FORGING THE LINK

Linking the Economic Benefits of Low Impact Development and Community Decisions

The guiding principle of this project is to illustrate the advantages of Low Impact Development (LID) in the economic terms of how municipal land use decisions are commonly made.

In addition to the environmental and water quality benefits for which Low Impact Development (LID) is so commonly known, considerable economic, infrastructure, and adaptation planning benefits are also being realized through the incorporation of LID-based strategies.

Forging the Link demonstrates the substantive economic benefits—for both construction budgets and project life-cycle costs—that are increasingly being observed by municipalities, commercial developers, and others when using Green Infrastructure for stormwater management.

In addition, the FTL curriculum demonstrates the use of LID as a means for building community resiliency to changing climates in a water resources management context.

THE FTL CURRICULUM DEMONSTRATES:

1. The ecological benefits of LID with respect to protection of water quality, aquatic habitat and watershed health
2. The economic benefits of using both traditional and innovative infrastructure to manage stormwater
3. The capability of LID to be used as a climate change adaptation planning tool to minimize the stress to urban stormwater infrastructure.

The FTL curriculum was developed in partnership with the Nonpoint Education for Municipal Officials (NEMO), Coastal Training Programs (CTP), Sea Grant Coastal Community Development Specialists, Cooperative Extension Agents, National Estuary Program (NEP) Staffs, and numerous volunteer municipal decision makers.

BENEFITS OF LOW IMPACT DEVELOPMENT

Low Impact Development (LID) is an innovative approach to stormwater management that is based upon the principle of managing rainfall at the source. The goal of LID is to mimic the predevelopment hydrology of a site using a combination of site planning and structural design strategies to control runoff rate and volumes. LID can be applied to new development, urban retrofitting, and redevelopment, and helps communities achieve a balance between public safety, economic development and ecological protection.

LID can be applied to new development, urban retrofitting, and redevelopment, and helps communities achieve a balance between public safety, economic development and ecological protection.

A case study of a large retail development in Greenland, NH demonstrates how utilizing an LID approach that featured porous asphalt and a gravel wetland resulted in a cost-competitive drainage system.

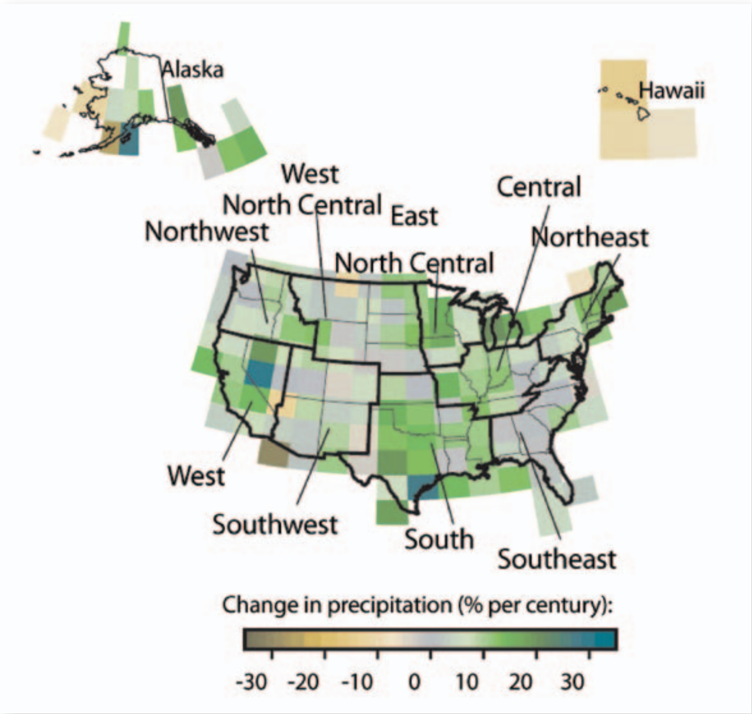
ECONOMICS AND LID

While better known for its capacity to reduce pollution and manage stormwater more sustainably, LID designs are also economically beneficial and more cost-effective as compared to conventional stormwater controls. LID is commonly misperceived as only adding expense to a project; however, this perspective fails to acknowledge the broader benefits that can be observed in terms of whole project costs for new construction, and in some instances, increased life-cycle benefits as well. By combining both gray (traditional) and a green (LID) approaches, the added expense of LID are offset by the reductions in other traditional practices such as curb and gutter or detention ponds.

HISTORIC AND PROJECTED CLIMATE CHANGE

> Scientists from around the globe have recorded changes in the hydrologic cycle, a decline in glaciers and polar ice, and shifts in precipitation intensity and trends.

The state of the earth's climate has been a topic of extreme debate. However, there is near consensus that climate change is expected to continue through the 21st century, and that for many regions of North America, projections are for an increase in the depth, frequency and duration of precipitation events. Concurrently, there are projections indicating sea level rise. Historically, many communities have made anecdotal observations regarding the timing of spring thaw or first frost and recent data has confirmed those observations to be accurate.

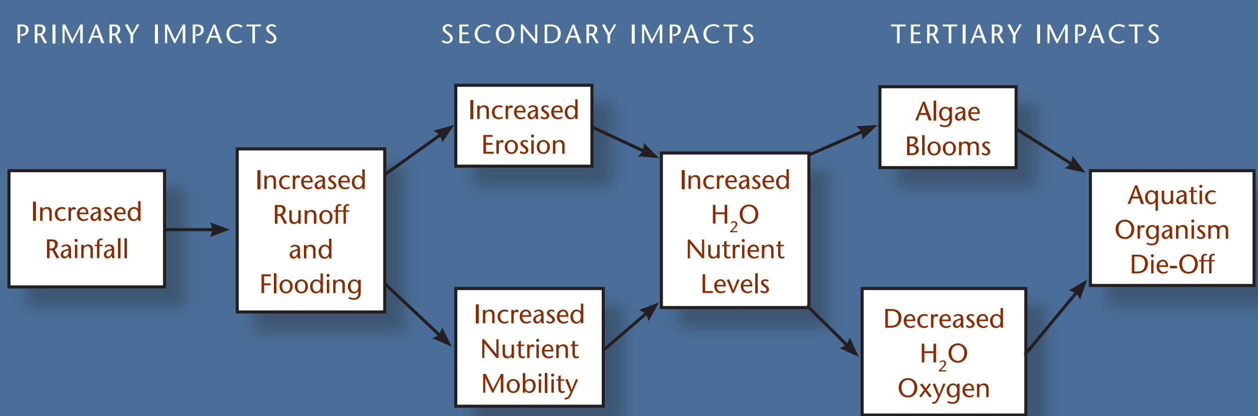


Average Precipitation Changes for the US (NOAA Climatic Data Center)

LID AS A CLIMATE CHANGE ADAPTATION TOOL

Low Impact Development planning and structural controls have the ability to manage increased stormwater flows from a changing climate. The same strategies that are applied to managing increased runoff volume from impervious surfaces can be used to manage increased storm size from climate change. The use of Green Infrastructure for adding distributed storage and infiltration throughout a project can also have a cumulative positive effect in a watershed and be used as a climate change adaptation tool for building resiliency to extreme precipitation events.

IMPACTS DUE TO CLIMATE CHANGE EFFECTS ON RAINFALL AND RUNOFF



OVERCOMING THE BARRIERS TO THE IMPLEMENTATION OF LID

During the 2000 census, many coastal communities experienced as much as 25 percent population growth and are expected to increase by another 5 percent by 2015. This tremendous growth pressure is forcing municipalities and other watershed stakeholders to develop strategies for managing growth while maintaining watershed health. In addition shrinking local budgets, due to challenging economic climates, reduces the ability of many municipalities to respond to their local demands. Overcoming these challenges require significant effort in outreach, communication and resource development.

IDENTIFIED BARRIERS

- Cost
- Education and Training
- Language
- Political WIll
- Lack of Capacity to Build Social Capital
- Credibility
- Maintenance and Operations Plans

FORGING THE LINK

is a science-based curriculum targeting the primary barrier to implementation of LID, identified as cost, as the core of the project.

THE FTL CURRICULUM CONTAINS:

- Scripted PowerPoint Presentation (modifiable by the end user)
- PowerPoint Presentation Delivery Guide
- Post Presentation Facilitated Discussion Process
- Resource Manual
- Executive Summaries of each chapter
- Web-Based Materials: www.unh.edu/unhsc/forgingthelink

Presentations may be delivered by staff of the UNHSC, upon request.

FORGING THE LINK: Linking the Economic Benefits of Low Impact Development and Community Decisions • www.unh.edu/unhsc/forgingthelink

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FACT SHEET

The Benefits of Low Impact Development

Low Impact Development (LID) is an innovative approach to stormwater management that is based on the principle of managing runoff at the source.

The goal of LID is to mimic the predevelopment hydrology of a site using a combination of site planning and structural design strategies to control runoff rate and volumes.

LID approaches can be used in any type of development scenario:

- new development,
- redevelopment, or
- existing condition retrofitting.

LID IS:

- A balanced watershed approach to managing altered hydrology
- A science-based solution to mitigating the impacts of smart development
- A way to decentralize and integrate stormwater best management

LID IS NOT:

- A silver bullet
- A substitute for proper planning
- A way to permit unfavorable development
- A single best management practice

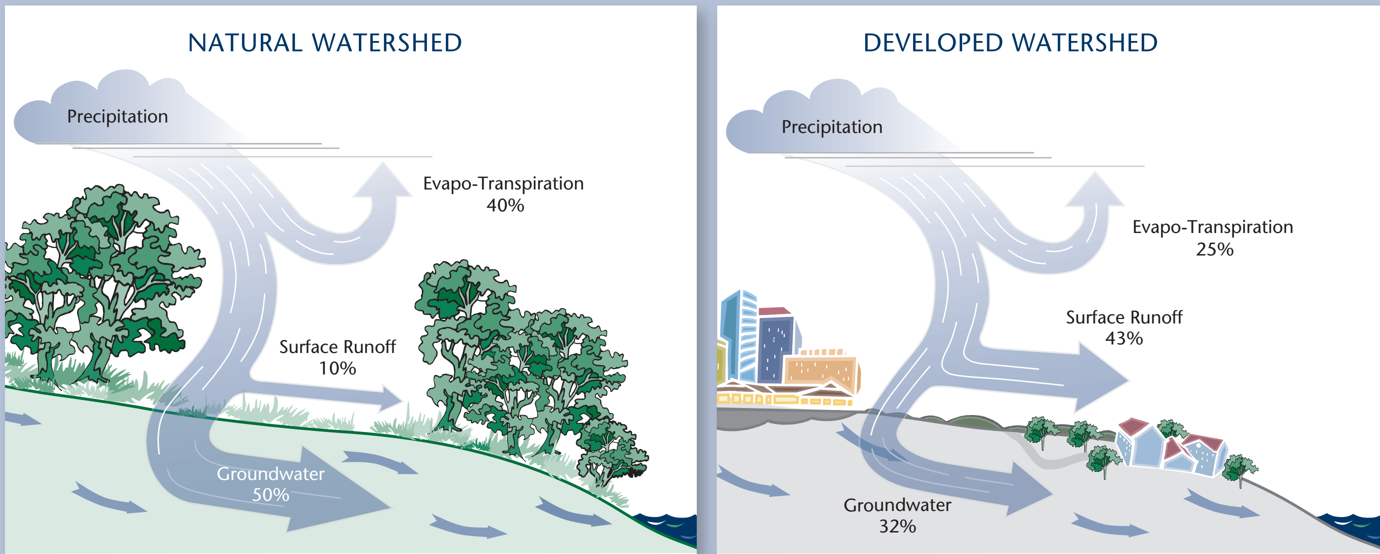
WHY LID, WHY NOW?

Historically, wetlands, rivers, lakes, and estuaries provided the work of cleaning and protecting water resources.

Intense development can significantly impair water quality and change how surface and groundwater interact.

Increases in impervious surfaces result in increased runoff, making it harder and harder to protect receiving waters.

FORGING THE LINK



TYPICAL PRE- AND POST-DEVELOPMENT HYDROLOGY PATTERNS

OLD DESIGN APPROACHES

Detention basins do an effective job of addressing flood protection requirements by detaining larger volumes of runoff from high levels of impervious surfaces. However, research has shown that sole reliance upon basins to manage stormwater has proven to be ineffective in protecting water resources.

TOWARD A BETTER APPROACH

The work of community board members and municipal decision makers in towns and cities throughout the country is critically important for shaping community character and protecting local natural, cultural and economic resources. This can be done by requiring effective LID designs that:

- attempt to decentralize drainage infrastructure,
- maximize onsite storage filtration and infiltration
- make use of natural landscape features to best manage runoff
- reduce the need for large detention structures

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FACT SHEET

Economics and LID Practices

The economic advantages of Low Impact Development are often not well understood and are deserving of close attention to inform municipal land use decisions.

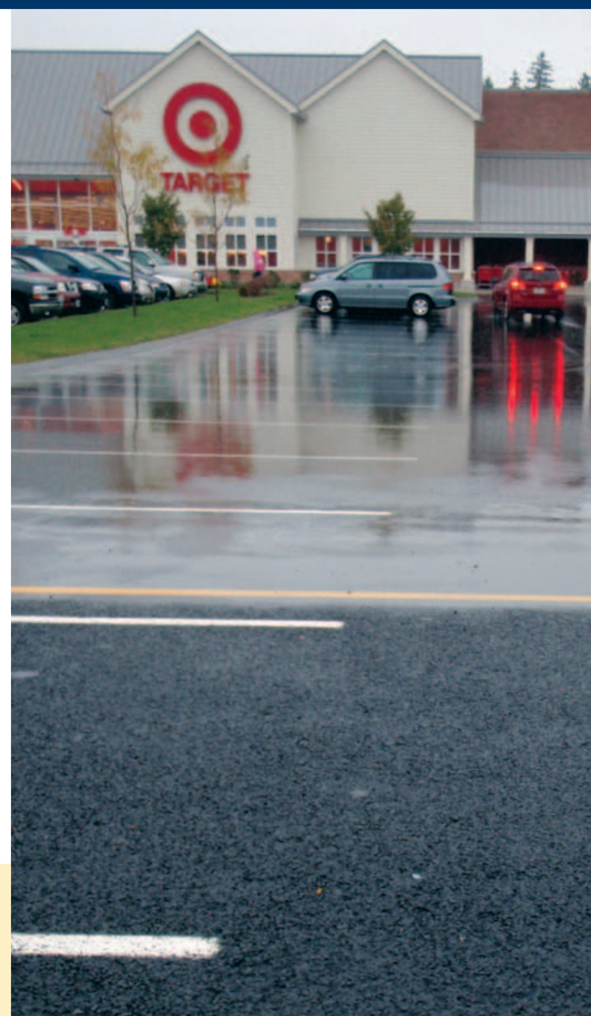
Economic benefits are being realized through the incorporation of LID-based strategies by municipalities, commercial developers, and others. There are increasing numbers of case studies that demonstrate the substantive economic benefits for commercial development and municipal infrastructure projects—for both construction budgets and project life-cycle costs. These economic benefits are increasingly being observed when using a combination of Gray and Green Infrastructure for stormwater management.

WISE LAND-USE PLANNING DECISIONS

have the potential to ease some of the financial demands driven by regulatory compliance. While individually, green infrastructure elements may add expense to a project, costs savings are often realized on an overall project basis as the need for conventional stormwater infrastructure—such as curbing, catch-basins, piping, ponds, and other controls—is reduced.

ECONOMIC BENEFITS ASSOCIATED WITH THE USE OF LID:

- Whole project cost savings for new development by reduction of drainage infrastructure
- Land development savings from a reduced amount of disturbance
- Higher property values of 12 to 16 percent
- Reduction in home cooling by 33 to 50 percent from the use of natural vegetation and reduced pavement area.



Utilizing an LID approach that featured porous asphalt and a gravel wetland, a cost-competitive drainage system was designed for a large retail development in Greenland, NH.

FORGING THE LINK

Three LID Case Studies that identify the scales at which there are clear economic incentives:

RESIDENTIAL SITE: Boulder Hills

This LID condominium community features a porous asphalt road and incorporated porous pavements and rooftop infiltration systems. The benefits included: improved local permitting, positive exposure for the developers, an 11 percent reduction in the amount of disturbed land and a stormwater management cost savings of 6 percent compared to a conventional design. Although porous asphalt was more costly, cost savings are realized through the reduction in drainage piping, erosion control measures, catch basins, and the elimination of curbing, outlet control structures, and stormwater detention ponds.

COMMERCIAL SITE: Greenland Meadows

This retail shopping center features the largest porous asphalt installation in the Northeast. The 56-acre development includes porous asphalt, landscaping areas, a large gravel wetland and other advanced stormwater management. Costly conventional strategies were avoided, and there was a cost savings of 26 percent for stormwater management.

COMBINED SEWER OVERFLOW

On a larger scale, communities are faced with the challenges of managing their combined sewer overflows to reduce the discharge of untreated sewage into waterways. These large often outdated systems carry price tags in the billions of dollars to store, separate and treat. By combining a gray and green approach the costs and volumes of stormwater are significantly reduced. For example, the city of Portland, Oregon was able to save an estimated $63M as compared to an estimated $144M, by considering a green approach, and the city of Chicago, Illinois, was able to divert over 70M gallons of stormwater from their CSO, in one year.

FORGING THE LINK: Linking the Economic Benefits of Low Impact Development and Community Decisions • www.unh.edu/unhsc/forgingthelink
Chapter 3: Economics and LID Practices

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FACT SHEET

Historic and Projected Climate Change

Scientists from around the globe and across the US have recorded changes in the hydrologic cycle, a decline in glaciers and polar ice, and shifts in precipitation intensity and trends.

This evidence strongly indicates that the earth's climate is changing (Bates et al., 2008, Clark et al., 2009, and Lawler et al., 2009).

A widespread consensus of research amongst the world's scientists indicates that:

- Human activities are changing the composition of the Earth's atmosphere. Since pre-industrial times, increasing atmospheric levels of GHGs (greenhouse gasses) like carbon dioxide (CO_2) are well-documented.
- The atmospheric buildup of CO_2 and other GHGs is largely the result of human activities such as the burning of fossil fuels.
- A warming trend of about 1.0 to 1.7°F occurred from 1906-2005. Warming occurred in both the Northern and Southern Hemispheres.
- Major GHGs emitted by human activities remain in the atmosphere from decades to centuries leading to a high degree of certainty that concentrations will continue to rise over the next few decades.
- Increasing GHG concentrations tend to warm the planet.

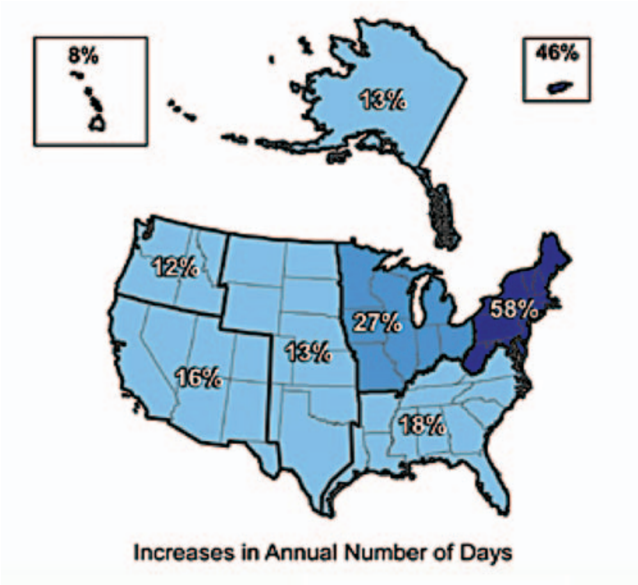
LONG-TERM CLIMATE RECORDS

Since last mid-century, CO_2 concentrations have increased dramatically. In the 1990s, global CO_2 emissions increased 1.3 percent per year, but since 2000, this rate has jumped to 3.3 percent per year. Data from the Mauna Loa Observatory, located on the island of Hawaii, indicates that current atmospheric CO_2 levels have risen approximately 138 percent above those of the pre-industrial period (Tans, 2010).

NATURAL AND HUMAN INFLUENCES

The long record of climate evidence found in ice cores, tree rings, and other natural records show that earth's climate patterns have undergone rapid shifts from one stable state to another within as short of a period as a decade. Paralleling the rise in global and regional temperatures are increases in the associated average precipitation and number of extreme storm events across the U.S.'s northern latitudes. Since the early 20th century, average precipitation has increased 6.1 percent. In New England from 1979 to 2000, there was a 20 to 28 percent increase in the average amount of rain that fell in a twenty-four hour period (Stack et al., 2005; Simpson et al., 2008).

INCREASE IN HEAVY RAINFALL EVENTS 1958-2007 (KARL 2009)



The northern states have shown trends over the last few decades that are associated with global temperature and precipitation change, including:

- Increase in frequency of intense storms
- Warmer winters
- Decreased snowfall
- Fewer days with snow on the ground
- Earlier spring runoff and later date of first frost
- Lake ice-out 9-16 days earlier
- Shifts in U.S. Department of Agriculture plant Hardiness Zones and earlier spring flower bloom dates
- More frequent summer drought periods

PROJECTED CHANGES IN CLIMATE (PRECIPITATION AND INTENSITY)

Based on building evidence from around the world, the United Nations created the Intergovernmental Panel on Climate Change (IPCC) in 1988. The IPCC released its Fourth Assessment Report (2007) assessing current climatic changes and projecting future climatic changes. This IPCC report is a culmination of decades of research and contributions from more than 1,200 authors and 2,500 scientific expert reviewers from over 130 countries.

According to multiple research efforts and studies, by mid-century across the northern tier of the U.S., the following can be expected:

- Temperatures will rise, with winters warming the fastest.
- The number of summer days exceeding 90°F will increase.
- Winter precipitation will increase with more precipitation falling in the form of rain as compared to snow.
- Summer precipitation will remain relatively the same.
- Snow-pack will not last as long and will melt earlier in the spring.
- The frequency of intense storms and storms with greater amounts of precipitation will increase.
- Rising temperatures will cause evaporation rates to increase, reducing soil moisture.
- The frequency of short-term summer droughts will increase.

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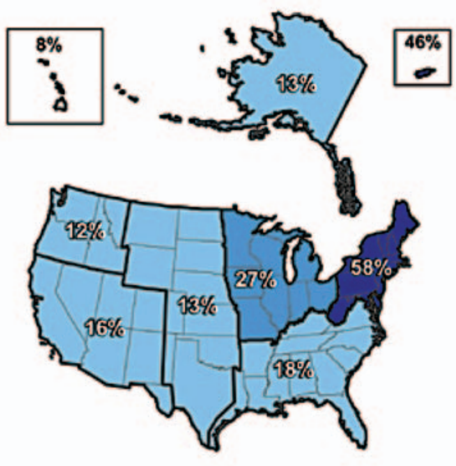
FACT SHEET

LID as a Climate Change Adaptation Tool

Low Impact Development can play an important role in climate adaptation planning for municipalities. Through the use of LID practices, resiliency can be planned into a watershed.

Through this century, climate projections show an increased frequency of larger precipitation events. This projected increase in higher rainfall events must be considered in the context of continued development of a watershed.

NOAA indicates that average precipitation has increased by approximately 6% in the lower 48 contiguous states. In regions of the Northeast and Midwest, the increase has been 10-20% since the beginning of the 21st century. Research has shown that an increase in average precipitation translates to a disproportional increase in frequency of larger precipitation events.



Increase in Heavy Rainfall Events: Annual Number of Days, 1958-2007

RESILIENCE

The ability of a system to absorb and rebound from weather extremes and climate variability and continue to function.

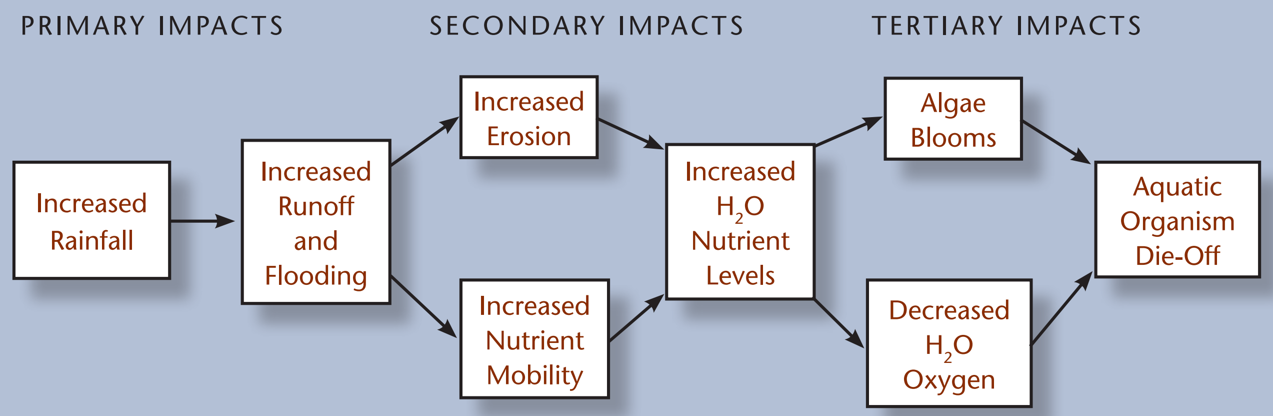
ADAPTATION

Any action or strategy that reduces vulnerability to the impacts of climate change. The main goal of adaptation strategies is to improve local community resilience.

As watersheds are developed, the increase in impervious surfaces results in a decrease in the ability of precipitation to infiltrate into soils. The addition of the dynamics of climate change to watershed build-out will result in increased runoff and in more frequent and higher flood waters, which can threaten both natural systems and built infrastructure.

At the municipal level, planning decisions should incorporate design capacities that can assimilate these projections. The option of not doing anything to prepare for climate change will increase risk to the community.

FORGING THE LINK

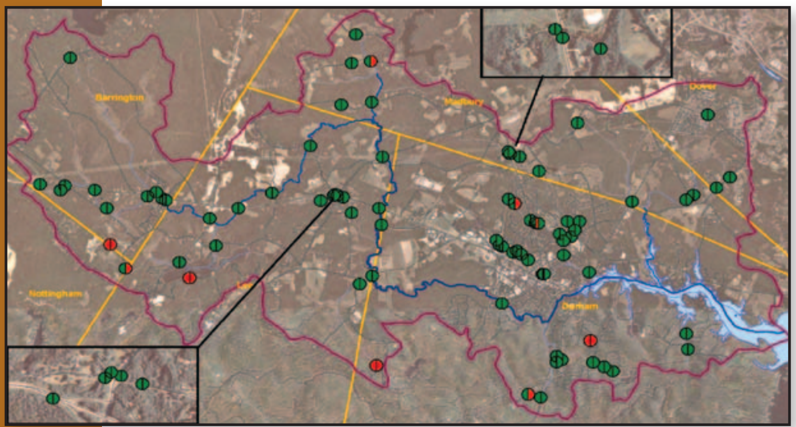


Primary, Secondary, and Tertiary Impacts Due to Climate Change Effects on Rainfall and Runoff

One study in New England provided an analysis of the changes in climate and related impacts to culverts, whose capacity had been designed based on historic designs storms. The study examined the use of LID to mitigate future impacts from increased runoff caused by both climate change and watershed development.

LID systems can mitigate impacts from increased precipitation by

- increasing infiltration,
- reducing runoff volumes, and
- delaying the runoff peak.



Culverts Analyzed Within the Oyster River Basin; red symbols indicate vulnerability.

The implementation of LID practices reduced the number of culverts determined to be undersized by 29 to 100 percent. Additionally, when considering the marginal cost increase to replace such undersized culverts, LID approaches were projected to reduce the total marginal cost increase across the watershed by one-third.

Per-Culvert Marginal Costs by Land-use Scenario, with Recent Precipitation Amount

Land Use	Marginal Cost Per Culvert	% Increase Over Current Land Use
Current	$2,952	—
Build-Out	$3,596	22%
LID	$3,372	14%

These results indicate that in addition to the water quality benefits of LID, wide-scale implementation can also build community resiliency and reduce the economic impacts from build out and increased precipitation trends.

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FACT SHEET

Overcoming the Barriers to the Implementation of LID

A survey of local decision makers provided important insight into the barriers to implementation of low impact development practices in communities.

In 2009, Project Investigators conducted a market survey of over 700 local decision makers representing localities in Minnesota, Ohio, Massachusetts, New Hampshire and Maine to understand the common barriers to implementing low impact development in their communities. The surveys showed that there were similar barriers in all of the communities.

THE FOUR MOST COMMON BARRIERS

1. The perceived costs associated with LID practices.
2. The need for additional education on specific topics directed to local officials and secondarily the general public.
3. Lack of political will to implement LID.
4. Concerns with long-term function and maintenance.

COST

LID is often perceived as a more expensive option than traditional stormwater management. LID can be a cost-effective solution to a community's stormwater management challenges due to the treatment of runoff at the source helping reduce the downstream infrastructure impacts during flooding events. LID can also reduce the development costs due to reductions in curbing and clearing for large detention basins and can introduce significant cost savings when separating storm sewers.

Connections between high levels of development and declining water quality are well established, and can result in financial impacts through the loss of natural resources within the community if they are not controlled or mitigated.

EDUCATION AND TRAINING

Many local officials identified the need to be informed as an important component to making good decisions for their community. Valuable outreach in innovative and cost effective stormwater management can be conducted by Nonpoint Education for Municipal Officials (NEMO), Coastal Training Programs (CTP), Extension Programs, Universities or NGOs. Consider hands-on exercises, field activities or planning charrettes.

FORGING THE LINK

LANGUAGE

The translation of technical materials for local officials is a key component to successful outreach activities. The backgrounds of local officials are often varied, and their understanding of stormwater management is not often equal between officials. Using terminology and communication formats that reach a broader audience improves comprehension of the outreach activity. Consider testing the message or materials with the intended audience to confirm understanding.

> Local officials tend to obtain most of their environmental information through the use of the Web and from direct trainings or presentations.

POLITICAL WILL

Local officials are representatives of their communities and need the support of their constituents when making decisions. Public outreach campaigns assist in the development of the political will necessary to implement innovative or alternative approaches.

> While many educators would hope that local decisions are made based upon factual, logical information, many decisions are influenced by emotional and personal bias.

LACK OF CAPACITY TO BUILD SOCIAL CAPITAL

Environmental educators are tasked with informing wide ranging audiences on ground breaking information regarding resource protection. However, those educators are often limited in their ability to lead group discussions to develop local policy changes in favor of innovative approaches. Consider improving the capacity to lead and nurture group process.

CREDIBILITY

Environmental educators are provided a short window of time to inform local decision makers about new information that could assist in their role. Providing information that is timely, relevant and unbiased are means to ensure successful delivery. Universities, NEMO, CTP, Sea Grant Cooperative Extension, and NGOs can be effective tools for implementing local change.

MAINTENANCE AND OPERATION PLANS

Stormwater management structures, both traditional and innovative require regular maintenance to be performed to maximize performance during their life span. Effective maintenance and operation plans outline the specific steps necessary to keep stormwater practices operating to the maximum benefit.

ADDITIONAL BARRIERS

- negative perceptions of "new technologies"
- concerns over long-term performance and liability
- doubt as to the performance and function of the technology.

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