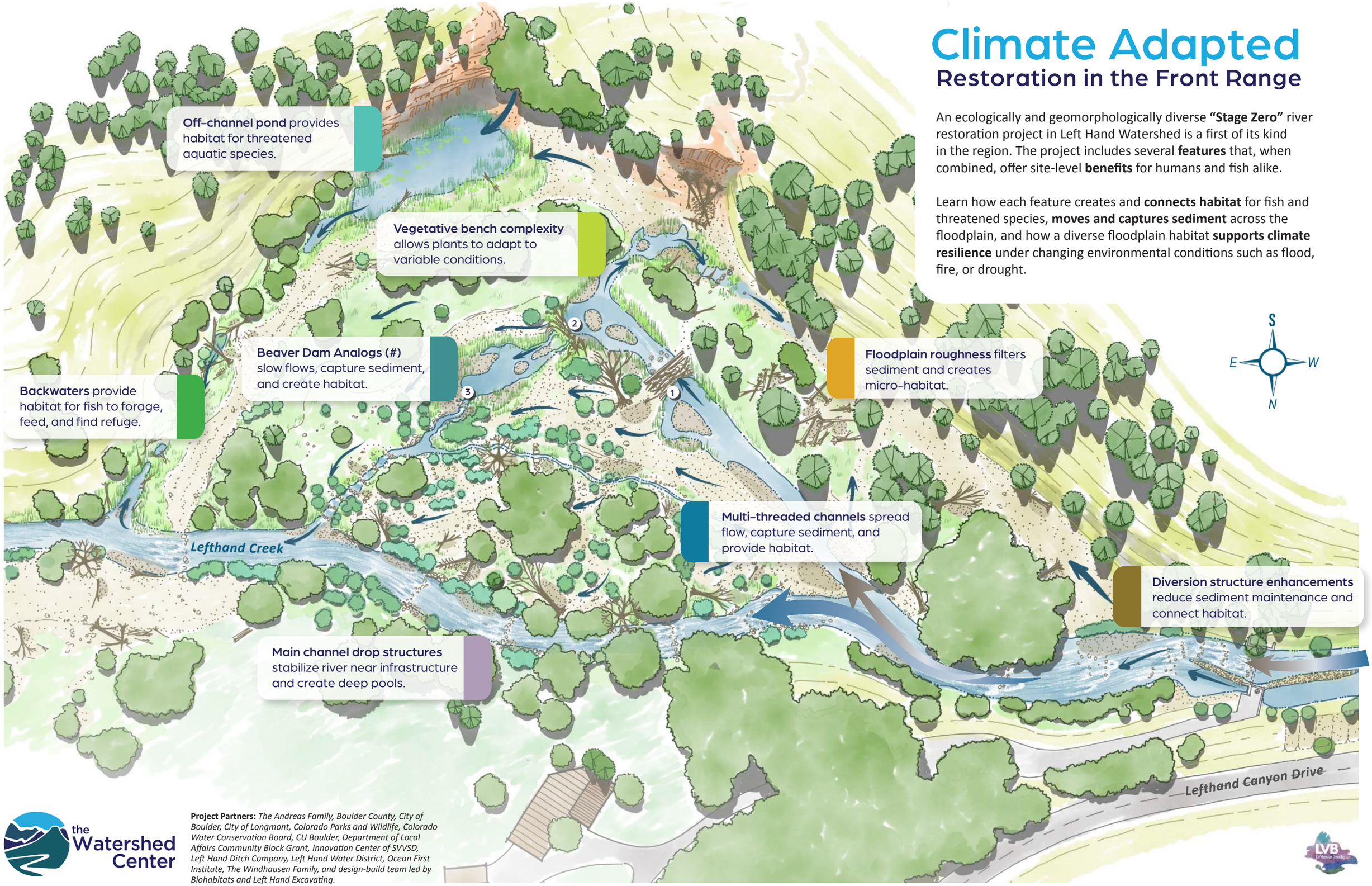
Climate Adapted

Restoration in the Front Range

An ecologically and geomorphologically diverse **"Stage Zero"** river restoration project in Left Hand Watershed is a first of its kind in the region. The project includes several **features** that, when combined, offer site-level **benefits** for humans and fish alike.

Learn how each feature creates and **connects habitat** for fish and threatened species, **moves and captures sediment** across the floodplain, and how a diverse floodplain habitat **supports climate resilience** under changing environmental conditions such as flood, fire, or drought.



the Watershed Center

Project Partners: *The Andreas Family, Boulder County, City of Boulder, City of Longmont, Colorado Parks and Wildlife, Colorado Water Conservation Board, CU Boulder, Department of Local Affairs Community Block Grant, Innovation Center of SVVSD, Left Hand Ditch Company, Left Hand Water District, Ocean First Institute, The Windhausen Family, and design-build team led by Biohabitats and Left Hand Excavating.*

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FEATURES + Benefits

Explore the multiple 'geomorphic' and 'ecological' benefits of the multiple floodplain and river restoration features installed across the project area.

Floodplain Roughness & Large Wood

A messy floodplain is a sign of a healthy river. Downed trees and large wood placement help scour the floodplain and create depositional areas for riparian vegetation to establish. Floodplain vegetation—grasses, sedges, riparian shrubs, tree saplings, mature trees, and standing snags—combine to make a mosaic of 'roughness.' During high flows, the vegetation captures sediment and creates microhabitats for aquatic and terrestrial wildlife to thrive. In-stream, large wood installed in the main channel outer bends stabilize the banks to protect critical infrastructure and provide scour pools, an important deep water refuge for fish.

Diversion Structure Enhancements

The pre-Stage Zero diversion structure posed challenges for both water managers and fish. Deposition behind the dam required continuous maintenance. Sediment also obstructed the water intake to downstream users reliant on the diversion for drinking water and agricultural production. For fish, the dam posed a physical barrier to upstream migration. The Stage Zero project installed an upstream flow divider to split flow between the diversion intake and over the dam, allowing sediment-laden flows to pass downstream and reduce dredging maintenance near the intake. A ramp constructed of rock step-pool structures allows fish to swim up and over the dam to their spawning grounds. A win-win for all!

Beaver Dam Analogs

Beaver reintroduction may not be feasible for many river reaches, yet we can still mimic their dam-building structures for similar floodplain benefits. Constructed of large wood, stone, and willow stakes, Beaver Dam Analogs (BDAs) impound water, slowing flows and capturing sediment, like here in the Stage Zero high-flow channel. Additionally, BDA ponds expand emergent wetland vegetation and shrub communities in the floodplain. During high flows, fish and wildlife seek this high-quality habitat for forage, breeding, and protection. Note: While sediment will continue to fill the open pools over time, this will not diminish the benefits to river processes (geomorphic) or fish and wildlife (ecological).

Vegetative Bench Complexity

The Watershed Center and CU Boulder conducted a vegetative bench experiment to test how well mixes of water-loving to drought-tolerant plants survive and out-compete non-native species at varying floodplain bench heights (i.e., higher-drier, lower-wetter) at the Stage Zero site. We found that low benches are key to building climate-adapted restoration projects. Lower benches resulted in more native cover for drought-tolerant and water-loving communities due to increased soil moisture and reduced invasion of non-native species. Higher-drier benches were prone to lower vegetative cover and invasion by non-native species. Species like snowberry, skunkbush, and narrowleaf cottonwood survived best in the higher benches.

Multi–Threaded Channels

Multi-threaded channels allow surface and groundwater to spread throughout the floodplain, providing multiple geomorphic and ecological benefits. During high flow, sediment-laden flood waters spread across the floodplain, slowing flows and depositing sediment. Multi-threaded channels also create high-quality fish and wildlife habitat such as side channels, backwaters, and wetlands. Note: Many multi-threaded channels do not flow year-round. They're activated during spring high flows through early summer, coinciding with flood pulses when many native fish seek these smaller channels for breeding, forage, and refuge.

Off–Channel Pond

Off-channel ponds provide isolated habitat to protect sensitive species from in-stream predators, like trout, and provide high-quality breeding, foraging, and protective habitat for the more than 20 species of fish found in the transition zone between the foothills of canyons to the edge of the high plains. The cool, spring-fed ponds provide thermal refuge in the face of climate change and warming surface water temperatures. The off-channel pond at Stage Zero is the site of a highly successful project to introduce a naturally reproducing population of Northern Redbelly Dace and the first-of-its-kind introduction of Northern Leopard Frog to the region!

Main Channel Drop Structures

Channel stability becomes critical when the river is adjacent to infrastructure, such as roads, utilities, homes, and other structures. Channel stability at Stage Zero was achieved through constructing a series of instream 'drop structures.' Drop structures are built as a cascade of large boulders installed across the channel to create a pool-riffle sequence in higher gradient streams, like in Left Hand Creek's alluvial fan. Drop structures help stabilize the main channel's slope or 'profile' during peak flows and create deep pool habitats for fish to rest during migration or refuge throughout the year in drought conditions.

Wetland & Backwater Habitat

Wetlands and backwaters are low-lying floodplain depressions characterized by wet soils and wetland plants (sedges, rushes). They provide multiple geomorphic and ecological benefits. For example, wetlands help filter sediment and nutrients out of the water column during high flows, improving water quality downstream. The diversity of vegetation and cover provided critical habitat when fish are seeking food (forage), a place to hide (refuge), and a place to reproduce (spawn). As river flows diminish in the summer and fall months, groundwater helps sustain floodplain wetlands and provides continuous benefits to wildlife, such as amphibians, birds, and mammals.