APPENDIX C LID CASE STUDIES

C-1 Economic Analyses Case Studies

C-2 LID Case Studies

C-1 Economic Analyses Case Studies

This appendix contains summary tables showing cost savings for almost 30 LID projects based on a literature search of nationwide LID cost-benefit studies conducted by ECONorthwest in 2007. Reported savings ranged from $500 to $7,000 per lot for residential projects and $2,000 to $13,000 per acre for commercial projects. The authors reported information only for those fraction of the total studies analyzed for which details of the source of the cost savings (e.g., reduced storm drain pipe or reduced fill) were available. Although the reported costs were taken from studies conducted in different years (late 1990s through 2006) and therefore perhaps not directly comparable, the assessment is nonetheless a useful tool for illustrating the potential cost savings of using LID instead of conventional stormwater management. (MacMullen, 2007).

Table 5-1: Cost savings attributed to installing LID stormwater controls in residential developments.

Location	Description	LID Cost Savings[a]
Meadow on the Hylebos Residential Subdivision Pierce County, WA	9-acre development reduced street width, added swale drainage system, rain gardens, and a sloped bio-terrace to slowly release stormwater to a creek. Stormwater pond reduced by 2/3, compared to conventional plan. (Zickler 2004)	LID cost 9% less than conventional
Somerset Community Residential Subdivision Prince George's Co., MD	80-acre development included rain gardens on each lot and a swale drainage system. Eliminated a stormwater pond and gained six extra lots. (NAHB Research Center Inc. 2003)	$916,382 $4,604 per lot
Pembroke Woods Residential Subdivision Frederick County, MD	43-acre, 70-lot development reduced street width, eliminated sidewalks, curb and gutter, and 2 stormwater ponds, and added swale drainage system, natural buffers, and filter strips. (Clar 2004; Lehner et al. 2001)	$420,000 $6,000 per lot[b]
Madera Community Residential Subdivision Gainesville, FL	44-acre, 80-lot development used natural drainage depressions in forested areas for infiltration instead of new stormwater ponds. (PATH 2005)	$40,000 $500 per lot[b]
Prairie Crossing Residential Subdivision Grayslake, IL	667-acre, 362-lot development clustered houses reducing infrastructure needs, and eliminated the need for a conventional stormwater system by building a natural drainage system using swales, constructed wetlands, and a central lake. (Lehner et al. 2001; Conservation Research Institute 2005)	$1,375,000-$2,700,000 $3,798-$7,458 per lot[b]
SEA Street Retrofit Residential street retrofit Seattle, WA	1-block retrofit narrowed street width, installed swales and rain gardens. (Tilley 2003)	$40,000
Gap Creek Residential Subdivision Sherwood, AK	130-acre, 72-lot development reduced street width, and preserved natural topography and drainage networks. (U.S. EPA 2005; Lehner et al. 2001; NAHB Research Center Inc. 2003)	$200,021 $4,819 per lot
Poplar Street Apartments Residential complex Aberdeen, NC	270-unit apartment complex eliminated curb and gutter stormwater system, replacing it with bioretention areas and swales. (U.S. EPA 2005)	$175,000
Kensington Estates* Residential Subdivision Pierce County, WA	24-acre, 103-lot hypothetical development reduced street width, used porous pavement, vegetated depressions on each lot, reduced stormwater pond size. (CH2MHill 2001; U.S. EPA 2005)	$86,800 $843 per lot[b]
Garden Valley* Residential Subdivision Pierce County, WA	10-acre, 34-lot hypothetical development reduced street width, used porous paving techniques, added swales between lots, and a central infiltration depression. (CH2MHill 2001)	$60,000 $1,765 per lot[b]
Circle C Ranch Residential Subdivision Austin, TX	Development employed filter strips and bioretention strips to slow and filter runoff before it reached a natural stream. (EPA 2005)	$185,000 $1,250 per lot

Location	Description	LID Cost Savings[a]
Woodland Reserve* Residential Development Lexana, KS	Reduced land clearing, reduced impervious surfaces, and added native plantings. (Beezhold 2006)	$118,420
The Trails* Multi-Family Residential Lexana, KS	Reduced land clearing, reduced impervious surfaces, and added native plantings. (Beezhold 2006)	$89,043
Medium Density Residential* Stafford County, VA	45-acre, 108-lot clustered development, reduced curb and gutter, storm sewer, paving, and stormwater pond size. (Center for Watershed Protection 1998b)	$300,547 $2,783 per lot[b]
Low Density Residential* Wicomico County, MD	24-acre, 8-lot development eliminated curb and gutter, reduced paving, storm drain, and reforestation needs. Eliminated stormwater pond and replaced with bioretention and bioswales. (Center for Watershed Protection 1998b)	$17,123 $2,140 per lot[b]

Source: ECONorthwest, with data from listed sources.
Notes: * indicates hypothetical or modeled project, not actually constructed.
[a] Dollar amounts as reported at the time of study.
[b] Per-lot cost savings calculated by ECONorthwest.

Table 5-2: Cost savings attributed to installing LID stormwater controls in commercial developments.

Location	Description	LID Cost Savings[a]
Parking Lot Retrofit Largo, MD	One-half acre of impervious surface. Stormwater directed to central bioretention island. (U.S. EPA 2005)	$10,500-$15,000
Old Farm Shopping Center* Frederick, MD	9.3-acre site redesigned to reduce impervious surfaces, added bioretention islands, filter strips, and infiltration trenches. (Zielinski 2000)	$36,230 $3,986 per acre[b]
270 Corporate Office Park* Germantown, MD	12.8-acre site redesigned to eliminate pipe and pond stormwater system, reduce impervious surface, added bioretention islands, swales, and grid pavers. (Zielinski 2000)	$27,900 $2,180 per acre[b]
OMSI Parking Lot Portland, OR	6-acre parking lot incorporated bioswales into the design, and reduced piping and catch basin infrastructure. (Liptan and Brown 1996)	$78,000 $13,000 per acre[b]
Light Industrial Parking Lot* Portland, OR	2-acre site incorporated bioswales into the design, and reduced piping and catch basin infrastructure. (Liptan and Brown 1996)	$11,247 $5,623 per acre[b]
Point West Shopping Center* Lexana, KS	Reduced curb and gutter, reduced storm sewer and inlets, reduced grading, and reduced land cost used porous pavers, added bioretention cells, and native plantings. (Beezhold 2006)	$168,898
Office Warehouse* Lexana, KS	Reduced impervious surfaces, reduced storm sewer and catch basins, reduced land cost, added bioswales and native plantings. (Beezhold 2006)	$317,483
Retail Shopping Center*	9-acre shopping development reduced parking lot area, added porous pavers, clustered retail spaces, added infiltration trench, bioretention and a sand filter, reduced curb and gutter and stormwater system, and eliminated infiltration basin. (Center for Watershed Protection 1998b)	$36,182 $4,020 per acre[b]
Commercial Office Park*	13-acre development reduced impervious surfaces, reduced stormwater ponds and added bioretention and swales. (Center for Watershed Protection 1998b)	$160,468 $12,344 per acre[b]
Tellabs Corporate Campus Naperville, IL	55-acre site developed into office space minimized site grading and preserved natural topography, eliminated storm sewer pipe and added bioswales. (Conservation Research Institute 2005)	$564,473 $10,263 per acre[b]
Vancouver Island Technology Park Redevelopment Saanich, British Columbia	Constructed wetlands, grassy swales and open channels, rather than piping to control stormwater. Also used amended soils, native plantings, shallow stormwater ponds within forested areas, and permeable surfaces on parking lots. (Tilley 2003)	$530,000

Source: ECONorthwest, with data from listed sources.
Notes: * indicates hypothetical or modeled project, not actually constructed.
[a] Dollar amounts as reported at the time of study.
[b] Per-acre cost savings calculated by ECONorthwest.

C-2 LID Case Studies

Descriptive information is included in this appendix for more than 30 projects, including three local Placer County case studies. Fact sheets are presented for the four California projects and more details for the remaining projects can be found on the Placer LID TAC web portal: http://cbecoeng.com/placerLIDTAC. The case studies were compiled by Charlene Daniels of Placer County.

Low Impact Development Case Studies for Use in the Placer County Sierra Nevada

SD-1. Protect Natural Conditions	SD-2. Optimize Site Layout	SD-3. Control Pollutants at Source	SD-4. Integrate Eco-Friendly Landscaping	RM-1. SW Flowpath Disconnection	RM-2. Rainwater and Snowmelt Harvesting	RM-3. Infiltration and Dry Well	RM-4. Bioretention	RM-5. Vegetated Filter Strip	RM-6. Vegetated Swale	RM-7. Permeable Pavement	RM-8. Green Roof	Project Name	Location	Landuse Type	New Construction/ Retrofit	Weblink	PDF	Contact Name/ Number/ Info
Local Studies																		
										•		Minnow Avenue Public Parking Lot	Kings Beach, California	Parking Lot	New Construction		Minnow Ave Parking Lot	Brian Stewart, (530) 581-6216
			•									Truckee Meadows Stormwater Plan	Reno, Sparks Nevada	Plan Area	New Construction/ Retrofit	http://www.werf.org/livablecommunities/studies_truckee_nv.htm	Truckee Meadows	N/A
			•									Truckee River Friendly Landscaping Program	Truckee, California	Existing Residential Development	Retrofit		Truckee River Program	Andy Otto (530) 550-8760, ext. 3, aotto@truckeeriverwc.org
			•			•					•	Cedar House Sport Hotel	Truckee, California	Existing Commercial Development	New Construction		Cedar House.pdf	Jeff Baird, (530) 559-5254, patty@cedarhousesporthotel.com
						•		•				UC Davis Tahoe City Field Station	Tahoe City, California	Existing Commercial Development	Retrofit		UC Davis Tahoe City Field Station.pdf	Dr. Alan Heyvaert, (775) 673-7322, Alan.Heyvaert@dri.edu
Protect Natural Conditions																		
•												Western Michigan University Business Park	Kalamazoo, Michigan	Office Park	New Construction	http://www.semcog.org/uploadedfiles/Programs_and_Projects/Water/Stormwater/LID/LID_Manual_chapter6.pdf	Western Michigan University Business	David Dakin (269) 387-8543
•												Pembroke Subdivision	Frederick County, Maryland	Subdivision	New Construction		NRDC Stormwater Strategies Ch12	Michael Clar (410) 804-8000
Optimize Site Layout																		
	•											Marywood Health Center	Grand Rapids, Michigan	Health Center	New Construction	http://www.semcog.org/uploadedfiles/Programs_and_Projects/Water/Stormwater/LID/LID_Manual_chapter6.pdf	Protect Natural Flow Pathways	Maureen Geary (616) 647-0133
	•											Gap Creek Subdivision	Sherwood, Arkansas	Residential Subdivision	New Construction		Sherwood Arkansas	Ron Tyne, roty@aol.com
	•											Nankin Mills Interpretie Center	Wayne County, Michigan	Interpretive Center	Restoration	http://www.semcog.org/Data/lid.report.cfm?lid=168	Nankin Mills Interpretive Center	Noel Mullet (734) 326-4486
	•											Macomb County Riparian Corridor Preservation	Clinton Township, Michigan	Office Building	New Construction	http://www.semcog.org/uploadedfiles/Programs_and_Projects/Water/Stormwater/LID/LID_Manual_chapter6.pdf	Macomb County Riparian Corridor	Lynne Seymour (586) 307-8229
	•											Willard Beach Implementation Project	Battle Creek, Michigan	Park Road System	Retrofit	http://www.semcog.org/uploadedfiles/Programs_and_Projects/Water/Stormwater/LID/LID_Manual_chapter6.pdf	Willard Beach Impl Project	Christine Kosmowski (269) 966-0712
	•											Somerset	Prince George County, Maryland	Residential Subdivision	New Construction		Somerset	N/A

Low Impact Development Case Studies for Use in the Placer County Sierra Nevada

SD-1. Protect Natural Conditions	SD-2. Optimize Site Layout	SD-3. Control Pollutants at Source	SD-4. Integrate Eco-Friendly Landscaping	RM-1. SW Flowpath Disconnection	RM-2. Rainwater and Snowmelt Harvesting	RM-3. Infiltration and Dry Well	RM-4. Bioretention	RM-5. Vegetated Filter Strip	RM-6. Vegetated Swale	RM-7. Permeable Pavement	RM-8. Green Roof	Project Name	Location	Landuse Type	New Construction/ Retrofit	Weblink	PDF	Contact Name/ Number/ Info
Control Pollutants at Source																		
		•										Village at Springbrook Farms	Lebanon County Pennsylvania	Subdivision	New Construction	http://www.stormwaterpa.org/low-impact-development.html	Village at Springbrook Farms	N/A
		•										Grayling Stormwater Project	Grayling, Michigan	Stormwater Project	Retrofit		Grayling Michigan	Jennifer Muladore (989) 344-0753
		•										Washington Naval Yard	Washington, DC	Primarily parking and storage areas	Retrofit		Washington Naval Yard	Camille Destafney (202) 433-6388
Integrate Eco-Friendly Landscaping																		
			•									Black River Heritage Trail and Waterfront Redev	Bangor, Michigan	Public Park	Retrofit	http://www.semcog.org/Data/lid.report.cfm?lid=164	Black River Heritage Trail	Erin Fuller (269) 657-4030
			•									Nemadji River Watershed Restoration	Minnesota Wisconsin	Watershed Restoration	Restoration		Nemadji River Watershed Restora	Brad Matlack, bradmatlack@carltonswcd.org
Stormwater Flowpath Disconnection																		
				•								Saugatuck Center for the Arts	Saugatuck, Michigan	Art Center	Retrofit	http://www.semcog.org/uploadedfiles/Programs_and_Projects/Water/Stormwater/LID/LID_Manual_chapter6.pdf	Saugatuck Center for the Arts	Gordan Gallagher (269) 857-2603
				•								Clean River Plan	Portland, Oregon	Retrofits for existing buildings	Retrofit		Stormwater Strategies Portland	Henry Stevens, henrys@bes.ci.portland.or.us
Rainwater and Snowmelt Harvesting																		
					•							People's Food Cooperative	Portland, Oregon	Commercial Building	Retrofit	http://www.portlandonline.com/bps/index.cfm?c=41950	Peoples Food Cooperative	Miles Uchida (530) 232-9051
					•							Harvesting Rainwater	Eugene, Oregon	Residential Building	New Construction	http://www.uoregon.edu/~hof/S01havestingrain/index.html	Harvesting Rainwater	N/A
Infiltration and Dry Well																		
						•						Saugatuck Center for the Arts	Saugatuck, Michigan	Art Center	Retrofit	http://library.semcog.org/InmagicGenie/DocumentFolder/LIDManualWeb.pdf	see above	Kirk Harrier (269) 857-2603
						•						Hills of Sullivan	London Grove Township, Pennsylvania	Residential Subdivision	New Construction		Hills of Sullivan	
						•						CVS Pharmacy	Elk Grove, California	Retail	New Construction		CVS Pharmacy	Marie Silveira, (916) 929-3323
Bioretention																		
							•					St. Francis Subdivision	Cross Plains, Wisconsin	Subdivision	New Construction	http://www.botany.wisc.edu/zedler/images/MorzariaLunaJAWRA.pdf	St Francis Subdivision	N/A

Low Impact Development Case Studies for Use in the Placer County Sierra Nevada

SD-1. Protect Natural Conditions	SD-2. Optimize Site Layout	SD-3. Control Pollutants at Source	SD-4. Integrate Eco-Friendly Landscaping	RM-1. SW Flowpath Disconnection	RM-2. Rainwater and Snowmelt Harvesting	RM-3. Infiltration and Dry Well	RM-4. Bioretention	RM-5. Vegetated Filter Strip	RM-6. Vegetated Swale	RM-7. Permeable Pavement	RM-8. Green Roof	Project Name	Location	Landuse Type	New Construction/ Retrofit	Weblink	PDF	Contact Name/ Number/ Info
							•					East Ridge Community Church	Duluth, Minnesota	Church	New Construction	http://www.lakesuperiorstreams.org/stormwater/toolkit/eastridge.html	East Ridge Comm Church	Barr Engineering (218) 529-8204
Vegetated Filter Strip																		
								•				Ford Road Outer Drive	Michigan	County Park	Retrofit	http://library.semcog.org/InmagicGenie/DocumentFolder/LIDManualWeb.pdf	Ford Rd Outer Dr	Noel Mullet (734) 326-4486
								•				Proctor City Hall	Proctor, Minnesota	City Hall	New Construction		Proctor	N/A
Vegetated Swale																		
									•			Nestucca Valley Prebyterian Church	Pacific City, Oregon	Church	New Construction	http://www.oeconline.org/our-work/rivers/rivers-files/stormwater-case-studies/LID_CaseStudy_NestuccaBioswale.pdf	Nestucca Bioswale	Robert Emanuel (503) 842-5708 X210
									•			Pingree Grove Case Study	Pingree Grove, Illinois	Historic Downtown	Retrofit	http://www.mickeywilson.com/articles/ML/2008_October-The_Future_Of_Stormwater_Management.pdf	The Future Of Stormwater Manag	N/A
Permeable Pavement																		
										•		Stratford Place	Sultan, Washington	Residential Subdivision	New Construction		Stratford Place WA	Craig Morrison, www.cmihomes.com
										•		City of Kinston Public Service Complex	Eastern North Carolina	Parking Lot	New Construction	http://www.bae.ncsu.edu/info/permeable-pavement/ICPI.2007Report.Final.EDITED.pdf	Eastern No Carolina	Scott Stevens and Steve Miller with the City of Kinston
Green Roof																		
											•	Seven Examples in Kings County	Seattle, Washington	Various public buildings	New Construction	http://www.cityofseattle.net/dpd/cms/groups/pan/@pan/@sustainableblding/documents/web_informational/dpdp_020117.pdf	King County	N/A
											•	Battle Creek Police Department	Battle Creek, Michigan	Public Building	Retrofit	http://www.semcog.org/Data/lid.report.cfm?lid=173	Battle Creek Police Dept	Christine Kosmowski (269) 966-0712
											•	Chicago City Hall	Chicago, Illinois	Public Building	Retrofit	http://www.metrofieldguide.com/?p=82	Chicago City Hall	N/A
Mountain Communities																		
										•		Holiday Development	Boulder, Colorado	Subdivision	New Construction	http://www.sustainablefutures.us/Best_Practices/Holiday_Neighborhood/Water_Quality_/CU_Final_Rpt_StormWater.pdf	Holiday Development	N/A
				•								Environmental Center of the Rockies	Boulder, Colorado	Office Building	Retrofit	http://www.nrdc.org/water/pollution/storm/chap12.asp	Boulder CO	James Heaney (303) 492-3276, Heaney@spot.colorado.edu

Minnow Avenue Public Parking Lot
Kings Beach, California

Case Study (2010)

In 2007, Placer County needed to construct a 21-space public parking lot in Kings Beach to help address an existing parking deficit identified in the Kings Beach Community Plan as well as to accommodate planned future development in the area. In order to comply with the Tahoe Regional Planning Agency's requirement to treat stormwater run-off before it enters Lake Tahoe, a special design concept utilizing Low Impact Development concepts was developed.

The site is approximately 9,600 square feet in size, relatively flat, and contained numerous conifer trees. Soil composition consisted of silty red/brown sandy layers and no expansive soils were identified.

The stormwater drainage system was designed to contain runoff from a 20-year, one-hour storm event to satisfy the standards establish in the Placer County Stormwater Management Manual. The proposed drainage system consists of crowning the centerline of the parking lot to allow drainage towards the pervious pavement located in the parking stalls. The design eliminated the need for the project to provide traditional stormwater infrastructure (manhole, storm drain piping, etc)

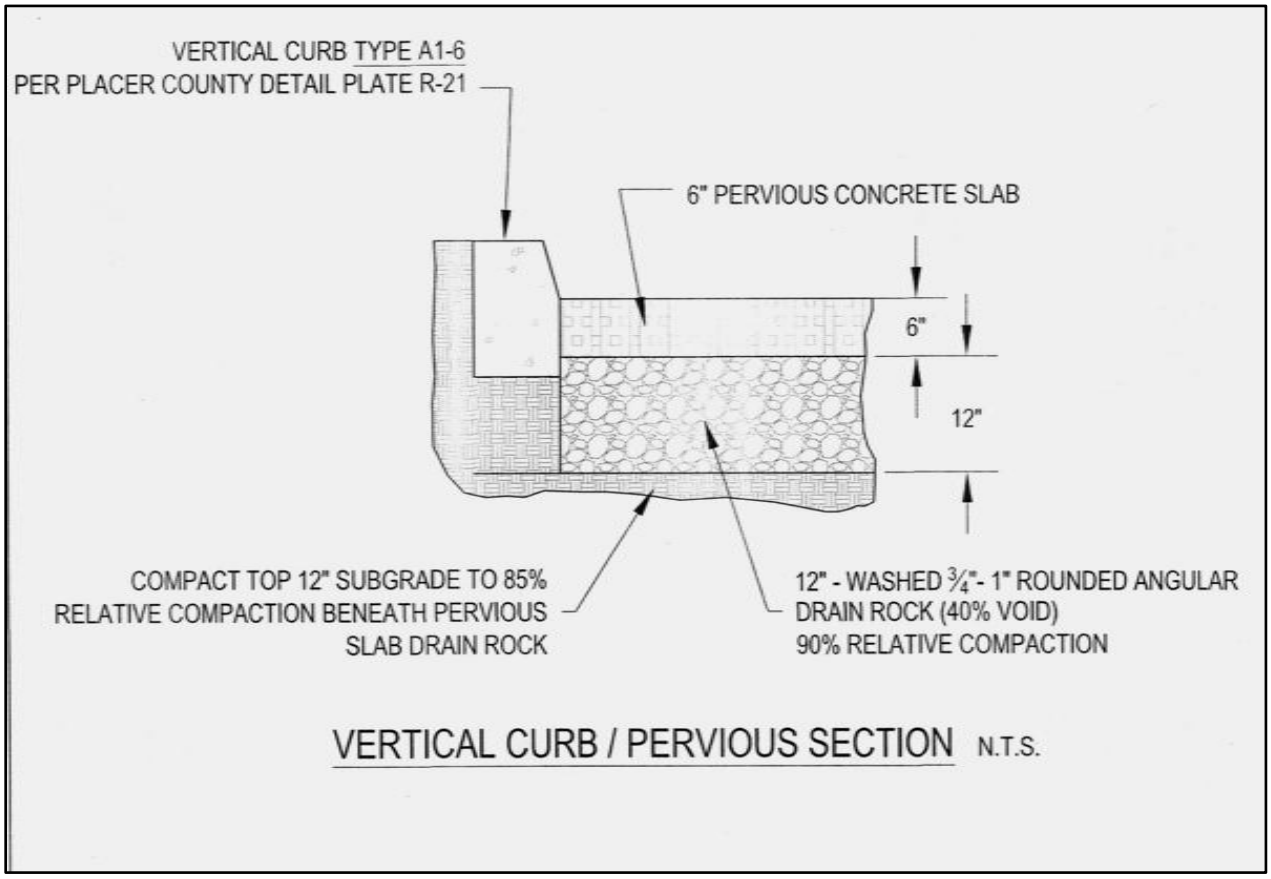
Several variances were granted to Placer County's parking lot standards, including reducing the 25-foot traffic aisle requirement to 22 feet. These variances decreased the total amount of impervious surfaces and also preserved some of the site's existing trees.

The use of pervious concrete provides several benefits to the project. Pervious concrete reduces the effect of heat islands (ground level ozone, etc) because it is a high albedo surface and the light colored pavement also reduces the need for more intensive night lighting. Automotive fluids discharged from vehicles are bioremediated by microbes living in the pervious concrete and soil to ensure that only treated stormwater enters Lake Tahoe. In addition, since there was no need to devote additional land area to accommodate traditional stormwater infrastructure, the maximum number of parking spaces could be achieved.

One of the main concerns with using pervious concrete in the harsh Lake Tahoe winters is the freeze/thaw cycles that can be damaging to all weather surfaces. Several years after the parking lot was constructed, the pervious pavement is providing the required rate of infiltration. However, there are some signs of wear and tear on the pervious pavement. In order to extend the life of pervious concrete in future projects, the Placer County Tahoe Design Division of Public Works has determined that by adding a plasticizer to the pervious concrete mixture, the strength and spalling components of

the pervious concrete can be enhanced. The Tahoe Design Division has also started requiring that a concrete strip, or flushing, be added between the asphalt and the pervious surfaces. This barrier helps avoid water intrusion from flowing under the asphalt paving section and creating a base failure.

Contact: Brian Stewart , Tahoe Design Division
(530) 581-6216



Truckee Meadows Region, Nevada

Regional Stormwater Quality Management Plan: A Comprehensive Approach

Infiltration "tree boxes" being pilot-tested as part of a roadway and streetscape improvement project in the City of Reno. (image courtesy of Sue Donaldson)

Nevada has experienced a tremendous growth in population over the past decade and is presently the fastest growing state in the country. Washoe County currently has a population of just under 400,000 people, an increase of roughly 20 percent since 2000 (Nevada State Demographer, 2006). The majority of this population resides in an area called Truckee Meadows, which includes the cities of Reno and Sparks and unincorporated areas of the County immediately adjacent. The climate is arid, with low humidity and an average annual rainfall of approximately seven inches. The Truckee River bisects Truckee Meadows into north and south sections and provides the major source of drinking water supply to the area, as well as recreational opportunities and habitat for fish and wildlife.

The Cities of Reno and Sparks, Washoe County, and the Nevada Department of Transportation (NDOT) operate and maintain the municipal storm drainage system, which includes conventional catch basin and storm drain pipes, open ditches, and wet pond structures and dry pond detention basins that are used primarily for flood control. Most of the stormwater that drains into the Truckee Meadows municipal storm drain system is conveyed untreated to the receiving waters of the Truckee River, and to three playas in unincorporated Washoe County.

Total Maximum Daily Load (TMDL) requirements have been established for the Truckee River, addressing three pollutants: nitrogen, phosphorus, and total dissolved solids. Nitrogen and phosphorus concentrations in the river have historically caused excessive plant and algal growth, which depletes oxygen when the plants die and decay. Oxygen depletion can result in the destruction of fish, wildlife, and habitats. The Nevada Division of Environmental Protection (NDEP), the cognizant regulatory authority, does not set specific requirements for TMDL implementation, but does expect that the cities and county will undertake programs that will improve water quality in the Truckee River and support the goals of the TMDL program.

The "Early Years"—Formation of the Truckee Meadows Interlocal Stormwater Committee

The first Phase I National Pollutant Discharge Elimination System permit (NPDES) was issued jointly to the City of Reno, the City of Sparks, Washoe County, and NDOT in 1990.

With the City of Reno as the lead agency, the permittees entered into an interlocal agreement and formed the Truckee Meadows Interlocal Stormwater Committee (TMISC), to better define responsibilities and address permit requirements in a coordinated effort. Responsibilities of the committee include the following:

- Complying with the NPDES permit conditions
- Coordinating and participating in committee meetings
- Funding and implementing NPDES permit compliance efforts
- Coordinating and implementing annual operating budgets for jointly shared tasks
- Submitting reports prepared by various parties to NDEP and the USEPA as required by the NPDES permit
- Maintaining knowledge of current and proposed state and federal policies, regulations and programs that impact "nonpoint" source pollution programs

The permit required preparation of a drainage basin map with outfalls to the Truckee River identified, an inventory of existing Best Management Practices (BMPs), an inventory of potential sources of commercial and industrial pollution, a work plan for a stormwater monitoring program, and submittal of monitoring program reports at 24, 36, and 48 months after the effective date of the permit. Stormwater monitoring took place between October 1990 and February 1992 with samples collected from all major storm drain outfalls located along the Truckee River within the Truckee Meadows and monitoring reports submitted at the specified intervals.

The Impetus for Change—Creation of the Regional Stormwater Management Quality Program

This initial permit (and most of the compliance activities) lapsed in 1995. The permit was finally reissued by NDEP in 2000. It required the permittees to establish a Regional Stormwater Quality Management Program and to implement methods for controlling pollutants "to the maximum extent practicable." "Maximum extent practicable" is a regulatory standard, developed by the U.S. Environmental Protection Agency, that has been interpreted to give local governments some flexibility in developing stormwater management programs that respond to their unique circumstances and local conditions.

The Stormwater Quality Management Program was further required to include the following components:

1. Best Management Practices—BMPs for local government operations, including standard plans and specifications, storm drain maintenance, street sweeping, litter control, spill response and hazardous material disposal.
2. Stormwater Discharge Monitoring—Development and implementation of a monitoring program to assess the quality of stormwater discharges, the effectiveness of BMPs, and impacts on receiving waters.
3. Illegal Discharge Detection and Elimination—Development and implementation of a program to detect and eliminate illegal discharges.
4. Structural BMP Controls for Water Quality Improvements—Consideration of structural controls in site drainage plans, storm drain projects, and flood control projects.
5. Discharges to Storm Drains and Watercourses—A plan and schedule for developing and implementing a local program for the regulation of stormwater discharges from industrial facilities and construction sites.
6. Public Education and Participation—Outreach to the public to provide information on stormwater pollution and its management and to ensure public participation in program development and implementation.
7. Intergovernmental Coordination—Inclusion of appropriate government agencies in implementation of the program.

The first monitoring report was to include a plan and implementation schedule for regulating stormwater discharges from construction and industrial sites, which, given the rapid pace of development in the County, posed particular concerns.

To address coordination, the TMISC was reconstituted as the Stormwater Permit Coordinating Committee (SWPCC), consisting of two representatives each from the City of Reno, the City of Sparks, and Washoe County. The City of Reno contributes legal counsel services, clerical support, and a Stormwater Coordinator. The Committee's activities, including development of plans and guidance documents, compliance monitoring, and outreach, are funded primarily through three sources: the City of Reno's Sanitary Sewer Fund, the City of Sparks' Sanitary Sewer Fund and Stormwater Utility, and Washoe County and NDOT's General Fund accounts.

The state's Regional Water Planning Commission (RWPC) also contributed financial resources to the development of the Stormwater Quality Management Program. This entity was created in 1995 by state legislation, to serve as a forum for the planning and coordination of water use, flood control, and wastewater management. Revenue is derived through a surcharge of 1.5 percent applied to each customer's water bill.

To develop the Program, the Committee hired a consulting team, led by Kennedy/Jenks Consultants. Fourteen public workshops were conducted between May 2000 and September 2001 to research, discuss, and develop required elements of the program. The NDEP also participated in the program development process. The resulting document included a detailed description of plans and implementation action steps for each element, anticipated staff requirements, quantifiable goals to track progress, and a detailed implementation schedule through 2007. By December 2001, the document had been approved by each of the participating permittees.

Implementation Success—From "Zero to 60" in Response to an EPA Mandate

In January 2002, the Committee hit a "bump in the road" that, in retrospect, significantly accelerated permittees' implementation of a very well-organized, multi-faceted approach to water quality management.

Vegetated swale at Costco parking lot (image courtesy of Sue Donaldson)

EPA conducted an audit of the Program, interviewing staff from Community Development, Municipal Operations, Environmental Control, and other departments to assess compliance with requirements of the Phase I permit. EPA representatives expected to find a fully implemented program - not just a Program plan - and was particularly concerned that inspection programs for construction and industrial sites had not yet been implemented. Further, the implementation schedule for the Program indicated that full implementation would not be achieved until 2004 or 2005—two to three years away.

In August 2002, permittees were directed to accelerate the schedule for Program implementation with specific emphasis placed on implementing inspection programs for construction and industrial sites by July 2003. Initially, this seemed like a nearly impossible challenge, given that the Committee relied on each co-permit-holder's Public Works staff as in-kind resources. Committee staff, however, took it as a challenge, and took the issue to the Reno and Sparks City Councils, the Washoe County Board of Commissioners, and the Regional Water Planning Commission (RWPC), explaining the situation in a series of presentations. The RWPC agreed to contribute just over $175,000 for the development of two manuals: one addressing construction site BMPs, the other addressing structural BMP controls, which would provide a foundation for the next phases of program implementation.

To maximize visibility and buy-in, the construction BMP handbook development process included extensive participation from the developer/builder/contractor community,

including the local Builders' Association, Associated General Contractors, and professional organizations representing the engineering and design communities (for example, the American Society of Civil Engineers).

As a next step, checklists were developed that identified requirements for obtaining a construction permit and for implementing on-site BMPs for the duration of construction. Administrative charges for construction permits were revised, so that longer-duration projects, projects with extreme risks of erosion (due to steep slopes), and projects in closer proximity to a floodplain, paid more to compensate for their (potentially) greater impact. An inspection program was developed that relied on cross-training Washoe County and City of Reno Public Works inspectors, City of Sparks Community development inspectors, and Nevada Department of Transportation inspectors. Regulatory staff at NDEP also conduct inspections at construction sites.

Structural BMP Controls

The implementation of structural BMPs in areas of new development and significant redevelopment was also fast-tracked. Development of a structural BMP manual was initiated in April 2003, with a public workshop held in May. The manual was completed on schedule in Fall 2003, and approved for implementation beginning in January 2004. It provides written guidance and training to local government staff, project designers, developers and structural BMP owners regarding the design, operation, inspection and maintenance of structural controls.

Land Use Planning and Low Impact Development Tools

Though EPA did not require that the SWPCC accelerate the development of land use planning and low impact development tools, Committee staff viewed them as critical components of the program, given the rapid pace of development in the Truckee Meadows region. By mid-2005, a draft Low Impact Development Handbook was developed, which outlines principles for land use planning that minimize runoff and protect water quality. It also incorporates a set of tools, including new site design requirements (e.g. riparian setbacks and calculation of impervious coverage), land conservation tools (e.g., conservation easements and deed restrictions) and public outreach methods to encourage land use planning designs that protect water quality.

Public Outreach

As the Program began to "ramp up" and guidance documents were developed and written, the Committee also accelerated its public outreach campaign. A new website for the RSQMP was developed that provides a central location for learning about the program; downloading guidance documents, forms, and worksheets; learning about training opportunities; and posting news and meeting agendas.

The Committee also formed an important partnership with the NEMO-Nevada program, operated through the University of Nevada Cooperative Extension Service. The Cooperative Extension program operates a public outreach program referred to as "Water Wise," hosted on KRNV Channel 4. Cooperative Extension also hosts a revolving series of public information sessions to educate area residents on water quality concerns and the role of both structural BMPs and Low Impact Development, in protecting water quality. Focused training sessions are also held on a regular basis for members of the construction and landscape contractor industry (primarily focused on the construction discharge program) and for engineers and landscape architects (focused on low impact development and structural BMPs). NEMO-Nevada has also sought speakers from across the country to provide practical lessons from other communities with similar climates and soil conditions.

Conclusion

The 2002 EPA mandate proved to be an important "tipping point" in building momentum for the Truckee Meadows region's adoption of a comprehensive Regional Stormwater Quality Management Program. Members of the Stormwater Permit Coordinating

"Rain garden" in residential neighborhood

Committee followed through, making the initial investment in preparing necessary manuals and guidance documents and insisted on completing these both on a very aggressive schedule so they would be ready for implementation. They did this through a transparent process that involved major developer and builder stakeholders, in addition to the public. The Committee was also fortunate to contract with a local engineering consultant who was knowledgeable about, and supportive of, landscape-based water quality treatment and low-impact development techniques to develop the guidance documents. The emphasis on public outreach, and the strong partnership with NEMO-Nevada and Cooperative Extension was also am important asset in raising awareness in both professional circles and with the general public.

Momentum is definitely building in the Truckee Meadows region. In 2006, a municipal street improvements project in the City of Reno incorporated infiltration tree boxes into the streetscape component, to "pilot-test" this approach to capturing storm runoff from the roadway. Vegetated swales and rain gardens are being incorporated into retail settings and new community design. Though the Committee would suggest that much more remains to be done, their aggressive and timely response to EPA's mandate, as well as their attention to public outreach have allowed them to make rapid and meaningful progress in a relatively short amount of time.

Additional Information

Truckee Meadows Regional Stormwater Quality Management Program

NEMO-Nevada

University of Nevada Cooperative Extension

City of Las Vegas Stormwater Quality Management Committee
The Stormwater Quality Management Committee is committed to the development and implementation of stormwater pollution monitoring, control and outreach efforts within the Las Vegas Valley

Return to top

Water Environment Research Foundation 635 Slaters Lane, Suite G-110 Alexandria, VA 22314 Tel: 571-384-2100 Fax: 703-299-0742

WERF research examines the social, economic, and environmental aspects of challenges confronting wastewater and stormwater facilities.
© 2009 Water Environment Research Foundation (WERF). All rights reserved. Privacy Notice. Terms of Use.

Truckee River Friendly Landscaping Program

Case Study (2/10/2012)

In 2010, the Truckee River Friendly Landscape program was established as a voluntary program implemented by the Truckee River Watershed Council (TRWC) in partnership with the Sierra Nevada Alliance and the Tahoe Resources Conservation District for existing residences. The intent of this incentive-based program is to help redesign existing residential landscaped areas to better mimic their natural surroundings and reduce sediment load that flows into the Truckee River. This is achieved by installing Best Management Practices (BMPs) which includes structural or non structural methods that prevent or reduce the movement of sediment, nutrients, pesticides, and other pollutant from the land to surface water. Donner Lake, Tahoe/Donner (Alder Creek and Tahoe Creek), and residences along the main Truckee River are the areas targeted by this program.

Above: Before Below: After
This landscape project included slope stabilization as well as armoring below the dripline and beneath the deck.

This landscape project included slope stabilization as well as armoring below the dripline and beneath the deck.

The TRWC works cooperatively with willing homeowners to help implement BMPs. The types of services provided by this program may include any one or a combination of the following:

- Structural materials for erosion control and water quality improvements.
- Plant materials for the purposes of soil stabilization or restoration.
- Technical assistance on designing and installing the various erosion control measures recommended on the homeowner's property. Technical assistance may also include planting techniques, soil and microclimate considerations.
- The Truckee River Watershed Council may monitor the effectiveness of various treatment systems and determine which improvements, if any, may be needed in the future. The site may also be utilized for demonstration purposes.

When a homeowner is interested in the program, a conservation assistant will meet with the homeowner to conduct a site evaluation and prepare a Development Treatment Workbook specifically prepared for the site. The homeowner owner will also contact their local fire professional for a fire defensible space inspection. The conservation assistant will review the results of the fire defensible space inspection to ensure that any recommended improvements will compliment with a fire defensible space program. If the homeowner agrees to participate in the project, a license agreement is signed by the Truckee River Watershed Council and the homeowner specifying the terms of the contract and granting the TRWC right of entry to the property. The homeowner has until December 2013 to implement at least 80 percent of the workbook in order to qualify for the Rebate Program, which has been established to assist homeowners with implementation expenses. TRWC will stay in contact with the homeowner to answer any questions and to also encourage completion of their project. Funding for the pilot program is available until December 2013.

The Truckee River Friendly Landscaping Program has enrolled 78 homeowners since the start of the program. As of the writing of this case study, none of the homeowners have had sufficient time to complete their projects. This case study will be periodically updated to provide feedback on the program's success.

Contact: Andy Otto, River Friendly Landscaping Program, Phone: 530-550-8760, ext. 3
aotto@truckeeriverwc.org http://www.truckeeriverwc.org/river-friendly-landscaping/rfl-overview

Cedar House Hotel / Truckee, California

Case Study (2004-2006)

Site Use and & Protection Measures Before & During Construction: One year before construction, the owner completed grading, drainage, and construction of 3 retention ponds to retain runoff. The retention ponds filter sediment and contaminants and allow water to percolate. The largest pond is 40' by 20' and 12' deep. Each pond has a sandy bottom. Paved areas are sloped toward the middle to runoff into the retention ponds.

Outdoor Water Efficiency Measures in Project: The green roof is underlain by five layers of fabric and drain channels. It is re-seeded each year. Water draining off the green roof goes through gutters down a hanging chain to the landscaping below. Water is dispersed from the chain in a circle with a diameter of 2-3 feet. The landscaping has an outward facing slope to maximize use of the runoff for irrigation. Subsurface perforated pipes direct water to gardens down slope.

A rock gabion wall on the perimeter of the property extends 3-4 feet below the ground. The rocks in the gabions filter subsurface flows. Permeable pavers cover the restaurant's patio area.

Designer: Ken Meffin, Rough & Ready, CA

Builder: Owners: JB Construction, Grass Valley, CA.

Contact: Jeff Baird
Owner / Cedar House Hotel
Phone: (530) 559-5254
Email: patty@cedarhousesporthotel.com

UC Davis Tahoe City Field Station / Tahoe City, California

Case Study (10/12/2011)

The UC Davis Tahoe City Field Station (aka Historic Fish Hatchery) building utilizes a number of innovative LID practices that were implemented on the Hatchery property when the building was renovated, including an underground infiltration system, rock-lined swales, slotted channel drains, drip-line trenches, riprap and paver infiltration areas.

Paver Infiltration Walkway

Vegetation under drip lines infiltrates roof runoff

Drip line rock armoring increases infiltration of roof runoff

Rock-lined swale

Contact: Alan C. Heyvaert, Ph.D.
Desert Research Institute
Phone: 775-673-7322
Alan.Heyvaert@dri.edu