Stormwater Management Considerations

City of Coralville Stormwater Management Criteria

The City of Coralville is a regulated MS4 Community (Municipal Separate Storm Sewer System), meaning that they are mandated by the US EPA and Iowa DNR to comply with specific portions of the Clean Water Act and National Pollutant Discharge Elimination System. One of the MS4 requirements pertinent to new developments, such as the West Land Use Area, is the institution of a Post-Construction Stormwater Management Ordinance, which Coralville executed in 2014. Coralville's ordinance is based on the requirements set forth by the State and Federal authorities in an effort to protect the quality of surface waters to the maximum extent possible without excessive encumbrance upon development. Requirement highlights include:

- Infiltration of the Water Quality volume (runoff from a 1.25-inch rain event) onsite
- Infiltration or extended detention (24 hours) of the Channel Protection volume (1-year rainfall event; 2.4 inches over 24 hours)
- Detention of the 5 to 100-year runoff, with release at no more than the 5-year, 24-hour pre-development rate
- Preservation of existing topsoil
- Vegetated riparian buffers (30-ft for low density residential; 50-ft all other land uses)

Although onsite infiltration of small storm runoff is stipulated in the ordinance, there is a general understanding that the large storm detention requirement may be applied development-wide, as discussed in the Development Standards for Stormwater Management section below. Additional conditions and exclusions can be found in the City's Post Construction Stormwater Ordinance.

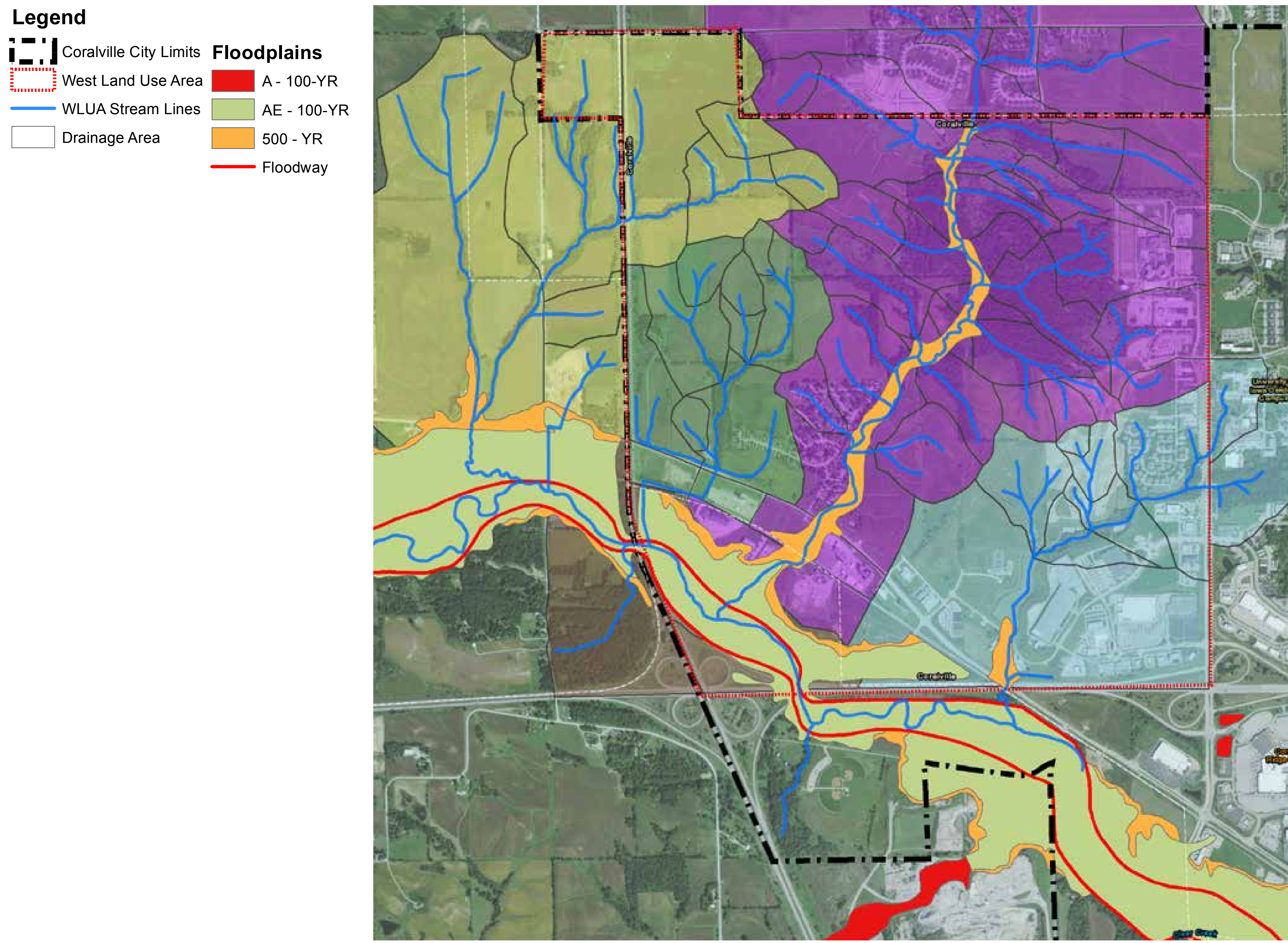


Figure 100: The West Land Use Area showing delineated watersheds, drainage basins, stream lines, and regulatory floodplains

Stormwater Management Recommendations for the West Land Use Area

Area-Wide Development Recommendations

These stormwater management considerations contain an overview of recommendations by HR Green. See HR Green's December 2015 West Land Use Area Stormwater Report for more detailed information.

The Master Plan for development and land use allocation in the project area includes guidance with respect to overall stormwater management and maintenance of regional hydrologic function. Approximately 18% of the study area is currently planned to be "open space" consisting primarily of green space, parks, or stream corridor and flood plain buffers. These locations have been strategically chosen based on existing natural and unique features that should be maintained in natural functioning condition. Some open space may require active maintenance or constructed measures to prevent or remove invasive species encroachment, prevent disruption of natural function by upstream hydrologic modification (increasing, contaminating, or warming of runoff), or mitigate other impacts typically associated with urban development adjacent to outstanding natural features. Some areas, particularly to the west of the existing Iowa Medical Classification Center, have such unique and outstanding natural properties that they should be stringently protected and perhaps celebrated and promoted by establishing a formal preserve, nature education center, or other means for protecting the area while also deriving public benefit from it.

Areas planned to be maintained as open or green space in perpetuity that include streams, ponds, wetlands or other surface water features shall be protected from increased runoff rate and runoff polluted by chemical, biological or physical constituents (including heat). Runoff from developed areas to said sensitive natural areas shall be treated by means meeting the City's Stormwater Ordinances and / or Iowa Stormwater Management Manual to limit runoff rate and pollutants such that the natural areas are not degraded due to the changes in runoff characteristics.

Particular care should be taken for the design and implementation of University Parkway, Jones Boulevard, Oakdale Boulevard and any other development adjacent theses valuable natural open spaces buffers and creeks. Pavement, grading and drainage design as well as best management practices should all be thoughtfully coordinated to provide the most environmentally sensitive design and implementation solutions.

Mapped floodplains should be considered when locating constructed development; the City of Coralville's development restrictions for floodplains are the same as state (Iowa DNR) and federal (NFIP / FEMA) requirements. Mapped floodplains consist of the regulatory "Floodway" within the 100-year floodplain, the 100-year floodplain itself, and the 500-year floodplain. The Floodway must absolutely not be encroached upon, even temporarily with material stockpiles or other impedances to stream flow, without a lengthy and stringent Federal approval process. The 100-year floodplain may be developed, but special restrictions will likely be required, and costly flood insurance will likely be imposed. Development within the 100-year floodplain is strongly discouraged. While development within the 500-year floodplain involves inherent risk, there is no intention by the City to formally prevent this development. In general, it should be understood that low lying areas adjacent to streams and rivers (even intermittent streams), are at risk of periodic flooding, and these spaces are typically best left as natural, green space where possible. See also section 08 of the City's Post Construction Stormwater Ordinance for buffer requirements along waterways.

Site Development Recommendations

The existing Municipal development criteria, primarily the City's Post Construction Stormwater Ordinance, should be strictly followed for the best ultimate results regarding protection of runoff water quality, reduction of post-development runoff quantity issues, and reduction of municipal maintenance effort and cost.

Transportation Related Drainage Recommendations

The transportation network has been designed in a way to minimize waterway crossings and, where possible, to follow ridgelines. Stormwater runoff from the roadways will discharge into the existing waterway areas zoned as open space. Per the City's Post Construction Stormwater Ordinance, roadway drainage systems should be designed to include some detention, retention, or infiltration of the Water Quality Volume and Channel Protection Volume to further minimize impacts on the waterways. Examples of BMP techniques applicable to roadway design include ditch or median bio-swales, curb-cut rain gardens, permeable paving systems, stormwater curb-cut planter boxes, minimizing pavement width, and underground storage.

Local roads with less traffic can be designed with permeable paving systems that can greatly reduce – in some cases eliminate – the need for conventional stormwater infrastructure. This option should be investigated on a site by site basis because it is possible that the total infrastructure cost may be less, while simultaneously providing significant water quality and quantity improvements. Additional benefits may include enhanced aesthetic appeal, reduced wintertime salt use and ice hazard, functional appeal, and downstream detention reductions.

Along roadways with ditches, if applicable, simply using amended soils and a native seed mix in ditches can significantly reduce downstream peak runoff volumes and flows. Another creative option is the installation of open-bottom manholes in areas where high infiltration rates exist. Often the cost of these simple practices is offset by cost savings in smaller storm sewer piping.

Stormwater Management Technique Decision Making

As indicated above, various practices exist for the management of stormwater, and the reasoning for selecting each type varies by site conditions and the scale of contributing drainage area. In general, the more dense the development, the smaller and more unobtrusive the practice must be. However, higher-density development correlates with increased fraction of the land surface that is made up of impermeable surfaces, thereby increasing the total volume of stormwater runoff that must be treated, retained, etc. per unit area. Because the fraction of runoff is greater, and the practices must have smaller footprints, these areas tend to require more frequent, well-distributed practices, usually one or more per parcel. The types of practices in these developments tend to be more diverse also, because they need to blend into each specific site design. At the highest level of development density, stormwater practices tend to be vertically combined with other development features, such as green roofs, underground detention chambers, or sub-pavement tree trenches below parking lots.

Lower density development caters to practices with larger footprints that complement the existing landscape because these practices tend to cost less per unit volume of runoff treated, and they blend aesthetically with their surroundings. Lower density development also presents the opportunity to incorporate measures to reduce and sometimes eliminate the need for storm drainage infrastructure. Using native landscaping, adding at least four to eight inches of quality topsoil under lawns, and using small distributed practices such as rain gardens can sequester rainfall onsite, reduce the need for storm infrastructure, and also reduce municipal and landowners' maintenance burden.

With proactive land use planning and Low Impact Development (LID) techniques, stormwater runoff from low density development can often be directed to green spaces, or other marginal land where natural infiltration is provided essentially for free. With this design philosophy, care must always be taken to ensure that runoff from heavy rain events is not concentrated in a manner that damages these natural areas. Some type of hard infrastructure is often provided for conveyance of larger events only, allowing small event runoff to bypass and infiltrate naturally.

The single most important variable in choosing a stormwater management technique is the type of soil on the site in question, and to a lesser extent, the uphill watershed to that site. This is because the soil's ability to infiltrate rainfall directly dictates how much runoff there will be and how quickly ponded water will percolate into the soil. The water that doesn't infiltrate is the water that must be managed with piping, detention, etc. Releasing runoff too quickly results in increased downstream costs: flooding, urban stream degradation, reduced water quality, and infrastructure damage. The soil's infiltration potential is a combination of geophysical traits that control the volume and rate of infiltration, and this metric is the key to preliminary stormwater management practice selection.

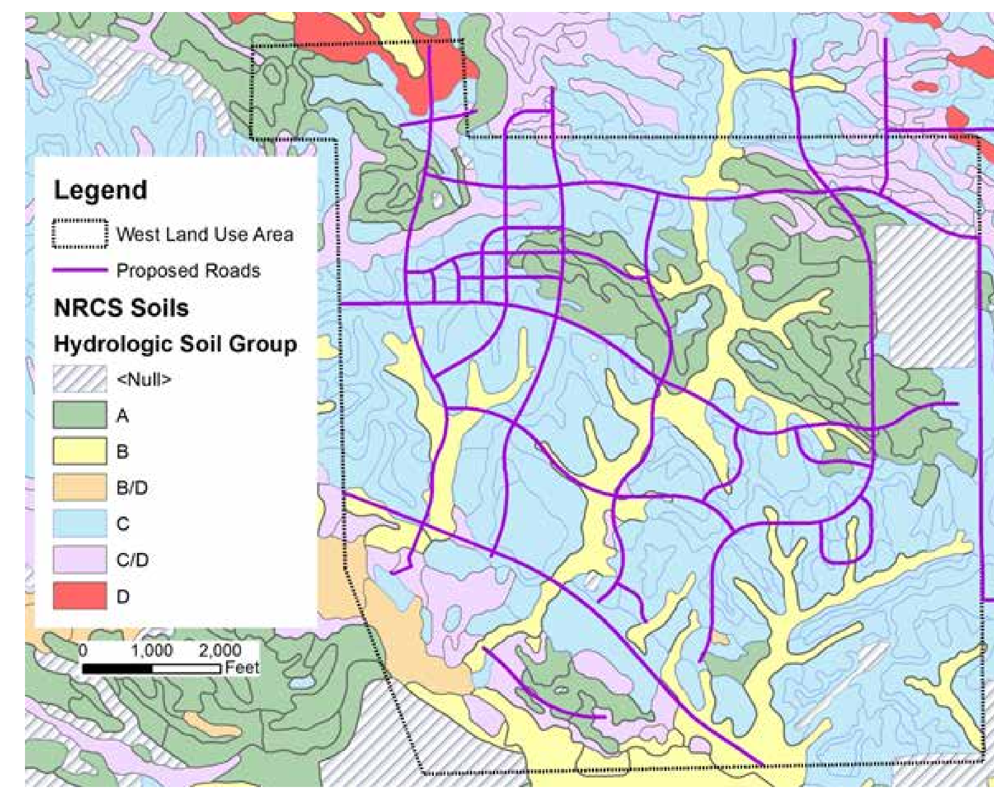


Figure 101: Soils map of the project area indicating general suitability of soils for infiltration-based stormwater BMPs (A = good infiltration potential, D = poor infiltration potential). See the area specific soils map in the Appendix for more information.

Summary Development Standards for West Land Use Area Stormwater Management

General Design Basis

Overall designs are based on SUDAS and Iowa DOT standards, and HEC-22 methods.

I. Additional design guidance and specific practice standards are available in the Iowa Stormwater Management Manual (ISWMM).

http://www.iowadnr.gov/Environment/WaterQuality/WatershedImprovement/Stormwater.aspx#Manual

II. SUDAS and the City's Post-Construction Stormwater Ordinance are the ultimate standards for permanent development guidance.

III. Erosion control ordinance and SUDAS Design Standards are the ultimate standard for construction site erosion control.

IV. Traditional roadway storm infrastructure should be based on the 10-year storm event with respect to gutter flow encroachment and hydraulic capacity of pipes.

V. Development areas that rely on regional or other offsite detention should provide conveyance capacity for the 100-year runoff event to the detention facility.

VI. Temporary detention facilities will be required from the beginning of development of a drainage area until any regional detention facilities are complete and functional.

VII. Ditches, drainage and conveyance areas, surrounding low-lying areas, unique environmental areas, etc. signed over to city as stormwater conveyance or detention facilities will be valued as non-buildable land.

Detention Basins

I. Residential detention

- A. Regional and consolidated
- B. Aesthetic, public amenities if wet ponds, not secluded and private
- C. Owned and maintained by homeowner or condo associations only if:
    1. A dry detention basin, with easements for inspection and maintenance
    2. The detention basin is not the only reason for the association to exist (Condo associations are good examples as management extends to multiple infrastructure aspects)
    3. The association will be required to perform regular maintenance to keep the facility in proper working order, a legally binding maintenance agreement will be required
    4. Legal framework exists for municipal enforcement of maintenance, and a single point of contact exists (legally responsible party)

II. Commercial detention

- A. Corporate campus and institutional areas
    1. On-site ponds (privately owned) allowed if:
        - a. One owner responsible for maintenance
        - b. Designed as an aesthetic amenity (front and center, landscaped, "celebrated")
        - c. Legal framework exists for municipal enforcement of maintenance, and a single point of contact exists (legally responsible party)
- B. Commercial Retail
    1. Private detention
        - a. Wet ponds not allowed with "out of sight, out of mind" placement
        - b. Use dry or underground basins instead, or
        - c. Likely better to use regional basins
- C. General design standards for detention basins
    1. Privately owned basins will require an agreement with the City for regular inspection and maintenance enforcement.
    2. Must include sediment permanent collection forebay
        - a. Hard surface maintenance access required
            - i. Hard surface entry ramp at 10:1 slope or flatter
            - ii. Access easement from public roadway (path between roadway and ramp does not need to be hard surfaced, but does need to remain free of obstruction)
        - b. All storm outlets routed to forebay, not distributed around pond
    3. Wet ponds
        - a. Accessible, fishable, public ponds, not fenced off
        - b. Green space around pond
            - i. Usable by public
            - ii. Designed for 100-year flood bounce volume and controlled release of storm runoff
        - c. Public sidewalk leading to greenspace, but no trail circumnavigating the pond is necessary
        - d. Design must address water quality concerns
            - i. Oxygenation and mixing
            - ii. Nutrient Control
                - Controlled vegetation for nutrient uptake
                - Education for contributing watershed users (signage?)
                    - Lawn fertilizer minimization
                    - Dog waste collection
                    - Discouragement of geese
            - iii. Individual pockets of native bank vegetation as well as areas of approachable, manicured edge are preferred
        - e. Design should discourage geese
            - i. Mowed turf grass to pond's edge strongly encourages geese and provides minimal runoff buffer, instead use medium-tall native vegetation (NOT cattails) around the pond's edge, see "f" below
            - ii. Encourage dog-walking in the area by providing pet waste bags and disposal cans
            - iii. Never feed geese, consider installing informative signage to that end
        - f. Design should discourage / prevent cattail invasion
            - i. Steeper side slopes (~3H : 1V) and rapid submerged drop-offs help as cattails prefer shallow edges, however this eliminates the use of a low-pitch "safety bench" (~10H : 1V) perimeter so this may not be appropriate in areas with frequent use by children or mobility impaired citizens. In these cases consider a pond with most of the perimeter steep, and a few easily accessible low-pitch areas for safety.
            - ii. A well-designed and maintained forebay prevents sedimentation and resulting shallowing of ponds, which often leads to cattail invasion
            - iii. Removal of sediment from the forebay often removes material that is initially colonized by cattails
            - iv. When cattails are first discovered, remove them physically, avoid chemical use
            - v. Native wetland plants can out-compete cattails once established, provide aesthetically pleasing habitat, and may help with discouraging geese, for example:
                - Blue flag iris (Iris virginica)
                - Pickerel weed (Pontederia cordata)
                - Burreed (Sparganium eurycarpum)

g. See typical wet pond and dry basin cross sections below

8. Dry basins

   a. Dual use (usable as recreation areas when dry)
   b. Design basin bottom for infiltration (amend soil with organic matter or compost if necessary to promote infiltration)
   c. Include a "cunette" (rock or concrete lined, depressed, low-flow channel) along one edge of basin bottom to keep turf usable while providing drainage
   d. Where soils are severely impermeable below amended layer ("C" or "D" soils), include subdrains daylighting to cunette to prevent waterlogged turf
   e. If the site consists of highly impermeable soils, consider implementing a partial wet pond with extended dry basin capacity
   f. Use 4-sided intakes (with bars) for outlet structures

5. Ditches

   a. Plant with native species (sedges and other wet meadow species) and design to provide water quality benefits as well as aesthetics
   b. Protect against erosion using rock riffles, level-spreaders, or other grade control devices

Detention Pond Classification

The Detention Pond Classification Plan identifies the type of cross section and construction detailing required for specific detention locations (Tiers 01 - 05b). See **Figures 103-108** Deviations from the prescribed classifications must be submitted as part of the site plan approval process and approved by the City. Any additional design, construction and maintenance costs of a detention pond classification change shall be the responsibility of the developer.

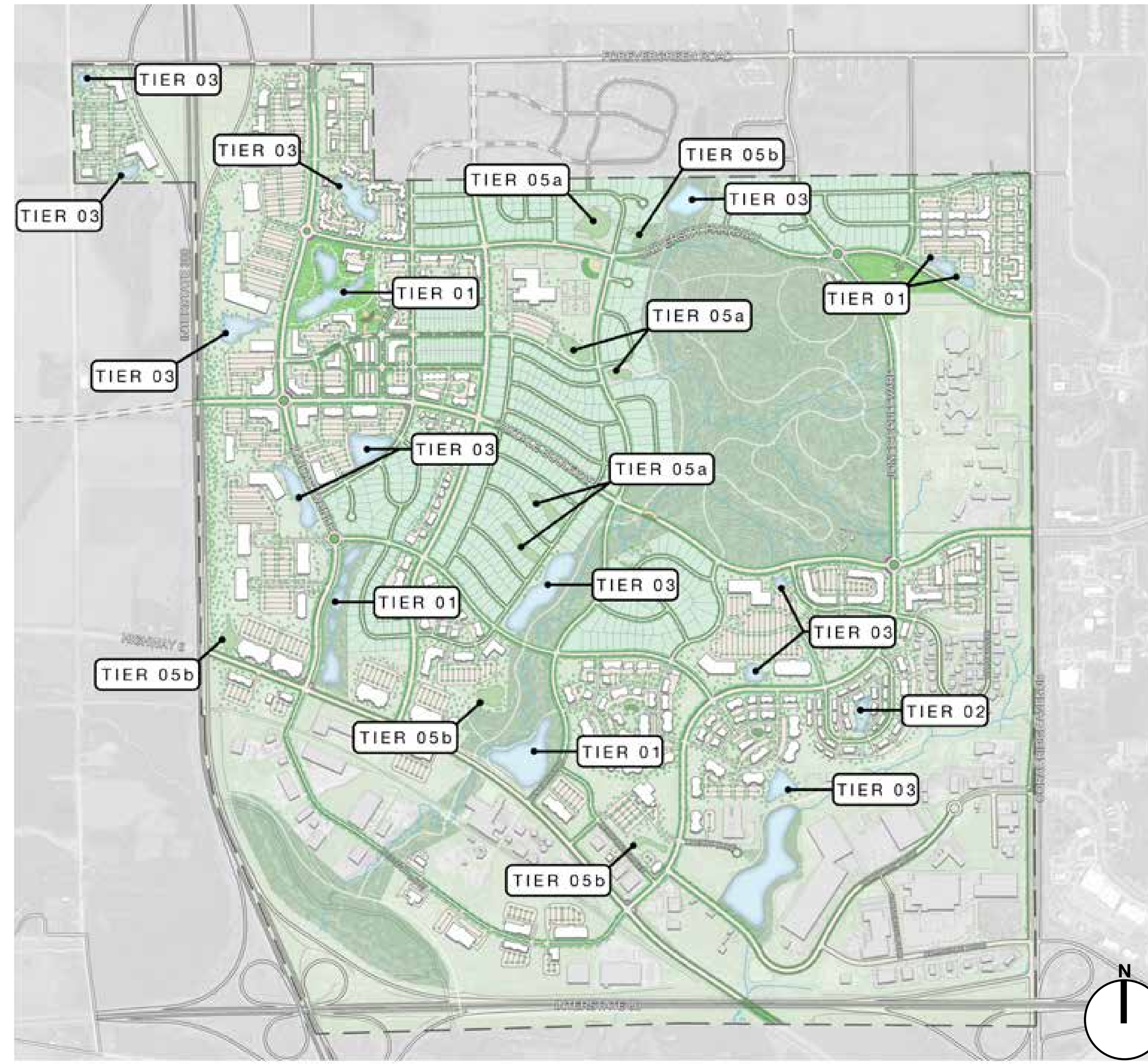
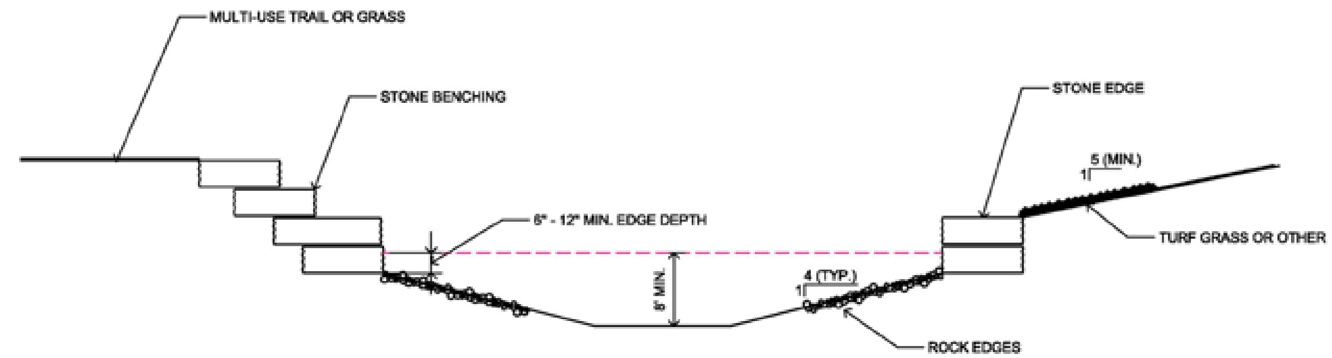


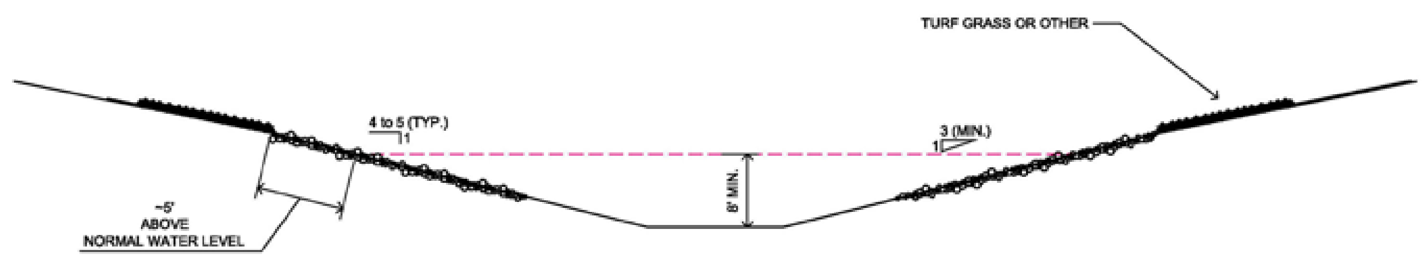
Figure 102: Detention Pond Classification Plan



TIER 01

FORMALIZED POND WITH HIGH VISIBILITY AND USE

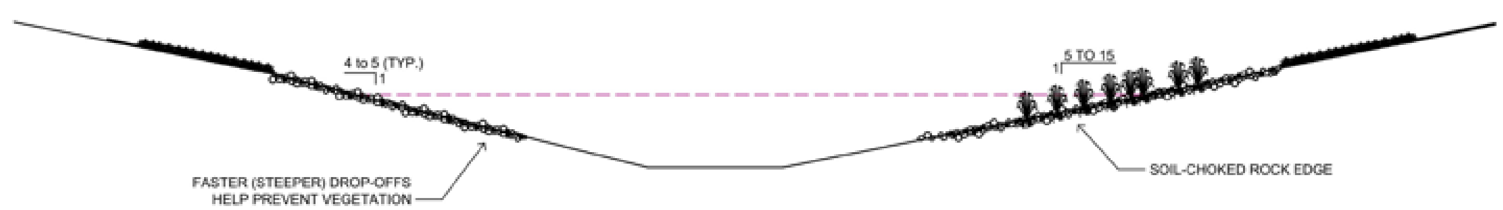
Figure 103: Detention Pond Section



TIER 02

ROCK EDGE WET DETENTION POND

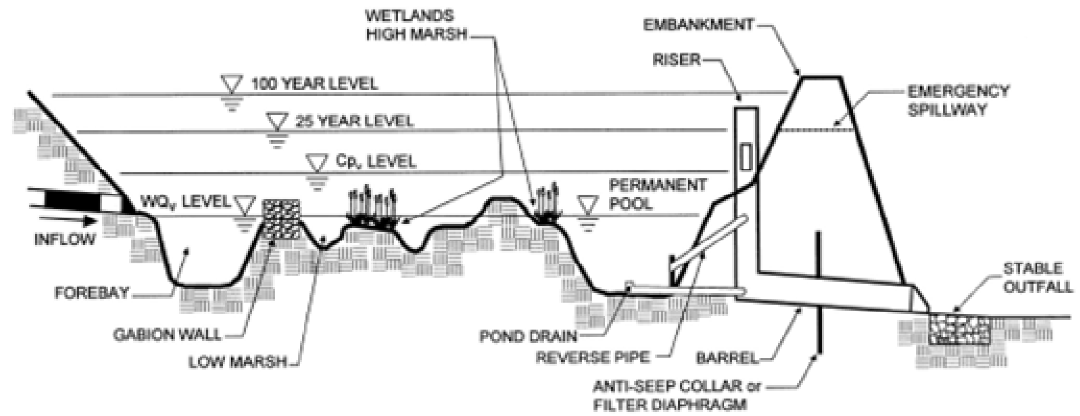
Figure 104: Detention Pond Section



TIER 03

COMBINATION ROCK AND VEGETATED EDGE

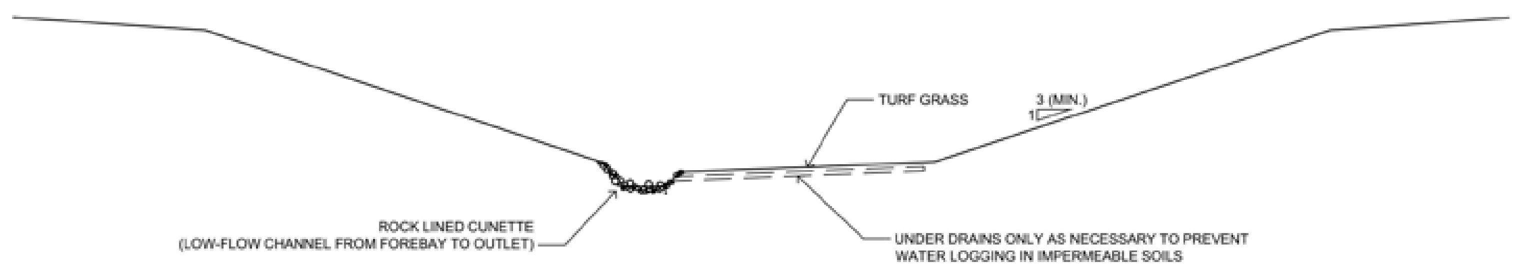
Figure 105: Detention Pond Section



TIER 04

SHALLOW WETLAND POND

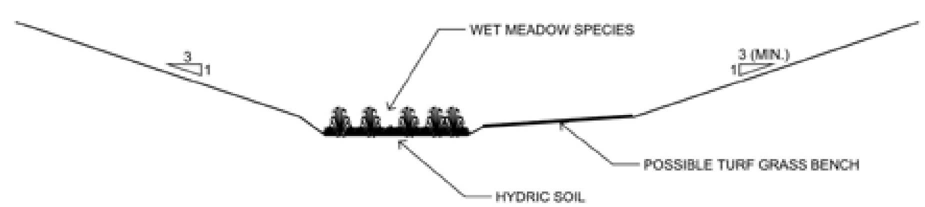
Figure 106: Detention Pond Section



TIER 05a

DRY BOTTOM BASIN WITH TURF GRASS

Figure 107: Detention Pond Section



TIER 05b

DRY BOTTOM BASIN COMBINATION

Figure 108: Detention Pond Section

Stormwater Management Technique Glossary

A variety of examples of stormwater management options are outlined in this section. These are options for managing runoff at the different levels discussed previously, and they are only a few of the many possibilities that can be implemented as space and budget allow. Actual implementation is typically a combination of the approaches, weighted according to the preferences of the managing entity.

Small Scale Stormwater Management Practices

The use of smaller, more numerous practices, such as bioretention cells, rain gardens, native landscaping, rain barrels, and other small scale stormwater treatment techniques should be incorporated into site development whenever possible. These types of practices offer the best downstream results because they are distributed across the watershed, each practice serving a relatively small drainage area. These stormwater management techniques are intended to infiltrate runoff close to the source, thus reducing both the rate and volume of storm water reaching the drainage ways and creeks and ultimately reducing downstream erosion and pollutant loading. The palpable effect is to promote healthy, attractive waterways and allow stormwater that does not infiltrate to function as an amenity instead of a dirty and destructive nuisance.

There are many types of standard stormwater BMPs available to choose from for meeting requirements on private property, the Iowa Stormwater Management Manual is an excellent resource for selection and design assistance. The City of Coralville has a set of preferred practices that have been implemented in and out of the public rights-of-way, including bio-retention cells, permeable paver systems, and tree trenches.

Small Scale Stormwater BMPs, for Infiltration and Water Quality Improvement

I. Tree Trenches and Infiltration Trenches – These are trenches filled with highly porous aggregate that receive directed runoff from small sites. Infiltration is promoted and water quality improvement is provided by filtration. One special type well suited to parking lots are called “Tree Trenches” wherein pavement runoff is intercepted by long grates over the trenches **(See Figure 109)**. The trenches then slope toward tree or landscaping clusters placed in parking medians or other spaces otherwise unusable for parking.

II. Bioretention Cells – These are shallow depressions planted with aesthetically appealing vegetation that can survive occasional flooding as well as drought conditions. The underground components consist of layers of amended soil and underlying drainable aggregate with a subdrain pipe **(See Figures 110 and 111)**. They are typically designed to fill to just below an overflow structure in a 1.25-inch rain event, then infiltrate and drain within 24 hours. Significant water quality improvement is provided by the combination of filtration, nutrient uptake by plants, and sequestration / immobilization of metals and some organic compounds.

One hybrid combination of bioretention cells and tree trenches, used extensively by the City of Coralville recently, are stormwater planters (aka “green intakes”). These are essentially bio-retention cells with hardscape perimeters which are placed between streets and sidewalks, and they remove roadway drainage uphill of traditional storm inlets.

III. Permeable Pavement / Paver Bricks – Permeable pavement systems are rapidly growing practices for improving rainwater infiltration and reducing runoff rate and volume **(See Figure 112)**. Few other practices are as immediately effective because the typical source of rainwater runoff is impermeable surfaces, such as pavement itself. Rainwater falling on the permeable pavement continues through to an open-graded rock layer below where it is then infiltrated or directed to a detention or conveyance means (perforated subdrains are often used to control saturation). While permeable pavements may require occasional maintenance – such as cleaning by vacuum truck – they can also require less conventional maintenance, less winter treatment (ice doesn’t accumulate as much), and less, if any, storm sewer infrastructure. The only application not currently recommended for permeables is high-speed, high-usage streets (speeds over 45 mph).

IV. Native Landscaping – This simple concept involves retaining or mimicking the existing undisturbed landscape (**See Figure 115**). An existing floodplain, grassland, or forested area may be left undisturbed – or replicated if not previously existing – or native plant species may be used in conventional development areas. Native species and long-established landscaping tend to infiltrate and retain runoff well and be better suited to the local climate that exotic, non-native cultivars, which means they tend to require much less maintenance. Water quality improvement varies with the application.

V. Grassed Swales – A swale is a long depression that slopes gently toward one end. It is used to direct the flow of runoff while slowing, filtering and infiltrating runoff with vegetation. Some pollutant removal occurs during low flow events, and the vegetation helps reduce erosion during larger events.

VI. Wet Swales – A wet swale is similar to a grassed swale with the exception of limited infiltration. Some stormwater detention may be provided, and additional water quality improvement is expected compared to a typically dry swale. Plant species are typical of wet meadow environments such as sedges and rushes.

VII. Vegetated Filter Strips – These are similar to swales except they are not always used to direct the flow of runoff, sometimes their primary purpose is to slow sheet flows from adjacent impervious surfaces. Filtration of sediment, infiltration of runoff, and uptake of nutrients may also occur. Filter strips are often used as pre-treatment uphill of sediment-sensitive practices such as bioretention cells or permeable pavements.

VIII. Green Roofs – These are low-pitch or flat roofs that are covered with a growth medium and hardy, drought-tolerant plants. Runoff from the roof is retarded by the system and atmospheric pollutants are reduced as the water passes through it. Some buildings with green roofs include rooftop public spaces for combined use benefits.

IX. Online Water Quality Devices – These are storm sewer system appurtenances that provide one or more types of treatment to water already in the storm sewer system. While volume and rate of runoff are not attenuated, concentrated pollutant removal is the goal. Typical applications include sequestering floating debris, settling out suspended solids and capturing oil and grease. These tend to be relatively expensive and are typically specified where known high pollutant loading is expected (industrial sites, parking ramps, etc.). Effective treatment is limited to low flow events; high flow events tend to bypass the treatment mechanisms.

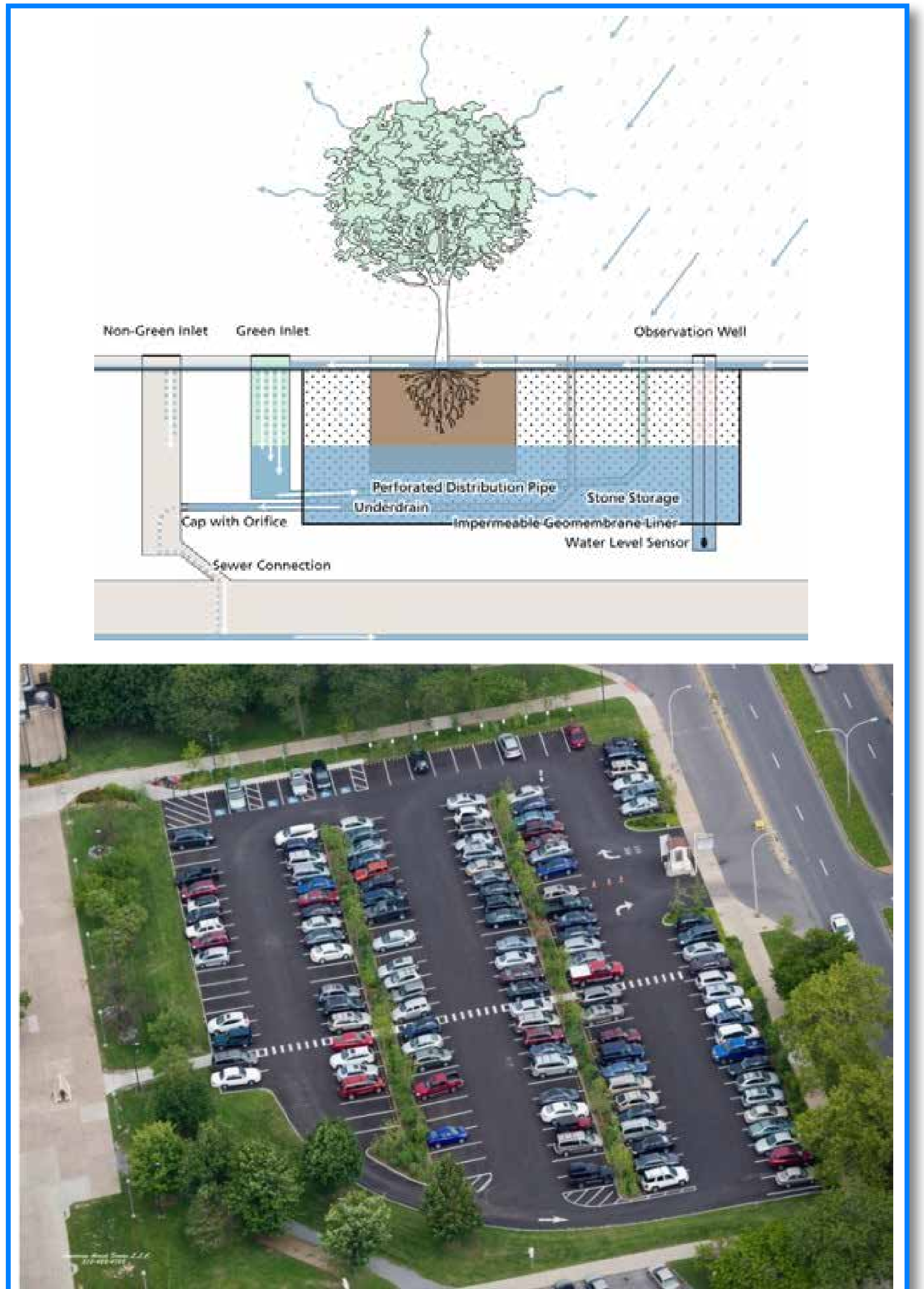


Figure 109: Aerial view and cross section of "tree infiltration trenches", which are often used to drain and cool parking lots while improving runoff water quality and enhancing aesthetics (images courtesy of phillywatersheds.org and savetherain.us)

Figure 110: Biocell at Wells Fargo West Des Moines Campus

Figure 111: Bioretention cell drainage detail

Figure 112: Stormwater planters intercept and filter road and sidewalk runoff during small storms, this example is at Iowa River Landing Place in Coralville. Also visible in the foreground is a permeable paver brick sidewalk.

Regional Detention/Retention

Regional detention means using large ponds **(Figures 113 and 114)** to collect and detain runoff from entire development areas (regions), instead of smaller, more frequent local or onsite detention ponds. Because they usually serve multiple small watersheds, regional basins are usually located in the middle third of the watershed, often within existing intermittent streams or flow lines, and are typically wet ponds even during dry weather. Note that detention is not permitted within existing natural wetlands without incurring mitigation. Detention within regulated floodplains can be approved at the discretion of the local authority requiring the detention; the federal authorities regulating the floodplains do not typically prohibit detention within them, so long as conveyance impediments are not created in the floodway. Regional detention is most feasible where commercial and higher density land use is specified and site by site detention is precluded by spatial requirements. Dry regional detention basins can also be designed as multi-use areas; for example, a soccer field or dog park could be located in a large basin that is flooded only occasionally and predictably. The size of regional basins, and maintenance needs, can be greatly reduced by implementing onsite stormwater BMPs high in the watershed.

Figure 113: Ewalt Pond is an example of a large "online" regional detention pond at approximately 10 acres (google.com/maps)

Local/Onsite Detention

Local detention means placing small distributed detention basins **(Figure 115)** on each parcel or development complex, usually immediately adjacent to the runoff source. One benefit of local detention is that the cost of construction is included in the development of each site and maintenance is typically handled by the owner. Emphasis should be placed on detention that also improves water quality – such as bio-filters, wet ponds or wetlands – or reduces runoff volume, such as infiltration oriented practices. In commercial and high density areas, permeable pavement and underground facilities such infiltration chambers may be a better fit than conventional detention practices that take up valuable land area. These types of multi-benefit BMPs are increasingly common and may qualify for funding assistance.

Figure 114: View of Ewalt Pond and the intake end of the primary outlet structure

Figure 115: Example of on-site detention, in this case a pair of small basins on a gas station site, planted with native vegetation.

Larger Scale Practices, Primarily for Detention

I. Dry Detention Basins – Dry ponds are similar to infiltration basins except they may be sized for temporary storage of runoff from larger storm events. Water quality is typically improved by settling of particulate matter only. Dry basins can be designed for infiltration (see Infiltration Basins below), and can be constructed as dual use areas that are open green space during dry periods.

II. Wet Detention Basins – Wet ponds are similar to dry ponds except infiltration is not promoted such that at least part of the basin maintains a permanent pool. The design typically provides for additional storage and slow release of stormwater runoff. Settling of particulate matter is expected, and water quality improvement by aquatic plants occurs.

III. Infiltration Basins – These are shallow basins, typically dry and covered in grasses, that receive runoff from impervious areas or small watersheds. Infiltration of rainwater is promoted by native soil porosity (only applicable for sites with suitable soil), and an overflow structure is usually provided for high flow events. Water quality is improved by filtration; infiltration is promoted so long as sediment clogging is avoided.

IV. Stormwater Wetlands – Basically a wet pond with additional plants and emphasis on biodiversity. More water quality improvement is expected than with a wet pond because the additional aquatic plants (and the microorganisms that they support) provide rapid uptake of nutrients, mineralization of some organic compounds, and sequestration of metals. Not to be confused with a natural wetland, these are designed and constructed for specific functionality; they also tend to harbor less total biodiversity than a natural pond. Note that existing, natural wetlands are not typically permitted to be converted for stormwater detention in excess of the natural capacity. **See Figure 116** for a visual example.

V. Underground Detention Chambers – These are constructed underground voids for temporary storage of runoff **(See Figure 117)**. They can be formed by pre-fabricated vaults, open bottom arch structures, large pipes, or simply by filling a pit with open-graded rock. They can be configured for water reuse such as irrigation, or for slow release to a typical storm sewer system pursuant to onsite detention regulations.

Figure 116: Example of a small constructed stormwater wetland (image courtesy of phillywatersheds.org)

Figure 117: Example of an underground detention system (image courtesy of hydrocad.net)

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