Cost-Estimation Tool for Low-Impact Development Stormwater Best Management Practices

by Muhammad Sharif and Harold Balbach

Low impact development is an approach to managing stormwater runoff by retaining the water onsite to the degree possible. The effect is to greatly reduce the outflow of water which must be managed by receiving drainageways, and to allow as much as possible to infiltrate the soil close to the site. The principles of LID have been known for more than 20 years, but implementation has been rather slow in many sectors, including within the Army. A major reason has often been the lack of ability to prepare acceptable cost analyses to compare LID projects with conventional stormwater management techniques.

Section 438 of the Energy Independence and Security Act required that LID practices be applied to all new federally funded construction projects for which the footprint exceeded 5,000 square feet. This requirement greatly increased the need for a methodology to prepare these cost analyses. In response to these needs, the U.S. Environmental Protection Agency and the Water Environment Research Foundation have developed a spreadsheet tool to prepare cost analyses for many of the most common LID practices. Public Works Technical Bulletin 200-1-135, Cost-Estimation Tool for Low-Impact Development Stormwater Best Management Practices, available at http://www.wbdg.org/ccb/ARMYCOE/PWTB/pwtb_200_1_135.pdf provides guidance on how to apply the estimating tool to provide reliable cost comparisons for installation of different LID projects at Army installations.

Much progress has been made in areas of LID research and policy development within the Department of Defense and the Army. The Army has established policy on LID and sustainability practices, including a requirement that LID and associated costs be documented with a form DD 1391 for all projects beginning in fiscal year 2013. There are related concerns that LID practices may require both higher capital and operation and maintenance costs than conventional systems. While initial costs may be higher for some LID practices than their respective conventional controls, what remains uncertain is the magnitude of these differences and the key life-cycle factors that affect both conventional and LID costs.

Acronyms and Abbreviations	
EISA	Energy Independence and Security Act
EPA	US Environmental Protection Agency
LID	Low Impact Development
PWTB	Public Works Technical Bulletin
WERF	Water Environment Research Foundation

The EPA-WERF tool is a series of spreadsheets which do not generally require special approval to be used on Army computer systems. They are available as a no-fee download for federal agencies after registration at the WERF website: http://www.werf.org/bmpcost. Each spreadsheet estimates capital costs, as well as operation and maintenance costs, to provide the user a whole-life cost estimate for a selected LID facility. The line item engineer's estimate allows the user to customize the project, For example, users may also select a level of maintenance appropriate for their project. The "Cost Summary" page summarizes annual costs for routine maintenance, corrective or infrequent maintenance, and capital costs. From this summary, the model builds a 50-year lifetime cost estimate. It is designed to produce a default planning-level cost estimate while allowing the user to enter a more specific cost value for every component where it is known. Advanced users may use this function to compare two separate sets of design options or system characteristics. Using the cost tool will result in consistent cost data so that users can determine the cost of each component of the LID project, both for materials ➤

Design & Maintenance Options

WATERSHED CHARACTERISTICS	Unit	Model Default	User	Chosen option
Drainage Area (DA)	ac	50.00	50.00	50.00
Drainage Area Impervious Cover (IC)*	pct	40%		40%
Watershed Land Use Type *("R"-Residential; "C"-Commercial; "Ro"-Roads; "I"-Industrial)*		R		R

FACILITY STORAGE VOLUME	Unit	Model Default	User	Chosen Option
Water Quality Volume (WQV)*	ft^3	90,750		90,750
Permanent Pool Volume as Ratio of Water Quality Volume**	ratio	1.00		1.00
Permanent Pool Volume	ft^3	90,750	90,750	90,750
Flood Detention/Attenuation Volume	ft^3			0
Channel Protection/Erosion Control Volume***	ft^3			0
Other Volume (e.g., Recharge Volume)	ft^3			0
TOTAL FACILITY STORAGE VOLUME	ft^3		**90,750**	**90,750**

DESIGN & MAINTENANCE OPTIONS	Unit	Model Default	User	Chosen Option
Choose Level of Maintenance *("H"=high; "M"=medium; "L"=low)*	-	M		M
Forebay Size (Pct. of Total Pool) [**Enter 0% if no forebay** or if not maintained separately from main pool]*	pct	0%		0%
Forebay Volume	yd^3	0		0
Main Pool Volume	yd^3	3,361		3,361
Pct. Full when sediment removed from Forebay/Main Pool**	pct	25%		25%
Quantity of Sediment Removed from Forebay	yd^3	0		0
Quantity of Sediment Removed from Main Pool	yd^3	840		840

Spreadsheet example for a Retention Pond

Challenges Presented in Managing Tank Trails: Bulletin Provides Guidance

by Muhammad Sharif and Harold Balbach

For tracked vehicles, tank trails provide critical access to firing ranges and training areas that support military training missions. However, they present severe management challenges. Degraded and gullied tank trails may present formidable problems with troop safety, vehicle downtime, fugitive dust, surface erosion, and sediment discharge into downstream woodlands and surface waters. Public Works Technical Bulletin 200-1-124, Environmental Considerations of Stabilizing Treatments for Tank Trails, available at http://www.wbdg.org/ccb/ARMYCOE/PWTB/pwtb_200_1_124.pdf answers some of the many questions about trail maintenance concerns and mitigation of environmental problems resulting from poor trail management.

Currently no Army policy specifically directs management of tank trails. However, there is Army guidance closely related to the subject. PWTB 200-1-124 follows guidelines specified in Technical Manual 5-626 "Unsurfaced Road Maintenance Management", TM 5-822-12 "Design of Aggregate Surfaced Roads and Airfields", and TM 5-822-5 "Pavement Design for Roads, Streets, Walks, and Open Surfaces." Another recent PWTB, 200-1-117, "Mitigation of Environmental Impacts from Unsurfaced Roads," provides both general guidance and examples of specific techniques to minimize soil loss and the resultant impacts to water bodies on an installation. The basic principles suggested for unpaved roads apply here as well. It does not, however, directly address the severe conditions found on tank trails.

Example of grid filled with high quality material, in this case crushed rock, which will support heavy loads and allow drainage. (Presto Geosystems)

Tracked vehicles are an integral part of most Army installations' training missions. Their weight and the action of the tracks cause severe damage to paved roads, so an alternate network of improved, but unpaved trails is constructed for access to firing points and training areas. Over the years, many installations have found that it is not adequate in the long run to simply dozer out a route across the landscape. The trails require continual repair and regrading, and are sometimes impassable and unsafe. In the absence of specific guidance as to how to build and maintain trails, a wide variety of ad-hoc responses have been used. Is there any experience or technology which could help training area and public works road maintenance planners to create a reliable trail system?

The basic principles of roadway engineering apply to tank trails. Among these are the necessity of creating a sound base layer before placing pavement, and assuring that surface and groundwater are carried away. Paved or unpaved, these rules still need to be followed. The photo shows an example of poor grading practices, where the accumulated soil mounds will not allow water to drain from the surface of the trail.

Acronyms and Abbreviations	
ERDC	Engineer Research and Development Center
GEOGRID™	Trade name of a brand of supporting soil grid used in the Fort Bragg study.
PWTB	Public Works Technical Bulletin

More than 15 years ago, Fort Bragg, North Carolina, undertook a then-experimental rebuilding of an important tank trail. In addition to implementing better practices in grading the surfaces, several sections of the trail were improved through placement of a GeoGrid™ subsurface support system. Originally developed by pavement engineers from the Engineer Research and Development Center in Vicksburg, Mississippi, variations of this system have been used in many places around the world where a trafficable surface is needed, and pavement is not an alternative.

More than 10 years after the Fort Bragg improvements had been installed, the results were reviewed. In the places where high-quality material, such as ➤

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and for planning and design. In addition to cost estimates, design concepts are presented in each model and this feature provides factors to consider during planning stages of an LID project. The consistent format allows a better understanding of the benefits of LID use and better decision-making for LID applications.

The appendices in the PWTB summarize LID background and benefits, explain different cost-estimation tools, and present practical guidelines for using this suite of cost-estimation spreadsheets.

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