Left Hand Creek Watershed: Conceptual Model
The Left Hand Watershed Center uses a conceptual model to describe the context of our watershed and define desired future conditions. As our watershed recovers from the 2013 floods, our desired future conditions are related to long-term watershed health and resilience. The model depicts the evolution of our watershed over time (relative to the 2013 floods) to help enhance understanding about the context of our watershed. Desired future conditions are determined by applying science to define watershed health and resilience goals given the unique context of our watershed. We use an illustrative conceptual model approach to help inspire deeper and more critical thinking about the future of our watershed. The model was developed collaboratively with technical experts and community members to achieve a shared understanding of the desired future conditions for the watershed.

Contributors note: The conceptual model was produced by Left Hand Watershed Center in collaboration with Lynker Inc. and LVBrown Studios, LLC. Funding was provided by Colorado Department of Local Affairs Community Development Block Grant - Disaster Recovery Resiliency Planning Program, June 2018.

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Through not depicted in our model, the history of our watershed provides essential information about our future. Historical conditions, as far back as pre-settlement and beyond, influenced our watershed significantly. The historical condition of the watershed and changes through time provide additional context and important information about what may be possible and desirable in the future. We do not look back at these conditions because we want to restore to some historical point in time, but rather to learn from our history.

Left Hand Creek Watershed carries more water than it would in its natural state due to Colorado’s historic first inter-basin transfer, the Left Hand Ditch. Dug in 1861, this diversion brings water from South St. Vrain Creek to James Creek, a tributary to Left Hand, just west of the town of Ward. Prior to 1861, Left Hand Creek was a seasonal creek or wetland swale that flowed seasonally and often went dry in late summer in all but the wettest years. However, after 1861, the Ditch Company began maintaining year-round flow in the creek as water passed through on its way to the farms and ranches on the plains. In its new role as a working river with an augmented flow regime, Left Hand Creek transformed from a seasonal creek or herbaceous wetland swale with occasional cottonwoods to a more defined river channel with increasing woody riparian vegetation along the channel margins.

At the same time, mining activities were booming in the upper reaches of the watershed and producing millions of dollars in gold and silver. By the early 20th century most mines were abandoned, leading to extensive acid mine drainage, leaching of metals into the creek, and excess sediment. Despite clean-up efforts, the impacts to water quality from these mine activities are still present in the watershed today.
The Left Hand Ditch transports water from the South St. Vrain to Left Hand Creek Watershed

Credit: Biohabitats, St. Vrain and Lef Hand Water Conservancy District Draft Stream Management Plan

*Monthly flow as average cfs/day

The diagram shows the modeled historical flow (Pre-Diversions) and the modeled current flow (Post-Diversions) for Left Hand Creek Simulated Flow 1950-2012. Monthly flow is indicated as average cfs/day.
Pre-flood, post-flood, and potential future states of Left Hand Creek are depicted for each of the watershed zones. The adaptive management cycle is positioned between the post-flood and potential future scenarios, indicating that adaptive management began with recovery from the 2013 flood. Desired future conditions are presented in the potential future panels. The potential future state depicts our vision of a healthy and resilient system.
Conceptual Model for Left Hand Creek Watershed

Pre-Flood:
- A wider stream corridor for stream movement. Rip-rap is significant damage with new flow paths, debris flows, agricultural land. Stream is single thread and straightened floodplain or entrenched with adjacent houses and floodplain. Stream has moderate channel grade and low sinuosity. Homes adjacent to stream bank and in the floodplain. Stream is in depositing trash and other debris.

Post-Flood:
- Stream exceeded channel capacity, damaging roads and amounts of sediment.
- Invasive crack willows are removed and normal channel evolution occurs with bars, riffles, and pools.
- Additional room for the stream and channel capacity.
- Floodplain is free of major development allowing normal channel evolution.
- Low grade stream is typically unconfined with adjacent low sinuosity. Partly confined stream with moderate channel grade and stream power.
- Stream is located in headwater or confined valley, structure and improvement of riparian habitat.
- Stream is single thread and straightened floodplain or entrenched with adjacent houses and floodplain. Stream has moderate channel grade and low sinuosity. Homes adjacent to stream bank and in the floodplain. Stream is in depositing trash and other debris.
Pre-Flood

From the 1860s to the 2013 flood, Left Hand Creek adapted to its role as a working river, with an increasing number of people relying on the creek for their livelihood and recreation. Like many rivers on the Front Range, diversions and ditches brought water, habitat, and life to places that would otherwise be dry. From wildlife habitat and fishing, to trails, cycling routes, and historic sites, our Front Range rivers, including their ditches and diversions, were increasingly relied upon to enhance our community’s quality of life.

As more people began relying on the creek, changes to the creek’s natural flow regime became evident. What was once a seasonal creek that went dry in late summer became a working river where flows were timed to meet community water-use needs. Despite augmentation from the trans-basin diversion and a somewhat more perennial flow regime, flows in Left Hand Creek were erratic and not necessarily timed with natural geomorphic and ecological processes. The creek still went dry, posing challenges for fish and wildlife that rely on perennial flow, ecosystem health, and recreation. At the same time, extreme floods, like the one that happened in September 2013, remained a normal part of the creek’s watershed hydrology.

In response to the altered flow regime, non-native vegetation, particularly crack willow (*Salix fragilis*), became prevalent throughout the watershed. These plants thrive along streams with regulated flows and tend to outcompete the natives. When they form dense stands, these shrubs encroach on the stream channel, making it deeper, narrower and more entrenched.

With increased entrenchment, the floodplain became disconnected and inundation events occurred less frequently. As a result, land use and cultivation right up to the creek edge became more prevalent. Infrastructure such as buildings, roads, and bridges were common in the floodway and adjacent to the creek. The combination of encroachment from crack willow, land use, and infrastructure resulted in a static “locked-in” stream form with limited floodplain access and little dynamic natural erosion/deposition processes. Water quality impairment from historical mining activities was still evident and mixed with other surrounding pollution sources, particularly in the plains where runoff from agriculture and urbanization was most prevalent.
Pre-Flood Photos

Canyons (near Rowena) Photo credit: Jim Fields

Alluvial Fan (Streamcrest Neighborhood) Photo credit: Teri Morelli

High Plains (63rd Street) Photo credit: Rod Schone
Post-Flood

The rainstorm of September 2013 brought a dramatic transformation to all Front Range Watersheds, including Left Hand Creek. Massive flood flows changed the landscape. Sediment and debris quickly plugged crossings, resulting in wide-spread sediment deposition, erosion, channel migration, and avulsion. Water quality and aquatic communities suffered due to contaminated sediment pulsed released form eroded mine tailings. Whole riparian areas were wiped out or covered by deposition. Agricultural fields, roads, houses, lawns, and infrastructure on the valley bottom were damaged or destroyed in the historic event. The flood was devastating on many levels, but also brought opportunity to rebuild and recover in a more resilient way.

Considering Desired Future Conditions

Desired future conditions are depicted on the following page. It is important to note that while the conceptual model depicts just one potential future condition, we recognize that watersheds are dynamic and that many different future conditions are possible, particularly in the face of processes such as flood, drought, fire, and climate change.
Today and Our Future

Diverse community members came together to define a common vision for the desired future of our watershed, and depicted that vision in this conceptual model. Together, we envision a watershed with a healthy riparian community and robust aquatic habitat created and maintained by good floodplain connectivity and dynamic geomorphic and ecological processes. We also envision room for the creek to move and adjust, in order to allow dynamic river processes to occur, and diverse, ever-changing, riparian habitat. Leveraging lessons learned from looking at our history we know that we must avoid a “locked-in” creek dominated by invasive crack willow (*Salix fragilis*), and that this will likely require on-going maintenance due to the artificial flow regime and other land-use constraints inherent to a working river. We also know that the best solutions for our resilient future offer multiple benefits to improve watershed health while also improving functions of ditches and diversions.

Managing to the Future

As our watershed continues to change and evolve after the floods, we continue to manage our trajectory towards a healthy and resilient future using an adaptive approach. Our approach is described in detail in our *Adaptive Management Guide*, available on our website.