STATE OF VERMONT
PUBLIC SERVICE BOARD

Docket No. ___________

Petition of Deerfield Wind, LLC for a Certificate	)
of Public Good pursuant to 30 V.S.A. section 248,	)
authorizing it to construct up to a 45 MW wind electric	)
generation facility, and associated transmission and	)
interconnection facilities, in Searsburg and Readsboro,	)
Vermont, and operate the same.	)

PREFILED DIRECT TESTIMONY OF JASON KRZANOWSKI

ON BEHALF OF DEERFIELD WIND, LLC

January 8, 2007

Summary:

Mr. Krzanowski testifies concerning site design, stormwater, soil erosion control, and transportation issues as they relate to the Deerfield Wind Project. The testimony concludes that the Project will not cause undue water pollution or unreasonable soil erosion, and will not cause unreasonable congestion or unsafe conditions on public roads.

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PRELIMINARY INFORMATION

Q. Please state your name and occupation.

Response. My name is Jason A. Krzanowski. I am currently an employee of Hill, Architects, Planners, Inc. (Hill). I work on civil engineering design and permit application preparation and representation for various residential, commercial and industrial site design projects.

Q. Please describe your qualifications and experience.

Response. Please refer to my resume, attached as ***Exhibit DFLD-JK-1***. I was educated at the University of Massachusetts at Amherst, and received my BSCE in 1993 and my MSCE in 1995. Immediately following my graduation, I was employed by the Massachusetts Highway Department, where I was a construction inspector and resident engineer on various roadway projects. In 2001, I came to Hill and have continued my involvement with roadway projects, and expanded into other site design projects. These projects frequently include the design of stormwater management systems and wetland impact mitigation. I now have approximately ten years of experience in design, permitting, construction and inspection of civil engineering works.

Hill's civil/survey division manager is Darrin Harris, P.E. Mr. Harris, who will directly supervise the work, holds a professional engineering license in Vermont.[1] His resume is included as part of ***Exhibit DFLD-JK-1***.

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[1] License Number 8800, expiring July 31, 2008.

Hill has been involved with the site design of two other WTG projects in the area: The Hoosac Wind Project and the Berkshire Wind Project.

Hill was contracted by enXco, Inc. to work on the Hoosac Wind Project in the towns of Florida and Monroe, Massachusetts, a twenty wind turbine generator ("WTG") facility. I was directly involved in route analysis, coordination of wetland delineations, design of roadways, culverts and erosion and storm water controls, permit compilation and public representation. There are approximately four miles of access and ridgeline roads, with twelve stream crossings, and twenty turbines.

Hill was also contracted by Disgen, Inc. to work on the Berkshire Wind Project in the towns of Hancock and Lanesborough, Massachusetts, a ten WTG facility. I was also involved in the route analysis and design of two miles of access road, and presentations to the permitting authorities.

Collectively, I have been routinely and directly involved in WTG projects for the last four years. I have developed a working knowledge of the particular transportation design issues that confront these types of projects.

Hill has most recently been contracted to work on the Deerfield Wind Project. There are approximately four miles of access and ridgeline roads, with four new stream crossings and between 15 and 24 turbines (depending on the specific WTG that will eventually be selected for use).

Q. Have you previously testified before the Public Service Board or in other judicial or administrative proceedings?

Response. I have not testified before the Public Service Board or in other judicial or administrative proceedings within the State of Vermont. I have testified in judicial and administrative proceedings in the Commonwealth of Massachusetts; the Hoosac Wind Project has one wetland impact permit currently under appeal in the Division of Administrative Law Appeals (DALA). I have also testified as to traffic control design and implementation for the I-91 viaduct reconstruction project in Springfield, MA (a civil proceeding regarding personal injuries).

Q. What is the purpose of your testimony?

Response. I will testify about the following items, as they pertain to the preliminary work by Hill:

- Transportation parameters and the resulting access road design.
- Stormwater management plans for the roadways, turbine sites, yards and intersections with the public way.
- Soil erosion controls during project construction.

For the remainder of the testimony, references to Hill will reflect my direct involvement and knowledge of the matters discussed, unless otherwise noted.

My testimony concludes that the Project will not cause undue water pollution, unreasonable soil erosion, unreasonable traffic congestion or unsafe conditions on public roads.

INVESTIGATION AND DESIGN WORK

Q. Please summarize the investigations, analyses, planning, and engineering you conducted regarding the Deerfield Wind Project.

Response. Hill has been contracted by Deerfield Wind, LLC to contribute to the design work on the subject project. To that end, I have familiarized myself with potential wind turbine components and Vermont's permitting processes.

Hill assessed the initial roadway routing of Deerfield Wind, LLC as proposed to the U.S. Forest Service for the Green Mountain National Forest. Hill subsequently generated a "20-Percent" design of the project roadways for a 24-turbine concept, then for a 22-turbine layout "worst-case" design (i.e., a smaller number of larger turbines, hence more restrictive with cranes and transport vehicles). Please refer to ***Exhibit DFLD-JK-2***. For purposes of clarity, turbine locations are identified numerically, increasing north to south and followed by either an "E" for Eastern Project Area or "W" for Western Project Area. Hill presented design information to the Forest Service, Vermont ANR, and VTrans. Hill has completed conceptual watershed analyses for some sections of the ridges, and preliminary design of stormwater and erosion control structures. Finally, Hill has been providing input regarding transportation limitations, both on-Project and off-Project.

Q. What were the objectives of the design work that you performed?

Response. The objective was to design project roadways that will provide adequate site access for both construction and operation of the wind farm, and balance those needs with the input from the wetland consultants and other professionals that contribute to the Project, and with stormwater and erosion control concerns. WTG projects' construction methods are not unique. However, some of the component delivery vehicles and the turbines themselves are relatively unique to the Vermont/Massachusetts landscape with which I am familiar. It is important that the roads have adequate width, curvature and grade for both crane and tractor-trailer travel.

Since this width is only temporarily necessary, an integral goal of the design is a limited restoration, the maximum feasible, to a more vegetated condition. This dovetails with a larger goal to cooperate with both Forest Service and State of Vermont goals regarding forest and animal management.

We incorporate, by reference, the State of Vermont's stormwater management goals as outlined in the Vermont Stormwater Management Manual, Volume I – Stormwater Treatment Standards. Beyond that, our goal is to maintain as much as possible the existing mountain hydrology.

Hill is aware of potential issues with stormwater near the public way. Hill's goal is to produce a design that will not interfere with public way use or stability, to safely convey stormwater both near and under Route 8 and Sleepy Hollow Road, and to otherwise comply with Vermont's stormwater standards.

Q. Please describe any research accomplished as part of the design work.

Response. Hill's research includes site visits, literature review, and contacts with public officials.

Site Visits

Hill walked the routes, looking for possible or probable jurisdictional wetlands, unique or potentially difficult landforms, and to become familiar with the general lay of the land.

On separate occasions, Hill has also walked portions of the route with the USDA Forest Service scientists, engineers and project coordinator.

Hill has also walked portions of the routes, and potential but currently unintended routes, with Michael Lew-Smith from Arrowwood Environmental. We compared impressions and considered alternatives to routes as originally envisioned, in order to minimize impacts to wetlands. Mr. Lew-Smith's fieldwork regarding wetland identification has been incorporated into Hill's electronic drawing files.

As Deerfield Wind, LLC has proceeded to discuss the Project with abutters, and as new potential access points have become available, we have conducted additional site visits to assess these routes, including Bishop Road and Putnam Road.

Literature Review

Hill reviewed literature in four areas to prepare for this Project. We reviewed the Vermont regulations pertaining to wetlands and stormwater, property line information, USDA roadway design information, and vehicle (crane and tractor-trailer) data that may be relevant to the Project.

Hill has reviewed the *Vermont Handbook for Soil Erosion and Sediment Control on Construction Site* as well as the *Vermont Standards and Specifications for Erosion Prevention & Sediment Control*. Since, by the nature of the work, there will be locations with more than two acres disturbed at one time, there are stream crossings, and most notably the mountain slopes are frequently more than ten percent, we do not consider this a low-erosion potential environment.

Hill has reviewed the *Interim Guidelines for Aquatic Organism Passage Through Stream Crossing Structures in Vermont (April 2005)* for guidance on the few stream crossings necessary for the site, as well as the *Guidance for Agency Act 250 and Section 248 Comments regarding Riparian Buffers*.

Contacts

Hill has been in contact with the USDA Forest Service, both in Vermont and in Wisconsin; we have discussed the Project in general and design inputs for consideration in my work. We have also attended a site visit with USDA Forest Service representatives, to both review the potential impact areas and to receive feedback on design methodologies. We anticipate that, as the design elements crystallize, we will continue the dialogue with that agency.

Hill has also contacted the USDA Natural Resource Conservation Service (NRCS) for information on Vermont storm design and suggested policy as to mountain stormwater design.

Hill has also been in contact with the Town of Searsburg's road supervisor, who is also a landowner in the Project. We have laid out the basic concepts, particularly as it pertains to Town roadways. My understanding is that, in his professional capacity, he does not express any immediate concerns as to road design.

Hill has made initial presentations to both VTrans and ANR, soliciting informal comment as to design methods. We have considered those comments as we have prepared this testimony and Project design. Following that, we attended two seminars with Vermont ANR, which discussed stormwater control as it relates to WTG projects.

We contacted crane and transport companies, working to clarify design factors for the roadways. While the finished design is not complete, we have been accumulating data for purposes of section 248 review.

Q. Describe the design work in general.

Response. Hill took the existing topography data and width, grade and setback criteria into our digital terrain modeling system. Starting with Deerfield Wind, LLC's initial roadway layout, and tentative turbine locations, we expounded and adjusted the layout with our criteria. Subject to Vermont design guidelines, Forest Service input, and discussion with Vermont ANR, we considered stormwater and erosion control methods, and figured the impacts of those methodologies on the overall site plan.

The drawings that resulted are included as ***Exhibit DFLD-JK-2 (Plans CS 101-116)***. The revisions incorporate comments from various regulatory officials and include conceptual alternatives. The plans illustrate the ridge-top and access roads along the east ridge (CS101-104), west ridge (CS105-110), the initial west side access from the south (CS111-112), the alternative access from Putnam Road (CS113-114), and potential east ridge access modifications along Green Mountain Power's (GMP's) existing Searsburg Wind Farm access road (CS115-116).

Q. Elaborate on the base design data that was incorporated in site design work.

Response. The topographic data was supplied by our client's local representative (VERA); the majority originated from Robinson Aerial Surveys five foot (5') contour data generated in the 1990's in conjunction with preliminary engineering work for the Searsburg Wind Facility, with additional as-built information forwarded by Green Mountain Power for the existing access road. This information was loaded into Hill's AutoCAD Land Development Desktop program. Additional information, such as stream data layers, provided by Arrowwood Environmental, was overlaid within the program on the topographic data.

The state rainfall data and data measured from the CADD program were programmed into Hill's Hydrowflow Hydrograph program, which allows preliminary analysis of storm drainage.

The road design itself is not an atypical process, and does not have atypical elements; however, the "design vehicles" are uncommon and the terrain is mountainous.

There are actually several classes of design vehicles used for the Project. First, Hill considered construction traffic – dump trucks, graders, bulldozers and the like. Second, we considered the most horizontally-restrictive vehicles; due to length, vehicle wheels will off-track to the inside of curves. Thirdly, we considered vertical restriction issues; trailers such as lowboys will limit the sharpness of crest vertical curves, and load overhangs (off the end of trailers) limit sag vertical curves. Lastly, we considered long-term facility access for maintenance and repair.

The design vehicle review was conducted along with a review of USDA Forest Service roadway requirements. The Forest Service has published handbooks (details provided below). These are reasonable guides for the overall roadway design as the vast majority of roads are on Forest Service lands. These handbooks offer guidance on roadway design, culvert design, erosion control and other design elements.

The application of alternative turbine scenarios, which would alter turbine-to-turbine spacing as well as locations along the roadway, will not cause any substantial deviation from the design concepts presented herein. The same roadway sections, stormwater controls, and erosion controls will apply.

Q. Describe, in more detail, the crane considerations for the Project.

Response. Within the realm of construction traffic, we considered the cranes that assemble the units. These cranes present a unique challenge in this mountainous terrain. Our research indicates that reasonably available track crawler cranes must turn on a roughly level area, typically on the order of 1%-2% cross-slope. In order to ascend steeper grades, the roads must be straight. Therefore, a significant design criterion is to provide turning locations for each change in road grade beyond 2% and into each turbine location. The design assumes that the crane is transported to the site in pieces, and then assembled at the wider road on the ridge.

We did consider alternatives, primarily hydraulic cranes, at the conceptual stage of the project roadway design. These cranes, with numerous rubber-tired axles, offer no advantage for this project construction. They are substantially more expensive, require more time to move around the Project (more pieces are removed and then reassembled each time it is relocated on the Project), and at some locations would require additional clearing and leveling (this relates to the luffing rig assembly). The cranes considered for the Project are of a reasonable size to assemble a 3 MW V90 WTG (the roadway worst-case scenario).

Q. Describe, in more detail, the Forest Service design inputs to the Project roads.

Response. The Forest Service handbook[2] provides significant detail on design processes and criteria. Early on the design process, Hill considered that the Project roadways would not neatly fit into the stereotypical Forest Service roads. These roads are not intended for routine public access. For example, the Forest Service guidelines discuss sufficient roadway width that will allow design vehicles (a.k.a. "critical vehicles" in the handbook) to pass each other; Hill assumes that there will be radio-coordinated traffic movement of construction traffic, and vehicles will hold for oncoming vehicles at critical locations. In another example, the handbook lists design speeds and minimum roadway widths, with a minimum of 22 feet at 20 mph. The Hill design typically uses a *finished* roadway of a narrower width in order to reduce long-term roadway erosion potential and improve stormwater management, while still meeting the design criteria of both the potential cranes and turbine component transport vehicles.

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[2] FSH 7709.56 Road Preconstruction Handbook.

The handbook provides details on turnouts, turnarounds, and curve widening; all these elements are handled on the Project. However, given the nature of the vehicles and weighing long-term use versus short-term impacts and construction requirements, they are sometimes handled in a unique fashion. There may be circumstances where, for example, trailers are turned by lifting with a crane instead of driving on the ground. Long-term, the turbine spur roads provide turnout space. The Project design does incorporate turnarounds at or near ends of the Project, usually in locations where material stockpiling may also occur. Curve widening was addressed by modeling and running the design vehicles up the roads, instead of using the packaged formulae of the handbook.

The handbook provides criteria for design speed, sight distance, horizontal curvature, vertical curvature, and guardrail use.[3] All these elements are considered in the presented design, whether from the Forest Service criteria or other sources, such as AASHTO[4] design guidelines.

Q. Describe, in more detail, the design inputs into the Project stormwater management.

Response. The Project stormwater management will be consistent with Forest Service requirements, primarily, since the vast majority of roads are on Forest Service land. Hill also acknowledges that other Project elements are off of Forest Service

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[3] I note that the design, more as a by-product, may minimize the need for guardrails. Often the re-loaming is on the fill side of the road, facing the drop-offs that need guard rails.

[4] American Association of State Highway and Transportation Officials (AASHTO).

land or will cause drainage toward off-Project lands, so all stormwater management will also be consistent with ANR guidelines and policies. We note that Forest Service handbooks[5] provide some guidance on design; as the work continues into permitting and more detailed Forest Service review, details will be fleshed out. The presumption is that stormwater is handled through surface drainage, and excepting for structures, there is no subsurface drainage. In particular, the frequency of "ditch relief culverts" and "intercepting ditches" will be discussed.

A major concept behind the stormwater management is to keep stormwater not only within the original watersheds, but to as much as possible keep the water in the original sub-watersheds, down to as small a level as practical. Accumulating water in channels or pipes to fewer, larger structures could increase issues with scour and available water to nearby plants. Whenever possible, treatment structures will be smaller and spaced more frequently, which will better maintain surface or interflow water flow to immediately down-gradient areas. This will also serve to reduce treatment structure sizes, reduce scour potential, and ease the burden on conveyance systems. Along with more and smaller treatment areas (stormwater treatment practices, or STPs), culverts will convey large-storm water out of the treatment conveyances. Details are described further on in the testimony.

We expect that the finished ridge road will be designed with a uni-directional cross slope; the ridge roads are intended to be narrowed by the re-application of loam, part of re-vegetation and impact minimization project goals. Wherever

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[5] FSH 7722 and FSH 7709.56b.

possible, the re-loamed area will be on the outside of embankment constructions. While this has no import for the construction phase, it may be factored into long-term embankment stability considerations.

Narrowing the ridge roads to approximately sixteen (16) feet will present no issues with "false ditches[6]" or other additional stormwater reroutes. The access roads are generally left at the wider construction width (see further discussion below in <u>INVESTIGATION AND DESIGN WORK RESULTS)</u> since re-loaming a small portion of the road shoulder would interfere with storm drainage.

Given the steep nature of the roads, the need for traction of construction equipment, and the concept that roads need to be drained to maintain strength, pervious surfaces are not considered for the Project roadways at this time. The steep road segments would not allow appreciable contact time for water to percolate into the embankment structure. The road materials will need to withstand the impacts and spinning of tractors (truck units), cranes, and other construction equipment. A surface pervious enough to allow water passage more easily than a gravel road will probably not hold up well during construction or long-term operation activities. A basic tenant of roadway design is to keep the roadway drained; water can lead to problems of weak substructures or slope failures; intentionally pervious surfaces for permanent roads subjected to heavy wheel loads directly contradicts good roadway design.

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[6] Gravel roads may form wheel ruts as plowing/grading operations may lower traveled way grades. Because of this, stormwater may not flow off the road and into constructed ditches, but create new channels along the road edge. These are "false ditches". In this Project's context, if a road is narrowed by a few feet by placing loam along its edge, that loam will be just as much an impediment to stormwater flows into a ditch. Water will flow along the loam edge.

Stormwater management analysis is intended to be consistent with the Vermont requirements. The design storm data has been modified to that presented in the Stormwater Management Manual, and initial designs are consistent with Vermont's policies. We point out that the model runs to-date are skeletal; that is, work up to this point is not intended to represent full design. We intend to present sufficient information to demonstrate that a workable design is possible, and to present assumptions and overall concepts for consideration. Information on specific Vermont stormwater management goals is provided further in the testimony.

Q. Describe, in more detail, the design inputs for Project erosion control.

Response. Since water does go off-Project and there are Project elements off of Forest Service land, the entire Project is intended to comply with ANR requirements. The design is intended to be consistent with Forest Service goals. Therefore, the primary design guides are the Vermont Stormwater Management Manual. Again, design elements will be further discussed with ANR and Forest Service representatives as specifics are drawn up.

The stormwater conveyance system will serve double-duty, collecting stormwater for erosion control as well as post-construction run-off. Typically, erosion controls would not be located at permanent treatment locations. But for this Project, it makes sense for portions of the stormwater conveyance system to be used, to reduce the Project footprint. To accomplish this, additional measures other than the permanent STPs are necessary.

Q. Describe, in more detail, design inputs for Project culvert design.

<u>Response</u>. The FS handbooks describe the crossing designs for "minor culverts", the category for this Project's stream crossings. The handbooks cross-reference with Federal Highway Administration (FHWA) guidance documents. The State of Vermont's input into the crossings is also an important design input. Pipe-arch culverts do appear appropriate, as would bridges, for the stream crossings. Stream crossing design is intended to be consistent with both FSH 7709.56b and the state's stream crossing guidelines.

Given the stream gradients, oversize pipe culverts appear inappropriate at this time. The pipe-arch is a prefabricated steel plate structure, with a shape similar to a letter 'D' flat side down. We can omit the bottom flat section, instead setting the curved sized on plates or concrete. This will leave the stream substrate intact.

Other minor culverts, such as road-crossing a.k.a. "ditch relief" culverts, will likely be high-density polyethylene (HDPE) pipes. Culverts associated with diversion structures will likely be polyvinyl chloride (PVC) pipe, given the availability of fittings to build up those diversion structures.

Any modifications to public way culverts will be checked with the appropriate regulatory officials. At this time, however, this is not anticipated based on roadway design work and mapped culvert locations.

INVESTIGATION AND DESIGN WORK RESULTS

Q. Describe the tentative roadway design.

Response. The input from my site visits, literature review and contacts are incorporated into the site plans, ***Exhibit DFLD-JK-2.***

The ridge roads (see also ***Exhibit DFLD-JK-3,*** Typical Roadway Section) are designed with a maximum grade of 12% and a nominal temporary width of thirty-eight (38) feet. This is Hill's current recommendation to accommodate Deerfield Wind's largest intended turbine sizes. That road connects crane pads that are adjacent to each turbine site. Following construction, the ridge road is narrowed by the application of loam and seed, to provide a nominal sixteen-foot long-term-use gravel road.

There will typically be spurs leading to each turbine site (see ***Exhibit DFLD-JK-2***); this generally allows the crane to work without obstructing the ridge road. Because the cranes will need a level turning area, each spur may require reverse vertical curves to be graded in the ridge road. There will be a level area around the foundation site, allowing worker access. Pending further information, Hill assumes that the balance points of individual blades will need to be on this level area, leading to a tentative 150-foot diameter area around the foundation. The foundation may be what's called an inverted-T, basically a buried flat slab of reinforced portland cement concrete, with a smaller section rising to the surface for the tower attachment.[7]

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[7] Alternative foundation designs may be constructed, depending on site conditions.

Hill refers to the roads that lead up to the ridges as “access roads”; crane components will be transported up these roads, as will turbine components. Because the crane is not intended to traverse these roads, they are typically twenty-four (24) feet wide during construction phase. This narrower width is based on a “design vehicle” contrived with a hypothetical maximum blade length and assuming fixed rear wheels. Within the National Forest, that road class has a maximum grade of 12% and a minimum 300-foot centerline radius. Following construction, the access road intersections and widest segments will be narrowed by the application of loam and seed, including at intersections with the public way, to provide a nominal sixteen-foot roadway width.

Following evaluations of a number of possible access sites, the Project primarily considers two access options for the Western Project Area, both of which are presented to both the Forest Service and the Public Service Board. The initial design considered access to the Western Project Area from Route 8 directly, entering the National Forest lands across from the Crosier Cemetery and Sleepy Hollow Road in Searsburg. The second western access is afforded from Putnam Road, a Searsburg town road located off the west side of State Route 8. Putnam Road access will require a road steeper than 12%, but the existing town road already has a 15%-16% maximum grade. A straight shot up the hill would result in 16% grade and substantial cut. However, by snaking the road as shown (***DFLD JK-2, CS114***), we intend to reduce the cut into the slope, reduce the grade, and reduce wetland resource exposure to potential sediment. This layout would provide space for erosion controls, stormwater detention, and a stabilized construction entrance. This roadway segment along Putnam Road would be temporarily wider than twenty-four feet, due to trailer turning geometries. Both of the above routes have been examined to assess their feasibility and impacts resulting in Putnam Rd. as the preferred alternative.

The Eastern Project Area has one access route that we contemplated using, that being the existing Searsburg Wind Farm access road. This will likely require widening near Route 8 to turn on Sleepy Hollow Road, widening to turn onto the existing access road, and access road modifications. Please refer to ***Exhibit DFLD-JK-2, CS115-116***.

Q. What is the tentative culvert design?

Response. Three streams drain vegetated wetlands, with approximate 10% stream gradients, between turbines 4E and 5E in the Eastern Project Area. The culverts would leave at least four feet between the stream thread and the crown, with a span at least 1.2 times the bankfull width. Since the streams are typically 1-3 feet wide, the culvert will probably be at least 7 feet wide, measured between inside walls. Please refer to ***Exhibit DFLD-JK-4***, Typical Stream-Crossing Culvert.

There will be another culvert located between turbines 9W and 10W, on the western slopes of the Western Project Area. The culvert will likely have similar geometry to that for the three streams on the eastern ridge.

There is a fifth stream (#10) on the southern access route up the west ridge. In the unlikely event that route were developed, it will have similar geometry to the other crossings. This crossing will be avoided by not using this access option.

Q. Why not relocate the road on the eastern ridge, to reduce the culvert crossings?

Response. Relocating the roadway to the east between WTG locations 3E and 5E would reduce the number of culvert crossings, but Hill feels such a design would increase the overall impact of the Project on the wetland system. The current proposal, while crossing three streams, is located downstream of the nearby vegetated wetlands. If the road were located to the east, given the terrain, the road would have to run roughly east-west to gain elevation with the hill to the south. Such relocation would need a crossing of two channels of a braided stream, threading between two vegetated wetlands. Such relocation would also put the road upstream of other nearby vegetated wetlands; roadway construction so close upstream, in this area, may alter subsurface stream flow that feeds the wetlands and certainly surface flows during rain events. (See ***Exhibit DFLD-JK-5,*** Road Layout Alternative – East Ridge Wetlands).

Q. Is this design complete?

Response. There is more design work necessary for the Project. At this juncture, Hill understands that it would be impractical to commit the resources to the full design without *some* indication that this is a viable project.

For the purposes of presenting the project concept, Hill has represented the design to the client as a "20-percent" design. While the basic elements will be as presented, the nuances will be fine-tuned. For example, Hill would like an instrument survey at least of roadway intersections and areas near wetlands – generally, our construction design plans utilize contour data at a two-foot interval. Another item that is pending is soil investigations in the field to verify infiltration capacity and soil map unit identification.

Notwithstanding pending items and full design, we believe that the design as presented is sufficient to understand the Project and to allow the issuance of a decision. Our maps present the relevant portion of Arrowwood's exhaustive search for wetlands proximate to the Project, as well as soil map units and topography, so we can weigh the erosion potentials adjacent to wetland resources. The plans describe the size and location of impervious areas, locations of soil disturbance, storm water treatment practices and tentative locations.

We understand ANR may want more detail on sub-watersheds. However, given the nature of the topography near wetland resources, I believe that this is more appropriately and more accurately delineated with higher-resolution contour data (two-foot versus five-foot contour intervals).

We also understand that ANR may want additional stormwater treatment practice information, as the Project develops. We certainly intend to share this information, and intend to fully comply with the standards in force.

I have reviewed John Zimmerman's testimony regarding the "conceptual approval" being sought for the Project. From the perspective of a civil engineering firm, which has been involved with wind project design, we concur with Mr. Zimmerman's testimony. We are very aware that the wind technology is continually developing, and that the turbines that will be made available for construction is unclear even a year or two ahead of time, a fact which we endeavor to track and incorporate into our project designs and our advice to the client. We are involved with the review and permit process with National Grid on another project, and can testify to the time commitment involved to coordinate the review process. We also agree that the input from other agencies can and will influence Hill's decisions and guidance for a successful project.

Q. What are the Project construction steps?

The Project construction, at its simplest, involves the following:

- Cut trees in road and foundation construction areas; use temporary bridge crossings where necessary.
- Install erosion control barriers, such as silt fences.
- Install diversion dikes and check dams and necessary temporary stormwater controls.
- Grub and stockpile loam for road and foundation construction.
- Excavate subsoil and rock; stabilize as necessary as work progresses.
- Build embankments to subgrade; stabilize as necessary as work progresses. Includes culvert installation.
- Install pavement on top of the embankments; complete permanent stormwater control structures.
- Install loam on embankments; seed and mulch.
- Monitor site during turbine construction; finish clearing near turbines where blades reach toward the woods, but do not grub.

- Finish turbine assembly.
- Apply loam to wide roads to reduce gravel width; apply interceptor ditches, seed and mulch to stabilize.
- Finish stabilizing former stockpile areas.
- Continue monitoring site until suitably stabilized for the long-term operations.

The Operations and Maintenance building construction involves foundation excavation, forming and pouring the foundations, then assembly of the building structure. Deerfield Wind, LLC has rights to construct the building on the parcel at the dead-end of Putnam Road. Prior to obtaining those rights, Hill considered other alternatives, such as a site near the southern access route to the Western Project Area. The Putnam Road site is already disturbed, convenient to public ways, and one of the most likely areas to provide suitable site absorption system soils (for the building's sanitary sewerage). The Operations and Maintenance building construction may be scheduled independent of other site activities, although the building's site does present a relatively ideal location for stockpiling and materials processing which may lead the developer to leave building construction to the latter stages of the Project.

There may be segments of public ways further from the site that are modified for the Project. These, if required, would proceed independently of the Project area road construction, but with a similar order of operations.

A substation will be located at the northwest quadrant of the crossing between the west ridge northern access road and the existing high-tension transmission line corridor. This may be constructed independent of most other scheduled work, except for the road, which must be constructed to obtain access to the construction site.

Q. What equipment and methods will be involved in road and turbine pad construction?

Response. Road construction will involve traditional equipment: skidders, uni-body dump trucks, trailer-dumps, bulldozers, tracked bucket excavators, payloaders, graders, backhoes and roller compactors.

Tree clearing will involve chainsaw cutting of trees, dragging by skidder to logging headers, then removal by logging trucks, chipping on site, or being left in small (two-foot high) piles as approved by the landowners. Any temporary bridges for this activity will be constructed within the current proposed footprint and removed prior to permanent culvert construction. Turbine clearing estimates are as follows:

Average Turbine Clearing (estimate)

Eastern Project Area	**22 turbines**	**24 turbines**	**Western Project Area**	**22 turbines**	**24 turbines**
	Area (sq. ft)	**Area**		**Area**	**Area**
1E	79,016	66,528	1W	55,319	44,922
2E	48,506	36,232	2W	51,084	36,853
3E	47,302	26,286	3W	40,483	12,998
4E	20,237	14,904	4W	49,764	26,733

5E	42,657	24,459	5W	54,295	39,922
6E	32,398	26,317	6W	48,017	24,789
7E	40,183	16,568	7W	47,199	25,112
8E	35,209	19,217	8W	44,698	23,901
9E	40,754	23,090	9W	38,936	12,363
10E	n/a	25,275	10W	49,546	27,507
Subtotal	386,262	278,876	11W	67,261	28,742
			12W	52,799	20,257
			13W	53,240	21,679
			14W	n/a	25,201
			Subtotal	652,641	370,979
Grand Total, s.f.	**1,038,903**	**649,855**			
Grand Total, ac	**23.85**	**14.92**			
Average, ac	**1.08**	**0.62**			

The reduction in average per-turbine clearing between the 22-turbine and the 24-turbine scenarios results from: (1) smaller area required for blades, *i.e.* smaller triangle footprint; (2) smaller clearing for the foundation; (3) more overlap with turnarounds; and (4) overlap with roadway. There is additional roadway clearing with 24 turbines. The clearing estimate includes that portion of the clearing required for turbine construction that excludes coincident or exclusive roadway clearing. This clearing includes most of the crane pad, and coincident turnaround or stockpile areas. Gross clearing less these totals is that clearing associated with road, stormwater control, and turnaround/stockpile outside of the turbine footprints.

We anticipate that the underlying rock will have varying resistance to excavation. There are numerous methods that may be employed to excavate that rock. Examples include: the upper layers may be sufficiently weathered or fractured that the excavator bucket can pull it apart; bulldozers may pull a rear-mounted ripper tooth across the rock, pulling it apart; the tracked excavators may be fitted with a pneumatic hoe-ram to bank the rock apart; or blasting could be used as a last resort.

Blasting will involve a pre-blast survey coordinated between landowners, the blasting firm's geotechnical engineering firm and the insurer. The geotechnical engineering firm would initiate seismograph monitoring and possibly test shots to assess the existing ground conditions; this would allow determination of minimum blasting loads and optimal shot timing sequences. These initial assessments would also consider application of mats, a concern where material may be thrown toward dwellings or use areas, and how drill holes are packed for the shots. There would be abutting landowner notification of blasting shots, warning sirens, and radio communication controls. Weather permitting; shots would typically go off at noon or day's end.

Regulations preclude on-site storage of explosives (dynamite or ammonium nitrate). These would be brought to the site as needed. Per ordinary industry practice and applicable regulations, the blasting company will pursue all licenses, bonding and local permitting.

Once the earth is prepared, the embankments will be built up with dump trucks, loaders, excavators and graders. Where necessary, geogrid will be lain down manually between lifts of fill material. On soft ground, geotextile will also be lain down manually to improve roadway strength. The same equipment will be used to install the gravel layers, loam, and rip rap.

Specialized transport vehicles will bring in the components of the WTGs.

Q. What is the current proposed Project phasing?

Response. We expect that construction will be phased consistent with Vermont's guidelines on EPSC plans for sites over two acres. That guidance document states that, "Ideally, this plan is developed in consultation with the grading contractor to ensure feasibility of the approach."[8]

Hill anticipates that the Eastern and Western Project Areas will be constructed concurrently, including clearing and road construction. Turbine assembly (with completed roads) is expected to start on one ridge, and then move to the other, given potential crane availability issues (not many of these heavy cranes are available). To that end, the roadway completion may be staggered to be ready when needed.

The 20% plans (***Exhibit DFLD-JK-2***) illustrate stockpile locations for materials intended for re-use, such as loams and crushed/ripped stone. The Operations and Maintenance area will provide additional space for stockpiling materials and equipment, and coordinating operations across the site.

On the Eastern Project Area, Deerfield Wind would first start clearing operations along the ridge. Tree cutting may start during the winter, when ground is frozen and less likely to erode. Stormwater control and erosion control items would be installed as soon as possible, and before other work.

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[8] Vermont Standards and Specifications For Erosion Prevention & Sedimentation Control. 1st Edition. 2006. Pg. 3.7.

The GMP access road should be upgraded prior to the start of Deerfield Wind's eastern ridge road, to ensure that the road has adequate strength and culvert capacity.

As construction progresses southerly, there would be small materials stockpiles at individual turbine sites, or at larger designated areas such as the Operations and Maintenance yard area or vehicle turnaround area. Materials suitable for re-use may be reprocessed by equipment that may be located near the Operations and Maintenance building. The bulk of cutting, filling and borrow movement can be split between the turbine 1E knob down to the saddle (STA 0+00 to 17+00), then from the saddle up to turbine 3E (STA 17+00 to 30+00); the first section would be stabilized prior to moving on to the next. The level ridge road for the turbine 3E spur will provide space for material storage (loam, riprap) without interfering with access to points south.

Succeeding phases would be segmented into approximately 1,000-foot lengths, with clearing proceeding ahead of the active earthwork segment, and stabilized segments trailing behind. This would break the Eastern Project Area road at turbine 5E pad, turbine 7E pad, and lastly to the turbine 9E pad. There would be materials stockpiled at the turnaround near turbine 8E (centered in the clearing).

Once each main ridge road segment is stabilized, the turbine spurs will be constructed one after the other. Following clearing and embankment construction, foundations will be excavated, poured, and backfilled. This turbine spur and foundation construction work will typically follow along the ridge, north to south, as the main road is completed. The foundations will be left to cure to appropriate strengths. In the meantime, WTG component deliveries will be transported from manufacturing locations in an (close to) on-demand schedule.

We expect that the bulk of the turbine foundations will be ready for loading (*i.e.*, tower assembly) in close order. The crane will arrive when there are a sufficient number of ready foundations and components for turbine erection. That way, the crane will be utilized to its maximum efficiency.

The crane will be assembled at either the north or south end of the ridge road and crawl to the other end, assembling each turbine along the ridgeline one at a time. There will also be a smaller crane or two assisting the larger crane; these may maneuver to off-load out-of-order component deliveries to other pads as well as assisting the main crane in assembly duties.

As the main crane works its way along the ridge, assembling each turbine, the stockpile loam will be used to dress the gravel road, turbine pads and foundation areas, narrowing all to the intended final operational width. This will leave sufficient width for the trailers, but not the crane. Except for Turbines 3E and 9E, the trailers can pull past the crane and turn around in a simple loop. At turbines 3E and 9E some loads may either back in or the crane could spin the trailers around in the air. When the crane has reached the opposite end, all WTGs will have been assembled, the cranes can be disassembled (and moved off), and the last bit of loaming at the turnaround and curves can occur.

<u>On the Western Project Area</u>, again working concurrently, much the same process is occurring. Again, the road will be segmented into roughly 1,000-foot pieces, with clearing working ahead of the active earthwork segment and trailing

areas being stabilized. Materials may be stockpiled near individual turbines or at several turnaround / stockpile clearings. Presuming access will occur along Putnam Road, this road will be modified first (preferably before other work on Forest Service land, to allow access to the private property yard area for materials stockpile).

The road construction may be split at the substation area; then proceed to turbine 13W; turbine 11W; turbine 9W; turbine 8W; turbine 6W; turbine 5W (and the side road to turbine 7W); turbine 3W and the southern turnaround sequentially, and finally to the southernmost turbine.

Again, the crane is assembled on the ridge, and starts component assembly at one end of the turbine string, moving toward the other (this string is assembled by the same cranes from the Eastern Project Area; before or after sequencing is flexible). As the crane works along, the road and turbine sites are re-loamed, except for the turnaround and curves. After the turbine gets to the other end of the turbine string, it is disassembled and the re-loaming is completed.

At Putnam Road, we anticipate highway proximity to be an issue in phasing, and we anticipate that erosion control and traffic non-interference must be managed during construction. We envision construction starting at the yard area, with installation of erosion controls at the low end of the yard. Then, the road segment one-half way to Route 8 will be constructed, then the old road will be dressed with loam; this does not represent substantially more gravel area than the current road, but the grade will drop. After that, the remaining portion of the access can be brought down to grade, the stabilized construction entrance installed, and a second basin for the stormwater retention constructed. This way, construction vehicles access the work area from behind, thereby reducing shoulder work. We anticipate that the yard work would be accomplished prior to other roadway construction, so that a stabilized construction entrance may be provided and there is space for materials stockpile at the start.

COMPLIANCE WITH STATE STANDARDS

Q. Will the Project cause undue water pollution, and will the Project meet all applicable state regulations re stormwater and waste disposal?

Response. The Project will not cause undue water pollution. The Project will meet all applicable stormwater and waste disposal regulations.

Water pollution. The perceived *potential* water pollution sources include, but are not limited to, motorized equipment fuel or oil, hydraulic fluid, eroded soil and/or roadway materials, turbine lubricants or miscellaneous debris. Specifics will be elaborated upon prior to construction through the NPDES Construction General Permit's Notice of Intent, but at this time, I expect that the Project will incorporate (at a minimum):

- Fueling no closer than 100 feet to wetland resources (including class 3 wetlands and stream channels);
- Prompt cleanup of any spills of fuel, motor oil, hydraulic fluid or cooling oil, and documentation of same;
- Secure containers for all chemicals and petroleum product on site;
- Erosion and Sediment Controls (elaborated below).

Stormwater. This Project will submit for approval under the state stormwater permit, since the Project will have more than one acre of impervious area (gravel roads). Hill has reviewed the treatment standards contained in the Vermont Stormwater Manual. All stormwater management will be designed for Water Quality, Recharge, Channel Protection, Overbank Flood and Extreme Storm conditions, unless waivers, exemptions, or credits apply. Subject to further discussion with ANR, the preliminary design concepts are as follows.

The basic concept in the stormwater management is to provide controls in a linear fashion, and distribute the runoff across the landscape. This will better maintain the local hydrology, reduce loading on the stormwater structures, and reduce potential impacts to wetlands. This translates into using the "perimeter dike" concept with some modification (hereafter, this is referred to as a perimeter swale). Essentially, the perimeter swale will be a "grass channel" or a riprap-armored channel (where scour velocities require it). We suggest using the perimeter swale as an integral element of operational-phase stormwater management, because post-construction access to construct other systems will be difficult at many locations, and because we want to, wherever possible, reduce land clearing.

Low-flow water that requires additional treatment will flow through Surface Sand Filters, Infiltration Trenches, or Infiltration Basins. These structures will be located to treat all discharge points, and to achieve the site's groundwater recharge requirements. The structures will be sized to control for the one-year design storm or lesser storms.

Larger storm flows will be allowed to divert down slope, outside of the perimeter swale, by means of flow diverters. This should minimize land clearing requirements (when compared to fewer, larger detention basins) and reduce the potential for roadway or channel scour. These frequent discharge points will all be armored by riprap.

The swale alone cannot meet the Total Phosphorus removal requirement, so the sand filters will supplement the water treatment. Also, these swales will serve as grading in areas under 5% slopes, where Deerfield Wind may capitalize on the design credits. At such locations, the swale's outer bank will be opened near check dams that are spaced 25 feet on center along a swale.

There are expected to be only a few discharges next to streams or vegetated wetlands. These include the wetland complex near turbine 4E, streams near the Putnam Road / Route 8 intersection, the stream that crosses Janovsky's driveway, and Streams #3 and #10 on the west ridge. However, roadway discharge will still remotely enter Vermont waters. One goal of the site's stormwater management is to diffuse the stormwater across the landscape, to better mimic existing hydrology and to reduce potential for concentrated, scouring flows.

<u>Waste Disposal</u>. The operations and maintenance building sanitary waste, if not using an existing site absorption system, will use such a system constructed consistent with Vermont's requirements and best engineering practices. Facility waste, both solid and liquid, is expected to be minimal; non-hazardous solid waste would be collected and disposed similar to any dwelling in the town. Hazardous waste (oil, most likely), will be collected, contained and transported pursuant to any and all applicable Vermont and Federal standards.

Oil containment. Each turbine contains cooling oil and lubricants. The greatest exposure is, then, during construction or component replacement. If there is oil containment on site, it will be in sealed and approved containers, typically 55-gallon or smaller drums. The facility would provide an appropriate level of secondary containment to ensure the protection of the water supply, public health, and worker safety. For example, waste drums that are stored, even temporarily, in the operations and maintenance building could be set on a spill pad (there are varieties sold with expandable sumps, little ramps, and other accouterments; refer to ***Exhibit DFLD-JK-6*** for examples).

Maintenance Building. As previously stated, Deerfield Wind has considered locating a new operations and maintenance building at several locations, with the preferred site on private land at the west end of Putnam Rd. Either at the base of the mountain, or converting an existing structure, Deerfield Wind will comply with the applicable statutes and regulations for water supply protection and waste disposal.

The building location at the Putnam Road terminus (LeMaire property) is hundreds of feet from the nearest private water supply wells, and it is expected that any new well would be adequately productive for the few full-time employees.

A simple and potentially feasible solution may be to utilize a house with pre-existing water supply and wastewater disposal. Deerfield Wind has option rights to the land and residence and is exploring this option.

Q. Please explain the proposed stormwater controls for the flat ridgetop areas.

Response. Impacts on the ridgetops may or may not be on relatively flat grades. Where the grades are under five percent, the land may be graded and runoff directed to take advantage of the "disconnection for non-rooftop runoff" credit under the Vermont Stormwater Manual. Generally, this means the perimeter swale will be leveled and regraded to provide discharge points every 25 feet. We anticipate some analysis of site soils and hydrologic conditions for design, to confirm the soils' permeability.

The Vermont Stormwater Manual limits contributing impervious runoff to 75 feet flowpath or 1,000 square feet. We propose that there be discharges every 25 feet; the area of 25 feet of a 38-foot-wide road is 950 square feet.

This may be applied to the turbine sites, as the area leveled for the foundation work may provide an area of suitable grade and size to meet the standard. Since the cranes will not be installing turbine components immediately after foundation installation (with concrete cure time, crane availability and other factors), it is reasonable that a vegetative cover can be established per the disconnection credit.

Q. Explain stormwater controls for roads crossing gradients.

Response. In many locations, either on the ridge top or on the ascending access roads, the roads will traverse across the sides of ridges. In these cases, there will be a cut into the slope on one side, and a fill slope on the other. Grades can vary, to a maximum 12 percent. Since grades would be more than five percent, there do not appear to be any applicable design credits, so neither water quality nor recharge volumes are reduced.

On the cut side of the road, Hill recommends leaving the diversion dike as a permanent feature. This will help protect the roadside stormwater collection ditches from additional flows that, for a given cross-sectional geometry, would increase scour. Water is channeled periodically down slope drains; we do not recommend half-pipes (suggested in the Standards) but riprap channels that are aligned with road-crossing culverts that discharge from the roadside ditches (there should be a lot of cobbles collected as part of the work, either from sifting soil or from blasted or ripped rock).

We recommend a different geometry than that shown in the Stormwater Manual. We feel that a berm unnecessarily requires tree clearing; and if constructed atop the forest duff, it would allow water to seep underneath. Instead, we would have a ditch cut into the slope, to the same depth as the specified berm height. This will cut through the duff and capture the “interflow”, water running just below the ground surface.

The slope drains will point at road-crossing culverts; the water will pass the roadway, avoiding mixing with road runoff, and will bypass the perimeter swale.

The roadway and cut slope runoff collect in the roadside ditch. Since these road segments are expected to be steeper than 5% grades, the ditch will be stone-lined and sized for up to the 100-year storm. The water either channeled from slope drains and through road-crossing pipes or sheet flowing from the fill slope is captured in the roadside swale. This water, unconnected to the gravel road, is conveyed away to continue running downhill.

Hill recommends that the perimeter swale be used to capture and treat the gravel road stormwater, with additional temporary controls uphill to stem sediment deposition (see erosion control section for details).

The receiving swale would be designed similarly to the "dry swale" or a "surface sand filter". The Standards state that the dry swale can meet the recharge and water quality treatment goals[9]. See ***Exhibit DFLD-JK-7*** - Surface Sand Filter for a concept sketch.

Essentially, we propose a surface sand filter that is aligned in a trench. Unlike the Standard's filter example, our filter substitutes a geotextile in place of the berm between a forebay and treatment area; the forebay holds the entire water volume that will filter through the geotextile to the filter bed; the filter bed is off-line, that is there is no overflow at the far end (to prevent solids re-suspension); the sand is exposed, *i.e.*, there is no topsoil layer on the filter layer. This design makes the filter very similar to the dry swale as exemplified in the Standards, but the check dam is more pronounced (higher) and there is no half-pipe weir at the outlet. Each filter would have the underdrain daylight to the side, in an attempt to maintain pre-development hydrology. However, if groundwater and soils allow, the filter may discharge to the groundwater as part of the groundwater recharge requirement.

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[9] Vermont Stormwater Manual 2-52

In other circumstances, there will be "dry swales" along the perimeter swale, between stone-lined segments of the perimeter swale. This way, there will be groundwater recharge close to impacted areas, with underdrain discharge down the mountain slope. We refer to these as dry swales, because the overflow will continue down the system toward a terminal retention basin.

Q. Please explain the proposed stormwater control on steep grades.

Response. On roadways that are closely aligned with the slope gradient, going straight uphill or downhill, we expect that we cannot disperse flow periodically from a filter structure. Under these circumstances, the stormwater will generate a plume that follows the road down the hill, effectively interfering with down-gradient groundwater recharge. To compensate in these areas, we recommend that (whether cut or fill) stone-lined ditches follow both sides of the road, and there be retention basins that lead to a dry swale. These swales will angle distinctly off of the road, following the land contour. Where there are multiple channels, they will be lined up strategically to maximize recharge potential. Road-crossing pipes will be aligned with these channels.

We recommend relatively frequent road crossings (ditch relief culverts) on gently graded road segments, based on hydraulic analysis, with the diffusion goal in mind. At steep roadway segments, if water is running down both sides of the road, we recommend keeping the flow split – crossing the flow may reduce scour potential in one channel to the detriment of the other. Water may instead be shunted off into the woods by dry swales.

Preliminary comments from ANR indicate that their preference is road-crossing pipes spaced at approximately 50-foot intervals. We suggest this may be excessive for properly designed channels. At steep roadway segments, if water is running down both sides of the road, we recommend keeping the flow split – allowing water to cross the road to a single ditch may reduce scour potential in one channel to the detriment of the other.

Q. How do these controls comply with Goal #1 of the goals of Vermont's stormwater regulations: "Site designs must minimize stormwater runoff and utilize pervious areas for stormwater treatment"?

Response. The Project will, where possible, re-vegetate a portion of the ridge road width and wide-constructed intersections; this will reduce the amount of impervious gravel surface exposed to rainfall, and absorb some runoff. The areas around turbine assembly sites will be cleared when necessary, soil disturbance will be minimized, and roots/stumps retained to the maximum practicable extent. The Project will use rip rap channels, grassed swales, and pervious basins for stormwater treatment and control. One area near Route 8, where grades allow and vehicle traction is less critical, may receive a pervious open-graded stone layer instead of packed gravel.

Hill is designing a road that avoids wetland impacts to the maximum practicable extent. However, there are competing factors (steep grades coupled with maximum design road grades being a major one) that necessitate the roadway being placed close to some wetland resources, such as between turbines 4E and 5E (discussed previously). Another example is the initial access option to the western turbine string, the "southern access" from near the Cemetery to the southern end of the turbine string. Based on the input from the Forest Service and Arrowwood Environmental, Deerfield Wind has identified a preferred Western Project Area access via Putnam Rd. This keeps the Project roads on existing disturbed areas (instead of cutting a new road and as preferred by the Forest Service) as well as avoiding close proximity to an ancient orchard and stone walls along the "southern access".

These are two clear examples of attempts to better site the proposed Project, fitting it into the landscape and avoiding unnecessary impacts.

Q. How do these controls comply with Goal #2 of the goals of Vermont's stormwater regulations: "Stormwater management should generally be provided though a combination of structural and non-structural practices. Where practical and feasible, non-structural practices should be incorporated into a site's design to reduce the reliance on structural practices"?

Response. The potential for integrating nonstructural stormwater controls has been reviewed for the Project. The Stormwater Treatment Standards use six different systems to provide these nonstructural practices, or "stormwater management credits". The Project will consider three Voluntary Stormwater Management Credits. These are for Natural Area Conservation, Disconnection of Rooftop Runoff, and Disconnection of Non-Rooftop Runoff.

Credit #1, the Natural Area Conservation Credit, may provide for the reduction of site area for water treatment volume calculation. This is allowed provided the credit area remains undisturbed by the work, the credit area is outside the plan-defined work limits, and the credit area's natural state is preserved for the life of the stormwater permit. Since this last condition is contingent upon agreements with the Forest Service, the credit is not at this time included in the calculations.

The effect on the water volumes is significant, and if Deerfield Wind can utilize this credit, it will. For example, a hypothetical 1,000-acre parcel, with 10-acres of impervious area within 100-acres of Project disturbance leaves 900 acres for the credit. Technical guidance suggests that the "site" is the lot, not the disturbance limits. So, ignoring the credit results in:

- R_V = 0.05 + 0.009 (10ac / 1000ac%) = 0.05 + 0.009 (1%) = 0.059
- WQ_V = (0.9 in) (0.059) (1000 ac) / (12 in / ft) = 4.425 ac-ft

Applying the credit results in:

- R_V is unchanged
- WQ_V = (0.9 in) (0.059) (1000 ac - 900 ac) / (12 in / ft) = 0.44 ac-ft.

Clearly, the credit is a benefit if we can make it work.

Recommendation: Coordinate with the landowners to ensure that the 3rd credit criterion is met: "Must be maintained in the natural vegetative state and restricted from development and disturbance for the life of the applicable stormwater permit."[10]

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[10] Vermont Stormwater Treatment Standards. Volume I, April 2002. Pg. 3-3.

Credit #3, the <u>Disconnection of Non-Rooftop Runoff</u> credit, appears applicable to several areas on the Project. There are areas on the ridge-top and near the operations and maintenance building, at which the land slope (under 5%) may allow use of the credit, subject to soil and groundwater examination.

The credit allows up to 1,000 square feet per discharge location. For a 38-foot wide road, this equates to approximately 26 feet. We propose that appropriately graded roads and adjacent land will receive discharges from perimeter swale outlets at 25-foot centers. The exact locations of such controls will be determined after suitable topographic data is assessed. Please refer to ***Exhibit DFLD-JK-8,*** *Non-Rooftop Runoff Disconnection*, for illustration.

The Disconnection of Rooftop runoff credit will not apply since this is not a residential project; notwithstanding that, runoff from the Operations and Maintenance building and the WTGs will be disconnected and infiltrated to the maximum extent feasible.

The stream buffer credit is similar to Credit #3, but only one or the other can be given credit, and the streams in this credit are typically associated with steeper gradients.

The grass channel credit is restricted to moderate to low density residential areas, and we expect that the average residence time for water of 10 minutes, as well as the maximum flow rate of one foot per second, would be issues.

The environmentally sensitive rural development credit is also restricted to residential developments.

Q. How do these controls comply with Goal #3 of the goals of Vermont's stormwater regulations: "Stormwater runoff generated from new development must be adequately detained and treated prior to discharging into a jurisdictional wetland or waters of the State of Vermont"?

Response. Project stormwater is detained and treated prior to discharge toward vegetated wetlands or waterways by use of the channels, swales, basins filters, and disconnections discussed within this testimony.

Q. How do these controls comply with Goal #4 of the goals of Vermont's stormwater regulations: "Annual groundwater recharge rate must be maintained, by promoting infiltration through the use of structural and non-structural methods"?

Response. Where practical, the Project uses the non-structural practices discussed in the Stormwater Manual and for Goal #2. Infiltration is possible in stormwater collecting channels and swales. Infiltration will be intentionally designed into the site basins.

Wherever possible, we will provide more, smaller groundwater discharge basins. This is consistent with the Project goal to retain natural drainage patterns. We understand that Vermont ANR will require verification of appropriate infiltration rates at basin locations. Given shallow bedrock in areas on-site and steep gradients, we expect that many areas would not provide approvable percolation rates, so some locations would require conveyance of water to better locations. On the other hand, shallow bedrock is often associated with soil types for which infiltration is waived. All this will be determined with additional fieldwork. At this point, Hill believes that the groundwater discharge requirement, where waiver by soil type is not justifiable, can be met with properly sized infiltration structures.

Water conveyance or infiltration will be accomplished in the perimeter swale, after impervious areas are collected in the roadside swale. With the proposed diversion system, the perimeter swale need only convey a one-year storm. Additionally, the frequent catch basins within the roadside swale may provide alternative locations for groundwater infiltration, subject to further review.

Q. How do these controls comply with Goal #5 of the goals of Vermont's stormwater regulations: "For new development, structural stormwater treatment practices (STPs) must be designed to remove 80% of the average annual post development total suspended solids load (TSS) and 40% for total phosphorus (TP)…"?

Response. The water quality volumes are conveyed to STPs that will be designed per the Stormwater Manual, and will be properly constructed and maintained. Infiltration structures for Goal #4 may also provide this volume, whether near the road in the catch basins or conveyed to infiltration structures or surface sand filters. Such structures may be places in the perimeter swale, notwithstanding any groundwater recharge incapability.

Q. How do these controls comply with Goal #6 of the goals of Vermont's stormwater regulations: "The post-development peak discharge rate must not exceed

the pre-development peak discharge rate for the 10-year frequency storm event unless specifically exempted" and the extreme flood protection standard?

Response. The Project stormwater management will not increase the 10-year storm or 100-year peak discharge rates, when fully designed. One concept we will use to meet this is frequent diversion of the larger storm runoff from smaller rainfall events that are subject to other goals.

By frequently (every 100-200 feet) allowing large storm events to pass into road-crossing culverts and disperse to shallow concentrated flow on the mountainsides, the water will not travel as quickly and the discharge will not be as intense.

Typically, stormwater management systems have multiple collection points for a single discharge point. The channels and pipes convey water much faster than the ground surface, allowing water to form a larger wave as it washes off the landscape. To compensate, an engineer can design a detention structure with multiple stages to control that single discharge point.

The proposed system still has conveyance to a single point, where necessary, for small storm control goals. By allowing larger storms to spill over at frequent small points, the water wave will not accumulate in a pipe system, but rather will be slowed by undisturbed ground and shallow flows. Subject to full analysis, the small-storm collection points will provide some retention or detention as part of the larger storms, too.

Please refer to ***Exhibits DFLD-JK-9A and DFLD-JK-9B*** for examples of stormwater calculations.

The Overbank Flood Protection Treatment Standard (10-year storm) controls site runoff as assessed with the 10-year, 24-hour, rain event. The post-development runoff peak discharge rate cannot exceed the pre-development condition's rate. This standard includes a downstream analysis to check a "10% rule", which may allow a waiver of this standard.

There are two possible waivers of the standard: First, the standard may be waived if the site discharges into a sufficiently large water body (not believed to be applicable to this project). Second, a small site may be waived if the channel's capacity is sufficient to convey post-development runoff down past the point of the "10% rule".

Subject to regulatory approval, the Project may be analyzed in segments at locations where the Project elements within the sub-watershed are less than five acres for compliance with this waiver. For the moment, we are not considering this waiver; however, we may apply this after significantly more detailed design efforts.

The Extreme Flood Protection Standard (100-year storm) is intended to prevent damage from extreme rain events, not increase the downstream flood zones, and protect the stormwater structures. The post-development peak discharge rates shall not exceed those of the pre-development conditions.

There are three possible waivers. First, discharge to a large water body (this does not appear applicable to the Project). Second, the site has no more than ten acres impervious area. Third, the downstream analysis indicates that controls are not necessary.

It may be possible to apply the second waiver; this would either be consistent with the Overbank standard on site segmentation or be based on the net finished impervious surface (currently, very close to ten acres).

Q. How do these controls comply with Goal #7 of the goals of Vermont's stormwater regulations: "…channel protection volume (CpV) must be provided by means of 12 to 24 hours of extended detention storage for the one year storm event or by the Distributed Runoff Control (DRC) method…"?

Response. While the larger storms are allowed to filter down the mountain wherever possible, the smaller storms are collected by a diversion mechanism. This mechanism is built up from pipe fittings and separates flow by its design rate. Smaller storms, with lower flow rates, flow in a small pipe. Larger storms will overtop that small pipe. This will detain the one-year storm, as required, but reduce the overall stormwater collected in the stormwater management system.

The small pipes will empty to the perimeter swale. The STPs for groundwater recharge, water quality, and channel protection are then built within the perimeter swale. This will better replicate existing groundwater recharge, reduce travel times in swales and keep runoff not only in its original watersheds, but near the original flow paths.

The above example neglects the Channel Protection Volume and diversions for treatment water calculations. Our perception is that this additional water detention will further reduce the developed area discharge component of the hydrographs, and will not place the model results into non-compliance with the 10 and 100-year storm events. The model can be expanded to areas further downstream to analyze other structures to demonstrate compliance with the peak discharge standards.

The Channel Protection Volume will involve 12-hour detention of the 1-year storm, which is 2.3" in Bennington County.[11] Again, please refer to ***Exhibits DFLD-JK-9A*** and ***DFLD-JK-9B***. The STPs intended to comply with the water quality, groundwater recharge, and channel protection volumes will be spread along the edge of the road. As mentioned previously, while the larger storm events use the ditch relief culverts as overflows, the smaller storms such as the 1-year storm event will be diverted into the perimeter swale. That swale is level enough at two locations to provide these STPs – the top of the knoll and at the bottom near the GMP access road. If percolation tests indicate viability for infiltration, there will be infiltration structures for the groundwater recharge, as well as unaccounted-for recharge from the swales and check dams. This design will take into account the presence of hydrologic group 'D' soils, which due to their nature will have recharge waived. Where STPs are located and groundwater recharge is infeasible, the water quality will be met with the surface sand filter, and the Channel protection volume will either be a surcharge on that volume or a separate detention basin, using the perimeter swale. If the channel protection volume is located only near the GMP access road, then in that approximately 150 feet of level area, the swale would have an average 15-foot width for 18" depth (shallow structure is reasonable on this topography). Taking

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[11] Vermont Stormwater Treatment Standards. Volume I, April 2002. Pg. 1-4, Table 1.2.

into account that we can also locate a detention area on the knoll, the average width is reduced to 8 feet. The design will be based on the **Harrington, 1987** approach, which corrects the calculation when there is a substantial difference between the STP discharge and uncontrolled discharge from other areas.

There are three possible waivers to this standard. First, expansions of up to one acre impervious cover may be waived. This Project does not comply. Second, pre-routed post-development discharges of less than two cubic feet per second are waived - this may apply. Third, a site that discharges into a water body of at least ten square miles and that would be less than 5% of the watershed area at its upstream boundary. Since the site's upper boundary is the ridge-top, it accounts for roughly all of the watershed at that point (*i.e.*, this is not applicable); also, no discharge goes into a water body of so large a watershed area, anyway. See below for more information on the second waiver.

Q. How do these controls comply with Goal #8 of the goals of Vermont's stormwater regulations: All STPs must have an enforceable operation and maintenance agreement to ensure the system functions as designed. In addition, every STP must have an acceptable form of water quality pretreatment"?

<u>Response</u>. The operations and maintenance plan will be developed as part of further work on the Project and will take into account input from the Forest Service, ANR and Deerfield Wind.

Q. How do these controls comply with Goal #9 of the goals of Vermont's stormwater regulations: Redevelopment and infill projects should maximize the treatment and management of runoff from existing impervious surfaces"?

Response. This project is not a redevelopment project on the ridges. The only conceivable "redevelopment" of Putnam Road and the GMP access road will comply with this goal.

Design work on Putnam Road, in particular, will strive to meet standards as new development, given potential issues with discharges directed under Route 8, contributions from newly developed areas nearby, and the snaking of the road into heretofore vegetated areas. ***Exhibit DFLD-JK-2*** (CS112) illustrates detention basins that will be installed for the stormwater controls. This is one of the few areas where large basins are being pursued. The stabilized construction entrance will be constructed of pervious open-graded gravel. The large basin nearest Route 8, currently sized to attenuate the 10 and 100-year storm peak discharges, will collect the re-routed Putnam Road's stormwater runoff.

The GMP access road will receive the same types of stormwater controls as the rest of the Project. By necessity, the stormwater runoff from widened roadway segments will incorporate runoff from existing graveled surfaces.

Q. How do these controls comply with Goal #10 of the goals of Vermont's stormwater regulations: "Stormwater discharges from certain intensive land uses or activities with higher potential pollutant loadings be required by ANR to use specific structural STPs and pollution prevention practices"?

Response. This is not believed to be applicable to the Project because the site does not appear in the Vermont Stormwater Treatment Standards hotspot identification (Section 2.6, table 2.3). The Project will not generate higher concentrations of hydrocarbons, trace metals, or toxicants.

Q. How do these controls comply with Goal #11 of the goals of Vermont's stormwater regulations: "To the maximum extent practical, surface discharges from stormwater management practices should be returned to the same drainage catchment or watershed that the majority of runoff originated in"?

Response. The Project will comply with this standard. This is discussed in other areas of the testimony.

Q. Will the Project cause unreasonable soil erosion, or reduction in the capacity of land to hold water so that dangerous or unhealthy conditions result?

Response. The Project will not cause unreasonable soil erosion. The Project will not reduce the land's water capacity so that a dangerous or unhealthy condition will result.

As required under the NPDES Construction General Permit for construction activities that will disturb more than 1 acre of land, the Project will develop an *Erosion Prevention and Sedimentation Control Plan*. Since the particulars of the Project are still in flux, the detailed plan is not complete. However, we have some details for presentation. Hill has reviewed the current General Permit, and its Appendix A risk checklist; at this point, we believe the risk factors less any possible mitigation factors would likely require an individual permit.[12] If possible and permissible, the Project would be designed minimize the risk factors (such as direct conveyance to class A waters, the size of soil disturbance areas, and duration of activities in any one area) and maximize the mitigation factors (such as 50-foot vegetative buffers wherever possible).

The Project will preserve existing natural drainage paths that it crosses and utilize oversized culverts for natural channels and small pipes for parabolic swales or saddles (*i.e.*, no actual cut channel).

Q. Will there be an EPSC for the Project?

Response. Yes, there will be a site-specific EPSC for the Project, to be submitted to ANR at a later date in conjunction with the NPDES permit application. This will comply with the EPSC standards; the Project is being designed with these draft standards in mind.

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[12] NPDES General Permit 3-9020 VTR100001. Effective September 13, 2006.

Q. What preliminary information has been compiled for the EPSC?

Response. Arrowwood Environmental provided soil survey data to Hill, which has been incorporated into the plans (***Exhibit DFLD-JK-10,*** *Soil Fact Sheets*). The soil fact sheets are also attached as ***Exhibit DFLD-JK-11***.

Hill has overlaid the Project on USGS maps that were digitized in the Topo! mapping program and exported to our digital terrain model (DTM). This information is not presented in its entirety here, although we have included other USGS mapping to illustrate the site.

Arrowwood Environmental has been compiling information on wetlands; at the appropriate juncture, their data and the National Wetland Inventory maps will be incorporated into the ESPC.

The mapping activities undertaken to date have inventoried existing stormwater infrastructure on site (excepting the GMP access road), established existing topography, located existing structures and allowed estimation of existing drainage patterns.

The mapping will be updated to provide more detail. Currently, the mapping is at 5-foot contour intervals, which is sufficient to locate the road, but does not identify minute details. Hill recommends that future mapping provide contour intervals of 2 feet, to capture stream channel sections and other relatively fine features within 300 feet of the Project disturbance or as otherwise appropriate.

That mapping will be used to develop the site's Drainage Map. We can, at this point, estimate flow concentrations and paths, contributing areas, sheet flow length and slope, receiving water proximity, and impacts to existing drainage structures or obstructions near the Project footprint.

Q. What is the Soil Erodibility on site?

Response. Soil erodibility will be measured by the Revised Universal Soil Loss Equation (RUSLE), as required by the EPSC plan guidance. This is a scientific and widely accepted method to estimate soil loss. This uses the equation

A = (R)(K)(LS)(C)(P)

Where

R (rainfall value) from EPSC standards, Figure A.2 = 97

K (soil erodibility factor) from USDA soil fact sheets = 0.28 to 0.64. This varies across the site, and by depth within the soil.

L (slope length) = typically under 50 feet, but may be as long as 100 feet.

S (slope gradient) = 50% on 2:1 side slopes.

LS factor from EPSC standards, Table A.2, is not expected to be > 9.

C (surface cover) = 1 for areas under construction, 0.1 after mulching.

P (operations) = 0.9, assuming soil roughing on worst-case slopes.

Reasonable worst-case:

A = (97)(0.64)(9)(1)(0.9) = 503 tons/acre/year.

This is a loss rate that reflects the relatively instantaneous new construction condition. When the site is stabilized with mulch, vegetation or flow paths are reduced and there will be a correspondingly lower loss rate. Obviously, timely stabilization is critical in an area such as this.

Generally speaking, we expect the K factor to be above 0.36, or "high". Given the soil slopes, the site has a high risk of soil erodibility (Table 3.2). The standards then expect to have prompt stabilization, runoff/flow control, and large sediment control. Each of these is provided, as noted below. ***Exhibit DFLD-JK-10,*** *Soil Fact Sheets***,** also indicates these soils are highly erodible.

Q. Are there any foreseeable "problem areas" as discussed in the draft EPSC Standards?

Response. Areas where the roads go relatively straight up-and-down the grades will have larger issues than areas in which water can be distributed across the slope. The water in those up-and-down areas will accumulate stormwater. The solution is to divert the water to either side of the road.

The areas near public rights-of-way will also engender more attention. We do not want eroded materials to accumulate in public stormwater structures, interfering with their operations. These are near Route 8, both at Putnam Road and Sleepy Hollow Road.

Areas closer to wetland resources will also garner more attention, such as between turbines 9W and 10W and 4E and 5E, and the Putnam Road access road east of the substation.

The EPSC plan guidance discusses disturbance minimization and existing topography maintenance. While the Project does attempt to reduce clearing, the types of equipment that will be used for Project construction will not allow substantial reduction of the proposed access road width. Those same types of equipment demand certain roadway geometries, which include certain turning radii and vertical curves, which will in turn create cuts and fills. We have endeavored to locate Project roadways to reduce cut and fill, but these cuts and fills will nevertheless appear substantial to lay viewers.

We do attempt to retain existing vegetation, where practicable. The turbine areas do not need to be totally grubbed for construction. We propose to retain vegetation where blades will project during assembly, as part of phasing. When that vegetation is removed, the roots and small plants may remain.

We will utilize the three precepts of erosion control – diversion around the disturbance, controlled conveyance through the disturbance, and dispersing outlet flows.

We also intend to have stabilization activities keep pace with earthwork progress along the roadways.

Q. What are the proposed erosion controls for the roads?

Response. The erosion and sediment controls are conceived to, in part, dovetail with finished stormwater controls.

Where there are cuts into the slope, there will be diversion berms above the cut and slope drains to convey the water down-slope to roadway-crossing culverts. Slopes themselves will be roughened when appropriate, and seeded and mulched as soon as work allows. The slope drains will be rip rap channels, re-using rock material removed from the site. There will be a channel at the bottom of the slope, collecting both roadway and slope runoff. That channel will be either armored with rip rap or a geotextile mat, depending on grades and channel velocities. Sediments from the road or the slope, both during construction and until final stabilization, will be caught by either stone check dams or sedimentation fence checks (preferred), again depending on grades. Water will, after passing through such checks, enter the roadway-crossing culverts for distribution across the slope or (when completed) treatment structures. Checks will be spaced frequently, to maximize sediment collection; the minimum frequency will be determined for each roadway segment as we assess soil types in more detail, with additional checks installed by the contractor as necessary.

The area down-slope of the road will drain to the perimeter swale. Just like the roadside swale, the perimeter swale will have check dams (stone preferred). The perimeter swale will also have sumps, where sediment may accumulate and would not be removed at the end of the Project but rather stabilized by stone or vegetation.

Both cut and fill slopes will have coir logs or sedimentation fences, and geotextile fabric. The logs or fences will be installed along longer slopes, and above the perimeter swale. The geotextile fabric will be used on steeper slopes and depending on the underlying soil characteristics.

There will also be a stabilized construction entrance at the toe of Putnam Road. This does not appear to be necessary on Sleepy Hollow Road, as the traffic drives over a substantial distance of existing gravel road, and Sleepy Hollow Road is also gravel.

Q. What are the proposed erosion controls around the turbine areas?

Response. The turbine areas will have similar issues to the roadway, with relatively significant cuts and fills. The differences lie in the radial nature and the absence of graveled roadways. The impervious areas will be the turbine itself and the crane pad, which will revert to an access road.

The turbine area can be divided into several areas. The area immediately around the turbine foundation will be leveled to around 5% for vehicles. Outside of that area, there will be cuts and fills for the leveled vehicle access. Outside the cuts and fills, there will be cleared areas where the blades project during assembly, areas where grubbing is not necessary.

Cuts and fills will have diversion berms on the high side when the cut is extensive enough, when there is sufficient undisturbed watershed above the cut, or wherever there is fill. The diversion water will be channeled to the side(s) of the leveled area when coming from a cut. The diversion water will be conveyed down stabilized channels over the fill slope or diverted to the outside edge of fill slopes.

Again, the Project will be phased to limit open and exposed soils and vegetation removal will be reduced wherever possible. Typically, WTG suppliers specify a circular clearing area, entirely graded. Hill proposes a two-phase WTG clearing, so that the grubbing and disturbance for the turbine's foundation is limited and tree clearing is limited to that absolutely necessary for turbine hub assembly. The duration of unstabilized soil's exposure will be limited when the EPSC Plan is eventually developed (typically 5-8 weeks for each segment), and seeding restrictions within the Construction General Permit will be adopted.

Q. What are the proposed erosion controls along the power line?

Response. The power line clearing and construction is unique in that there will be neither embankment nor impervious area construction and that the clearing can occur on far steeper slopes than the roadway and turbine construction. The slopes can run significant distances and average over 30%. The steepest gradients, at least on the west ridge, run parallel to the transmission line connector path.

When the transmission line is installed, a portion will be underground. This is a safety and security feature where the line is closer to the turbines. This will prevent damage that might otherwise occur to overhead lines, such as by tree falls.

Further down the ridge, the transmission line will be strung on utility poles. Those poles will require clearing of approximately fifty feet in width to keep branches or trees from impacting the transmission line.

The underground installation will be either a direct-buried cable or a shallow cable encased in concrete. The method will depend on the depth of soil, and the presence of ledge rock or boulders that interfere with trenching. The worst case is a trench that will be constructed running down the west ridge up to perhaps one-half way to Route 8.

The actual disturbance will be narrow. Consistent with EPSC plan guidance, no more than 500 feet per day of trench would be opened. The trench would be seeded and mulched, with periodic diversion structures to prevent scour along the trench's length. This would be coir logs or sedimentation fences.

Q. What other generic erosion control measures will be on site?

Response. Wherever possible, there will be a buffer strip of vegetation of at least twenty-five feet between the Project disturbances and nearby vegetated wetland resources, per discussion with Vermont ANR.

Finished graded slopes will be seeded and mulched within a week's time. Mulch could be: 1) weed-free straw (placed loose on gentle slopes); 2) an erosion control and re-vegetation mat (ECRM) that is stapled to slopes (swale bottoms, concentrated flow areas, long slopes with more rilling potential or slopes greater than 3:1 slope); or 3) standard mulch incorporated into hydroseed mixes (small areas, gentle slopes). The mantra of mulching quickly and minimizing disturbance areas will be an important element on this site. During construction, the slopes can be roughened to improve infiltration characteristics (typically, running a bulldozer up/down a slope). Also, the re-loamed and seeded roadway segments will have interceptors, to reduce erosion until plants are established.

There will be coir logs (wattles) or stone check dams and barriers installed across the site at strategic points, including along diversion channels and channel ends. Coir logs (wattles) are an alternative to silt fence or earthen dikes. They would likely be installed at less accessible locations (if left, they will degrade), where leakage around bales is less of a concern, on less steep slopes where rollover is less of an issue, and crossing swales in the landscape (then, built like a check dam).

Snow fencing will be installed along down-gradient slopes, at least within one hundred feet of any wetland resources.

Near wetland resources, both would be used. There, dikes will keep water away from the wetland, and the coir logs and/or silt fence will serve as backup should the diversion dike become clogged during a significant rain event. Equipment will be encouraged by the snow fence line to leave the diversion dikes unmolested. After coir logs, silt fence and snow fence are removed, the diversion dikes will remain, as will stilling basins, to infiltrate water.

All channels, whether above the cut slope or at the termini of stone channels, will end in stilling basins that collect sediment.

Any borrow pits and stockpiles will also be stabilized. Existing pits will continue to exercise erosion control and new pits will apply the above-noted methodologies. Stockpiles will be sites on the most gentle of site gradients, as far away from wetland resources as is possible (and no closer than 100 feet), in existing cleared areas if possible, and will be ringed with erosion control barriers.

Hill recommends that the Project use water for dust control, dispersed from a water truck. This could be filled from a nearby dwelling's water supply, most likely filled at the operations/maintenance building's well. Such water would be applied as necessary and any runoff considered in overall stormwater design (expected to not be significant compared to actual storm events).

There would be a monitor on site, as required in the General Permit (or Individual Permit), to observe, inspect and document control performance and maintenance /repair activities. All such erosion control measures will be inspected weekly and after storms of more than ½-inch rainfall as recorded at an on-site rain gage. The specifics of observation, inspection, record keeping, maintenance and repair will be coordinated with the General Permit (or Individual Permit).

Q. What about winter work?

Response. If work does not extend past October 15, the Project will incorporate the guidance regarding winter shutdown. This includes establishment of vegetated stabilization by September 15 wherever possible, non-vegetated stabilization only where necessary. Where mulch is used, it will likely be netted or crimped in to reduce blow-away.

In the event that portions of the site are under construction between October 15 and April 15, additional measures will be undertaken. These include space for plowed snow, for access and near erosion control structures; a snow management plan; thicker mulching and netting to reduce blow-away; stone stabilization in areas of construction vehicle passage, and other suggested erosion control measures that are recommended by the EPSC Standards, as appropriate.

Q. Will there be sufficient water available for the reasonably foreseeable needs of the Project?

Response. There will be sufficient water available for foreseeable needs.

First, as outlined above, water will be used for dust control. Any dwelling-type service will work. The contractor will feed the hose into the tank and fill up over the hours, and then have a full water truck ready and waiting. Worst-case analysis: using a 3,000-gallon tank of dust control water, two trucks per day, has an average of 4.2 gallons per minute (gpm) withdrawal rate from a well. An average wellhead production rate is 5-6 gpm in Hill-Engineer's experience. That is worst case; typically, the truck could fill overnight and be ready for next day's use one-time. Additionally, there will be weekends, holidays, rainy days, winter…such use should be imperceptible in nearby wellheads.

Second, boring equipment for foundation design may require water. Typically, such work is wet-drilled. However, if the work is done in the winter, the boring may use air to purge spoils (we would not want the boring machine to freeze up, literally!). That amount would be on the order of several hundred gallons at a time, spread out over later construction periods.

Third, there will be the long-term staffing at the operations and maintenance building that will require potable water. We expect that the employees would demand approximately 60 gallons per day over the life of the Project.

All these needs can be met with a typical house well, and all indications are that such a well can be drilled on-site, would produce adequate water, and I believe that such demand is sufficiently small as to not present an impact to nearby wells.

Q. Will the Project cause an unreasonable congestion or unsafe conditions on public roads?

Response. The Project will not unreasonably congest or make unsafe any public roads.

DURING CONSTRUCTION: Transportation of WTG components may be seen as intriguing in their size and complexity; however, they are transported by vehicles intended to fit to existing infrastructure in good repair. There clearly are several distinctions from typical vehicles that cross the State of Vermont:

Weight. The load trailers have axle numbers that distribute load, to ensure that the gross weight does not exceed the structural limitations of pavements or bridges. The current critical point may be the long span bridges, a point that will be scrutinized in great detail as the Project progresses. The current worst-case load is 78 tons, plus a tractor-trailer combination with more than fourteen axles. The Project will need to assess the longer spans, over which the trailers cannot span the load.

Length. Many of the tractor-trailer combinations that bring components to the site will be longer than the typical. The current design vehicle (for horizontal turning characteristics) incorporates a blade for a 295-foot (90 meter) diameter rotor (roughly, ½ that diameter). While I have assessed Project roads and started assessments on nearby public ways, design constraints have not been completely identified. However the route analysis works out, the horizontal geometries of the public way will not pose a problem to the Project as Deerfield Wind simply can use more flexible, but more expensive, equipment for site access. Such equipment includes the Gold Hoffer, a self-propelled trailer, or trailers with steerable rear axles. As the Project development continues, there will be continued assessment of available public way and potential easements to provide the optimal transportation method.

Also, to the extent that minor improvements would be needed to public roads, the cost would be borne by Deerfield Wind.

<u>Traffic volume</u>. The Project traffic, for this discussion, can be divided into several parts.

<u>Road construction</u>: Large numbers of dump trucks will work around the site, hauling to and from the off-road excavators, tractors and trucks that build this Project. The exact number cannot be known at this time, as issues of site volume balances, amounts of rock versus soil in the existing ground, and fine points of grading are yet to be addressed. There is no reason to believe that this Project is any more inconvenient than highway upgrades that VTrans has routinely engaged; the recent Route 9 upgrades are a good example. In this case, the bulk of material manipulation is well off the public way, away from passers-by. Worst case, for dump trucks moving materials from stockpile to roadwork areas, is currently estimated at 10 trucks per hour.

<u>Component transport</u>: This will depend upon the final turbine number and selection. Each turbine may need eight component vehicles (four tower loads, nacelle load, hub load, two blade loads) plus miscellaneous smaller loads for such items as electrical equipment.

No use of airports is planned at this time. The only foreseeable option would be the use of helicopters to transport light components (*e.g.*, blades). Any such work would be coordinated with the relevant regulatory authorities for airport access, laydown areas for rigging helicopters, fuel storage and flight plans. Any use of helicopters, if possible, would provide a net benefit by reducing highway transport time (thereby reducing congestion concerns). However, there are significant unknowns (component weights, permissibility, public safety, worker safety, and costs), and at this time, Hill does not endorse this transport method.

DURING OPERATIONS: Project-generated traffic during the operational phase, based upon several employees, is not expected to cause any traffic problems. See letter correspondence from Craig S. Keller, Vermont Agency of Transportation, attached to John Zimmerman's testimony as ***Exhibit DFLD-JZ-17.***

Q. Have you relied on the work of any other experts concerning this Project?

Response. I relied on the input from crane and transport company representatives, the input of Arrowwood Environmental's wetland expert, and Deerfield Wind's representatives on property issues and turbine selections.

RECOMMENDATIONS

Q. Describe your recommendations to Deerfield Wind regarding the design and siting of the Project based upon the results of your investigations and analyses.

Response. Hill's current roadway layout recommendations are represented on the "20-percent" design drawings. Exhibit ***DFLD-JK-2***

Roadway design is, even with all the above information, incomplete. Hill design work was intended for route selection and impact assessment. As the process continues, there will be additional input from the Forest Service, VTrans, ANR, the Town and other appropriate agencies.

We recommend:

Vegetation restoration: As noted above, roads that are constructed based upon the needs of construction-phase equipment should receive loam and seed over portions of that width. The road grade for its full width should be retained for, at least, the eventual Project decommissioning. However, it is unnecessary to maintain the full width as gravel, and so portions of the road width should be loamed and seeded, with occasional mowing to control shrub and tree growth. Vermont ANR has also expressed interest in Deerfield Wind's preparation of a "Vegetation Management Plan".

Turbine sites: Only the foundation site and associated cut and fill areas need to be grubbed and thoroughly disturbed to approximately a 150-foot diameter. The outlying areas, where the blades of the assembled rotor will project, can be cleared with stumps and roots retained, for erosion control.

Erosion control: Deerfield Wind should coordinate with the general contractor, once selected, to ensure successful implementation and protection of wetland and habitat resources.

Deerfield Wind should also obtain a geotechnical report regarding slope stability. This will provide data for the design of reinforced slopes where necessary.

Stormwater control. Conduct a thorough watershed evaluation to locate potential downstream issues and to determine waiver applicability. Also, there should be a clear maintenance plan and a commitment to ensure successful implementation and protection of wetland and habitat resources, abutting undisturbed property and the public way.

This will involve a detailed assessment of nearby roads and culverts, to ensure adequate capacity in existing structures.

This will also involve a detailed assessment of site soils, to better understand limits for both short-term erosion control and long-term stability under stormwater influences.

Percolation tests should be run at the proposed STP locations, to ascertain where infiltration is viable, including groundwater elevations.

Transport issues. Once the turbine components are ascertained, or at least the upper limits of weights and dimension, further discussion and formal presentation should proceed with VTrans. In particular, discussions should be had with VTrans regarding the bridge crossings. We recommend this prior to finalized project design or construction scheduling. In previous consultation, VTrans has indicated pending construction work near Bennington in which highway construction may alter transportation plans. Deerfield Wind may also want to present a hypothetical load shipment, and pay the associated fees to verify shipping routes, as part of construction planning and project financing.

We should conduct further review of the GMP access road and the Sleepy Hollow Road. The property ownership and rights for betterments needs to be better understood as design progresses. The wetlands along the GMP access road should be completely flagged and located, so that potential impacts of the current transportation design can be fully understood and modified where necessary.

The wetlands along the entire route should also be instrument-surveyed, so locations will be as precise as reasonably possible.

Q. Does this conclude your testimony at this time?

Response. Yes, it does. Thank you for your attention.