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LID Research Project for Bluffdale City

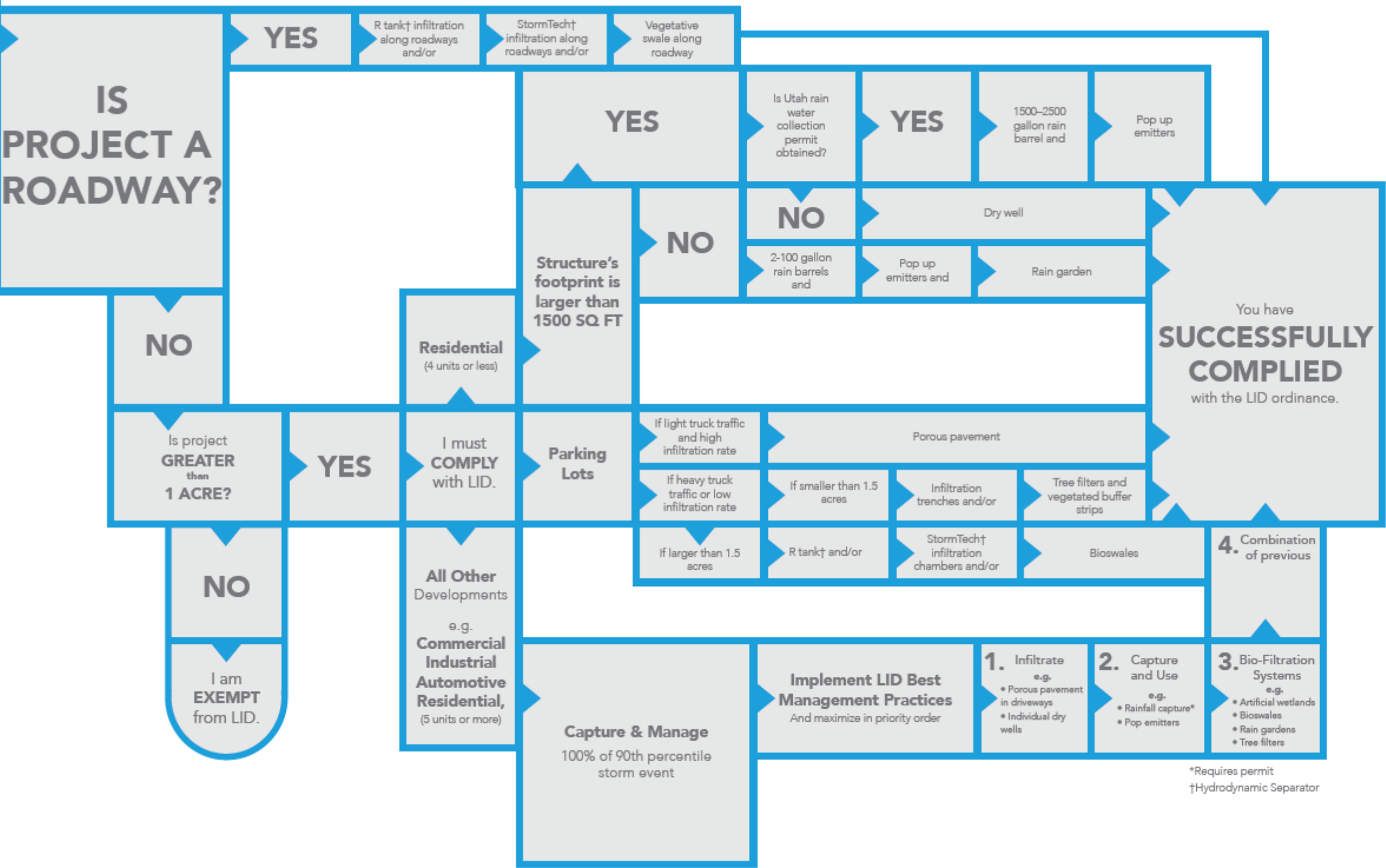
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Overview

In 2018, the Utah Department of Environmental Quality and the US Environmental Protection Agency will produce new stormwater management regulations called Low – Impact Development (LID). Bluffdale City wanted to prepare ahead of time for the new regulations affecting their stormwater permit. LID is a stormwater management practice that attempts to reduce runoff by using stormwater management techniques that better mimic nature.

Low Impact Development Road Map
for Residents, Developers & City Planners

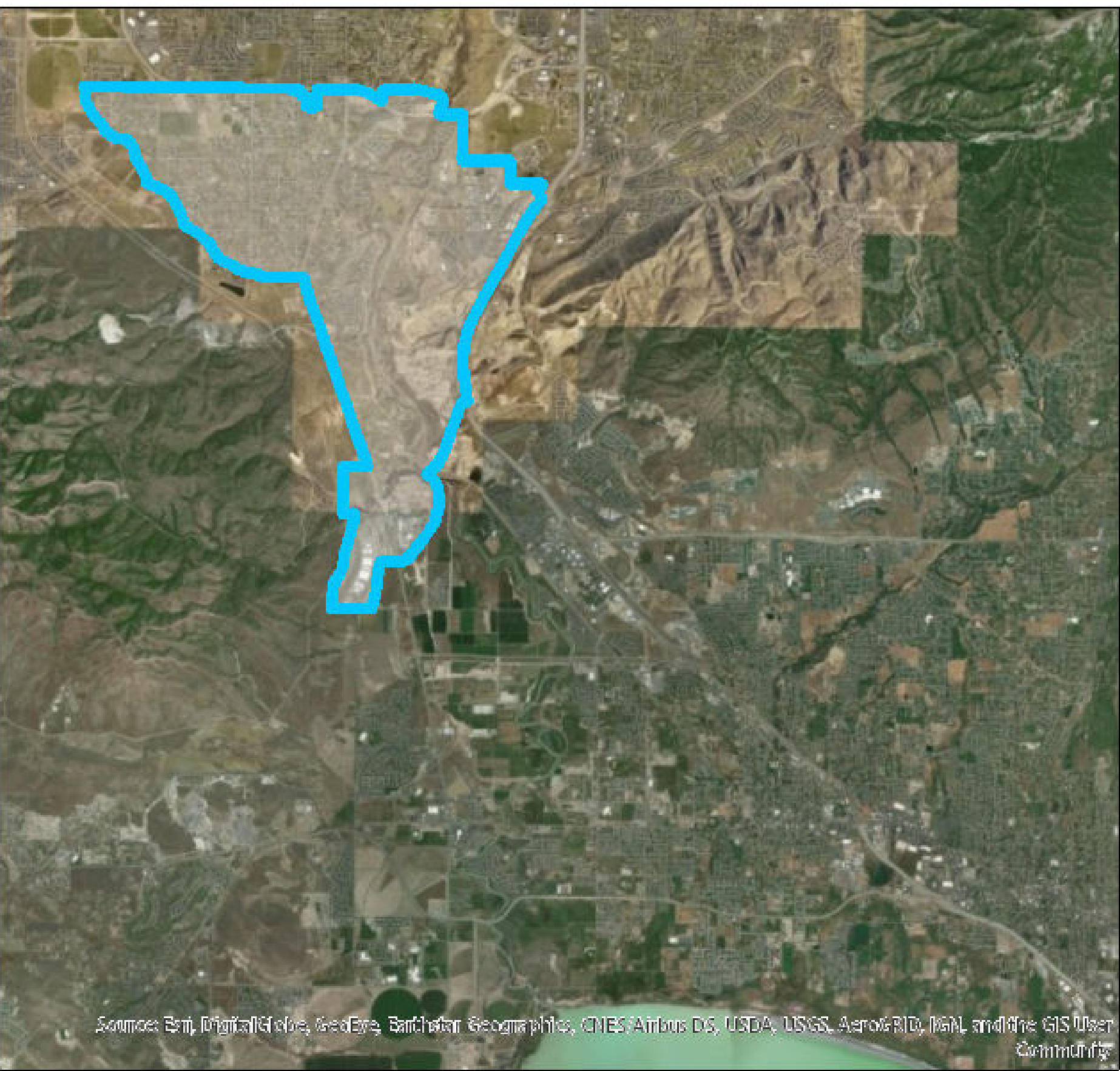
BLUFFDALE
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Analysis

Our process started with identifying Low – Impact Development techniques, and determining which ones are suitable for the climate of Utah. We used criteria such as durability in freeze/thaw cycles, high levels of infiltration, and low cost. Once specific LID treatments were decided upon, we researched the construction, limitations, benefits, and applicable circumstances of each.

Bluffdale City Limits



Challenges

Creating a manual of research for new Best Management Practices has its own unique set of difficulties. The first obstacle is the US Environmental Protection Agency and the Utah Department of Environmental Quality have not produced specific regulations on Low – Impact Development (LID). Working with Bluffdale City engineers and researching states that have already implemented LID, we were able to determine reasonable criteria. Another complication is that LID projects are not particularly common in Utah, so identifying working examples to research took time and creativity. . Perhaps the largest dilemma is that the climate in Utah is not ideal for LID because of the low frequency of storm events, the small volume of precipitation, and the excessive amount of dust. Extensive analysis of scholarly publications on LID and satellite imagery of Daybreak Community, just west of South Jordan, helped us to understand what options were available to Bluffdale City.

LID Summary
Bioswales

Overview
Swales remove pollutants, reduce velocities, and partially infiltrate runoff as water is conveyed to further storm water structures.

Advantages
Swales are cheap and easy to construct.
Swales can effectively pre-treat water before entering other LID structures.

Disadvantages
Not appropriate in high water table areas.
Impractical in areas with steep slopes or very flat grades.
On steeper slopes, check dams, filter berms, or weirs should be included to reduce velocity and encourage infiltration.

Bioswales

Overview: Vegetated channels and grassed swales can be used in lieu of traditional curb and gutter and subsurface piping to convey storm water runoff. Swales consist of a shallow trough-like vegetated depression underlain by at least 24 inches of permeable soil, with side slopes not exceeding 3:1 slope. The swale should include dense, low-growing native vegetation that is water-resistant, drought tolerant, and provides substantial pollutant removal. Grass swales are less expensive, but provide far less infiltration and pollutant removal than vegetated swales. Unlike conventional systems, vegetated swales slow the erosive velocity of the storm water, increase time of concentration, filter pollutants such as sediment, and infiltrate a portion of the runoff volume. Swales and channels are low-cost when compared to conventional conveyance systems. The inlet and outlet structures of swales should be carefully designed to prevent erosion, scouring, and the accumulation of standing water for more than 48 hours.

Bioswale Detail
Typical Bioswale Cross-Section

Application: Bioswales can be effectively used to pre-treat and convey runoff to bio-retention areas or infiltration structures and are applicable in residential, industrial, and commercial settings as well as along highways, roads, or parking lots. Swales are impractical for areas with very flat grades or steep slopes, and should be used to serve an area of less than 10 acres, with slopes no greater than 5% and no less than 1% (University of Florida IFAS Extension, 2008). Swales with slopes exceeding 3% should include filter berms, check dams, or weirs perpendicular to the flow to reduce flow velocity, facilitate storage volume, and extend treatment and infiltration time (PA DEP (Pennsylvania Department of Environmental Protection), 2006). Vegetated swales should not be installed in areas with high water tables where groundwater reaches the bottom of the swale.

Construction: Vegetated swale construction should occur only after upstream erosion and sediment control measures are in place. The swale should be rough graded, avoiding excessive compaction. Where substantial compaction occurs, or in poor draining soils, the first 18 inches of soil should be removed and replaced with a blend of topsoil and sand to promote infiltration and plant growth (PA DEP (Pennsylvania Department of Environmental Protection), 2006). Check dams should then be installed as required. The swale should

LID Summary
Bioswales

Cost
\$4.50-\$8.50 per linear foot for a 15 ft wide swale.

Pollutant Removal

Removal Efficiencies	
Total Suspended Solids (TSS)	81%
Total Phosphorus (TP)	10-65%
Total Nitrogen (TN)	-
Copper (Cu)	-
Zinc (Zn)	88%
Petroleum Hydrocarbons	82%

Maintenance
Swales should be inspected for bare areas and reroseeded as necessary.
Vegetation must be irrigated during dry periods.

then be fine graded and then seeded and vegetated. Vegetation should consist of dense, drought and salt tolerant, water-resistant plants such as Western Wheatgrass or Salt grass (Pratt, 2018).

Cost: In general, vegetated swales are considered a low-cost LID. A fifteen feet wide vegetated swale will typically cost from \$4.50-\$8.50 per linear foot (Pennsylvania DEP), significantly cheaper than curb and gutter.

Pollutant Removal: The University of New Hampshire reports reduction of 81% total suspended solids (TSS), 82% total Petroleum Hydrocarbons in the Diesel Range (TPH-D), and 88% Total Zinc (Zn) for vegetated swales. The same study found that stone (or rip-rap) swales reduce 50% TSS, 33% TPH-D, and 64% total Zn (University of New Hampshire Stormwater Center (UNHC), 2009).

Maintenance: Swales should be periodically inspected to ensure the successful establishment of plants and grasses. Any bare areas should be reroseeded and appropriate erosion control measures should be taken if erosion channels begin forming. Check dams should be monitored and inspected for signs of erosion or channelization. During dry periods, swale vegetation should be watered. If swales convey parking lot or roadside runoff, mulching and/or soil aeration may be required in the spring to restore soil structure and moisture capacity and to reduce the impact of deicing agents (PA DEP (Pennsylvania Department of Environmental Protection), 2006).

References
PA DEP (Pennsylvania Department of Environmental Protection). (2006). *Pennsylvania Stormwater Best Management Practices Manual*. Harrisburg, Pennsylvania: Pennsylvania Department of Environmental Protection.
Pratt, M. S. (2018). *Ranger Plants of Utah*. Logan, UT: Utah State University Extension.
University of Florida IFAS Extension. (2008). *Florida Field Guide to Low Impact Development*.
University of New Hampshire Stormwater Center (UNHC). (2009). *Biannual Report*. Durham, NH.

Product

For our final product, we created an easy to follow “road map” for residents, developers, and city planners of Bluffdale, UT. We also created an in depth manual to reference while using the road map, which emphasizes application, construction, cost, pollutant removal, and maintenance. This will help engineers and developers make the right decision for their situation while employing low impact development practices.