Keep It Legal with LID

Ohio hospital site team adheres to regulations, reaps benefits using low-impact design (LID) techniques

By Scott E. Sonnenberg, P.E., LA, CPESC

Preparing site design and construction plans to meet the requirements of state and federal National Pollutant Discharge Elimination System (NPDES) regulations presents a variety of obstacles and challenges. Preparation of a storm water pollution prevention plan (SWPPP) with appropriate erosion and sediment control best management practices (BMPs), sediment basins with volume and trap efficiency requirements, detailed construction schedules and post-construction water quality criteria requires coordination between temporary and final design elements.

Site design influences, including landscape codes, green space requirements, setback regulations and local standards for roads, parking, lawns and storm drain systems, limit the design, location and area for storm water management systems. Construction standards, schedules and processes contrary to design objectives may create compliance issues.

LID may have solutions to many of these obstacles and challenges. There are many sources dedicated to the explanation of LID techniques, and the six major goals and concepts can be summarized as:

1) Minimizing impervious impacts;
2) Maximizing flow lengths;
3) Minimizing flow velocities;
4) Maximizing infiltration;
5) Providing water quality filtration; and
6) Providing controlled flood storage.

The Dublin Methodist Hospital site was designed and constructed to meet the six major goals of LID.

The following project is an example of how incorporating various LID measures across the site—from the planning phase through final design—can help site teams overcome challenges, limits and compliance issues.

Planning Period

Preliminary planning for the Dublin Methodist Hospital project in Dublin, Ohio, began more than a year before construction, with the owner (OhioHealth), architects (Karlsberger Architecture Inc.), interior designers, landscape architects (Myers Schmalenberger Inc.), site engineer (Eco-Design & Engineering Ltd.), building engineers and construction managers involved in the process.

One of the owner's initial goals was to be as environmentally sensitive as possible, using U.S. Green Building Council Leadership in Energy and Environmental Design certification criteria as a guide, without incurring significant additional costs.

The existing oddly shaped 71-acre site was a relatively flat farm field with tile and surface drainage into three different city storm drain systems and 40 percent hydric soils. The proposed site was divided by a new road into a 13-acre future medical office site, a 10-acre future highway exit ramp and the primary 45.5-acre hospital site. The hospital building, medical office building, parking lots, helipad and access drives cover more than 27.8 acres (61 percent), with 17.7 acres (39 percent) green space used for landscaping, islands, setbacks and storm water management.

Local Regulations

Local storm water regulations required that any new development restrict release rates to levels set by a city storm water master plan. The state NPDES Phase II regulations necessitated the preparation of a SWPPP, plus a post-construction water quality volume equal to the 0.75-in. rainfall runoff be released over a 24-hour minimum.

The city's landscape regulations called for landscaped setbacks and islands throughout the parking areas, but these

green spaces could not be used for storm water management without special permission. The city's engineering standards required minimum slopes and velocities for any storm flows through grassed swales and pipes.

LID Features

LID measures were proposed to address all six of the aforementioned goals. Impervious surface impact was minimized by disconnecting all parking lot runoff from the storm drain system; all runoff either sheet flows or passes through curb cuts into grassed or vegetated basins with undersized outlets that help detain runoff.

Flow lengths were maximized by directing runoff through multiple basins or vegetated swales before it flows into an extended detention basin. Velocities were minimized by using a series of basins or long vegetated swales at 0.1-percent slopes. Infiltration was maximized by detaining runoff in more than 50 vegetated or grassed islands and basins, five vegetated wetland swales and three extended wetland detention basins.

All impervious surface runoff passes through multiple wetland basins or swales prior to flowing into a forebay and another vegetated wetland channel. The runoff then flows through the extended wetland detention basin and a stone subdrain filter at the outlet structure. The open-channel drainage system and basins provide more than 3.5 acre-ft of water quality volume, released slowly over more than 48 hours, and more than 18 acre-ft of flood storage that will contain up to the 100-year storm.

Compliance Issues

Preparing a SWPPP that will trap sediment coming from large pavement subgrade areas typically results in numerous small, temporary sediment basins located in future pavement areas. These basins have to be removed, filled and compacted prior to final paving but leave potential for future pavement failure. The placement of all storm drain inlets in vegetated areas allows for temporary sediment basins to remain in operation until after final paving is complete, leaving no potential for future pavement failures.

Designing a development plan using a typical storm drain pipe system on a large, flat site with limited fall to the discharge points may require large quantities of fill or large pipe systems to meet minimum slopes and velocities. Collecting runoff into vegetated islands with short pipe lengths and into open-channel drainage systems and multiple basins in series can significantly reduce required fill and pipe sizes and provide increased sediment removal and flood storage volumes. These open-channel systems can also provide significantly better onsite drainage away from construction areas, resulting in less downtime due to severe weather.

The expansion of NPDES regulations to include post-construction water quality volume criteria typically results in very small outlet structure designs that can become clogged. The use of multiple basins in series and extended wetland detention basins with various cells and wetland shelves helps to reduce the ability of trash and debris to be transported to the outlet structure.

The outlet structure designed for Dublin Methodist Hospital included a subdrain pipe covered with stone as the only source of water flow into the outlet structure. It also included a standpipe inside the structure, with a small orifice for water quality volume release and larger openings for larger storms. This design prevents clogging and provides a final course filter of storm water release.

Summary of Benefits

The integration of LID techniques into any site plan can simplify the preparation of the SWPPP; keep temporary BMPs operational longer; increase sediment removal efficiency; keep construction areas drier; prevent clogging of small outlet structures; meet minimum engineering standards; minimize construction costs; lessen potential pavement failures; provide greater flood storage volume; and minimize future maintenance costs. SWS

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