APPENDIX B

ECOLOGICAL ASSESSMENT

Walsh
Environmental Scientists and Engineers, LLC
an ecology and environment company

Technical Memo

To: David Jula, PE – Michael Baker Jr., Inc.

From: Katie Jagt, PE and Julie Ash, PE – Walsh Environmental

CC:

Date: July 15, 2014

Re: Rapid Ecological Assessment of St. Vrain Creek Corridor

Introduction

A healthy, resilient stream ecosystem is one that maintains key ecological and physical functions though varied hydrologic conditions, though space and through time. Many factors influence the health of a stream system including: physical structures, energy sources, biotic elements, chemical variables and flow regime. The physical structure of a healthy stream corridor displays a complex and diverse set of features, including channel form (meanders, pools, riffles, backwaters, wetlands), channel profile (stream gradient, width, and depth), materials that have fallen into the channel (trees and bank material), overhanging vegetation, roots extending into the flow, and streambed materials (sand, gravel, rocks, and boulders). This complexity influences the physical function of the stream (i.e., increases channel roughness, which in turn dissipates the energy of water and reduces its erosive power) and increases the potential for higher diversity of aquatic species.

As part of the St. Vrain Creek Corridor Master Planning effort, scientists and engineers from Walsh Environmental completed a rapid ecologic stream assessment of St. Vrain Creek including North St. Vrain, South St. Vrain and Middle St. Vrain creeks. The ecological stream assessment was completed using the Stream Visual Assessment Protocol (SVAP2), developed by the US Natural Resources Conservation Service (NRCS, 2009). The SVAP2 is a national protocol that provides an initial evaluation of the overall condition of streams, their riparian zones, and their in-stream habitats. It is often used as a tool for conservation planning, identifying restoration goals and objectives, and assessing trends in stream and riparian conditions through time. For the purposes of this analysis the results will be used to identify critical riparian ecosystem elements that are damaged or absent from the creek system, as well as to identify highly degraded areas. The evaluations are intended to supplement an overall understanding of the vulnerabilities that certain key species may have in St. Vrain Creek and assist with focusing appropriate restoration strategies.

The application of the SVAP2 protocol includes the evaluation of features in the stream system that affect overall stream conditions and generally encompass the following categories:

1) Channel stability (channel condition, bank condition)
2) Water quantity (hydrologic alteration)
3) Water quality (nutrient enrichment and manure/human waste)
4) Vegetation (riparian area quantity/quality and canopy cover)
5) Instream habitat (pools, habitat complexity)

A description of the specific elements evaluated as part of the SVAP2 protocol is presented in Table 1: *SVAP2 Ecologic Stream Assessment – Ecosystem Elements*. At completion of the SVAP2 protocol stream reaches are classified into one of the following categories:

Severely Degraded: Channel and banks are highly unstable and/or covered with rip-rap or concrete; homogenous channel bed lacking in habitat complexity; natural flow regime is significantly altered; limited floodplain access; and there is little to no riparian vegetation.

Poor: Channel is unstable with fairly homogenous channel bed lacking in habitat complexity; inadequate riparian corridor with large gaps of vegetation along the reach; developments in floodplain, or inaccessible floodplain, with diverted flow altering the natural flow regime.

Fair: Channel may be displaying some instability, with marginal connections between the active channel and floodplain; narrow riparian corridor with large gaps of vegetation along the reach and limited canopy cover; limited habitat complexity.

Good: Channel may be displaying some instability, but the active channel and floodplain are connected in most areas; some development in floodplain, but does not significantly alter natural flow regime; adequate riparian corridor is present, but may have gaps along reach; moderate habitat complexity.

Excellent: Channel is stable with continuous floodplain access, complex fish habitat including numerous shallow and deep pools; extensive and diverse riparian corridor; natural flow regime prevails.

Methods

The first task in the ecologic stream assessment was to divide the St. Vrain Creek into reaches of similar geomorphic form. Aerial imagery and high-resolution topography were evaluated to identify changes in geomorphic conditions (gradient, channel form, tributary confluences, etc.) which dictated locations of reach breaks. The reach breaks were adjusted, if necessary, during the initial field investigation. Ultimately, St. Vrain Creek was divided into 33 ecosystem reaches (11 reaches on the main stem, 5 reaches on North St. Vrain Creek, 11 reaches on South St. Vrain Creek, and 6 reaches on Middle St. Vrain Creek; Table 2). Each reach was evaluated, from a representative location within the reach, using the SVAP2 protocol. Table 1 describes the elements assessed as part of the SVAP2 protocol. Each element is scored with a value of zero to 10, where a higher score indicates a more

healthy system. An overall score was assigned to each reach, based on the average of the scores for the 11 elements.

Results

Photographs from each reach are presented in Appendix A. The resulting SVAP2 scores are presented in Table 3 and the overall score is mapped by reach in Figure 1. The overall ecological score for each reach were classified using the following categories:

- Score of 1 to 2.9: Severely Degraded
- Score of 3 to 4.9: Poor
- Score of 5 to 6.9: Fair
- Score of 7 to 8.9: Good
- Score of 9 to 10: Excellent

The majority of the main stem St. Vrain Creek between Lyons and Longmont to the County Line received "fair" to "good" overall ecosystem scores meaning the channel may be displaying some instability and there are only marginal or intermittent connections between the active channel and floodplain. Most of the system has a narrow riparian corridor with large gaps of vegetation along the reach and limited canopy cover with some habitat complexity, there are also several substantial in-stream structures that break up longitudinal connectivity and form fish and aquatic organism passage barriers. The primary reason the scores for the main stem St. Vrain Creek are within this regime is due to the fact that a great majority of the creek corridor is in Boulder County open space with limited floodplain development. There is one reach in Longmont (between Sunset St. and Main St.) which received a "poor" designation, due to the engineered-stable channel form and lack of riparian vegetation, canopy cover, and aquatic habitat complexity.

Similarly, the North St. Vrain and Middle St. Vrain reaches received "fair" to "good" overall ecosystem scores. South St. Vrain received a range of scores: the lower reaches (south/southwest of Lyons) scored as "poor," due to the lack of riparian vegetation, canopy cover, and aquatic habitat complexity; the middle reaches scored as "fair"; and the upper reaches (upstream of the confluence with Middle St. Vrain) scored as "good" and "excellent." The "fair" reaches tend to lack aquatic habitat complexity, as well as appropriate riparian zone width and diversity, due to encroaching development and/or roadways. The reaches designated as "good" and "excellent" tended to have wider riparian zones and more vegetation diversity and canopy cover, as well as numerous deep and shallow pools, which leads to higher quality, more complex fish and invertebrate habitat. No reaches were classified as severely degraded.

Channel Stability

Channel stability is specifically addressed in a subsequent technical memo, *Rapid Geomorphic Assessment of St. Vrain Creek Corridor*.

Water Quantity

Water quantity and flow timing has been dramatically altered in the St. Vrain Creek watershed, mainly because of upstream reservoirs/lakes and diversion ditches. Button Rock Reservoir and Longmont Dam are located on North St. Vrain Creek (upper bounds of this assessment), and while there is a seasonal high flow release from the dam, it does not follow the natural hydrograph of this system. Brainard Lake is located on South St. Vrain Creek (upper bounds of this assessment), which releases a fairly natural hydrograph. Just downstream of Brainard Lake, some flow from South St. Vrain Creek is diverted into Lefthand Creek (Figure 1). The hydrologic alteration scores continue to decrease downstream of the reservoirs/lakes due to the increasing number of diversion ditches and floodplain development in the lower reaches.

Water Quality

General water quality related to nutrients and manure/septic presence was visually assessed at reference locations along the St. Vrain Creek corridor. Only a few reaches displayed a minor presence of algal growth. Several reaches were noted as having livestock access to the stream or having the potential for treated sewage entering stream.

Vegetation

The majority of the riparian area along the St. Vrain Creek corridor (with the exception of the upper reaches) is lacking in width, vegetative diversity, and canopy cover. Several reaches on the main stem, all of North St. Vrain and the lower portions of South St. Vrain have considerably deficient canopy cover (less than 20 percent water surface shading).

Instream Habitat

The majority of St. Vrain Creek, with the exception of the upper reaches of South St. Vrain are deficient in fish and aquatic invertebrate habitat complexity, most notably deep pools and wood (large wood and small wood accumulations). Also, there exist several barriers to movement along the corridor, mainly in the form of diversion structures.

The assessment of habitat features in this study was limited by the moderate flow in the system at the time of the assessment (as dictated by project schedule). NRCS (2009) states that if a "stream can be sampled during low flow periods of the year without a boat, it can be assessed using the SVAP," and that "the SVAP2 ideally should be completed during baseflows when habitat feature limitations are likely to be most visible." Considering the accelerated schedule of this assessment, a baseflow assessment was not feasible. The team allowed for the peak snowmelt flows to subside before the assessment was initiated, but with even the moderate amount of flow in the creek system, many of the elements, specifically habitat features (i.e. riffles, pools) were not completely visible.

Recommendations

A list of recommended habitat enhancements for each reach is presented in Table 4.

References

NRCS, 2009. *National Biology Handbook, Subpart B-Conservation Planning, Part 614-Stream Visual Assessment Protocol Version 2,* Washington D.C.: United States Department of Agriculture Natural Resources Conservation Service.

Table 1 SVAP2 Ecologic Stream Assessment – Ecosystem Elements

Element	Description	Scoring
1. Channel Condition	Evaluates the relative geomorphic stability of the channel. The shape of a stream channel changes constantly depending on the flow and sediment conditions in the channel. This element is a description of the geomorphic condition and the relative relationship between the channel and its floodplain.	**High Score:** The active channel and floodplain are connected throughout the reach, no signs of incision or aggradation. **Low Score:** Headcuts or massive incision present, no floodplain access, or severe lateral migration/avulsions.
2. Hydrologic Alteration	Hydrologic Alteration is the degree to which streamflow conditions differ from normal, unregulated conditions and patterns. Naturally occurring daily and annual flow variations provide ecological benefits to floodplain and riparian ecosystems. For example, variations in flow provide cues to fish for spawning, egg hatching, rearing, feeding locations, and migration (Junk, et al., 1989).	**High Score:** The river, creek, or stream has an unaltered hydrologic regime, there are no dams, impoundments, levees, withdrawls, diversions, or flow additions. **Low Score:** The river, creek, or stream has significantly less or more water during parts or all of the daily or annual cycle.
3. Bank Condition	Stable stream banks are essential to healthy stream systems. Failing banks provide an influx of fine sediments which have detrimental ecosystem, water quality, and economic consequences. As much as 85% of a stream's sediment load can come from failing banks. Healthy vegetation on streambanks promotes bank stability and reduces the impact of high flows.	**High Score:** Banks are stable, protected by vegetation, wood, or natural rock. **Low Score:** Banks are unstable with no protection, numerous active bank failures, and/or dominated by riprap or other fabricated structures.
4. Riparian Area Quantity	Riparian areas function as transitional areas between the stream and uplands. They may include wetlands or floodplains, depending on the valley form and stream corridor. They are important habitat and travel corridors for numerous plants, insects, amphibians, birds, and mammals.	**High Score:** Riparian corridor width is at least two bankfull widths or more than the active floodplain and is contiguous across and down the corridor. **Low Score:** Riparian corridor is less than 25% of the active floodplain or vegetation gaps exceed 30% of the property.
5. Riparian Area Quality	The quality of the riparian area increases with the width, complexity, and linear extent of the vegetation along the stream. A complex community consists of diverse plant species native to the area with varying age classes.	**High Score:** Natural and diverse vegetation with varied age classes. No invasive species. **Low Score:** Little to no native vegetation, invasive species widespread.
6. Canopy Cover	In forested riparian areas, shading of the stream is important as it helps maintain cool water temperatures. Loss of shading vegetation can cause a decline in certain species of fish (including trout), insects, and some aquatic plants. Additionally, cool water can hold more dissolved oxygen.	**High Score:** Greater than 75% of water surface shaded. **Low Score:** Less than 20% of water surface shaded.
7. Manure or Septic Present	Manure or human waste increases nutrients and oxygen demand in streams. This alters food webs, nutrient cycling, algal growth, and could cause bacterial or viral contamination.	**High Score:** No livestock access and no leaking septics, sewers, and/or untreated waste discharges. **Low Score:** Livestock have unlimited access to stream and manure is noticeable and/or there is visible septic, sewer, or untreated wastewater discharges.
8. Pools	Pools are important resting, hiding, winter habitat and feeding locations for fish. Streams with a mix of shallow and deep pools offer diverse habitat for diverse species and age-classes of fish and other aquatic species.	**High Score:** More than three deep pools separated by riffles or boulders; shallow pools also present. **Low Score:** Pools absent.
9. Barriers to movement	Most aquatic organisms move around their habitat or take daily or seasonal migrations. Some species use headwater streams for spawning and move downstream to lakes and larger creeks for feeding as they mature. Barriers that block the movement of fish or other aquatic organisms interrupt these natural cycles.	**High Score:** No artificial barriers that prohibit movement during any time of the year. **Low Score:** Physical structures, water withdrawals, and or water quality prohibit movement.
10. Fish Habitat Complexity	Quality fish habitat is a mosaic of different types of habitat created by different combinations of water depth, velocity, wood, boulders, riparian vegetation, and species. Fish require these complex habitats and the dynamic nature of instream habitat features assures that fish are able to find suitable areas to rear, feed, grow, hide, and reproduce. The greater the variety of habitat features the more likely it is to support a diverse aquatic ecosystem.	**High Score:** Ten or more habitat features available, including logs or large wood, small wood accumulations, deep pools, shallow pools, overhanging vegetation, large boulders, small boulder clusters, riffles, undercut banks, and side channels or floodplains. **Low Score:** Less than four habitat features available.
11. Aquatic Invertebrate Complexity	In a healthy stream, substrates are varied, free of fine sediment, abundant, and in place long enough to allow for colonization of aquatic invertebrates. High stream velocities, high sediment loads, and frequent flooding may cause reaches to be unsuitable for these organisms. Wood and riffle areas with boulders and cobbles support the bulk of the invertebrate community. Reaches with wood tend to support a more diverse aquatic invertebrate community.	**High Score:** Nine or more habitat features available, including logs or large wood, small wood accumulations, deep pools, shallow pools, overhanging vegetation, large boulders, small boulder clusters, riffles, undercut banks, and side channels or floodplains, and must include at least one wood/riffle combination. **Low Score:** No habitat features available.

Table 2 St. Vrain Creek Reach Break Descriptors

Reach Name	Downstream End	Upstream End
SVC01	County Line Rd.	N 119th St.
SVC02	N 119th St.	Confluence with Lefthand Creek
SVC03	Confluence with Lefthand Creek	Main St./US-287
SVC04	Main St./US-287	Sunset St.
SVC05	Sunset St.	Hover St.
SVC06	Hover St.	Airport Rd.
SVC07	Airport Rd.	N 75th St.
SVC08	N 75th St.	Hygiene Rd.
SVC09	Hygiene Rd.	N 63rd St.
SVC10	N 63rd St.	US-36
SVC11	US-36	Confluence of North and South St. Vrain creeks
NSV01	Confluence with South St. Vrain Creek	End of W Evans St.
NSV02	End of W Evans St.	US-36/W Main St.
NSV03	US-36/W Main St.	Apple Valley Rd.
NSV04	Apple Valley Rd.	Slope break (-105.324389 40.232424)
NSV05	Slope break (-105.324389 40.232424)	Button Rock Reservoir
SSV01	Confluence with North St. Vrain Creek	Old St. Vrain Rd.
SSV02	Old St. Vrain Rd.	Quarry
SSV03	Quarry	-105.326248 40.197844
SSV04	-105.326248 40.197844	-105.335733 40.186248
SSV05	-105.335733 40.186248	-105.362803 40.171695
SSV06	-105.362803 40.171695	Confluence with Middle St. Vrain Creek
SSV07	Confluence with Middle St. Vrain Creek	Bridge at Ceran St. Vrain Trailhead
SSV08	Bridge at Ceran St. Vrain Trailhead	Hwy 72
SSV09	Hwy 72	Slope break near South St. Vrain Trailhead
SSV10	Slope break near South St. Vrain Trailhead	Lefthand Creek Diversion
SSV11	Lefthand Creek Diversion	Brainard Lake
MSV01	Confluence with South St. Vrain Creek	-105.414699 40.170151
MSV02	-105.414699 40.170151	Hwy 7 and Riverside Dr.
MSV03	Hwy 7 and Riverside Dr.	-105.439772 40.170560
MSV04	-105.439772 40.170560	Raymond Store bridge (downstream of)
MSV05	Raymond Store bridge (downstream of)	-105.467518 40.148421
MSV06	-105.467518 40.148421	Peaceful Valley & Hwy-72

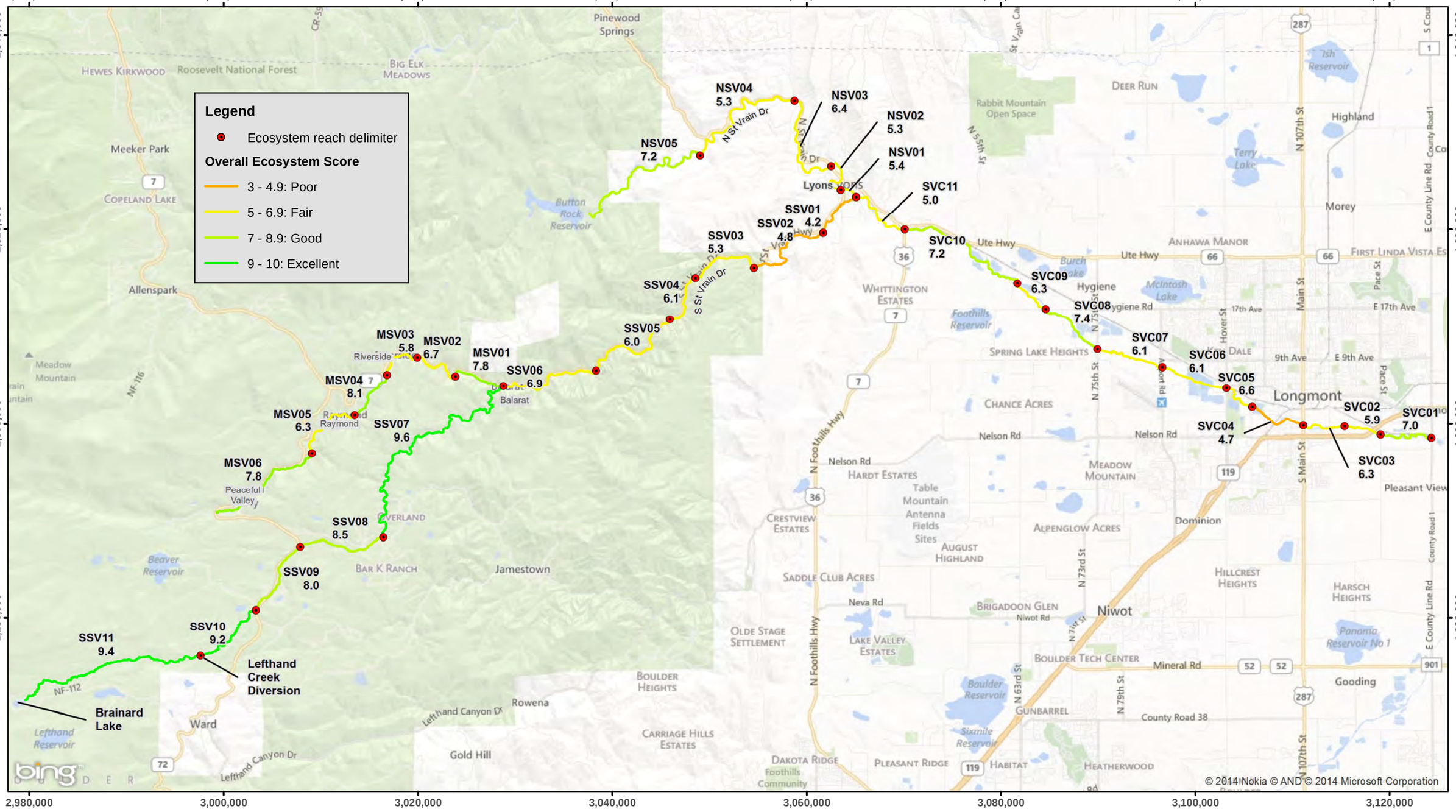
Table 3 SVAP2 Results for St. Vrain Creek

Reach	Channel Condition	Hydrologic Alteration	Bank Condition	Riparian Quantity	Riparian Quality	Canopy Cover	Nutrient Enrichment	Manure or Septic	Pools	Barriers to Movement	Fish Habitat Complexity	Aquatic Invertebrate Habitat	Overall Score	Reach
SVC01	6	2	5	6.5	7	7	9	10	8	10	6	7	7.0	SVC01
SVC02	4	2	7	6	7	3	10	5	4	10	6	7	5.9	SVC02
SVC03	6	2	7	4	5	2	10	10	8	10	5	6	6.3	SVC03
SVC04	4	2	2	3	3	3	10	10	4	8	3	4	4.7	SVC04
SVC05	5	2	4	7	8	5	10	10	7	10	5	6	6.6	SVC05
SVC06	6	2	8	7	9	6	10	10	4	2	4	5	6.1	SVC06
SVC07	5	2	5	7	5	4	10	10	4	10	5	6	6.1	SVC07
SVC08	8	3	7	8	5	6	10	10	7	10	7	8	7.4	SVC08
SVC09	5	4	3	2	3	1	10	10	10	10	8	9	6.3	SVC09
SVC10	7	4	7	9	7	4	10	10	7	6	7	8	7.2	SVC10
SVC11	6	5	3	3	3	2	10	10	6	1	5	6	5.0	SVC11
NSV01	6	5	7	3	4	3	10	10	1	7	4	5	5.4	NSV01
NSV02	6	5	4	2	1	2	10	10	5	10	4	5	5.3	NSV02
NSV03	6	5	3	6	3	2	10	10	9	10	7	6	6.4	NSV03
NSV04	6	5	1.5	3	1	1	10	10	9	8	4	5	5.3	NSV04
NSV05	8	5	8	8	8	2	10	10	10	2	7	8	7.2	NSV05
SSV01	2	7	1	3	2	1	10	10	1	10	1	2	4.2	SSV01
SSV02	3	7	2	3	1	1	10	10	1	10	4	5	4.8	SSV02
SSV03	4	8	3	3	3	1	10	10	4	10	3	4	5.3	SSV03
SSV04	6	8	6	3	2.5	1	10	10	6	10	5	6	6.1	SSV04
SSV05	3	8	2.5	2.5	2.5	3	10	10	7	10	6	7	6.0	SSV05
SSV06	5	8	4	6.5	7	4	10	10	8	5	7	8	6.9	SSV06
SSV07	10	8	9	10	9.5	10	10	10	10	10	9	10	9.6	SSV07
SSV08	9	8	8	8	7	7	9	10	9	7	10	10	8.5	SSV08
SSV09	8	7	7	8	8	9	9	7	8	8	8	9	8.0	SSV09
SSV10	10	7	8	9	9	6	10	10	10	10	10	10	9.1	SSV10
SSV11	10	8	9	9	9	8	10	10	10	10	10	10	9.4	SSV11
MSV01	8	8	8	8	7	5	10	10	5	10	7	8	7.8	MSV01
MSV02	4	8	5	5	7	2	10	10	4	10	7	8	6.7	MSV02
MSV03	3	7	3	4	4	4	10	10	4	10	5	6	5.8	MSV03
MSV04	8	8	7	9	9	6	10	10	5	10	7	8	8.1	MSV04
MSV05	6	7	5	6	4	3	10	10	3	8	6	7	6.3	MSV05
MSV06	7	8	8	7	7	5	9	8	8	10	8	9	7.8	MSV06

Table 4 St. Vrain Creek Ecosystem Recommendations

Reach	Recommendation
SVC01	Passive restoration; span bridge across active width.
SVC02	Add wood and low-flow complexity, ensure ecological flows.
SVC03	Rebuild floodplain benches, narrow the channel, reinforce pond berms (or consider conversion from pond to floodplain wetland allowing Creek seasonal access); retrofit for stormwater contributions from development on south bank if not already in place.
SVC04	Remove levy, create more floodplain; actively seek easements and land conversions along creek from development to open space; create pools/planform complexity (LWD/boulders).
SVC05	Create pools/planform complexity (LWD/boulders) in lower end of reach.
SVC06	Create pools/planform complexity (LWD/boulders); consider whether concrete diversion structure is a habitat break and whether a retrofit could allow for improved aquatic organism passage.
SVC07	Increase capacity of Airport Road bridge; assess benefit/potential of agricultural programs to improve riparian forest buffer.
SVC08	Possible floodplain conservation/enhancement projects utilizing existing undeveloped and vegetated areas (further investigation of landowners and existing conditions needed).
SVC09	Help reestablish vegetation; keep development out; additional stability in low flow channel; stabilize pond berms.
SVC10	Investigate whether diversion dam at downstream end of reach impedes aquatic organism passage; conserve existing floodplain/riparian habitat.
SVC11	Retrofit diversion structure for AOP and recreational (boater) passage; conserve/maintain flood flow paths and features (e.g. overflow chutes) as much as possible.
NSV01	Maintain channel as necessary to convey water and sediment through high density downtown development of Lyons.
NVS02	Investigate bridge capacities; maintain floodplain as undeveloped areas through tight canyon meanders. Highway 36 roadbed cuts across valley in two places - look for opportunities to reduce this floodplain constriction with additional overflow culverts
NSV03	Add meanders/maintain new and historic channels as undeveloped floodplain; buyout properties, conversion back to ag/open space. (large planform space).
NSV04	Create pools/planform complexity (LWD/boulders).
NSV05	Create pools/planform complexity (LWD/boulders).
SSV01	Master plan reach to consider opportunities for improved meanders, habitat, crossings, etc.; room to create more planform complexity
SSV02	Develop sediment transport/channel alignment plan through this reach; regrade floodplain while keeping floodplain access; protect as depositional reach (raising road to allow for clearance after another 5-10 feet of deposition).
SSV03	Improve floodplain extent and in-stream habitat in conjunction with Hwy 7 reconstruction/realignment.
SSV04	Improve floodplain extent and in-stream habitat in conjunction with Hwy 7 reconstruction/realignment.

Reach	Recommendation
SSV05	Improve floodplain extent and in-stream habitat in conjunction with Hwy 7 reconstruction/realignment.
SSV06	Improve floodplain extent and in-stream habitat in conjunction with Hwy 7 reconstruction/realignment.
SSV07	USFS land – no further management recommended (ongoing USFS trout habitat improvements underway in this segment).
SSV08	Replace undersized culvert at Overland Road crossing; control stormwater from road that gullied during storm at this same crossing (gravel road comes down very steep hill – needs turnouts or sediment trap).
SSV09	Culvert under Peak to Peak highway at upper end of reach has drop out outlet, could use drop structure/grade control to ensure AOP. Recommend culvert replacement at additional crossings at this reach that access private lands.
SSV10	USFS land – no further management recommended.
SSV11	USFS land – no further management recommended.
MSV01	Improve floodplain extent and in-stream habitat in conjunction with Hwy 7 reconstruction/realignment. Consider specifically reconnection of large meander bend that was cutoff by highway near downstream end of reach.
MSV02	Improve floodplain extent and in-stream habitat in conjunction with Hwy 7 reconstruction/realignment. Opportunities to install grade controls to increase floodplain connection.
MSV03	Community meetings to discuss risk with landowners. Private structures being rebuilt undersized. Extensive armoring and dredging through reach has left poor habitat; improve with boulder clusters and pocket pool creation.
MSV04	Consider raising road elevation; stream has excellent floodplain access due to aggradation in channel. Protect multiple floodchutes and braids that were established during flood. Replace private crossings (if necessary) with appropriate sized structures.
MSV05	Improve in-channel habitat complexity with addition of LWD; ensure private structures are adequately sized.
MSV06	Limit access to horses at Pleasant Valley via off channel watering and/or bridge crossings (for water quality concerns).



NAD 1983 HARN StatePlane Colorado North FIPS 0501 Feet

N W E S

0 5

Miles

1 inch = 9,500 feet

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Figure 1
St. Vrain River
Overall Ecosystem Score
Boulder County, Colorado

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APPENDIX A

St. Vrain Creek Photograph Log

Reach SVC01

County Line Rd. – looking river right (6/20/2014)

County Line Rd. – looking downstream (5/27/14)

Reach SVC01 (Cont.)

County Line Rd. – looking upstream (5/27/14)

Upstream of County Line Rd. – looking river right at outlet of headcut gully (6/20/2014)

Reach SVC02

Upstream of Hwy 119 – looking upstream (6/20/2014)

Upstream of Hwy 119 – looking downstream (6/20/2014)

Reach SVC02 (Cont.)

Hwy 119 – looking upstream (6/20/2014)

Hwy 119 – looking downstream (6/20/2014)

Reach SVC03

Upstream of Martin St., downstream of channel avulsion into pond – looking upstream (6/20/2014)

Upstream of Martin St., downstream of channel avulsion into pond – looking downstream (6/20/2014)

Reach SVC03 (Cont.)

Upstream of Martin St., original channel – looking upstream (6/20/2014)

Upstream of Martin St., original channel – looking downstream (6/20/2014)

Reach SVC03 (Cont.)

Downstream of Main St./US-287 – looking upstream (6/20/2014)

Downstream of Main St./US-287 – looking downstream (6/20/2014)

Reach SVC04

Boston Ave. – looking upstream (6/20/2014)

Boston Ave. – looking downstream (6/20/2014)

Reach SVC05

Upstream of Sunset Ave. – looking upstream (6/20/2014)

Upstream of Sunset Ave. – looking downstream (6/20/2014)

Reach SVC05 (cont.)

Upstream of Sunset Ave., at pedestrian bridge – looking upstream (6/20/2014)

Upstream of Sunset Ave. and pedestrian bridge – looking upstream (6/20/2014)

Reach SVC06

Golden Ponds, pedestrian bridge downstream of diversion structure – looking upstream (6/20/2014)

Golden Ponds, pedestrian bridge downstream of diversion structure – looking downstream (6/20/2014)

Reach SVC06 (Cont.)

Golden Ponds – looking upstream (6/20/2014)

Golden Ponds – looking downstream (6/20/2014)

Reach SVC07

75th St. bridge – looking downstream (6/20/2014)

Upstream of Airport Rd. bridge – looking upstream (5/27/2014)

Reach SVC08

Crane Creek Hollow Rd. – looking upstream (6/20/2014)

Crane Creek Hollow Rd. – looking downstream (6/20/2014)

Reach SVC09

Downstream of 63rd St. – looking upstream (6/20/2014)

Downstream of 63rd St. – looking downstream (6/20/2014)

Reach SVC10

CEMEX at new diversion structure – looking upstream (6/20/2014)

CEMEX at new diversion structure – looking river right (6/20/2014)

Reach SVC10 (Cont.)

CEMEX railroad bridge – looking upstream (6/20/2014)

CEMEX railroad bridge – looking downstream (6/20/2014)

Reach SVC11

Downstream of McConnell Dr. – looking upstream (6/20/2014)

Downstream of McConnell Dr. – looking downstream (6/20/2014)

Reach NSV01

Evans St. and 4th Ave. – looking upstream (7/09/2014)

Evans St. and 4th Ave. – looking downstream (7/09/14)

Reach NSV01 (Cont.)

End of Park St. – looking upstream (7/09/2014)

End of Park St. – looking downstream (7/09/2014)

Reach NSV02

Main St. bridge – looking upstream (7/09/2014)

Main St. bridge – looking downstream (7/09/2014)

Reach NSV02 (Cont.)

Main St./Apple Valley Rd. bridge – looking downstream (7/09/2014)

Reach NSV03

Looking upstream (6/21/2014)

Looking downstream (6/21/14)

Reach NSV04

Looking upstream (6/21/2014)

Looking downstream (6/21/14)

Reach NSV05

Box culvert crossing downstream of Longmont Reservoir – looking upstream (6/24/2014)

Box culvert crossing downstream of Longmont Reservoir – looking downstream (6/24/2014)

Reach SVC05 (cont.)

Upstream of Longmont Reservoir – looking upstream (6/24/2014)

Upstream of confluence with spillway channel – looking upstream (6/24/2014)

Reach SVC05 (cont.)

Spillway channel – looking upstream (6/24/2014)

Spillway channel – looking downstream (6/24/2014)

Reach SSV01

Looking upstream (6/21/2014)

Looking downstream (6/21/2014)

Reach SSV02

Looking river left (6/21/2014)

Looking downstream (6/21/2014)

Reach SSV03

Looking upstream (6/23/2014)

Looking downstream (6/23/2014)

Reach SSV04

Looking upstream (6/23/2014)

Looking downstream (6/23/2014)

Reach SSV05

Looking upstream (6/23/2014)

Looking upstream (6/23/2014)

Reach SSV05 (Cont.)

Looking downstream (6/23/2014)

Reach SSV06

Looking upstream (6/23/2014)

Looking downstream (6/23/2014)

Reach SSV06 (Cont.)

Looking upstream (6/23/2014)

Looking downstream (6/23/2014)

Reach SSV07

Confluence with Middle St. Vrain Creek – looking upstream (6/24/2014)

Confluence with Middle St. Vrain Creek – looking downstream (6/24/2014)

Reach SSV07 (Cont.)

Ceran St. Vrain trail – looking upstream (6/24/2014)

Ceran St. Vrain trail – looking downstream (6/24/2014)

Reach SSV07 (Cont.)

Ceran St. Vrain trail – looking river right (6/24/2014)

Ceran St. Vrain trail (6/24/2014)

Reach SSV08

Ceran St. Vrain trailhead bridge – looking upstream (6/24/2014)

Ceran St. Vrain trailhead bridge – looking downstream (6/24/2014)

Reach SSV08 (Cont.)

Ceran St. Vrain trailhead – looking upstream (6/24/2014)

Ceran St. Vrain trailhead – looking downstream (6/24/2014)

Reach SSV08 (Cont.)

Overland Rd culvert crossing – looking upstream (6/24/2014)

Overland Rd culvert crossing – looking downstream (6/24/2014)

Reach SSV09

Driveway crossing – looking upstream (6/24/2014)

Driveway crossing – looking downstream (6/24/2014)

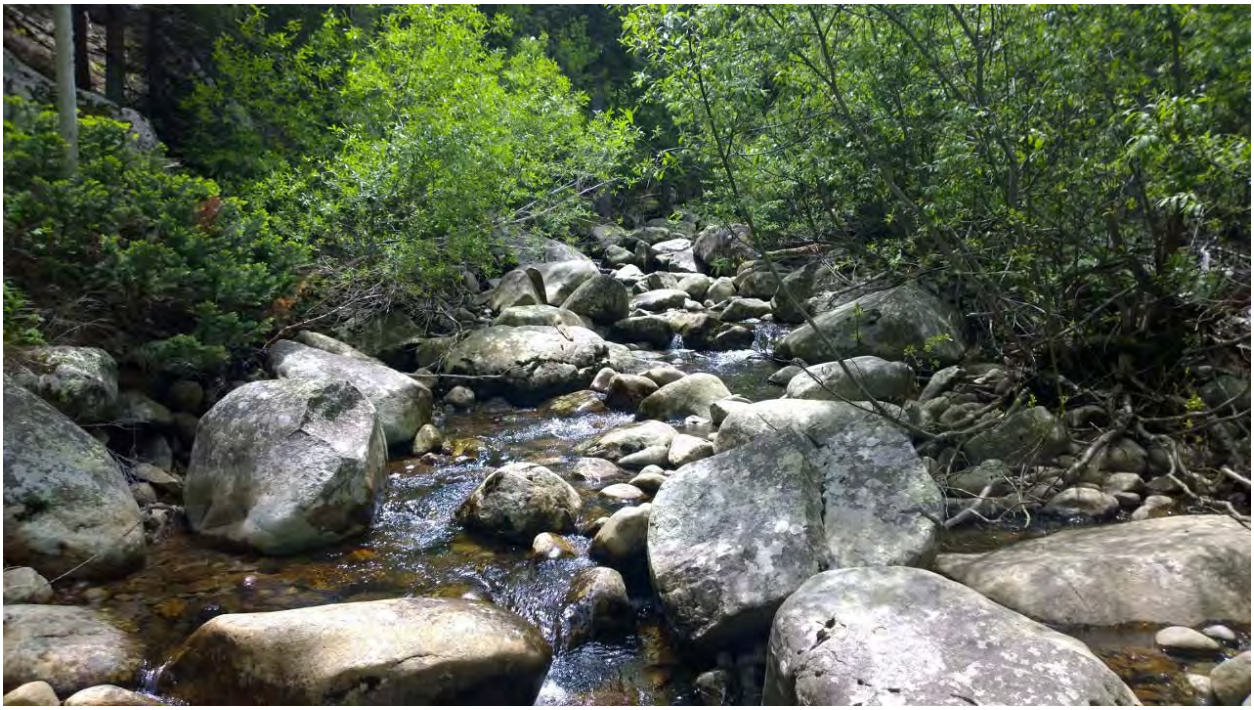
Reach SSV09 (Cont.)

Hwy 72 box culvert crossing – looking downstream (6/24/2014)

Hwy 72 box culvert crossing – looking river left (6/24/2014)

Reach SSV10

South St. Vrain trail – looking upstream (6/24/2014)



South St. Vrain trail – looking downstream (6/24/2014)

Reach SSV10 (Cont.)

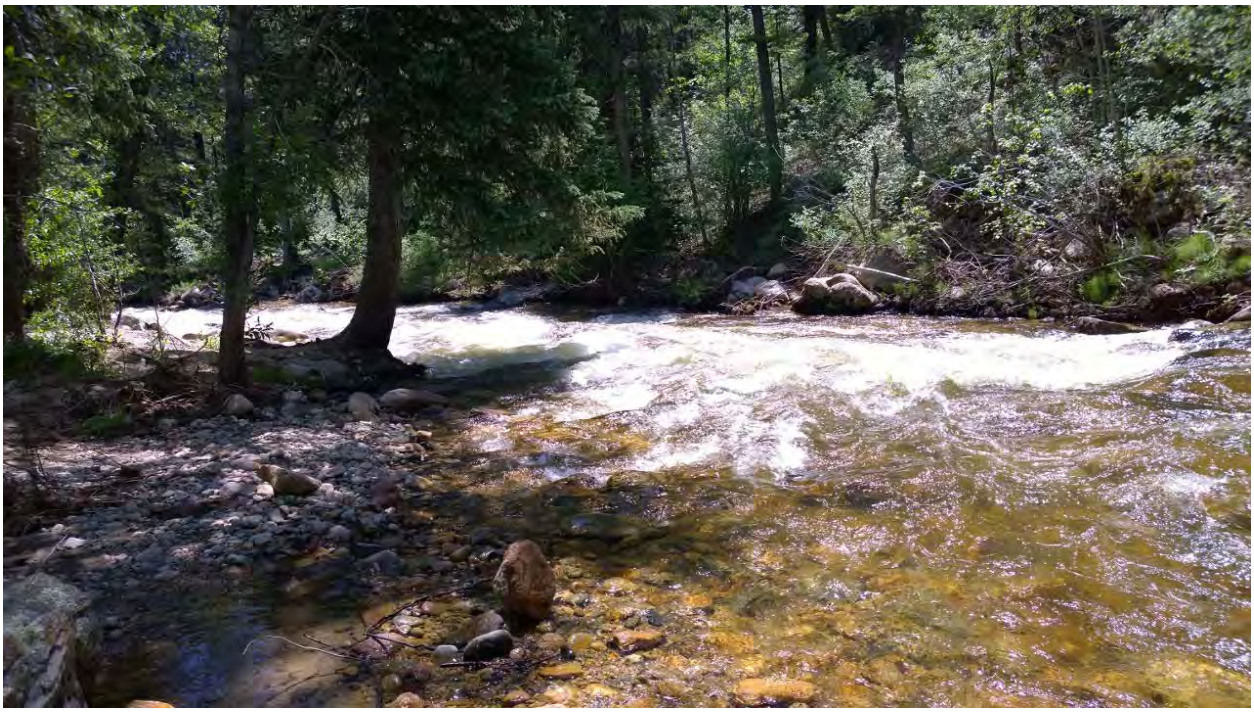
Brainard Lake outlet – looking downstream (6/24/2014)

Brainard Lake outlet – looking river left (6/24/2014)

Reach MSV01

Looking upstream (6/23/2014)

Looking downstream (6/23/2014)



Reach MSV02

Looking upstream (6/23/2014)

Looking downstream (6/23/2014)

Reach MSV02 (Cont.)

Looking upstream (6/23/2014)

Looking downstream (6/23/2014)

Reach MSV03

Riverside Dr. bridge – looking upstream (6/23/2014)

Riverside Dr. bridge – looking downstream (6/23/2014)

Reach MSV04

Looking upstream (6/23/2014)

Looking downstream (6/23/2014)

Reach MSV04 (Cont.)

Raymond Store bridge – looking downstream (6/23/2014)

Reach MSV05

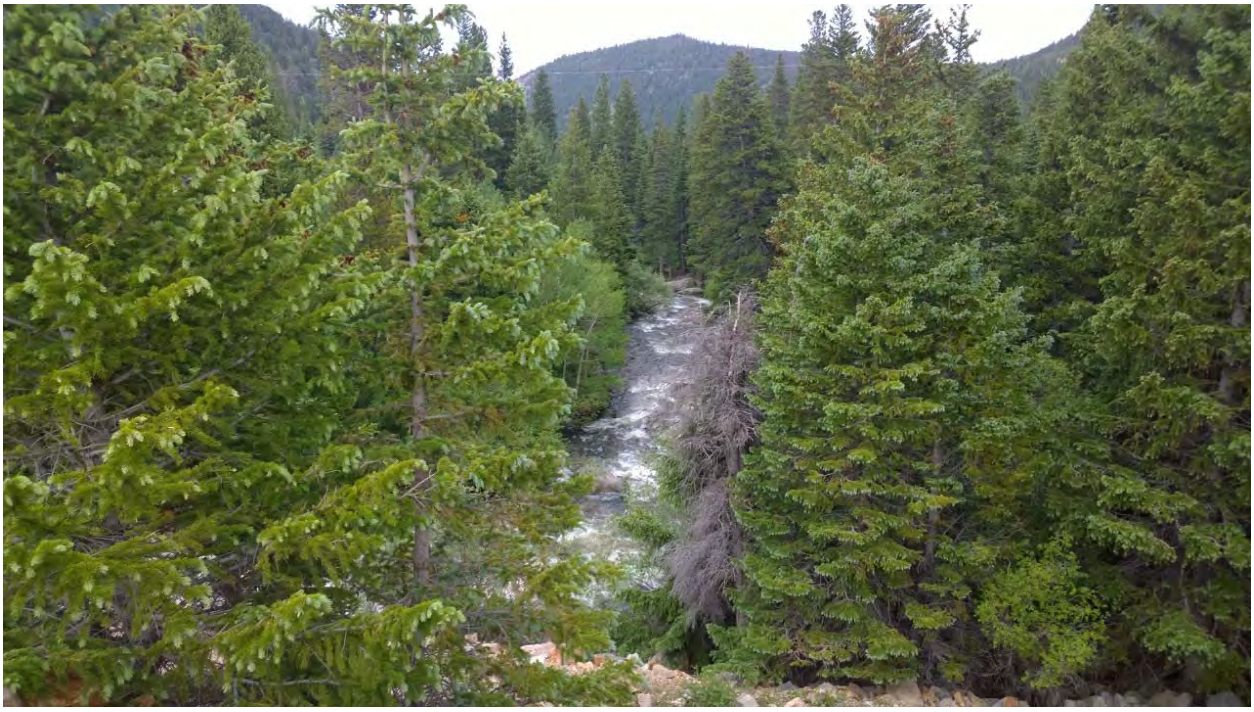
Looking upstream (6/23/2014)

Looking downstream (6/23/2014)

Reach MSV05 (Cont.)

Culvert/low flow crossing - looking downstream (6/23/2014)

Reach MSV06

Looking river right (6/23/2014)

Hwy 72 – looking downstream (6/23/2014)