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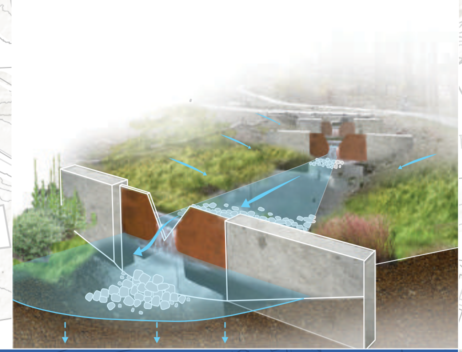
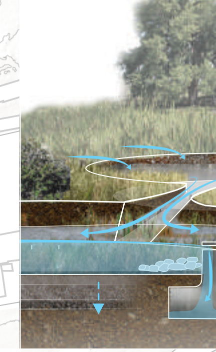
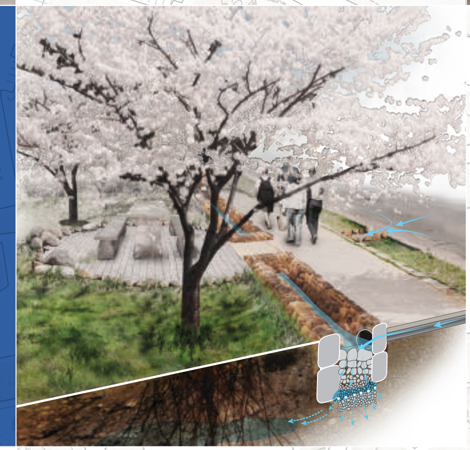
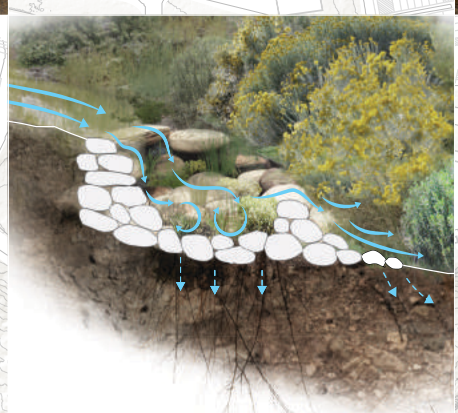




LOW IMPACT DEVELOPMENT MASTER PLAN

SEPTEMBER 18, 2017
LA-UR-17-27538





Los Alamos
NATIONAL LABORATORY

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ACKNOWLEDGMENTS

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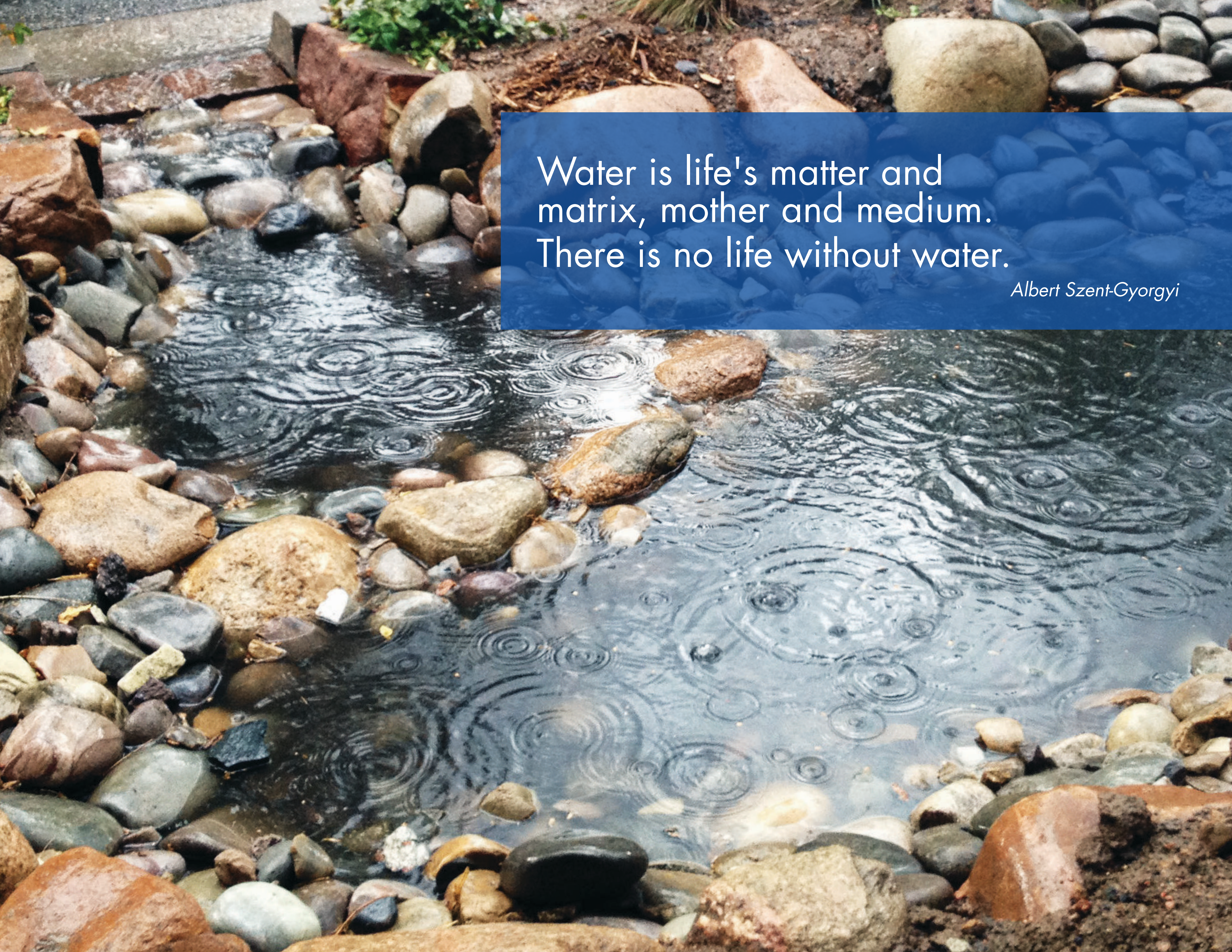


Water is life's matter and
matrix, mother and medium.
There is no life without water.

Albert Szent-Gyorgyi

INTRODUCTION

PROJECT HISTORY

The New Mexico Environment Department (*NMED*), the U.S. Department of Energy (*DOE*) and Los Alamos National Security, LLC (*LANS*), signed a Settlement Agreement and Stipulated Final Order for the purposes of resolving Compliance Order No. HWB-14-20 issued on December 6, 2014. The Settlement Agreement resulted in the development of five Supplemental Environmental Projects (*SEPs)*.

The objective of one of the SEPs is to implement a number of projects to slow storm water flow and decrease sediment loads to improve water quality and allow surface water management at the watershed scale. The planning process established an Integrated Project List that identified a subproject "Institutional Low-Impact Development Master Plan". This LID Master Plan fulfills a portion of that objective.

PROJECT PURPOSE

This project creates a Low Impact Development *(LID)* Master Plan to guide and prioritize future development of LID projects at Los Alamos National Laboratory *(LANL or the Laboratory)*.

The LID Master Plan applies to developed areas across the Laboratory and focuses on identifying opportunities for storm water quality and hydrological improvements in the heavily urbanized areas of Technical Areas 03, 35 and 53.

The LID Master Plan is organized to allow the addition of LID projects for other technical areas as time and funds allow in the future.

PROJECT PROCESS

The LID Master Plan was developed by the Storm Water Permitting Team within the Compliance Programs Group *(EPC-CP)* through the following activities:

- review of relevant Laboratory policies and documents,
- work-sessions on project goals and vision,
- on-site walking reviews of potential project locations and conditions,
- mapping of potential projects,
- work-sessions on project criteria and priorities,
- development of LID standard guidance details,
- reviews of the LID master plan with potential partner organizations within the Laboratory.

In many cases, the first flush of stormwater... may have a level of contamination much higher than normally present in sewage...

Craig Campbell & Michael Ogden
Constructed Wetlands in the Sustainable Landscape

STORM WATER AT LANL

THE CHALLENGE

Hydrological modification and resultant non-point source pollution are storm water management challenges that the Laboratory faces today. All major drainages receiving waters within LANL boundaries are listed as impaired by the state of New Mexico for one or more pollutants.

Much of the Laboratory was built well before modern storm water pollution regulations were enacted and associated technologies developed. This LANL LID Master Plan is part of a strategic effort to address storm water management issues across the existing developed areas of the Laboratory.

NON-POINT SOURCE POLLUTION

Non-point source pollutants have harmful effects on drinking water supplies, recreation, fisheries and wildlife.

The EPA website states:

"Non-point source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrological modification. Non-point source pollution, unlike pollution from industrial and sewage treatment plants, comes from many different sources.

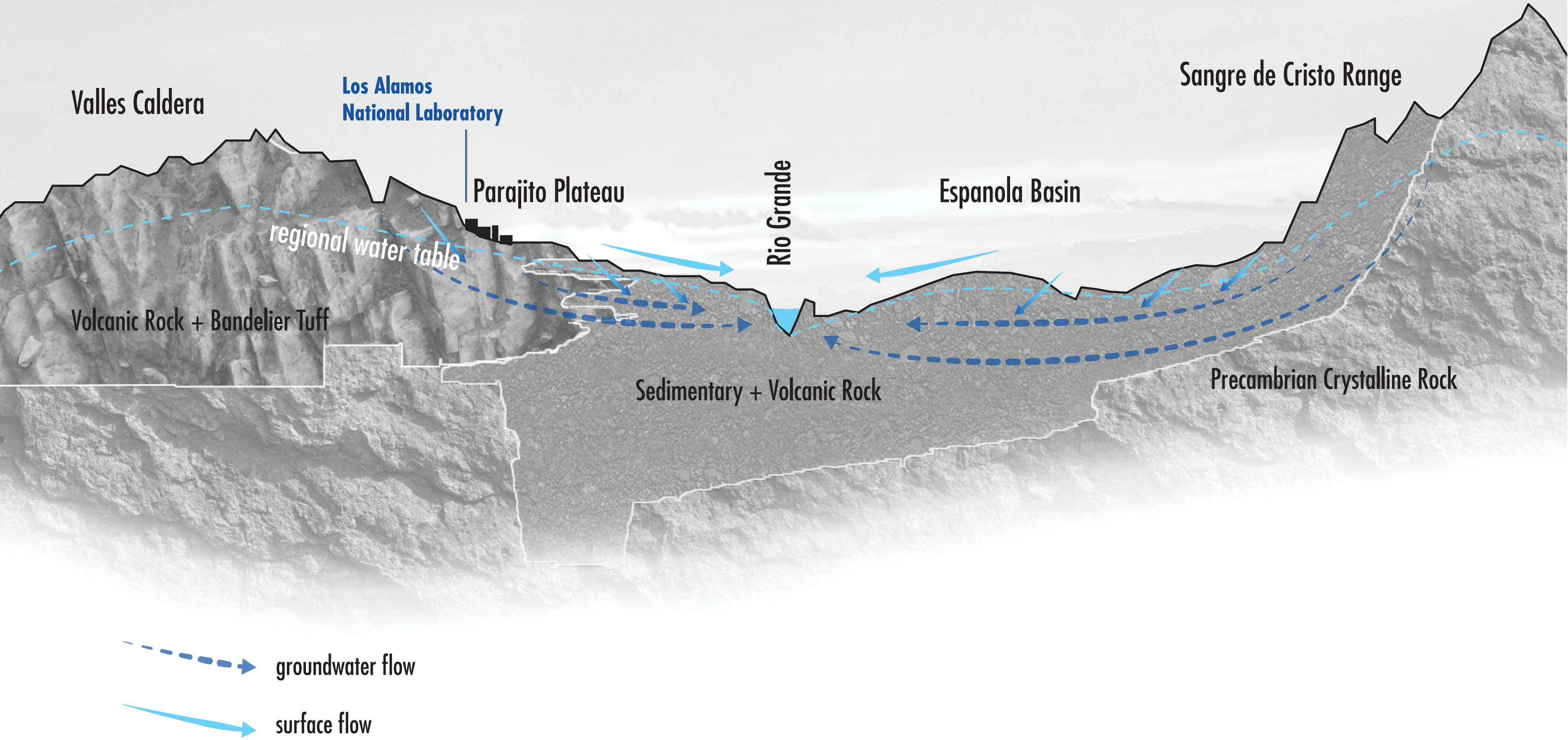
Non-point source pollution is caused by rainfall or snow-melt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal and ground waters."

Non-point source pollution at LANL can include:

- Hydrocarbons and metals from parking lots, roadways and older buildings
- Sediment from disturbed areas, site activities, and other site erosion
- Salt from roadway de-icing applications
- Excess fertilizers, herbicides and insecticides from landscape areas
- Atmospheric deposition and hydro-modification.

RIO GRANDE BASIN SECTION DIAGRAM:

Storm water surface flows directly impact nearby groundwater resources.



LABORATORY SPECIFIC CONCERNS

The Laboratory faces other storm water issues indirectly related to non-point source pollution. The mesa top and steep canyon topography, the naturally sparse vegetation, and the native soils make the area susceptible to soil erosion, particularly on steep slopes and within canyon bottoms. Past development has resulted in extensive impervious areas with a storm sewer infrastructure that routes runoff directly into the nearest canyon with little or no interception or treatment. Consequently, in some locations, uncontrolled storm water discharge has resulted in extensive channel and bank erosion, sediment migration and damage to riparian vegetation.

In addition to these storm water management issues, LANL must also maintain compliance with multiple storm water permits and regulations.

CURRENT + UPCOMING REGULATIONS

The Laboratory currently operates under four National Pollutant Discharge Elimination System *(NPDES)* permits. The Industrial Outfall permit manages pollutants discharged from 11 outfalls. The Multi-Sector General Permit manages discharges from 40+ industrial facilities. The Construction General Permit manages storm water discharges from construction projects of 1 acre or larger. The Storm Water Individual Permit manages storm water pollutants from 405 legacy waste sites. These permits operate on 5-yr cycles and each renewal brings increasingly stringent requirements.

In addition to NPDES permits, all Federal facilities are required to comply with the Energy Independence and Security Act, Section 438 which requires all development or redevelopment activities disturbing greater than 5,000 sq ft to manage storm water discharges at pre-development levels.

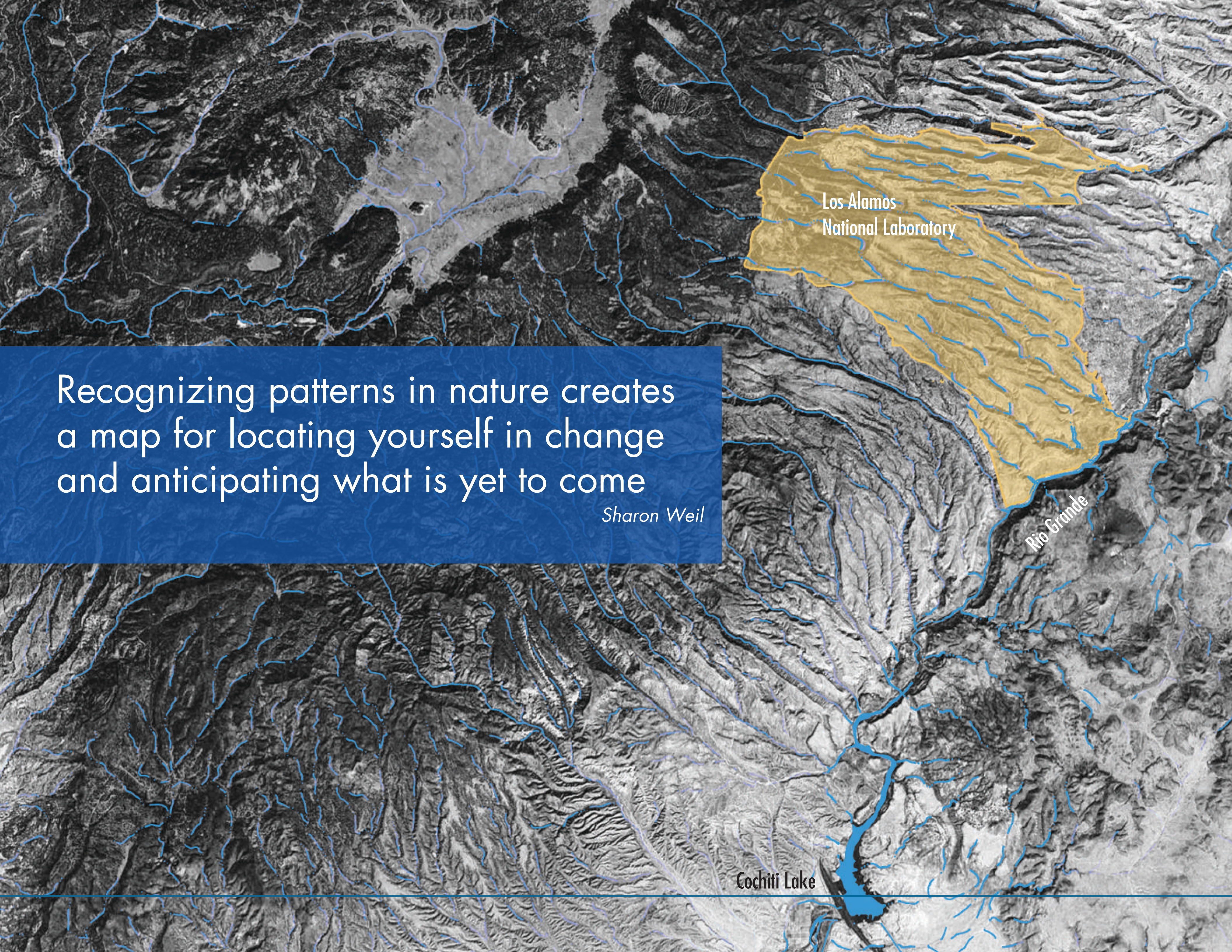
Changes in storm water pollution discharge permit requirements are anticipated to affect the Laboratory in the future. LANL has received a preliminary NPDES Municipal Separate Storm Sewer System *(MS4)* designation and a permit is considered an imminent requirement.

To minimize the discharge of harmful pollutants from urban/developed areas, the EPA created MS4 storm water discharge permit regulations.

MS4 permits require permittees to develop a storm water management plan, which describes the storm water control practices that will be implemented consistent with permit requirements to minimize storm water discharges and the discharge of pollutants from storm sewer systems. LID may be identified as a requirement in the upcoming MS4 permit.

Recognizing patterns in nature creates a map for locating yourself in change and anticipating what is yet to come

Sharon Weil



WHAT IS LID + WHY DOES LANL NEED IT?

WHAT IS LID + GREEN INFRASTRUCTURE?

LID is a storm water management approach to create functional and appealing site drainage features that utilize storm water as a resource rather than a waste product. Green infrastructure *(GI)* is storm water control elements that mimic natural ecosystems to promote infiltration, evapotranspiration or reuse of storm water near the point of generation. When used together they are highly effective tools in storm water quality and non-point source pollution management.

A key element of LID is to mimic a site's pre-development hydrology as closely as possible. When retrofitting an existing system, LID begins to return the site's hydrology to pre-development characteristics while not adversely impacting the performance of the existing storm water management system.

GI is used to support LID principles. Specific GI elements used in LID projects are generally small, low tech and more nature mimicking than conventional, engineered drainage structures.

WHAT ARE THE BENEFITS OF LID FOR LANL?

LID works on the concept that many small and moderate sized bio-engineered storm water interventions throughout a developed area are more environmentally effective and cost efficient than relying only on large storm water controls. The smaller size means that the treatment of storm water for non-point pollution can be placed closer to the source and treated more immediately.

The failure of a small component in a comprehensive LID system rarely affects overall capacity or effectiveness of the system to address storm water management. In comparison, the failure of a large single-point control based system can be catastrophic. Similarly, repairs to LID components are generally easier, lower cost and quicker to make.

The largest benefit from LID and GI is often at the human level. By treating storm water through landscaped structures, they support vegetation, wildlife and the human desire for natural beauty. LID development attracts people and supports a healthy environment for them to work, recreate and live in.

WHAT ARE RISKS OF INACTION?

The risk of not incorporating LID and GI as part of an overall storm water management plan is continued degradation of surface water resources at the Laboratory, resulting in adverse impacts to regional water resources, and ultimately the need for more expensive, engineered solutions.

Pragmatically, the risk to delaying is that future regulatory storm water discharge permits could require more sudden, complex, and large-cost solutions. The lack of action also allows current negative public perceptions of the Laboratory's environmental stewardship to continue without the benefit of a complimentary positive model of Laboratory storm water management efforts.

We are committed to act as stewards of our environment to achieve our mission……

LANL Governing Policy on Environment

LANL LID MASTER PLAN VISION

LANL LID VISION / GOALS / OBJECTIVES

With members of the Storm Water Compliance Team and a variety of Laboratory staff involved with activities that impact or relate to storm water compliance efforts, a vision statement for the LANL LID Master Plan was developed.

The vision for Los Alamos National Laboratory's Low-Impact Development is:

> *"Through the application of low-impact development strategies and green infrastructure improvements, Los Alamos National Laboratory will manage storm water hydrology and non-point source storm water pollution risks while enhancing the natural beauty of its exceptional land."*

Goals and objectives in support of this vision are:

The Goals

Demonstrate LANL environmental stewardship in managing storm water through LID and GI.

- *Pro-actively address storm water regulatory requirements.*
- *Create a clear, organized, practical set of planning, design and implementation strategies for application of LID by the Laboratory.*
- *Integrate LID standards in project budgets,plans, construction and maintenance activities.*
- *Coordinate LID with operations and maintenance activities.*
- *Leverage LID implementation with other project initiatives and activities.*
- *Educate employees about the benefits and necessity for LID.*

Objectives/Measuring Success

- *LID is incorporated as a critical component of LANL responses to storm water regulations and permitting.*
- *The LID Master Plan and Standards are regularly used by LANL staff from project definition and planning through construction, operations and maintenance.*
- *An on-going educational-information component for LID is supported and operated within LANL.*
- *An institutional champion arises who advocates for LID integration at LANL.*

LANL SUPPORTING GUIDANCE

The LANL LID Master Plan supports Laboratory and other relevant agencies policies and regulations on storm water management. Some of those policies and regulations are:

LANL Policies + Regulations

Governing Policy on the Environment
LANL Storm water BMP Manual
LANL Engineering Standards

Related Federal Laws + Regulations

CWA - Clean Water Act/NPDES
EISA - Energy Independence & Security Act
NEPA - National Environmental Policy Act
PPA - Pollution Prevention Act

Relevant New Mexico State Regulations

NM Administrative Code - Title 20

We need to see storm water as the valuable resource it is. It is water – the source of life.

LID CONCEPTS + GENERAL METHODOLOGIES

LID CONCEPTS

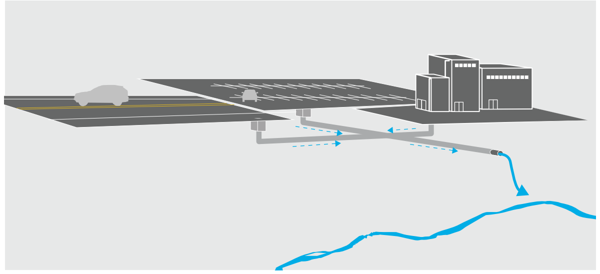
LID uses landscapes, soils and plants to address surface water pollution treatment and management.

Current conventional "hard" engineered systems that pipe and concentrate surface runoff increase non-point pollution effects from hydrocarbons, chemicals, heavy metals and soil erosion produced by every day modern activities such as driving, agriculture and development. Low-Impact Development *(LID)* advances a concept of "soft" landscape engineered systems that compliment and mitigate affects of hard engineered systems.

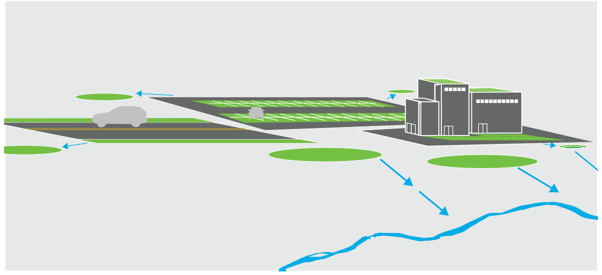
The LID strategy is to apply a holistic watershed management approach–which requires planning as well as design and engineering. A comprehensive LID approach looks at all components within the watershed for opportunities to treat surface water runoff flows and quality. LID supports and enhances the natural hydrological functions of every site to improve surface water quality and enhance the overall biologic and environmental health of the site.

There are Five Core Concepts associated with designing for LID.

1. Conserve or restore natural areas wherever possible (refrain from paving over the whole site if it is not necessary).
2. Minimize the development impact on hydrology.
3. Manage runoff rate and duration from the site (maintain or restore pre-development hydrology).
4. Minimize scale of treatment (integrate LID/GI throughout developed areas to manage storm water close to the source).
5. Implement pollution prevention, proper maintenance and public education programs.



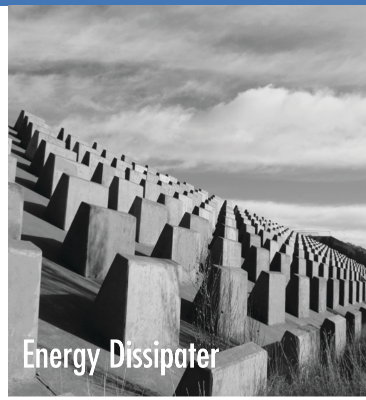
Conventional "hard" engineered systems concentrate pollution and system scales

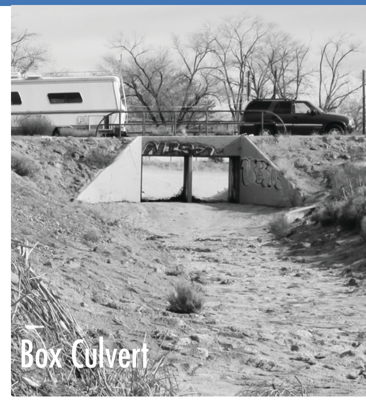


LID approach is to treat pollution closer to the source through nature based systems

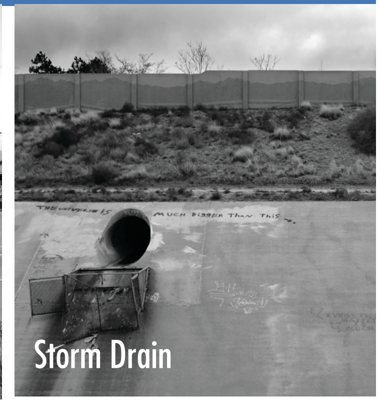
CONVENTIONAL ENGINEERING APPROACHES


Concrete Channel

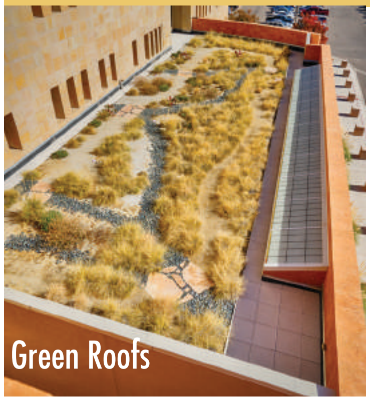

Energy Dissipater

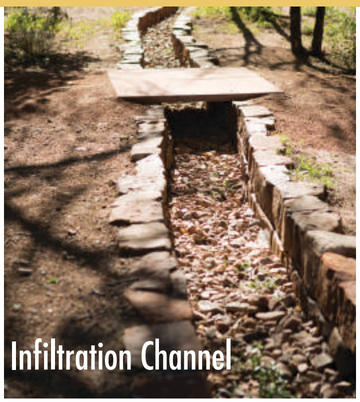

Box Culvert

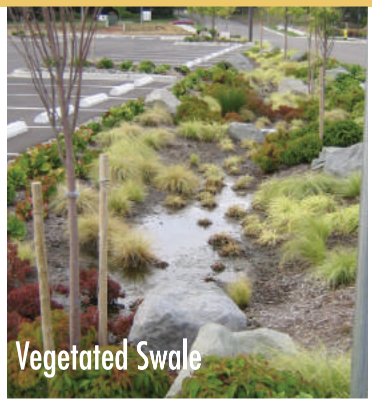

Concrete Basin

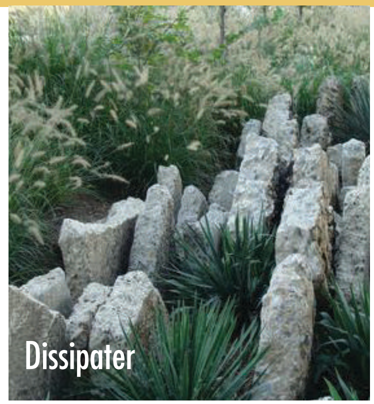

Storm Drain

GREEN INFRASTRUCTURE SOLUTIONS


Green Roofs

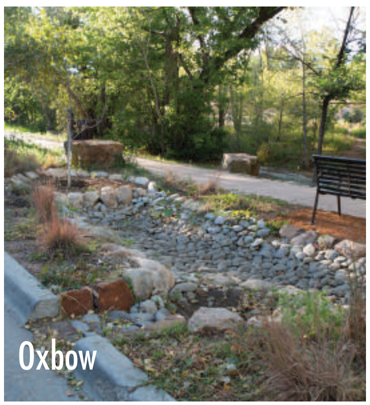

Infiltration Channel

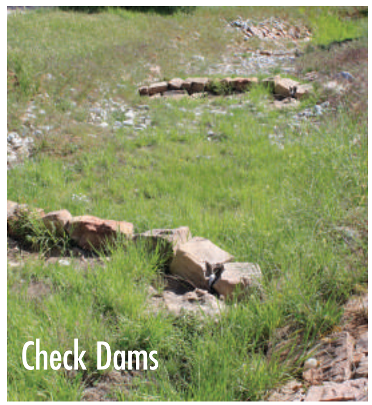

Vegetated Swale

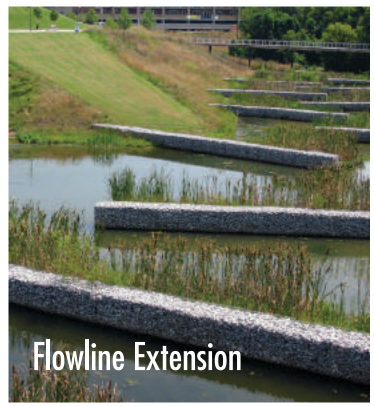

Dissipater

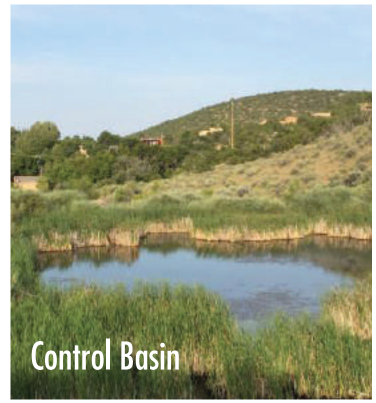

Terraces / Level Spreaders


Permeable Paving


Oxbow


Check Dams


Flowline Extension


Control Basin

CONVENTIONAL ENGINEERING

Conventional "hard" engineering primarily pipes and conveys storm water to large detention ponds with no treatment. They simply transfer pollution from one site to another.

SOFT ENGINEERING

Soft engineering mimics natural ecological systems by integrating plants and soils to mitigate discharge and treat and contain waterborne pollutants and sediment.

BMP + LID

LANL has a Storm water Best Management (BMP) Practices Manual that describes construction related Storm Water BMP's. The LID Standards fully complements this LID Master Plan.

CONVENTIONAL ENGINEERING SYSTEM

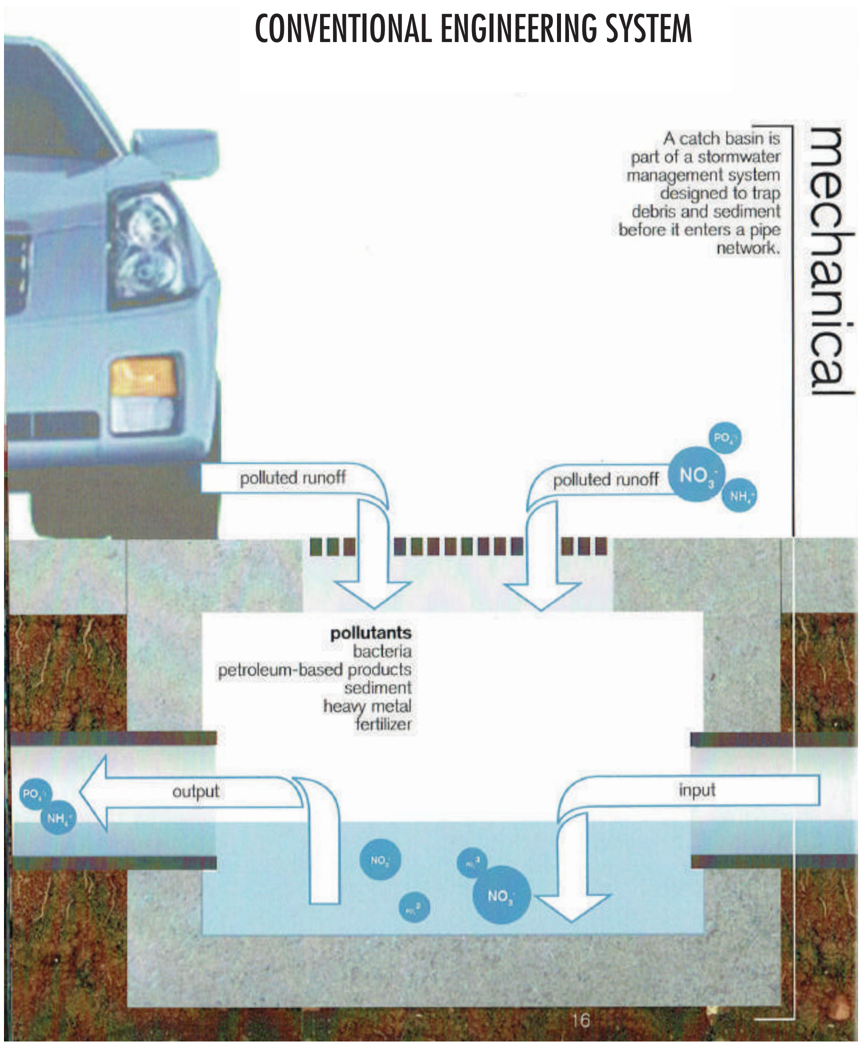


IMAGE SOURCE: *LID: LOW IMPACT DEVELOPMENT a design manual for urban areas.* Fay Jones School Of Architecture, University Of Arkansas.

SOFT ENGINEERING SYSTEM

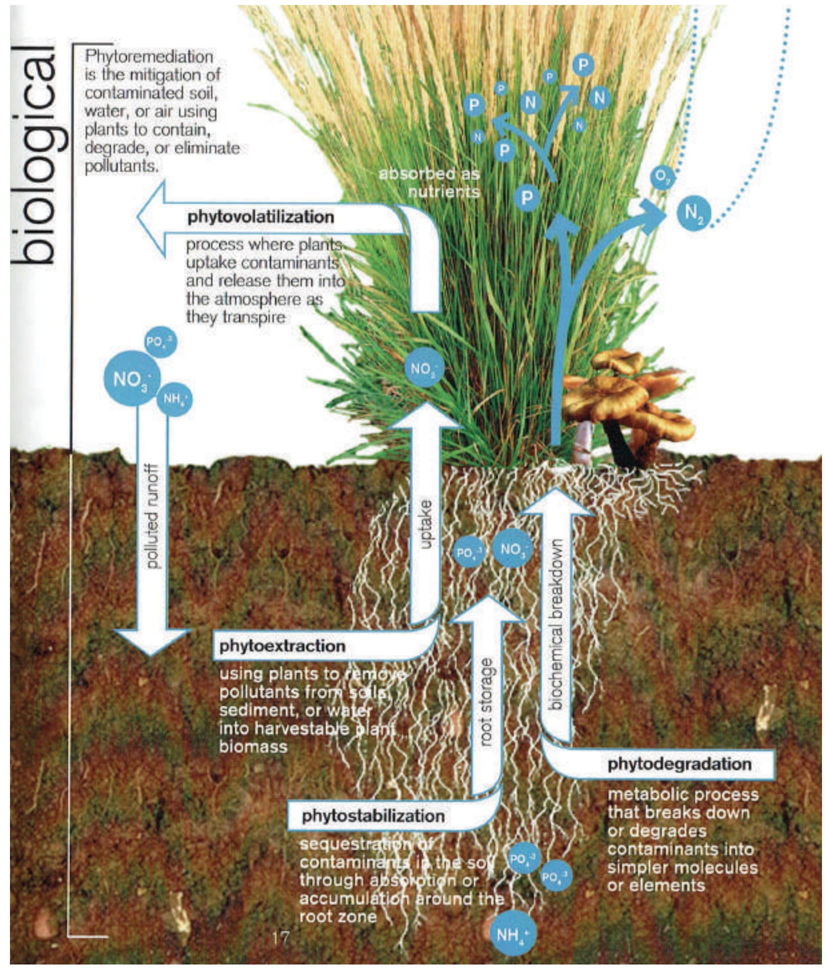


IMAGE SOURCE: *LID: LOW IMPACT DEVELOPMENT a design manual for urban areas.* Fay Jones School Of Architecture, University Of Arkansas.

Entry Pond Perspective - Existing

Entry Pond Perspective - Re-envisioned

LID + ENVIRONMENTAL WELL BEING

A specific goal for LID is to integrate natural processes and beautiful landscapes back into our built environments.

Although a seemingly ephemeral and low priority in today's hyper-digital designed world, research is finding that humans have an innate need for natural environments at perhaps a basic, evolutionary level. Humans evolved within nature and there may be essential needs we have as a species to retain that connection on a daily basis.

LID is centered on integrating nature, vegetation, and natural materials into the design of storm water management features. This emphasis on including vegetation is paramount. Plants are extremely effective in removing and storing air and waterborne pollutants, while reducing the migration of sediments. Plants provide the most accessible way for humans to re-engage with nature over a wide variety of settings.

For LANL, the importance of the natural beauty of the land is part of its scientific history. During the high-pressure, critical years that the Laboratory led the development of our nation's atomic capabilities in WWII, a consistent sentiment in the diaries and memories of the scientists and staff was of the enormous importance of being surrounded by the natural environment. The outstanding beauty of this landscape provided a place for solitude and respite for workers to re-energize and expand their thinking.

The LID Master Plan imagines that the modern day Laboratory needs those same resources to continue to conduct exceptional scientific practices and to continue to attract the best minds. An effective and efficient way to achieve that is to implement LID in LANL development efforts. It supports the required storm water management needs and reconnects us with our greater natural world.

Wellness Center Perspective - Re-envisioned

STORM WATER REUSE STRATEGY

Harvesting rainfall runoff for reuse is a storm water reduction strategy that should be systemically considered and evaluated for existing and future buildings at LANL. The need to preserve potable water for drinking and food production is likely to increase as regional water supplies are affected by climatic change and increasing human demand. One of the most readily available opportunities for LANL to capture rainfall for reuse is from rooftops. With the almost 2000 structures at LANL, the storm water reuse opportunity is substantial.

Benefits to water harvesting roof runoff are:

- reduction to the need for LANL storm water detention and management systems, due to the removal of roof areas from contributing runoff flows
- reduction of off-site storm water flow impacts as overall runoff quantities are decreased, due to the removal of roof areas from contributing to the overall LANL storm volume,
- reduction of potable water use by using harvested roof water for irrigation, toilet flushing, cooling towers, wash down, and other water uses that do not require potable water quality,
- enhanced use of sustainable design throughout LANL, and,
- integration with green roofs, can reduce heat island effects and treat runoff to improve water quality.

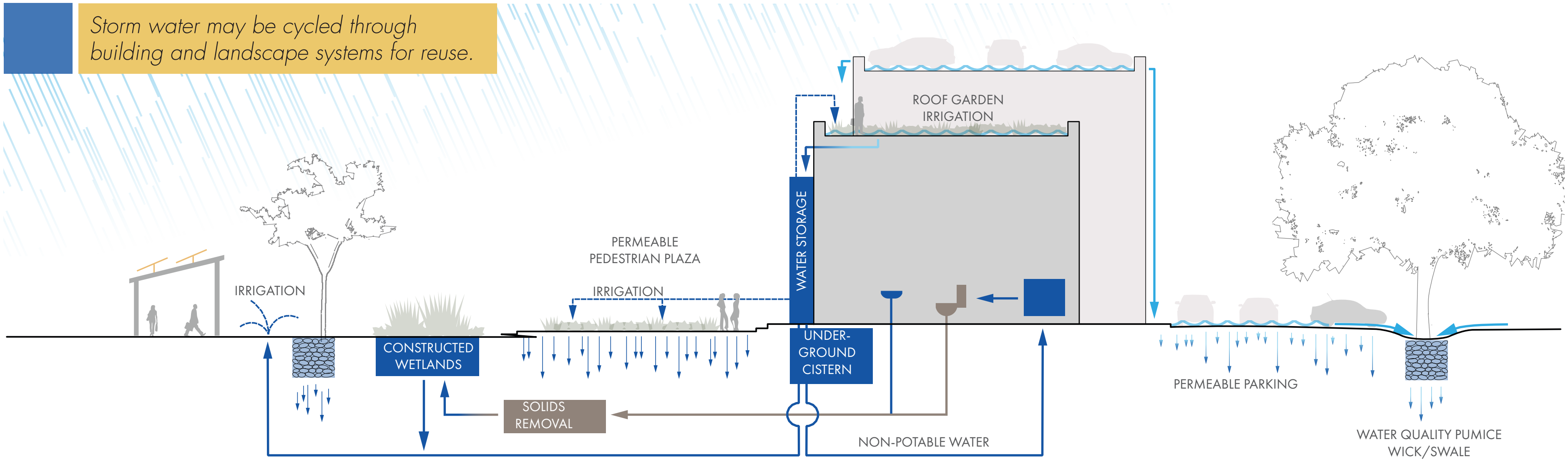
EXISTING BUILDING ROOFS

Many of the large existing structures and buildings at LANL pipe roof runoff directly to canyon edges. Often these pipes are deeply buried. Thus, the best opportunity for recapturing roof runoff for reuse is at a time when the building is undergoing re-roofing or building renovation. Opportunities may include redirecting runoff to ground level infiltration and GI improvements, or to cisterns or storage tanks for irrigation or other non-potable uses.

FUTURE BUILDINGS

Future buildings plans should include strategies for reusing harvested roof runoff. Integrative design that incorporates opportunities such as reuse lines to toilets, cisterns for storage, green roofs for storm water quality treatment, and irrigation systems designed for recycled water use, creates more sustainable and resilient building for a changing future. Storm water reuse improvements are least expensive and most effective when incorporated during the initial planning and design of a building or structure.

Storm water may be cycled through building and landscape systems for reuse.



LID GENERAL METHODOLOGIES

LID emphasizes conservation and use of on-site natural features to protect water quality.

This approach implements engineered, small-scale hydrological controls to replicate the pre-development hydrological regime of watersheds through:

- infiltration
- filtration
- detention
- evapotranspiration
- reuse

LID OPPORTUNITIES AT LANL

This LANL LID Master Plan identifies a broad range of opportunities for the application of LID and GI. The opportunities range from simple preservation of LID buffer spaces, to integration into planning and architecture, to constructed improvements.

The diagram on the next page illustrates conceptually where LID and GI methods can be incorporated and integrated. The methods noted below each development area type are indications of where they are most often applied. All methods can be used in all zones as appropriate to site conditions.

The intent is to lead the Laboratory to approach this issue from a wider framework rather than just as a storm water issue to be addressed after construction. It is to consider how LID and GI can be integrated in all Laboratory processes from site-wide master plan, through project definition, budgeting, design, construction, and maintenance.

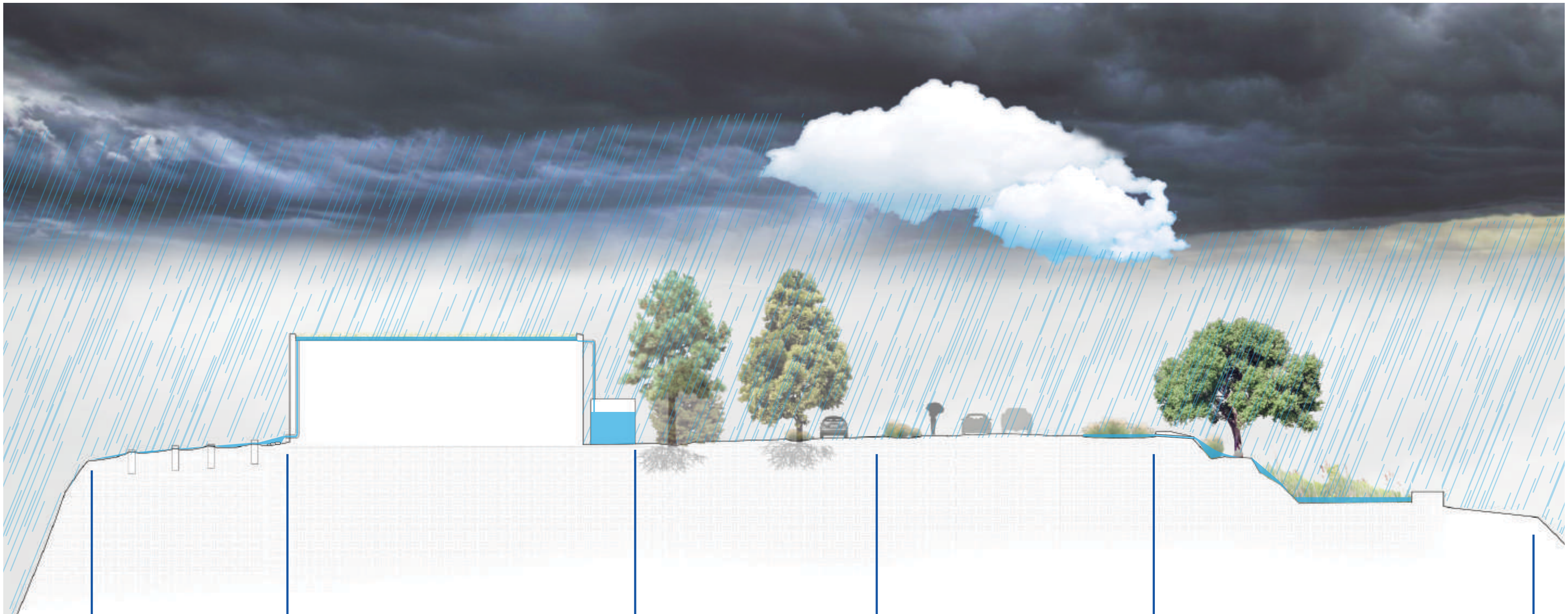
Some LID opportunities can be completed relatively easily and quickly. Others will require considerable time and effort to implement. Both types of opportunities are important to a comprehensive LID approach.

EXAMPLE LANL LID METHODOLOGIES

LID and GI methods or techniques applicable to LANL generally fall into the following categories and are illustrated in this section.

- LID natural buffer
- Vegetated swale / bio-swale
- Storm water channel
- Check dam / swale
- 'V' weir / swale
- Dissipater / zuni bowl
- Flowline extender
- Terrace / level spreader
- Filter media
- Permeable paving
- Bio-retention cell / oxbow
- Control basin
- Sub-surface chamber
- Cistern
- Green roof

The actual design and style of each method can vary widely. In urban settings, the method may be part of a very detailed landscape design. In rural settings, the same method might be very pastoral and natural in look and feel. Although aesthetics are important, LID is concentrated more on how the element functions within the hydrological needs of the project.



BUFFER ZONES

- LID natural buffers
- Terraces / level spreaders
- Flowline extenders

ARCHITECTURE RELATED

- Green roofs
- Cisterns

PARKING AREAS

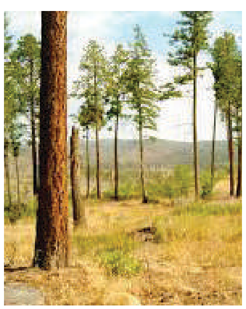
- Vegetated swales / bio-swales
- Permeable paving
- Sub-surface chambers

ROADWAY AREAS

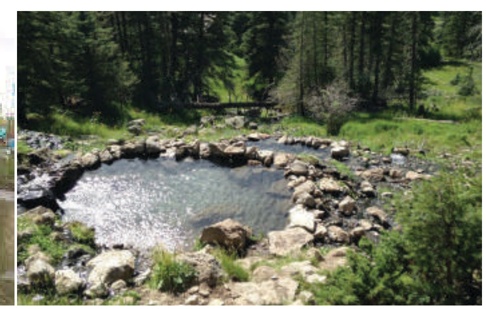
- Vegetated swales / check dams
- Bio-retention cells / oxbows
- Storm water channels
- Permeable paving

DRAINAGE ZONES

- LID natural buffers
- Vegetated swales / check dams / 'v' weirs
- Dissipaters / Zuni bowls
- Control basins
- Flowline extenders







LID Natural Buffer

Description: Preserve undeveloped, natural landscape areas for LID uses.

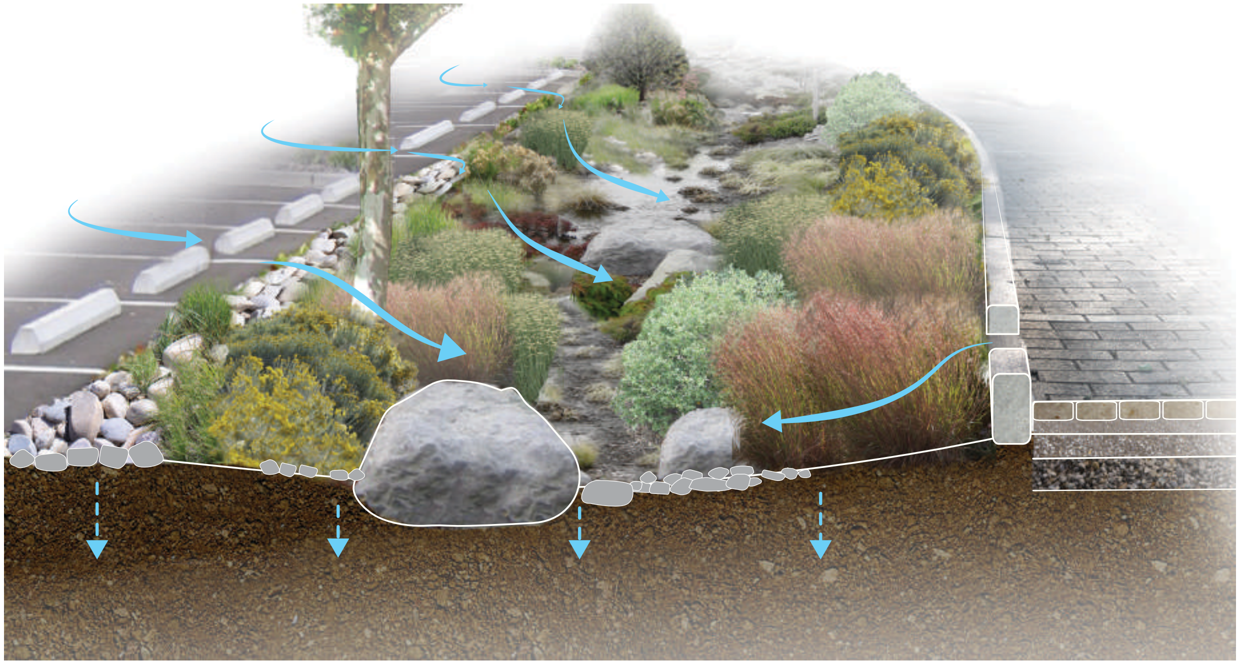
Benefits: Natural buffers retain the environmental functions of the native landscape.

This is one of the lowest cost LID methods that is available at the Laboratory.

Vegetated Swale / Bio-Swale

Description: Vegetated swales are broad, shallow channels designed to convey and infiltrate storm water runoff.

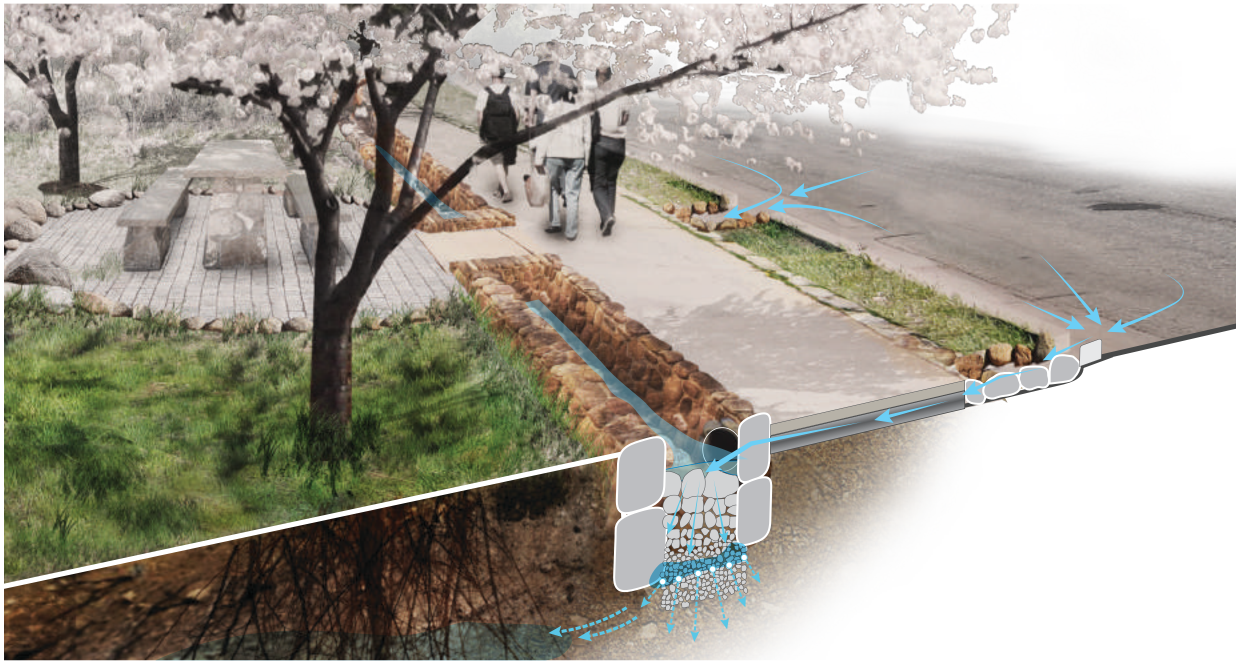
Benefits: Swales allow storm water infiltration, water treatment and sediment filtration. Swales are useful in areas with slight to moderate slopes. Vegetated swales are one of the most implemented GI methods in both urban and rural areas.



Storm Water Channel

Description: Storm water channels are structured conveyances designed to infiltrate storm water into subsoils, and carry runoff at higher flows.

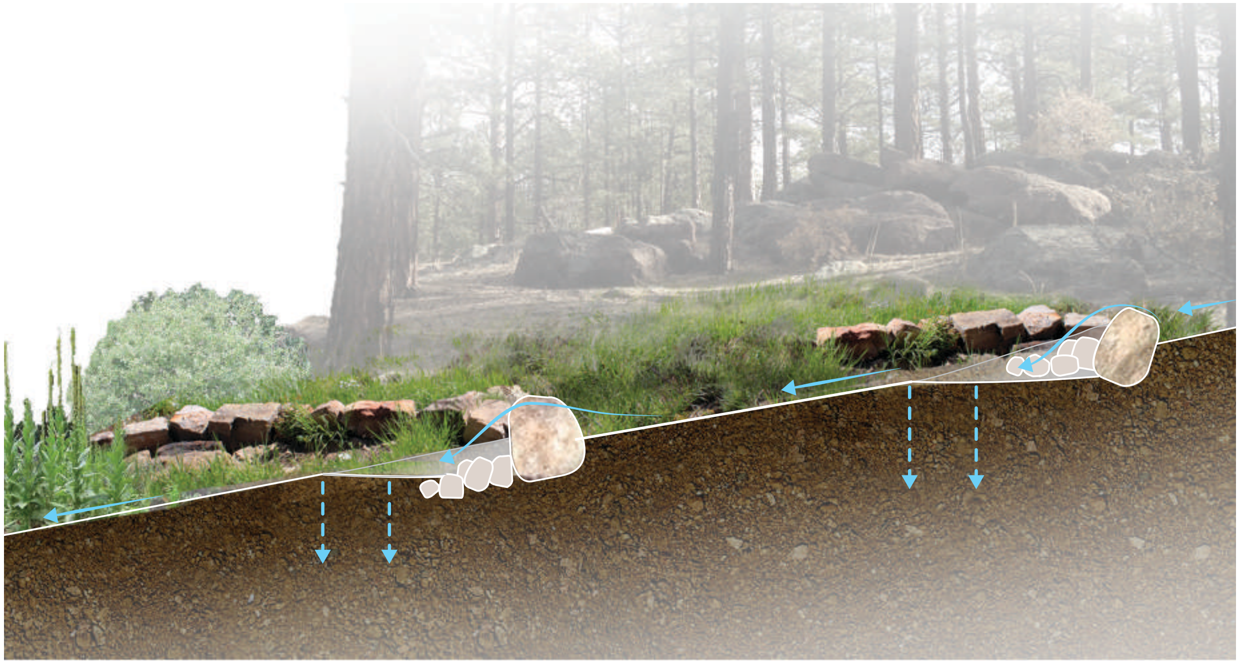
Benefits: Storm water channels provide infiltration, storm flow attenuation and pollutant filtration. These channels are useful along roads and other linear features that generate high runoff volumes and velocity.



Check Dam / Swale

Description: Check dams are small, shallow controls, constructed across a swale, drainage ditch, or waterway.

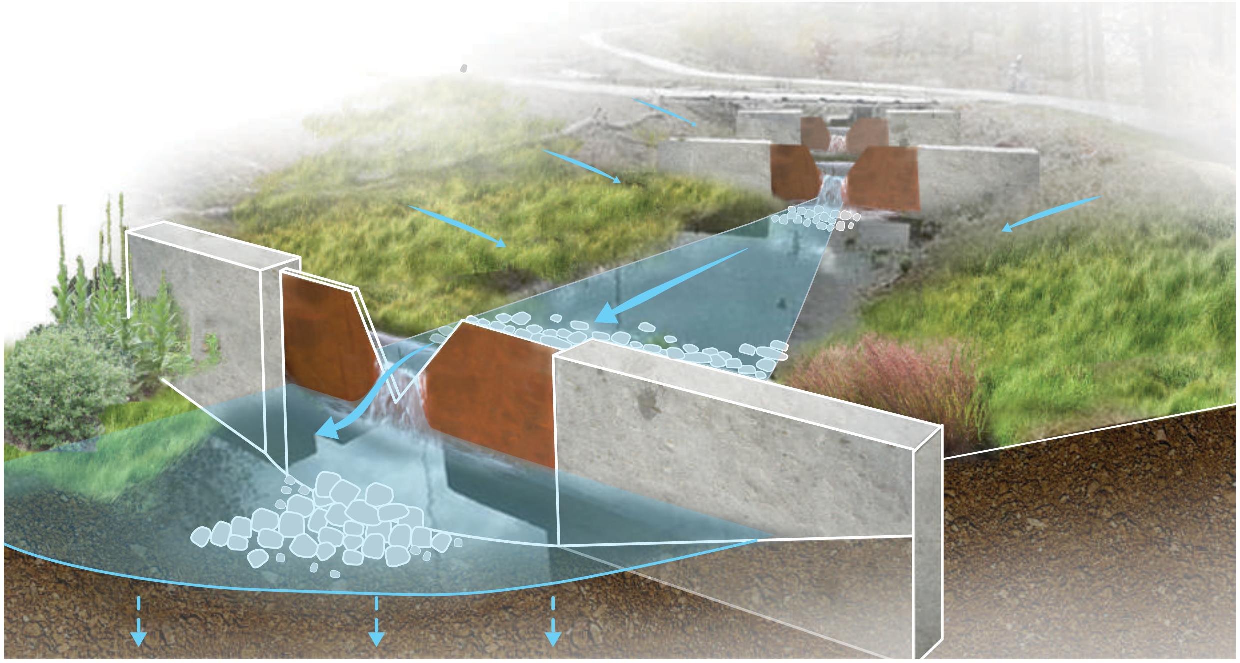
Benefits: These are used to counteract erosion by reducing water flow velocity.



'V' Weir / Swale

Description: A 'V' weir is simply a 'v' notch in a plate or structure that is placed to obstruct an open channel flow.

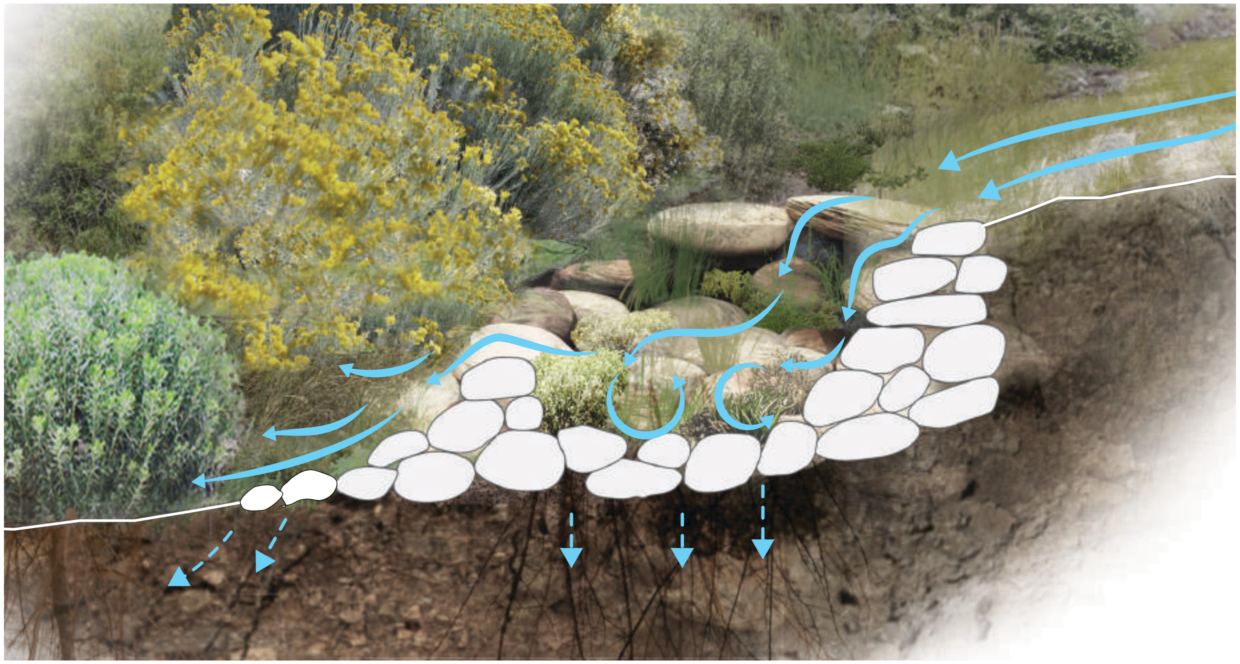
Benefits: The weir allows a measured volume of water to flow through the notch while helping to attenuate storm flows and rates.



Dissipater / Zuni Bowl

Description: Dissipaters and zuni bowls use roughened surfaces and deep basins along the flowline to breakup water flows and remove energy.

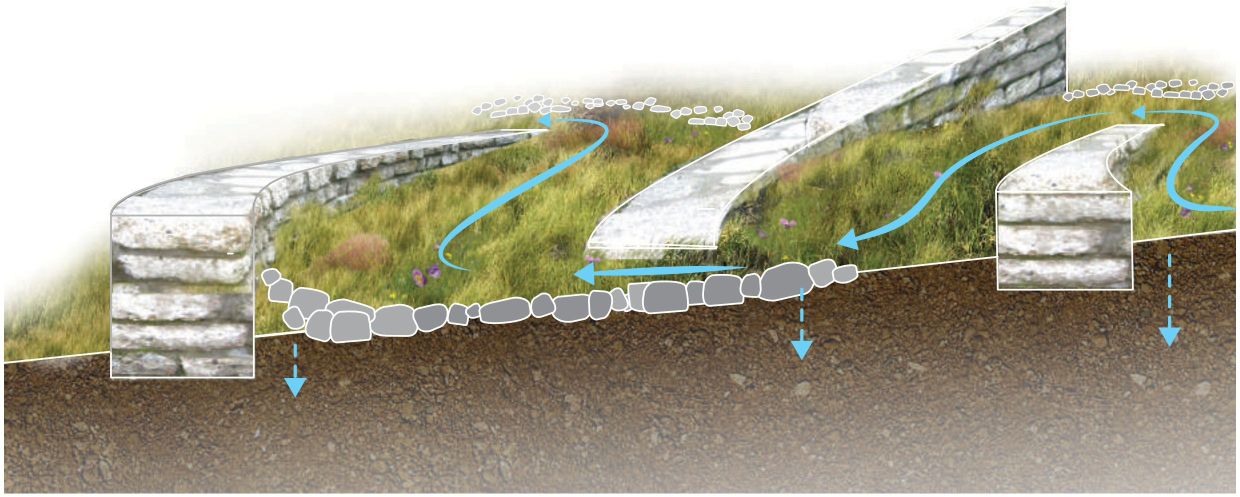
Benefits: Dissipaters and zuni bowls are most effective in preventing concentrated flows from eroding into slopes and creating head-cuts.



Flowline Extender

Description: Flowline extenders are a series of linear structures placed across a storm water flowline, causing the flowline to meander, thereby extending the length of its route.

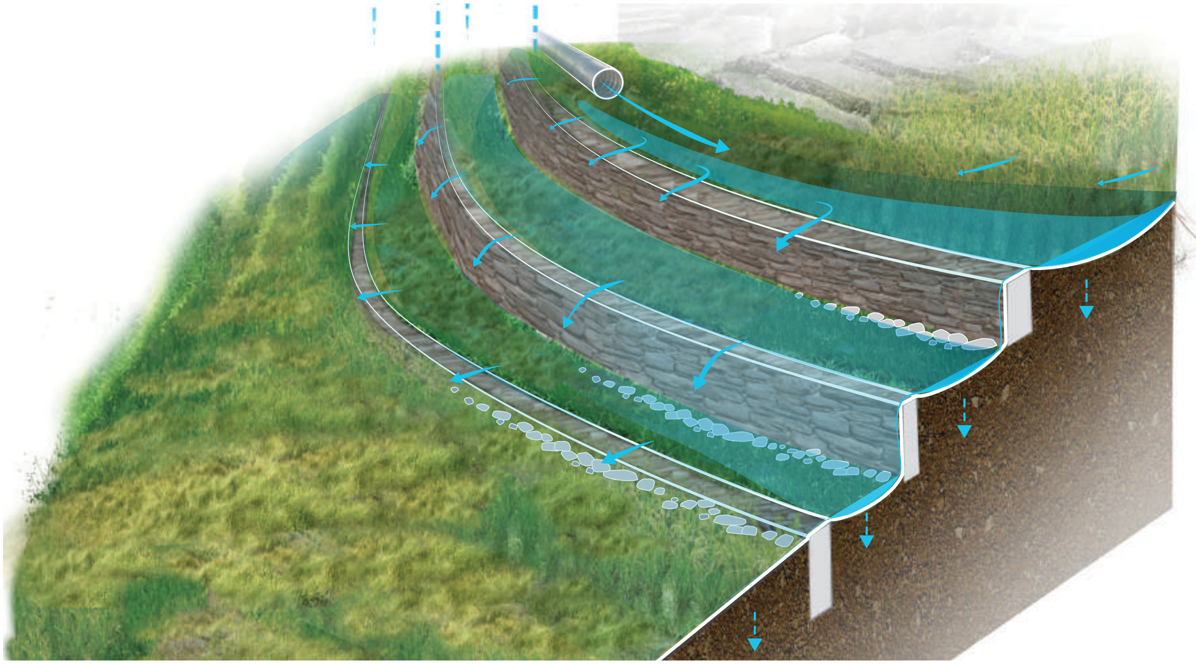
Benefits: By making the length of the flowline longer, storm water has more time to infiltrate, filter pollutants, and remove sediments. They are most effective in relatively wide, shallow sloped areas.



Terrace / Level Spreader

Description: Terraces and level spreaders disperse storm water across a level, hardened edge.

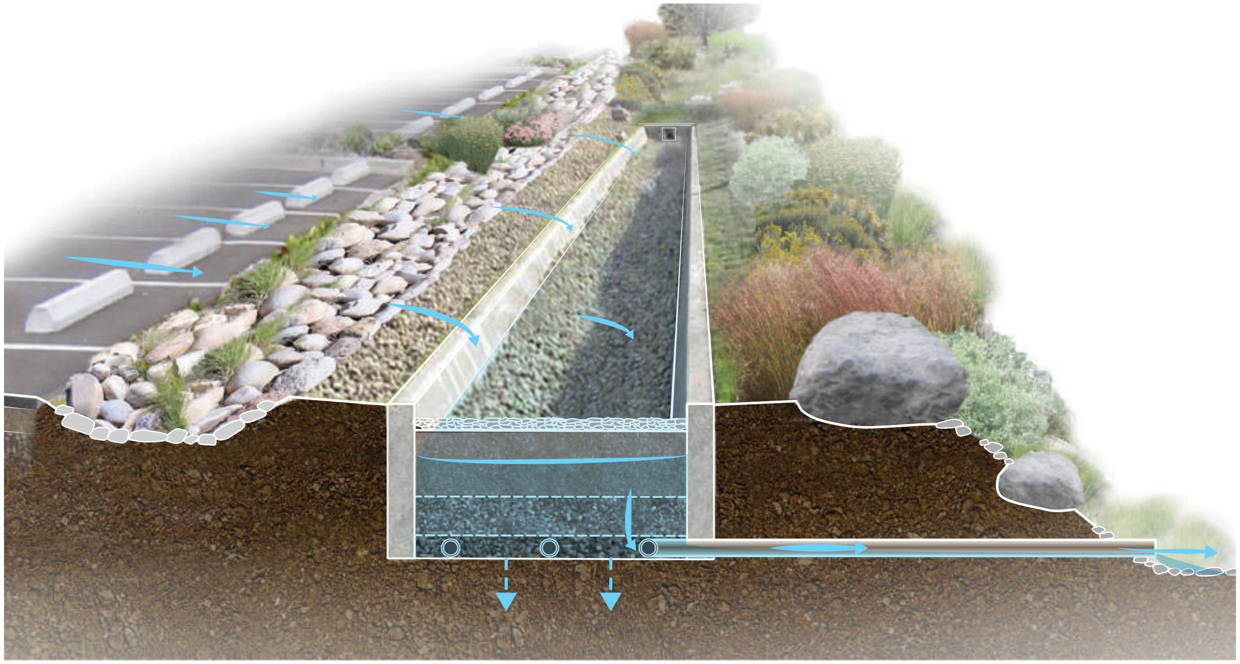
Benefits: Terraces and level spreaders help prevent concentrated erosion in sheet flow areas. By spreading runoff, the terraces allow for infiltration across a wide zone and support vegetation.



Filter Media

Description: A feature with granular or aggregate materials such as gravels, mulches and manufactured media selected and layered to filter pollutants from storm water.

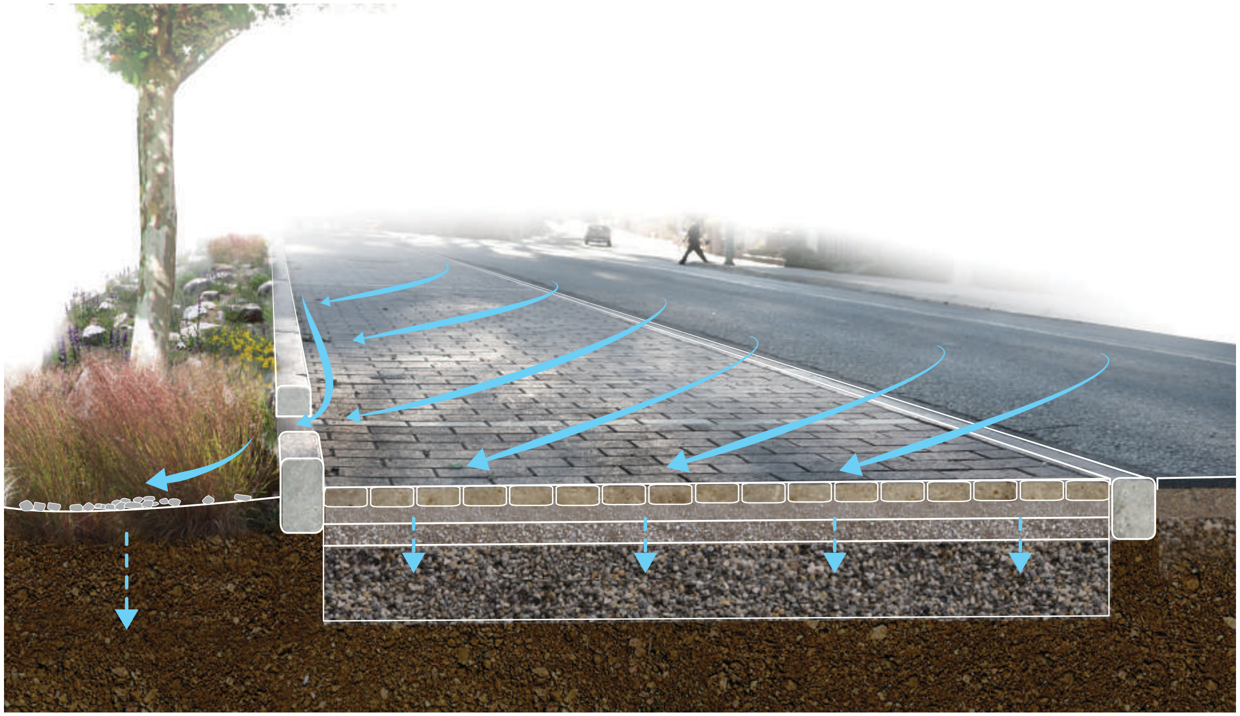
Benefits: Filter medias are important to use in areas where heavy metals and other pollutants can be effectively mitigated or removed from storm water.



Permeable Paving

Description: Permeable paving uses porous paving materials on a designed sub-base that allows the percolation of storm water through the sub-strata.

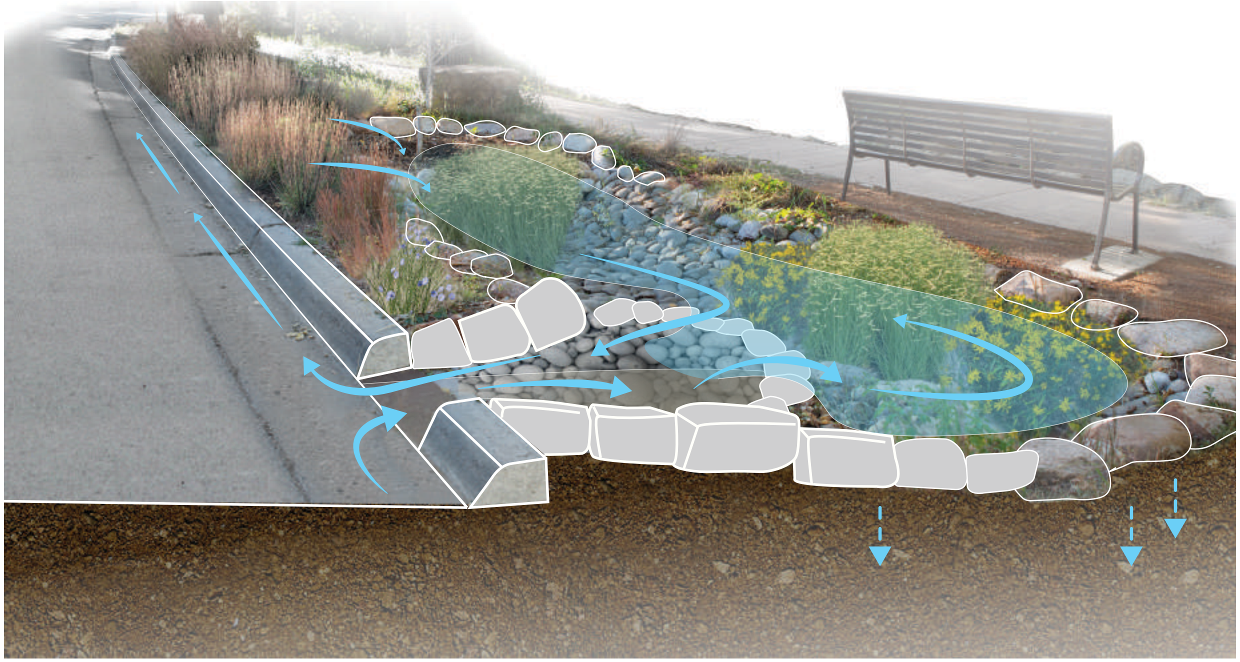
Benefits: This paving system reduces runoff, traps suspended solids and filters pollutants from surface runoff. Permeable pavement is especially effective in treating runoff from parking areas and roadways. Permeable paving materials that can be used include: supported gravel, porous asphalt, porous concrete, bricks, and concrete pavers.



Bio-Retention Cell / Oxbow

Description: A landscaped depression or shallow basin that temporarily captures storm water from roadways. When the capacity of the cell is reached water bypasses the inlet point.

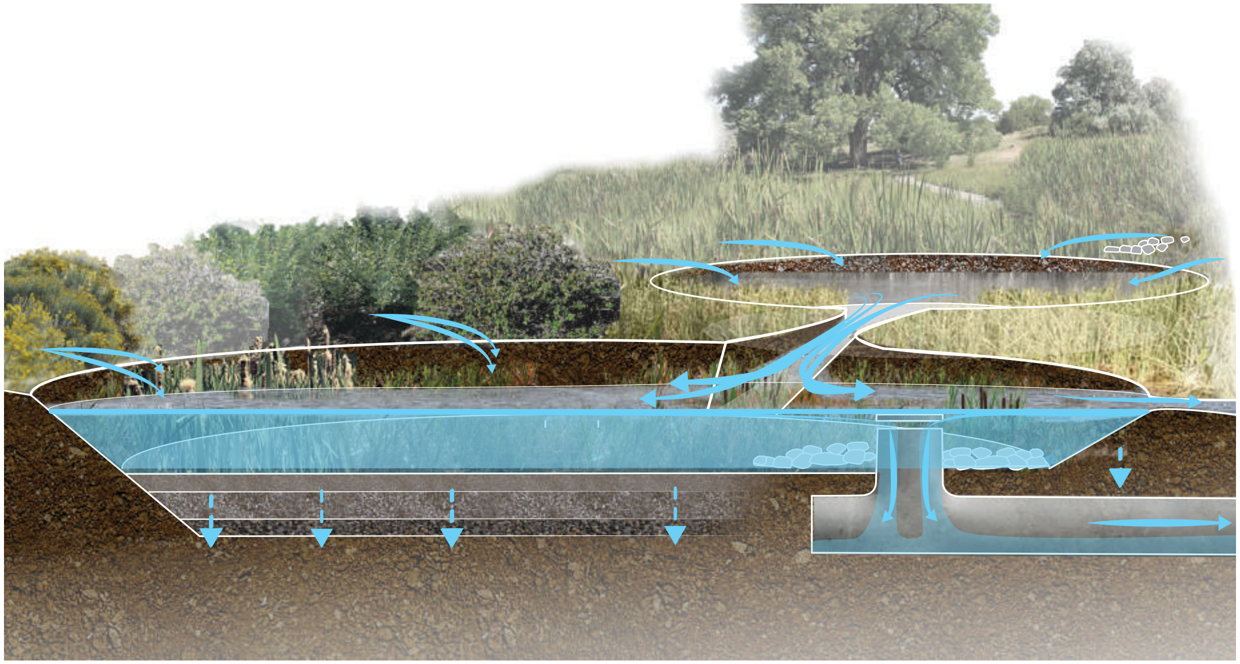
Benefits: Bio-retention cells or oxbows retain, infiltrate, treat and reduce runoff volumes. Plants and soil in the bio-retention cell provide physical, chemical and biological treatment of pollutants. Bio-retention cells and oxbows are particularly effective along road sections with flat gradients. They are very effective in capturing low volume storm events.



Control Basin

Description: Control basins collect storm water and release it at a controlled rate through a designed outlet system or a subsurface underdrain, and often with an accompanying filter media.

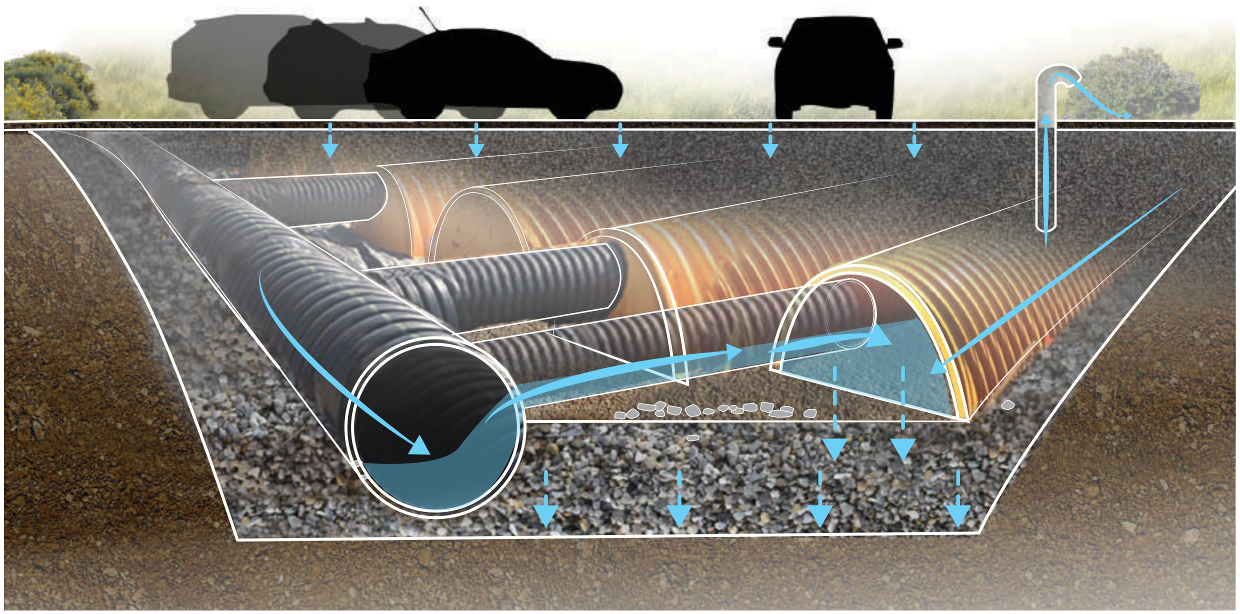
Benefits: Control basins help reduce risks to downstream areas from flooding and erosion by temporarily detaining flows. They infiltrate storm water, and if constructed with plant islands and/or filter media, can treat storm water pollution and sediment migration.



Sub-surface Chamber

Description: Sub-surface chambers collect storm water, infiltrate and release flows while preserving surface areas for other uses such as parking.

Benefits: Sub-surface chambers help reduce risks to downstream areas from flooding or erosion by detaining and infiltrating storm water. They are most applicable in heavily developed areas that need to preserve surface uses such as parking and substantially improve storm water flow management. When designed with root barriers, they are valuable in supporting adjacent vegetated areas.



Cistern

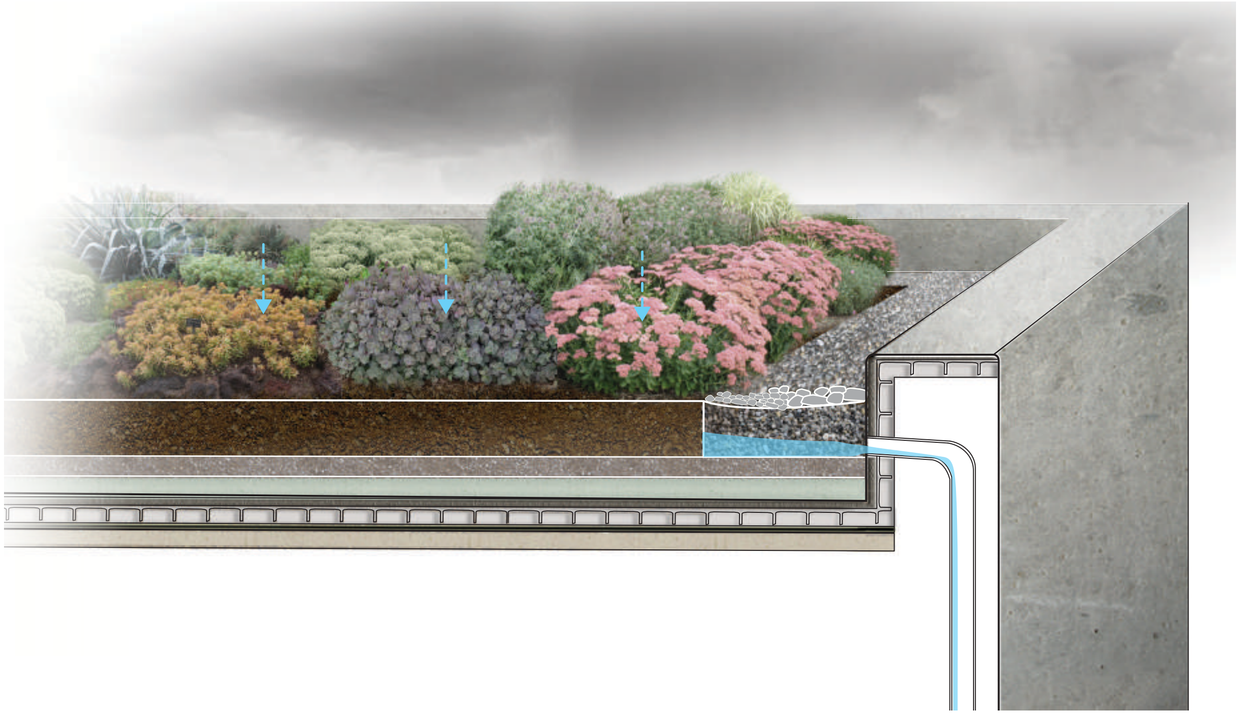
Description: Roof-catchment cisterns are systems used to collect and store rainwater from buildings.

Benefits: Cisterns are effective in developed areas that have managed landscapes. When the harvested storm water is used for landscape irrigation, cisterns help to reduce potable water consumption, support landscape health and increase soil moisture and infiltration capability. Coordinating the design of the roof catchment area with the cistern capacity is an important component of cistern design.

Green Roof

Description: A green roof is a system that partially or completely covers a building's roof with vegetation and a growing medium over a water proof membrane.

Benefits: Green roofs provide immediate treatment, control and reuse of rain water. Modern green roof systems are available as complete design and installation packages that come with long-term warranties and maintenance options. Green roofs provide other important environmental benefits, including the reduction of heat-island effect, and a reduction in building energy consumption for heating and cooling.



Green Infrastructure Method	Infiltration	Filtration	Storage/Detention	Evaporation/Transpiration
LID Natural Buffer	●	●		●
Vegetated Swale / Bio-Swale	●	●		●
Storm water Channel	●	●		●
Check Dam + 'V' Weir / Swale	●		●	
Dissipater / Zuni Bowl	●		●	
Flowline Extender	●	●		●
Terrace / Level Spreader	●	●		●
Filter Media		●		
Permeable Paving	●		●	
Bio-Retention Cell / Oxbow	●		●	
Control Basin	●	●	●	●
Sub-surface Chamber	●		●	
Cistern		●	●	
Green Roof	●	●		●

A plan is always successful if the plan is good.

Peter Drucker

POTENTIAL PROJECTS

MASTER PLAN APPROACH

LID and GI are most effective when applied systematically across a site. The LID Master Plan proposes small and moderate improvements and projects across the developed area of the Laboratory to address non-point source storm water pollution and hydrological modifications.

The LID Master Plan focuses on an incremental and systematic approach to accomplish LID projects. The Plan describes a variety of opportunities to coordinate with other development and site maintenance activities.

PLAN ORGANIZATION

The LID Master Plan is organized by the Laboratory's technical areas. The LID Master Plan initially includes TA-35, TA-53 and TA-03.

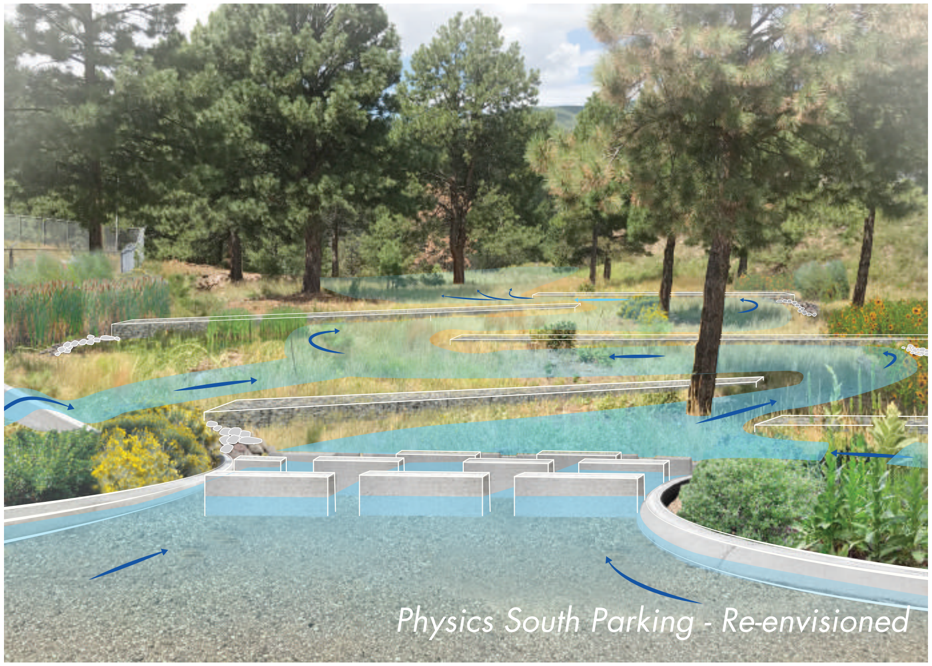
A future goal is to expand the LID Master Plan to include other technical areas as time and funds allow.

POTENTIAL PROJECTS

LID potential projects were identified and reviewed through site assessments and working sessions with the Storm Water Compliance Team.

The potential projects are mapped and described in this section. The LID/GI application or methodology that seems most applicable are noted for each project. As potential projects move to design and construction, detailed evaluation of existing conditions and specific design will need to be completed to determine the actual strategy to be used.


Physics South Parking - Before


Physics South Parking - Re-envisioned

POTENTIAL PROJECTS MATRIX

Potential LID projects have been assessed using the following characteristics. The characteristics are useful to understand the general potential of each project regarding environmental considerations, construction feasibility, cost and visibility. The matrix is only a general summary for future planning and design.

EVALUATION OF EXISTING SITE CONDITIONS

1. **Impervious Percentage**

   Based on parking, road, and roof areas as a percentage of drainage area related to the project. Higher imperviousness of an area is often related to higher peak discharges and higher non-point source pollutants. Areas with high imperviousness are a target for LID.

   - High = >90%
   - Mod = 75-90%
   - Low = <75%

2. **Drainage Area**

   The overall size (acres) of a contributing drainage area affecting the project. The larger the drainage area, the greater potential benefits can be obtained through LID treatment.

   - High = >5 acres
   - Mod = 1-5 acres
   - Low = <1 acre

3. **Erosion**

   General assessment of erosion evident in project area. Visual evidence of erosion in an area often indicates soils with higher erosion potential and higher sediment loads.

   - Yes = obvious visible evidence of erosion
   - No = no obvious visible evidence of erosion

4. **Slope**

   Slope in contributing drainage area for the project. Steeper slopes increase the speed of surface water flow, increasing the potential for soil erosion.

   - High = >20%
   - Mod = 10-20%
   - Low = <10%

5. **Visibility**

   General number of people who would see the project area on a daily basis. The more people that see an LID project on a daily basis provides a higher potential to educate LANL staff and visitors about LID.

   - High = thousands/day
   - Mod = hundred/day
   - Low = dozens/day

EVALUATION OF PROJECT VIABILITY

6. **Cost**

   Gross assessment of construction costs associated with the project. The higher the cost assessment the longer it may take to budget and fund the project.

   - Low = < $150K
   - Mod = $150-$500K
   - High = >$500K

7. **Construction**

   General assessment of construction accessibility, security, and infrastructure considerations that could affect project design and construction.

   - Easy = Easy access to location, little or no infrastructure considerations.
   - Fair = Accessible with considerations, minor or limited infrastructure considerations.
   - Difficult = Very controlled access, major infrastructure considerations, high traffic areas.

The below five evaluation criteria relate to a project's existing conditions. Items marked in red are of critical concern and should be addressed immediately. Items marked in yellow and green are in descending orders of criticality.

These two criteria relate to cost factors. Red indicates higher cost effects. Yellow and green items generally less.

TA - 35

Project ID	Project Name	Impervious %	Drainage Area	Erosion	Slope	Visibility	Budget Range	Constructibility
A	West Parking	Green	Yellow	Green	Yellow	Yellow	Yellow	Yellow
B	East Parking	Yellow	Red	Red	Yellow	Yellow	Yellow	Yellow
C	East End	Green	Red	Red	Yellow	Yellow	Green	Green
D	Pecos Drive- Swales	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Yellow

TA - 53

Project ID	Project Name	Impervious %	Drainage Area	Erosion	Slope	Visibility	Budget Range	Constructibility
A	TA-53 Administration	Green	Yellow	Green	Green	Yellow	Yellow	Green
B	Bldg 365 West Parking	Green	Yellow	Green	Yellow	Green	Yellow	Green
C	Bldg 18 East	Green	Yellow	Green	Yellow	Green	Yellow	Green
D	Orange Box - South	Red	Red	Red	Green	Green	Yellow	Yellow
E	Orange Box - North	Green	Yellow	Red	Yellow	Yellow	Green	Green
F	La Mesita Swale	Yellow	Red	Green	Yellow	Yellow	Yellow	Red
G	Bldg 622 - North	Yellow	Red	Green	Green	Yellow	Green	Yellow
H	Bldg 622 - South	Green	Red	Green	Yellow	Green	Yellow	Yellow
I	La Mesita - East	Green	Red	Green	Yellow	Green	Yellow	Yellow

	Impervious %	Drainage Area	Erosion	Slope	Visibility	Cost	Constructibility
Red	> 90%	>5 acres	Yes = erosion	>20%	thousands/day	>$500K	Difficult
Yellow	75-90%	1-5 acres		10-25%	hundred/day	$150-$500K	Fair
Green	<75%	<1 acre	No = no erosion	<10%	dozens/day	< $150K	Easy

TA - 03

Project ID	Project Name	Impervious Percentage	Drainage Area	Erosion	Slope	Visibility	Cost	Constructibility
A	NW West Jemez Rd Intersection	Green	Red	Green	Yellow	Red	Green	Yellow
B	Wellness Center	Green	Red	Green	Yellow	Red	Red	Yellow
C	Mercury Road-West End	Red	Red	Green	Yellow	Yellow	Yellow	Yellow
D	SCC - South	Red	Yellow	Green	Red	Yellow	Green	Green
E	Pajarito Rd - South Swale	Red	Green	Green	Red	Red	Yellow	Red
F	Physics - South Parking	Red	Red	Red	Yellow	Green	Yellow	Green
G	CMR South	Green	Yellow	Red	Yellow	Red	Yellow	Red
H	Diamond - Pajarito Intersection	Yellow	Red	Green	Yellow	Red	Yellow	Red
I	Diamond - Eastside	Green	Yellow	Green	Red	Red	Yellow	Red
J	Mercury Road - South	Yellow	Yellow	Green	Red	Green	Green	Yellow
K	Mercury Road - North	Green	Yellow	Green	Red	Yellow	Green	Yellow
L	Building 28 East	Green	Yellow	Red	Yellow	Yellow	Yellow	Yellow
M	NNSB Bldg - South	Green	Red	Green	Red	Yellow	Yellow	Yellow
N	Otowi - Roof Garden	Red	Green	Green	Red	Yellow	Red	Red
O	Otowi - North	Green	Yellow	Green	Red	Red	Yellow	Red
P	University House Drainage	Yellow	Red	Red	Yellow	Red	Red	Red
Q	Building 123 - East	Yellow	Yellow	Green	Red	Yellow	Green	Yellow
R	Northeast Parking - North Swale	Green	Yellow	Green	Yellow	Red	Green	Yellow
S	Main Gate Entry	Yellow	Yellow	Green	Yellow	Green	Yellow	Yellow
T	Northeast Parking - West Swale	Yellow	Yellow	Green	Yellow	Red	Green	Yellow
U	Power Plant - North	Green	Red	Red	Yellow	Red	Yellow	Yellow
V	Power Plant - South	Yellow	Red	Red	Green	Red	Yellow	Yellow
W	CINT East	Yellow	Yellow	Green	Green	Green	Yellow	Yellow
X	Maniac Rd	Green	Red	Green	Yellow	Yellow	Yellow	Yellow
Y	Sigma Rd Parking	Red	Yellow	Green	Red	Green	Green	Red

Impervious %	Drainage Area	Erosion	Slope	Visibility	Cost	Constructibility
Red: > 90%	Red: >5 acres	Red: Yes = erosion	Red: >20%	Red: thousands/day	Green: < $150K	Green: Easy
Yellow: 75-90%	Yellow: 1-5 acres	Green: No = no erosion	Yellow: 10-25%	Yellow: hundred/day	Yellow: $150-$500K	Yellow: Fair
Green: <75%	Green: <1 acre		Green: <10%	Green: dozens/day	Red: >$500K	Red: Difficult

Great things are done by a series of small things brought together.

Vincent Van Gogh

FUTURE IMPLEMENTATION

LID, in the future, is envisioned to be implemented through greater integration with development planning. Activities recommended for improved integration of LID goals are:

- inclusion in budgets, project definition, and requirements,
- integration into engineering standards,
- coordination with operations and maintenance,
- leveraging partnerships and collaborations with other development activities.

BUDGETS + PROJECT DEFINITION

The most important activity for ensuring that LID goals and standards are incorporated into project planning is budgeting and project defining.

Current storm water management improvements are often added after a project has been defined and budgeted. This action generates resistance to the incorporation of additional requirements, creates potential conflict with site layout and project functional requirements and may add cost for the necessary storm water improvements.

By including LID standards and requirements as part of the initial budget formation and project definition, LANL will ensure that proper storm water management measures are holistically integrated with all project elements, and incorporated at the lowest cost potential for the project.

ENGINEERING STANDARDS

LANL Engineering Standards are the Laboratory's means for creating design and construction consistency. LID/GI standards need to be formally integrated with the LANL Engineering Standards and be compatible with the LANL Architectural Standards.

The current LANL Storm Water BMP Manual addresses the construction phase of storm water management. The LID/GI Standards would address a broader range of information including design criteria, installation requirements, and inspection and maintenance considerations.

OPERATIONS + MAINTENANCE

As with any functional system, LID features will need to be evaluated, maintained, and repaired overtime. Incorporation of LID/GI features into preventative maintenance processes is necessary. This includes budgeting and resource planning.

The first step is to develop LID/GI design and construction standards that are both durable and easy to maintain. LID/GI standards need to be refined and upgraded on a regular basis.

The second component is to help educate and provide budgeting guidance to operations and maintenance groups on what and when regular maintenance of various LID/GI improvements will be needed. This requires personnel with a good working knowledge of LID/GI function and requirements, or adequate access to such resources.

PARTNERING + COLLABORATION

Partnering and coordinating LID/GI improvements with other on-going projects and development activities has practical management and cost benefits for the Laboratory.

From a project process perspective, coordinating LID/GI initiatives with appropriate complimentary development activities could reduce LANL purchasing, contracting and construction management costs that would be incurred by retrofitting the site at a later date.

From a project fiscal perspective, small LID/GI projects when incorporated into larger projects generally do not increase contractor costs, as much as managing a stand-alone small project.

Project types that often have complimentary aims with LID goals are utility and infrastructure projects, parking and road improvement projects, and pedestrian improvement projects. Developing ways to track possible partnering and/or collaboration opportunities with these types of projects to incorporate LID/GI methods and funding will be an important tool for the implementation of LID throughout the Laboratory.

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