Chapter 7: **Landscape Design and Management**

- *Landscape Issues at LANL*
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Chapter 7

Landscape Design and Management

Landscape Issues at LANL

Once the site analysis has been completed, design scheme alternatives have been developed and evaluated, and the building footprint and placement have been determined, design and specifications can be refined for the landscape surrounding the building.

Several key elements of the landscape design are addressed in this section:

- Stormwater management
- Using water outdoors
- Parking pavement
- Landscape vegetation
- Exterior lighting

The first four of these elements are linked by their impacts on water. The Laboratory is located in an area where water resources are limited and local hydrology is driven by evaporation. The source of water for the Laboratory is a series of deep wells that draw water from the regional aquifer. If the Laboratory draws too much water from the aquifer, the Rio Grande will not be sufficiently recharged – which is particularly important downstream. Under current operations, water is consumed for purposes such as cooling tower use, temperature control, domestic use, and landscape irrigation. In FY 2000, the Laboratory used approximately 446 million gallons of water for its operation.

Other sustainability priorities addressed in this chapter include keeping pollutants out of the Rio Grande watershed, saving exterior lighting energy, and minimizing light pollution.

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An example of a historical water management technique.

Opportunities

Sustainable landscape design can help protect the regional watershed while enhancing the sustainability of the site. Specific opportunities include:

- Minimizing costs and resource impacts of ongoing landscape management
- Reducing fire risk and promoting recovery from past fire damage
- Protecting soil and topography features on the site
- Minimizing pollutant loading of groundwater and surface waters
- Avoiding depletion of the regional aquifer

Additional benefits of sustainable site/landscape design include:

- Reducing energy use in buildings and for lighting around buildings
- Protecting the night skies through light pollution control
- Increasing durability of building foundations through water management
- Protecting and enhancing the natural beauty and ecological value of the site
- Interpreting the value of sustainable landscape management to employees and visitors
- Creating markets for recycled landscape construction materials

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Stormwater management and landscape water efficiency have impacts on the Rio Grande watershed.

Stormwater Management

Stormwater is precipitation that does not soak into the ground or evaporate but flows along the surface of the ground as runoff. Conventional practice for stormwater management – concentrating runoff and carrying it off a site as quickly as possible through storm sewers – causes various environmental problems, including erosion, downstream flooding, pollution loading of surface waters, and reduced groundwater recharge.

There are two basic principles of sustainable stormwater management:

- ***Drainage and flood control*** is based on managing the quantity of stormwater runoff potentially generated during a design-basis storm event (a storm event likely to occur only once in a specified time period). Major contributors to stormwater runoff are impervious surfaces such as rooftops, parking lots, and roadways.
- ***Water quality control*** is based on managing on-site sources of pollutants in stormwater and, if needed, treating the stormwater to remove these pollutants. Pollutants enter stormwater primarily by erosion of soil (sediment loading) or by being picked up from impervious surfaces. Rooftop surfaces typically accumulate pollutants that are deposited from the atmosphere or blown on during adverse weather. Parking lot surfaces collect a variety of pollutants leaked from vehicles.

The primary goal of sustainable stormwater management should be to generate no additional runoff from the existing site compared with pre-development conditions. The intent of this design goal is to use an integrated approach that minimizes generation of stormwater runoff and maximizes infiltration of the generated stormwater into the ground. This approach limits runoff (and potential pollutants) from leaving the site.

An integrated design approach involves configuring the location and placement of impervious surfaces, avoiding contiguous impervious surfaces where feasible, specifying land-based structural practices for stormwater detention and treatment, and providing proprietary stormwater pollutant removal devices where significant pollutant sources occur.

A green (vegetated) roof can serve as a very effective stormwater management system. This practice is gaining wide attention for stormwater control and pollutant filtration systems. Such a roof will typically absorb the first half-inch or more of a rain event, detaining the runoff from that storm.

I recognize the right and duty of this generation to develop and use the natural resources of our land; but I do not recognize the right to waste them, or to rob, by wasteful use, the generations that come after us.

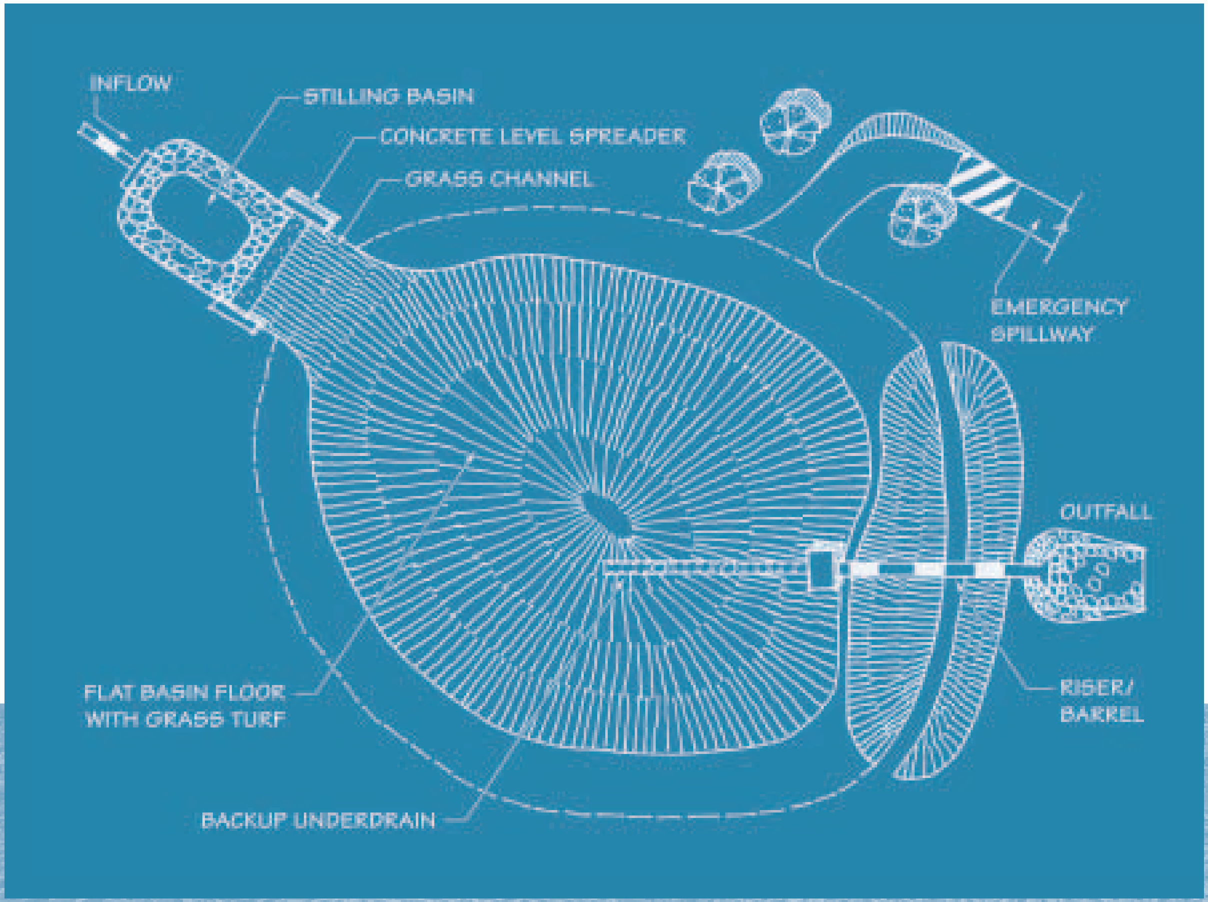
– Theodore Roosevelt, 1910

Stormwater Management

Investigate the feasibility of applying stormwater management strategies to detain and treat stormwater on the site. Note that stormwater detention areas at the Laboratory should be designed to be "dry" most of the year, unless they are also serving as fire control ponds. Wet detention ponds (sometimes called stormwater retention ponds) are appropriate in other areas, but not appropriate for the Laboratory because development of wetlands or breeding areas presents operational risks. Each of the following stormwater structural practices described and illustrated requires specific periodic maintenance practices for proper operation.

Infiltration Basin

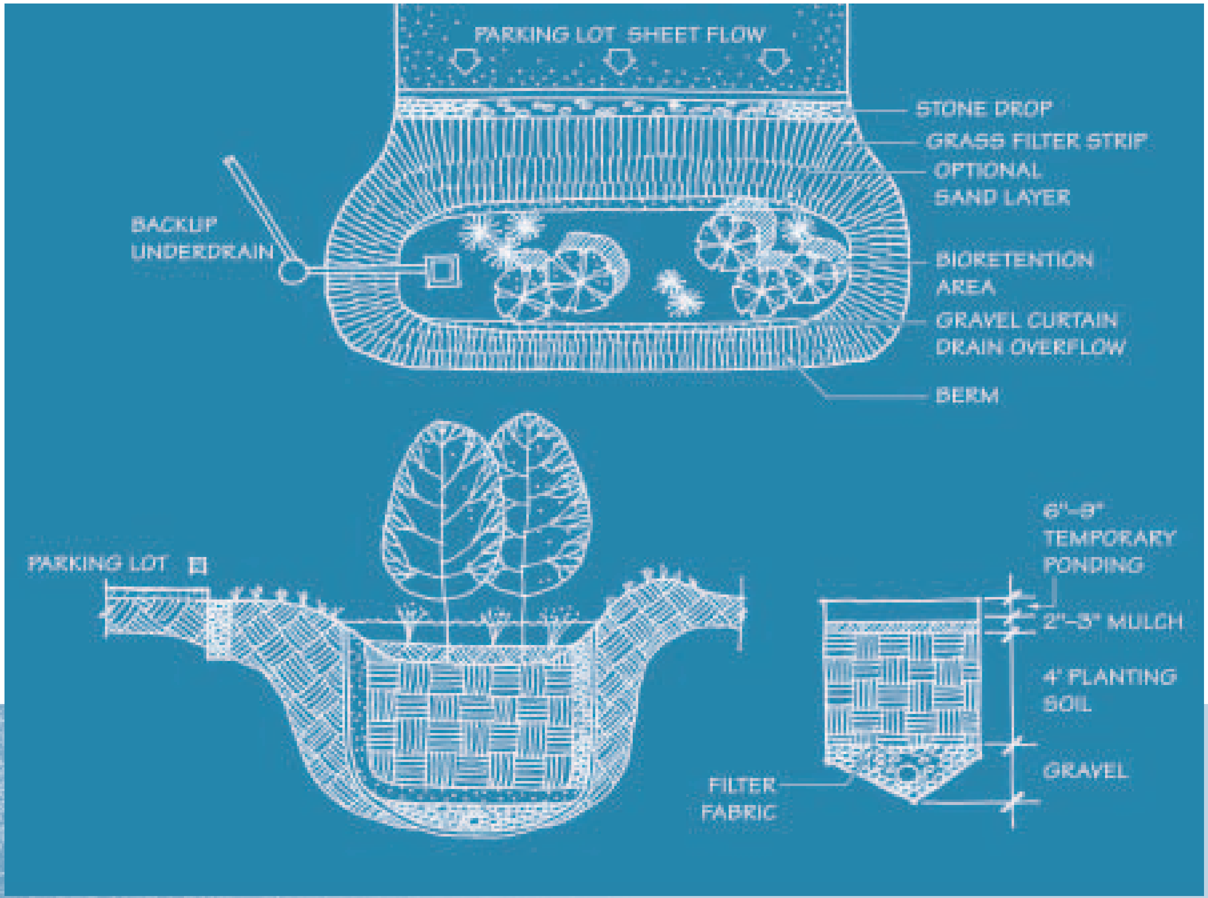
- Best applied to drainage areas of less than 10 acres.
- Soil infiltration rate should range between 0.5 and 3 inches per hour.
- Can be optimized for seasonal operation and to accommodate snow melt.



An infiltration basin is a shallow impoundment designed to infiltrate stormwater into the ground. Design elements direct stormwater to flow through a stilling basin, concrete level spreader, grass channel, and a flat basin floor with a backup underdrain and an emergency spillway.

Bioretention Swales

- Landscaping features can be adapted to treat and infiltrate stormwater runoff.
- Surface runoff is directed into shallow, landscaped depressions with ecologically engineered layers to facilitate pollutant removal.
- Typically, some portion of the filtered runoff is infiltrated through the bioretention system into the ground beneath; additional stormwater is carried away to a secondary detention or infiltration area.
- Parking lot biofiltration swales should be sized to equal 5 to 10 percent of the area being drained.
- These bioretention areas can be designed to hold plowed snow.

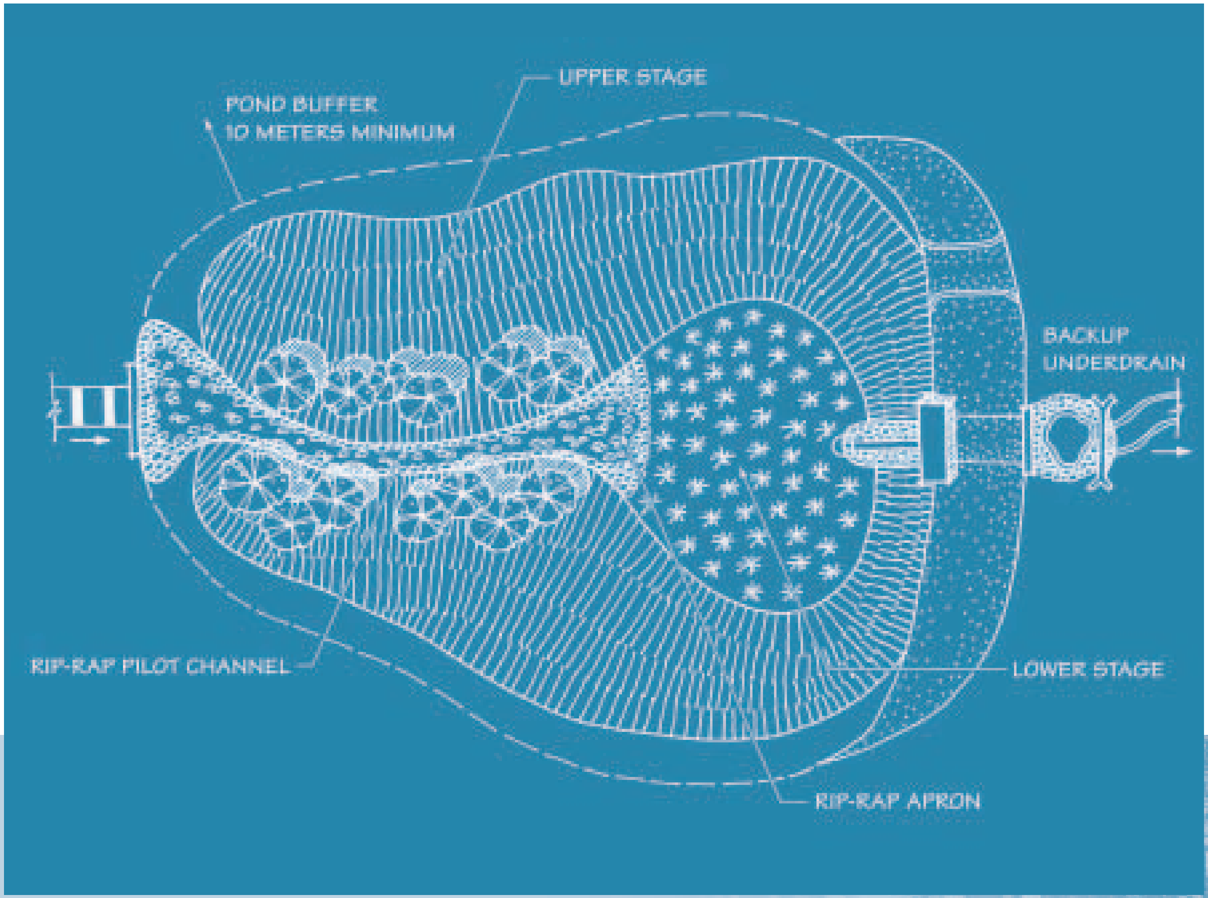


Bioretention swales direct water across a stone drop and grass filter strip to collect and filter through the mulch, prepared soil, or aggregate mix. Filtered runoff not absorbed into the ground is typically collected in a perforated underdrain.

Example pedestrian area swale near the Nicholas C. Metropolis Modeling and Simulation Center.

Dry Extended Detention Pond

- Vegetated, open-channel management practice.
- May be an option as a snow storage facility to promote treatment of plowed snow.
- Recommended for sites with a minimum drainage of 10 acres.
- Least expensive stormwater treatment practice, on a cost-per-area treated basis.
- Best long-term performance track record (fewest clogging problems).



Dry extended detention ponds are basins with outlets designed to detain the stormwater runoff from a storm event to allow particles and associated pollutants to settle. Design elements direct stormwater to flow in a rip-rap pilot channel through an upper stage meadow to a lower stage basin with an underdrain and a spillway.

Proprietary Systems for Stormwater Pollutant Removal

The longest-lasting and lowest-maintenance stormwater management systems are features designed into the landscape (structural practices). However, these structural practices can be aided by proprietary stormwater products in areas that generate high levels of pollutants. Proprietary stormwater products are manufactured systems – often precast concrete with specialized filtration systems – used to capture pollutants from maintenance garages, parking lots, fuel-storage zones, and other areas where fuel or chemical spills are likely. Often referred to as "oil/grit filters," these systems require regular maintenance to remain effective, so they should not be installed unless there is a long-term commitment to maintenance.

There are approximately two dozen manufacturers of proprietary stormwater treatment systems currently on the market. They are becoming an important component of permitting under the National Pollutant Discharge Elimination System (NPDES). Most are designed to replace or fit into the storm-drain inlets of storm sewer systems. They may include floatation chambers to capture hydrocarbons that float on the surface of the water and sophisticated filters to capture silt and other pollutants. Listings and descriptions of these proprietary products can be found on the U.S. EPA Web site and in references listed at the end of this chapter.

While management of stormwater is a high priority, it makes sense to also implement policies designed to keep pollutants out of stormwater in the first place. Such measures could include regular vehicle inspections of Laboratory vehicles and equipment, strong policies regulating the transport of chemicals and fuels on the LANL campus, limitations on fertilizer and pesticide use, restrictions on road salt use, and regular street and parking lot cleaning. Keeping pollutants out of stormwater is almost always cheaper and more effective than trying to remove them.

Stormwater Pollutants

A wide range of pollutants are found in stormwater, including:

- ***Suspended solids.*** Soil particles and other materials deposited by wind or erosion.
- ***Nutrients.*** Primarily nitrogen and phosphorus from fertilizers. These cause excessive algae growth in surface waters.
- ***Organic carbon.*** Commonly referred to as biochemical oxygen demand (BOD), organic matter washed into surface waters robs the water of oxygen as it breaks down.
- ***Bacteria.*** Fecal coliform and other bacteria are regularly found in stormwater and can result in the closing of public swimming areas.
- ***Hydrocarbons.*** Engine oil, gasoline and diesel fuels, and other hydrocarbons are leaked onto parking lots and roadways; they are often toxic to aquatic organisms.
- ***Trace metals.*** Lead, zinc, copper, and mercury are found in stormwater. The leading source of lead in stormwater today is from automobile tire weights that get ground to dust on roadways.
- ***Pesticides.*** While safer than the persistent pesticides used several decades ago, today's pesticides can be toxic to aquatic organisms.
- ***Chlorides.*** Calcium chloride is commonly applied to roadways and parking lots for snow and ice control/removal.
- ***Trash and debris.*** Primarily a visual pollutant, trash also can be contaminated with toxics.
- ***Thermal pollution.*** Stormwater washed off parking lots and roadways in summer thunderstorms can be warmed by the pavement and raise the temperature of streams – sometimes harming cold-water fish species, such as trout.

Using Water Outdoors

Strategies for Reducing Water Use Associated with Landscaping

Water efficiency is the planned management of potable water to prevent waste, overuse, and exploitation of the resource. Effective water-efficiency planning seeks to "do more with less," without sacrificing performance. Irrigation water can be reduced by applying the following strategies:

- Preserve, encourage, or reintroduce native, drought-tolerant vegetation that is already optimized for Los Alamos precipitation levels.
- If plants are desired that need water, group them by similar watering and soil type needs.
- Where irrigation is needed, use efficient practices:
  - Use ultra-low-volume distribution devices such as drip irrigation systems.
  - Irrigate after on-site inspection or electronic sensing of moisture requirements, rather than just by a timeclock. Automatic irrigation controllers should have rain switches that override the "on" signal when sufficient rain has fallen or soils are moist.
  - Water requirements vary greatly by season, and as the landscape matures, less irrigation should be required (assuming native, drought-tolerant plantings).

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This xeriscape area at TA-48 RC-1 has been tended by employees for a couple of years. Xeriscaping creates an aesthetically pleasing landscape with native, drought-tolerant plants and low maintenance requirements.

Rainwater Harvesting

Rainwater harvesting is the practice of collecting rainwater off roof surfaces and storing that water for later use. While collected water can be filtered and treated for potable uses, such systems are fairly complex (see Chapter 5 for additional details). Using collected rainwater for landscape irrigation is more easily accomplished. The basic elements of a rainwater harvesting system are:

- Construct the building roof of materials that will not contaminate rainwater falling on it (avoid asphaltic membranes).
- Channel rainwater into an above-ground or buried cistern. Above-ground cisterns should be covered to keep people and animals out and to block sunlight so that algae doesn't grow; freeze-protection may be required if the cisterns aren't drained in the winter months.
- Provide a gravity-fed outlet or pump system to extract water from the cistern for irrigation.

Robb Williamson

A small cistern stores rainwater for landscape irrigation at the Chesapeake Bay Foundation's Phillip Merrill Environmental Center in Annapolis, Maryland.

Recycled Water

Recycled water is either reclaimed wastewater or untreated greywater – two other possible sources for irrigation water.

Reclaimed wastewater, sometimes called irrigation quality or IQ water, is water from a wastewater treatment plant that has been treated and can be used for nonpotable uses such as landscape irrigation, cooling towers, industrial processes, toilet flushing, and fire-protection. The New Mexico Environment Department is currently reviewing its guidance for the use of reclaimed wastewater.

Greywater is untreated wastewater generated within the facility from showers, laundry, and bathroom sinks (not from toilets, urinals, kitchen sinks, or dishwashers). Greywater can be used for below-ground irrigation, but it is not recommended for use above-ground. Due to organic matter, greywater should be used right away and not stored. If greywater is stored too long, the oxygen will be used up and anaerobic conditions will result in unpleasant odors. The New Mexico Environment Department regulates treatment and use of greywater.

Reclaimed wastewater systems must be scrupulously isolated from potable water distribution, and all IQ hose bibs must be clearly marked as "nonpotable."

Parking Pavement

If large parking areas must be included on the building site, then design bioretention areas into the parking lot landscaping as part of the exterior water management strategy. Bioretention areas or swales can include trees for shade as well as understory plantings. Provide infiltration swales along roadways (with no curbs, so that sheet-flow can distribute water thinly during storm events). Permeable pavement surfaces can reduce runoff (see sidebar).

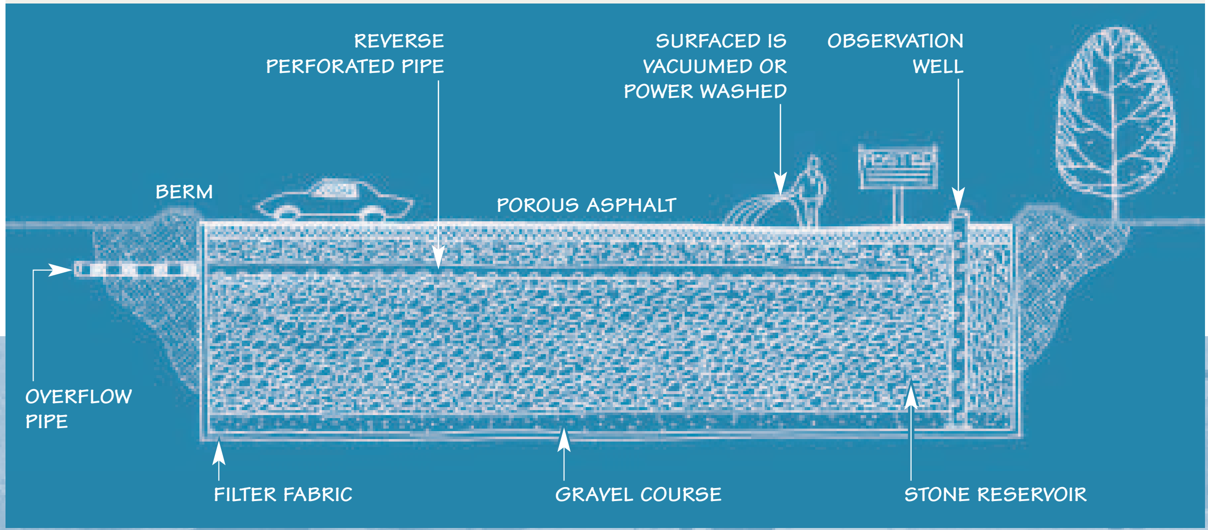
To minimize the heat island effect (a localized warming that occurs around built-up and urban areas), paving material for parking lots should have a high reflectance to minimize absorption of solar heat. However, be aware that light-colored parking lots can reflect light onto adjacent buildings, increasing cooling loads and causing visual glare. Abate this glare by screening or shading the parking lot with vegetation, such as drought-tolerant groundcover and canopy trees.

Permeable paving is a powerful tool for maintaining and restoring natural hydrological cycles on developed sites by allowing water infiltration rather than concentrating rainwater into runoff. A permeable paving system is a pavement surface that contains voids, allowing water to infiltrate through. The pavement surface can be pervious concrete, porous asphalt, or hard unit pavers that allow water to infiltrate between the units or through hollow cores. A stone reservoir beneath the pervious pavement surface temporarily stores surface runoff before infiltrating into the subsoil.

Permeable pavement systems have been used successfully in cold climates with the base of the stone reservoir extending below the frost line to reduce the risk of frost heave. Snow will melt faster because of accelerated drainage below the surface.

However, permeable pavement is not recommended for surfaces receiving snow and ice treatments. Sand will clog the permeable surface and chlorides from road salt may migrate into the groundwater. If a paved area is treated for snow removal only by plowing (no salt, sand, or chemicals), then permeable pavement is viable with proper maintenance, including periodic cleaning (power washing or vacuum sweeping) to prevent clogging.

Alternative paving surfaces are appropriate for vehicle and pedestrian areas that do not receive snow and ice removal treatments. These surfaces can reduce the runoff from paved areas but typically do not incorporate the reservoir for temporary storage below the pavement (see Chapter 6). Soft paving strategies provide stable load support rated for accessible pedestrian surfaces and low-volume vehicle traffic (such as emergency and utility vehicles or overflow parking).



Porous pavement is a permeable pavement surface with an underlying stone reservoir to temporarily store surface runoff before it infiltrates into the subsoil. Design elements include fabric lining to prevent underground sediment entry and a sign posted to prevent resurfacing, sand treatment, and use of abrasives.

Landscape Vegetation

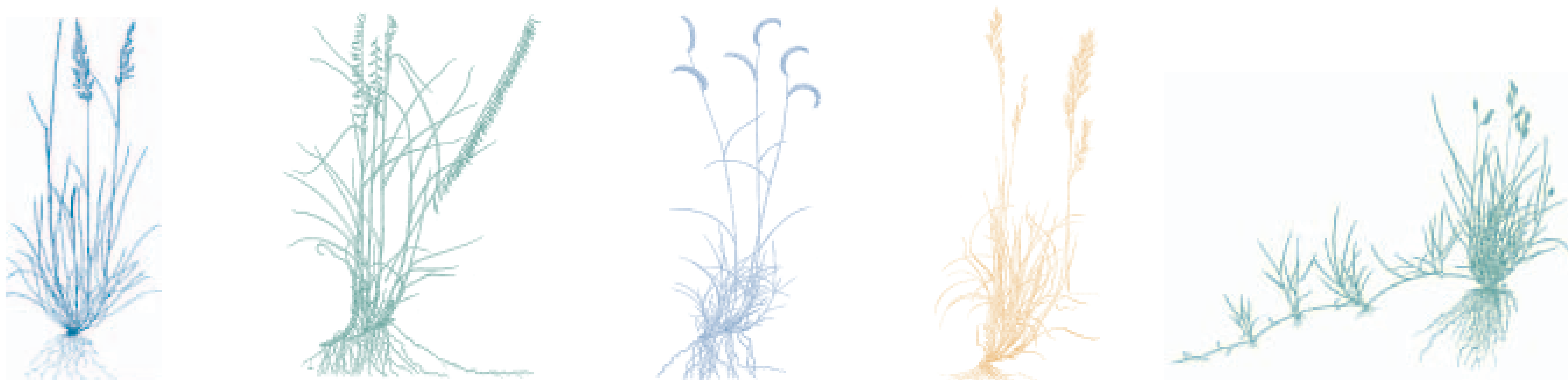
Landscaping is key to the relationship of the building and the site. Functional aspects of landscaping should be incorporated into the site design. Landscaping is an integral component of any sustainable design and must be integrated with all aspects of the building design, construction, and operation. The landscape functions as a system that supports the overall sustainability goals of the project. Specific functional uses of plants are given on page 87 of the *Design Principles.*

Native landscape on the LANL campus ranges from wooded areas to grasslands and alluvial water environments. Native forests include piñon and ponderosa pines, aspen, and gamble oak. Forested areas often have a rich understory of shrubs and flowering plants. The native flora has evolved to flourish within specific regional conditions, is self-propagating, and requires no additional water, nutrients, or maintenance. Native plants also have natural controls, so they will not become invasive as many non-native, introduced plants have become. A wide array of trees, shrubs, groundcovers and grasses that are indigenous, hardy, and drought-resistant can be incorporated into the landscape design using xeriscape principles. A listing of approved plants is given in Appendix B of the *Design Principles.*

Natural vegetation in many areas has been damaged by development, erosion, wildlife, and introduction of non-native, invasive plants. An important component of landscape design can be ecological restoration. Through ecological restoration and careful siting of buildings on a degraded site, it is possible for a post-development site to support greater biodiversity than prior to development.

Be sure to follow the guidance for fire management zones, general fire risk reduction, landscape fire risk reduction, and defensible space as given on pages 24–26 of the *Design Principles.*

Examples of regional native plants.



Blue Fescue, *Festuca ovina*

Sideoats Grama, *Bouteloua curtipendula*

Blue Grama, *Bouteloua gracilis*

Creeping Red Fescue, *Festuca rubra*

Buffalo Grass, *Bichloe dactyloides*

Illustrations courtesy of Texas A&M University.

Exterior Lighting

Exterior lighting improves security, enhances safety, and directs pedestrians and vehicles. A wide selection of new lamps, ballasts, fixtures, and controls is available to lighting designers to replace traditional inefficient exterior lighting systems. With any exterior lighting design, control of light pollution and light trespass should be a high priority. *Light pollution* is the upward transmission of light into the night sky. *Light trespass* is the transmission of direct–beam light off the premises (glare that is obnoxious to neighbors or passing drivers). Careful luminaire and lamp selection can minimize or eliminate these problems.

Light pollution can disrupt biological cycles in plants and animals, including humans. Glare increases hazards by creating stark contrasts and making areas outside the light even less visible. Light pollution often hinders effective stargazing and astronomical research by over-illuminating the night sky. The State of New Mexico has legislated against light pollution with the New Mexico Night Sky Protection Act. Specifically, fixtures greater than 150 Watts must be shielded or turned-off between 11 p.m. and sunrise. Also, mercury vapor lamps can no longer be sold or installed.

Remember that lighting design should be for the actual site usage patterns, safety and security requirements, not just for footcandles. Here is a checklist of suggested practices for outdoor lighting.

Solar Outdoor Lighting, Inc.

Solar lights are self-contained, stand alone, and useful in a variety of outdoor lighting applications. This parking lot lighting example has a shoebox fixture with a full-cutoff lens and an 8-ft. arm.

✓ Exterior Lighting Checklist

Light the minimum area for the minimum time.

- ☐ Limit all-night illumination to areas with actual all-night use or specific security concerns. Simple timers and photocells can turn lights on and off at seasonally appropriate times. For security lighting, motion or infrared sensors can spotlight intruders without beaming constantly glaring lights.
- ☐ Use full cut-off fixtures, shades or highly focused lamps to avoid spillover. Linear "tube lights," fiber-optics, and electro-luminescent fixtures can light the way for pedestrians without over-illuminating a much larger area.
- ☐ Question the "brighter is better" myth, especially for security and advertisement. Avoiding areas of high contrast is better than increasing lumen levels for security lighting.

Clearly identify the actual purpose of lighting to determine minimum acceptable levels.

- ☐ Hazard lighting is usually focused on the hazard, bright enough to warn, identify, and allow judgment of distance. Area lighting, seldom as bright or focused, allows a user to choose a safe route.

Use energy-efficient lamps and ballasts.

- ☐ The most efficient new lamps produce 10 times as many lumens per watt of power as a conventional incandescent bulb. Operating-cost savings (including deferred bulb replacement, labor, and equipment rental for inefficient, hard-to-reach parking-lot lamps) quickly recover the cost of re-lamping. High-pressure sodium (HPS) lamps are a common choice for an energy-efficient outdoor light source. New fixtures are often miniaturized, allowing design flexibility. Low-temperature-starting compact fluorescent lamps are suitable for some outdoor applications, such as bollard lighting, lamp posts, and exterior wall sconces.

Optimize uniformity and minimize shadows.

- ☐ Design the placement of exterior lighting systems to provide good uniformity ratios and minimal glare. Locate luminaires to minimize shadow effects of trees and other fixed objects such as large signs or security-building walls.

Use renewable energy sources for lighting and other outdoor power applications.

- ☐ Photovoltaic (PV) power is generally cost-effective for light fixture sites over 200 yards from the utility grid and is an attractive alternative to power lines. With the right specifications, PV-powered fixtures are low-maintenance and very reliable. Manufacturers offer solar path-lights, streetlights, and security lights.

Reducing Light Pollution at the Nicholas C. Metropolis Modeling and Simulation Center at the Strategic Computing Complex (SCC)

The outdoor lighting at the SCC includes bollards with downward angled louvers, wall-mounted sconces with adjustable shields, and a variety of emergency lighting fixtures. Timers control all outdoor lighting through a programmable dimming system.

Security lighting must be designed for the people and the equipment involved in the security plan and for the security of the property at issue. High-efficacy light sources (light source efficiency expressed in lumens per watt) with inferior color rendering properties may be used for security lighting when motion rather than identification is the prime security concern. Avoid bright "glare bomb" fixtures that can actually decrease security by inhibiting vision and creating shadowed spaces. New infrared and motion-sensing security systems with remote alarms may reduce the need for security lighting, depending on the security objectives. Placement of vegetation and other landscape features (walls, etc.) also can have a significant impact on security. In parking lots, for example, planting tall trees with exposed trunks rather than shrubbery may provide longer views and increase safety.

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Mists over the San Ildefonso Pueblo.

✓ Landscaping Integration Issues

- ☐ Provide capacity in the building control system for exterior lighting if not already using campus-based energy management control system
- ☐ Integrate the landscaping plan with the design of "exterior space" (see Chapter 4)
- ☐ Reduce/avoid parking lot glare that can conflict with daylighting
- ☐ Balance preserving natural vegetation and new landscape plantings with fire risk reduction guidelines
- ☐ Coordinate building design strategy with landscaping decisions
- ☐ Avoid placing either vehicle idling areas or plants that produce allergens near building air intakes
- ☐ Landscape designs must be coordinated with LANL Civil Grading Standards

	✓ *Standard Practice/ Code-Compliant*	✓ *Better Performance*	✓ *High Performance for Sustainability*
Exterior Water Management			
Stormwater	◯ Federal and local codes	◯ Site grading and erosion control according to the *Design Principles* (p. 19, 28) and the *LEM* civil design standards, using surface and channel treatments from the *Storm Water/Surface Water Pollution Prevention Best Management Practices Guidance Document*	*PLUS:* ◯ No net increase in the rate or quantity of stormwater runoff from undisturbed to developed conditions by implementing structural practices for groundwater recharge and biologically-based features for pollutant load reduction
Landscape water use	◯ Federal and local codes *(note: the town of Los Alamos uses reclaimed wastewater above ground, but local regulations are under review)*	◯ Xeriscape, water conservation, and rainwater harvest guidelines as given in the Design Principles (p. 84–86)	◯ Acceptable aesthetics with native plants, no irrigation, and low maintenance (i.e., only following landscape fire risk reduction guidelines)
	◯ Conventional turf irrigation practices with potable water	◯ Reliable, low-flow, water-efficient irrigation systems to establish plants in initial years	◯ Cistern-harvested rainwater or recycled water for landscape irrigation
Parking lot landscaping	◯ Federal and local codes	◯ Parking design guidelines in the *Design Principles* (p. 44–49) including bioretention areas (or parking lot water harvesting swales)	*PLUS:* ◯ Use permeable paving materials in overflow, or low volume parking areas as well as bicycle and pedestrian trails
Exterior Lighting			
General specifications *(walkway, plazas, parking areas)*	◯ New Mexico Night Sky Protection Act	◯ Exterior lighting guidelines in the *Design Principles* (p. 75–77) with shielded fixtures (full-cutoff luminaires)	*PLUS:* ◯ Clearly identify lighting purpose to optimize light fixture density, lighting intensity, and light uniformity
	◯ Federal and local codes	◯ High-efficacy lamps and fixtures with timer or photocell control	◯ High-efficacy lamps and fixtures with motion or IR sensor control so that they're only lit when site staff are present at night OR non-grid tied fixtures (with PV and battery system)
Security	◯ DOE and LANL S-1 requirements	◯ *Design Principles:* Security lighting guidelines (p. 77)	◯ Renewable energy powered fixtures (i.e., photovoltaics)

References

"Greening Federal Facilities: An Energy, Environmental, and Economic Resource Guide for Federal Facility Managers and Designers." DOE/EE Federal Energy Management Program, 2001.

"Sustainable Building Technical Manual." Public Technology, Inc., 1996.

Center for Watershed Protection, ***www.stormwatercenter.net***

New Mexico Environment Department ***www.nmenv.state.nm.us***

"The Laboratory's Footprint: Our Environmental Impacts." LA-UR-02-1971, April 2002.

Environmental Building News, ***www.buildinggreen.com***

- "Cleaning Up Stormwater: Understanding Pollutant Removal from Runoff," Vol. 11, No. 2, February 2002.
- "Development and Nature: Enhancing Ecosystems Where We Build," Vol. 10, No. 2, February 2001.
- "Light Pollution: Efforts to Bring Back the Night Sky," Vol. 7, No. 8, September 1998.

Additional Resources

"Site and Architectural Design Principles." LA-UR 01-5383, January 2002.

"Storm Water/Surface Water Pollution Prevention Best Management Practices Guidance Document" (LANL, Revision 1.0 August 1998)

DOE-OEM Fact Sheets at ***http://emeso.lanl.gov/useful_info/success_stories/success_stories.html***

- "Recycling Construction and Landscaping Materials"
- "Dust Suppression with Less Water"
- "Asphalt Recycling"

National Stormwater Best Management Practices (BMP) Database ***www.bmpdatabase.org***.

New Mexico Night Sky Protection Act, ***www.rld.state.nm.us/cid/news.htm***

IESNA Recommended Practices Manuals:

- Lighting for Parking Facilities, RP-20-98
- Lighting for Exterior Environments, RP-33-99
- Selection of Photocontrols for Outdoor Lighting Applications, D6-13-99

Whole Building Design Guidelines, ***www.wbdg.org***

ASTM Standard E-50.06.08, A guide for green landscaping, xeriscaping, and pollution prevention.

EPA's Storm Water Management of Construction Activities, Chapter 3, EPA Document No. EPA 832-R-92-005

"Greenways: A Guide to Planning, Design, and Development." Island Press, 1996.

"Parking Spaces: A Design Implementation, and Use Manual for Architects, Planners, and Engineers." McGraw-Hill, 1999.

"GreenSpec: Product Directory with Guideline Specifications." 3rd Edition, October 2002. BuildingGreen, Inc. ***www.buildinggreen.com***

Society for Ecological Restoration, ***www.ser.org***

American Society of Landscape Architects, publisher of Landscape Architecture, ***www.asla.org***

International Dark Sky Association, ***www.darksky.org***

EPA's National Pollutant Discharge Elimination System (NPDES), ***http://cfpub.epa.gov/npdes***