean:	22.5	Mean:	22.5	Mean:	22.5	Mean:	24.9	Mean:	38.8	Mean:	20.0	Mean:	15.1
	<b>6</b> Ri	iffle Width, ft (W <sub>bkf</sub> )	Min:	22.5	Min:	22.5	Min:	22.5	Min:	22.5	Min:	23.8	Min:	37.8	Min:	15.4	Min:	12.8
			Max:	22.5	Мах:	22.5	Мах:	22.5	Мах:	22.5	Мах:	25.9	Мах:	39.9	Мах:	22.5	Мах:	18.7
			Mean:	1.2	Mean:	1.2	Mean:	1.2	Mean:	1.2	Mean:	1.07	Mean:	1.70	Mean:	1.3	Mean:	1.1
	<b>7</b> Ri	iffle Mean Depth, ft (d <sub>bkf</sub> )	Min:	1.2	Min:	1.2	Min:	1.2	Min:	1.2	Min:	1.03	Min:	1.51	Min:	1.2	Min:	0.8
			Max:	1.2	Мах:	1.2	Мах:	1.2	Мах:	1.2	Мах:	1.12	Мах:	1.88	Мах:	1.7	Мах:	1.4
			Mean:	19.1	Mean:	19.1	Mean:	19.1	Mean:	19.1	Mean:	23.1	Mean:	23.1	Mean:	15.0	Mean:	15.0
	<b>8</b> Ri	iffle Width/Depth Ratio (W <sub>bkf</sub> /d <sub>bkf</sub> )	Min:	19.1	Min:	19.1	Min:	19.1	Min:	19.1	Min:	21.2	Min:	21.2	Min:	8.9	Min:	8.9
			Мах:	19.1	Мах:	19.1	Мах:	19.1	Мах:	19.1	Мах:	25.1	Мах:	25.1	Мах:	18.9	Мах:	18.9
Suc			Mean:	26.7	Mean:	26.7	Mean:	26.7	Mean:	26.7	Mean:	26.7	Mean:	66.0	Mean:	26.7	Mean:	15.9
ısi	<b>9</b> Ri	iffle Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkf</sub> )	Min:	26.7	Min:	26.7	Min:	26.7	Min:	26.7			Min:	57.0			Min:	10.8
ne			Max:	26.7	Мах:	26.7	Мах:	26.7	Мах:	26.7			Мах:	75.1			Мах:	18.6
Riffle Dimensions			Mean:	2.0	Mean:	2.0	Mean:	2.0	Mean:	2.0	Mean:	1.81	Mean:	2.79	Mean:	2.7	Mean:	2.1
£ e	<b>10</b> R	iffle Maximum Depth (d <sub>max</sub> )	Min:	2.0	Min:	2.0	Min:	2.0	Min:	2.0	Min:	1.69	Min:	2.65	Min:	2.3	Min:	1.8
~			Max:	2.0	Мах:	2.0	Мах:	2.0	Max:	2.0	Мах:	1.97	Мах:	2.95	Max:	3.0	Мах:	2.5
	R	iffle Maximum Depth to Riffle	Mean:	1.7	Mean:	1.7	Mean:	1.7	Mean:	1.7	Mean:	1.686	Mean:	1.686	Mean:	2.0	Mean:	2.0
	111	Nean Depth (d <sub>max</sub> /d <sub>bkf</sub> )	Min:	1.7	Min:	1.7	Min:	1.7	Min:	1.7	Min:	1.569	Min:	1.569	Min:	1.7	Min:	1.7
		real Depth (a <sub>max</sub> /a <sub>bkf</sub> )	Max:	1.7	Мах:	1.7	Мах:	1.7	Мах:	1.7	Max:	1.834	Мах:	1.834	Мах:	2.2	Мах:	2.2
	١٨	Vidth of Flood-Prone Area at	Mean:	42.5	Mean:	42.5	Mean:	42.5	Mean:	42.5	Mean:	51.0	Mean:	280.7	Mean:		Mean:	59.3
	12 E	Elevation of 2 * d <sub>max</sub> , ft (W <sub>fpa</sub> )	Min:	37.1	Min:	37.1	Min:	37.1	Min:	37.1	Min:	35.0	Min:	220.0	Min:		Min:	46.4
		- Illax/ · ( Ipa/	Max:	47.8	Мах:	47.8	Мах:	47.8	Мах:	47.8	Max:	85.0	Max:	320.0	Мах:		Max:	79.4
			Mean:	1.9	Mean:	1.9	Mean:	1.9	Mean:	1.9	Mean:	2.1	Mean:	7.3	Mean:	0.0	Mean:	4.2
	13 E	Intrenchment Ratio (W <sub>fpa</sub> /W <sub>bkf</sub> )	Min:	1.6	Min:	1.6	Min:	1.6	Min:	1.6	Min:	1.5	Min:	5.5	Min:	0.0	Min:	2.5
			Мах:	2.1	Мах:	2.1	Мах:	2.1	Max:	2.1	Max:	3.3	Мах:	8.5	Max:	0.0	Max:	6.2
			Mean:	10.5	Mean:	10.5	Mean:	10.5	Mean:	10.5	Mean:	13.7	Mean:	21.3	Mean:	13.4	Mean:	10.2
	<b>14</b> R	iffle Inner Berm Width, ft (W <sub>ib</sub> )	Min:	10.5	Min:	10.5	Min:	10.5	Min:	10.5	Min:	12.1	Min:	18.3	Min:	10.2	Min:	7.0
			Max:	10.5	Мах:	10.5	Мах:	10.5	Мах:	10.5	Мах:	14.6	Мах:	23.3	Мах:	15.9	Мах:	14.8
	D	iffle Inner Dorm Width to Diffle	Mean:	0.5	Mean:	0.5	Mean:	0.5	Mean:	0.5	Mean:	0.552	Mean:	0.552	Mean:	0.7	Mean:	0.7
		iffle Inner Berm Width to Riffle Vidth (W <sub>ib</sub> /W <sub>bkf</sub> )	Min:	0.5	Min:	0.5	Min:	0.5	Min:	0.5	Min:	0.485	Min:	0.485	Min:	0.5	Min:	0.5
S	v	viatri (vv <sub>ib</sub> /vv <sub>bkf</sub> )	Max:	0.5	Мах:	0.5	Мах:	0.5	Мах:	0.5	Мах:	0.586	Max:	0.586	Мах:	8.0	Мах:	0.8
Ö	Г.	iffle Inner Derm Mann Denti- ft	Mean:	0.7	Mean:	0.7	Mean:	0.7	Mean:	0.7	Mean:	0.42	Mean:	0.66	Mean:	0.8	Mean:	0.7
suoisus	16	iffle Inner Berm Mean Depth, ft	Min:	0.7	Min:	0.7	Min:	0.7	Min:	0.7	Min:	0.34	Min:	0.51	Min:	8.0	Min:	0.5

		Entry Number & Variable		n Reach ol-1	_	Reach	_	Reach	_	n Reach Riffle	Bas	Design ed on erence	Arka	Fork ansas rence	Base	Design ed on rence	Elk (	rk of N. Creek erence
Dime		(Uib)	Мах:	0.7	Мах:	0.7	Мах:	0.7	Мах:	0.7	Мах:	0.48	Мах:	0.79	Мах:	0.9	Мах:	0.8
Ö		Diffic Inner Down Maco Doubh to	Mean:	0.6	Mean:	0.6	Mean:	0.6	Mean:	0.6	Mean:	0.394	Mean:	0.394	Mean:	0.6	Mean:	0.6
erm	17	Riffle Inner Berm Mean Depth to	Min:	0.6	Min:	0.6	Min:	0.6	Min:	0.6	Min:	0.320	Min:	0.320	Min:	0.6	Min:	0.6
Riffle Inner Berm		Riffle Mean Depth (d <sub>ib</sub> /d <sub>bkf</sub> )	Мах:	0.6	Мах:	0.6	Max:	0.6	Мах:	0.6	Max:	0.444	Max:	0.444	Мах:	0.7	Мах:	0.7
ne		Difficulture of Decree Middle /Decret	Mean:	15.9	Mean:	15.9	Mean:	15.9	Mean:	15.9	Mean:	33.6	Mean:	33.6	Mean:	16.5	Mean:	16.5
e E	18	Riffle Inner Berm Width/Depth	Min:	15.9	Min:	15.9	Min:	15.9	Min:	15.9	Min:	27.4	Min:	27.4	Min:	10.7	Min:	10.7
Œ		Ratio (W <sub>ib</sub> /d <sub>ib</sub> )	Мах:	15.9	Мах:	15.9	Max:	15.9	Мах:	15.9	Мах:	43.6	Max:	43.6	Мах:	25.5	Мах:	25.5
<u> </u>		Biffle Inner Borm Cross Sectional	Mean:	7.0	Mean:	7.0	Mean:	7.0	Mean:	7.0	Mean:	5.8	Mean:	14.0	Mean:	10.8	Mean:	6.6
	19	Riffle Inner Berm Cross-Sectional	Min:	7.0	Min:	7.0	Min:	7.0	Min:	7.0	Min:	5.0	Min:	11.4	Min:	9.0	Min:	3.7
		Area (A <sub>ib</sub> )	Мах:	7.0	Мах:	7.0	Max:	7.0	Мах:	7.0	Max:	6.5	Max:	18.4	Мах:	12.4	Мах:	8.6
		Riffle Inner Berm Cross-Sectional	Mean:	0.3	Mean:	0.3	Mean:	0.3	Mean:	0.3	Mean:	0.216	Mean:	0.216	Mean:	0.4	Mean:	0.4
	20	Area to Riffle Cross-Sectional Area	Min:	0.3	Min:	0.3	Min:	0.3	Min:	0.3	Min:	0.187	Min:	0.187	Min:	0.3	Min:	0.3
		$(A_{ib}/A_{bkf})$	Max:	0.3	Max:	0.3	Мах:	0.3	Мах:	0.3	Max:	0.245	Мах:	0.245	Мах:	0.5	Мах:	0.5
			Mean:	23.5	Mean:	23.5	Mean:	23.5	Mean:		Mean:	22.3	Mean:	35.8	Mean:	14.6	Mean:	11.0
	21	Pool Width, ft (W <sub>bkfp</sub> )	Min:	23.5	Min:	23.5	Min:	23.5	Min:		Min:	19.6	Min:	31.5	Min:	14.6	Min:	11.0
			Max:	23.5	Мах:	23.5	Мах:	23.5	Мах:		Max:	24.9	Max:	40.0	Мах:	14.6	Мах:	11.0
		D   \A/; -  d  - d - D; ff  - \A/; -  d  -	Mean:	1.0	Mean:	1.0	Mean:	1.0	Mean:	0.0	Mean:	0.897	Mean:	0.897	Mean:	0.7	Mean:	0.7
	22	Pool Width to Riffle Width	Min:	1.0	Min:	1.0	Min:	1.0	Min:	0.0	Min:	0.790	Min:	0.790	Min:	0.7	Min:	0.7
		$(W_{bkfp}/W_{bkf})$	Мах:	1.0	Мах:	1.0	Max:	1.0	Мах:	0.0	Мах:	1.004	Max:	1.004	Мах:	0.7	Мах:	0.7
			Mean:	1.3	Mean:	1.5	Mean:	1.3	Mean:		Mean:	1.33	Mean:	2.32	Mean:	1.3	Mean:	1.1
	23	Pool Mean Depth, ft (d <sub>bkfp</sub> )	Min:	1.3	Min:	1.5	Min:	1.3	Min:		Min:	1.30	Min:	2.27	Min:	1.3	Min:	1.1
		·	Max:	1.3	Max:	1.5	Max:	1.3	Мах:		Max:	1.35	Max:	2.37	Мах:	1.3	Мах:	1.1
		Dool Many Double to Diffle Many	Mean:	1.1	Mean:	1.3	Mean:	1.1	Mean:	0.0	Mean:	1.234	Mean:	1.234	Mean:	1.0	Mean:	1.0
	24	Pool Mean Depth to Riffle Mean	Min:	1.1	Min:	1.3	Min:	1.1	Min:	0.0	Min:	1.207	Min:	1.207	Min:	1.0	Min:	1.0
		Depth (d <sub>bkfp</sub> /d <sub>bkf</sub> )	Мах:	1.1	Мах:	1.3	Мах:	1.1	Мах:	0.0	Max:	1.261	Max:	1.261	Мах:	1.0	Мах:	1.0
ns			Mean:	18.1	Mean:	15.7	Mean:	18.1	Mean:	#DIV/0!	Mean:	15.4	Mean:	15.4	Mean:	10.2	Mean:	10.2
Si	25	Pool Width/Depth Ratio (W <sub>bkfp</sub> /d <sub>bkfp</sub> )	Min:	18.1	Min:	15.7	Min:	18.1	Min:	#DIV/0!	Min:	13.3	Min:	13.3	Min:	10.2	Min:	10.2
Pool Dimensions			Мах:	18.1	Мах:	15.7	Max:	18.1	Мах:	#DIV/0!	Max:	17.6	Max:	17.6	Мах:	10.2	Мах:	10.2
۱			Mean:	31.0	Mean:	35.0	Mean:	29.9	Mean:		Mean:	29.6	Mean:	83.2	Mean:	19.9	Mean:	11.9
=	26	Pool Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkfp</sub> )	Min:	31.0	Min:	35.0	Min:	29.9	Min:		Min:	25.5	Min:	71.6	Min:	19.9	Min:	11.9
S.			Max:	31.0	Max:	35.0	Max:	29.9	Max:		Max:	33.7	Max:	94.7	Мах:	19.9	Мах:	11.9
			Mean:	1.2	Mean:	1.3	Mean:	1.1	Mean:	0.0	Mean:	1.107	Mean:	1.107	Mean:	0.7	Mean:	0.7
	27	Pool Area to Riffle Area (A <sub>bkfp</sub> /A <sub>bkf</sub> )	Min:	1.2	Min:	1.3	Min:	1.1	Min:	0.0	Min:	0.954	Min:	0.954	Min:	0.7	Min:	0.7
			Max:	1.2	Max:	1.3	Max:	1.1	Max:	0.0	Max:	1.261	Мах:	1.261	Мах:	0.7	Max:	0.7
			Mean:	2.3	Mean:	2.6	Mean:	2.3	Mean:		Mean:	2.80	Mean:	4.90	Mean:	3.1	Mean:	2.5
	28	Pool Maximum Depth (d <sub>maxp</sub> )	Min:	2.3	Min:	2.6	Min:	2.3	Min:		Min:	2.58	Min:	4.52	Min:	3.1	Min:	2.5
			Max:	2.3	Max:	2.6	Max:	2.3	Мах:		Max:	3.01	Max:	5.27	Мах:	3.1	Мах:	2.5
		Pool Maximum Donth to Diffle	Mean:	1.9	Mean:	2.2	Mean:	1.9	Mean:	0.0	Mean:	2.606	Mean:	2.606	Mean:	2.3	Mean:	2.3
	29	Pool Maximum Depth to Riffle	Min:	1.9	Min:	2.2	Min:	1.9	Min:	0.0	Min:	2.404	Min:	2.404	Min:	2.3	Min:	2.3
		Mean Depth (d <sub>maxp</sub> /d <sub>bkf</sub> )	Мах:	1.9	Max:	2.2	Max:	1.9	Max:	0.0	Max:	2.803	Max:	2.803	Мах:	2.3	Мах:	2.3
			Mean:	8.5	Mean:	8.6	Mean:	11.0	Mean:		Mean:	33.300	Mean:	33.300	Mean:	5.6	Mean:	5.6
	30	Point Bar Slope (S <sub>pb</sub> )	Min:	8.5	Min:	8.6	Min:	11.0	Min:		Min:	28.600	Min:	28.600	Min:	10.0	Min:	10.0

		Entry Number & Variable		Reach		Reach	_	Reach	_	n Reach Riffle	Bas	Design ed on rence	Arka	Fork ansas rence	_	Design ed on	N. Forl Elk C Refer	Creek
			Max:	8.5	Мах:	8.6	Мах:	11.0	Мах:		Max:	38.000	Max:	38.000	Max:	2.5	Max:	2.5
			Mean:	12.0	Mean:	10.8	Mean:	10.8	Mean:		Mean:	11.8	Mean:	16.9	Mean:	7.5	Mean:	4.1
	31	Pool Inner Berm Width, ft (W <sub>ihn</sub> )	Min:	12.0	Min:	10.8	Min:	10.8	Min:		Min:	11.7	Min:	15.1	Min:	7.5	Min:	4.1
			Max:	12.0	Max:	10.8	Мах:	10.8	Max:		Мах:	11.9	Max:	18.8	Мах:	7.5	Max:	4.1
			Mean:	0.5	Mean:	0.5	Mean:	0.5	Mean:	#DIV/0!	Mean:	0.530	Mean:	0.475	Mean:	0.5	Mean:	0.4
	32	Pool Inner Berm Width to Pool	Min:	0.5	Min:	0.5	Min:	0.5	Min:	#DIV/0!	Min:	0.524	Min:	0.470	Min:	0.5	Min:	0.4
		Width (W <sub>ibp</sub> /W <sub>bkfp</sub> )	Max:	0.5	Max:	0.5	Мах:	0.5	Мах:	#DIV/0!	Мах:	0.535	Max:	0.480	Мах:	0.5	Max:	0.4
Berm Dimensions		D 11 D 14 D 11 C	Mean:	1.0	Mean:	1.0	Mean:	1.0	Mean:		Mean:	1.08	Mean:	1.89	Mean:	0.5	Mean:	0.4
ısic	33	Pool Inner Berm Mean Depth, ft	Min:	1.0	Min:	1.0	Min:	1.0	Min:		Min:	0.94	Min:	1.68	Min:	0.5	Min:	0.4
Je l		(d <sub>ibp</sub> )	Max:	1.0	Max:	1.0	Мах:	1.0	Мах:		Мах:	1.22	Max:	2.09	Мах:	0.5	Max:	0.4
₫		D 11 D 11 1	Mean:	0.7	Mean:	0.7	Mean:	0.8	Mean:	#DIV/0!	Mean:	0.815	Mean:	0.815	Mean:	0.3	Mean:	0.3
١ž	34	Pool Inner Berm Mean Depth to	Min:	0.7	Min:	0.7	Min:	0.8	Min:	#DIV/0!	Min:	0.709	Min:	0.709	Min:	0.3	Min:	0.3
ă		Pool Mean Depth (d <sub>ibp</sub> /d <sub>bkfp</sub> )	Max:	0.7	Max:	0.7	Мах:	8.0	Мах:	#DIV/0!	Мах:	0.921	Max:	0.921	Мах:	0.3	Max:	0.3
Pool Inner		Dool Inner Borm Width /Donth Batio	Mean:	12.4	Mean:	10.6	Mean:	10.6	Mean:	#DIV/0!	Mean:	9.2	Mean:	9.2	Mean:	11.1	Mean:	11.1
트	35	Pool Inner Berm Width/Depth Ratio	Min:	12.4	Min:	10.6	Min:	10.6	Min:	#DIV/0!	Min:	7.2	Min:	7.2	Min:	11.1	Min:	11.1
ြို		$(W_{ibp}/d_{ibp})$	Max:	12.4	Max:	10.6	Мах:	10.6	Мах:	#DIV/0!	Мах:	11.2	Max:	11.2	Мах:	11.1	Max:	11.1
_		Pool Inner Berm Cross-Sectional	Mean:	11.5	Mean:	11.0	Mean:	11.0	Mean:		Mean:	11.4	Mean:	31.6	Mean:	2.6	Mean:	1.5
	36	Area (A <sub>ibp</sub> )	Min:	11.5	Min:	11.0	Min:	11.0	Min:		Min:	9.8	Min:	31.6	Min:	2.6	Min:	1.5
		Alea (A <sub>ibp</sub> )	Max:	11.5	Max:	11.0	Мах:	11.0	Мах:		Max:	13.0	Max:	31.6	Мах:	2.6	Мах:	1.5
		Pool Inner Berm Cross-Sectional	Mean:	0.4	Mean:	0.3	Mean:	0.4	Mean:	#DIV/0!	Mean:	0.387	Mean:	0.387	Mean:	0.1	Mean:	0.1
	37	Area to Pool Cross-Sectional Area	Min:	0.4	Min:	0.3	Min:	0.4	Min:	#DIV/0!	Min:	0.333	Min:	0.333	Min:	0.1	Min:	0.1
		$(A_{ibp}/A_{bkfp})$	Мах:	0.4	Max:	0.3	Мах:	0.4	Мах:	#DIV/0!	Мах:	0.441	Max:	0.441	Мах:	0.1	Max:	0.1
									Mean:		Mean:	25.2	Mean:	40.5	Mean:	22.0	Mean:	16.5
	38	Run Width, ft (W <sub>bkfr</sub> )							Min:		Min:		Min:		Min:	14.8	Min:	11.1
									Max:		Max:		Max:		Мах:	35.1	Max:	26.4
		Run Width to Riffle Width							Mean:	0.0	Mean:	1.015	Mean:	1.015	Mean:	1.1	Mean:	1.1
	39	(W <sub>bkfr</sub> /W <sub>bkf</sub> )							Min:	0.0	Min:		Min:		Min:	0.7	Min:	0.7
		( • • bktr • • bkt/							Мах:	0.0	Мах:		Мах:		Мах:	1.8	Мах:	1.8
									Mean:		Mean:	1.04	Mean:	1.82	Mean:	0.9	Mean:	0.8
	40	Run Mean Depth, ft (d <sub>bkfr</sub> )							Min:		Min:		Min:		Min:	0.5	Min:	0.4
									Мах:		Мах:		Мах:		Мах:	1.5	Мах:	1.2
		Run Mean Depth to Riffle Mean							Mean:	0.0	Mean:	0.968	Mean:	0.968	Mean:	0.7	Mean:	0.7
တ	41	Depth (d <sub>bkfr</sub> /d <sub>bkf</sub> )							Min:	0.0	Min:		Min:		Min:	0.4	Min:	0.4
Dimensions		(bki)							Мах:	0.0	Мах:		Max:		Мах:	1.1	Мах:	1.1
sue									Mean:	#DIV/0!	Mean:	22.2	Mean:	22.2	Mean:	30.6	Mean:	30.6
≣ِ.	42	Run Width/Depth Ratio (W <sub>bkfr</sub> /d <sub>bkfr</sub> )							Min:	#DIV/0!	Min:		Min:		Min:	15.9	Min:	9.3
n D									Мах:	#DIV/0!	Мах:		Max:		Мах:	10.8	Мах:	64.3
Run									Mean:		Mean:	26.2	Mean:	73.8	Mean:	17.9	Mean:	10.7
	43	Run Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkfr</sub> )							Min:		Min:		Min:		Min:	13.4	Min:	7.9
									Мах:		Мах:		Max:		Max:	22.3	Мах:	13.2
		2160							Mean:	0.0	Mean:	0.982	Mean:	0.982	Mean:	0.7	Mean:	0.7
	44	Run Area to Riffle Area (A <sub>bkfr</sub> /A <sub>bkf</sub> )							Min:	0.0	Min:		Min:		Min:	0.5	Min:	0.5

	Entry Number & Variable	Design Reach Pool-1	Design Reach Pool-2	Design Reach Pool-3	_	n Reach Riffle	Bas	Design ed on rence	Arka	Fork insas rence	Base	Design ed on rence	Elk C	k of N. Creek rence
					Мах:	0.0	Мах:		Мах:		Мах:	0.8	Мах:	0.8
					Mean:	2.2	Mean:	1.94	Mean:	3.39	Mean:	2.1	Mean:	1.7
	<b>45</b> Run Maximum Depth (d <sub>maxr</sub> )				Min:	2.2	Min:		Min:		Min:	1.7	Min:	1.3
					Max:	2.2	Max:		Мах:		Мах:	2.7	Мах:	2.1
	2 11 2 2:00				Mean:	1.9	Mean:	1.803	Mean:	1.803	Mean:	1.6	Mean:	1.6
	Run Maximum Depth to Riffle Mean				Min:	1.9	Min:		Min:		Min:	1.2	Min:	1.2
	Depth (d <sub>maxr</sub> /d <sub>bkf</sub> )				Max:	1.9	Мах:		Мах:		Мах:	2.0	Мах:	2.0
					Mean:		Mean:	26.6	Mean:	42.7	Mean:	33.2	Mean:	25.0
	<b>47</b> Glide Width, ft (W <sub>bkfa</sub> )				Min:		Min:	24.5	Min:	39.3	Min:	33.2	Min:	25.0
					Max:		Max:	28.7	Мах:	46.0	Мах:	33.2	Мах:	25.0
	CITE ME IN A DISSE ME IN				Mean:	0.0	Mean:	1.070	Mean:	1.070	Mean:	1.7	Mean:	1.7
	Glide Width to Riffle Width				Min:	0.0	Min:	0.986	Min:	0.986	Min:	1.7	Min:	1.7
	(W <sub>bkfg</sub> /W <sub>bkf</sub> )				Max:	0.0	Мах:	1.154	Мах:	1.154	Мах:	1.7	Мах:	1.7
					Mean:		Mean:	0.96	Mean:	1.68	Mean:	0.5	Mean:	0.4
	<b>49</b> Glide Mean Depth, ft (d <sub>bkfg</sub> )				Min:		Min:	0.87	Min:	1.52	Min:	0.5	Min:	0.4
	, · · · · Sug				Мах:		Мах:	1.05	Max:	1.84	Мах:	0.5	Мах:	0.4
					Mean:	0.0	Mean:	0.894	Mean:	0.894	Mean:	0.4	Mean:	0.4
"	Glide Mean Depth to Riffle Mean				Min:	0.0	Min:	0.809	Min:	0.809	Min:	0.4	Min:	0.4
l si	Depth (d <sub>bkfg</sub> /d <sub>bkf</sub> )				Мах:	0.0	Мах:	0.979	Мах:	0.979	Мах:	0.4	Мах:	0.4
Glide Dimensions					Mean:	#DIV/0!	Mean:	25.4	Mean:	25.4	Mean:	62.4	Mean:	62.4
me	Glide Width/Depth Ratio				Min:	#DIV/0!	Min:	25.0	Min:	25.0	Min:	62.4	Min:	62.4
Ö	(W <sub>bkfg</sub> /d <sub>bkfg</sub> )				Мах:	#DIV/0!	Мах:	25.9	Max:	25.9	Мах:	62.4	Мах:	62.4
ide					Mean:		Mean:	25.7	Mean:	72.2	Mean:	16.6	Mean:	9.9
ত	<b>52</b> Glide Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkfq</sub> )				Min:		Min:	21.2	Min:	59.6	Min:	16.6	Min:	9.9
	- Line Country				Max:		Мах:	30.1	Max:	84.8	Мах:	16.6	Max:	9.9
					Mean:	0.0	Mean:	0.961	Mean:	0.961	Mean:	0.6	Mean:	0.6
	<b>53</b> Glide Area to Riffle Area (A <sub>bkfg</sub> /A <sub>bkf</sub> )				Min:	0.0	Min:	0.794	Min:	0.794	Min:	0.6	Min:	0.6
	- Constitution of the control of the				Max:	0.0	Max:	1.129	Max:	1.129	Мах:	0.6	Max:	0.6
					Mean:	1.6	Mean:	1.30	Mean:	2.27	Mean:	2.0	Mean:	1.6
	<b>54</b> Glide Maximum Depth (d <sub>maxq</sub> )				Min:	1.6	Min:	1.22	Min:	2.14	Min:	2.0	Min:	1.6
	Zopan (omaxg/				Max:	1.6	Max:	1.37	Max:	2.40	Max:	2.0	Max:	1.6
					Mean:	1.4	Mean:	1.207	Mean:	1.207	Mean:	1.5	Mean:	1.5
	55 Glide Maximum Depth to Riffle				Min:	1.4	Min:	1.138	Min:	1.138	Min:	1.5	Min:	1.5
	Mean Depth (d <sub>maxg</sub> /d <sub>bkf</sub> )				Max:	1.4	Мах:	1.277	Max:	1.277	Мах:	1.5	Max:	1.5
					Mean:	1.4	Mean:	15.3	Mean:	24.7	Mean:	6.1	Mean:	4.6
	<b>56</b> Glide Inner Berm Width, ft (W <sub>ibo</sub> )				Min:		Min:	14.0	Min:	20.8	Min:	6.1	Min:	4.6
	Glide Hiller Berlin Wilder, it (Wibg)				Max:		Max:	16.5	Max:	28.6	Max:	6.1	Max:	4.6
					Mean:	#DIV/0!	Mean:	0.575	Mean:	0.575	Mean:	0.1	Mean:	0.2
	57 Glide Inner Berm Width to Glide				Min:	#DIV/0! #DIV/0!	Min:	0.528	Min:	0.528	Min:	0.2	Min:	0.2
	Width (W <sub>ibg</sub> /W <sub>bkfg</sub> )					#DIV/0! #DIV/0!	Max:	0.622	Max:	0.526		0.2	Max:	0.2
ns					Max: Mean:	#DIV/U!			мах: Mean:		Max: Mean:	0.2	мах: Mean:	0.2
suoisus	Glide Inner Berm Mean Depth, ft						Mean:	0.25		0.43				
Ĕ	58 (d. )				Min:		Min:	0.18	Min:	0.34	Min:	0.6	Min:	0.5

		Entry Number & Variable		Design Reach Pool-1	Design Reach Pool-2	Design Reach Pool-3		n Reach Riffle	Base	Design ed on rence	Arka	Fork ansas rence	Target Base Refer	d on	Elk C	k of N. Creek rence
mŧ		(Uibg)					Мах:		Мах:	0.33	Мах:	0.52	Мах:	0.6	Мах:	0.5
Glide Inner Berm Dime		Clida Innay Daysa Maan Danth ta					Mean:	#DIV/0!	Mean:	0.265	Mean:	0.265	Mean:	1.2	Mean:	1.2
ern	59	Glide Mann Benth (d. /d. )					Min:	#DIV/0!	Min:	0.185	Min:	0.185	Min:	1.2	Min:	1.2
ĕ		Glide Mean Depth (d <sub>ibg</sub> /d <sub>bkfg</sub> )					Мах:	#DIV/0!	Мах:	0.345	Max:	0.345	Max:	1.2	Max:	1.2
ne		Clide Inner Device Midth /Depth					Mean:	#DIV/0!	Mean:	61.9	Mean:	61.9	Mean:	9.3	Mean:	9.3
e =	60	Glide Inner Berm Width/Depth					Min:	#DIV/0!	Min:	39.6	Min:	39.6	Min:	9.3	Min:	9.3
β		Ratio (W <sub>ibg</sub> /d <sub>ibg</sub> )					Мах:	#DIV/0!	Max:	84.2	Max:	84.2	Мах:	9.3	Мах:	9.3
0		Glida Innar Barm Cross Sastianal	Γ				Mean:		Mean:	3.8	Mean:	10.3	Mean:	3.8	Mean:	2.3
	61	Glide Inner Berm Cross-Sectional					Min:		Min:	3.0	Min:	9.7	Min:	3.8	Min:	2.3
		Area (A <sub>ibg</sub> )					Мах:		Max:	4.7	Max:	10.9	Мах:	3.8	Max:	2.3
		Clida Innau Danna Anaa ta Clida Anaa					Mean:	#DIV/0!	Mean:	0.149	Mean:	0.149	Mean:	0.2	Mean:	0.2
	62						Min:	#DIV/0!	Min:	0.115	Min:	0.115	Min:	0.2	Min:	0.2
		$(A_{ibg}/A_{bkfg})$					Мах:	#DIV/0!	Мах:	0.183	Max:	0.183	Max:	0.2	Мах:	0.2
			ſ				Mean:		Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	63	Step Width, ft (W <sub>bkfs</sub> )					Min:		Min:		Min:		Min:	0.0	Min:	0.0
							Мах:		Мах:		Max:		Max:	0.0	Max:	0.0
		Chan Width to Diffic Width	Ī				Mean:	0.0	Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	64	Step Width to Riffle Width					Min:	0.0	Min:		Min:		Min:	0.0	Min:	0.0
		(W <sub>bkfs</sub> /W <sub>bkf</sub> )					Мах:	0.0	Мах:		Мах:		Мах:	0.0	Мах:	0.0
							Mean:		Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	65	Step Mean Depth, ft (d <sub>bkfs</sub> )					Min:		Min:		Min:		Min:	0.0	Min:	0.0
							Мах:		Мах:		Max:		Max:	0.0	Max:	0.0
		Chara Manage Doughb to Diffic Manage	Ī				Mean:	0.0	Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	66	Step Mean Depth to Riffle Mean					Min:	0.0	Min:		Min:		Min:	0.0	Min:	0.0
l si		Depth (d <sub>bkfs</sub> /d <sub>bkf</sub> )					Мах:	0.0	Мах:		Мах:		Мах:	0.0	Мах:	0.0
nsi							Mean:	#DIV/0!	Mean:		Mean:		Mean:	0.0	Mean:	0.0
me	67	Step Width/Depth Ratio (W <sub>bkfs</sub> /d <sub>bkfs</sub> )					Min:	#DIV/0!	Min:		Min:		Min:	0.0	Min:	0.0
Ö							Мах:	#DIV/0!	Мах:		Мах:		Мах:	0.0	Мах:	0.0
Step Dimensions							Mean:		Mean:	N/A	Mean:		Mean:	0.0	Mean:	0.0
S	68	Step Cross-Sectional Area, ft <sup>2</sup> (A <sub>bkfs</sub> )					Min:		Min:		Min:		Min:	0.0	Min:	0.0
		·					Мах:		Мах:		Мах:		Мах:	0.0	Мах:	0.0
			f				Mean:	0.0	Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	69	Step Area to Riffle Area (A <sub>bkfs</sub> /A <sub>bkf</sub> )					Min:	0.0	Min:		Min:		Min:	0.0	Min:	0.0
		, , , , , , , , , , , , , , , , , , , ,					Мах:	0.0	Мах:		Max:		Мах:	0.0	Max:	0.0
			F				Mean:		Mean:	N/A	Mean:		Mean:	0.0	Mean:	0.0
	70	Step Maximum Depth (d <sub>maxs</sub> )					Min:		Min:		Min:		Min:	0.0	Min:	0.0
		· · · · · · · · · · · · · · · · · · · ·					Мах:		Мах:		Max:		Мах:	0.0	Мах:	0.0
			f				Mean:	0.0	Mean:	N/A	Mean:	N/A	Mean:	0.0	Mean:	0.0
	71	Step Maximum Depth to Riffle					Min:	0.0	Min:		Min:	•	Min:	0.0	Min:	0.0
		Mean Depth (d <sub>maxs</sub> /d <sub>bkf</sub> )					Max:	0.0	Max:		Max:		Мах:	0.0	Max:	0.0
			t				Mean:	143.0	Mean:	299.2	Mean:	467.2	Mean:	74.6	Mean:	56.0
	72	Linear Wavelength, ft (λ)					Min:	40.9	Min:	268.4	Min:	419.0		55.9	Min:	42.0
	12	Linear wavelength, it (//)					iviii i.	70.3	IVIII I.	200.7	IVIII I.	713.0	IVIII I.	33.3	IVIII I.	74.

	Entry Number & Variable	Design Reach Pool-1	Design Reach Pool-2	Design Reach Pool-3	_	n Reach Riffle	Bas	Design ed on rence	Arka	Fork ansas rence	Base	Design ed on rence	Elk (	k of N. Creek rence
					Мах:	595.2	Мах:	318.1	Мах:	496.6	Мах:	102.5	Мах:	77.0
					Mean:	6.4	Mean:	12.040	Mean:	12.040	Mean:	3.7	Mean:	3.7
	Linear Wavelength to Riffle Width				Min:	1.8	Min:	10.800	Min:	10.800	Min:	2.8	Min:	2.8
	$(\lambda/W_{bkf})$				Max:	26.5	Max:	12.800	Max:	12.800	Max:	5.1	Max:	5.1
					Mean:	149.0	Mean:	340.5	Mean:	531.6	Mean:	86.5	Mean:	65.0
	<b>74</b> Stream Meander Length, ft (L <sub>m</sub> )				Min:	48.5	Min:	305.7	Min:	477.2	Min:	59.9	Min:	45.0
	THE Stream Meanaer Length, it (Lm)				Max:	611.2	Max:	375.2	Max:	585.9	Max:	106.5	Max:	80.0
					Mean:	6.6	Mean:	13.700	Mean:	13.700	Mean:	4.3	Mean:	4.3
	75 Stream Meander Length Ratio				Min:	2.2	Min:	12.300	Min:		Min:	3.0	Min:	3.0
	$(L_m/W_{bkf})$				Max:	27.2	Max:	15.100	Max:	15.100	Max:	5.3	Max:	5.3
					Mean:	65.0	Mean:	125.2	Mean:	195.6	Mean:	54.6	Mean:	41.0
	76 Polt Width ft (W)						Min:							
	<b>76</b> Belt Width, ft (W <sub>blt</sub> )				Min:	0.0		99.7	Min:	155.6	Min:	39.9	Min:	30.0
					Мах:	0.0	Max:	176.4	Мах:	275.5	Max:	73.2	Мах:	55.0
					Mean:	2.9	Mean:	5.040	Mean:	5.040	Mean:	2.7	Mean:	2.7
	77 Meander Width Ratio (W <sub>blt</sub> /W <sub>bkf</sub> )				Min:	0.0	Min:	4.010	Min:	4.010	Min:	2.0	Min:	2.0
					Max:	0.0	Мах:	7.100	Max:	7.100	Мах:	3.7	Мах:	3.7
					Mean:	75.4	Mean:	84.8	Mean:	132.4	Mean:	17.3	Mean:	13.0
	<b>78</b> Radius of Curvature, ft (R <sub>c</sub> )				Min:	10.0	Min:	54.7	Min:	85.4	Min:	5.3	Min:	4.0
					Мах:	300.0	Мах:	112.2	Мах:	175.2	Мах:	37.3	Мах:	28.0
٤	Radius of Curvature to Riffle Width				Mean:	3.4	Mean:	3.412	Mean:	3.412	Mean:	0.9	Mean:	0.9
Pattern	79 (R <sub>c</sub> /W <sub>bkf</sub> )				Min:	0.4	Min:	2.200	Min:	2.200	Min:	0.3	Min:	0.3
P	(IN <sub>C</sub> / VV bkf)				Мах:	13.3	Max:	4.516	Мах:	4.516	Мах:	1.9	Мах:	1.9
Channel					Mean:	44.2	Mean:	89.8	Mean:	140.2	Mean:	34.6	Mean:	26.0
ıan	<b>80</b> Arc Length, ft (L <sub>a</sub> )				Min:	8.9	Min:	52.2	Min:	81.5	Min:	16.0	Min:	12.0
ਠ					Мах:	136.2	Мах:	127.2	Мах:	198.6	Мах:	61.2	Мах:	46.0
					Mean:	2.0	Mean:	3.613	Mean:	3.613	Mean:	1.7	Mean:	1.7
	<b>81</b> Arc Length to Riffle Width (L <sub>a</sub> /W <sub>bkf</sub> )				Min:	0.4	Min:	2.100	Min:	2.100	Min:	0.8	Min:	0.8
	C ( a 5)				Max:	6.1	Мах:	5.119	Мах:	5.119	Мах:	3.1	Мах:	3.1
					Mean:	60.7	Mean:	77.0	Mean:	120.3	Mean:	22.3	Mean:	16.7
	<b>82</b> Riffle Length (L <sub>r</sub> ), ft				Min:	2.5	Min:	52.2	Min:	81.5	Min:	10.6	Min:	8.0
					Max:	290.3	Мах:	99.7	Max:	155.6	Мах:	41.4	Мах:	31.1
					Mean:	2.7	Mean:	3.100	Mean:	3.100	Mean:	1.1	Mean:	1.1
	<b>83</b> Riffle Length to Riffle Width (L <sub>r</sub> /W <sub>bkf</sub> )				Min:	0.1	Min:	2.100	Min:	2.100	Min:	0.5	Min:	0.5
	The second secon				Max:	12.9	Max:	4.010	Max:	4.010	Max:	2.1	Max:	2.1
					Mean:	31.0	Mean:	54.7	Mean:	85.4	Mean:	23.7	Mean:	17.8
	84 Individual Pool Length, ft (L <sub>D</sub> )				Min:	6.2	Min:	44.7	Min:	69.8	Min:	8.5	Min:	6.4
	or maividual root Length, it (Lp)				Max:	95.3	Max:	68.3	Max:	106.7	Max:	81.2	Max:	61.0
	95 Dool Longth to Diffle Width / M				Mean:	1.4	Mean:	2.200	Mean:	2.200	Mean:	1.2	Mean:	1.2
	<b>85</b> Pool Length to Riffle Width (L <sub>p</sub> /W <sub>bkf</sub> )				Min:	0.3	Min:	1.800	Min:	1.800	Min:	0.4	Min:	0.4
					Мах:	4.2	Max:	2.750	Мах:	2.750	Мах:	4.1	Max:	4.1
					Mean:	74.7	Mean:	157.3	Mean:	245.6	Mean:	59.0	Mean:	44.3
	<b>86</b> Pool-to-Pool Spacing, ft (P <sub>s</sub> )				Min:	16.3	Min:	124.3	Min:	194.0	Min:	16.0	Min:	12.0

		Entry Number & Variable		Design Reach Pool-1	Design Reach Pool-2	Design Reach Pool-3	_	n Reach Riffle	Bas	Design ed on rence	Ark	Fork ansas erence	Base	Design ed on rence	Elk	ork of N. Creek erence
			Ī				Мах:	328.8	Мах:	186.4	Мах:	291.0	Мах:	117.6	Мах:	88.3
		Pool to Pool Spacing to Piffle Width	Ī				Mean:	3.3	Mean:	6.330	Mean:	6.330	Mean:	2.9	Mean:	2.9
	87	Pool-to-Pool Spacing to Riffle Width (P <sub>s</sub> /W <sub>bkf</sub> )					Min:	0.7	Min:	5.000	Min:	5.000	Min:	8.0	Min:	8.0
		( S - DKI)					Мах:	14.6	Мах:	7.500	Max:	7.500	Мах:	5.9	Max:	5.9
	88	B Stream Length (SL)					72	228.6	128	320.0	34	20.0	128	24.0	34	<b>420.0</b>
Slope	89	9 Valley Length (VL)					67	786.0	120	0.00	30	0.00	120	09.0	30	0.00
y and	90	<b>0</b> Valley Slope (S <sub>val</sub> )					0.0	0442	0.0	389	0.0	0114	0.0	389	0.0	0336
Sinuosity and Slope	91	1 Sinuosity (k)					SL/VL:	1.07	SL/VL:		SL/VL: VS/S:	1.14 1.14	SL/VL:		SL/VL: VS/S:	1.14 1.14
įŠ		2 Average Water Surface Slope (S)					0.0	0423		S <sub>val</sub> /k <b>)364</b>	0.0	0100		S <sub>val</sub> /k <b>364</b>	0.0	0294
							Mean:		Mean:		Mean:	305.000			Mean:	305.000
흪	93	<b>3</b> Floodplain Width, ft (W <sub>f</sub> )					Min:		Min:		Min:	210.000			Min:	210.000
lg							Мах:		Мах:		Max:	400.000			Мах:	400.000
Floodplain		Floodplain Surface Depth Limit, ft					Mean:		Mean:		Mean:	2.0			Mean:	2.0
Ĕ	94	(d <sub>f</sub> )					Min:		Min:		Min:	1.8			Min:	1.8
		(4)					Мах:		Мах:		Мах:	2.2			Мах:	2.2
							Mean:		Mean:		Mean:	450.000			Mean:	450.000
ace	95	5 Low Terrace Width, ft (W <sub>lt</sub> )					Min:		Min:		Min:	290.000			Min:	290.000
Low Terrace			L				Мах:		Мах:		Мах:	620.000			Мах:	620.000
		Low Terrace Surface Depth Limit, ft					Mean:		Mean:		Mean:	5.6			Mean:	5.6
P	96	6 (d <sub>lt</sub> )					Min:		Min:		Min:	5.3			Min:	5.3
		(-11)					Мах:		Мах:		Max:	6.0			Max:	6.0
ea							Mean:	42.500	Mean:		Mean:	450.000			Mean:	450.000
Ā	97	<b>7</b> Flood-Prone Area Width, ft (W <sub>fpa</sub> )	ļ				Min:		Min:		Min:	290.000			Min:	290.000
one	L		ļ				Мах:		Мах:		Max:	610.000			Max:	610.000
Flood-Prone Area		Flood-Prone Area Surface Depth	Į				Mean:		Mean:		Mean:	5.6			Mean:	5.6
8	98	Limit, ft (d <sub>fpa</sub> )	ļ				Min:		Min:		Min:	5.3			Min:	5.3
표		· · · · · · · · · · · · · · · · · · ·	Į				Мах:		Мах:		Max:	6.0			Max:	6.0
			J				Mean:	·	Mean:		Mean:	2.575			Mean:	0.000
Ë	99	9 Low Bank Height (LBH)	ļ				Min:		Min:		Min:	2.310			Min:	0.000
Degree of Incision							Мах:		Мах:		Мах:	2.840			Мах:	0.000
lnc	1	Maximum Bankfull Depth (d <sub>max</sub> ) at					Mean:		Mean:		Mean:	2.6			Mean:	2.1
ð	10	0 Same Location as Low Bank Height	1				Min:		Min:		Min:	2.3			Min:	2.1
ê		(LBH) Measurement					Мах:		Мах:		Max:	2.8			Мах:	2.1
edi							Mean:	·	Mean:		Mean:	1.000			Mean:	0.000
	10	1 Bank-Height Ratio (LBH/d <sub>max</sub> )	ļ				Min:		Min:		Min:	1.000			Min:	0.000
			Į				Мах:		Мах:		Max:	1.000			Мах:	0.000

	Entry Number & Variable	Design Reach Pool-1	Design Reach Pool-2	Design Reach Pool-3	Design Reach DS Riffle	Base	Design ed on rence	Ark	Fork ansas erence	Target Design Based on Reference	Elk (	k of N. Creek rence
					Mean:	Mean:	1.9	Mean:	3.3	2.0	Mean:	1.6
	102 Riffle Maximum Depth, ft (d <sub>max</sub> )				Min:	Min:	1.7	Min:	3.0	0.5	Min:	0.4
ile					Мах:	Мах:	1.9	Max:	3.4	2.5	Max:	2.0
Ratios from Profile	Riffle Maximum Depth to Riffle				Mean:	Mean:	1.734	Mean:	1.734	1.505	Mean:	1.505
Ξ	Mean Depth (d <sub>max</sub> /d <sub>bkf</sub> )				Min:	Min:	1.617	Min:	1.617	0.355	Min:	0.355
fro	Wieari Deptii (u <sub>max</sub> /u <sub>bkf</sub> )				Max:	Мах:	1.803	Max:	1.803	1.897	Max:	1.897
SO					Mean:	Mean:	2.8	Mean:	4.9	3.3	Mean:	2.6
Sati	<b>104</b> Pool Maximum Depth, ft (d <sub>maxp</sub> )				Min:	Min:	2.4	Min:	4.2	2.2	Min:	1.8
					Мах:	Max:	3.0	Мах:	5.3	4.8	Max:	3.9
and Dimensionless	Pool Maximum Depth to Riffle				Mean:	Mean:	2.606	Mean:	2.606	2.467	Mean:	2.467
Ϊ́ο	Mean Depth (d <sub>maxp</sub> /d <sub>bkf</sub> )				Min:	Min:	2.255	Min:	2.255	1.682	Min:	1.682
ens	Wicum Depth (umaxp/ubkt/)				Мах:	Max:	2.793	Max:	2.793	3.607	Max:	3.607
Ξ					Mean:	Mean:	2.0	Mean:	3.4	2.4	Mean:	1.9
9	<b>106</b> Run Maximum Depth, ft (d <sub>maxr</sub> )				Min:	Min:	1.8	Min:	3.2	1.6	Min:	1.3
					Мах:	Max:	2.1	Max:	3.7	3.3	Max:	2.7
Measurements	Run Maximum Depth to Riffle Mean				Mean:	Mean:	1.824	Mean:	1.824	1.813	Mean:	1.813
me .	Depth (d <sub>maxr</sub> /d <sub>bkf</sub> )				Min:	Min:	1.681	Min:	1.681	1.206	Min:	1.206
nre	Deptii (amaxii abki)				Мах:	Мах:	1.963	Max:	1.963	2.486	Мах:	2.486
as					Mean:	Mean:	1.4	Mean:	2.5	2.1	Mean:	1.7
ž	108 Glide Maximum Depth, ft (d <sub>maxg</sub> )				Min:	Min:	1.2	Min:	2.2	1.0	Min:	8.0
듍					Max:	Max:	1.6	Max:	2.8	3.0	Max:	2.4
Depth	Glide Maximum Depth to Riffle				Mean:	Mean:	1.309	Mean:	1.309	1.607	Mean:	1.607
<u>a</u>	Mean Depth (d <sub>maxg</sub> /d <sub>bkf</sub> )				Min:	Min:	1.149	Min:	1.149	0.757	Min:	0.757
e ≥	Wicum Depth (umaxg/ubkr/)				Мах:	Max:	1.473	Мах:	1.473	2.215	Мах:	2.215
ţ					Mean:	Mean:	N/A	Mean:	N/A	0.0	Mean:	0.0
Feature Max	<b>110</b> Step Maximum Depth, ft (d <sub>maxs</sub> )				Min:	Min:		Min:		0.0	Min:	0.0
Bed					Мах:	Мах:		Мах:		0.0	Max:	0.0
ă	Step Maximum Depth to Riffle				Mean:	Mean:	N/A	Mean:	N/A	0.000	Mean:	0.000
	Mean Depth (d <sub>maxs</sub> /d <sub>bkf</sub> )				Min:	Min:		Min:		0.000	Min:	0.000
	ivican Deptii (u <sub>maxs</sub> /u <sub>bkf</sub> )				Мах:	Мах:		Max:		0.000	Max:	0.000

## USGS StreamStats Summary

# **™USGS**Colorado StreamStats

#### Streamstats Ungaged Site Report

Date: Tue May 19 2015 15:57:48 Mountain Daylight Time

Site Location: Colorado

NAD27 Latitude: 40.0643 (40 03 51) NAD27 Longitude: -105.3081 (-105 18 29) NAD83 Latitude: 40.0643 (40 03 51) NAD83 Longitude: -105.3087 (-105 18 31)

Drainage Area: 4.92 mi2

Peak-Flows Basin Characteristic	S		
10% Mountain Region Peak Flow (0.5 n	ni2)		
Parameter	Value	Regression Equ	ation Valid Range
raiametei		Min	Max
Drainage Area (square miles)	4.92	1	1060
Mean Basin Slope from 10m DEM (percent)	36.2	7.6	60.2
Mean Annual Precipitation (inches)	20.71	18	47
90% Plains Region Peak Flow (4.42 mi2	2)		
Parameter	Value	Regression Equ	ation Valid Range
raiametei		Min	Max
Drainage Area (square miles)	4.92	0.5	2930
6 Hour 100 Year Precipitation (inches)	3.24	2.4	5.1

Low-Flows Basin Characteristics						
10% Mountain Region Min Flow	(0.5 mi2)					
Parameter Value Regression Equation Valid Range						
r ai ai i letei		Min	Max			
Drainage Area (square miles)	4.92	1	1060			
Mean Annual Precipitation (inches)	20.71	18	47			
Mean Basin Elevation (feet)6950 (below min value 8600)860012000						
90% Undefined Region (4.42 m	i2)					

Warning: The selected watershed is partly in an area for which flow equations were not defined. Whole-watershed flow estimates have been provided using the regional equations that are available for other parts of the watershed. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Flow-Duration Basin Characteristics								
10% Mountain Region Flow Duration (0.5 mi2)								
Parameter Value Regression Equation Valid Range								
raiametei		Min	Max					
Drainage Area (square miles)	4.92	1	1060					
Mean Annual Precipitation (inches) 20.71 18								
90% Undefined Region (4.42 m	i2)							

Warning: The selected watershed is partly in an area for which flow equations were not defined. Whole-watershed flow estimates have been provided using the regional equations that are available for other parts of the watershed. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates.

Maximum-Flows Basin Characteristics						
10% Mountain Region Max Flow (0.5 mi2)						
Parameter	Value	Regression Equation Valid Range				
r ai ailletei		Min Max				
Drainage Area (square miles)	4.92	1	1060			

Mean Annual Precipitation (inches)   20.71   18   4
20.71

Warning: The selected watershed is partly in an area for which flow equations were not defined. Whole-watershed flow estimates have been provided using the regional equations that are available for other parts of the watershed. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates.

Mean-Flows Basin Characteristics							
10% Mountain Region Mean Flow (0.5 mi2)							
Parameter Value Regression Equation Valid Range							
raiametei		Min	Max				
Drainage Area (square miles)	4.92	1	1060				
Mean Annual Precipitation (inches) 20.71 18 47							
90% Undefined Region (4.42 m	i2)						

Warning: The selected watershed is partly in an area for which flow equations were not defined. Whole-watershed flow estimates have been provided using the regional equations that are available for other parts of the watershed. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates.

Peak-F	<b>Tows Strea</b>	mflow Statistics Area-	Averaged
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	Equivalent years of record
PK2	59.9	170	
PK5	139	130	
PK10	210	130	
PK25	345	130	
PK50	464	130	
PK100	630	130	
PK200	1160	150	
PK500	1110	130	

			Equivalent	Peak Flow 90-Percent Prec	liction Interval	
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	years of record	Minimum	Maximum	
PK2	33	49				
PK5	50.9	44				
PK10	63.3	41				
PK25	81	40				
PK50	99.3	39				
PK100	113	36				
PK200	126	36				
PK500	154	33				

			Equivalent	90-Percent Pre	diction Interval	
Statistic	Flow (ft 3/s)	Prediction Error (percent)	years of record	Minimum	Maximum	
PK2	62.9	180				
PK5	148	140				
PK10	227	140				
PK25	375	140				
PK50	505	140				
PK100	688	140				
PK200	1280	160				

PK500	1220	140				
Low-Flows Streamflow Statistics Mountain Region Min Flow						
			Equivalent	90-Percent Pre	diction Interval	
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	years of record	Minimum	Maximum	
M7D2Y	0.0227					
M7D10Y	0.00494					
M7D50Y	0.0237					

Flow-D	Flow-Duration Streamflow Statistics Mountain Region Flow Duration					
		<b>5 5</b> S	Equivalent years of record	90-Percent Pre	diction Interval	
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)		Minimum	Maximum	
D10	7.9	45				
D25	2.14	55				
D50	0.89	55				
D75	0.49	64				
D90	0.25	85				

Maxim	Maximum-Flows Streamflow Statistics Mountain Region Max Flow						
a			Equivalent	90-Percent Pre	ediction Interval		
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	years of record	Minimum	Maximum		
V7D2Y	20.7	46					
V7D10Y	35.6	35					
V7D50Y	51.8	31					

			Equivalent	90-Percent Pre	diction Interva
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	years of record	Minimum	Maximum
Q1	0.54	50			
Q2	0.51	51			
Q3	0.54	49			
Q4	0.99	44			
Q5	8.83	46			
Q6	19	46			
Q7	5.2	76			
Q8	2.36	80			
Q9	1.34	59			
QA	3.54	33			
Q10	0.97	45			
Q11	0.76	46			
Q12	0.62	47			

# Colorado StreamStats

#### Streamstats Ungaged Site Report

Date: Tue May 19 2015 15:54:59 Mountain Daylight Time

Site Location: Colorado

NAD27 Latitude: 40.0636 (40 03 49) NAD27 Longitude: -105.2979 (-105 17 53) NAD83 Latitude: 40.0636 (40 03 49) NAD83 Longitude: -105.2985 (-105 17 55)

Drainage Area: 7.19 mi2

Peak-Flows Basin Characteristics						
7% Mountain Region Peak Flow (0.5 mi	2)					
Parameter	Value	Regression Equation Valid Ran				
Parameter		Min	Max			
Drainage Area (square miles)	7.19	1	1060			
Mean Basin Slope from 10m DEM (percent)	36.5	6.5 7.6				
Mean Annual Precipitation (inches)	20.63 18					
93% Plains Region Peak Flow (6.69 mi2	2)					
Parameter	Value	Regression Equ	ation Valid Range			
raiametei		Min	Max			
Drainage Area (square miles)	7.19	0.5	2930			
6 Hour 100 Year Precipitation (inches)	3.32	2.4	5.1			

Low-Flows Basin Characteristics						
7% Mountain Region Min Flow (0.5 mi2)						
Value Regression Equation Valid Range						
Min Max						
Drainage Area (square miles)	7.19	1	1060			
Mean Annual Precipitation (inches)	20.63	18	47			
Mean Basin Elevation (feet)6820 (below min value 8600)860012000						
93% Undefined Region (6.69 m	i2)					

Warning: The selected watershed is partly in an area for which flow equations were not defined. Whole-watershed flow estimates have been provided using the regional equations that are available for other parts of the watershed. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Flow-Duration Basin Characteristics 7% Mountain Region Flow Duration (0.5 mi2)					
Parameter Value Regression Equation Valid Range					
Parameter		Min	Max		
Drainage Area (square miles)	7.19	1	1060		
Mean Annual Precipitation (inches)	20.63	18	47		
93% Undefined Region (6.69 mi2)					

Warning: The selected watershed is partly in an area for which flow equations were not defined. Whole-watershed flow estimates have been provided using the regional equations that are available for other parts of the watershed. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates.

Maximum-Flows Basin Characteristics					
7% Mountain Region Max Flow (0.5 mi2)					
Parameter Value Regression Equation Valid R					
raiametei		Min	Max		
Drainage Area (square miles)	7.19	1	1060		

93% Undefined Region (6.69 mi		10	47
Mean Annual Precipitation (inches)	20.42	10	47

Warning: The selected watershed is partly in an area for which flow equations were not defined. Whole-watershed flow estimates have been provided using the regional equations that are available for other parts of the watershed. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates.

Mean-Flows Basin Characteristics						
7% Mountain Region Mean Flow (0.5 mi2)						
Value Regression Equation Valid Range						
rarameter		Min	Max			
Drainage Area (square miles)	7.19	1	1060			
Mean Annual Precipitation (inches) 20.63 18 47						
93% Undefined Region (6.69 mi2)						

Warning: The selected watershed is partly in an area for which flow equations were not defined. Whole-watershed flow estimates have been provided using the regional equations that are available for other parts of the watershed. Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates.

Peak-Flows Streamflow Statistics Area-Averaged					
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	Equivalent years of record		
PK2	75	170			
PK5	183	140			
PK10	284	130			
PK25	476	130			
PK50	646	130			
PK100	885	130			
PK200	1650	150			
PK500	1590	130			

Peak-F	Peak-Flows Streamflow Statistics Mountain Region Peak Flow						
Chadiadia		Duradiation Funan (nament)	Equivalent	90-Percent Pre	diction Interval		
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	years of record	Minimum	Maximum		
PK2	44.1	49					
PK5	67.8	44					
PK10	84.4	41					
PK25	107	40					
PK50	131	39					
PK100	150	36					
PK200	167	36					
PK500	203	33					

Peak-Flows Streamflow Statistics Plains Region Peak Flow						
	2		Equivalent	90-Percent Pre	ediction Interval	
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	years of record	Minimum	Maximum	
PK2	77.2	180				
PK5	192	140				
PK10	299	140				
PK25	503	140				
PK50	684	140				
PK100	939	140				
PK200	1760	160				

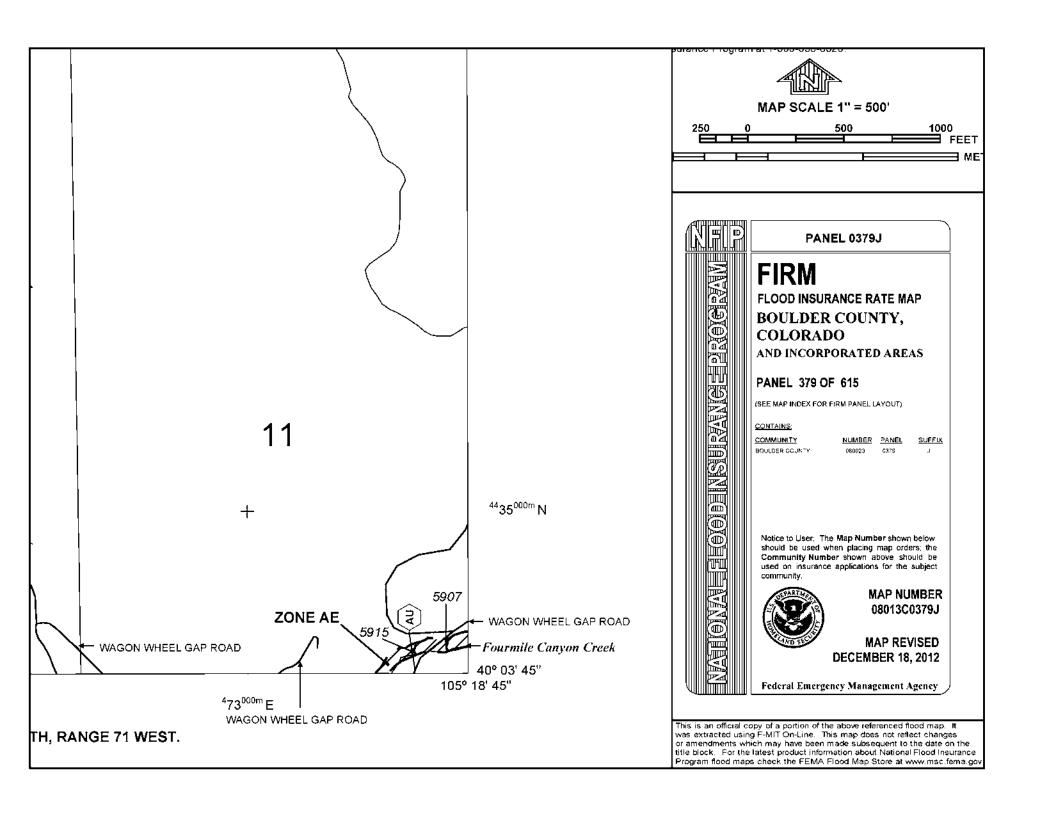
PK500	1700	140			
Low-Flows Streamflow Statistics Mountain Region Min Flow					
	2		Equivalent	90-Percent Pre	diction Interval
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	years of record	Minimum	Maximum
M7D2Y	0.031				
M7D10Y	0.00674				
M7D50Y	0.0343				

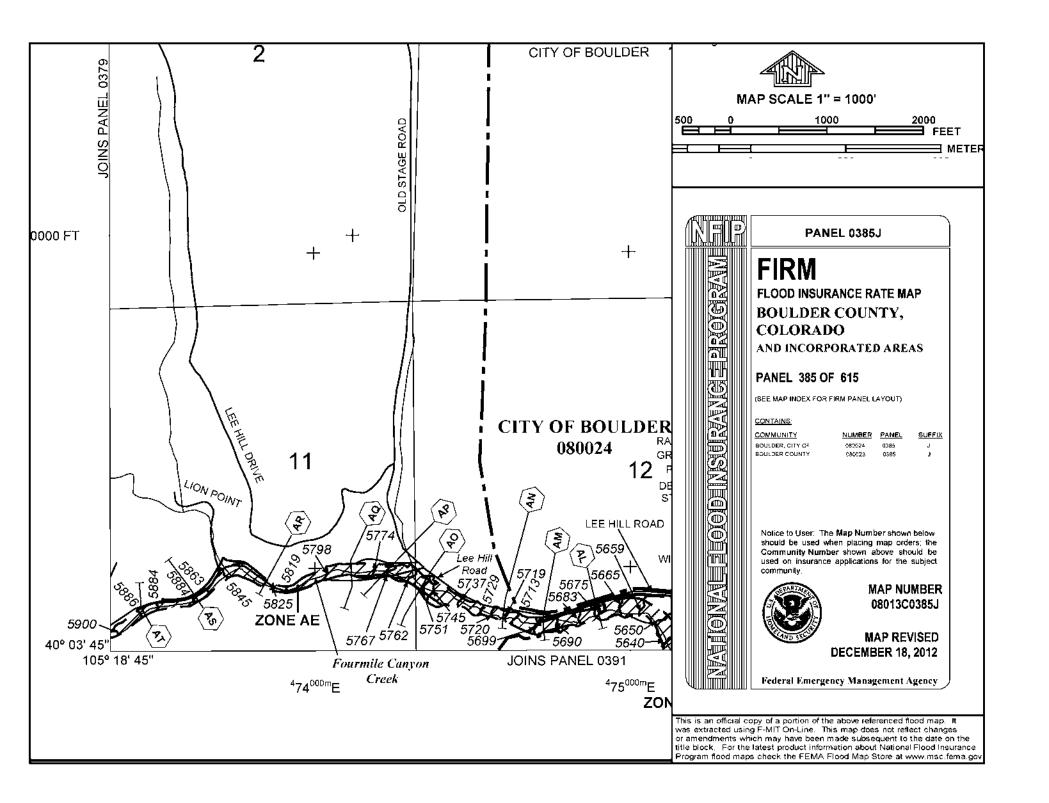
Flow-D	Flow-Duration Streamflow Statistics Mountain Region Flow Duration						
a		<b>5 5</b> S	Equivalent	90-Percent Pre	ediction Interval		
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	years of record	Minimum	Maximum		
D10	11	45					
D25	3.06	55					
D50	1.28	55					
D75	0.72	64					
D90	0.37	85					

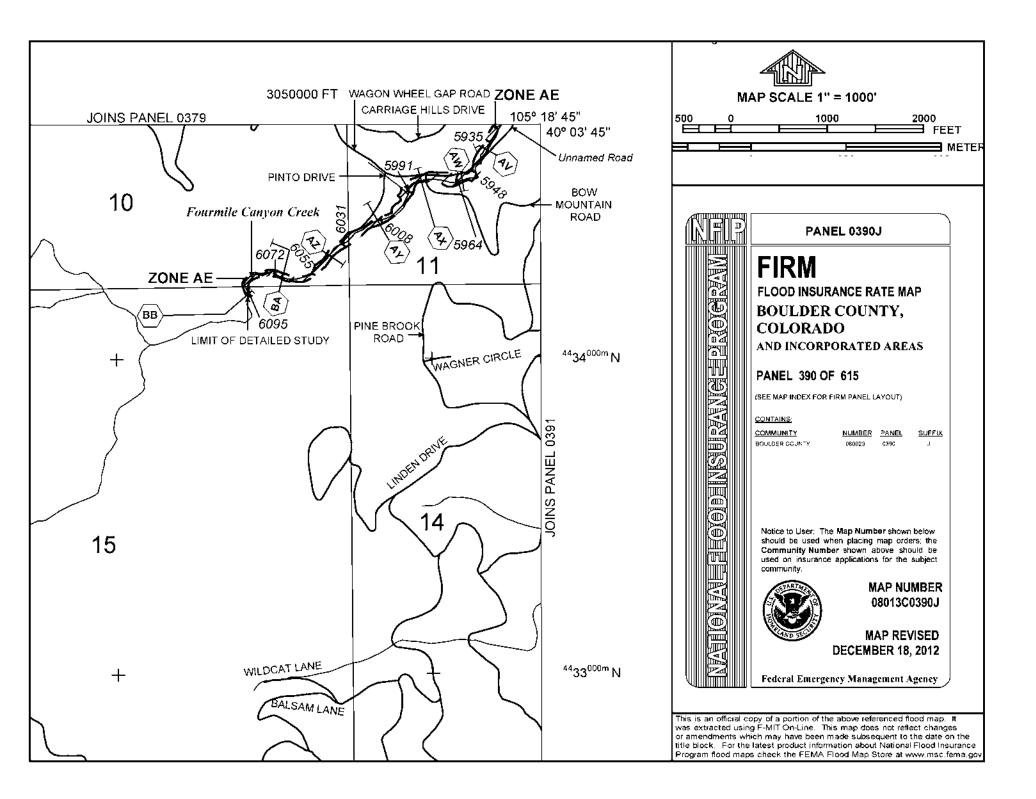
Maximum-Flows Streamflow Statistics Mountain Region Max Flow						
		<b>5 5</b>	Equivalent	90-Percent Pre	ediction Interval	
Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	years of record	Minimum	Maximum	
V7D2Y	28	46				
V7D10Y	48.8	35				
V7D50Y	71.1	31				

Statistic	Flow (ft <sup>3</sup> /s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interva	
				Minimum	Maximum
Q1	0.79	50			
Q2	0.75	51			
Q3	0.8	49			
Q4	1.52	44			
Q5	12.5	46			
Q6	25.7	46			
Q7	7.1	76			
Q8	3.23	80			
Q9	1.89	59			
QA	4.92	33			
Q10	1.39	45			
Q11	1.09	46			
Q12	0.9	47			

### FEMA FIRM

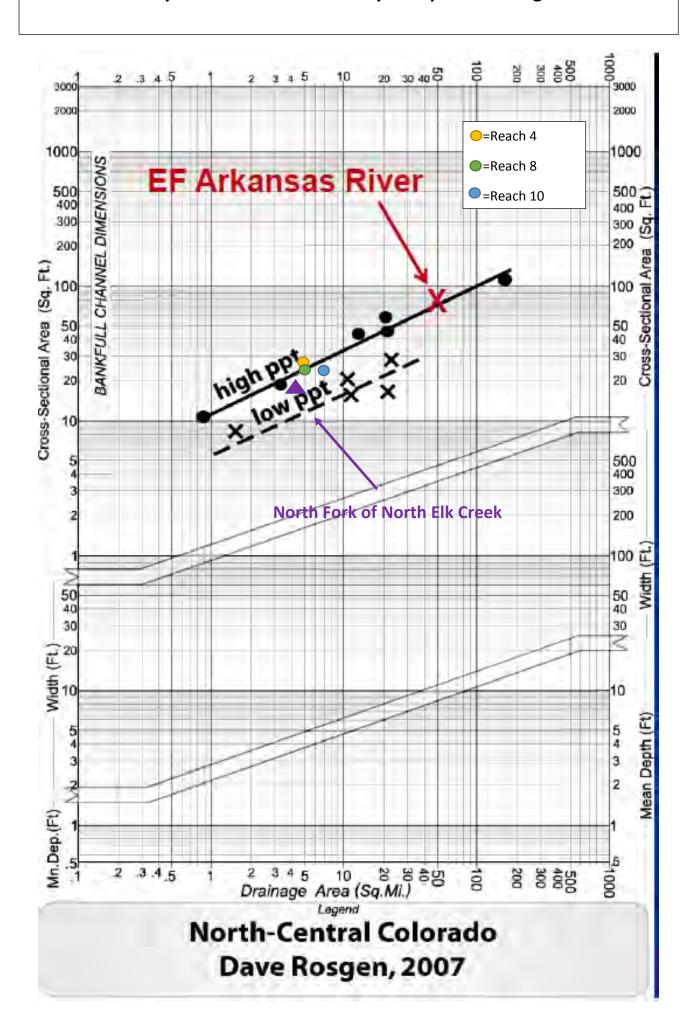


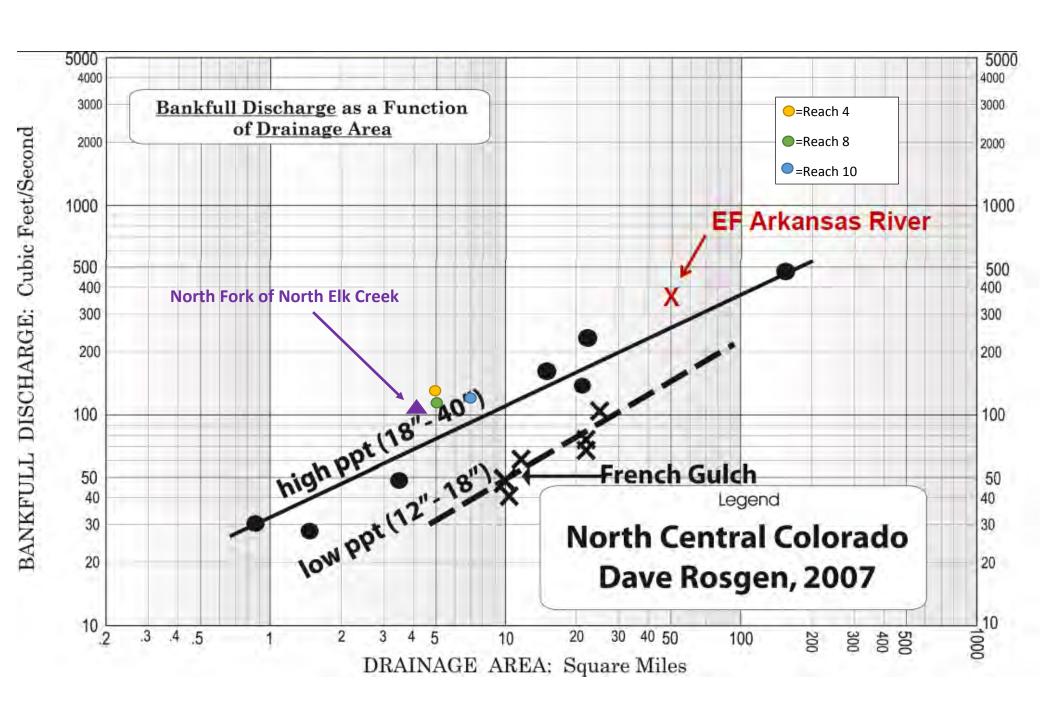




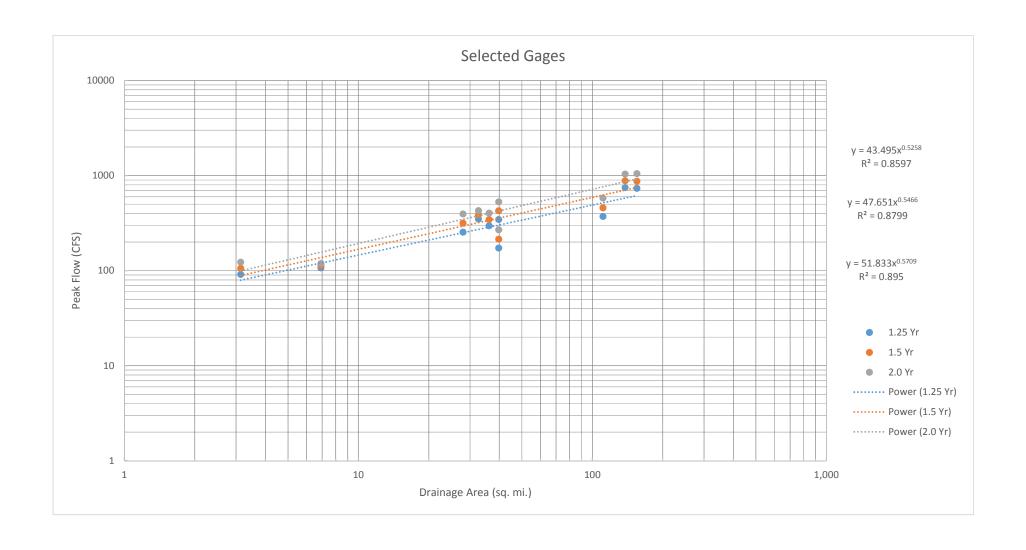
# Regional Curves

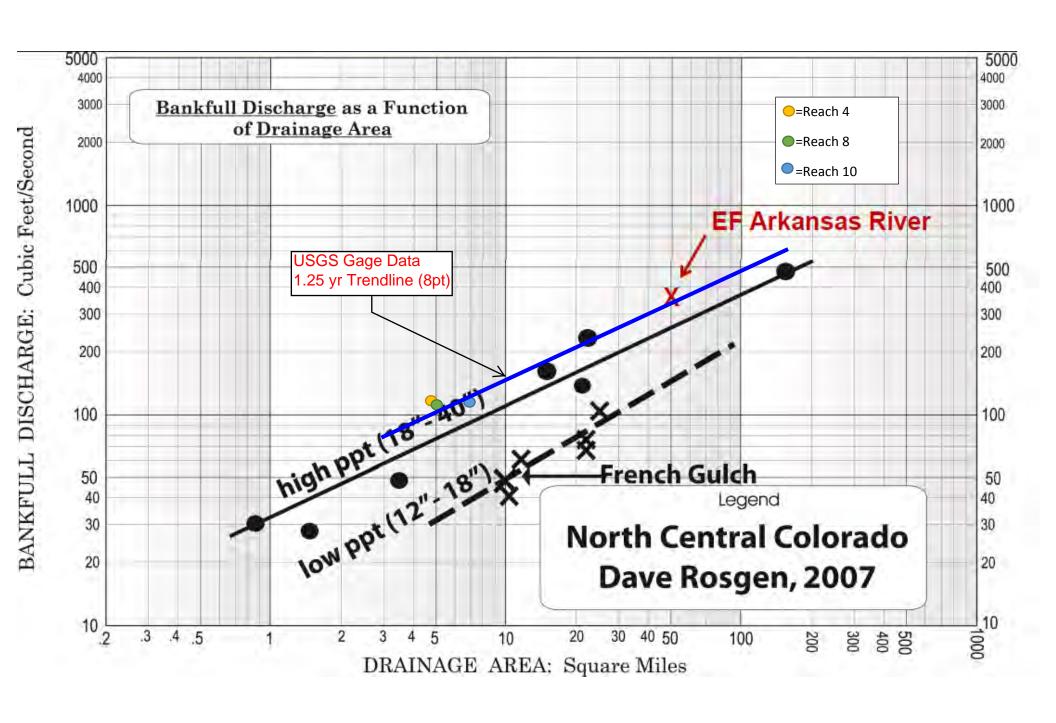
# **Fourmile Canyon Creek Stream Survey Compared to Regional Curves**





# Statistical Analysis of USGS Gage Data





# Hydraulic Modeling Results

# **Hydraulic Analysis Report**

# **Project Data**

Project Title: Project - FMCC

Designer:

Project Date: Wednesday, January 06, 2016

Project Units: U.S. Customary Units

Notes:

**Channel Analysis: Reach 8** 

Notes:

**Input Parameters** 

Channel Type: Custom Cross Section

# **Cross Section Data**

Elevation (ft)	Elevation (ft)	Manning's n
0.00	4.90	0.0500
0.50	2.90	0.0500
3.50	2.70	0.0500
6.80	1.70	0.0500
9.50	1.60	0.0500
10.50	1.00	0.0500
14.25	0.80	0.0500
18.00	1.00	0.0500
19.00	1.60	0.0500
21.70	1.70	0.0500
25.00	2.70	0.0500
28.00	2.90	0.0500
28.50	4.90	

Longitudinal Slope: 0.0650 ft/ft

Depth: 1.9000 ft

# **Result Parameters**

Flow: 209.1005 cfs

Area of Flow: 25.2700 ft^2 Wetted Perimeter: 22.1431 ft Hydraulic Radius: 1.1412 ft Average Velocity: 8.2747 ft/s

Top Width: 21.5000 ft
Froude Number: 1.3451
Critical Depth: 2.2191 ft
Critical Velocity: 6.2514 ft/s
Critical Slope: 0.0356 ft/ft
Critical Top Width: 27.56 ft

Calculated Max Shear Stress: 7.7064 lb/ft^2 Calculated Avg Shear Stress: 4.6288 lb/ft^2

Composite Manning's n Equation: Lotter method

Channel Analysis: Reach 9B

Notes:

**Input Parameters** 

Channel Type: Custom Cross Section

### **Cross Section Data**

Elevation (ft)	Elevation (ft)	Manning's n
0.00	4.90	0.0500
0.50	2.90	0.0500
3.50	2.70	0.0500
6.80	1.70	0.0500
9.50	1.60	0.0500
10.50	1.00	0.0500
14.25	0.80	0.0500
18.00	1.00	0.0500
19.00	1.60	0.0500
21.70	1.70	0.0500
25.00	2.70	0.0500
28.00	2.90	0.0500
28.50	4.90	

Longitudinal Slope: 0.0600 ft/ft

Depth: 1.9000 ft

# **Result Parameters**

Flow: 200.8972 cfs

Area of Flow: 25.2700 ft^2 Wetted Perimeter: 22.1431 ft Hydraulic Radius: 1.1412 ft Average Velocity: 7.9500 ft/s

Top Width: 21.5000 ft
Froude Number: 1.2923
Critical Depth: 2.1869 ft
Critical Velocity: 6.1698 ft/s
Critical Slope: 0.0358 ft/ft
Critical Top Width: 27.54 ft

Calculated Max Shear Stress: 7.1136 lb/ft^2 Calculated Avg Shear Stress: 4.2727 lb/ft^2

Composite Manning's n Equation: Lotter method

**Channel Analysis: Pool-1** 

Notes:

# **Input Parameters**

Channel Type: Custom Cross Section

### **Cross Section Data**

Elevation (ft)	Elevation (ft)	Manning's n
0.00	3.30	0.0500
9.35	2.20	0.0500
11.40	1.00	0.0500
15.15	1.00	0.0500
18.90	1.00	0.0500
21.30	2.20	0.0500
23.50	3.30	

Longitudinal Slope: 0.0550 ft/ft

Depth: 2.3000 ft

### **Result Parameters**

Flow: 255.5157 cfs

Area of Flow: 31.1675 ft^2 Wetted Perimeter: 24.4328 ft Hydraulic Radius: 1.2756 ft Average Velocity: 8.1981 ft/s

Top Width: 23.5000 ft
Froude Number: 1.2545
Critical Depth: 2.5164 ft
Critical Velocity: 7.0480 ft/s
Critical Slope: 0.0332 ft/ft
Critical Top Width: 23.50 ft

Calculated Max Shear Stress: 7.8936 lb/ft^2 Calculated Avg Shear Stress: 4.3780 lb/ft^2

Composite Manning's n Equation: Lotter method

**Channel Analysis: Pool-2** 

Notes:

# **Input Parameters**

Channel Type: Custom Cross Section

# **Cross Section Data**

Elevation (ft)	Elevation (ft)	Manning's n
0.00	3.60	0.0500
11.97	2.20	0.0500
14.70	1.00	0.0500
18.45	1.00	0.0500
22.20	1.00	0.0500
22.80	2.20	0.0500
23.50	3.60	

Longitudinal Slope: 0.0550 ft/ft

Depth: 2.6000 ft

# **Result Parameters**

Flow: 302.2328 cfs

Area of Flow: 35.0329 ft^2 Wetted Perimeter: 25.4403 ft Hydraulic Radius: 1.3771 ft Average Velocity: 8.6271 ft/s

Top Width: 23.5000 ft
Froude Number: 1.2452
Critical Depth: 2.8347 ft
Critical Velocity: 7.4538 ft/s
Critical Slope: 0.0338 ft/ft
Critical Top Width: 23.50 ft

Calculated Max Shear Stress: 8.9232 lb/ft^2 Calculated Avg Shear Stress: 4.7261 lb/ft^2

Composite Manning's n Equation: Lotter method

**Channel Analysis: Pool-3** 

Notes:

# **Input Parameters**

Channel Type: Custom Cross Section

# **Cross Section Data**

Elevation (ft)	Elevation (ft)	Manning's n
0.00	3.30	0.0500
12.12	2.20	0.0500
14.85	1.00	0.0500
18.60	1.00	0.0500
22.35	1.00	0.0500
22.95	2.20	0.0500
23.50	3.30	

Longitudinal Slope: 0.0550 ft/ft

Depth: 2.3000 ft

### **Result Parameters**

Flow: 233.2042 cfs

Area of Flow: 29.8829 ft^2 Wetted Perimeter: 25.2231 ft Hydraulic Radius: 1.1847 ft Average Velocity: 7.8039 ft/s

Top Width: 23.5000 ft
Froude Number: 1.2196
Critical Depth: 2.4799 ft
Critical Velocity: 6.8366 ft/s
Critical Slope: 0.0354 ft/ft
Critical Top Width: 23.50 ft

Calculated Max Shear Stress: 7.8936 lb/ft^2 Calculated Avg Shear Stress: 4.0660 lb/ft^2

Composite Manning's n Equation: Lotter method

Client: Boulder County

SOURCE:

INPUT DATA

Sf:

Cs =

Cv =

**METHOD 1 - CORPS OF ENGINEERS** 

Project: Fourmile Canyon Creek Stream Restoration

2.3 Depth of Flow

1.1 Safety Factor

Calculate Cv for channel bend:

4.5 Blanket Thickness Coefficient

Calculate design velocity (Vss) for channel bend:

8.198 Avg Channel Velocity U/S of Bend (ft/s)

Description: LPSTP Toe Protection for Bankfull Flow in Pool-1 at Maximum Velocity

Channels. EM 1110-2-1601, Change 1. June 30. Revetment Method (Recommended for slopes < 2%)

U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control

0.3 Stability Coefficient (0.3 for angular rock, 0.375 for rounded)

#### **METHOD 2 - UDFCD/SPRINGS**

SOURCE: Urban Storm Drainage Criteria Manual, Vol. 2

Uban Drainage and Flood Control District, Denver, Colorado

Rev. April 2008

City of Colorado Springs/El Paso County Drainage Criteria Manual

#### INPUT DATA

V = 8.198 Mean channel flow velocity (ft/s)

Adjust Velocity for Bend (UDFCD EQ. MD-10, pg MD-47). No Adjustment for Rc/T > 8.

Rc = 50 radius of curvature (ft From design pattern min T = 23.5 Topwidth (ft) Bankfull

T = 23.5 Topwidth (ft) Bankfull
Va = 15 Velocity adjusted for bend (ft/s)

Class/Type

S = 0.055 Channel slope (ft/ft) from proposed grading

 $S_s = 2.65$  Rock specific gravity

COMPUTED DATA

D50 (ft) =

Theta = 76 Bank Angle in Degrees Measured on outside of pool cross section from toe

Phi = 90 Angle of repose (degrees) of riprap material (normally 40 degrees)

Sg = 2.65 Rock Specific Gravity

g = 2.65 Rock Specific Gravity

g = 32.2 Gravity

50 radius of curvature (ft From design pattern min 23.5 Topwidth (ft)

Bankfull

1.22 Velocity Distribution Coeff. (Use 1.0 for Rc/T > 26)

12.9 Design velocity (bank area of bend in natural channel)

Boulder **D50 (ft) = 2.50 B30** 

6.7 >2.0!!! !NA!

COMPUTED DATA

Values in UDFCD Manual

K1 = 0.24 Side slope correction factor D30 = 35.8 ft

43.0 ft

D30 = 35.8 ft D50 = 43.0 ft

Max D50 =

Extrapolated from UDFCD Values (See Curves Below)

12 -	Rp vs D50
8 -	
D50 (inches)	
4 -	y = 2.8058ln(x) - 3.2582 R <sup>2</sup> = 0.9557
0 -	•
	0 6 12 18 <b>2</b> <sup>4</sup> 30 36 42 48

Riprap

Min	Max	Riprap	D50
Rp	Rp	Type	(inches)
1.4	3.2	VL	6
3.3	3.9	L	9
4	4.5	M	12
4.6	5.5	Н	18
5.6	6.4	VH	24
6.3	6.8		30
6.8	7.2		36
7.2	7.5		42
7.6	7.8		48
7.9	8.1		54
8.2	8.3		60

SMA

31-Dec-15

By: Date:

Min Rp	Max Rp	Boulder Class	D50 (inches)
4.6	5.5	B18	18
5.6	6.4	B24	24
6.5	7.1	B30	30
7.2	7.8	B36	36
7.9	8.4	B42	42
8.5	9.0	B48	48

**Boulder County** Client:

SOURCE:

INPUT DATA

Sf:

Cs =

Cv =

**METHOD 1 - CORPS OF ENGINEERS** 

Project: Fourmile Canyon Creek Stream Restoration

2.6 Depth of Flow

1.1 Safety Factor

Calculate Cv for channel bend:

4.5 Blanket Thickness Coefficient

Calculate design velocity (Vss) for channel bend:

8.627 Avg Channel Velocity U/S of Bend (ft/s)

Description: LPSTP Toe Protection for Bankfull Flow in Pool-2 at Maximum Velocity

Channels. EM 1110-2-1601, Change 1. June 30. Revetment Method (Recommended for slopes < 2%)

50 radius of curvature (ft From design pattern min 23.5 Topwidth (ft)

Bankfull

1.22 Velocity Distribution Coeff. (Use 1.0 for Rc/T > 26)

U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control

Stability Coefficient (0.3 for angular rock, 0.375 for rounded)

#### **METHOD 2 - UDFCD/SPRINGS**

SOURCE: Urban Storm Drainage Criteria Manual, Vol. 2

Uban Drainage and Flood Control District, Denver, Colorado

Rev. April 2008

City of Colorado Springs/El Paso County Drainage Criteria Manual

#### INPUT DATA

V = 8.627 Mean channel flow velocity (ft/s)

Adjust Velocity for Bend (UDFCD EQ. MD-10, pg MD-47). No Adjustment for Rc/T > 8.

50 radius of curvature (ft From design pattern min 3.5 Topwidth (ft)

Bankfull Rc = 23.5 Topwidth (ft)

Va = 16 Velocity adjusted for bend (ft/s)

S= 0.055 Channel slope (ft/ft) from proposed grading

S<sub>s</sub> = 2.65 Rock specific gravity

13.5 Design velocity (bank area of bend in natural channel) COMPUTED DATA

Measured on outside of pool cross section from toe 76 Bank Angle in Degrees Theta =

90 Angle of repose (degrees) of riprap material (normally 40 degrees) Phi =

2.65 Rock Specific Gravity Sg =

32.2 Gravity g =

Class/Type

7.1 >2.0!!! !NA! D50 (ft) = D50 (ft) = 2.50 B30

#### COMPUTED DATA

K1 = 0.24 Side slope correction factor D30 =39.5 ft

47.4 ft

47.4 ft D50 = Max D50 =

Values in UDFCD Manual

Extrapolated from UDFCD Values (See Curves Below)

12 -	Rp vs D50
12	
10	
8 · (se	
9 nche	
050 (inches)	y = 2.8058ln(x) - 3.2582 R <sup>2</sup> = 0.9557
2	
0	0 6 12 18 24 30 36 42 48
	0 6 12 18 <b>24</b> 30 36 42 48

Riprap

Boulder

Min	Max	Riprap Type	D50 (inches)
Rp	Rp		(Inches)
1.4	3.2	VL	6
3.3	3.9	L	9
4	4.5	M	12
4.6	5.5	Н	18
5.6	6.4	VH	24
6.3	6.8		30
6.8	7.2		36
7.2	7.5		42
7.6	7.8		48
7.9	8.1		54
8.2	8.3		60

SMA

31-Dec-15

By: Date:

Min Rp	Max Rp	Boulder Class	D50 (inches)
4.6	5.5	B18	18
5.6	6.4	B24	24
6.5	7.1	B30	30
7.2	7.8	B36	36
7.9	8.4	B42	42
8.5	9.0	B48	48

**Boulder County** Client:

SOURCE:

INPUT DATA

Sf:

Cs =

**METHOD 1 - CORPS OF ENGINEERS** 

Project: Fourmile Canyon Creek Stream Restoration

Description: LPSTP Toe Protection for Bankfull Flow in Pool-3 at Maximum Velocity

U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control

Stability Coefficient (0.3 for angular rock, 0.375 for rounded)

#### **METHOD 2 - UDFCD/SPRINGS**

SOURCE: Urban Storm Drainage Criteria Manual, Vol. 2

Uban Drainage and Flood Control District, Denver, Colorado

Rev. April 2008

City of Colorado Springs/El Paso County Drainage Criteria Manual

#### INPUT DATA

V = 7.894 Mean channel flow velocity (ft/s)

Adjust Velocity for Bend (UDFCD EQ. MD-10, pg MD-47). No Adjustment for Rc/T > 8.

50 radius of curvature (ft From design pattern min 3.5 Topwidth (ft)

Bankfull Rc = 23.5 Topwidth (ft)

Va = 15 Velocity adjusted for bend (ft/s)

Class/Type

S= 0.055 Channel slope (ft/ft) from proposed grading  $S_s =$ 2.65 Rock specific gravity

COMPUTED DATA

Calculate Cv for channel bend: Rc =

2.3 Depth of Flow

1.1 Safety Factor

50 radius of curvature (ft From design pattern min 23.5 Topwidth (ft)

Bankfull

Channels. EM 1110-2-1601, Change 1. June 30. Revetment Method (Recommended for slopes < 2%)

1.22 Velocity Distribution Coeff. (Use 1.0 for Rc/T > 26) Cv =

4.5 Blanket Thickness Coefficient

Calculate design velocity (Vss) for channel bend:

7.894 Avg Channel Velocity U/S of Bend (ft/s)

12.4 Design velocity (bank area of bend in natural channel)

Measured on outside of pool cross section from toe 76 Bank Angle in Degrees Theta =

90 Angle of repose (degrees) of riprap material (normally 40 degrees) Phi =

2.65 Rock Specific Gravity Sg =

32.2 Gravity g =

>2.0!!! !NA! Riprap D50 (ft) = Boulder D50 (ft) = 2.50 B30

6.5

COMPUTED DATA Values in UDFCD Manual

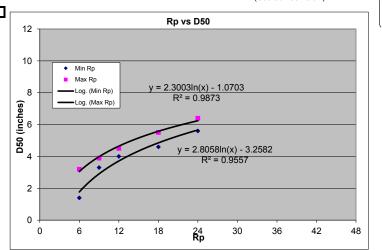
K1 = 0.24 Side slope correction factor D30 = 32.6 ft

39.1 ft

39.1 ft D50 =

Max D50 =

Extrapolated from UDFCD Values (See Curves Below)



Min	Max	Riprap	D50
Rp	Rp	Type	(inches)
1.4	3.2	VL	6
3.3	3.9	L	9
4	4.5	M	12
4.6	5.5	Н	18
5.6	6.4	VH	24
6.3	6.8		30
6.8	7.2		36
7.2	7.5		42
7.6	7.8		48
7.9	8.1		54
8.2	8.3		60

SMA

31-Dec-15

By: Date:

Min Rp	Max Rp	Boulder Class	D50 (inches)
4.6	5.5	B18	18
5.6	6.4	B24	24
6.5	7.1	B30	30
7.2	7.8	B36	36
7.9	8.4	B42	42
8.5	9.0	B48	48

By: Date: Client: **Boulder County** SMA Project: Fourmile Canyon Creek Stream Restoration 31-Dec-15

Description: LPSTP Toe Protection for Bankfull Flow in Riffle at Maximum Velocity Upstream of Lion Point

#### **METHOD 1 - CORPS OF ENGINEERS**

U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control Channels. EM 1110-2-1601, Change 1. June 30. SOURCE:

Revetment Method (Recommended for slopes < 2%)

#### INPUT DATA

v =	1.9	Depth of Flow
Sf =		Safety Factor
Cs =	0.3	Stability Coefficient (0.3 for angular rock, 0.375 for rounded)
Cv =	1	Velocity Distribution Coeff.
Ct =	4.5	Blanket Thickness Coefficient
Vdes =	8.275	Design Velocity
Theta =	23	Bank Angle in Degrees
Sg =	2.65	Rock Specific Gravity
g =	32.2	Gravity
		•

#### COMPUTED DATA

K1 =	0.93	Side slope correction factor
D30 =	1.9	ft
D50 =	2.3	ft

### METHOD 2 - UDFCD/SPRINGS

**SOURCE:** Urban Storm Drainage Criteria Manual, Vol. 2
Uban Drainage and Flood Control District, Denver, Colorado
Rev. April 2008

City of Colorado Springs/El Paso County Drainage Criteria Manual

12-Oct-94

#### INPUT DATA

V =	8.275	Mean channel flow velocity (ft/s)
s =	0.065	Channel slope (ft/ft)
S <sub>s</sub> =	2.65	Rock specific gravity

#### COMPUTED DATA

$R_p =$	3.7	
D50 =	0.75	ft

	Riprap	D50
Rp	Type	(inches)
1.4 to 3.2	VL	6
3.3 to 3.9	L	9
4.0 to 4.5	M	12
4.6 to 5.5	Η	18
5.6 to 6.4	VH	24

By: Date: Client: **Boulder County** SMA Project: Fourmile Canyon Creek Stream Restoration 31-Dec-15

Description: LPSTP Toe Protection for Bankfull Flow in Riffle at Maximum Velocity Downstream of Lion Point

#### **METHOD 1 - CORPS OF ENGINEERS**

U.S. Army Corps of Engineers. 1994. Hydraulic Design of Flood Control Channels. EM 1110-2-1601, Change 1. June 30. SOURCE:

Revetment Method (Recommended for slopes < 2%)

#### INPUT DATA

y =	1.9	Depth of Flow
Sf =	1.1	Safety Factor
Cs =	0.3	Stability Coefficient (0.3 for angular rock, 0.375 for rounded)
Cv =	1	Velocity Distribution Coeff.
Ct =	4.5	Blanket Thickness Coefficient
Vdes =	8.275	Design Velocity
Theta =	23	Bank Angle in Degrees
Sg =	2.65	Rock Specific Gravity
g =	32.2	Gravity

#### COMPUTED DATA

K1 =	0.93	Side slope correction factor
D30 =	1.9	ft
D50 =	2.3	ft

### METHOD 2 - UDFCD/SPRINGS

**SOURCE:** Urban Storm Drainage Criteria Manual, Vol. 2
Uban Drainage and Flood Control District, Denver, Colorado Rev. April 2008

City of Colorado Springs/El Paso County Drainage Criteria Manual

12-Oct-94

#### INPUT DATA

V =	7.95	Mean channel flow velocity (ft/s)
s =	0.065	Channel slope (ft/ft)
$S_s =$	2.65	Rock specific gravity

#### COMPUTED DATA

$R_p =$	3.6	
D50 =	0.75	ft

Rp	Riprap Type	D50 (inches)
1.4 to 3.2	VL	6
3.3 to 3.9	L	9
4.0 to 4.5	M	12
4.6 to 5.5	Η	18
5.6 to 6.4	VH	24

Ref: HEC-23 Page 4.10, method assumes bank is protected and that erosion potential will be directed at invert.

$D_{mnc}$	1.2 ft	cross section area/topwidth upstream of bend	Reach 8 Pool
$R_c$	45 ft	centerline radius of bend	From Proposed Alignn
W	23.5 ft	topwidth in bend	Reach 8 Pool
D	2 ft	Flow depth in bend without scour	Reach 8 Pool
$D_mxb$	2.2 ft	Water depth at max scour	
Ds	0.2 ft	Scour depth (below existing invert)	
Ds X 2	0.5 ft	Scour depth (below existing invert) including recom	mended SF of 2

Ref: HEC-23 Page 4.10, method assumes bank is protected and that erosion potential will be directed at invert.

$D_{mnc}$	1.2 ft	cross section area/topwidth upstream of bend	Reach 8 Pool
$R_c$	75 ft	centerline radius of bend	From Proposed Alignn
W	23.5 ft	topwidth in bend	Reach 8 Pool
D	2 ft	Flow depth in bend without scour	Reach 8 Pool
$D_mxb$	2.2 ft	Water depth at max scour	
Ds	0.2 ft	Scour depth (below existing invert)	
Ds X 2	0.3 ft	Scour depth (below existing invert) including recom	nmended SF of 2

Ref: HEC-23 Page 4.10, method assumes bank is protected and that erosion potential will be directed at invert.

$D_{mnc}$	1.4 ft	cross section area/topwidth upstream of bend	Reach 9 Pool
$R_c$	45 ft	centerline radius of bend	From Proposed Alignm
W	25 ft	topwidth in bend	Reach 9 Pool
D	2.4 ft	Flow depth in bend without scour	Reach 9 Pool
	-		
$D_mxb$	2.6 ft	Water depth at max scour	
Ds	0.2 ft	Scour depth (below existing invert)	
Ds X 2	0.3 ft	Scour depth (below existing invert) including recom	mended SF of 2

Ref: HEC-23 Page 4.10, method assumes bank is protected and that erosion potential will be directed at invert.

$D_{mnc}$	1.4 ft	cross section area/topwidth upstream of bend	Reach 9 Pool
$R_c$	75 ft	centerline radius of bend	From Proposed Alignn
W	25 ft	topwidth in bend	Reach 9 Pool
D	2.4 ft	Flow depth in bend without scour	Reach 9 Pool
$D_mxb$	2.5 ft	Water depth at max scour	
Ds	0.1 ft	Scour depth (below existing invert)	
Ds X 2	0.2 ft	Scour depth (below existing invert) including recom	mended SF of 2

# Sediment Transport Modeling Results

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfı	ıll VELO	CITY & [	DISCHAR	GE Esti	mates		
Stream:	Fourmile Canyon	Creek		Location:	Reach - I	Reach 1		
Date:	Stre	am Type:	C4	Valley	Туре:		VIII	
Observers:				HUC:				
	INPUT VARIAE	BLES			OUTP	UT VARIA	ABLES	
	Bankfull Riffle Cross-Sectional AREA 25.27 Abkf				Riffle Mear	n DEPTH	1.18	d <sub>bkf</sub> (ft)
Bankfull	Riffle WIDTH	21.50	W <sub>bkf</sub> (ft)		d PERMIN 2 * d <sub>bkf</sub> ) + V		22.14	W <sub>p</sub> (ft)
D <sub>84</sub>	₁ at Riffle	90.00	Dia.		(mm) / 30		0.30	<b>D</b> <sub>84</sub> (ft)
Bank	full SLOPE	0.0430	S <sub>bkf</sub> (ft / ft)		aulic RAD A <sub>bkf</sub> / W <sub>p</sub>		1.14	R (ft)
Gravitation	nal Acceleration	32.2	g (ft / sec²)	R	ive Rough (ft) / D <sub>84</sub> (ff	t)	3.86	R / D <sub>84</sub>
Draii	nage Area	4.5	<b>DA</b> (mi²)		ear Veloc u* = (gRS) <sup>½</sup>	, ,	1.256	u* (ft/sec)
	ESTIMATION	N METHO	DS			kfull OCITY	Bankfull DISCHARGE	
1. Friction Factor	Relative $u = I$	2.83 + 5.6	6 * Log { R	/D <sub>84</sub> }]u*	7.74	ft / sec	195.48	cfs
2. Roughness Roughness (Fig	Coefficient: a) Mannings. 2-18, 2-19) $u = 1$	ng's <i>n</i> from Fi 1.49*R <sup>2/3</sup> *S <sup>1/</sup>		/ Relative 0.04	8.42	ft / sec	212.67	cfs
2. Roughness b) Manning's	Coefficient:  n from Stream Type	(Fig. 2-20)	u = 1.49*F n =	8 <sup>2/3</sup> *S <sup>1/2</sup> /n 0.04	8.42	ft / sec	212.67	cfs
	Coefficient:  n from Jarrett (USGS ion is applicable to steep, ste		n = 0.39*	S <sup>0.38</sup> *R <sup>-0.16</sup>	2.92	ft / sec	73.66	cfs
roughness, cobb	ole- and boulder-dominated	stream systems	n = 0; i.e., for $n = 0$	0.116				
	<mark>ods (Hey, Darcy-Weis</mark> l sbach (Leopold, Wo		<u> </u>		8.03	ft / sec	202.97	cfs
3. Other Metho Chezy C	ods (Hey, Darcy-Weis	bach, Chezy	C, etc.)		0.00	ft / sec	0.00	cfs
4. Continuity E Return Period fo	Equations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	year	0.00	ft / sec	0.00	cfs
4. Continuity E	Equations: b) USG	S Gage Data	a u = Q / A	Α	0.00	ft / sec	0.00	cfs
	n Height Options for t	<u> </u>						
	For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.							
	Option 2. For <b>boulder-dominated</b> channels: Measure 100 <b>"protrusion heights"</b> of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.							
Option 3. For to above	pedrock-dominated chan e channel bed elevation.	nels: Measure Substitute the	e 100 <b>"protrus</b> D <sub>84</sub> bedrock pi	i <b>on heights"</b> o rotrusion height	f rock separat t in ft for the D	ions, steps, jo <sub>84</sub> term in metl	ints or uplifted hod 1.	surfaces
Option 4. For I	og-influenced channels: og on upstream side if em	Measure " <b>pro</b> bedded. Subs	otrustion height stitute the $D_{84}$ p	hts" proportiona protrusion heigh	ate to channel at in ft for the <i>l</i>	l width of log d D <sub>84</sub> term in me	iameters or the	e height of

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfı	ıll VELO	CITY & [	DISCHAR	GE Esti	mates		
Stream:	Fourmile Canyon	Creek		Location: Reach - Reach 2				
Date:	Stre	am Type:	B4	Valley	Туре:		VIII	
Observers:				HUC:				
	INPUT VARIAE	BLES			OUTP	UT VARIA	ABLES	
	Bankfull Riffle Cross-Sectional AREA 25.27 Abkf				Riffle Mear	n DEPTH	1.18	d <sub>bkf</sub> (ft)
Bankfull	Riffle WIDTH	21.50	W <sub>bkf</sub> (ft)		d PERMIN 2 * d <sub>bkf</sub> ) + V		22.14	W <sub>p</sub>
D <sub>84</sub>	at Riffle	90.00	Dia.	D <sub>84</sub>	(mm) / 30	)4.8	0.30	<b>D</b> <sub>84</sub> (ft)
Bank	full SLOPE	0.0500	S <sub>bkf</sub> (ft / ft)	Hydr	aulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	1.14	R (ft)
Gravitation	nal Acceleration	32.2	g (ft / sec²)	R	ive Rough (ft) / D <sub>84</sub> (ft	t)	3.97	R / D <sub>84</sub>
Draii	nage Area	4.5	<b>DA</b> (mi <sup>2</sup> )		ear Veloc u* = (gRS) <sup>½</sup>	,	1.355	u* (ft/sec)
	ESTIMATION	N METHO	DS			kfull OCITY	Ban DISCH	kfull ARGE
1. Friction Factor	Relative $u = I$	2.83 + 5.60	6 * Log { R	/D <sub>84</sub> }]u*	8.34	ft / sec	210.79	cfs
2. Roughness Roughness (Fig	Coefficient: a) Mannings. 2-18, 2-19) $u = 1$	ng's <i>n</i> from Fi 1.49*R <sup>2/3</sup> *S <sup>1/</sup>		/ Relative 0.057	6.37	ft / sec	160.95	cfs
2. Roughness b) Manning's	Coefficient:  n from Stream Type	(Fig. 2-20)	u = 1.49*F n =	0.057	6.37	ft / sec	160.95	cfs
	Coefficient:  n from Jarrett (USGS ion is applicable to steep, ste		n = 0.39*	S <sup>2/3</sup> *S <sup>1/2</sup> /n S <sup>0.38</sup> *R <sup>-0.16</sup>	2.97	ft / sec	75.00	cfs
roughness, cobb	ele- and boulder-dominated	stream systems	$a_{\text{s; i.e., for}}$ $n =$	0.122				
	<mark>ods (Hey, Darcy-Weis</mark> sbach (Leopold, Wo		<u> </u>		8.66	ft / sec	218.87	cfs
3. Other Metho Chezy C	ods (Hey, Darcy-Weis	bach, Chezy	C, etc.)		0.00	ft / sec	0.00	cfs
4. Continuity E Return Period fo	Equations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	year	0.00	ft / sec	0.00	cfs
4. Continuity E	Equations: b) USG	S Gage Data	a u = Q / A	Α	0.00	ft / sec	0.00	cfs
	n Height Options for t					• • • • • • • • • • • • • • • • • • • •		
	For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.							
	Option 2. For <b>boulder-dominated</b> channels: Measure 100 <b>"protrusion heights"</b> of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.							
Option 3. For to above	pedrock-dominated chan e channel bed elevation.	nels: Measure Substitute the	e 100 <b>"protrus</b> D <sub>84</sub> bedrock pr	ion heights" o rotrusion height	f rock separat t in ft for the D	ions, steps, jo <sub>84</sub> term in metl	ints or uplifted hod 1.	surfaces
Option 4. For I	og-influenced channels: og on upstream side if em	Measure " <b>pro</b> bedded. Subs	otrustion heig stitute the D <sub>84</sub> p	hts" proportiona protrusion heigh	ate to channe It in ft for the <i>l</i>	l width of log d D <sub>84</sub> term in me	iameters or the	height of

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfı	ıll VELO	CITY & [	DISCHAR	GE Esti	mates		
Stream:	Fourmile Canyon	Creek		Location: Reach - Reach 3				
Date:	Stre	am Type:	B4	Valley	Туре:		VIII	
Observers:				HUC:				
	INPUT VARIAE	BLES			OUTP	UT VARIA	ABLES	
	Bankfull Riffle Cross-Sectional AREA 24.93				Riffle Mear	n DEPTH	1.25	d <sub>bkf</sub>
Bankfull	Riffle WIDTH	20.00	W <sub>bkf</sub> (ft)		d PERMIN 2 * d <sub>bkf</sub> ) + V		21.03	W <sub>p</sub> (ft)
D <sub>84</sub>	₄ at Riffle	90.00	Dia.	D <sub>84</sub>	(mm) / 30	)4.8	0.30	<b>D</b> <sub>84</sub> (ft)
Bank	full SLOPE	0.0440	S <sub>bkf</sub> (ft / ft)	Hydr	aulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	1.19	R (ft)
Gravitation	nal Acceleration	32.2	g (ft / sec²)	R	ive Rough (ft) / D <sub>84</sub> (ft	t)	3.97	R / D <sub>84</sub>
Draiı	nage Area	4.9	<b>DA</b> (mi <sup>2</sup> )		near Veloc u* = (gRS) <sup>½</sup>	•	1.298	u* (ft/sec)
	ESTIMATION	N METHO	DS			kfull OCITY	Bankfull DISCHARGE	
1. Friction Factor	Relative $u = I$	2.83 + 5.60	6 * Log { R	/D <sub>84</sub> }] u*	8.10	ft / sec	201.82	cfs
2. Roughness Roughness (Fig	Coefficient: a) Mannings. 2-18, 2-19) $u = 1$	ng's <i>n</i> from Fi .49*R <sup>2/3</sup> *S <sup>1/</sup>		/ Relative 0.057	6.13	ft / sec	152.75	cfs
2. Roughness b) Manning's	Coefficient: n from Stream Type	(Fig. 2-20)	u = 1.49*F n =	0.057	6.13	ft / sec	152.75	cfs
	Coefficient:  n from Jarrett (USGS ion is applicable to steep, ste		n = 0.39*	R <sup>2/3</sup> *S <sup>1/2</sup> /n S <sup>0.38</sup> *R <sup>-0.16</sup>	3.02	ft / sec	75.19	cfs
roughness, cobb	ole- and boulder-dominated	stream systems	$a_{\text{s; i.e., for}}$ $n =$	0.116				
	<mark>ods (Hey, Darcy-Weis</mark> sbach (Leopold, Wo				8.55	ft / sec	213.25	cfs
3. Other Metho Chezy C	ods (Hey, Darcy-Weis	bach, Chezy	C, etc.)		0.00	ft / sec	0.00	cfs
4. Continuity E Return Period fo	Equations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / / 0.0	year	0.00	ft / sec	0.00	cfs
4. Continuity E	Equations: b) USG	S Gage Data	a u = Q / A	Α	0.00	ft / sec	0.00	cfs
	n Height Options for t							
	For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.							
	Option 2. For <b>boulder-dominated</b> channels: Measure 100 <b>"protrusion heights"</b> of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.							
Option 3. For to above	pedrock-dominated chan re channel bed elevation.	nels: Measure Substitute the	e 100 <b>"protrus</b> D <sub>84</sub> bedrock p	ion heights" o rotrusion height	f rock separat t in ft for the <i>D</i>	ions, steps, joi <sub>84</sub> term in meth	ints or uplifted hod 1.	surfaces
Option 4. For I	log-influenced channels: og on upstream side if em	Measure " <b>pro</b> bedded. Subs	otrustion height stitute the D <sub>84</sub> p	hts" proportiona protrusion heigh	ate to channe at in ft for the <i>l</i>	l width of log d D <sub>84</sub> term in met	iameters or the	e height of

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfu	ıll VELO	CITY & [	DISCHAR	GE Esti	mates			
Stream:	Fourmile Canyon	Creek		Location:	Location: Reach - Reach 4				
Date:	Stre	am Type:	B4	Valley	Туре:		VIII		
Observers:				HUC:					
	INPUT VARIAE	BLES			OUTP	UT VARIA	ABLES		
	e Cross-Sectional AREA	A <sub>bkf</sub>	Bankfull F	Riffle Mear	n DEPTH	1.25	d <sub>bkf</sub> (ft)		
Bankfull	Riffle WIDTH	20.00	W <sub>bkf</sub> (ft)		d PERMIN 2 * d <sub>bkf</sub> ) + V		21.03	W <sub>p</sub> (ft)	
D <sub>84</sub>	at Riffle	90.00	Dia.	D <sub>84</sub>	(mm) / 30	)4.8	0.30	<b>D</b> <sub>84</sub> (ft)	
Bank	full SLOPE	0.0440	S <sub>bkf</sub> (ft / ft)	Hydr	aulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	1.19	R (ft)	
Gravitation	nal Acceleration	32.2	g (ft / sec²)	R	ive Rough (ft) / D <sub>84</sub> (ft	t)	4.03	R / D <sub>84</sub>	
Draiı	nage Area	4.9	<b>DA</b> (mi <sup>2</sup> )		near Veloc u* = (gRS) <sup>½</sup>	•	1.298	u* (ft/sec)	
	ESTIMATION	N METHO	DS			kfull OCITY	Ban DISCH	kfull IARGE	
1. Friction Factor	Relative $u = I$	2.83 + 5.60	6 * Log { R	/D <sub>84</sub> }] u*	8.10	ft / sec	201.82	cfs	
2. Roughness Roughness (Fig	Coefficient: a) Mannings. 2-18, 2-19) $u = 1$	ng's <i>n</i> from Fi 1.49*R <sup>2/3</sup> *S <sup>1/</sup>		/ Relative 0.057	6.13	ft / sec	152.75	cfs	
2. Roughness b) Manning's	Coefficient: n from Stream Type (	(Fig. 2-20)	u = 1.49*F n =	0.057	6.13	ft / sec	152.75	cfs	
	Coefficient:  n from Jarrett (USGS on is applicable to steep, ste		n = 0.39*	S <sup>2/3</sup> *S <sup>1/2</sup> /n S <sup>0.38</sup> *R <sup>-0.16</sup>	3.02	ft / sec	75.19	cfs	
roughness, cobb	ole- and boulder-dominated	stream systems	$\mathbf{n}$ i.e., for $\mathbf{n}$	0.116					
	<mark>ods (Hey, Darcy-Weisl</mark> sbach (Leopold, Wo				8.55	ft / sec	213.25	cfs	
3. Other Metho Chezy C	ods (Hey, Darcy-Weisl	bach, Chezy	C, etc.)		0.00	ft / sec	0.00	cfs	
4. Continuity E Return Period fo	equations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	A year	0.00	ft / sec	0.00	cfs	
4. Continuity E	Equations: b) USG	S Gage Data	a u = Q / A	4	0.00	ft / sec	0.00	cfs	
	1 Height Options for t								
	Option 1. For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.								
	Option 2. For <b>boulder-dominated</b> channels: Measure 100 <b>"protrusion heights"</b> of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.								
Option 3. For to above	pedrock-dominated chan e channel bed elevation.	nels: Measure Substitute the	e 100 <b>"protrus</b> D <sub>84</sub> bedrock pr	ion heights" o rotrusion height	f rock separat t in ft for the <i>D</i>	ions, steps, joi <sub>84</sub> term in metl	ints or uplifted hod 1.	surfaces	
Option 4. For I	og-influenced channels: og on upstream side if em	Measure " <b>pro</b> bedded. Subs	otrustion height stitute the $D_{84}$ p	hts" proportiona protrusion heigh	ate to channe at in ft for the <i>l</i>	l width of log d D <sub>84</sub> term in met	iameters or the thod 1.	e height of	

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfu	ıll VELO	CITY & [	DISCHAR	GE Esti	mates		
Stream:	Fourmile Canyon	Creek		Location: Reach - Reach 5				
Date:	Stre	am Type:	B4	Valley	Туре:		VIII	
Observers:				HUC:				
	INPUT VARIAE	BLES			OUTP	UT VARIA	ABLES	
	Bankfull Riffle Cross-Sectional AREA 24.93				Riffle Mear	n DEPTH	1.25	d <sub>bkf</sub> (ft)
Bankfull	Riffle WIDTH	20.00	W <sub>bkf</sub> (ft)		d PERMIN 2 * d <sub>bkf</sub> ) + V		21.03	W <sub>p</sub> (ft)
D <sub>84</sub>	₁ at Riffle	90.00	Dia.		(mm) / 30		0.30	<b>D</b> <sub>84</sub> (ft)
Bank	full SLOPE	0.0430	S <sub>bkf</sub> (ft / ft)		aulic RAD A <sub>bkf</sub> / W <sub>p</sub>		1.19	R (ft)
Gravitation	nal Acceleration	32.2	g (ft / sec²)	R	ive Rough (ft) / D <sub>84</sub> (ff	t)	3.97	R / D <sub>84</sub>
Draii	nage Area	4.9	<b>DA</b> (mi²)		ear Veloc u* = (gRS) <sup>½</sup>	, , ,	1.284	u* (ft/sec)
	ESTIMATION	N METHO	DS			kfull OCITY	Ban DISCH	kfull ARGE
1. Friction Factor	Relative $u = I$	2.83 + 5.60	6 * Log { R	/D <sub>84</sub> }] u*	8.00	ft / sec	199.51	cfs
2. Roughness Roughness (Fig	Coefficient: a) Mannings. 2-18, 2-19) $u = 1$	ng's <i>n</i> from Fi .49*R <sup>2/3</sup> *S <sup>1/</sup>		/ Relative 0.057	6.06	ft / sec	151.00	cfs
2. Roughness b) Manning's	Coefficient:  n from Stream Type (	(Fig. 2-20)	u = 1.49*F n =	0.057	6.06	ft / sec	151.00	cfs
	Coefficient:  n from Jarrett (USGS on is applicable to steep, ste		n = 0.39*	S <sup>2/3</sup> *S <sup>1/2</sup> /n S <sup>0.38</sup> *R <sup>-0.16</sup>	3.01	ft / sec	74.99	cfs
roughness, cobb	ele- and boulder-dominated	stream systems	$a_{i}$ ; i.e., for $n =$	0.115				
	<mark>ods (Hey, Darcy-Weisl</mark> sbach (Leopold, Wo				8.46	ft / sec	210.81	cfs
3. Other Metho Chezy C	ods (Hey, Darcy-Weisl	bach, Chezy	C, etc.)		0.00	ft / sec	0.00	cfs
4. Continuity E Return Period fo	equations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	year	0.00	ft / sec	0.00	cfs
4. Continuity E	Equations: b) USG	S Gage Data	a u = Q / A	4	0.00	ft / sec	0.00	cfs
	1 Height Options for t							
	For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.							
	Option 2. For <b>boulder-dominated</b> channels: Measure 100 <b>"protrusion heights"</b> of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.							
Option 3. For to above	pedrock-dominated chan e channel bed elevation.	nels: Measure Substitute the	e 100 <b>"protrus</b> <i>D</i> <sub>84</sub> bedrock pi	i <b>on heights"</b> o rotrusion height	f rock separat t in ft for the D	ions, steps, joi <sub>84</sub> term in meth	ints or uplifted hod 1.	surfaces
Option 4. For I	og-influenced channels: og on upstream side if em	Measure " <b>pro</b> bedded. Subs	otrustion height stitute the $D_{84}$ p	hts" proportiona protrusion heigh	ate to channe at in ft for the <i>l</i>	I width of log d D <sub>84</sub> term in met	iameters or the	height of

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfı	ıll VELO	CITY & [	DISCHAR	GE Esti	mates		
Stream:	Fourmile Canyon	Creek		Location: Reach - Reach 6				
Date:	Stre	am Type:	C4	Valley	Туре:		VIII	
Observers:				HUC:				
	INPUT VARIAE	BLES			OUTP	UT VARIA	ABLES	
	e Cross-Sectional AREA	25.27	A <sub>bkf</sub>	Bankfull F	Riffle Mea	n DEPTH	1.18	d <sub>bkf</sub>
Bankfull	Riffle WIDTH	21.50	W <sub>bkf</sub> (ft)		d PERMIN 2 * d <sub>bkf</sub> ) + V		22.14	W <sub>p</sub>
D <sub>84</sub>	at Riffle	86.00	Dia.	D <sub>84</sub>	(mm) / 30	)4.8	0.28	<b>D</b> <sub>84</sub> (ft)
Bankt	full SLOPE	0.0400	S <sub>bkf</sub> (ft / ft)	Hydr	aulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	1.14	R (ft)
Gravitation	nal Acceleration	32.2	g (ft / sec²)	R	ive Rough (ft) / D <sub>84</sub> (ff	t)	4.04	R / D <sub>84</sub>
Drair	nage Area	4.9	<b>DA</b> (mi <sup>2</sup> )		ear Veloc u* = (gRS) <sup>½</sup>	. •	1.212	u* (ft/sec)
	ESTIMATION	N METHO	DS			kfull OCITY	Ban DISCH	kfull IARGE
1. Friction Factor	Relative $u = I$	2.83 + 5.60	6 * Log { R	/D <sub>84</sub> }] u*	7.60	ft / sec	191.96	cfs
	Coefficient: a) Mannings. 2-18, 2-19) $u = 1$	ng's <i>n</i> from Fi 1.49*R <sup>2/3</sup> *S <sup>1/</sup>		/ Relative	8.12	ft / sec	205.12	cfs
2. Roughness b) Manning's	Coefficient:  n from Stream Type	(Fig. 2-20)	u = 1.49*F n =	8 <sup>2/3</sup> *S <sup>1/2</sup> /n 0.04	8.12	ft / sec	205.12	cfs
,	n from Jarrett (USGS	,	$n = 0.39^*$	R <sup>2/3</sup> *S <sup>1/2</sup> /n	2.89	ft / sec	73.01	cfs
roughness, cobb	on is applicable to steep, ste le- and boulder-dominated	stream systems	n = 0; i.e., for $n = 0$	0.112				
	<mark>ods (Hey, Darcy-Weis</mark> sbach (Leopold, Wo				7.89	ft / sec	199.29	cfs
3. Other Metho Chezy C	ods (Hey, Darcy-Weis	bach, Chezy	C, etc.)		0.00	ft / sec	0.00	cfs
4. Continuity E Return Period fo	Equations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / / 0.0	4 year	0.00	ft / sec	0.00	cfs
4. Continuity E	Equations: b) USG	S Gage Data	a u = Q / A	Α	0.00	ft / sec	0.00	cfs
	n Height Options for t sand-bed channels: Mea							
	sand-bed channels: Measure. Substitute the $D_{84}$ san						e or reacure to	me rob ol
Option 2. For top of	Sption 2. For <b>boulder-dominated</b> channels: Measure 100 " <b>protrusion heights</b> " of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.							
Option 3. For to above	pedrock-dominated chan e channel bed elevation.	nels: Measure Substitute the	e 100 <b>"protrus</b> D <sub>84</sub> bedrock p	ion heights" o rotrusion height	f rock separat t in ft for the <i>D</i>	ions, steps, jo <sub>84</sub> term in metl	ints or uplifted hod 1.	surfaces
Option 4. For I	og-influenced channels: og on upstream side if em	Measure " <b>pro</b> bedded. Subs	<b>strustion heig</b> stitute the $D_{84}$ p	hts" proportiona protrusion heigh	ate to channe at in ft for the <i>l</i>	l width of log d D <sub>84</sub> term in me	liameters or the thod 1.	e height of

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfı	ıll VELO	CITY & [	DISCHAR	GE Esti	mates		
Stream:	Fourmile Canyon	Creek		Location: Reach - Reach 7				
Date:	Stre	am Type:	B4	Valley	Туре:		VIII	
Observers:				HUC:				
	INPUT VARIAE	BLES			OUTP	UT VARIA	ABLES	
	e Cross-Sectional AREA	A <sub>bkf</sub>	Bankfull F	Riffle Mear	n DEPTH	1.25	d <sub>bkf</sub> (ft)	
Bankfull	Riffle WIDTH	20.00	W <sub>bkf</sub> (ft)		d PERMIN 2 * d <sub>bkf</sub> ) + V		21.03	W <sub>p</sub> (ft)
D <sub>84</sub>	₄ at Riffle	90.00	Dia.	D <sub>84</sub>	(mm) / 30	)4.8	0.30	<b>D</b> <sub>84</sub> (ft)
Bank	full SLOPE	0.0470	S <sub>bkf</sub> (ft / ft)	Hydr	raulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	1.19	R (ft)
Gravitation	nal Acceleration	32.2	g (ft / sec²)	R	rive Rough R(ft) / D <sub>84</sub> (ff	t)	3.97	R / D <sub>84</sub>
Draiı	nage Area	4.9	<b>DA</b> (mi <sup>2</sup> )		near Veloc u* = (gRS) <sup>½</sup>	•	1.342	u* (ft/sec)
	ESTIMATION	N METHO	DS			kfull OCITY	Ban DISCH	kfull ARGE
1. Friction Factor	Relative $u = I$	2.83 + 5.60	6 * Log { R	/D <sub>84</sub> }] u*	8.37	ft / sec	208.58	cfs
2. Roughness Roughness (Fig	Coefficient: a) Mannings. 2-18, 2-19) $u = 1$	ng's <i>n</i> from Fi 1.49*R <sup>2/3</sup> *S <sup>1/</sup>		/ Relative 0.057	6.33	ft / sec	157.88	cfs
2. Roughness b) Manning's	Coefficient: n from Stream Type	(Fig. 2-20)	u = 1.49*F n =	0.057	6.33	ft / sec	157.88	cfs
	Coefficient:  n from Jarrett (USGS) ion is applicable to steep, ste		n = 0.39*	S <sup>2/3</sup> *S <sup>1/2</sup> /n S <sup>0.38</sup> *R <sup>-0.16</sup>	3.04	ft / sec	75.74	cfs
roughness, cobb	ole- and boulder-dominated	stream systems	$a_{\text{s; i.e., for}}$ $n =$	0.119				
	<mark>ods (Hey, Darcy-Weis</mark> sbach (Leopold, Wo				8.84	ft / sec	220.40	cfs
3. Other Metho Chezy C	ods (Hey, Darcy-Weis	bach, Chezy	C, etc.)		0.00	ft / sec	0.00	cfs
4. Continuity E Return Period fo	Equations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	year	0.00	ft / sec	0.00	cfs
4. Continuity E	Equations: b) USG	S Gage Data	a u = Q / A	Α	0.00	ft / sec	0.00	cfs
	n Height Options for t							
	For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.							
	Option 2. For <b>boulder-dominated</b> channels: Measure 100 <b>"protrusion heights"</b> of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.							
Option 3. For to above	pedrock-dominated chan re channel bed elevation.	nels: Measure Substitute the	e 100 <b>"protrus</b> D <sub>84</sub> bedrock p	ion heights" o rotrusion height	f rock separat t in ft for the <i>D</i>	ions, steps, jo <sub>84</sub> term in metl	ints or uplifted hod 1.	surfaces
Option 4. For I	log-influenced channels: og on upstream side if em	Measure " <b>pro</b> bedded. Subs	otrustion height stitute the D <sub>84</sub> p	hts" proportiona protrusion heigh	ate to channe nt in ft for the <i>l</i>	l width of log d D <sub>84</sub> term in me	iameters or the	height of

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfu	ıll VELO	CITY & [	DISCHAR	GE Esti	mates			
Stream:	Fourmile Canyon	Creek		Location:	Location: Reach - Reach 8				
Date:	Stre	am Type:	B4	Valley	Туре:		VIII		
Observers:				HUC:					
	INPUT VARIAE	BLES			OUTP	UT VARIA	ABLES		
	e Cross-Sectional AREA	A <sub>bkf</sub>	Bankfull F	Riffle Mea	n DEPTH	1.18	d <sub>bkf</sub> (ft)		
Bankfull	Riffle WIDTH	21.50	W <sub>bkf</sub> (ft)		d PERMIN 2 * d <sub>bkf</sub> ) + V		22.14	W <sub>p</sub> (ft)	
D <sub>84</sub>	at Riffle	86.00	Dia.	D <sub>84</sub>	(mm) / 30	)4.8	0.28	<b>D</b> <sub>84</sub> (ft)	
Bank	full SLOPE	0.0420	S <sub>bkf</sub> (ft / ft)	Hydr	raulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	1.14	R (ft)	
Gravitation	nal Acceleration	32.2	g (ft / sec²)	R	ive Rough (ft) / D <sub>84</sub> (ff	t)	4.04	R / D <sub>84</sub>	
Draiı	nage Area	4.9	<b>DA</b> (mi <sup>2</sup> )		near Veloc u* = (gRS) <sup>½</sup>	,	1.242	u* (ft/sec)	
	ESTIMATION	N METHO	DS			kfull OCITY	Ban DISCH	kfull IARGE	
1. Friction Factor	Relative $u = I$	2.83 + 5.60	6 * Log { R	/D <sub>84</sub> }] u*	7.78	ft / sec	196.70	cfs	
2. Roughness Roughness (Fig	Coefficient: a) Mannings. 2-18, 2-19) $u = 1$	ng's <i>n</i> from Fi 1.49*R <sup>2/3</sup> *S <sup>1/</sup>		/ Relative 0.057	5.84	ft / sec	147.50	cfs	
2. Roughness b) Manning's	Coefficient: n from Stream Type (	(Fig. 2-20)	u = 1.49*F n =	0.057	5.84	ft / sec	147.50	cfs	
, -	Coefficient:  n from Jarrett (USGS on is applicable to steep, ste	,	n = 0.39*	R <sup>2/3</sup> *S <sup>1/2</sup> /n S <sup>0.38</sup> *R <sup>-0.16</sup>	2.91	ft / sec	73.44	cfs	
roughness, cobb	ele- and boulder-dominated	stream systems	$n = \frac{1}{3}$ ; i.e., for $n = \frac{1}{3}$	0.115					
	<mark>ods (Hey, Darcy-Weisl</mark> sbach (Leopold, Wo				8.08	ft / sec	204.21	cfs	
3. Other Metho Chezy C	ods (Hey, Darcy-Weisl	bach, Chezy	C, etc.)		0.00	ft / sec	0.00	cfs	
4. Continuity E Return Period fo	Equations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	year	0.00	ft / sec	0.00	cfs	
4. Continuity E	Equations: b) USG	S Gage Data	a u = Q / A	Α	0.00	ft / sec	0.00	cfs	
	1 Height Options for t								
	For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.								
	boulder-dominated chan of the rock on that side. Su							ion to the	
Option 3. For to above	pedrock-dominated chan e channel bed elevation.	nels: Measure Substitute the	e 100 <b>"protrus</b> D <sub>84</sub> bedrock p	ion heights" o rotrusion height	f rock separat t in ft for the D	ions, steps, jo <sub>84</sub> term in metl	ints or uplifted hod 1.	surfaces	
Option 4. For I	og-influenced channels: og on upstream side if em	Measure " <b>pro</b> bedded. Subs	otrustion height stitute the $D_{84}$ p	hts" proportiona protrusion heigh	ate to channe nt in ft for the <i>l</i>	l width of log d D <sub>84</sub> term in me	iameters or the thod 1.	e height of	

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

	Bankfı	ıll VELO	CITY & [	DISCHAR	GE Esti	mates		
Stream:	Fourmile Canyon	Creek		Location: Reach - Reach 9				
Date:	Stre	am Type:	B4	Valley	Туре:		VIII	
Observers:				HUC:				
	INPUT VARIAE	BLES			OUTP	UT VARIA	ABLES	
	e Cross-Sectional AREA	A <sub>bkf</sub>	Bankfull F	Riffle Mear	n DEPTH	1.18	d <sub>bkf</sub>	
Bankfull	Riffle WIDTH	22.50	W <sub>bkf</sub> (ft)		d PERMIN 2 * d <sub>bkf</sub> ) + V		23.13	W <sub>p</sub> (ft)
D <sub>84</sub>	at Riffle	90.00	Dia.	D <sub>84</sub>	(mm) / 30	)4.8	0.30	<b>D</b> <sub>84</sub> (ft)
Bank	full SLOPE	0.0430	S <sub>bkf</sub> (ft / ft)	Hydr	aulic RAD A <sub>bkf</sub> / W <sub>p</sub>	IUS	1.15	R (ft)
Gravitation	nal Acceleration	32.2	g (ft / sec²)	R	ive Rough (ft) / D <sub>84</sub> (ft	t)	3.90	R / D <sub>84</sub>
Draiı	nage Area	7.4	<b>DA</b> (mi <sup>2</sup> )		ear Veloc u* = (gRS) <sup>½</sup>	,	1.262	u* (ft/sec)
	ESTIMATION	N METHO	DS			kfull OCITY	Ban DISCH	kfull IARGE
1. Friction Factor	Relative $u = I$	2.83 + 5.6	6 * Log { R	/D <sub>84</sub> }] u*	7.80	ft / sec	207.76	cfs
2. Roughness Roughness (Fig	Coefficient: a) Mannings. 2-18, 2-19) $u = 1$	ng's <i>n</i> from Fi 1.49*R <sup>2/3</sup> *S <sup>1/</sup>		/ Relative 0.057	5.94	ft / sec	158.30	cfs
2. Roughness b) Manning's	Coefficient:  n from Stream Type	(Fig. 2-20)	u = 1.49*F n =	0.057	5.94	ft / sec	158.30	cfs
,	Coefficient:  n from Jarrett (USGS ion is applicable to steep, ste	,	n = 0.39*	S <sup>0.38</sup> *R <sup>-0.16</sup>	2.94	ft / sec	78.24	cfs
roughness, cobb	ole- and boulder-dominated	stream systems	$\mathbf{n}$ i.e., for $\mathbf{n}$	0.115				
	<mark>ods (Hey, Darcy-Weis</mark> l sbach (Leopold, Wo		<u> </u>		8.03	ft / sec	213.97	cfs
3. Other Metho Chezy C	ods (Hey, Darcy-Weis	bach, Chezy	C, etc.)		0.00	ft / sec	0.00	cfs
4. Continuity E Return Period fo	Equations: a) Regi or Bankfull Discharge	onal Curves Q =	u = Q / A 0.0	year	0.00	ft / sec	0.00	cfs
4. Continuity E	Equations: b) USG	S Gage Data	a u = Q / A	4	0.00	ft / sec	0.00	cfs
	1 Height Options for t							
	For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.							
	Option 2. For <b>boulder-dominated</b> channels: Measure 100 <b>"protrusion heights"</b> of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.							
Option 3. For to above	pedrock-dominated chan e channel bed elevation.	nels: Measure Substitute the	e 100 <b>"protrus</b> D <sub>84</sub> bedrock pr	ion heights" o rotrusion height	f rock separat t in ft for the <i>D</i>	ions, steps, joi <sub>84</sub> term in meth	ints or uplifted hod 1.	surfaces
Option 4. For I	og-influenced channels: og on upstream side if em	Measure " <b>pro</b> bedded. Subs	otrustion height stitute the $D_{84}$ p	hts" proportiona protrusion heigh	ate to channe It in ft for the <i>l</i>	l width of log d D <sub>84</sub> term in met	iameters or the	e height of

**Worksheet 2-2.** Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bankfull VELOCITY & DISCHARGE Estimates									
Stream:	Fourmile Canyon	Location: Reach - Reach 10							
Date:	Stre	am Type:	B4	Valley Type:			VIII		
Observers:				HUC:					
	OUTPUT VARIABLES								
	e Cross-Sectional AREA	26.64	A <sub>bkf</sub>	Bankfull Riffle Mean DEPTH		1.18	d <sub>bkf</sub> (ft)		
Bankfull Riffle WIDTH		22.50	W <sub>bkf</sub> (ft)	Wetted PERMIMETER ~ (2 * d <sub>bkf</sub> ) + W <sub>bkf</sub>		23.13	W <sub>p</sub>		
D <sub>84</sub>	Die.		<sub>4</sub> (mm) / 304.8		0.28	<b>D</b> <sub>84</sub> (ft)			
Bank	Bankfull SLOPE 0.0380		S <sub>bkf</sub> (ft / ft)	Hydraulic RADIUS A <sub>bkf</sub> / W <sub>p</sub>		1.15	R (ft)		
Gravitation	nal Acceleration	32.2	g (ft / sec²)	Relative Roughness R(ft) / D <sub>84</sub> (ft)			4.08	R / D <sub>84</sub>	
Draiı	nage Area	7.4	<b>DA</b> (mi <sup>2</sup> )	Shear Velocity u* = (gRS) <sup>½</sup>		1.186	u* (ft/sec)		
ESTIMATION METHODS					Bankfull VELOCITY		Bankfull DISCHARGE		
1. Friction Relative Factor Roughness $u = [2.83 + 5.66 * Log \{R/D_{84}\}]u^*$						ft / sec	198.84	cfs	
2. Roughness Coefficient: a) Manning's $n$ from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49 ^{\circ}R^{2/3} ^{\circ}S^{1/2}/n$ $n = \boxed{0.057}$						ft / sec	148.81	cfs	
2. Roughness Coefficient: $u = 1.49*R^{2/3}*S^{1/2}/n$ b) Manning's $n$ from Stream Type (Fig. 2-20) $n = 0.057$						ft / sec	148.81	cfs	
2. Roughness Coefficient: $u = 1.49 \times R^{2/3} \times S^{1/2}$ c) Manning's $n$ from Jarrett (USGS): $n = 0.39 \times S^{0.38} \times R^{-6}$ Note: This equation is applicable to steep, step/pool, high boundary					2.89	ft / sec	77.10	cfs	
roughness, cobb	ele- and boulder-dominated	stream systems	$a_{\text{s; i.e., for}}$ $n =$	0.110					
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)  Darcy-Weisbach (Leopold, Wolman and Miller)						ft / sec	204.78	cfs	
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Chezy C						ft / sec	0.00	cfs	
4. Continuity Equations: a) Regional Curves $u = Q / A$ Return Period for Bankfull Discharge $Q = 0.0$ year					0.00	ft / sec	0.00	cfs	
4. Continuity Equations: b) USGS Gage Data u = Q / A						ft / sec	0.00	cfs	
	1 Height Options for t								
For <b>sand-bed</b> channels: Measure 100 <b>"protrusion heights"</b> of sand dunes from the downstream side of feature to the top of Option 1. feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1.									
Option 2. For <b>boulder-dominated</b> channels: Measure 100 <b>"protrusion heights"</b> of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1.									
Option 3. For <b>bedrock-dominated</b> channels: Measure 100 <b>"protrusion heights"</b> of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the $D_{84}$ bedrock protrusion height in ft for the $D_{84}$ term in method 1.									
Option 4. For <b>log-influenced</b> channels: Measure " <b>protrustion heights</b> " proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the $D_{84}$ protrusion height in ft for the $D_{84}$ term in method 1.									

Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	Stream Type: <b>C 4b</b>						
Location:		Reach 1			Valley Type: <b>VIII</b>						
Observer		Lucas Bab			Date: <b>05/11/2015</b>						
Enter Required Information for Existing Condition											
41.	.0	D 50	D <sub>50</sub> Median particle size of riffle bed material (mm)								
0.0	0	D 50									
0.79	91	D <sub>max</sub>	Largest particle from b	oar sample (ft)	241	(mm)	304.8 mm/ft				
0.04	300	S	Existing bankfull water surface slope (ft/ft)								
1.1	8	d	Existing bankfull mean depth (ft)								
1.6	55	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gravity of sediment								
Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress											
0.0	00	$D_{50}/D_{50}^{\wedge}$	$D_{50}/D_{50}^{\wedge}$ Range: 3-7 Use EQUATION 1: $\tau^* = 0.0834 (D_{50}/D_{50}^{\wedge})^{-0}$								
5.8	88	$D_{\rm max}/D_{50}$	$_{\text{max}}/D_{50}$ Range: 1.3 – 3.0 Use EQUATION 2: $\tau^* = 0.0384 (D_{\text{max}}/D_{50})^{-1}$								
	τ*		Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A				
Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample											
	d Required bankfull mean depth (ft) $d = \frac{\mathcal{T} * (\gamma_s - 1) D_{\text{max}}}{S}$ (use $D_n$					D <sub>max</sub> in ft)					
Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample											
<b>S</b> Requi			Required bankfull water	Required bankfull water surface slope (ft/ft) $\mathbf{S} = \frac{\mathcal{T}^*(\gamma_s - 1)D_{\text{max}}}{\mathbf{d}}$ (use $D_{\text{max}}$ in ft)							
		Check:	☐ Stable ☐ Aggradii	ng 🔽 Degrading							
Sedime	nt Con	petence U	sing Dimensional Shea	r Stress							
3.10	66		hear stress $\tau = \gamma dS$ (lbs/ft <sup>2</sup>		dius, R, with	mean depth,	d )				
Shields	СО	γ = 62.4, d = existing depth, S = existing slope									
259.1	354.8	Predicted largest moveable particle size (mm) at bankfull shear stress τ (Figure 3-11)									
Shields <b>2.954</b>	CO <b>1.871</b>	Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)									
Shields	СО	Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm) $\mathbf{d} = \frac{\tau}{2}$									
1.10	0.70	$\tau$ = predicted shear stress, $\gamma$ = 62.4, S = existing slope									
Shields <b>0.0401</b>	CO <b>0.0254</b>	Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm)  T = predicted shear stress $V = 62.4$ d = existing depth  S = $\frac{\tau}{V d}$									
$\tau$ = predicted shear stress, $\gamma$ = 62.4, d = existing depth $\gamma$ Check: □ Stable □ Aggrading ☑ Degrading											
Olicer.   Otable   Aggrading   Degrading											

Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:	Fourmile	Canyon Creek	S	tream Type:	D4a						
Location:	Reach 2		,	Valley Type:	XIII						
Observers:	Lucas Bal	bbitt		Date:	05/11/2015	5					
Enter Requ	ired Informati	ion for Existing Condit	ion								
41.0	D 50	Median particle size o	f riffle bed material (mr	m)							
0.0	D 50	Median particle size o	f bar or sub-pavement	sample (mr	n)						
0.791	D <sub>max</sub>	Largest particle from I	oar sample (ft)	241	(mm)	304.8 mm/ft					
0.05000	S	Existing bankfull wate	r surface slope (ft/ft)								
1.18	d	Existing bankfull mea	n depth (ft)								
1.65	$\gamma_s - \gamma / \gamma$	Immersed specific gra	avity of sediment								
Select the	Appropriate E	quation and Calculate	Critical Dimensionles	s Shear St	ress						
0.00	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>)</b> ^) -0.872					
5.88	$D_{\text{max}}/D_{50}$	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>					
	τ*	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A					
Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample											
d Required bankfull mean depth (ft) $d = \frac{\mathcal{T} * (\gamma_s - 1) D_{\text{max}}}{S}$ (use $D_{\text{max}}$ in ft)											
Calculate E	Sankfull Water	Surface Slope Require	ed for Entrainment of	Largest Pa	article in Ba	ır Sample					
	S	Required bankfull water	surface slope (ft/ft) <b>S</b> =	$\frac{\mathcal{T}^*(\gamma_s - 1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)					
	Check:	☐ Stable ☐ Aggradi	ing ☑ Degrading								
Sediment C	ompetence U	Ising Dimensional She	ar Stress								
3.682		shear stress $\tau = \gamma dS$ (lbs/ft	•	dius, R, with	mean depth,	d )					
Shields Co	)	d = existing depth, S = exis									
303.2 396	5.5	largest moveable particle s	size (mm) at bankfull shea	ar stress τ (F	igure 3-11)						
Shields CO 2.954 1.871 Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)											
Shields Co	••	mean depth required to ini		red $D_{\rm max}$ (mi	$\mathbf{d} = \frac{1}{2}$						
0.95 0.6 Shields C0	t predic	cted shear stress, $\gamma = 62.4$ ,	<u> </u>	(mm)	<del></del>	/ <b>o</b>					
0.0401 0.02		slope required to initiate material shear stress, $\gamma = 62.4$ ,	·	max (IIIIII)	$S = \frac{\tau}{\gamma d}$						
	t prodic	☐ Stable ☐ Aggradi			, -						

Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	tream Type:	F 4b					
Location:		Reach 3		,	Valley Type:	XIII					
Observers	S:	Lucas Bab	bitt		Date:	08/20/2015	5				
Enter Re	quire	d Informati	on for Existing Conditi	on							
41.0	)	D 50	Median particle size o	f riffle bed material (mr	m)						
0.0		D 50	Median particle size o	f bar or sub-pavement	sample (mr	n)					
0.79	1	D <sub>max</sub>	Largest particle from b	par sample (ft)	241	(mm)	304.8 mm/ft				
0.044	00	S	Existing bankfull wate	r surface slope (ft/ft)							
1.25	5	d	Existing bankfull mear	n depth (ft)							
1.65	5	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	vity of sediment							
Select th	е Арр	ropriate Ed	quation and Calculate	Critical Dimensionles	s Shear St	ress					
0.00	)	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>)</b> ^) -0.872				
5.88	3	D <sub>max</sub> /D <sub>50</sub>	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>				
		τ*	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A				
Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample											
d Required bankfull mean depth (ft) $d = \frac{\mathcal{T}^*(\gamma_s - 1)D_{\text{max}}}{S}$ (use $D_{\text{max}}$ in ft)											
Calculate	e Banl	kfull Water	Surface Slope Require	ed for Entrainment of	Largest Pa	rticle in Ba	r Sample				
		S	Required bankfull water	surface slope (ft/ft) <b>\$</b> =	$\frac{\mathcal{T}^*(\gamma_s - 1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)				
		Check:	☐ Stable ☑ Aggradi	ng □ Degrading							
Sedimen	nt Com	petence U	sing Dimensional Shea	ar Stress							
3.43	2		hear stress $\tau = \gamma ds$ (lbs/ft		dius, R, with	mean depth,	d )				
Shields	CO	$\gamma = 62.4, 0$	d = existing depth, S = exis	urig siope							
	376.5	Predicted	largest moveable particle s	size (mm) at bankfull shea	ar stress τ (F	igure 3-11)					
Shields CO 2.954 1.871 Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)											
Shields	CO		mean depth required to init		red $D_{max}$ (mi	$\mathbf{d} = \frac{7}{2}$	T S				
1.08 Shields	0.68 CO	•	ted shear stress, $\gamma$ = 62.4, slope required to initiate m	<u> </u>	(mm)	<u> </u>	/ <b>J</b>				
	0.0240		slope required to initiate matter that the shear stress, $\gamma = 62.4$ ,	·	max (IIIIII)	$S = \frac{\iota}{\gamma d}$					
			☐ Stable ☑ Aggradi			,					

Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	tream Type:	B 4					
Location:		Reach 4		,	Valley Type:	XIII					
Observers	<b>3</b> :	Lucas Bab	bitt		Date:	08/20/2015	5				
Enter Re	quire	d Informati	on for Existing Conditi	on							
41.0	0	D 50	Median particle size o	f riffle bed material (mr	m)						
0.0		D 50	Median particle size o	f bar or sub-pavement	sample (mr	n)					
0.79	1	D <sub>max</sub>	Largest particle from b	oar sample (ft)	241	(mm)	304.8 mm/ft				
0.044	00	S	Existing bankfull wate	r surface slope (ft/ft)							
1.25	5	d	Existing bankfull mear	n depth (ft)							
1.65	5	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	avity of sediment							
Select th	іе Арр	ropriate Ed	quation and Calculate	Critical Dimensionles	s Shear St	ress					
0.00	0	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	34 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>)</b> ^) -0.872				
5.88	В	D <sub>max</sub> /D <sub>50</sub>	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	34 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>				
		τ*	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A				
Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample											
d Required bankfull mean depth (ft) $d = \frac{\mathcal{T}^*(\gamma_s - 1)D_{\text{max}}}{S}$ (use $D_{\text{max}}$ in ft)											
Calculate	e Banl	kfull Water	Surface Slope Require	ed for Entrainment of	Largest Pa	article in Ba	ar Sample				
		S	Required bankfull water	surface slope (ft/ft) <b>S</b> =	$\frac{\mathcal{T}^*(\gamma_s - 1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)				
		Check:	✓ Stable  ☐ Aggradi	ng □ Degrading							
Sedimen	nt Com	petence U	sing Dimensional Shea	ar Stress							
3.43	2		hear stress $\tau = \gamma dS$ (lbs/ft	•	dius, R, with	mean depth,	d )				
Shields	СО	$\gamma = 62.4, c$	d = existing depth, S = exis	ting slope							
281.8	376.5	Predicted	largest moveable particle s	size (mm) at bankfull shea	ar stress τ (F	igure 3-11)					
Shields CO 2.954 1.871 Predicted shear stress required to initiate movement of measured D <sub>max</sub> (mm) (Figure 3-11)											
Shields	CO		mean depth required to init		red $D_{\rm max}$ (mi	$\mathbf{d} = \frac{7}{2}$	T				
1.08 Shields	0.68 CO	•	ted shear stress, $\gamma = 62.4$ ,	• .	/mm\	<del></del>	/ <b>ວ</b>				
	). <b>0240</b>		slope required to initiate m ted shear stress, $\gamma = 62.4$ ,	·	max (IIIIII)	$S = \frac{\tau}{\gamma d}$					
			✓ Stable ☐ Aggradi			,					

Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	tream Type:						
Location:		Reach 5	<del>-</del>	,	Valley Type:	VIII					
Observers:	:	Lucas Bab	bitt		Date:	08/20/2015	;				
Enter Red	quire	d Informati	on for Existing Condit	ion							
41.0	)	D 50	Median particle size o	of riffle bed material (mr	n)						
0.0		D 50	Median particle size o	of bar or sub-pavement	sample (mr	m)					
0.791	1	D <sub>max</sub>	Largest particle from l	bar sample (ft)	241	(mm)	304.8 mm/ft				
0.0430	00	S	Existing bankfull wate	er surface slope (ft/ft)							
1.25	5	d	Existing bankfull mea	n depth (ft)							
1.65	5	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	avity of sediment							
Select the	е Арр	ropriate Ed	quation and Calculate	Critical Dimensionles	s Shear St	ress					
0.00	)	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>)</b> ^) -0.872				
5.88	3	D <sub>max</sub> /D <sub>50</sub>	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>				
		τ*	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A				
Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample											
		d	Required bankfull mean	depth (ft) $d = \frac{\tau}{\tau}$	$*(\gamma_{s}-1)D_{n}$ S	use (use	D <sub>max</sub> in ft)				
Calculate	e Banl	kfull Water	Surface Slope Require	ed for Entrainment of	Largest Pa	rticle in Ba	ır Sample				
		s	Required bankfull water	surface slope (ft/ft) <b>S</b> =	$\frac{\mathcal{T}^*(\gamma_s - 1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)				
		Check:	✓ Stable  ☐ Aggradi	ing □ Degrading							
Sediment	t Com	petence U	sing Dimensional She	ar Stress							
3.354	4		hear stress $\tau = \gamma dS$ (lbs/ft	•	dius, R, with	mean depth,	d )				
Shields	CO		d = existing depth, S = exis								
	370.2	Predicted	largest moveable particle s	size (mm) at bankfull shea	ar stress τ (F	igure 3-11)					
Shields CO 2.954 1.871 Predicted shear stress required to initiate movement of measured D <sub>max</sub> (mm) (Figure 3-11)											
	CO		mean depth required to ini		red $D_{\rm max}$ (mi	$\mathbf{d} = \frac{1}{2}$					
	0.70 CO		ted shear stress, $\gamma = 62.4$ ,	<u> </u>	(mm)	<u> </u>	/3				
	.0240		slope required to initiate m ted shear stress, $\gamma$ = 62.4,	·	max (IIIIII)	$S = \frac{\tau}{\gamma d}$					
			✓ Stable ☐ Aggradi			,					

Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Location:         Reach 6         Valley Type: XIII           Observers:         Lucas Babbitt         Date: 08/20/2015           Enter Required Information for Existing Condition         39.0 $D_{50}$ Median particle size of riffle bed material (mm)           0.0 $D_{50}^{\circ}$ Median particle size of bar or sub-pavement sample (mm)           0.764 $D_{max}$ Largest particle from bar sample (ft)         233         (mm)         304.8 mm/ft           0.04000         S         Existing bankfull water surface slope (ft/ft)         233         (mm)         304.8 mm/ft           1.18         d         Existing bankfull water surface slope (ft/ft)         233         (mm)         304.8 mm/ft           1.18         d         Existing bankfull water surface slope (ft/ft)         233         (mm)         304.8 mm/ft           1.18         d         Existing bankfull water surface slope (ft/ft)         240.8 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft         240.2 mm/ft	Stream:	Fourmile (	Canyon Creek	5	Stream Type:	C4	
Enter Required Information for Existing Condition         39.0 $D_{50}$ Median particle size of riffle bed material (mm)           0.0 $D_{50}^{^{^{\circ}}}$ Median particle size of bar or sub-pavement sample (mm)           0.764 $D_{max}$ Largest particle from bar sample (ft)         233         (mm)         304.8 mm/ft           0.04000         S         Existing bankfull water surface slope (ft/ft)         1.18         d         Existing bankfull mean depth (ft)           1.65         γ <sub>5</sub> -γ/γ         Immersed specific gravity of sediment           Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress           0.00 $D_{50}/D_{50}^{^{\circ}}$ Range: 3 - 7         Use EQUATION 1: $\tau^* = 0.0834$ ( $D_{50}/D_{50}^{^{\circ}}$ ) $^{-0.872}$ 5.97 $D_{max}/D_{50}$ Range: 1.3 - 3.0         Use EQUATION 2: $\tau^* = 0.0384$ ( $D_{max}/D_{50}/D_{50}^{^{\circ}}$ ) $^{-0.872}$ 5.97 $D_{max}/D_{50}$ Range: 1.3 - 3.0         Use EQUATION 2: $\tau^* = 0.0384$ ( $D_{max}/D_{50}/D_{50}^{^{\circ}}$ ) $^{-0.872}$ 5.97 $D_{max}/D_{50}$ Range: 1.3 - 3.0         Use EQUATION 2: $\tau^* = 0.0384$ ( $D_{max}/D_{50}/D_{50}^{^{\circ}}$ ) $^{-0.872}$ 6         Required bankfull mean depth (ft) $d_{max}/D_{50}/D_{50}/D_{50}^{^{\circ}}$ (use $D_{max}/D_{50}/D_{50}/D_{50}/D_{50}/D_{50}/D_{50}/D_{50}/D_{50}/D_{50}/D_{50}/D_{50}/D_{50}/D_{50}/D_{$	Location:	Reach 6			Valley Type:	XIII	
39.0 $D_{50}$ Median particle size of riffle bed material (mm)  0.0 $D_{50}^{\wedge}$ Median particle size of bar or sub-pavement sample (mm)  0.764 $D_{max}$ Largest particle from bar sample (ft) 233 (mm) 304.8 mm/ft  0.04000 $S$ Existing bankfull water surface slope (ft/ft)  1.18 $d$ Existing bankfull mean depth (ft)  1.18 $d$ Existing bankfull mean depth (ft)  1.19 $D_{50}^{\wedge}$ Immersed specific gravity of sediment  Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress  0.00 $D_{50}/D_{50}^{\wedge}$ Range: 3 – 7 Use EQUATION 1: $\tau^* = 0.0834$ ( $D_{50}/D_{50}^{\wedge}$ ) $-0.872$ 5.97 $D_{max}/D_{50}$ Range: 1.3 – 3.0 Use EQUATION 2: $\tau^* = 0.0384$ ( $D_{max}/D_{50}$ ) $-0.887$ $\tau^*$ Bankfull Dimensionless Shear Stress EQUATION USED: N/A  Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample $d$ Required bankfull water surface slope (ft/ft) $d = \frac{\mathcal{T}^*(\gamma_* - 1)D_{max}}{S}$ (use $D_{max}$ in ft)  Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample $S$ Required bankfull water surface slope (ft/ft) $S = \frac{\mathcal{T}^*(\gamma_* - 1)D_{max}}{d}$ (use $D_{max}$ in ft)  Check: $\Box$ Stable $\overline{\lor}$ Aggrading $\Box$ Degrading  Sediment Competence Using Dimensional Shear Stress  2.945 Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4$ , $d = existing$ depth, $S = existing$ slope  Shields $CO$ Predicted largest moveable particle size (mm) at bankfull shear stress $\tau$ (Figure 3-11)  Shields $CO$ Predicted shear stress $\tau = 62.4$ , $S = existing$ slope  1.15 0.72 $\tau = predicted$ shear stress, $\gamma = 62.4$ , $S = existing$ slope  Shields $CO$ Predicted shear stress, $\gamma = 62.4$ , $S = existing$ slope  Predicted slope required to initiate movement of measured $D_{max}$ (mm) $\tau = \frac{\tau}{\gamma S}$	Observers:	Lucas Bab	bitt		Date:	08/20/2015	1
0.0 $D_{s0}^{\bullet}$ Median particle size of bar or sub-pavement sample (mm)  0.764 $D_{max}$ Largest particle from bar sample (ft)  0.04000 $S$ Existing bankfull water surface slope (ft/ft)  1.18 $d$ Existing bankfull mean depth (ft)  1.65 $Y_s - Y/Y$ Immersed specific gravity of sediment  Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress  0.00 $D_{s0}/D_{s0}^{\bullet}$ Range: 3 − 7 Use EQUATION 1: $\tau^* = 0.0834$ ( $D_{s0}/D_{s0}^{\bullet}$ ) $^{-0.872}$ 5.97 $D_{max}/D_{s0}$ Range: 1.3 − 3.0 Use EQUATION 2: $\tau^* = 0.0384$ ( $D_{max}/D_{s0}^{\bullet}$ ) $^{-0.887}$ $\tau^*$ Bankfull Dimensionless Shear Stress EQUATION USED: N/A  Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample $d$ Required bankfull mean depth (ft) $d = \frac{\tau^*(\gamma_s - 1)D_{max}}{S}$ (use $D_{max}$ in ft)  Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample $S$ Required bankfull water surface slope (ft/ft) $S = \frac{\tau^*(\gamma_s - 1)D_{max}}{S}$ (use $D_{max}$ in ft)  Check: $\Box$ Stable $\Box$ Aggrading $\Box$ Degrading  Sediment Competence Using Dimensional Shear Stress  2.945 Sankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4$ , d = existing depth, S = existing slope  Shields $\Box$ Predicted largest moveable particle size (mm) at bankfull shear stress $\tau$ (Figure 3-11)  Shields $\Box$ Predicted mean depth required to initiate movement of measured $D_{max}$ (mm) (Figure 3-11)  Shields $\Box$ Predicted shear stress required to initiate movement of measured $D_{max}$ (mm) $d = \frac{\tau}{\gamma S}$ Shields $\Box$ Predicted shear stress, $\gamma = 62.4$ , $S = existing slope$ Predicted slope required to initiate movement of measured $D_{max}$ (mm) $D_{max}$ (mm) $D_{max}$ (mm) $D_{max}$ (mm) $D_{max}$ (mm)	Enter Requ	uired Informati	on for Existing Condition				
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	39.0	D 50	Median particle size of riffle bed	d material (m	m)		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	0.0	D <sub>50</sub>	Median particle size of bar or s	ub-pavement	sample (mr	n)	
1.18	0.764	D <sub>max</sub>	Largest particle from bar sample	e (ft)	233	(mm)	
1.65 $\gamma_s - \gamma/\gamma$ Immersed specific gravity of sediment  Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress  0.00 $D_{50}/D_{50}$ Range: 3 - 7 Use EQUATION 1: $\tau^* = 0.0834$ ( $D_{50}/D_{50}^*$ ) $^{-0.872}$ 5.97 $D_{max}/D_{50}$ Range: 1.3 - 3.0 Use EQUATION 2: $\tau^* = 0.0384$ ( $D_{max}/D_{50}^*$ ) $^{-0.887}$ $\tau^*$ Bankfull Dimensionless Shear Stress EQUATION USED: N/A  Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample $d$ Required bankfull mean depth (ft) $d = \frac{\tau^*(\gamma_* - 1)D_{max}}{S}$ (use $D_{max}$ in ft)  Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample $g$ Required bankfull water surface slope (ft/ft) $g$ $f$ $f$ $f$ $f$ $f$ $f$ $f$ $f$ $f$ $f$	0.04000	S	Existing bankfull water surface	slope (ft/ft)			
Select the Appropriate Equation and Calculate Critical Dimensionless Shear Stress  0.00 $D_{so}/D_{so}^{c}$ Range: 3 - 7 Use EQUATION 1: $\tau^* = 0.0834$ ( $D_{so}/D_{so}^{c}$ ) $^{-0.872}$ 5.97 $D_{max}/D_{50}$ Range: 1.3 - 3.0 Use EQUATION 2: $\tau^* = 0.0384$ ( $D_{max}/D_{50}$ ) $^{-0.887}$ $\tau^*$ Bankfull Dimensionless Shear Stress EQUATION USED: N/A  Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample  d Required bankfull mean depth (ft) $d = \frac{\tau^*(\gamma_s - 1)D_{max}}{s}$ (use $D_{max}$ in ft)  Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample  S Required bankfull water surface slope (ft/ft) $S = \frac{\tau^*(\gamma_s - 1)D_{max}}{d}$ (use $D_{max}$ in ft)  Check: Stable Aggrading Degrading  Sediment Competence Using Dimensional Shear Stress  2.945 Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4$ , d = existing depth, S = existing slope  Shields CO Predicted largest moveable particle size (mm) at bankfull shear stress $\tau$ (Figure 3-11)  Shields CO Predicted shear stress required to initiate movement of measured $D_{max}$ (mm) (Figure 3-11)  Shields CO Predicted mean depth required to initiate movement of measured $D_{max}$ (mm) $d = \frac{\tau}{\gamma S}$ Shields CO Predicted shear stress, $\gamma = 62.4$ , $S = existing$ slope  Shields CO Predicted shear stress, $\gamma = 62.4$ , $S = existing$ slope	1.18	d	Existing bankfull mean depth (f	t)			
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	1.65	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gravity of se	diment			
5.97 $D_{max}/D_{50}$ Range: 1.3 – 3.0 Use EQUATION 2: $\tau^*$ = 0.0384 ( $D_{max}/D_{50}$ ) $^{-0.887}$ $\tau^*$ Bankfull Dimensionless Shear Stress EQUATION USED: N/A  Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample  d Required bankfull mean depth (ft) $d = \frac{\tau^*(\gamma_s - 1)D_{max}}{S}$ (use $D_{max}$ in ft)  Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample  S Required bankfull water surface slope (ft/ft) $S = \frac{\tau^*(\gamma_s - 1)D_{max}}{d}$ (use $D_{max}$ in ft)  Check: □ Stable □ Aggrading □ Degrading  Sediment Competence Using Dimensional Shear Stress  2.945 Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4$ , d = existing depth, S = existing slope  Shields CO 240.3 336.5 Predicted largest moveable particle size (mm) at bankfull shear stress $\tau$ (Figure 3-11)  Shields CO 2.86 1.787 Predicted shear stress required to initiate movement of measured $D_{max}$ (mm) (Figure 3-11)  Shields CO Predicted mean depth required to initiate movement of measured $D_{max}$ (mm) $d = \frac{\tau}{\gamma S}$ Shields CO Predicted shear stress, $\gamma = 62.4$ , S = existing slope  Shields CO Predicted shear stress, $\gamma = 62.4$ , S = existing slope	Select the	Appropriate E	quation and Calculate Critical D	imensionles	s Shear St	ress	
	0.00	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7 Use E	QUATION 1:	$\tau^* = 0.083$	34 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>)</b> ^) -0.872
Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample  d Required bankfull mean depth (ft) $d = \frac{\mathcal{T} * (\gamma_s - 1) D_{max}}{S}$ (use $D_{max}$ in ft)  Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample  S Required bankfull water surface slope (ft/ft) $S = \frac{\mathcal{T} * (\gamma_s - 1) D_{max}}{d}$ (use $D_{max}$ in ft)  Check: $\square$ Stable $\square$ Aggrading $\square$ Degrading  Sediment Competence Using Dimensional Shear Stress  2.945 Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4$ , $\gamma = 62.4$	5.97	$D_{\rm max}/D_{50}$	Range: 1.3 – 3.0 Use E	QUATION 2:	$\tau^* = 0.038$	4 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>
d Required bankfull mean depth (ft) $d = \frac{\mathcal{T}^*(\gamma_s - 1)D_{max}}{S}$ (use $D_{max}$ in ft) Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample  S Required bankfull water surface slope (ft/ft) $S = \frac{\mathcal{T}^*(\gamma_s - 1)D_{max}}{d}$ (use $D_{max}$ in ft) Check: $\square$ Stable $\square$ Aggrading $\square$ Degrading  Sediment Competence Using Dimensional Shear Stress  2.945 Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4$ ,		τ*	Bankfull Dimensionless Shear Stre	ess	EQUATIO	ON USED:	N/A
Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle in Bar Sample  S Required bankfull water surface slope (ft/ft) $S = \frac{\mathcal{T} * (\gamma_s - 1) D_{max}}{d}$ (use $D_{max}$ in ft)  Check: Stable Aggrading Degrading  Sediment Competence Using Dimensional Shear Stress  2.945 Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4$ , $d = existing depth$ , $S = existing slope$ Shields CO 240.3 336.5 Predicted largest moveable particle size (mm) at bankfull shear stress $\tau$ (Figure 3-11)  Shields CO 2.86 1.787 Predicted shear stress required to initiate movement of measured $D_{max}$ (mm) (Figure 3-11)  Shields CO 1.15 0.72 Predicted mean depth required to initiate movement of measured $D_{max}$ (mm) $\tau = \text{predicted shear stress}$ , $\gamma = 62.4$ , $S = \text{existing slope}$ Shields CO Predicted slope required to initiate movement of measured $D_{max}$ (mm) $\tau = \text{predicted shear stress}$ , $\tau = 62.4$ , $\tau = \text{predicted shear stress}$ and $\tau = \frac{\tau}{\gamma S}$	Calculate B	ankfull Mean D	epth Required for Entrainment o	f Largest Pa	ticle in Bar	Sample	
Required bankfull water surface slope (ft/ft) $S = \frac{T * (\gamma_s - 1)D_{max}}{d}$ (use $D_{max}$ in ft) $T *$		d	Required bankfull mean depth (ft)	$d = \frac{T}{T}$	$\frac{*(\gamma_s - 1)D_r}{S}$	max (use	D <sub>max</sub> in ft)
Check: Stable Aggrading Degrading  Sediment Competence Using Dimensional Shear Stress  2.945  Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4, d = \text{existing depth}, S = \text{existing slope}$ Shields  CO  240.3 336.5  Predicted largest moveable particle size (mm) at bankfull shear stress $\tau$ (Figure 3-11)  Shields  CO  2.86 1.787  Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)  Shields  CO  Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted shear stress}, \gamma = 62.4, S = \text{existing slope}$ Shields  CO  Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted shear stress}, \gamma = 62.4, S = \text{existing slope}$ Shields  CO  Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted slope required to initiate movement of measured } D_{\text{max}}$ (mm) $\tau = \frac{\tau}{\gamma S}$	Calculate E	Bankfull Water	Surface Slope Required for En	trainment of	Largest Pa	article in Ba	ır Sample
Sediment Competence Using Dimensional Shear Stress  2.945  Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4, d = \text{existing depth}, S = \text{existing slope}$ Shields CO 240.3 336.5  Predicted largest moveable particle size (mm) at bankfull shear stress $\tau$ (Figure 3-11)  Shields CO 2.86 1.787  Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)  Shields CO 1.15 0.72  Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted shear stress}, \gamma = 62.4, S = \text{existing slope}$ Shields CO Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted shear stress}, \gamma = 62.4, S = \text{existing slope}$ Shields CO Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted slope required to initiate movement of measured } D_{\text{max}}$ (mm) $S = \frac{\tau}{\gamma}$		s	Required bankfull water surface sle	ope (ft/ft) <b>S</b> =	$=\frac{\tau^*(\gamma_s-1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)
Bankfull shear stress $\tau = \gamma dS$ (lbs/ft²) (substitute hydraulic radius, R, with mean depth, d) $\gamma = 62.4$ , d = existing depth, S = existing slope  Shields CO 240.3 336.5 Predicted largest moveable particle size (mm) at bankfull shear stress $\tau$ (Figure 3-11)  Shields CO 2.86 1.787 Predicted shear stress required to initiate movement of measured $D_{max}$ (mm) (Figure 3-11)  Shields CO 1.15 0.72 Predicted mean depth required to initiate movement of measured $D_{max}$ (mm) $d = \frac{\tau}{\gamma S}$ Shields CO Predicted shear stress, $\gamma = 62.4$ , $S = existing slope$ Shields CO Predicted slope required to initiate movement of measured $D_{max}$ (mm) $T = \text{predicted shear stress},  T = 62.4$ Shields CO Predicted slope required to initiate movement of measured $D_{max}$ (mm) $S = \frac{\tau}{\gamma S}$		Check:	☐ Stable ☑ Aggrading ☐ □	Degrading			
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Sediment (	Competence U	sing Dimensional Shear Stress				
Shields CO 240.3 336.5 Predicted largest moveable particle size (mm) at bankfull shear stress $\tau$ (Figure 3-11)  Shields CO 2.86 1.787 Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)  Shields CO Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm) $d = \frac{\tau}{\gamma S}$ Shields CO Predicted shear stress, $\gamma = 62.4$ , $S = \text{existing slope}$ Shields CO Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $S = \frac{\tau}{\gamma S}$	2.945		• • • • • • • • • • • • • • • • • • • •	ite hydraulic ra	dius, R, with	mean depth,	d )
Shields CO 2.86 1.787 Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)  Shields CO Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted shear stress}, \gamma = 62.4, S = \text{existing slope}$ Shields CO Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted slope required to initiate movement of measured } D_{\text{max}}$ (mm) $\tau = \text{predicted slope required to initiate movement of measured } D_{\text{max}}$ (mm) $\tau = \text{predicted slope required to initiate movement of measured } D_{\text{max}}$ (mm)	Shields C	0					
Predicted shear stress required to initiate movement of measured $D_{\text{max}}$ (mm) (Figure 3-11)  Shields CO Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted shear stress}, \ \gamma = 62.4, \ S = \text{existing slope}$ Shields CO Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau = \text{predicted slope required to initiate movement of measured } D_{\text{max}}$ (mm) $\tau = \text{predicted slope required to initiate movement of measured } D_{\text{max}}$ (mm) $\tau = \text{predicted slope required to initiate movement of measured } D_{\text{max}}$ (mm)		0.0	iargest moveable particle size (mm) a	at bankfull she	ar stress τ (F	·ıgure 3-11)	
1.15 0.72 $\tau$ = predicted shear stress, $\gamma$ = 62.4, S = existing slope Shields CO Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau$ = $\tau$ $\tau$ = predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\tau$ = $\tau$		Dredicted	shear stress required to initiate move	ment of meas	ured $D_{\rm max}$ (m	m) <b>(Figure 3</b>	-11)
Shields CO Predicted slope required to initiate movement of measured $D_{\text{max}}$ (mm) $\mathbf{S} = \frac{\mathbf{T}}{\mathbf{S}}$			mean depth required to initiate move	ment of measu	ired $D_{\rm max}$ (mi		<u>r</u>
$S = \frac{1}{2}$		t – predie		• •	(100.155)	<u> </u>	/S
producted crists, and one of the control of the con					<sub>max</sub> (mm)	$S = \frac{\tau}{\gamma d}$	
Check: ☐ Stable ☑ Aggrading ☐ Degrading		•	·			, -	

Worksheet 3-14. Sediment competence calculation form to assess bed stability.

Stream:		Fourmile C	Canyon Creek	S	tream Type:	F 4b	
Location:		Reach 7		,	Valley Type:	XIII	
Observers	s:	Lucas Bab	bitt		Date:	08/20/2015	3
Enter Re	equire	d Informati	on for Existing Condition	on			
41.0	0	D 50	Median particle size of	riffle bed material (mr	n)		
0.0		D 50	Median particle size of	bar or sub-pavement	sample (mr	m)	
0.79	)1	$D_{max}$	Largest particle from b	ar sample (ft)	241	(mm)	304.8 mm/ft
0.047	'00	S	Existing bankfull water	surface slope (ft/ft)			
1.23	3	d	Existing bankfull mean	depth (ft)			
1.6	5	$\gamma_s$ - $\gamma/\gamma$	Immersed specific grav	vity of sediment			
Select th	пе Арр	ropriate Ed	quation and Calculate C	critical Dimensionles	s Shear St	ress	
0.00	0	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	34 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>P</b> ^\_50) -0.872
5.88	8	$D_{\rm max}/D_{50}$	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	34 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>
		τ*	Bankfull Dimensionless S	Shear Stress	EQUATIO	ON USED:	N/A
Calculate	e Bank	full Mean D	epth Required for Entrai	inment of Largest Par	ticle in Bar	Sample	
		d	Required bankfull mean of	depth (ft) $d = \frac{\tau}{}$	$\frac{*(\gamma_{s}-1)D_{r}}{S}$	use (use	D <sub>max</sub> in ft)
Calculat	e Ban	kfull Water	Surface Slope Require	d for Entrainment of	Largest Pa	article in Ba	ır Sample
		s	Required bankfull water s	surface slope (ft/ft) <b>S</b> =	$\frac{\mathcal{T}^*(\gamma_s - 1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)
		Check:	☐ Stable ☐ Aggradir	ng 🔽 Degrading			
Sedimer	nt Com	petence U	sing Dimensional Shea	r Stress			
3.60	7		hear stress $\tau = \gamma dS$ (lbs/ft <sup>2</sup> ) d = existing depth, S = existi	•	dius, R, with	mean depth,	d )
Shields	СО				or otress = '=	Saura 0 44)	
296.8 Shields	390.6	Predicted	largest moveable particle si	ze (mm) at banktuli shea	ai stress τ (F	rigure 3-11)	
	1.871	Predicted	shear stress required to initi	iate movement of measu	ared $D_{\rm max}$ (m	m) <b>(Figure 3</b>	-11)
Shields	CO	Predicted	mean depth required to initi	ate movement of measu	red $D_{\rm max}$ (mi		
	0.64 CO	•	ted shear stress, $\gamma = 62.4$ , S		(mm)	<u> </u>	<i>'</i> S
Shields 0.0385 0	0. <b>0244</b>		slope required to initiate motentiate ted shear stress, $\gamma$ = 62.4, $\sigma$	·	max (IIIIII)	$S = \frac{\tau}{\gamma d}$	
			☐ Stable ☐ Aggradin			, , , , , , , , , , , , , , , , , , ,	

Worksheet 3-14. Sediment competence calculation form to assess bed stability.

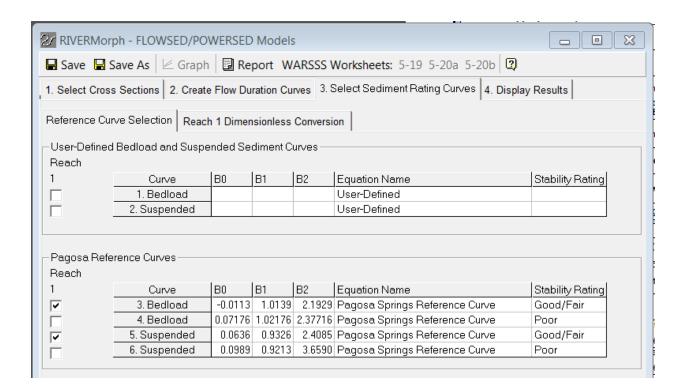
Stream:		Fourmile C	Canyon Creek	S	tream Type:	C 4b					
Location:		Reach 8		,	Valley Type:	XIII					
Observer	s:	Lucas Bab	bitt		Date:	08/20/2015	5				
Enter Re	equire	d Informati	on for Existing Conditi	on							
39.	0	D 50	Median particle size o	f riffle bed material (mr	m)						
0.0	)	D 50	Median particle size o	f bar or sub-pavement	sample (mr	n)					
0.76	64	D <sub>max</sub>	Largest particle from b	oar sample (ft)	233	(mm)	304.8 mm/ft				
0.042	200	S	Existing bankfull wate	r surface slope (ft/ft)							
1.1	8	d	Existing bankfull mear	n depth (ft)							
1.6	5	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	avity of sediment							
Select th	he App	ropriate Ed	quation and Calculate	Critical Dimensionles	s Shear St	ress					
0.0	0	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	34 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>)</b> ^) -0.872				
5.9	7	D <sub>max</sub> /D <sub>50</sub>	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	34 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>				
		τ*	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A				
Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample											
		d	Required bankfull mean	depth (ft) $d = \frac{\tau}{}$	$*(\gamma_{ m s}$ - 1) $D_{ m n}$	use (use	D <sub>max</sub> in ft)				
Calculat	te Banl	kfull Water	Surface Slope Require	ed for Entrainment of	Largest Pa	article in Ba	ar Sample				
		s	Required bankfull water	surface slope (ft/ft) <b>S</b> =	$\frac{\mathcal{T}^*(\gamma_s - 1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)				
		Check:	☐ Stable ☐ Aggradi	ng 🗹 Degrading							
Sedime	nt Com	petence U	sing Dimensional Shea	ar Stress							
3.09	93		hear stress $\tau = \gamma dS$ (lbs/ft	•	dius, R, with	mean depth,	d )				
Shields	CO	y = 62.4, 0	d = existing depth, S = exis	ung slope							
	348.8	Predicted I	largest moveable particle s	size (mm) at bankfull shea	ar stress τ (F	igure 3-11)					
Shields CO 2.86 1.787 Predicted shear stress required to initiate movement of measured D <sub>max</sub> (mm) (Figure 3-11)											
Shields	CO	Predicted	mean depth required to init	tiate movement of measu	red $D_{\rm max}$ (mi	$\mathbf{d} = \frac{1}{2}$					
1.09	0.68	•	ted shear stress, $\gamma = 62.4$ ,	• .	/ra\	?	75				
Shields <b>0.0388</b>	CO <b>0.0243</b>		slope required to initiate m ted shear stress, $\gamma = 62.4$ ,	·	<sub>nax</sub> (mm)	$S = \frac{\tau}{\gamma d}$					
			☐ Stable ☐ Aggradi			1					

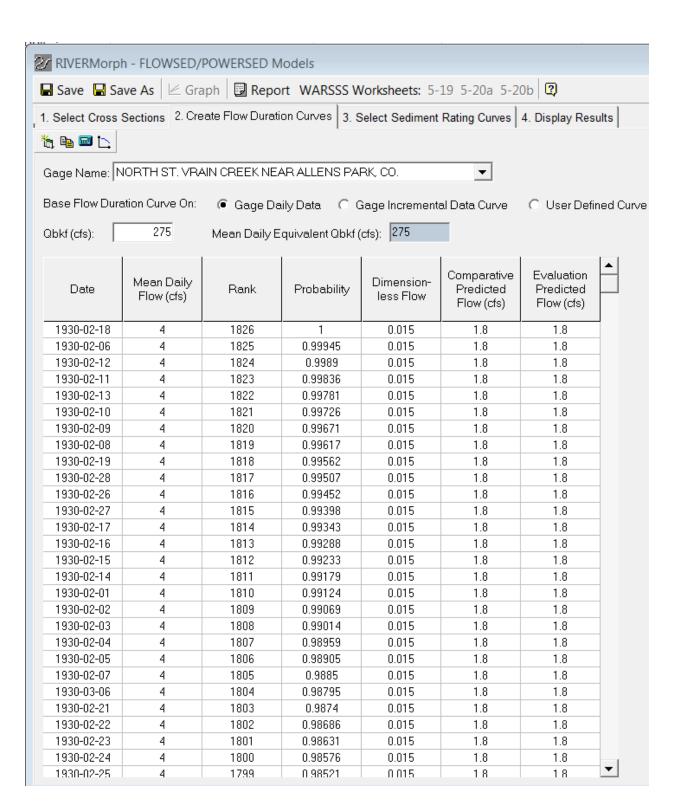
Worksheet 3-14. Sediment competence calculation form to assess bed stability.

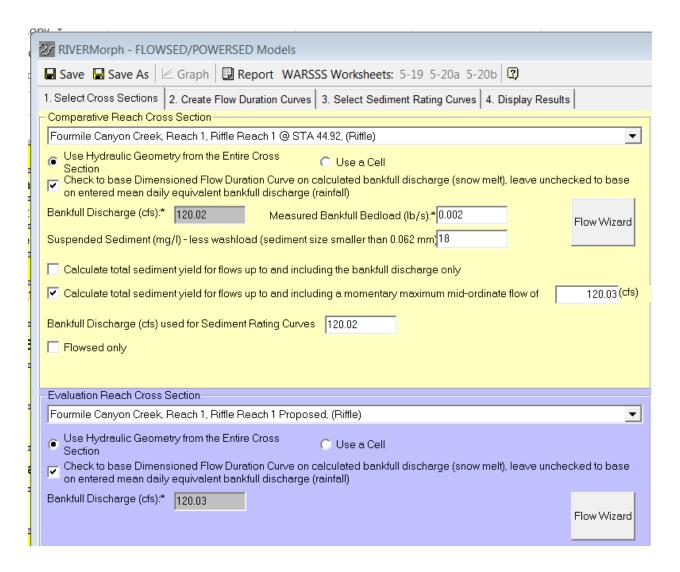
Stream:		Fourmile C	Canyon Creek	S	tream Type:	E 4b	
Location	:	Reach 9		,	Valley Type:	XIII	
Observe	ers:	Lucas Bab	bitt		Date:	08/20/2015	}
Enter R	Require	d Informati	on for Existing Condition	n			
41	.0	D 50	Median particle size of r	riffle bed material (mr	n)		
0.	.0	D <sub>50</sub>	Median particle size of I	par or sub-pavement	sample (mr	m)	
0.7	'91	$D_{max}$	Largest particle from ba	r sample (ft)	241	(mm)	304.8 mm/ft
0.04	300	S	Existing bankfull water	surface slope (ft/ft)			
1.1	18	d	Existing bankfull mean	depth (ft)			
1.6	65	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gravi	ty of sediment			
Select t	the App	ropriate Ed	quation and Calculate C	ritical Dimensionles	s Shear St	ress	
0.0	00	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	34 ( <b>D</b> <sub>50</sub> / <b>L</b>	<b>)</b> ^) -0.872
5.8	88	$D_{\rm max}/D_{50}$	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>
		τ*	Bankfull Dimensionless Sl	near Stress	EQUATIO	ON USED:	N/A
Calcula	te Bank	full Mean D	epth Required for Entrain	nment of Largest Par	ticle in Bar	Sample	
		d	Required bankfull mean de	epth (ft) $d = \frac{\tau}{}$	$*(\gamma_s - 1)D_r$	max (use	D <sub>max</sub> in ft)
Calcula	ate Ban	kfull Water	Surface Slope Required	for Entrainment of	Largest Pa	article in Ba	ır Sample
		S	Required bankfull water so	urface slope (ft/ft) <b>S</b> =	$\frac{\mathcal{T}^*(\gamma_s - 1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)
		Check:	☐ Stable ☐ Aggrading	g 🗹 Degrading			
Sedime	ent Con	npetence U	sing Dimensional Shear	Stress			
3.1	66		hear stress $\tau = \gamma dS$ (lbs/ft <sup>2</sup> ) d = existing depth, S = existing	`	dius, R, with	mean depth,	d )
Shields	CO				or otress = '=	Saura 0 44)	
259.1	354.8 CO	Predicted	largest moveable particle siz	e (mm) at banktull shea	ai stress τ (F	rigure 3-11)	
Shields <b>2.954</b>	1.871	Predicted	shear stress required to initia	ate movement of measu	ared $D_{\rm max}$ (m	m) <b>(Figure 3</b>	-11)
Shields	CO	Predicted	mean depth required to initia	te movement of measu	red D <sub>max</sub> (m		
1.10	<b>0.70</b>		ted shear stress, $\gamma$ = 62.4, S	• .	(mm)	<u> </u>	'S
Shields <b>0.0401</b>	0.0254		slope required to initiate move ted shear stress, $\gamma$ = 62.4, d	·	max (IIIIII)	$S = \frac{\tau}{\gamma d}$	
			☐ Stable ☐ Aggrading			/	

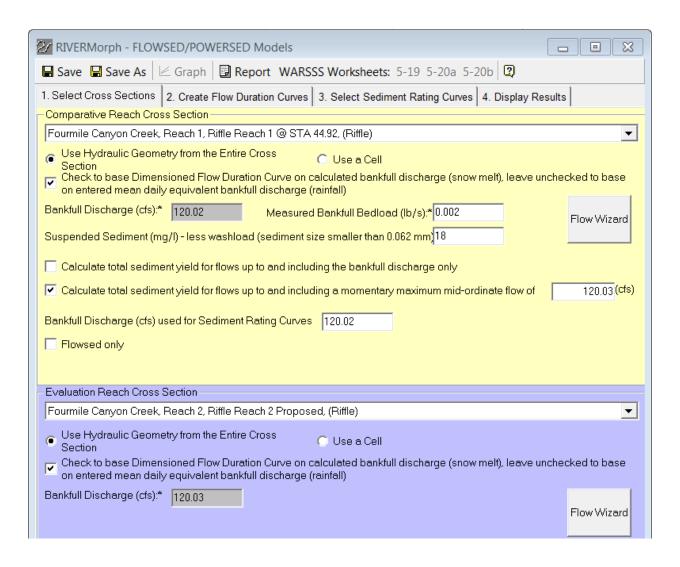
Worksheet 3-14. Sediment competence calculation form to assess bed stability.

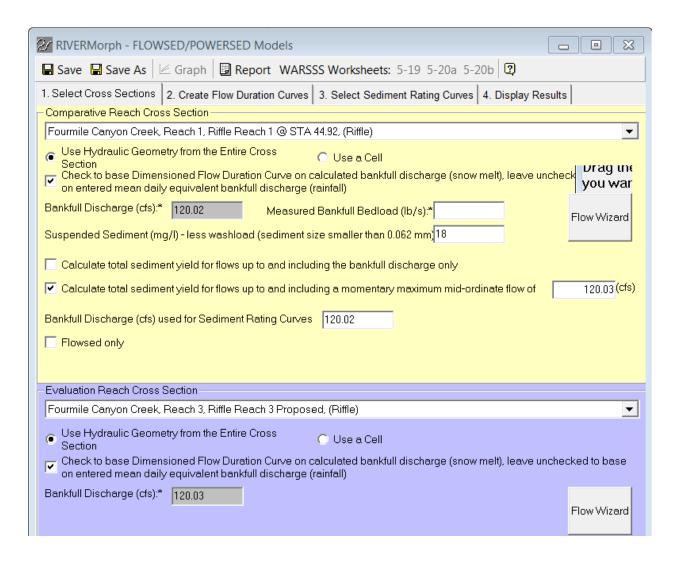
Stream:		Fourmile C	Canyon Creek	S	tream Type:	B 4					
Location	:	Reach 10		,	Valley Type:	XIII					
Observe		Lucas Bab			Date:	08/20/2015	i				
Enter R	Require	d Information	on for Existing Condition	on							
39	.0	D 50	Median particle size of	riffle bed material (mr	n)						
0.	.0	D 50	Median particle size of	bar or sub-pavement	sample (mr	n)					
0.7	64	D <sub>max</sub>	Largest particle from b	ar sample (ft)	233	(mm)	304.8 mm/ft				
0.03	800	S	Existing bankfull water	surface slope (ft/ft)							
1.1	18	d	Existing bankfull mear	n depth (ft)							
1.0	65	$\gamma_s$ - $\gamma/\gamma$	Immersed specific gra	vity of sediment							
Select	the App	ropriate Ed	quation and Calculate (	Critical Dimensionles	s Shear St	ress					
0.0	00	$D_{50}/D_{50}^{\wedge}$	Range: 3 – 7	Use EQUATION 1:	$\tau^* = 0.083$	4 ( <b>D</b> <sub>50</sub> / <b>E</b>	<b>P</b> ^\				
5.9	97	$D_{\rm max}/D_{50}$	Range: 1.3 – 3.0	Use EQUATION 2:	$\tau^* = 0.038$	4 (D <sub>max</sub> /D	<sub>50</sub> ) <sup>-0.887</sup>				
		$ au^*$	Bankfull Dimensionless	Shear Stress	EQUATIO	ON USED:	N/A				
Calculate Bankfull Mean Depth Required for Entrainment of Largest Particle in Bar Sample											
		d	Required bankfull mean	depth (ft) $d = \frac{T}{T}$	$*(\gamma_s - 1)D_r$	use (use	D <sub>max</sub> in ft)				
Calcula	ite Ban	kfull Water	Surface Slope Require	d for Entrainment of	Largest Pa	nrticle in Ba	ır Sample				
		S	Required bankfull water	surface slope (ft/ft) <b>S</b> =	$\frac{\mathcal{T}^*(\gamma_s - 1)}{d}$	) <b>D</b> <sub>max</sub> (use	D <sub>max</sub> in ft)				
		Check:	☐ Stable ☐ Aggradii	ng 🗹 Degrading							
Sedime	ent Con	petence U	sing Dimensional Shea	r Stress							
2.7	98		near stress $\tau = \gamma dS$ (lbs/ft <sup>2</sup>		dius, R, with	mean depth,	d )				
Shields	CO		d = existing depth, S = exist								
227.8	324	Predicted I	largest moveable particle s	ize (mm) at bankfull shea	ar stress τ (F	igure 3-11)					
Shields CO 2.86 1.787 Predicted shear stress required to initiate movement of measured D <sub>max</sub> (mm) (Figure 3-11)											
Shields CO Predicted mean depth required to initiate movement of measured $D_{\text{max}}$ (mm) $\mathbf{d} = \frac{\mathbf{r}}{\mathbf{r}}$											
1.21	0.75		ted shear stress, $\gamma$ = 62.4,	• .		<u> </u>	<i>'</i> S				
Shields <b>0.0388</b>	CO <b>0.0243</b>		slope required to initiate mo	·	<sub>max</sub> (mm)	$S = \frac{\tau}{\gamma d}$					
0.0300	0.0243		ted shear stress, γ = 62.4, ☐ Stable ☐ Aggradii			γu					
		3.13 <b>0</b> 111									

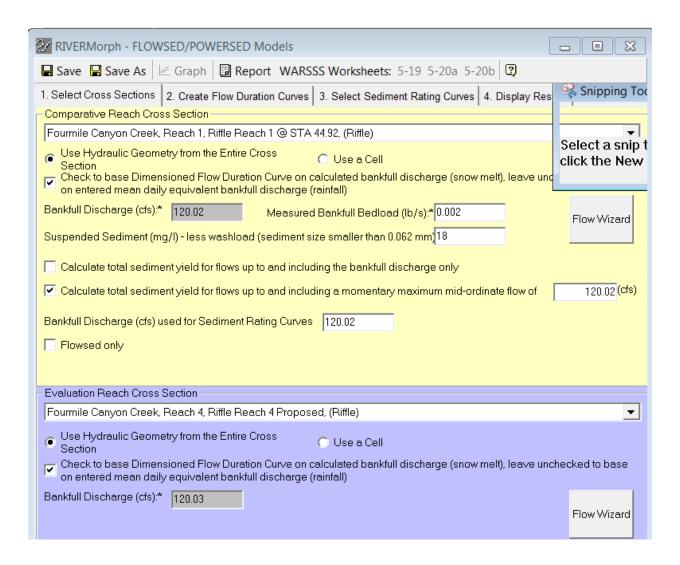


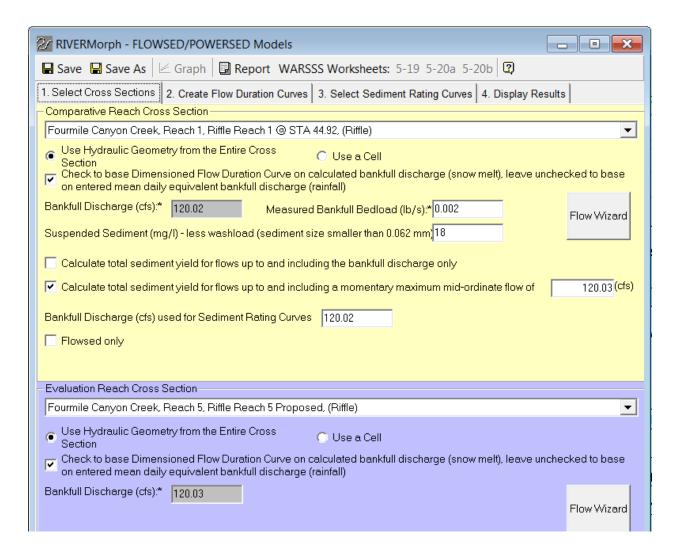


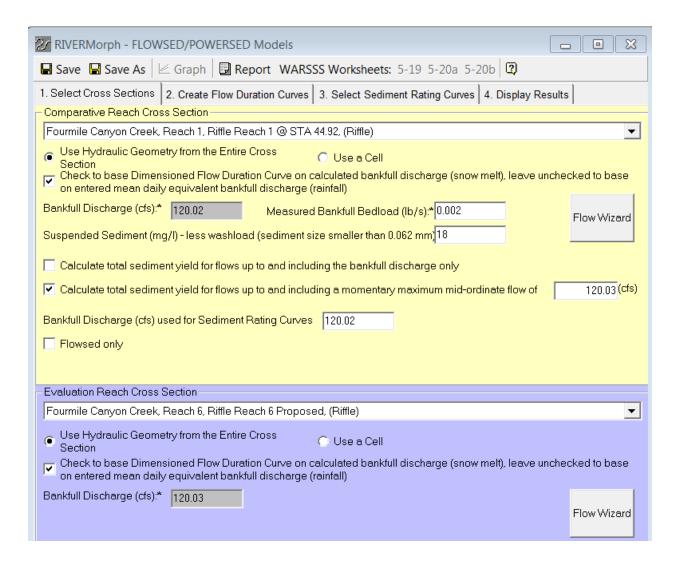


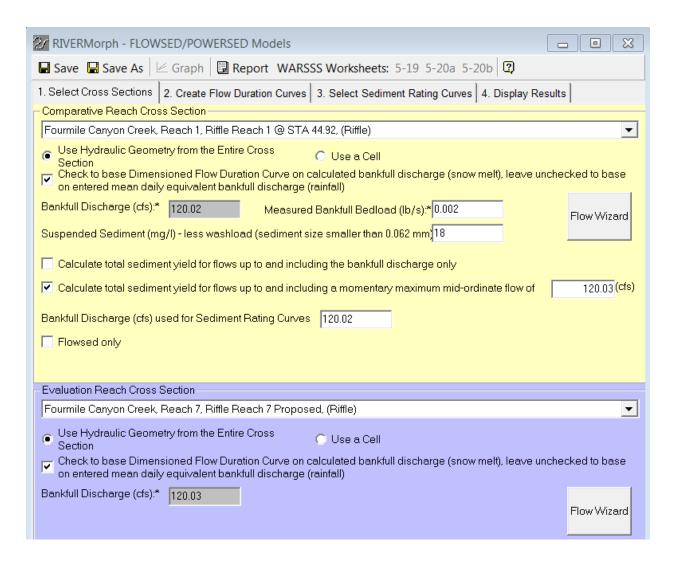


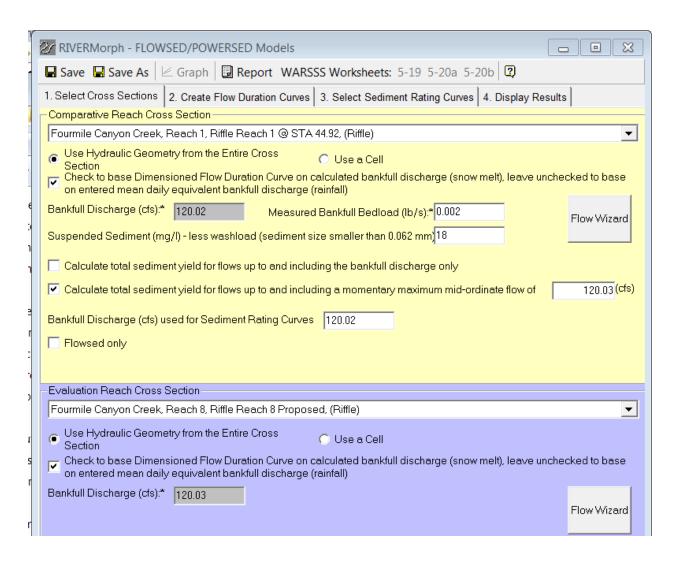


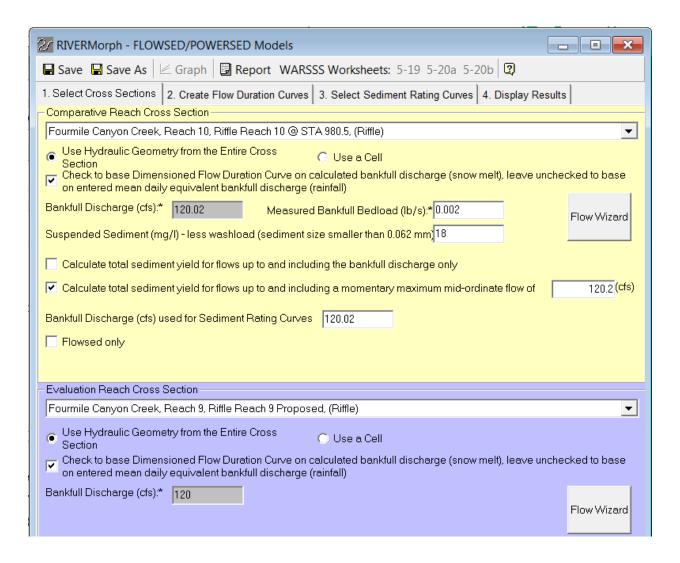


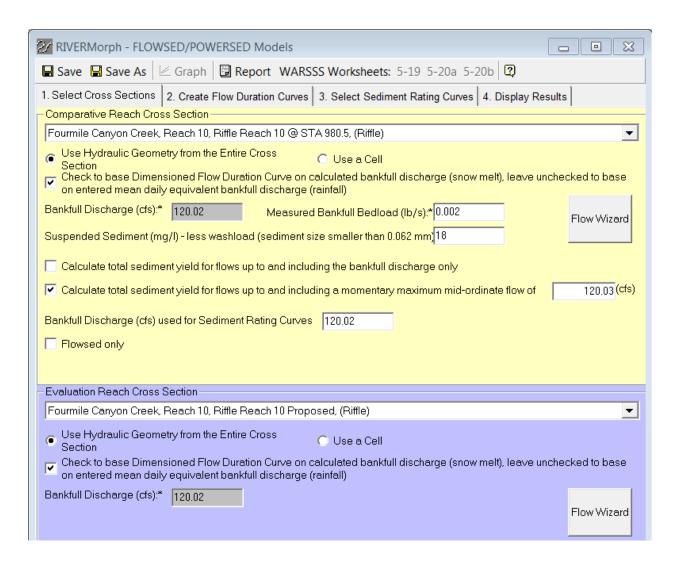












Worksheet 5-19. FLOWSED calculation of total annual sediment yield.

Bedload (dimensionless)     Suspended sediment (dimensionless)     User-defined relations (bedload)     User-defined relations (suspended sediment)  Fro     (1) (2)	Intercept -0.0113 0.0636	t Coefficient 1.0139 0.9326 ensioned flow-d (4)	2.1929 2.4085  uration curve (5) Time increment (days)	Form (e.g., linear Non-Non-Non-Non-Non-Non-Non-Non-Non-Non-	age Station #: linear, non- r, etc.) Linear Linear	Pagosa Sprii Ct Pagosa Sprii Ct	on name ngs Reference urve ngs Reference urve	Bankfull dis	Stream Type: charge (cfs)	Bankfull be	dload (kg/s)	Valley Type: Bankfull s	: 05/11/2015 : VIII suspended ng/l)
Company   Comp	-0.0113 0.0636  from dimens (3) Mid-ordinate	0.9326  nnsioned flow-d  (4)  Time increment (percent)	2.1929 2.4085  uration curve (5) Time increment	Form (e.g., linear Non-Non-Non-Non-Non-Non-Non-Non-Non-Non-	linear, non- r, etc.) Linear	Equation Pagosa Spring Cu Pagosa Spring Cu Pagosa Spring Cu	ngs Reference urve ngs Reference	Bankfull dis	charge (cfs)	Bankfull be		Bankfull s	suspended ng/l)
1. Bedload (dimensionless) 2. Suspended sediment (dimensionless) 3. User-defined relations (bedload) 4. User-defined relations (suspended sediment) From (1) (2) Flow Daily mean exceedence discharge Mischarge  -0.0113 0.0636 From dimens (3) Mid-ordinate	0.9326  nnsioned flow-d  (4)  Time increment (percent)	2.1929 2.4085  uration curve (5) Time increment	Non- Non-  (6)  Mid-ordinate	Linear Linear	Pagosa Sprii Cu Pagosa Sprii Cu	ngs Reference urve ngs Reference	120				,	-	
(dimensionless) 2. Suspended sediment (dimensionless) 3. User-defined relations (bedload) 4. User-defined relations (suspended sediment)  Fro  (1) (2) Flow Daily mean exceedence discharge  (%) (cfs) 100.000 1.8 90.000 2.8 80.000 3.5 70.000 4.0 60.000 5.3 50.000 8.8 40.000 13.9 30.000 26.2 20.000 51.0 10.000 87.9 5.000 108.6 4.000 116.1 3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	0.0636  From dimens (3)  Mid-ordinate	0.9326  Insigned flow-d  (4)  Time increment (percent)	2.4085  uration curve (5) Time increment	Non-	Linear	Pagosa Sprii	ngs Reference		0.02	0.0	009	,	18
(dimensionless) 3. User-defined relations (bedload) 4. User-defined relations (suspended sediment)  Fro  (1) (2) Flow Daily mean exceedence discharge  (%) (cfs) 100.000 1.8 90.000 2.8 80.000 3.5 70.000 4.0 60.000 5.3 50.000 8.8 40.000 13.9 30.000 26.2 20.000 51.0 10.000 87.9 5.000 108.6 4.000 116.1 3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	(3) Mid-ordinate	e Time increment (percent)	uration curve (5) Time increment	e (6) Mid-ordinate		Cı			7.02				
3. User-defined relations (bedload) 4. User-defined relations (suspended sediment)  Fro  (1) (2) Flow Daily mean exceedence discharge  (%) (cfs) 100.000 1.8 90.000 2.8 80.000 3.5 70.000 4.0 60.000 5.3 50.000 8.8 40.000 13.9 30.000 26.2 20.000 51.0 10.000 87.9 5.000 108.6 4.000 116.1 3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	(3) Mid-ordinate (%)	Time increment (percent)	(5) Time increment	(6) Mid-ordinate				Notes:	<u> </u>				
4. User-defined relations (suspended sediment)  Fro  (1) (2) Flow Daily mean exceedence discharge  (%) (cfs)  100.000 1.8  90.000 2.8  80.000 3.5  70.000 4.0  60.000 5.3  50.000 8.8  40.000 13.9  30.000 26.2  20.000 51.0  10.000 87.9  5.000 108.6  4.000 116.1  3.000 124.0  2.000 131.4  1.500 138.4  1.000 152.2  0.900 152.8  0.800 154.1  0.700 156.3  0.600 158.6	(3) Mid-ordinate (%)	Time increment (percent)	(5) Time increment	(6) Mid-ordinate									
(%) (cfs) Midscharge M	(3) Mid-ordinate (%)	Time increment (percent)	(5) Time increment	(6) Mid-ordinate									
(1) (2) Flow exceedence discharge Midscharge	(3) Mid-ordinate (%)	Time increment (percent)	(5) Time increment	(6) Mid-ordinate			rom sedimer	t rating curv	ne	Calculate	Calau	late sedimer	t viold
Flow exceedence discharge Midscharge (%) (cfs) 100.000 1.8 90.000 2.8 80.000 3.5 70.000 4.0 60.000 5.3 50.000 8.8 40.000 13.9 30.000 26.2 20.000 51.0 10.000 87.9 5.000 108.6 4.000 116.1 3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	Mid-ordinate (%)	e Time increment (percent)	Time increment	Mid-ordinate	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(%) (cfs) 100.000 1.8 90.000 2.8 80.000 3.5 70.000 4.0 60.000 5.3 50.000 8.8 40.000 13.9 30.000 26.2 20.000 51.0 10.000 87.9 5.000 108.6 4.000 116.1 3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6		(percent)			Dimension-	Dimension-	Suspended	Dimension-	Bedload	Time adjusted	Suspended	Bedload	Suspended +
100.000         1.8           90.000         2.8           80.000         3.5           70.000         4.0           60.000         5.3           50.000         8.8           40.000         13.9           30.000         26.2           20.000         51.0           10.000         87.9           5.000         108.6           4.000         116.1           3.000         124.0           2.000         131.4           1.500         138.4           1.000         152.2           0.900         152.8           0.800         154.1           0.700         156.3           0.600         158.6		(%)	1	streamflow	less streamflow	less suspended sediment discharge	sediment discharge	less bedload discharge		streamflow	sediment [(5)×(9)]	sediment [(5)×(11)]	bedload [(13)+(14)]
90.000 2.8 80.000 3.5 70.000 4.0 60.000 5.3 50.000 8.8 40.000 13.9 30.000 26.2 20.000 51.0 10.000 87.9 5.000 108.6 4.000 116.1 3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	95.00		(days)	(cfs)	(Q/Q <sub>bkf</sub> )	(S/S <sub>bkf</sub> )	(tons/day)	(b <sub>s</sub> /b <sub>bkf</sub> )	(tons/day)	(cfs)	(tons)	(tons)	(tons)
80.000 3.5 70.000 4.0 60.000 5.3 50.000 8.8 40.000 13.9 30.000 26.2 20.000 51.0 10.000 87.9 5.000 108.6 4.000 116.1 3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	95.00												
70.000         4.0           60.000         5.3           50.000         8.8           40.000         13.9           30.000         26.2           20.000         51.0           10.000         87.9           5.000         108.6           4.000         116.1           3.000         124.0           2.000         131.4           1.500         138.4           1.000         152.2           0.900         152.8           0.800         154.1           0.700         156.3           0.600         158.6		10.00	36.50	2.3	0.02	0.0637	0.0	0.0000	0.00	22.80	0.36	0.00	0.36
60.000         5.3           50.000         8.8           40.000         13.9           30.000         26.2           20.000         51.0           10.000         87.9           5.000         108.6           4.000         116.1           3.000         124.0           2.000         131.4           1.500         138.4           1.000         152.2           0.900         152.8           0.800         154.1           0.700         156.3           0.600         158.6	85.00	10.00	36.50	3.1	0.03	0.0637	0.0	0.0000	0.00	31.20	0.36	0.00	0.36
50.000         8.8           40.000         13.9           30.000         26.2           20.000         51.0           10.000         87.9           5.000         108.6           4.000         116.1           3.000         124.0           2.000         131.4           1.500         138.4           1.000         152.2           0.900         152.8           0.800         154.1           0.700         156.3           0.600         158.6	75.00	10.00	36.50	3.7	0.03	0.0638	0.0	0.0000	0.00	37.20	0.36	0.00	0.36
40.000         13.9           30.000         26.2           20.000         51.0           10.000         87.9           5.000         108.6           4.000         116.1           3.000         124.0           2.000         131.4           1.500         138.4           1.000         152.2           0.900         152.8           0.800         154.1           0.700         156.3           0.600         158.6	65.00	10.00	36.50	4.6	0.04	0.0640	0.0	0.0000	0.00	46.20	0.36	0.00	0.36
30.000         26.2           20.000         51.0           10.000         87.9           5.000         108.6           4.000         116.1           3.000         124.0           2.000         131.4           1.500         138.4           1.000         152.2           0.900         152.8           0.800         154.1           0.700         156.3           0.600         158.6	55.00	10.00	36.50	7.0	0.06	0.0646	0.0	0.0000	0.00	70.20	0.73	0.00	0.73
20.000         51.0           10.000         87.9           5.000         108.6           4.000         116.1           3.000         124.0           2.000         131.4           1.500         138.4           1.000         152.2           0.900         152.8           0.800         154.1           0.700         156.3           0.600         158.6	45.00	10.00	36.50	11.3	0.09	0.0668	0.0	0.0000	0.00	113.40	1.46	0.00	1.46
10.000 87.9 5.000 108.6 4.000 116.1 3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	35.00	10.00	36.50	20.0	0.17	0.0761	0.1	0.0087	0.00	200.40	2.56	0.00	2.56
5.000 108.6 4.000 116.1 3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	25.00	10.00	36.50	38.6	0.32	0.1243	0.2	0.0729	0.00	385.90	8.39	0.00	8.39
4.000     116.1       3.000     124.0       2.000     131.4       1.500     138.4       1.000     152.2       0.900     152.8       0.800     154.1       0.700     156.3       0.600     158.6	15.00	10.00	36.50	69.5	0.58	0.3135	1.1	0.2944	0.04	694.70	38.69	1.46	40.15
3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	7.50	5.00	18.25	98.3	0.82	0.6399	3.1	0.6428	0.04	491.40	55.84	0.73	56.57
3.000 124.0 2.000 131.4 1.500 138.4 1.000 152.2 0.900 152.8 0.800 154.1 0.700 156.3 0.600 158.6	4.50	1.00	3.65	112.3	0.94	0.8589	4.7	0.8657	0.09	112.34	17.12	0.33	17.45
2.000     131.4       1.500     138.4       1.000     152.2       0.900     152.8       0.800     154.1       0.700     156.3       0.600     158.6	3.50	1.00	3.65	120.0	1.00	0.9962	5.8	1.0026	0.09	120.02	21.21	0.33	21.54
1.000     152.2       0.900     152.8       0.800     154.1       0.700     156.3       0.600     158.6	2.50			127.7	1.06	1.1456		1.1495		0.00	0.00	0.00	0.00
0.900         152.8           0.800         154.1           0.700         156.3           0.600         158.6	1.75			134.9	1.12	1.2987		1.2982		0.00	0.00	0.00	0.00
0.800         154.1           0.700         156.3           0.600         158.6	1.25			145.3	1.21	1.5410		1.5300		0.00	0.00	0.00	0.00
0.700 156.3 0.600 158.6	0.95			152.5	1.27	1.7235		1.7025		0.00	0.00	0.00	0.00
0.600 158.6	0.85			153.4	1.28	1.7488		1.7263		0.00	0.00	0.00	0.00
0.600 158.6	0.75			155.2	1.29	1.7954		1.7700		0.00	0.00	0.00	0.00
	0.65			157.4	1.31	1.8565		1.8272		0.00	0.00	0.00	0.00
	0.55			161.9	1.35	1.9802		1.9422		0.00	0.00	0.00	0.00
0.250 177.2	0.38			171.1	1.43	2.2553		2.1960		0.00	0.00	0.00	0.00
0.100 188.3	0.18			182.7	1.52	2.6293		2.5365		0.00	0.00	0.00	0.00
0.050 189.0	0.08			188.6	1.57	2.8349		2.7217		0.00	0.00	0.00	0.00
0.010 189.0	0.03			189.0	1.57	2.8487		2.7341		0.00	0.00	0.00	0.00
0.005 189.0				189.0	1.57	2.8487		2.7341		0.00	0.00	0.00	0.00
0.001 189.0				189.0	1.57	2.8487		2.7341		0.00	0.00	0.00	0.00
	0.01		1		,				Annı	ial totals:	147.4 (tons/yr)	2.9 (tons/yr)	150.3 (tons/yr)

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Worksheet 5-20a. Bedload and suspended sand bed-material load transport prediction for the upstream reach, using the POWERSED model.

Stream:	Fourmile Ca	nyon Cree	k, Reach	1, Riffle F	Reach 1 @	į	Location:									Date:	05/11/15
Observers:	Lucas Babb	itt				Str	eam Type:	C 4b	V	alley Type:	VIII	Gage	Station #:	06721500			
Flow-dur	ation curve	Calculate		Hydraulio	geometry	•	Measure					C	alculate				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	discharge	Mid- ordinate stream- flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power		Time increment	Daily mean bedload transport	Daily mean suspended sand transport	adjusted bedload transport [(13)×(14)]	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)
(%)	(cfs)	(cfs)	(ft <sup>2</sup> )	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft <sup>2</sup> )	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.000	1.80									0.00					0.00	0.00	0.00
90.000	2.76	2.28	1.01	5.78	0.17	2.24	0.0370	0.39	5.26	0.91	10.000	36.50	0.00	0.01	0.00	0.36	0.36
80.000	3.48	3.12	1.25	6.18	0.20	2.43	0.0370	0.45	7.20	1.17	10.000	36.50	0.00	0.01	0.00	0.36	0.36
70.000	3.96	3.72	1.42	6.47	0.22	2.57	0.0370	0.49	8.59	1.33	10.000	36.50	0.00	0.01	0.00	0.36	0.36
60.000	5.28	4.62	1.66	6.84	0.24	2.77	0.0370	0.54	10.67	1.56	10.000	36.50	0.00	0.01	0.00	0.36	0.36
50.000	8.76	7.02	2.17	7.17	0.30	3.20	0.0370	0.67	16.21	2.26	10.000	36.50	0.00	0.02	0.00	0.73	0.73
40.000	13.92	11.34	3.00	7.75	0.39	3.77	0.0370	0.86	26.18	3.38	10.000	36.50	0.00	0.04	0.00	1.46	1.46
30.000	26.16	20.04	4.34	8.27	0.52	4.59	0.0370	1.15	46.27	5.59	10.000	36.50	0.00	0.07	0.00	2.56	2.56
20.000	51.01	38.59	7.14	10.69	0.67	5.39	0.0370	1.47	89.10	8.33	10.000	36.50	0.00	0.23	0.00	8.39	8.39
10.000	87.93	69.47	10.69	12.05	0.89	6.49	0.0370	1.93	160.39	13.31	10.000	36.50	0.04	0.72	1.46	26.28	27.74
5.000	108.62	98.28	14.29	14.72	0.97	6.87	0.0370	2.10	226.91	15.42	5.000	18.25	0.04	1.19	0.73	21.72	22.45
4.000	116.06	112.34	18.14	22.14	0.82	6.21	0.0370	1.80	259.37	11.71	1.000	3.65	0.04	1.38	0.15	5.04	5.19
3.000	123.98	120.02	19.91	25.34	0.79	6.03	0.0370	1.73	277.10	10.94	1.000	3.65	0.04	1.3	0.15	4.75	4.90
2.000	131.35	127.66					0.0370			0.00					0.00	0.00	0.00
1.500	138.38	134.87					0.0370			0.00					0.00	0.00	0.00
1.000	152.18	145.28					0.0370			0.00					0.00	0.00	0.00
0.900	152.78	152.48					0.0370			0.00					0.00	0.00	0.00
0.800	154.11	153.44					0.0370			0.00					0.00	0.00	0.00
0.700	156.27	155.19					0.0370			0.00					0.00	0.00	0.00
0.600	158.60	157.44					0.0370			0.00					0.00	0.00	0.00
0.500	165.11	161.86					0.0370			0.00					0.00	0.00	0.00
0.250	177.16	171.13					0.0370			0.00					0.00	0.00	0.00
0.100	188.25	182.70					0.0370			0.00					0.00	0.00	0.00
0.050	189.03	188.64					0.0370			0.00					0.00	0.00	0.00
0.010	189.03	189.03					0.0370			0.00					0.00	0.00	0.00
0.005	189.03	189.03					0.0370			0.00					0.00	0.00	0.00
0.001	189.03	189.03					0.0370			0.00					0.00	0.00	0.00
										61	Total ann	ual sedime			2.4	72.6	75.0

Worksheet 5-20b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream:	Fourmile Ca	nyon Creel	k, Reach	1, Riffle R	each 1 P	r	Location:									Date:	05/11/15
Observers:	Lucas Babbi						eam Type:	C 4b	V	alley Type:	VIII	Gage	e Station #:	06721500			
Flow-dura	ation curve	Calculate		Hydraulic	geometry		Measure			<u> </u>		_	alculate				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid- ordinate stream- flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)	Time adjusted suspended sand transport I(13)×(15)1	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft <sup>2</sup> )	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft <sup>2</sup> )	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.000	1.80								0.00						0.00	0.00	0.00
90.000	2.76	2.28	1.55	7.85	0.20	1.46	0.0430	0.53	6.12	0.78	10.000	36.50	0.00	0.01	0.00	0.36	0.36
80.000	3.48	3.12	1.87	7.98	0.23	1.63	0.0430	0.62	8.37	1.05	10.000	36.50	0.00	0.01	0.00	0.36	0.36
70.000	3.96	3.72	2.09	8.07	0.26	1.74	0.0430	0.69	9.98	1.24	10.000	36.50	0.00	0.01	0.00	0.36	0.36
60.000	5.28	4.62	2.41	8.21	0.29	1.90	0.0430	0.78	12.40	1.51	10.000	36.50	0.00	0.01	0.00	0.36	0.36
50.000	8.76	7.02	3.16	8.51	0.37	2.22	0.0430	0.98	18.84	2.21	10.000	36.50	0.00	0.02	0.00	0.73	0.73
40.000	13.92	11.34	4.31	8.94	0.48	2.62	0.0430	1.26	30.43	3.40	10.000	36.50	0.00	0.04	0.00	1.46	1.46
30.000	26.17	20.05	7.46	15.07	0.50	2.68	0.0430	1.30	53.80	3.57	10.000	36.50	0.00	0.07	0.00	2.56	2.56
20.000	51.01	38.59	11.56	16.77	0.69	3.33	0.0430	1.80	103.54	6.17	10.000	36.50	0.00	0.16	0.00	5.84	5.84
10.000	87.93	69.47	17.27	18.88	0.91	4.02	0.0430	2.39	186.40	9.87	10.000	36.50	0.00	0.62	0.00	22.63	22.63
5.000	108.63	98.28	21.96	20.46	1.07	4.47	0.0430	2.80	263.70	12.89	5.000	18.25	0.04	1.42	0.73	25.91	26.64
4.000	116.07	112.35	24.12	21.14	1.14	4.66	0.0430	2.97	301.46	14.26	1.000	3.65	0.04	1.91	0.15	6.97	7.12
3.000	123.99	120.03	25.27	21.50	1.18	4.75	0.0430	3.06	322.06	14.98	1.000	3.65	0.04	2.2	0.15	8.03	8.18
2.000	131.36	127.68					0.0430		0.00						0.00	0.00	0.00
1.500	138.39	134.88					0.0430		0.00						0.00	0.00	0.00
1.000	152.20	145.29					0.0430		0.00						0.00	0.00	0.00
0.900	152.80	152.50					0.0430		0.00						0.00	0.00	0.00
0.800	154.12	153.46					0.0430		0.00						0.00	0.00	0.00
0.700	156.28	155.20					0.0430		0.00						0.00	0.00	0.00
0.600	158.62	157.45					0.0430		0.00						0.00	0.00	0.00
0.500	165.13	161.88					0.0430		0.00						0.00	0.00	0.00
0.250	177.17	171.15					0.0430		0.00						0.00	0.00	0.00
0.100	188.26	182.71					0.0430		0.00						0.00	0.00	0.00
0.050	189.05	188.66					0.0430		0.00						0.00	0.00	0.00
0.010	189.05	189.05					0.0430		0.00						0.00	0.00	0.00
0.005	189.05	189.05					0.0430		0.00						0.00	0.00	0.00
0.001	189.05	189.05					0.0430		0.00						0.00	0.00	0.00
Notes:				•		•						ual sedimer			0.9	75.7	76.7
										su		and bed-ma Jpstream to tive reach (	otal annual	sediment	2.5	72.4	74.9
										01.1.	Difference	e in sedime	nt transpor (tons/yr)	t capacity ) (+ or - ):	-1.6	3.3	1.8
										Stabilit	ty evaluatio	n: Aggrada	ation, Degra	adation or Stable:			

Worksheet 5-20b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream:	Fourmile Ca	nyon Creel	k, Reach	2, Riffle R	each 2 Pi	r	Location:									Date:	05/11/15
Observers:	Lucas Babbi	tt				Str	eam Type:	C 4b	V	alley Type:	VIII	Gage	e Station #:	06721500			
Flow-dura	ation curve	Calculate		Hydraulic	geometry	,	Measure						alculate				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid- ordinate stream- flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)	Time adjusted suspended sand transport I(13)×(15)1	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft <sup>2</sup> )	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft <sup>2</sup> )	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.000	1.80								0.00						0.00	0.00	0.00
90.000	2.76	2.28	1.55	7.85	0.20	1.46	0.0500	0.61	7.11	0.91	10.000	36.50	0.00	0.01	0.00	0.36	0.36
80.000	3.48	3.12	1.87	7.98	0.23	1.63	0.0500	0.72	9.73	1.22	10.000	36.50	0.00	0.01	0.00	0.36	0.36
70.000	3.96	3.72	2.09	8.07	0.26	1.74	0.0500	0.80	11.61	1.44	10.000	36.50	0.00	0.01	0.00	0.36	0.36
60.000	5.28	4.62	2.41	8.21	0.29	1.90	0.0500	0.90	14.41	1.76	10.000	36.50	0.00	0.01	0.00	0.36	0.36
50.000	8.76	7.02	3.16	8.51	0.37	2.22	0.0500	1.14	21.90	2.57	10.000	36.50	0.00	0.02	0.00	0.73	0.73
40.000	13.92	11.34	4.31	8.94	0.48	2.62	0.0500	1.46	35.38	3.96	10.000	36.50	0.00	0.04	0.00	1.46	1.46
30.000	26.17	20.05	7.46	15.07	0.50	2.68	0.0500	1.51	62.56	4.15	10.000	36.50	0.00	0.07	0.00	2.56	2.56
20.000	51.01	38.59	11.56	16.77	0.69	3.33	0.0500	2.10	120.40	7.18	10.000	36.50	0.00	0.19	0.00	6.94	6.94
10.000	87.93	69.47	17.27	18.88	0.91	4.02	0.0500	2.78	216.75	11.48	10.000	36.50	0.04	0.82	1.46	29.93	31.39
5.000	108.63	98.28	21.96	20.46	1.07	4.47	0.0500	3.25	306.63	14.99	5.000	18.25	0.04	1.80	0.73	32.85	33.58
4.000	116.07	112.35	24.11	21.14	1.14	4.66	0.0500	3.46	350.53	16.58	1.000	3.65	0.04	2.39	0.15	8.72	8.87
3.000	123.99	120.03	25.27	21.50	1.18	4.75	0.0500	3.56	374.49	17.42	1.000	3.65	0.00	2.74	0.00	10.00	10.00
2.000	131.36	127.68					0.0500		0.00						0.00	0.00	0.00
1.500	138.39	134.88					0.0500		0.00						0.00	0.00	0.00
1.000	152.20	145.29					0.0500		0.00						0.00	0.00	0.00
0.900	152.80	152.50					0.0500		0.00						0.00	0.00	0.00
0.800	154.12	153.46					0.0500		0.00						0.00	0.00	0.00
0.700	156.28	155.20					0.0500		0.00						0.00	0.00	0.00
0.600	158.62	157.45					0.0500		0.00						0.00	0.00	0.00
0.500	165.13	161.88					0.0500		0.00						0.00	0.00	0.00
0.250	177.17	171.15					0.0500		0.00						0.00	0.00	0.00
0.100	188.26	182.71					0.0500		0.00						0.00	0.00	0.00
0.050	189.05	188.66					0.0500		0.00						0.00	0.00	0.00
0.010	189.05	189.05					0.0500		0.00						0.00	0.00	0.00
0.005	189.05	189.05					0.0500		0.00						0.00	0.00	0.00
0.001	189.05	189.05			İ	Ì	0.0500	İ	0.00	İ			İ		0.00	0.00	0.00
Notes:						•				***		ual sedimer			2.3	94.8	97.2
										su		and bed-ma Jpstream to tive reach (	otal annual	sediment	2.5	72.4	74.9
										Ctab "		e in sedime	(tons/yr)	) (+ or - ):	-0.2	22.4	22.3
										Stabili	ty evaluatio	n. Aggrada	mon, Degra	Stable:			

Worksheet 5-20b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream:	Fourmile Ca	nyon Creel	k, Reach	3, Riffle R	each 3 P	r	Location:									Date:	05/11/15
Observers:	Lucas Babbi	tt				Str	eam Type:	C 4b	V	alley Type:	: VIII	Gage	e Station #:	06721500			
Flow-dura	ation curve	Calculate		Hydraulic	geometry	,	Measure						alculate				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid- ordinate stream- flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft <sup>2</sup> )	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft <sup>2</sup> )	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.000	1.80								0.00						0.00	0.00	0.00
90.000	2.76	2.28	1.55	7.85	0.20	1.46	0.0440	0.54	6.26	0.80	10.000	36.50	0.00	0.01	0.00	0.36	0.36
80.000	3.48	3.12	1.87	7.98	0.23	1.63	0.0440	0.64	8.57	1.07	10.000	36.50	0.00	0.01	0.00	0.36	0.36
70.000	3.96	3.72	2.09	8.07	0.26	1.74	0.0440	0.70	10.21	1.27	10.000	36.50	0.00	0.01	0.00	0.36	0.36
60.000	5.28	4.62	2.41	8.21	0.29	1.90	0.0440	0.79	12.68	1.54	10.000	36.50	0.00	0.01	0.00	0.36	0.36
50.000	8.76	7.02	3.16	8.51	0.37	2.22	0.0440	1.00	19.27	2.26	10.000	36.50	0.00	0.02	0.00	0.73	0.73
40.000	13.92	11.34	4.31	8.94	0.48	2.62	0.0440	1.29	31.14	3.48	10.000	36.50	0.00	0.04	0.00	1.46	1.46
30.000	26.17	20.05	7.46	15.07	0.50	2.68	0.0440	1.33	55.05	3.65	10.000	36.50	0.00	0.07	0.00	2.56	2.56
20.000	51.01	38.59	11.56	16.77	0.69	3.33	0.0440	1.85	105.95	6.32	10.000	36.50	0.00	0.17	0.00	6.21	6.21
10.000	87.93	69.47	17.27	18.88	0.91	4.02	0.0440	2.44	190.74	10.10	10.000	36.50	0.00	0.65	0.00	23.73	23.73
5.000	108.63	98.28	21.96	20.46	1.07	4.47	0.0440	2.86	269.84	13.19	5.000	18.25	0.04	1.48	0.73	27.01	27.74
4.000	116.07	112.35	24.12	21.14	1.14	4.66	0.0440	3.04	308.47	14.59	1.000	3.65	0.04	1.97	0.15	7.19	7.34
3.000	123.99	120.03	25.27	21.50	1.18	4.75	0.0440	3.13	329.55	15.33	1.000	3.65	0.04	2.28	0.15	8.32	8.47
2.000	131.36	127.68					0.0440		0.00						0.00	0.00	0.00
1.500	138.39	134.88					0.0440		0.00						0.00	0.00	0.00
1.000	152.20	145.29					0.0440		0.00						0.00	0.00	0.00
0.900	152.80	152.50					0.0440		0.00						0.00	0.00	0.00
0.800	154.12	153.46					0.0440		0.00						0.00	0.00	0.00
0.700	156.28	155.20					0.0440		0.00						0.00	0.00	0.00
0.600	158.62	157.45					0.0440		0.00						0.00	0.00	0.00
0.500	165.13	161.88					0.0440		0.00						0.00	0.00	0.00
0.250	177.17	171.15					0.0440		0.00						0.00	0.00	0.00
0.100	188.26	182.71					0.0440		0.00						0.00	0.00	0.00
0.050	189.05	188.66					0.0440		0.00						0.00	0.00	0.00
0.010	189.05	189.05					0.0440		0.00						0.00	0.00	0.00
0.005	189.05	189.05					0.0440		0.00						0.00	0.00	0.00
0.001	189.05	189.05					0.0440		0.00						0.00	0.00	0.00
Notes:										C	Total annu	ual sedimer			0.9	78.8	79.8
										Su		Jpstream to tive reach (	otal annual	sediment	2.5	72.4	74.9
										Ctat "		e in sedime	(tons/yr)	) (+ or - ):	-1.6	6.4	4.9
										Stabili	ty evaluatio	n. Aygrada	mon, Degra	Stable:			

Worksheet 5-20b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream:	Fourmile Ca	nyon Creel	k, Reach	4, Riffle R	each 4 Pı	,	Location:									Date:	05/11/15
Observers:	Lucas Babbi	tt		•		Str	eam Type:	C 4b	V	alley Type:	VIII	Gage	e Station #:	06721500			
Flow-dura	ation curve	Calculate		Hydraulic	geometry	,	Measure					_	alculate				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid- ordinate stream- flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft <sup>2</sup> )	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft <sup>2</sup> )	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.000	1.80								0.00						0.00	0.00	0.00
90.000	2.76	2.28	1.55	7.85	0.20	1.46	0.0440	0.54	6.26	0.80	10.000	36.50	0.00	0.01	0.00	0.36	0.36
80.000	3.48	3.12	1.87	7.98	0.23	1.63	0.0440	0.64	8.57	1.07	10.000	36.50	0.00	0.01	0.00	0.36	0.36
70.000	3.96	3.72	2.09	8.07	0.26	1.74	0.0440	0.70	10.21	1.27	10.000	36.50	0.00	0.01	0.00	0.36	0.36
60.000	5.28	4.62	2.41	8.21	0.29	1.90	0.0440	0.79	12.68	1.54	10.000	36.50	0.00	0.01	0.00	0.36	0.36
50.000	8.76	7.02	3.16	8.51	0.37	2.22	0.0440	1.00	19.27	2.26	10.000	36.50	0.00	0.02	0.00	0.73	0.73
40.000	13.92	11.34	4.31	8.94	0.48	2.62	0.0440	1.29	31.14	3.48	10.000	36.50	0.00	0.04	0.00	1.46	1.46
30.000	26.17	20.05	7.46	15.07	0.50	2.68	0.0440	1.33	55.05	3.65	10.000	36.50	0.00	0.07	0.00	2.56	2.56
20.000	51.01	38.59	11.56	16.77	0.69	3.33	0.0440	1.85	105.95	6.32	10.000	36.50	0.00	0.17	0.00	6.21	6.21
10.000	87.93	69.47	17.27	18.88	0.91	4.02	0.0440	2.44	190.74	10.10	10.000	36.50	0.00	0.65	0.00	23.73	23.73
5.000	108.63	98.28	21.96	20.46	1.07	4.47	0.0440	2.86	269.84	13.19	5.000	18.25	0.04	1.48	0.73	27.01	27.74
4.000	116.07	112.35	24.12	21.14	1.14	4.66	0.0440	3.04	308.47	14.59	1.000	3.65	0.04	1.97	0.15	7.19	7.34
3.000	123.99	120.03					0.0440		0.00						0.00	0.00	0.00
2.000	131.36	127.68					0.0440		0.00						0.00	0.00	0.00
1.500	138.39	134.88					0.0440		0.00						0.00	0.00	0.00
1.000	152.20	145.29					0.0440		0.00						0.00	0.00	0.00
0.900	152.80	152.50					0.0440		0.00						0.00	0.00	0.00
0.800	154.12	153.46					0.0440		0.00						0.00	0.00	0.00
0.700	156.28	155.20					0.0440		0.00						0.00	0.00	0.00
0.600	158.62	157.45					0.0440		0.00						0.00	0.00	0.00
0.500	165.13	161.88					0.0440		0.00						0.00	0.00	0.00
0.250	177.17	171.15					0.0440		0.00						0.00	0.00	0.00
0.100	188.26	182.71					0.0440		0.00						0.00	0.00	0.00
0.050	189.05	188.66					0.0440		0.00						0.00	0.00	0.00
0.010	189.05	189.05					0.0440		0.00						0.00	0.00	0.00
0.005	189.05	189.05					0.0440		0.00						0.00	0.00	0.00
0.001	189.05	189.05		İ		İ	0.0440	İ	0.00	İ			İ		0.00	0.00	0.00
Notes:		•										ual sedimer			0.8	70.5	71.3
										su		Jpstream to tive reach (	otal annual	sediment	2.5	72.4	74.9
										01.1.	Difference	e in sedime	nt transpor (tons/yr)	t capacity ) (+ or - ):	-1.7	-1.9	-3.6
										Stabilit	ty evaluatio	n: Aggrada	ation, Degra	adation or Stable:			

Worksheet 5-20b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream:	Fourmile Ca	nyon Creel	k, Reach	5, Riffle R	each 5 Pi	r	Location:									Date:	05/11/15
Observers:	Lucas Babbi						eam Type:	C 4b	V	alley Type:	VIII	Gage	e Station #:	06721500			
Flow-dura	ation curve	Calculate		Hydraulic	geometry		Measure			<u> </u>		_	alculate				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid- ordinate stream- flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft <sup>2</sup> )	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft <sup>2</sup> )	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.000	1.80								0.00						0.00	0.00	0.00
90.000	2.76	2.28	1.55	7.85	0.20	1.46	0.0430	0.53	6.12	0.78	10.000	36.50	0.00	0.01	0.00	0.36	0.36
80.000	3.48	3.12	1.87	7.98	0.23	1.63	0.0430	0.62	8.37	1.05	10.000	36.50	0.00	0.01	0.00	0.36	0.36
70.000	3.96	3.72	2.09	8.07	0.26	1.74	0.0430	0.69	9.98	1.24	10.000	36.50	0.00	0.01	0.00	0.36	0.36
60.000	5.28	4.62	2.41	8.21	0.29	1.90	0.0430	0.78	12.40	1.51	10.000	36.50	0.00	0.01	0.00	0.36	0.36
50.000	8.76	7.02	3.16	8.51	0.37	2.22	0.0430	0.98	18.84	2.21	10.000	36.50	0.00	0.02	0.00	0.73	0.73
40.000	13.92	11.34	4.31	8.94	0.48	2.62	0.0430	1.26	30.43	3.40	10.000	36.50	0.00	0.04	0.00	1.46	1.46
30.000	26.17	20.05	7.46	15.07	0.50	2.68	0.0430	1.30	53.80	3.57	10.000	36.50	0.00	0.07	0.00	2.56	2.56
20.000	51.01	38.59	11.56	16.77	0.69	3.33	0.0430	1.80	103.54	6.17	10.000	36.50	0.00	0.16	0.00	5.84	5.84
10.000	87.93	69.47	17.27	18.88	0.91	4.02	0.0430	2.39	186.40	9.87	10.000	36.50	0.00	0.62	0.00	22.63	22.63
5.000	108.63	98.28	21.96	20.46	1.07	4.47	0.0430	2.80	263.70	12.89	5.000	18.25	0.04	1.42	0.73	25.91	26.64
4.000	116.07	112.35	24.12	21.14	1.14	4.66	0.0430	2.97	301.46	14.26	1.000	3.65	0.04	1.91	0.15	6.97	7.12
3.000	123.99	120.03	25.27	21.50	1.18	4.75	0.0430	3.06	322.06	14.98	1.000	3.65	0.04	2.2	0.15	8.03	8.18
2.000	131.36	127.68					0.0430		0.00						0.00	0.00	0.00
1.500	138.39	134.88					0.0430		0.00						0.00	0.00	0.00
1.000	152.20	145.29					0.0430		0.00						0.00	0.00	0.00
0.900	152.80	152.50					0.0430		0.00						0.00	0.00	0.00
0.800	154.12	153.46					0.0430		0.00						0.00	0.00	0.00
0.700	156.28	155.20					0.0430		0.00						0.00	0.00	0.00
0.600	158.62	157.45					0.0430		0.00						0.00	0.00	0.00
0.500	165.13	161.88					0.0430		0.00						0.00	0.00	0.00
0.250	177.17	171.15					0.0430		0.00						0.00	0.00	0.00
0.100	188.26	182.71					0.0430		0.00						0.00	0.00	0.00
0.050	189.05	188.66					0.0430		0.00						0.00	0.00	0.00
0.010	189.05	189.05					0.0430		0.00						0.00	0.00	0.00
0.005	189.05	189.05					0.0430		0.00						0.00	0.00	0.00
0.001	189.05	189.05					0.0430		0.00						0.00	0.00	0.00
Notes:										· · ·	Total annu	ial sedimer			0.9	75.7	76.7
										Su		Jpstream to tive reach (	otal annual	sediment	2.5	72.4	74.9
										01-1-11		e in sedime	(tons/yr)	) (+ or - ):	-1.6	3.3	1.8
										Stabilit	ty evaluatio	n: Aggrada	ilion, Degra	Stable:			

Worksheet 5-20b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream:	Fourmile Ca	nyon Creel	k, Reach	6, Riffle R	each 6 Pi	,	Location:									Date:	05/11/15
Observers:	Lucas Babbi						eam Type:	C 4b	V	alley Type:	VIII	Gage	e Station #:	06721500			
Flow-dura	ation curve	Calculate		Hydraulic	geometry		Measure			<u> </u>		_	alculate				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid- ordinate stream- flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft <sup>2</sup> )	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft <sup>2</sup> )	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.000	1.80								0.00						0.00	0.00	0.00
90.000	2.76	2.28	1.55	7.85	0.20	1.46	0.0400	0.49	5.69	0.72	10.000	36.50	0.00	0.01	0.00	0.36	0.36
80.000	3.48	3.12	1.87	7.98	0.23	1.63	0.0400	0.58	7.79	0.98	10.000	36.50	0.00	0.01	0.00	0.36	0.36
70.000	3.96	3.72	2.09	8.07	0.26	1.74	0.0400	0.64	9.29	1.15	10.000	36.50	0.00	0.01	0.00	0.36	0.36
60.000	5.28	4.62	2.41	8.21	0.29	1.90	0.0400	0.72	11.53	1.40	10.000	36.50	0.00	0.01	0.00	0.36	0.36
50.000	8.76	7.02	3.16	8.51	0.37	2.22	0.0400	0.91	17.52	2.06	10.000	36.50	0.00	0.02	0.00	0.73	0.73
40.000	13.92	11.34	4.31	8.94	0.48	2.62	0.0400	1.17	28.30	3.17	10.000	36.50	0.00	0.04	0.00	1.46	1.46
30.000	26.17	20.05	7.46	15.07	0.50	2.68	0.0400	1.21	50.04	3.32	10.000	36.50	0.00	0.07	0.00	2.56	2.56
20.000	51.01	38.59	11.56	16.77	0.69	3.33	0.0400	1.68	96.32	5.74	10.000	36.50	0.00	0.15	0.00	5.47	5.47
10.000	87.93	69.47	17.27	18.88	0.91	4.02	0.0400	2.22	173.40	9.18	10.000	36.50	0.00	0.53	0.00	19.35	19.35
5.000	108.63	98.28	21.96	20.46	1.07	4.47	0.0400	2.60	245.31	11.99	5.000	18.25	0.04	1.26	0.73	23.00	23.73
4.000	116.07	112.35	24.11	21.14	1.14	4.66	0.0400	2.76	280.43	13.27	1.000	3.65	0.04	1.70	0.15	6.21	6.36
3.000	123.99	120.03	25.27	21.50	1.18	4.75	0.0400	2.85	299.59	13.93	1.000	3.65	0.04	1.96	0.15	7.15	7.30
2.000	131.36	127.68					0.0400		0.00						0.00	0.00	0.00
1.500	138.39	134.88					0.0400		0.00						0.00	0.00	0.00
1.000	152.20	145.29					0.0400		0.00						0.00	0.00	0.00
0.900	152.80	152.50					0.0400		0.00						0.00	0.00	0.00
0.800	154.12	153.46					0.0400		0.00						0.00	0.00	0.00
0.700	156.28	155.20					0.0400		0.00						0.00	0.00	0.00
0.600	158.62	157.45					0.0400		0.00						0.00	0.00	0.00
0.500	165.13	161.88					0.0400		0.00						0.00	0.00	0.00
0.250	177.17	171.15					0.0400		0.00						0.00	0.00	0.00
0.100	188.26	182.71					0.0400		0.00						0.00	0.00	0.00
0.050	189.05	188.66					0.0400		0.00						0.00	0.00	0.00
0.010	189.05	189.05					0.0400		0.00						0.00	0.00	0.00
0.005	189.05	189.05					0.0400		0.00						0.00	0.00	0.00
0.001	189.05	189.05					0.0400		0.00						0.00	0.00	0.00
Notes:										911	Total annu spended sa	ual sedimer			0.9	67.7	68.7
												Jpstream to tive reach (	otal annual	sediment	2.5	72.4	74.9
										Ctab "		e in sedime	(tons/yr)	) (+ or - ):	-1.6	-4.7	-6.2
										Stabilit	ty evaluatio	n: Aggrada	ilion, Degra	Stable:			

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Worksheet 5-20b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream:	Fourmile Ca	nyon Creel	k, Reach	7, Riffle R	each 7 Pi	r	Location:									Date:	05/11/15
Observers:	Lucas Babbi	tt				Str	eam Type:	C 4b	V	alley Type:	: VIII	Gage	e Station #:	06721500			
Flow-dura	ation curve	Calculate		Hydraulic	geometry	,	Measure						alculate				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid- ordinate stream- flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft <sup>2</sup> )	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft <sup>2</sup> )	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.000	1.80								0.00						0.00	0.00	0.00
90.000	2.76	2.28	1.55	7.85	0.20	1.46	0.0470	0.57	6.69	0.85	10.000	36.50	0.00	0.01	0.00	0.36	0.36
80.000	3.48	3.12	1.87	7.98	0.23	1.63	0.0470	0.68	9.15	1.15	10.000	36.50	0.00	0.01	0.00	0.36	0.36
70.000	3.96	3.72	2.09	8.07	0.26	1.74	0.0470	0.75	10.91	1.35	10.000	36.50	0.00	0.01	0.00	0.36	0.36
60.000	5.28	4.62	2.41	8.21	0.29	1.90	0.0470	0.85	13.55	1.65	10.000	36.50	0.00	0.01	0.00	0.36	0.36
50.000	8.76	7.02	3.16	8.51	0.37	2.22	0.0470	1.07	20.59	2.42	10.000	36.50	0.00	0.02	0.00	0.73	0.73
40.000	13.92	11.34	4.31	8.94	0.48	2.62	0.0470	1.38	33.26	3.72	10.000	36.50	0.00	0.04	0.00	1.46	1.46
30.000	26.17	20.05	7.46	15.07	0.50	2.68	0.0470	1.42	58.80	3.90	10.000	36.50	0.00	0.07	0.00	2.56	2.56
20.000	51.01	38.59	11.56	16.77	0.69	3.33	0.0470	1.97	113.18	6.75	10.000	36.50	0.00	0.18	0.00	6.57	6.57
10.000	87.93	69.47	17.27	18.88	0.91	4.02	0.0470	2.61	203.74	10.79	10.000	36.50	0.00	0.74	0.00	27.01	27.01
5.000	108.63	98.28	21.96	20.46	1.07	4.47	0.0470	3.06	288.24	14.09	5.000	18.25	0.04	1.64	0.73	29.93	30.66
4.000	116.07	112.35	24.11	21.14	1.14	4.66	0.0470	3.25	329.50	15.59	1.000	3.65	0.04	2.18	0.15	7.96	8.11
3.000	123.99	120.03	25.27	21.50	1.18	4.75	0.0470	3.35	352.02	16.37	1.000	3.65	0.04	2.51	0.15	9.16	9.31
2.000	131.36	127.68					0.0470		0.00						0.00	0.00	0.00
1.500	138.39	134.88					0.0470		0.00						0.00	0.00	0.00
1.000	152.20	145.29					0.0470		0.00						0.00	0.00	0.00
0.900	152.80	152.50					0.0470		0.00						0.00	0.00	0.00
0.800	154.12	153.46					0.0470		0.00						0.00	0.00	0.00
0.700	156.28	155.20					0.0470		0.00						0.00	0.00	0.00
0.600	158.62	157.45					0.0470		0.00						0.00	0.00	0.00
0.500	165.13	161.88					0.0470		0.00						0.00	0.00	0.00
0.250	177.17	171.15					0.0470		0.00						0.00	0.00	0.00
0.100	188.26	182.71					0.0470		0.00						0.00	0.00	0.00
0.050	189.05	188.66					0.0470		0.00						0.00	0.00	0.00
0.010	189.05	189.05					0.0470		0.00						0.00	0.00	0.00
0.005	189.05	189.05					0.0470		0.00						0.00	0.00	0.00
0.001	189.05	189.05					0.0470		0.00						0.00	0.00	0.00
Notes:										en	Total annu	ual sedimer			0.9	87.1	88.1
										30		Jpstream to tive reach (	otal annual	sediment	2.5	72.4	74.9
										Otal: III		e in sedime	(tons/yr)	) (+ or - ):	-1.6	14.7	13.2
										Stabili	ty evaluatio	n. Aygrada	mon, Degra	Stable:			

Worksheet 5-20b. Bedload and suspended sand bed-material load transport prediction for the potentially impaired reach, using the POWERSED model.

Stream:	Fourmile Ca	nyon Creel	k, Reach	8, Riffle R	each 8 Pi	r	Location:									Date:	05/11/15
Observers:	Lucas Babbi						eam Type:	C 4b	V	alley Type:	VIII	Gage	e Station #:	06721500			
Flow-dura	ation curve	Calculate		Hydraulic	geometry		Measure			<u> </u>		_	alculate				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Percentage of time	Daily mean discharge	Mid- ordinate stream- flow	Area	Width	Depth	Velocity	Slope	Shear stress	Stream power	Unit power	Time increment	Time increment	Daily mean bedload transport	Daily mean suspended sand transport	Time adjusted bedload transport [(13)×(14)	Time adjusted suspended sand transport [(13)×(15)]	Time adjusted total transport [(16)+(17)]
(%)	(cfs)	(cfs)	(ft <sup>2</sup> )	(ft)	(ft)	(ft/s)	(ft/ft)	(lb/ft <sup>2</sup> )	(lb/s)	(lb/ft/s)	(%)	(days)	(tons/day)	(tons/day)	(tons)	(tons)	(tons)
100.000	1.80								0.00						0.00	0.00	0.00
90.000	2.76	2.28	1.55	7.85	0.20	1.46	0.0420	0.51	5.98	0.76	10.000	36.50	0.00	0.01	0.00	0.36	0.36
80.000	3.48	3.12	1.87	7.98	0.23	1.63	0.0420	0.61	8.18	1.03	10.000	36.50	0.00	0.01	0.00	0.36	0.36
70.000	3.96	3.72	2.09	8.07	0.26	1.74	0.0420	0.67	9.75	1.21	10.000	36.50	0.00	0.01	0.00	0.36	0.36
60.000	5.28	4.62	2.41	8.21	0.29	1.90	0.0420	0.76	12.11	1.48	10.000	36.50	0.00	0.01	0.00	0.36	0.36
50.000	8.76	7.02	3.16	8.51	0.37	2.22	0.0420	0.95	18.40	2.16	10.000	36.50	0.00	0.02	0.00	0.73	0.73
40.000	13.92	11.34	4.31	8.94	0.48	2.62	0.0420	1.23	29.72	3.32	10.000	36.50	0.00	0.04	0.00	1.46	1.46
30.000	26.17	20.05	7.46	15.07	0.50	2.68	0.0420	1.27	52.55	3.49	10.000	36.50	0.00	0.07	0.00	2.56	2.56
20.000	51.01	38.59	11.56	16.77	0.69	3.33	0.0420	1.76	101.14	6.03	10.000	36.50	0.00	0.16	0.00	5.84	5.84
10.000	87.93	69.47	17.27	18.88	0.91	4.02	0.0420	2.33	182.07	9.64	10.000	36.50	0.00	0.59	0.00	21.54	21.54
5.000	108.63	98.28	21.96	20.46	1.07	4.47	0.0420	2.73	257.57	12.59	5.000	18.25	0.04	1.37	0.73	25.00	25.73
4.000	116.07	112.35	24.11	21.14	1.14	4.66	0.0420	2.90	294.45	13.93	1.000	3.65	0.04	1.84	0.15	6.72	6.87
3.000	123.99	120.03	25.27	21.50	1.18	4.75	0.0420	2.99	314.57	14.63	1.000	3.65	0.04	2.12	0.15	7.74	7.89
2.000	131.36	127.68					0.0420		0.00						0.00	0.00	0.00
1.500	138.39	134.88					0.0420		0.00						0.00	0.00	0.00
1.000	152.20	145.29					0.0420		0.00						0.00	0.00	0.00
0.900	152.80	152.50					0.0420		0.00						0.00	0.00	0.00
0.800	154.12	153.46					0.0420		0.00						0.00	0.00	0.00
0.700	156.28	155.20					0.0420		0.00						0.00	0.00	0.00
0.600	158.62	157.45					0.0420		0.00						0.00	0.00	0.00
0.500	165.13	161.88					0.0420		0.00						0.00	0.00	0.00
0.250	177.17	171.15					0.0420		0.00						0.00	0.00	0.00
0.100	188.26	182.71					0.0420		0.00						0.00	0.00	0.00
0.050	189.05	188.66					0.0420		0.00						0.00	0.00	0.00
0.010	189.05	189.05					0.0420		0.00						0.00	0.00	0.00
0.005	189.05	189.05					0.0420		0.00						0.00	0.00	0.00
0.001	189.05	189.05					0.0420		0.00						0.00	0.00	0.00
Notes:										· · ·	Total annu	ial sedimer			0.9	73.1	74.2
										Su		Jpstream to tive reach (	otal annual	sediment	2.5	72.4	74.9
										01-1-11		e in sedime	(tons/yr)	(+ or - ):	-1.6	0.7	-0.7
										Stabili	ty evaluatio	n: Aggrada	uon, Degra	Stable:			

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	Ç	Sed Analysis	5			Competend	ce		Vel	ocity Discha	rge
	n	Q	tons	Str. Type	D50	Dmax	Dcomp	Shear	D84	Q	V
Reach 1	0.07087	120.03	76.6	C4	41	241	354.8	3.1662	90	212.67	8.42
Reach 2	0.07642	120.03	96.9	B4	41	241	396.5	3.682	90	160.95	6.37
Reach 3	0.07169	120.03	79.7	B4	41	241	376.5	3.432	90	152.75	6.13
Reach 4	0.07169	120.03	79.7	B4	41	241	376.5	3.432	90	152.75	6.13
Reach 5	0.07087	120.03	76.6	B4	41	241	370.2	3.352	90	151	6.06
Reach 6	0.06835	120.03	68.4	C4	39	233	336.5	2.945	86	205.12	8.12
Reach 7	0.07409	120.03	87.8	B4	41	241	390.6	3.607	90	157.88	6.33
Reach 8	0.07004	120.03	74.0	B4	39	233	348.8	3.093	86	147.5	5.84
Reach 9	0.07520	120.00	93.8	B4	41	241	354.8	3.166	90	158.3	5.94
Reach 10	0.07068	120.02	75.5	B4	39	233	324	2.798	86	148.81	5.59
Comparitive R1:	0.03911	120.02	74.9								

## Reach Prioritization

## **Fourmile Canyon Creek Reach Prioritization**

Reach	Reach Condition Rating	Ongoing Erosion to Impact VAR	Required for Road Reconstruction	Accessibility/Ease of Construction	Amount of Private Property Coordination	Total	Rank
1	2	2	1	3	3	11	5
2	3	2	1	3	2	11	5
3	2	3	2	3	3	13	1
4	1	2	2	3	3	11	4
5	3	3	2	3	1	12	2
6	2	2	2	3	1	10	3
7	3	1	1	1	2	8	3
8	3	1	1	1	2	8	3
9	2	2	3	3	2	12	2
10	3	3	3	3	1	13	1

Notes:

Scoring: 1=worst, 3=best

## Fourmile Canyon Creek DSR Field Walk

			Future Flooding Concern	Values At F	Risk if Channel Is	n't Repaired		Pro	posed Improveme	ents		
Reach	Existing Erosion Problem	Concern?	Why?	Property	Homes	Infrastructure	Natural Channel Restoration	Revegetation	Channel Bank Stabilization	Channel Grade Stabilization	Road Crossing Enhancement	Estimated Cost
1	Moderate	Yes	Homes in floodplain	х	х		Х	х	х			
2	Extreme	Yes	Homes in floodplain	Х	х		Х	х	Х	Х		
3	Moderate	Yes	Homes in floodplain, road overtopping	х	х	х	Х	х	х		х	
4	Major	Yes	Road flooding	х		х	Х	х	х	х		
5	Major	Yes	Homes in floodplain, road overtopping	х	х	х	Х	х	х		х	
6	Moderate	Yes	Homes in floodplain	х	х		Х	х	х			
7	Major	Yes	Road flooding	х			Х	х	х	х		
8	Major	Yes	Road flooding	х			х	х	х	х		
9	Moderate	Yes	Road flooding	х		х	х	х	х	х	х	
10	Extreme	Yes	Homes in floodplain, road overtopping, road flooding	х	х	х	Х	Х	Х	х	Х	