Soil Resource

Introduction

Monitoring and evaluation are critical elements in determining whether the Forest is meeting its obligation for protection of the soil resource. It is only through monitoring and evaluation that we can determine effects that may be occurring to soils from management activities and other influences, and adjust our management practices accordingly to keep those effects within acceptable levels and ensure that we maintain or improve soil quality and productivity.

2006 Program Accomplishments

The Program accomplishments for 2006 included:
- Budget and work planning, including out-year planning.
- Analyzing effects for a variety of Forest projects.
- Completing scheduled soil surveys.
- Providing input and review for the Forest Plan revision effort.
- Additional projects described below.

SOIL DISPLAY FOR THE SENECA ROCKS DISCOVERY CENTER

The Seneca Rocks Discovery Center received a new soil monolith display in 2006. This monolith was taken in a highly productive forest soil, Guyandotte Soil Series. The future intent of this monolith is to be used in a new display at the visitor center that would teach the public about soil conservation, land management, and soil properties.

SOIL SAMPLING WITH THE USDA-NRCS SOIL SURVEY DIVISION

In 2005-2006, the Soil Resource Inventory was updated by an additional 14,950 acres through the Tucker County Soil Survey Update, conducted by the USDA Natural Resource Conservation Service (NRCS). The benefit of participating in this resource update is two-fold to the Forest. One, the Forest is able to update mapping conducted in the 1940s that did not incorporate forest soil information. Two, the Forest can “piggy-back” soil sampling efforts on important soil types in the area where there is currently very little soils information. The Forest sends split samples off to university labs for special forest soil chemistry analyses. The soil chemistry data coincides with the air quality monitoring and water chemistry monitoring conducted in the area. The air monitoring program annual collects data about deposition of pollutants, monitors visibility, and other parameters of air science (See the Air Quality Report for details). The relevance of this information to the soil resource is in the relationships between acid deposition, soil chemistry, water chemistry, and aquatic habitat.

Accomplishments also included the monitoring and evaluation efforts described below.

Monitoring and Evaluation

1986 FOREST PLAN MONITORING ITEMS FOR THE SOIL RESOURCE

There are no monitoring items in the 1986 Forest Plan as amended that are specific to the soil resource, nor are there any specific soil goals or objectives to monitor. However, there is a required general monitoring item on page 250 that is directly applicable to soil management:

Document measured prescriptions/effects, including significant changes in productivity of the land [from CFR 219.12.(k)(2)].

Monitoring results for this item are reported below.

Monitoring Item 1. Soil Chemistry Work Done in Red Spruce and Hogback Areas

Soil water and stream acidification are real phenomena that have been shown to occur in West Virginia. Long-term, increasing losses of base cations to stream water due to ambient acid deposition have been documented in stream water on a control watershed in the Fernow Experimental Forest, which is located in the Monongahela NF (Edwards and Helvey 1991). Other watersheds on and near the Fernow Experimental Forest that have been artificially acidified with Sulfur and Nitrogen to determine effects on soils and stream water have shown mobilization of base cations in soil and consequent leaching to stream water and substantial reductions in the acid-neutralizing capacity of soil and water (Edwards et al. 2002a, 2002b).

Since 1995 intensive soil data collection has occurred in various locations across the Forest, including comprehensive studies in the Otter Creek Wilderness. This effort began the development of baseline soil chemistry data across the Forest, especially in areas assessed by the Soil Nutrient Sensitivity Map to be highly sensitive to acidification (Connolly et al. 2004). Through 2006, more than 600 soil samples have been collected across varying soil types, landscape positions, and aspects, and they have been analyzed for physical and chemical characteristics. Preliminary results show that soils in sensitive areas are affected adversely by acid deposition. Base saturation values are often below 15 percent in areas where base-poor geologies exist (Jenkins 2002, Schnably 2003, Desert Branch EA Soil Resource Report 2003, Cherry River EA Soil Resource Report 2004), and Calcium to Aluminum (Ca:Al) ratios are less than 1.0 for soils found on ridgetops and benches of these same areas (Desert Branch EA Soil Resource Report, Cherry River EA Soil Resource Report). Some south-facing cove soils have soil Al levels that might indicate possible toxicity for vegetation.

In the spring and summer of 2006, two areas of interest where sampled. The first area was within the Hogback Project Area, Cheat Ranger District, Tucker County, WV. This sampling was done as a preliminary assessment for the upcoming 2007 Environmental Assessment to support a vegetation removal project. Soils sampled were formed over Hampshire and Chemung geologies. Five pits were excavated and sampled by horizon. Samples were sent to the University of Maine for general forest soil chemistry analysis and to the Soil Testing Lab at Pennsylvania University for the specific Aluminum Stress Test (Ca:Al ratio using a $SrCl_2$ extraction method).

The second area sampled was related to red spruce ecosystems. A partnership was formed with Forest Service Research (Morgantown, WV), NRCS, and West Virginia University to monitor 10 Forest Health Monitoring Plots set up in the red spruce ecosystem across the Forest some thirty years ago. These plots were established by researchers to look at growth trends in the red spruce related to decline or expansion of the ecosystem. However, no other data were collected over the time period to look at other parameters such as soil chemistry, foliar chemistry, and other biological indicators. Therefore, this project was designed to capture this additional data and establish baseline numbers for future comparison of data.

Twelve different site plots were selected for sampling and monitoring (Fig. SL-1). Objectives of the sampling effort coincided with Forest Service Research and Forest Health Monitoring objectives and sampling efforts to:

- Characterize soil types under red spruce habitats.
- Assess soil productivity levels and soil quality with respect to acid deposition effects.
- Determine whether mycorrhizae can be an indicator of red spruce health.
- Assess foliar nutrition levels to determine if red spruce are under stress or malnourished.

Figure SL-1. Stephanie Connolly Collecting Soil Sample in Red Spruce Soil Pit

Monitoring Item 1. Evaluation, Conclusions, and Recommendations

Data from the Hogback sampling effort showed that soils were currently adequately buffered. Ca:Al ratios were well above 1, and base saturations were above 15 percent (see Hogback

Timber Sale Soil Resource Report). Therefore, no additional monitoring was required, and the project for the Hogback Timber Sale began in late 2006.

Data from the Red Spruce Monitoring Project are anticipated from the labs in early FY07. At that time, it would be advantageous to have a scientist with expert knowledge of red spruce literature and ecosystems review the data sets, interpret the data using statistics, and make recommendations to the Forest with reference to management and additional monitoring needs if applicable. This review should answer whether objectives of the project were met.

Monitoring Item 2. Soil Water Table Monitoring with Partners (USDA Natural Resource Conservation Service and West Virginia University, Dr. James Thompson)

The depth to the seasonally high water table is a primary factor in determining soil suitability and limitations for most land uses. Modern soil survey reports are the primary source of soils information used to determine the presence of suitable soils for any given land area. Use and limitation ratings contained in soil survey reports for most soils are not based on directly measured soil wetness characteristics but are inferred from the presence of and depth to specific soil color patterns associated with the transformation of iron oxide minerals that occur in saturated soil. Furthermore, soils with perched water tables present special problems for the identification of seasonally saturated conditions. For many such soils in West Virginia it is not known when, how long, or how deep below the soil surface saturated conditions exist.

The objectives of this monitoring were to:

- Determine the frequency and duration of high water tables in selected seasonally saturated soils with perched water tables in West Virginia;
- Document the physical, chemical, and morphological characteristics of these soil and relate these properties to measured hydrologic characteristics; and
- Establish soil-landscape relationships by which the soil-hydrologic relationships can be extrapolated across landscapes.

A partnership was developed with local NRCS soil scientists, West Virginia University, and other local government and private entities to achieve the objectives of the monitoring project. We identified fragipan soils and associated landscapes in West Virginia where observable morphologic properties do not seem to agree with perceived soil hydrology. A monitoring location was selected in the Desert Branch watershed of eastern Nicholas County in the Monongahela National Forest (Fig. SL-2).

Four monitoring sites were established along a topographic gradient (Fig. SL-3) to include the full range of soil types found in these landscapes, including three important benchmark soils[1] in West Virginia (Buchanan, Ernest, and Gilpin). At each of these monitoring sites, the group installed a shallow well with a maximum water table recording device (MWTRD). For sites with a fragipan (Buchanan and Ernest), the well was installed to the top of the fragipan. For sites with shallow bedrock (Fenwick and Gilpin), the well was installed to the top of the bedrock. When installing these wells, soil samples were retained, and the morphology was

[1] Benchmark soils are soils that are geographically extensive and of greater than average importance for farming, engineering, forestry, ranching, recreational development, urban development, wetland restoration, or other uses.

described in detail. These monitoring sites are co-located where previous monitoring had been conducted in association with the on-going Desert Branch Timber Sale (see 2005 Soil Monitoring Report). This monitoring involved more intensive soil profile characterization. Wells at this site are monitored on a weekly basis by USDA Forest Service cooperators.

Figure SL-2. Location of the Desert Branch Watershed in Nicholas County, WV

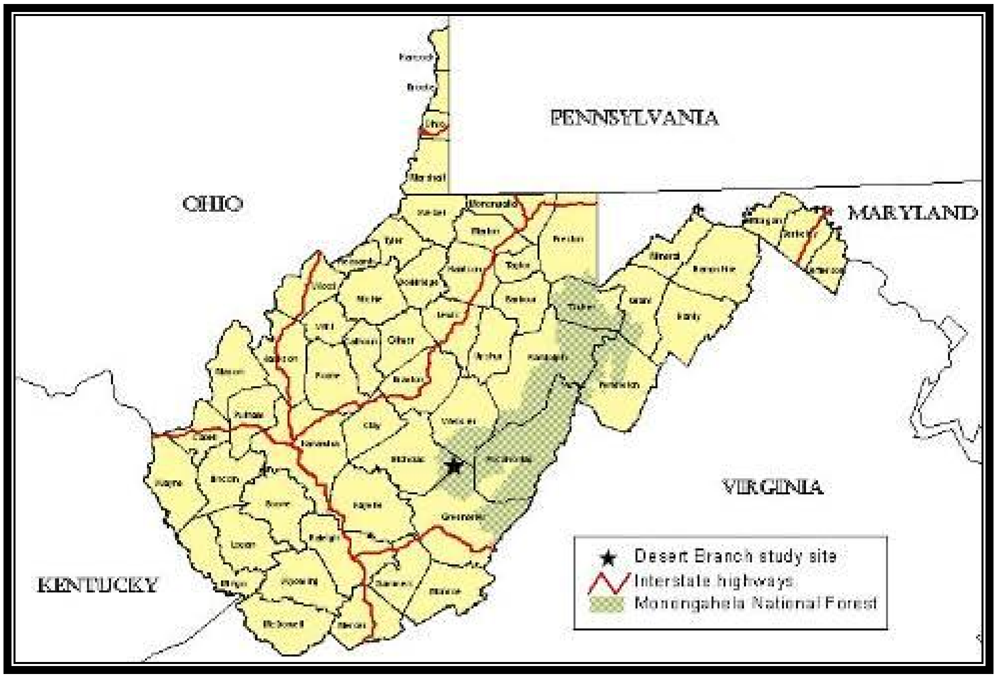
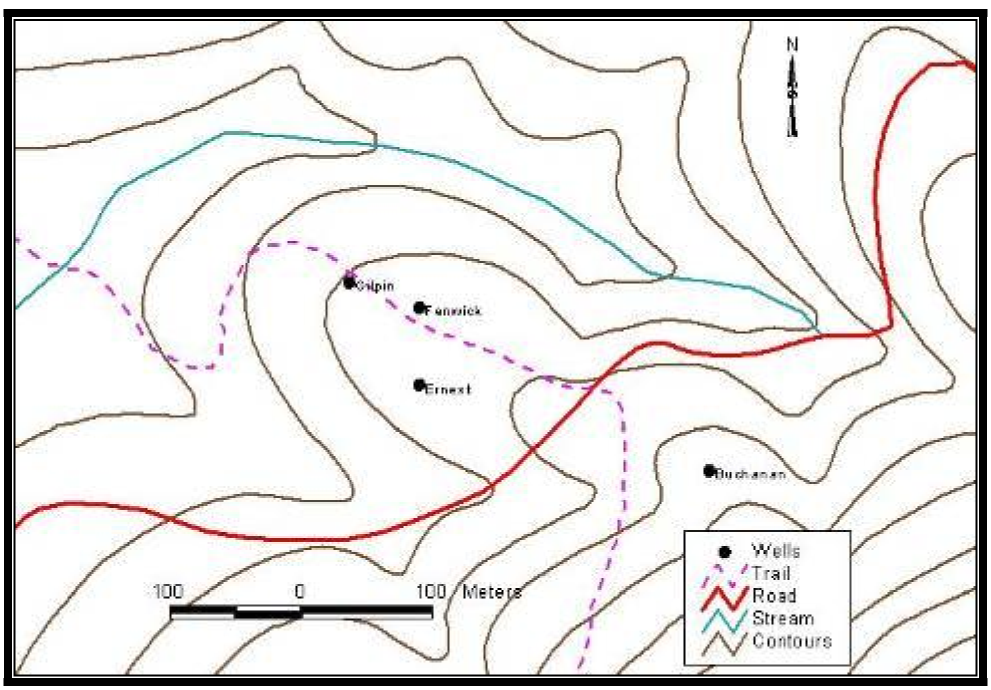


Figure SL-3. Soil Sampling Locations in the Desert Branch Timber Sale



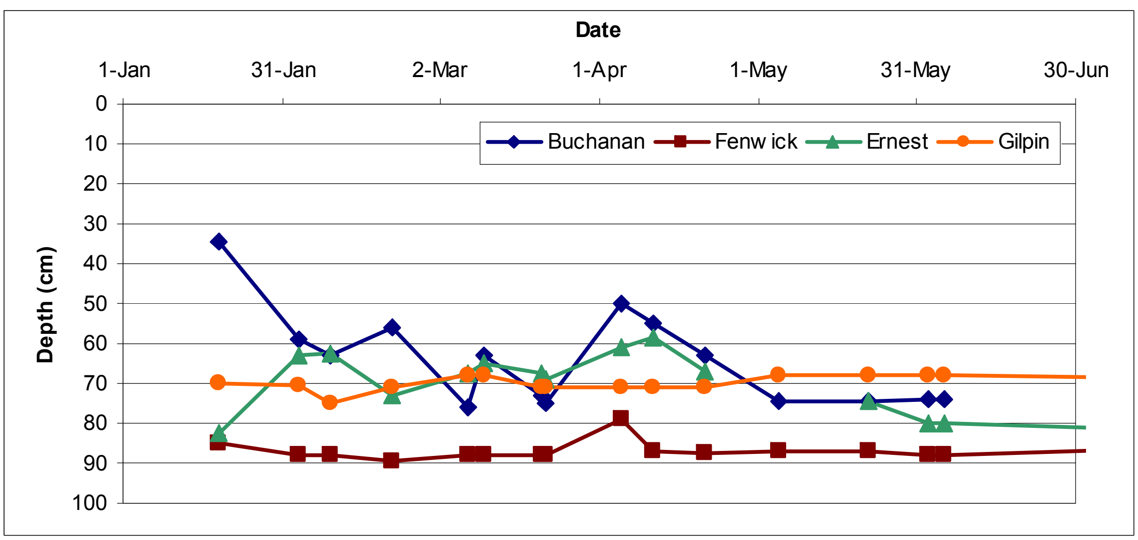
Monitoring Item 2. Evaluation, Conclusions, and Recommendations

By working with benchmark soils that exist in areas with a well-established landscape model, we anticipate that our results will be able to be widely applied to similar landscapes around West Virginia and in neighboring states.

Soil hydrologic response can vary greatly from year-to-year with the normal fluctuations in weather patterns. As such, the data collected to date do not permit the development of definitive conclusions about the hydrologic response of these soils. Data collection at these sites will continue for two to three additional years of monitoring, with local NRCS and Forest Service personnel collecting data and maintaining the equipment. However, the data already acquired are beginning to increase our understanding of the water table dynamics in these soils, especially water table fluctuations that occur rapidly in response to individual precipitation events.

The Gilpin soil is the driest soil and does not seem to exhibit a perched water table above the moderately shallow bedrock, which is as expected (Fig. SL-4). The Fenwick soil also has moderately shallow bedrock but has morphologic evidence that suggests it has seasonally perched water tables. Our data indicate that there are occasional instances of water perched above the bedrock (Fig. SL-4).

Figure SL-4. Water Table Fluctuations for All Soils in the Desert Branch Plots



Furthermore, with some precipitation events it appears that the perched water table may rise and fall rapidly. The maximum water table height, as recorded by the MWTRD, verifies this for the Fenwick soil (Fig. SL-5). This difference between the Fenwick and Gilpin soils may is likely due to its landscape position. The Fenwick is on the relatively flat portion of a bench position of the slope while the Gilpin is on a more steeply sloping portion of the bench (Fig. SL-3). The water table in the Fenwick soil, though, is much less responsive to precipitation inputs compared to the two fragipan soils. Both the Buchanan and the Ernest have sustained perched water tables (Fig. SL-4), and these saturated conditions are more frequently within 50 cm of the soil surface. Furthermore, these perched water tables respond readily to precipitation events as indicated by the maximum water table height recorded between monitoring dates (Fig. SL-6). The Buchanan soil is located on a concave footslope position (Fig. SL-3) and is expected to have convergent water flow, which can explain the thicker and more persistent perched water table (Figs. SL-4 and SL-6). The Ernest is on the edge of the bench and does not accumulate water from as much of a contributing area.

Figure SL-5. Water Table Fluctuations for Fenwick Soil in the Desert Branch Plots

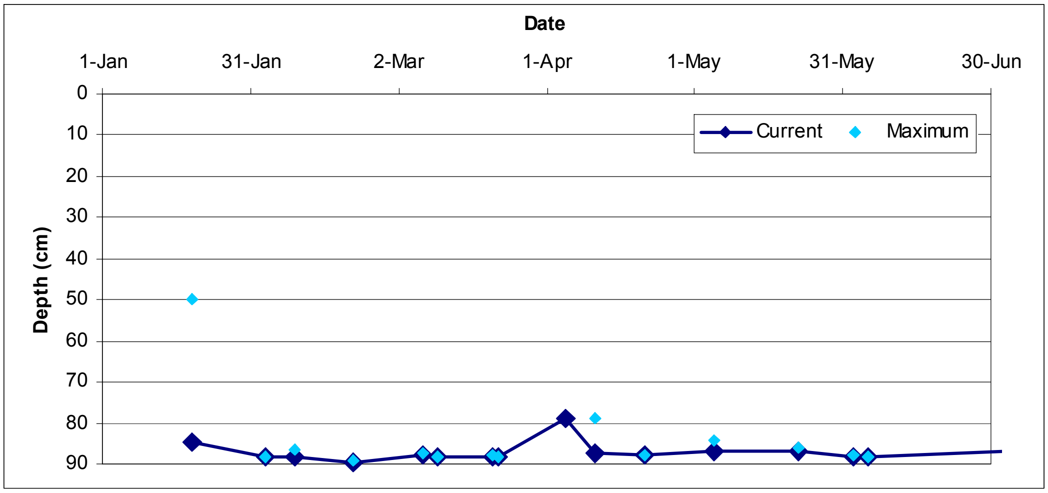
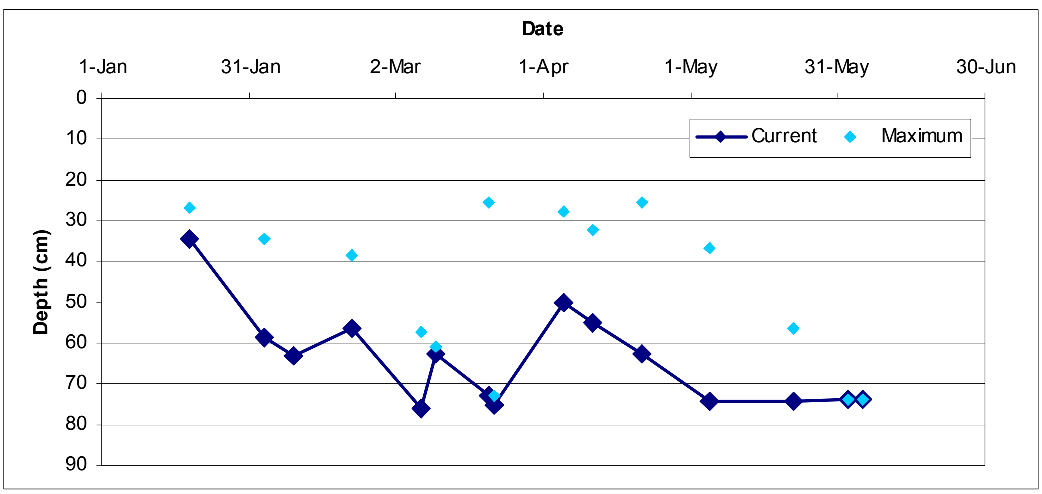


Figure SL-6. Water Table Fluctuations for Buchanan Soil in the Desert Branch Plots



These data indicate that useful information is captured by MWTRD that would be lost with normal weekly or biweekly monitoring. The data also demonstrate that the soils with fragipan subsurface horizons (Buchanan and Ernest) show much greater water table fluctuations than do the soils with moderately shallow bedrock (Fenwick and Gilpin), with the greatest fluctuations in the Buchanan.

The wells are well suited for site-specific monitoring for project related activities. Within the Forest these data are critical for soil interpretations and land management related to ground-disturbing activities and National Environmental Policy Act (NEPA) effects analyses. The data is directly related to the Forest Standard in Appendix S of the 1986 Forest Plan that requires "Soil Protection on Poorly Drained/Compactable soil/site conditions." This type of monitoring and data is valuable to the Forest Service because it is defensible in court and also because it is an excellent way to display to individuals without soil science training how water tables fluctuate within the soil profile throughout a year.

Monitoring Item 3. Desert Branch Timber Sale Implementation and Effectiveness of Forest Plan Standards pertaining to soil disturbance

In FY 2005, the implementation of the Desert Branch Timber Sale began on the Gauley Ranger District. In early FY 2006 in October, the Forest Soil Scientist was called in by the Timber Sale Administrator for specialist opinion and to conduct a short monitoring trip to review implementation and effectiveness of mitigations applied to areas where new soil disturbance was occurring.

Monitoring Item 3. Evaluation, Conclusions, and Recommendations

It is often the weather and then preceding levels of soil moisture that have the greatest effect on whether operating on disturbed soils results in adverse conditions to the soil resource such as rutting and compaction or even erosion. On October 6, 2006 the weather was sunny; however many days of precipitation had occurred prior to monitoring. All of the operators had been not working in days prior to the monitoring trip. Today was their first day back on the job. Soils seemed not so saturated and drained by mid day. Some ponding of water was still visible in rutted areas.

Forest Road 946
The new road surfacing for the main hauling road in the Desert Branch Timber Sale looked excellent in most areas (Fig. SL-7). The TSA says that 4 to 5 inches of stone was applied prior to hauling. Engineering and soil scientist recommend an application of 8 to 12 inches of stone in the EA. In places, the road bed was failing and becoming soft. There was little sign of existing or new stone in place in some of these areas. The recommendation was to spot stone those areas immediately to prevent any further damage of the subgrade. This may have occurred because the additional stone (up to 12 inches) was not added as dictated by pre-sampling and during road design. Given that some areas of the road looked good and were holding up to current levels of logging traffic and other spot areas were not holding up to use, a range of soil conditions were determined to be present in the road prism. The Specialist checked with Engineering as to why the full amount of stone was not added, and the response was that the amount dictated in the EA should have been in the contract. Follow-up is needed to see if contract called for 4 to 5 inches of stone or more as the design indicated.

Figure SL-7. New Road Surfacing on Forest Road 946

Figure SL-8. Seeded and Stabilized Cutbank in Desert Branch Sale Area

Seeding
Seeding of disturbed soils looked excellent throughout the project area. Most all of the disturbed soil was seeded. No mulch was required because the seeding was so efficient in establishment (Fig. SL-8). Even extreme sloping cutbanks looked stable. The Contractor used a hydro seeder. There was a good bit of precipitation prior to the monitoring trip, which allowed for good seeding establishment.

Units Observed

Unit 2 – This was a ridge top unit that was actively being harvested.

Unit 25 and Associated Landing – The landing area (Fig. SL-9) looks highly disturbed into the O and A horizons and surface of the subsoil; however this is to be expected. The main skid road into the landing from the harvest area show signs of some compaction and will need to be ripped in order to restore hydrologic flow (conductivity). The entrance to the landing was heavily stoned and holding well. Logs were not muddy indicating that, although showing some signs of wetness, the soil was not saturated.

Figure SL-9. Soil Disturbance in Unit 25 Landing

Edge of Unit 15 and Associated Landing – The entrance to landing was well stoned and hardened. The culvert needed to be removed and replaced so that it would allow positive drainage in the ditch line. The landing looked stable and although there was quite a bit of disturbance, soil did not seem to be moving off site and deep rutting was not evident. The Specialist observed main haul road into landing from harvest unit. Operator was not working this day due to what he perceived to be wet conditions. The Specialist recommended that the operator put in more temporary water bars and open the ends to allow for drainage. Native surface rock was apparent in the skid trail and was acting to stabilize the surface and prevent compaction and rutting (Fig. SL-10). There were several temporary water bars present, but the skid road needed more and in closer spacing to deal with surface water problems. This excessive ponding may have been due to the presence of layers in the soil perching the water and bringing to the surface subsurface water from the bladed skid trail.

Figure SL-10. Surface Rock in Unit 15 Skid Trail

Summary: Overall, the project looked very good, especially considering recent weather conditions. The TSA called the Specialist in for input, which shows a good working relationship between district staff and the Supervisor's Office. The TSA and Specialist discussed other problem areas and potential for special mitigation like silt fences around landing boundaries near ephemerals.

The Specialist will return for additional monitoring when pioneering of new road construction is completed and additional units are open for harvest. More rock will be need to be added to main road to support the hauling for helicopter harvesting.

Heritage Resources

Introduction

The Heritage Resources Program strives to maintain professional standards regarding site management, artifact curation, and response to requests from other forest programs in a timely and efficient manner. In addition, the Heritage Resources Program seeks to provide heritage education opportunities.

The Heritage Resources Program also strives to maintain an active, open relationship with professional archaeological associations, scholarly institutions, local history groups, interested individuals, and regional interest groups that emphasize heritage resources. We provide information and support to these groups and individuals in as timely and efficient manner as possible.

The Forest Archaeologist participates on the boards of various community public history groups, including the Council for West Virginia Archaeology, Rich Mountain Battlefield Foundation and the Appalachian Forest Heritage Area (AFHA) Group. Heritage resources personnel also participated in the semi-annual meetings of the Council for West Virginia Archaeology and the West Virginia Archaeological Society.

2006 Program Accomplishments

In FY 2003, the Monongahela National Forest, the West Virginia Department of Highways (WVDOH) and the Federal Highways Administration (FHWA) entered into an agreement to mitigate the effects of Corridor H to archaeological resources on Monongahela National Forest lands. The agreement provides $1.2 million to the Heritage Resources Program over a five-year period. The Heritage Resources Program accomplished numerous products, services, and activities as a result of this agreement.

The Monongahela National Forest received $240,000 from the WVDOH and FHWA as part of the initial installment of the mitigation agreement in FY 2006. These funds were used to improve the Heritage Program in several ways. Two full-time term employees were hired to update the Forest Service curation facilities, site files, and databases, and to evaluate and interpret prehistoric and historic resources. In the summer of 2006 the term employees plus four seasonal employees completed field work for the site evaluations of three sites on the Cheat, Marlinton and White Sulphur Springs Ranger Districts. An additional $240,000 was received in FY 2005 and was used for FY 2005 term employee salaries and program improvements.

The Heritage Resources Program completed 40 projects that resulted in a file letter or report. Sixteen project requiring field work were undertaken, involving survey of a total of 4,191 acres.

As part of our regular program work, we coordinate our actions with the WV State Historic Preservation Office and when appropriate, the Advisory Council on Historic Preservation, under the terms of a Memorandum of Agreement that was executed in 1994.

In 2006, the Heritage Resources Program hosted a Passport in Time archaeological field project (Figure HR-1). Members of the public participated in the excavation and site evaluation of a prehistoric site within the Shaver's Fork Drainage. These individuals contributed a total of 352 volunteer hours to the agency for the benefit of archaeology. An additional 700 hours of volunteer time was gained through the participation by the Forest in a joint field school held in cooperation with West Virginia Wesleyan College.

Monitoring and Evaluation

2006 FOREST PLAN MONITORING ITEMS FOR HERITAGE RESOURCES

The 2006 Forest Plan has a specific monitoring item for cultural resources, found on page II-38. This monitoring item is part of Goal HR 01 from the 2006 Forest Plan:

> *b) Preserve, protect, stabilize, monitor, interpret and, when appropriate, mitigate for loss of, or adverse effects to, historic properties.*

In 2006, the Heritage Resources Program inventoried 65 new sites to the heritage site files. Many of these newly recorded sites derived from two projects related to timber sales.

We also monitored the current condition of archaeological sites as part of our larger field schedules. In FY 2006 a total of 73 sites were monitored. Sites that were monitored include National Register listed sites, National Register eligible sites, and sites located in or near current projects. We monitored these sites in order to assess changes in the site conditions and to identify natural or human causes of these changes.

Evaluation, Conclusions, and Recommendations

Of the 73 sites that were monitored, all were found to be in good or undamaged condition (site forms are on file with the Heritage Resources Program Manager at the Forest Supervisor's Office). However, monitoring in previous years has revealed that occasionally sites are adversely affected by Forest Service activities. Forest Service activities are generally planned to avoid adverse effects to NRHP-listed, eligible, or unevaluated heritage sites. These previous incidents involving adverse effects were likely caused by, or exacerbated by, communication failures.

Recommendations:

1. Work with the Forest Plan revision team to incorporate clearer direction for the protection and interpretation of cultural resources on the Forest. Specific direction should include:
    - Minimum standards for in-place protection for eligible and unevaluated cultural resources,

- Heritage Program review of all undertakings that may affect cultural resources in compliance with Sections 106 and 110 prior to decision documents being signed,
- Guidance to consult with specialists in the early planning stages of projects that may involve ground disturbance or other influence on cultural resources.
- Links between key Heritage Resource direction and other resource areas where disturbance projects may be proposed.

1. Expand the goals and desired conditions for Heritage Resources to better describe the intent and responsibilities of the Program.

2. Provide for monitoring of cultural resources in the revised plan. Look at separating out general monitoring from more specific mitigation measure monitoring.

3. Look for potential ways to better provide Heritage Resource input prior to and during project implementation with both Forest staff and contractors.

4. Continue to seek additional funding and personnel for increased monitoring efforts. There are 1,993 heritage sites recorded on the Monongahela National Forest. Only 381 sites have been monitored in the past two decades. Given that the previous monitoring program in 2004 revealed that sites may be destroyed during project implementation, attempts should continue to be made in future to work more closely other Forest staff and contractors to ensure site avoidance, and to monitor known sites for success or failure in these efforts.

Figure HR-1. 2006 Passport in Time Excavation at Shavers Fork Site