BMP 5.4.3: Protect/Utilize Natural Flow Pathways in Overall Stormwater Planning and Design

Identify, protect, and utilize the site's natural drainage features as part of the stormwater management system.

Key Design Elements

- Identify and map natural drainage features (swales, channels, ephemeral streams, depressions, etc.)
- Use natural drainage features to guide site design
- Minimize filling, clearing, or other disturbance of drainage features
- Utilize drainage features instead of engineered systems whenever possible
- Distribute non-erosive surface flow to natural drainage features
- Keep non-erosive channel flow within drainage pathways
- Plant native vegetative buffers around drainage features

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: No
Industrial: Yes
Retrofit: Yes
Highway/Road: Yes

Stormwater Functions

Volume Reduction: Low/Med.
Recharge: Low
Peak Rate Control: Med./High
Water Quality: Medium

Water Quality Functions

TSS: 30%
TP: 20%
NO3: 0%

Description

Most natural sites have identifiable drainage features such as swales, depressions, watercourses, ephemeral streams, etc. which serve to effectively manage any stormwater that is generated on the site. By identifying, protecting, and utilizing these features a development can minimize its stormwater impacts. Instead of ignoring or replacing natural drainage features with engineered systems that rapidly convey runoff downstream, designers can use these features to reduce or eliminate the need for structural drainage systems. Naturally vegetated drainage features tend to slow runoff and thereby reduce peak discharges, improve water quality through filtration, and allow some infiltration and evapotranspiration to occur. Protecting natural drainage features can provide for significant open space and wildlife habitat, improve site aesthetics and property values, and reduce the generation of stormwater runoff. If protected and used properly, natural drainage features generally require very little maintenance and can function effectively for many years.

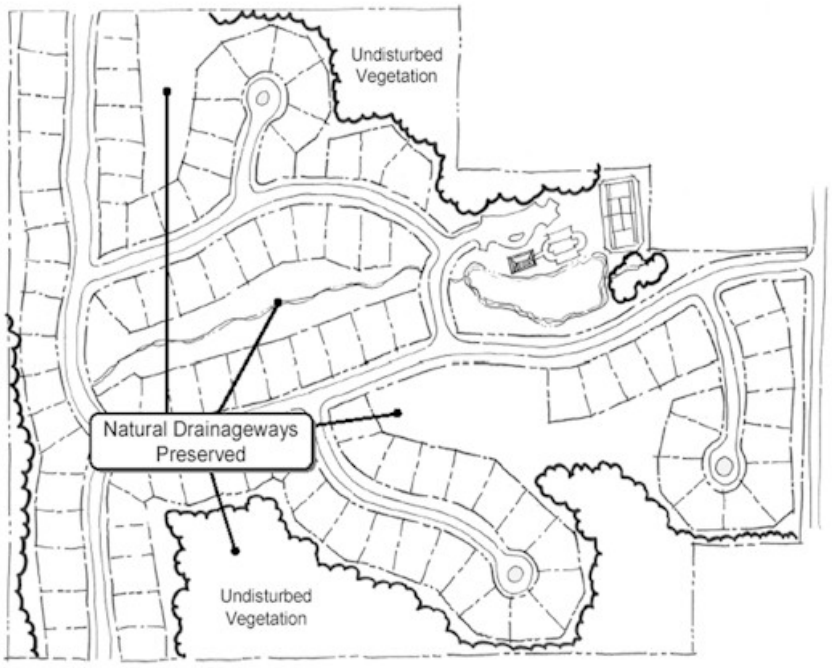

Figure 5.3-1 Protect natural drainage features

Variations

Natural drainage features can also be made more effective through the design process. Examples include constructing slight earthen berms around natural depressions or other features to create additional storage, installing check dams within drainage pathways to slow runoff, and planting additional native vegetation.

Applications

- **Use buffers to treat stormwater runoff.**

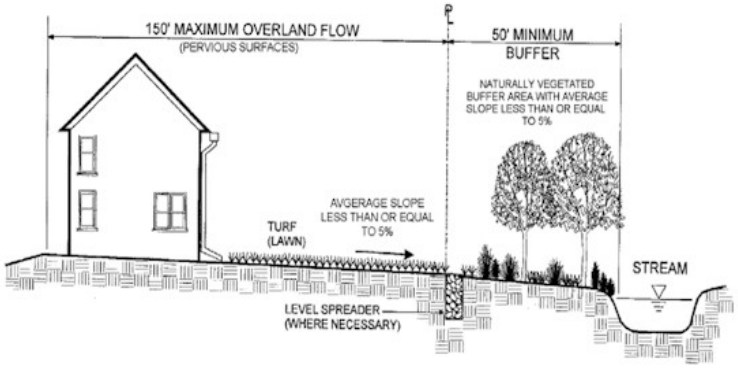

Figure 5.3-2 Section of buffer utilization

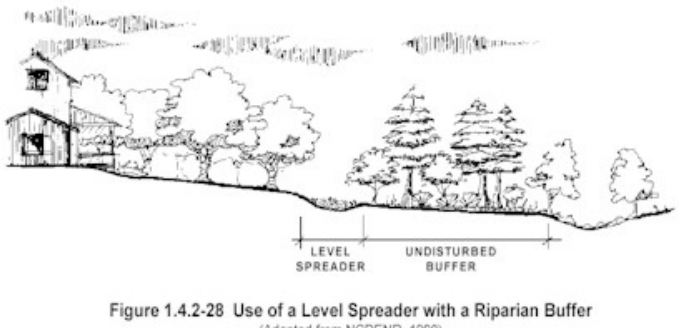

Figure 1.4.2-28 Use of a Level Spreader with a Riparian Buffer

Figure 5.3-3 Section of buffer utilization

- Use natural drainage pathways instead of structural drainage systems

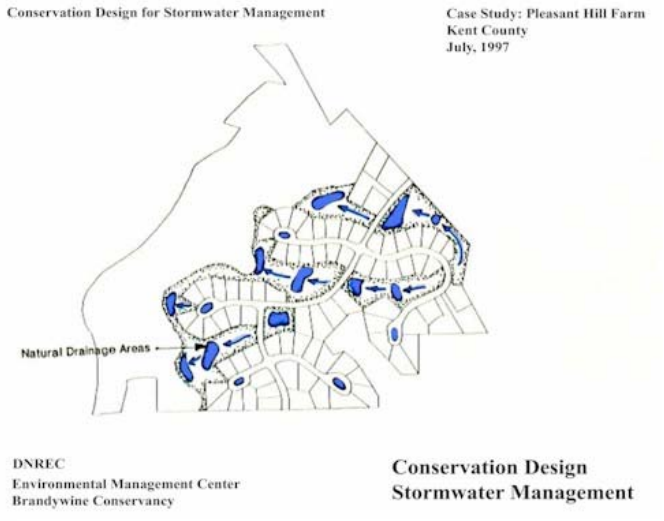

Figure 5.3-4 The natural surface can provide stormwater drainage pathways

- Use natural drainage features to guide site design

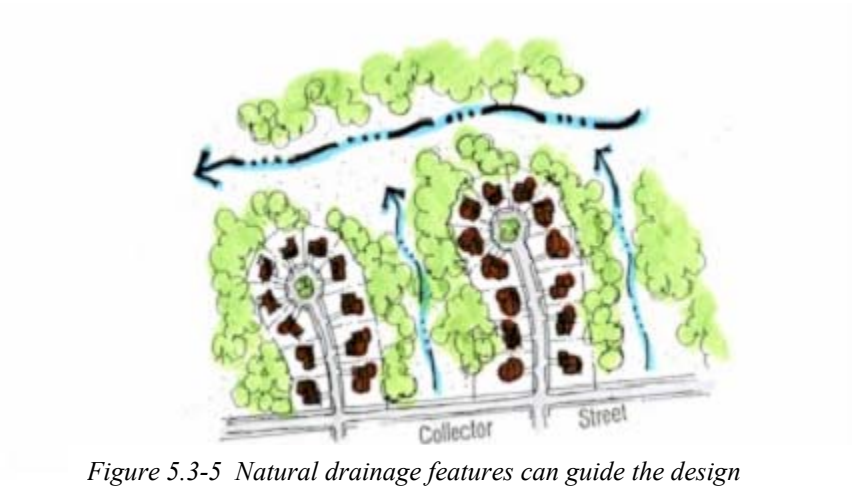

Figure 5.3-5 Natural drainage features can guide the design

- Others…

Figure 5.3-6 Natural surface depressions can temporarily store stormwater.

Design Considerations

1. IDENTIFICATION OF NATURAL DRAINAGE FEATURES. Identifying and mapping natural drainage features is generally done as part of a comprehensive site analysis. This process is an integral part of site design and is the first step for many of the non-structural BMPs described in this Chapter.

2. NATURAL DRAINAGE FEATURES GUIDE SITE DESIGN. Instead of imposing a two-dimensional 'paper' design on a particular site, designers can use natural drainage features to steer the site layout. Drainage features can be used to define contiguous open space/undisturbed areas as well as road alignment and building placement. The design should minimize disturbance to natural drainage features and crossings of them. Drainage features that are to be protected should be clearly shown on

all construction plans. Methods for protection, such as signage and fencing, should also be noted on applicable plans.

3. UTILIZE NATURAL DRAINAGE FEATURES. Natural drainage features should be used in place of engineered stormwater conveyance systems wherever possible. Site designs should use and/or improve natural drainage pathways to reduce or eliminate the need for stormwater pipe networks. This can reduce costs, maintenance burdens, disturbance/earthwork related to pipe installation, and the size of other stormwater management facilities. Natural drainage features should be protected from any increased runoff volumes and rates due to development. The design should prevent the erosion and degradation of natural drainage features through the use of upstream volume and rate control BMPs. Level spreaders, erosion control matting, re-vegetation, outlet stabilization and check dams can also be used to protect natural drainage features, where appropriate.

4. NATIVE VEGETATION. Natural drainage pathways should be provided with native vegetative buffers and the features themselves should include native vegetation where applicable. If drainage features have been previously disturbed, they can be restored with native vegetation and buffers.

Detailed Stormwater Functions

Volume Reduction Calculations
Protecting/utilizing natural drainage features can reduce the volume of runoff in several ways. Reducing disturbance and maintaining a natural cover can significantly reduce the volume of runoff through infiltration and evapotranspiration. This will be self-crediting in site stormwater calculations through lower runoff coefficients and/or higher infiltration rates. Utilizing natural drainage features can reduce runoff volumes because natural drainage pathways allow infiltration to occur, especially during smaller storm events. Encouraging infiltration in natural depressions also reduces stormwater volumes. Employing strategies that direct non-erosive sheet flow onto naturally vegetated areas can allow considerable infiltration. See Chapter 8 for volume reduction calculation methodologies.

Peak Rate Mitigation Calculations
Protecting/utilizing natural drainage features can reduce the anticipated peak rate of runoff in several ways. Reducing disturbance and maintaining a natural cover can significantly reduce the runoff rate. This will be self-crediting in site stormwater calculations through lower runoff coefficients, higher infiltration rates, and longer times of travel. Using natural drainage features can lower discharge rates significantly by slowing runoff and increasing on-site storage.

Water Quality Improvement
Protecting/utilizing natural drainage features can improve water quality through filtration, infiltration, sedimentation, and thermal mitigation. See Chapter 8 for Water Quality Improvement methodologies.

Construction Issues

1. At the start of construction, natural drainage features to be protected should be flagged/fenced with signage as shown on the construction drawings.
2. Non-disturbance and minimal disturbance zones should be strictly enforced.
3. Natural drainage features must be protected from excessive sediment and stormwater loads while their drainage areas remain in a disturbed state.

Maintenance Issues

Natural drainage features that are properly protected/utilized as part of site development should require very little maintenance. However, periodic inspections and maintenance actions (if necessary) are important. Inspections should assess erosion, bank stability, sediment/debris accumulation, and vegetative conditions including the presence of invasive species. Problems should be corrected in a timely manner. If native vegetation is being established it may require some support – watering, weeding, mulching, replanting, etc. – during the first few years. Undesirable species should be removed and desirable replacements planted if necessary.

Protected drainage features on private property should have an easement, deed restriction, or other legal measure to prevent future disturbance or neglect. DEP has worked with the Pennsylvania Land Trust Association (PALTA) to develop an easement template with guiding commentary for permanently protecting forest riparian buffers. The model is tailored to protect a relatively narrow ribbon of land along a waterway or lake. Presumably, the riparian buffers will most often comprise lands of severely limited development potential and the landowner will not be seeking a charitable federal income tax deduction.

In preparing the model, it was also assumed that landowners would be receiving no more than a nominal sum for placing the restrictive covenants on their land. To promote landowner donation, the model was drafted to be as brief as possible while providing core protections to forest riparian buffers. The model with guiding commentary is available at http://conserveland.org/model_documents/#riparian PALTA is now offering landowners who use this model a grant of up to $6000 to cover associated costs such as attorney's fees.

Cost Issues

Protecting/utilizing natural drainage features generally results in a significant construction cost savings. Protecting these features results in less disturbance, clearing, earthwork, etc. and requires less re-vegetation. Utilizing natural drainage features can reduce the need and size of costly, engineered stormwater conveyance systems. Together, protecting and utilizing drainage features can reduce or eliminate the need for stormwater management facilities (structural BMPs), lowering costs even more.

Design costs may increase slightly due to a more thoughtful, site-specific design.

Specifications

Not applicable

5.5 Cluster and Concentrate