Appendix G

Draft UCSC Low Impact Development (LID) Checklist

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Background

LID, Low Impact Development, seeks to control storm water at the source rather than conveying storm water off-site by integrating site hydrologic and environmental functions into the development design. The implementation of LID practices varies widely. This is partially because LID responds to varying site needs and conditions and because the definitions of LID principles and practices vary. The NRDC website, http://www.nrdc.org/water/pollution/storm/chap12.asp, contains the following useful discussion of LID principles and practices:

> *LID is grounded in a core set of principles based on the paradigm that stormwater management should not be seen as stormwater disposal and that numerous opportunities exist within the developed landscape to control stormwater runoff close to the source. Underlying these principles is an understanding of natural systems and a commitment to work within their limits whenever possible. Doing so creates an opportunity for development to occur with low environmental impact. The principles are:*
>
> *-integrate stormwater management early in site planning activities*
> *-use natural hydrologic functions as the integrating framework*
> *-focus on prevention rather than mitigation*
> *-emphasize simple, nonstructural, low-tech, and low cost methods*
> *-manage as close to the source as possible*
> *-distribute small-scale practices throughout the landscape*
> *-rely on natural features and processes*
> *-create a multifunctional landscape*
>
> *LID uses a systems approach that emulates natural landscape functions. A near limitless universe of runoff control strategies, combined with common sense and good housekeeping practices, are the essence of a LID strategy.*
>
> *These basic strategies, also known as integrated management practices, rely on the earth's natural cycles, predominantly the water cycle, to reduce land development impacts on hydrology, water quality, and ecology. Integrated management practices combine a variety of physical, chemical, and biological processes to capture runoff and remove pollutants at the lot level.*
>
> *Several strategies focus on disconnecting roofs and paved areas from traditional drainage infrastructure and conveying runoff instead to bioretention areas, swales, and vegetated open spaces. LID also strives to prevent the generation of runoff by reducing the impervious foot print of a site, thereby reducing the amount of water that needs treatment. The end hydrological results are a reduction in runoff volume, an increased time of concentration, reduced peak flow and duration, and improved water quality.*
>
> *Developers apply most LID strategies on the micro-scale, distributed throughout the site near the source of runoff. They customize strategies according to site conditions in order to reduce specific pollutants and to control runoff, a technique known as site foot-printing. LID is particularly effective when practices are integrated into a series of linked, strategically placed and designed elements that each contribute to the management of stormwater.*

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UCSC has a long history of implementing practices that are consistent with LID. These include: general planning (LRDP) measures to cluster development, reduce building footprints, return stormwater runoff to the environment via a dispersed, reverse-collection system, make the campus "pedestrian friendly", protect sensitive areas from development, and reduce the number of vehicle trips. A description of those practices is included in the Storm Water Management Plan section 4.2.5.3. UCSC intends to build upon the existing practices by implementing an LID program for all projects that increase the impervious surface.

Among many other considerations, an environment that is functional for both human and natural ecosystems requires a careful balancing of the density and permeability of the built environment. For more information, see various "smart growth" references such as Protecting Water Resources with Higher Density Development [1], Protecting Water Resources with Smart Growth[2] and Using Smart Growth Techniques as Stormwater Best Management Practices[3]. UCSC is committed to balancing these often conflicting land use needs, as evidenced by the previous LRDP discussion.

The UCSC Main Campus occupies a portion of 4 watersheds (Cave Gulch, Moore Creek, Jordan Gulch and San Lorenzo/Pogonip). The on-campus portion of these watersheds can be further divided into more than 40 sub-watersheds. The large number of sub-watersheds is primarily due to the underlying karst geology. Sinkholes and swallow holes in the karst capture much of the surface flow within the drainages, effectively isolating that portion from the rest of the watershed with respect to surface drainage. Karst geology has helped shape the UCSC requirements for development and storm water management. LID techniques in areas potentially affected by karst geology must take into account the recommendations of the geotechnical report.

UCSC standards require that post development peak flows do not exceed pre-development peak flows. While LID techniques can be used to meet that standard, LID techniques to control volume changes must also be implemented in accordance with LRDP HYD-3D.

Instructions for Completing the LID Checklist:

In accordance with the 2005 LRDP EIR Mitigation measure HYD-3D, Low Impact Development (LID) techniques must be incorporated to the Maximum Extent Practicable (MEP)[4] into all projects which will result in increased impervious

[1] U.S. Environmental Protection Agency. Not dated. Protecting Water Resources with Higher Density Development. Washington, DC: EPA 231-R-06-001. http://www.epa.gov/smartgrowth/pdf/protect_water_higher_density.pdf

[2] U.S. EPA Office of Policy, Economics, and Innovation. Not dated. Protecting Water Resources with Smart Growth. Washington, DC: EPA 231-R-04-002. http://www.epa.gov/smartgrowth/pdf/waterresources_with_sg.pdf

[3] U.S. Environmental Protection Agency. Not dated. Using Smart Growth Techniques as Stormwater Best Management Practices. Washington, DC: EPA 231-B-05-002. http://www.epa.gov/smartgrowth/pdf/sg_stormwater_BMP.pdf

[4] Maximum Extent Practicable (MEP): MEP is a regulatory standard for storm water management. MEP is generally a result of emphasizing pollution prevention and source control BMPs (Best Management Practices) as the first lines of defense in combination with structural and treatment methods where appropriate serving as additional lines of

surface. A narrative demonstration that LID techniques have been incorporated to the MEP is made by completing the LID checklist.

For all projects, the applicable checklist shall be completed, updated as necessary and included with each iteration of design documents.

No project will incorporate all of the listed LID measures nor are all of the measures equally valuable or appropriate for every project. Rather LID measures should be integrated into the project design so storm water quality is maintained and or improved to the MEP while providing for other project goals which further "UCSC's academic, research, and public service mission while maintaining the campus's strong traditions of environmental stewardship and sustainability."

The user may notice both overlap and omission of potential techniques. In the case of overlap, the user is encouraged to describe all of the ways the techniques are utilized even when it may appear repetitive. For storm water enhancement techniques that appear to be omitted a final item is at the end of the checklist allowing the user to add one or more techniques not listed.

Section A: Site Selection

While site selection may or may have been completed prior to selection of a site designer, an evaluation of storm water benefits and disadvantages attributed to the project through site selection are important to document the balancing of multiple project goals and to inform site design.
For each item select from the following items: the item is incorporated, item is not feasible, other measures achieve the same goal or item is not applicable. **An explanatory narrative description is required for every item**.

Section B: Site Design Checklist

Prior to developing any structural storm water practices on a site, significant reductions in storm water quantity and quality impacts can be made through efficient site design. Three general categories of site design practices can be used to minimize storm water impacts: preservation of natural areas, minimization of overall impervious cover and the disconnection[5] of impervious areas to minimize the impact of impervious cover.

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defense. The MEP approach is an ever evolving, flexible, and advancing concept, which considers technical and economic feasibility. As knowledge about controlling urban runoff continues to evolve, so does that which constitutes MEP… The way in which MEP is met may vary between communities.
In discussing the MEP standard, the State Water Resources Control Board has said the following: "There must be a serious attempt to comply, and practical solutions may not be lightly rejected. If, from the list of BMPs, a permittee chooses only a few of the least expensive methods, it is likely that MEP has not been met. On the other hand, if a permittee employs all applicable BMPs except those where it can show that they are not technically feasible in the locality, or whose cost would exceed any benefit to be derived, it would have met the standard. MEP requires permittees to choose effective BMPs, and to reject applicable BMPs only where other effective BMPs will serve the same purpose, the BMPs would not be technically feasible, or the cost would be prohibitive."
(See SWRCB Order WQ 2000-11, http://www.waterboards.ca.gov/resdec/wqorders/2000/00wqo.html.)

[5] "Disconnecting" means having impervious cover drain to pervious cover, i.e. downspouts draining to the landscape, not piped conveyance systems. This decreases both the runoff volume and time of Concentration. Disconnected parking lots, for example, can provide sheet flow into bioretention areas or engineered infiltration swales. Level spreaders may be used along the edges of developed areas to redistribute concentrated runoff into adjoining natural open space. Wherever buffers or other areas of

Infiltration techniques are becoming a widely used technique for offsetting imperviousness. In karst areas safety concerns limit the extent of infiltration. However, small infiltration areas may be designed to reduce the volumes from discrete impervious areas.
For each item select from the following items: item is incorporated, item is not feasible, other measures achieve the same goal or item is not applicable. An explanatory narrative description is required for every item.

Definitions:

Storm water facility: Storm water facilities are either manmade or natural structures, such as detention/retention ponds, detention tanks, engineered treatment systems, pipes and bioswales, that help reduce flooding, slow down water flow, and clean contaminants from the water.
Stream: A general term for a body of flowing water; natural water course containing water at least part of the year.
Wetland: An area that is saturated by surface or ground water with vegetation adapted for life under those soil conditions, as swamps, bogs, fens, marshes, and estuaries. (EPA)
Buffer: a vegetated zone adjacent to a stream, wetland, or shoreline where development is restricted or controlled to minimize the effects of development. (EPA)
Bioretention Area: on-site retention of storm water through the use of vegetated depressions engineered to collect, store, and infiltrate runoff. (EPA)
Infiltration Swale: vegetated, open drainage channel engineered to collect, detain, and infiltrate storm water
Rainwater harvesting: Rainwater harvesting is a method of inducing, collecting, and storing and conserving storm water runoff
Level Spreader: An outlet designed to convert concentrated runoff to sheet flow and disperse it uniformly across a slope.
HSG A and HSG B soils: Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. **Group A** is sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates. They consist mostly of deep, well drained sands or gravels and have a high rate of water transmission. **Group B** is silt loam or loam. It has a moderate infiltration rate and consists mostly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

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open space are preserved, ensure that they are made hydrologically functional by making them receiving areas for sheet flow, not concentrated flow. Ensure that flow volumes do not cause channelized flow and erosion in receiving buffers.

Project Name:

SECTION A: SITE SELECTION

Practice	Incorporated	Not Feasible	Other measures achieve same goal	Not Applicable	Description
Project located within urban core in order to limit direct impacts to natural areas and to maximize use of existing infrastructure.					
Site selected effectively utilizes existing transportation nodes (bus service, bike routes and pedestrian routes).					
Project is sited in proximity to existing utility services or corridors (potable water, sanitary sewer, electricity, heating and cooling systems).					

SECTION B: SITE DESIGN

Practice	Incorporated	Not Feasible	Other measures achieve same goal	Not Applicable	Description
Natural areas preserved by locating storm water facilities outside of streams and wetlands.					
Natural areas preserved by maintaining natural drainage routes on site.					
Natural areas preserved by maintaining buffers.					
Natural areas preserved by maintaining other existing vegetation.					
Natural areas preserved by maintaining most permeable site soils (HSG A and HSG B soils), i.e. development occurs on least permeable site soils.					
Site imperviousness is minimized by using the					

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Practice	Incorporated	Not Feasible	Other measures achieve same goal	Not Applicable	Description
minimum required width for streets and roads.					
Site imperviousness is minimized by only providing parking spaces in the project to provide for necessary medical, handicapped and service access.					
Site imperviousness is minimized by utilizing pervious pavements in pedestrian and vehicular areas.					
Site imperviousness is minimized by including pervious and semi-pervious surfaces wherever possible.					
Site imperviousness is minimized by utilizing structured or shared parking.					
Site imperviousness is minimized by using multi-storied structures, to the maximum extent allowable within campus design guidelines, to minimize building footprints.					
Site imperviousness is minimized by providing appropriately sized and located pedestrian and bicycle circulation to both promote such access and to minimize the potential for shortcuts by such modes of transportation.					
Site imperviousness is minimized by providing pervious trails where appropriate for pedestrian circulation.					
Site imperviousness is minimized by using soil conservation management techniques to maintain soil absorption. Where soils are designated for the preservation of infiltration capacity such areas will be marked in the field to restrict heavy equipment access.					
Site imperviousness is					

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Practice	Incorporated	Not Feasible	Other measures achieve same goal	Not Applicable	Description
minimized by using soil enhancement techniques to increase soil absorption. Where compacted soils will receive sheet flow runoff provisions, such as disking and amended with loam or sand prior to seeding/ landscaping, shall be made to improve the infiltration capacity.					
Site imperviousness is minimized by replanting all cleared or graded areas.					
Impervious areas are disconnected by harvesting rainfall for post storm uses.					
Impervious areas are disconnected by directing sheet flow from impervious areas to vegetated areas.					
Impervious areas are disconnected by the installation of infiltration areas (trenches, planters, basins, etc.) to receive the flow from impervious areas.					
Impervious areas are disconnected by use of level spreaders which redistribute concentrated flows from impervious areas into sheet flow.					
Impervious areas are disconnected by directing flows to vegetated and other rough conveyance systems.					
Impervious areas are disconnected by eliminating or minimizing curb and gutter design features.					
Other technique:					
Other technique:					

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