

Appendix C

Municipal Planning and Site Restoration Considerations

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This appendix contains “best practice” standards for site planning and site restoration. These standards are intended to provide merely a guide to municipalities in addressing land uses that may adversely impact the local environment. When addressing site planning and restoration, municipalities should be mindful to look at all uses (not just gas development), and apply standards generally. Municipalities should also consult with knowledgeable legal counsel to ensure consistency with state law limitations and Pennsylvania constitutional obligations. Consultation with relevant experts, such as stormwater engineers or ecological restoration specialists, is also recommended.

Site Planning

- It is important to address existing conditions of a site as a determinant of site planning. Site planning needs to start with a site analysis task including analysis of soils, vegetation, hydrology, topography, habitat, protected species, views, noise, and adjacent conditions. Site plan design, including the design of construction access and temporary facilities, needs to be based upon the site analysis. Factors need to be reviewed and balanced to determine the construction locations with the least negative environmental and social impacts.
- A minimum of two substantial site design alternatives (with at least 50% variance from each other) should be required. The pros and cons of each alternative, including life cycle analysis, restoration costs, and ecological analysis, need to be included in the submission for each site. The chosen alternative then needs technical review by qualified staff and/or consultants and should receive public input, before deciding the preferred design option.

Construction Phase Landscape Installation

- During construction, there will be open disturbed areas that could be fully planted. This planting can include native trees and shrubs, as well as a native seed mix used for soil stabilization, without detriment to the industrial facilities and functions. This planting could help reduce the impact of the forest fragmentation, and reduce the impact of the “edge effect” that encourages invasive species, while the facilities are in operation. Some of this construction phase planting could include the final ecological restoration planting for locations that will not be disturbed in the future.
- At construction disturbances in forest, the “edge effect” and potential impact of invasive species needs to be partially mitigated by extensive tree and shrub planting along the open edges of the forest. This is especially important on the south/east/west-facing edges, to provide shade where sun impact is more intense. This planting needs to occur wherever spatially feasible, during the construction phase of the facilities. This will help “seal the edge” and help reduce the advance of invasive species into the forests.
- Significant visual screening is recommended at facilities that impact populated areas, as well as recreational and tourism areas. Planting should be included as a component of the design of the visual screening, where appropriate.

Protection of Existing Vegetation

- Facilities and operations, including but not limited to parking, access roads and temporary facilities, should be designed to fit the available landscape and minimize native tree removal (as well as limiting impact on mature non-invasive non-native trees). Roots of existing remaining trees should be protected using fencing or similar barriers, placed outside of the tree drip lines to protect from compaction because the compaction kills trees, typically in the few years following the construction activity. Tree protection plans should be required for review.
- Non-native invasive species that exist on the site should be identified by species and mapped by percent of cover of the site (mapping per species) to establish baseline conditions regarding the presence of invasives. A goal of percent removal of each invasive species should be set in the planning stages, carried out through monitoring and invasive removal practices during construction, and met as a requirement of site restoration post construction. An invasive species monitoring and removal plan should be required for at least 3 years following the construction phase due to the robust nature of latent seed banks and rhizomes.

Soils Management

- Native topsoil should be protected in place through best management practices when possible. Fencing off areas that are not necessary for clearing to prevent compaction and disturbance of soil and the soil mantle will provide optimum conditions for the re-establishment of native vegetation and ecosystem functions post-construction. Native soil and the associated soil mantle takes many years to develop, and is usually a determinant of the existing vegetation type.
- Existing topsoil should not be removed from sites and sold/dumped elsewhere, but it needs to remain on site wherever feasible for re-use on site, for use during initial construction-phase planting stabilization, and to enable proper vegetation re-establishment (including forest and grassland restoration) after facilities are decommissioned. This “no-export” requirement is to prevent a site from having deficient topsoil needed for the proper initial planting and eventual restoration of a site and to protect native ecosystems and functions as much as possible. This also helps avoid importation of improper topsoil, or topsoil containing non-native invasive plant species, since the need for importation is reduced. Restoration activities attempting to re-establish appropriate pre-construction vegetation communities would benefit greatly from re-using existing topsoil rather than imported topsoil.
- Top soil brought to the site for construction and reclamation activities should be obtained from a source known to be free of invasive species as determined by an invasive species expert, and tested to be free of invasive species. Any organic matter brought to the site needs to be certified to be free of viable seeds. Invasive species are sometimes present as dormant seed and not obviously present; testing using current scientific protocols for seed identification and/or sprout testing is needed to determine if a soil is free of invasive weed seeds.
 - Testing should be required during the pre-construction submittal process, as well as for batch testing of delivered top soil since it can easily vary from the original submittals.
 - An expert in invasive plant identification is needed to properly certify the topsoil source site is free of invasive species.

- Imported organic matter including compost and mulch should be regulated because it can be a source of weed seeds. Protocols for determining weed free organic matter should be based on industry standards.
- Depth and contours of re-placed topsoil of constructed sites and restored sites should match the existing depths, at a minimum, and re-establish natural grading as much as possible to enable appropriate planting and the sustainable establishment of a vegetative community. The type of topsoil used needs to match pre-construction soil type to enable proper restoration. Pre-construction soil testing and soil profile identification is required to inform this soil management. Re-grading should be designed in conjunction with re-establishment of the pre-existing drainage patterns as an integral part of the restoration. Professionals knowledgeable in grading, stormwater management and ecological restoration should be involved in determining, designing and overseeing this restoration. Wherever feasible, excess existing topsoil (excavated from paving and pads) should remain and be installed on-site, at increased depths.
- A typical problem of construction sites is that subsoil (soil under the topsoil) becomes extremely compacted from vehicular use, which is detrimental to natural infiltration, soil oxygen levels, and plant health. Likewise, subsoil under building pads and pavement is compacted and is detrimental to plant growth. Therefore compacted subsoil should be de-compacted prior to topsoil placement. Overly-compacted topsoil also needs de-compaction. The contractors should be required to obtain a certified inspection for determining completion of de-compaction, prior to continuing soil and landscape operations. Recommended maximum compaction of each soil layer at planting areas is 85% proctor density, ASTM D-698; testing of subsoil is to be completed and certified prior to topsoil placement.
- Any gravel or crushed stone installed for the buildings, pads or pavements needs full removal, when the sites are restored.

Post Construction Phase Landscape Installation and Comprehensive Site Restoration

- Site restoration should be based on plant communities and reference ecosystems, as informed by pre-construction botanical surveys identifying the full range of species, accurate pre-construction topographic surveys, and plant community identification. To mitigate the negative impacts and re-establish ecosystem services, the restoration needs to include re-establishment of various landscape types including riparian areas, wetlands, grasslands and forests that were disturbed. Restoration requires careful planning of the landscape regeneration, including proper re-grading; it includes proper soils management for each landscape type.
- There will be many interstitial areas that should be fully planted, not just planted with grass seed, immediately after facility construction. For instance disturbed areas such as temporary construction stockpile areas, temporary siltation pond areas, temporary contractor mobilization areas, and temporary access roads could be fully restored immediately.
- Only locally native species should be used in restoration plantings; and invasive species should be removed. Monitoring for invasive plant species and the removal of emerging invasive species should be done on a six month schedule for at least three years following the close of construction.
- Mixed vegetation should be planted post construction to restore the vegetative system that was in place prior to construction, excluding non-native species. For grasslands, a native seed mix should be

used. For woodland edge and forest areas, the full array of vegetative species should be used: scrub/shrub, understory trees and large trees.

- Selection of the native species for planting should be based on the existing plant communities on the site prior to disturbance, adjacent areas and/or reference plant communities, as determined by a restoration specialist. Site-level plant surveying of existing plant species and identification of existing communities must be completed prior to initial construction.
- For the planted areas, the quantity and size of plants (for instance trees planted per acre, and average tree size) needs to be stipulated to ensure significant and effective landscape plantings. A substantially dense tree and shrub planting would help “heal” the landscape while the facilities are in operation, would suppress invasive species, and would help restore ecosystem services of the site including reducing stormwater runoff, improving air quality, and increasing carbon sequestration.
- Timing should require installation of landscape plantings for trees and shrubs prior to opening the permanent facility, or where not feasible due to season, in the first available season.
- There should be an escrow fee structure or similar financial security structure set up to ensure covering the decommissioning-phase ecological restoration costs. These costs include but are not limited to design, selective demolition, grading, soils management, planting, maintenance to ensure planting establishment, and invasive species management. Invasive plant species have direct economic implications to both landowners and society. Invasive species, for instance, have been estimated to cost the U.S. economy approximately \$120 billion dollars per year (Pimintel et al. 2004), much of that absorbed by the taxpayer.