January 9, 2012

Attn: dSGEIS Comments
New York State Department of Environmental Conservation
625 Broadway
Albany, NY 12233-6510

Re: Revised dSGEIS Comments, SPDES GP for Stormwater Discharges for High-Volume Hydraulic Fracturing, and Proposed Regulations for HVHF; primarily Sections 6.4 and 7.4

Delaware Riverkeeper Network (DRN) submits these comments as supplemental to other comments we have submitted regarding the revised dSGEIS. In this comment letter, we focus on impacts to Ecosystems and Wildlife, primarily addressed in Section 6.4 and Mitigation of Potential Significant Impacts on Ecosystems and Wildlife addressed in Section 7.4.

Attached are two reports: Professional Review and Comment by Kevin Heatley, Restoration Ecologist, 1.5.12 and Professional Review and Comment by John Nystedt, Landscape Architect, 12.20.11.

Based on these reports, DRN concludes that the dSGEIS is inadequate in its assessment and mitigation of potential impacts to wildlife and ecosystems as a result of high volume hydraulic fracturing and horizontal drilling for natural gas in New York. DRN advocates for the New York State Department of Environmental Conservation (DEC) to revisit Sections 6.4 and 7.4, starting with a re-assessment of the potential impacts, studying both qualitative and quantitative aspects of these impacts, and including individual as well as cumulative, short term as well as long term, analyses. DEC should then develop an approach that prevents the degradation to which the proposed dSGEIS will inevitably lead.

As drafted, the degradation of New York's terrestrial habitats, wildlife, and biodiversity is unavoidable (Sect. 7.4.1) and yet DEC recognizes that the law requires New York State to "conserve, improve, and protect its natural resources and environment" (Sect. 1.2). DRN considers DEC's acceptance of degradation to be unjustified and in violation of its responsibility. The reason the impacts are unavoidable is because the dSGEIS doesn't accurately assess the potential impacts and doesn't present an effective mitigation option to avoid degradation. An effective mitigation option would be aggressive region-wide restrictions on the spatial and temporal scale of disturbance that could prevent degradation or the choice of a "no action" option under the State Environmental Quality Review Act. DEC's minimal permit conditions and requirements (triggered by thresholds of 150 acre forest patch and 30 acre grassland patch)

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amount to halfway measures that are ineffective and will lead to expensive and long lasting environmental problems.

Further, the dSGEIS only offers three "musts" in proposed permit conditions (Appendix 10, Att. 3): Department-approved ecological assessment; monitoring for a minimum of two years; and adaptive management strategies. These are examined in more detail below.

The Value of the Forest-Water Connection

To provide context for this issue, Mr. Heatley explains that the water quality and quantity benefits of ecosystems depend on the health of those natural systems. 57% of the land cover in New York that is underlain by shale formations is forested. It is estimated that there are 1,387,514 acres of forest in the Delaware River Basin portion of New York, covering much of the 5% of New York that lies in the Delaware River Basin. (Kauffman, Socioeconomic Value of the Delaware River Basin in Delaware, New Jersey, New York, and Pennsylvania, 2011) The natural capital value of the 4,343,190 acres of forest throughout the Delaware River Basin is $8,591,000, with annual economic benefits of $5.13 billion, far greater than any other value. And New York's forests and natural ecosystems provide the public with $3.5 billion worth of natural goods and services. (Kauffman, 2011) Additionally, tens of thousands of jobs in New York's portion of the Delaware River Basin earning billions in wages rely on the waters of the Delaware River. (Kauffman, 2011)

The forest is key to both the quality and quantity of water that flows from a watershed. This is because the forest: filters contaminants; moderates stream temperatures; buffers stream flow volume; and recharges groundwater that, in turn, fills aquifers for water supply and provides healthy base flow to streams, wetlands, and other hydrologically connected features. These functions have positive water quality and quantity impacts and help to maintain natural flow regimes in receiving waterways.

Conversely, a reduction in forest cover: leads to changes in a stream's water chemistry (such as increased nitrogen, phosphorus, sodium, chlorides, and sulfates); causes higher and less stable temperatures; disrupts natural stream flows and the critical habitats these flows provide for biota such as macroinvertebrates, mollusks, and fish; leading to reduced flora and fauna health and biodiversity in and adjacent to streams and less recharge to groundwater supplies, resulting in more runoff to waterways.

The negative changes in stream water chemistry from reductions in forest cover increase the cost of water treatment for drinking water supplies. Every 10% increase in forest cover in a watershed decreases the cost of water treatment by 20%. The converse is also true: a 10% decrease in forest will increase water purification costs by approximately 20%. This translates to an increase of $1.00 to $1.50 per thousand gallons of drinking water, depending on the extent of deforestation. These costs are very real and will be borne by the public. DEC does not consider these costs in the dSGEIS economic analysis.

Forest fragmentation has its own set of impacts, including local species extinction and dramatic shifts in floral and faunal populations, as detailed in Mr. Heatley's report. Species that are dependent on "core" forest and other forest habitat features are impacted, such as the cerulean warbler and many amphibian populations; some are species of special concern in New York. As the forest edge increases, light increases in the forest, soil moisture is reduced, and soil chemistry and microbiota change. One impact of shifts in soil chemistry is interference with the regeneration of certain native trees, impacting the natural community and potentially the economic value of the

forest. Invasive organisms take hold and drive out native species. Invasive species cost the U.S. economy $120 billion per year; suppression of invasive plants costs between $1000 and $2500 per acre. Restoration of forests can cost between $4000 and $10,000 per acre. DEC does not consider these costs in the dSGEIS economic analysis.

Proposed permit conditions and "partial" mitigation regarding ecosystems and wildlife (Sect. 7.4 and Appendix 10, Att. 3)

Department-approved ecological assessment and BMP's

The dSGEIS's proposed "partial" mitigation through "Department-approved ecological assessment" and mitigation measures, including some best management practices (BMPs) to protect forest and grassland habitats and species (Sect. 7.4.1) does not provide a basic framework to successfully accomplish that goal. Why?

- The approach, explained by Mr. Heatley, should be based on ecological planning units for natural resource protection such as subwatersheds, not on the unitization of production areas designed around maximization of gas extraction. Studies show that pad density and gas well placement is a significant indicator of landscape level impacts to water quality. Impermeable surfaces, also a function of density of well development, directly impacts water quality as well. The dSGEIS should develop an ecosystem-based plan that sets limits on gas development based on individual and cumulative impacts on ecosystems.

- The 150 acres forest cover and 30 acres grassland threshold approach provides some protection to "core" areas but falls short as a mitigation approach because it ignores the basic aspect of ecosystem health – landscape connectivity. Without the connection of "patches" for species migration, dispersal, and continued genetic fitness of flora and fauna, forest and grassland ecosystem health will inevitably decline, no matter what mitigation and BMPs are used in "core" areas.

- The setting of the thresholds is primarily based on protection of certain birds, which certainly need this habitat protection. But other species need protection as well and the 150 acre/30 acre blocks may not provide adequate protection for these species, such as amphibians and snakes, depending on their specific needs. The dSGEIS should be supplemented with an assessment of the habitat needs of all potentially affected species and the thresholds should be set using this broad information. Also, there is no justification given in the dSGEIS as to how these thresholds are protective of ecosystem health; this assessment should be done and the information used to set thresholds.

- The proposed requirement by DEC that a site-specific ecological assessment be done when the threshold is triggered and that BMPs be implemented for disturbed areas within the "core" provides some additional oversight, but there is little specificity to the measures that would be required; this vagueness contributes to the weakness of the approach being used in the dSGEIS. The proposed permit conditions do not provide needed protection for these areas and, as discussed by Mr. Heatley, the result will be inevitable decline. Further, the areas not protected by the triggering of the proposed thresholds are left completely vulnerable to degradation, amounting to sacrifice zones. Again, an ecosystem-based plan that limits gas development should be the approach used. Robust data about the potentially impacted ecosystems and wildlife is essential to setting those limits through regulation based on the dSGEIS.

- Forest fragmentation impacts need to be evaluated and addressed through the impacts of increased edge habitat because of the potent long term harms on forest cover and soils (carbon sequestration, air filtration, watershed flows and volume, etc.), through the introduction of invasive species, and through noise, light, and other quality changes that effect species, including threatened, endangered and species of special concern.

- State forests and Watershed Management Areas should be protected but the same ecological impacts discussed in the dSGEIS will occur in the 93% of New York forests that are not publicly owned.

- The ecological assessment does not require a thorough site analysis in the planning stages. The requirement for "pre-development surveys of plants and animals" (Sect. 7.4.1.3) is not comprehensively described. Site analysis - before any disturbance - should include analysis of soils, vegetation, hydrology, topography (including natural contours and soil depths), and adjacent conditions from the perspective of how wildlife and ecosystems will be impacted. The information gathered can then be used in site design to determine locations for activity that will have the least adverse impacts and can be used when the site is permanently restored. An example of how this information can help protect terrestrial habitats would be locating construction access and temporary high impact facilities such as chemical storage to protect existing natural conditions. There is some good advice such as "design roads to lessen impacts" (Sect. 7.4.1.1) but no comprehensive planning guidance is provided.

  Also, while it is important to "design well pads to fit the available landscape and minimize tree removal" (Sect. 7.4.1.1), all project-related facilities (such as roads, parking areas, tanks, basins, etc.) should meet this requirement. And to protect existing trees, tree protection plans should be required and should include fencing and other barriers that are placed outside of the tree drip line to protect roots. This is also important to prevent compaction of soil. Travel over soil with heavy equipment or repeated travel with lighter equipment compacts the soil, reducing the pores in the soil, reducing soil oxygen levels, and reducing the soil's ability to absorb and infiltrate rainfall; the upper layers of soil can be compacted to nearly the density of concrete (Chris Smith, "Soil Health Restoration," April 1998) preventing absorption into the deeper layers of soil; subsoil can also become compacted by vehicular traffic. Trees and other flora are robbed of needed groundwater and soil moisture, negatively impacting plant health. Other ecosystem components, such as natural contours and faunal habitat, are also protected by preserving natural soil and vegetative conditions by fencing off treed areas to the drip lines.

  The inclusion of a vegetation survey in the ecological assessment will provide data needed to select species for planting of the site; native species selected for restoration should be based on existing plant communities and reference communities, as determined by a restoration specialist.

- During construction, sites should be required to be planted, not just seeded. Immediately after clearing and once construction components are located, planting open areas with a mix of native trees, shrubs and herbaceous material will suppress invasive species by helping to "seal the edge" of the disturbed area and will provide positive interim ecological benefits such as reducing "edge effect", providing shade, temperature modification and other protection to soils and native ground conditions and

buffering adjacent habitats. The mixed planting will also allow for the beginning of healing of disturbed areas, phasing in the permanent restoration process. The proposed requirement of "soft edges" through shrubbery is inadequate and will not provide needed protection (Sect. 7.4.1.1) Also, only native seeds or plant material should be allowed during construction; the use of native species is only addressed in the restoration and preservation period (Sect. 7.4.2.1)

- Chapter 7 fails to address the value of onsite native topsoil and soil mantle. It takes tens of thousands of years to create topsoil. The soil mantle, naturally deposited over geologic time, once disturbed is very difficult to renovate. The most economical and effective means of preventing degradation of terrestrial habitats is to protect the soil with vegetation; existing contours are also preserved, protecting natural conditions. For areas that must be disturbed, topsoil should not be allowed to be removed from the site. Topsoil can then be returned to its original location and there is less need of imported material, avoiding the import of invasive species and ensuring the soils match ecologically. For any soils that are imported, the proposed requirement that topsoil for reclamation be free of invasive species (Sect. 7.4.2.1) should be extended to soils brought in during all phases of disturbance and construction and the testing of all soil, compost, mulch, and other soil amendments for invasive species (including seeds) by a qualified expert should be required to prevent invasives from entering the site.

  If soils are compacted both the upper soil layers and the subsoil should be de-compacted and the soil mantle replicated as accurately as possible. The dSGEIS only requires decompaction of agricultural land (Sect. 3.2.5); soil decompaction should be required of disturbed soils to protect wildlife and ecosystems as well. Also, gravel, crushed stone, and drill cuttings, should all be removed from the site to allow restoration of natural conditions and healthy ecosystems.

The proposed mitigation through ecological assessment and BMPs is inadequate. In fact, according to Mr. Heatley's report, the dSGEIS assures widespread dramatic changes to the current integrity and future succession of watersheds and forests, which will lead to the diminution of ecosystem benefits and services and, in turn, to cascading ecological effects that are uncontrollable and extremely costly for the public and for private landowners.

Monitoring for a minimum of two years and adaptive management strategy

Monitoring is an important requirement but is not an adequate mitigation measure. It cannot substitute for the prevention of adverse impacts through ecologically based planning to protect resources by limiting activity in space and time. Monitoring will provide information to guide future actions but it will not effectively provide a means to stop harm. The dSGEIS relies on adaptive management (changing mitigation measures and BMPs based on emerging conditions revealed by monitoring) as the primary mitigation technique but this is a flawed approach. This is because the nature of the landscape impacts that accompany gas development is that it occurs on multiple levels in terms of type of impact, space and time. This means that previously crossed tolerance thresholds in an ecosystem or for a species may be unknown and cumulative or synergistic impacts may combine without warning. This can lead to sudden system collapse with no adequate advance indication of stress and therefore no opportunity to effectively adapt activities and mitigation measures. System collapse often occurs in just this manner for these reasons. The precautionary principle is the only way to effectively guard against system collapse; this requires limiting development, not just monitoring it. Adapting practices to address changes in the

environment is an important strategy but will not prevent significant degradation of New York's forests and their ecosystems. It is only one part of a BMP strategy that must primarily be based on limiting development if substantial and permanent damage from gas development is to be averted.

While monitoring for two years is better than no monitoring following well completion (Sect. 7.4.1.3), it is far too short to be meaningful in terms of ecosystem and wildlife protection. For example, seeds of many invasive species live for several years in the environment and simply need the right conditions to sprout. In regards to invasive species - one of the major threats to ecosystems and native wildlife health - a comprehensive set of BMPs and a long term suppression program is needed. Also, the monitoring requirement should apply to all sites, not only those that meet the 150 acre/30 acre threshold criteria. The disturbance of smaller sites will provide a critical foothold for invasives in the larger landscape.

The BMPs that are recommended are wholly inadequate and do not prevent the degradation of New York's terrestrial environments.
Under the dSGEIS, invasive species can be expected to substantially degrade New York's environment, harming wildlife and ecosystems. Suggested changes to the invasive species control planning and BMPs (Sect. 6.4 and 7.4):

- Expand to include invasive terrestrial invertebrates (i.e., earthworms) and pathogens.
- Set a percent cover reduction from pre-disturbance for each identified invasive plant species to suppress invasion.
- Long term monitoring and suppression should be required to address latent seed banks and long-lived rhizomes.
- New activity should require new monitoring and suppression regimes including infrastructure such as pipelines, compressor stations and producing well sites that have continual traffic and maintenance activity.
- Monitoring and suppression should extend well into the forest or grassland habitat since the "ecotone" and the forest edge (330 feet or 100 meters as per Sect. 6.4.1.2) is vulnerable to invasion.
- Inspection by a qualified ecologist should be done on a six-month basis to catch outbreaks and should continue until final site reforestation or grassland restoration is complete. In the instance of forest, this requires the closure of the forest canopy.

No meaningful guidance or requirements are included in the dSGEIS in terms of restoring the ecosystems and wildlife value of a site, which will result in inevitable substantial degradation. Suggested changes to site restoration requirements and BMPs:

- Ecological restoration should be the required goal of site restoration; seeding with grass is inadequate. Sections 7.4.2.1 and 7.4.2.2 should require substantial restoration of the native plant community in both quality and quantity. Structure and function of the site need to be restored, not simply vegetation. Reclamation is not restoration.
- Site restoration should be based on the pre-disturbance survey or referenced natural systems to insure the establishment of the full range of plants species and the complete plant community.
- Restoration should include soil renovation, as discussed above.
- Forest connectivity should be a major aspect of site restoration, utilizing regional planning to accomplish a goal of connectivity.

- Re-establishment of natural contours and topography (such as ridges and depressions) should be required.
- Predisturbance ecosystems should be restored such as riparian areas, vernal pools, wetlands, and other habitats; grasslands, forests, and other unique vegetative communities, including rare native species, should be restored.
- Restoration requirements should continue throughout the life of pipelines since they are the longest lasting components of actively maintained infrastructure. Mitigation banks should also be considered for pipelines similar to banking for wetlands since pipelines are permanently removed from the existing ecosystem.
- Chemicals should be used as the last choice of suppression management and only by a qualified professional.
- A professional ecologist should be required to oversee restoration activities. There are no requirements related to expertise in this area in the dSGEIS.
- A bond, escrow, or some other financial assurance should be required to insure site restoration that protects and restores wildlife and ecosystems at all project sites.

Summary and Recommendations

In summary, the dSGEIS does not provide adequate assessment of the likely impacts of the conversion of forested and rural ecosystems to industrial sites. Under what is proposed, New York's forests will rapidly degrade and the functions of these ecosystems, as well as the wildlife that depends on them, will suffer permanent decline. The dSGEIS offers inadequate mitigation and options to reduce or avoid significant impacts for our native terrestrial ecosystems. This mistake will cost New York and its residents, as well as all those communities downstream who rely on the water resources of the state's watersheds, such as the Delaware River Basin and the Susquehanna River Basin, millions in increased water treatment costs and lost natural resource values.

There is no excuse for this. Damage can be avoided if a preventive approach that recognizes the value of these resources is employed. The dSGEIS doesn't pay required attention to: the density related impacts of gas well development and infrastructure; forest fragmentation and natural ecosystem connectivity; invasive species; and site restoration. If DEC were to address these issues by limiting activity and employing comprehensive assessment and management practices designed to protect ecosystems then degradation could be prevented.

As stated earlier, effective mitigation would be aggressive region-wide restrictions on the spatial and temporal scale of disturbance that would prevent degradation. This requires that ecosystems and wildlife be recognized as valuable resources that are an integral and necessary part of New York's heritage; the loss of these natural systems should be considered unacceptable.

Also, the costs associated with ignoring these values must be calculated and considered in weighing options and designing regulatory structures. These costs – increased drinking water treatment, increased flood and storm flows, billions in lost natural values, jobs, and economic activity, and the increased cost of invasive species management and ecosystem restoration -- correctly identified, should be part of the socioeconomic analysis performed by DEC for the dSGEIS, yet they are not. The public and private landowners will have to pay for these costs far into the future. The dSGEIS assessment should be amended to include these costs.

Section 9 of the dSGEIS examines various actions that could be taken by DEC in regards to high-volume hydraulic fracturing to develop the Marcellus shale and other low permeability gas

reservoirs. Section 9.1 states that the no-action alternative would result in none of the potential "significant adverse impacts" occurring. It would also mean that none of the "substantial economic benefits" would occur. It further states that the negative impacts "can be fully mitigated" or "partially mitigated" or are "temporary" in nature.

The dSGEIS accepts the degradation of ecosystems and wildlife as "unavoidable" and yet does not offer adequate mitigation, despite the fact that this can be done if priorities were re-arranged to value these resources. If DEC does not choose to adopt adequate measures, the adverse impacts to ecosystems and wildlife will be long lasting and, in some instances - such as species extirpation – permanent. This means that the negative impacts are not mitigated adequately; the measures are cut short to the benefit of industry goals to maximize development.

The dSGEIS does not consider the public costs or private landowner expenses associated with this proposed development of natural gas in its socioeconomic analysis. The increased cost of drinking water treatment will require more dollars to be spent by the public on this essential commodity. People must drink water, there's no alternative. The loss of natural values, annual economic benefits, jobs and wages and the additional costs that ecosystem damages will accrue are all costs that must be calculated fairly in order to assess the "no action" alternative.

Until that is done, DEC should not proceed with the dSGEIS. The underlying assumption that the harms are adequately mitigated and the benefits outweigh them is unfounded. This means that DEC's decision not to recommend the "no action" alternative (Sect. 9.1) cannot be relied upon. The dSGEIS must revisit this conclusion with reliable information (regarding the assessment of potential harms and mitigation as well as the potential economic impacts) in the context that meets the State's requirement that they "conserve, improve, and protect its natural resources and environment".

DRN champions the rights of our communities to a Delaware River and tributary streams that are free-flowing, clean and healthy. DRN is a nonprofit membership organization dedicated to the protection and restoration of the Delaware River Watershed representing communities - human and nonhuman - throughout its ~13,000 square miles with many members in New York State. Based on these comments and the attached expert reports, DRN respectfully requests that DEC reject the ecosystem and wildlife analysis and proposed mitigation in the dSGEIS and not proceed under the document's flawed assumptions. Alternatively, DRN requests that the "no action" alternative be recommended by DEC.

Thank you for the opportunity to submit this comment.

Sincerely,

Maya K. van Rossum
the Delaware Riverkeeper

Tracy Carluccio
Deputy Director

Enclosures: Professional Review and Comment by Kevin Heatley, Restoration Ecologist, 1.5.12
Professional Review and Comment by John Nystedt, Landscape Architect, 12.20.11

Professional Review & Comment

on

Revised Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program (Revised September 7, 2011)

January 5, 2012

Prepared for:

Delaware Riverkeeper Network

Prepared By:

Kevin Heatley, M.EPC LEED AP

Restoration Ecologist

EXECUTIVE SUMMARY

This review of the New York State Department of Environmental Conservation (NYDEC) revised draft Supplemental Generic Environmental Impact Statement (RDSGEIS) on the Oil, Gas and Solution Mining Regulatory Program (issued September 7, 2011) was prepared in response to a request by the Delaware Riverkeeper Network to provide expert opinion on issues of terrestrial and restoration ecology. The ecological health and integrity of the forested landscapes located within watersheds has a direct bearing on both the water quality and the biotic composition of the streams and aquatic resources of the Delaware River and other major drainages of the Marcellus and Utica region. Mitigation of land disturbance impacts, such as those associated with unconventional fossil fuel extraction, is critical to ecological sustainability.

The NYDEC recognizes in section 1.2 of the RDSGEIS that it is required by NY state law to "conserve, improve and protect its natural resources and environment . . ." However, the agency openly, and correctly, acknowledges that this mandate cannot be achieved for terrestrial habitats and wildlife resources in the state under the proposed RDSGEIS mitigation recommendations. According to section 7.4.1, "Significant adverse impacts to habitats, wildlife, and biodiversity from site disturbance associated with high-volume hydraulic fracturing in the area underlain by the Marcellus Shale in New York will be unavoidable." The agency presents no mitigation option, such as aggressive region-wide restrictions on the spatial and/or temporal scale of this land disturbance sufficient to negate the undesirable ecological impacts of shale gas development.

The RDSGEIS identified four major areas of concern with respect to ecosystems and wildlife:

1. Fragmentation of habitat
2. Potential transfer of invasive species
3. Potential impacts on endangered and threatened species

4. Use of certain state-owned lands

While the RDSGEIS correctly emphasizes the importance of habitat fragmentation on terrestrial vertebrate species (in particular avian organisms) it fails to document the long term ecological consequences of fragmentation, deforestation, increasing forest edge and reduced surface permeability on desirable forest regeneration, surface water quality, soil chemistry, biodiversity, and sustainable ecosystem services.

Unfortunately, the mitigation measures proposed fail to fully address fragmentation and landscape connectivity issues for the majority of the affected ecosystems. In addition, the proposed invasive species best management practices lack the following key components:

- Quantifiable control metrics
- Latent seed bank management
- Forest edge management

The RDSGEIS also fails to provide any effective regulatory guidance and/or mandates regarding the final ecological restoration of ecosystem structure and function to well pads, pipelines, access road sites, and other related infrastructure upon cessation of natural gas extraction activities.

As written, the revised draft RDSGEIS presented by the NYDEC assures that widespread, dramatic changes in both the current integrity, and the future successional trajectory, of the watersheds and forests in the Marcellus and Utica regions will occur should the anticipated level of landscape industrialization occur. Changes in the successional trajectory (the type of tree species regenerating in the forest understory and that will ultimately comprise the forest canopy) will cause cascading ecological consequences. These changes are likely to result in an undesirable diminution of the ecosystem benefits and services currently provided by these biotic communities. Cascading ecological effects and consequences are probable and

will require costly management interventions of significant spatial and temporal scale in order to achieve system restoration.

DISCUSSION

A careful review and analysis of the draft NYDEC RDSGEIS reveals a number of areas of concern with respect to the maintenance of the ecological integrity of terrestrial ecosystems and the corresponding impacts upon aquatic resources. In particular the RDSGEIS does not adequately provide for the protection and sustainable regeneration of critical headwater forests within the Delaware River drainage. Forested ecosystems are the dominant land cover type (57%) within the areas of potential shale gas extraction in the State of New York. This canopy cover is of extreme importance to both the quality and quantity of water that flows within the Delaware River drainage.

Forests filter contaminants, moderate stream temperatures and buffer flow volumes associated with precipitation events. They are the structural foundation upon which the ecological integrity and health of the basin's biological resources are built. The link between percent forest cover and water quality is clearly established in the scientific literature. As an example, reductions in forest cover are directly correlated with negative changes in water chemistry, such as increases in nitrogen, phosphorus, sodium, chlorides, and sulfates, and with reductions in stream macroinvertebrate diversity (Jackson and Sweeny 2010).

A healthy, viable forest canopy creates tangible economic value that accrues directly to local and regional communities. This value comes both from forest-dependent industries and from the ecosystem services (air filtration, climate regulation, water purification, etc.) that the forest provides. For instance, a 2002 survey of 27 water suppliers found that for every 10% increase in forest cover within a municipal

watershed, the costs of water treatment and purification decreased by approximately 20% (Ernst, Caryn, Gullick and Nixon 2004). In New York State, forest-dependent industries are estimated to generate nine billion dollars of economic activity on an annual basis (North East State Foresters Association 2001).

Forest fragmentation as a result of anthropogenic landscape modification is well recognized within biogeographic theory and conservation biology as a leading cause of local species extinctions (extirpation). It can also cause dramatic shifts in the floral and faunal composition of woodland communities. Sub-lethal impacts to floral and faunal populations (population isolation, reduced genetic fitness and diversity) have also been associated with disruptions to forest connectivity (Clark, et.al. 2010).

Species dependent upon large, intact areas of interior, or "core" forest and those with limited dispersal abilities are at particular risk from forest fragmentation. A large body of scientific literature associated with neotropical migratory birds clearly links the survival of many of these species to the preservation and restoration of core forest habitat. The Cerulean warbler *(Dendroica cerulean*), a species of special concern in New York State, is a prime example. These populations are already in decline due to massive reductions in the amount of intact core forest. Even if the remaining interior forest habitat is preserved, the extensive fragmentation of the rest of the forested landscape will effectively preclude these areas from reconnection and restoration as interior forest habitat.

As pointed out by Semlitsch and Bodie (2003), the long-term persistence of many amphibian populations depends on the availability of vernal (seasonal) woodland pools and the surrounding, connective forest habitat. The ability of local populations to safely disperse is critical for the survival of these species. For instance, while many species of salamanders return to where they hatched to breed and lay eggs, it has been shown that they will use other vernal pools for breeding if their vernal pool of origin has been disturbed (if it is within their migration distance capacity). Linear disturbance corridors such as roadways

and pipeline right-of-ways can create impermeable barriers to movement and effectively isolate populations of these organisms from alternative breeding sites. Isolated populations are at greater risk for extirpation (local extinction). The Jefferson salamander (*Ambystoma jeffersonianum*), another species of special concern in New York, is an example of an amphibian that will be at risk should significant forest alterations occur.

The development of shale gas infrastructure in the New York and Pennsylvania region will have profound forest fragmentation impacts. Recent modeling work performed by the Pennsylvania Chapter of The Nature Conservancy indicates that approximately 2/3^{rds} of the Marcellus well pads to be built in Pennsylvania will be located in what is currently forested habitat (TNC 2010). Coupled with the associated connective infrastructure of access roads and pipeline right-of-ways (ROWs), disruption of vital ecological processes is assured.

Fragmentation creates an increase in the amount of forest edge (the interface between forest and non-forest). This transitional zone or "ecotone" is fundamentally different in structure and functionality from an interior forest system. Edge habitat is characterized by increased light levels on the forest floor, reduced soil moisture, and a high degree of biological invasion from non-native invasive organisms. Dramatic changes can occur in the soil chemistry and associated micro biota. The top layer of the soil profile, the rich organic duff, begins to dry out and the primary decomposition community begins to shift from fungal to bacterial. Changes in the soil micro biota will result in shifts in the macro biotic community structure. The regeneration of desirable tree species (the successional trajectory) will be affected, potentially impacting the level of valuable ecosystem benefits supplied by the forest. These changes 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).

Invasive organisms within terrestrial forest environments tend to be early successional species that respond favorably to site disturbance. Disruption of native plant cover and the exposure of the forest floor to sunlight provide an opportunity for these organisms to establish satellite populations. These populations eventually radiate out into the adjacent forest, displacing native species and retarding desirable tree regeneration (Bennet et al. 2011). Dispersal (vectoring) mechanisms and/or corridors are required in order for these non-native species to colonize new locations and the access roads, pipelines, and vehicular traffic associated with natural gas extraction are ideally configured to serve this function. Long beyond the point when wells are decommissioned, the landscape legacy of forest edge spreading outward from pipeline corridors, access roads, well pads, and related infrastructure will continue to disrupt ecosystem functioning as non-native organisms repeatedly colonize exposed areas and impede desirable tree regeneration.

Invasive species suppression and the eventual restoration of these disturbed sites to forested systems will require resources of a significant financial and temporal scale. While published information is scarce, it is in the professional experience of restoration practitioners in this region that the reasonable reconstruction of forest canopy and understory diversity can cost between $4,000 and $10,000 per acre. The suppression of invasive plant species is also a major, recurring expense with the initial years' treatment often costing between $1,000 and $2,500 per acre. Invasive treatment in subsequent years typically drops in cost by approximately 50% per year during the first three years of suppression. Treatment and monitoring will need to continue on an annual basis until forest canopy closure is re-established and the resulting changes in light penetration and soil conditions begin to favor native species.

As the effects of forest fragmentation may not immediately manifest themselves following the disturbance, monitoring is often suggested as a methodology to balance and modify the level of fragmenting activity in accordance with the conservation of forest-related ecosystem services.

Unfortunately, these effects may not be linear in nature and thus are not always amenable to an adaptive management approach. Biological systems may possess thresholds that provide little indication of impending adverse impacts until sudden system collapse.

It is from within this conceptual framework that a review of the NYDEC Revised Draft RDSGEIS was undertaken and the following concerns identified:

Infrastructure Density-related Ecological Impacts -

- While mandatory unitization of production areas is in effect in New York¸ this spacing regime is geared toward maximization of gas extraction and not natural resource protection. Preliminary research results already point towards pad density as a significant indicator of potential landscape level impacts to water quality (Academy of Natural Sciences 2011). The RDSGEIS makes no mention of utilizing ecological planning units (such as the sub watershed) or ecological carrying capacity models. This is necessary to assure the industrial development pattern is consistent with the maintenance of ecological integrity.

- Density of infrastructure is also directly correlated to percent impermeable surface within subwatersheds. Increased impermeable surface area will disrupt both surface and subsurface hydrologic regimes within currently forested systems resulting in shifts in species composition and functional benefits. For instance, it is widely accepted among watershed managers that negative changes in water quality and quantity become clearly evident when impermeable surface begins to exceed 10% of a given watershed area. The RDSGEIS-proposed mitigation strategies do not address allowable levels of impermeable surface within ecological planning units such as the subwatershed.

Forest Fragmentation

- While the requirement for ecological assessments and site-specific mitigation measures on well pads placed in grasslands of greater than 30 acres (in grassland focus areas) and for forest patches of greater than 150 acres (in forest focus areas), is helpful this approach is, in essence, ironically fragmented. It completely fails to address the importance of landscape connectivity between patches. As such, it will not protect the landscape-level ecological processes that maintain regional forest integrity. It will also fail to protect connective corridors vital to the movement of plant and animal populations in response to climate change. A preferable methodology would be to set maximum allowable levels of deforestation and fragmentation based upon ecological planning units such as the subwatershed.
- It is strongly recommended that a comprehensive, ecosystem-based plan guide the decision-making and permitting process in place of the piecemeal approach to land use planning and the protection of watershed resources set forth in the RDSGEIS. Setting maximum thresholds and spatial parameters for percent forest cover loss and forest connectivity would assure that density levels and cumulative impacts of natural gas extraction do not exceed the ability of the regional ecosystem to absorb these activities.
- The RDSGEIS correctly emphasizes the importance of minimum patch sizes and landscape connectivity in protecting terrestrial wildlife habitat and/or the human recreation associated with such wildlife. However, no discussion or analysis is present regarding the impact that fragmentation and increasing edge habitat will have upon long term forest successional trajectory and associated biodiversity.

- No analysis has been presented in the RDSGEIS regarding the potential diminution of critical ecosystem services associated with the disruption of forest cover and soils (carbon sequestration and storage, air filtration, watershed flow rates and volume, surface water quality and thermal condition).

- Section 6.4.1.2 estimates that a mere 7% of the forest cover underlain by the Marcellus Shale in NY occurs on State-owned land. However, section 7.4.4 proposes a ban on surface disturbance within state forests and state wildlife management areas only. It is important to understand that this prohibition is not based upon any substantive ecological differences between forests under different ownership.

- Section 7.4.4 gives several reasons for prohibiting surface disturbance on State-owned land including: "Increased light and noise levels would be likely to have significant impacts on local wildlife populations, including impacts on breeding, feeding and migration" and "The local wildlife populations could take years or even decades to recover." These concerns are equally applicable to privately-owned forests, yet full mitigation of these identified impacts to wildlife is not addressed for the remaining 93% of the forest cover in the state. In particular, noise reduction strategies are entirely omitted from section 7.4.1.1 (BMPs for Reducing Direct Impacts at Individual Well Sites).

- Section 7.4.1.1 requires full cutoff (downward) lighting only during bird migration periods. As the ecological impacts of artificial night lighting across a range of species are well documented in the scientific literature, this requirement should be extended year-round.

- Section 7.4.1.1 fails to address BMPs for placement and maintenance of gathering pipelines. As this infrastructure is fundamental to well pad development, and has the potential to disrupt a greater net acreage than the actual pad, BMP recommendations should be developed.

- Section 7.4.1.1 fails to address BMPs for placement and mitigation of compressor station impacts.

- Section 7.4.1.2 indicates that for forest patches of 150 acres or more (within Forest Focus Areas) where the DEC issues a disturbance permit after reviewing the required Ecological Assessment, "enhanced monitoring of forest interior birds during the construction phase of the project and for a minimum period of two years following the end of high-volume hydraulic fracturing activities (i.e., following date of well completion) would be required." While this is an important recommendation, such enhanced monitoring should be extended to less mobile species sensitive to the radical changes in forest floor light and moisture levels that forest fragmentation will cause. Forest-dwelling amphibian species are at a particular risk of extirpation (local extinction) following the loss of interior forest conditions given their limited ability to traverse across linear landscape barriers such as roadways and pipeline ROWs.

- As connectivity between forest patches is critical to allowing for species migration, dispersal, and the continued genetic fitness of terrestrial species, mitigation strategies protective of this landscape level feature should be required. The RDSGEIS does not presently address protection of landscape connectivity and mitigation of disruptions to connective corridors.

- Definition of a disturbed area – clarification should be made as to the minimum size that defines a disturbed area.

- Section 7.4.1.3, *Monitoring Changes in Habitat* recommends, on parcels meeting the threshold criteria in grassland and forest focus areas, that monitoring of disturbance effects should occur during the drilling process and for a minimum of two years following well completion. While monitoring is indeed a valuable tool, effective implementation of operational changes (adaptive management) following and in response to ecosystem disruption is not always possible. Ecosystem response to disturbance may not follow a linear pattern as previously unknown tolerance thresholds may be crossed. Sudden system collapse and the loss of valuable structural and functional features of an ecosystem may occur even in the absence of discernible advance indicators of stress. A more appropriate response would be to apply the precautionary principle and study the likely impacts prior to widespread, and potentially irreversible, landscape modification.

Invasive Species Introduction & Management

- It is recommended that section 6.4 be expanded to include an analysis of the threat potential to forest health from the inadvertent introduction and facilitation of the spread of invasive terrestrial invertebrates and pathogens. The current analysis only considers invasive plants and aquatic organisms.

- The construction of infrastructure necessary to develop the Marcellus and Utica shales will entail the movement of large fleets of vehicles and equipment from various sections of North America. It will also entail the movement of large numbers of transient laborers and technical personnel from across the United States. This activity carries an inherent risk of acting as a vectoring mechanism

for a number of threats to forest health. The RDSGEIS should review this potential mechanism of invasive threat and propose mitigation strategies.

- Section 6.4 should also be expanded to include an analysis of the impact that massive increases in forest edge habitat will have upon the incursion and establishment of invasive plant species. Edge habitat is inherently attractive to the type of plant species that display invasive characteristics. Invasive plants tend to be early successional species adapted to disturbed sites. The ecotone between forest and grassland is an area generated by recent disturbance and thus presents ideal conditions for these opportunistic, rapidly-reproducing species. Periodic re-infestation of edge habitat by invasive plant species is also highly probable given the high light levels and frequent deposition of wind-borne and bird-deposited seeds in such areas. The creation of edge habitat on the scale anticipated by natural gas infrastructure is likely to result in chronic, regional infestations of undesirable species that will require regular, and expensive, control interventions. The creation of forest edge is, in and of itself, an important precursor to biological invasion.

- Section 7.4.2.1 fails to include compressor stations and pipeline ROWs in the requirements for invasive species best management practices.

- Section 7.4.2.1 indicates that an invasive species survey "should be conducted by an environmental consultant familiar with the invasive species in New York." It is recommended that the word "should" be replaced by "must".

- It is recommended that the invasive species survey required under section 7.4.2.1 stipulate that percent aerial cover be classified <u>for each</u> identified invasive plant species on the site.

Identification of baseline infestation levels is critical to determining target levels of cover reduction and control.

- Section 7.4.2.1 fails to provide any measurable metric, such as percent cover reduction from pre-disturbance levels, for quantifying levels of invasive control. The recommendation strategy that, "Any new invasive species occurrences found at the project location should be removed and disposed of appropriately" should be qualified to include the latent seed bank in the soil.

- Section 7.4.2.1 fails to define the temporal timeframe of responsibility for invasive suppression. The seeds of many invasive plant species can lie dormant in the soil for years. This latent seed bank creates a reservoir for future outbreaks following soil disturbance. It is critical that a long term monitoring and treatment program be implemented for all sites and associated infrastructure. Monitoring and suppression treatments should continue until final site reforestation and effective closure of the tree canopy.

- Section 7.4.2.1 fails to provide a spatial framework for the area of invasive species control responsibility. Invasive species are highly mobile and akin to a wildfire in their dispersal from initial point of infestation. At a minimum, site developers should be required to manage invasive infestations within all forest edge environments surrounding new pads, pipeline ROWs, and newly constructed access roads. Failure to do so will result in migration of these species off-site and the transfer of the financial burden of control onto adjacent property owners.

- As prevention is more cost effective than control, requirements should be adopted mandating independent site inspections by a qualified ecologist on no less than a semiannual basis until final

reforestation and canopy closure occurs. Failing to provide for frequent site inspections assures compliance will be minimal.

Site Restoration

- The RDSGEIS fails to provide any meaningful guidance regarding the ultimate restoration of well pads, pipeline ROWs and access roads to full ecosystem functionality upon decommissioning. Effective restoration requires a comprehensive, site-level assessment of the existing plant community prior to disturbance and the use of local reference ecosystems as templates for restoration. Ecological restoration is based upon the concept of rebuilding degraded areas such that they are structurally and functionally similar to pre-disturbance conditions. Reclamation is NOT restoration. Grassy fields neither function in a biologically similar manner as a forest nor supply the ecosystem benefits of a forest system. The replacement of a decades-old, complex assemblage of woodland species with a simple mix of grasses is not “restoration”. It may retard erosion but it does not replace the original functionality and structure of the displaced ecosystem.

- Restoration objectives and planning should be integrated into best management practices and developed based upon a landscape-level analysis. Re-establishing forest connectivity should be a primary goal.

- As the service life of gas extraction infrastructure such as transmission pipelines may extend for decades, mitigation banks and sites where restoration of previously degraded systems might off-set the disturbance for the interim period should be utilized. This will help assure that no net loss of ecosystem benefits occurs within the region.

- Requirements for an independent, qualified restoration ecologist to oversee and inspect site restoration should be developed in order to assure effective compliance.

Summary

As currently proposed, the NYDEC RDSGEIS does not provide an adequate assessment of likely impacts associated with the rapid conversion of forested and rural ecosystems to industrial sites. It also fails to recommend potential mitigation strategies and options that would offset and reduce the "significant" impacts anticipated for native terrestrial ecosystems. Protection of these terrestrial ecosystems is critical to the continued health of the regions' aquatic resources. Inadequate attention has been given to the following vital considerations: density related impacts of infrastructure, forest fragmentation, invasive species, and site restoration. Should the RDSGEIS be adopted in its current form, widespread disruption to forest ecosystems within the upper Delaware River Basin and other watersheds underlain by the Marcellus and Utica formations will occur. Restoration of these systems following the eventual cessation of natural gas extraction will be a monumental cost incurred by both the taxpaying public and adjacent private property owners. It is strongly recommended that the NYDEC consider a more comprehensive approach to protecting the integrity of the forested landscapes in New York. Setting maximum thresholds and spatial parameters for percent forest cover loss, forest connectivity, and core forest integrity within ecological planning units, such as the subwatershed, would assure that density levels and cumulative impacts of natural gas extraction do not exceed the ability of the regional ecosystem to absorb these activities.

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Professional Review & Comment

on

Draft Supplemental Generic Environmental Impact Statement On The Oil, Gas and Solution Mining Regulatory Program (Revised September 7, 2011)

December 20, 2011

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EXECUTIVE SUMMARY

This review of the New York State Department of Environmental Conservation (NY DEC) Supplemental Generic Environmental Impact Statement (SGEIS) on the Oil, Gas and Solution Mining Regulatory Program (issued September 7, 2011) was prepared to provide a professional review and comment of the regulations regarding the construction-phase site planning and landscape construction, and the ecological restoration for the facilities.

The DEC SGEIS fails to provide significant and substantive guidance regarding the construction-phase plantings and ultimate landscape restoration of the facilities. It also fails to provide significant and substantive guidance for proper site planning.

Site Planning

Little significant guidance is given for the best management practices and recommended procedures for site planning. There is some good advice, such as "Design roads to lessen impacts … and limit canopy gaps"; however no comprehensive guidance for effective site planning and design review is provided.

- Chapter 7 fails to adequately address existing conditions as a determinant of site planning. Site planning needs to start with a site analysis task including analysis of soils, vegetation, hydrology, topography, habitat, 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 to be presented to state reviewers qualified to review the technical site planning issues including civil engineering, landscape architecture, and ecological factors. The pro's and con's 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 should receive public input, before deciding the preferred design option.

Construction Phase Landscape Installation

In Chapter 7, no requirements are given to adequately re-plant the sites as part of the initial construction. Only seeding is required (though there are references to potential vegetative screening). There will be open disturbed areas that could be fully planted, for instance with native trees and shrubs in addition to the native seed requirement, without detriment to the gas extraction 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.

- 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.
- At construction disturbances in forest, the "edge effect" and potential impact of invasive species needs to be partially mitigated by extensive tree 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. Refer to Kevin Heatley's Professional Opinion and Comment letter being submitted concurrently with this letter, for further discussion on edge effect and invasive species.

- The Section 7.4.1.1 regulation requiring "soft edges around forest clearings by either maintaining existing shrub areas, planting shrubs or allowing shrub areas to grow" is wholly inadequate to provide a substantive landscape with visual and ecological value. This requirement has no practical construction-phase planting impact other than the requiring grass seed. Over time, if shrubs are allowed to grow, they could provide some habitat value but do not adequately mitigate the negative invasive species problem exacerbated by the "edge effect," because shrubs provide only minor shade for woodland edges, and do not substantially slow the spread of invasive species. By planting trees as well as shrubs along forest edges during the construction phase, impact by invasive species can be reduced via prevention.
- 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 substantive requirement for tree and shrub planting would help "heal" the landscape while the facilities are in operation; it would help restore ecosystem services of the sites including reducing stormwater runoff, improving air quality, and increasing carbon sequestration.
- Timing of planting needs to be addressed: the regulations should require installation of landscape plantings for trees and shrubs prior to opening the facilities, or where not feasible due to season, in the first available season.
- Selection of the native species for planting needs to be based on existing plant communities and 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.

- Section 7.4.2.1 Restoration and Preservation of Native Vegetation states that "Only native (non-invasive) seeds or plant material should be used for re-vegetation during site reclamation." Add the following for clarity: "…as well as during initial and interim landscape construction." This revision will prevent non-native plants from being installed during any phase of installation.

Protection of Existing Native Vegetation

Section 7.4.1.1 states "Design well pads to fit the available landscape and minimize tree removal." It is recommended to revise the text to read: "Design well pads, *and related facilities including but not limited to parking, access roads and temporary facilities*, to fit the available landscape and minimize *native* tree removal. *Protect roots of existing remaining trees using fencing or similar barriers, placed outside of the tree drip lines. Submit tree protection plans for review."* The revision is for the following reasons.

- The original text fails to address limiting the negative impact on trees from all construction activities.
- The roots of trees-to-remain need protection using tree protection fencing or similar techniques. Roots need protection from compaction because the compaction kills trees, typically in the few years following the construction activity.

Soils Management

Chapter 7 fails to address the valuable onsite resource of native topsoil. Existing topsoil takes many years to develop, and is usually a determinant of the existing vegetation type. Restoration activities attempting to re-establish appropriate pre-construction vegetation communities would benefit greatly from re-using existing topsoil rather than imported topsoil.

- 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. This also helps avoid importation of improper topsoil, or topsoil infested by non-native invasive weeds, since the need for importation is reduced.
- Depth of re-placed topsoil of constructed sites and restored sites needs to match the existing depths, at a minimum, to enable appropriate planting. This requirement therefore needs pre-construction soil profile identification and measurement. Wherever feasible, excess existing topsoil (excavated from paving and pads) should remain and be installed on-site, at increased depths.

Section 7.4.2.1 states "Any top soil brought to the site for reclamation activities should be obtained from a source tested to be free of invasive species." For a stronger and more comprehensive regulation this text needs to be revised to "Any 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.*" This revision is for the following reasons.

- 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 needs to 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.
- Topsoil requirement needs to apply to both construction phase and restoration phase, in order to prevent invasive plants during all phases.
- Imported organic matter including compost and mulch needs to be regulated because it can be a source of weed seeds. Protocols for determining weed free organic matter should be based on industry standards.

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 there needs to be a requirement to de-compact overly-compacted subsoil prior to topsoil placement. The current regulation only addresses de-compaction for agricultural farmlands, in Section 3.3.

- 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.
- Any gravel or crushed stone installed for the buildings, pads or pavements needs full removal, when the sites are restored.

Site Restoration

No adequate guidance for site restoration is provided in the regulations. Site restoration needs to 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.

- Section 7.4.1.1 states "Native tree, shrub and grass species should be used in appropriate habitats." This requirement needs to be strengthened to be a required substantial restoration. Note that Section 7.4.2.1, Restoration and Preservation of Native Vegetation, fails to mention the trees and shrubs requirement, which could cause confusion.
- The qualitative and quantitative requirements of the restoration are not stipulated but need to be stipulated in order to achieve a quality ecological restoration.

There should be an escrow fee structure, bond or similar financial structure set up to ensure covering the decommissioning-phase ecological restoration costs.

There is no mention of a requirement to properly re-grade sites in support of proper ecological restoration. Unnatural features such as flat building pads and highly-disturbed slopes usually need to be re-graded in order to facilitate re-establishment of original landscape types. Re-grading needs to 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 need to be involved in determining, designing and overseeing this restoration.

Summary

The regulations are inadequate in regards to:

- Site Planning
- Construction Phase Landscape Installation
- Protection of Existing Native Vegetation
- Soils Management
- Site Restoration

Stronger and more comprehensive regulations, including improved qualitative and quantitative requirements, are needed to provide adequate protection of the environment and adequate restoration.