

LID ELEMENT #22: GREEN ROOFS, RAINWATER REUSE, LID FOUNDATIONS

OBJECTIVE

New building construction that incorporates LID techniques such as green roofs, rainwater collection and reuse, and low impact foundation design.

CONSIDERATIONS

Green roofs and reuse of rainwater reduce peak flows during storm events by detaining runoff. LID foundations preserve the natural soil profile and hydrologic properties within the footprint of a structure. These three elements are evaluated together because they are elements related to building construction and are distinct from the site development considerations discussed as part of other elements.

When considering potential options related to these elements, mandating their use has not been proposed. Mandating LID techniques in building construction such as use of green roofs, rainwater reuse or LID foundations would require a state-approved amendment of the building code. Although building code amendments by local jurisdictions are possible, they must be supported by special circumstances. Given the nature of the issue, a local amendment may not be supportable. However, the City can support and facilitate these techniques on a case-by-case basis as builders and homeowners seek to use them.

“Vegetated roofs improve energy efficiency and air quality, reduce temperatures and noise in urban areas, improve aesthetics, extend the life of the roof, and reduce stormwater flows.”

*Low Impact Development
Technical Guidance Manual for
Puget Sound (2012)*

TRADITIONAL APPROACH TO BUILDING CONSTRUCTION

Typical foundations excavate out much of the native soil beneath a building. Most roofs are constructed of hard surfaces and drainage systems that convey roof runoff away from the building to detention and infiltration facilities. The focus of these systems is to create safe, livable buildings. Foundations must provide structural support and seismic protection.

CODES AND STANDARDS REVIEWED

International Building Code (IBC)
International Residential Code (IRC)
Uniform Plumbing Code (UPC)

BENEFITS OF USING GREEN ROOFS, RAINWATER REUSE AND LID FOUNDATIONS

Green roofs and rainwater reuse systems slow roof runoff resulting in reduced peak storm flows. Reducing peak storm flows can help prevent storm flooding. Green roofs have the added benefits of

improving energy efficiency and air quality, reducing temperature and noise in urban areas, and can extend the life of the roof. LID foundation systems (also called minimal excavation foundation systems) limit soil disturbance and allow storm flows to more closely approximate natural shallow subsurface interflow paths.

OLYMPIA CODE ANALYSIS

The design standards for green roofs, rainwater reuse systems and LID foundation systems are governed by building and plumbing codes. The City of Olympia has adopted the International Building Code (IBC), International Residential Code (IRC), and Uniform Plumbing Code (UPC) (as amended by the Washington State Building Code Council and City of Olympia). Green roofs, rainwater reuse systems, and LID foundation systems are currently allowed by these codes. Use of these systems generally requires additional engineering and analysis for approval. For instance, a green roof has a much higher weight than a standard roof. Therefore, a green roof requires greater structural support and requires more engineering, analysis and City review than a standard roof.

Building codes are adopted at the State and local level and include State specific amendments. Individual jurisdictions are allowed to amend building codes based on their unique circumstances. Building codes have a 3 year update and re-adoption cycle. Both the State and jurisdiction specific amendments are typically incorporated as part of the adoption cycle, although off-cycle amendments are also possible. Amendments, such as requiring the use of specific LID techniques must be supported by findings of fact that support the need for the amendment to obtain approval. The City of Olympia has adopted some jurisdiction specific amendments - most recently the City obtained authorization to require residential sprinkler (fire suppression) systems.



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The City could propose to adopt the International Green Construction Code (IGCC) which emphasizes sustainable construction practices. Although the IGCC does provide requirements for sustainable design and construction, it does not have specialized requirements for green roofs, rainwater reuse systems, or LID foundations that would make review and approval of these systems simpler than currently adopted City codes.

HURDLES TO USE OF GREEN ROOFS, RAINWATER REUSE, AND LID FOUNDATION SYSTEMS
These low impact design strategies present the following challenges:

Additional Design/Construction Costs – Both green roofs and LID foundations require additional engineering analysis and design beyond what is required for standard roofs and foundations. As

discussed above, green roofs are heavier than standard roofs and require greater structural support. LID foundations are elevated above the soil and hence do not have the support of surrounding soil against lateral movement as with traditional foundations. Given that both green roofs and LID foundations have structural support issues that are not standard, their design and permitting require additional analysis to obtain approval. Rainwater reuse systems, depending on how the rainwater will be reused, often require additional analysis and design as well. If roof runoff is to be reused for internal use in the building (i.e., toilet flushing), then dual plumbing systems are needed with overflows and cross connection protections. In addition, the storage facilities (cisterns, tanks, etc.) for the reuse water can be quite large and heavy. Depending on the facility size, specialized foundation support may be required. Given the additional analysis and design that is required, green roofs, rainwater reuse, and LID foundations are more expensive to design and permit than standard systems.

Green roofs, rainwater reuse, and LID foundations are also typically more expensive to construct than standard systems. Given that these are not standard, materials for their construction are typically more expensive. In addition, as with the case of the rainwater reuse systems, additional materials are needed (dual plumbing requires double the pipe and connections) which also increases cost. Finally, contractors are not typically as familiar with the construction techniques required for non-standard systems which could drive construction costs up.

Maintenance – Maintenance requirements for green roofs and rainwater reuse systems are different than the maintenance requirements for standard systems.

Maintenance activities are not typically something that can be performed by a homeowner and often require professional assistance. Rainwater reuse systems often involve pumps, filters and other parts that require regular inspection, maintenance and replacement. Green roof systems include structural components, waterproofing, drainage layers, soil substrate, vegetation and drains - all of which require inspection to ensure proper operation throughout the life of the system.

Other Challenges – In addition to the above, the three elements considered have these unique challenges:



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Green Roofs

- Roofs are also where HVAC and other equipment are often located. In commercial, multifamily, and industrial settings, green roofs must be designed to provide space required for such equipment.

Rainwater Reuse

- Storage tanks could be subject to setback requirements of the zoning code. For small residential lots, meeting setbacks may be difficult.
- Using collected rainwater for irrigation requires storing large volumes of water. Irrigation is typically needed most during the dry season. In the Pacific Northwest, rainwater is most plentiful during the wet season. Therefore, the limiting factor in the effectiveness of the rainwater to be used for irrigation is the availability of storage. The availability of storage is limited by space and cost.

LID Foundations

- The structural capacity of the underlying soil is a limiting factor. Soils that are susceptible to compaction or movement limit the feasibility of LID foundations. This can be particularly challenging in Olympia where new construction must comply with strict earthquake standards.

OPTIONS CONSIDERED

The following options were considered:

- Option 1: No change.
- Option 2: Provide prescriptive checklists for review and approval of green roofs, rainwater reuse, and LID foundations.
- Option 3: Provide incentives for use of green roofs, rainwater reuse, and LID foundations.

ANALYSIS

Option 1 (no change) would maintain the status quo. Green roofs, rainwater reuse systems, and LID foundations are currently allowed within the City of Olympia. New buildings can be constructed using traditional techniques or may propose to incorporate LID components such as green roofs, rainwater collection and reuse systems, or LID foundations. Additional design and analysis of the building plans is typically required in order to incorporate LID building features, depending on the size and nature of the feature being proposed.



LID Foundation at Clearwater Commons in Bothell.

Option 2 (prescriptive checklist) supports the preparation of prescriptive checklists that, if followed, would simplify City permitting for green roofs, rainwater reuse systems, or LID foundation systems through clarification of requirements. Additional design and analysis would be required over standard systems, but the checklist would clarify the requirements and steps to be followed. Providing clarity regarding the requirements would promote use of these systems.

Option 3 (incentives) would provide incentives to use of green roofs, rainwater reuse, and LID foundations. Incentives could include priority review of permit applications, reduced permit fees or utility rates, etc. Given the cost differences of green roofs, rainwater reuse and LID foundations over standard systems, incentives would need to be enticing enough to offset increased costs. Use of incentives is likely to be the most effective way to increase use of LID building features such as green roofs, rainwater collection and reuse systems and LID foundations. While these systems are valuable and can help reduce the amount of runoff generated by buildings and roof area, limited use of the systems due to the complexity of their construction and maintenance and increased cost of installation, will result in relatively minor reductions in runoff city wide associated with this element.

RECOMMENDATION

Staff recommends Option 3. Current code already allows these systems but they are infrequently constructed. Option 1 would result in no change and Option 2 might clarify the process for approval but likely would not increase usage. Option 3 would allow staff to develop incentives that encourage the use of these systems. An incentive strategy would need to be aligned with budget discussions in 2017.

