

A Landowner Checklist for Replanting Areas Impacted by Natural Gas Development

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If you are a landowner who will be impacted by natural gas development and infrastructure on your property(ies), you need to be involved in the planning process from start to finish. While some parts of the process are out of your control, staying informed and keeping the lines of communication open are in everyone's best interest. Even if you cannot be a part of all phases of development, there are things impacting your property that you can take an active role in planning. One major area of involvement will be that of reclaiming areas of disturbance caused by natural gas development. Depending on the type of development, the amount of surface disturbance will vary. Yet regardless of what disturbance is caused, minor to major amounts of reclamation will be required. All landowners; those owning their mineral and surface rights and those who own surface rights only, have the opportunity to oversee reclamation on their property.



Figure 1. Typical Marcellus Shale well site in West Virginia. Photo reprinted with permission of West Virginia Department of Environmental Protection.

The natural gas industry disturbs significant land areas during exploration, development, and transfer causing soil disturbance and water quality impacts. Once a drilling operation, compressor station, road, or pipeline right-of-way is complete, the land must be returned to a sustainable and usable condition that meets the desires and goals of the landowner. Reclamation involves returning the area to the approximate original contour by grading and replacing topsoil based on regulations established by the West Virginia Legislature and enforced by the West Virginia Department of Environmental Protection. It also involves replanting the disturbed area(s) with the appropriate species that meet the landowner's

objectives. The species may include grasses and legumes for pasture and hay land or may include an herbaceous cover into which trees are planted. Once the soil has been prepared, proper methods must be followed in order to effectively reclaim the area to pasture land, hay land, forest land or wildlife habitat.

The goals of this fact sheet are to:

1. explain the basic processes involved in reclamation following natural gas development;
2. provide a checklist to ensure proper reclamation and re-planting on areas impacted by natural gas development; and
3. offer guidance in choosing appropriate seed mixtures for re-planting on your land.

What Areas Need to Be Replanted?

Any area of soil disturbance (drilling sites, compressor stations, road banks, pipeline rights-of-way, etc.) will require reclamation. Be aware that certain areas may not be returned to their former use. For example, pipeline rights-of-way through woodlands cannot be replanted in trees. However they can be utilized as new pasture land, hay land, or developed into habitat for wildlife. Some disturbed woodlands may allow for the replanting of trees within a certain distance of permanent drilling infrastructures such as a well pads.



Figure 2. Cleared corridor for natural gas pipeline. Photo reprinted with permission from Amir Hass, West Virginia State University.



When Does Reclamation and Replanting Begin?

The real work for reclamation and re-planting on these sites should start before a contract with the natural gas company is signed. Whether you own the mineral rights on your property or the surface rights only, all landowners have the opportunity to decide what types of grasses and legumes they want planted on their land when the job is completed. When developing a lease agreement or surface disturbance agreement, be sure to state in writing what you want.

What Occurs During the Development Phase?

There are three main phases of natural gas development: pre-disturbance, disturbance, and post-disturbance. Each phase may be controlled by different people, use different types of equipment, and impact the land differently during the different activities that occur.

Pre-Disturbance:

During the pre-disturbance phase when a leasing or surface agreement is being developed, it is important to put in writing that the company will conduct a site survey. The West Virginia Department of Environmental Protection, Office of Oil and Gas under the West Virginia State Code 22-6-6(d) 22-6A-7c) requires that an erosion and sedimentation control plan shall accompany each application for a well work permit¹⁰. This plan serves as the basis for the site survey and will: 1) establish pre-existing soil fertility (soil testing), 2) establish an inventory of what is currently growing on the site, 3) identify areas of concern, and 4) provide aid for re-establishing plants. This will allow you and the replanting company to ensure the appropriate seed mixtures are used. You can choose to design a seed mixture of your own or use one the company recommends for your area and growing conditions.

West Virginia University has a certified soil testing lab that provides free soil testing for West Virginia landowners. Soil test kits are available at all 55 WVU Extension Offices. Soil test results will tell you the existing soil fertility by providing information on pH, nitrogen, phosphorus, potassium, and other soil nutrients, and will also give recommendations for lime and fertilizer applications. Applying too little or too much of either results in poor plant growth or nutrient waste. Your county WVU Extension Agent can help you with interpreting soil test results. Natural gas companies also work with independent labs and may agree to take care of soil testing through their lab. Please note that soil test results from WVU will take significantly longer to obtain than test results from an independent lab. If the natural gas company will agree to handling soil testing at an independent lab, have them do it. The independent labs can perform additional analyses the WVU lab is not equipped to provide.

The types and species of plants before disturbance should be documented, mapped and an inventory created. This will help you with restoring the areas to their original plants, preserving critical areas, and saving sensitive plants for relocation to another area. Note that forested areas where trees are removed will not necessarily be replanted in trees, but rather in grasses and legumes suitable for shady areas.

Areas to be disturbed should have site evaluations conducted. A good site evaluation will contain, besides just a list of the existing plants, an identification of soil types, water/wet areas, sensitive areas, rock



outcroppings, existing structures, slopes, and other land features that might need to be avoided or require specialized treatment for proper reclamation.

Disturbance:

Once the agreements have been signed and approved, a time period of inactivity will occur. Since natural gas companies work year-round, the land disturbance on your property can happen at any time. Be prepared for disturbance, reclamation, and replanting to occur during any season. Understand that this can disrupt your normal activities such as gardening, grazing, hunting, hiking, etc. It may also occur when you least want it, like during winter cold and rainy times, which will create extremely muddy conditions and impact the soil and water.

During disturbance, heavy equipment of varying types will be on your property to remove plants and soil. Be prepared for noise, dust and possible adjustments in your normal activities. Salvage and stockpile any existing topsoil (down to four feet) for re-distribution onto the site during reclamation. Protect the stockpiled topsoil from erosion by temporarily seeding the pile with an annual grain (wheat, rye, etc.). Be sure to save topsoil from all developed areas including the drilling bench, ditches or water catchment area, roadways, and pipeline rights-of-way. Always stay informed about what is occurring, and communicate with the company(ies) to ensure that your contract agreements are being followed.



Figure 3. Preparing a Marcellus well site. Photo reprinted with permission from Jeff Skousen, West Virginia University Extension Service.

When the main job is done, reclamation begins. During this phase, the land should be re-contoured and the preserved topsoil replaced at a thickness similar to when it was removed. This will allow the site to be replanted with plants similar to those that were originally present.



Post-Disturbance:

Soil Prep: Once the land has been re-contoured and topsoil replaced, the process of replanting can begin. The company conducting the replanting should determine soil fertility levels post disturbance by re-testing the soil at a soil testing lab and adding the recommended rates of lime and fertilizer needed to produce suitable vegetative cover before replanting. By conducting pre- and post-soil testing, you will also have justification for adding soil amendments to ensure the land is replanted as similarly as possible to its pre-disturbance state. We strongly recommend that a soil test be done (to avoid under- or over-application of lime and fertilizers), but if one is not conducted, we recommend you apply 3 to 5 tons/acre of lime and 500 pounds/acre of 10-10-10 N-P-K (Nitrogen, Phosphorus, Potassium) fertilizer⁶. This will help to ensure a continuous plant cover to protect the soil from erosion.



Figures 4 and 5. Hydroseeding following reclamation on a natural gas well site¹ (l) and natural gas pipeline right-of-way² (r). Photo reprinted with permission from Jeff Skousen¹, West Virginia University Extension Service, and Amir Hass², West Virginia State University.

Replanting: As the soil is being replaced and amended, you should talk with the company in charge of replanting to confirm their plans to plant the seed mixtures you had specified in your lease agreement. Since the replanting processes may occur during any time of year, and reclamation laws stipulate that reclaimed areas must be replanted within 30 days of when the project is completed ([WV Code § 22-6A-14 \(2014\)](#)), know that replanting can take place at any time of year and not necessarily under the best growing conditions. In certain situations it may be advisable to seed an annual for temporary stabilization and have the area re-seeded with the desired permanent seed mix in the spring. For example, if replanting occurs in November, use a temporary seeding of winter wheat then follow-up with the permanent seeding during the spring growing season. This approach can be quite valuable in soil conservation efforts.





Figure 6. Composite aerial photo showing an agricultural field in West Virginia before, during, and after natural gas development (l-r). Photo reprinted with permission from Rebecca Flanagan, Natural Resources Conservation Service, Weston, WV.

Be aware that sometimes replanting does not work well for a variety of reasons. Regardless of the season when replanting occurs, if regrowth is poor within 45 days after replanting, the natural gas companies are obligated to come back and replant the area to ensure good growth and coverage of plants. Planting from January to early March almost always requires replanting.



Figures 7 and 8. Properly reclaimed natural gas well site¹ and natural gas pipeline right-of-way². Photos reprinted with permission from the West Virginia Department of Environmental Protection¹ and Amir Hass², West Virginia State University.

Below is a guide for understanding the best times for replanting an area.

- Seeding Date Selection
 - Best Dates: March to June, and late August to early October
 - Worst Dates: June and July, and December through February. Seeding can be done during these times, but weather conditions may limit success.
 - Frost Seeding/Seeding on Snow: February or early March.
- Legume seeds must be inoculated before seeding.



While all of this may sound complicated, making sure you are satisfied with the completed project is critical. The following checklist will assist you with reaching your goals.

✓ Checklist for Replanting Your Land⁶

Specify the following in writing in your lease/soil disturbance agreement.

A. Pre-Disturbance

- Conduct pre-disturbance soil testing.
- Conduct an inventory and create a map of existing plants.
- Conduct a site evaluation to determine areas of concern or areas for preservation.

B. Disturbance

- Topsoil should be preserved properly and held in undisturbed areas for reuse.
- Adequate erosion control measures should be taken.
- Ensure areas outside of the disturbance zone are not impacted.

C. Post-Disturbance

- Preserved topsoil should be pushed back onto the contoured areas at a thickness similar to before the land was disturbed.
- Areas of compacted soil should be scarified to a depth of 2-3 inches for good seed germination and rooting to occur.
- Conduct post-disturbance soil testing.
- Apply lime and fertilizer based on soil test results.
- Plant the proper seed mixtures using low or no-till (i.e. hydro-seeding) methods to stabilize and provide a suitable use of the site.
- Seed mixtures are site specific but general recommendations are included at the end of this fact sheet.
- Mulch with straw (if no-till methods are used) at a rate of 1.5 tons/ac of straw mulch. (Hay can contain seeds from non-native and exotic species, thereby encouraging their spread). Mulching is not needed if the area is hydro-seeded.

D. Post-Seeding

- Re-evaluate the areas to ensure good coverage of plants has occurred in successive years.
- Re-seed areas that did not respond well to replanting.

For more information on reseeding areas disturbed by natural gas exploration and development, refer to the *References and Additional Information* section of this fact sheet. You can also contact your West Virginia University Extension county office or the WVU Extension Specialists listed below, based on their area of expertise.



West Virginia University Extension Service Specialists

Dr. Sheldon Owen-Wildlife

Dr. Ed Rayburn-Agronomy: Pastures and Haylands

Dr. Jeff Skousen-Land Reclamation

West Virginia University Extension Service County Offices

http://www.ext.wvu.edu/county_offices



Recommended Seed Mixtures and Seeding Rates/Acre based on your projected goals for your reclaimed land.

A. If you want Pastures and Hayfields⁴

Species	lbs/acre	Species	lbs/acre
Mixture #1		Mixture #3	
^a Tall fescue, endophyte free	12	^b Tall fescue, endophyte enhanced	12
^c Kentucky bluegrass	3	^c Kentucky bluegrass	3
^d Red clover	6	^d Red clover	6
^e White clover	2	^e White clover	2
Mixture #2		Mixture #4	
^f Orchardgrass	8	Smooth bromegrass	10
^c Kentucky bluegrass	3	Timothy	8
^d Red clover	6	^d Red clover or ^g alfalfa	6
^e White clover	2	^e White clover	2

Notes:

Seeding rates are for pure live seed; adjust for labeled germination rate.

Do not use KY-31 endophyte-infected tall fescue on pasture or hay land due to its toxicity to livestock.

For hay land on well-drained soils, 8-12 lbs. of alfalfa seed/acre can be substituted for the red clover.

Recommended Varieties

^aTall fescue, endophyte-free

Select, Barolex, Pennington

^bTall fescue, endophyte-enhanced

Max-Q, BARPtima+E34

^cKentucky bluegrass

Kenblue, Ginger

^dRed clover

Cinnamon+, Freedom

^eWhite clover

Will, Durana

^fOrchardgrass

Benchmark+, Olympia, Persist

^gAlfalfa

Those with high disease resistance



B. If you have Woodlands that you will be converting to permanent openings (Roads and Pipeline Rights of Way)^{7,8}

Basic grass and legume mixtures			
Shaded Areas	lbs/ac	Sunny Areas	lbs/ac
Mixture #1		Mixture #1	
Late summer and fall		Late summer and fall	
Lathco flat pea	30	Winter wheat	50
Winter wheat	50	Crimson or red clover	12
Creeping red fescue	15	Creeping red fescue	15
Mixture #2		Mixture #2	
Spring and summer		Spring and summer	
Lathco flat pea	30	Annual ryegrass	20
Annual ryegrass	20	Crimson or red clover	12
Creeping red fescue	15	Creeping red fescue	15

C. If you are hoping to provide Wildlife Habitat⁹

Option 1		
Common Name	Scientific Name	lbs/ac ^a
Ladino white clover ^b	<i>Trifolium repens</i>	8
Red clover ^b	<i>Trifolium pratense</i>	5
Birdsfoot trefoil ^b	<i>Lotus corniculatus</i>	8
Orchardgrass	<i>Dactylis glomerata</i>	15
Winter wheat ^{**}	<i>Triticum aestivum</i>	50

^{**}Plant September 1 – October 15 or substitute annual rye for fall planting. If a spring planting is desired, substitute oats at the same rate February 15 – March 15 and retain the other species as listed.

Option 2		
Common Name	Scientific Name	lbs/ac ^a
Ladino white clover ^b	<i>Trifolium repens</i>	4
Mammoth red clover ^b	<i>Trifolium pratense</i>	5
Forage chicory	<i>Cichorium intybus</i>	2
Winter wheat ^{**}	<i>Triticum aestivum</i>	50

^{**}Plant September 1 – October 15. If a spring planting is desired, substitute oats at the same rate February 15 – March 15 and retain the other species as listed.

Option 2 can be used on flatter areas where the objective is to have a good vegetative cover for pollinators, structure and insects for turkey/grouse broods and forage for deer.



Option 3 - Native Seed Bank			
Common Name	Scientific Name	Inoculant ^b	lbs/ac ^a
Winter wheat**	<i>Triticum aestivum</i>		50
Crimson clover	<i>Trifolium incarnatum</i>	Rhizobium leguminosarum biovar <i>trifolii</i> , (inoculant code R)	5

**Plant September 1 – October 15. If a spring planting is desired, substitute oats at the same rate February 15 – March 15 and retain the other species as listed. Change the clover to Ladino white clover at 4 lbs/ac, inoculant code B and add 5# peredovic sunflower (black oil type) to enhance aesthetics.

Option 3 can be used on flatter areas where the objective is to have a natural, old field appearing area the second year after planting. During the first growing season, one should expect this to resemble a somewhat “weedy” wheat or oat field. This option creates good vegetative cover for pollinators, structure and insects for turkey/grouse broods and forage for deer.

^aSeeding rate suggested is for Pure Live Seed (PLS) in pounds per acre.

^bHerbaceous legumes must be treated with the appropriate inoculant before seeding.

D. If you are planting for Erosion Control (Grasslands and Pastures)⁷

Species	lbs/acre	Species	lbs/acre
Mixture #1		Mixture #3	
Birdsfoot trefoil	8	Ladino clover	2
Timothy	4	^b Orchardgrass	10
		Redtop	3
Mixture #2		Mixture #4	
^a Kentucky bluegrass	6	^b Orchardgrass	8
Timothy	2	Timothy	6
^c White clover	1	Winter wheat	50

Recommended Varieties

^aKentucky bluegrass

Kenblue, Ginger

^bOrchardgrass

Benchmark+, Olympia, Persist

^cWhite clover

Will, Durana



E. *If you are replanting Critical/Sensitive Areas (like Stream Crossings)*⁷

Species	lbs/acre	Species	lbs/acre
Mixture #1		Mixture #2	
^a Tall fescue, endophyte free or endophyte enhanced	12	^b Tall fescue, endophyte free or endophyte enhanced	12
Ladino clover	5	Winter wheat	50

Recommended Varieties

^aTall fescue, endophyte-free Select, Barolex

^bTall fescue, endophyte-enhanced Max-Q, BArPtima+E34

References and Additional Information:

¹Combining Forage Species in a Seeding Mixture

<http://anr.ext.wvu.edu/r/download/195129>

²Forage Varieties for West Virginia

<http://anr.ext.wvu.edu/r/download/194591>

³Pasture and Hay Seeding Rates

<http://anr.ext.wvu.edu/r/download/194600>

⁴Pasture and Hay Seeding Mixtures

<http://anr.ext.wvu.edu/r/download/194599>

⁵Powell River Project - Establishing Groundcover for Forested Postmining Land Uses

<http://pubs.ext.vt.edu/460/460-124/460-124.html>

⁶Reclamation of Marcellus Shale Drilling Sites in West Virginia. Jeff Skousen and Paul Ziemkiewicz, WVU.

<http://anr.ext.wvu.edu/r/download/104190>

⁷Recommended Seed Mixtures

<http://www.wvu.edu/~agexten/forestry/seed-mix.pdf>

⁸WV Division of Forestry, Best Management Practices for Logging Jobs

<http://www.wvforestry.com/DOFbmpManual2014.pdf>

⁹WV Division of Natural Resources, Enhancing Wildlife Habitat on Oil and Gas Infrastructure, 2015

www.wvdnr.gov

¹⁰West Virginia Erosion and Sediment Control Field Manual, WVDEP Office of Oil and Gas, May 2014

<http://www.dep.wv.gov/oil-and-gas/Documents/Erosion%20Manual%2004.pdf>



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