



River Planning | Design | Engineering | Implementation











MASTER PLANNING



RIVER RESTORATION



DAM SAFE BOATER BYPASS AND HABITAT IMPROVEMENTS



INSTREAM WHITEWATER PARKS



PUMPED WHITEWATER PARKS





What Do We Do? S2o specializes in river engineering, restoration, whitewater park design, and the design of community focused river parks. Our process involves working with a community to define needs, desires, and constraints. We feel that the design of river corridors is a blend of science, engineering, and social inputs that guide a design process. For S2o, the best solution is one that meets the needs of a community, decreases flood risks, and emphasizes a restoration and recreational plan that provides connected habitat and valuable recreation.

Who Are We? We are an engineering firm composed of design professionals that are also river enthusiasts. Our staff includes Scott Shipley, P.E., professional engineer in many states and also a 3-time Olympian and World Champion paddler; Nathan Werner, P.E., professional engineer and sponsored freestyle athlete; Christine Clark, PLA, AICP, planner, landscape architect, and whitewater SUP racer, Kurt Smithgall, E.I.T., hydraulic modeling specialist and a 3-time Wildwater National Team member, Riley Adams, E.I.T., project manager and extreme boater; and Julia Pershken, E.I.T., river engineer and raft guide.

What Have We Done? S2o has built a design portfolio that approaches river restoration and recreation holistically. We have the capability of working on a project from the initial planning through construction management. Recent planning projects include the St. Vrain Creek Watershed Master Plan and the Canon City River Improvements Master Plan. Most recently, we have completed four in-stream projects; LaVern M. Johnson Park in Lyons, CO; The Durango Whitewater Park in Durango, CO; The Camphill Surf Park in Wanaka, NZ; and the design-build of the Apple Valley South Stream Restoration project in Lyons, CO.

Why Do A Park In Your Town? River corridor projects are about inviting an entire community outside by creating healthy, active, outdoor recreation. These parks provide a live-where-you play environment in which you can paddle and surf on your lunch-break, after work, or on weekends.

How Do You Get Started? The best way to get started is to pick up the phone and give us a call. Every project is unique and we are happy to tailor our approach to fit your needs. S2o recommends starting almost any project with a feasibility and conceptual design study. This is a study that we conduct to determine if your project, or a similar project in the area, is feasible. We also create a design report that documents the study, provides a roadmap to completion, and details a cost estimate for completion. Our experience shows that this type of study provides the three things you need to get a project moving: A full-color design that shows how the project will look and function, a report that shows how to get the project completed, and a preliminary cost estimate that shows how much the project will cost.



ABOUT THE S20 DESIGN AND ENGINEERING TEAM:

WE ARE THE WORLD'S PREMIER RIVER RECREATION DESIGN AND ENGINEERING TEAM

S2o specializes in river engineering, recreation, restoration, and the design of community focused river parks. Our team of expert boater-engineers has planned, conceived, designed, and created some of the highest profile pumped and in-stream whitewater parks in existence today. Our award winning pumped parks are the largest and most dynamic recirculating whitewater parks in the world. Our in-stream parks include features and river restorations that range from small waves to massive, river-wide re-designs of dangerous weirs and dams. We have extensive experience in master planning of river parks including bankside restoration, bank erosion, habitat and river morphology, bankside seating, river and trail access, and recreational river amenities. The quality of our work, and the depth of our experience, has made us the go-to team for discerning whitewater and river engineering projects throughout the world.

S2o's advantage is its ability to incorporate cutting edge technology in a natural, sustainable, and environmentally friendly manner. Our innovations in whitewater design, all of them patented, allow us to create waves that are pneumatically adjustable, or mechanically reconfigurable. Our designs and techniques provide unparalleled recreation in a natural and stunning setting.

We employ an industry leading process that is collaborative and information-based, and is driven by the wishes and desires of the people who use the park. We center our design approach on public and stakeholder input and the information gathered is used to define the project's attributes and constraints.

The real S20 difference is our people. We are trained, licensed, and innovative design and engineering professionals. We take great satisfaction in our ability to apply our technical expertise to create the optimal whitewater experience for all types of paddlers. Moreover, we are expert boaters that share a lifelong passion for whitewater recreation, and believe that a river experience for paddlers should be designed by paddlers!

Led by engineer, Olympian, three-time World Cup Kayak Champion and Freestyle Kayak Champion Scott Shipley, you can expect nothing short of championship-caliber results that are fun and friendly for the entire community.



PROJECT: RIVERSPORT RAPIDS WHITEWATER CENTER Oklahoma City, OK Project Construction Cost: \$45 million

Riversport Rapids Whitewater Center is the first pumpedpark design in the world that offers a recreational channel, a competition channel and a combined-flow freestyle channel in the same whitewater venue. The Whitewater Center is ideally located at the crossroads of two arterial highways and Project Construction Cost: \$45 million Key Staff: Scott Shipley, Jeffrey Gustin, Christine Clark

Project Dates: August 2012- March 2016 Reference: Mike Knopp, Executive Director, OKC Boathouse Foundation, 405-552-4040, mknopp@chesapeakboathouse.org

strategically placed within the city; a short water taxi or river walk away from Bricktown and Downtown OKC.

The Whitewater Center is part of the larger OKC Boathouse District Campus; encompassing a flatwater race and training channel on the Oklahoma River; a recreational boat house and multiple, local collegiate boat houses; a high performance training center; and an adventure center equipped with zip-lines, a climbing wall, and a dynamic-belay high ropes course. The boathouse district is also the headquarters for the USA Canoe and Kayak Federation and is designated as a U.S. Olympic and Paralympic Training Center.

S2o, as project lead, worked with the City, stakeholders, and sub-contractors throughout the planning and design process to create a design that is unique to the Western United States. The Whitewater Center has the technology of a world class venue but also has the aesthetics and scale to blend into the existing Boathouse District Master Plan and the City of Oklahoma City. S2o lead the design, construction and construction oversight of The Whitewater Center.

- 1,305 linear foot Recreational Channel that drops 19.5 feet in elevation.
- 1,073 linear foot regulation length Competition Channel that drops 19.5 feet in elevation.
- 2 feature, combined-flow channel creates the highest volume, pumped freestyle features, in the world.
- Pump station (6 pumps) that pumps 492,000 gallons/minute, 23 feet in elevation.
- Conveyor belt capable of carrying nine loaded rafts, or 13,500 lbs, to recirculate users to the top pool.
- State-of-the-art movable Rapidblocs moveable obstacle system allowing the course to change and adapt to different users and events over time.
- Main building with operations, guest facilities, and a restaurant for viewing the freestyle channel and the finish line of the competition channel.
- Kayak building specifically designed for professional athletes and recreational kayakers.



PROJECT: Eagle River Park

Eagle, Colorado

Eagle, Colorado is situated on the Western slope of the Rocky Mountains, in the center of Colorado's ski country. The Eagle River Park project was designed as a venue to

Project Construction Cost: \$2.7 million Key Staff: Scott Shipley, Christine Clark, Nathan Werner Project Dates: October 2015- December 2018 Reference: Tom Boni, Town Planner, Town of Eagle, 303-328-9619, tomboni@townofeagle.org

attract summer visitors to the Town and to highlight the growing trend of creating a town centered around outdoor recreation.

The Eagle River Park is located at an existing 3+ rapid in a relatively calm section of the Eagle River. The design focused on habitat improvements, as well as creating a world-class whitewater venue. The design was vetted through an extensive public process and was a cooperative effort with the Colorado Parks and Wildlife. S2o completed all planning, design, permitting, and construction oversight of this project.

The whitewater park contains 4 drop structures and a crossvain diversion structure. The first two drop structures contain a fish and boater by-pass channel and the last two drop structures contain a low-flow fish notch. Habitat boulders and a fish-friendly boulder cross-vain round out the design.

The drop structures are designed for a variety of flows and conditions and features rapidblocs compatible concrete pads that allow the features to be adjusted over time. Spectator viewing areas, judging platforms, a removable slalom mast system, and accessible ramps create a park that can be enjoyed by various users on a daily basis and a venue capable of hosting local and regional events.

- Encompasses 4 drop structures and a fish and boater by-pass channel.
- Includes in-stream habitat improvements and habitat structure design.
- Designed for world-class whitewater and is equipped with rapidblocs compatible concrete pads for long term adjustability.
- Designed through comprehensive 1d and 2d modeling.
- Planned through cooperation and coordination with Colorado Parks and Wildlife.
- Completed all required Local, State and National permitting.



PROJECT: CAMPHILL SURF PARK

Wanaka, NZ

For the Camphill Surf Park, S2o was hired to find a site, complete a design, and oversee construction of a whitewater park near Wanaka, NZ. The resulting park has been referred to as the world's best freestyle whitewater park. Users of all abilities come from around the world to

Project Construction Cost: \$1.3 million Key Staff: Scott Shipley, Christine Clark Project Dates: Spring 2011- Fall 2012 Reference: Ken Roberts, Contact Energy, 64-3-440-0300, ken.roberts@contactenergy.co.nz

watch, surf, and compete on the S2o designed features at Camphill Surf Park.

Camphill Surf Park was made possible through unprecedented levels of cooperation between multiple stakeholders including, Contact Energy, one of New Zealand's largest utility companies, the Central Otago Whitewater Association (COWA), regional and local town councils, government agencies, and landowners.

The park features two separate waves that attract paddlers of all abilities. The top hole provides stable side surfing with a wide foam pile that allows for surfing, spins, and basic freestyle practice at all flows. The lower feature is characterized by a fast jet of water used for basic maneuvers at lower flows, and a fast, single foam pile wave capable of large airborne maneuvers, at higher flows.

- The two drop feature are designed to be paddled at a large variety of flows (10-200 cumecs), as well as accommodate a variety of skill levels and paddling crafts.
- The first drop feature functions as a stable hole, ideal for side surfing, spins, and basic freestyle practice.
- The second drop feature is a stable hole with 3 distinct foam piles at lower flows, and a fast wave with a single pile at higher flows, allowing for advanced freestyle practice.
- The Camphill Surf Park has been a tremendous success; alluring paddlers throughout New Zealand and the world to its banks.



PROJECT: THE U.S. NATIONAL WHITEWATER CENTER Charlotte, North Carolina

The U.S. National Whitewater Center is the largest and most profitable whitewater park of its kind in the world. The park surpasses all previous pumped whitewater parks in terms of efficiency, quality of whitewater, variety of uses and fun. It features four separate channel segments, including the world's steepest slalom channel, the world's highest-volume big water channel, and purpose-built Project Construction Cost: \$34 million Key Staff: Scott Shipley Project Dates: Spring 2004- Summer 2006 Reference: Jeff Wise, CEO, USNWC, 5000 Whitewater Center Parkway, Charlotte, NC, 28214

areas for instruction, development, safety training, big-wave surfing, hole riding and more.

Special features include four separate, moveable, obstacle systems; natural rock structures; headgates allowing operating costs to be scaled to the day's customer base; and specific design features tailored to maximize profitable rafting operations.

The park, which opened in 2006, was designed with the dual goals of creating a seamlessly integrated outdoor adventure center and a cost-effective, state-of-the-art whitewater facility.

- Four separate purpose-built channels.
- Four completely autonomous moveable obstacle systems.
- Host of the 2008, 2012 and 2016 USA Olympic Team Trials, and 2007 Junior World Championships.
- State-of-the-art conveyor belt system that recycles kayaks and rafts to the top of the course with customers never leaving their boats.
- 1,200 cfs of water, making it the largest pumped whitewater course in the world.
- S2o's highly successful M-wave "Wavemaker" surfing feature.



PROJECT: Apple Valley Stream Restoration Boulder County, Colorado

Apple Valley is small community located just outside of the Town of Lyons, along the North St. Vrain Creek. During the 2013 Colorado Flood, the floodplain resulted in a loss of life and property. The design aimed to achieve flood recovery, improve the connectivity and habitat of

Project Construction Cost: \$620,516 Key Staff: Scott Shipley, Nathan Werner, Christine Clark Project Dates: September 2016- January 2018 Reference: Saint Vrain Creek Coalition, Ken Huson, 303-774-4514, office@saintvraincreekcoalition.org.

the floodplain through stream restoration, and increase long-term flood resilience for future flood events.

S2o completed all preliminary planning through the 30% design drawings for a 2.7 mile stretch of the Apple Valley Stream Restoration Project. The design included channel realignments, braided overflow channels and expanded floodplain terraces.

Upon completion of the 30% design, s2o was awarded the Apple Valley South Design-Build contract for the .9 mile lower portion of the Apple Valley Stream Restoration Project. The design included the construction of habitat boulders, rootwads, hardened riffles and pools, controlled overflow channels, and vegetated floodplain terraces. The project was sustainably planted and seeded with native, riparian vegetation.

- Encompassed in-stream habitat improvements and habitat structure design.
- Included a detailed design report outlining recommended channel improvements.
- Completed comprehensive 1D and 2D modeling of various alternative channel alignments and designs.
- Directed extensive public outreach and participation with stakeholders and private landowners.
- Accomplished preliminary planning, design, construction documentation, and construction oversight activities.
- Completed all required Local, State and National permitting.



PROJECT: Great Falls-Dearborn Diversion Bypass Great Falls, South Carolina

The Great Falls-Dearborn Dam is near the of North and South Carolina boarder, on the Catawba River. As part of the Catawba River Agreement and FERC re-licensing, Duke Energy will return water to the river for biological and recreational flows. Project Construction Cost: \$130,000 (Physical Model) \$3 million (Expected Construction) Key Staff: Scott Shipley, Kurt Smithgall Project Dates: Design: August 2017- November 2018. Construction: Spring of 2020- Fall 2020 Reference: Timothy L Huffman, Senior Project Manager, Duke Energy, 704-382-5185, Timothy.Huffman@duke-energy.com

The goal of the project was to provide recreational opportunities and to restore hydrologic connectivity between the Great Falls Dearborn Reservoir and the historically de-watered Long Bypass Reach. The proposed design requires an increased level of safety near the Diversion dam to provide a safe bypass for paddlers who wish to navigate the dam during recreational releases. To accomplish the goal, S2o proposed a design with two dam notches, a main channel to convey water continuously, and a high water channel to provide recreational opportunities during the recreational releases.

The main channel contains a multi-stage dam notch and two multi-stage drop structures on the downstream side of the dam, to allow safe paddler passage at recreational flows. The bypass channel contains nine drop structures on the downstream side of the dam, designed to only covey water at higher flows. The design also includes dam safety and informative signage and a well-marked portage trail.

- Completed all conceptual design, 1D and 2D computer modeling, physical modeling, construction documents, and construction visualization renderings.
- Collaborated with Duke Energy and multiple stakeholders through the public comment process.
- Completed a 1:20 Froude scale physical model of both channels which was evaluated for a range of flow conditions, to meet design parameters and the project goals.
- Designed a 400' long main bypass channel that met the project goals for five unique flow regimes.
- Designed a 1,075' long high water bypass channel that maintained the project goals for three unique flow regimes.



PROJECT: LEE VALLEY WHITEWATER CENTRE

London, UK

Lee Valley Whitewater Centre, the 2012 Olympic Venue, was cited by the International Canoe Federation (ICF) as the best use of design modeling, and the easiest course to tune to an Olympic Standard. S20 /EPDUK were commissioned to complete the design for this Olympic Project Construction Cost: \$45 million Key Staff: Scott Shipley (S2o) Andy Laird (EPDUK) Project Dates: Spring 2009- Summer 2010 Reference: Andy Maddock, Program Director, British Canoeing, andy.maddock@gbcanoeing.org.uk

Venue on a rush basis. Within four months of receiving authority to proceed, our team reviewed all pertinent materials, recreated the entire drawing set, created both computer and physical models, and completed design documents for the most modern whitewater park in the world.

The S2o/EPDUK team continued to work with the Client to implement the design for construction, including construction oversight and project commissioning. The completed project was approved by the ICF, who cited the modeling and design as the most advanced and predictive ever used for a whitewater park.

The Lee Valley Whitewater Centre has been a tremendous success with athletes, who reference its challenging, yet predictive, flows as ideal for competition. The athletes and coaches also applaud the RapidBlocs moveable obstacle system, innovated by S2o and EPDUK for this course. The movable obstacle system is a tremendous step forward from previous systems, and is the future of whitewater slalom channels.

- S2o completed a remake of the master plan design documents, and created computer and a physical models within 12 weeks of receiving a contract.
- Commissioned the park in a record 3 weeks.
- Used advanced physical modeling to accurately predict flows and key features.
- S2o and EPDUK worked with the contractor to ensure a fast and cost efficient build.
- The project is equipped with the patented RapidBlocs[™] obstacle system.



PROJECT: DURANGO WHITEWATER PARK

Durango, Colorado

The Durango Whitewater Park is one of the country's most utilized Whitewater Parks. S2o's re-design and Recreational In-Channel Diversion (RICD) permit for this project modernized the park to perform at a level capable

Project Construction Cost: \$ 1,100,000 Key Staff: Scott Shipley, Christine Clark, Project Dates: Fall 2012- Spring 2014 Reference: Scott McClain, City of Durango, 970-375-7322, Scott.McClain@durangogov.org

of hosting recreational paddling, as well as international standard freestyle, slalom and paddle board competitions.

Due to the numerous challenges associated with this park, the design requirements were stringent and publicly reviewed by all parties. The design was further challenged when Durango submitted its park for a RICD water right. As a part of this process, S2o testified at the CWCB hearing, submitted expert reports on the park's design, and successfully defended the design on behalf of its stakeholders and against the flow-restricting opposition. Based largely on the testimony of S2o's principal, the objectors eventually settled and the original flow claims proposed by S2o were awarded.

The design of this park involved an extensive public process including work with the Animas River Task Force, the City of Durango, numerous stakeholders, and various permitting agencies. S2o completed all planning, design, RICD assistance, and construction oversight on the project.

- Design efforts and testimony helped protect the flows of the Animas River for the foreseeable future, while avoiding an expensive and extended trial.
- Obtained a RICD with maximum flows of 1,400 CFS, four times greater than the CWCB proposed maximum.
- Worked with varied stakeholders to create a design that met everyone's needs.
- S2o completed pre-design, RICD, design, construction documents and provided construction management of the project.



PROJECT: LaVern M. Johnson Park Lyons, Colorado

Project Construction Cost: \$5.6 million Key Staff: Scott Shipley, Nathan Werner Project Dates: February 2014- April 2016 Reference: Dave Cosgrove, Director of Parks, Recreation and Cultural Events, Town of Lyons, 303-823-8250, davec@townoflyons.com

Nearly all of the park's amenities, which were a focal point and revenue generator for the Town of Lyons, were

damaged or destroyed during the September, 2013 flood. S2o was the lead designer and engineer for all river components and the lead engineer for the park site plan.

S2o was tasked with re-establishing the parking and camping areas and to ensure the park could continue to host several annual festivals during the 2014 summer season. The improvements included: 96 parking spaces, 22 RV camping spots, 9 tent camping spots, landscaping and hardscaping, and the construction of a large multipurpose field. The project was completed on an expedited design and construction schedule.

S2o completed all stream restoration planning, design, and construction oversight. S2o's stream restoration design included a grouted rock ramp diversion structure for the Lyons Ditch and eight grouted rock ramp whitewater park structures. All grouted rock ramp structure designs implemented a variety of techniques to facilitate fish passage. These techniques included a low slope notch to decrease velocities at critical low flows, grout set six to eight inches below rock surfaces to provide interstitial spaces, and ramp stages set at alternating elevations to reduce velocities on the structure shoulders as stages increase with higher flows.

S2o's design also included the restoration of fish habitat. In the reaches between the whitewater park structures, riffles were maintained to increase fish and macro-invertebrate habitat. An adjustable split flow channel included a riffle pool sequence that incorporated large woody debris, random boulders, and stream barbs.

- Parking lot and RV capacity of the park was expanded.
- Increased flood conveyance through expanded floodplain benches and a split flow channel.
- The first collaborating effort with Colorado Park and Wildlife to combine whitewater recreation improvements with fish and aquatic habitat enhancements.
- S2o's fish passage techniques are being researched and analyzed through a series of three dimensional hydraulic models by Colorado Park and Wildlife aquatic research scientists.



PROJECT: BOHN PARK Lyons, Colorado

Bohn Park was devastated by the 2013 Colorado Flood. Record rainfall in the North St. Vrain Creek topped its banks and decimated Bohn Park. Almost all of the park's amenities and infrastructure were damaged or completely destroyed. Project Construction Cost: \$1.2 million (Creek Portion) \$4.1 million (Entire Park)
Key Staff: Scott Shipley, Nathan Werner, Christine Clark
Project Dates: May 2016- May 2017
Reference: Dave Cosgrove, Director of Parks, Recreation and Cultural Events, Town of Lyons, 303-823-8250, davec@townoflyons.com

S2o was part of the team selected to redesign Bohn Park and was tasked with restoring the North St. Vrain Creek. The project included extensive modeling and the design of overflow channels to increase flood capacity and control future flood events. The design also included the implementation of a variety of creek stabilization and habitat structures within the project area. The creek is very steep, with a maximum slope of 3%. To mediate the steep slope and respect the public's desire to keep the park looking natural, S2o designed several cross vane structures, as well as a series of pools and riffles to curtail the steep slope. Finally, the design included deep pools, wetland areas, and structure and boulder placement that provide habitat for aquatic species throughout the year.

Additionally, balancing recreational creek access and protection of the riparian habitat corridor was also a critical issue. On average, the park hosts 200 to 400 residents and visitors every weekend. The design addressed this issue by strategically placing hardened river access points allowing users to access the river for fishing and active creek recreation, and allowing riparian habitat areas to remain undisturbed and thriving.

- Extensive public outreach and public participation throughout the design process.
- The design of three boulder cross vain structures and a series of defined pools and riffles.
- The design and placement of habitat structures including: habitat boulders, rootwads, and a toe wood structure.
- Detailed 2D hydraulic modeling of the park area that lead to the design of two overflow channels that lessened the impact of future flood events.











Coal Creek Canyon-Twin PROJECT: Spruce **Restoration Project** Project Construction Cost: \$393,830

Unincorporated Jefferson County, Colorado

S2o collaborated with Whinnery Construction on the design-build project to produce a channel that would enhance Coal Creek near Twin Spruce Junction.

Junction

Key Staff: Scott Shipley, Nathan Werner, Project Dates: August 2016- September 2017 Reference: Jackie Daoust, Coal Creek Canyon Watershed Partnership, 303-586-1491, jackie@cccwp.org

Connected floodplains were incorporated into the design and provided a storage area for floodwater, reduced flood peak flows, slowed the velocity of the floodwater, retarded erosion, trapped sediment, enhanced water quality, and provided a high-quality habitat for wildlife. The steep banks along the creek were reduced throughout the reach to create a stable area that minimized erosion and provided habitat for riparian trees and shrubs. Banks adjacent to the critical infrastructure of Highway 72, were armored with buried riprap and revegetated using bioengineering techniques. In addition, native willows were planted along the slopes of the streambank to stabilize the banks, shade and cool the water for fish, and provide habitat for terrestrial wildlife. The floodplain areas and streambanks were restored to a native riparian community that included native grasses, forbs, shrubs, and trees. The native plants stabilize the site, provide a high-quality wildlife habitat, and are a scenic amenity for the area.

Prior to the flood, a culvert at the downstream end of the site provided access to a private property south of the creek. This culvert, which restricted the flow in Coal Creek, was replaced with a three-sided box culvert that was open on the bottom. The open bottom allows the stream to have a natural substrate and create a higher quality aquatic habitat, allowing for fish movement up and down the stream. The square box culvert also allows for better movement of debris through the culvert during high flows.

- Included 900 linear feet of stream restoration.
- Replaced an existing culvert with a three-sided box culvert to increase stream capacity and provide a higher quality aquatic habitat.
- Produced an interpretive signage display of the design and engineering techniques used at the site.



PROJECT: Fourmile Canyon Bank Stabilization and Logan Mill Restoration Boulder County, Colorado

The Fourmile Watershed Coalition was awarded a grant from the Colorado Department of Local Affairs to cover two project sites: Lower Fourmile Canyon and Logan Project Construction Cost: \$175,462 Key Staff: Scott Shipley, Nathan Werner, Project Dates: June 2016- May 2017 Reference: Fourmile Watershed Coalition, Maya MacHamer, 303-449-3333, fourmilewatershed@gmail.com.

Mill. The goal was to align watershed restoration and risk mitigation with community and economic development goals using a collaborative, multi-jurisdictional, coalition-of-partners approach.

The projects were issued under one design-build contract and had a tight budget and a quick turn-around time for the design and construction. S2o worked as part of the team to facilitate the stakeholder process, to complete the engineering design drawings, and to provide construction oversight.

Fourmile Canyon was devastated by the 2013 Colorado Flood. The design and construction efforts focused on bank stabilization, site grading, and revegetation of four private properties in Fourmile Canyon. The completed design protects private structures, bridges, and the public road from continued erosion, reduces flood risk, and improves habitat and creek function.

All of the trees and vegetation at the Logan Mill site were burned in the 2010 Fourmile Fire. The 2013 flooding scoured the area and created additional creek and bankside instability. The design realigned Fourmile Creek to add sinuosity and created a vegetated floodplain bench, with riparian and wetland species, on both sides of the creek. The completed design increases aquatic habitat and aquatic function and improves flood resiliency.

- Completed a two-project combined total of 500 linear feet of creek restoration that encompassed engineered and bioengineered banks, creek habitat improvements, and habitat structure design.
- Worked with local stakeholders including private land owners, to complete the project on time and on budget.
- Completed all required Local, State and National permitting.



PROJECT: APPLE VALLEY BANK STABILIZATION PROJECT

Lyons, Colorado

The private residence is located along the North Saint Vrain Creek in Lyons, Colorado. The 2013 Colorado Flood devastated the property; damaging an existing bridge abutment, severing the residence's waterline, eradicating 120 linear feet of multi-tier rock terracing, and washing away approximately 3,600 square feet of river front property.

Project Construction Cost: \$120,000 Key Staff: Scott Shipley, Christine Clark, Nathan Werner Project Dates: January 2014- November 2014 Reference: Mr. Bill Cronin, Homeowner, 303-709-6977, billstvrain@gmail.com

Balancing site aesthetics with structural engineering presented a challenge; the bankside dropped approximately 16 feet over a 30 foot horizontal distance. The balanced design focused on restabilizing the bank and restoring the existing bank line by constructing a four tier rock terrace wall. The terraces, which were placed at varying elevations, created multiple outdoor living areas and provided the family with spaces they could enjoy at various water levels. The terraces were engineered to withstand large flood events and groundwater infiltration, and designed to lighten the look and feel of the engineered wall. This was accomplished by reducing the rock size as the tiers elevated and by placing planting pockets, at varying elevations, to enclose spaces and contrast the rigid red sandstone.

The project was designed and engineered on a tight time line to ensure the project was completed prior to spring run-off to avoid additional damage.

- Design and construction management services.
- Extensive design process and engagement with the client.
- Successful applications for local, state and federal permits.
- Knowledge of the FEMA Emergency Flood Relief Permit application process and procedures.



PROJECT: ST. VRAIN CREEK CHANNEL FLOOD RECOVERY DESIGN-BUILD Lyons, Colorado

In response to the catastrophic damage caused by a historic flood in 2013, S2o was part of a design-build team that aimed to complete infrastructure improvements to the stream, its banks, and the upland areas on the St. Vrain Creek through the Town of Lyons, Colorado.

Project Construction Cost: \$2.5 million Key Staff: Scott Shipley, Nathan Werner, Christine Clark Project Dates: October 2015- May 2016

Reference: Jim Blankenship, Town of Lyons Engineer, 303-604-1634, jim@jblcivil.com

The final flood recovery channel sought to return the flood affected areas to a natural, more resilient, and sustainable stream corridor. S2o was commissioned to engineer and restore the St. Vrain Creek to a healthy and well defined multi-stage river channel, with natural sinuosity, gradient, and character.

- Engaged in extensive public process through outreach, education, and conceptual design meetings.
- Led a conceptual design process where varying solutions to meet the design objectives were defined and evaluated until an acceptable design was reached.
- Evaluated the watershed at different scales to define priorities and objectives for each reach within the context of the entire creek system.
- Completed computer floodplain modeling to ensure no homes or property were negatively impacted by the project and that the channel velocities and depths met design objectives.
- Created several stage design plans including grading, engineered wall plans, design of the river, and design of the habitat.
- Assisted in the acquisition of all required permits to met the regulatory requirements to work within the creek.
- Designed to meet the requirements for Community Development Block Grant (CDBG) funding.
- Project team also included ecos who completed permitting, environmental compliance, and the vegetation plan.



PROJECT: PARK FLOOD RECOVERY PLANNING

Lyons, Colorado

S2o teamed with DHM to replan the Town of Lyons Park system following major flooding in 2013. The project was tasked with creating a cohesive park plan that was resilient, decreased flood risks, and met the recreational needs of both locals and visitors to the community. Key Staff: Scott Shipley, Nathan Werner Project Dates: August 2015- December 2015 Reference: Dave Cosgrove, Director of Parks, Recreation and Cultural Events, Town of Lyons, 303-823-8250, davec@townoflyons.com

The project was completed in 4 months and included weekly public meetings with the community during the first nine weeks. This extensive public outreach resulted in a collaborative process that was guided by community and stakeholder needs and wishes. The planning process produced final conceptual designs for Bohn Park and Lyons Valley River Park (Meadow Park was already redesigned). These parks were linked by a comprehensive Trails Plan that draws visitors into the parks and connects the entire North and South St. Vrain Corridors. Additionally, the final plans envisioned future design and planning needs as the flood recovery process continues.

The plans were unanimously approved by the Town Board and several of the projects have proceeded to the design and implementation phase.

- Successful public outreach and public participation (9 public meetings).
- Unanimous public and Town Board approval.
- Short project timeline delivered on schedule.
- Concrete steps towards implementation.
- Project was funded by FEMA and included federal reporting requirements.





PROJECT: ARKANSAS RIVERWALK TRAIL BANK STABILIZATION Canon City, Colorado

The Arkansas River is the main recreational attraction in Canon City. Locals and visitors are drawn to the river to walk, picnic, tube, and paddle. The lush riparian vegetation and deep blue water, contrasts the arid landscape around it, creating a picturesque landscape.

Project Construction Cost: \$187,541 Key Staff: Scott Shipley, Nathan Werner, Project Dates: August 2016- March 2016 Reference: Jim Hoar. Executive Director. Canon City Area Recreation and Park District, 719-275-1578, jhoar@ccrec.org

The Arkansas Riverwalk Trail Bank Stabilization project, located adjacent to the Canon City Whitewater Park, is a heavily visited site. The project intended to stabilize 600 linear feet of bank that was eroded and contained unnatural river materials. The design replaced the failing concrete blocks with a naturally engineered, boulder retaining wall. The wall consisted of large, round, stacked boulders that stabilized the bank and created a bankside with a more natural appearance and character. The design also included a series of strategically placed jetties, along the stacked boulder wall, to control the flow of the river. The jetties were constructed with large boulders and were spaced to prevent scouring in between the jetty structures. Finally, the large rounded boulders were placed along the trail to breakup the linear character of the trail and to provide places for visitors to sit and enjoy the water. The bankside and the trail will be protected from scour, long into the future.

- Engineered a dry-stack boulder retaining wall, 10 foot tall, 470 foot long.
- Engineered, a dry-stack boulder retaining wall, 6 foot tall, 130 foot long.
- Designed several jetties.
- Revegetated and improved the landscape that was disturbed during construct.
- Enhanced the Riverwalk trail with boulders and landscaping. •
- Acquired all necessary permits including, ACOE 404 and County Floodplain Development.
- Completed the construction documents and provided construction oversight.



PROJECT: TOWN OF EAGLE VISITORS CENTER BOAT LAUNCH

Eagle, Colorado

The Town of Eagle Visitors Center Boat Launch was constructed in the fall of 2015 to provided an alternative put-in/take-out to an existing boat launch downstream. The Eagle Visitors Center Boat Launch allows users to exit the river before a difficult Class IV rapid. S20 provided Project Construction Cost: \$98,000 Key Staff: Scott Shipley Project Dates: September 2015- October 2015 Reference: John Staight, Town of Eagle Open Space Coordinator, 970-328-9654, john.staight@townofeagle.org

conceptual design, construction documents, and construction oversight for the Town of Eagle on this project.

The project created an improved concrete boat launch at an existing unimproved takeout that enhanced ingress/egress through the creation of eddies and tie-off boulders for boat holding. The project also protected the designed improvements from erosion by guiding flows away from the river bank using boulder weirs. The design also excavated and hauled-off native bank and channel materials from the site to create a self-maintaining, sheltered cove. Prior to the completion of the project, all disturbed areas were reclaimed with biodegradable erosion control blanket and native turf grasses.

- Installed a 10 ft x 60 ft cast-in-place concrete boat launch.
- Installed two Bendway Weirs.
- Improved visibility of the boat launch from the river by removing overgrown riparian vegetation.
- Enhanced aesthetics and use of the site by reclaiming disturbed banks with foot friendly grasses which simultaneously prevented erosion.
- Created a space for the community and visitors to observe and interact with the Eagle River.
- Value engineered the project to meet the pre-established budget outlined by the Town of Eagle and Great Oudoors Colorado (GOCO).



PROJECT: CANON CITY RIVER IMPROVEMENT MASTER PLAN Canon City, Colorado

The Arkansas River is the main recreational attraction in Canon City. Locals and visitors are drawn to the river to walk, picnic, tube, and paddle. The lush riparian vegetation and deep blue water, contrasted against the arid landscape around it, creates a picturesque landscape. Project Construction Cost: N/A Key Staff: Scott Shipley, Nathan Werner, Christine Clark Project Dates: August 2016- March 2016 Reference: Warren Hart, Whitewater Kayak & Recreation Park Committee, warrenhart3@gmail.com

S2o's task was to study a 3 reach section of the Arkansas River through Canon City, and to plan and prioritize projects within each of the reaches. A master plan and report was created and used as a starting point for conceptualizing possible design solutions to enhance whitewater recreation, fish habitat, and stream beautification.

The project objectives focused on expanding the existing community riverside park; restoring the function and aesthetics of the river corridor; stabilizing the streambanks; and enhancing the venue for rafting, whitewater kayaking (slalom and freestyle), tubing, and other healthy, active, outdoor recreational activities.

- · Created an overall master plan and report.
- Created reach specific design solutions and project priorities.
- Created a master plan document that balanced the needs of the community, as well as the environment.



PROJECT: SUPPLY IRRIGATION DITCH COMPANY DIVERSION STRUCTURE Lyons, Colorado

The Supply Irrigating Ditch Company diversion structure was a multipurpose project on the St. Vrain Creek. S2o was hired by the ditch company to design a diversion dam that maintained the ditch company's decreed flow, facilitated fish passage, and created recreational amenities for other users on the St. Vrain Creek. Project Construction Cost: \$181,300 Key Staff: Scott Shipley, Nathan Werner, Project Dates: November 2014- April 2015 Reference: Dan Grant, Secretary/Treasurer, Supply Irrigating Ditch Company, 303-776-7207, drgnlg@msn.com

Historically, the structure was a barely noticeable, at-grade concrete dam. Flooding in September, 2013 caused significant erosion downstream of the structure, degrading the channel to the extent that a new at-grade diversion structure could not be built.

S2o used it's creative innovation in multi-purpose river engineering to design a grouted rock ramp structure that ensured the ditch company's decreed flow was diverted to the headgates, and provided added benefits to the fish and recreational users. The structure was designed to facilitate fish passage at a variety of flows and included a low flow fish passage notch, as well as designed interstitial spaces. This was created by holding grout back from the surface of the rock on the low, medium and high flow tiers of the structure. The design of the structure also promoted recreation at the site; the hydraulic conditions across the grouted rock ramp and in the tail water pool were designed in the same manner as a whitewater park structure, thus allowing the water not diverted down the ditch inlet to be enjoyed by recreational users.

- Facilitated a design that maintained the ditch decree and provided safe passage for fish and water users.
- Created a low flow fish passage channel.
- Acquired all necessary local, state and federal permits.



PROJECT: SAINT VRAIN CREEK WATERSHED MASTER PLAN

Lyons, Colorado

The South Saint Vrain Creek Watershed is one of the most important natural features in the Northern Front Range of Colorado. In September, 2013, a flood devastated the watershed, the infrastructure, and the communities along the Saint Vrain Creek and its tributaries. Key Staff: Scott Shipley, Nathan Werner Project Dates: April 2014- November 2014 Reference: Julie McKay, Planning Manager, Board of Directors for the St. Vrain Creek Coalition, Boulder County Transportation Department, 303-441-3900 jmckay@bouldercounty.org

The Watershed Master Plan was developed by S2o and Baker Engineering, among others. The goal of the project was to create a science-based, community oriented, stream master plan. The project was part of an initiative supported by the Colorado Water Conservation Board to approach river projects from a wholistic approach bearing in mind the morphology of the river, the role and importance of habitat to the entire ecosystem, and the needs of communities and private landowners in terms of land use, flood and debris risk, and all types of in-stream recreation.

The master plan included assessments to geomorphology, FEMA risk assessments, habitat needs, and other scientific inputs. The information was blended with community and public process inputs that considered land-use pre-flood, and proposed land-use post flood. The resulting study produced and prioritized projects that allowed for a resilient and healthy stream corridor, a healthy riparian zone, a vital ecosystem, and a thriving economy along the riverbanks that is founded on healthy, active, outdoor-living.

- Regional collaboration efforts, including Boulder County and the Saint Vrain Creek Coalition, to propose a large scale master plan project comprising the entire watershed.
- Produced an all-encompassing science-based master plan, that led the way for future planning and watershed restoration projects.
- The Watershed Master Plan has become a regulatory guideline for design and restoration efforts currently underway.



PROJECT: NRCS EXIGENT STREAM BANK STABILIZATION

Lyons, Colorado

S2o provided design and construction management services for the emergency watershed protection project in Lyons, CO. The project was sponsored by the Town of Lyons and funded by the Natural Resources Conservation Service (NRCS), Colorado Department of Emergency Management, and the property owners. Project Construction Cost: \$130,000 Key Staff: Scott Shipley, Nathan Werner, Project Dates: January 2014- June 2014 Reference: Jim Blankenship, Town of Lyons Engineer, 303-604-1634, jim@jlbcivil.com

NRCS classified several sites along the St. Vrain Creek as exigent sites in need of immediate attention to prevent further, future damage to private properties. S2o provided designs to protect properties from flows up to a 25 year return flow for seven properties in Lyons, CO. After the first runoff season, where flows peaked between a 5 and 10 year return flow, the streambank stabilizations performed as expected. This project was one of the first permanent flood recovery projects to be construction in Lyons, CO.

To accomplish the project objectives, the design aimed to remove large, channel blocking flood debris and stabilize streambanks with a combination of rock and bioengineering techniques. The rockwork was covered with topsoil and an erosion control blanket. The banks were seeded and trees and willow stakes were placed intermittently throughout the sites. The project includes approximately 450 feet of streambanks on seven private properties.

- S2o produced all design drawings and construction documents.
- · Worked with all stakeholders throughout the design and construction process.
- Streambank stabilization designs protected property from floods up to a 25 year return flow.
- Designed to provide an economic solution with superior protection.
- Implemented a combination of hardscape and bioengineering techniques.
- Placed riprap over the ordinary high water line and then covered it with topsoil and vegetation to mitigate for Preble's Meadow Jumping Mouse habitat, as well as to produce a more aesthetic streambank.
- Large woody debris was incorporated to create aquatic habitat.



PROJECT: SAN MARCOS WHITEWATER PARK

San Marcos, Texas

The completed whitewater park in San Marcos, Texas is one of the most dramatic transformations designed by S2o Principal, Scott Shipley. The San Marcos River has long impacted the local economy by attracting visitors Project Construction Cost: \$500,000 Key Staff: Scott Shipley Project Date: 2005 Reference: Mr. Ben Kvanli, 512-203-0093, benkvanli@veteransadventure.org

to its banks and waters. In order to enhance the recreational hub, the project was tasked with rebuilding the failing Rio Vista Dam with a design solution tailored to preserve and enhance existing use by swimmers, tubers, paddlers, and spectators.

The new park provides a recreational amenity that attracts thousands of tourists and locals, and benefits the city's economy. Tubers, paddlers, swimmers, and waders line the banks throughout the spring, summer, and fall. Design features, such as large swimming rocks in the pools and sandy beaches in the eddies, provide entertainment for the entire family. Shaded areas and picnic benches invite the community to gather together. The surfing waves, eddies, and fast jets provide fun for kayakers and tubers of all abilities.

In addition, by removing the failing concrete sidewalls and grading the river banks, the dam replacement costs were reduced to less than \$500,000 from \$1.8 million. The project was completed in under four months.

- Repaired a failing dam and increased recreational usage for passive users, tubers and paddlers.
- Drastically reduced the project cost by removing concrete walls and grading the bank (cost savings: \$1.3 million)
- Design and construction phasing accommodated two endangered species within the project footprint.



PROJECT: TEESSIDE INTERNATIONAL WHITEWATER COURSE United Kingdom

Teesside is a fascinating project. It is partially situated below sea level and is run entirely on green, tidal power. The design harnesses the Atlantic Ocean's tidal flows in partnership with the Tees Barrage (dam) to generate energy through 4 fish friendly, 13m long, 3.5m diameter Project Construction Cost: \$24 million Key Staff: Scott Shipley (S2o), Andy Laird (EPDUK) Project Dates: Spring 2008- Spring 2011 Reference: Andy Laird, andy@epduk.com, (44)755 444 2124, 5 Churchill Drive, Moresby Parks Whitehaven, Cumbria, CA28 8UZ

Archimedean screw pumps. The screw pumps are capable of generating recreational flow and/ or generating power (screw pumps run in reverse). When the tide is contrary, generators are run as pumps to operate the course. When the tide is favorable, there is ample flow to operate the course and generate power.

The Teeside project included improving the existing channel, completed by EPDUK, and adding an additional recreational channel designed to provide world class recreation. S2o was hired to design the new recreational channel. The S2o designed channel included a proprietary "M-wave" feature, a flow-through headgate and S2o's "tourist trap" big drop feature. In addition to the innovative pumping and channel design features, the RapidBlocs[™] movable obstacle system was also installed. The RapidBlocs[™] system provides well formed, stable whitewater that can adapt and change to a variety of uses, long into the future. The park is one of a kind and has redefined whitewater parks for generations to come.

- The entire project is powered by green power.
- Project Innovations include an "M-Wave" feature, flow-through headgate and "Tourist Trap" big drop feature.
- Due to it's design enhancing characteristics, Teesside International Whitewater Course is used extensively for swiftwater rescue training.
- Project includes partnership with British design firm EPDUK, expanding S2o's capabilities to Europe.
- The project is equipped with the patented RapidBlocs™ obstacle system.



PROJECT: HOLME-PIERREPONT NATIONAL WATERSPORTS

Nottingham, Great Britain

The Holme-Pierrepont National Watersports Centre has a storied history. The channels were one of the first great whitewater slalom channels and home to the British Slalom Team for more than twenty years. The challenge associated with this project was taking an existing worldProject Construction Cost: \$6 million Key Staff: Scott Shipley (S2o), Andy Laird (EPDUK) Project Dates: Spring 2008- Spring 2009 Reference: Andy Maddock, Program Director, British Canoeing, andy.maddock@gbcanoeing.org.uk

class facility and updating it to be a state-of-the-art racing channel, without decreasing any of the already attractive features within the channel.

The project was led on the S2o side by Scott Shipley, who won his first World Cup and World Championship medals at this venue. S2o used innovative applications of computer modeling to establish that the proposed improvements, laid out by EPDUK, would give the desired effect, while protecting the existing "muncher" section of the course. This method of computer modeling was cutting-edge and challenged by many but, in the end, led to a highly successful and cost effective re-design of the channels. The completed project played host to the European Championships in its first season and remains a mainstay of the United Kingdom's whitewater programs.

- Project modeled using an innovative application of computer flow modeling that established the degree of improvement and verified that certain portions of the course were preserved and protected.
- Project completed in under 2 months with construction and implementation immediately following.
- Design realization through a distributed team that managed to effect a successful design without traveling from the United States to Great Britain.
- Project included the first implementation of a new moveable obstacle system.
- Project played host to the European Championships in its first season following the improvements.



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"80 percent of design costs are allocated in the first 20 percent of the design process"

PROJECT ECONOMICS & OPERATIONS: BUSINESS MODEL

A typical project allocates 80% of its costs in the first 20% of the design phase. Choices made at these early phases also affect the functionality, capacity, marketability and, ultimately, profitability of the project. S2o's team brings a host of economic and operational experts. These include PhD economists and seasoned operators that apply experienced and scientific analysis to our projects to ensure they are feasible and sustainable. We offer four services related to business and operational modeling:

Economic and Market Assessment: This study details the potential market for a project in terms of demographic and quantity of potential users. This study also helps target potential price points and incomes, and helps evaluate the viability of complementary activities.

Business Modeling: This study is conducted in concert with a conceptual design study and is often based, in part, on information gathered from the Economic and Market Assessment. The model was designed in cooperation with a PhD Candidate in Economics and examines the costs and profits associated with a whitewater park from design through the first 15 years of operation. The model accounts for the cost of financing, start-up and operational costs, depreciation of assets, maintenance, upkeep and other items. The model was created to understand the costs and incomes associated with constructing a whitewater park and allows for comparisons between differing concept designs. The model is very robust and withstands both banking and governmental review.

Economic Impact Assessment: This study analyses the market information and calculates the gross and net effects of project development on the economy. This report:

- Details the nature of the local economy and region, providing highly specific information as to how the park will feed and enhance the local economy – in quantitative dollar amounts, employment numbers, personal income and by economic/industry sector.
- Precisely determines the costs to local government to service the park (e.g. road and public safety).
- · Projects potential revenues to local and other government agencies stemming directly from the project's activity.
- Utilizes customized input/output modeling to determine total gross and net economic effects (primary and secondary) of the project locally and in the region.

Operational Consulting: In this task we work with industry experts to design an operating plan, execute training and testing of systems, purchase necessary FF&E and implement a start-up. Our consultants have extensive experience in the field and can help execute a seamless start-up targeted at efficient and profitable operations from Day 1.



PROJECT TECHNOLOGY: RapidBlocs™

RapidBlocs[™] is a patented, three dimensional movable obstacle system. The blocs allow for the creation of any shape, at any angle, at any point within the channel system. A feature as simple as a standing wave can be made larger or glassier, moved up or down, and moved left or right. Eddies can be created above or below the feature or simply removed from the area altogether. This system truly gives the course operator a fully adjustable course that can be tuned, remodeled, or updated.

The beauty of using this standard adjustable system is that it allows a channel owner the confidence to know that their channel will be state-of-the-art for years to come. As the sport evolves so will the RapidBlocs[™] configurations. Long into the future, a RapidBlocs[™] channel will still provide high-tech dynamic whitewater. This is the system of choice for the world's most modern whitewater parks.

RapidBlocs[™] gives the owner the flexibility of creating an olympic- and international standard slalom course, but also provides the ability to tune the park to appropriate configurations for rafting, freestyle events, recreational boating, and instruction.

The RapidBlocs[™] Obstacle System has many advantages:

- The RapidBlocs[™] system uses the standard Unistrut connection system. An entire channel system can feature this connector channel for a fraction of our competitors' price. Unistrut is also common to most construction projects, making it an off-the-shelf, familiar solution for contractors.
- RapidBlocs[™] is stackable and interlocking, allowing the operator to install the system to the height and strength needed at any particular point.
- RapidBlocs[™] is fully reconfigurable—blocs can be used to make eddies, holes, islands, berms, and virtually any other shape to suit any purpose.
- RapidBlocs[™] can be installed in a cost-effective manner to both existing and new channels.
- RapidBlocs[™] is fully recyclable, making them the green solution.
- RapidBlocs[™] is updateable, offering clients a system that will keep up with the sport.