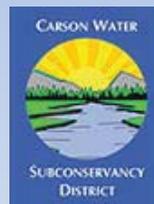


Low Impact Development In the Carson River Watershed

Promote Implement Maintain

April 2015



Prepared for

Carson Water Subconservancy District

Prepared by

Resource Concepts, Inc.





Low Impact Development in the Carson River Watershed

The Carson Water Subconservancy District (CWSD) is the Governor of Nevada appointed Water Quality Planning Agency under Section 208 of the Federal Clean Water Act for the Carson River Watershed. This document was prepared by Resource Concepts, Inc. (RCI) and the Carson Water Subconservancy District with funding provided by the Nevada Division of Environmental Protection's (NDEP) Clean Water Act Section 208 planning funds.

Document Purpose & Development

Green infrastructure and/or Low Impact Development (LID) practices are being promoted by EPA and others as a means to enhance water quality by reducing stormwater run-off and non-point source pollution. The incorporation of LID practices into development proposals for floodplain lands is also a suggested action (SA-8) for local governments in the Carson River Watershed Floodplain Management Plan (CRWFMP 2008). This plan was adopted by all five counties along the Carson River.

LID practices decrease the amount of pollutants and volume of water delivered directly to waterways by infiltrating the water on site.

The process of developing this document included:

- gathering existing information on LID practices and its promotion and use within the Carson River watershed;
- reviewing LID practices, policies, and implementation strategies in other local areas (examples Reno, Sparks, Tahoe) that will benefit the Carson River Watershed; and
- working with members of the Carson River Coalition (CRC) to create consistent strategies and policies that promote the use of green infrastructure/LID throughout the more urbanized areas in the watershed.

Research for this document included identifying possible road blocks to implement LID in the various counties; the creation and/or modification of existing promotional materials, guidelines, public service announcements on LID; the potential for training workshops with local staff, local builders/developers/landscapers, and the general public to promote the benefits of LID and how to implement LID practices; and ultimately, identifying recommended actions Counties and communities in the Carson River Watershed can take to implement LID practices.

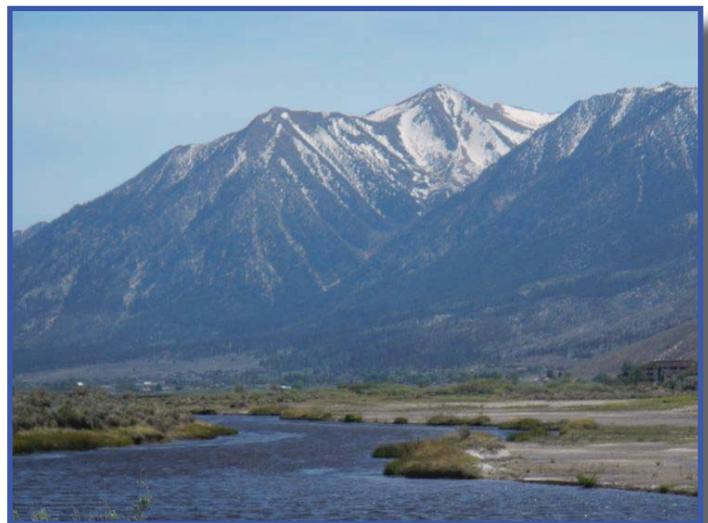


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SECTION 1: INTRODUCTION

1.1 What is Stormwater? Why Manage It Using LID?

Stormwater results from precipitation events (rain, snow, sleet) where the water collects on and runs off land. Precipitation in the Carson River Watershed is 40"+ in the Sierra Nevada and ranges 4" – 8" in the lower elevations. Even though the lower elevations may not receive much rain, both short intense rain storms, and rain on snow events, can cause flooding and soil erosion.

Urban stormwater runoff is one of the main sources of Non-point Source Pollution (NPS) in the Carson River Watershed (Water Quality Management Plan, 2005). Defined by the Environmental Protection Agency (EPA), NPS pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves across impervious surfaces/hardscapes like roads, driveways and rooftops, it picks up and carries away natural and human-made pollutants. These pollutants, like oil, trash, fecal matter, soil sediments, pesticides and fertilizers are deposited into watershed lakes, streams, wetlands, rivers and eventually even our ground water.



Main Low Impact Development (LID) Goal:

Decrease the amounts of pollutants delivered to the local waterways by infiltrating stormwater on-site.

Man made impervious surfaces do not allow water to sink into the soil as it would under more natural conditions. These developed areas typically have little vegetation to slow the runoff; so as our urban areas expand, there is more stormwater, and it moves faster. This increase in volume and velocity puts

pressure on our surface drainage areas, leading to impacts to our natural and water resources.

Green Infrastructure or Low Impact Development (LID), is a land development practice that improves stormwater quality in urban areas. LID practices reduce the amount of runoff and filter stormwater by slowing, holding, infiltrating, and evaporating stormwater onsite. LID practices filter out pollutants such as oil, bacteria, sediment and nutrients by allowing the runoff to seep through onsite vegetation and soil. Urbanized areas within the Carson River Watershed can incorporate LID practices into their stormwater management repertoire and gain many benefits that enhance overall watershed health (See LID Benefits below).



LID Benefits:

- Reduces Flooding
- Improves Air and Water Quality
- Restores Aquatic Habitat
- Improves Groundwater Recharge
- Enhances Neighborhood Beauty
- Reduces Cost and Maintenance of Stormwater Infrastructure
- Mitigates Urban Heat Islands

1.2 Overcoming Barriers to LID

The Carson River Watershed is a diverse place. Its climate, landscape, and natural and urban communities vary throughout the nearly 4,000 square miles. Therefore there are different types of LID practices to apply or modify given these variables.

Typical barriers to the implementation of LID practices are (see VanPatten, 2014):



Low Impact Development in the Carson River Watershed

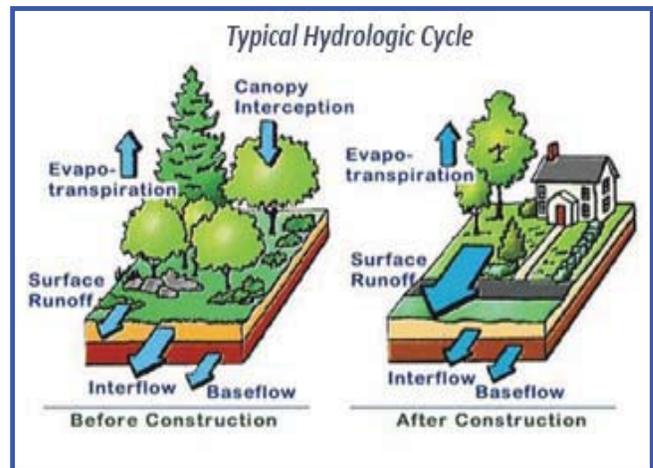
- lack of technical knowledge; not sure it will work or it is too expensive;
- institutional issues such as regulation requirements and property rights;
- social issues including resident apathy about flood concerns until it floods;
- economic issues including a proven track record and perceived high costs;
- risk aversion to trying something new and how it will effect career or department.

This report is a step toward overcoming many of these typical barriers to LID implementation in the Carson River Watershed.

1.3 Report Features

This report highlights the LID practices that are most appropriate for the Carson River Watershed. There are a variety of LID options available; however the LID practices highlighted have been shown to work well in our arid and sometimes cold environment. Whether your jurisdiction requires a National Pollutant Discharge Elimination System (NPDES) permit for a small municipal separate storm sewer system (MS4) or not, this document along with an array of other resources can be a reference and resource to assist in the implementation of LID practices in your area. The document includes specific LID practices that

will work well in our arid environment, describes existing LID policies and on-going LID implementation occurring in Northern Nevada, and outlines specific actions to move forward with LID in our watershed, including incorporating LID into planning policies and checklists, and other incentives and outreach efforts. We hope LID practices will become a useful tool for your community's toolbox.



Henry County Board of Commissioners, *Why Stormwater Matters* 2009

EPA - Low Impact Development (LID) Defined:

LID: (Low Impact Development) A comprehensive stormwater management and site-design technique. Within the LID framework, the goal of any construction project is to design a hydrologically functional site that mimics pre-development conditions. This is achieved by using design techniques that infiltrate, filter, evaporate, and store runoff close to its source. Rather than rely on costly large-scale conveyance and treatment systems, LID addresses stormwater through a variety of small, cost-effective landscape features located on-site. LID is a versatile approach that can be applied to new development, urban retrofits, and revitalization projects. This design approach incorporates strategic planning with micro-management techniques to achieve environmental protection goals while still allowing for development or infrastructure rehabilitation to occur.



SECTION 2: LID BENEFITS AND PRACTICES FOR THE CARSON RIVER WATERSHED



LID Primary Principles:

1. Minimize site disturbance and protect or restore natural landscape features including vegetation and natural drainage patterns on site.
2. Minimize and disconnect impervious cover directing water to on-site infiltration areas. (See McKinley Arts Center Diagram on page 4).
3. Considers stormwater a resource rather than waste product.
4. Facilitate stormwater detention and infiltration on site with on-site natural areas or improved infiltration areas.

LID practices reduce, minimize and disconnect impervious areas, maximizing on-site infiltration and limiting off-site runoff. The resulting improved stormwater quality is achieved through planning and design to maintain a site's natural hydrologic functions. LID is appropriate for retrofits, re-development and new development.

2.1 LID Benefits and Practices

Bioretention areas, increased flow paths, drainage swales, retention areas and other practices can be used to slow and infiltrate stormwater and reduce

runoff from on-site impervious areas. The end result is an integrated functional site that maintains the pre-development hydrology in addition to improving aesthetic values.

Those LID practices that are most appropriate for the Carson River watershed and our climate are:

- LID Site Design and Layout
- Bioretention Systems
- Swales and Buffer Strips
- Rainwater Catchment Systems
- Permeable Pavers and Porous Pavement

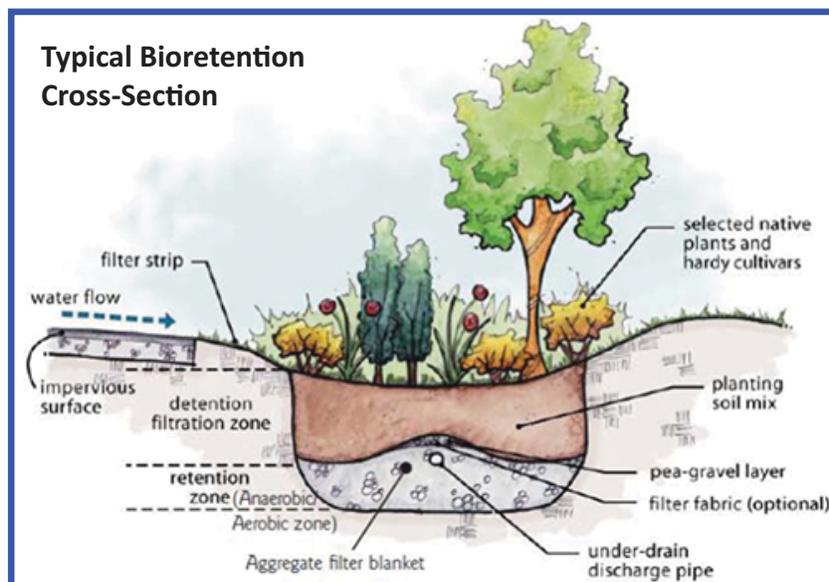
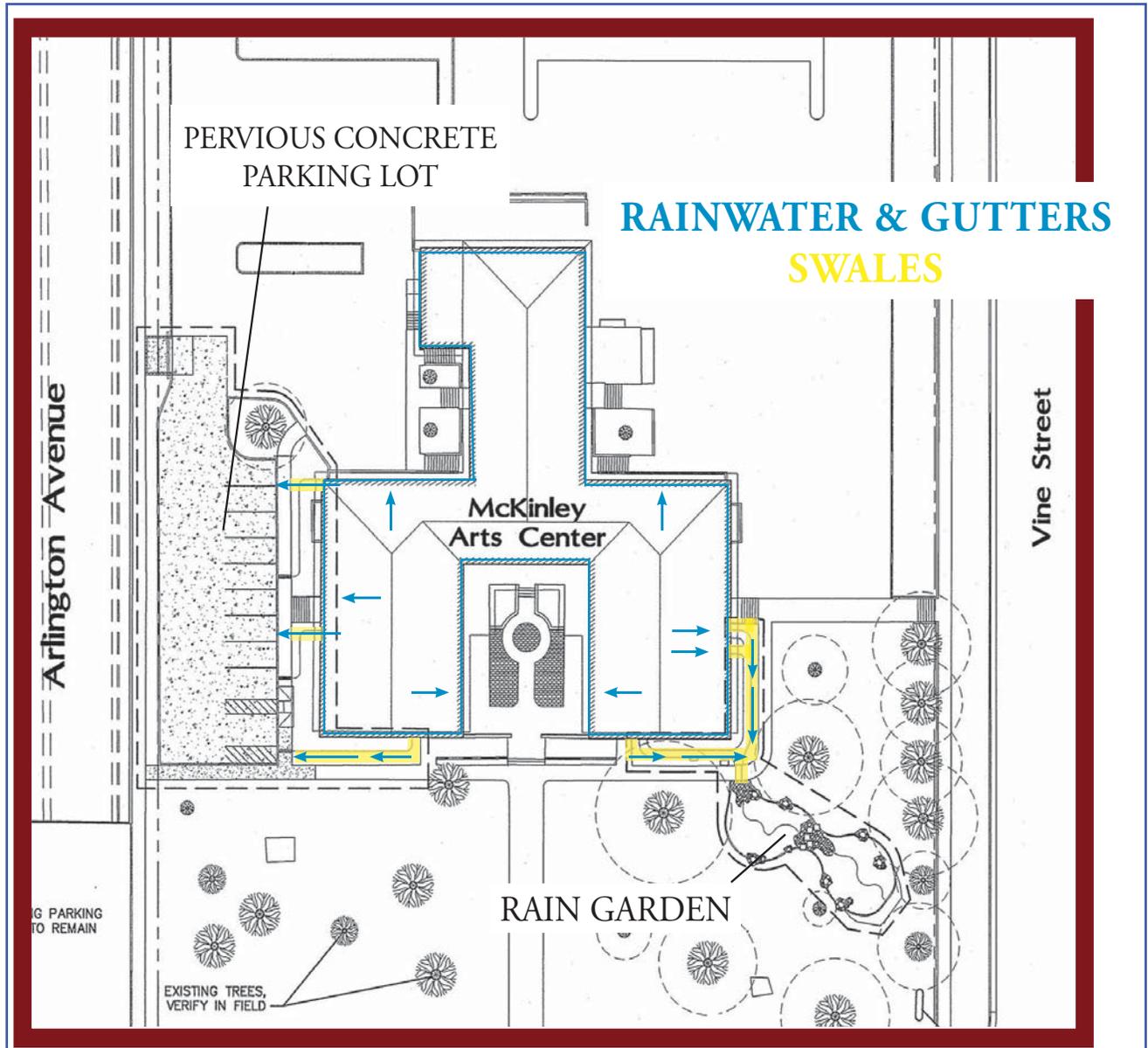


Illustration courtesy of the Low Impact Development Technical Guidance Manual for Puget Sound





Site Design illustrating rainwater conveyance to landscape features. Illustration courtesy of City of Reno.



Site Design and Layout

Site design and layout on small sub catchments, residential lots, or common areas can allow for distributed on-site storm water control. Opportunities to maintain the site's key hydrologic functions include infiltration, depression storage, and interception. LID site design and layout techniques include:

- Minimize impervious surfaces
- Minimize disturbance of natural ground
- Convey stormwater through vegetated or rock landscaped features (see drawing on page 4)
- Maximize opportunities for on-site infiltration (i.e. curb cuts)
- Disconnect impervious areas from storm drains
- Protect sensitive natural features and processes (i.e. Drainages)
- Maximize open space, and link greenways and parks

Bioretention Systems

Bioretention systems include landscape detention basins, rain gardens, tree box filters, and storm water planters. Bioretention systems are very effective at reducing the volume and pollutant loading since the combination of engineered soils and vegetation remove pollutants through a variety of processes. These systems provide an opportunity to implement water wise landscaping and land shaping, especially in redevelopment and previously disturbed locations. An example of water wise landscaping and land shaping includes making the vegetated islands in a parking lot lower, to collect and infiltrate water as opposed to creating a vegetated berm which is difficult to water and maintain the vegetation.

Many local earthwork contractors are already familiar with detention basin construction and therefore bioretention systems may be the "biggest bang for the buck". Appropriate vegetation for the site and continued maintenance for weeds, trash, and general function are critical for the success of this LID practice.

Successful example for Site Design and Layout:

In Carson City, runoff from the new Community Center parking lot is conveyed into landscape features to infiltrate and filter the stormwater.



Successful example for Bioretention Systems:

In Downtown Reno, tree boxes infiltrate stormwater, water the trees, and add beauty to the area.



Swales and Buffer Strips

Swales and buffer strips convey, infiltrate and filter stormwater by slowing the velocity of stormwater runoff. Slower runoff promotes filtration of sediments and pollutants and water infiltration into underlying soils. Strategically placed swales and buffer strips, with native vegetation, rock or other linings that limit erosion, can reduce stormwater and irrigation water from running off of properties, over sidewalks and into the street. Plant selection and long-term maintenance are essential to the success of this LID practice. By encouraging this type of water-wise landscaping and land shaping, communities within the urbanized area of the Carson River Watershed can utilize stormwater as a valuable resource.

Rain Gardens and Rainwater Catchment Systems

Rainwater can be harvested from impervious surfaces, such as roof tops and driveways, and directed to pervious areas/rain garden areas. Water can be captured and allowed to infiltrate in landscaping beds, swales, or rain gardens.

This practice can be coupled with design features such as gutter/downspouts and curb cuts that direct stormwater from impervious areas into swales, landscape features or buffer strips to infiltrate. Small/residential users can use rain barrels to catch rainwater and water vegetation in gardens. This LID practice looks at stormwater as a resource and allows on-site infiltration to benefit landscape features.

Successful example for Buffer Strips:

In the City of Sparks, irrigated landscaped grassy swales have been successful in improving water quality and landscape beauty in the City.



Successful example for Catchment Systems, Rain Gardens and Permeable Pavers:

The City of Reno LID Demonstration Project at the McKinley Arts & Cultural Center building and park treats rooftop runoff and sidewalk runoff. A rain garden on the property captures these flows.



Also Good Example:

Cabela's parking lot west of Reno



Permeable Pavers

Permeable pavers are modular systems with pervious openings that allow water to seep through and infiltrate rather than run-off. There are two types: grass and interlocking concrete. Grass pavers allow water to drain through their hollow centers and enrich the soil underneath. Interlocking concrete permeable pavers also have a void which can be filled with soil and vegetation allowing water to seep into the ground and recharge groundwater.

Pervious Pavement or Asphalt

Porous pavement or asphalt provides a durable, continuous, smooth paving surface for high traffic loads. This type of pavement contains void spaces that allow water to pass through to a permeable sub-base allowing stormwater to be stored and infiltrated. Pervious concrete works well when siting, design, and maintenance are considered in advance. This includes considering proximity to large amounts of deciduous vegetation and/or sediment laden run-off and whether the climate tends to freeze and thaw. Leaf debris and sediment can clog the void spaces over time. Specific recommendations from the National Ready Mixed Concrete Association's (NRMCA) website on pervious pavement suggest this practice has been successfully used in freeze thaw climates for over 15 years. Ensuring "the cement paste is air-entrained, and the pervious concrete is placed on 6–12 inches of drainable aggregate base ($\frac{3}{4}$ " or larger clean gravel)" is important for freeze thaw conditions. There are examples in our area discussed in the Section 3.0. Maintenance of this LID practice is essential to maintain long-term functionality. Regularly scheduled sweeping, cleaning with a vacuum sweeper, and/or pressure washing, should keep this issue in check. (NRMCA 2011)

Successful Permeable Paver Example at the Patagonia Warehouse parking lot in Reno Nevada.



Example of grass pavers.



LID Maintenance

Like all stormwater controls, LID practices require ongoing maintenance, especially as vegetation becomes established. Once the vegetation is established, then the areas are maintained in the same way as other traditional landscaped areas such as mowing, weeding and debris removal. Permeable pavers, pervious pavement and asphalt require sweeping, vacuum sweeping, or pressure washing to keep the pores clear and the system functioning as designed.



LID Limitations

LID has been used successfully throughout the world in all climate regimes. Although frozen ground conditions seasonally reduce LID function, the Minnesota DOT noted that snow and ice melted faster on porous asphalt than on standard pavements in sunny conditions even in very low ambient temperatures and frozen subsurface conditions (Lebens and Troyer, 2012). As stated above, pervious concrete in cold environments should have cement paste that is air-entrained on top of 6 to 12 inches of drainable aggregate base (¾" or larger clean gravel) (see NRMCA 2011).

Green roofs are the only LID practice not recommended in this report because our watershed may not receive any rain during the hot summer months and on average only receives 0.2 inches in July and August. The cost of green roof installation and maintenance would be more efficiently used for other LID practices in our watershed.

The Environmental Protection Agency reviewed 17 LID case studies around the country and found total capital cost savings typically ranged from 15% to 80% when LID methods were used.



2.2 LID Practices Save Money

LID practices can result in reduced development costs when compared to traditional stormwater management approaches. Cost savings can be seen in reduced infrastructure needs because the total volume of stormwater runoff to be managed is lessened due to on-site infiltration and evapotranspiration. LID practices require a lower initial investment compared to traditional practices (such as curbs, pipes, large water basins) making them inviting implementation choices.

Examples of how cost savings can be realized include:

- Capturing roof run-off and disconnecting roof downspouts from impervious surfaces (driveways or streets), and directing runoff to bioretention areas on-site saves money by eliminating the need for costly runoff detention basins and pipe delivery systems.
- Adding roadside bio-swales, making roads narrower and designing smaller or porous parking lots with on-site runoff retention saves money by reducing the amount of pavement, curbs and gutters needed.

In northwestern Nevada, LID practices can be used to address stormwater rather than creating large infrastructure that municipalities do not have the financial or staff resources to build or maintain. The EPA provided sample cost savings comparisons in Table 1 below.

Table 1: Sample Costs: Comparing Traditional Stormwater Controls with LID Techniques in a Corporate Development in Illinois (EPA, 2009).

Construction Item	Cost of Traditional Development	Cost Using LID Practices	Dollars Saved with LID
Site Preparation	\$2,178,500	\$1,966,000	\$212,500
Stormwater Management	\$480,910	\$418,000	\$62,910
Landscape Development	\$502,570	\$316,650	\$186,100
Total	\$3,162,160	\$2,700,650	\$461,510



It is important to realize, that a straight cost analysis does not account for the external benefits associated with LID such as increased air and water quality, lessened flood risks, and recreation and property improvements.

SECTION 3: LID PRACTICES IN SURROUNDING AREAS

In Northern Nevada, The Truckee Meadows Regional Stormwater Quality Management Program and the Lake Tahoe BMP program have resulted in good examples of successful LID practices and useful on-line information resources.

3.1 Truckee Meadows Regional Stormwater Quality Management Program

The Truckee Meadows Regional Stormwater Quality Management Program is a comprehensive program comprised of efforts by the governments of Reno, Sparks and Washoe County. The program was created in 1990 to manage the multiple agency regional storm water discharge permit.

Contacts:

- Lynell Garfield-Qualls, City of Reno
- Andy Hummel with the City of Sparks
- Walt West PE, Washoe County

Information Resources (See links in Section 4.0 below):

- Truckee Meadows LID Handbook, with LID practices that are applicable to the Northern Nevada climate.
- Structural Controls Design Manual, which provides a description, design considerations, limitations, maintenance considerations and examples for LID practices.
- An informational web page with many documents to browse.

Ordinances:

- City of Reno 2009 Structural Controls/LID Ordinance requires new developments to include LID features or other stormwater treatment on site where feasible.
- Washoe County 2010 LID ordinance allows for LID use but it is not mandatory.

LID Implementation Resources

- The Truckee River Fund is a 501(c)(3) organization established in 2004 by the Truckee Meadows Water Authority (TMWA) to help fund projects that protect and enhance water quality or water resources of the Truckee River, or its watershed. Grants assist with public and private partnerships such as the tree boxes and the LID demonstration project at McKinley Park.
- NDEP/EPA provided “Clean Water Act Funding” through the 319 Nonpoint Source Program for the LID demonstration project.



LID Success in the Truckee Meadows:

- Developed excellent LID Handbook and Manual
- LID ordinances implemented in Reno
- LID projects implemented (see City of Reno Stormwater Program)
- Outreach efforts including Art project “Mouth of the River” Campaign using local artists.

LID Lessons Learned in the Truckee Meadows:

- Maintenance is critical to LID function
- Consider soil type and depth to groundwater
- Consider proximity to well-head protection areas
- Consider potential for soil or water contamination

3.2 Lake Tahoe

Lake Tahoe's BMP Program incorporates a large number of LID practices including pervious pavement, infiltration basins/trenches, rain barrels/cisterns, rain gardens, filter strips, bio-filtration and detention elements such as wet basins, bio-swales and dry basins.

Information Resources (See links in Section 4.0 below):

- TRPA Best Management Practices Handbook, 2014.
- Home Landscaping Guide for Lake Tahoe and Vicinity by University of Nevada Cooperative Extension.
- An interpretive garden with examples of LID at Sierra Nevada College.
- Numerous BMP technical documents.

Ordinances:

- LID practices are mandated for all residential, commercial, and industrial properties under TRPA Code of Ordinances.



LID Success in Lake Tahoe Basin:

- Developed excellent BMP Handbook
- LID ordinances implemented, through TRPA
- LID projects implemented

LID Lessons Learned in the Lake Tahoe Basin:

- LID design must address ease of maintenance, which is critical to LID function
- Conservation District technical assistance to homeowners has increased implementation success

LID Implementation Resources

- The Tahoe Resource Conservation District and the Nevada Tahoe Conservation District guide homeowners, contractors and property managers with LID implementation using workshops and other outreach methods.

Successful examples for LID Landscaping in Lake Tahoe Basin:



SECTION 4: IMPLEMENTING LID IN THE CARSON RIVER WATERSHED

Lid practices reduce development and redevelopment stormwater control costs, improve our water quality, enhance neighborhood beauty, reduce the severity of costly flooding events and improve groundwater recharge. There are many opportunities in the Carson River Watershed to implement LID practices.

4.1 Incorporate LID into the fabric of the Planning Process

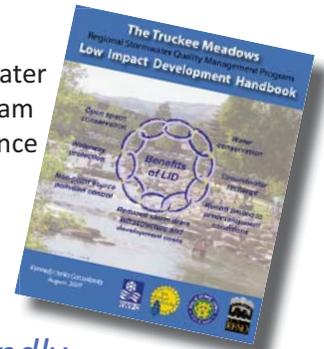
Development and Re-Development Projects

Incorporate LID into projects throughout the development, re-development, and retrofit planning process. Add checklists to the pre-application process to identify opportunities for LID. For instance, add a question to permit applications through County Planning and Building Departments "Have you considered Low Impact Development (LID) for this project such as: reducing the impervious surfaces, infiltrating stormwater on-site using swales and retention areas with native and/or low water plants to limit stormwater infrastructure and benefit water quality?"

LID in the Carson River Regional Stormwater Management Plan

CWSD is working with NDEP and our local jurisdiction partners to complete a joint Carson River Regional Stormwater Management Plan (CRRSMP) for the watershed that currently includes each jurisdiction that requires a small MS4 NPDES permit. LID practices are included and described in the list of best management practices addressed in this plan. The CRRSMP will be a useful roadmap for all watershed jurisdictions. It also is an opportunity for local jurisdictions that are not currently part of an MS4 NPDES permit requirement to be proactive about ways to limit stormwater impacts before their jurisdiction becomes subject to the requirements for MS4s. The Low Impact Development Handbook

developed by the Truckee Meadows Regional Stormwater Quality Management Program (2007) is also a good reference document with great resources regarding the proper implementation of LID practices.



Encourage LID Friendly Ordinances and Design Standards

Some ordinances and design standards unrelated to LID or stormwater, can limit LID practices. A critical LID implementation step is to introduce LID friendly ordinances and, review existing policies and standards that encourage or inadvertently discourage LID practices. Examples that encourage LID include:

- Paving material requirements should allow for the use of porous and permeable pavers;
- Road and sidewalk designs should allow for curb cuts and directed drainage into landscaped filtration areas;
- A minimum of 10% of all parking and loading areas should be devoted to interior landscaping for water infiltration (Truckee Meadows LID Handbook, 2007);
- Cul-de-sac designs should include provisions for center vegetation infiltration with paved surface grading directing water to center vegetated strips.

Where allowed, LID may be used in place of existing standards and still achieve desired outcomes such as aesthetic qualities. For instance,

- Allow for alternate paving materials;
- Plant trees and shrubs with a positive drainage;
- Encourage water conservation through appropriate landscape and irrigation planning design and management; and
- Preserve existing vegetation and disturb as small a footprint as possible.



Use and Improve Existing GIS Planning Tools

Douglas, Carson City, and Lyon counties all have GIS planning tools to assist with their planning needs. Each uses an internal use only password-protected web based FlexViewer tool that includes interactive mapping layers. The mapping layers can be expanded to include available digital data including USDA soil types, depth to groundwater, source water protection areas, hydrography, existing stormwater systems, and zoning. The mapping layers help to locate, select, and analyze the best locations for LID practices and determine those areas where LID practices may need to be limited or may not be appropriate (such as shallow depth to groundwater, saline soils, or wellhead protection areas). Flexviewer tools available to the general public would not contain every mapping layer for security reasons.

4.2 LID Incentives

Information and Outreach Materials

Existing outreach materials are available for use in the Carson River watershed for public outreach and education. This information includes photos and descriptions of the LID benefits that can be incentives for landowners to implement LID on their properties. The following table lists some of the best on-line LID literature resources.

LID On-Line Literature Sources

Web Page Source	Web Address
University of Nevada Reno Cooperative Extension NEMO Program	unce.unr.edu/programs/sites/nemo
Truckee Meadows Regional Stormwater Quality Management Program	http://www.reno.gov/government/departments/public-works/regional-stormwater-quality-management-program
Tahoe Resource Conservation District	http://tahoercd.org/about-tahoe-resource-conservation-district/
Nevada Tahoe Conservation District	http://www.ntcd.org/
Middle Rio Grande Low Impact Developments: Projects for Storm Water Management (New Mexico)	http://xeriscapenm.com/wp-content/uploads/ARIDi-LIDpackage-2nd-Edition.pdf
Case Study and Summary: Low Impact Development In Mesa, Arizona	https://sustainablecities.asu.edu/files/2015/01/Mesa-LID-Report.pdf , https://sustainablecities.asu.edu/files/2015/01/Mesa-LID-Brief.pdf
Green Values National Stormwater Management Calculator (Compares Conventional Stormwater treatment costs to LID/Green Infrastructure costs)	http://greenvalues.cnt.org/national/calculator.php





**Example Demonstration Project, Fairfax County, VA
(The Cub and Bull Run Watershed Management Plan)**

Low-Impact Development Retrofit Projects at Public Facilities:

The Cub and Bull Run Watershed Plan includes retrofits of 26 public facilities to include low-impact development (LID) stormwater controls. The project sites include schools, libraries, recreation centers, county office buildings, parks and commuter parking lots. The LID projects will minimize and control runoff from parking lots and rooftops. The full range of LID practices will be evaluated when these projects are implemented, including biofiltration rain gardens, manufactured biofiltration units, removal of impervious surfaces, grassed drainage swales, and disconnection of impervious areas and other onsite practices. A primary benefit of this action is that each facility will provide an opportunity to educate county residents about innovative stormwater controls such as bioretention and biofiltration facilities, rain gardens, etc., that they can use on their properties. The program will also demonstrate Fairfax County's commitment to implementing these measures throughout the watershed and, in turn, to improving stream conditions throughout the county.

LID Demonstration Projects

LID demonstration projects may be used as community incentives to become more familiar with and see the benefits of LID practices. Local jurisdictions, including those with existing Stormwater Program Managers, may have interest in LID implementation on municipal parcels, such as the school properties, local parks, the county or city office lots, or NDEP or NDOT properties. Other areas of the Country have done similar projects and included into their Watershed planning action plan. See example from Fairfax, VA.

The best sites can be selected using local planning tools or, if in place, the GIS Flexviewer planning tool. Areas with the biggest potential for water quality improvements include the large industrial and commercial developments with large impervious surfaces such as parking lots and large buildings.

Carson City was recently selected to receive technical assistance from the EPA for redevelopment of Williams Street. The assistance is from EPA's Greening America's Capitals program to help state capitals develop environmentally friendly neighborhoods that incorporate innovative green infrastructure strategies. This is an excellent opportunity to incorporate LID into this project along Williams Street. This full scale project will be a great project to display the variety of benefits described throughout this report.

Incentive Programs

Incentive programs can encourage landowners to retrofit their existing sites with LID practices. Similarly, incentives on new developments can be used to entice developers to use green infrastructure practices when they are planning, designing and constructing their projects. There are a number of possible incentive options outlined below:

Rebates and Installation Financing

Grants, matching funds, low-interest loans, tax credits or reimbursements are available for LID practices. Communities may offer programs that subsidize the cost of plants, landscaping and other materials that are used in LID bioretention, swale and buffer strip applications. For instance the City of Palo Alto, California Innovative Stormwater Measures Rebate Program provides various rebates for rain barrels, cisterns and permeable pavement. St. Paul, Minnesota and Santa Monica, California provide rebates for rain gutter downspout redirection. The Truckee River Watershed Council using rebates to conduct their River Friendly Landscaping Program (TRWC 2015).



Award and Recognition Programs

LID design or installation contests may encourage local participation and innovation. Successful LID sites may be highlighted by featuring them in newspaper articles, on websites or in utility bill mailings. Yard signs can be issued to recognize property owners or companies. Philadelphia provides an annual sustainability award in a variety of categories including water efficiency/ conservation, pollution prevention, landscaping / stormwater management, and green building elements, among many others. Portland Oregon presents the annual Businesses for an Environmentally Sustainable Tomorrow (BEST) Award to Portland area companies demonstrating excellence in business practices that promote sustainability and environmental benefits. The Water Environment Federation has put together a White Paper on how to host a LID Design Competition. Their website states, "LID design competitions give engineers, developers, landscape architects, and others a chance to gain experience with LID in a low-risk environment. Competitions can also break down perceived barriers to LID, such as performance and cost, and give the development and permitting community a chance to evaluate the benefits of using LID." This competition could be linked to a demonstration project by allowing the winner's design to be built.

Stormwater Fee Discount or Credit

In the Carson River watershed Carson City and Lyon County have fees relating to stormwater controls. Carson City charges a monthly stormwater fee with variable rates based on the zoning of the property. The City's revenues fund flood preservation and information, stormwater infrastructure, facility maintenance and water quality preservation. In Denver, the stormwater fee is based on the actual impervious area. In Orlando Florida, properties that have approved onsite retention receive credits to their stormwater fees.



Development Incentives

Municipalities can offer incentives for developers to use LID practices. For example, municipalities might offer to waive or reduce permit fees, allow higher density developments, or reduce local stormwater requirements when LID practices are used and maintained. If LID is incorporated throughout a development then less land is needed to be devoted to large costly stormwater basins.



SECTION 5: RECOMMENDATIONS AND NEXT STEPS/STRATEGIES FOR IMPLEMENTATION

Review Existing Ordinances and Design Standards

Review the intention behind existing ordinances and design standards that limit LID implementation and re-word them to allow LID activities, where appropriate, while still achieving the intent of the ordinance/standards. Ensure that LID is encouraged and potentially incentivized where appropriate.

Support LID Measures in the Planning Process

Incorporate LID into the fabric of the planning process. Involve all the stakeholders (urban and transportation planners, architects, landscape architects, engineers, developers, property owners and private enterprise) and work together to incorporate LID design early in the development process (Van Patterson 2014). Pre-development and pre-application meetings and checklists can include all aspects of LID. For instance, site design and layout, reducing the impervious surfaces, infiltrating stormwater on-site using swales and retention areas with native and/or low water plants, and long-term maintenance all can be encouraged from the start. LID for the Carson River watershed will be incorporated in the Carson River Regional Stormwater Management Plan, currently in development. LID measures, by design, remain in effect after construction is complete providing many benefits and can help to satisfy small MS4 NPDES permit requirements for some jurisdictions.

Review your GIS Planning Tool

Local jurisdictions can either obtain or update the GIS Flexviewer planning tool. This password protected internal use only tool can be used for planning purposes and should include USDA soils, depth to groundwater, well head protection areas, hydrography and existing stormwater systems, and

zoning layers to identify areas appropriate for LID practices. Use this tool to help locate, select, and analyze the strategic demonstration areas.

Build and Publicize Demonstration Areas

Local jurisdictions can implement LID retrofits on public facilities, and work with businesses (i.e. nurseries, landscaping companies, developers, architects, and engineers) to complete projects that can be promoted as LID demonstration projects. Celebrate LID successes as they occur with press releases, tours, and awards.

Explore Incentive Options

There are numerous ways to incentivize the use of LID practices during redevelopment, retrofitting, or new development of commercial, industrial, and/or residential property. Explore which option may be best suited to your jurisdiction. For example, if a property owner adds LID practices to reduce the amount of stormwater runoff leaving their property, the municipality could propose a credit in stormwater fees for a time to off-set some of the installation cost. Finding funds through grant programs or other means to help subsidize LID practices being implemented on properties is another excellent option.

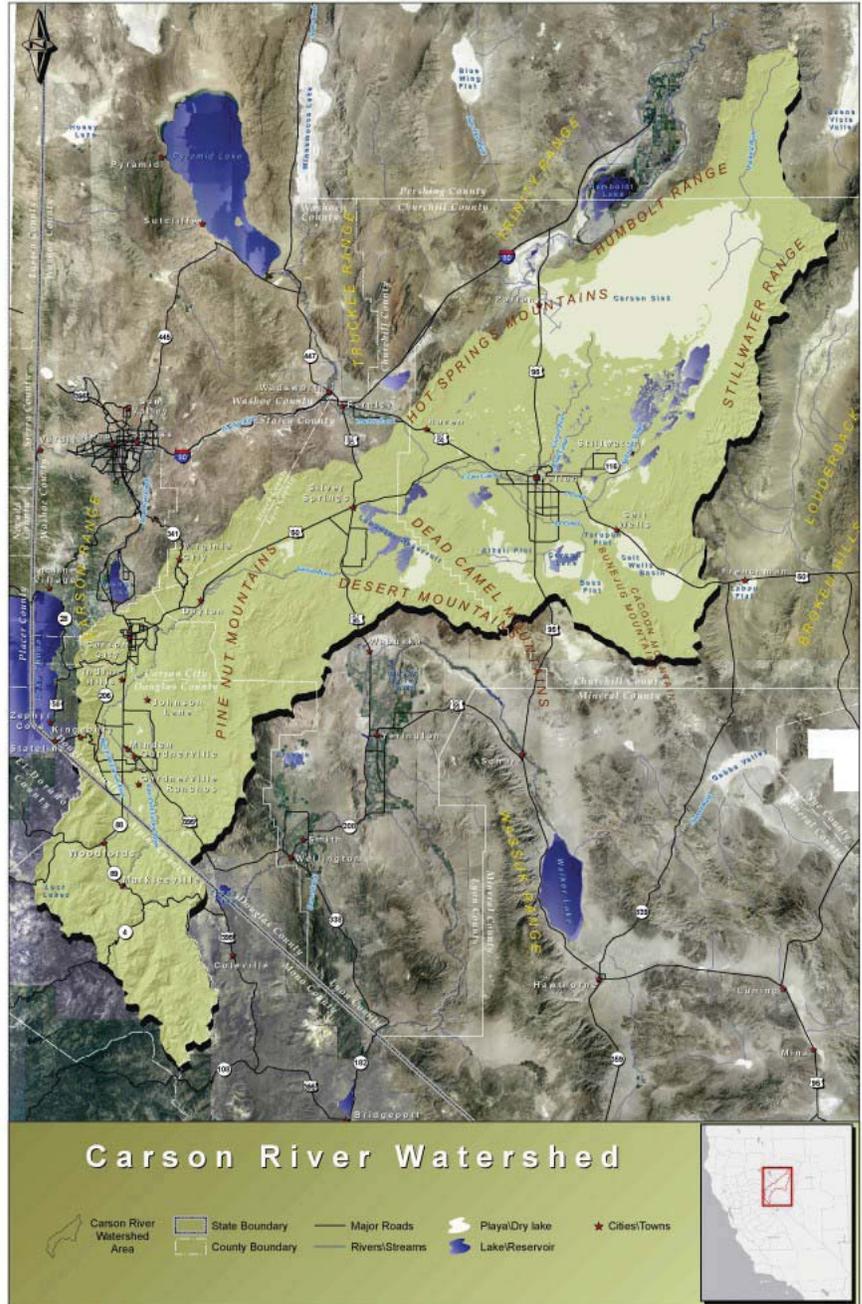
Provide LID Public Outreach and Education

Foster community and staff awareness of LID benefits and success stories through websites, programs, brochures and other types of media. Helpful LID promotional materials include photos and descriptions of the LID benefits that can be incentives for landowners to implement LID on their properties as described in Section 4.2.



SECTION 6: FINAL THOUGHTS

LID practices will help improve water quality and overall watershed health. Local jurisdictions throughout the Carson River Watershed are key players in the implementation of water quality and watershed health measures. They also are critical partners ensuring the goals and suggested actions of the Carson River Floodplain Management Plan are met and implemented. LID practices are straightforward, and should be incorporated into the fabric of the planning process to ensure effective implementation and long-term maintenance. Urbanized areas within the Carson River Watershed will benefit by incorporating LID practices into their stormwater management repertoire through reduced flooding, improved groundwater recharge, reduced stormwater infrastructure costs and maintenance as well as enhanced neighborhood beauty.



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