Red Butte Creek Strategic Vision

University of Utah

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Overview

The Red Butte Creek Strategic Vision presents a special opportunity for the University of Utah. While college campuses can build or acquire many types of facilities needed for research, education, and outreach, natural resources such as Red Butte Creek are unique features that have no simple analogues or substitutes in the built environment. Red Butte Creek is a valuable campus asset that is currently underutilized, but which could make important contributions toward the campus mission.

At the University of Utah, this potential was first recognized more than two decades ago by faculty such as Dr. James Ehleringer, the founding director of the Global Change and Sustainability Center. While the creek is currently not well integrated into campus life, there is growing recognition that stewardship and revitalization of Red Butte Creek can create a unique focal point of campus activities, amenities, and identities.

The Red Butte Creek Strategic Vision is a comprehensive plan to transform the creek into a distinctive campus resource. It represents both the culmination of years of research, teaching, and capacity-building, and the earliest phase of a commitment to reimagine and revitalize a natural amenity here on the University of Utah campus.

The Red Butte Creek Strategic Vision articulates the vision for the creek and its watershed and charts a path toward making this vision a reality. It identifies challenges, sets clear objectives, is based on broad consensus, and proposes actionable solutions. It establishes a framework for the University of Utah to revitalize both the physical and social aspects of Red Butte Creek.

A revitalized Red Butte Creek will require new infrastructure, institutional policies, research and teaching facilities, and funding streams for ongoing operations and maintenance. Success will be a campus-wide endeavor, with roles for students, faculty, staff, and administration.

Stakeholders from across the university have already come together to develop this shared vision. The resources needed to revitalize Red Butte Creek will be vastly outweighed by the benefits of establishing, in perpetuity, an invaluable campus asset.

This is the purpose of the Red Butte Creek Strategic Vision.

The possibilities of a revitalized Red Butte Creek fall into several clear categories:

1. Creating a green corridor that facilitates campus connectivity, outdoor recreation, and experiences in a beautiful natural setting;
2. Demonstrating municipal and national leadership in sustainability, livability, and resilience;
3. Promoting cutting edge research, place-based environmental education, and student and faculty involvement in campus planning and design; and
4. Engaging the surrounding community in creating spaces that reflect local values and provide public benefits.

Red Butte Creek Strategic Vision Steering Committee

Diane Pataki – Biology, Project Supervisor

Amy Wildermuth – Law, Associate Vice President for Faculty, Chief Sustainability Officer

Brenda Bowen – Geology and Geophysics, Global Change & Sustainability Center Director

Sarah Hinners – City and Metropolitan Planning

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James Ehleringer – Biology

Keith Bartholomew – City and Metropolitan Planning

John McNary – Director of Campus Planning

Steven Burian – Civil Engineering

Matthew Brownlee – Parks, Recreation, and Tourism

Greg Lee – Red Butte Garden

Michael Brehm – Occupational Health and Safety

Robin Rothfeder – City and Metropolitan Planning, Strategic Vision author and Project Manager

Stephanie Ainsworth – Center for Ecological Planning + Design, graphic design

Red Butte Garden

Executive Summary

The Red Butte Creek (RBC) Strategic Vision is a sustainability, environmental stewardship, and ecological planning initiative at the University of Utah. The vision was produced by a steering committee of campus faculty and administrators with input from a diverse group of stakeholders including campus facilities, planning, and landscape maintenance staff; Research Park administrators; neighboring community members and community council representatives; Salt Lake City and Salt Lake County municipal employees; faculty across campus; students and student groups.

The RBC Strategic Vision draws on several resources. The structure, content, and goals of the plan were guided by the Center for Watershed Protection (CWP) Urban Subwatershed Restoration Manual Series (2005-2008), the CWP Watershed Plans and Guidance case examples, and by similar initiatives at other universities including Clemson, Georgia, UC Davis, and North Carolina State. Data specific to Red Butte Creek were available from local municipal studies, government agencies, and planning documents (Salt Lake City and Salt Lake County) and from a wide range of university resources including faculty and student research.

The Strategic Vision is structured in five sections. With these five sections, the vision seeks a balance between the detail of site-specific design and the breadth of master planning. It covers what RBC has been, what it is today, and what it might become at the University of Utah. A unique feature of this vision is the necessary incorporation of research, teaching, and outreach into planning and design processes. Rather than a static prescription of future actions, therefore, the RBC Strategic Vision is a dynamic framework for coordinated efforts over time.

1 Introduction

Section 1 begins with the future we envision for Red Butte Creek. This vision statement has been central to generating consensus and shared understanding about the purpose, process, and function of urban stream revitalization on campus. The vision statement describes a high quality ecological, recreational, and educational campus amenity, in support of the University of Utah's three-part mission and seven-part planning vision.

Section 1 also presents a brief history of Red Butte Creek (RBC) above, on, and below campus: from its beginnings as a unique natural ecosystem, through initial calls for restoration of the urban segments, to the current focus on more broadly revitalizing the creek through an ecological planning process. Lastly, Section 1 reviews important planning documents that set the context for the vision, including the 2008 Campus Master Plan, the 2010 Salt Lake City Riparian Corridor Study, the 2011 Campus Bicycle Master Plan, the 2012 Salt Lake County restoration project, the 2014 Campus Design Standards, and the 2014 Riparian Corridor Buffer Zone.

2 Watershed Characteristics

Section 2 describes the current state of RBC and its watershed, including land ownership and land use; land cover; hydrology and geomorphology; water quality and site maintenance; and flora, fauna, and habitat quality. Currently, more than 35% of the land surrounding the campus section of the creek is hardscape. While these levels of imperviousness are in line with regulatory requirements, studies have shown that this level of impervious cover generally corresponds with pronounced erosion of streambanks, water quality, habitat quality, and plant and wildlife diversity, as well as lack of safe access for recreational or educational purposes.

Effective stewardship of RBC depends on complex interactions at multiple scales and across varying timeframes. For the strategic vision, the two most important spatial units are the riparian corridor—delineated as a 100-foot buffer from the creek's average high water line—and the subwatershed—the total land area that drains to university reaches of RBC, between Red Butte Garden and Sunnyside Park. Within and between these spatial units, the vision of revitalization calls for coordinated planning, policy, and design activities over a long timeframe. This will require adjustments to the existing administrative framework for the RBC riparian corridor and subwatershed (managing space in addition to buildings), long-term funding that includes operations and maintenance, and a design process that incorporates education and research goals, including establishing baseline data and tracking metrics of project success.

3 Goals and Objectives

Section 3 lays out the goals and objectives for the RBC Strategic Vision. The goals are general outcomes, structured around the University of Utah's core three-part mission of research (in support of revitalization), teaching (using the creek and the revitalization process as a resource for student participation and course involvement), and public life (community engagement and outreach). Each goal is associated with more specific objectives for which planning solutions can be designed, implemented, and monitored over time.

Because the university is a research and teaching institution, and because revitalizing an urban stream is such a complex effort, the goal of ecological revitalization is inextricably linked with the goal of advancing research and creating new knowledge. This is the great challenge, but also the great opportunity, of the RBC Strategic Vision.

4 Stakeholder Engagement

Section 4 describes the engagement process that was undertaken to generate the RBC Strategic Vision. During spring and summer 2015, targeted focus groups were conducted with stakeholders both on and off campus. This process helped to refine the mission, goals, objectives, and planning principles of the strategic vision; to generate broad consensus and support for revitalizing RBC; and to identify key collaborators and partners for the implementation phase of the vision.

5 Implementation

Section 5 presents implementation strategies to meet the goals and objectives and to realize the mission statement of the RBC Strategic Vision. For all of the proposed strategies, there are three guiding planning principles:

1. Recognizing interconnectivity throughout the watershed,
2. Enhancing the transition from mountain wildlands to fully urbanized stream corridor, and
3. Reimagining and reintegrating campus life around Red Butte Creek.

The proposed implementation strategies fall into three general categories. The first category focuses on university policies and administrative structures for managing the riparian corridor and the subwatershed. The second category focuses on revitalization project concepts, including specific proposals for initial demonstration projects. The third category focuses on opportunities for community engagement and public life. Each implementation strategy includes an estimated timeframe and total life cost.

Miller Park

Introduction 1

The Vision for Red Butte Creek

At the University of Utah, Red Butte Creek (RBC) is largely invisible to the thousands of people who pass by it every day. The Red Butte Creek Strategic Vision will transform RBC into a showcase and embodiment of the University's mission and core values.

The vision focuses on the portion of RBC running through campus and Research Park, but seeks to leverage assets and create benefits along the riparian corridor and throughout the watershed. The transformation envisioned is a process of revitalization to a healthy, beautiful, and valued corridor that connects the Wasatch Foothills to Salt Lake City and creates a vibrant campus at the urban-wildland interface.

Revitalization will mean shifting university activities to prioritize the creek and its watershed. Campus plans and design standards will make enforceable policy commitments that support environmental restoration, improve watershed management, and facilitate interdisciplinary research. The university community will have state of the art facilities for place-based, hands-on learning and environmental education. Research Park, Fort Douglas, Salt Lake City and County, and other partners will help to build capacity, engage the community, and implement a plan with broad public support.

Revitalization will also mean changing the face and function of RBC and its watershed, especially the built environment on campus. Native flora and fauna will stabilize the stream bank, provide critical habitat, and improve water quality through nutrient uptake and cycling. Bioswales and other stormwater management practices will become part of the watershed, protecting and restoring the riparian environment by controlling and treating urban runoff. In place of conventional fences and walls, paths, benches, and bridges will integrate RBC into campus life.

These changes will require the University of Utah to reimagine its relationship with RBC.

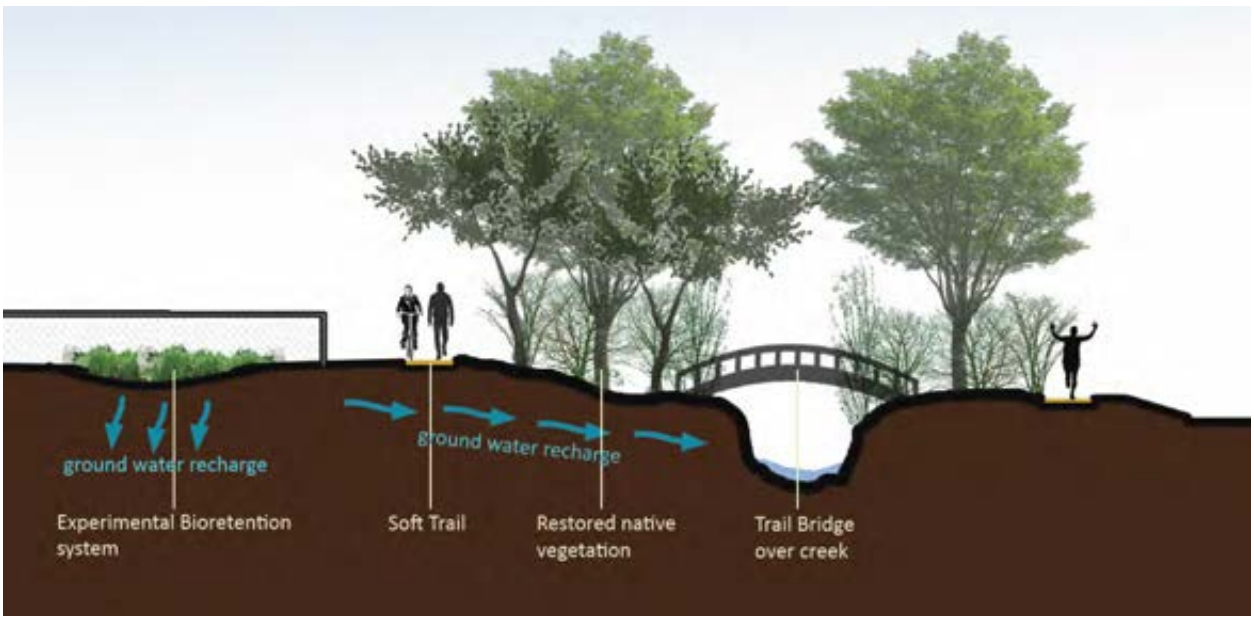


Figure 1.1: Student design for active transportation and stormwater green infrastructure along Red Butte Creek

Miller Park

Through restoration and revitalization, we propose create a unique campus amenity that promotes health, advances knowledge, and provides sense of place. This is a tremendous opportunity for the U to become a leader in sustainability and to advance the seven-part vision that guides the Campus Master Plan (2008):

1. A lively campus; a magnet for student, faculty, staff and public life;
2. State of the art facilities to support the university's mission for teaching, research and public life;
3. A setting to foster interdisciplinary collaboration and interaction;
4. Campus as a destination for the public;
5. Functional and sustainable transportation;
6. Capitalize on the natural landscape setting; and
7. Leadership in environmental stewardship.

Red Butte Creek Timeline

32,000 yrs bp	Lake Bonneville forms.
14,500 yrs bp	Bonneville Flood releases waters of Lake Bonneville.
Pre-1847	Canyon most likely used intermittently by Native people for food and shelter.
1847	First pioneers arrive in the Salt Lake Valley.
1848	Red Sandstone quarried (for almost 100 years) and used in building Salt Lake City.
1850s	Water first diverted from Red Butte Creek for irrigation. Timber harvested from the canyon.
1854	Young man drowns in a flash flood in the canyon.
1862	Homestead Act allows for claims of private land ownership; Fort Douglas established at the mouth of the canyon.
1863	Army constructs 34 buildings for Fort Douglas from canyon timber.
1867	Fort Douglas land taken out of the public domain and given to the Army by Andrew Johnson.
1869	War Department appoints a herder to control loose grazing animals in the canyon.
1870	Settlement in Yalecrest area begins.
1875	Army constructs two reservoirs and fills them with Red Butte Creek water.
1882	Salt Lake City purchases 8 acres to build Liberty Park. Liberty Lake is constructed.
1887	US Congress approves railroad right of way to be built to the rock quarry.
1889	66 men and 38 oxen and horses lived at the canyon bottom causing pollution; court action required Salt Lake Rock Company to control pollution, and cease housing men and animals in the canyon.
1890	Because of recurring pollution, Territory District Court declares waters of RBC property of U.S. Army under juristiction of Fort Douglas; U.S. Congress passes a law preventing the sale of any land in the canyon or futher watershed development.
1906	U.S. Army builds dam to supply water for Fort Douglas.
1909	Fort Douglas obtains most remaining private parcels of land in the canyon; Army builds gate at mouth of canyon to control access, largely prevent grazing.
1920s	Growth of residential construction in Yalecrest area.
1928-1930	Present dam construction which provided water to Fort Douglas until its closure.
1930	Miller Park established.
1969	Red Butte Canyon acquired by National Forest Service from Department of Defense.
1970	Canyon declared Research Natural Area to serve as reference area for education & research.
1970s	Liberty Lake retrofitted to act as stormwater detention facility.
1982	Flooding destroys beaver dams and deposits a delta at the mouth of the reservoir; beaver population removed from canyon to protect Fort Douglas water supply.
1983	Heavy snows followed by warm temperatures lead to largest flooding event in recent times.
1985	Red Butte Garden formally opened to public.
1987-1988	Canyon opened to public in late spring for several days; fire from Emigration Canyon moves into headwaters of Red Butte Canyon.
1988	Fire is contained and land reseeded with native species.
1991	US Forest Service asks Division of Wildlife Resources to reinstate beaver.
1994	400 June Sucker fish planted in the reservoir within the canyon.
2007	Yalecrest area added to National Register of Historic Places.
June 2010	36,000 gallons of crude oil from Chevron Pipe pollute Red Butte Creek.
Dec. 2010	21,000 gallons released in second spill near Red Butte Creek.
Dec. 2012	Utah Division of Water Quality declares RBC clean after intensive clean-up efforts.
2013	Development of Friends of Red Butte Creek.
2015	Stormwater Management Program Plan.

Background

As early as 1848, miners began quarrying sandstone in Red Butte Canyon. Just a few years later, pioneers first diverted the waters of Red Butte Creek (RBC) to irrigate ranch- and farmland. In 1862, the U.S. Army built Fort Douglas at the mouth of the canyon. The army constructed upstream reservoirs to support the base in 1875 and again in the years 1928-1930. In 1890, Fort Douglas, seeking to protect its water supply from upstream pollution caused by mining, gained sole jurisdiction over the creek. Management responsibilities were transferred from the Army to the U.S. Forest Service in 1969.

Today, the upper portion of the watershed—the Red Butte Canyon Research Natural Area—has enjoyed over a century of continuous protection by the U.S. federal government. Grazing, logging, recreational tourism, and other human activities that have substantially altered canyons across the Wasatch Front have been largely absent from Red Butte Canyon. As such, the canyon hosts "one of the few remaining undisturbed riparian ecosystems" in the Intermountain West (Ehleringer et al., 1992, p. 95).

However, the state of the creek's lower reaches is very different. Over time, RBC has experienced the effects of urban development after it leaves the canyon. Roads, parking lots, and buildings have covered much of the watershed, resulting in altered hydrology. From Liberty Park to its outflow at the Jordan River, the creek is confined to an underground pipe. In June and December 2010, a Chevron pipeline leaked tens of thousands of gallons of crude oil directly into the creek.

Urban stretches of RBC now experience enhanced erosion, altered ecological habitats, lack of safe access for people. Paradoxically, although RBC is surrounded by built infrastructure, it has not been integrated into planning and design of the built environment at the university.

Recently, a wide range of faculty, students, and administrators across the University of Utah campus have recognized the challenges and opportunities associated with RBC. A number of classes at both the undergraduate and graduate level have utilized the creek in recent years, and there are a growing number of research projects focusing on RBC across several disciplines. In response to this growing awareness, and student advocacy, university attitudes toward RBC are changing; in 2014 the Board of Trustees voted to establish a 100 foot riparian corridor buffer zone around RBC.

This Red Butte Creek Strategic Vision represents an important next step in the University of Utah's commitment to revitalize RBC as a campus asset. The vision provides a framework for revitalization, a set of goals and objectives in support of that vision, and a set of implementation strategies for meeting the goals and objectives, all within a collaborative framework of stakeholder participation and feedback.

Figure 1.2: Red Butte Dam

Existing Plans

Several relevant planning documents precede this strategic vision. In 2009, the Salt Lake County Watershed Planning and Restoration Program (WPRP) completed a Water Quality Stewardship Plan for all Jordan River subwatersheds, including the University reaches of Red Butte Creek. In 2010, the Salt Lake City Public Utilities Department commissioned a Riparian Corridor Study, including a watershed assessment and corresponding recommendations for planning and restoration on campus. In 2012, WPRP implemented a $212,500 restoration and stabilization project, funded by the Chevron oil spill mitigation fund and administered by the Utah Department of Environmental Quality.

Figure 1.3: Campus Master Plan (2008)

Figure 1.4: Campus Master Plan Open Space Corridor (2008)

Much of the analysis and planning in these preceding documents informs the current plan. However, since the Red Butte Creek Strategic Vision will be administered by the university, it can craft a more comprehensive vision for revitalization, especially on the crucial issues of land use and land cover throughout the watershed.

On campus, the 2008 Campus Master Plan proposed an open space preservation corridor along Red Butte Creek, and in 2014 the Board of Trustees made this a reality by establishing a 100 foot buffer zone from the average high water line. In addition, the 2011 Bicycle Master Plan proposed a trail system that would both parallel RBC, promoting community access, and also cross the creek, promoting campus connectivity. All of these documents contain language that supports the use of RBC for teaching, research, recreation, and ecological restoration, as do the 2014 Campus Design Standards. In addition, the 2010 Climate Action Plan (CAP) provides a model university initiative that supports research and teaching in conjunction with campus sustainability projects.

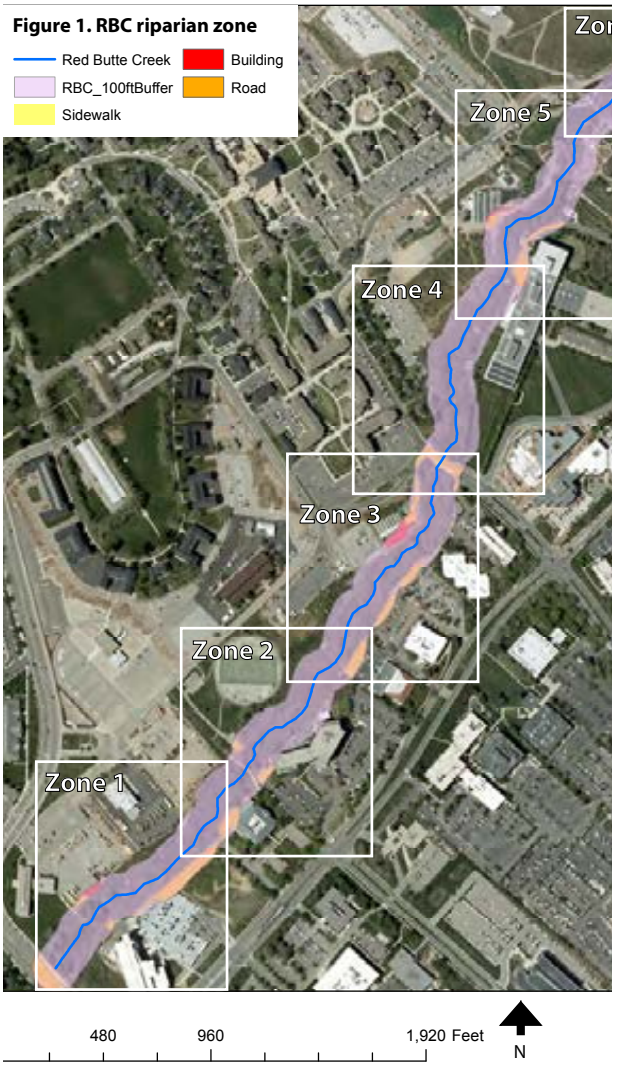
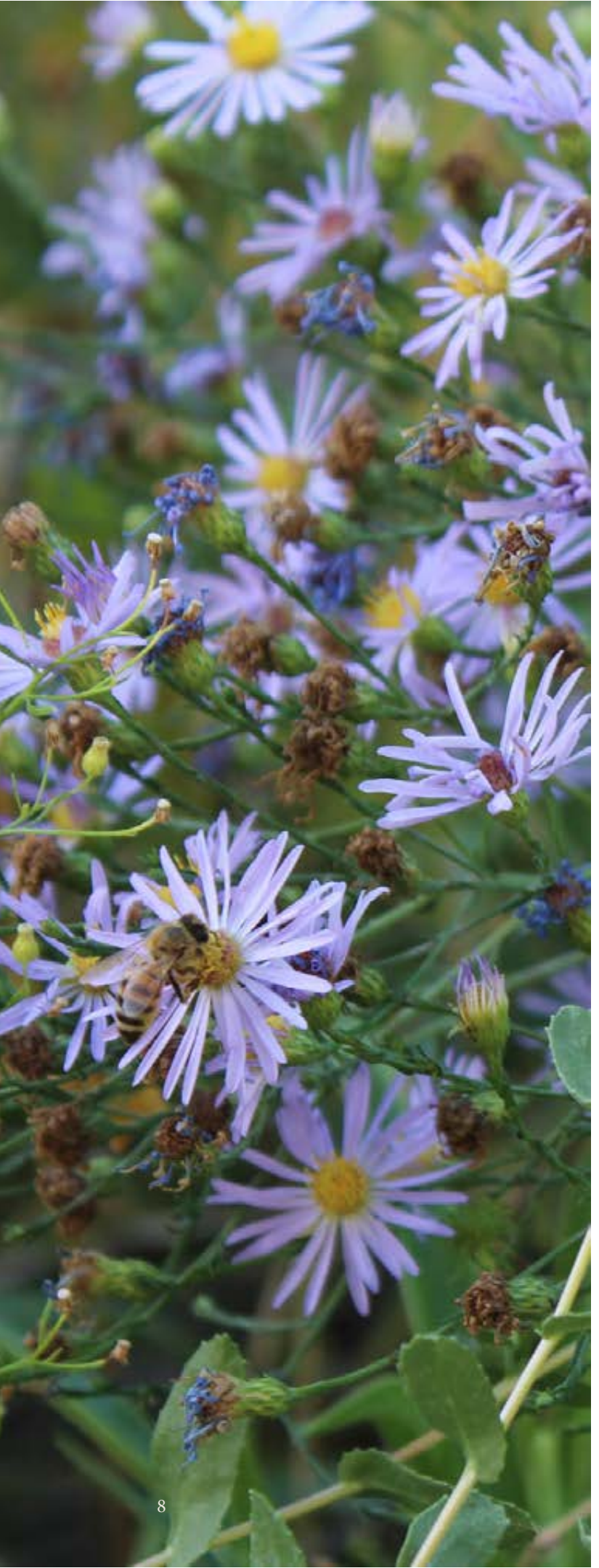


Figure 1.5: Riparian Corridor Buffer Zone. T. Walsh (2012)

Figure 1.6: Bicycle Master Plan (2011)



RELEVANT UNIVERSITY PLANS

Campus Master Plan (2008)

"Improve stormwater quality… reuse water on campus to the greatest extent possible," and "reduce the overall burden on conventional stormwater systems," including "water quality enhancing bioswales wherever feasible"

Bicycle Master Plan (2011)

Crossing from Wakara Way to Red Butte Canyon Road and from Wakara Way to Pollock Road

Red Butte Creek Trail Segments 1-4, Sunnyside Avenue to Chipeta Way

Campus Design Standards (2015)

3.1.A.3. "predevelopment hydrology"

3.2.D.4.a.(2).(e). "bid alternate that incorporates pervious pavement"

3.2.D.4.a.(4).(c-f). "minimize paved and impervious surfaces… create micro detention and bioswale areas… and maximize water quality"

3.2.E.3.j. "Capture roof runoff"

Climate Action Plan (2010)

"Reaching that delicate balance between environmental care, economic development, and social responsibility"

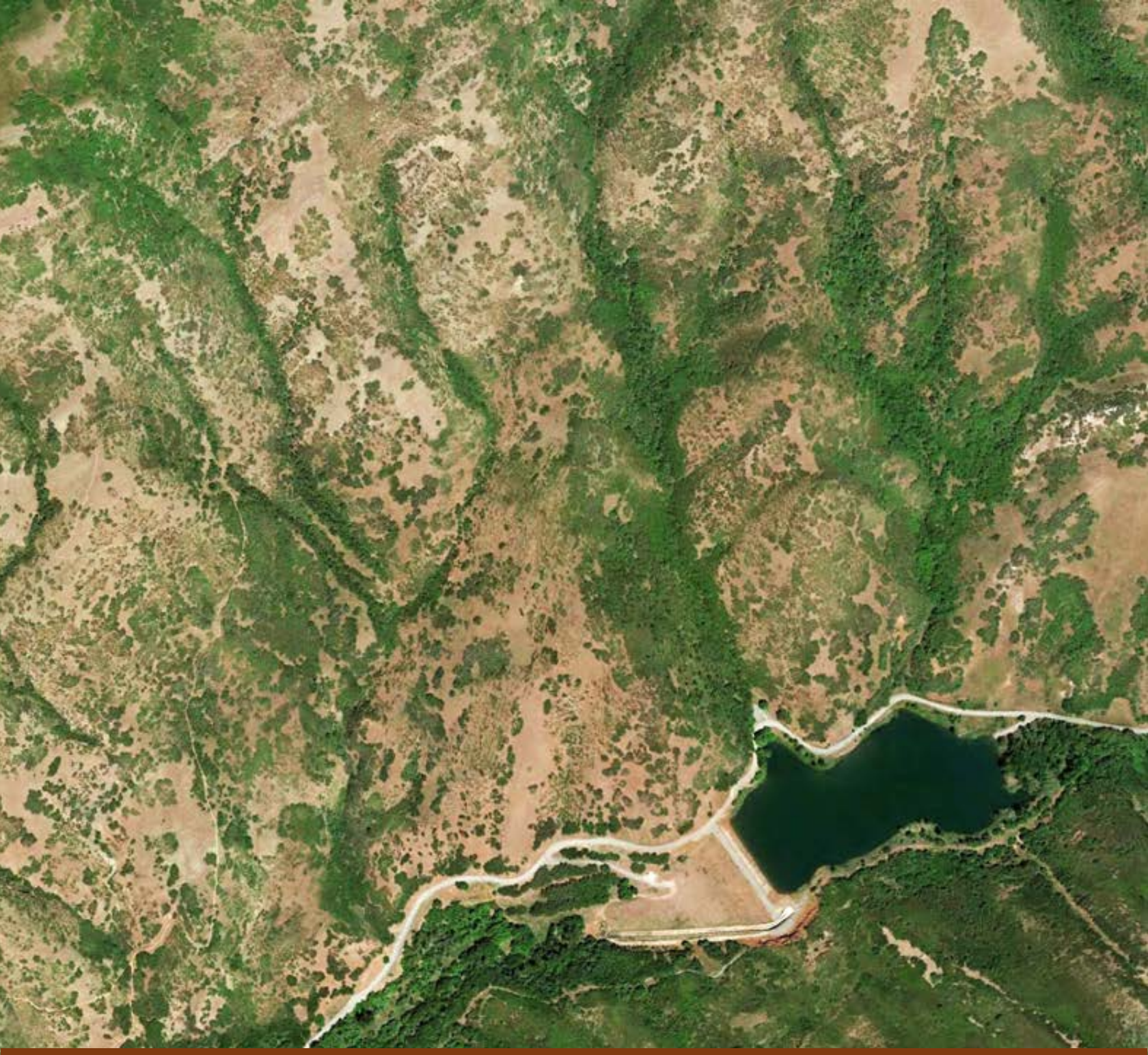
Stormwater Management Program Plan (2015)

RECENT RESEARCH INITIATIVES

- Innovative Urban Transitions and Aridregion Hydrosustainability (iUTAH) iutahepscor.org
    - Climate and Hydrology
    - Water quality
    - Land use and land cover
    - Bioretention
    - Biogeochemistry
    - Isotope sampling
    - Organic matter composition
    - Evapotranspiration
    - Surface/Ground water interactions
    - Research Natural Area isotope data
- Global Change & Sustainability Center environment.utah.edu
    - Friends of Red Butte Creek Mini-Grants
    - ~$80,000 to support RBC projects in natural sciences, social sciences, and the humanities
    - Biology Growth Site / GIRF

EDUCATION

- HONOR3700 Honors College Think Tank: Wasatch Waters (2012) -Jim Ehleringer
- SUST 6000/BIOL 7961 Global Changes and Society (2012, 2013) -Jim Ehleringer and Brenda Bowen
- BIOL 5440/CMP6610 Urban Ecology (2013) - Diane Pataki
- CMP 4260 Land, Law & Culture (2014) - Keith Bartholomew
- BIOL 3480 Biography of an Urban Stream (2012-2017) - Pat Shae
- GEO 5350 Groundwater (Annually) - Kip Solomon
- GEO 5660 Geochemistry (2013) - Thure Cerling
- CVEEN 7440 Urban Watershed Management (2013) - Christine Pomeroy



Watershed Characteristics

2

Introduction

The RBC watershed is divided into two subwatersheds: the upper subwatershed, which extends from the headwaters to the mouth of Red Butte Canyon, and the lower subwatershed, which extends from the mouth of Red Butte Canyon to the Jordan River.

The upper RBC subwatershed ranges from 8,200 feet to 5,000 feet in elevation, running 4.1 miles and draining 5,403 acres of land that is primarily owned by the United States Forest Service (WPRP, 2009; BioWest. 2010). As described in Section 1, the upper subwatershed has been a protected area for almost a century. The waters are classified as high quality drinking waters, and only 9.3% of the subwatershed area is impervious land cover (id.).

Near the mouth of Red Butte Canyon, Red Butte Reservoir was constructed in 1930 to supply water for Fort Douglas. The Central Utah Water Conservancy District assumed management responsibilities for the reservoir in 2004, managing it primarily as habitat for the indigenous and endangered June Sucker fish (WPRP, 2009). Red Butte Reservoir is generally referred to as the dividing point between the upper and lower stretches of Red Butte Creek.

The lower RBC subwatershed ranges from 5,000 to 4,300 feet in elevation, running 2.7

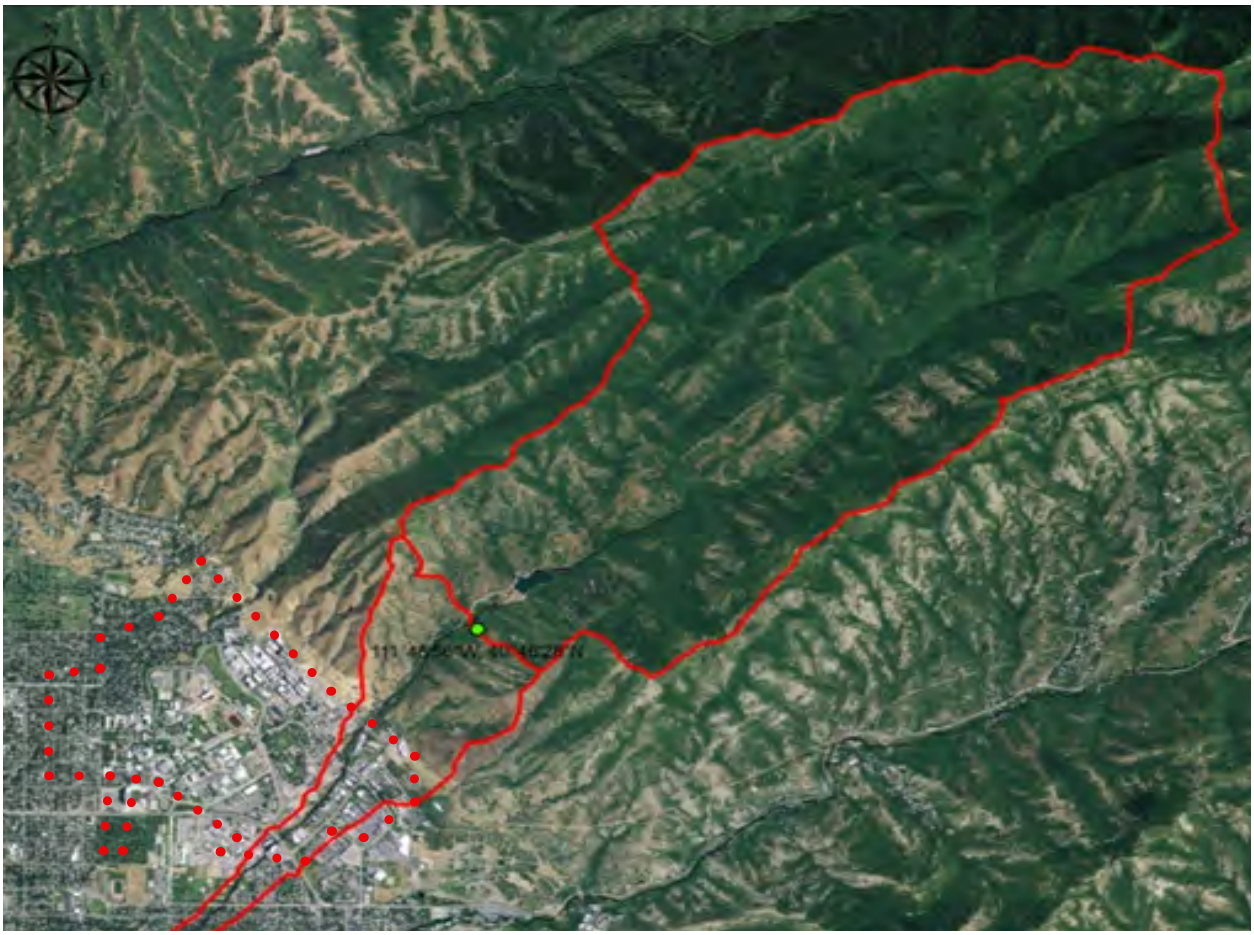


Figure 2.1: RBC Subwatersheds, headwaters to Sunnyside Ave.
Source: GCSC Red Butte Creek Project, 2012 (solid line: watershed, dotted line: U of U campus

miles and draining 1,652 acres of land. Lower RBC exits the protected mountain wildlands and flows through the University of Utah campus and Research Park, the Veteran's Affairs (VA) Medical Center, and Sunnyside Park. It continues through the Sunnyside, Yalecrest, and East Liberty Park neighborhoods, enters a culvert at 1100 East, resurfaces at the Liberty Park Pond (around 700 East), and then flows into the 1300 South Conduit, which receives Emigration Creek and Parleys Creek and eventually discharges into the Jordan River.

Figure 2.2: June Sucker; Source: UDWR, no date

The lower RBC subwatershed thus transitions from mostly undisturbed to fully-urbanized in under three miles. Lower RBC is the focus of this strategic vision, with the approximately 1.1 mile stretch running through the University of Utah campus and Research Park as the primary focus and the 0.4 mile stretch running from Foothill Drive to Sunnyside Avenue as the secondary focus. The remaining 1.2 mile stretch of creek runs through private and municipally owned land.

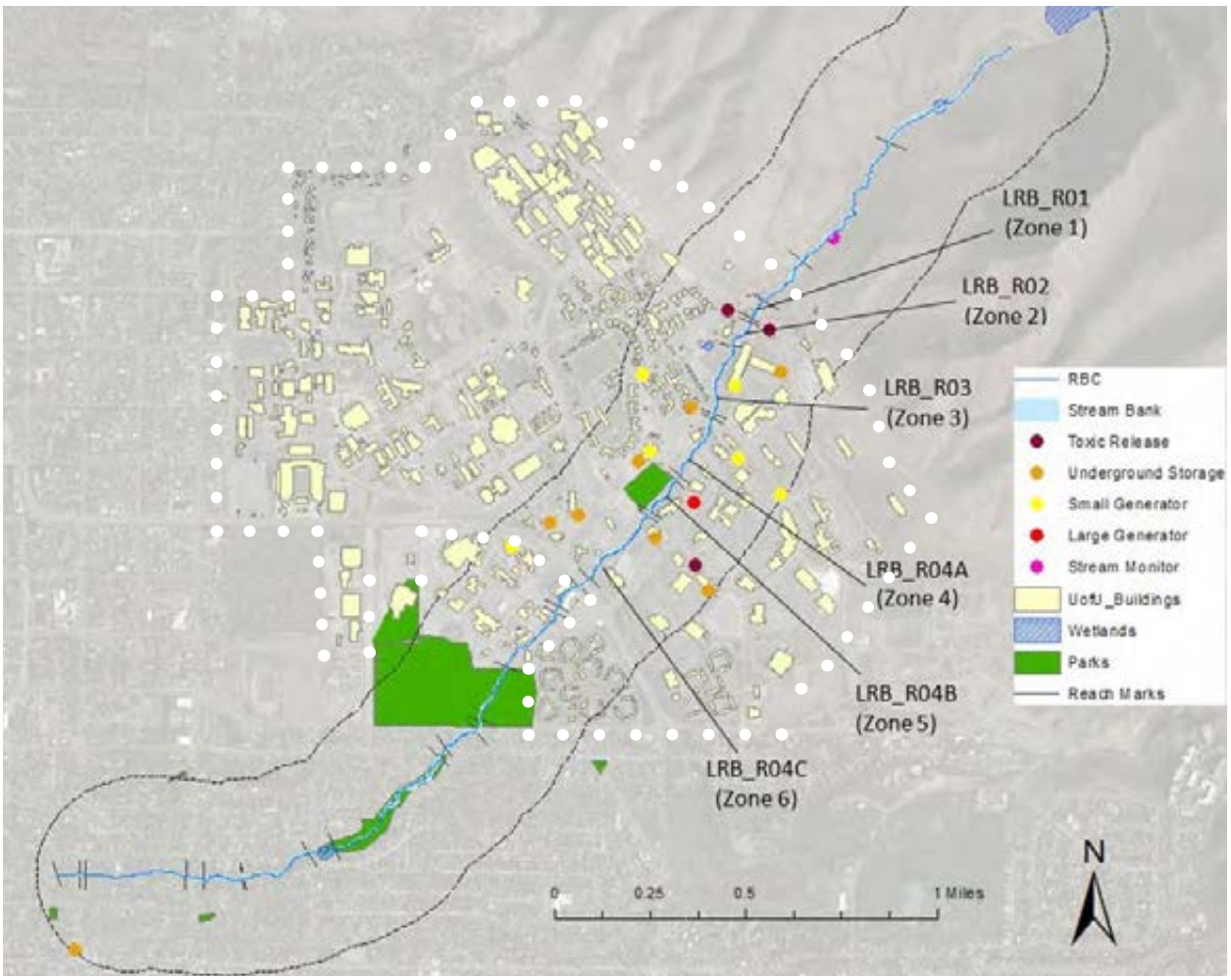


Figure 2.3: Lower Red Butte Creek with 0.25 mile buffer, from mouth of Red Butte Canyon to 1100 East. White dotted line shows approximate boundary of U of U campus.

Land Ownership and Land Use

Along the 1.5 mile riparian corridor at the heart of the RBC Strategic Vision, the University of Utah is the primary land owner. Figure 2.4 shows the university boundary, with the riparian corridor just inside university jurisdiction from Red Butte Garden to Foothill Drive, and split between the university and the VA Medical Center from Foothill to Sunnyside Ave. The only other landowner in the subwatershed focus area is the US Federal Government at the VA Medical Center and Fort Douglas, both just north of the creek. Figure 2.4 (below) shows land ownership in a 0.25 mile buffer along the length of lower RBC. It is important to note that while Salt Lake City is not a landowner in the subwatershed focus area, it is a stakeholder because of its interest in the sewer and stormwater infrastructure (see Figure 2.5, p. 15).

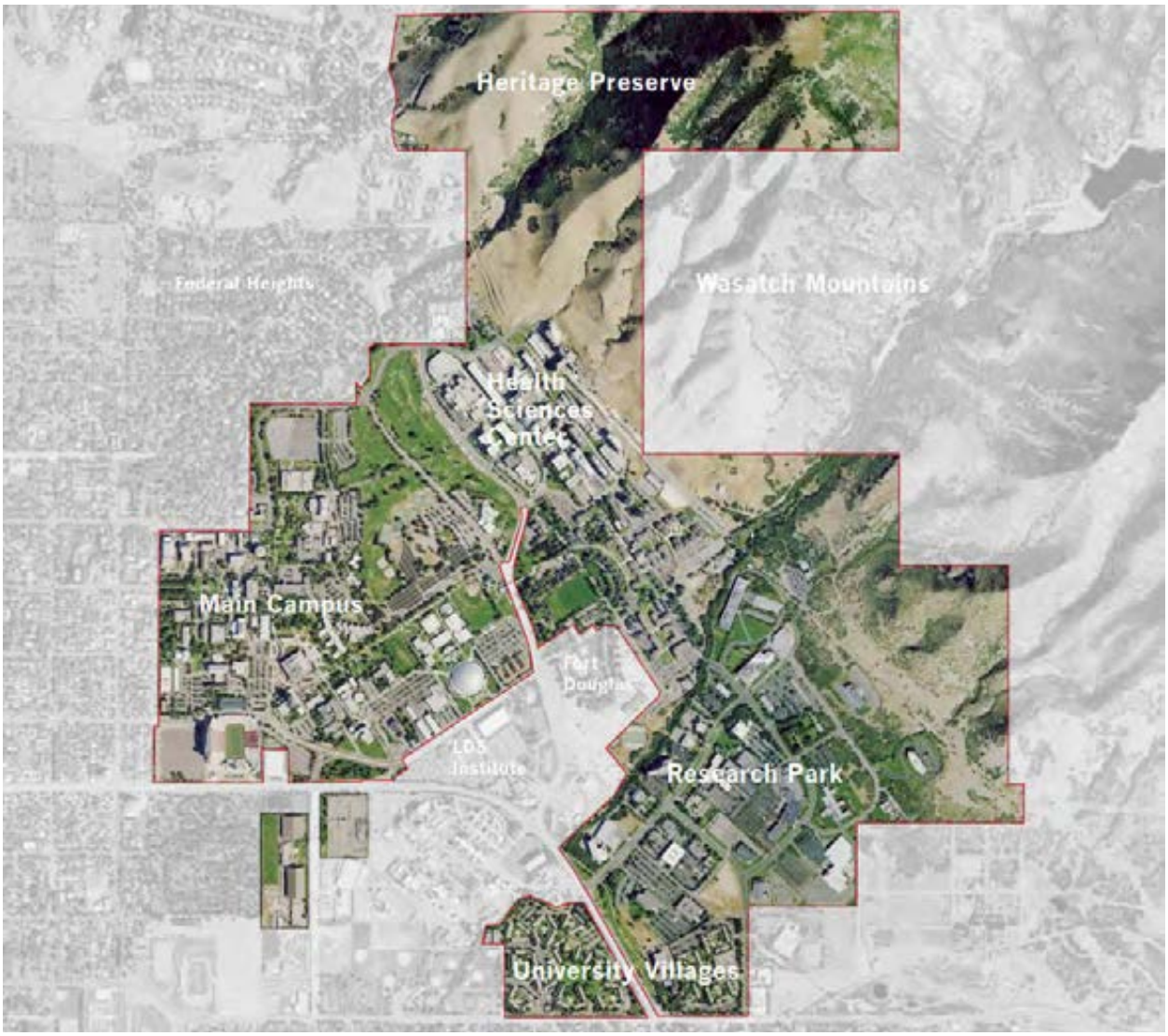


Figure 2.4: University Boundary;
Source: Campus Master Plan (2008)

University of Utah Storm Water System

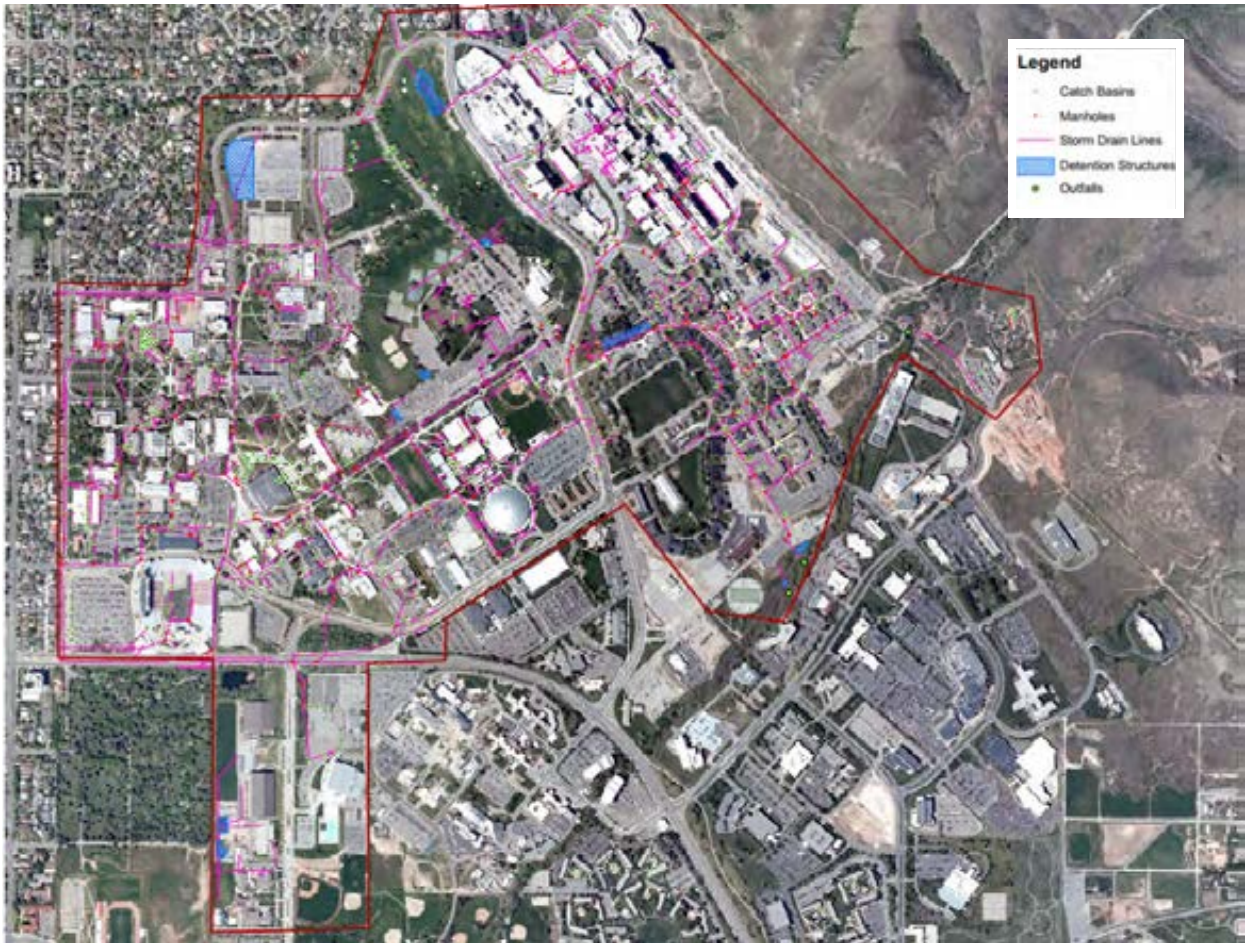


Figure 2.5: University of Utah Storm Sewer System (does not include Research Park or University Villages Property)
Source: University of Utah Storm Water Management Program Plan (2015)

Figure 2.6: Erosion along Red Butte Creek

Figure 2.7: Storm drain outfall into Red Butte Creek in Research Park

While the University of Utah is the primary land owner, there are several long-term lessees of university property within Research Park. Table 2.1 (p. 17) lists properties along the creek, including business name, physical address, lease terms (if applicable), and contact information. Achieving the RBC Strategic Vision will require close coordination with Research Park businesses and with Fort Douglas, as their roofs, parking lots, and landscapes drain to the creek, playing a crucial role in land use, land cover, hydrology, geomorphology, water quality, and habitat quality. In addition, as leases expire and the university reacquires buildings and property along the riparian corridor, there will be excellent opportunities to create state of the art teaching and research facilities, and to transform land use and land cover in the subwatershed. Here we refer to this process as 'property succession' (see Section 5.1, p. 46).

Figure 2.8 shows the land use zoning in a 0.25 mile buffer along the length of lower RBC.

The subwatershed focus area is zoned for institutional and light industrial land use. Figure 2.9 shows parcel values along the riparian corridor. Of note, much of the highest valued property is immediately adjacent to RBC. This is an important consideration for issues such as bank stability and flood control. Critically, as Figure 2.11 (p. 17) and Figure 2.6 (p. 15) show, much of RBC is currently inaccessible and lacking in safe access points. To date, campus development has been oriented facing away from RBC, impeding public access. There are numerous advantages to integrating RBC more fully into campus design; research suggests that a more integrated relationship between natural and built spaces can promote both human and ecosystem health (Ulrich, 1979; Takano et al., 2002; Frumkin, 2012). More specifically, RBC provides many opportunities to enhance the university's core mission for research, education, and public outreach.

Figure 2.8: Land Use Zoning along lower RBC

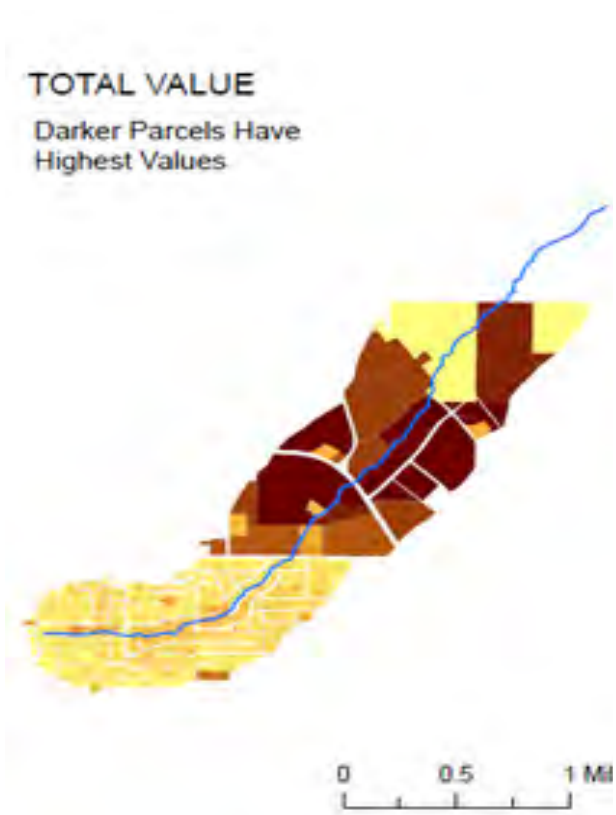


Figure 2.9: Parcel Values along lower RBC

Company Name	Address	Ownership	Contact	Phone
RED BUTTE GARDEN	300 Wakara Way	University of Utah	Mr. Gregory Lee, Executive Director	801-585-0556
WILLIAMS BUILDING / UNIVERSITY OF UTAH DEPARTMENT OF PEDIATRICS	295 Chipeta Way	U of U Research Foundation	Mr. Braden J. Hellewell, Property Manager, Real Estate Administration	801-581-6478
BF ENTERPRISES	360 Wakara Way	Expires 6/30/2019, 10 year option to extend until 6/30/2029	Mrs. Diane B. Whittaker, Owner	801-582-4374
BIOFIRE DIAGNOSTICS, INC.	390 Wakara Way	Expires 9/30/2052	Mr. Bill Phifer, VP Facilities	801-870-8597
BIOFIRE DIAGNOSTICS, INC.	400 Wakara Way	Expires 9/30/2052	Mr. Bill Phifer, VP Facilities	801-870-8597
OFFICE II, LLC	420 Wakara Way	Expires 11/9/2051	Dr. Audie Levanthal, Owner	801-598-4048
MARRIOTT-UNIVERSITY PARK HOTEL	480 Wakara Way	Expires 12/31/2045, 10 year option to extend until 12/31/2055	Not Listed	801-581-1000
COLLEGE OF HEALTH (DUMKE BLDG)	520 Wakara Way	U of U Research Foundation	Managed by Physical Plant	801-581-7221
UNIVERSITY SCHOOL OF DENTISTRY	530 Wakara Way	University of Utah	Mrs. Julie Oyler, Director of Administration	801-585-0718
UNIVERSITY ORTHOPEDIC CENTER	590 Wakara Way	University of Utah	Mr. Bart B. Adams, Executive Director	801-587-7109

Table 2.1: Research Park Properties and Business Owners Adjacent to Red Butte Creek (as of Fall 2016)

Figure 2.10: Land Ownership along RBC

Figure 2.11: Red Butte Creek on the University of Utah Campus

Land Cover

Land cover, such as the extent of pervious versus impervious surfaces, is considered a critical aspect of the health of urban streams. Impervious surfaces consist primarily of parking lots, roads, sidewalks, and roofs that prevent infiltration of precipitation into the soil. On campus as in most other urban areas, runoff from impervious surfaces is collected in storm drains and piped through the storm sewer system, flowing rapidly to the creek through stormwater outfalls (see Figures 2.12 and 2.13). Previous studies suggest that this process fundamentally changes stream hydrology, ecology, chemistry, and geomorphology by increasing runoff volume and intensity, altering the timing of flows, and transporting pollutants from the ground surface (Booth, 1990). Quantifying the extent of impervious land cover is therefore an important aspect of understanding the relationship between university activities and stream functioning.

In 2010, Biowest estimated the impervious land cover of the lower RBC subwatershed at 31.9%. In 2012, the Global Change & Sustainability Center's (GCSC) Red Butte Creek Project calculated impervious land cover specifically for the RBC subwatershed that drains University of Utah property. They divided the subwatershed into 22 sub-catchment areas, shown in Figure 2.15 (p. 19), and used geospatial data to estimate impervious land cover for each sub-catchment area, shown in Table 2.2 (p. 19) and Figure 2.14 (p. 19).

Figure 2.12: University of Utah Storm Drain Outfalls
Source: Storm Water Managment Program Plan (2016)

Figure 2.13: Sub-catchment areas for RBC subwatershed
Source: GCSC, Red Butte Creek Project (2012)

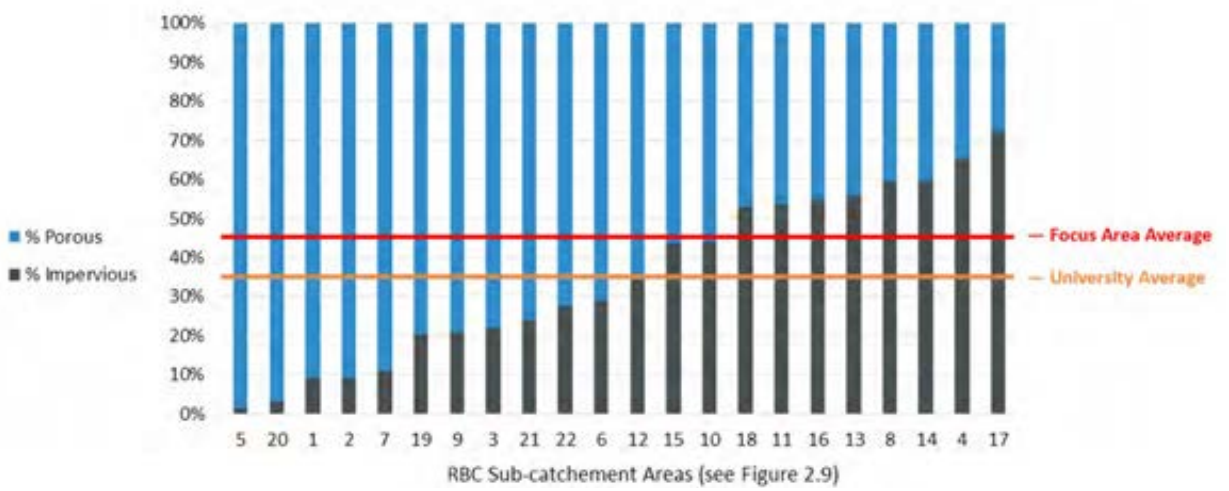


Figure 2.14: Impervious and porous land cover by sub-catchment area (see figure 2.15)

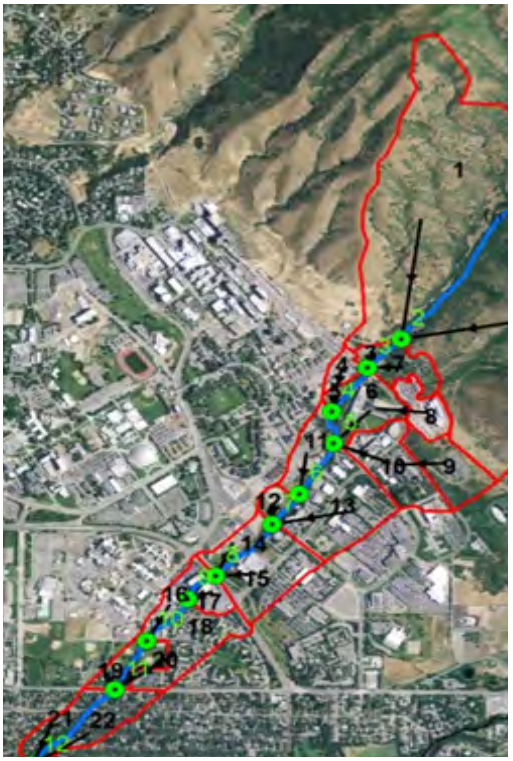


Figure 2.15: Sub-catchment areas for RBC subwatershed
Source: GCSC, Red Butte Creek Project (2012)

Sub Catchment Number	Elevation Change (feet)	Length	Slope	Width	Impervious (%)
1	395	1,576	25%	3,107	9.10%
2	440	1,249	35%	1,489	9.10%
3	10	92	11%	418	22.12%
4	20	256	8%	509	65.40%
5	15	248	6%	731	1.31%
6	24	340	7%	1,277	28.93%
7	32	262	12%	652	10.98%
8	23	170	14%	614	59.59%
9	30	237	13%	669	20.83%
10	23	292	8%	688	43.89%
11	30	441	7%	1,623	53.69%
12	14	208	7%	534	34.25%
13	28	468	6%	1,601	56.04%
14	23	341	7%	1,185	59.68%
15	21	438	5%	1,393	43.69%
16	23	497	5%	1,631	55.00%
17	7	157	4%	480	72.21%
18	27	649	4%	1,583	53.00%
19	10	325	3%	1,017	20.39%
20	14	340	4%	920	3.08%
21	23	345	7%	1,560	24.02%
22	27	591	5%	18,418	27.59%
AVE.	57	433	9%	1,914	35.18%

Table 2.2: Impervious cover by sub-catchment area
Source: GCSC, Red Butte Creek Project (2012)

Figure 2.16 summarizes previous work about the stream quality implications of impervious cover. At an average impervious cover of 35.2%, the University of Utah's RBC subwatershed is considered a non-supporting stream, with fair to poor conditions according to the Center for Watershed Protection (2005). The 1.5 mile stretch from Red Butte Garden to Sunnyside Avenue (sub-catchments 4-6 and 8-19) has an average impervious cover of 44.5%. We note that the detailed hydrology of RBC is currently the subject of active research by campus faculty and students, and our understanding of the relationship between land use, geomorphology, groundwater flow, riparian ecology, and water quality is rapidly expanding.

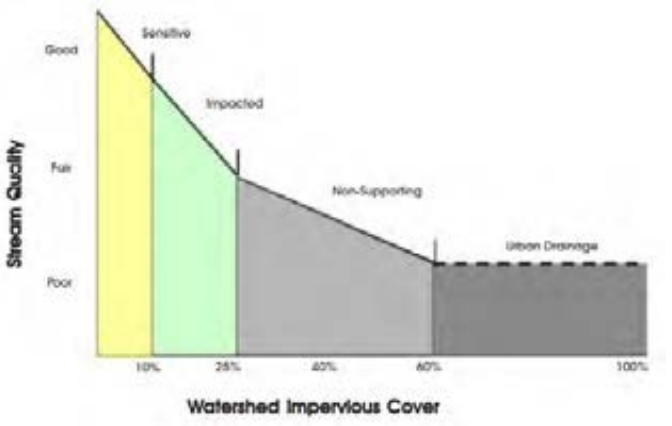


Figure 2.16: Impervious Cover and Stream Quality
Source: CWP, Manual 1 (2005)

Subwatershed Restoration Goals	Percent Subwatershed Impervious Cover			
	10 to 25	25 to 40	40 to 60	60 to 100
Water Quality				
Reduce pollutants of concern	●	●	●	◉
Prevent illegal discharges/spills	◉	●	●	◉
Meet water quality standards	●	◉	○	×
Reduce sediment contamination	●	●	◉	×
Allow water contact recreation	●	●	◉	×
Protect drinking water supply	◉	○	×	×
Biological				
Restore aquatic diversity	●	◉	×	×
Restore wetlands/natural areas	●	◉	◉	×
Expand forest cover	●	●	●	◉
Restore/reintroduce species	●	◉	×	×
Improve fish passages	●	●	◉	×
Enhance wildlife habitat	●	●	◉	×
Remove invasive species	●	●	×	×
Keep shellfish beds open	◉	×	×	×
Enhance riparian areas	●	●	◉	○
Physical/Hydrological				
Increase groundwater recharge	●	◉	◉	×
Reduce channel erosion	●	◉	×	×
Reclaim stream network	●	◉	×	×
Reduce flood damage	●	●	◉	○
Reconnect with floodplain	●	◉	×	×
Restore physical habitat	●	○	×	×
Protect municipal infrastructure	●	●	◉	◉
Community				
Eliminate trash/debris	●	●	●	●
Create greenways/waterfront access/open space	●	●	●	◉
Revitalize neighborhoods	●	●	●	●
Improve aesthetics/beautification	●	●	●	●
Increase citizen awareness	●	●	●	●
Improve recreation	●	●	●	●
Increase angling opportunities	●	●	◉	×

● Goal can often be achieved in many subwatersheds
◉ Goal can be achieved in some subwatersheds depending on degree of treatment
○ Goal can possibly be achieved in unusual circumstances
× Goal generally not achievable

Table 2.3: Impervious Cover and Plan Goals | Source: CWP, Manual 5 (2005)

Research Note

It is important to note that the influence of land cover on Red Butte Creek – and its relationship with stream quality factors such as hydrology and geomorphology (pp. 21-23), water quality and biogeochemistry (p. 24), wildlife habitat and biodiversity (p. 26), etc. – are at present unresolved research questions. Conventional assumptions about these factors, as represented in Figure 2.16 and Table 2.3, have not been tested extensively in places as arid and as heavily urbanized as the University of Utah. In addition, the role of other site-specific characteristics, such as steep slope and erosive soil, remains unclear. Several University faculty and students are actively studying these important questions, especially the iUTAH and the GIRF / Biology Growth Site projects. Nevertheless, we are far from definitive answers. The RBC Strategic Vision thus presents a unique opportunity to create important original knowledge about urban stream functioning and management, placing the University of Utah in a leadership role locally, nationally, and globally.

— Streamflow below Red Butte Reservoir
— Streamflow at Cottam's Grove
— Streamflow at Foothill Drive

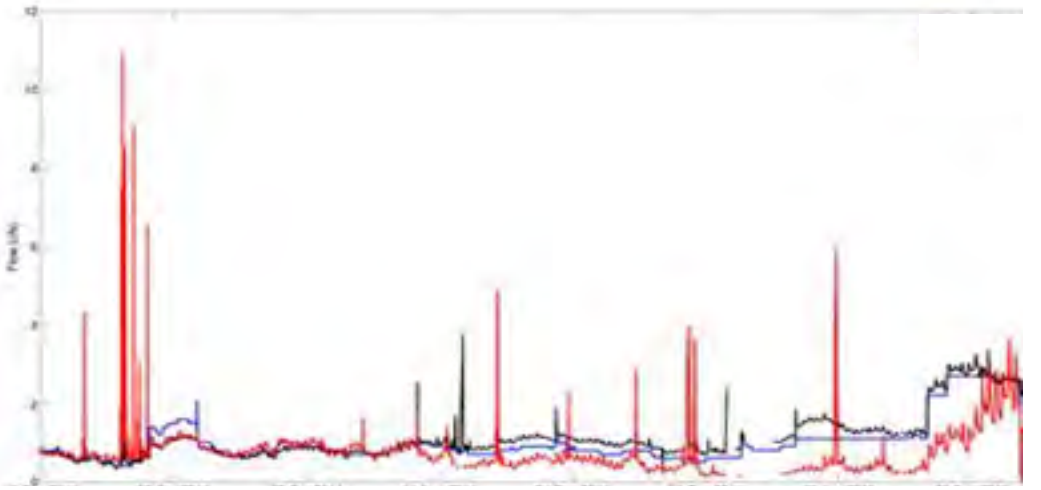


Figure 2.17: Flashy Hydrology on the University reaches of RBC | Source: iUTAH (2014-2015)

The surface hydrology of RBC is typical of a mountain stream fed by snowmelt. Salt Lake County estimates that the highest average monthly flow occurs in May and that the highest daily flow occurs in late April (WPRP, 2009). The stretch of RBC between the reservoir and about 1600 East is considered to be a losing reach, with waters from the creek seeping into the groundwater table (WPRP, 2009; Bio-West, 2010). The stretch from 1600 East to the 1300 South conduit is considered to be a gaining reach, with water entering RBC from groundwater springs. However, the specific interactions between surface water and groundwater, depending on season, climate, etc., is currently an area of active study (see Research Note, p. 20).

Below Red Butte Reservoir, in the lower subwatershed, RBC streamflow is "perennial-reduced" (WPRP, 2009), meaning that due to reservoir operations and irrigation diversions, water volumes in the creek are lower than would otherwise be the case. In fact, summertime base flows in the lower reaches of RBC are sometimes completely eliminated by upstream diversions at Mount Olivet Cemetery. This is a high priority concern for local stakeholders (Bio-West, 2010).

The lower reaches of RBC also exhibit the "flashy" hydrology during storm events that is typical of urban streams with high levels of impervious land cover (Biowest, 2010). Figure 2.17 shows data from iUTAH flow sensors for a five month period between September 2014 and February 2015. The blue line represents releases from the Red Butte Reservoir, the black line represents streamflow at Cottam's Grove (1.3 miles downstream), and the red line represents streamflow at Foothill Drive (0.7 miles further downstream). The large spikes at Foothill Drive show the effect of impervious land cover on stormwater runoff along just 0.7 miles of urbanized watershed.

Figure 2.18: Impervious cover in the campus watershed

Adapting land cover design practices over time will reduce impervious surfaces and introduce alternative storm water management and landscape irrigation. Section 5.7 (p. 64) outlines an initial demonstration project at the Williams Building (downstream of Red Butte Garden) that treats runoff from least 2 acres of impervious parking surfaces and at least 0.5 acres of impervious rooftop, with green infrastructure designs.

An additional consideration is that the Campus Master Plan anticipates increasing impervious land cover in Research Park over the coming decades. It is important that these projects are coupled with low impact development and green infrastructure (LID/GI) stormwater controls.

Flashy hydrology enhances erosion and creates overly incised channels with unstable banks. Indeed, incision, erosion, and bank instability are widely evident throughout the urbanized reaches of RBC. According to Salt Lake County, the stream channel in the lower RBC subwatershed is entrenched, and more than half the length of the channel suffers from fair to poor bank stability (WPRP, 2009). University reaches of RBC show especially pronounced conditions: "the stream channel is entrenched and deeply incised… and becomes less entrenched as it passes over the valley floor." Figures 2.19-2.21 below show the geomorphological characteristics along campus reaches of RBC.

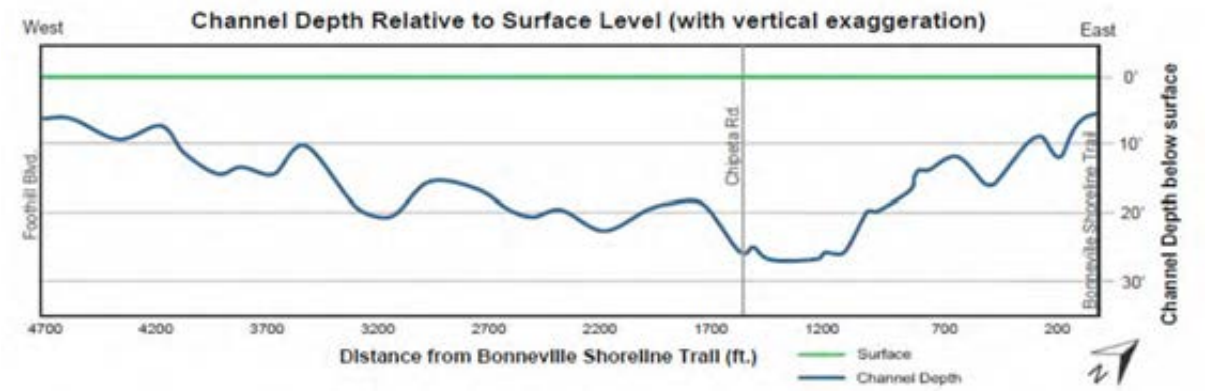


Figure 2.19: Normalized Channel Depth of RBC, Foothill Drive to Bonneville Shoreline Trail

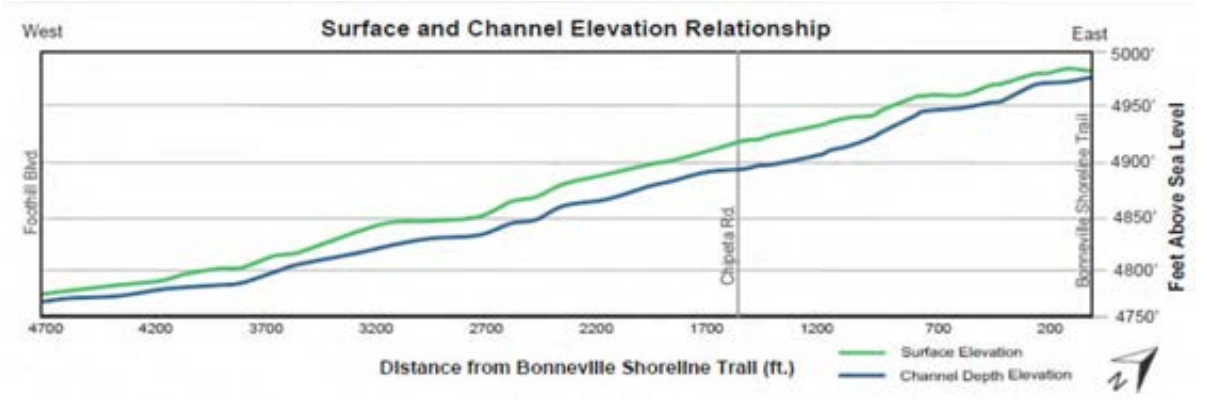


Figure 2.20: Channel Depth from Top of RBC Streambank, Foothill Drive to Bonneville Shoreline Trail

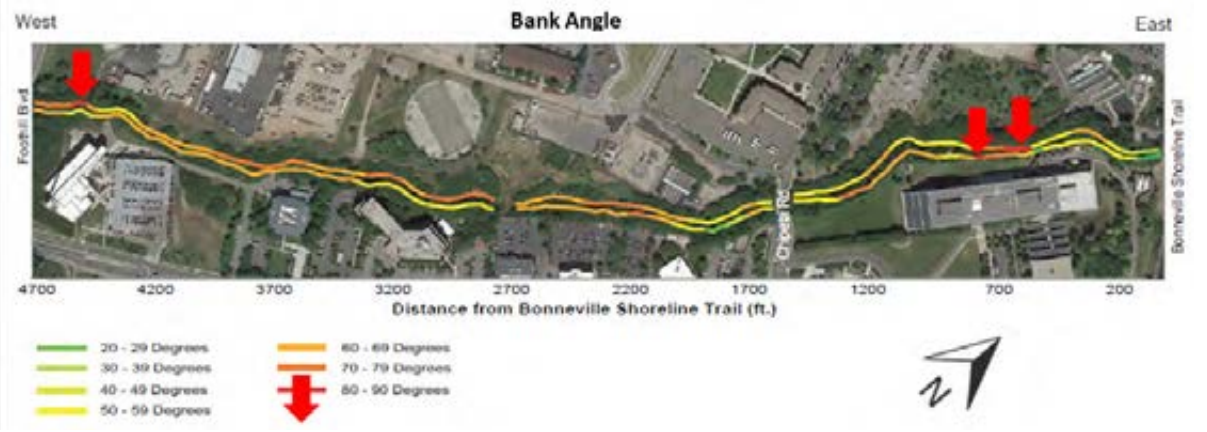


Figure 2.21: Color-Coded RBC Angle, Foothill Drive to Bonneville Shoreline Trail

Figure 2.19-21 by Brenda Bowen and Nathan Andersen

Culverts under Bonneville Shoreline Trail

Land cover is an important aspect of stormwater management. The current paradigm of intensive impervious cover and extensive plumbing with grey infrastructure has obvious benefits of efficiency for drainage and flood control. However, this approach also has costs. Erosion and instability limit the use of RBC for teaching, research, recreation, habitat, and campus aesthetics. Without a comprehensive focus on the relationship between land use and hydrology at the watershed scale, other efforts at restoration and revitalization are unlikely to see long-term success.

Water Quality and Site Maintenance

The Utah Division of Water Quality (DWQ) designates beneficial uses for streams corresponding with different water quality standards. For example, the pristine waters of Red Butte Canyon are designated high quality drinking waters. However, the lower RBC subwatershed, and most urban stream reaches in Salt Lake City, have not yet been assessed for beneficial use and are therefore assigned the default value for protection of waterfowl and shorebirds.

In 2010, Bio-West reported that RBC was in compliance with its default beneficial use. However, this was prior to the 2010 Chevron oil spills. DWQ issued a final closure document in 2012, declaring the spill cleanup a success: "no further cleanup is needed… traces of contamination remaining in the creek are not a threat to human health or the environment". The DWQ carried out additional monitoring through 2015.

iUTAH researchers have instrumented the lower RBC subwatershed with water quality sensors, and have conducted 'synoptic' sampling in the creek. Currently, the water quality characteristics of the lower subwatershed are uncertain, for both the surface and especially sub-surface flows. According to the Salt Lake County Department of Engineering and Flood Control, stormwater runoff into RBC contains pollutants (collected from impervious surfaces) including sediment, nutrients, chlorides, metals, oils and greases, bacteria, and organic pollutants (SLCO, 2012). More research is needed to identify the main sources of water pollution on campus and the dynamics of how those pollutants enter and impact the creek. It is also important to confirm that there are no point source emissions contaminating the creek.

Other water quality issues relate to campus design and the ramifications for maintenance. Site visits have revealed large amounts of trash and signs of human occupation (Figure 2.22 and Figure 2.23, above). Shifting land use so that RBC is more fully included in campus life would help to mitigate these impacts.

Figure 2.22: Liberty Lake Contaminated by the 2010 Chevron Oil Spill

Figure 2.23: Homeless encampment on the banks of RBC

Flora, Fauna, and Habitat

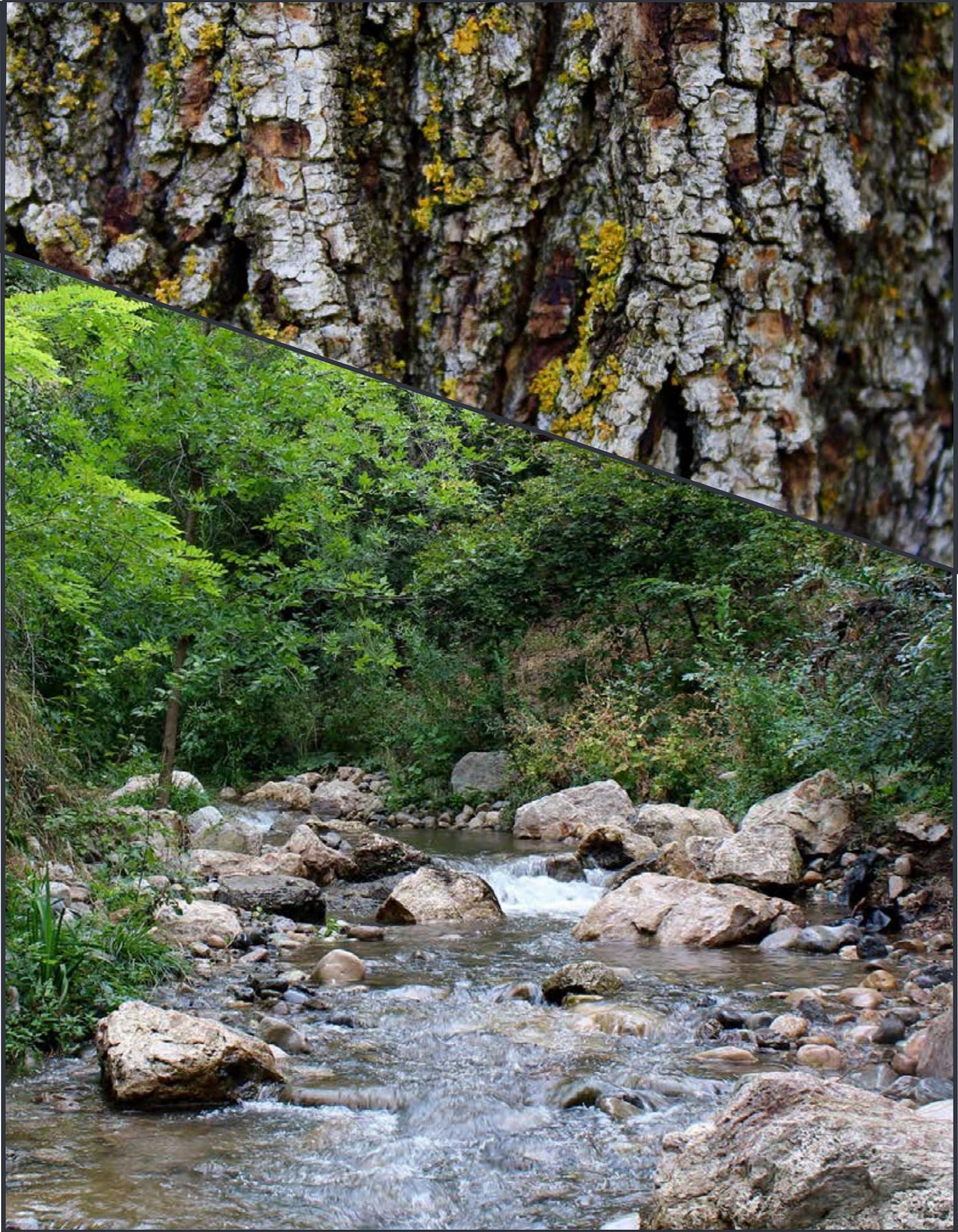
The most common canopy trees species along the university reaches of RBC are Box Elder (***Acer negundo***) and Gamble Oak (***Quercus gambelii***) (Bio-West, 2010). The most common shrub species are Red Osier Dogwood (***Cornus sericea***) and Woods' Rose (***Rosa woodsii***). Western Poison Ivy (***Toxicodendron rydbergii***) and Lesser Burdock (***Arctium minus***) are common understory species, with the poison ivy acting as a barrier to safe access and the Lesser Burdock a non-native species. Other non-native species observed on campus reaches include Smooth Brome (***Bromus inermis***), Whitetop (***Cardaria draba***), Quackgrass (***Elymus repens***), and Houndstongue (***Cynoglossum officinale***). The latter three are all listed as noxious weeds by city and state agencies. The stretch of RBC just upstream of Foothill Drive (see Section 5.8, pp. 68-71) has the highest degree of non-native species cover (Bio-West, 2010). The Salt Lake Public Utilities Department has raised concerns that these are invasive plants which degrade riparian habitats, reduce filtration of sediments and pollutants, and undermine streambank stability. Further investigating these concerns is an important future research question.

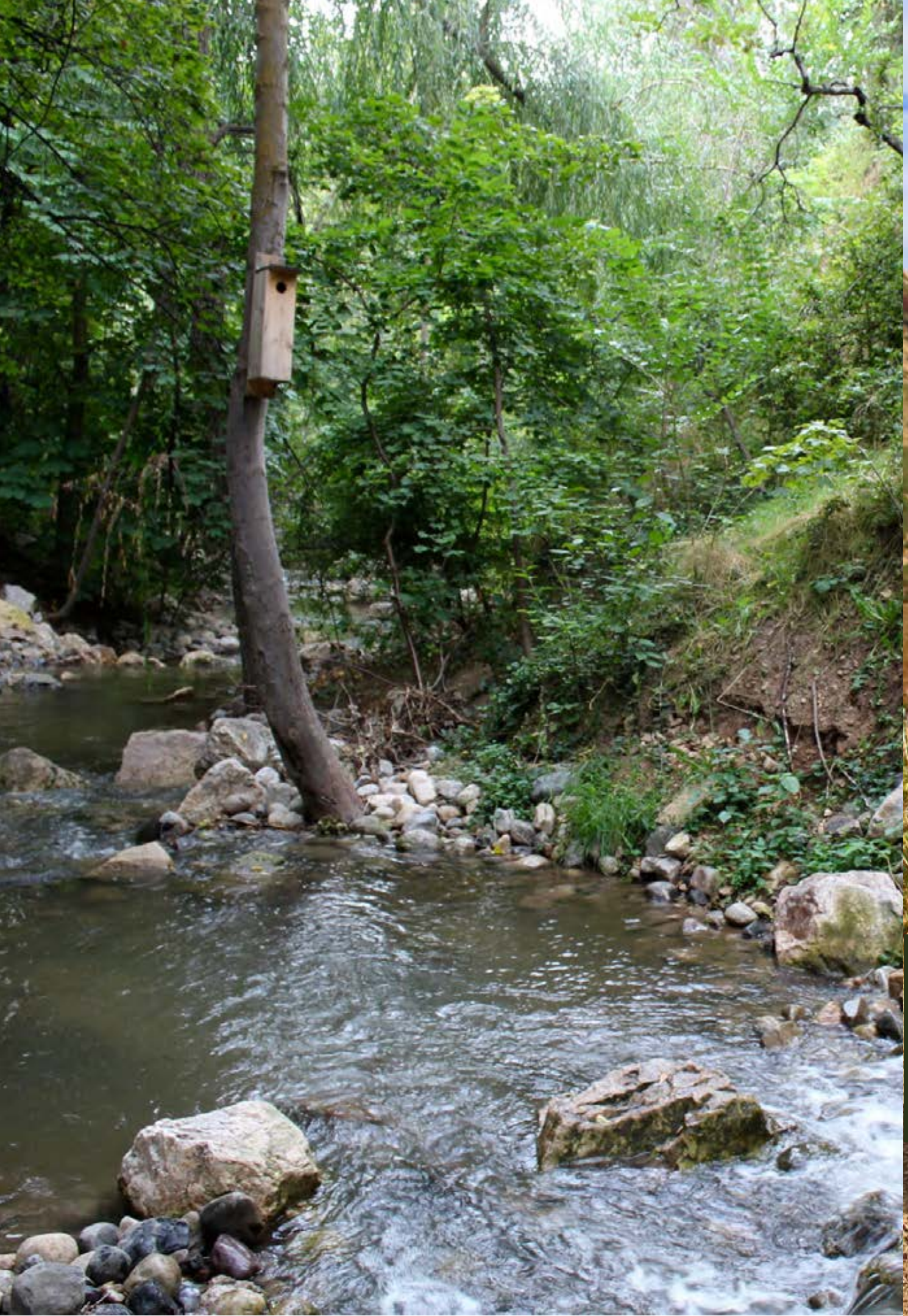
Deer, birds, and small rodents have been identified along the lower RBC riparian corridor (Bio-West, 2010). While lower RBC was not recognized by Salt Lake County as supporting any native or non-native fish species as of 2009 (WPRP, 2009), the Utah Division of Wildlife Resources (UDWR) stocked the creek with Bonneville Cutthroat Trout in 2011, 2012, and

Figure 2.24: Quakegrass

2014. It is unclear whether or not these efforts have produced viable populations. The Salt Lake County WPRP states: "At present, impacts on aquatic habitat appear to be substantial with potential to limit self-sustaining populations… the streambed between Red Butte Garden and Chipeta Way appears to be (the) most degraded" (WPRP, 2009).

Habitat quality and wildlife viability are connected to hydrology, geomorphology, and water quality. The opportunity for the University of Utah, is to address this nexus of issues in a way that promotes 1) ecological revitalization, 2) supports research and teaching, and 3) facilitates human engagement with the creek. These goals can be met with differing emphases in different places along the riparian corridor and throughout the subwatershed, but a successful plan will need to envision and respond to all three components.





Goals and Objectives 3

Goals for the Red Butte Creek Strategic Vision

1. Advance knowledge of urban streams through action to revitalize the ecological functions of, and the human relationships with, RBC
2. Promote interdisciplinary, active learning that advances stewardship, sustainability, and watershed revitalization
3. Promote awareness of RBC on campus, heighten local understanding of its social and ecological value, and provide a beautiful natural amenity for the University of Utah, Research Park, and Salt Lake City communities

The goals and objectives for the RBC Strategic Vision are structured around the University of Utah's core three-part mission to promote research (discovery, creation, and application of knowledge), teaching (dissemination of knowledge), and public life (community engagement). The creek presents a unique opportunity for the university to create and apply new knowledge about urban streams, to promote place-based environmental education, and to engage the local community by creating a beautiful natural amenity. In addition, the goals and objectives of this strategic vision align with the Office of the President's strategic goals for the university: promote student success to transform lives; develop and transfer new knowledge; engage communities to improve health and quality of life; and ensure long-term viability of the university.

The three goals for the RBC Strategic Vision are general outcomes valued by the RBC Steering Committee, the University of Utah, and the many stakeholders involved in the planning process. Each goal is associated with specific objectives for which planning activities can be designed, implemented, and monitored. At the same time, these goals represent inseparable processes that must occur in tandem. The vision therefore calls for researchers and students to participate in all phases of implementation, so that RBC can fulfill its potential as an exemplary case study in ecological design, adaptive management, and interdisciplinary education.

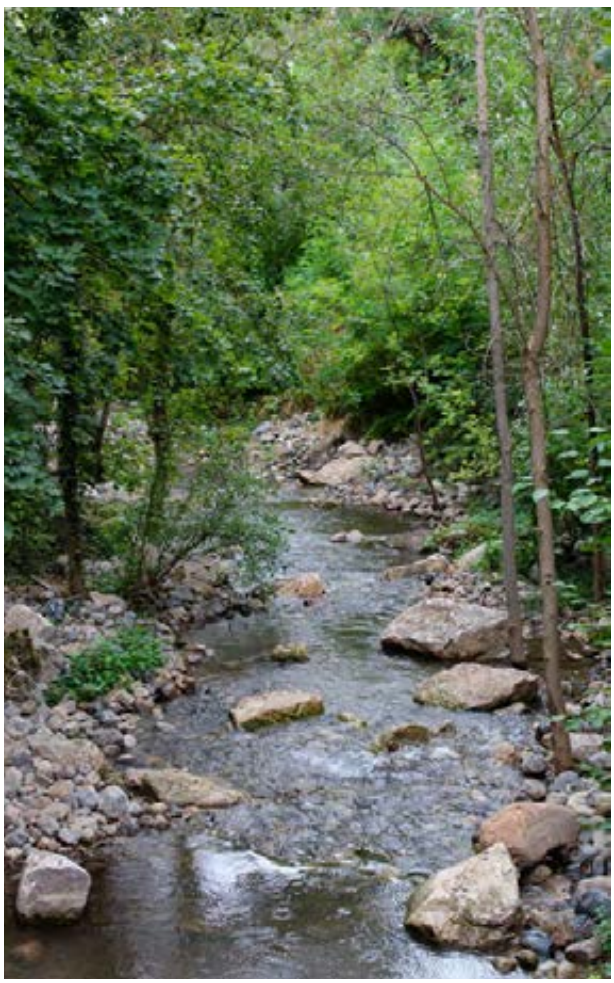


Figure 3.1: Revitalized RBC section of Miller Park

Goal #1 and its objectives address the creek's ecological and environmental issues and propose a corresponding research agenda. The theme for Goal #1 is revitalization – not as a static restoration goal, but as a dynamic process driven by (and supporting) cutting edge research, coupled with teaching and outreach. In this way, the theme of revitalization applies not only to ecology and environmental quality but also more broadly to the relationship between the University of Utah and RBC, including intellectual, institutional, and sociocultural dimensions. There is widespread interest in revitalizing both the ecological and the human aspects of urban streams, but these efforts remain challenging, and there is a great need to develop and test effective methods and approaches. Goal #1 seeks to address that need.

Goal #2 and its objectives address interdisciplinary teaching and learning. The theme for Goal #2 is student participation and course involvement in research/revitalization projects, campus design processes, and community outreach activities. With its unique position along the RBC waterway (at the transition from a protected to an urbanized watershed), the University of Utah has access to a unique educational resource. Increasingly, iUTAH, the GCSC, and other faculty have used the creek as a site for place-based, participatory learning. However, the broader campus community remains largely unaware of RBC (GCSC, 2012), which is compounded by the lack of site maintenance and of safe, convenient access. Goal #2 seeks to capitalize on the creek's potential for campus-wide teaching.

Goal #3 and its objectives address community engagement and public life. The theme for Goal #3 is connection with and celebration of Red Butte Creek as a community resource. Red Butte Garden and the Tracy Aviary offer good examples of how RBC can be used to create a vibrant, multi-purpose public space. In and of itself, establishing such a space at the University of Utah would be enormously valuable.

Figure 3.2: Revitalized bank in Miller Park

Figure 3.3: Dave Eriksson, iUtah RBC Instrument Technician

Figure 3.4: Picnic area in Red Butte Garden

Themes for Implementation

1. Ecological *Revitalization*
2. Student *Participation*
3. Community *Connection* and *Celebration*

The approach to urban stream revitalization proposed here is experimental: it recognizes many inherent challenges and uncertainties. For this reason, the research objectives associated with Goal #1 are not exhaustive; rather, they illustrate current areas of scientific uncertainty where RBC can provide a valuable laboratory for advancing the knowledge of urban stream processes and the practice of restoration. These activities will provide needed baseline data and monitoring metrics for each of the revitalization objectives (see p. 33, Objectives 1A-1E). In addition, there are research areas in which faculty members have expressed particular interest, including:

- Ecological planning and design, environmental quality, and the process of revitalization;
- Hydrology, water chemistry, green infrastructure, and new methodologies for managing stormwater and streamflows;
- Geomorphology and the potential for stream channel and stream bank modifications/ improvements;
- Habitat, wildlife, and ecosystem functioning within the stream and the riparian corridor;
- Human uses and responses to different riparian and landscape designs.

All of these research areas present exciting opportunities for faculty and students. Section 5.3 (pp. 54-57) describes strategies for widespread student participation and course involvement. Sections 5.4-5.8 (pp. 58-71) describe revitalization projects that could incorporate all of the topics listed above. There is also a need for formal administrative oversight research in the RBC riparian corridor and subwatershed. For this purpose, Section 5.1 (pp. 46-49) proposes a RBC Committee which is run by a RBC Director.

Figure 3.5: Biology Growth Site

Figure 3.6: iUtah Water Quality Station

In projects at other universities comparable to the RBC Strategic Vision and revitalization project (especially North Carolina State University and the University of Georgia), the goals and objectives are expected to grow and evolve over time. We propose the same approach at the University of Utah, with the RBC director and committee (see Section 5.1, p. 46) reviewing the goals and objectives annually, assessing metrics and indicators, and making modifications as necessary.

Goal #1

DISCOVERY, CREATION, AND APPLICATION OF KNOWLEDGE

Advance knowledge of urban streams to revitalize the ecological functions of, and the human relationships with, Red Butte Creek

Objectives

1A) Utilize the campus as a living lab to evaluate methods of urban stream restoration.

1B) Identify and halt the causes of environmental degradation including erosion, reduced water quality, and reduced habitat quality.

1C) Advance knowledge of the relationship between land use practices and policies, the built environment, and stream ecohydrology.

1D) Study human use and response to riparian site and landscape designs.

1E) Gather baseline data and create monitoring metrics to assess the progress of objectives 1A-1D.

Figure 3.7: Biology Growth Site

From top to bottom:
GCSC Students, Friends of RBC logo, BioWest Research, Undergraduate Honors Think Tank

Goal #2

DISSEMINATION OF KNOWLEDGE

Promote interdisciplinary, active learning that advances stewardship, sustainability, and watershed revitalization

Objectives

2A) Utilize Red Butte Creek as an educational resource across campus, from natural sciences, to social sciences, engineering, humanities, and the arts.

2B) Involve students in research, analysis, planning, design, adaptation, and program monitoring activities.

2C) Integrate RBC into campus life through the development of safe access points and infrastructure.

2D) Develop demonstration projects as exemplary case studies for other institutions and municipalities.

Goal #3

COMMUNITY ENGAGEMENT

Promote awareness of RBC on campus, heighten local understanding of its social and ecological value, and provide a beautiful natural amenity for the University of Utah, Research Park, and Salt Lake City communities

Objectives

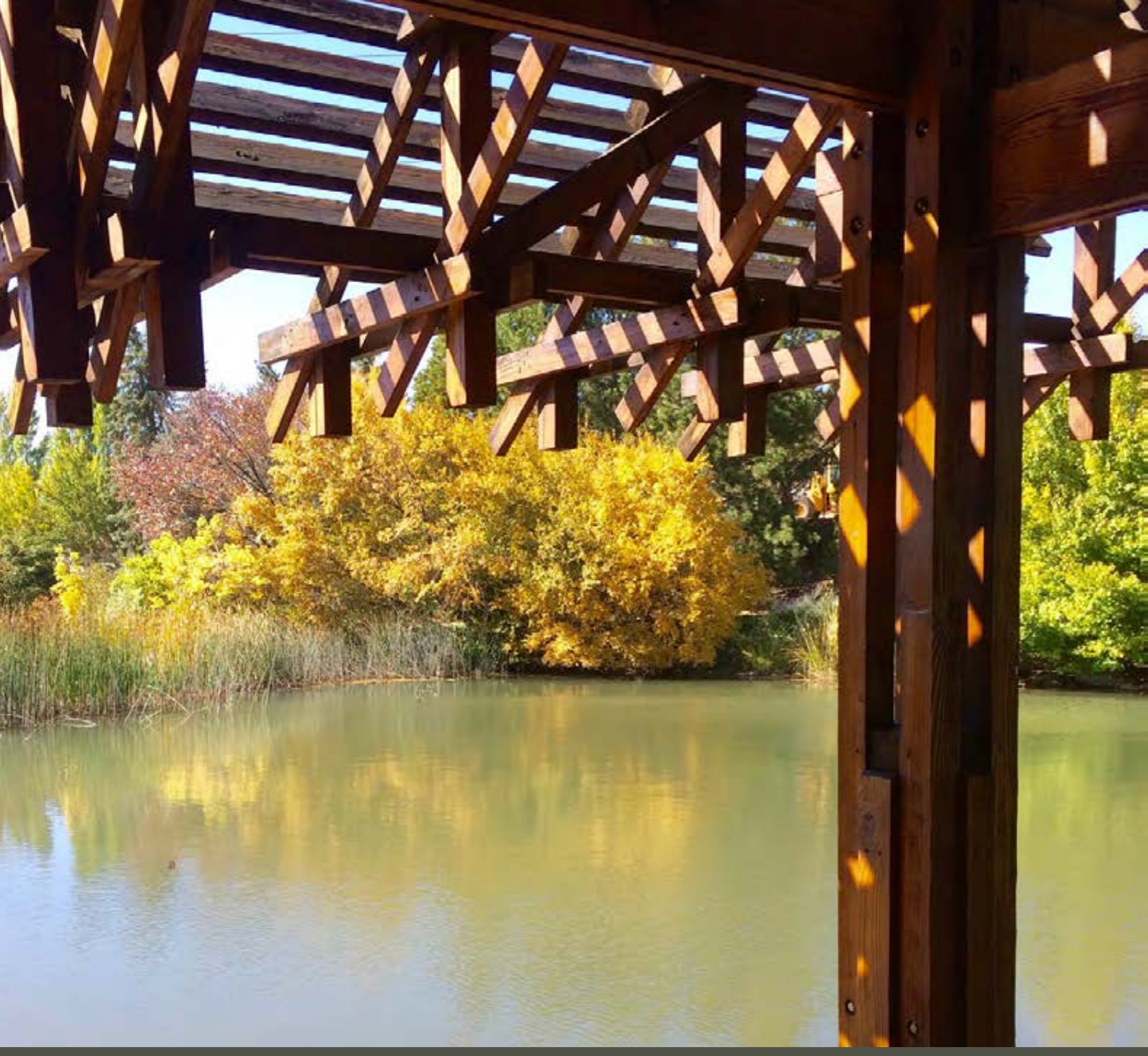
3A) Provide opportunities for the community to experience and appreciate Red Butte Creek, creating a space that is functional and attractive without compromising stream health and functioning.

3B) Coordinate with local schools and environmental education programs to promote outdoor learning opportunities for K-12 students.

3C) Participate with Salt Lake City, Salt Lake County, the State of Utah, and other community partners on stewardship and sustainability initiatives.

From top to bottom:
Community Clean Up, K-12 Education Programs, Community Workshop, Public Bench by Creek

Dave Bowling,
iUtah RBC Instrument Technican



Stakeholder Engagement

4

KEY PUBLIC OUTREACH FINDINGS

POINTS OF ENTHUSIASM

- Trail access and campus connectivity
- Green infrastructure experimentation and large-scale application
- Environmental stewardship
- Creating new knowledge
- Creating a unique campus amenity and identity
- Establishing a 100-foot low-impact area along the riparian corridor

POINTS OF CONCERN

- Will the university create binding and enforceable policies?
- Will future land use and infrastructure support the RBC Strategic Vision?
- Can research capacity and support keep pace with infrastructure development?
- Will there be a reliable O&M budget?
- Can human use be balanced with environmental protection?

Community outreach activities for the RBC Strategic Vision involved small focus groups of key stakeholders, who were convened to provide early input on the content and direction of the vision.

The stakeholder engagement process took place during spring of 2015. PhD candidate Robin Rothfeder conducted outreach meetings with 63 participants from Salt Lake City, Salt Lake County, the State of Utah, local neighborhood and community councils in close proximity to RBC, University of Utah faculty, facilities staff, and students. Table 4.1 lists the stakeholder groups and the representatives engaged during this process.

The outreach meetings were small to medium (10-20 person) focus groups tailored for each set of stakeholders, generally lasting 1½-2 hours. Prior to the meetings, participants were provided with draft versions of the mission statement, goals and objectives, and planning principles (see Section 5, p. 43) for the RBC Strategic Vision. Each focus group then covered five subject areas: introducing the need and purpose of revitalizing RBC; obtaining feedback on the mission statement; obtaining feedback on the goals, objectives, and planning principles; discussing and evaluating different implementation strategies and demonstration project concepts; and identifying other comments, interests, and concerns. Interactive materials for participants included maps, photographs, a large notepad for brainstorming, and copies of relevant draft documents.

Stakeholder Group	Representatives
Salt Lake City	Public Utilities, Parks & Public Lands
Salt Lake County	Watershed Protection & Restoration Program, County Mayor
State of Utah	Jordan River Commission
Neighborhood and Community Councils	Yalecrest, Sunnyside East, East Central
U of U Faculty	Biology, Computing, Engineering, Anthropology, Geology & Geophysics, Political Science, Undergraduate Studies, Environmental & Sustainability Studies, Parks Recreation & Tourism, Architecture, City & Metropolitan Planning
U of U Facilities	Campus Planning, Grounds & Open Spaces, Environmental Health & Safety, Real Estate Administration, Red Butte Garden
U of U Students	Biology, Engineering, Environmental & Sustainability Studies, Parks Recreation & Tourism, Architecture, City & Metropolitan Planning

Table 4.1: Stateholder Groups Engaged

Focus Groups

Four official focus groups were conducted with: University of Utah faculty, undergraduate students, staff and administrators, and representatives from the larger community (e.g. community council representatives, city and county employees, etc.). R. Rothfeder facilitated the meetings, and a graduate student volunteer recorded the minutes. The meetings were structured to maximize stakeholders' opportunities for active participation and provide substantive feedback. In addition, many small group and individual consultations were held with stakeholders unable to make the larger meetings. These used the same interactive materials and covered the same subject matter as the official focus groups.

Several consensus findings emerged from the stakeholder outreach efforts. First, all of the stakeholder groups showed support for the mission, goals, objectives, and planning principles of the Red Butte Creek Strategic Vision. A campus amenity that demonstrates environmental stewardship, promotes sustainability, advances best management practices, facilitates cutting edge research, and supports place-based education holds a strong appeal for people both on and off campus.

Second, all of the stakeholder groups had clear priorities for plan implementation strategies, showing widespread support for two concepts: trails, and low impact development/green infrastructure (LID/GI). Both strategies generated significant interest in all of the meetings.

Stakeholders are particularly interested in trails, steps, and public access to RBC. Students, faculty, staff, and the broader community all see the potential for a high quality aesthetic and recreational amenity. At the same time, all stakeholder groups perceive that it is necessary to find a balance between community access and riparian corridor integrity: the corridor should

Figure 4.1: Mayor Ralph Becker speaking at 2013 Friends of Red Butte Creek event

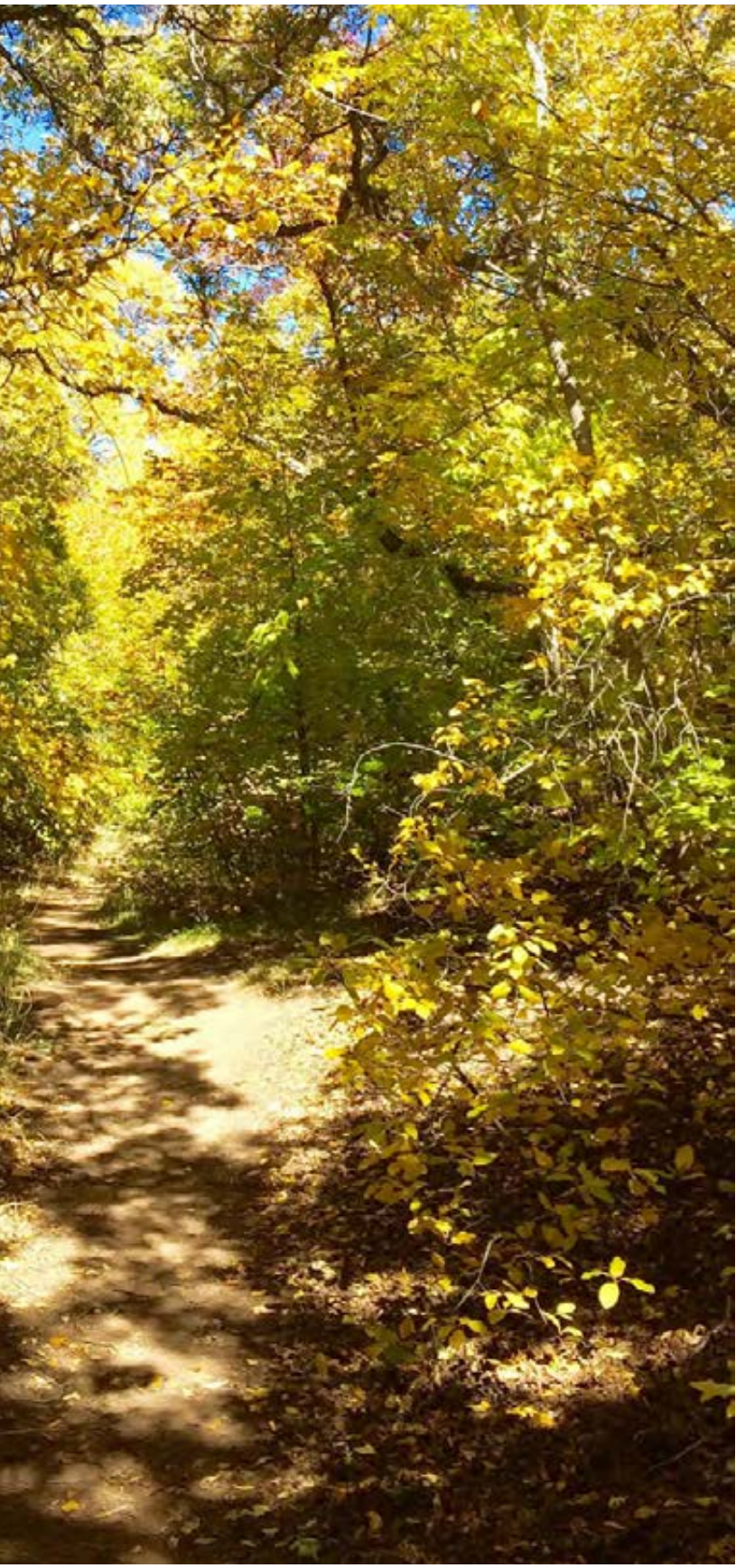
not be compromised and degraded to support public use. There is a consistent belief that such a balance can be struck with careful planning and design and with enforceable policy commitments.

Stakeholders are also interested in options for green infrastructure to mitigate stormwater runoff, including bioswales, green roofs, rain gardens, and other forms of rain capture. The interest includes not only the scientific and experimental potential of LID/GI, but also the larger-scale application of research findings in watershed management. Designs would be developed in collaboration with researchers and students in the natural sciences, social sciences, and engineering, who would monitor the outcomes in order to inform future plans for renovating and retrofitting properties in the RBC watershed.

An important development from the outreach efforts is a high level of interest from Salt Lake City and Salt Lake County. In particular, the County Watershed Protection and Restoration Program expressed a desire to collaborate on channel improvement projects and Salt Lake Public Utilities expressed a desire to collaborate on possible trails, as well as measures to protect the creek from future point-source pollution. In both cases, there may be a possibility of creating funding partnerships.

Another important development is a high level of interest by Environmental Health and Safety, Campus Planning, and Landscape Maintenance. All three departments are enthusiastic about revitalization efforts in the riparian corridor and subwatershed, and all three will be central to the success of those efforts. Campus Planning has designated a project manager for activities pertaining to Red Butte Creek who will help to coordinate future planning, design, and implementation activities.

Some stakeholders expressed reservations about effective implementation of the strategic vision, particularly with regard to developing a management plan that will be binding and effective over time. As a result, stakeholders favored enforceable campus design standards, such as binding language to protect the riparian buffer zone voted on by the Board of Trustees. Discussions focused on the idea of a “low

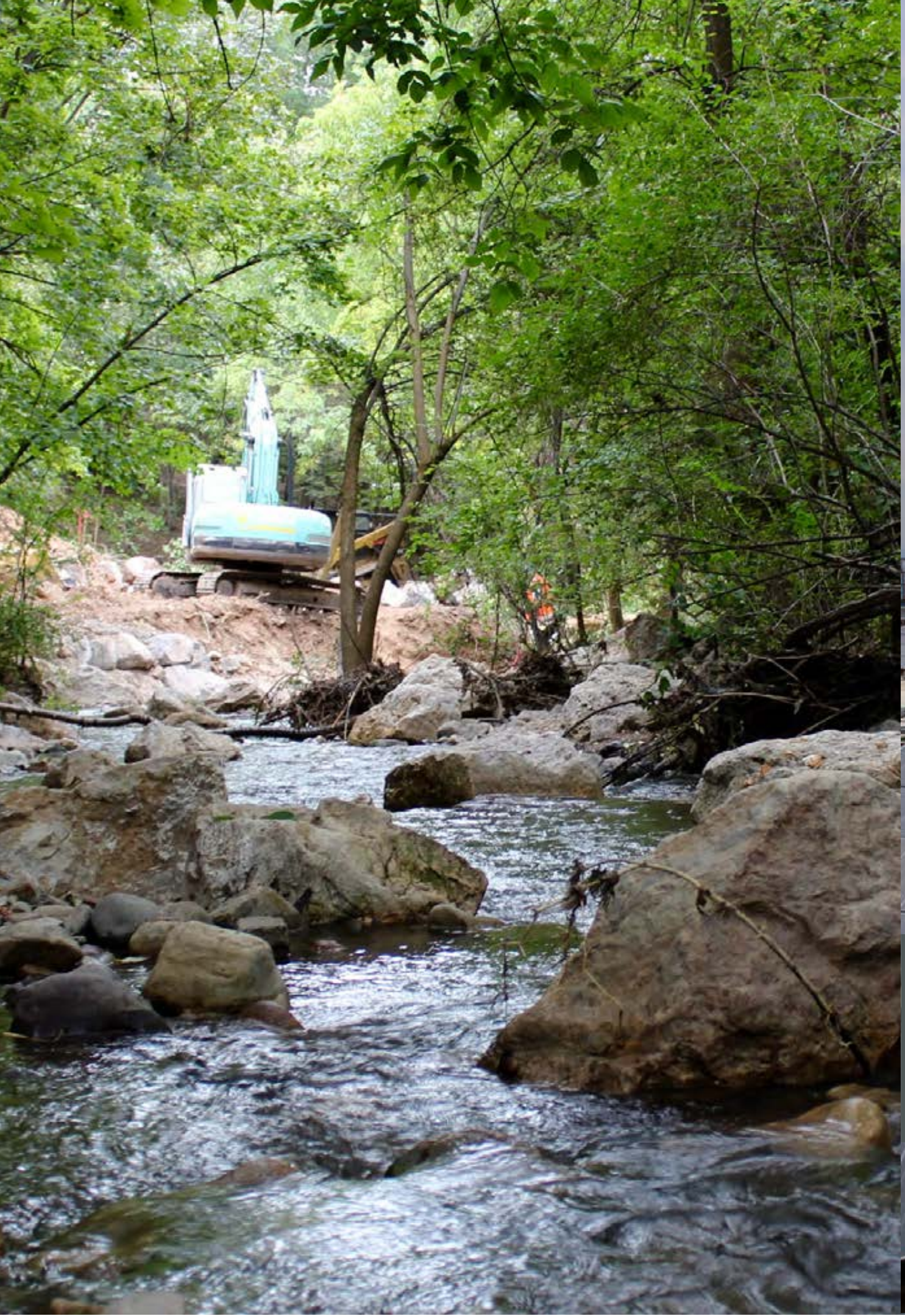


impact area," modeled after Salt Lake City's Riparian Corridor Overlay zoning district (see Section 5.1, pp. 46-49). The low-impact area allows site maintenance, removing invasive vegetation and planting native vegetation, and outdoor projects that do not require heavy equipment. Under a permitting process, more extensive activities can be authorized. All of the stakeholder groups showed support for creating a 100 -foot low-impact area along RBC through campus.

In a similar vein, stakeholders also expressed the concern that future land use and construction decisions will be at odds with the RBC Strategic Vision. In particular, there were concerns about new land acquisitions (in Research Park and Fort Douglas) or other projects that would infringe on the riparian corridor, increase impervious cover in the subwatershed, and further degrade the creek. It was agreed that both formal administrative oversight, as well as a succession plan for Research Park and Fort Douglas properties, would alleviate this concern.

Overall, the focus groups revealed a great deal of excitement and a strong overall consensus around the Red Butte Creek Strategic Vision. Moving forward, ongoing outreach activities will continue to build an even broader consensus and will obtain more specific feedback on a completed draft of the strategic vision.

Following the finalization of this vision, we suggest a public comment period and additional stakeholder engagement process involving individual meetings with land owners and property managers adjacent to RBC in order to identify future collaborators and specific implementation opportunities. Those approached would include: Research Park properties, Fort Douglas, the Salt Lake City Regional Veterans Affairs Office, and the LDS Church on Sunnyside Ave. These outreach efforts would also involve continuing discussions with the Salt Lake City Department of Public Utilities and the Salt Lake County WPRP.



Implementation 5

We propose three focus areas for implementing the RBC Strategic Vision. The first category of implementation strategies addresses University of Utah policies and administrative structures for managing the RBC riparian corridor and subwatershed. The second category addresses revitalization project concepts, including specific proposals for demonstration projects that can build momentum for the strategic vision and show early proof of success. The third category focuses on opportunities for community engagement and public life.

There are three planning principles for implementing the RBC Strategic Vision. First is the understanding that RBC and its watershed are an interconnected system. Policies and activities across the university have an impact on RBC, not only as it runs through campus, but all along its riparian corridor and throughout the Jordan River Basin. The second principle is the idea of campus as an interface, or transition zone, between the mountain wildlands and the urbanized valley floor. The University of Utah can enhance this interface, creating a unique space that is neither fully protected nor fully urbanized. The third planning principle is that planning and design activities should seek to reimagine and reintegrate campus life around RBC, creating a one-of-a-kind resource that will become a definitive component of the University of Utah's sense of place.

In implementing the RBC Strategic Vision, the timing of specific projects will depend upon university, donor, grantor, and property managers' priorities. Here, the implementation strategies are described in approximate chronological order, along with time frame and cost estimates. It is important that individual implementation projects be linked and phased in a way that supports the overall Strategic Vision. This is necessary in order to achieve the holistic goals and objectives listed in Section 3 and to create a coherent campus space that is beautiful, functional, and fully utilized.

Some of the implementation strategies are potential demonstration projects. A demonstration project will provide an early example of the RBC Strategic Vision in action, building momentum for the plan in its entirety. The project must be of an appropriate scale and feasible in an appropriate timeframe to fulfill the intended purpose. Potential demonstration projects that meet these criteria are highlighted below.

IMPLEMENTATION STRATEGIES

<u>First Focus Area</u>

1) Creek Administration
2) Design Standards
3) Student Participation and Course Involvement

<u>Second Focus Area</u>

4) Trail System
5) Green Infrastructure
6) Culvert Replacement
7) *Williams Building
8) *LRB 04C

* Denotes potential demonstration project

<u>Third Focus Area</u>

9) Community Engagement
    a. Cleanup
    b. K-12 Education
    c. Three Creeks Park

1. Creek Administration

Time Frame: 0-6 Months
Cost: ~ $1-3 million
Objectives Met: 1A, 1B, 1C, 1D, 1E, 1F, 3C

OVERVIEW

There is an immediate need for a formal administrative structure for setting and enforcing policies that protect and enhance Red Butte Creek. RBC administrators must be able to advocate for the creek, to advance activities that promote revitalization, to disallow or modify activities that cause degradation, and to coordinate and implement the various components of the strategic vision.

There are two main areas of activity that require administrative oversight: infrastructure and research. Infrastructure includes buildings, parking facilities, outdoor structures (decks, fences, paths, etc.), stormwater management facilities, and other built structures, both within the riparian corridor and throughout the subwatershed. Research projects may involve a variety of activities in and near the creek, driven by faculty interests and by courses and student-led activities.

As described in Section 3, the research agenda for this strategic vision focuses on developing and testing strategies for achieving ecological revitalization through activities and designs that enhance RBC as a valued campus amenity. Within this focus, some research areas are inherently associated with infrastructure, such as designing low-impact development and green infrastructure (LID/GI) stormwater systems, constructing paths and trails, altering existing landscape characteristics, and modifying the stream bank or channel. Similarly, many infrastructure issues will directly impact research and revitalization, especially increasing impervious cover in the subwatershed and/or fragmenting the riparian corridor through new buildings and parking facilities. For these reasons, it is important that infrastructure and research oversight occur in tandem.

PROPOSED ADMINISTRATIVE STRUCTURE FOR RBC

In the State of Utah, the Department of Facilities and Construction Management (DFCM) is responsible for all work on state property, including the university. On campus, the state has delegated to the university the authority to oversee and conduct projects under $10 million. The Associate Vice President for Facilities Management (AVP FM) is responsible for directing such work under specific state approval guidelines. Ultimately, all work on campus, including RBC and its subwatershed, must conform to the guidelines of the institution and the state and must be conducted under the jurisdiction of the AVP FM. Typically, such campus infrastructure projects are overseen by a steering committee, which receives reports from and delegates to a working committee as needed.

Consistent with current campus administration, we recommend the creation of a Red Butte Creek Committee, supervised by an RBC Director and by the Director of Campus Planning. The RBC Committee would be appointed by the supervisors and would include a group of faculty experts in natural sciences, engineering, and social sciences, as well as the appropriate representatives from University administration and facilities management. They would evaluate, authorize, and monitor research proposals pertaining to the creek; identify infrastructure projects to advance the goals of the strategic vision; and provide technical expertise on the likely social and ecological impacts of proposed construction projects (such as new parking structures). In reporting to steering committees for specific projects, the RBC Committee would ensure that proposed activities are consistent with the research and revitalization agenda of the strategic vision.

We further recommend that the RBC Director be included as a member of the steering committee for any campus infrastructure project associated with RBC, or in their absence to appoint a member of their choice from the RBC Committee. The purview for the RBC Director's committee membership would include any projects within the 100-foot low-impact area (see Figure 1.5, p.7, and Section 5.2, pp. 50-53), within the sub-catchment

areas that drain surface water to the creek (See Figure 2.15, p. 19), and that would impact the storm sewer infrastructure that drains to the creek (see Figures 2.12 and 2.13, p. 18). As a steering committee member, the RBC Director or their appointee would thus be responsible for helping to structurally implement the RBC Strategic Vision and for ensuring that campus activities along RBC, within its subwatershed, or otherwise connected with the creek (e.g. through stormwater discharge) are consistent with the mission, goals, and objectives of the strategic vision. Further, the RBC Director or their appointee would ensure that infrastructure projects properly follow the university's RBC-specific policies and permitting requirements (such as the updated campus design standards, see pp. 50-53).

This proposed administrative structure is modeled after the UC Davis Putah Creek Riparian Reserve. It will require the University of Utah to create a position for an RBC Director, to establish a formal RBC Committee, and to vest the RBC Director as a member of appropriate project steering committees.

The RBC Director and Committee would also provide guidance for property succession within the RBC subwatershed. In Research Park, half of the creekside properties are currently owned and managed by the University of Utah (Red Butte Garden, School of Dentistry, and Orthopedic Center) or by the University of Utah Research Foundation (Williams Property and Dumke Health Professions Building) (See Table 2.1, p. 17). The remaining properties are leased and managed by third party tenants. Of these, only one will see the current lease expire within the next five years (360 Wakara Way, lease expiring 2019); the other properties are under long-term leases not set to expire for over 30 years (390, 400, 420, and 480 Wakara Way). In addition, a federal mandate has called for the eventual transfer of the remaining Fort Douglas property on campus to the university.

These creekside properties are important to the mission, goals, and objectives of the RBC Strategic Vision and will form highly visible components of plan implementation. Therefore, property managers will need to be engaged as collaborators well before the long-term leases expire. We recommend that the University of Utah: 1) engage current leaseholders (and Fort Douglas) in project implementation within their existing lease terms; 2) re-draft the Research Park Design Standards with language and policies comparable to the updated Campus Design Standards proposed in this document; 3) engage current leaseholders (and Fort Douglas) in rewriting leases as necessary to support the mission, goals, and objectives of the RBC Strategic Vision; 4) commit to set the terms of future leases in support of the RBC Strategic Vision; and 5) develop a long-term plan for the RBC riparian corridor and subwatershed based on university management of all relevant properties. It will be the responsibility of the RBC Director and Committee to ensure that as the university assumes ownership of new parcels, these are managed in such a way that is consistent with the strategic vision and with the encouraged and prohibited activities listed below.

For the ultimate success of the RBC Strategic Vision, an additional need identified not only by the RBC Steering Committee but also by most stakeholder focus groups is a dedicated operations and maintenance (O&M) budget to support the vision over a long time frame. The RBC Strategic Vision is one of the top three development priorities for the University of Utah Sustainability Office; as support is raised, an appropriate O&M budget should be established. In addition, the RBC Steering Committee identified the need for a central archive that houses and makes publicly available the RBC Strategic Vision and the data that both precedes and is created as a result of this document. This effort should be a collaboration with the Sustainability Office's Campus Green Map and the Marriott Library's sustainability data archive.

Lastly, the Williams Property demonstration project is developing a new approach to integrating campus planning and design with faculty expertise and research by arranging for a campus design committee to coordinate with the hired design consultant. This should serve as a model for future RBC Strategic Vision projects, with design team leaders appointed by the RBC Director and Committee.

Next Page:
Top: Brett Boyer, iUtah RBC Instrument Technican
Bottom: Williams Property Design Committee Meeting


"YOU HAVE TO GET OVER
THE COLOR GREEN.
GARDENS AND LAWNS.
WALLACE STEGNER

2. Design Guidelines

Time Frame: 0-6 Months
Cost: $12,500
Objectives Met: 1A, 1B, 1C, 1D, 1E, 1F, 3C

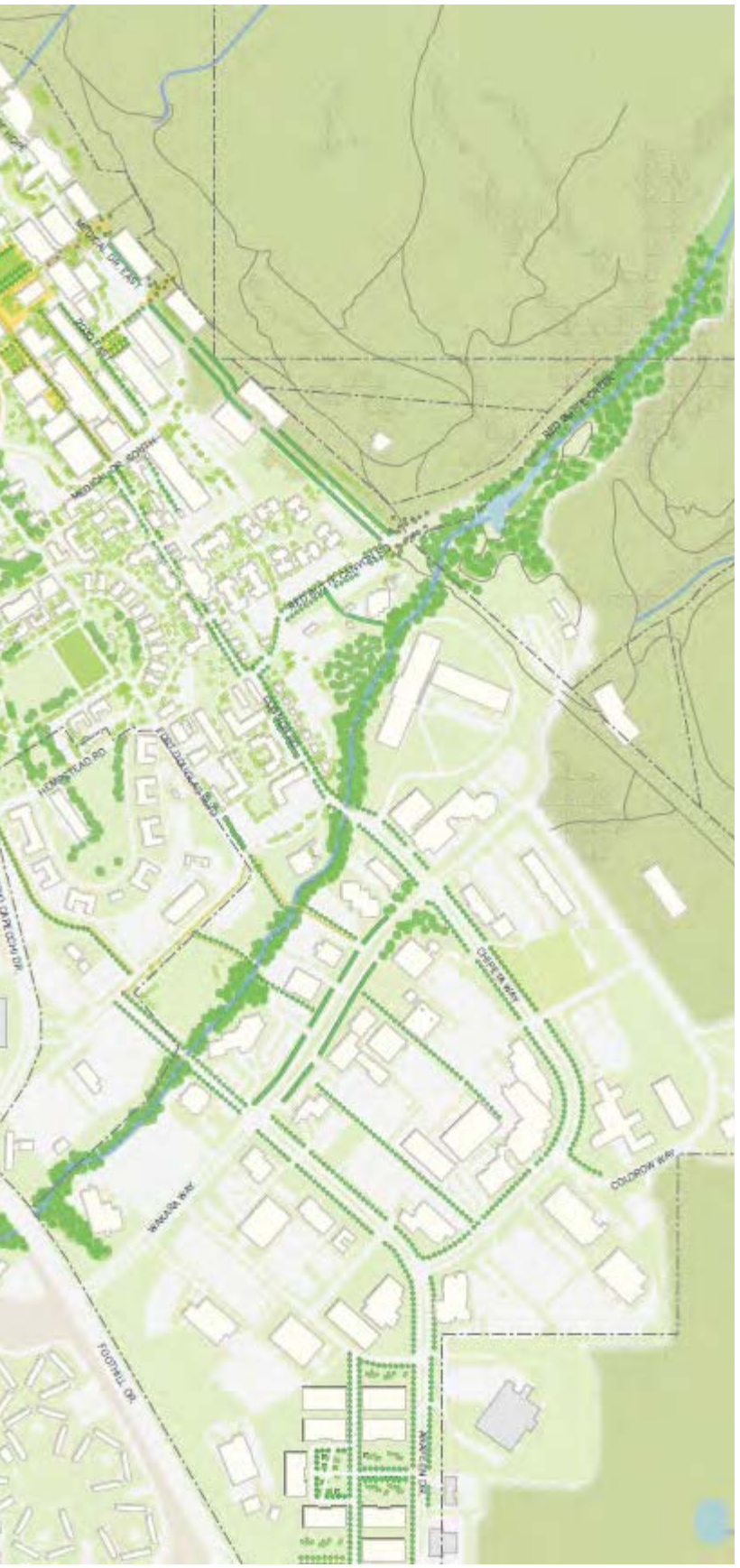
The University of Utah Campus Design Standards "form the core standard for architectural/engineering services" on campus. The Research Park Design Standards perform a comparable function in Research Park. More than the non-binding Campus Master Plan, the design standards represent an enforceable policy commitment that can be utilized to support the revitalization of RBC.

A key function of the RBC Committee will be to interpret Campus and Research Park Design Standards pertaining to RBC. Some of these are already in place across the university, including the RBC subwatershed. To protect the riparian corridor, and to further protect the subwatershed, additional design standards are also recommended. Carefully crafting these standards is a key mechanism for achieving this vision.

The 100 -foot RBC riparian corridor buffer zone, established by the University Board of Trustees, is the first step toward updating the design standards. This zone is similar to the 100 -foot Riparian Corridor Overlay (RCO) District established by Salt Lake City (Ordinance 62, 2008). However, since university property is not subject to the RCO, the campus must establish its own regulatory standards.

The RCO divides the 100-foot riparian buffer into three sections: the no disturbance area (O-25 feet), the structure limit area (25-50 feet), and the buffer transition area (50-100 feet). On undeveloped land, the RCO extends the no-disturbance area through the full 100-foot buffer. The no disturbance area allows site maintenance, removing invasive vegetation and planting native vegetation, and outdoor projects that do not require heavy equipment, such as paths and stairs, fencing, open patios and decks, and low-impact stream crossings. Commercial parking lots are forbidden throughout all three sections.

Campus Landscape Plan



An intact riparian corridor that is not fragmented by the built environment holds tremendous value for the ecological, aesthetic, and interactive function of RBC. Compared to the dense residential fabric downstream, there are few vested property owners along the campus reaches of the creek. The university can update the Campus Design Standards to create a no-disturbance area, referred to here as the "low impact area," throughout the 100-foot buffer zone, with certain more extensive restoration projects allowable following a permitting process. If long-term revitalization efforts are to be successful, this is a necessary first step. To do so, a detailed proposal to establish a 100-foot low-impact area as a new campus design standard that meets the criteria described here must be submitted to, and approved by, the Chief Design and Construction Officer and the Director of Campus Planning. Additionally, the Research Park Design Standards can be updated to establish a 100-foot low-impact area following a two-thirds vote of property managers. Beyond the 100-foot corridor, we also suggest language that encourages some land uses and regulates others throughout the subwatershed, in order to promote revitalization activities.

At present the University of Utah Campus Design Standards have six sections: (1) General, (2) Codes, Laws, Rules, and Regulatory Requirements, (3) DFCM Requirements, (4) Landscape and Irrigation Standards / Detail Drawings, (5) LEED and High Performance Building Rating System, (6) Summary of Products and Vendors. Design standard updates to protect the RBC riparian corridor may necessitate a new seventh section – Red Butte Creek – in order to fully define the low impact area and the subwatershed, to enumerate the permitting requirements, and to specify prohibited and encouraged land uses. The Research Park Design Standards may similarly require a new section focused on Red Butte Creek.

Here we list the proposed encouraged and prohibited uses, both permit-requiring and unpermitted.

Encouraged Activities, Permit Not Required

a. In the 100-foot low-impact area, the following unpermitted activities are encouraged:

   i. Remove trash and storm debris.

   ii. Reduce or eliminate landscape irrigation, mowing, and chemical application.

   iii. Train maintenance staff in riparian corridor best management practices.

b. In the subwatershed drainage area, the following unpermitted activities are encouraged:

   i. Reduce irrigation and chemical applications to outdoor landscapes.

   ii. Employ water-wise landscaping and rain infiltration.

   iii. Prioritize pedestrian and bicycle mobility and connectivity over automobiles and parking facilities.

Encouraged Activities, Permit Required

a. In the 100-foot low-impact area, the following permit-requiring activities are encouraged:

   i. Remove invasive plant species.

   ii. Plant noninvasive vegetation from an approved list.

   iii. Remove diseased or dead trees or other vegetation.

   iv. Facilitate safe access and community use with low impact paths, trails, stairs, benches, signage, crossings, fences, decking, etc., provided these activities do not change the existing grade and do not require the use of heavy machinery.

   v. Replace infringing impervious surfaces with pervious land cover.

   vi. Install and maintain erosion control devices.

   vii. Replace closed culverts with open box culverts.

b. In the subwatershed drainage area, the following permit-requiring activities are encouraged:

   i. Design land use to restore pre-development stormflow hydrological characteristics.

   ii. Encourage retrofitting of hardscaped, ‘grey’ stormwater infrastructure with LID/GI designs.

Prohibited Activities, Exemptions by Permit

a. In the 100-foot low-impact area, the following activities are prohibited:

    i. New construction of any buildings.

    ii. New construction of any parking facilities.

    iii. Any work with heavy machinery is prohibited. The Chief Design and Construction Officer may grant an exemption if the applicant submits a proposal demonstrating that a project is necessary to advance the RBC Strategic Vision and that sufficient mitigation measures are feasible.

b. In the subwatershed drainage area, the following activities are prohibited:

    i. Construction activities shall not increase impervious surfaces in the subwatershed and shall not increase stormwater runoff into RBC. The Chief Design and Construction Officer may grant an exemption if the Applicant submits site-specific LID/GI designs that provide mitigation of potential hydrologic and water quality impacts.

    ii. Land uses that pose a high risk of point source pollution or acute accidental contamination are prohibited.

c. The RBC Committee shall grant an exception and expedited permit if deemed necessary for public health and safety.

3. Student Participation

Time Frame: 8-16 Months

Cost: ~ $0-2 million

Objectives Met: 1A, 1C, 1E, 1F, 1G, 1H, 1I, 2A, 2B, 2C, 2D

COURSE WORK

Currently, at least nine courses at the University of Utah have focused their teaching efforts around Red Butte Creek:

- GCSC Global Changes and Society (BIOL 7961/SUST 6000)
    - 2012: Red Butte Creek Project
    - 2013:
        - Friends of Red Butte Creek
        - Photo-journal
        - K-12 Lesson Plans
        - Layered PDF Map
        - Mini-grants
- Undergraduate Honors Think Tank (HONOR 3700)—An Assessment of Water: Awareness, Use, Education, and Sustainability at the University of Utah
- Introduction to Behavioral Science Foundations (PRT 6010)—Community-engaged learning focused on identifying, evaluating, and mapping student preferences for trail features, routes, quality, access, and uses in the RBC riparian corridor on campus
- Urban Ecology (BIOL 5440, CMP 6610)—RBC Planning and Design for restoration, stewardship, and recreation
- Urban Watershed Management (CVEEN 7440)—Hydrologic modelling of RBC at the subwatershed scale and proposal for LID/GI implementation on campus and in Research Park
- Land, Law & Culture (CMP 4260)—Uses RBC as a case study to combine historical, geographic, policy, and public administration approaches to gain a better understanding of how the physical landscape, economic activity, and public policy mutually influence each other
- Biography of an Urban Stream (BIOL 3480)—Uses Red Butte Canyon as a case example to discuss and explore the human/water dynamic from biophysical, cultural and socioeconomic perspectives
- Groundwater (GEO 5350)—Uses RBC as a case study/project area
- Geochemistry (GEO 5660)—Class projects measuring stormwater outfall chemistry on campus

Figure 5.1: Brett Boyer and Ka-Voka Jackson, iUtah RBC Instrument Technicans

In addition to these, the GCSC 2012 Red Butte Creek Project identified more than 100 courses in over 25 departments that could utilize RBC as an

educational resource. Students in Atmospheric Sciences, Biology, Chemistry, Engineering, Geology & Geophysics, and Physics could use the creek as an outdoor field laboratory, conducting site visits and taking scientific measurements (as in BIOL 5400 or GEO 5350). Students in Anthropology, Communication, Education, Environmental Studies, Family and Consumer Studies, History, Psychology, Parks Recreation & Tourism (PRT), and Sociology could use the creek to explore human-nature relationships, public health, environmental and natural resource policy, and strategies in environmental education and communication (as in HONOR 3700 or BIOL 3480). Students in Architecture, Economics, Geography, Political Science, Public Administration, PRT, and City & Metropolitan Planning (CMP) could use the creek as a case study site for designing policies, plans, maps, trails, and other applied skills (as in SUST 6000 or CMP 4260). Students in Art, English, Environmental Humanities, and Writing could use the creek as a place for generating and displaying creative works (as in SUST 6000).

As described above (p. 44), a key theme of the RBC Strategic Vision is reimagining and reintegrating campus life around the creek. Widespread educational use in university courses is one of the most important ways to realize this theme. Supporting infrastructure will help to make RBC a more convenient teaching tool. Section 5.4 (pp. 58-59) describes a system of trails and steps that would provide connectivity across campus to RBC, as well as safe access along and even down to the creek. Section 5.7 (pp. 64-67) highlights two locations on the Williams Property that could serve as outdoor classrooms, including a patio immediately adjacent to the creek and a large amphitheater at the southeast corner of the building.

Equally as important as supporting infrastructure is buy-in and participation from faculty across campus. Many campus entities can help to encourage course involvement with RBC, including the Sustainability Office, the Vice President of Faculty, the RBC Committee, the GCSC, and the Center for Teaching and Learning Excellence (CTLE). To further encourage instructors to include RBC in their syllabi, the university may attempt to incentivize multi-department, interdisciplinary courses through small seed grants. Over time, if course visitation rates are sufficiently high and with noticeable impacts, then the RBC Committee may need to develop a scheduling system and usage rules for visiting classes.

Figure 5.3: Amphitheatre behind the Williams Building along Red Butte Creek

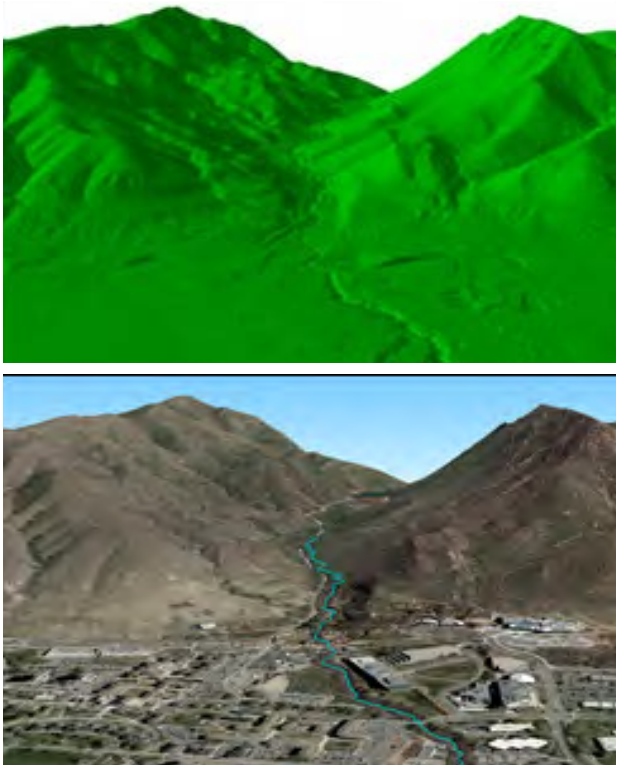


Figure 5.2: SUST 6000 Student Mapping Project; Dudley (2013)

RESEARCH

RBC is also a resource for students to be involved in research projects. Dozens of students associated with iUTAH, the GCSC, CMP, and PRT have utilized the creek as a research site. Since the revitalization of RBC will be research-driven, this means that students will have the opportunity to apply their work to the benefit their own campus and community.

Figure 5.4: John Lillquist, iUtah RBC Instrument Technican

Creating a dedicated budget for research in the subwatershed would contribute substantially to realizing the RBC Strategic Vision. This would ensure that revitalization projects and associated research activities have the necessary support at the appropriate time. The GCSC is prioritizing fundraising and research proposals focused on RBC. Prior to the creation of a dedicated budget, the Sustainable Campus Initiative Fund (SCIF) is a well-suited existing funding source for student research. For example, SCIF recently approved a large student-proposed grant to monitor the quality of stormwater entering RBC on campus. All told, more than thirty students, from undergraduates to post docs, will help to complete this project. Additional resources allocated to student and research involvement will promote more rapid implementation.

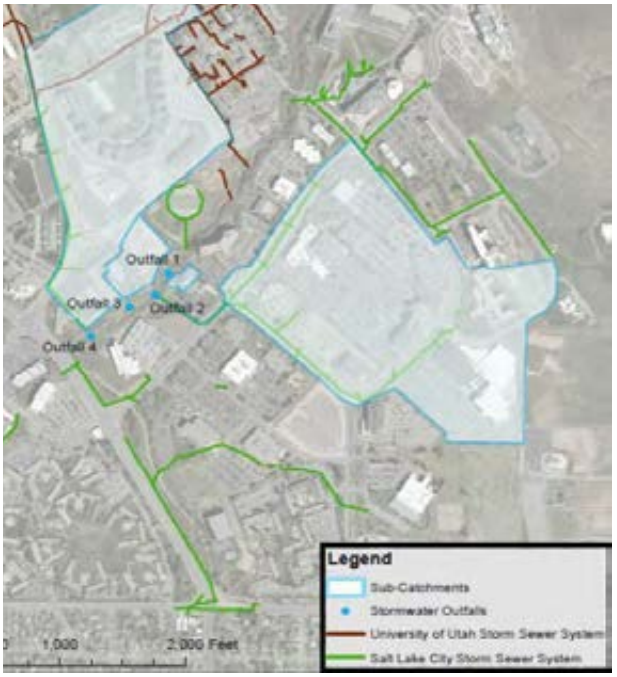


Figure 5.5: Red Butte REHAB Student Research

PLANNING AND DESIGN

Opportunities for students to participate directly in planning and design activities is an important aspect of the RBC Strategic Vision. These may involve engineering students helping to design and implement LID/GI solutions, Parks Recreation & Tourism and CMP students helping to design and implement trails and signage, biology and geology students helping to develop metrics and to track project impacts over time, or art and architecture students helping to create beautiful aesthetic places. There will be many opportunities for applied, real-world learning opportunities in the enhancement, reintegration, and revitalization of Red Butte Creek. For example, a popular idea amongst stakeholder focus groups was a student design competition to reimagine the small strips of impervious land cover that currently infringe the 100-foot low-impact area.

The expectation of including students in campus planning and design activities will place additional responsibilities on project managers carrying out the RBC Strategic Vision. Although consulting firms are commonly engaged by the campus in developing planning and design documents, the learning opportunities in planning and design of RBC are entirely unique, and students and faculty can play a unique role that aligns with the university's mission. Examples include the BIOL 7961 Red Butte Creek Project, the CMP 6610 Red Butte REHAB Project, and the HONOR 3700 Assessment of Water. The RBC Strategic Vision itself is also an example of student participation in planning and design processes, to the benefit of both the student and the university.

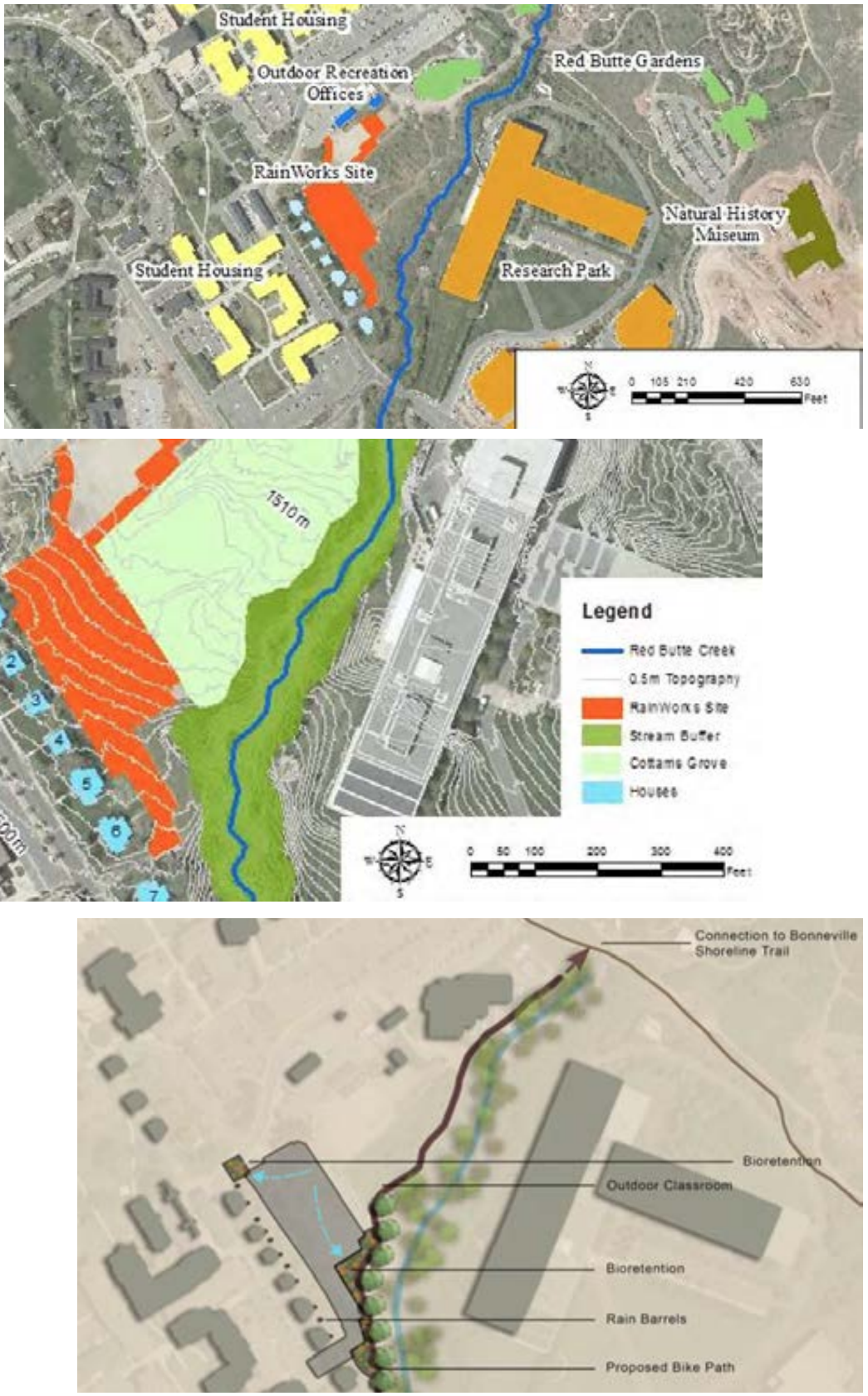


Figure 5.6: Student LID/GI and trail designs
Source: Rain Drops to Rain Gardens (2012)

4. Trail System

Time Frame: 1-5 years
Cost: $50,000 - 250,000
Objectives Met: 2A, 2B, 2C, 2D, 3A, 3B, 3C

Safe and convenient access to RBC by trail is a high priority for stakeholders. As described above, stakeholders understand that access must be balanced with riparian corridor integrity and stream and habitat quality. To this end, there is a great need for safe access and transportation corridors for bicycles and pedestrians near the border or outside the 100-foot buffer zone. Where appropriate and permitted by the updated design standards, closer trails and periodic step access to the stream itself should also be considered.

A trail system will be crucial if RBC is to become a community amenity to connect the riparian corridor with the campus fabric, and to facilitate research and teaching opportunities. Trails will also provide visitors to the Marriott Hotel or Williams Building, patients at the Orthopedic Center, and other onsite occupants with opportunities for recreation and exercise, access to campus and local businesses, and even outdoor physical therapy for patients.

Trails along and across RBC should include directional and educational signage that informs visitors about revitalization projects and onsite research, as well as the history and ecology of the creek. This is an excellent opportunity for public outreach, education, and dissemination of research. Where feasible, trails should also meet ADA requirements and should offer wheelchair accessibility.

The University of Utah Bicycle Master Plan proposes a paved shared-use path to run along RBC. However, we recommend that any trail networks should be unpaved, shared-use trails that do not increase impervious cover, do not require heavy machinery for installation, and can be constructed on sloped terrain, such as the banks of RBC (see Figure 5.7). Currently, the PRT 6010 course is conducting preliminary research and producing trail proposals for the RBC riparian corridor.

Figure 5.7: Preferred Trail Type

Unpaved shared-use trails cost approximately $4.00 per square foot (WERF, 2011). A trail from the existing Bonneville Shoreline Trail to Chipeta Way at the west end of the Williams property would run about 1,375 feet and cost about $22,000. A trail from Foothill Drive to the Marriott Hotel would entail approximately the same length and cost. A trail along the full length from Sunnyside Ave. to the Shoreline Trail would run about 6,900 feet and cost about $110,000. Access steps cost about $50 per linear foot (Biowest, 2010), or about $2,500 to descend the inner half of the buffer zone. Four sets of access steps each 50 feet in length would cost about $10,000. Final decisions about trail siting and maintenance have not yet been determined. Here we assume 5% annual maintenance costs.

Given the high value that stakeholders place on trail access to RBC, appropriate designs should be given high priority, including potential demonstration projects. Planning, architecture, engineering, PRT, and other students should be involved in designing and implementing both the trails and the associated signage, seating and viewing areas, etc., as in the Fall 2015 PRT 6010 course. The issue of trail siting and design merits in-depth research and careful supervision by the RBC Committee.

The first proposed trail segments for RBC are adjacent to the Williams Property (see Section 5.7, pp. 48-50) and to the University Orthopedic Center and the Marriott Hotel (see Section 5.8, pp. 51-53). Eventually, the objective of safe and convenient access and the planning principle of

integrating campus life around the creek suggest, at a minimum, a trail that runs parallel to RBC throughout the adjacent University property, from the Bonneville Shoreline Trail to Sunnyside Park (the cost estimate above represents this linear trail segment). Ultimately, in order to fully integrate with the rest of campus, additional connecting trails will be required. Figure 5.8 shows a recent Masters student thesis project from the Department of City and Metropolitan Planning, which proposes pedestrian trails along the length of RBC.

Figure 5.8: Proposed Trail Siting along Red Butte Creek
Source: Hyun Soon Kim, City & Metropolitan Planning department (2015)

Figure 5.9: Trail along RBC in Miller Park

Figure 5.10: Trail along RBC in Miller Park

5. Green Infrastructure

Time Frame: 1-10 years

Cost: $145,000 - 1.5 million

Objectives Met: 1A, 1B, 1C, 1D, 1E, 1F, 1G, 1H, 1I, 2A, 2B, 2D, 3B, 3C

Low-impact development and green infrastructure (LID/GI) can help to mitigate the impact of stormwater runoff from impervious surfaces on RBC, not only as it runs through campus but downstream as well. LID/GI practices include bioretention, rain gardens, rainwater harvesting and other forms of rain capture, pervious pavement, and green roofs. The goal of LID/GI is to replicate and restore the natural hydrologic cycle (EPA, 2009; Shaver et al, 2007). This includes the reduction of peak flow and volume, the restoration of streamflow timing and duration, and the use of vegetation to treat stormwater. By promoting more natural hydrology, LID/GI practices improve channel stability and encourage a healthier riparian ecosystem (Poff et al, 1997; Roy et al, 2008).

The ultimate vision for RBC is a system of distributed LID/GI stormwater retrofits throughout the watershed (Roy et al., 2008). As summarized in Section 1, the University of Utah already has plans and policies in place that support this vision.

In producing cost estimates for LID/GI implementation, WPRP (2009) estimates that swales, infiltration basins, and rain gardens cost between $18,000 and $25,000 per impervious acre, with 5-6% annual maintenance cost (2009). Non-residential green roofs are estimated to cost as much as $91,000 per impervious acre.

Figure 5.11: Green Roof on Marriott Library
Source: Storm Water Management Program Plan (2016)

For a demonstration project, the University of Utah should aim to treat at least 2 acres of impervious parking space and 0.5 acres of impervious rooftop with LID/GI practices. With 20 years O&M, the total cost would be approximately $145,000. Replicating this strategy over a 10 year period to treat 20 acres of impervious parking space and 5 acres of impervious rooftop would cost at least $1.5 million.

LID/GI is a prevalent research interest at the University of Utah. Faculty and students from engineering, biology, and other departments should be involved in every stage of design, implementation, and monitoring for the distributed LID/GI system. This will ultimately entail additional costs associated with research personnel, scientific equipment, supplies, and analysis. Such research support should be included in all major development efforts.

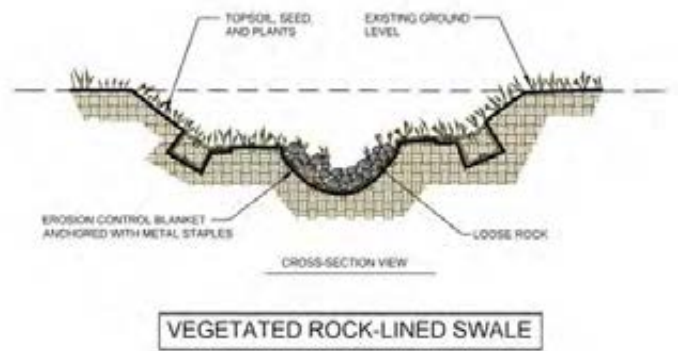


Figure 5.12: Bioswale Design

6. Culvert Replacement

Bridge and open-bottom box culverts allow for sediment and debris transport and eliminate the deposition and scour problems associated with the constricted streamflows at narrow-diameter culvert crossings. This improves stream stability, connectivity for fish and wildlife, and floodplain storage. Other benefits include a highly improved aesthetic experience and reduced maintenance for clogging issues.

The five main culvert crossings on University reaches of RBC are below Red Butte Garden, at Chipeta Way, near the Biology Growth Site, near the Marriott Hotel, and at Foothill Drive. Biowest (2010) estimates that it would cost $70,000 to replace the culvert below Red Butte Garden with a bridge and trail crossing; $486,000 to replace the culvert at Chipeta Way with an open box design; $405,000 to replace the culvert near the Biology Growth Site with an open box design; $324,000 to replace the culvert near the Marriott Hotel with an open box design; and $864,000 to replace the culvert at Foothill Drive with an open box design, with the short-term alternative of culvert outlet protection via rock-lined tailwater pool and an additional step pool at $24,000.

In the short term, the bridge crossing below Red Butte Garden and the outlet protection below Foothill Drive are the most sensible potential demonstration projects. In the longer-term, culvert replacement will be a high profile way of revitalizing RBC, not only in ecological functioning and aesthetic quality, but in the symbolic step of encouraging a creek that is more free-flowing than it is plumbed.

Figure 5.13: Side Panels - Closed culverts and bridges along RBC
Center Panel - Replacing a closed culvert with an open arch design at North Carolina State University

Miller Park

7. Williams Property

Time Frame: ~1 year

Cost: ~$371,000

Objectives Met: 1B, 1D, 1F, 1G, 1H, 2A, 2B, 2C, 2D, 3A, 3C

The Williams Property is set to become the first demonstration project for the RBC Strategic Vision. The property is a large parcel (approximately 18 acres), just southwest of Red Butte Garden and east of Red Butte Creek (see Figure 5.16, p. 65). It is owned and managed by the University of Utah Research Foundation (UURF). The primary tenant is currently Goldman Sachs, but they will vacate the building in the 2016-2017 fiscal year. The new tenant is uncertain but will likely be the University of Utah Medical School. The majority of the landscape surrounding the Williams Building is Kentucky bluegrass.

Figure 5.14: Williams Property, Kentucky Bluegrass

The Williams property is an ideal demonstration project site for the Red Butte Creek Strategic Vision and Revitalization Project. As a UURF property, it has a simplified administrative context: the foundation manages its own grounds and facilities. We recommend three projects (see Figure 5.17, p. 67): a trail that would run along the northwest edge of the property, paralleling Red Butte Creek from the Bonneville Shoreline Trail to Chipeta Way/Connor Road; a re-landscaping of the turfgrass areas on the southeastern, southern, and western sides of the building; and a low-impact development/green infrastructure (LID/GI) stormwater management system for a new surface parking structure on the eastern side of the building.

Figure 5.15: Williams Property, North Amphitheatre

Figure 5.16: Williams Property, Aerial View

The proposed trail would run approximately 1,375 feet and would include at least one creek access point, with the potential for an outdoor classroom facility. The proposed re-landscaping would convert approximately 3.5 acres of turfgrass (see the green area in Figure 5.17, p. 67) into a combination of native riparian vegetation (e.g. a Gamble Oak or Cottonwood grove), water-wise landscaping (e.g. a rain garden, conservation garden, or xeric garden), and stormwater green infrastructure (e.g. retention basins, bioswales, etc.). Using the initial concept design as a springboard, faculty will be invited to propose research experiments that will be woven directly into the transformed landscape. This will require a new approach to design that allows for uncertainty and change over time. Potential projects include water quality monitoring, public landscape perception, and/or green infrastructure performance.

As described in Section 5.1 (pp. 46-49), the Williams Property demonstration project will be a collaborative effort, coordinated by a campus design committee and a hired design firm. The design committee will work to integrate faculty research and student participation into the trail, landscaping, and LID/GI projects. They will also develop and track appropriate metrics of project success, such as landscaping resource inputs, stormwater infiltration, number of site users and visitors, etc. The process developed by this first design committee will serve as a model for future RBC Strategic Vision projects.

The trail and re-landscaping projects could feasibly be completed by the summer of 2016. Also in summer 2016, a new surface parking facility will be constructed on a 1.45 acre segment of the Williams property (see the grey area in Figure 5.17, p. 67). Thus, over the next calendar year, the Williams property offers the chance to implement a demonstration project that exemplifies the RBC Strategic Vision and that contributes to all aspects of the University's three part mission of research, teaching, and public life.

ROUGH COST ESTIMATES

- **Trail**
  - 1,375 feet long, 5 feet wide, $8 per square foot: $55,000
  - 2% annual O&M costs for 20 years: $22,000
  - **Subtotal:** $77,000
- **Re-Landscaping**
  - 90 two-inch caliper trees per acre, 3.5 acres, $250 per plant: $78,750
  - 200 shrubs per acre, 3.5 acres, $35 per five-gallon containerized plant: $24,500
  - Revegetation by seed, $3,000 per acre, 3.5 acres: $10,500
  - **Subtotal:** $113,750
- **Green Infrastructure**
  - $18,000 per impervious acre, ~4 acres existing impervious cover + ~1 acre new surface parking structure: $90,000
  - 5% annual O&M costs for 20 years: $90,000
  - **Subtotal:** $180,000
- **Total**
  - $77,000 + $113,750 + $180,000 = $370,750

Williams Property Design Committee

- Dr. Sarah Hinners - City & Metropolitan Planning
- Jonathon Bates - Research Park Real Estate Admin.
- Braden Hellewell - Research Park Real Estate Admin.
- Tami Cleveland - Campus Planning
- Dr. Brenda Bowen - Geology and Geophysics
- Dr. Diane Pataki - Biology
- Dr. Steve Burian - Civil and Environmental Engineering
- Dr. Matt Brownlee - Parks, Recreation and Tourism
- Sue Pope - Grounds and Open Spaces
- Kevin Jensen - Red Butte Garden
- Robin Rothfeder - Center for Ecological Planning and Design

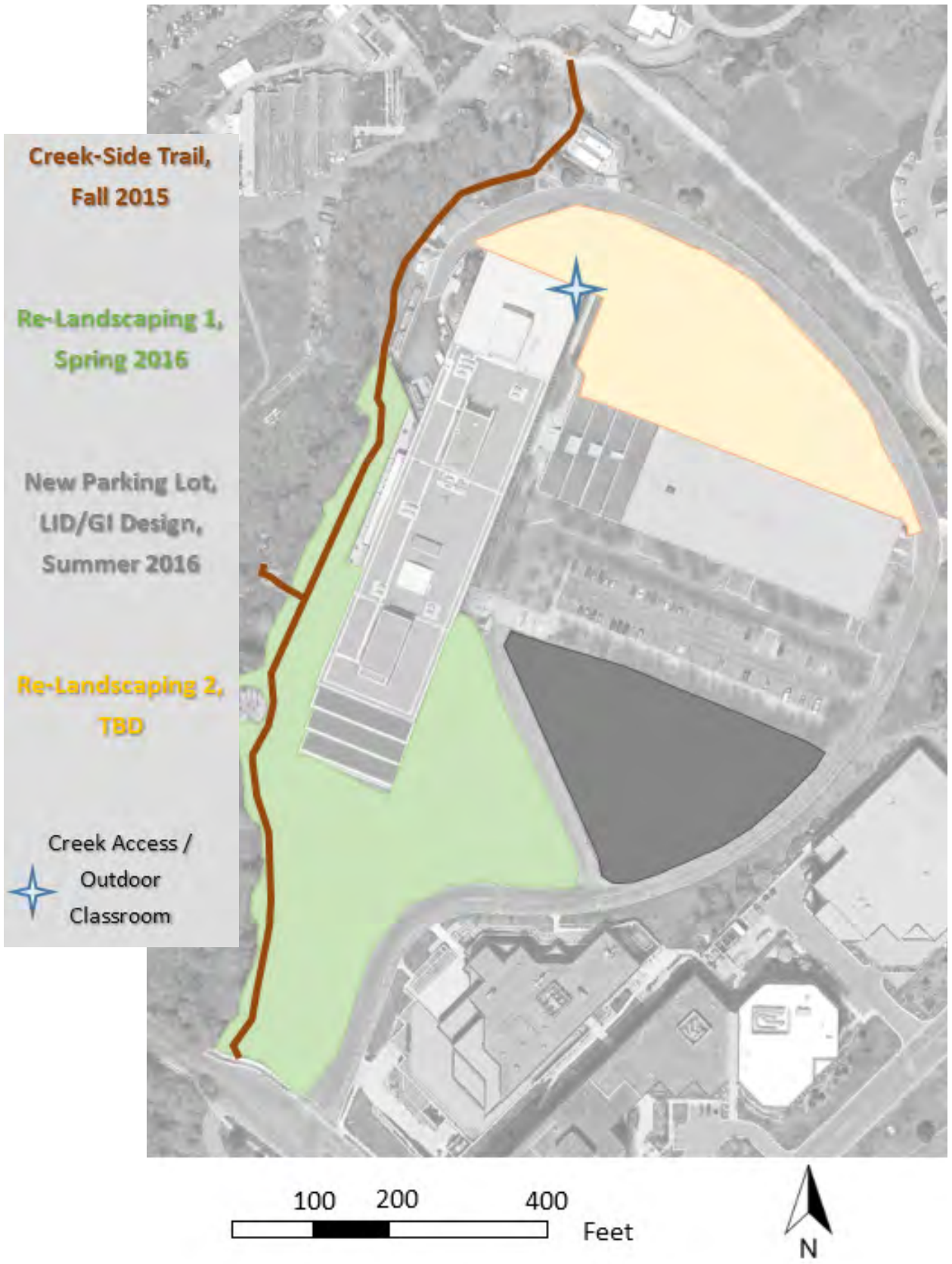


Figure 5.17: Williams Property, Proposed Demonstration Project Components

8. LRB - 04C

Time Frame: 1-3 years

Cost: ~$265,000

Objectives Met: 1B, 1D, 1E, 1F, 1G, 1H, 2A, 2B, 2C, 2D, 3A, 3C

Another promising location for a demonstration project is LRB_04C—the stretch of creek running from the Salt Lake City Marriott Hotel to Foothill Drive. Properties along the south side of LRB_04C include the University of Utah Orthopedic Center, the University Dental School, the Dumke Health Professions Education Building, and the Marriott Hotel, with Fort Douglas along the north side of the creek. Early design work for a demonstration project along LRB_04C was completed in the 2013 student project Red Butte REHAB, as part of a joint Biology and City & Metropolitan Planning course. Red Butte REHAB proposed three project components for LRB_04C: invasive species removal and native species revegetation, soft path construction, and LID/GI stormwater management. Removing invasive species poses an important research question about the balance between improving stream

Figure 5.18: LRB_04C, Aerial View

Figure 5.19: LRB_04C, Existing Foot Path

Figure 5.20: LRB_04C, Outfall

functions (including wildlife habitat and filtration) and potentially destabilizing the stream bank (especially in the absence of native species revegetation) (Bio-West, 2010). Invasive species removal and revegetation with native plants has potential ecological benefits including habitat improvement, shading and water-temperature control, aesthetic desirability, floodplain storage, organic matter inputs, sediment and pollution filtration, and bank stability. Native plants for revegetation must be suited for the part sun/part shade and seasonally moist conditions at LRB_R04C. Examples include blue wildrye (Elymus glaucus), Indianhemp (Apocynum cannabinum), sticky purple geranium (Geranium viscosissiumum), towering Jacob's ladder (Polemonium faliosissimum), western sweetroot (Osmorhiza occidentalie), western white clematis (Artemisia ludoviciana), and wild bergamot (Monarda fistulosa) (id.).

Removal and revegetation activities would be mechanical (by hand) and volunteer-based. Volunteers can be obtained from public outreach efforts in conjunction with Friends of Red Butte Creek (FORBC), the Utah Rivers Council (URC), and the Salt Lake County Watershed Planning and Restoration Program (WPRP). These first two groups have already expressed willingness to participate in restoration activities at LRB_R04C. Necessary equipment will include instructional materials and gardening supplies (gloves, shovels, pruning shears, etc.).

At 1,300 feet of creek, with a 50-foot buffer out from both banks, LRB_R04C covers approximately 130,000 square feet or about 3 acres of land. According to Bio-West (2010), invasive plant removal costs $600-$900 per acre, which translates to $1,800-$2,700 for Red Butte REHAB. According to Pima County Riparian Habitat Mitigation Standards (Pima County, 2001), revegetation should include a minimum of 90 trees per acre and 200 shrubs per acre. Bio-West estimates live plant stakes to cost $2-$5 per plant, one-gallon containerized

plants to cost $9-$17 per plant, five-gallon containerized plants to cost $15-$30 per plant, and two-inch caliper trees to cost $175-$325 per plant. This translates to as little as $1,740 for revegetation (using nothing but live plant stakes) or as much as $105,750 (using the most expensive five-gallon containerized plants and two-inch caliper trees). Maintenance and monitoring require an additional $10,000-$40,000, bringing total costs for invasive plant removal and native revegetation between $11,475 and $142,387. A middle ground—between $40,000 and $80,000—is a reasonable estimate.

With the proximity of tourist and rehabilitative facilities, LRB_04C is an especially desirable location for creating trails.

At $4.00 per square foot, a 4-foot wide, 1,300-foot long trail along LRB_04C will cost approximately $20,800 (WERF, 2011). The total budget for the trail may be as high as $35,000. Since their patients and guests would be major beneficiaries of this trail, the Orthopedic Center and Marriott Hotel are likely funding partners.

To mitigate the impact of stormwater runoff on LRB_R04C and on downstream reaches, Red Butte REHAB proposed LID/GI stormwater controls. The first on-site GI measure proposed is a bioretention system (rain garden) northwest of stormwater outfall #4 (see Figure 5.21, and Figure 5.22, p. 71), with a design geared specifically for arid climates, developed by Houdeshel et al. (2012). This design utilizes native plant species and a 2-foot gravel storage layer under 2 feet of native soil, providing biological treatment and infiltrating the stormwater inflows without the need for supplemental irrigation during dry, hot Utah summers. The Houdeshel et al. design is meant to maximize infiltration and therefore does not include lining or an under-drain. The authors recommend that the bioretention system be sized at approximately 6% of the drainage area, in order to capture and treat the 95 percentile storm. The drainage area of LRB_R04C is approximately 235,000 square feet, which therefore requires a bioretention system of 14,100 square feet. An overflow structure will allow releases to Red Butte Creek to prevent flooding during larger storm events.

The cost estimates for this bioretention system were produced using the Whole Life Cost Tool from the Water Environmental Research Foundation (WERF, 2011) (Houdeshel and Pomeroy, 2011). The WERF cost tool provides estimates of capital, operation and maintenance (O&M), whole lifecycle costs, and net present value for a 50-year lifecycle. The REHAB team modified the default cost option to align with the high end of actual costs incurred during the construction of two similar units on campus, specifying a “low” maintenance level. With these assumptions, they calculated a capital cost for the bioretention garden of $172,500 and a whole life cost of $331,560.

It is important to note that this bioretention system would primarily treat land owned by Fort Douglas, and that at least part of the garden would need to be located on United States government property. In fact, several pieces of federal legislation effectively mandate that Fort Douglas institute an LID/GI stormwater management system, even if the land is not transferred to the university. Section 438 of the Energy Independence and Security Act (2007) set new stormwater management standards, requiring that federal agencies maintain or restore predevelopment hydrology for any development or re-development that exceeds 5,000 square feet. Moreover, an executive order in 2009 (EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance) called for all federal agencies to “conserve and protect water resources through efficiency, reuse, and stormwater management.” EPA guidance documents (Section 438 and EO 13514) specifically recommend the use of green infrastructure, including vegetative practices (bioretention) and porous pavement, as the best means to comply with these federal mandates (EPA, 2009).

Although bioretention has been used for many years in different environments, it has not been applied and monitored at a functional scale in the arid and semi-arid west. The LRB_04C demonstration project thus offers an opportunity for students and faculty to fill an important knowledge gap and conduct research of regional and national significance.

Figure 5.21: Outfalls at LRB_04C

Figure 5.22: LID/GI Designs along LRB_04C

9. Community Engagement

Time Frame: Ongoing

Cost: $0 - 500 per event

Objectives Met: 1A, 1H, 2A, 2B, 2C, 2D, 3A, 3B, 3C

The implementation strategies in sections 5.1-5.8 point toward a campus resource that is a centerpiece of learning, research, and sustainability. Such an amenity, by itself, would be an effective means of public engagement. In the stakeholder outreach focus groups, community council representatives were confident that a well-executed plan would benefit their neighborhoods. Faculty members from these neighborhoods expressed similar opinions – they found the idea of a new, aesthetic connecting corridor into campus especially compelling.

There are also more active ways for the University of Utah to leverage a revitalized Red Butte Creek as a focal point for community engagement and public life. Section 4 describes potential revitalization and funding partnerships with Salt Lake City and Salt Lake County. Here, we consider three additional proposals, but there are numerous other strategies that could be equally meaningful.

COMMUNITY CLEANUP EVENTS

As described in Section 3, RBC currently suffers from poor site maintenance. Its banks and trees are littered with trash and debris. Community cleanup events are an easy, low-cost strategy for raising awareness of RBC on campus while beautifying and maintaining the riparian corridor.

The University of Utah Sustainability Office organized the first RBC cleanup event in the fall of 2015 in partnership with the Office of Student Housing and approximately 15 incoming freshmen who live on campus. In addition, the student group Friends of Red Butte Creek (FORBC) currently hosts an annual spring event focused on the creek. In spring 2016 the FORBC event will be a day of community service, including trash removal, invasive plant removal, biological inventories, and watershed education.

Figure 5.23: Friends of Red Butte Creek Event

Figure 5.24: Community Cleanup Event

Local neighborhood councils (including Yalecrest and Sunnyside) and local non-profits (including Seven Canyons Trust and Utah Rivers Council) have also expressed interest in helping to plan, fund, and staff volunteer cleanup and site maintenance activities along the creek. In addition to on-campus activities, therefore, the revitalization of RBC at the University of Utah could help to galvanize local action along the full length of the creek.

Before more extensive revitalization projects move forward, it is necessary to develop and demonstrate a sense of care for RBC. Simple stewardship activities such as community service and cleanup events can contribute toward this goal.

K-12 EDUCATION

In addition to University Students, RBC presents an excellent educational opportunity for local K-12 students. The 2013 SUST 6000 class has

Figure 5.25: K-12 Environmental Education

Figure 5.26: K-12 Environmental Education

created K-12 curriculum materials focused on the creek; further expanding and implementing that curriculum could be a fitting class project or individual thesis project for students in Education. In addition, the Friends of Red Butte Creek mini-grant program has supported K-12 environmental education along RBC, including a team of graduate students who organized a field trip series for the Rose Park Elementary School 4th grade Science Club (in coordination with the National Science Foundation funded "Think Globally Learn Locally" program).

One promising partnership for K-12 education is Nature in Cities, a new program funded by Salt Lake City and administered by the Tracy Aviary. Nature in Cities facilitates outdoor access and education opportunities for local public schools. RBC can provide several program destinations for Nature in Cities that offer a holistic understanding of watershed functioning: from the relatively pristine research natural area, to the urban transition zone on the U of U campus, to the post- oil spill restoration at Liberty Park and Tracy Aviary, to the confluence with the Jordan River at the new proposed Three Creeks Park (see below). Importantly, funding and logistics (such as bus transportation) have already been established, such that the university needs only to facilitate access and to offer the RBC-specific curriculum designed by FORBC as an additional resource. Administrators at the Tracy Aviary have expressed early interest in this strategic partnership.

Another promising partnership is the local Science, Technology, Engineering, and Math (STEM) initiative. STEM has become "a critical focus area of the Salt Lake City School District," focused on "hands-on, experiential, and lab-based learning opportunities" (Salt Lake Education Foundation homepage). Red Butte Creek offers a good outdoor laboratory to provide these opportunities. Programming could extend from young children learning about and experiencing the basic functioning of riparian corridors, to more advanced programming and environmental sampling with high school students. To These activities can be integrated with campus programs for teacher training.

THREE CREEKS PARK

At 1300 South and 900 West, Red Butte Creek, Emigration Creek, and Parleys Creek all flow from the underground 1300 South conduit into the Jordan River. Seven Canyons Trust, in collaboration with the Jordan River Commission and with university students and faculty (especially Professor Stephen Goldsmith), have proposed to develop what they call "Three Creeks Park" in this location. The proposal has a champion in the Salt Lake City Council, and the only private landowner has expressed a willingness to sell.

By implementing its work at Three Parks Creek in tandem with the RBC Strategic Vision, the University of Utah has a wider sphere in which to solidify its position as a leader in environmental stewardship and sustainability: not only on campus, but along the riparian corridor and throughout the watershed.

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