



# Evaluation of Restoration Needs for Illegal Cannabis Cultivation Sites in Shenandoah National Park

## *The Point Overlook and Dry Run Falls Road*

Natural Resource Report NPS/SHEN/NRR—2017/1535



**ON THE COVER**

Looking west from Skyline Drive, Shenandoah National Park  
Photograph courtesy of NPS

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# **Evaluation of Restoration Needs for Illegal Cannabis Cultivation Sites in Shenandoah National Park**

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## **Abstract**

This report outlines the natural resource assessment of two backcountry *Cannabis sativa* (cannabis) cultivation sites discovered in Shenandoah National Park (SHEN). The sites were located near The Point Overlook and Dry Run Falls Road. In 2013 and 2014, National Park Service (NPS) staff visited the sites and assessed impacts to watersheds, soils, vegetation, wildlife, and cultural resources. Most impacts were associated with deposited trash and debris from site occupation and with vegetation modifications from cannabis cultivation. The use of fertilizers may have occurred. Trash clean-up at The Point Overlook site occurred in 2014. No other restorations efforts are recommended at this time.

## Introduction

In 2013 and 2014, two backcountry areas were evaluated for resource impacts following the discovery of *Cannabis sativa* (cannabis) cultivation sites in Shenandoah National Park (SHEN). Park law enforcement (LE) rangers originally investigated the sites near The Point Overlook and Dry Run Falls road in 2012. The disturbance at The Point Overlook was reported by park staff in 2012, and we estimated it to be 2-3 years old during the fall 2013 site visit. We estimated the disturbances near Dry Run Falls to be between 5-7 years old when we visited in spring 2014. The following report presents a general evaluation of the site conditions, and describes possible remediation actions.

The evaluation process of illegal cultivation sites typically examines five resource areas (Mallery, 2011). Impacts on each resource can vary by site. Some examples of potential impacts at cannabis cultivation sites are listed below:

### Watershed impacts

- Water courses may have been altered to irrigate plants.
- Run-off may be contaminated with chemical fertilizers and pesticides.

### Soil impacts

- Terracing may have been used for garden plots and vegetation may have been displaced to optimize growing conditions.
- Holes may have been dug for latrines and for plantings.
- Tilling may have been done to facilitate cultivation.
- Paths may be worn from foot traffic to and from site.
- Soil may be contaminated with chemical fertilizers and pesticides.

### Vegetation impacts

- Woody plants may have been removed to provide more sun for cannabis plants.
- Low vegetation may have been cleared to make room for plants and to optimize growing conditions.
- Vegetation may have been cut back to make paths for travel and transport of materials to and from site.
- Invasive plants may have capitalized on the areas of disturbed soil left behind after cultivation activities.

### Wildlife impacts

- Chemical fertilizers and pesticides (i.e. insecticides, rat poison) may have poisoned wildlife.

- Personal supplies left around the campsite may harm wildlife.
- Contaminated run-off may impact aquatic biota in the greater watershed.

**Cultural impacts**

- The presence of significant cultural resources in SHEN, means that any areas of soil disturbance may have a chance of destroying or degrading historic and/or prehistoric artifacts.

## Methods

Site visits included a visual inspection of growing sites by natural resource staff in an attempt to document resource issues as described above. However, cultivation of cannabis could include application of many contaminant materials, including chemical fertilizers that would be impossible to assess visually. As a result, soil samples were also collected from inside the suspected area of cultivation (“Disturbed”) and outside the suspected area of cultivation (“Control”) at as many areas as possible. A large number of soil analyses was cost prohibitive, so some areas not thought to be contaminated were excluded from analysis. Excluded areas included The Point Overlook Area E (no sample collected) and area D (no control collected).

Soil analyses were completed by Brookside Laboratories (New Bremen, Ohio). Analyses tested for inorganic levels of nitrogen in the form of ammonium (NH<sub>4</sub>-N) and nitrate (NO<sub>3</sub>-N). We were unable to find specific information regarding normal background levels of nitrogen in Appalachian forest soils. However, in unfertilized agricultural soils, nitrate levels are typically between 5 and 10 parts per million (ppm), while ammonium is typically between 0 and 4 ppm (Brookside laboratory, personal communication). For the purpose of this document we will use 5-10 ppm of nitrate and 0-4 ppm of ammonium as our threshold for fertilizer contamination.

# Site Assessments

## The Point Overlook

Five disturbed areas were identified at the Point Overlook site (Figure 1). Three of the areas appear to have been cultivated (A, B, C). Area D appears to have been a staging area or an unfinished plot, and area E was the campsite. Area C is the closest to Skyline Drive at a little over 300m (984ft) from The Point Overlook. The steepness of the slope between Area C and The Point Overlook makes the location seem remote and hinders detection from Skyline drive.

At the site visit on November 22, 2013, we took GPS track logs to document the area of disturbance, and collected soil samples for analysis from inside and outside the areas of assumed cultivation. Area calculations (Table 1) were taken from track logs and given a two meter (6.5 ft.) buffer.

**Table 1.** Area in acres and hectares for disturbed areas A through E near The Point Overlook. Area estimates were derived from GPS track logs with a 2m buffer. UTM coordinates shown are NAD 83.

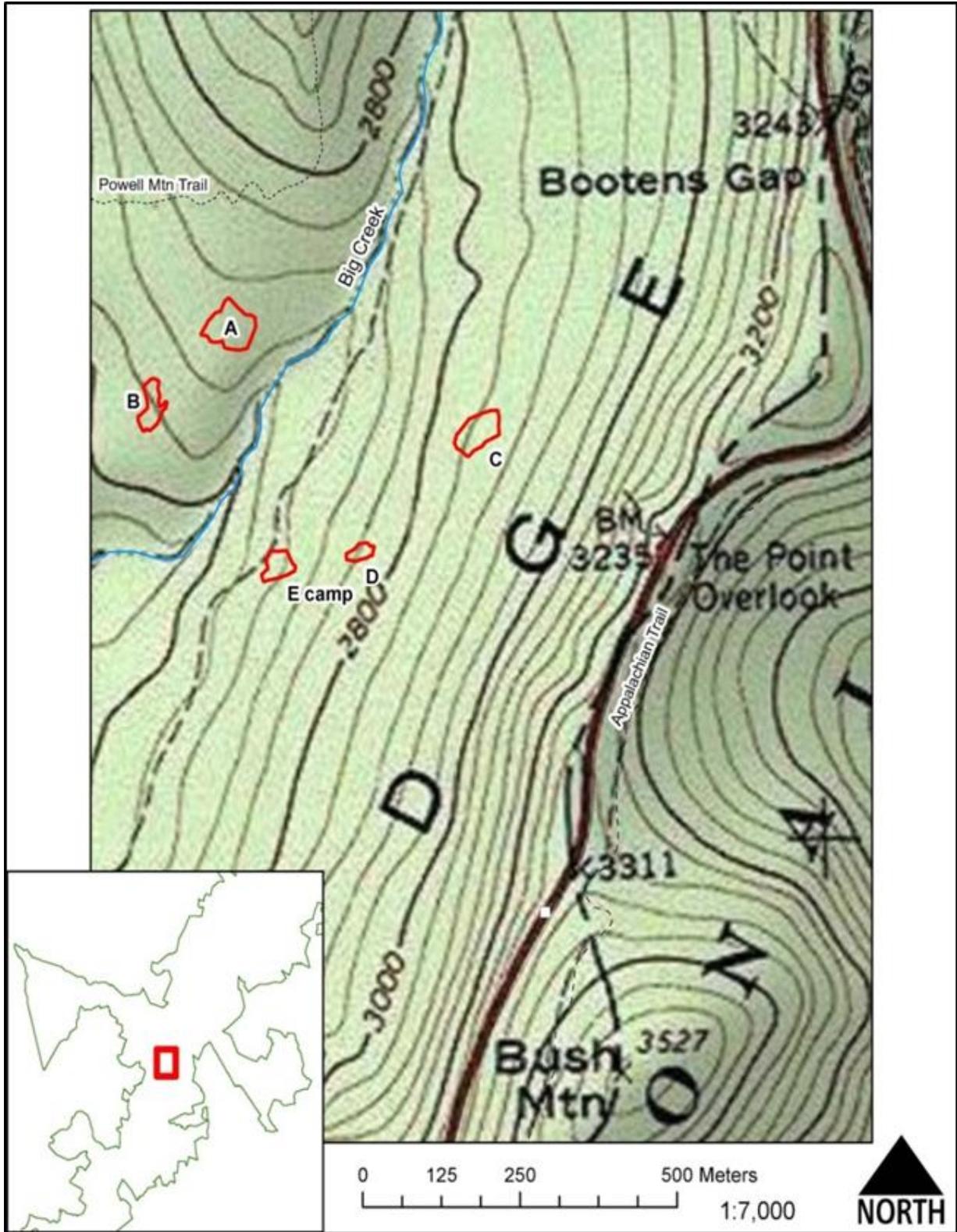
Disturbed Area Designation	Area (acres)	Area (hectares)	Coordinates (UTMs, zone = 17)
A	1.00	0.40	720852.23 E, 4260485.08 N
B	0.46	0.19	720719.72 E, 4260372.15 N
C	0.73	0.29	721230.08 E, 4260345.76 N
D	0.19	0.08	721065.70 E, 4260178.63 N
E	0.40	0.16	720914.24 E, 4260163.91 N
<b>Total</b>	<b>2.78</b>	<b>1.12</b>	<b>-</b>

## Vegetation and Land-use History

In 1941, Areas A and B were classified as “Open Grassland” on the park vegetation map. Areas C, D, and E fell within “Open Restocking Forest Type”, which indicates repeated logging (Berg and Moore 1941).

The Park’s current vegetation map shows that Areas A and C are classified as “Northeastern Modified Successional Forest”. The majority of Area B is listed as “Central Appalachian Montane Oak - Hickory Forest (Basic Type)”, but we found the vegetation to be more similar to the “Northeastern Modified Successional Forest” on the field visit. This forest type is classified as early successional, disturbed and a transition from old fields on “gentle ridgetops”. Invasive exotic plants are common, as are quick growing weedy trees. Areas D and E fall within “Central Appalachian Rich Cove Forest”, a mesic forest type with fertile soils on mid to lower elevations (Young et al. 2009).

Land appraisal notes for The Point Overlook cannabis site indicate that it had a lengthy logging history at the time it was acquired for use as Park land. Records also indicate that 5.3 hectares (13 acres) of land were deemed tillable and that much of the land had been cleared for grazing. There were improvements to the property such as a five room house and pipes from a spring to a structure (National Park Service, Shenandoah National Park Archives). No evidence of this pipe or structure was seen in the area of cultivation during the field visit.



**Figure 1.** Map showing the location of disturbed areas A through E in relation to Skyline Drive and The Point Overlook, Central District, Shenandoah National Park. Site are shown as small, red labeled polygons.

### **Site Visit Details**

The following description of each area comes from field notes during the November 22nd, 2013 site visit by law enforcement rangers Lora Peppers, and Eric Yount, and natural resources technician Abigail Hyduke.

#### Area A

This is the largest disturbed area of all the sites. Many plastic cups are strewn across the area and shrubs and small trees are resprouting. The overstory at Area A consists of black cherry (*Prunus serotina*), black locust (*Robinia pseudoacacia*) and white ash (*Fraxinus americana*). The shrub layer is mountain holly (*Ilex montana*) and black raspberry (*Rubus occidentalis*). Herbaceous species are garlic mustard (*Alliaria petiolata*), sweet cicely (*Osmorhiza* spp.), dock (*Rumex* spp.), white vervain (*Verbena urticifolia*), yellow giant-hyssop (*Agastache nepetoides*), violets (*Viola* spp.), and avens (*Geum* spp.).

Area A is located in a flat area with deep soil. It is possible that some hand-tilling was done here as we encountered very few rocks while taking soil samples; however, locations outside of the plot seemed to have a similar soil profile so this may be related to historical land-use. Hickories (*Carya* spp.), black cherry (*Prunus serotina*) and many mountain holly (*Ilex montana*) were cut, but are now resprouting. In the cleared areas black raspberry (*Rubus occidentalis*) and shrubs were cut back. Many small chickweed (*Stellaria media*) and violet (*Viola* spp.) sprouts populate the herbaceous layer in a way consistent with an area that has sustained a surface disturbance.

#### Area B

Area B is located on the same side of Big Creek as Area A. The soil is also deep at this site. Area B is smaller and appears like a work in progress when compared to Area A. The canopy at Area B is black cherry (*Prunus serotina*) and white ash (*Fraxinus americana*) with a subcanopy of red maple (*Acer rubrum*) and hickories (*Carya* spp.), a shrub layer of (*Lindera benzoin*) and (*Ilex montana*) and an herbaceous layer of garlic mustard (*Alliaria petiolata*), sweet cicely (*Osmorhiza* sp.), violets (*Viola* spp.), yellow giant-hyssop (*Agastache nepetoides*) and Japanese stilt grass (*Microstegium vimineum*). Tree of heaven (*Ailanthus altissima*) at Area B were girdled, but still alive. Areas A and B are indicative of old-field vegetation described above as “Northeastern Modified Successional Forest”.

#### Area C

Area C is on a flat-shelf with a deep soil profile and signs of cultivation. While there is no evidence of the soil being tilled, numerous shrubs were cut-back at this location including spicebush (*Lindera benzoin*) and ironwood (*Ostrya virginiana*). The overstory is composed of tulip tree (*Liriodendron tulipifera*), shagbark hickory (*Carya ovata*), and white ash (*Fraxinus americana*) with a shrub layer of witch-hazel (*Hamamelis virginiana*). The herbaceous vegetation consists of native vegetation with weedy habits and several invasive species: yellow giant-hyssop (*Agastache nepetoides*), burdock (*Arctium minus*), garlic mustard (*Alliaria petiolata*), wood nettle (*Laportea canadensis*), Japanese stilt grass (*Microstegium vimineum*) and celandine (*Chelidonium majus*). There were discarded fertilizer containers at this location.

### Area D

There were no signs of cultivation at this area other than nursery materials and tools (two pick-axes). Area D may have been a nursery or staging area, but the soil depth is shallow. A 13 centimeter (five inch diameter) red maple (*Acer rubrum*) was cut at Area D along with many shrubs. The woody vegetation is similar to that of Area C. Herbaceous vegetation is sparse and consists of Virginia waterleaf (*Hydrophyllum virginianum*), sweet cicely (*Osmorhiza* sp.), fancy fern (*Dryopteris intermedia*), blue wood aster (*Symphotrichum cordifolium*), rattlesnake orchid (*Goodyera pubescens*), Christmas fern (*Polystichum acrostichoides*) and garlic mustard (*Alliaria petiolata*). There is a good amount of downed woody material, perhaps due to gypsy moth infestations.

### Area E

Area E was the camp area for the people who tended the cultivation sites. There is no evidence of cultivation at the camp. The core of the camp is located over an area of 0.16 hectares (.4 acres), though items have been strewn across a larger area by animals or weather events. The vegetation is similar to that found at Area D. There is an ephemeral stream running through the camp with a patch of golden saxifrage (*Chrysosplenium americanum*).

The camp is littered with plastic food wrappers (tortilla and ramen noodles), red solo cups and empty tin food cans. The ephemeral stream was used for washing pans as several discarded pans remain nearby. There is an abandoned camping stove as well as a larger propane tank. Tents, tarps, backpacks and other camping supplies are strewn around with evidence of bear activity. We found an empty container of “Liquid Fence” which may have been used to deter animals from the food supplies. There was no evidence of digging or a latrine in the vicinity. While we saw no signs of cultivation, there were “Marshalls” bags of NPK fertilizer, “Miracle-Gro” products, and a mixture of sand and gravel.

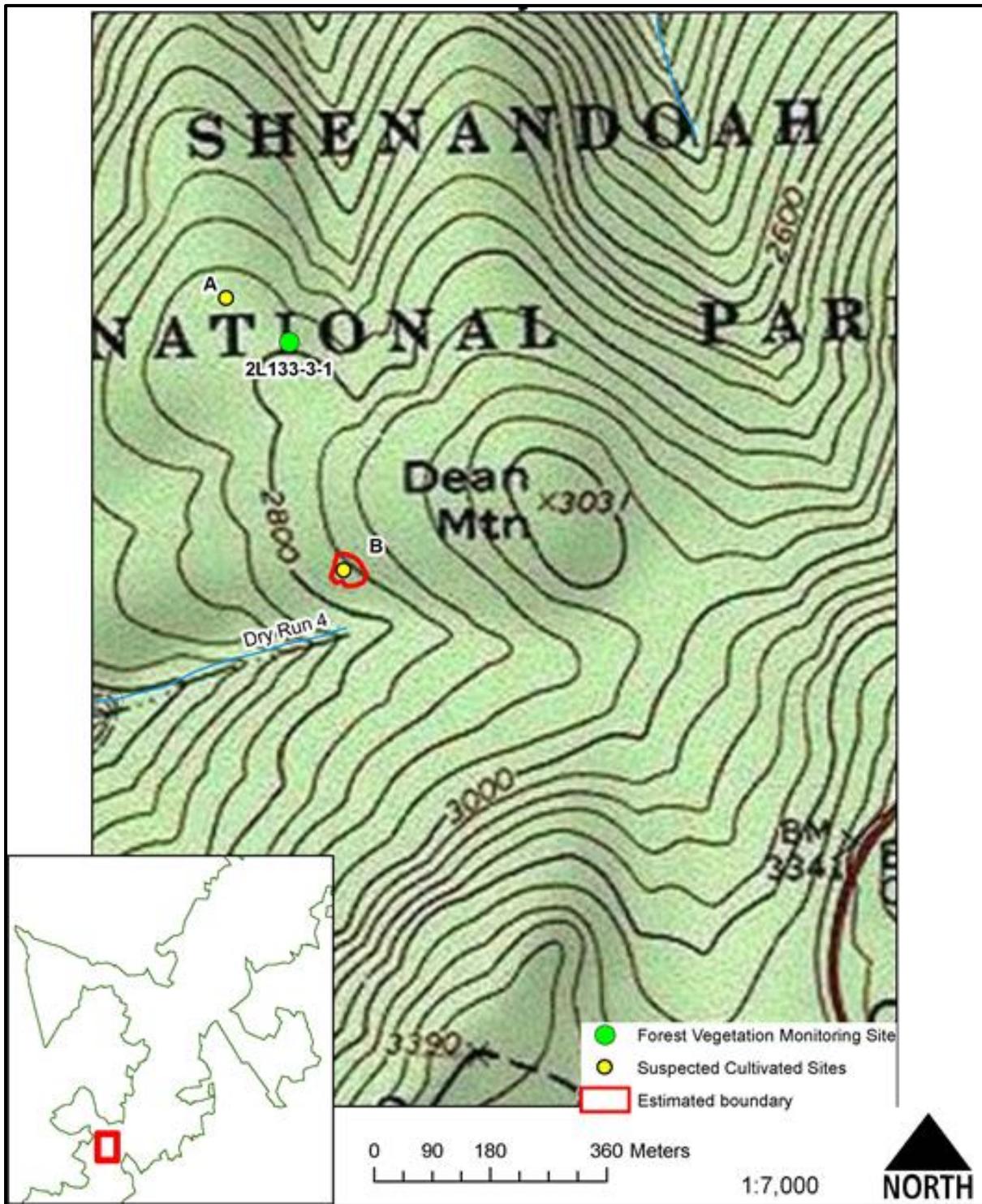
### **Dry Run Falls Road**

Two disturbed areas were identified at the Dry Run Road site (Areas A and B) (Figure 2). Both areas have deep soil and appear to have been cultivated.

During the site visit, on April 28, 2014, we took GPS track logs to document the area of disturbance at the larger area (Area B), and averaged waypoints at both areas (Table 2). We also collected soil samples inside and outside of both areas for analyses. An area calculation was taken from the track log and given a two meter (6.5 foot) buffer.

**Table 2.** Area in acres and hectares for disturbed areas A and B near Dry Run Falls. Area estimates were derived from GPS track logs with a 2m buffer. UTM coordinates shown are NAD 83.

<b>Disturbed Area Designation</b>	<b>Area (acres)</b>	<b>Area (hectares)</b>	<b>Coordinates (UTMs, zone = 17)</b>
A	NA	NA	716675.70 E, 4253670.55 N
B	0.44	0.18	716857.79 E, 4253250.52 N



**Figure 2.** Map showing the location of disturbed areas A and B near Dry Run Falls, Central District, Shenandoah National Park.

### ***Vegetation and Land-use History***

In 1941, the vegetation near Dry Run Falls Road was classified as “Open Restocking Forest Type”, indicating it was logged repeatedly (Berg and Moore 1941).

On the most current vegetation map, Area A is classified as “Northeastern Modified Successional Forest”. Area B is listed as “Central Appalachian Montane Oak - Hickory Forest (Basic Type)”, but we found that Area B matched the description of “Northeastern Modified Successional Forest” on the field visit. This forest type is classified as early successional, disturbed and a transition from old fields on “gentle ridgetops”. Invasive exotics are common as are fast growing weedy trees (Young et al. 2009).

This tract of land was part of a 145.5 hectares (359.6 acre) tract purchased for use as Park land from E.S. Meadows. A likely cultural artifact in Area B is the collapsed chimney to the log house that was at the site when the land was purchased. Along with a house, there are records of a barn, granary and wagon road. The owners had used the land as an orchard and for timber. In 1923, 40 hectares (100 acres) burned and the surveyors reported some of the trees to be in poor condition (National Park Service, Shenandoah National Park Archives).

### ***Site Visit Details***

The following description of each area presents information obtained during the April 28, 2014 site visit by law enforcement ranger Eric Yount, and natural resources technician Abigail Hyduke.

#### Area A

The overstory of Area A is composed of white ash (*Fraxinus americana*) and red maple (*Acer rubrum*) with a sparse shrub layer of spicebush (*Lindera benzoin*). There are many downed trees and vines in the area (unrelated to the cultivation). Around five trees from 10-20 centimeters (4-8 inches) in diameter were noticeably cut in an overgrown area. The paucity and growth form of shrubs suggest the layer was disturbed in the past. The understory is composed of weedy species and brambles such as multi-flora rose (*Rosa multiflora*). It was too early in the season for many other species to have emerged. Based on the visual inspection, we presume that this site has not been used in around 10 years. There was no noticeable trash from the suspected cultivation. Area A is located within 100 meters (328 feet) of Forest Vegetation Monitoring plot (2L133-3). We saw old rebar and PVC from 2L133-1 and 2L133-2, (abandoned plots), and many tagged trees in the area.

#### Area B

Area B appears to have been used more recently than Area A and rests on a flat ledge with deep soil above Dry Run Falls. The overstory is composed of white ash (*Fraxinus americana*), black locust (*Robinia pseudoacacia*), and red maple (*Acer rubrum*) with some white pine (*Pinus strobus*). Many small trees (10-20 centimeters or 4-8 inches) were cut and shrubs were likely cleared to create a larger open area. There is some evidence of shrub resprouting in the area. Weedy plants are present in the understory; including multi-flora rose (*Rosa multiflora*), burdock (*Arctium minus*), garlic mustard (*Alliaria petiolata*), bedstraw (*Galium* spp.), kidney-leaved crowfoot (*Ranunculus abortivus*), and possibly chickweed (*Stellaria media*). There were many bricks (10-20) strewn around the site, and it is unclear whether they were brought in by the growers or were cultural artifacts. There is a

cultural artifact within the plot which may be a collapsed chimney. Some cultural objects appear to have been disturbed in the area. The trash in the area is mostly composed of plastic food packaging and dental hygiene items, and indicates the growers were camping nearby. A few plastic buckets found near and in Dry Run were likely used to water the cannabis plants.

As we were scouting further along Dry Run on our way back to Dry Run Falls Road, we saw more trees that had been cut. We speculate that these areas were cleared to create a path to the cultivation site as the soil is very rocky and shows no sign of disturbance caused by recent cultivation.

# Summary of Impacted Resources and Recommendations

## Water and surface features

There is no indication that any watercourse was modified to hydrate the cannabis plots. We found no signs of irrigation hoses, and assume the plots were watered with buckets or required little supplemental watering. No action is recommended to restore water features, except for cleaning the trash out of the ephemeral creek at The Point Overlook Area E. Dry Run should also be investigated for trash immediately below the disturbed Area B. Additional trash, such as propane tanks and empty pesticide containers could lead to potential contamination until removed. Surface features were modified at the camp near The Point Overlook and in the plots to create a flatter area for habitation and cultivation. The damage to surface features is minimal and will not impact drainage.

## Vegetation

While many trees and shrubs were cut at The Point Overlook site, the majority of them were re-sprouting. Growth and terminal bud-scale scars on a hickory (*Carya* spp.) at Area B indicated at least two years since the initial pruning. We saw no signs of herbicide application.

There was less evidence of re-sprouting on trees in the Dry Run Falls area, but shrubs appear to be re-sprouting where they exist.

Disturbance to the soil and seed-bank from cultivation and removal of shrubby vegetation may lead to a rise of invasive exotic vegetation. The many chickweed (*Stellaria media*) sprouts may be a result of seed-bank disturbance. Areas A, B, and C at The Point Overlook site are most susceptible to an increase in invasive exotic plants. The sites at Dry Run Falls also show disturbance to the seed bank and greater abundance of exotics than the adjacent forest communities. Nevertheless, we recommend no action to remediate the disturbance to vegetation caused by the cultivation activities.

## Wildlife Management

Evidence of animal activity was observed at The Point Overlook site. Many of the items left behind were strewn about and punctured as with teeth or claws. Anticoagulant rodenticides, observed to be used liberally in illegal cannabis cultivation on public lands in California, are lethal to exposed wildlife (Gabriel, 2012). We did not see any signs of rodenticide, and the only obvious deterrent was the “Liquid Fence” in Area E of The Point Overlook. Fertilizer containers and other products left behind could cause harm to wildlife and should be removed.

Fewer signs of wildlife activity were evident near Dry Run Falls, but similar actions should be taken to remove potentially harmful objects left by the suspected growers.

## Cultural Impacts

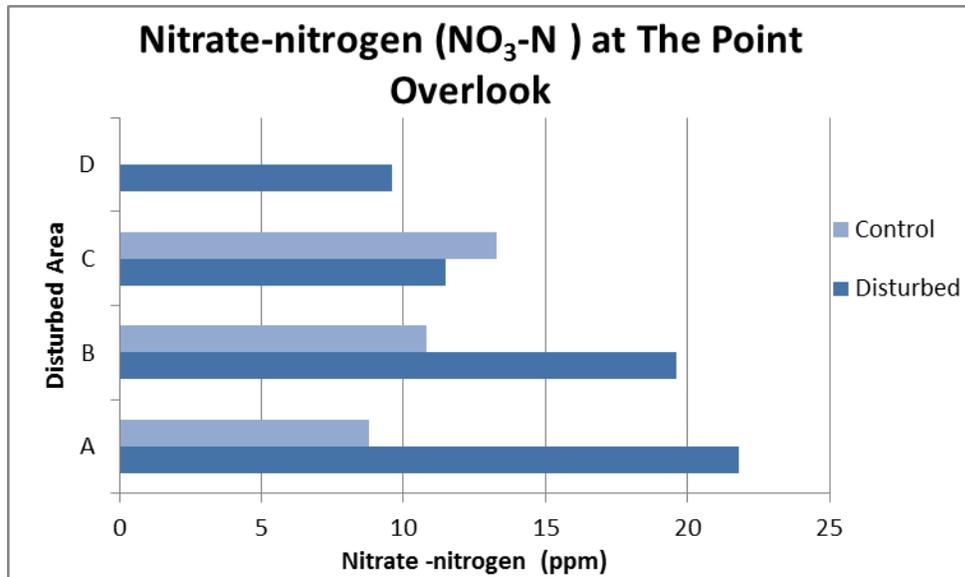
While no cultural resources were observed in the disturbed areas near The Point Overlook, there was disturbance to a structure off of Dry Run Falls Road at Area B. Further investigation by Cultural Resources Staff is necessary to quantify the level of damage.

## Soil

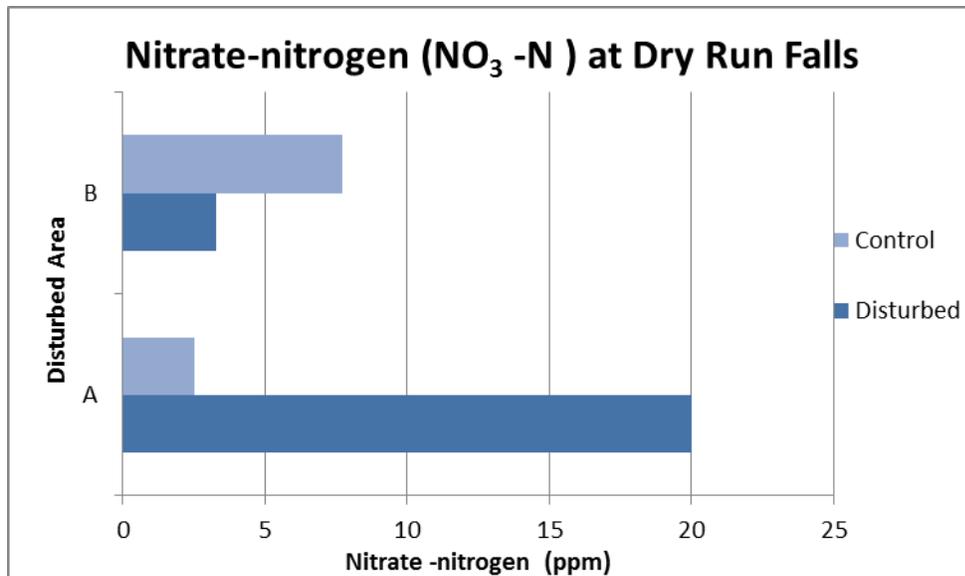
Cultivation of cannabis could include application of many contaminant materials, including chemical fertilizers that would be impossible to assess visually. As a result, soil samples were collected from inside the suspected area of cultivation (Disturbed) and outside the suspected area of cultivation (Control) at as many areas as possible.

### ***Nitrate – Nitrogen***

All samples at The Point Overlook, with the exception of that collected in Area D and Control for Area A, exceeded the estimated threshold for fertilizer contamination (Figure 3). The Disturbed samples from Areas A and B were the highest recorded while the Control from Area C was slightly higher than thresholds. At Dry Run Falls, the Disturbed sample from Area A was the only sample that exceeded the 5-10 ppm threshold for nitrate (Figure 4). This was unexpected as more time has gone by since we estimate Dry Run Falls Area A was cultivated than any other Disturbed sample. Nevertheless, it is possible that Area A was cultivated for a longer number of years, and thus, had more fertilized applied in total. Nitrate levels in the Control soil sample for Dry Run Falls Area B were greater than the Disturbed soil sample, yet both values were below thresholds.



**Figure 3.** Nitrate-nitrogen levels in soils samples collected near The Point Overlook in November 2013, Central District, Shenandoah National Park.

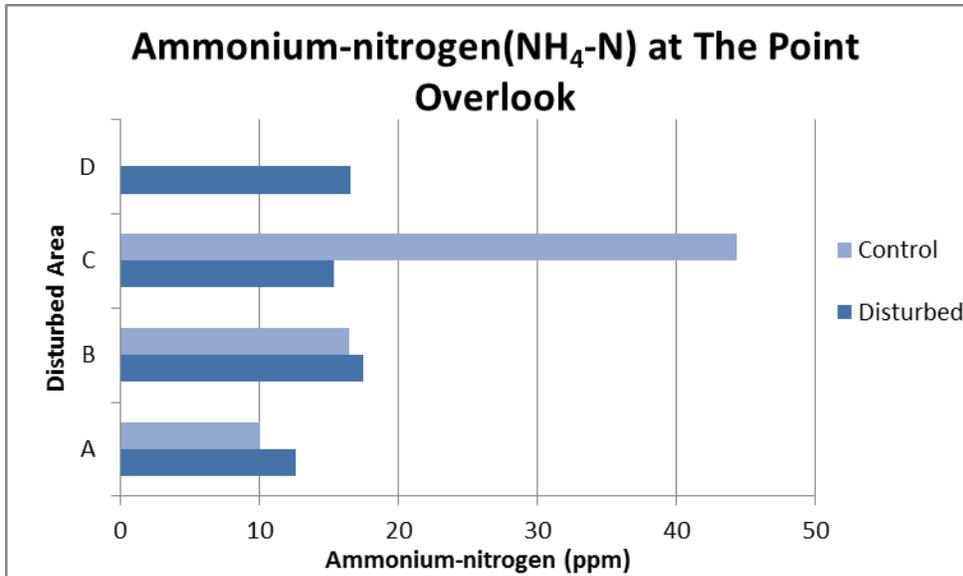


**Figure 4.** Nitrate-nitrogen levels in soils samples collected near Dry Run Falls in April 2014, Central District, Shenandoah National Park.

### ***Ammonium - Nitrogen***

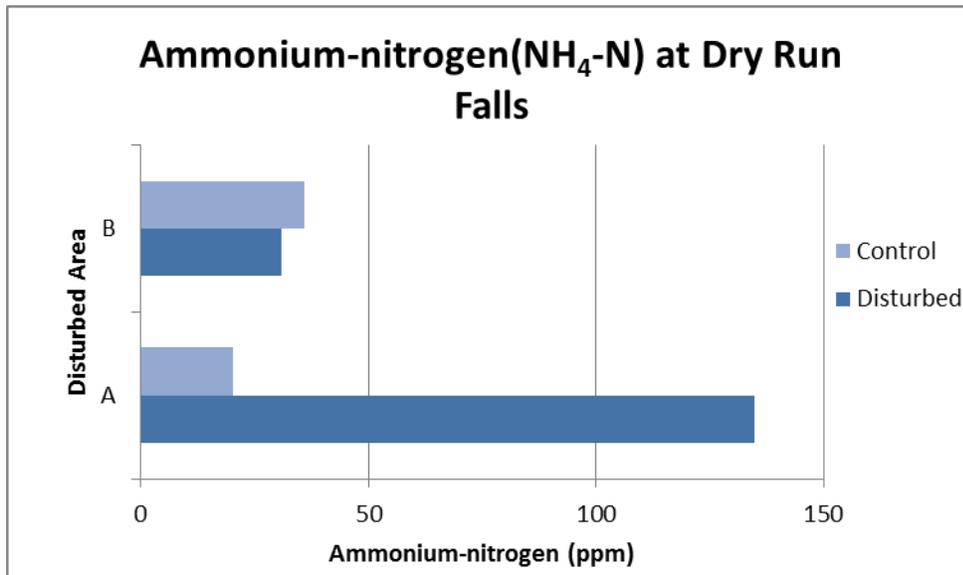
Ammonium-nitrogen levels are generally low in soils as it is quickly converted into nitrate through the nitrogen cycle. An amount of 0-4 ppm is a normal background level for unfertilized agricultural lands (Brookside laboratory, personal communication). However, concentrations of 2-10ppm have been found to be normal in some environments, with levels above 10ppm in cold or saturated soils (Marx 1999).

Values of ammonium-nitrogen in soils samples at The Point Overlook ranged from 9 ppm at Control Area A to 44 at Control Area C (Figure 5). All samples exceeded the threshold of 0-4ppm and most were beyond the higher threshold of 10 ppm. Collecting the samples in November 2013, outside of the growing season and at a time when the nitrogen cycle has slowed, may contribute to some of the excessive amounts of ammonium-nitrogen in soil samples collected at The Point Overlook.



**Figure 5.** Ammonium -nitrogen levels in soils samples collected near The Point Overlook in November 2013, Central District, Shenandoah National Park.

Values of ammonium-nitrogen in soil samples at Dry Run Falls ranged from 20 ppm at Control Area A to 135 at Disturbed Area A (Figure 6). All samples greatly exceeded the more substantial threshold of 10 ppm. As noted above, the time of sample collection (i.e. outside of growing seasons) may contribute to some of the excessive amounts of ammonium-nitrogen in soil samples collected at Dry Run Falls. However, given such elevated levels at Dry Run Falls, fertilizer contamination is a probable explanation.



**Figure 6.** Ammonium -nitrogen levels in soils samples collected near Dry Run Falls in April 2014, Central District, Shenandoah National Park.

### **Soil Summary**

Nitrate-nitrogen and ammonium-nitrogen levels were elevated in many of the soil samples collected from The Point Overlook and Dry Run Falls Road. Disturbed samples do not demonstrate any obvious patterns in elevated contamination (Figures 3-6). Both Disturbed and Control samples contained higher concentrations of nitrate-nitrogen and ammonium-nitrogen levels than would be expected in a non-fertilized forest. Several factors may explain these elevated levels of nitrogen. As mentioned above, the samples were collected in cooler months (November 2013 and April 2014). As biological activity is slower during the cooler months, nitrogen levels may accumulate in the soil.

A second explanation for the unclear pattern between the Control and Disturbed samples is that the Control samples were not collected at a sufficient distance from the disturbance. The delineation between Control and Disturbed was based on visual estimates of cleared brush and damaged woody growth. Errors may have been made in the estimation of the disturbance boundaries and future collections should ensure the proper distance. In addition, we suggest that in the future, the collection of control samples should occur from upslope or across slope from the disturbance where the likelihood of fertilizer contamination of control samples is reduced.

Lastly, the land-use history of the sites could also be influencing the elevated concentrations of nitrate-nitrogen and ammonium-nitrogen in the soil samples. Brookside Laboratories indicated that contamination from over-fertilized orchards from the 1930s could be showing up in our soil samples. It is also possible that acid deposition was influencing the chemistry of the soil samples, given the well documented existence and impacts of acid deposition on mid-Atlantic mountain streams and soils (Connolly et al. 2007, Lovett and Tear 2008).

Results from the soil samples were inconclusive regarding the use of chemical fertilizer in the recent past for cultivation of cannabis. We have forwarded our test results to soil scientists and ecologists within NPS and will report additional interpretation if any new information becomes available.

### **Remediation**

A debris clean-up was led by Robert Sloop (Central District-law enforcement) on April 16, 2014 in the disturbed area near The Point Overlook. Twenty rangers spent six hours (cumulative of 120 hours) to collect 25 bags of garbage and 15 propane canisters. There are plans to lead a similar effort with fewer individuals in the disturbed area off of Dry Run Falls Road. However, as of September 2017, no additional work has been done at either site.

## Conclusions

If the growing operation had been discovered while active, we would have had to properly dispose of plant and other materials and may have had additional tasks to restore natural and cultural resources closer to the time of the disturbance. However, as some time has passed since the activity, we did not find cause for significant restoration efforts, other than trash removal.

Cultivation of *Cannabis sativa* on public lands in the Mid-Atlantic has not had as significant and widespread an impact as in western States. While it seems like an unlikely threat to SHEN, with its many visitors and over 500 miles of trails, we know that clandestine activity can go undetected. With an estimated of 380 miles of boundary, SHEN is vulnerable to criminal activities such as cannabis cultivation. However, many sites are rocky and unsuitable for cultivation. We suspect that the growers were familiar enough with the area to select a site that was both remote and appropriate for cultivation. Significant cultural and natural resources are at risk as a result of the disturbances caused by cannabis cultivation in SHEN. Natural and cultural resources staff and law enforcement rangers may work together to deter this sort of activity in areas identified as highest risk through occasional patrols.

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