Colorado Trout Unlimited and Boulder Flycasters
Lower South Boulder Creek
Stream Management Plan Phase II - Final Report
September 30, 2022

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Final Report

TABLE OF CONTENTS

[Please note that in this report there are a few terms that have specific or equivalent meaning.

- *"South Boulder Creek" or "SBC" refers to the entire watershed from the continental divide to the confluence with Boulder creek*
- *"lower South Boulder Creek" or "lower SBC" refers to the stretch of water included in the project study area*
- *"aquatic species passage" refers to the ability of all aquatic life such as fish, macroinvertebrates, aquatic plants, etc. to freely move / migrate within the creek channel*
- *"channel connectivity" refers to mechanisms to reconnect isolated sub-reaches (channels) and create the opportunity for aquatic species passage]*

1. REPORT SUMMARY

1.1. Project Background and Overview

The project location is the (approximately) 9-mile reach of South Boulder Creek at the Community Ditch (FRICO) diversion structure at the mouth of Eldorado Canyon to the confluence with Boulder Creek.

Please refer to Exhibit A – Lower South Boulder Creek Reach Map

Beginning in 2017, Colorado Trout Unlimited (CTU) and Boulder Flycasters chapter of Trout Unlimited (BFC) (collectively referred to as "TU") contacted key stakeholders to form a collaborative working group to address watershed improvement opportunities in lower SBC. The catalyst for bringing this group together was the (then) pending Gross Reservoir expansion project. The proposed (now approved) project included construction and implementation of an Environmental Pool (EP) within Gross Reservoir to provide for sustainable year-round, in-stream flows. This is described in an inter-governmental agreement (IGA) between Denver Water, and the cities of Boulder and Lafayette. The initial collaboration focused on how to implement the IGA, and what flow management / infrastructure changes might be required. As the collaboration matured, the working group expanded discussions to include opportunities for channel connectivity, aquatic species passage and habitat improvement to mitigate environmental degradation.

The Stream Management Plan (SMP) Phase I project began in April 2019. In 2020, Phase I work was completed (coalition building, planning, data collection), and final reports submitted (June 2020). SMP Phase II was funded in August of 2020 and focused primarily on sub-reach level improvement opportunities based on field assessment of biology, hydrology, geo-morphology, and recreational needs and impacts. Phase II (final phase) is the focus of this report. This work was accomplished in close consultation with City of Boulder Open Space & Mountain Parks, the majority public land management agency along lower SBC.

As a result of the SMP Phase I, recommendations for multiple ditch diversion structures' modifications were identified. These recommendations were to help improve ditch operations, address environmental impacts, and meet the EP IGA requirements. This work progressed to the point of justifying a separate project. For this "spin out" project, "Watershed Restoration Phase I (WSR PH I)", TU applied for, and was awarded, Colorado Water Conservation Board (CWCB) and US Fish & Wildlife Service (USFWS) grant funding in 2020. WSR PH I (structure modification conceptual designs for channel connectivity, aquatic species passage, flow management, associated operational improvement, and proximate habitat / environmental improvements) launched in August 2020, and completed in August 2022.

Stakeholders include:

- Steering Committee: City of Boulder – Public Works, Utilities Department, Water Resources; and Open Space & Mountain Parks; City of Lafayette – Public Works, Water; Denver Water; Trout Unlimited
- Core (Directly Effected) Stakeholders: Boulder County – Parks & Open Space; City of Louisville – Water Utility; 14 ditch ownership groups; Xcel Energy
- Additional Stakeholders: private landowners along lower SBC; Eldorado Artesian Water
- Advisors: Colorado Parks & Wildlife (CPW); Colorado Water Conservation Board; Division of Water Resources (DWR – District 6 Water Commissioner); US Fish & Wildlife Service – Fish Passage; Cities of Boulder / Lafayette and Denver Water professional staff

1.2. Goals and Objectives

The primary goals associated with completion of the SMP for lower SBC ties directly to the Colorado Water Plan goals for "Watershed Health, Environment, and Recreation." Overall health of this stretch of the creek corridor, and balancing health improvement with recreational use, is a primary goal of the lower SBC SMP and related projects.

The original "call to action" was to use the SMP results to help better define and enhance efforts to implement an Environmental Pool within Gross Reservoir to provide for sustainable year-round in-stream water flows. Hence a related primary goal is more efficient water management.

As the project progressed, expanded goals provide for improved lower SBC water quality and creek function through increases in flow, direct improvements to the channel geomorphology, and direct improvements to the riparian corridor biota.

The three supporting project objectives are:

- Objective 1: Develop working collaboration between key stakeholders committed to habitat quality, and water quantity and quality
- Objective 2: Improve understanding of the current state, challenges, and future opportunities for improvement to the overall lower SBC watershed
- Objective 3: Define and launch specific opportunities and projects for on-the-ground improvement, and leverage / pool resources across stakeholders

These objectives are interrelated and interdependent on achievement.

As stated above, the SMP Phase I was largely stakeholder engagement, methodology and data / information identification driven. SMP Phase II focused on: expanding stakeholder communications / involvement, completing the data set (fill in the gaps), performing data analysis, completing the River Heath Assessment (RHA), and identifying specific improvements and monitoring requirements / projects from the RHA results.

1.3. Current State

In SMP PH II, the project team conducted a sub-reach-level River Health Assessment (RHA) that included both office-based and in-the-field evaluation. The RHA considered flow, water quality, landscape context, riparian and geomorphologic characteristics, aquatic habitat, and recreation use. SMP PH I identified flow as the single most important factor contributing to deteriorating stream function and riparian conditions. However, flow records for lower SBC are incomplete, and frequently rely on inconsistently collected, manual measurements. Additionally, the 2013 flood destroyed all the instream gaging within the lower reach. The only gage to be replaced to-date is the one just upstream of South Boulder Road. This gage is prone to inaccurate measurement that requires additional processing to obtain meaningful data. Given the importance of flow data and lack of a strong, consistent historical record, the project team developed a Point Flow Model to simulate stream flow conditions.

The Point Flow Model (PFM) estimates a broad range of surface water inflows and outflows at ungauged stations, based on available stream and diversion flow records from 10/1/1997 to 10/31/2018, and estimated gains. It starts at the Eldorado Springs stream gauge (BOCELSCO – 0603610) and ends at the confluence of Boulder Creek. For comparison, it also estimates flows above Gross Reservoir with all water development inputs / outputs removed as a surrogate for natural flow conditions. The model calculates flows at a daily time step at 13 reach breakpoints along lower SBC. The result is a model that shows natural and artificially developed sources and uses. For more detail, please reference the two technical memorandums provided in the **3. Exhibits** section of this report. Since the flow data record is incomplete, particularly for downstream sub-reaches, the current model has limitations, but is very useful for under-standing the flow trends along the reach.

In summary, the project team observed that the lower ~9 miles of SBC is a highly disturbed ecological system. The assessment confirmed SMP PH I observations of environmental degradation from urban development, past mining, agriculture, water diversion activities, and flow regime management. There are also 17 channel-spanning diversion

structures in the 9-mile study reach. Eight (8) were identified as the primary sources of most flow management and channel connectivity / aquatic species passage issues, as well as stream function disruption.

During the field portion of the RHA, assessors made observations related to water quality but no direct measurements and statistical analysis. Historically, water quality data for lower SBC were not collected in a sufficiently comprehensive and consistent manner to perform a sub-reach by sub-reach water quality assessment.

A sub-reach level RHA score card was prepared across the study reach. A review of the sub-reach scores and consolidation to an overall score for the study reach was then performed. Based on the assessment, the overall Functional Score for lower SBC is 2.0 out of 4.0, described as "Partially Functioning."

Please refer to Exhibit B - River Health Assessment Methodology / Field Assessment Parameters / Score Guide, Exhibit C - Reach Descriptions, Exhibit D - RHA Field Assessment - Summary Assessment Table, and Exhibit F - Point Flow Model

According to the Colorado Department of Public Health and Environment (CDPHE) 2022 integrated report, the upper section (COSPBO04b-D) is classified as Category 5, indicating that there is water quality impairment. It is listed on the State's 303(d) List.

- Water Supply Use - dissolved arsenic
- Aquatic Life Use – dissolved silver
- Aquatic Life Use - macro-invertebrates

This section is also on the State's Monitoring and Evaluation (M&E) List.

- Recreation Use – e. Coli monitoring (there may be an impairment, but e. Coli data are insufficient)

The lower section (COSPBO05-A) is classified as Category 1a, indicating attainment for all water quality standards.

Additionally, the Boulder County Keep It Clean (BCKIC) Coalition reports on overall Boulder Creek and St Vrain watersheds' water quality. Again, there are limited data and testing sites related to lower SBC. The BCKIC report references the CDPHE impairments and highlights challenges specific to lower SBC.

To better understand water quality throughout lower SBC in the mid-to-long term, TU initiated a data collection program that currently focuses on measuring dissolved oxygen (monthly) and water / air temperature (hourly) at five stations distributed throughout lower SBC. This work is another "spin-out" project (self-funded to-date) that came out of the observed need for such data. Although still in the early stages of building an overall water quality / quantity database, and developing lower SBC water quality analysis results, the initial findings identified:

1. Earlier and more compact spring run-off timing, as well as decreased overall flow trends, and
2. Increasing seasonal instances of low dissolved oxygen levels

Please refer to Exhibit G - Data Analysis Graphs and Charts

Specific functional impairment include:

- Not surprisingly, flow is significantly impaired. As such, the level of stream function can dramatically change depending on water diversion demand. During winter months the creek experiences very-low-to-no-flow conditions
- Sediment disposition / movement is greatly impaired, and the channel substrate is embedded in many locations with a high silt percentage
- Access / connection to the floodplain is limited in part or whole in all but one (1) sub-reach (out of 19)
- Very few off-channel habitats exist (i.e., backwaters, oxbows, side channels, etc.)

- Pool habitat in general, and especially over-winter-depth pool habitat, is lacking and, where deeper pools are present, there is little protective cover / structure
- Riparian health varies along the sub-reaches, with property ownership and land use driving overall function, such as:
    - lack of woody vegetation
    - sparser than expected stands of cottonwood trees and woody riparian brush such as willows
    - very little wood in the channel and very little (dead or alive) in the riparian zone
    - a disconnected flood plain inhibits cottonwood propagation
- Conditions tend to worsen moving downstream

Please refer to Exhibit E - RHA Field Assessment - Reach Assessments and Project Recommendations

1.4. Conclusions and Path Forward

Flow (along with the direct disruption by water diversion infrastructure addressed in the WSR project) is the most significant limiting factor for lower SBC improvement. The major flow improvement opportunity is the Environmental Pool. This will allow for year-round storage and release of water in support of agreed-to targeted flow needs. The EP will be constructed as part of the Gross Reservoir expansion project currently underway (approximately 5 – 7 years to complete.) Targeted flows were developed through extensive work between CWCB, CPW and the Cities of Boulder and Lafayette. A Water Delivery Agreement with CWCB is in place. The water stored in the EP will be owned by the cities of Lafayette and Boulder, and will be filled through existing eastern-slope water rights.

There are also potential opportunities to improve flow by working with water rights' owners, water users and owners of infrastructure to keep more water in the creek for longer stretches through water management and operational changes. Achieving this objective would directly support the Colorado Water Plan goals stated above but will require more research and negotiation to achieve.

<u>Recommendations:</u>

Continue to emphasize the operational planning, administrative tools, and water management infrastructure modifications necessary to successfully operate the EP, especially at very low flow levels, i.e., 1.5 to 10 cfs. And work toward other outcomes such as:

- Keeping more water in lower SBC for longer stretches through more efficient water delivery infrastructure, as well as potential water management and use, and associated operational changes
- Some of the non-flow assessment categories could potentially improve through alternative flow regime management techniques to better mimic natural stream flow conditions
- Stream bank and floodplain improvement will benefit the public and help Boulder OSMP maintain these lands
- Recommended riparian, geo-morphology, and aquatic habitat actions and future projects include:
    - Education outreach regarding landscape and creek-side improvements with private landowners
    - Moving recreation trails away from the creek bank, changes in grazing protocols, and alternative stock-water sources
    - Increase streambank native plantings
    - Use fencing to protect new plantings from people and cattle
    - Enhance existing meanders and riffle / pool sequences, and stabilize eroding banks
    - Incorporate channel connectivity / aquatic life passage into applicable ditch diversion structures to help reconnect the creek channel, allow for more natural migration patterns and improve overall creek function. (See WSR PH I final report)

- Recommended updates to the Point Flow Model (as described in Section 2.4 of the Detail Report) as new data is available – likely 3 to 5 years from now

- Define and implement an overall watershed database and associated analytics for lower SBC

Please refer to Exhibit E - RHA Field Assessment - Reach Assessments and Project Recommendations

The immediate next phase of funded projects will continue developing engineering designs for structures. These new projects were approved for funding by CWCB at the March 2022, Board meeting, and contracting with the State of Colorado is complete (August 2022). USFWS approved funding and completed contracting in January 2022. The project team currently estimates that these projects will likely begin in September 2022.

1.5. Project Administration and Financial Management

The project tasks were completed successfully, and all described deliverables are complete, except for those few noted in the Detail Report section. The project was delivered within the budgets provided in grant documents. The project suffered several disruptions to the original timeline due primarily to the discovery of New Zealand Mud Snails in lower SBC, COVID project team illnesses, general COVID societal restrictions, and most recently the Marshall Fire. A project extension was requested and granted by the State of Colorado. These delays are reflected in the changed project schedule and the timing of project tasks described in the Detail Report section. However, there was no impact to the project financial budget.

Please refer to Exhibit J - Project Financial and In-Kind Detail Support, and Exhibit K - Project Funding Detail

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2. REPORT DETAIL

2.1. Project Background and Status

This report is the second of two Stream Management Plan (SMP) reports for lower South Boulder Creek. Much of the background and events leading up to and through SMP Phase I, and contained in that first report, will not be repeated in this second SMP Phase II report. The lower SBC SMP PH I report is available at the SMP sharing and learning website**: https://www.coloradosmp.org/**.

Beginning in 2017, Colorado Trout Unlimited (CTU) and Boulder Flycasters chapter of Trout Unlimited (BFC) (collectively referred to as "TU") contacted key stakeholders to form a collaborative working group to address watershed improvement opportunities in the lower SBC. The project location is the (approximately) 9-mile reach of SBC beginning at the Community Ditch (FRICO) diversion structure at the mouth of Eldorado Canyon (LAT: 39.932 / LONG: -105.281), to the confluence with Boulder Creek (LAT: 40.033 / LONG: -105.217).

Please refer to Exhibit A – Lower South Boulder Creek Reach Map

The catalyst for bringing this group together was the (then) pending Gross Reservoir expansion project. The proposed project (now approved) included implementation of an Environmental Pool (EP) within Gross Reservoir to provide for sustainable year-round, in-stream flows. This is described in an inter-governmental agreement (IGA) between Denver Water, and the cities of Boulder and Lafayette. The initial collaboration focused on how to implement the IGA, and what flow management / infrastructure changes might be required. As the collaboration matured, the working group expanded discussions to include opportunities for channel connectivity, aquatic species passage, and habitat improvement to mitigate environmental degradation.

In 2018, TU applied for, and was awarded, a Colorado Water Conservation Board (CWCB) grant to prepare a Stream Management Plan for lower SBC. The SMP Phase I project began in April 2019. In 2020, Phase I work was completed (coalition building, planning, data collection), and final reports submitted (June 2020). SMP PH II was funded in August 2020 and focused primarily on sub-reach level improvement opportunities based on field assessment of biology, hydrology, geomorphology, and recreational needs and impacts. SMP PH II (final phase) is the focus of this report. This work was accomplished in close consultation with City of Boulder Open Space & Mountain Parks, the majority land manager along lower SBC.

The project suffered several disruptions to the original timeline due to a sub-contractor conflict-of-interest resolution period, the discovery of New Zealand Mud Snails in lower SBC, COVID project team illnesses, general COVID societal restrictions, and, most recently, the Marshall Fire. A project extension was requested and granted by the State of Colorado. These delays are reflected in the changed project schedule and the timing of project tasks. However, there was no negative impact to the project financial budget or task level deliverables.

As a result of the SMP Phase I, recommendations for multiple ditch diversion structures' modifications were identified. These recommendations were to help improve ditch operations, address environmental impacts, and meet the EP IGA requirements. This work progressed to the point of justifying a separate project. For this "spin out" project, "Watershed Restoration Phase I (WSR PH I)", TU applied for, and was awarded, Colorado Water Conservation Board (CWCB) and US Fish & Wildlife Service (USFWS) grant funding in 2020.

WSR PH I (structure modification conceptual designs for channel connectivity / aquatic species passage, flow management, associated operational improvement, and proximate habitat / environmental improvements)

launched in August 2020. High level, diversion structure conceptual designs, and associated operational improvements, are described for eight (8) high priority structures. Preliminary engineering designs (~15-20%) are complete for three (3) of the eight (8) structures. The SBC WSR PH I Report is available at the SMP sharing and learning website: **https://www.coloradosmp.org/**

The next phase of funded projects will continue developing engineering designs for structures.

- Grants and matching funding were approved to take two (2) additional structures to the 100% design level (permit and construction phase ready), and two (2) structures to the preliminary design stage (~15-20%)
- Grants and matching funding were approved for a ditch automation project to demonstrate the integrated use of automated gates linked to flow gages and operated locally or remotely over a network.

These new projects were approved for funding by CWCB at the March 16, 2022, Board meeting. Contracting with the State of Colorado is complete (August 15, 2022). USFWS approved funding and completed contracting in January 2022. The project team currently estimates that these projects will likely begin in September 2022.

2.2. Key Participants: Stakeholders, Advisors, Funding Sources and Contractors

Stakeholders

Steering Committee
- **City of Boulder – Public Works, Utilities Department, Water Resources; and Open Space & Mountain Parks**
- **City of Lafayette – Public Works, Water**
- **Denver Water**
- **Trout Unlimited**

Advisors
- **Colorado Parks & Wildlife (CPW)**
- **Colorado Water Conservation Board**
- **Division of Water Resources (DWR – District 6 Water Commissioner)**
- **US Fish & Wildlife Service – Fish Passage**
- **Cities of Boulder and Lafayette professional staff**

Additional Stakeholders
- **Boulder County – Parks & Open Space**
- **City of Louisville – Water Utility**
- **Eight ditch ownership groups (one representing seven (7) ditch / reservoir companies)**
  - **Farmers Reservoir and Irrigation Company (Community Ditch)**
  - **Davidson Ditch and Reservoir Company**
  - **Goodhue Ditch and Reservoir Company**
  - **Marshallville Ditch Company**
  - **New Dry Creek Carrier Ditch (serving: Base Line Land and Reservoir Company, Enterprise Irrigating Ditch Company, Dry Creek Davidson Ditch Company, Andrews Farwell Ditch Company, LH Davidson Ditch Company, Leyner Cottonwood Ditch Company, and Cottonwood No. 2 Ditch)**
  - **Howard Ditch Company**
  - **East Boulder Ditch Company**
  - **Leggett Inlet Canal Complex**

Note: Xcel Energy, City of Boulder, City of Lafayette, City of Louisville, and Boulder County have various ownership stakes in these ditches and sit on the boards of many of the ditch companies.

Funding Sources

The SMP PH II project was funded by cash grants, direct cash matching contributions, and in-kind services matching contributions from the following organizations:

- **Colorado Water Conservation Board – Colorado Watershed Restoration Program (CWRP) – Stream Management Plan grant (cash)**
- **Metro Round Table – Water Supply Reserve Fund (WSRF) – cash match**
- **South Platte Basin Round Table – Water Supply Reserve Fund (WSRF) – cash match**
- **US Fish & Wildlife Service – Fish Passage Grant (cash)**
- **City of Boulder – Public Works, Utilities Department, Water Resources – in-kind services match**
- **City of Boulder – Open Space & Mountain Parks (OSMP) – in-kind services match**
- **City of Lafayette – Public Works, Water – in-kind services match**
- **Denver Water – cash and in-kind services match**
- **Trout Unlimited – cash and in-kind services match**

Contractors and Consultants

- **Biohabitats – prime contractor**
- **Wright Water Engineers – sub contractor**
- **GEI – sub contractor**
- **Wilson Water Group – sub contractor**

2.3. Goals and Objectives

The Colorado Water Plan goals led to the establishment of Stream Management Plans (administered by CWCB) for improvement of Colorado's watersheds The Colorado Water Plan states that: "The goals within Colorado's Water Plan are to meet the water supply and demand gaps; defend Colorado's compact entitlements; improve regulatory processes; and explore financial incentives—all while honoring Colorado's water values and ensuring that the state's most valuable resource is protected and available for generations to come." A more detailed, sub-goal directly applicable to the creation of SMPs, as well as to the lower SBC SMP, is to promote and protect:

"Watershed Health, Environment, and Recreation: Cover 80 percent of the locally prioritized lists of rivers with stream management plans, and 80 percent of critical watersheds with watershed protection plans, all by 2030."

- Overall health of this stretch of the creek corridor is a primary goal of the lower SBC SMP and related projects.

A related set of sub-goals that are most applicable to our municipal, industrial, and agricultural stakeholders include:

"Conservation: Achieve 400,000 acre-feet of municipal and industrial water conservation by 2050."

- Although not directly applicable as a goal for this project, the expansion of Gross Reservoir is a very important part of local efforts to improve lower SBC through the additional of an Environmental Pool. Integral to this and other projects is to prepare SBC water management infrastructure to be able to administer, protect and pass target flows.

"Land Use: By 2025, 75 percent of Coloradans will live in communities that have incorporated water-saving actions into land-use planning."

- This is directly related to the SMP objectives for leaving more water in the creek longer.

"Agriculture: Agricultural productivity will keep pace with growing state, national, and global needs, even if some acres go out of production."

- Although not a specific project goal, many of the owners within the ditch company stakeholders are providing water for agricultural use and need to improve their water delivery and infrastructure efficiency.

The primary goal associated with completion of the SMP for lower SBC ties directly to the Colorado Water Plan goals for watershed health, environment, and recreation, as well as more efficient water management. These goals remain largely the same for Phase II as stated in Phase I:

Original Call-to-Action Goal:

- Use the SMP results to help better define and enhance efforts to implement an Environmental Pool within Gross Reservoir to provide for sustainable, year-round, in-stream water flows, as described in the IGA between Denver Water, Boulder, and Lafayette

Expanded Goals include:

- Identify opportunities for habitat improvement, channel connectivity and low flow in-channel modifications to improve lower SBC water quality and creek function
- Support the recreational and environmental goals of local stakeholders based on target flows provided by the Environmental Pool, and investigate other opportunities to keep more water in the creek longer
- Work toward the longer-term potential for flows that can exceed current in-stream flow targets and provide a more natural hydrograph in the future

Three supporting objectives are:

- Objective 1: Develop working collaboration between key stakeholders committed to habitat quality, and water quantity and quality
- Objective 2: Improve understanding of the current state, challenges, and future opportunities for improvement to the lower SBC watershed
- Objective 3: Define and launch specific opportunities and projects for on-the-ground improvement, and leverage / pool resources across stakeholders

These objectives are interrelated and interdependent on achievement.

As stated above, the SMP Phase I was largely stakeholder engagement, methodology and data / information identification driven. The SMP PH II then focused on: expanding stakeholder communications / involvement, completing the data set (fill in the gaps), performing data analysis, completing the River Heath Assessment (RHA), and identifying specific improvements and monitoring requirements / projects from the RHA results.

2.4. Assessment, Findings and Recommendations

Approach and Observations:

In SMP PH II, evidence of environmental degradation from urban development, past mining, agriculture, water diversion activities and flow regime management were confirmed through a comprehensive River Health Assessment. The RHA considered flow, water quality, landscape, riparian and geomorphologic characteristics, aquatic habitat, and recreation use. The level of detail of the assessment varied depending on the nature of the parameter being assessed and available data. Eight (8) channel-spanning diversion structures were identified

as the primary sources of most flow management and channel connectivity / aquatic species passage issues, as well as stream function disruption.

In SMP PH II, our team conducted a sub-reach-level River Health Assessment (RHA) that included both office-based and in-the-field evaluation. The RHA considered flow, water quality, landscape context, riparian and geomorphologic characteristics, aquatic habitat, and recreation use. SMP PH I identified flow as the single most important factor contributing to deteriorating stream function and riparian conditions. However, flow records for lower SBC are incomplete, and frequently rely on inconsistently collected, manual measurements. Additionally, the 2013 flood destroyed all the instream gaging within the lower reach. The only gage to be replaced to-date is the one just upstream of South Boulder Road. This gage is prone to inaccurate measurement that requires additional processing to obtain meaningful data. Given the importance of flow data and lack of a strong, consistent historical record, the project team developed a Point Flow Model to simulate stream flow conditions.

The Point Flow Model (PFM) estimates a broad range of surface water inflows and outflows at ungauged stations, based on available stream and diversion flow records from 10/1/1997 to 10/31/2018, and estimated gains. It starts at the Eldorado Springs stream gauge (BOCELSCO – 0603610) and ends at the confluence of Boulder Creek. For comparison, it also estimates flows above Gross Reservoir with all water development inputs / outputs removed as a surrogate for natural flow conditions. The model calculates flows at a daily time step at 13 reach breakpoints along lower SBC. The result is a model that shows natural and artificially developed sources and uses. For more detail, please reference the two technical memorandums provided in the **3. Exhibits** section of this report.

The longer-term goal is to continue to update and make more useful the PFM, with the potential for its usefulness to extend beyond this project and to be a useful tool for future management of SBC. For example, it will allow water managers to better understand discrete flows in and around their diversions, assist land managers with restoration efforts, and could be used to help stakeholders manage the future Environmental Pool. As of this writing, the following data collection / measurement improvements will be needed if the PFM is to become a better operational tool.

1. The additional telemetry-based flow gages at 4 locations (Eldorado Springs (bridge #2), downstream of New Dry Creek Carrier ditch, downstream of East Boulder ditch and downstream of Leggett Inlet Canal Complex) on lower SBC, and the planned upgrade of the South Boulder Road gage (currently managed by Mile Hi Flood District / One Rain), will greatly improve data accuracy. It will likely require 3 to 5 years of continuous data to be meaningful within the context of the PFM
2. Additional electronic gaging should be installed at the outflow of both Anderson Extension Ditch and Viele Channel
3. Wellman ditch is owned by Xcel Energy, and currently only limited flow records are available. Future revision efforts should work with Xcel to obtain both diversion and outflow data. Wellman Ditch does have an outflow flume, but it is observed to be in poor condition and will likely need to be updated. Ideally electronic gaging would be installed and connected to the State flow data system (Colorado DSS)
4. In the future work with diverters downstream of Leggett Inlet Canal Complex to install accurate, electronic measurement devices and ensure that diversion records are maintained
5. The last two nodes in the PFM (KOA Lake, End of South Boulder Creek (confluence with Boulder Creek)) were flagged and a note was added explaining that the two nodes are not recommended for use until more data is available on water use downstream of the Leggett Inlet Canal Complex. This includes the KOA Lake, the Martin Marietta aggregate processing plant pipe below KOA lake outflow, the Butte Mill Ditch and at the confluence with mainstem Boulder Creek

The point flow model could be updated in the future if more data becomes available. It is important to keep in mind that even with additional data, the point flow model is still limited by the accuracy of the stream gage and diversion flumes. It is also limited by how often diversions are visited and recorded by the water commissioner for ditches that do not have telemetry or other forms of automated gaging.

Since the flow data record is incomplete, particularly for downstream sub-reaches, the current model has limitations, but is very useful for under-standing the flow trends along the reach. Overall, flow conditions worsen further downstream. Low-flow conditions that are critical to aquatic health drop too low, and annual peak flows that are critical to channel flushing and maintenance are not being sustained.

Please refer to Exhibit B - River Health Assessment Methodology / Field Assessment Parameters / Score Guide, and Exhibit F – Point Flow Model

Biohabitats and GEI, with assistance from TU, conducted desktop assessments in October and November 2020, and field assessments in March and April 2021. The following methods and measures were employed during the assessment tasks:

- The PFM was used to determine level of function for flow in each sub-reach. The PFM also supported conclusions on the impact of current flow management practices. Due to data limitations, the PFM results are approximate. Further refinement of the PFM is being considered and may be a useful tool in the future for key stakeholders (see above)
- Water quality was considered in a more general manner. *See Water Quality Assessment, below*
- Landscape parameters for each sub-reach consisted of landscape buffer and terrestrial connectivity. They were assessed mainly using aerial imagery with some field checking
- Riparian and geomorphology parameters for each sub-reach were determined mostly in the field with some preliminary remote analysis. Riparian assessment looked at extent of canopy, tree age classes, and number of structural classes. Geomorphology looked at cross-section, profile, resistance (or resiliency), and equilibrium (extent of entrenchment). Observational field notes were also recorded for both categories
- Aquatic habitat for each sub-reach consisted of a field assessment of applicable features (pool depth, cover, etc.) and channel connectivity / aquatic species passage
- Recreational use and its impact were noted for each sub-reach

The team also developed a reach numbering schema for the study area, working from the CPW Segments defined for SBC (three Segments defined from Gross Reservoir outlet to the confluence with Boulder Creek). This was done in consultation with stakeholders and is now used as a common descriptor when identifying activities and locations on lower South Boulder Creek.

Please refer to Exhibit C – Reach Descriptions, and Exhibit F – Point Flow Model

Assessments were conducted from sub-reach 2.1 (beginning below the Community Ditch (FRICO) diversion structure), to sub-reach 3.7 (Indian Road / confluence with Boulder Creek). In summary, the project team observed that the lower ~9 miles of SBC is a highly disturbed ecological system. Historically this stretch has been subject to:

- Quarry mining
- Grazing and associated bank degradation / reduction of woody structures
- Residential, industrial, and recreational development, and associated urban infrastructure
- Creekside residential and recreational development
- Channel straightening

- Modification for flood conveyance
- Armoring of banks, especially in residential areas
- Impoundment for pond creation
- High levels of water diversion for agriculture, municipal and commercial / industrial uses resulting in 17 channel spanning / blocking diversion structures

Water Quality Assessment:

During the field portion of the RHA, assessors made observations related to water quality but no direct measurements. Historically, water quality data for lower SBC were not collected in a sufficiently comprehensive and consistent manner to perform a sub-reach by sub-reach water quality assessment.

Colorado Department of Public Health and Environment (CDPHE) monitors water quality as part of its Clean Water Act requirements. CDPHE organizes this part of SBC into two sections (identified as COSPBO04b-D and COSPBO05-A) with South Boulder Road forming the dividing line between them. CDPHE's organization corresponds with this SMP's sub-reaches 2.x and 3.x, respectively, and with CPW Segments 2 and 3. The City of Boulder has a monitoring station in lower SBC located in sub-reach 2.7. The city collects various data, including water quality. This data is the basis for the CDPHE data reported within the Colorado DSS.

According to the CDPHE 2022 integrated report, the upper section (COSPBO04b-D) is classified as Category 5, indicating that there is water quality impairment. It is listed on the State's 303(d) List.

- Water Supply Use - dissolved arsenic
- Aquatic Life Use – dissolved silver
- Aquatic Life Use - macro-invertebrates

This section is also on the State's Monitoring and Evaluation (M&E) List.

- Recreation Use – e Coli monitoring (there may be an impairment, but E. coli data are insufficient)

The lower section (COSPBO05-A) is classified as Category 1a, indicating attainment for all water quality standards.

Additionally, the Boulder County Keep It Clean Coalition (BCKIC) reports on overall Boulder Creek and St Vrain watersheds' water quality. Again, there are limited data and testing sites related lower SBC. That report references the CDPHE impairments and highlights challenges (data collected 2015 through 2019).

- Water temperature, conductivity, total suspended solids, alkalinity, hardness, and pH generally increases from upstream to downstream
- Overall, pH is showing an increasing trend; nitrogen is a neutral trend; phosphates showing an increasing trend

However, due to limited data, the above observations are general trends. It is not possible to assess lower SBC at the major reach level, let alone the sub-reach level, to develop a better understanding of the proximate causes.

To better understand water quality throughout lower SBC, TU initiated a data collection program that currently focuses on dissolved oxygen (monthly) and water / air temperature (hourly) at five (5) stations distributed throughout lower SBC. This work is another "spin-out" project (self-funded to-date) that came out the SMP PH I observed need for such data.

The project team is building an integrated watershed database incorporating the TU collected data with City of Boulder, Denver Water, CDPHE and other data sources. The goal is to develop a more comprehensive lower SBC

water quality and quantity assessment capability. Although still in the early stages of this database, the initial findings identified:

1. Earlier and more compact spring run-off timing, as well as decreased overall flow trends, and
2. Increasing seasonal instances of low dissolved oxygen levels.

Please refer to Exhibit G – Data Analysis Graphs and Charts

River Health Assessment Results:

- Not surprisingly, flow is significantly impaired. As such, the level of stream function can dramatically change depending on water diversion demand (i.e., irrigation, municipal water use), time of year, and seasonal weather conditions. During winter months the creek experiences very-low-to-no-flow conditions

- Sediment disposition / movement is greatly impaired by the 21 channel spanning structures as well as the decrease in frequency and magnitude of adequate flushing flows. Consequently, the channel substrate is embedded in many locations with a high silt percentage
- Access / connection to the floodplain is limited in part or whole in all but one (1) sub-reach (2.2) out of 19
- We found very few off-channel habitats (i.e., backwaters, oxbows, side channels, etc.)
- Pool habitat in general, and especially over-winter-depth pool habitat, is lacking and, where deeper pools are present, there is little protective cover / structure
- Riparian health varies along the sub-reaches with property ownership and land use driving overall function
    - Historically cottonwood gallery forests in the west did not form a continuous canopy. Stands of trees were separated by open areas in the floodplain. However, private properties tend to lack woody vegetation except for larger trees that are part of a maintained and often non-native lawn-species landscape. OSMP lands are higher quality
    - Overall, stands of cottonwood trees and woody riparian brush like willows are sparser than expected. Some areas on OSMP land also lack woody species. Some of this is due to naturally occurring gaps. Other gaps are due to grazing impacts. OSMP is balancing management actions such as invasive species removal and protecting habitat for rare / threatened species, with canopy density. There are opportunities to revisit some of these gap areas for additional native shrub and tree plantings

    - Very little wood in the channel and very little (dead or alive) in the riparian zone. Active cattle grazing and private residential properties with lawns maintained to the stream bank are contributing factors
    - Disconnected flood plain also inhibits cottonwood propagation
- Conditions tend to worsen moving downstream. Flow impacts become more obvious beginning at South Boulder Road (Segment 2 to 3 transition). This is the location of the New Dry Creek Carrier Ditch that delivers water to six (6) other ditches and a storage reservoir. Operationally, this structure diverts significant amounts of water, has the right to sweep-the-creek, and is the most significant disruptor of creek function within the study stretch. The downstream-most reaches demonstrate the lowest function due to the compounding impacts of the stressors that were listed previously. On the upstream end, sub-reach 2.2 showed the highest function overall.

Please refer to Exhibit D – RHA Field Assessment – Summary Assessment Table, and Exhibit E – RHA Field Assessment – Reach Assessments and Project Recommendations

Recommendations:

Flow and Water Management Improvement:

- Continue to emphasize the water management infrastructure modifications necessary to successfully operate the EP, especially at very low flow levels, i.e., 1.5 to 10 cfs. Beyond the more obvious benefits to the watershed, the Cities of Boulder and Lafayette will benefit from support for the EP IGA implementation. The EP is specifically for maintaining target flows in lower SBC. This is especially needed during the non-irrigation / dry season. Improved water management infrastructure will benefit ditch companies by providing them with updated infrastructure that is more efficient with water delivery. Updated headgates and improved automation / gauging / telemetry are integral to attaining these benefits. Keeping more water in the creek for longer stretches through more efficient water delivery infrastructure, and potential water management and operational changes would improve stream function, and especially existing pool habitat
- Some of the non-flow assessment categories could potentially improve through alternative flow regime management techniques to better mimic natural stream flow conditions. There is a concern that the expansion of Gross Reservoir may dampen the annual peak flows that help maintain a better channel cross-section, and flush fine sediment, reducing embeddedness. Achieving these benefits will be directly related to how the EP is managed / operated
- Increase water movement at the Leggett Canal Complex backwater through flow and water management programs to help reduce algae blooms and invasive plant species, and decreased dissolved oxygen (DO) levels
- Implement recommended updates to the Point Flow Model (as described in Section 2.4) as new data is available – likely 3 to 5 years from now
- Define and implement an overall watershed database and associated analytics for lower SBC

The SBC WSR PH I Report is available at the SMP sharing and learning website**: https://www.coloradosmp.org/**

Riparian/Geomorphology/Aquatic Habitat resulting from the RHA field work:

Stream Bank and Floodplain Improvement will benefit the public and private lands adjacent to SBC, as well as help Boulder OSMP maintain these lands:

- Education outreach regarding landscape and creek-side improvements with private landowners to help improve bankside habitat and reduce disruptions to geomorphology
- Moving recreation trails away from the creek bank and changes in grazing protocols, in conjunction with alternative stock-water sources / modified stock access water gaps, to help protect banks and maintain a natural channel cross section
- Increase streambank native plantings for more structural variation and further improve riparian buffer
- Use fencing to protect new plantings from people and cattle, in an up to 200’ corridor along either side of the creek
- Enhance existing meanders and riffle / pool sequences and stabilize eroding banks to increase riparian buffer in appropriate locations. Protect and, where appropriate, increase the number of pools of one foot or greater for fish habitat, as well as natural structures (boulders, woody structures, undercut banks, canopy)
- Enhance existing meanders and riffle / pool sequences and stabilize eroding banks to increase riparian buffer in appropriate locations.
- Incorporate channel connectivity / aquatic species passage into applicable ditch diversion structures to help reconnect the creek channel, allow for more natural migration patterns and improve overall creek function

Please refer to Exhibit E – RHA Field Assessment – Reach Assessments and Project Recommendations

Overall RHA Functional Score for the Study Area and Sub-Reaches:

Summary Assessment Functional Scores for Lower SBC: *2.0 Partially Functioning*

FUNCTION SCORE				
HIGH	**MODERATE**	**PARTLY**	**POOR**	**NOT**
>3-4	>2-3	>1-2	>0-1	0

REACH		LOWER SOUTH BOULDER CREEK - STREAM FUNCTION ASSESSMENT							
Number	Description	Flow	Riparian		Landscape		Geomorphology	Aquatic Habitat	Overall Assessment
			River Left	River Right	River Left	River Right			
2.1	Eldorado Springs beginning at Farmers Reservoir and Irrigation Company ("FRICO") / Community Diversion and Ditch Structure to 3575 Eldorado Springs Road	2.8	1.0	1.0	1.5	2.0	1.8	1.0	**1.5**
2.2	3575 Eldorado Springs Road (downstream of property line) to Davidson Diversion and Ditch Structure	2.8	3.0	3.0	4.0	3.0	3.0	2.5	**3.1**
2.3	Davidson Diversion and Ditch Structure to Goodhue Diversion and Ditch Structure	2.3	2.3	1.3	3.0	2.0	2.5	1.0	**2.0**
2.4	Goodhue Diversion and Ditch Structure to Dry Creek #2 Ditch Structure	1.8	2.7	2.0	3.0	2.0	2.5	1.5	**2.5**
2.5.1	Dry Creek No. 2 Ditch Structure to Marshallville Diversion and Ditch Structure	1.8	3.0	1.3	2.5	1.0	2.3	2.0	**2.0**
2.5.2	Marshallville Diversion and Ditch Structure to City of Boulder Open Space & Mountain Parks Property Line	1.8	2.3	2.0	1.5	1.5	2.5	2.0	**2.0**
2.6	City of Boulder Open Space & Mountain Parks Property Line to Shearer Diversion and Ditch Structure	1.8	2.0	2.0	3.5	3.0	2.5	2.0	**2.5**
2.7	Shearer Diversion and Ditch Structure to South Boulder Canyon Diversion and Ditch Structure	1.7	1.7	1.7	3.0	3.0	2.3	2.5	**2.5**
2.8	South Boulder Canyon Diversion and Ditch Structure to McGinn Diversion and Ditch Structure	1.7	1.0	2.0	2.5	2.5	2.0	2.5	**2.0**
2.9	McGinn Diversion and Ditch Structure to New Dry Creek Carrier Diversion and Ditch Structure	1.2	1.3	2.3	1.5	1.0	1.8	2.0	**1.5**
3.1.1	New Dry Creek Carrier Diversion and Ditch Structure to Howard Diversion and Ditch Structure	1.2	1.3	2.3	2.0	2.5	1.5	1.0	**1.5**
3.1.2	Howard Diversion and Ditch Structure to Pedestrian Bridge	1.0	2.0	1.7	2.5	3.0	1.8	2.0	**2.0**
3.2.1	Pedestrian Bridge to East Boulder Diversion and Ditch Structure	1.0	2.3	2.3	3.0	3.0	1.8	1.5	**2.0**
3.2.2	East Boulder Ditch to Baseline Road	0.8	2.3	2.3	2.5	2.5	1.5	0.5	**2.0**
3.3	Baseline Road to Wellman Canal Outlet	0.8	2.0	1.0	2.5	1.0	1.8	1.0	**1.1**
3.4	Wellman Canal Outlet to Leggett/Jones-Donnelly Canal Control Structure	1.3	1.0	1.3	0.5	0.5	1.5	1.0	**1.1**
3.5	Leggett/Jones-Donnelly Canal Control Structure to KOA Lake Inlet Structure	1.0	2.3	1.7	1.0	1.0	1.0	0.5	**1.0**
3.6	KOA Lake to Butte Mill Ditch Structure	1.0	1.3	0.7	0.5	0.5	-	-	**0.5**
3.7	Butte Mill Ditch Structure to Boulder Creek Confluence	1.0	1.7	1.7	3.0	2.0	2.0	2.5	**2.0**

Detailed assessments, recommendations and associated future projects are part of this report.
Please refer to Exhibit E – RHA Field Assessment - Reach Assessments and Project Recommendations

Target Flows:

Flow (along with the direct disruption by water diversion infrastructure addressed in the WSR PH I project) is the most significant limiting factor for lower SBC improvement. Overall, 13 out of 19 sub-reaches fell within partly or poorly functioning categories; only sub-reach 2.2 was within the high functioning category. Also, flow conditions tend to worsen in the downstream direction, though there is some variation depending on the parameter being considered. This is especially apparent downstream of South Boulder Road, which is the transition from Segment 2

(the cold-water fishery) to Segment 3 (the warm water fishery). New Dry Creek Carrier ditch diversion structure (NDCC) is directly downstream of South Boulder Road. It diverts water to six (6) ditches and one (1) storage reservoir. These diversions represent some of the most senior rights on lower SBC. NDCC can also sweep-the-creek. Below NDCC is the East Boulder Ditch diversion structure (EBD), which can also sweep-the-creek.

The major flow improvement opportunity is the Environmental Pool for storage and release of water in support of agreed to targeted flow needs. The EP will be constructed as part of the Gross Reservoir expansion project currently underway (5-7 years to complete). The water stored in the EP will be owned by the cities of Lafayette and Boulder and will be filled through existing eastern slope water rights. A Water Delivery Agreement with CWCB is in place. The State Engineer's Office will shepherd these flows for downstream users.

In summary, the cities of Boulder and Lafayette and Denver Water will work together to make releases from Gross Reservoir based on current downstream flows in South Boulder Creek as compared to the IGA targeted flows. Releases will be protected from diversion in the identified Segments by the CWCB and the District 6 Water Commissioner.

There are other opportunities to improve flow, as stated above, by working with water rights' owners, water users and owners of infrastructure to keep more water in the creek for longer stretches through water management and operational changes. Pursing options such as swaps, leases and transfers are all possible routes. Achieving this objective would directly support the Colorado Water Plan goals stated above. Accumulating relatively small amounts of flow over time into this kind of program could add up to significant improvement opportunities. However, these opportunities are currently undefined and will likely take a relatively long period of time to achieve.

Stream Segment	IGA TARGETED FLOWS				CWCB/CPW FLOWS	
	Summer (May–Sept.)		Winter (Oct.–April)		Summer (May–Sept.)	Winter (Oct.–April)
	Average Year	Dry Year	Average Year	Dry Year	All Year Types	
Segment 1						
Gross Reservoir to USGS gauge 06729500	10 cfs	7 cfs	7 cfs	5 cfs	15 cfs (Preserve)	8 cfs (Preserve)
Segment 2						
USGS gage 06729500 to South Boulder Road	10 cfs	7 cfs	7 cfs	5 cfs	15 cfs (Preserve)	8 cfs (Preserve)
Segment 3						
South Boulder Road to confluence with Boulder Creek	4 cfs	2 cfs	2.5 cfs	1.5 cfs	5.8 cfs (Preserve)	2.5 cfs (Preserve)

Extensive work was performed by CWCB and the City of Boulder to establish the IGA target flows. The flows established (earlier in time than the IGA targets) by CWCB / CPW to reach a "preserve" level of environmental protection are higher but are difficult to achieve under the current water management operating regime. So, although targeted flows are currently the best opportunity, we will continue to work in future project phases to find other ways to keep more water in the creek longer, as described above. Even an addition 2 – 3 cfs throughout the dry season would improvement conditions significantly.

2.5. Communications and Outreach

Steering Committee:

The project team worked through the Steering Committee (SC) for most project task-level related communications. The Cities of Boulder and Lafayette are primarily responsible for implementing the IGA with Denver Water. Their presence on the SC, and the access this gave the project team to professional city staff resources, was critical to

success. Denver Water, also on the SC, was an important source of information, data, and assistance during the project.

After a project kick-off meeting on August 12, 2020, formal SC meetings were held every other month. However, it quickly became clear that interaction with the City of Boulder, and to a lesser degree the City of Lafayette, required meeting more often. Waiting two months for group discussions was too long, and too many activities were occurring in the interim. We agreed to hold bi-monthly "check in calls" with the Cities of Boulder and Lafayette to ensure alignment with activities (alternating months with SC meetings). These additional monthly meetings resulted in much closer interaction and reduction in misunderstandings and / or duplicate work.

Ditch / Diversion Structure Owners:

External communications with other stakeholder groups began with direct contact to six (6) of eight (8) high priority diversion structure / ditch owners – Davidson Ditch and Reservoir Company, Goodhue Ditch and Reservoir Company, Marshallville Ditch Company, New Dry Creek Carrier Ditch (serving: Base Line Land and Reservoir Company, Enterprise Irrigating Ditch Company, Dry Creek Davidson Ditch Company, Andrews Farwell Ditch Company, LH Davidson Ditch Company, Leyner Cottonwood Ditch Company, and Cottonwood No. 2 Ditch), Howard Ditch Company, and East Boulder Ditch Company. In all, the project team met on multiple occasions, in the field and / or via video conference, with representatives of all six (6) of the high priority structures. Initially these discussions centered on owner maintenance and operations issues, and then progressed to project objectives for low flow and channel connectivity / aquatic species passage. As work progressed, joint conversations were held to review conceptual design modifications to structures, and incorporation of owners' specific needs. Contact with the two (2) remaining structures (Farmers Reservoir and Irrigation Company (Community Ditch) and Leggett Inlet Canal Complex (XCEL Energy)) occurred later in the project. Discussions with the latter two ditch companies progressed to the point of agreement on high-level concepts and willingness to work together on engineering designs in the future. The lower SBC WSR PH I Report is available at the SMP sharing and learning website**: https://www.coloradosmp.org/**

Other Stakeholders:

The project team met with several other stakeholders from time-to-time, including:

- Worked with 3 different District 6 Water Commissioners over the course of the project. In general, with all of them, the project team walked the creek and discussed issues and diversion structure needs, described the project, and received input on objectives and priorities. The changes in commissioner resulted in repeated efforts to re-introduce each one to the SMP project and to incorporate differing points of view on how to manage in-stream flows from the Environmental Pool. However, there were few substantive changes to the project scope and direction.
- Successfully included Boulder County and City of Louisville to participate more directly in the SMP process
- Conducted a day-long field trip in July 2021 to update advisors and solicit expert input. Participants included: CWCB, CPW, USFWS, City of Boulder and TU.
- Continued dialog with XCEL Energy regarding modifications to their majority owned ditch structures – East Boulder Ditch, Enterprise Ditch, and the Leggett Inlet Canal Complex
- Sent out mailers to 34 proximate landowners along SBC, targeting those along the most important sub-reaches for RHA study. Resulted in direct contact with six landowners.
- Initiated project discussions with Farmers Reservoir and Irrigation Company (Community Ditch) and held on-site meetings.

2.6. Major Project Recommendations

The major projects recommended from SMP PH II are as follows:

Landowner outreach and education regarding landscaping, natural bank stabilization, and stream function disruptions from owner creek-scaping, at scale
- Eight-to-ten-year passive restoration program, primarily on OSMP lands, to include plantings up to 200 ft. of either side of the creek channel, fencing to allow new plantings to mature, and addition of woody structures - Redirection of recreational trails from the immediate creek bank - Modify grazing practices including more directive fencing, seasonal rotations, and other methods - Improve flood plain connectivity - Create more consistent over-wintering pools in the creek channel
Work with Denver Water and SBC water-rights holders to find ways to modify Gross Dam operating regime and various diversion operations to improve the overall flow regime, and leave as much water as legally possibly in the creek longer without jeopardizing water rights. Also investigate smaller water-rights holders to include in a program of transfers, swaps, leases, etc.
- Improve channel connectivity / aquatic species passage though modifications to diversion structures and proximate habitat improvement, which are important to the overall river health. **These assessments and recommendations can be found in the WSR PH I final report.**

Although many of these recommendations were implemented by OSMP on their managed lands in the past, the project team recommendations are at a higher level of scale, involve more sub-reach integration and hence encompass a larger scope.

Please refer to Exhibit E – RHA Field Assessment - Reach Assessments and Project Recommendations

2.7. Project Scope, Schedule, and Task Budget

The project was managed at the task / sub-task level against the budget and schedule estimated, and documented in the grant application Statement of Work (SOW.) This occurred at the beginning of the grant process and was then later adjusted during the State contracting process The project extension granted in February 2022 did not change the SOW. The "Scope of Work and Task Completion" section below uses the language / terms contained in the grant contract. Some terms, language and organization names may differ slightly from those in the body of this report.

<u>Scope of Work and Task Completion</u>

Task 1.0: Execute Stakeholder Communications Plan

- Overview: Stakeholder engagement / expansion accomplished through two sub-task areas: Steering Committee involvement and stakeholder outreach, as defined in the Communications Plan
- Method / Procedure:
    - Execute the Communications Plan:
        - Steering Committee (Direct Project Partners): Coordinated and regularly met with Steering Committee to provide project updates and solicit input and assistance from committee members, which include City of Boulder – Water Utilities Division, City of Boulder – Open Space & Mountain Parks, City of Lafayette – Public Works, Denver Water, TU / Boulder Flycasters, Biohabitats Consulting Team. Meetings were held every other month. Additional meetings were held every other month (when no SC meeting) with cities of Boulder and Lafayette to maintain project coordination

- Core (Directly Affected) Stakeholders: Directly communicated with High Priority Infrastructure Owners and High Priority Water Rights Owners as identified in Communication Plan to continue coordination that started in Phase I. This included 14 ditch companies, 1 reservoir storage company, the City of Louisville, and Xcel Energy
- Secondary (Indirectly Affected) Stakeholders: Initiated and carried out interaction with Other Infrastructure Owners (Ditch Companies and Commercial Entities), Other Water Rights Owners (Other Private, Industrial, Commercial and Municipal Entities), and Proximate Private Landowners as identified in Communication Plan. This included Eldorado Artesian Water, Valle Del Rio, and Arroyo Campo Subdivisions (Prado Drive / Senda Rocosa Street) residential landowners, and Canterbury Subdivision (Old Tale Road / Gaper Road / Cherryvale Road) residential landowners
- Other Related Stakeholders: Informed applicable Conservation / Advocacy / Recreational Groups with a Boulder Creek Watershed Mission and Other Adjacent Private Landowners about project. This included Boulder Watershed Collective, Lefthand Watershed Center, and Preble's Meadow Jumping Mouse Site Conservation Team (US Forest Service)
- ***General Public as Stakeholder: opted to not provide outreach regarding project to the general public at this time based on input from steering committee to not communicate until there would be concrete actions for discussion***
- The Communication Plan also identified an Advisors stakeholder group: the project team worked directly with Colorado Water Conservation Board, Colorado Parks & Wildlife, District Water Commissioner, Colorado TU, Other SMP Projects, and the Metro and South Platte Basin Roundtables. They were consulted throughout the project as needed

- Deliverables:
  - Stakeholder group specific messaging package
  - Stakeholder meetings and related schedules

Task 2.0: Close Data / Criteria Gaps to Support RHA, Flow, and Infrastructure Tasks

- Overview: Use the Gap Assessment from Phase I to gather or obtain the data and target criteria information needed to complete the Flow, RHA, and Infrastructure tasks described below.

- Method / Procedure:
  - Kicked off this task with a coordination meeting (August 2020) to discuss data sources and overall scope. Key participants included staff from municipal partners, CWCB, and CPW, as well as the district water commissioner, our consultants and TU personnel
    - Confirmed use of existing data, reports, and models
    - Developed a daily point-flow model, using the StateMod underlying data where appropriate, state water records and existing rough model from City of Boulder (2020) data sources
    - Developed spreadsheet tool for existing and natural flows on daily time-step.
  - Closed criteria gaps and finalized assessment procedure for River Health Assessment
    - Defined sub-reaches for assessment through collaboration with municipalities, CWCB, CPW, district water commissioner and others as identified. Result was based on CPW Segment schema, and then added reach and sub-reach naming standards
    - Reviewed draft assessment procedure and refined approach based on updated data sources and information.
    - Determined criteria necessary to evaluate remaining categories.
  - Developed "highest practical" scenario representing an undefined but reasonable (in the realm of possibility) future condition of higher in-stream flows than provided by the Environmental Pool IGA
    - Created and discussed potential scenario alternatives

        - Refined "highest practical" opportunities through further discussion with Steering Committee, CWCB, CPW, the district water commissioner and other experts as needed.
        - ***However, there is not enough high-quality data to develop this scenario. The RHA data cannot correlate flow to riparian health in a meaningful way (at the sub-reach and specific improvement level). There is limited data regarding actual flows and significant data from modeled flows, but the riparian channel is so degraded that ANY amount of additional flow would improve conditions. Hence, it is not within the realm of possibility to establish the highest practical scenario as the level of complexity and data to identify potential sources of "leaving more water in the creek longer" is beyond the scope and budget of this project***
        - ***Did not develop a backup plan in the event the Gross Reservoir Expansion project was significantly delayed or unable to obtain necessary permits to proceed, as this resolved in favor of the expansion during the project timeline***
    - Closed data gaps based on final criteria and as identified in Phase I.
        - Reviewed compiled data list and, with stakeholder's assistance, searched for information to fill existing data gaps and add to inventory.
        - In cases where data are not available, adjusted criteria or made assumptions to move forward with available and / or most relevant information.
    - Finalized Infrastructure Assessment
        - Reviewed compiled information on structures, in coordination with WSR PH I project team
        - Added missing information.
- Deliverables:
    - Spreadsheet flow tool (point flow model)
    - Finalized RHA criteria
    - Finalized data compilation / analysis tools
    - Final infrastructure assessment (handoff to the WSR PH I parallel project)

Task 3. 0: Conduct River Health and Environmental Goals Assessment

- Overview: Use the agreed-to methodology from Phase I combined with Phase II data / criteria gap collection in Task 2.0 above. Continue to analyze and update flow targets in conjunction with the RHA. Based on assessment results, complete analysis of restoration opportunities and constraints, and define opportunities / projects.

- Method / Procedure:
    - Performed desktop analysis of stream conditions to evaluate applicable categories and help prepare for field visits (below)
        - Completed Level 1 assessment of RHA categories
    - Conducted field work necessary to complete RHA
        - Prepared field forms for data collection
        - Completed Level 2 assessment for applicable categories that required field assessment and verification
    - Displayed baseline and increased flow target assessment results for river health (using CWCB / CPW derived targets)
        - Produced maps showing results for existing conditions suing ARCGIS
        - ***Were unable to quantify specific sub-reach level increased effects of Environmental Pool Scenario and "highest practical" scenario to river health (see above). However, we were able to identify study area-wide effects***
    - Integrated recreation component
        - Collected recreational use information from OSMP and other identified available sources

        - Included results in restoration analysis, below
    - Completed ecological restoration opportunities analysis
        - Evaluated restoration opportunities and constraints
        - Developed data to support analysis and results
        - Identified potential restoration projects and reviewed with OSMP (the major landowner)
- Deliverables:
    - River Health Assessment results
    - Ecological Restoration analysis results
    - Non-infrastructure project recommendations (see WSR PH I report for infrastructure projects)
    - Supporting statistical analysis

Task 4.0: Program Management and Administration

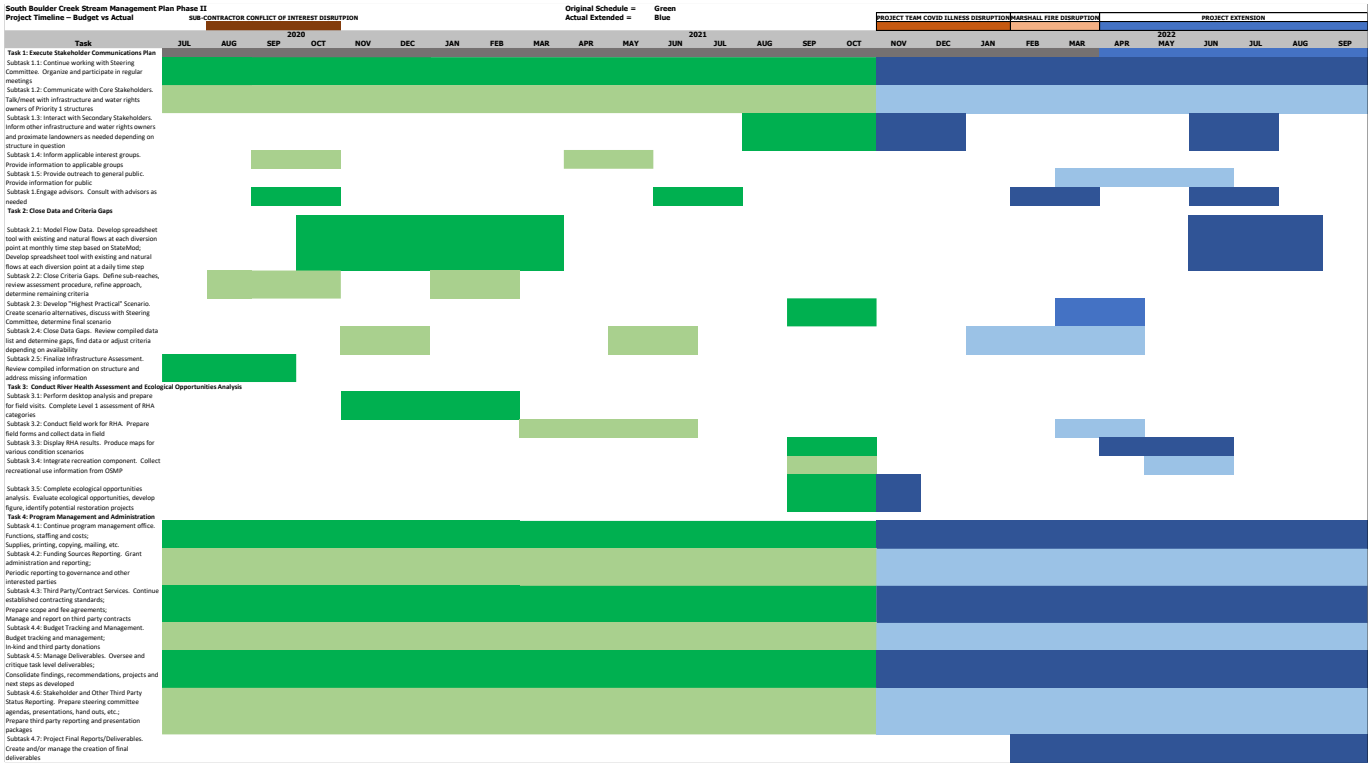
- Overview: Overall management of the project, including budget tracking, periodic reporting, task deliverable tracking, and final deliverables development.
- Method / Procedure:
    - Program Management Office – provided administrative and coordination
    - Funding Sources Reporting
        - Provided grant administration and reporting
        - Provided periodic reporting to governance and other interested parties
    - Third Party / Contract Services
        - Prepared scope and fees agreements / contracts
        - Managed and reported on third party contracts
    - Budget tracking and management
        - Provided budget tracking and management
        - Tracked in-kind and third-party donations (time sheets)
    - Managed Deliverables
        - Oversaw and critiqued task level deliverables
        - Consolidated findings, recommendations, projects, and next steps as developed
    - Stakeholder and Other Third-Party Status Reporting
        - Prepared Steering Committee agendas, presentations, handouts, etc.
        - Prepared third party reporting and presentation packages
    - Project Final Reports / Deliverables
        - Created and / or managed the creation of final deliverables
- Deliverables:
    - Grant Specific Reports
    - Budget Reporting
    - Deliverables Library
    - Final Report

These tasks were completed successfully, and all described deliverables are complete, except for those noted. The project was delivered within the budgets provided in grant documents. The timeline was lengthened by 6 months after setbacks due to COVID and wildfire extenuating circumstances (see below).

Timeline – Actual versus Estimated:

The project suffered several disruptions to the original timeline due primarily to the discovery of New Zealand Mud Snails in SBC, COVID project team illnesses, general COVID societal restrictions, and most recently the Marshall Fire. A project extension was requested and granted by the State of Colorado. These delays are reflected in the changed project schedule and the timing of project tasks.

The project took significantly longer to complete than the original estimated timeline. All tasks and deliverables were completed. However, there was no impact to the project financial budget.



Budget versus Actual – Dollars and Hours:

The project was delivered within the estimated budget. In-kind services match exceeded expectations for volunteer participation.

as of 11/18/2022

Task	Description	Budget		Actual		Variance	
		Cash	In-Kind	Cash	In-Kind	Cash	In-Kind
1	Execute Stakeholder Communications Plan	$ 10,798.17	$ 1,356	$ 8,003.36	$ 2,208	$ 2,795	$ 852
2	Close and Criteria Data Gaps	$ 50,812.75	$ 6,393	$ 69,916.27	$ 10,410	$ (19,104)	$ 4,017
3	Conduct River Health Assessment and Ecological Opportunities Analysis	$ 89,161.88	$ 11,237	$ 74,567.86	$ 18,297	$ 14,594	$ 7,060
4	Program Management and Administration	$ 10,172.19	$ 2,540	$ 16,675.42	$ 4,136	$ (6,503)	$ 1,596
	Project Team Expenses	$ 10,000.01	$ -	$ 1,782.09	$ -	$ 8,218	$ -
TOTALS		**$170,945**	**$ 21,526**	**$ 170,945**	**$ 35,051**	**$ -**	**$ 13,525**

Please refer to Exhibit J – Project Financial and In-Kind Detail Support

Project Funding Sources – Budget versus Actual:

Project costs and in-kind services were allocated proportionately across funding sources.

As of 11/18/22							
SMP PH II FUNDING SOURCE	TYPE	CASH			IN-KIND		
		BUDGET	ACTUAL	VARIANCE	BUDGET	ACTUAL	VARIANCE
Colorado Water Conservation Board	Colorado Water Plan – WSRG/SMP	$95,500	$95,500	$0	$0	$0	$0
Metro Round Table	WSRF Account Grant	$23,875	$23,875	$0	$0	$0	$0
South Platte Basin Round Table	WSRF Account Grant	$23,875	$23,875	$0	$0	$0	$0
Colorado Trout Unlimited	Local Chapter Grants	$5,000	$5,000	$0	$3,976	$588	-$3,388
Boulder Flycasters	Local Chapter Cash Match	$11,461	$11,461	$0	$8,540	$18,788	$10,248
City of Boulder	Cash Match and Staff Support	$0	$0	$0	$6,000	$11,850	$5,850
City of Lafayette	Cash Match and Staff Support	$0	$0	$0	$0	$2,050	$2,050
Denver Water	Cash Match and Staff Support	$10,000	$10,000	$0	$3,000	$1,775	-$1,225
USF&WS	Cash (incremental to CWCB Grant)	$1,234	$1,234	$0	$0	$0	$0
TOTAL		**$170,945**	**$170,945**	**$0**	**$21,516**	**$35,051**	$13,535

3.0 . Exhibits

A. Reach / Sub-Reach Maps and Photos
B. River Health Assessment Methodology
C. Reach Descriptions
D. RHA Field Assessment - Summary Assessment Table
E. RHA Field Assessment - Reach Assessments and Project Recommendations
F. Point Flow Model
G. Data Analysis Graphs and Charts
J. Project Financial and In-Kind Detail Support
K. Project Funding Detail