

Redington Wind Farm Project

Access Road Maintenance

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1.0 Maintenance of Roadway System

1.1 Overview

DeLuca-Hoffman Associates, Inc. has prepared the following Access Road Maintenance report. Redington Mountain Windpower, LLC has retained DeLuca-Hoffman Associates, Inc. to prepare a number of reports for the Redington Wind Farm Project. The work of DeLuca-Hoffman Associates, Inc. is summarized in seven reports, which accompany the Maine Department of Environmental Protection (MeDEP) and LURC applications and are titled:

- Erosion and Sedimentation Control Plan for Roadway Construction;
- Basis of Design for the Roadways to Access Wind Turbines;
- Basis of Stormwater Management for Access Roadways;
- Access Road Maintenance;
- Blasting;
- Erosion and Sedimentation Control Plan for Transmission Line Corridor Construction; and
- Solid Waste

This narrative contains the Access Road Maintenance elements required for existing roads, the new access roadways to be constructed to the wind turbines on the Redington and Black Nubble mountaintop ridges, the new access roadway to the proposed substation and the access roadways to the transmission line at Inset areas 1 and 2.

The proposed roadway system is the sole means of access to the various components of the Wind Farm Project. Maintenance of this roadway system is of paramount importance to maintain access for safety, upkeep of the facility, water quality protection of down gradient water bodies, and avoidance of costs associated with long-term reconstruction of damaged sections of roadway.

The Stormwater Management Report for this project provides a narrative for maintenance of the roadway stormwater system. The stormwater report highlights the maintenance of ditches, ditch flow dispersion berms, stormwater inlets and culverts, tributary drainage system, and sorbent booms.

“Gravel roads are generally maintainable by routine blading and adding gravel as needed either by “spot gravelling” or regravelling entire sections. However, almost any gravel road will gradually begin to show distress that requires more than routine maintenance to correct. The common problems that develop are berms or secondary ditches that build up along the shoulder line and the shifting of material from the surface to the shoulder area and even onto the inslope of the grade. This comes from gravel being displaced by traffic, winter plowing operations, erosion of material in heavy rain, and sometimes from poor routine blading techniques. This often causes major problems with drainage. At certain intervals, virtually every gravel road requires some major rehabilitation”. (Reference: Gravel Roads, page 18)¹

The Redington Wind Farm project consists of proposed roads with grades up to 14 percent and existing roads, some with grades greater than 14 percent. The steep topography and hence steep roadways in this project make it critical to put a detailed maintenance plan of action into place in order to increase the safety of the roads, increase the longevity of the travel surface itself and keep the long-term maintenance expenses to a minimum.

This portion of the narrative addresses the maintenance of the roadway. The key elements identified for the maintenance of the roadway are maintenance of the road surface, road shoulders and cut and fill slopes. A roadway inspection checklist is also included as Attachment A.

¹ Gravel Roads Maintenance and Design Manual (USDOT, Federal Highway Administration) South Dakota Local Transportation Assistance Program (SD LTAP) November 2000

Key permits issued (or applied for) on the project include:

- ❑ MeDEP Site Location of Development and Natural Resources Protection Permits
- ❑ Land Use Regulation Zoning Approvals

The permit application for this project contains the basis of design information for the roadways and stormwater management system within separate sections of this application.

A copy of these permits and applicable sections of the application should be appended to this manual as Appendix C. The Permittee and Operator of the roadways should review these permits for a general description and background of the project, as well as any specific permit conditions or requirements of the project.

DeLuca-Hoffman Associates, Inc. has been the consultant who was engaged to prepare the basis of design for the roadway and may be contacted at:

DeLuca-Hoffman Associates, Inc.
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It is recommended the preparer of the plan be contacted with any particular questions on the design intent or similar issues.

References:

Gravel Roads Maintenance and Design Manual (U.S. Department of Transportation, Federal Highway Administration), South Dakota Local Transportation Assistance Program (SD LTAP), November 2000, and Camp Road Maintenance Manual – A Guide for Landowners Kennebec County Soil and Water Conservation District and Maine Department of Environmental Protection, Bureau of Land and Water Quality, December 2000 were utilized to compile this maintenance guide.

The following narrative has been prepared to describe the recommended maintenance for the roadways of this project.

1.2 Road Surface

1.2.1 Grading/Crowning

Regular grading will allow water to reach ditches and prevent significant erosion from the road surface. Grading is the process of smoothing and crowning a gravel road. This practice involves using a steel cutting blade to redistribute soil material. The grader is the piece of equipment most frequently used for gravel road maintenance. Bulldozers are not generally recommended for road grading due to difficulty in establishing a good crown. Regular grading is an effective means of redistributing ridges of road material that has either been washed onto the road edge or has been pushed to the edge by vehicle traffic. These little ridges defeat the purpose of crowning by catching water before it can drain off the road and channeling it along the outer edge of the road surface, which can severely damage the road surface during heavy storm events. The amount and type of use a road receives will determine how often grading should be done. Grading is typically done at least once a year on seasonal roads and more often on year-round roads because the combination of snow plowing, normal use and other associated activities flattens the road over the course of a year. Flat roads are prone to drainage problems; they need a crown. Flat roads for this project generally only exist in the area of the existing roads down away from the mountainous terrain. Proposed roads will be constructed with up to a 14 percent vertical grade and are therefore, not crowned, but graded to drain to the inside ditch at a grade of approximately ½" per foot. This will help to collect stormwater and discharge it to stabilized culvert outlets and dispersion berms. The best time to perform grading is when a road is moist, that is, in the spring or after a rainfall. Moisture in the roadway loosens gravel and makes it easier to reshape.

Proper grading and crown shaping at bridge approaches is important. At approximately 100 feet from the bridge begin to gradually take the crown out of the gravel road so that the bridge deck can be matched as closely as possible.

1.2.2 Potholes and Rutting

The formation of potholes and rutting is common in gravel roadways. When surface water is not drained off the road, it can lead to washouts, muddy conditions and potholes. A well constructed and maintained road with proper crowning or superelevation and grading, stable road ditches, diversions, turnouts and buffers can help drain water to reduce the possibility of pothole formation. It is critical to monitor the gravel roadway on a regular basis for the formation of potholes and rutting. The best time to inspect a gravel road is on a rainy day. The water on the road surface highlights the locations of these problems. Refilling of sections of a road that continue to wash out every year is a waste of money and does not effectively address the problem. Effective maintenance should prevent or minimize recurring problems. Gravel surfaced roads have the advantage that regions with potholes can be re-graded and filled much more economically than in asphalt surfaced roads. Proper grading is the most effective means of removing potholes. The grader should cut to the full depth of the potholes; otherwise they will tend to reform rather quickly.

Rutting or ‘corrugation’ on the road surface is caused by a combination of people’s driving habits and lack of moisture. In some cases, groundwater in the road base softens the pavement layers above and hence makes the road surface more susceptible to rutting. Rutting tends to occur at intersections, going up or down hills, and leading into or out of sharp curves. These are all places where drivers tend to accelerate hard or brake aggressively. Lack of moisture or prolonged dry periods can encourage the surface gravel to loosen and align itself into the rutting pattern.

All gravel roads will develop some rutting under traffic. The key to effective maintenance is to strive to keep the material blended. It is advantageous to rework these areas when moisture is present. The material should be cut to one inch or more below the depressions, mixed and re-laid to the proper shape. Compaction is also encouraged on these areas following the re-laying to reform the crust.

1.2.3 Erosion Control During Surface Maintenance

When grading/reshaping a gravel roadway it is important to take measures to reduce the erosion of soil. The following list highlights common practices implemented to provide erosion control during reshaping/grading activity.

- Avoid reshaping work during periods of frequent heavy rainfall.
- Keep disturbed areas small – establish work boundaries.
- Consider stabilization of disturbed areas – silt fences, mulching, and erosion control blankets. Additional details regarding erosion control measures are provided in the Erosion and Sedimentation Control Report included with this application.
- Keep water velocity slow. Keep slopes shallow and re-vegetate as soon as practicably after grading is complete.
- Keep sediment within work boundaries.
- Inspect recent work for formation of channels.

1.2.4 Soft and Weak Subgrade

Soft and weak subgrades are common in regions where the roadway is in close proximity to wetlands or in locations where subsurface water is present. These areas tend to rut and potholes form more rapidly, and therefore, generally need more than routine maintenance and reshaping if the problem is to be fixed permanently. This problem can be solved by either excavating and removing the weak, wet material and replacing it with a more suitable clean and drainable fill, or through the use of geotextiles/geosynthetics. The latter solution is described in

Section 3 of the “Basis of Design for the Roadways to Access Wind Turbines” included with this submission as the method of improving subgrades when the roadway is constructed. In the event that soft and weak subgrades are observed in existing roads to be utilized for access to the wind turbines, appropriate replacement of suitable fill or placement of geotextile material should be implemented to restore the existing road to be able to withstand heavy vehicle impacts.

1.2.5 Stabilizing Steep Road Segments Experiencing Erosion

The proposed access roads have steep grades. Runoff across the roadway has a propensity to erode the surface. Over time, the roadway unravels and becomes rutted. There are a series of options available to stabilize steep road segments experiencing erosion. One option is to regrade and level of the roadway surface after a significant rainfall. A further more expensive, but potentially longer lasting, option is to treating the surface to reduce the erosion potential of the roadway surface. In this case either Reclaimed Pavement/Recycled Asphalt (RAP) could be mixed through the surface gravel creating a stronger surface or a layer of an asphalt/chip seal or asphalt/gravel mix-in-place could be applied. If this option is adopted, the final design of the asphalt/aggregate mix should be performed by the geotechnical engineer.

1.2.6 Snow Removal

The roads from State Route 16 to the maintenance center, approximately 4.5 miles in from Route 16, including the parking lot, will be plowed through the winter to allow for normal automobile access.

1.2.7 Snow Grooming

During snow months, the roads from the maintenance building to the turbine sites will not be plowed but “groomed,” as ski areas do, to allow access to the turbine sites by snowcat, snowmobile, ATV or tracked vehicles. During snow months it

will not be suitable for heavy vehicles to travel on these sections of the roadway and hence, not have access to the turbines during this period.

1.2.8 Dust Control and Stabilization

All gravel roads will give off dust under traffic. Dust is not only a nuisance to drivers, but also hastens the deterioration of a gravel road and can make it prone to erosion. “Gravel pavements can lose as much as up to ½ inch of surface material (primarily fines) per year.”² The loss of soil fines is both expensive to periodically replace and also, being the binding agent between the gravel, loosens the pavement surface. Dust creation is a direct result of the road surface drying out. The more moisture present in the pavement, the less dust produced. The soil fines shrink due to lack of moisture which, in turn, weakens and loosens the surface. There are many methods for dust control including chlorides, resins, natural clays, asphalts, soybean oil and several other commercial binders. Virtually all the methods require annual treatment. The cost can be prohibitive if traffic volume is low. If traffic volume is high, the cost of dust control can more than pay for itself with the benefits of reduced material loss and reduced need for blade maintenance. Chlorides are the most commonly used dust control products. Calcium Chloride can be effective when used properly. Calcium Chloride is a hygroscopic product, that is, a product that draws moisture from the surrounding air to keep the road surface constantly damp. Calcium Chloride comes in two forms: solution and flakes. The flake form is commonly used on small gravel roads as it does not require special equipment to apply. On large sites, such as the roadway for this project, the liquid application is more cost-effective. Generally solutions with 30% calcium chloride are recommended.

² Camp Road Maintenance Manual, A Guide for Landowners, Kennebec County Soil and Water Conservation District and Maine Department of Environmental Protection, Bureau of Land and Water Quality, December 2000

Dust Control Application

- Abide by supplier's recommended application rate.
- Do not apply while it is raining to avoid rain leaching out and diluting the chloride, causing it to run off the road and temporarily harm adjacent grass.
- It is best to apply calcium chloride solution when soil is moist, preferably when it is at optimum moisture.
- Scarify the surface with a rake or grader before application to ensure a better bond.
- Regrade or rake the surface after application to mix the calcium chloride uniformly with surface material.
- Keep traffic off the road for at least two hours.
- It is wise to perform a test section of dust control/stabilization treatment on a small section of the road surface before moving onto larger sections of the roadway if this type of work has not been done before.
- Reapply calcium chloride as necessary. Successful applications can remain effective for 2-3 years.

1.3 Road Shoulders

Maintaining road shoulders is a critical part of gravel road maintenance. The road shoulder serves several important functions. The shoulder supports the edge of the traveled portion of the roadway and also provides a safety area for drivers to regain control of vehicles if forced to leave the road surface. A further important function of the road shoulder is to transport water further away from the road surface to the foreslope and ultimately into the ditch.

Maintaining the shape of the shoulder is crucial if the shoulder is to perform. The shoulder should meet the edge of the roadway at the same elevation, that is, the shoulder should be no higher and no lower than the edge of the roadway. Low shoulders are a safety hazard and promote an increased need for roadway edge support. High shoulders on the other hand prevent the drainage of water directly from

the road surface to the ditch. High shoulders, also known as ‘secondary ditches’, collect water which seeps into the subgrade, causing it to soften. On steep slopes the water flowing downhill in the secondary ditch erodes the edge of the pavement, in some cases down to the subgrade, which in turn promotes a safety hazard.

High Shoulders are commonly formed from the following:

- Improper Maintenance
 - Losing material from the toe of grader’s moldboard, which builds up a high shoulder.
 - Cutting too deep at the shoulder line with the moldboard. This generally occurs when the cutting edge is not kept straight.
- Traffic
 - Excessive “whip-off” of loose material from fast traffic which builds up on the shoulder line.
 - Heavy loads on gravel roads with weak subgrades. When heavy vehicles travel near the shoulder while meeting other traffic, the roadway can rut while the shoulder area shoves upward.
- Sand Build-up
 - The build-up of sand in the shoulder area is common in the northern regions where winter/ice/snow control requires some winter sanding.

In areas with minor high shoulders/secondary ditches it is important to regularly ensure that water can get off the road by smoothing the edge of the road with the grading blade. It is difficult to eliminate high shoulders/secondary ditches completely, but regular inspection and maintenance can keep them to an absolute minimum. In sections of road with steep grades it is extremely important to maintain the roadway shoulders. The following are maintenance procedures for high shoulders:

- **Mowing**

All of the procedures discussed below are easier to accomplish if a good job of mowing is done in advance. Excessive grass and vegetation makes it difficult to maintain a clean, uniform shoulder line.

- **Recovering and Spreading on Roadway**

If there is little or no vegetation on the shoulder, extend the grader's moldboard out into the shoulder material and begin to pull it onto the roadway. It may be possible to do this in one pass if the amount of material is light. The recovered material is often good gravel that needs to be returned to the roadway surface.

- **Breaking up Sod and Vegetation in Recovered Materials**

The material pulled out onto the roadway is often hard to spread due to the amount of vegetative material in it. It may take several passes to break it up. Alternatively a disk, drag or sophisticated pulverizing equipment can be used to break up the material.

- **Pulling Shoulders and Covering**

The material from the high shoulder is not always appropriate for re-use on the roadway. In this case it is recommended that the material be hauled to and stockpiled at the maintenance lot to be used as fill for future maintenance or for future development.

1.4 Fill Slopes and Back Slopes

1.4.1 Fill Slope Construction Options

The following fill slope construction options are proposed to be implemented for rehabilitation of existing roadways and for new roadways for this project:

- Sideslope 0 to 3H:1V
 - Loam and Seed with Mulch and Mesh, **or**
 - Wood waste with Mesh
- Sideslope 3H:1V to 2H:1V
 - Stone Face, **or**
 - Reinforced Turf
- Sideslope 2H:1V to 1½H:1V
 - Rip Rap, **or**
 - Alternate Fill with Reinforcement
- Sideslope 1½H:1V to 1H:6V
 - Gabions, **or**
 - Reinforced Embankment

Details of each of the above fill slope erosion and sedimentation control methods are located on sheet C-24 of the drawing set.

1.4.2 Back Slope Construction Options

The following back slope construction options are proposed to be implemented for rehabilitation of existing roadways and for new roadways for this project:

- Sideslope 0 to 3H:1V
 - Loam and Seed with Mulch and Mesh, **or**
 - Wood waste with Mesh
- Sideslope 3H:1V to 2H:1V
 - Stone Face, **or**
 - Reinforced Turf

- Sideslope 2H:1V to 1½H:1V
 - Rip Rap, **or**
 - Alternate Fill with Reinforcement
- Sideslope 1½H:1V to 1H:6V
 - Gabions, **or**
 - Soil Nail Wall, **or**
 - Rock Face

Details of each of the above back slope erosion and sedimentation control methods are located on sheet C-21 of the drawing set.

1.4.3 Fill Slope and Back Slope Maintenance Procedures

Fortunately the roadway proposed for construction for the Redington Wind Farm project includes measures to minimize erosion and degradation of both the fill and back slopes. It is still critical that the fill slopes and back slopes are inspected frequently, especially during the spring melt and after heavy rain, to catch any fill slope or back slope deterioration before the damage becomes too extensive. Regular inspection, identification and maintenance will ensure that the implemented side slope support materials are performing as they are intended to.

The list below provides routine maintenance procedures for each of the side slope construction options listed in section 1.4.1 and 1.4.2:

Side Slope Treatment Option	Recommended Maintenance Procedure
Loam and Seed with Mulch and Mesh	<ul style="list-style-type: none"> - Mowing. - Replacement of washout areas.
Wood waste with Mesh	<ul style="list-style-type: none"> - Replacement of lost wood waste.
Stone Face	<ul style="list-style-type: none"> - Washing to remove sediment. - Replacing displaced stones. - Filling gaps with new stone.
Reinforced Turf	<ul style="list-style-type: none"> - Mowing. - Replacement of damaged/removed reinforcement.
Rip Rap	<ul style="list-style-type: none"> - Removal of sediment. - Replacing displaced stones. - Filling gaps with new stone.
Alternate Fill with Reinforcement	<ul style="list-style-type: none"> - Mowing. - Reparation of damaged mesh.
Reinforced Embankment	<ul style="list-style-type: none"> - Removal of larger vegetation.
Gabions	<ul style="list-style-type: none"> - Repairing broken baskets. - Replacing squashed/empty baskets with new gabion baskets. - Replace backfill in eroded areas.
Soil Nail Wall	<ul style="list-style-type: none"> - Reapplying shotcrete. - Replacement/reparation of damaged urethane foam.
Rock Face	<ul style="list-style-type: none"> - Remove loose rock from rock face. - Stabilize deteriorated areas.

It may be necessary to upgrade the construction option if selected/constructed option is not performing as required.

APPENDIX A

1.5 Inspection Checklist

Roadway System Maintenance Program Summary Checklist						
Item	Commentary	Frequency				
		Month	Quarterly	Semi-Annual	Annual	Long Term
Restoring Road Cross-Section	Grading to smooth and recreate crown or cross slope on road. Best to grade when surface is moist – easier to reshape. Remove any crowning or ditches at bridge crossing approaches. Ensure erosion and sedimentation control measures are put in place during grading.			Inspect	X	
Removing Potholes	Inspect on a rainy day – so potholes are highlighted. Using grader, cut to full depth of potholes, fill and regrade. Ensure erosion and sedimentation control measures are put in place during repairs.		Inspect on a rainy day	X		
Removing Rutting	Inspect on a rainy day – so rutting is highlighted. Blend surface material. Devise a plan to prevent surface material from drying out. Ensure erosion and sedimentation control measures are put in place during repairs.		Inspect on a rainy day	X		
Restoring Soft/Weak Subgrades	Identify areas near wetlands and areas with subsurface water. Check semi-annually. If damage is prevalent either excavate and replace weak material with more suitable fill, or place geotextiles.			X		
Stabilizing Steep Road Segments	Inspect steep sections of road. If heavily eroded consider use of Reclaimed Pavement/Recycled Asphalt.			Inspect	X	
Removing Snow	Roads from Route 16 to Maintenance building to be plowed during winter.	Winter Months				
Grooming Snow	Roads from maintenance building to turbine locations to be groomed.	Winter Months				

APPENDIX A

Roadway System Maintenance Program Summary Checklist						
Item	Commentary	Frequency				
		Monthly	Quarterly	Semi-Annual	Annually	Long Term
Controlling Dust	If large amounts of dust are produced from traffic, assess the benefit of laying calcium chloride solution to roadway to increase and maintain moisture levels and control dust.	More frequent during construction				Apply Every 2 years
Remove High Shoulders	Mow shoulder as needed to prevent excessive grass and vegetation. Use grader to remove high or low shoulders. Recover high shoulder and spread on roadway. Either load and remove excess shoulder material or "sweep under the carpet".			Inspect	X	
Inspect Loam and Seed	Mow loam and seed areas and rehabilitate eroded areas.	Inspect	X			
Inspect Mulch and Mesh	Re-mulch areas where mulch has washed away.	Inspect	X			
Inspect Stone Face	Remove sediment and debris. Replace displaced stones, fill gaps with new stone.	Inspect	X			
Inspect Reinforced Turf	Regular mowing, replacement of damaged/displaced reinforcement.	Inspect	X			
Inspect Rip Rap	Remove sediment. Replace any displaced stones.	Inspect	X			
Inspect Gabions	Repair broken baskets; replace squashed/empty baskets with new gabion baskets; replace backfill in eroded areas.	Inspect	X			
Inspect Soil Nail Wall	Reapplying shotcrete, replace/repair urethane foam damage.	Inspect	X			
Inspect Rock Face	Remove loose rock from rock face, stabilize deteriorated areas	Inspect	X			
Inspect Reinforced Embankments		Inspect	X			
Inspect Alternate Fill with Reinforcement		Inspect	X			
Ditches & Culverts	Remove sediment.	Inspect	X			

APPENDIX B

Sample Inspection Logs

REDINGTON WIND FARM

REDINGTON, MAINE

ROADWAY SYSTEM

ROAD SURFACE

ANNUAL AND SEMI-ANNUAL INSPECTION & MAINTENANCE LOG

FACILITY: <i>Redington Wind Farm Access Roadway</i>		YEAR:	
LOCATION:		CONTRACTOR:	
FUNCTION: <i>Road Surface</i>		INSPECTOR:	
DATE OF INSPECTION:			
ITEM IDENTIFICATION	DESCRIPTION OF CONDITIONS	MAINTENANCE ACCOMPLISHED	DATE OF MAINTENANCE
LOSS OF CROWN			
HIGH or LOW SHOULDERS			
DUST CONTROL			
POTHoles			
RUTTING			
WEAK SUBGRADE			
GENERAL COMMENTS:			

**REDINGTON WIND FARM
REDINGTON, MAINE**

**ROADWAY SYSTEM
FILL SLOPE AND BACK SLOPE
MONTHLY INSPECTION & MAINTENANCE LOG**

FACILITY: <i>Redington Wind Farm Project</i>		<i>Access Roadway</i>	YEAR:
LOCATION:			CONTRACTOR:
FUNCTION: <i>Fill Slope Back Slope Inspection and Misc.</i>			
MONTH	DAY	INSPECTOR	COMMENTS:
JANUARY			
FEBRUARY			
MARCH			
APRIL			
MAY			
JUNE			
JULY			
AUGUST			
SEPTEMBER			
OCTOBER			
NOVEMBER			
DECEMBER			
LIST SPECIAL MAINTENANCE UNDERTAKEN:			

Permits for Project

To be added at a subsequent time