DENVER WATER

1600 West 12th Ave
Denver, CO 80204-3412
303.628.6000
denverwater.org

Proposal Deadline: 2:00 p.m., October 30, 2017
South Boulder Creek Restoration Project
Pre- and Post-Construction Monitoring Request for Proposals (RFP)

Project Mission

The goal of the South Boulder Creek Restoration Project (SBCRP) is to restore bank stability, habitat connectivity, and in-stream habitat complexity to a degraded section of South Boulder Creek below Gross Reservoir. Per the terms of the 2017 Final Mitigation Plan and Section 404 Permit, this project serves as compensatory mitigation for the Gross Reservoir Expansion Project being required of Denver Water by the U.S. Army Corps of Engineers (Corps). As such, the project must demonstrate an improvement of habitat for rainbow trout based on the Stream Functions Pyramid Framework and as measured through the application of the models and information presented in the Habitat Suitability Index (HSI) curves: Rainbow Trout (*Salmo gairdneri*) (Raleigh et al. 1984). The HSI method was developed by the U.S. Fish and Wildlife Service (USFWS) and rates physical stream characteristics, channel hydrology, and water quality, based on important life cycle variables of targeted fish species.

Request for Proposals

Denver Water is soliciting proposals from qualified firms for a fluvial geomorphologist/fisheries biologist/hydrologist or other related professional to perform baseline pre-construction and post-construction monitoring and reporting of the SBCRP according to the Corps' compensatory mitigation requirements. The responsibilities of the Stream Monitor are presented herein with instructions for preparing a complete proposal.

Role and Responsibility of the Stream Monitor

The Stream Monitor will be responsible for **Tasks 1-4** identified in **Section 2 - Scope of Work**.

Project Background

Denver Water and the City of Boulder have partnered on this project through an Intergovernmental Agreement. The SBCRP includes the rehabilitation of an approximately 10,350 linear foot (1.96 mile) section of lower South Boulder Creek below Highway 93 in Boulder, Colorado. The project reach and surrounding lands are owned and managed by City of Boulder Open Space and Mountain Parks (OSMP). OSMP has retained a contractor responsible for the design and construction of the SBCRP, which will include mechanical manipulation of the stream that will result in improved low flow conditions, instream diversity, channel stability and creation of a minimum of two riffle/pool complexes. Construction of the SBCRP is scheduled for mid-January 2018. Completion of the project is expected in March 2018.

Section 1 – Administrative Requirements

1.1 Project Contact Information

Any requests for clarification or additional information regarding submission of this RFP shall be submitted to Jessica Alexander (jessica.alexander@denverwater.org or 303-628-6573) by **October 16, 2017**. Respondent communication regarding the proposal with other Denver Water personnel or other contracted agents is prohibited and shall be grounds for disqualification.

1.2 Proposal Submission

Responses shall be in the format noted. Denver Water reserves the right to disqualify any response submitted incorrectly. Respondents are requested to submit:

- Two (2) hard copies of the Respondent's proposal.
- One (1) electronic copy of the proposal provided as a pdf on DVD or flash drive.

Responses shall be addressed as follows:

Project Title:	South Boulder Creek Restoration Project, RFP for Pre- and Post-Construction Monitoring
Attention:	Jessica Alexander, Environmental Scientist Denver Water External Affairs Division, Administration Building
Address:	1600 West 12th Avenue Denver, Colorado 80204-3412

Submittal Instructions:

1. Proposals may be either mailed or hand-delivered. If the proposal is sent by mail, please allow extra time for delivery before the deadline. (Note: No e-mailed or faxed proposals will be accepted.)
2. Proposals shall contain the signature of a duly authorized officer or agent of the Respondent's company empowered with the right to contractually bind the Respondent.
3. Proposal shall be sealed and addressed as stated previously to ensure confidentiality of the information prior to the submission date and time. Denver Water is not be responsible for premature opening of proposals improperly labeled.
4. Proposals become the property of Denver Water upon receipt. The content of proposals will be kept confidential until an award is made, after which the content will no longer be kept confidential, except as provided herein.
5. Proposals may be withdrawn or modified in writing prior to the proposal submission deadline. Proposals that are modified shall be sealed and resubmitted according to the aforementioned instructions prior to the proposal submission deadline.

1.3 Proposal Requirements

The proposal must contain all of the following information, in the same sequence as presented below. Each proposal should provide a straightforward and concise presentation adequate to satisfy the requirements of this RFP.

1. Cover Letter

2. Approach to Pre- and Post-Construction Monitoring and Reporting

a. Description of the Respondent's understanding of the monitoring and reporting methodologies and requirements

b. Description of approach to accomplishing the Scope of Work (refer to **Section 2**)

c. Schedule of work by task

3. Budget or Cost Estimate

Itemized budget listed by task

i. Provide a manpower labor estimate via a detailed breakdown by labor type/hours
ii. Provide a valid 2018 labor rate sheet including how indirect costs will be invoiced
iii. Provide a proposed labor rate escalation approach for 5 years and future years to be negotiated

4. Key Staff and Previous Experience on Similar Projects

Provide a description of similar work previously completed. Provide a list of the principal individuals who will work on this project along with resumes of their relevant Section 404 monitoring and reporting experience.

1.4 Award of Contract

Agreements may be negotiated with Respondents whose proposal is determined to be most responsive to Denver Water's needs and most advantageous to Denver Water, considering the factors based on the criteria described in **Section 4**, all as solely determined by Denver Water. Award of an Agreement may be made after proposals are received and without interviews. Therefore, proposals shall be submitted initially on the most favorable terms of qualifications, technical experience, cost, and proposed financial terms. Denver Water reserves the right to reject any or all proposals.

Once a proposal for Stream Monitor is selected, the final scope of work will be agreed upon between the selected firm and Denver Water and contained in a Professional Services Agreement. Denver Water reserves the right to extend the Agreement, based on the Stream Monitor's performance, with future tasks negotiated as the project progresses.

1.5 Respondent Responsible For Proposal Costs

Denver Water is not liable for any cost incurred by any Respondent associated with the preparation of a proposal or the negotiation of an Agreement for services prior to the issuance of an Agreement. The Respondent is responsible for costs associated with responding to the RFP including costs related to site visit(s) and estimate preparation(s) for work authorized under the Agreement. Respondents may be asked to present their proposals to Denver Water's representatives at Denver Water offices. The Respondents shall bear the costs for such presentations.

1.6 Binding Proposal

Respondents are advised that proposals shall be binding upon the Respondent for sixty (60) days from the proposal due date. A Respondent may withdraw or modify their proposal any time prior to the proposal due date by a written request, signed in the same manner and by the same person who signed the proposal.

1.7 Notification

Each Respondent submitting a proposal in response to this RFP will be notified in writing as to acceptance or rejection of their proposal. Denver Water plans to release such letters within two weeks of the proposal submittal date. Denver Water may delay this action if it is deemed to be in the best interest of Denver Water.

1.8 Right to Reject Proposals and Negotiation

Denver Water reserves the right to reject any and all proposals and to waive any formality in proposals received, to accept or reject any or all of the items in the proposal, if it is deemed in Denver Water's best interest. Denver Water reserves the right to negotiate any and all elements of the proposal, if such action is deemed to be in the best interest of Denver Water.

1.9 Confidentiality

Proposers acknowledge that Denver Water may be required to disclose any or all of the documents submitted with a Response, pursuant to the Colorado Open Records Act, C.R.S 24-72-200.1, et seq. Under C.R.S § 24-72-204(3) (a) (IV), Denver Water may deny inspection of any confidential commercial or financial information furnished to Denver Water by an outside party. Therefore, a Respondent shall clearly designate any documents submitted with its Response that the Respondent deems proprietary or confidential, to aid Denver Water in determining what should be disclosed in the event of a request for documents under the Colorado Open Records Act. Proposals submitted and terms and conditions specified in each Respondent's response shall remain the property of Denver Water.

Section 2 – Scope of Work

The selected firm and Denver Water will enter into a Professional Services Agreement based on project milestones and performance. The Stream Monitor will perform the monitoring and reporting (Tasks 1-4) consistent with the Corps' requirements per the Final Mitigation Plan for the Moffat System Project (Refer to **Appendices A** and **B**). A description of the SBCRP habitat improvement elements and performance standards is provided in **Appendix A – Excerpt of Section 1.2 from Denver Water's Final Mitigation Plan for the Moffat Collection System Project**. The Corps' monitoring and reporting requirements are found in **Appendix B - Corps Regulatory Guidance Letter No. 08-03, October 10, 2008**.

2.1 Task 1 – Pre-Construction (Baseline Conditions) Site Survey

Prior to the start of construction of the SBCRP anticipated in mid-January 2018, the Stream Monitor must conduct a pre-construction (baseline conditions) site survey to establish the following:

i. Existing Stream Function. Establish sampling sites in which to measure the four (4) HSI parameters at the SBCRP [i.e. average thalweg depth (HSI V_4), percent stable banks (HSI V_{12}), percent pool habitat (HSI V_{10}) and percent fines in riffles (HSI V_{16})]. Collect baseline measurements for these four HSI parameters.
ii. Existing Riffle/Pool Complexes. Evaluate the number and location of existing riffle and pool features at the SBCRP site.
iii. Existing Pool Quality. Evaluate the existing pool quality at the SBCRP site.
iv. Photo Points. Using GIS, establish photo points and take baseline photos to be used to document site conditions before, during, and after construction of the SBCRP.

Deliverables: Compile all data collected in the field. Provide a summary report to Denver Water within one (1) week prior to the start of construction of the SBCRP, include a map identifying the sample site locations. All HSI scores must relate to the performance standards established in Section 1.2.9 of the Final Mitigation Plan for the Moffat Collection System Project (**Appendix A**).

2.2 Task 2 – Project Completion (As-Built Condition) Site Survey

Within one (1) week following the completion of construction of the SBCRP, the Stream Monitor must conduct an as-built condition survey to evaluate the following:

i. Stream Function. For each of the four (4) HSI sampling sites at the SBCRP [i.e. average thalweg depth (HSI V_4), percent stable banks (HSI V_{12}), percent pool habitat (HSI V_{10}) and percent fines in riffles (HSI V_{16})], collect measurements to document the as-built condition.
ii. Riffle/Pool Complexes. Evaluate the number and location of riffle and pool features at the SBCRP site to document the as-built condition.
iii. Pool Quality. Evaluate the pool quality at the SBCRP site to document the as-built condition.
iv. Photo Points. At the established photo points, take photos to document the as-built condition.

Deliverables: Compile all data collected in the field. Provide a summary as-built conditions report and map to Denver Water by May 1st. All HSI scores must relate to the performance standards established in Section 1.2.9 of the Final Mitigation Plan for the Moffat Collection System Project (**Appendix A**).

2.3 Task 3 – Post-Construction Annual Site Surveys (5-Year Monitoring)

Per Denver Water's 404 Permit, beginning exactly one (1) year after the completion of the SBCRP for a total of five (5) years or until the Performance Standards have been met and the monitoring requirements are fulfilled, the Stream Monitor will return to collect the data described above in Task 2. An annual post-construction summary report and map will be provided to Denver Water by May 1st each year.

2.4 Task 4 – Post-Construction Annual Reporting

The annual report shall contain the post-construction monitoring results and must adhere to the Corps' requirements as described in **Appendix B – Corps Regulatory Guidance Letter No. 08-03, October 10, 2008**.

Section 3 – Project Schedule

3.1 Tentative Schedule

The following procurement and construction schedule is provided for planning purposes.

Activity/Milestone	Date
Advertisement of RFP	October 9, 2017
Proposals due	October 30, 2017 @ 2:00 PM MT
Notice of award	November 9, 2017
Construction start	Week of January 15, 2017
Date of substantial completion	February 28, 2018
Project completion	March 30, 2018

Section 4 – Selection Criteria

Denver Water will perform a complete review of the Proposal items according to the following selection criteria. Once a Proposal is selected, the final scope of work will be negotiated between the selected firm and Denver Water and defined in a Professional Services Agreement.

- Proposed Approach (30%)
- Key Staff Experience (50%)
- Cost and Work Hours (20%)

Appendices

A. Section 1.2 excerpt from Denver Water's Final Mitigation Plan for the Moffat Collection System Project (Corps File No. NWO-2002-80762-DEN) dated July 8, 2017
B. Corps Regulatory Guidance Letter No. 08-03, October 10, 2008.

APPENDIX A

EXCERPT - CONTAINS SECTION 1.2 ONLY

Final Mitigation Plan for the Moffat Collection System Project

Corps File No. NWO-2002-80762-DEN

Prepared For:
U.S. Army Corps of Engineers
Denver Regulatory Office
9307 S. Wadsworth Blvd.
Littleton, CO 80128

June 8, 2017

Prepared By:

DENVER WATER

- *Allows the development and maintenance of characteristic plant communities* by reestablishing critical elements of the physical setting, particularly hydrology and soil characteristics;
- *Improves the wetland's ability* to *provide habitat for characteristic wildlife* by expanding the wetland's extent, improving vegetative structure, and increasing available forage;
- *Maintains faunal food webs* by perpetuating the wetland conditions necessary to support wetland dependent species, particularly aquatic invertebrates; and
- *Maintains regional and landscape biodiversity* by preserving and expanding wetland conditions in the semi-arid short-grass steppe habitat that predominates in the area.

1.1.4 Baseline Information

The baseline conditions of the impacted wetlands are described in detail in the 2015 *Wetland Delineation Report, Gross Reservoir* and summarized above in ***Section 1.1.1 Impact Area Characterization***.

1.1.5 Determination of Credits

The 2008 Mitigation Rule establishes a priority for the use of wetland mitigation banks to offset wetland impacts. The compensatory mitigation provided by Denver Water's Bank represents a rare wetland type of greater ecological functions and values as compared to the wetlands to be impacted by the Project (JEC 2007; Corps 2014). Denver Water will secure credits at a 1.5:1 ratio (3.36 wetland credits) from its Corps-approved wetland mitigation Bank to offset the loss of 2.24 acres of wetlands. These 3.36 wetland credits represent full compensatory mitigation, which provides the required compensation for unavoidable impacts to aquatic resources resulting from the permitted activity [CFR Section 332.3(f)].

1.2 South Boulder Creek Restoration Project - Compensatory Mitigation for Other Waters of the U.S Impacts (East Slope)

1.2.1 Impact Area Characterization

The Project will result in permanent impacts to **9,447 feet (3.54 acres) in total** to other waters of the U.S. tributary to Gross Reservoir. Portions of these tributaries will be inundated by the expanded reservoir and transformed from stream habitat into reservoir habitat. Specifically, the tributary waters that would be impacted (Impact Site) include:

- **7,285 ft (3.36 ac) of perennial streams** (South Boulder Creek, Forsythe Canyon, Winiger Gulch Tributary, Winiger Gulch);
- **2,162 ft (0.18 ac) of intermittent streams** (Unnamed Southern Tributaries, Chamberlain Gulch/Advent Gulch); and

- **Two Special Aquatic Sites** [riffle/pool complexes, each identified with 20-foot pools (ERC 2016)] included in the total of perennial streams.

The majority of Project impacts to other waters of the U.S. will result from reservoir inundation. Smaller areas of South Boulder Creek and Chamberlain Gulch will be permanently affected by the footprint of the enlarged dam and auxiliary spillway. Temporary impacts to these streams will occur from construction disturbance related to the dam and auxiliary spillway. Project impacts to two riffle/pool complexes will occur in South Boulder Creek upstream of Gross Reservoir (**Figures 2** and **3**). ERC (2016) describes the length of the riffle/pools as follows: "*The [first] pool was observed to be approximately 20 feet long and was found to be of good quality despite only extending for roughly 25% of the total channel width. The [second] pool was observed to be approximately 20 feet long and extended for approximately half of the overall channel width.*"

Riffle/pool complexes are defined in the Clean Water Act 404(b)(1) guidelines at 40 CFR 230.45(a) as: *"Steep gradient sections of streams are sometimes characterized by riffle and pool complexes. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a coarse substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. Pools are characterized by a slower stream velocity, a streaming flow, a smooth surface, and a finer substrate. Riffle and pool complexes are particularly valuable habitat for fish and wildlife."* The Corps used the Rosgen and Montgomery-Buffington classification systems to define geomorphic features related to riffle/pool complexes. Both classification systems are common stream characterization techniques that include stream types found in the South Boulder Creek river system (ERC 2016).

A map showing the locations of the tributary waters of the U.S. and the two riffle/pool features is provided as **Figure 1**.

Physical Functions of Impact Site

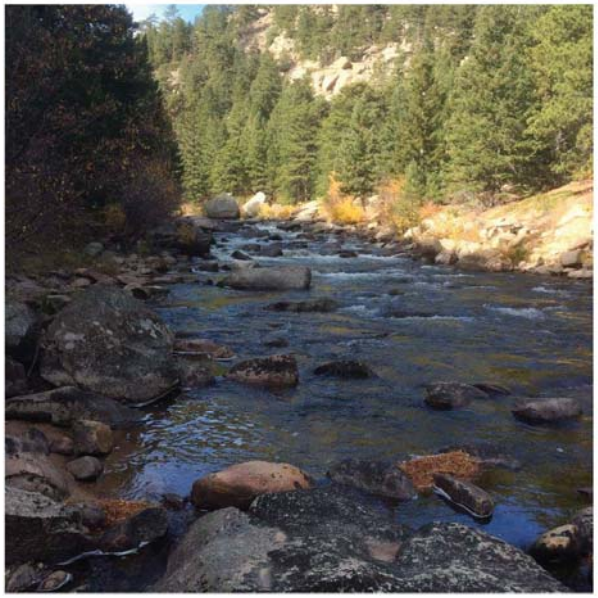
The Impact Site is situated in the Middle South Boulder Creek Subbasin (12-digit HUC 101900050503) of the South Boulder Creek Watershed (10-digit HUC 1019000505) at an elevation ranging from approximately 7,282 to 7,406 feet.

South Boulder Creek is a tributary of Boulder Creek in the larger St. Vrain Creek Basin, which flows into the South Platte River. Most of the South Boulder Creek Basin is located west and a little south of the City of Boulder. South Boulder Creek drains the east side of the Continental Divide from Rollins Pass to James Peak at an elevation of approximately 13,300 feet and joins Boulder Creek on the plains east of Boulder at an elevation of approximately 5,175 feet (Corps 2014).

The following describes the physical characteristics of the streams within the Impact Site:

South Boulder Creek enters the reservoir at the southwest end of Gross Reservoir and exits at the dam outlet. Upper South Boulder Creek through the Impact Site is characterized as a perennial, steep, wide stream with average bankfull width of approximately 40 feet and average

Figure 2. General Physical Characteristics of South Boulder Creek Impact Site



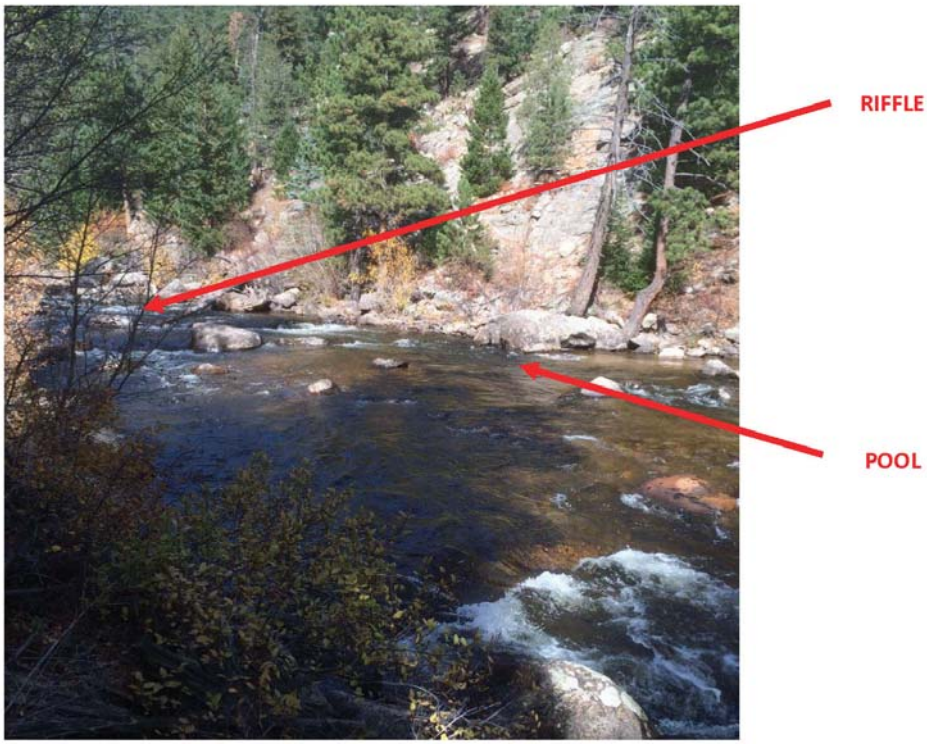
Even in a majority of the lower gradient stream sections, riffle/pool complexes were not observed. This photo shows a cascade segment in the background transitioning to a step pool segment.

A majority of the South Boulder Creek inlet channel was steep and dominated by large boulders. Riffle/pool complexes were absent from most of the channel.

Source: ERC 2016

Figure 3. General Physical Characteristics of South Boulder Creek Riffle-Pool Complex Impact Site

Despite the fact that the steep channel and larger substrate dominated the portion of South Boulder Creek that would be inundated by the proposed Gross Enlargement, two riffle/pool features were observed. Photos and descriptions of the two riffle pools are provided below.



The first riffle/pool complex is located approximately 1/3 of the distance upstream from the current high water line. A low gradient riffle is located above a pool, which is confined to the left bank. Although boulders were found to occur at this location, cobbles and gravel dominated the substrate in this area. The pool was observed to be approximately 20 feet long and was found to be of good quality despite only extending for roughly 25% of the total channel width.

Source: ERC 2016

depth of 2 feet. As described in ERC's assessment of riffle/pool complexes at Gross Reservoir (ERC 2016), cascades and step pools dominate the bed form along with few existing riffle/pool complexes. The stream is laterally confined and dominated by large cobbles and boulders that likely originate from the immediate hillsides. The average slope of the stream section is approximately 4.1%. The flattest calculated slope over the nearly 2,700-foot section was less than 1% while the steepest slope was on the order of 8%. Based on an average slope of 4.1%, South Boulder Creek through the impact area classifies as on the border of a Type A and Type B stream using the Rosgen Classification system, where rapids, cascades and steps dominate the bed form. The stream classifies as a Step-Pool type stream under the Montgomery-Buffington system. Elevation of these stream segments range from roughly 7,300 to 7,400 feet.

Forsythe Creek enters the reservoir at the northwest arm of the reservoir. Forsythe Creek was found to be a steep stream that is approximately 5 feet wide. Substrate is dominated by larger cobbles, boulders and bedrock with smaller amounts of finer material present. Steps, cascades and one predominant waterfall were observed. Pools were observed, but always below steps, cascades or the waterfall; no riffle complexes were identified (Corps 2014).

Winiger Gulch appears to be a perennial stream. Other localized areas of surface water were intermixed with dry segments, showing that Winiger Gulch is both a gaining and losing stream at different locations. Where water was observed, it was generally confined to approximately 2-3 feet and the bankfull channel width was observed to be on the order of 5 feet in most places. The channel substrate is dominated by cobbles and gravels with some boulders (Corps 2014).

Unnamed Southern Tributaries and Chamberlain Gulch/Advent Gulch have been defined as smaller intermittent/ephemeral streams (Alpine Eco 2015). An intermittent/ephemeral stream has flowing water during certain times of the year in response to precipitation or when groundwater provides water for stream flow. During dry periods, these streams may not have flowing water.

Biological Functions of Impact Site

The following describes the biological characteristics of the streams within the Impact Site:

South Boulder Creek - Fish populations were sampled in South Boulder Creek periodically since the 1960s by Colorado Parks and Wildlife (CPW) or Chadwick Ecological Consultants (GEI 2013). South Boulder Creek in the overall study area contains several species of trout, along with suckers, and longnose dace. Resident, naturally reproducing rainbow trout is the dominant fish species present in South Boulder Creek in the overall study area. In the canyon between Pinecliffe and Gross Reservoir, habitat for brook and rainbow trout is highest over a broad range of flows from 100 to 800 cfs.

Upstream of Gross Reservoir, resident rainbow trout are the main component of the fishery, with cutthroat, brook, and brown trout also present in smaller numbers. White and longnose sucker are also present. Total fish density averages 814 fish/ha. Trout species represent the largest proportion of biomass in this stream, although suckers comprised up to 30.8 kg/ha in one sample year.

Rainbow trout inhabit small to moderately large streams with gravel substrates and riffle/pool morphology. The native range of the rainbow trout is the Pacific Coast of North America and streams west of the Rocky Mountains; this range stretches from Baja California north to the Kuskokwim River in Alaska (Corps 2014). This species is not native to the area; however, rainbow trout have been introduced worldwide and are common in Colorado (Bernstein and Montgomery 2008). They are one of the most common species of fish stocked by CPW in Colorado (Corps 2014).

Forsythe Canyon and Winiger Gulch - Fish surveys were conducted in the two inlet streams to Gross Reservoir, Forsythe Canyon and Winiger Gulch. Forsythe Canyon was sampled in 1985 and 2010, and fish were absent. Forsythe Canyon is likely too small with insufficient flow to support fish (Corps 2014). Winiger Gulch was also sampled in 1984 and 2010, and brook trout, brown trout, and rainbow trout were present in both years (Corps 2014).

Intermittent/Ephemeral Streams - These streams are dry for much of the year and do not support fish (GEI 2013; Corps 2014).

1.2.2 Mitigation Objective

Compensatory mitigation will be provided through rehabilitation of an approximately 10,350 linear foot (1.96 mile) section of lower South Boulder Creek below Gross Reservoir; hereinafter, referred to as the **South Boulder Creek Restoration Project (SBCRP)** (**Figures 4** and **5**). The stream reach and surrounding lands are owned and managed by City of Boulder Open Space and Mountain Parks (OSMP). OSMP has defined general restoration goals to be achieved through mechanical manipulation of the stream that will result in improved low flow conditions, instream diversity, channel stability and creation of a minimum of two riffle/pool complexes.

The SBCRP will consist of aquatic resource restoration through rehabilitation. Per the 2008 Mitigation Rule, restoration means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: reestablishment and rehabilitation. Rehabilitation, which will be the method employed for the SBCRP, means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Specific Project Objectives

Upon more detailed analysis and design development, specific, more quantifiable objectives were established for the SBCRP based upon the OSMP's initial concept goals. The goal of the SBCRP is restoration of aquatic resource form, function and services to a degraded section of lower South Boulder Creek below Gross Reservoir. The goal will be met through the following five (5) specific objectives:

1. **Low Flow Channel Condition**: re-establish appropriate channel geometry in balance with the current flow regime to establish a defined low flow thalweg.

Figure 4. Topographic Map of South Boulder Creek Mitigation Site

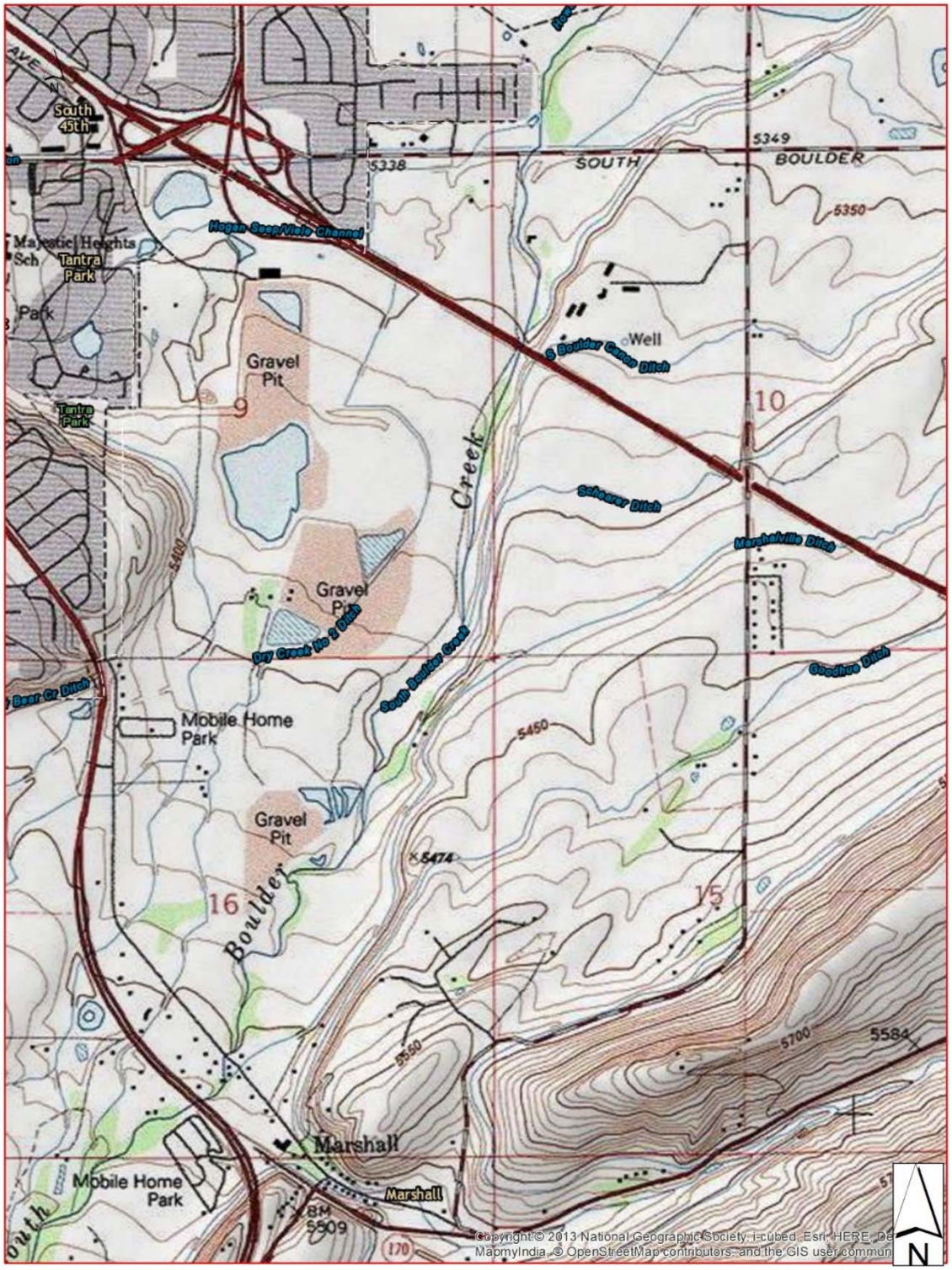
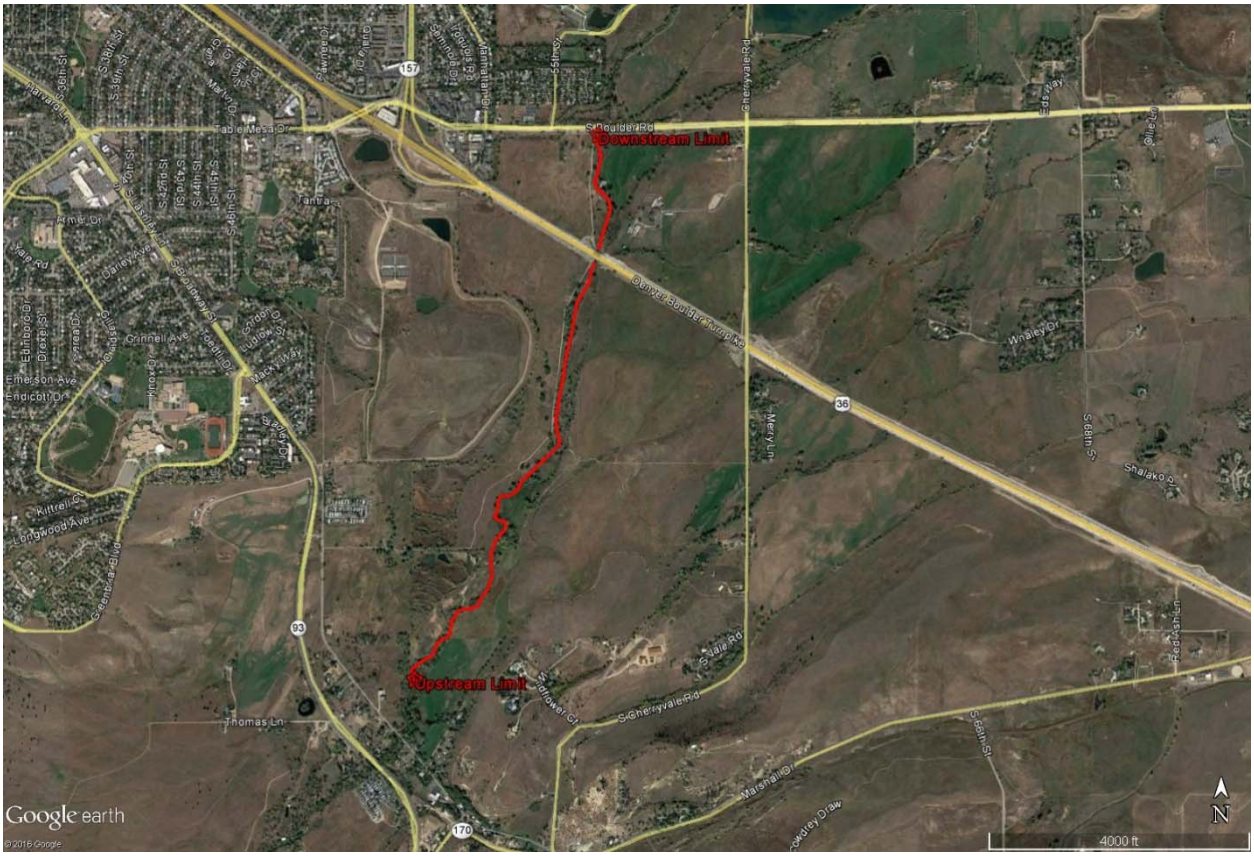


Figure 5. Aerial Image of South Boulder Creek Mitigation Site



2. **Bank Stability**: stabilize eroded banks.
3. **Habitat and Bed Form Diversity**: increase aquatic habitat and bedform diversity by establishing natural riffle/pool complexes based on typical, natural sequencing.
4. **Habitat and Bed Form Diversity**: increase aquatic habitat and bedform diversity by improving pool condition and instream cover.
5. **Habitat and Bed Form Diversity**: improve pool quality.

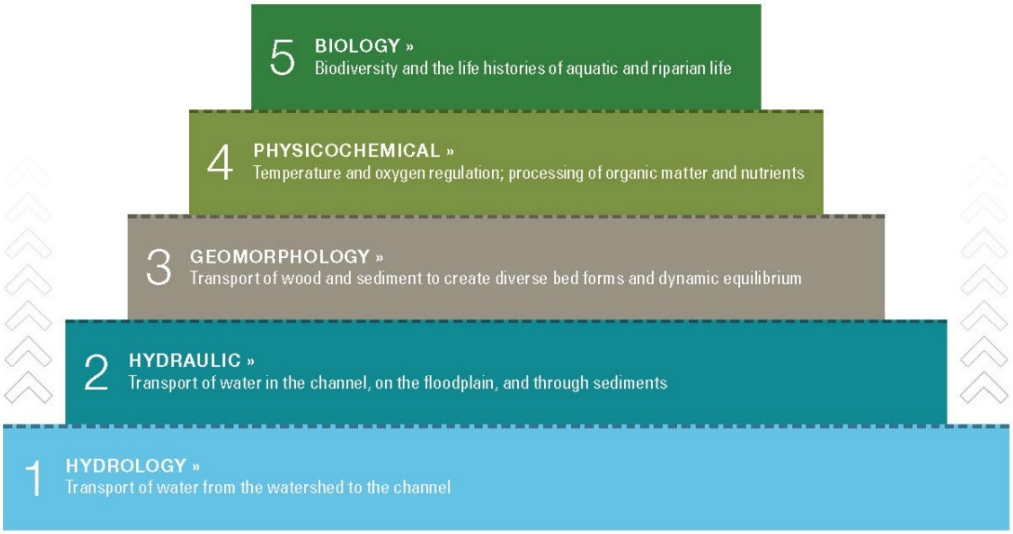
Target Stream Function Uplift

To successfully restore stream functions, it is necessary to understand how these different functions work together and which restoration techniques influence a given function. It is also imperative to understand that stream functions are interrelated and build on each other in a specific order or functional hierarchy. If this hierarchy is understood, it is easier to establish project goals and objectives. With clear goals and objectives, it is easier to evaluate project success (Harman et al. 2012). Well-articulated goals and objectives establish a foundation for project success. Vague, too broad, or poorly articulated goals and objectives often lead to project failure (worst case) or misunderstandings at best. Goals are statements about why the project or effort is needed. They are general intentions and often cannot be validated. Objectives are more specific. They help explain how the project will be completed. They are tangible and can be validated, typically by performance standards.

There is not one regional, commonly accepted functional assessment methodology currently available that can evaluate stream restoration projects in this region to determine success of goals and objectives. Therefore, in order to define functions and ultimately overall project benefits (or functional lift) resulting from the project, the Stream Functions Pyramid Framework (Framework) has been employed for evaluation of existing and proposed conditions (Harman et al. 2012). It is the intent with this Framework that specific functional parameters can be defined, quantified and used in comparing pre- and post-project condition to ensure the SBCRP results in a net increase in aquatic function and services (functional lift).

The Framework was developed through a partnership between the U.S. Fish and Wildlife Service (USFWS) and the U.S. Environmental Protection Agency (EPA) in coordination with the Corps. The Framework organizes stream functions in a pyramid form and illustrates that stream functions are supported by lower-level functions in a hierarchical structure. It identifies a suite of 15 functions critical to the health of stream and riparian ecosystems. The functions are ordered into a hierarchy, where the relative significance of each function is inferred by assessing the interrelations among functions. Functions that affect the greatest number of other functions are ranked highest and form the foundation of the pyramid, while functions that have the least effect on other functions are ranked lower. The purpose of this hierarchy is to indicate the complex set of linkages that exists between functions of stream and riparian systems and to indicate which functions are most critical and interrelated to the restoration of stream and riparian functions. Stream functions are separated into a hierarchy of categories, ranging from Level 1 (greatest importance) to Level 5 as summarized in **Figure 6**.

Figure 6. Stream Functions Pyramid Framework



The Framework can be used to first determine the function of existing parameters that are impaired or non-existent and then compare anticipated functional lift or improvements resulting from the mitigation project. Per the 2008 Mitigation Rule, compensatory mitigation must result in a net increase in aquatic function and services. By applying the Framework, the net increase of aquatic function and services can be determined when a specific function parameter shows a lift or improvement.

Table 1 provides a summary of the Framework Level Category and function parameters as they relate to the SBCRP. Functional parameters identified with a bullet are generally considered critical for this type of restoration project. These parameters represent critical stream and aquatic functions that can be reasonably measured, provide quantifiable results and that can be directly correlated to performance standards. While these functional parameters have been selected for the SBCRP it should be noted that in the Framework these higher-level categories (Level 2 and 3) correlate to many other lower level (Level 4 and 5) categories and functions that have not been specifically addressed. **Table 2** provides a summary of the Mitigation Objectives as they relate to target stream functions.

Table 1. Summary of Level, Category and Function Parameters Selected for the SBCRP

Level-Category	Function Parameter Description
Level 1-Hydrology	No direct alterations to system hydrology proposed. Basin hydrology to be maintained and serve as the basis for natural channel design principles.
Level 2-Hydraulics	• Flow Depth
Level 3-Geomphology	• Bed Form Diversity • Bank Stability • Sediment Transport and Substrate Condition • Pool Quality
Level 4-Physicochemical	No direct alterations to the system physicochemical proposed.
Level 5-Biology	Indirect benefits of Level 2 and 3. • Fish Communities (Habitat Availability)

Table 2. Mitigation Objectives and Target Functions of the SBCRP

Specific Mitigation Objective		Functional Category - Functional Parameter*	Functional Description*
1	Low flow channel condition improvement - establish defined thalweg	Level 2 Hydraulics • Flow Depth	Transport of water in the channel, on the floodplain and through sediments. It defines how water behaves once it reaches a channel and how it interacts with the bed, banks, floodplain, hyporheic zone, etc. Level 2 functions have a dramatic effect on Level 3 and affect many functions in Levels 4 and 5 because they determine the amount of force and power that is exerted by the water on aquatic habitats.
2	Bank stabilization - stabilize active erosion	Level 3 Geomorphology • Bank Stability	Transport of wood and sediment to create diverse bed forms and dynamic equilibrium. Natural streams rarely have flat uniform beds. Instead, the hydraulic and sediment transport processes shape the stream bed into a myriad of forms, slopes and type of bed materials. Geomorphic functions create diverse bed forms and channel stability (dynamic equilibrium) that has a dramatic effect on Levels 4 and 5 functions.
3	Habitat and bedform diversity - increase riffle/pool complexes	Level 3 Geomorphology • Bedform Diversity	
4	Habitat and bedform diversity - improve pool condition and instream cover	Level 3 Geomorphology • Bedform Diversity	
5	Proper sediment transport and substrate condition - improve riffle substrate	Level 3 Geomorphology • Bed Material Characterization	
6	Habitat and bedform diversity - improve pool quality	Level 3 Geomorphology • Bedform Diversity /Pool Quality	

Note: *Based on *A Function-Based Framework for Stream Assessments and Restoration Projects* (Harman et al. 2012).

1.2.3 Site Selection

Site selection for potential mitigation opportunities followed a watershed approach by taking a landscape view of the South Boulder Creek Watershed, how it functions, and its need for improvement. The 2008 Mitigation Rule emphasizes the strategic selection of mitigation sites on a watershed basis and the desire to maintain and improve the quantity and quality of other aquatic resources. The following framework per the 2008 Mitigation Rule was implemented as part of the site selection process:

1. No mitigation banks or in-lieu fee program currently service the South Boulder Creek watershed that could provide appropriate stream mitigation credit, therefore Permittee-responsible mitigation was determined most appropriate.

2. Locations for compensatory mitigation options were focused within the same watershed as the Impact Site and at locations where the replacement of functions and services is most likely to be successful. Mitigation options are limited within the confines of the South Boulder Creek Watershed (10-digit HUC 1019000505).

3. Opportunities for preservation of high-value wetlands and other Waters of the U.S. upstream of Gross Reservoir were evaluated, including Denver Water's forthcoming conveyance of the 539-acre Toll Property to the U.S. Forest Service, which contains approximately 43 acres of wetland and fen habitat and 5 miles of stream (including South Boulder Creek). Although the property is considered by the Corps to be a high-value resource that has important contributions to the ecological integrity of the area, the mitigation proposal did not meet all of the requirements for preservation under the 2008 Mitigation Rule (Corps 2016b).

4. Rehabilitation was determined to be the preferred method of compensatory mitigation for this type of stream impact. Rehabilitation of existing degraded stream reaches was considered the most appropriate option as the likelihood of success is greater when compared to establishment, and the potential gains in terms of aquatic resource functions are greater when compared to enhancement or preservation.

5. Onsite and in-kind mitigation opportunities were considered first. Stream reaches immediately upstream and downstream of the Impact Site were evaluated, however they were not determined appropriate for restoration consideration. The stream characteristics and condition of South Boulder Creek immediately below the Impact Site (Gross Reservoir and Dam) generally does not support riffle/pool complexes because the slope of the river channel is steep and comprised of large boulders; therefore, riffle/pool stream mitigation should focus on locations downstream where lower slopes exist and riffle/pool complexes are naturally occurring.

6. Offsite and in-kind mitigation opportunities were considered second. Segments of South Boulder Creek were evaluated for potential restoration efforts that could present an uplift to functions and services while achieving adequate mitigation ratios. Few segments were identified from the base of Gross Reservoir Dam to Eldorado that exhibited restoration potential.

7. ERC identified appropriate geomorphic characteristics on lower South Boulder Creek from Eldorado to the confluence with Boulder Creek for potential restoration opportunities.

8. Communication with OSMP identified a restoration priority reach on lower South Boulder Creek. OSMP has worked over the years to improve aquatic habitat in South Boulder Creek including instream habitat improvements, land management for ecological benefits, public recreation and native riparian enhancements. OSMP identified the section of South Boulder Creek below Highway 93 as a priority for restoration and in 2016 initiated design development on this segment. The 2016 OSMP analysis identified key concerns associated with historic channelization, damage from the 2013 flood, stream instability, poor instream habitat connectivity, bank erosion and instream habitat complexity. These common concerns are prevalent throughout the entire South Boulder Creek watershed. OSMP has not been able to implement restoration measures due to limited funding.

9. OSMP's project site is situated on land owned by a single entity (City of Boulder), which has conservation-oriented land use requirements that allow for long-term management, adaptive management and site protections.

10. OSMP's project site provides adequate mitigation ratios, is located in the same watershed, has been identified as a long-term priority for restoration, and exhibits similar stream characteristics, functions and services as the Impact Site.

In summary, Denver Water's compensatory mitigation project, the SBCRP, offers the following:

- **In-kind mitigation.** The SBCRP will restore at least 1.8 miles (9,447 linear feet; 3.54 acres) of waters of the U.S., including at least 2 riffle/pool complexes; and
- **Same Hydrologic Unit Code.** The SBCRP is located within the same HUC as the proposed impacts at Gross Reservoir (10-digit HUC 1019000505 – South Boulder Creek Watershed).

1.2.4. Site Protection Instrument

The City of Boulder and Denver Water have entered into an Intergovernmental Agreement to establish the legal arrangements and obligations of the parties for the construction, monitoring, and long-term protection of the SBCRP per the requirements of the Corps Section 404 permit and the City of Boulder's existing and continued protection of the Mitigation Site.

As for long-term protection of the Mitigation Site, the Mitigation Site is on land owned by the City of Boulder and managed as open space by the City of Boulder OSMP Department under the City Charter (Article XII). The City Charter is the legal instrument by which lands designated as open space are managed to ensure preservation and protection of the natural environment. The following section from Article XII demonstrates how preservation of open space will ensure long-term protection of the Mitigation Site.

Sec. 176 – Open space purposes – open space land.

Open space land shall be acquired, maintained, preserved, retained, and used only for the following purposes:

(a) Preservation or restoration of natural areas characterized by or including terrain, geologic formations, flora, or fauna that are unusual, spectacular, historically important, scientifically valuable, or unique, or that represent outstanding or rare examples of native species;
(b) Preservation of water resources in their natural or traditional state, scenic areas or vistas, wildlife habitats, or fragile ecosystems;
(c) Preservation of land for passive recreational use, such as hiking, photography or nature studies, and, if specifically designated, bicycling, horseback riding, or fishing;
(d) Preservation of agricultural uses and land suitable for agricultural production;
(e) Utilization of land for shaping the development of the city, limiting urban sprawl, and disciplining growth;
(f) Utilization of non-urban land for spatial definition of urban areas;
(g) Utilization of land to prevent encroachment on floodplains; and
(h) Preservation of land for its aesthetic or passive recreational value and its contribution to the quality of life of the community.

Open space land may not be improved after acquisition unless such improvements are necessary to protect or maintain the land or to provide for passive recreational, open agricultural, or wildlife habitat use of the land. (Added by Ord. No. 4996 (1986), § 1, adopted by electorate on November 4, 1986.)

Disposal by the City of open space land is unlikely to occur. According to the City Charter, disposal would require a vote and affirmative approval from the open space board of trustees after a public hearing on the matter. Approval by city council is also required. Additionally, registered electors may request that the disposal be put to a vote of the electors.

The City of Boulder's continued management of the designated open space area will sustain and preserve the SBCRP after performance standards are met and monitoring requirements have been fulfilled.

1.2.5 Baseline Information

The Mitigation Site consists of an approximately 1.96-mile continuous reach of South Boulder Creek extending approximately from Highway 93 downstream to South Boulder Road within the City and County of Boulder, Colorado (**Figure 7**).

Physical Functions of Mitigation Site

The following describes the physical characteristics of the Mitigation Site:

Figure 7. General Physical Characteristics of South Boulder Creek Mitigation Site

Typical seasonal low flow conditions. Here flood flows have altered the channel, eliminating any natural low flow channel thalweg and any significant bed diversity (riffle/pools or micro habitat).

Typical seasonal low flow condition. Here flood flows deposited significant sediment blocking the original channel now creating an alternative flow path.

Typical seasonal moderate flow conditions. Bank erosion (seen to the right) increases channel width resulting in a wide channel with shallow flow depth.

Typical seasonal moderate flow conditions. Here the channel is wide, flows are shallow and the bank to the right is eroding.

The Mitigation Site is situated in the Lower South Boulder Creek Subbasin (12-digit HUC 101900050504) of the South Boulder Creek Watershed (10-digit HUC 1019000505) at an elevation ranging from approximately 5,332 to 5,401 feet. South Boulder Creek through the Mitigation Site is a relatively large, perennial stream dominated by gravel, cobble and boulder substrate within long continuous riffles and few pools.

Based on an average slope of 0.6%, this section of South Boulder Creek is generally classified as a Type C stream using the Rosgen Classification system, where sequencing of steeps (riffles) and flats (pools) dominate the bedform linked to a meandering geometry. The primary morphological features of the "C" stream type are the sinuous, low relief channel, the well-developed floodplains built by the river, and characteristic "point bars" within the active channel. The channel aggradation/degradation and lateral extension processes, notably active in "C" stream types, are inherently dependent on the natural stability of streambanks, the existing upstream watershed conditions and flow and sediment regime. Channels of the "C" stream type can be significantly altered and rapidly de-stabilized when the effects of imposed changes in bank stability, watershed condition, or flow regime are combined to cause an exceedance of a channel stability threshold.

The Mitigation Site has been significantly impacted from historic agricultural practices, gravel mining, water diversion and channelization. Numerous bridges bisect the Mitigation Site (South Boulder Road, Hwy 36 and Hwy 93) and numerous water diversion structures are present within the primary channel. More recently the Mitigation Site along with a majority of lower South Boulder Creek was significantly impacted by the 2013 floods. OSMP has outlined the following primary concerns within the project reach:

1. **Stream Stability**. The 2013 floods resulted in significant downcutting in areas of historic channelization. Downcutting is contributing to bank erosion along some stretches. The 2013 floods also resulted in aggradation of the stream bed in other locations.
2. **Instream Habitat Connectivity**. Channelization and flood erosion resulted in stretches of the stream with relatively uniform shallow depth and a poorly defined thalweg providing inadequate cover for fish, especially in low-flow winter months.
3. **Bank Erosion**. The 2013 flood exacerbated existing bank erosion issues and resulted in stretches of unstable stream banks.
4. **Instream Habitat Complexity**. The 2013 flood resulted in stretches of the stream with relatively uniform depth and poor cover for fish.

Due to these concerns with the existing physical characteristics of the stream, the South Boulder Creek Mitigation Site is considered “Not Functioning” or “Functioning-at-Risk” within the context of the Framework.

Special Status Species

The City of Boulder completed informal consultation with the U.S. Fish and Wildlife Service in 2016, which concluded that the SBCRP would *“not likely adversely affect”* threatened or endangered species protected under Section 7 of the Endangered Species Act (**Appendix A**).

1.2.6 Determination of Credits

Compensatory mitigation is provided at a 1:1 ratio for permanent impact to waters of the U.S. Direct, permanent impact from flooding to 9,447 feet (3.54 acres) of stream channel including two riffle/pool complexes will be offset by the rehabilitation of a minimum of 9,447 feet (3.54 acres) of degraded stream channel including the creation of a minimum of two riffle/pool complexes. The SBCRP will provide an overall measurable uplift in aquatic resource function and services within the South Boulder Creek watershed. The SBCRP represents full compensatory mitigation, which provides the required compensation for unavoidable impacts to aquatic resources resulting from the permitted activity [CFR Section 332.3(f)].

1.2.7 Mitigation Work Plan

The *South Boulder Creek Habitat Improvement Project Design Plan* (August 29, 2016) (Design Plan) serves as the primary SBCRP Work Plan. Refer to **Appendix B**. The Design Plan provides specific details and specifications for project implementation including enhancement locations, key profile elevations and cross-section dimensions, access and staging locations as well as material and operation specifications. An overview of key components presented in the Design Plan are summarized in **Table 3**.

Table 3. South Boulder Creek Restoration Project Key Components

Item	Features	Quantity
1	Channel Grading and Shaping	10,350 feet
2	Riffle/Pool Complex Construction	50
3	Boulder Habitat Cluster Features	31
4	Large Woody Debris Features	37
5	Bank Stabilization	1,425 feet
6	Sediment Removal	800 cubic yards
7	Access Reclamation	1 acre
General Dimensions		
A	Average Bankfull Width	30 feet
B	Channel Bottom Thalweg Width	2 to 21 feet
C	Riffle Length	35 to 190 feet
D	Riffle Slope	0.8 to 2.6 %
E	Design Bankfull Flow	185 cubic feet per second

1.2.8 Maintenance Plan

Once construction is completed, Denver Water will be responsible for ongoing monitoring and maintenance until the performance standards have been met and the monitoring requirements are fulfilled. The annual monitoring reports, as described in detail below under **Section 1.2.10**, will serve as the primary mechanism to identify potential maintenance needs. Maintenance needs can vary widely and will need to be assessed on a case-by-case basis. The restored system is intended to be able to function as a natural stream, which means that the channel and instream features are not intended to be locked or fixed in place. Rather the stream is designed and constructed as a dynamic system intended to evolve in response to flow and sediment load in the

way that a natural channel would. With the project-intended, natural channel design, local adjustments to the channel profile, cross-section and instream features are expected from year to year.

Maintenance needs should only be considered when a potential condition is identified that could lead to catastrophic failure, significant deviations from the project objectives and/or situations where performance standards would not be achieved. Potential maintenance activities will be reviewed by Denver Water and OSMP to ensure technical consistency with the Design Plan. Potential maintenance concerns will be addressed though the following systemic approach: 1) potential maintenance concerns are identified during annual monitoring or as they may be identified by OSMP, 2) a proposed maintenance plan will be developed and reviewed by Denver Water and OSMP, and 3) a maintenance plan will be implemented by Denver Water in coordination with OSMP.

1.2.9 Performance Standards

Success of the SBCRP shall be based on a demonstrated benefit to, i.e. uplift in, stream function and on the number and quality of riffle/pool complexes created. Uplift in physical stream function will be quantified based on Habitat Suitability Index (HSI) curves for rainbow trout (*Salmo gairdneri*) (Raleigh et al. 1984). The HSI method was developed by the USFWS and rates physical stream characteristics, channel hydrology and water quality, based on important life cycle variables. Rainbow trout were selected as the representative species when evaluating aquatic habitat as they are the dominant trout species in both the Impact Site and Mitigation Site. Although the specific habitat requirements for trout are not the only component of an aquatic ecosystem, they are considered a good indicator of overall aquatic ecosystem quality. Generally, if specific trout habitat requirements are present, the overall aquatic ecosystem can be considered to be of higher quality. Therefore, the HSI method provides a technically sound, reproducible and quantifiable process for comparing pre- and post-project conditions. The specific HSI parameters selected for the South Boulder Creek Mitigation Site are based on the existing physical characteristics of the stream, specifically those parameter areas affording the highest potential for ecological lift through restoration.

Overall success of the SBCRP will be quantified using three ways:

1) **Stream Function Uplift.** By the numeric uplift based on the average score of the four HSI parameters measured at the Mitigation Site [i.e. average thalweg depth (HSI V_4), percent stable banks (HSI V_{12}), percent pool habitat (HSI V_{10}) and percent fines in riffles (HSI V_{16})]. In addition, each of the individual HSI scores will show improvement over baseline conditions. This method accomplishes the mitigation objective of ensuring that the ecological lift occurs above the baseline condition for each parameter and that the overall mitigation project results in a restored stream reach that is functioning from an ecological perspective.

2) **Riffle/Pool Creation.** By creating of two riffle/pool complexes, among the creation of approximately 50 riffle/pool complexes as part of the overall SBCRP, which accomplishes the mitigation objective of directly offsetting the loss of two riffle/pool complexes due to the Project.

3) **Pool Quality Improvement.** By increasing pool quality (HSI V_{15}) compared to baseline conditions as evaluated during the late growing season low flow period. (Note: Since HSI pool class rating is scored as a "step function," improvement will be defined by a trend towards improved pool habitat, but does not require an increase in pool class rating.)

To meet these three success criteria, the SBCRP will be evaluated using a set of ecological-based performance standards and quantification of functional uplift to meet Mitigation Objectives. **Table 4** provides a Summary of the Measurement Methods for Annual Monitoring of the SBCRP. Annual monitoring will be performed to measure the success of the SBCRP over time.

Table 4. SBCRP Summary of Measurement Methods for Annual Monitoring

Mitigation Objective	Measurement Method for Annual Monitoring	Relevance to Restoration Objectives and Functions
Stream Function Uplift		
1.) Low flow channel improvement - establish defined thalweg	HSI* Variable V_4 curve for streams >5 meters. Average thalweg depth during late growing season low water period. Measurement of thalweg taken at 50-foot intervals during late summer/fall.	Depth of water at low flow is a known limiting factor in the watershed. Increasing average flow depths improves instream habitat. Average thalweg depths that provide the best combination of pools, instream cover and instream movement of adult trout are optimal.
2.) Bank stabilization – stabilize active erosion	HSI* Variable V_{12}. Average rooted vegetation and stable rocky ground cover along stream bank. Quantification of % of bank that is stable due to rooted vegetation and rocky cover.	Unstable banks are sources of sediment load, channel widening, riparian degradation and do not provide cover for aquatic species. The average percent rooted vegetation and rocky ground cover that provides adequate erosion control to the stream is optimal.
3.) Habitat and bedform diversity – percent pool	HSI* Variable V_{10}. Percent pools present during late growing season, low flow periods. Quantification of % pool habitat along stream during late summer/fall.	Pools and instream cover are known limiting factors in the watershed. The percent pools during late summer low flows that is associated with the greatest trout abundance is optimal.
4.) Proper sediment transport and substrate condition – improve riffle substrates	HSI* Variable $V_{16.}$ Percent fines in riffle-runs. Wohlman Pebble Count taken at four riffles.	Accumulation of fine sediment is a known limiting factor in the watershed. Excessive fines in riffles can plug interstitial spaces limiting aquatic organisms. The percent fines associated with the highest standing crops of food organisms, embryos and fry in each designated area is optimal.
Riffle/Pool Creation		
5.) Habitat and bedform diversity – increase riffle/pool complexes	Visual observation of riffle/pool complexes. Direct measurement of riffle and pool dimensions.	Riffle/pool complexes are special aquatic sites therefore their presence benefits the aquatic system. Increase in Level 3 Geomorphic Functional Category-Bedform Diversity Functional Parameter provides an overall benefit to the entire aquatic system.
Pool Quality Improvement		
6.) Habitat and bedform diversity – improve pool quality	HSI* Variable V_{15}. Quality of pool habitat evaluated during late growing season low flow period.	Pool quality is an indicator of the number and size of fish that can be supported. Larger, deeper pools with low velocity resting areas and an obscured surface provide optimal habitat.

Note: **USFWS Habitat Suitability Information: Rainbow Trout, Suitability Graphs* (Raleigh et al. 1984).

The following describes the methods for measuring each of the parameters at the South Boulder Creek Mitigation Site and the performance standard(s) for each of the three success criteria. Refer to **Appendix C** for the relevant HSI curves.

1. Stream Function Uplift

a. Method for Measuring the HSI Parameters for Mitigation Objectives #1-4

***Low Flow Channel Conditions (HSI V_4)* -** The relationship between the average water depth during low flow and stream function is quantified by variable 4 (V_4) of the HSI curves for the rainbow trout. Curve B, which is appropriate for streams wider than 5 meters, will be used. A numeric score from 0 to 1.0 based on average thalweg depth will be generated as part of each year's monitoring activities.

***Bank Stability (HSI V_{12})* -** The relationship between bank stability and stream function is quantified by variable 12 (V_{12}) of the HSI curves for the rainbow trout. A numeric score from 0 to 1.0 will be generated based on the percentage of stable banks observed during each monitoring period.

Habitat and Bedform Diversity – Percent Pool (HSI V_{10}) - The relationship between habitat diversity and stream function is quantified by variable 10 (V_{10}) of the HSI curves for the rainbow trout where optimal habitat is between 35% and 65% pool. A numeric score from 0 to 1.0 based on the percentage of the restored reach that is pool habitat will be generated as part of each year's monitoring activities.

Sediment Transport and Substrate Conditions – Percent Fines in Riffle-runs (HSI V_{16}) - The relationship between the fine sediment composition of riffles and stream function is quantified by variable 16 (V_{16}) of the HSI curves for rainbow trout. Curve B, which is based on riffle-run areas will be used. A numeric score from 0 to 1.0 will be generated for the percent fines material (<3 mm) determined from the Wohlman sampling event as part of each year's monitoring activities.

b. Ranking Each HSI Parameter

Each measured HSI parameter will be ranked according to "Functioning," "Functioning-at-Risk," or "Not Functioning," by using the following classifications developed from the Framework (refer to **Table 5** and **Appendix C**).

- **Not Functioning (HSI Score ≤ 0.33)**: A Not Functioning score means that the measurement method is quantifying or describing one or more aspects of a function-based parameter in a way that does not support a healthy aquatic ecosystem. The aquatic ecosystem is considered as below average condition, not stable and/or resilient and provides habitat characteristics considered as a limiting factor to aquatic life.

- **Functioning-at-Risk (HSI Score 0.34 – 0.66)**: A Functioning-at-Risk score means that the measurement method is quantifying or describing one or more aspects of a function-based parameter in a way that can support a healthy aquatic

ecosystem. In many cases, this indicates the function-based parameter is adjusting in response to changes in the reach or the watershed. The trend may be towards lower or higher function. A Functioning-at-Risk score implies that the aspect of the function-based parameter, described by the measurement method, is between Functioning and Not Functioning.

- **Functioning (HSI Score ≥ 0.67)**: A Functioning score means that the measurement method is quantifying or describing one or more aspects of a function-based parameter in a way that does support a healthy aquatic ecosystem. The aquatic ecosystem is considered as above average condition, stable, resilient and provides high quality habitat characteristics and conditions for aquatic life.

Table 5. HSI Parameter Ranking

HSI Parameter	Not Functioning (HSI Score ≤ 0.33)	Functioning-at-Risk (HSI Score 0.34 - 0.66)	Functioning (HSI Score ≥ 0.67)
HSI V_4 - Low flow channel improvement - establish defined thalweg	< 22 cm	22 - 31 cm	> 31 cm
HSI V_{12} - Bank stabilization – stabilize active erosion*	< 24% stable banks	24- 45% stable banks	> 45% stable banks
HSI V_{10} - Habitat and bedform diversity – percent pools	< 5% pools	5 - 15% pools or > 90% pools	> 15 - 90% pools
HSI V_{16} - Sediment transport and substrate conditions – percent fines in riffle-runs	>47% fines in riffle-run	33 - 47% fines in riffle-run	<33% fines in riffle-run

Note: *Score for bank stabilization will be based on areas where these improvements are made, not the entire reach.

c. Performance Standard for Stream Function Uplift

Stream Function Uplift will be deemed successful if the average score of the four HSI parameters (V_4, V_{12}, V_{10} and V_{16}) results in a score of 0.67 or greater, which indicates a "Functioning" stream system. In addition, each of the individual HSI scores will be required to show improvement over baseline conditions.

The average score of 0.67 or greater is used because it represents the overall health of the system as defined by these HSI parameters. Given the variability that is inherent in a natural system such as the stream setting, it is possible for a parameter's rating to increase or decrease over time. Since four parameters are to be used to calculate the overall HSI site score (V_4, V_{12}, V_{10} and V_{16}), a single significantly low score would make it difficult for the average score to remain high. Requiring that the average of these four parameters is at or above a value of 0.67 is a way to ensure the overall system is functioning as intended while acknowledging fluctuations will occur causing variation in the individual parameter scores.

2. <u>Riffle/pool Creation</u>

Riffle/pool complexes will be counted and measured within the South Boulder Creek Mitigation Site. Riffle/pool creation will be deemed successful if the number of complexes observed in each year is at least two (2) more than observed during the pre-restoration baseline monitoring.

3. <u>Pool Quality Improvement</u>

The quality of pools in a stream are evaluated by variable 15 (V_{15}) of the HSI curves for rainbow trout. Pool class is defined based on the size and depth of available pool habitat where optimal habitat (first class pools) are large and deep, providing sufficient habitat for several adult trout. The percent of first, second, and third class pools will be defined during the pre-restoration baseline monitoring and evaluated again as part of each year's monitoring activities. Pool quality improvement will be deemed successful if the quality of pool habitat improves over the baseline conditions.

1.2.10 Monitoring and Reporting

The purpose of the monitoring plan is to determine if the SBCRP is meeting its performance standards and to determine if measures are necessary to ensure that the project is accomplishing its objectives. Denver Water shall be responsible for monitoring the Mitigation Site.

Monitoring Period

Prior to Moffat Project construction activities at Gross Dam and prior to construction associated with the SBCRP, Denver Water will assess conditions of the Mitigation Site to establish baseline conditions of the existing stream system. Immediately following completion of the SBCRP construction and before Moffat Project construction activities are completed at Gross Dam, Denver Water will assess as-built conditions of the Mitigation Site. Five (5) annual monitoring events, with annual monitoring reports developed for each, will be completed beginning the year after as-built conditions are reported.

Annual monitoring reports will be submitted to the Corps to assess the status and success of the SBCRP as well as provide information that can be used for corrective measures and/or adaptive management (as necessary).

Denver Water will submit an annual monitoring report to the Corps by December 31st of each year until Performance Standards have been met and monitoring requirements are fulfilled. In addition, a Baseline Report and an As-Built Conditions Report, described above, will each be submitted prior to the first annual monitoring report. The annual monitoring reports will follow in each of the next five years. Each annual monitoring report will include a summary of the previous year's monitoring. The 5-year monitoring period provides sufficient time and data for the required surveys and measurements to be taken in the low flow period of each year. Data can then be evaluated and compared with results from previous years for submitting the annual monitoring report by the end of the year.

Annual Monitoring Report

An annual monitoring report, which follows the *Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources* (Corps 2008b), will be submitted to the Corps prior to December 31 of the monitoring year. Per the Corps Minimum Monitoring Requirements, the monitoring report narrative (which does not include supporting data) will be less than 10 pages and will include the following information:

i. Project Overview (1 page)
ii. Requirements (1 page)
iii. Summary Data (maximum of 4 pages)
iv. Maps and Plans (maximum of 3 pages)
v. Conclusions (1 page)
    - Completion of Compensatory Mitigation Requirements
    - Special Conditions

Data to be summarized as part annual monitoring reports shall contain, at a minimum, the following:

- Monitoring methods
- Performance standards
- Annual monitoring data
- Quantitative comparison of current year results with past years' results
- Assessment of observed trends or trajectory of measured parameters
- Site photos
- A discussion of the success or failure of achieving performance standards for the individual parameters and the restoration as a whole
- Recommendations for remedial actions, if necessary.

Photo Monitoring

In order to visually document rehabilitation efforts, pre-construction photos depicting the physical setting shall be taken to be compared to post-construction site conditions from the same photo point locations. As shown in the attached Design Plan (**Appendix B**), the South Boulder Creek Mitigation Site is divided into four restoration reaches. Denver Water will establish one photo point in each reach, capturing both the upstream and downstream perspectives for a total of 8 photographs.

Permanent photo monitoring points shall be established that depict the overall condition and character of the pre-construction condition and then the completed rehabilitation features that will be used for year-to-year comparison. Permanent photo monitoring points shall be established prior to construction that depict specific representative conditions and rehabilitation features. Each photo monitoring point shall be marked in the field with a metal T-Post driven into the ground and clearly labeled with all identification information. The location of each photo point shall be recorded using GPS mapping technology and compass bearing and depicted on an overall monitoring map.

Two high resolution digital photos shall be taken at each location in different directions. General condition, photo date, location and bearing shall be recorded for each photo. Photos shall be taken prior to construction, immediately following construction (as-built) and during each post construction monitoring year. Photo monitoring will be incorporated into each annual monitoring report.

1.2.11 Long-Term Management Plan

The SBCRP will be developed to be self-sustaining once performance standards have been achieved. As described above in **Section 1.2.8**, after the SBCRP has met performance standards and the monitoring requirements are fulfilled, the City of Boulder's continued management of open space land will maintain the long-term protection of the Mitigation Site.

1.2.12 Adaptive Management Plan

The implementation of an adaptive management plan is essential for evaluating whether the Mitigation Site is developed and maintained properly during the critical establishment period (1 to 3 years after restoration). The immature state of many restoration projects can be vulnerable to severe bank erosion, bed shifting and excessive aggradation/degradation which could lead to the incorrect development of desired results. An adaptive management plan in conjunction with the monitoring program is to be used as a tool to evaluate the restoration achieved by the mitigation project and determine necessary corrective measures that must be implemented during the early stages of establishment to ensure the desired goals and success criteria are met.

Once construction is completed, Denver Water will be responsible for ongoing monitoring and maintenance until the success criteria are met and the Corps approves the mitigation. In the event the Corps determines that the Mitigation Site is not meeting the success criteria, Denver Water shall recommend remedial actions to ensure success is met. Recommended remedial actions may include, but are not limited to: mechanical bank stabilization, revegetation of banks, reconstruction of localized stream segments, or rework of the full project reach. Any recommendations shall be outlined in the annual mitigation monitoring report and presented to the Corps for review and approval, as described above. Potential adaptive management will take items such as extreme flood events into consideration. All remedial activities under the adaptive management plan will be the financial responsibility of Denver Water.

1.2.13 Financial Assurances

Denver Water assumes financial responsibility for all of its compensatory mitigation under Section 404 of the Clean Water Act related to the Moffat Project. Denver Water will be financially responsible for the construction, maintenance, monitoring, and any necessary remedial actions/adaptive management associated with the Mitigation Site during the construction and monitoring period. The attached letter is provided as evidence of Denver Water's assurance of sufficient financial resources that the mitigation project will be successfully completed in accordance with the performance standards. Refer to **Appendix D.**

US Army Corps of Engineers®

REGULATORY GUIDANCE LETTER

No. 08-03 **Date: 10 October 2008**

SUBJECT: Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources.

1. Purpose and Applicability

a. Purpose. This Regulatory Guidance Letter (RGL) provides the Districts and regulated public guidance on minimum monitoring requirements for compensatory mitigation projects, including the required minimum content for monitoring reports. This RGL replaces RGL 06-03.

b. Applicability. The final Mitigation Rule published on April 10, 2008, states that the submission of monitoring reports to assess the development and condition of compensatory mitigation projects is required, but the content and level of detail for those reports must be commensurate with the scale and scope of the compensatory mitigation projects as well as the compensatory mitigation project type (see 33 CFR 332.6(a)(1)).

This RGL applies to all Department of the Army (DA) permit authorizations under Section 404 of the Clean Water Act and Sections 9 and 10 of the Rivers and Harbors Act that contain special conditions requiring compensatory mitigation provided through aquatic resource restoration, establishment and/or enhancement. This guidance also applies to monitoring reports that are prepared for mitigation bank sites and in-lieu-fee project sites.

This RGL supports the Program Analysis and Review Tool (PART) program goals for the Regulatory Program. Specifically, this RGL supports the PART performance measures for mitigation site compliance and mitigation bank/ in-lieu-fee compliance. These measures apply to active mitigation sites, mitigation banks, and in-lieu-fee project sites that still require monitoring.

2. Background

Recent studies by the Government Accountability Office (GAO) and National

mitigation lacked monitoring reports despite the fact that such reports were required as a condition of the permit. Similarly, the NRC study documented that a lack of clearly stated objectives and performance standards in the approved compensatory mitigation proposals made it difficult to ascertain whether the goal of no net loss of wetland resources was achieved.

On April 10, 2008, the Corps and Environmental Protection Agency published the "Compensatory Mitigation for Losses of Aquatic Resources: Final Rule" (Mitigation Rule) which governs compensatory mitigation for activities authorized by permits issued by the Department of the Army (33 CFR Parts 325 and 332). This RGL complements and is consistent with the final Mitigation Rule.

3. Discussion

Inconsistent approaches to monitoring compensatory mitigation projects are one of several factors that have affected the ability of Corps project managers (PMs) to adequately assess achievement of the performance standards of Corps-approved mitigation plans. Standardized monitoring requirements will aid PMs when reviewing compensatory mitigation sites, thereby allowing the Corps to effectively assess the status and success of compensatory mitigation projects.

This RGL addresses the minimum information needed for monitoring reports that are used to evaluate compensatory mitigation sites. Monitoring requirements are typically based on the performance standards for a particular compensatory mitigation project and may vary from one project to another.

Monitoring reports are documents intended to provide the Corps with information to determine if a compensatory mitigation project site is successfully meeting its performance standards. Remediation and/or adaptive management used to correct deficiencies in compensatory mitigation project outcomes should be based on information provided in the monitoring reports and site inspections.

4. Guidance

a. Monitoring guidelines for compensatory mitigation.

i. Performance Standards. Performance standards, as defined in 33 CFR 332.2, and discussed in more detail at 33 CFR 332.5, will be consistent with the objectives of the compensatory mitigation project. These standards ensure that the compensatory mitigation project is objectively evaluated to determine if it is developing into the desired resource type and providing the expected functions. The objectives, performance standards, and monitoring requirements for compensatory mitigation projects required to

special conditions to determine if the site is achieving the desired functional capacity. Compensatory mitigation projects offset the impacts to diverse types of aquatic resources, including riverine and estuarine habitats. Special conditions of the DA permits will clearly state performance standards specific to the type and function of the ecosystem in relation to the objectives of the compensatory mitigation project.

ii. Monitoring Timeframe. The special conditions of the DA permit (or the mitigation plan as referenced in the special conditions) must specify the length of the monitoring period (see 33 CFR 332.6(a)(1)). For mitigation banks, the length of the monitoring period will be specified in either the DA permit, mitigation banking instrument, or approved mitigation plan. For in-lieu fee projects, the length of the monitoring period will be specified in either the DA permit or the approved in-lieu fee project plan.

The monitoring period must be sufficient to demonstrate that the compensatory mitigation project has met performance standards, but not less than five years (see 33 CFR 332.6(b)). The District determines how frequently monitoring reports are submitted, the monitoring period length, and report content. If a compensatory mitigation project has met its performance standards in less than five years, the monitoring period length can be reduced, if there are at least two consecutive monitoring reports that demonstrate that success. Permit conditions will support the specified monitoring requirement and include deadlines for monitoring report submittal. Longer monitoring timeframes are necessary for compensatory mitigation projects that take longer to develop (see 33 CFR 332.6(b)). For example, forested wetland restoration may take longer than five years to meet performance standards.

Annual monitoring and reporting to the Corps is appropriate for most types of compensatory mitigation projects, though the project sponsor may have to monitor progress more often during the project's early stages. Certain compensatory mitigation projects may require more frequent monitoring and reporting during the early stages of development to allow project managers to quickly address problems and/or concerns. Annual monitoring can resume once the project develops in accordance with the approved performance standards. In cases where monitoring is required for longer than five years, monitoring may be conducted on a less than annual timeframe (such as every other year), though yearly monitoring is recommended until the project becomes established as a successful mitigation project. In this case, off-year monitoring should include some form of screening assessment such as driving by the mitigation site, telephone conversations regarding condition of the mitigation site, etc. On-site conditions, the complexity of the approved mitigation plan, and unforeseen circumstances will ultimately determine whether the monitoring period should be extended beyond the specified monitoring time frame for a particular project. Complex and/or ecologically significant compensatory mitigation projects should have higher priority for site visits.

performance standards have not been met or the compensatory mitigation project is not on track to meet them (e.g., high mortality rate of vegetation). Monitoring requirements may also be revised in cases where adaptive management or remediation is required.

iii. Monitoring Reports. Monitoring requirements, including the frequency for providing monitoring reports to the District Commander and the Interagency Review Team (IRT), will be determined on a case-by-case basis and specified in either the DA permit, mitigation banking instrument, or approved mitigation plan. The content of the monitoring reports will be specified in the special conditions of the DA permit so that the requirements are clearly identified for the permittee or third-party mitigation sponsor. In addition, the monitoring reports should comply with the timeframes specified in the special conditions of the DA permit. Monitoring reports will not be used as a substitute for on site compliance inspections. The monitoring report will provide the PM with sufficient information on the compensatory mitigation project to assess whether it is meeting performance standards, and to determine whether a compliance visit is warranted. The party responsible for monitoring can electronically submit the monitoring reports and photos for review.

Visits to mitigation sites will be documented in the administrative record and will count toward District performance goals. An enforcement action may be taken if the responsible party fails to submit complete and timely monitoring reports.

b. Contents of Monitoring Reports. Monitoring reports provide the PM with a convenient mechanism for assessing the status of required compensatory mitigation projects. The PM should schedule a site visit and determine potential remedial actions if problems with the compensatory mitigation project are identified in a monitoring report.

The submittal of large bulky reports that provide mostly general information should be discouraged. While often helpful as background, reiteration of the mitigation and monitoring plan content, lengthy discussions of site progress, and extensive paraphrasing of quantified data are unnecessary. Monitoring reports should be concise and effectively provide the information necessary to assess the status of the compensatory mitigation project. Reports should provide information necessary to describe the site conditions and whether the compensatory mitigation project is meeting its performance standards.

Monitoring reports will include a Monitoring Report Narrative that provides an overview of site conditions and functions. This Monitoring Report Narrative should be concise and generally less than 10 pages, but may be longer for compensatory mitigation projects with complex monitoring requirements. Monitoring Report Narratives may be posted on each District's Regulatory web site.

Monitoring reports will also include appropriate supporting data to assist District

conditions, as well as the results of functional, condition, or other assessments used to provide quantitative or qualitative measures of the functions provided by the compensatory mitigation project site.

c. Monitoring Report Narrative:

i. Project Overview (1 page)

(1) Corps Permit Number or Name of the Mitigation Bank or In-Lieu Fee Project

(2) Name of party responsible for conducting the monitoring and the date(s) the inspection was conducted.

(3) A brief paragraph describing the purpose of the approved project, acreage and type of aquatic resources impacted, and mitigation acreage and type of aquatic resources authorized to compensate for the aquatic impacts.

(4) Written description of the location, any identifiable landmarks of the compensatory mitigation project including information to locate the site perimeter(s), and coordinates of the mitigation site (expressed as latitude, longitudes, UTMs, state plane coordinate system, etc.).

(5) Dates the compensatory mitigation project commenced and/or was completed.

(6) Short statement on whether the performance standards are being met.

(7) Dates of any recent corrective or maintenance activities conducted since the previous report submission.

(8) Specific recommendations for any additional corrective or remedial actions.

ii. Requirements (1 page)

List the monitoring requirements and performance standards, as specified in the approved mitigation plan, mitigation banking instrument, or special conditions of the DA permit, and evaluate whether the compensatory mitigation project site is successfully achieving the approved performance standards or trending towards success. A table is a recommended option for comparing the performance standards to the conditions and status of the developing mitigation site.

iii. Summary Data (maximum of 4 pages)

Summary data should be provided to substantiate the success and/or potential challenges associated with the compensatory mitigation project. Photo documentation may be provided to support the findings and recommendations referenced in the monitoring report and to assist the PM in assessing whether the compensatory mitigation project is meeting applicable performance standards for that monitoring period. Submitted photos should be formatted to print on a standard 8 ½" x 11" piece of paper, dated, and clearly labeled with the direction from which the photo was taken. The photo location points should also be identified on the appropriate maps.

iv. Maps and Plans (maximum of 3 pages)

Maps should be provided to show the location of the compensatory mitigation site relative to other landscape features, habitat types, locations of photographic reference points, transects, sampling data points, and/or other features pertinent to the mitigation plan. In addition, the submitted maps and plans should clearly delineate the mitigation site perimeter(s), which will assist PMs in locating the mitigation area(s) during subsequent site inspections. Each map or diagram should be formatted to print on a standard 8 ½" x 11" piece of paper and include a legend and the location of any photos submitted for review. As-built plans may be included.

v. Conclusions (1 page)

A general statement should be included that describes the conditions of the compensatory mitigation project. If performance standards are not being met, a brief explanation of the difficulties and potential remedial actions proposed by the permittee or sponsor, including a timetable, should be provided. The District Commander will ultimately determine if the mitigation site is successful for a given monitoring period.

d. Completion of Compensatory Mitigation Requirements. For permittee-responsible mitigation projects, compensatory mitigation requirements will not be considered fulfilled until the permittee has received written concurrence from the District Commander that the compensatory mitigation project has met its objectives and no additional monitoring reports are required. PMs will review the final monitoring reports to make this determination. A final field visit should be conducted to verify that on-site conditions are consistent with information documented in the monitoring reports.

e. Special Condition. The following condition should be added to all DA permits that require permittee-responsible mitigation. This condition does not apply to mitigation banks or in-lieu-fee programs:

Your responsibility to complete the required compensatory mitigation as set forth in Special Condition X will not be considered fulfilled until you have demonstrated compensatory mitigation project success and have received written verification of that success from the U.S. Army Corps of Engineers.

5. Duration

This guidance remains in effect unless revised or rescinded.

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