NATIONAL SCIENCE FOUNDATION

Environmental Impact Statement for the Green Bank Observatory

Green Bank, West Virginia

Draft

November 9, 2017

Draft

Environmental Impact Statement for the Green Bank Observatory, Green Bank, West Virginia

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Cover Sheet
Draft Environmental Impact Statement
Green Bank Observatory, Green Bank, West Virginia

Responsible Agency: The National Science Foundation (NSF)

For more information, contact:
Ms. Elizabeth Pentecost
Division of Astronomical Sciences
Room W9152
2415 Eisenhower Avenue
Alexandria, VA 22314

Public Comment Period: November 9, 2017 through January 8, 2018 (extended beyond typical 45-day review period to allow for the holidays)

To Submit a Comment:

- **Send email with subject line "Green Bank Observatory" to:**
  envcomp-AST-greenbank@nsf.gov

- **Send mail addressed to:**
  Ms. Elizabeth Pentecost, RE: Green Bank Observatory
  Division of Astronomical Sciences
  Room W9152
  2415 Eisenhower Avenue
  Alexandria, VA 22314

Abstract: The NSF has produced a Draft Environmental Impact Statement (DEIS) to analyze the potential environmental impacts associated with potential funding changes for Green Bank Observatory in Green Bank, West Virginia. The five Alternatives analyzed in the DEIS are: A) collaboration with interested parties for continued science- and education-focused operations with reduced NSF funding (the Agency-preferred Alternative); B) collaboration with interested parties for operation as a technology and education park; C) mothballing of facilities; D) demolition and site restoration; and the No-Action Alternative. The environmental resources considered in the DEIS are biological resources, cultural resources, visual resources, geology and soils, water resources, hazardous materials, solid waste, health and safety, noise, traffic and transportation, socioeconomics, and environmental justice.

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Executive Summary

ES.1 Introduction

The National Science Foundation (NSF) prepared this Draft Environmental Impact Statement (DEIS) to evaluate the potential environmental effects of proposed operational changes and potential demolition activities due to funding constraints at the Green Bank Observatory (GBO) in Green Bank, West Virginia. The DEIS was prepared in compliance with the National Environmental Policy Act of 1969 (NEPA) (42 United States Code §§4321, *et seq.*); Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (Title 40 *Code of Federal Regulations* Parts 1500–1508); and NSF procedures for implementing NEPA and CEQ regulations.

GBO is located on federal land in Pocahontas County, West Virginia, adjacent to the Monongahela National Forest. A key component of the GBO is the 100-meter Robert C. Byrd Green Bank Telescope (GBT). GBO infrastructure includes instrumentation for astronomy and astrophysics, office and laboratory buildings, a visitor and education facility, and lodging facilities for visiting scientists. GBO is staffed by approximately 100 year-round employees, with up to 140 employees during the summer months. The number of annual visitors averages 50,000 (NSF, 2017).

NSF acknowledges that valuable science and education activities are conducted at GBO, as evidenced by decades of substantial funding of both the facility and research grants. However, the purpose of the current Proposed Action is to reduce NSF funding in light of a constrained budgetary environment. Neither the merits of the science and education activities at GBO nor NSF's budgetary decisions are the focus of this review. As explained in this DEIS and during public meetings, NSF relies on the scientific community, via decadal surveys and senior-level reviews, to provide input on priorities, and this community has repeatedly recommended NSF divestment from GBO, as well as from other observatories currently under similar review, in this constrained budgetary environment. These recommendations are summarized in this document only to explain the need for the current proposal. In accordance with NEPA, the DEIS analyzes the potential environmental impacts of a range of alternatives to meet the objective of reduced NSF funding for GBO.

ES.2 Purpose and Need

NSF needs to maintain a balanced research portfolio with the largest science return for the taxpayer dollar. NSF's Division of Astronomical Sciences (AST) is the federal steward for ground-based astronomy in the United States. Its mission is to support forefront research in ground-based astronomy, help ensure the scientific excellence of the United States astronomical community, provide access to world-class research facilities through merit review, support the development of new instrumentation and next-generation facilities, and encourage a broad understanding of the astronomical sciences by a diverse

population of scientists, policy makers, educators, and the public at large. AST supports research in all areas of astronomy and astrophysics as well as related multidisciplinary studies. Because of the scale of modern astronomical research, AST engages in numerous interagency and international collaborations. Areas of emphasis and the priorities of specific programs are guided by recommendations of the scientific community, which have been developed and transmitted by National Research Council (NRC; now National Academies) decadal surveys, other National Academies committees, as well as federal advisory committees, such as the Astronomy and Astrophysics Advisory Committee (AAAC) and the Advisory Committee for the Directorate for Mathematical and Physical Sciences (MPSAC).

In 2006, the AST Senior Review (SR) Committee, a subcommittee of the MPSAC, delivered a report to NSF. This committee of external scientists was charged with examining the AST investment portfolio and finding $30 million in annual savings, primarily from the facilities portion of the AST budget, while following the priorities and recommendations of community reports. The SR recommended that the GBT be a component of the "Radio-Millimeter-Submillimeter Base Program" (Recommendation 3) and that "[r]eductions in the cost of Green Bank Telescope operations, administrative support and the scientific staff at the National Radio Astronomy Observatory should be sought" (Recommendation 6) (NSF, 2006). Details of the rationale for the GBT cost-reduction are provided in Section 6.2.2 of the SR Committee report (NSF, 2006):

> The SR found that the GBT operations cost of $10M ($15M burdened) to be conspicuously large, especially as it is several years since the instrument was commissioned. The former figure is 12 percent of the construction cost, much larger than the seven percent rule of thumb and large in comparison with the proposed running costs for Atacama Large Millimeter Array (ALMA) (six percent of capital costs minus the component set aside for new instrumentation). Based upon its analysis, the SR believes that there are opportunities for operating Green Bank significantly more efficiently and redeploying some of the existing personnel to help meet other [National Radio Astronomy Observatory] NRAO responsibilities as has happened in the past, consistent with Principle 2. This should be considered in detail by the NRAO cost review.

In 2010, the NRC conducted its sixth decadal survey in astronomy and astrophysics. In its report, *New Worlds, New Horizons in Astronomy and Astrophysics* (NRC, 2010a), the NRC recommended that:

> NSF-Astronomy should complete its next senior review before the mid-decade independent review that is recommended in this report, so as to determine which, if any, facilities NSF-AST should cease to support in order to release funds for (1) the construction and ongoing operation of new telescopes and instruments and (2) the science analysis needed to capitalize on the results from existing and future facilities.

In response to this recommendation, the NSF Directorate for Mathematical and Physical Sciences, which includes AST, commissioned a subcommittee of the MPSAC to assess the AST portfolio of facilities and grants programs. This subcommittee, composed solely of external members of the scientific community, was charged with recommending a balanced portfolio to maximize the science recommended by National Academy of Sciences surveys of the field. These surveys are carried out every decade. The resulting Portfolio Review Committee Report (PRC Report) was accepted by the MPSAC and released in August 2012.

In the PRC Report (NSF, 2012), the subcommittee recommended divestment of several telescopes from the AST funding portfolio to maintain a balance of small-, medium-, and large-scale programs that would best address decadal survey-recommended science priorities. With respect to the GBT at GBO, the subcommittee made the following recommendation (Recommendation 10.6): "We recommend that AST divest from the Mayall, WIYN, and 2.1-meter telescopes at Kitt Peak, the Robert C. Byrd Green Bank Telescope, the Very Long Baseline Array, and the McMath-Pierce solar telescope."

The continued importance of the NSF response to the PRC Report (NSF, 2012) is highlighted in the AAAC's annual report, released in March 2016, in which the AAAC recommended that "[s]trong efforts by NSF for facility divestment should continue as fast as is possible." The recently released 2017 AAAC report reaffirmed this advice with similar recommendations (AAAC, 2017).

In the August 2016 mid-decadal report, *New Worlds, New Horizons, A Midterm Assessment* (NAS, 2016), the National Academies also made a consistent recommendation (Recommendation 3-1):

> The National Science Foundation (NSF) should proceed with divestment from ground-based facilities which have a lower scientific impact, implementing the recommendations of the NSF Portfolio Review that is essential to sustaining the scientific vitality of the U.S. ground-based astronomy program as new facilities come into operation.

At present, GBO serves a variety of scientific user communities in astronomy and astrophysics, and the Observatory is funded for an active education and public outreach program. At the same time, the scientific community evaluations cited previously indicate that GBO's science capability is lower in priority than other science capabilities that NSF funds. In a funding-constrained environment, NSF needs to maintain a balanced research portfolio with the largest science return for the taxpayer dollar. Therefore, the purpose of the Proposed Action is to substantially reduce NSF's contribution to the funding of GBO.

ES.3 Public Disclosure and Involvement

NSF notified, contacted, and/or consulted with agencies, individuals, and organizations during development of this DEIS. Public disclosure and involvement regarding the Proposed Action included pre-assessment notification letters to agencies; social media announcements; website updates; scientific

digest and blog postings; newspaper public notices; fliers mailed to local schools, post offices, and businesses; and two public scoping meetings conducted on November 9, 2016, at GBO in Green Bank, West Virginia. The public was encouraged to comment during the scoping process. Detailed information about these activities and a summary of scoping comments is provided in Section 5, *Notification, Public Involvement, and Consulted Parties*, of the DEIS. The DEIS has been distributed to federal, state, local, and private agencies, organizations, and individuals for review and comment, and it was filed with the U.S. Environmental Protection Agency (EPA). A Notice of Availability (NOA) was announced in the *Federal Register* on November 9, 2017; this DEIS has been published on the NSF website and distributed to local libraries. A public meeting to present the findings of this DEIS will be conducted on November 30, 2017, at GBO; the public is also encouraged to submit comments on this DEIS during the 60-day comment period, starting on November 9, 2017.

ES.4 Agency Notification and Collaboration

In October 2016, NSF began the process of informal consultation with federal and state agencies, West Virginia elected officials, community groups, and relevant commercial interests. Details on agency collaboration and consultation throughout this NEPA process are located in Section 5, *Notification, Public Involvement, and Consulted Parties*, of this DEIS. Both formal and informal consultations have been taking place with these parties to ensure full disclosure of information. These consultations include, but are not limited to, discussions and correspondence with the Advisory Council on Historic Preservation (ACHP), the West Virginia State Historic Preservation Office (SHPO) under Section 106 of the National Historic Preservation Act of 1966 (NHPA), and U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act of 1973 (ESA).

ES.5 Alternatives under Consideration

The following Alternatives are considered in detail in this DEIS. The Alternatives were developed with input from the scientific community and refined based on input received during the public scoping period.

Under each Action Alternative, some buildings and structures could be demolished; **buildings that could be demolished are identified for analysis purposes only, but these buildings would not necessarily be demolished.** Alternatives A and B are defined by the reduction of NSF funding and the continuance of science- and education-focused operations (under Alternative A) or operation as a technology and education park (under Alternative B) and not the disposition of any one facility or structure. Use or demolition of any particular building or instrument cannot be determined unless or until a viable collaboration option is under consideration.

Because reduction of NSF funding may require the safe-abandonment[1], mothballing[2], or demolition of facilities, the Alternatives are described under the most conservative (highest environmental impact) scenario in terms of NSF's analysis of potential changes to facilities, so that the EIS may be inclusive of the full range of potential environmental impacts. The analysis approach is consistent with NEPA requirements and is sufficiently broad to allow NSF to complete the analysis during planning and without regard to the specifics of a future collaboration. The Agency-preferred Alternative does not include, and this DEIS does not *mandate*, the demolition or removal of specific buildings and infrastructure, even if specific buildings are identified in the various Alternatives. Because of this, this DEIS should not be viewed to preclude a proposed activity or use of infrastructure.

ES.5.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF funding (Agency-preferred Alternative)

Action Alternative A would involve collaborations with new stakeholder(s) who would use and maintain GBO for continued science- and education-focused operations. NSF would reduce its funding of the Observatory and the new stakeholder(s) would be responsible for future maintenance and upgrades. Under this Alternative, NSF could transfer or retain the property. Potential transfers could include other federal agencies, commercial interests, or non-profit entities. Action Alternative A would involve the least change to the current facility and would retain the GBT, other appropriate telescopes, and appropriate supporting facilities for education and research as determined by NSF and the new and/or existing stakeholder(s). Any structures not needed to meet the anticipated operational goals would be safe-abandoned, mothballed, or demolished, as appropriate.

The implementation period, defined as the period in which demolition, mothballing and/or safe-abandonment would occur, is expected to last 21 weeks under Action Alternative A. However, due to funding constraints, implementation might have to occur in multiple phases over a longer time period. No tree removal or disturbances to unmaintained areas would be necessary. All demolition activities would occur in areas that are maintained with mowed landscape grasses, and additional maintained areas are available for staging and support during demolition.

[1] Safe-abandonment: To remove a building or facility from service without demolishing it. This includes removing furnishings, disconnecting utilities, and isolating the structure from public access by fencing or other means to reduce fall and tripping hazards and preclude vandalism. The structure is also made secure from environmental damage due to wind, rain, humidity, and temperature extremes. Pest and insect damage must also be taken into account and biodegradable items must be removed to the maximum extent practicable. Under safe-abandonment, there is no intention that structures would be brought back to operational status.

[2] Mothball: To remove a facility or structure from daily use while maintaining the general condition for a defined period. Equipment and structures are kept in working order but are not used.

Operations after implementation would be similar to current operations, and operation staffing levels would be expected to stay the same. Operations would be expected to continue at non-affected facilities during any scheduled demolition activities. Demolition activities that could interfere with the use of the GBT and other telescopes and data collection would be coordinated with GBO staff to minimize the potential for disrupting scientific work.

Alternative A is the Agency-preferred Alternative. This Action Alternative would meet the purpose of reducing the funding required from NSF and allow continued benefits to the scientific and educational communities. However, this Alternative could occur only if new and/or existing collaborators come forward to participate as collaborating parties with viable proposed plans to provide additional non-NSF funding in support of their science- and education-focused operations. Collaborators are being sought and could include agencies, educational institutions, non-profit entities, industrial or commercial ventures, or private individuals.

ES.5.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Action Alternative B would involve collaborating with outside entities to operate and maintain GBO as a technology and education park. In this scenario, the site would focus on tourism and serve as a local attraction. The Science Center, residential hall, cafeteria, and 40-foot telescope would remain active. Under this Alternative, NSF could transfer or retain the property. Potential transfers could include other federal agencies, commercial interests, or non-profit entities.

The implementation period under Action Alternative B is expected to last 21 weeks. However, due to funding constraints, implementation might have to occur in multiple phases over a longer time period. No tree removal or disturbances to unmaintained areas would be necessary. All demolition activities would occur in areas that are maintained with mowed landscape grasses, and additional maintained areas are available for staging and support during demolition.

Operations would be expected to continue during implementation. Demolition activities that could interfere with the use of the 40-foot telescope and data collection would be coordinated with GBO staff to minimize the potential for disrupting observational work.

Operations after demolition would be comparable to current operations. However, it is anticipated that there would be a reduction in operations staff under Action Alternative B.

ES.5.3 Action Alternative C: Mothballing of Facilities

Action Alternative C would involve mothballing (preserving) essential buildings, telescopes, and other equipment, with periodic maintenance to keep them in working order. This method would allow the facility to suspend operations in a manner that would permit operations to resume efficiently at some time in the future. It is not known what types of operations would be implemented at the end of the mothball phase.

Operations at the time of resumption could be similar to current operations, other science-based operations, education-based operations, or some other type of operations. Because of this uncertainty, the resumption of operations is not considered part of this Alternative.

Supporting structures would be evaluated to determine whether they are critical to the operation of the telescopes. Up to nine structures and facilities may be determined to be obsolete and could be removed.

A maintenance program would be required to protect the facilities (e.g., buildings and structures) from deterioration, vandalism, and other damage. Regular security patrols would be performed to monitor the site. Common mothballing measures, such as providing proper ventilation, keeping roofs and gutters cleaned of debris, and performing ground maintenance and pest control, would be implemented. Lubrication and other deterioration-preventing measures would be required on the remaining telescopes.

Visitor housing and recreational areas would be closed indefinitely, with water lines drained and electricity turned off. All supplies, books, photographs, furnishings, and other items not needed for periodic maintenance would be removed from the site. Equipment, tools, machinery, furniture, and ancillary items not needed for the resumption of operations would be disposed of in accordance with federal law.

Gates and fencing would be evaluated to determine whether upgrades would be needed to provide appropriate security.

Implementation for Action Alternative C is expected to last 24 weeks. However, due to funding constraints, implementation under this Alternative may have to occur in multiple phases over a longer time period. No tree removal or disturbances to unmaintained areas would be necessary to demolish the structures. All demolition activities are in areas that are maintained with mowed landscape grasses, and additional maintained areas are available for staging and support during demolition.

Landscaped areas would be maintained during the mothball period. All infrastructure related to the telescopes would be conditioned for safe storage to prevent the degradation of equipment and allow operations to be restarted. Regular vegetation maintenance would be implemented to keep vegetation from overgrowing the reflector dishes.

For purposes of the analyses in this DEIS, it is assumed that operations would be suspended for an indefinite time and then resumed at some point in the future. It is anticipated that technical staff responsible for operating the telescopes, scientific support staff, and cafeteria workers would not be retained. However, it is expected that current staffing levels for facilities maintenance would mostly remain the same under Action Alternative C because of the level of maintenance required to keep the infrastructure operable.

ES.5.4 Action Alternative D: Demolition and Site Restoration

Action Alternative D involves the removal of all structures. Demolition would be accomplished using conventional demolition equipment (cranes, hydraulic excavator equipped with hydraulic-operated shears, grapplers, and hoe rams), other conventional heavy and light duty construction equipment, trades personnel, and trained demolition crews. For safe demolition of the GBT, 43-meter telescope, and water tower, initial demolition would likely be accomplished using explosives in the form of shaped charges and conventional demolition and/or construction equipment.

Equipment, tools, machinery, furniture, and ancillary items that have a salvage value could be transported to another NSF facility, sold, or donated by GBO prior to demolition activities. All remaining facilities and structures, except for the existing perimeter fencing, would be demolished. Exposed below-grade structures would be removed to a maximum of 4 feet below grade to enable the restoration of the ground surface topography.

The demolition period for Action Alternative D would be expected to last 36 weeks. However, due to funding constraints, activities under this Alternative might have to occur in multiple phases over a longer time period. No tree removal or disturbance to unmaintained areas would be necessary to accomplish demolition. All demolition activities would occur in areas that are maintained with mowed landscape grasses, and additional maintained areas are available for staging and support during demolition.

Areas revegetated following demolition activities would be maintained for a period of up to 18 months, or less if target revegetation were achieved sooner. Vegetation maintenance staff would be retained through this period.

Operations at GBO would cease. It is anticipated that under this Alternative, staffing levels would not be maintained.

ES.5.5 No-Action Alternative: Continued NSF Investment for Science-focused Operations

Under the No-Action Alternative, NSF would continue funding GBO at current levels. None of the Action Alternatives would be implemented. However, this Alternative does not meet the intended purpose or need for the Proposed Action. This Alternative is used as a baseline to evaluate the impacts of the Action Alternatives in Section 4, *Environmental Consequences*, of the DEIS.

ES.6 Resources Not Considered in Detail

Initial analysis indicated that certain resource areas would not have the potential for noticeable or measurable impacts under any of the considered Alternatives. These resource areas are identified here and not discussed further:

- Air Quality: The Proposed Action could involve the short-term use of diesel generators and short-term emissions associated with demolition. However, GBO is located in an area that is in full attainment for all National Ambient Air Quality Standards (NAAQS) criteria pollutants (EPA, 2016a). Therefore, Clean Air Act (CAA) conformity analysis is not required and there is limited likelihood for the Proposed Action to cause a violation in CAA NAAQS. Any air quality impacts would be negligible on a regional basis.
- Climate Change: Potential greenhouse gas (GHG) emissions under Action Alternatives A and B are expected to be similar to current conditions and under Action Alternatives C and D would decrease over the long term. Consequently, there are no new adverse effects to climate change expected under the proposed Action Alternatives. Based on the location of the facility, impacts from climate change would not affect future activities at GBO.
- Utilities: No new utility infrastructure would be required and utility usage would be expected to either stay the same or be reduced under any Action Alternative.

ES.7 Mitigation Measures

Under Action Alternatives A through D, appropriate mitigation measures, including best management practices (BMPs), have been identified that would be implemented to reduce the potential for impacts. The following mitigation measures would be implemented:

Air Quality

- All Alternatives: Contracts for demolition work would require vehicle idle reduction and proper equipment maintenance to reduce emissions during demolition.

Biological Resources

- All Action Alternatives: Demolition activities would occur only in previously disturbed and currently maintained areas. Forested areas and streams would be fully avoided.
- All Action Alternatives: In order to protect adjacent and downstream wildlife habitat from the indirect effects of sedimentation and erosion, stormwater BMPs and erosion control measures would be implemented prior to starting demolition activities. Erosion controls, such as compost blankets, mulching, riprap, geotextiles, and slope drains, could be used to protect exposed soil and minimize erosion. BMPs, such as check dams, slope diversions, and temporary diversion dikes, could be implemented for runoff control. Sediment control measures that could be implemented include compost filter berms and socks; fiber rolls or berms; sediment basins, rock dams, filters, chambers, or traps; silt fences; and weed-free hay bales. Good housekeeping measures would be practiced during demolition.

- All Action Alternatives: While it is unknown whether GBO would be transferred out of federal control, if the GBO property were transferred out of federal control in the future, NSF would consult with USFWS, as appropriate, to meet Section 7 consultation requirements and to determine any necessary mitigation measures (e.g., land use controls).
- All Action Alternatives: If demolition activities were to extend beyond one year, NSF would confirm with the USFWS that there are no new threatened or endangered species expected in the area. If new species are present NSF will reengage in ESA Section 7 consultation.

Cultural Resources

- All Action Alternatives: Stipulations specified in the Section 106 agreement document (Memorandum of Agreement [MOA] or Programmatic Agreement [PA]), reached through consultation, would be implemented. These stipulations would address the necessary mitigation for major impacts on cultural resources under NEPA. Specific mitigation measures would be developed in consultation with the SHPO, ACHP, and other Consulting Parties.
- All Action Alternatives: Stipulations specified as a result of consultation with the ACHP and the Secretary of the Interior regarding proposed impacts and effects to the Reber Radio Telescope, which is a designated National Historic Landmark, would be followed.
- All Action Alternatives: An unanticipated discovery plan would be developed prior to demolition under the selected Action Alternative to address any archeological resources that might be discovered during demolition.
- Action Alternatives A, B, and C: Mothballing historic properties would be completed in accordance with the National Park Service's (NPS's) Preservation Brief 31, "Mothballing Historic Buildings" (Park, 1993) and *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings* (Grimmer, 2017).

Visual Resources

- Action Alternatives A, B and C: Mothballed and safe-abandoned buildings would be regularly maintained to preserve the visual character of the site.

Geology and Soils

- All Action Alternatives: Appropriate stormwater controls would be implemented and maintained to prevent scour and soil loss from runoff during demolition.
- All Action Alternatives: Disturbed areas would be stabilized and revegetated and/or re-landscaped to minimize the potential for erosion after demolition is completed.

- All Action Alternatives: Earth-disturbing activities would be conducted in a manner that minimizes alteration of existing grade and hydrology.
- All Action Alternatives: Because of the potential for heavy rain events to result in unsafe work conditions and increased landslide conditions, including, but not limited to, debris flow, the decision to work during heavy rain events would be evaluated on a case-by-case basis to lower the risk for debris flow.

Water Resources

- All Action Alternatives: Stormwater BMPs and erosion control measures would be implemented prior to starting demolition activities. Site-specific stormwater BMPs would be detailed in a stormwater pollution prevention plan, which would be prepared before breaking ground.
- All Action Alternatives: A groundwater protection plan (GPP) would be developed for the project to address risks to groundwater from potential spills. The GPP would address equipment inspections, equipment refueling, equipment servicing and maintenance, equipment washing, and the use and storage of any hazardous materials, chemicals, fuels, lubricating oils, and other petroleum products.

Hazardous Materials

- All Action Alternatives: A complete site characterization and the removal or remediation of contamination would be completed prior to any demolition and/or any land transfer activities.
- All Action Alternatives: Hazardous materials and waste would be used, stored, disposed of, and transported during demolition in compliance with all applicable laws and regulations.
- All Action Alternatives: Contractors would create and implement a spill response plan.
- All Action Alternatives: NSF would require all contractors to create and implement a construction management plan, including hazardous materials discovery protocols. The construction management plan would include, at a minimum, a list of contact persons in case of a possible encounter with undocumented contamination; provisions for immediate notification of the observation to construction management; and provisions for notifying the regulatory agency with jurisdiction. If previously unknown contamination were found, demolition would halt near the find and the next steps would be decided in consultation with the regulatory agency.

Solid Waste

- All Action Alternatives: Whenever possible, demolition debris such as soil would be re-used on site.
- All Action Alternatives: Demolition debris would be diverted from landfills through reuse and recycling to the extent practicable.

Health and Safety

- All Action Alternatives: The contractor would develop and implement a demolition health and safety plan.
- All Action Alternatives: GBO personnel and contractor personnel would comply with Occupational Safety and Health Act safety protocols.
- All Action Alternatives: Fencing and signage would be installed around demolition sites.
- Action Alternative C: A maintenance and security program would be implemented for mothballed facilities.
- Action Alternative D: Individuals handling explosives would be properly trained and industry standard safety protocols would be implemented.

Noise

- All Action Alternatives: Neighbors would be notified of demolition noise in advance and its expected duration so they may plan appropriately.
- All Action Alternatives: Exhaust systems on equipment would be in good working order. Equipment would be maintained on a regular basis and would be subject to inspection by the project manager to ensure maintenance.
- All Action Alternatives: Properly designed engine enclosures and intake silencers would be used where appropriate.
- All Action Alternatives: Temporary noise barriers would be used where appropriate and possible.
- All Action Alternatives: New equipment would be subject to new product noise emission standards.
- All Action Alternatives: Stationary equipment would be located as far from sensitive receptors as possible.
- All Action Alternatives: In noise sensitive areas, demolition activities would be performed during hours that are the least disturbing for adjacent and nearby residents.
- Action Alternative D: Explosive materials that are a small enough caliber to prevent a blast overpressure or sound pressure wave would be used.

Traffic and Transportation

- All Action Alternatives: Transport of materials and large vehicles would occur during off-peak hours when practicable.

- All Action Alternatives: Delivery truck personnel and demolition workers would be notified of all potential height restrictions and overhead obstructions.
- All Action Alternatives: Vehicles used for material transport would comply with local standards for height, width, and length of vehicles, when practicable. If at any time vehicles of excessive size and weight are required on local roads and bridges, permits would be obtained from the proper authority.
- All Action Alternatives: Further detailed waste haul routes and concerns would be addressed during the demolition planning phase of the Proposed Action, including verification that all bridge crossings on the delivery route have adequate strength and capacity.
- All Action Alternatives: The contractor would coordinate with local public schools to ensure haul routes do not adversely affect school bus traffic.

ES.8 Impact Summary

The impacts for each of the considered alternatives are presented below. The designated impact level under Action Alternatives A through D assumes the BMPs and mitigation measures identified previously would be implemented. A definition and explanation of each impact is provided in the corresponding resource section in Section 4, *Environmental Consequences*, of the DEIS.

Impacts from any of the Alternatives would not result in disproportionately high and adverse impacts on minority and low-income populations. Therefore, there would be no environmental justice concerns associated with the Proposed Action. A detailed explanation of this finding can be found in Section 4.12, *Environmental Justice,* of the DEIS.

Further no cumulative impacts are expected from implementation of the Proposed Action. A detailed explanation of this finding is provided in Section 4.13, *Cumulative Impacts*, of the DEIS.

ES.8.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF funding (Agency-preferred Alternative)

Biological Resources: Demolition would result in minor, adverse, and short-term impacts on vegetation, negligible impacts on wildlife and migratory birds, and no impacts on threatened and endangered species. There would be no impacts on vegetation, wildlife, threatened and endangered species, and migratory birds post-demolition.

Cultural Resources: Demolition would result in a major, adverse, and long-term impact on known historic properties. Safe-abandonment would result in a moderate, adverse, and long-term impact on known historic properties. Mothballing would have a negligible impact on known historic properties. The impacts on known historical properties during operations would be major, adverse, and long-term. If the property were to remain under federal ownership, there would be moderate, adverse, long-term impacts

on the historic district. If the property were transferred out of federal ownership, there would be a major, adverse, long-term impact on the historic district. There would be no impacts on archeology during either demolition or operation activities.

Visual: Impacts on visual resources during demolition, safe-abandonment, and mothballing would be minor, adverse, and short-term. Impacts on visual resources post-implementation would be minor, adverse, and long-term.

Geology and Soils: Demolition, safe-abandonment, and mothballing activities would have negligible impacts on topography, landslides, and soils and no impact on geological resources of economic concern and seismicity. There would be no impacts during operations.

Water Resources: Demolition, safe-abandonment, and mothballing activities would result in negligible impacts on underlying groundwater and no impacts on wetlands, floodplains, and surface water. There would be no impacts on wetlands, groundwater, floodplains, or surface water during operations.

Hazardous Materials: A minor, long-term benefit to site contamination would be expected as a result of clean-up conducted during demolition, safe-abandonment, and mothballing. A minor, adverse, and short-term impact would result from the increased use of hazardous materials during demolition, safe-abandonment, and mothballing. A minor, long-term benefit would occur from the reduced use of hazardous materials during operations.

Solid Waste: Minor, adverse, and long-term impacts on solid waste would occur during demolition, safe-abandonment, and mothballing. There would be minor, long-term benefits to solid waste during operations.

Health and Safety: Negligible impacts on public safety and protection of children would be expected during demolition, safe-abandonment, and mothballing. Minor, adverse, short-term impacts on occupational health during demolition, safe-abandonment, and mothballing might occur. Negligible impacts to public safety could occur during operations.

Noise: Moderate, adverse, and short-term impacts on noise from large equipment and negligible impacts on traffic would be expected during demolition, safe-abandonment, and mothballing. There would be no noise impacts during operations.

Traffic and Transportation: Minor, adverse, and short-term impacts on traffic and transportation would be expected during demolition. No traffic impacts would be expected during operations.

Socioeconomics: Demolition, safe-abandonment, and mothballing activities would result in moderate, short-term benefits to population and housing, and the economy, employment, and income. Negligible impacts would occur to the economy, employment, and income during operations. Impacts on education due to reduced regional education opportunities would be minor, adverse, and long-term. Impacts on

Pocahontas County community cohesion would be minor, adverse, and long-term. Impacts on Green Bank and Arbovale community cohesion would be moderate, adverse, and long-term.

ES.8.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Biological Resources: Demolition would result in minor, adverse, short-term impacts on vegetation, negligible impacts on wildlife and migratory birds, and no impacts on threatened and endangered species. Post-demolition would result in no impacts on vegetation, wildlife, threatened and endangered species, and migratory birds.

Cultural Resources: Demolition would result in a major, adverse, long-term impact on known historic properties. Safe-abandonment would result in a moderate, adverse, long-term impact on known historic properties. Mothballing would have a negligible impact on known historic properties. The impacts on known historic properties during operations would be major, adverse, and long-term. If the property were to remain under federal ownership, there would be moderate, adverse, and long-term impacts on the historic district. If the property were to be transferred out of federal ownership, there would be a major, adverse, and long-term impact on the historic district. There would be no impacts on archeology during either demolition or operation activities.

Visual Resources: Impacts on visual resources during demolition, safe-abandonment, and/or mothballing would be minor, adverse, and short-term. Impacts on visual resources post-implementation would be minor, adverse, and long-term.

Geology and Soils: Demolition, safe-abandonment, and mothballing activities would have negligible impacts on topography, landslides, and soils and no impact on geological resources of economic concern and seismicity. There would be no impacts during operations.

Water Resources: Demolition, safe-abandonment, and mothballing activities would result in negligible impacts on underlying groundwater and no impacts on wetlands, floodplains, and surface water. There would be no impacts on wetlands, groundwater, floodplains, or surface water during operations.

Hazardous Materials: A minor, long-term benefit to site contamination would be expected during demolition, safe-abandonment, and/or mothballing. A minor, adverse, and short-term impact would result from increased use of hazardous materials during demolition, safe-abandonment, and/or mothballing. A minor, long-term benefit would occur from the reduced use of hazardous materials during operations.

Solid Waste: Minor, adverse, and long-term impacts on solid waste would occur during demolition, safe-abandonment, and/or mothballing. There would be minor, long-term benefits on solid waste during operations.

Health and Safety: Negligible impacts would be expected to public safety and protection of children during demolition, safe-abandonment, and/or mothballing. Minor, adverse, and short-term impacts on

occupational health during demolition, safe-abandonment, and/or mothballing might occur. Negligible impacts on public safety could occur during operations.

Noise: Moderate, adverse, and short-term impacts on noise from large equipment and negligible impacts on traffic would be expected during demolition, safe-abandonment, and/or mothballing. There would be no noise impacts during operations.

Traffic and Transportation: Minor, adverse, and short-term impacts on traffic and transportation would be expected during demolition. Negligible traffic impacts would be expected during operations.

Socioeconomics: Demolition, safe-abandonment, and mothballing activities would result in moderate, short-term benefits to population and housing, and the economy, employment, and income. Moderate, adverse, and long-term impacts would occur to the economy, employment, and income during operations. Minor, adverse, and long-term impacts on population and housing in Pocahontas County, Green Bank, and Arbovale would occur during operations. Impacts on education due to reduced regional education opportunities and Green Bank and Arbovale school enrollment would be moderate, adverse, and long-term. Impacts on education due to Pocahontas County school enrollment during operations would be minor, adverse, and long-term. Impacts on Pocahontas County community cohesion would be minor, adverse, and long-term. Impacts on Green Bank and Arbovale community cohesion and regional tourism would be moderate, adverse, and long-term.

ES.8.3 Action Alternative C: Mothballing of Facilities

Biological Resources: Demolition would result in minor, adverse, and short-term impacts on vegetation, negligible impacts on wildlife and migratory birds, and no impacts on threatened and endangered species. There would be no impacts on vegetation, a minor long-term benefit to wildlife and migratory birds, and a negligible benefit to threatened and endangered species during the mothball period.

Cultural Resources: Demolition would result in a major, adverse, and long-term impact on known historic properties. Mothballing would have negligible impact on known historic properties. The impacts on known historical properties post-demolition would be moderate, adverse, and long-term. There would be a moderate, adverse, and long-term impact on the historic district. There would be no impacts on archeology during either demolition or post-demolition activities.

Visual Resources: Impacts on visual resources during mothballing would be minor, adverse, and short-term. Impacts on visual resources post-implementation would be minor, adverse, and long-term.

Geology and Soils: Mothballing activities would have negligible impacts on topography, landslides, and soils and no impact on geological resources of economic concern and seismicity. There would be no impacts after the completion of mothballing activities.

Water Resources: Mothballing results in negligible impacts on underlying groundwater and no impacts on wetlands, floodplains, and surface water. There would be no impacts on wetlands, floodplains, and groundwater and a negligible impact on surface water during the mothball period.

Hazardous Materials: A minor, long-term benefit to site contamination would be expected during mothballing. A minor, adverse, and short-term impact would result from increased use of hazardous materials during mothballing. A minor, long-term benefit would occur from the reduced use of hazardous materials during the mothball period.

Solid Waste: Minor, adverse, and long-term impacts on solid waste would occur during mothballing. There would be minor, long-term benefits to solid waste during the mothball period.

Health and Safety: Negligible impacts to public safety and protection of children during mothballing activities would be expected. Minor, adverse, and short-term impacts on occupational health during mothballing might occur. Minor, adverse, and long-term impacts on public safety could occur during the mothball period.

Noise: Moderate, adverse, and short-term impacts on noise from large equipment and negligible impacts on traffic would be expected during mothballing activities. There would be no noise impacts during the mothball period.

Traffic and Transportation: Minor, adverse, and short-term impacts on traffic and transportation would be expected during demolition. A minor, long-term benefit would be expected during the mothball period.

Socioeconomics: Mothballing and demolition activities would result in a moderate, short-term benefit to population and housing and minor, short-term benefit to the economy, employment, and income. Major, adverse, and long-term impacts would occur to the economy, employment, and income during the mothball period. Moderate, adverse, and long-term impacts on population and housing in Pocahontas County, and major, adverse, and long-term impacts on population and housing in Green Bank and Arbovale would occur during mothball period. Impacts on education due to reduced regional education opportunities and Green Bank and Arbovale school enrollment would be major, adverse and long-term. Impacts on education due to Pocahontas County school enrollment during the mothball period would be moderate, adverse and long-term. Impacts on Pocahontas County community cohesion would be moderate, adverse, and long-term. Impacts on Green Bank and Arbovale community cohesion and regional tourism would be major, adverse, and long-term.

ES.8.4 Action Alternative D: Demolition and Site Restoration

Biological Resources: Demolition would result in minor, adverse, and short-term impacts on vegetation, negligible impacts on wildlife and migratory birds, and no impacts on threatened and endangered species. During the post-demolition period, there would be a moderate, long-term benefit to vegetation, wildlife, and migratory birds, and a minor, long-term benefit to threatened and endangered species.

Cultural Resources: Demolition would result in a major, adverse, and long-term impact on known historic properties and the historic district. There would be no impacts on archeology during either demolition or post-demolition activities.

Visual Resources: Impacts on visual resources during mothballing would be moderate, adverse, and short-term. Impacts on visual resources post-implementation would be moderate, adverse, and long-term.

Geology and Soils: Demolition activities would have a minor, adverse and long-term impact on topography, negligible impacts on landslides and soils, and no impact on geological resources of economic concern and seismicity. There would be no impacts post-demolition.

Water Resources: During either demolition activities or post-demolition, there would be negligible impacts on underlying groundwater and no impacts on wetlands, floodplains, and surface water.

Hazardous Materials: A minor, long-term benefit to site contamination would be expected during demolition. A minor, adverse, and short-term impact would result from the increased use of hazardous materials during demolition. A minor, long-term benefit would occur from the reduced use of hazardous materials post-demolition.

Solid Waste: Minor, adverse, and long-term impacts on solid waste would occur during demolition. There would be minor, long-term benefits to solid waste post-demolition.

Health and Safety: Minor, adverse, and short-term impacts on public safety and occupational health and negligible impacts on the protection of children would occur during demolition. Minor, adverse, and long-term impacts to public safety could occur post-demolition.

Noise: Moderate, adverse, and short-term impacts on noise from large equipment and negligible impacts on traffic would be expected during demolition. There would be no noise impacts post-demolition.

Traffic and Transportation: Minor, adverse, and short-term impacts on traffic and transportation would be expected during demolition. A moderate, long-term benefit would be expected from reduced traffic after demolition.

Socioeconomics: Demolition activities would result in a moderate, short-term benefit to population and housing, the economy, employment, and income. Major, adverse, and long-term impacts would occur to the economy, employment, and income post-demolition. Moderate, adverse, and long-term impacts on population and housing in Pocahontas County and major, adverse, and long-term impacts on population and housing in Green Bank and Arbovale would occur post-demolition due to the relative decline in population as employees relocate. Impacts on education due to reduced regional education opportunities and Green Bank and Arbovale school enrollment would be major, adverse and long-term. Impacts on education due to Pocahontas County school enrollment post-demolition would be moderate, adverse and long-term. Impacts on Pocahontas County community cohesion would be moderate, adverse, and long-

term. Impacts on Green Bank and Arbovale community cohesion and regional tourism would be major, adverse, and long-term.

ES.8.5 No-Action Alternative: Continued NSF Investment for Science-focused Operations

Under the No-Action Alternative, current operations of the GBO would continue. No demolition would occur and no change from current conditions would result. There would be no impacts on resources under the No-Action Alternative.

SECTION 1.0

Purpose and Need

The National Science Foundation (NSF) prepared this Draft Environmental Impact Statement (DEIS) to evaluate the potential environmental effects of proposed operational changes and potential demolition activities due to funding constraints at the Green Bank Observatory (GBO) in Green Bank, West Virginia. The DEIS was prepared in compliance with the National Environmental Policy Act of 1969 (NEPA) (42 United States Code [U.S.C.] §4321, *et seq*.); Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (Title 40 *Code of Federal Regulations* [C.F.R.] Parts 1500–1508); and NSF procedures for implementing NEPA and CEQ regulations (45 C.F.R. Part 640). The NEPA process ensures that environmental impacts of proposed major federal actions are considered in the decision-making process and that the public has an opportunity to participate.

NSF acknowledges that valuable science and educational activities are conducted at GBO, as evidenced by decades of substantial funding of both the facility and research grants. However, the purpose of the current Proposed Action is to reduce NSF funding in light of a constrained budgetary environment. Neither the merits of the science and education activities at GBO nor NSF's budgetary decisions are the focus of this review. As explained in this DEIS and during public meetings, NSF relies on the scientific community, via decadal surveys and senior-level reviews, to provide input on priorities, and this community has repeatedly recommended divestment from GBO, as well as from other observatories currently under similar review. These recommendations are summarized in Section 1.2, *Purpose and Need*, to explain the need for the current proposal. In accordance with NEPA, the DEIS analyzes the potential environmental impacts of a range of alternatives to meet the objective of reduced NSF funding for GBO.

Public and regulatory agency scoping on the preliminary alternatives and issues of concern was initiated with the publication of a Notice of Intent (NOI) to prepare a DEIS in the *Federal Register* on October 19, 2016, and a revised NOI on November 1, 2016. Two public meetings were held on November 9, 2016, in Green Bank, West Virginia. NSF considered public and agency comments in developing the scope of the analysis in this DEIS. A summary of the comments received during scoping is in Section 5, *Notification, Public Involvement, and Consulted Parties*.

A public meeting will be held on November 30, 2017, to give the public an opportunity to comment on this DEIS. A Final EIS (FEIS) that considers the comments on this DEIS will then be prepared. NSF will issue a Record of Decision (ROD) no earlier than 30 days following the publication of the FEIS; issuance of the ROD will conclude the NEPA and NSF's decision-making process. Concurrently with this NEPA process, NSF is carrying out its compliance with Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended (54 U.S.C. §306108, formerly 16 U.S.C. §470f), and the implementing regulations

promulgated by the Advisory Council on Historic Preservation (ACHP) found at 36 C.F.R. Part 800. NSF has also carried out its compliance responsibilities with Section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. §§1531–1544), and the Department of the Interior and Department of Commerce regulations implementing Section 7 on interagency cooperation (50 C.F.R. Part 402).

1.1 Project Background and Location

GBO is located on federal land in Pocahontas County, West Virginia, adjacent to the Monongahela National Forest (Figure 1.1-1). This land is owned by NSF and consists of numerous parcels that were acquired by the U.S. Army Corps of Engineers (USACE) in the 1950s when GBO was formed as the first (and then, only) site of the National Radio Astronomy Observatory (NRAO). GBO is the anchor and administrative site of the 13,000-square-mile National Radio Quiet Zone (NRQZ), where all radio transmissions are limited. GBO is situated on approximately 2,200 acres in the NRQZ.

GBO was the initial location of the NRAO and has made astronomical research telescopes available to the scientific community since the late 1950s. The primary research facilities started with the initial 85-foot telescope in the 1950s, succeeded by the 300-foot telescope (collapsed in 1988) and the 43-meter (140-foot) telescope in the 1960s, the three-element Green Bank Interferometer in the 1960s and 1970s, and then the Robert C. Byrd Green Bank Telescope (GBT) that was dedicated in 2000. Other telescopes have been used for specific project purposes over the course of the 60-year lifetime of GBO.

GBO also has a long history of providing science, technology, engineering, and mathematics education, ranging from student training and mentorships to broader outreach and training opportunities. Approximately 50,000 visitors pass through the Green Bank Science Center each year. Those visitors include students, educators, and the public who generally stay on the site for more than one night to take advantage of the educational facilities. GBO hosts multiple educational workshops and programs for middle school through post-graduate student training (NSF, 2017).

The current GBO facilities include the 100-meter GBT, the 43-meter telescope (also referred to as the 140-foot telescope), the Green Bank Solar Radio Burst Spectrometer (45-foot telescope), the Interferometer Range (includes three 85-foot-diameter telescopes), the 20-meter Geodetic Telescope, the 40-foot telescope, historical telescopes (Jansky Replica Antenna, Reber Radio Telescope, and Ewen-Purcell Horn), support facilities, and infrastructure. Figure 1.1-2 shows the site layout and the immediate area surrounding the facility.

FIGURE 1.1-1
Project Location Map

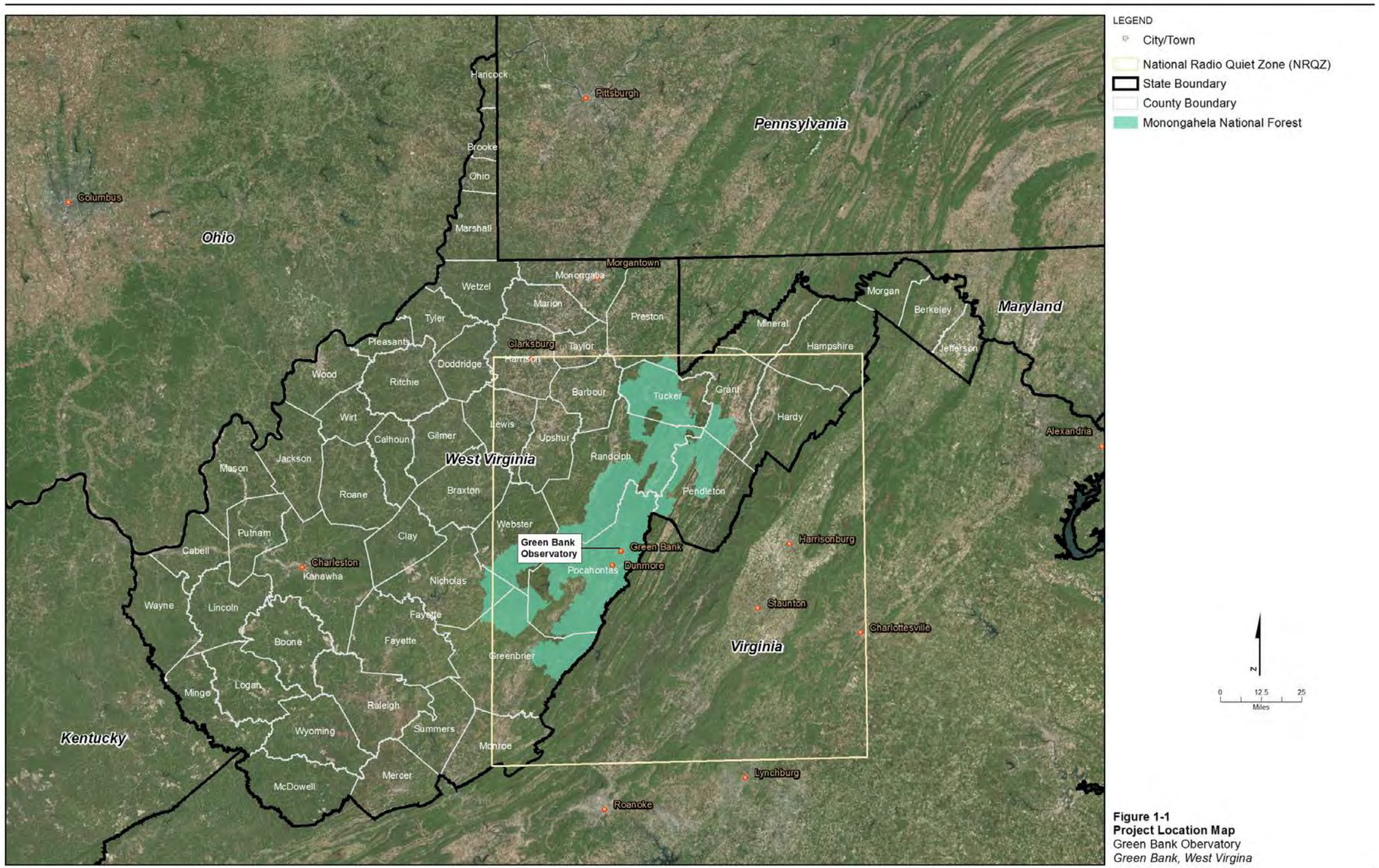

Figure 1-1
Project Location Map
Green Bank Obervatory
Green Bank, West Virgina

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FIGURE 1.1-2
Site Layout

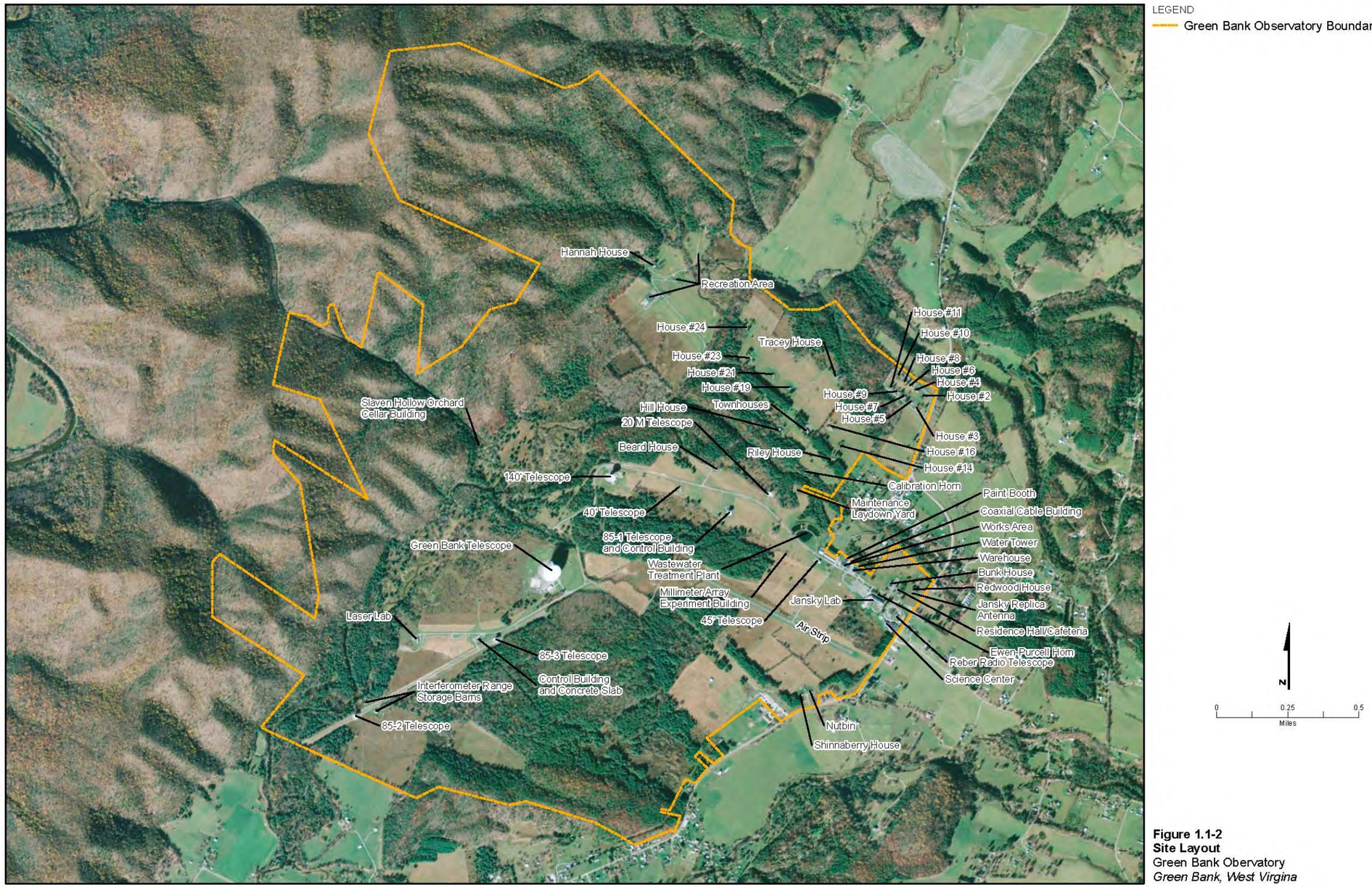

Figure 1.1-2
Site Layout
Green Bank Obervatory
Green Bank, West Virgina

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NSF owns GBO and provides funding through a Cooperative Agreement with Associated Universities, Inc. (AUI) for management of the facility. The Breakthrough Prize Foundation provides additional funding to AUI to support research at GBO in the search for extraterrestrial intelligence. Other GBO funding partners include the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) Project (through a separate NSF funding line) and West Virginia University (WVU). On October 1, 2016, GBO was separated from the NSF-funded NRAO. NSF communicated the plan for separation to the research community on March 22, 2013, in a Dear Colleague Letter (NSF 13-074). That letter requested expressions of interest in exploring ideas for future operation and management of GBO.

1.2 Purpose and Need

NSF needs to maintain a balanced research portfolio with the largest science return for the taxpayer dollar. NSF's Division of Astronomical Sciences (AST) is the federal steward for ground-based astronomy in the United States. Its mission is to support forefront research in ground-based astronomy, help ensure the scientific excellence of the U.S. astronomical community, provide access to world-class research facilities through merit review, support the development of new instrumentation and next-generation facilities, and encourage a broad understanding of the astronomical sciences by a diverse population of scientists, policy makers, educators, and the public at large. AST supports research in all areas of astronomy and astrophysics as well as related multidisciplinary studies. Because of the scale of modern astronomical research, AST engages in numerous interagency and international collaborations. Areas of emphasis and the priorities of specific programs are guided by recommendations of the scientific community, which have been developed and transmitted by National Research Council (NRC, now National Academies) decadal surveys, other National Academies committees, as well as federal advisory committees, such as the Astronomy and Astrophysics Advisory Committee (AAAC) and the Advisory Committee for the Directorate for Mathematical and Physical Sciences (MPSAC).

In 2006, the AST Senior Review (SR) Committee, a subcommittee of the MPSAC, delivered a report to NSF. This committee of external scientists was charged with examining the AST investment portfolio and finding $30 million in annual savings, primarily from the facilities portion of the AST budget, while following the priorities and recommendations of community reports. The SR recommended that the GBT be a component of the "Radio-Millimeter-Submillimeter Base Program" (Recommendation 3) and that "[r]eductions in the cost of Green Bank Telescope operations, administrative support and the scientific staff at the National Radio Astronomy Observatory should be sought" (Recommendation 6) (NSF, 2006). Details of the rationale for the GBT cost-reduction are in Section 6.2.2 of the SR Committee report (NSF, 2006):

> The SR found that the GBT operations cost of $10M ($15M burdened) to be conspicuously large, especially as it is several years since the instrument was commissioned. The former figure is 12 percent of the construction cost, much larger than the seven percent rule of thumb

> and large in comparison with the proposed running costs for Atacama Large Millimeter Array (ALMA) (six percent of capital costs minus the component set aside for new instrumentation). Based upon its analysis, the SR believes that there are opportunities for operating Green Bank significantly more efficiently and redeploying some of the existing personnel to help meet other NRAO responsibilities as has happened in the past, consistent with Principle 2. This should be considered in detail by the NRAO cost review.

In 2010, the NRC conducted its sixth decadal survey in astronomy and astrophysics. In its report, *New Worlds, New Horizons in Astronomy and Astrophysics* (NRC, 2010a), the NRC recommended that:

> NSF-Astronomy should complete its next senior review before the mid-decade independent review that is recommended in this report, so as to determine which, if any, facilities NSF-AST should cease to support in order to release funds for (1) the construction and ongoing operation of new telescopes and instruments and (2) the science analysis needed to capitalize on the results from existing and future facilities.

In response to this recommendation, the NSF Directorate for Mathematical and Physical Sciences, which includes AST, commissioned a subcommittee of the MPSAC to assess the AST portfolio of facilities and grants programs. This subcommittee, composed solely of external members of the scientific community, was charged with recommending a balanced portfolio to maximize the science recommended by National Academy of Sciences surveys of the field. These surveys are carried out every decade. The resulting Portfolio Review Committee Report (PRC Report) was accepted by the MPSAC and released in August 2012.

In the PRC Report (NSF, 2012), the subcommittee recommended divestment of a number of telescopes from the AST funding portfolio to maintain a balance of small-, medium-, and large-scale programs that would best address decadal survey-recommended science priorities. With respect to the GBT at GBO, the subcommittee made the following recommendation (Recommendation 10.6): "We recommend that AST divest from the Mayall, WIYN, and 2.1-meter telescopes at Kitt Peak, the Robert C. Byrd Green Bank Telescope, the Very Long Baseline Array, and the McMath-Pierce solar telescope."

The continued importance of the NSF response to the PRC Report (NSF, 2012) is highlighted in the AAAC's annual report, released in March 2016, in which the AAAC recommended that "[s]trong efforts by NSF for facility divestment should continue as fast as is possible." The recently released 2017 AAAC report reaffirmed this advice with similar recommendations (AAAC, 2017).

In the August 2016 mid-decadal report, *New Worlds, New Horizons, A Midterm Assessment* (NAS, 2016), the National Academies also made a consistent recommendation (Recommendation 3-1):

> The National Science Foundation (NSF) should proceed with divestment from ground-based facilities which have a lower scientific impact, implementing the recommendations

of the NSF Portfolio Review that is essential to sustaining the scientific vitality of the U.S. ground-based astronomy program as new facilities come into operation.

At present, GBO serves a variety of scientific user communities in astronomy and astrophysics, and the Observatory is funded for an active education and public outreach program. However, the scientific community evaluations cited previously indicate that GBO's science capability is lower in priority than other science capabilities that NSF funds. In a funding-constrained environment, NSF needs to maintain a balanced research portfolio with the largest science return for the taxpayer dollar. Therefore, the purpose of the Proposed Action is to substantially reduce NSF's contribution to the funding of GBO.

1.3 Federal Regulatory Setting

This Section identifies the key federal statutory and regulatory authorities relevant to the Proposed Action.

1.3.1 National Environmental Policy Act

In 1969, Congress enacted NEPA to provide for the consideration of environmental issues in federal agency planning and decision making. CEQ issued *Regulations for Implementing Procedural Provisions of the NEPA* (40 C.F.R. Parts 1500–1508) to establish the process for federal agency implementation of NEPA. NEPA requires preparation of an EIS for major federal actions that may significantly affect the quality of the human and natural environments. The EIS must disclose significant direct, indirect, and cumulative environmental impacts of the considered Alternatives to inform decision makers and the public. This DEIS also complies with 45 C.F.R. Part 640, *NSF Compliance with the National Environmental Policy Act*.

1.3.2 National Historic Preservation Act

The NHPA, as amended (54 U.S.C. 300101, *et seq*.), recognizes the nation's historic heritage and establishes a national policy for the preservation of historic properties, as well as the National Register of Historic Places (NRHP). Section 106 of the NHPA (54 U.S.C. 306108) requires that federal agencies consider the effects of their projects on significant historic properties.

The implementing regulations for the NHPA are found in the Protection of Historic Properties (36 C.F.R. Part 800), which defines historic properties as any prehistoric or historic district, site, building, structure, or object that is included in, or eligible for inclusion in, the NRHP (54 U.S.C. 302101). In the case of this Proposed Action, use of federal funds establishes the obligation for Section 106 compliance. The purpose of the Section 106 consultation process is to evaluate the potential for effects on existing historic properties, if any, resulting from the Proposed Action.

The Section 106 review process encompasses a good faith effort to ascertain the existence and location of historic properties near and within the Proposed Action site, establishing an Area of Potential Effects (APE) for the Proposed Action, identifying whether the Proposed Action may adversely affect historic properties that are listed, or are eligible for listing, in the NRHP, and if so, developing ways to avoid,

minimize, and/or mitigate those adverse effects. The resolution of any adverse effects is typically memorialized in a Memorandum of Agreement (MOA) or Programmatic Agreement (PA) created through consultation with the State Historic Preservation Officer (SHPO), ACHP (if it chooses to participate), and any consulting government agencies, community associations, Native American tribes, and interested parties who participate as Consulting Parties.

1.3.3 Endangered Species Act

The ESA and subsequent amendments provide for the protection and conservation of threatened and endangered species, and the ecosystems on which the species depend. The ESA prohibits federal agencies from funding, authorizing, or carrying out actions likely to jeopardize the existence of listed species through direct taking or through the destruction or adverse modification of critical habitat designated for these species under the ESA. Section 7 of the ESA requires consultation with the U.S. Fish and Wildlife Service (USFWS), or the National Marine Fisheries Service, if applicable, when any listed species under its jurisdiction may be affected by a Proposed Action.

1.3.4 National Radio Quiet Zone

The NRQZ was established in 1958 by the Federal Communications Commission (FCC), which regulates non-federal transmitters, and by the Interdepartment Radio Advisory Committee, which advises the National Telecommunications and Information Administration (NTIA) in its management of the U.S. Government's use of the radio frequency spectrum. The purpose of the NRQZ is to minimize possible interference to NRAO in Green Bank and the former radio receiving facilities for the U.S. Navy in Sugar Grove, West Virginia. The zone covers an area of approximately 13,000 square miles in West Virginia and Virginia. Regulations at 47 C.F.R. §1.924 require that any applicant to the FCC for the authority to operate a station within this area notify the Director of the NRAO at GBO. NRAO may object or consent to the application on behalf of itself or on behalf of the Naval Radio Research Observatory in Sugar Grove, with the ultimate authorization issued by the FCC. Regulations at 47 C.F.R. §300.1 incorporate by reference the NTIA's "Manual of Regulations and Procedures for Federal Radio Frequency Management (September 2015 revision of the May 2013 edition), which requires that assignments to stations to be located in the NRQZ be coordinated with NRAO. In addition to these federal regulations, West Virginia's Radio Astronomy Zoning Act (West Virginia Code, Chapter 37A) restricts the operation of electrical equipment within a certain distance of any radio astronomy facility.

As a result of these protections, NRAO has an Interference Office that reviews proposed uses and manages potential interference to radio astronomy. NRQZ management and administration is being carried out by the GBO Director (operating as an adjunct NRAO Assistant Director solely for this purpose) until such time as the federal regulations can be changed to make GBO the legal administrator of the NRQZ. Note that none of the Action Alternatives include the elimination of the NRQZ, as the FCC

has jurisdiction over the NRQZ; the selection of an alternative for GBO would not confer authority on NSF to dissolve or alter the NRQZ.

1.4 Agency Notification and Collaboration

In October 2016, NSF began the process of informal consultation with federal and state agencies, West Virginia elected officials, community groups, and relevant commercial interests. Details on agency collaboration and consultation throughout this NEPA process is located in Section 5, *Notification, Public Involvement, and Consulted Parties*, of this DEIS. Both formal and informal consultations have been taking place with these parties to ensure full disclosure of information. These consultations include, but are not limited to, discussions and correspondence with the ACHP, USFWS, and the West Virginia SHPO. Table 1.4-1 provides a list of the agencies consulted.

TABLE 1.4-1
Entities Contacted

Federal	ACHP; U.S. Forest Service (USFS) (Monongahela National Forest); U.S. House of Representatives, West Virginia; U.S. Senate, West Virginia; USFWS
West Virginia	SHPO; West Virginia Division of Culture and History; Governor, West Virginia; West Virginia Department of Natural Resources (WVDNR); West Virginia State Senate District 10; West Virginia State Senate District 11; West Virginia State House District 42; West Virginia State House District 43
Pocahontas County	Pocahontas County Commission; Pocahontas County Historical Society Museum, Preservation Alliance of West Virginia
Native American Tribes	Absentee Shawnee Tribe; Cayuga Nation; Cherokee Nation; Delaware Nation; Delaware Tribe of Indians; Eastern Band of Cherokee Indians, Eastern Shawnee Tribe of Oklahoma; Oneida Indian Nation; Oneida Nation; Onondaga Nation; Seneca Nation of Indians; Seneca-Cayuga Nation; St. Regis Mohawk Tribe; The Shawnee Tribe; Tonawanda Band of Seneca; Tuscarora Nation; United Keetoowah Band of Cherokee Indians in Oklahoma
Other Public-Private Stakeholder Organizations	West Virginia University; Cornell University; University of California at Berkeley; Oberlin College; Franklin & Marshall College; University of Wisconsin at Milwaukee; Berkeley Search for Extraterrestrial Intelligence (SETI) Research Center; Greenbrier Valley Economic Development Corporation; Associated Universities Inc.; Region 4 Planning & Development Council Office; University of Texas, Rio Grande Valley

Note: WVDNR's Division of Parks and Recreation and Division of Wildlife Resources was contacted via email on November 21, 2016. Delaware Nation was sent invitation letter on August 7, 2017.

1.5 Public Disclosure and Involvement

NSF notified, contacted, and/or consulted with agencies, individuals, and organizations during development of this DEIS. Details of public disclosure and involvement regarding the Proposed Action included pre-assessment notification letters to agencies, social media announcements, website updates, scientific digests and blogs, newspaper public notices, fliers mailed to local schools, post offices, and businesses, and two public scoping meetings conducted on November 9, 2016, at GBO in Green Bank, West Virginia. The public was encouraged to comment during the scoping process. Scoping meeting

attendees and those who submitted written scoping comments were added to the email distribution list and received updates regarding the EIS process. Detailed information on these activities including a summary of scoping comments can be found in Section 5, *Notification, Public Involvement, and Consulted Parties*. NSF considered the public comments received during the scoping period when developing the scope of the analyses in this DEIS.

A public meeting to present the findings of this DEIS will be conducted on November 30, 2017, at GBO. The public is also encouraged to submit comments on this DEIS during the 60-day comment period, starting on November 9, 2017.

1.6 Arrangement and Content of the Draft Environmental Impact Statement

1.6.1 Document Content

This DEIS is arranged as follows:

- Executive Summary
- Section 1: Purpose and Need
- Section 2: Description of Proposed Action and Alternatives
- Section 3: Affected Environment
- Section 4: Environmental Consequences
- Section 5: Notification, Public Involvement, and Consulted Parties
- Section 6: List of Preparers
- Section 7: References
- Section 8: Acronyms and Abbreviations

1.6.2 Resource Analysis

The analysis in this DEIS considers the following resource areas, as these resources would have the potential for environmental impacts under one or more of the Alternatives:

- Biological Resources: Potential impacts on vegetation, wildlife, wetlands, threatened and endangered species, and migratory birds.
- Cultural Resources: Potential impacts on historic resources.
- Visual Resources: Potential impacts on the existing visual character of the area.
- Geology and Soils: Potential impacts on soil and sensitive geologic features.
- Water Resources: Potential impacts on surface water and groundwater.
- Hazardous Materials: Potential impacts on existing hazardous material contamination and the generation of hazardous materials.

- Solid Waste: Potential impacts from the generation of solid waste.
- Health and Safety: Potential impacts on public health, occupational health, and the protection of children.
- Noise: Potential impacts from construction and traffic noise.
- Traffic and Transportation: Potential impacts from construction traffic
- Socioeconomics: Potential economic impacts, including those relating to education, and impacts on the Green Bank community.
- Environmental Justice: Potential impacts, including human health, economic, and social effects from the Proposed Action on minority and low-income communities.

The following resource areas are not considered in detail, because there is no potential for noticeable or measurable impacts on these resources:

- Air Quality: The Proposed Action could involve the short-term use of diesel generators and short-term emissions associated with demolition. However, GBO is located in an area that is in full attainment for all National Ambient Air Quality Standards (NAAQS) criteria pollutants (U.S. Environmental Protection Agency [EPA], 2016). Therefore, Clean Air Act (CAA) conformity analysis is not required and there is limited likelihood for the Proposed Action to cause a violation in CAA NAAQS. Any air quality impacts would be negligible on a regional basis.
- Climate Change: Potential greenhouse gas (GHG) emissions under Action Alternatives A and B are expected to be similar to current conditions and under Action Alternatives C and D would decrease over the long term. Consequently, there are no new adverse effects to climate change expected under the Action Alternatives. Based on the location of the facility, impacts from climate change would not affect future activities at GBO.
- Utilities: No new utility infrastructure would be required and utility usage would either stay the same or be reduced under any Action Alternative.

SECTION 2.0

Description of Proposed Action and Alternatives

2.1 Introduction

Alternatives were developed using input from the scientific community, including oral responses to the 2013 Dear Colleague Letter, NRC decadal surveys, and federal advisory committees. These preliminary alternatives were included in the NOI published in the *Federal Register* on October 19, 2016, and were presented during the scoping process, which was completed on November 25, 2016. Input received during scoping was then used to vet the preliminary alternatives presented in the NOI and help focus on the issues to be evaluated in the EIS. These preliminary alternatives were slightly modified to become the Alternatives, with detailed descriptions provided below. None of the Alternatives analyzed herein include the elimination of the NRQZ, as the FCC has jurisdiction over the NRQZ (see Section 1.3.4, *National Radio Quiet Zone*); the selection of an Alternative analyzed during this EIS process would not confer authority upon NSF to dissolve or alter the NRQZ.

Under each Action Alternative, some buildings and structures could be demolished; these are identified for analysis purposes only, as depending on final plans these buildings would not necessarily be demolished. Alternatives A and B are defined by the reduction of NSF funding and the continuance of science- and education-focused operations (under Alternative A) or operation as a technology and education park (under Alternative B) and not the disposition of any one facility or structure. Use or demolition of any particular building or instrument cannot be determined unless or until a viable collaboration option is under consideration.

Because reduction of NSF funding may require the safe-abandonment[3], mothballing[4], or demolition of facilities, the Alternatives are described under the most conservative (highest environmental impact) scenario in terms of NSF's analysis of potential changes to facilities, so that the EIS may be inclusive of the full range of potential environmental impacts. The analysis approach is consistent with NEPA requirements and is sufficiently broad to allow NSF to complete the analysis during planning and without regard to the specifics of a future collaboration. Table 2.6-1 provides a detailed list of facilities identified for potential retention, demolition, safe-abandonment, or mothballing under the Alternatives for the

[3] Safe-abandonment: To remove a building or facility from service without demolishing it. This includes removing furnishings, disconnecting utilities, and isolating the structure from public access by fencing or other means to reduce fall and tripping hazards and preclude vandalism. The structure is also made secure from environmental damage due to wind, rain, humidity, and temperature extremes. Pest and insect damage must also be taken into account and biodegradable items must be removed to the maximum extent practicable. Under safe-abandonment, there is no intention that structures would be brought back to operational status.

[4] Mothball: To remove a facility or structure from daily use while maintaining the general condition for a defined period. Equipment and structures are kept in working order but are not used.

purpose of NSF's environmental review. However, it must be emphasized that a collaboration may not require the full extent of demolition, safe-abandonment, or mothballing activities analyzed and could involve none or only a subset of the activities listed in Table 2.6-1. The Agency-preferred Alternative does not include, and this DEIS does not *mandate*, the demolition or removal of specific buildings and infrastructure, even if specific buildings are identified in the various Alternatives. Because of this, this DEIS should not be viewed to preclude a proposed activity or use of infrastructure.

2.2 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF funding (Agency-preferred Alternative)

Action Alternative A would involve collaborations with new stakeholder(s) who would use and maintain GBO for continued science- and education-focused operations. NSF would reduce its funding of the Observatory and the new stakeholder(s) would be responsible for future maintenance and upgrades. Under this Alternative, NSF could transfer or retain the property. Potential transfer recipients could include other federal agencies, commercial interests, or non-profit entities. Action Alternative A would involve the least change to the current facility and would retain the GBT, other appropriate telescopes, and supporting facilities for education and research as determined by NSF and the new and/or existing stakeholder(s). Any structures not needed to meet the anticipated operational goals would be safe-abandoned, mothballed, or demolished, as appropriate.

The anticipated safe-abandonment, mothballing, or demolition activities include the following:

- Prepare facilities to be safe-abandoned, including installing fencing and turning off utilities.
- Prepare buildings and structures to be mothballed and turn off non-essential utilities.
- Conduct a hazardous materials assessment for asbestos-containing material (ACM), lead-based paint (LBP), and other conditions of concern for structures to be demolished. Remediate as necessary.
- Demolish buildings and structures that are no longer needed. Concrete buildings would be removed using hammerhoes, jackhammers, and other heavy equipment.
- Segregate, load, and transport waste materials to appropriate offsite landfills and recycling centers.
- Establish soil in areas where buildings were removed from bedrock. Landscape areas of bare soil.

The implementation period, defined as the period in which demolition, mothballing and safe-abandonment would occur, is expected to last 21 weeks for Alternative A. Note that, due to funding constraints, implementation might have to occur in multiple phases over a longer time period. All structures that could be demolished under this Alternative are within areas that are maintained with

mowed landscape grasses. Additional maintained areas are available for staging and support during demolition. No tree removal or disturbances to unmaintained areas would be necessary.

Operations after implementation activities would be similar to current operations, and operation staffing levels would be expected to stay the approximately same. Operations would be expected to continue at non-affected facilities during implementation. Implementation activities that could interfere with the use of the GBT and other telescopes and data collection would be coordinated with GBO staff to minimize the potential for disrupting scientific work.

Alternative A is the Agency-preferred Alternative. This Alternative would meet the purpose of reducing the funding required from NSF and allow continued benefits to the scientific and educational communities. However, this Alternative could occur only if new and/or existing collaborators come forward to participate as collaborating parties with viable proposed plans to provide additional non-NSF funding in support of their science- and education-focused operations. Collaborators are being sought and could include agencies, non-profit entities, educational institutions, industrial or commercial ventures, or private individuals.

2.3 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Action Alternative B would involve collaborating with outside entities to operate and maintain GBO as a technology and education park. In this scenario, the site would focus on tourism and serve as a local attraction. The Science Center, residential hall, cafeteria, and 40-foot telescope would remain active. Under this Alternative, NSF could transfer or retain the property. Potential transfers could include other federal agencies, commercial interests, or non-profit entities. The anticipated safe-abandonment, mothballing, or demolition activities include the following:

- Prepare facilities to be safe-abandoned, including installing fencing and turning off utilities.
- Prepare buildings and structures to be mothballed and turn off non-essential utilities.
- Conduct a hazardous materials assessment for ACM, LBP, and other conditions of concern for structures to be demolished. Remediate as necessary.
- Demolish buildings and structures that are no longer needed. Concrete buildings would be removed using hammerhoes, jackhammers, and other heavy equipment.
- Segregate, load, and transport waste materials to appropriate offsite landfills and recycling centers.
- Establish soil in areas where buildings were removed from bedrock. Landscape areas of bare soil.

Implementation of Alternative B would be expected to last 21 weeks. Note that, due to funding constraints, activities under this Alternative might have to occur in multiple phases over a longer time period. All structures that would be demolished are within areas that are maintained with mowed landscape grasses. Additional maintained areas are available for staging and support during implementation. No tree removal or disturbances to unmaintained areas would be necessary.

Operations would be expected to continue during implementation activities. Implementation activities that could interfere with the use of the 40-foot telescope and data collection would be coordinated with GBO staff to minimize the potential for disrupting observational work.

Operations after implementation would be similar to current operations. However, it is anticipated that there would be a reduction in operations staff under Action Alternative B.

2.4 Action Alternative C: Mothballing of Facilities

Action Alternative C would involve mothballing (preservation of) essential buildings, telescopes, and other equipment, with periodic maintenance to keep them in working order. This method would allow the facility to suspend operations in a manner that would permit operations to resume efficiently at some time in the future. It is not known what type of operations would be implemented at the end of the mothball phase. Operations at the time of resumption could be similar to current operations, other science-based operations, education-based operations, or some other type of operations. Because of this uncertainty, the resumption of operations is not considered part of this Alternative.

Supporting structures would be evaluated to determine whether they are critical to the operation of the telescopes. Up to nine structures and facilities may be determined to be obsolete and not needed, and such structures would be removed. Table 2.6-1 provides a list of the nine facilities that could be removed, and the 46 facilities that would be mothballed under Action Alternative C.

A maintenance program would be required to protect the facilities from deterioration, vandalism, and other damage. Regular security patrols would be performed to monitor the site. Common mothballing measures, such as providing proper ventilation, keeping roofs and gutters cleaned of debris, and performing ground maintenance and pest control, would be implemented. Lubrication and other deterioration-preventing measures would be required on the remaining telescopes.

Visitor housing and recreational areas would be closed indefinitely, with water lines drained and electricity turned off. All supplies, books, photographs, furnishings, and other items not needed for periodic maintenance would be removed from the site. Equipment, tools, machinery, furniture, and ancillary items that would not be needed for the resumption of operations would be disposed of in accordance with federal law.

Gates and fencing would be evaluated to determine whether upgrades would be needed to provide appropriate security.

The anticipated mothballing activities include the following:

- Prepare buildings and structures to be mothballed and turn off non-essential utilities.
- Conduct a hazardous materials assessment for ACM, LBP, and other conditions of concern for structures to be demolished. Remediate as necessary.
- Demolish structures and buildings that are no longer needed. Concrete buildings would be removed using hammerhoes, jackhammers, and other heavy equipment.
- Segregate, load, and transport waste materials to appropriate offsite landfills and recycling centers.
- Establish soil in disturbed areas where buildings were removed from bedrock. Landscape areas of bare soil.
- Establish site security and facilities maintenance.

The implementation period for Action Alternative C would be expected to last 24 weeks. Note that, due to funding constraints, activities under this Alternative might have to occur in multiple phases over a longer time period. All structures that would be demolished are within areas that are maintained with mowed landscape grasses. Additional maintained areas are available for staging and support during implementation. No tree removal or disturbances to unmaintained areas would be necessary during implementation.

Landscaped areas would be maintained during the mothball period. All infrastructure related to the telescopes would be conditioned for safe storage to prevent degradation of equipment and allow operations to be restarted. Regular vegetation maintenance would be implemented to keep vegetation from overgrowing the reflector dishes.

For purposes of the analyses in this DEIS, it is assumed operations would be suspended for an indefinite time and then resumed at some point in the future. It is anticipated that technical staff responsible for operating the telescopes, scientific support staff, and cafeteria workers would not be retained. However, it is expected that current staffing levels for facilities maintenance would mostly remain the same under Action Alternative C because of the level of maintenance required to keep the infrastructure operable.

2.5 Action Alternative D: Demolition and Site Restoration

Action Alternative D involves the removal of all structures. Table 2.6-1 provides a list of the facilities that would be removed under Action Alternative D.

Demolition would be accomplished using conventional demolition equipment (cranes, hydraulic excavator equipped with hydraulic-operated shears, grapplers, and hoe rams), other conventional heavy

and light duty construction equipment, trades personnel, and trained demolition crews. For safe demolition of the GBT, 43-meter telescope, and water tower, initial demolition would likely be accomplished using explosives in the form of shaped charges and conventional demolition and/or construction equipment.

Equipment, tools, machinery, furniture, and ancillary items that have a salvage value could be transported to another NSF facility, or disposed of prior to demolition activities. All remaining facilities and structures, with the exception of the existing perimeter fencing, would be demolished. Exposed below-grade structures would be removed to a maximum of 4 feet below grade to enable the restoration of the ground surface topography.

The anticipated activities to implement Action Alternative D include the following:

- Turn off and cap utilities.
- Conduct a hazardous materials assessment for ACM, LBP, and other conditions of concern for structures to be demolished. Remediate as necessary.
- Demolish structures identified in Table 2.6-1.
- Flush or otherwise clean and drain wastewater treatment pond. Evaluate need to remove sludge from bottom of pond and fill in pond with soil.
- Demolish all ancillary structures including roads, airstrip, building, sheds, fences (except for perimeter), and gates.
- Segregate, load, and transport waste materials to appropriate offsite landfills and recycling centers.
- Conduct site restoration work: re-grade affected areas to desired elevations and contours; use available concrete rubble as necessary; bring in fill as needed to establish grade.
- Install soil and vegetation: place soil where needed to support growth of desired vegetation; seed and transplant native species; install temporary erosion control (biodegradable fiber mats) where needed; maintain (appropriate watering as needed and weed control) until desired vegetation is established.

The implementation period for Action Alternative D would be expected to last 36 weeks. Note that, due to funding constraints, activities under this Alternative might have to occur in multiple phases over a longer time period. All structures that would be demolished are within areas that are maintained with mowed landscape grasses. Additional maintained areas are available for staging and support during demolition. No tree removal or disturbance to unmaintained areas would be necessary to accomplish demolition.

Areas revegetated following demolition activities would be maintained for a period of up to 18 months, less if target revegetation is achieved sooner. A vegetation maintenance staff would be retained through this period.

Operations at GBO would cease. It is anticipated that under this Alternative, staffing levels would not be maintained following demolition activities.

2.6 No-Action Alternative: Continued NSF Investment for Science-focused Operations

Under the No-Action Alternative, NSF would continue funding GBO at current levels. None of the Action Alternatives would be implemented. However, this Alternative does not meet the intended purpose or need of the Proposed Action. This Alternative will be used as a baseline to evaluate the impacts of the Action Alternatives in Section 4, *Environmental Consequences*, of the DEIS.

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TABLE 2.6-1
Facility Disposition Being Analyzed in this DEIS, By Action Alternative

	Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF funding[a]	Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park[b]	Action Alternative C: Mothballing of Facilities	Action Alternative D: Demolition and Site Restoration
Facilities Anticipated to Remain	1. 40-foot Telescope 2. Coaxial Cable Building 3. Bunk House (Dormitory) 4. Green Bank Telescope 5. New and Old Jansky Laboratory 6. Maintenance Lot 7. Science Center 8. Warehouse Building by Water Tower 9. Water Tower 10. Works Area 11. Wastewater Treatment Plant 12. Airfield 13. Residence Hall & Cafeteria 14. Redwood House 15. Townhouse Units 16. Riley House 17. Hannah House	1. 40-foot Telescope 2. Bunk House (Dormitory) 3. New and Old Jansky Laboratory 4. Maintenance Lot 5. Science Center 6. Warehouse Building by Water Tower 7. Water Tower 8. Works Area 9. Wastewater Treatment Plant 10. Airfield 11. Residence Hall & Cafeteria 12. Townhouse Units	None	None
Facilities that Could be Demolished	1. 45-foot Telescope 2. Slaven Hollow Orchard Cellar Building 3. 300-foot Telescope Control Building (Laser Lab) 4. Telescope 85-1 (Tatel Telescope) 5. Telescope 85-2 6. Telescope 85-3 7. Control Building 8. 85-1 Control Building 9. Interferometer Range Barns 10. Interferometer Range Concrete Slab 11. Miscellaneous Yard Items including the Calibration Horn 12. Paint Shop Building 13. Recreation Area 14. Nut Bin 15. Shinnaberry 16. Tracey House 17. Beard House 18. Hill House 19. House 2 20. House 3 21. House 4 22. House 5 23. House 6 24. House 7 25. House 8 26. House 9 27. House 10 28. House 11 29. House 14 30. House 16 31. House 19 32. House 21 33. House 23 34. House 24 35. Millimeter Array Experiment Building	1. 45-foot Telescope 2. Slaven Hollow Orchard Cellar Building 3. 300-foot Telescope Control Building (Laser Lab) 4. Coaxial Cable Building 5. Telescope 85-1 (Tatel Telescope) 6. Telescope 85-2 7. Telescope 85-3 8. Control Building 9. 85-1 Control Building 10. Interferometer Range Barns 11. Interferometer Range Concrete Slab 12. Miscellaneous Yard Items including the Calibration Horn 13. Paint Shop Building 14. Recreation Area 15. Nut Bin 16. Shinnaberry 17. Redwood House 18. Tracey House 19. Riley House 20. Beard House 21. Hill House 22. Hannah House 23. House 2 24. House 3 25. House 4 26. House 5 27. House 6 28. House 7 29. House 8 30. House 9 31. House 10 32. House 11 33. House 14 34. House 16 35. House 19	1. Slaven Hollow Orchard Building 2. Telescope 85-1 (Tatel Telescope) 3. Telescope 85-2 4. Telescope 85-3 5. Control Building 6. 85-1 Control Building 7. Interferometer Range Barns 8. Interferometer Range Concrete Slab 9. Miscellaneous Yard Items including the Calibration Horn 10. Beard House 11. Millimeter Array Experiment Building	1. 20-meter Telescope 2. 40-foot Telescope 3. 43-meter Telescope (140-foot Telescope) 4. 45-foot Telescope 5. Slaven Hollow Orchard Building 6. 300-foot Telescope Control Building (Laser Lab) 7. Coaxial Cable Building 8. Bunk House (Dormitory) 9. Green Bank Telescope 10. Reber Radio Telescope[c] 11. Jansky Replica Antenna 12. Ewen-Purcell Horn 13. Telescope 85-1 (Tatel Telescope) 14. Telescope 85-2 15. Telescope 85-3 16. Control Building 17. 85-1 Control Building 18. Interferometer Range Barns 19. Interferometer Range Concrete Slab 20. New and Old Jansky Laboratory 21. Maintenance Lot (Laydown Yard) 22. Miscellaneous Yard Items including the Calibration Horn 23. Paint Shop Building (Paint Booth) 24. Science Center 25. Warehouse Building by Water Tower 26. Water Tower 27. Works Area 28. Wastewater Treatment Plant 29. Airfield (Airstrip) 30. Recreation Area 31. Residence Hall & Cafeteria 32. Nut Bin 33. Shinnaberry 34. Redwood House

TABLE 2.6-1
Facility Disposition Being Analyzed in this DEIS, By Action Alternative

	Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF funding[a]	Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park[b]	Action Alternative C: Mothballing of Facilities	Action Alternative D: Demolition and Site Restoration
		36. House 21 37. House 23 38. House 24 39. Millimeter Array Experiment Building		35. Tracey House 36. Townhouse Units 37. Riley House 38. Beard House 39. Hill House 40. Hannah House 41. House 2 42. House 3 43. House 4 44. House 5 45. House 6 46. House 7 47. House 8 48. House 9 49. House 10 50. House 11 51. House 14 52. House 16 53. House 19 54. House 21 55. House 23 56. House 24 57. Millimeter Array Experiment Building
Facilities that Could be Safe-abandoned	1. 20-meter Telescope 2. 43-meter Telescope (140-foot Telescope)	1. 20-meter Telescope 2. 43-meter Telescope (140-foot Telescope) 3. Green Bank Telescope	None	None
Facilities that Could be Mothballed	1. Reber Radio Telescope[c] 2. Jansky Replica Antenna 3. Ewen-Purcell Horn	1. Reber Radio Telescope[c] 2. Jansky Replica Antenna 3. Ewen-Purcell Horn	1. 20-meter Telescope 2. 40-foot Telescope 3. 43-meter Telescope (140-foot Telescope) 4. 45-foot Telescope 5. 300-foot Telescope Control Building (Laser Lab) 6. Coaxial Cable Building 7. Bunk House (Dormitory) 8. Green Bank Telescope 9. Reber Radio Telescope[c] 10. Jansky Replica Antenna 11. Ewen-Purcell Horn 12. New and Old Jansky Laboratory 13. Maintenance Lot (Laydown Yard) 14. Paint Shop Building (Paint Booth) 15. Science Center 16. Warehouse Building by Water Tower 17. Water Tower 18. Works Area 19. Wastewater Treatment Plant 20. Airfield (Airstrip) 21. Recreation Area 22. Residence Hall & Cafeteria 23. Nut Bin 24. Shinnaberry	None

TABLE 2.6-1
Facility Disposition Being Analyzed in this DEIS, By Action Alternative

	Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF funding[a]	Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park[b]	Action Alternative C: Mothballing of Facilities	Action Alternative D: Demolition and Site Restoration
			25. Redwood House 26. Tracey House 27. Townhouse Units 28. Riley House 29. Hill House 30. Hannah House 31. House 2 32. House 3 33. House 4 34. House 5 35. House 6 36. House 7 37. House 8 38. House 9 39. House 10 40. House 11 41. House 14 42. House 16 43. House 19 44. House 21 45. House 23 46. House 24	

[a] Note that the demolition, safe-abandoning, and mothballing activities described below are meant to describe the most inclusive and conservative (in terms of environmental impacts) scenario, but none of these activities, or a subset of these activities, may ultimately be chosen based on the needs of the collaboration, should this alternative be selected.

[b] Note that the demolition, safe-abandoning, and mothballing activities described below are meant to describe the most inclusive and conservative (in terms of environmental impacts) scenario, but none of these activities, or a subset of these activities, may ultimately be chosen based on the needs of the collaboration, should this alternative be selected.

[c] Reber Radio Telescope is currently a display piece and could be moved to another location.

SECTION 3.0

Affected Environment

This Section provides an overview of the existing physical, biological, economic, and social conditions at GBO. In compliance with NEPA and NSF NEPA-implementing regulations (45 C.F.R. Part 640), the descriptions of the affected environment focus on those resources and conditions potentially impacted by the Proposed Action.

This Section is organized by resource area and contains descriptions of the existing environment at each site. The region of influence (ROI) is also described for each resource. The ROI is defined as the area in which environmental impacts resulting from the Proposed Action would be most greatly concentrated.

3.1 Biological Resources

This Section describes biological resources at GBO, including vegetation, wildlife, threatened and endangered species, and migratory birds. The ROI for biological resources is generally the GBO property; however, ecoregions and regional wildlife populations are broadly discussed to provide context.

3.1.1 Ecological Setting

GBO is located along the boundary of the Ridge and Valley ecoregion and Central Appalachians ecoregion (EPA, 2003). The property lies adjacent to the east-central portion of the Monongahela National Forest, which encompasses 1,439 square miles. Most of the forests in the region were clear cut for timber in the early 20th century. As a result, most of the present-day forest cover is secondary growth and old growth forest cover is relatively sparse in the region.

Deer Creek flows toward the southwest through the GBO property. The portions of the property north and west of Deer Creek are largely undeveloped and consist primarily of dense forests and tributaries of the creek. The portions of the property south and east of Deer Creek have flatter topography and consist primarily of developed areas, patches of forest, and tributaries of the creek. The developed areas contain facilities, structures, parking lots, roadways, and other infrastructure. The unpaved portions of the developed areas consist of mowed grassy fields and sparse cover of planted shrubs and trees.

3.1.2 Vegetation

Upland forest and mowed grassy fields are the dominant vegetative communities on the GBO property. The portions of the property north and west of Deer Creek consist primarily of dense upland forests that extend beyond the property boundary. Vegetation on the property south and east of Deer Creek primarily consists of parcels of fragmented upland forest, mowed grassy fields, and maintained landscaped vegetation. Based on the field investigation conducted for this EIS in November 2016, the upland forests on the property are dominated by red oak (*Quercus rubra*) and white pine (*Pinus strobus*), and include relatively small and varying amounts of red spruce (*Picea rubens*), eastern hemlock (*Tsuga canadensis*),

white oak (*Quercus alba*), red maple (*Acer rubrum*), and American elm (*Ulmus americana*). All the infrastructure on the property is located in maintained areas that consist of mowed grass and/or maintained landscaped vegetation. Certain areas include sparse cover of planted white pine, red spruce, eastern hemlock, and shrubs.

During the field investigation conducted for this EIS in November 2016, the channel of Deer Creek within the GBO property contained sparse vegetation and large amounts of leaf litter. No vegetation was observed within the channels of any of the tributaries of Deer Creek that were inspected (Section 3.5.2, *Surface Water*). Dominant plant species observed at Data Point 1 in the southernmost wetland on the GBO property (Figure 3.5-1) included tall ironweed (*Vernonia gigantean*), woolgrass (*Scirpus cyperinus*), and bushy St. John's-wort *(Hypericum densiflorum*).

3.1.3 Wildlife

The GBO property contains habitats that may be used by a number of fish and wildlife species that occur in West Virginia. The portions of the property north and west of Deer Creek, which are mostly undeveloped and densely forested, provide relatively high-quality wildlife habitat. The portions of the property south and east of Deer Creek consist mostly of developed areas, mowed grassy fields, and fragmented parcels of forest, which provide relatively low-quality wildlife habitat.

A number of game and non-game fish and wildlife species occur within the ROI. For regional context, over 225 species of birds, 12 species of game fish, 60 species of non-game fish, and a wide variety of other animal species have been documented to occur in the Monongahela National Forest (USFS, 2017a). Deer Creek, which flows toward the southwest through the GBO property, supports a variety of aquatic species, is stocked for trout, and is classified as a state mussel stream. Hunting is prohibited on the GBO property except during the annual, resident-only controlled deer hunt, held in cooperation with the WVDNR.

3.1.4 Threatened and Endangered Species

To assess the potential occurrence of species that are federally listed as threatened or endangered on the GBO property, a USFWS Information for Planning and Conservation (IPaC) report was generated for Pocahontas County, West Virginia (USFWS, 2017a). In addition, information on threatened and endangered species that have the potential to occur on the GBO property was requested from the USFWS West Virginia Field Office. During the scoping process, the WVDNR also identified a number of non-listed species of concern that have the potential to occur on the property. This correspondence is provided in Appendix 3.1A.

The IPaC report identified eight federally listed species that have the potential to occur in Pocahontas County (Table 3.1-1). Based on the habitat requirements of the identified species, only the federally endangered Indiana bat (*Myotis sodalis*) and federally threatened northern long-eared bat (*Myotis*

septentrionalis) are expected to occur on the GBO property (Table 3.1-1). These bat species were also the only federally listed species identified by the USFWS West Virginia Field Office as having the potential to occur on the property (USFWS, 2016a). The remaining species occur in habitats that either do not exist or are very limited on the GBO property; therefore, these species have little to no potential to occur on the property. No critical habitat for any species has been designated in Pocahontas County (USFWS, 2017a).

TABLE 3.1-1
Federally Listed Species that Have Potential to Occur in Pocahontas County, West Virginia[a]

Common Name	Scientific Name	Status	Habitat	Expected to Occur at GBO
Mammals				
Indiana bat	*Myotis sodalis*	E	During winter, it hibernates in caves or mines; it requires cool humid caves with stable temperatures, under 50 degrees Fahrenheit but above freezing. During summer, it roosts underneath loose bark on dead or dying trees (USFWS, 2017b).	Yes
Northern long-eared bat	*Myotis septentrionalis*	T	During winter, it hibernates in caves or mines with constant temperatures, high humidity, and no air currents. During summer, it roosts underneath loose bark, in cavities, or in crevices of live or dead trees (USFWS, 2017b).	Yes
Amphibians				
Cheat Mountain salamander	*Plethodon nettingi*	T	Cool, moist red spruce forests with a ground cover consisting of Bazzania (a liverwort) and an abundance of leaf litter, fallen logs, and sticks (WVDNR, 2017).	No
Fish				
Diamond darter	*Crystallaria cincotta*	E	Clean sand, gravel, and cobble runs of small to medium rivers. It formerly occurred throughout the Ohio River basin; it is currently known to exist only in the Elk River in West Virginia (NatureServe, 2013).	No
Plants				
Northeastern bulrush	*Scirpus ancistrochaetus*	E	In or on the edge of ponds and other small water bodies having water levels that fluctuate throughout the year. In West Virginia, it is known to occur in only four small sinkhole ponds in Berkeley County and in one sinkhole pond in Hardy County (WVDNR, 2017).	No
Running buffalo clover	*Trifolium stoloniferum*	E	Habitats with filtered sunlight that have had some kind of recent disturbance. In West Virginia, it has been found on jeep trails, old logging roads, skid roads, and wooded thickets (WVDNR, 2017).	No
Shale barren rock cress	*Arabis serotina*	E	Shale barrens. In West Virginia, it has been found only in Greenbrier, Pendleton, and Hardy counties (WVDNR, 2017).	No
Virginia spirea	*Spiraea virginiana*	T	Rocky, flood-scoured banks of high-energy (high gradient) streams or rivers. In West Virginia, it is known to occur only along the Gauley, Meadow, Bluestone, and Greenbrier rivers (WVDNR, 2017).	No

[a] Species identified in USFWS Information for Planning and Conservation report generated for Pocahontas County, West Virginia (USFWS, 2017a).

Notes:

E = Endangered: Species in danger of extinction throughout all or a significant portion of its range.

T = Threatened: Species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

The non-listed species of concern identified by the WVDNR as having the potential to occur on the GBO property are presented in Table 3.1-2.

TABLE 3.1-2
Species of Concern that have the Potential to Occur at the Green Bank Observatory [a]

Common Name	Scientific Name
Amphibians	
Eastern hellbender	*Cryptobranchus alleganiensis*
Northern red salamander	*Pseudotriton ruber*
Fish	
Appalachia darter	*Percina gymnocephala*
Brook trout	*Salvelinus fontinalis*
Candy darter	*Etheostoma osburni*
Kanawha sculpin	*Cottus kanawhae*
New River shiner	*Notropis scabriceps*
Tonguetied minnow	*Exoglossum laurae*
Crustaceans	
Greenbrier crayfish	*Cambarus smilax*
New River crayfish	*Cambarus chasmodactylus*
Insects	
Two-spotted skipper	*Euphyes bimacula*
Plants	
Bashful bulrush	*Trichophorum planifolium*
Bent sedge	*Carex styloflexa*
Blackgirdle bulrush	*Scirpus atrocinctus*
Hemlock rosette grass	*Dichanthelium sabulorum var. thinium*
Mannagrass	*Glyceria laxa*

[a] Species identified by the WVDNR during scoping.

3.1.5 Migratory Birds

The IPaC report generated for Pocahontas County, West Virginia (USFWS, 2017a) identified a total of 24 migratory bird species of conservation concern that have the potential to occur in the county (Table 3.1-3). All of the identified migratory bird species have the potential to occur on the GBO property. A number of other migratory bird species that are not species of conservation concern also have the potential to occur on the property.

TABLE 3.1-3
Migratory Bird Species of Conservation Concern that have the Potential to Occur in Pocahontas County, West Virginia[a]

Common Name	Scientific Name	Season of Occurrence
Bald eagle	*Haliaeetus leucocephalus*	Year-round
Bewick's wren	*Thryomanes bewickii ssp. bewickii*	Breeding
Black-billed cuckoo	*Coccyzus erythropthalmus*	Breeding
Black-capped chickadee	*Poecile atricapillus*	Year-round

TABLE 3.1-3
Migratory Bird Species of Conservation Concern that have the Potential to Occur in Pocahontas County, West Virginia[a]

Common Name	Scientific Name	Season of Occurrence
Blue-winged warbler	*Vermivora pinus*	Breeding
Canada warbler	*Wilsonia canadensis*	Breeding
Cerulean warbler	*Dendroica cerulea*	Breeding
Fox sparrow	*Passerella iliaca*	Wintering
Golden-winged warbler	*Vermivora chrysoptera*	Breeding
Kentucky warbler	*Oporornis formosus*	Breeding
Louisiana waterthrush	*Parkesia motacilla*	Breeding
Northern saw-whet owl	*Aegolius acadicus*	Year-round
Olive-sided flycatcher	*Contopus cooperi*	Breeding
Peregrine falcon	*Falco peregrinus*	Breeding
Pied-billed grebe	*Podilymbus podiceps*	Breeding
Prairie warbler	*Dendroica discolor*	Breeding
Red crossbill	*Loxia curvirostra*	Year-round
Red-headed woodpecker	*Melanerpes erythrocephalus*	Breeding
Rusty blackbird	*Euphagus carolinus*	Wintering
Short-eared owl	*Asio flammeus*	Wintering
Willow flycatcher	*Empidonax traillii*	Breeding
Wood thrush	*Hylocichla mustelina*	Breeding
Worm eating warbler	*Helmitheros vermivorum*	Breeding
Yellow-bellied sapsucker	*Sphyrapicus varius*	Breeding

[a] Species identified in USFWS Information for Planning and Conservation report generated for Pocahontas County, West Virginia (USFWS, 2017a).

3.2 Cultural Resources

The primary federal regulations that apply to cultural resources are NEPA and Section 106 of the NHPA (54 U.S.C. §306108). Cultural resources are specifically included under the NEPA mandate to "preserve important historic, cultural, and natural aspects of our national heritage…" (42 U.S.C. §4331). The implementing regulation for the NHPA is the Protection of Historic Properties (36 C.F.R. Part 800), which defines historic properties as any prehistoric or historic district, site, building, structure, or object that is included in, or eligible for inclusion in, the NRHP (36 C.F.R. §800.16). As stated in 36 C.F.R. §800.8(a)(1), the NHPA encourages federal agencies to coordinate compliance with NEPA to maximize the timely and efficient execution of both statutes and to allow the federal agency, in this case NSF, to use its procedures for public involvement under NEPA to fulfill the public involvement requirements for Section 106 (36 C.F.R. §800.2(d)(3)). This is not equivalent to using NEPA to comply with Section 106 "in lieu of" the standard Section 106 process as described in 36 C.F.R. §800.8(c); NSF is not implementing NEPA "in lieu of" Section 106.

3.2.1 Area of Potential Effects

The ROI for cultural resources is referred to as the APE per NHPA. The APE for the four Action Alternatives and the No-Action Alternative is defined as the property boundary of GBO (Figure 3.2-1). The boundaries of GBO were determined to be the APE so that it includes all areas where the Alternatives could occur. The West Virginia SHPO concurred with the APE on December 22, 2016.

3.2.2 Site History

The sensitive nature of radio telescopes limits the number of potential locations to establish an observatory using them. Man-made radio noise from Earth can interfere with signals from space, making it difficult to distinguish between various types of data collected. Geographic barriers, such as mountains, help isolate radio signals from space, making valleys an ideal location for the placement of radio telescopes. Green Bank in the Deer Creek Valley had several other appealing characteristics such as its rural surroundings, small population, and mild climate in addition to its geographic location encircled by mountains. A book produced by the NSF in 1959 titled, *The National Radio Astronomy Observatory*, provides a historical narrative of the early years of the NRAO site and states, "[t]he large site was selected so that a number of telescopes could be installed and operated without mutual interference" (NSF, 1959).

The land for GBO was purchased by the U.S. Army Corps of Engineers on behalf of the NSF in 1957 (NSF, 1959). The Observatory was a small-scale yet fully functioning community, complete with scientific equipment, administrative buildings, laboratories, residences, and recreation facilities. Today GBO facilities include the GBT, 43-meter telescope (140-foot telescope), 45-foot telescope, Interferometer Range (includes three 85-foot-diameter telescopes), 20-meter geodetic telescope, 40-foot telescope, three non-operational historical instruments (Jansky Replica Antenna, Reber Radio Telescope, and Ewen-Purcell Horn), and other support facilities and infrastructure.

This collection of telescopes provides a comprehensive, linear history of radio astronomical observation starting with the Jansky Replica Antenna and ending with the GBT.

3.2.2.1 Architectural Resources

Historic architectural resources consist of physical buildings, structures, and other built items that resulted from human activities occurring after European settlement.

The federal historic properties database known as the National Register Information System was reviewed to identify existing, recorded historic architectural properties within the APE. The Reber Radio Telescope is the only structure or building at GBO listed in the NRHP. The Reber Radio Telescope was listed in the NRHP in 1972 for its nationally significant association with the origins of radio astronomy and for its association with Grote Reber. It was designated a National Historic Landmark (NHL) in 1986 (NPS, 1986). The Reber Radio Telescope, which was constructed in 1937, was moved to GBO in 1959–1960 to be displayed at the entrance, and at that time, some elements of the structure, including deteriorated wood pieces, were replaced. The instrument has never been in operation at GBO.

A literature review, which focused on the APE and included an additional 0.5-mile buffer beyond the APE referred to as the study area, was conducted through the West Virginia SHPO Interactive Map on November 7, 2016. One residence within the APE, the Riley House (House #15), was previously recorded in 2011. The associated survey form states that the early 20th century wood-frame farmhouse did not appear to be individually eligible for the NRHP. The resource was re-evaluated as part of the current Proposed Action.

For the current Proposed Action, a Secretary of the Interior-qualified architectural historian conducted an intensive architectural survey at GBO from October 6 through 9, 2014. During the survey, informal interviews were conducted with GBO staff and archival research was performed, including a review of historic photographs and narratives, newspaper articles, construction records, and architectural drawings. The field survey encompassed architectural resources built in or before 1969, which is 48 years from the present year (2017). The standard age threshold for listing in the NRHP is 50 years; however, using 48 years as the cutoff allowed a buffer for the execution of the Alternatives. All architectural resources from 1969 or earlier within the APE that had not been previously listed in the NRHP were surveyed and evaluated for NRHP eligibility. The GBT, which was completed in 2000, was also surveyed and evaluated because it qualifies under NRHP Criteria Consideration G, which applies to properties that have achieved significance within the last 50 years. No other buildings or structures at GBO are considered significant under Criteria Consideration G.

Using aerial photographs of GBO and information provided by the staff, 47 architectural resources that had been constructed in or before 1969 were identified within the APE, including 5 telescopes (several of which include more than one structure), 2 horn instruments, 1 display antenna (the Reber Radio

Telescope), 1 airstrip, 1 water tower, 1 recreation area, 24 residential buildings (one of which is the previously recorded Riley House), and 12 operational and administrative buildings. As noted previously, the Reber Radio Telescope was previously listed in the NRHP and is an NHL; therefore, it was not evaluated for NRHP individual eligibility. The remaining 46 built environment resources in the APE built in or before 1969 were photographed and evaluated for NRHP eligibility. Data collected through the background research and field investigations were analyzed to determine the NRHP eligibility of each of these 46 architectural resources individually. In addition, the GBT, which was constructed after 1969, was evaluated individually for its exceptional importance to radio astronomy over the last 50 years. The properties surveyed in 2014 are described in detail in the *Cultural Resource Evaluation*, provided in Appendix 3.2A. Figure 3.2-2 shows the location of each individually evaluated architectural resource. In 2016, NSF determined that within the historical context of NRAO and GBO, there are four telescopes that are individually eligible for listing in the NRHP: the Interferometer Range (which includes three telescopes and two control buildings), the 40-foot telescope (which includes an associated control building), the 43-meter telescope (140-foot telescope; includes a maintenance structure), and the GBT (Table 3.2-1). The West Virginia SHPO concurred with these determinations of individual eligibility on December 22, 2016.

3.2.2.2 Historic District

A total of 48 architectural resources, which includes 47 architectural resources constructed in or before 1969 (one of which is the individually NRHP-listed Reber Radio Telescope), and the GBT (which is less than 50 years old), were evaluated for their eligibility for listing in the NRHP as a potential historic district. NSF determined that GBO is eligible as a historic district for representing an important time in science history and for its significant contribution to the advancement of radio astronomy. Of the 48 evaluated architectural resources within the APE, 44 were determined as contributing to the eligible GBO historic district, the boundaries of which coincide with GBO's property boundaries and the APE. Contributing elements include 8 administrative/operational buildings, 1 airstrip, 1 water tower, 1 recreational area, 24 residential buildings, 2 horn instruments, 1 antenna, and 6 telescopes (one of which, the Interferometer Range, includes 3 large telescopes) (Table 3.3-2). At the request of the West Virginia SHPO, Historic Property Inventory (HPI) forms were completed for each resource at least 45 years of age located at GBO, as well as any resource less than 45 years of age that may contribute to the potential historic district. A total of 48 HPI forms were submitted to the West Virginia SHPO on May 19, 2017, for review and concurrence. The West Virginia SHPO concurred with the historic district determination of eligibility, and the 44 contributing resources, on June 12, 2017.

The scientific instruments within the APE are a collection of telescopes, horn instruments, and antenna that are significant for their role in the development of radio astronomy and, in several instances, as remarkable feats of engineering. The majority of the components that make up the potential district's

historic character possess integrity. The administrative and operations buildings and structures within GBO are primarily utilitarian buildings or structures with simple designs executed using practical and standard materials. These elements create a cohesive, visual unit that emphasizes their historically linked function as support for the Observatory, even though many of the buildings are individually undistinguished. As a group, the 44 contributing architectural resources are a distinct and well-preserved representation of the early years of the NRAO. Additionally, the scientific instruments at GBO illustrate a linear, historical narrative of the history of radio astronomy, from the Jansky Replica Antenna and Reber Radio Telescope to the monumental GBT. Four buildings within the APE were identified as non-contributing resources: three barns and one cellar building. These buildings pre-date the establishment of the NRAO and have been primarily left vacant or are used as miscellaneous storage facilities.

TABLE 3.2-1
Historic Buildings and Structures at GBO

Building/Structure Name (year of construction)	Description	NRHP Eligibility
GBO Historic District (1958–2000)	Collection of administrative/operational buildings and structures, residential buildings, and radio astronomy structures and instruments associated with the NRAO/GBO.	Eligible under Criterion A as a historic district with 44 contributing resources (SHPO concurrence 2017)
Interferometer Range: Howard E. Tatel Telescope (85'-1) and 85'-1 control building (1958–1959); 85'-2 Telescope (1963–1964); 85'-3 Telescope (1965–1968); Interferometer control building (1967–1968)	The Tatel Telescope (85'-1) was the first telescope constructed by the NRAO and performed the world's first SETI observations. The Interferometer Range connected two nearly identical telescopes to the Tatel Telescope in a linear formation. The three telescopes operated in unison and proved that the reflector dishes could be combined to form very large telescopes. This information spurred the construction of the Very Large Array telescope in New Mexico in the 1970s.	Individually eligible under Criterion A; contributing to GBO Historic District (SHPO concurrence 2017).
40-foot Telescope and control building (1962)	First fully automated radio telescope in the world. Currently operates as an educational telescope for visiting students.	Individually eligible under Criterion A; contributing to GBO Historic District (SHPO concurrence 2017).
43-meter Telescope (140-foot Telescope) (1958–1965)	Largest telescope in the world to use an equatorial (or polar aligned) mount. Currently used as part of the Russian Radioastron project.	Individually eligible under Criteria A and C; contributing to GBO Historic District (SHPO concurrence 2017).
Robert C. Byrd Green Bank Telescope (Green Bank Telescope) 1991–2000)	Largest moving structure on land in the world; tilt and point design that can rotate a full 360 degrees; performs highly sensitive data collection.	Individually eligible under Criteria A and C, Criterion Consideration G; contributing to GBO Historic District (SHPO concurrence 2017).

3.2.2.3 Archeological Resources

Prehistoric and historic archeological resources are items or sites resulting from human activities that predate and postdate written records, respectively.

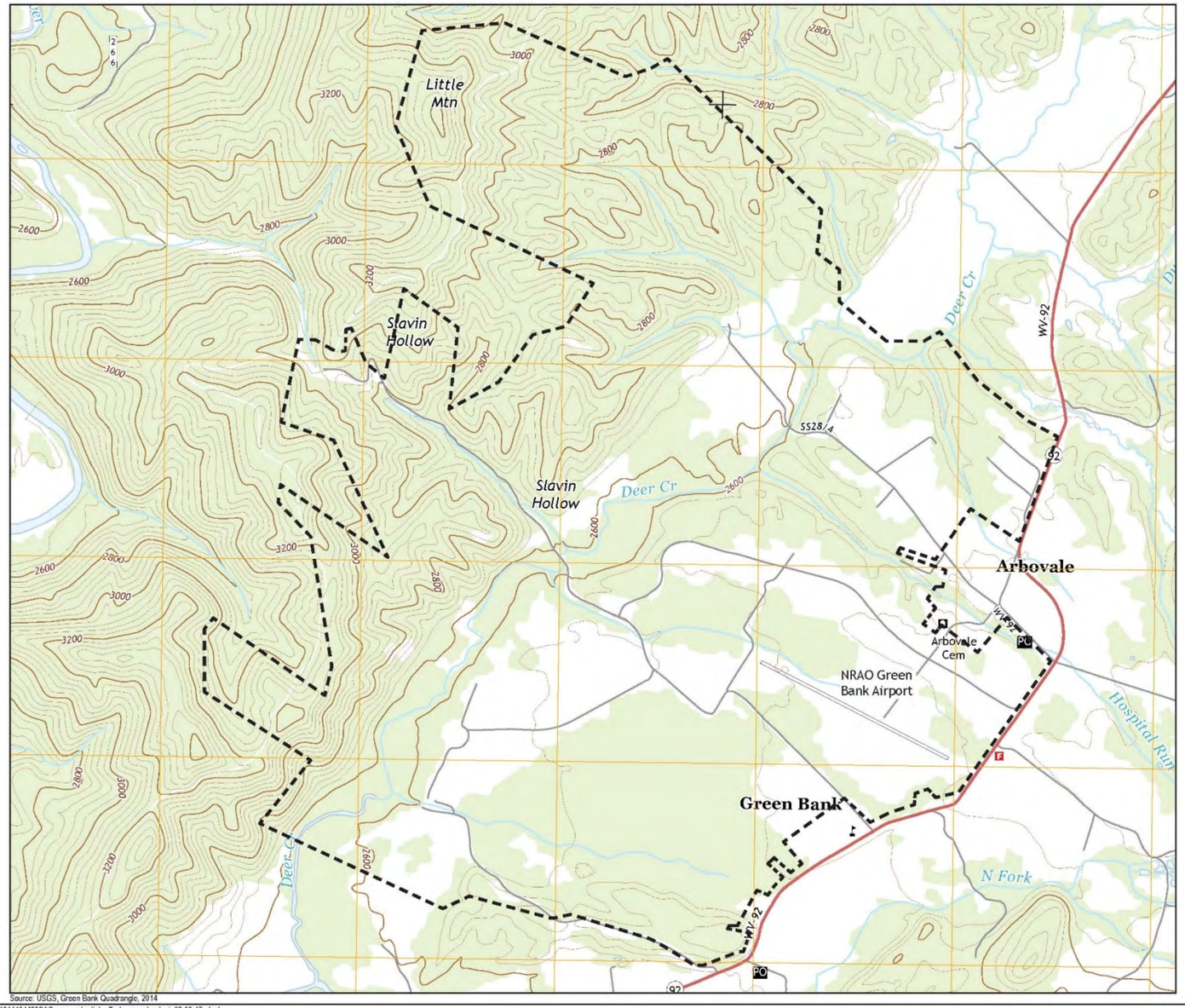
The literature review conducted through the West Virginia SHPO Interactive Map did not identify any previously recorded archeological sites within the APE, and it confirmed GBO has not been surveyed previously for archeological resources. Two archeological sites have been recorded outside the APE, directly adjacent to the eastern boundary of GBO along State Routes 28 and 92, although the sites have not been evaluated for the NRHP. Additional cultural resources studies have occurred within 0.5-mile of the APE, the area referred to as the study area, resulting in the recordation of 34 cultural resources. Based on this research, there are no known archeological resources at GBO. However, because no archeological survey work was conducted as part of the NEPA or Section 106 processes, there may be archeological resources below ground that are not currently apparent.

3.2.2.4 Traditional Cultural Properties

Traditional cultural properties (TCPs) are sites, areas, and materials associated with cultural practices or beliefs of a living community that are rooted in that community's history and are important in maintaining the continuing cultural identity of the community.

No TCPs have been identified at GBO; however, the Delaware Nation has expressed interest in being a Consulting Party on this Proposed Action and, therefore, is being kept up to date on the progress of this Proposed Action. This sub-resource will not be analyzed further, due to the current lack of identified TCPs.

FIGURE 3.2-1
Area of Potential Effects (APE)



LEGEND

Area of Potential Effects (APE)

North

0 1,700
Approximate scale in feet

FIGURE 3.2-1
Area of Potential Effects (APE)
Green Bank Observatory
Pocahontas County
Green Bank, West Virginia

Source: USGS, Green Bank Quadrangle, 2014
ES111914104429SAC area_potential_effects_greenbank.ai 03-09-17 dash

ch2m:

FIGURE 3.2-2
Built Environment Resources

Building / Structure Name

Administrative / Operational

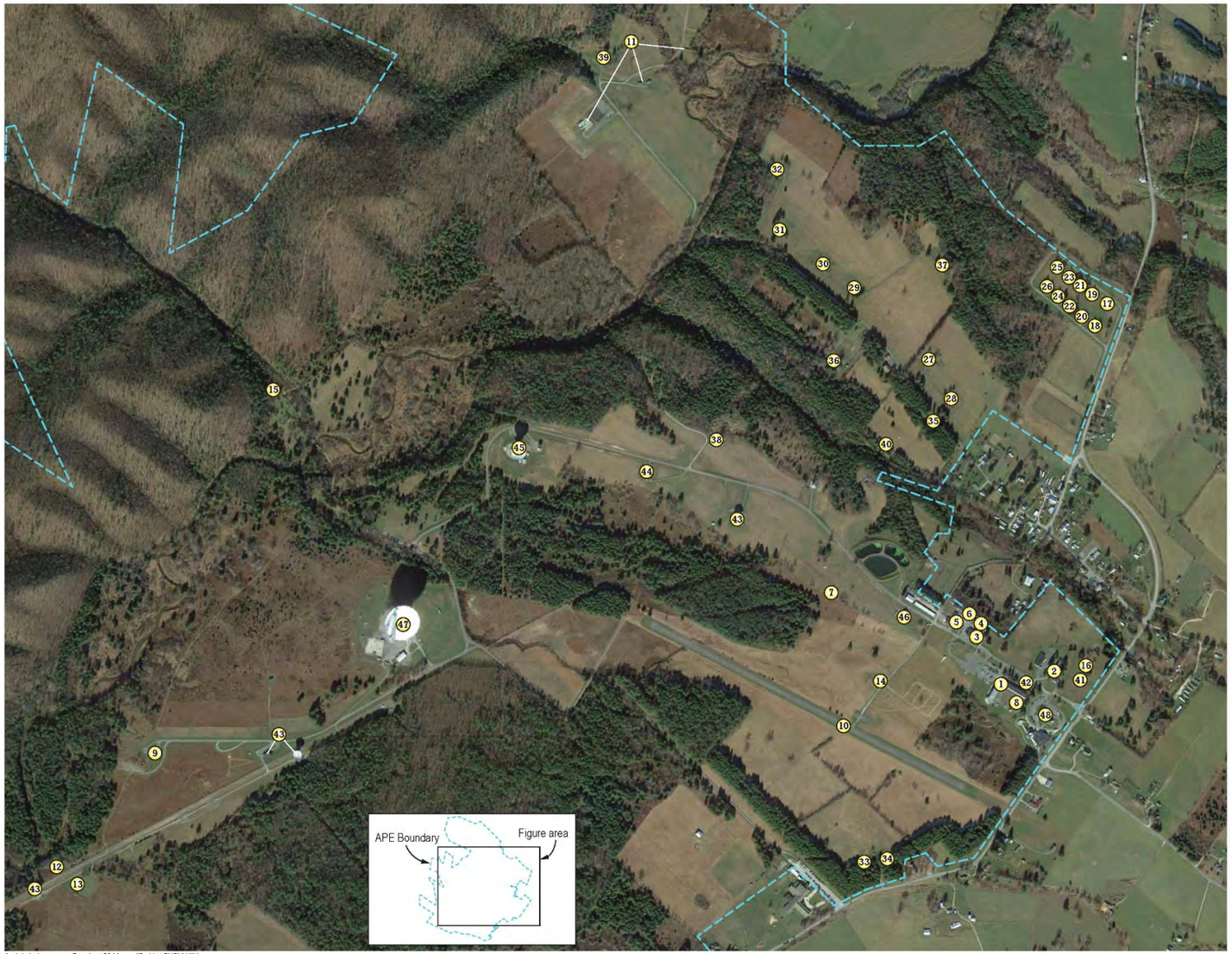
1. Karl Guthe Jansky Laboratory
2. Cafeteria Building and Residence
3. Warehouse
4. Water Tower
5. Works Area Building
6. Telescope Mechanics Office (formerly Cable Storage Warehouse)
7. Millimeter Array Experiment Building
8. Outdoor Test Building
9. Laser Lab (formerly 300' Telescope Control Building)
10. Airstrip
11. Recreation Area
12. Barn
13. Barn
14. Barn
15. Slaven Hollow Orchard Cellar Building

Residential Buildings

16. Redwood House (House #1; Director's House)
17. House #2 (Rabbit Patch)
18. House #3 (Rabbit Patch)
19. House #4 (Rabbit Patch)
20. House #5 (Rabbit Patch)
21. House #6 (Rabbit Patch)
22. House #7 (Rabbit Patch)
23. House #8 (Rabbit Patch)
24. House #9 (Rabbit Patch)
25. House #10 (Rabbit Patch)
26. House #11 (Rabbit Patch)
27. House #16
28. House #14
29. House #19
30. House #21
31. House #23
32. House #24
33. Shinnaberry House
34. Nut Bin
35. Riley House (#15)
36. Hill House (#17)
37. Tracy House (#18)
38. Beard House
39. Hannah House

Structures / Telescopes

40. Calibration Horn
41. Karl Guthe Jansky Replica Antenna
42. Ewen-Purcell Horn
43. Green Bank Interferometer: Includes Howard E. Tatel (85'-1) Telescope & 85'-1 control building; 85'-2 Telescope; 85'-3 Telescope; and the Interferometer Control Building
44. 40' Telescope & 40' Telescope Control Building
45. 140' Telescope (43m Telescope) & maintenance structure
46. 45' Telescope
47. Robert C. Byrd Green Bank Telescope (GBT)
48. Reber Radio Telescope



LEGEND

- NRHP Contributing
- NRHP Non-Contributing
- NRHP Individually Eligible
- NRHP Individually Listed
- Surveyed Property
- Area of Potential Effects (APE)

Aerial photo source: Google ©2014, modified by CH2M HILL

North

0 1,000
Approximate scale in feet

FIGURE 3.2-2
Built Environment Resources
Green Bank Observatory
Green Bank, West Virginia

CH2MHILL.

ES111914104429SAC built_environment_greenbank.ai 12-08-14 dash

3.3 Visual Resources

Visual resources include natural and built features that can be seen by the public and contribute to the public's appreciation and enjoyment of these features. The CEQ regulations to implement NEPA (40 C.F.R. §1508.8) identify aesthetics (visual resources) as one of the elements of the human environment that must be considered in determining the effects of a project.

Visual resources can include solitary built and natural landmarks (such as buildings, trees, and bodies of water) or entire landscapes. Impacts on visual resources are defined by the extent to which a proposed project's presence would change the visual character and quality of the environment as seen by the public.

Visual character is defined by the relationships between the visible natural and built landscape features and how objects relate to each other in terms of visual dominance, scale, diversity, and continuity. Visual character is simply a description of the viewed environment and does not assign value or degree of attractiveness to the viewed environment.

Visual quality is considered in terms of high, average, or low. To assess visual quality, the following questions are answered:

- Is this view common (average) or dramatic (high)?
- Is it a pleasing composition with a mix of elements that seem to belong together (high) or one with a mix of elements that either do not belong together or are an eyesore and contrast with the other elements in the surroundings (low)?

Visual resources were identified through materials and observations collected during the site visits, aerial photos, and maps. The ROI for visual resources corresponds to the areas from which the Observatory employees and the public would potentially see changes to the site as a result of the Action Alternatives.

3.3.1 Proposed Action Area

GBO, which consists of approximately 2,200 acres, is in a rural area adjacent to the Monongahela National Forest. Heavily wooded and mountainous terrain surrounds GBO (Figures 3.3-1 through 3.3-6). Dotted throughout the property are a selection of administrative/operational support buildings, residential buildings, and towering radio telescopes.

Collectively, the facilities at GBO are a distinct and well-preserved representation of the early years of the NRAO, complete with scientific instruments, administration/operational facilities, recreation area, and residential buildings, situated in a dramatic natural setting. Most of the built environment resources in GBO contribute to the NRHP-eligible GBO Historic District. However, the historic district as a whole is not considered aesthetically significant per NHPA guidelines; the historic district is considered significant as a result of its function as a science facility and for its historic associations.

The GBT and the 43-meter telescope (140-foot telescope) are two features individually eligible for the NRHP as a result of design and engineering and, therefore, are considered aesthetically important. Within the natural setting, the GBT stands out as the most dominant visual feature of the built environment in GBO. At 485 feet tall with a 2.3-acre receiving dish, the GBT is visually imposing and is significant in terms of its design and engineering. The 43-meter telescope (140-foot telescope) is also visually imposing within the natural setting, but on a smaller scale than the GBT.

Most of the buildings and structures associated with GBO are small in scale compared to the vastness of the surrounding natural setting and are largely arranged based on function. Within the natural setting, they have either a utilitarian or residential visual character (Figure 3.11-6). Although some of these areas contribute to the NRHP-eligible historic district, many of them also detract from the surrounding natural landscape.

Since the majority of buildings within the site are utilitarian and are not visually significant, GBO's aesthetic character is defined largely by its natural setting. As a result of the natural environment, the site is considered to have high visual quality to the primary viewers, which are the staff and visitors. The natural setting of GBO as a whole is considered a sensitive visual resource.

FIGURE 3.3-1
Landscape of GBO with two of the Interferometer Range telescopes (85'-2 and 85'-3); photograph taken from the GBT, view to the southwest (2014).

FIGURE 3.3-2
Wooded area with the Howard E. Tatel (85'-1) Telescope and the 20-meter Telescope; view from the GBT to the northeast (2014).

FIGURE 3.3-3
Landscape of GBO; view from the GBT to the east (2014).

FIGURE 3.3-4
West side of the 43-meter Telescope (140-foot Telescope); view to the northeast (2014).

FIGURE 3.3-5
South side of the GBT; view to the northwest (2014).

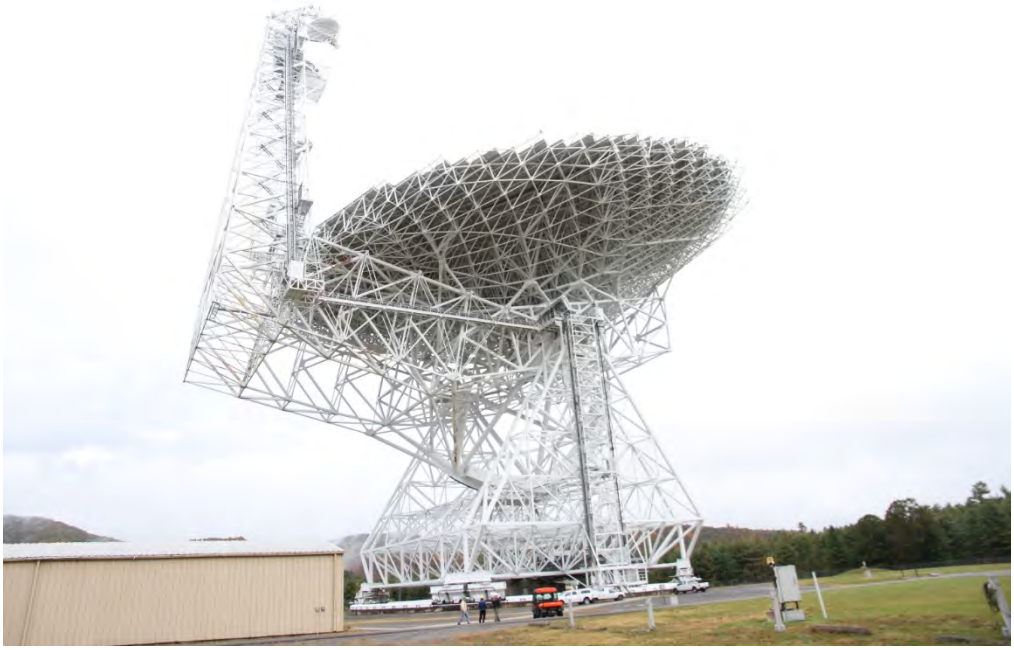


FIGURE 3.3-6
Sample Utilitarian Buildings, Mechanics Building and Water Tower (2014).

3.4 Geology and Soil

This Section describes the geologic and soil conditions at GBO. The ROI for geology and soil is the GBO boundary.

3.4.1 Proposed Action Area

3.4.1.1 Geology

A physiographic region is used to divide the Earth's landforms into distinct regions. GBO is in the Valley and Ridge Physiographic Province of West Virginia within the greater Appalachian Region (West Virginia Geological & Economic Survey [WVGES], 2015; Appalachian Regional Commission, 2017). The Appalachian Province is bordered to the east by the Great Valley and Blue Ridge Mountains and to the west by the Allegheny Front. The geology of this province is structurally complex and is composed primarily of sedimentary rocks. The topography of the site is fairly flat, and the site is surrounded by mountains.

The Appalachian Province has several major gas plays, which represent geological features of economic importance. A play is defined as a group of rocks and its contained hydrocarbons (de Witt, 1993). Within the ROI and greater surrounding region, the Tuscarora gas play is of greatest importance (WVGES, 2017a).

There are no reported natural gas wells on the GBO property, but one well is located 0.4 mile south of the property, south of Route 92 (WVGES, 2017a). The specific well type was not reported (WVGES, 2017b).

3.4.1.2 Seismicity

West Virginia has a history of moderate earthquakes. Between 1824 through 2016, six earthquakes occurred in Pocahontas County (WVGES, 2016). The magnitudes of these earthquakes ranged from 0.4 through 3.0 with epicenter depths ranging from 2.2 kilometers to 17.8 kilometers (WVGES, 2016). The U.S. Geological Survey (USGS) has determined that the Central and Eastern United States, including the ROI, experiences potential ground-shaking hazards from both human-induced and natural earthquakes and have a less than 1 percent chance of experiencing damage from human-induced or natural earthquakes. Therefore, the ROI is not considered to have a high hazard risk (USGS, 2017a, 2017b).

3.4.1.3 Landslides

The local geology and regional climatic conditions make portions of the Appalachian Province prone to landslide hazards, including debris flows. Debris flows are a dangerous form of landslides where downslope movement of material can be rapid and have great force. On a regional scale, rainfall and slope steepness are key factors in debris flow distribution. Extreme rainfall events are the most likely trigger for debris flows in the Valley and Ridge Physiographic Province (USGS, 2008). Along the slopes of ridges, extensive loose sediment is highly susceptible to sliding. However, most of the movement along these slope areas consist of slow moving debris slides, except when triggered by heavy or persistent rain (USGS, 1982).

The USGS has delineated areas in the conterminous United States where landslides occur or are susceptible to landslides. Landslide incidence is classified as low in the ROI (USGS, 2011).

3.4.1.4 Soil

Soil is an integrated expression of the underlying rock, climate, and environmental factors of a region. The Soil and Water Resources Conservation Act of 1977 requires federal agencies to consider the conservation and protection of soil resources in planning activities. There are 16 mapped soil units on the GBO property (Figure 3.4-1). (Natural Resources Conservation Service [NRCS], 2017). The following subsections describe the soil units (NRCS, 1998).

Weikert Soil Series

This soil covers 35 percent of the ROI. This soil series is shallow, well drained, and typically occurs on low convex ridgetops or adjacent terraces. The available water capacity is very low, and the permeability is moderately rapid in the subsoil. Runoff is rapid, and natural fertility is low. Bedrock is located at a depth of 10 to 20 inches. The hazard of erosion is severe in unprotected areas. The soil can be drought-prone because it has a high content of sand and gravel (NRCS, 1998).

Allegheny Soil Series

This soil covers approximately 32 percent of the ROI. Soil in this series is very deep in the ROI and typically occurs on stream terraces and foot slopes. Water capacity is moderate to high, and permeability is moderate in the subsoil. Depth to bedrock is greater than 60 inches (NRCS, 1998). The erosion hazard is moderate (3 to 8 percent slopes) to severe (greater than 8 percent slopes) in unprotected areas (NRCS, 1998).

Purdy Soil Series

This soil covers approximately 15 percent of the ROI. This unit is very deep, nearly level, poorly drained, and typically occurs on low stream terraces along Deer Creek. The available water capacity is moderate to high, and the permeability is slow to very slow in the subsoil. Runoff is slow to medium, and natural fertility is medium. The seasonal high-water table is within a depth of 1 foot. The depth to bedrock is greater than 60 inches. The erosion hazard is slight (NRCS, 1998).

Berks Soil Series

This soil covers less than 7 percent of the ROI. Soil in this series is moderately deep, very steep, and well drained. Berks soil is typical on the upper side slopes and benches, and stones cover 1 to 3 percent of the surface. Permeability is moderate to moderately rapid in the subsoil. Bedrock is located at a depth of 20 to 40 inches (NRCS, 1998). Erosion hazard is severe to very severe in unprotected areas (NRCS, 1998).

Atkins Soil Series

This soil covers approximately 6 percent of the ROI and is very deep, nearly level, poorly drained. This soil occurs on the floodplains of Deer Creek and is subject to frequent flooding. The available water capacity is moderate to high, and permeability is slow to moderate. Runoff is slow, and natural fertility is medium. The seasonal high-water table is within 1 foot of the surface, and depth to bedrock is greater than 60 inches. This soil series has a potential for frost action (NRCS, 1998).

Macove Soil Series

This soil covers approximately 4 percent of the ROI and is very deep, well drained, and it typically occurs on foot slopes. The available water capacity is moderate, and permeability is moderately rapid in the subsoil. The depth to bedrock is greater than 60 inches. The surface can be stony. The erosion hazard is moderate (3 to 8 percent slopes) to severe (greater than 8 percent slopes) in unprotected areas (NRCS, 1998).

Chavies Soil Series

This soil covers nearly 1 percent of the ROI. This unit is very deep, nearly level, and well drained, and it occurs on low stream terraces. It is subject to rare flooding. The available water capacity is moderate to high, permeability is moderately rapid in the subsoil. Runoff is slow to medium, and natural fertility is medium. Depth to bedrock is greater than 60 inches. Erosion hazard is slight, and there is hazard for flooding (NRCS, 1998).

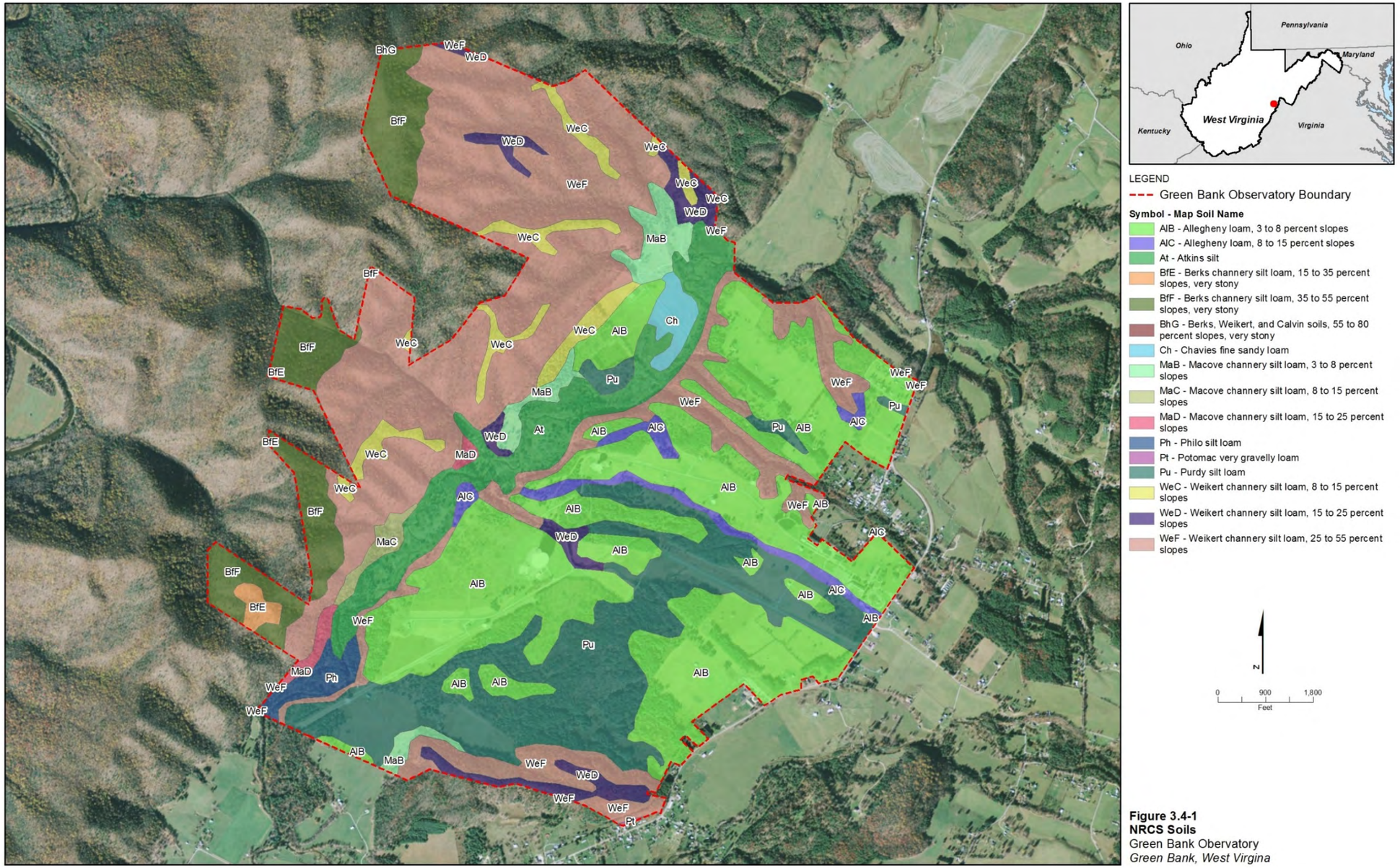
Philo Soil Series

This soil covers nearly 1 percent of the ROI. This unit is very deep, nearly level, moderately well drained, and it occurs on floodplains of the Deer Creek watershed. It is subject to occasional flooding, and slopes range from 0 to 3 percent. The available water capacity is moderate in the subsoil and rapid to very rapid in the substratum. Runoff is slow, and natural fertility is medium. The seasonal high-water table ranges from a depth of 1.5 to 3.0 feet. Depth to bedrock is greater than 60 inches (NRCS, 1998).

Potomac Soil Series

This soil covers less than 1 percent of the ROI. This unit is very deep, nearly level, and somewhat excessively drained, and it typically occurs on moderately wide to narrow floodplains. It is subject to frequent flooding. Slopes range from 0 to 3 percent. The available water capacity is very low to low, and permeability is very low to low. Runoff is slow, and natural fertility is medium. The depth to bedrock is greater than 60 inches. The hazard of erosion is light. This soil can be drought-prone because it has a high content of sand and gravel (NRCS, 1998).

FIGURE 3.4-1
NRCS Soils



LEGEND

Green Bank Observatory Boundary

Symbol - Map Soil Name

- AlB - Allegheny loam, 3 to 8 percent slopes
- AlC - Allegheny loam, 8 to 15 percent slopes
- At - Atkins silt
- BfE - Berks channery silt loam, 15 to 35 percent slopes, very stony
- BfF - Berks channery silt loam, 35 to 55 percent slopes, very stony
- BhG - Berks, Weikert, and Calvin soils, 55 to 80 percent slopes, very stony
- Ch - Chavies fine sandy loam
- MaB - Macove channery silt loam, 3 to 8 percent slopes
- MaC - Macove channery silt loam, 8 to 15 percent slopes
- MaD - Macove channery silt loam, 15 to 25 percent slopes
- Ph - Philo silt loam
- Pt - Potomac very gravelly loam
- Pu - Purdy silt loam
- WeC - Weikert channery silt loam, 8 to 15 percent slopes
- WeD - Weikert channery silt loam, 15 to 25 percent slopes
- WeF - Weikert channery silt loam, 25 to 55 percent slopes

N

0 900 1,800
Feet

Figure 3.4-1
NRCS Soils
Green Bank Obervatory
Green Bank, West Virgina

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3.5 Water Resources

This Section describes the water resources at GBO, including wetlands, surface water, floodplains, and groundwater. The ROI for water resources is generally the boundary of GBO; however, the regional watershed and groundwater basin are broadly discussed to provide context.

3.5.1 Wetlands

Wetlands on the GBO site were evaluated by reviewing USFWS National Wetlands Inventory (NWI) maps (USFWS, 2016b) and the results of the field investigation conducted for this EIS in November 2016 to ground truth the information provided on the NWI maps. Onsite wetlands primarily exist within the floodplain of Deer Creek and along the southern boundary of the property (Figure 3.5-1). Based on NWI mapping, there are 32.08 acres of wetlands on the GBO site. Onsite wetland types include freshwater forested, freshwater scrub-shrub, and freshwater emergent wetlands. During the field investigation, hydric conditions were observed in the southernmost onsite wetland (Data Point 1 on Figure 3.5-1), including hydric plant species and saturated, organic surface soil. The dominant plant species observed at Data Point 1 in this wetland are identified in Section 3.1.2, *Vegetation*.

3.5.2 Surface Water

Surface water bodies on the GBO site were evaluated by reviewing USFWS NWI maps (USFWS, 2016b), USGS National Hydrography Dataset (NHD) maps (USGS, 2016a), and the results of the field investigation conducted for this EIS in November 2016. Onsite surface water bodies include freshwater ponds and perennial streams, which include Deer Creek and the tributaries of Deer Creek (Figure 3.5-1). Based on NWI and NHD maps, there are 9.35 miles of perennial streams, including Deer Creek, and a total of 0.26 acre of freshwater ponds on the GBO site.

Deer Creek flows in a southwesterly direction through GBO and discharges to the Greenbrier River near Cass, West Virginia; the Greenbrier River discharges to Kanawha (New) River near Hinton, West Virginia. Six onsite streams are tributaries of Deer Creek. The stream closest to the main entrance of GBO is named Hospital Run; the other onsite streams are unnamed. The onsite freshwater ponds are near the main entrance. Based on field observations, the pond just south of the Jansky Lab and Science Center (Data Point 2 on Figure 3.5-1) serves as a stormwater retention pond for the adjacent facilities. This pond receives stormwater drainage from the adjacent facilities via a culvert; it is not evident whether this pond is natural or artificially created.

Section 303(d) of the Clean Water Act requires states to list water bodies that do not meet water quality standards and designated uses (impaired waters). Deer Creek is listed by the West Virginia Department of Environmental Protection (WVDEP) as an impaired water body, and has a total maximum daily load for fecal coliform.

The GBO wastewater treatment plant (WWTP) is operated under a Water Pollution Control Permit issued by the WVDEP. The WWTP includes three wastewater treatment ponds and has a treatment capacity of approximately 10,000 gallons per day. The WWTP discharges to Hospital Run; levels of fecal coliform and other water quality parameters in the discharges are limited and monitored per the requirements of the Water Pollution Control Permit.

3.5.3 Floodplains

Floodplains on the GBO site were evaluated based on Federal Emergency Management System (FEMA) floodplain maps (FEMA, 2016). Portions of the GBO site along Deer Creek are within the 100-year floodplain, which coincides with the 500-year floodplain within GBO property boundaries (Figure 3.5-1). Based on FEMA floodplain maps, 159.25 acres of the GBO site are in the 100-year and 500-year floodplains; however, no structures are within these floodplains.

3.5.4 Groundwater

GBO is located along the boundary of the Ridge and Valley physiographic province and the Appalachian Plateaus physiographic province (USGS, 2016b). There are no principal aquifers directly under GBO; however, the Ridge and Valley aquifer and Appalachian Plateaus aquifer are just east and west of the property, respectively (USGS, 2016b). GBO does not contain any of the karst areas identified in Pocahontas County; the nearest karst area is approximately 2 miles south of the property (Downstream Strategies, 2013).

Fifteen water wells are located within a 1-mile radius of the center of the GBO site (Appendix 3.6A). Two of the wells supply water to the GBO Science Center and surrounding facilities; the water is stored in the water tower prior to distribution. The water for each telescope and a number of onsite houses is supplied by other water wells. Within Pocahontas County, the majority of the citizens rely on private groundwater wells or springs for their primary water supply.

FIGURE 3.5-1
Wetlands, Waters, and Floodplains

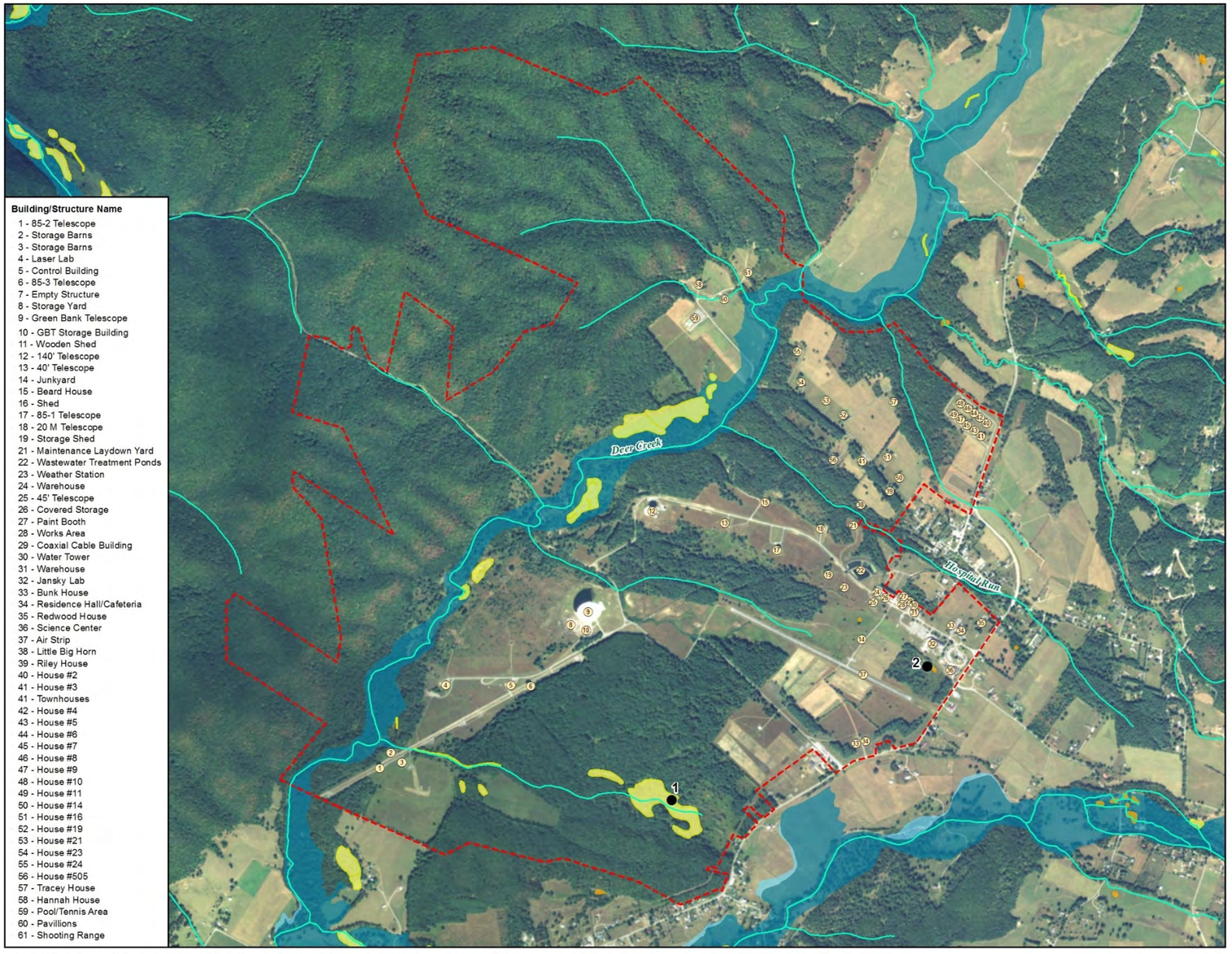

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Figure 3.5-1
Wetlands, Waters and Floodplains
Green Bank Obervatory
Green Bank, West Virgina

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3.6 Hazardous Materials

This Section discusses the hazardous materials contamination that may be present at the site and the hazardous materials and waste that may be used and generated during demolition and/or operation of GBO. A hazardous material is defined as a material that exhibits ignitability, corrosivity, reactivity, or toxicity characteristics.

The ROI for hazardous materials and waste analyses follows the requirements prescribed by American Society for Testing and Materials (ASTM) International Standard Practice E1527-13, *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM E1527-13). The ROI includes the area within the GBO property boundary and the approximate minimum search distances for select federal and state standard source environmental databases ranging from the GBO property to 1 mile (see figures and additional details in Appendix 3.6A).

3.6.1 Existing Site Contamination

An environmental baseline study (EBS) was prepared for the GBO site (CH2M, 2016); the study is included as Appendix 3.6A. The EBS serves as the basis of this analysis.

The following recognized environmental conditions (RECs) were found at GBO:

- A 1,000-gallon gasoline underground storage tank located in front of the Warehouse building was abandoned in place (emptied and filled with a cement slurry) in 1991 after water was found in the gasoline. Soil samples were not collected to determine if there was a release.
- Soil in the target areas of the shooting range may contain lead. Gunpowder residues, including polycyclic aromatic hydrocarbons, may have reached the soil at the firing line.

The following de minimis conditions were identified at GBO:

- 20-gallon drum of lubricant leaked on an absorbent pad in the 43-meter telescope (140-foot telescope).
- Staining on the concrete floor of the GBT warehouse.
- Staining on the concrete floor in the Works Area garage.
- Staining on the tile floor in the shed southwest of telescope 85-1.

The following conditions on the subject property are not considered RECs:

- According to the 1989 Asbestos Management Plan, nine buildings were surveyed for ACM. Other buildings including residential homes were not surveyed. ACM was found at the following buildings: 43-meter telescope (140-foot telescope), telescope 85-1 Control Building, Works Area building, Jansky Laboratory building, Residence Hall, Interferometer building, Warehouse building, and the Cable building.

- A military-style fuel truck was staged north of the telescope area off Slavin Hollow Road. The truck is permanently parked on a hillside and is used as a diesel aboveground storage tank. Secondary containment was not observed under the filling port behind the truck and spills from the truck would immediately impact the soil.
- A burn pile of scrap wood, furniture, and brush located in the junkyard. WVDNR recommended that the pile be removed.

3.6.2 Use of Hazardous Materials

Hazardous materials typically used for building maintenance, landscaping, scientific instruments, fuel for generators, heating oil, vehicle maintenance, drinking water treatment, and pool maintenance are onsite. There is no single storage area for hazardous materials and petroleum products. The products are stored at the building where they are intended to be used (CH2M, 2016). Fuel oil is stored in aboveground and underground storage tanks.

3.7 Solid Waste

This Section presents descriptions of solid waste generation and infrastructure at GBO. Solid waste at the Observatory includes a broad range of materials such as garbage, refuse, sludge, demolition and construction waste, nonhazardous industrial waste, universal waste, municipal waste, and hazardous waste.

The ROI for solid waste includes the GBO site and the facilities in which the solid waste would be landfilled. Four facilities could potentially receive solid waste generated by the Alternatives (Figure 3.11-2 in Section 3.11, *Traffic and Transportation*, for landfill locations).

3.7.1 Proposed Action Area

The closest landfill to GBO is the Pocahontas County Landfill. The Pocahontas County Landfill accepts only municipal solid waste, dewatered septic sludge that is certified per WVDEP regulations, and construction and demolition debris (Alderman, 2017). The Pocahontas County Landfill does not accept ACM or LBP abatement waste (Alderman, 2017). The closest landfill that accepts construction and demolition debris, as well as ACM and LBP abatement waste, is the HAM Sanitary Landfill, which is located outside Peterstown, West Virginia (Bradley, 2017) (Figure 3.11-2 in Section 3.11, *Traffic and Transportation*). Based on GBO's location, it is most likely that the Pocahontas County and HAM Sanitary landfills would be used. Table 3.7-1 contains information describing all the regional the landfills.

TABLE 3.7-1
Landfill Facility Summary for the ROI

Facility Name	Address	Estimated Annual Waste Received (Ton)	Estimated Remaining Capacity (Ton)	Wastes Accepted	Distance from GBO (Miles - One Direction)	Estimated Permit Closure Date
Pocahontas County Landfill	Route 28 Dunmore, WV	9,600[a]	124,800[a,e]	Municipal solid waste, construction waste, dewatered sludge (treated per WVDEP procedures)[a]	13	2030
HAM Sanitary Landfill	519 Roy Martin Rd. Peterstown, WV 24963	120,000[d]	10,440,000 (combined)[d,e] 127,400 (ACM and LBP only)[d,e]	Municipal solid waste, construction waste, septic waste, LBP abatement waste, ACM abatement waste[d]	112	2104
Greenbrier County Landfill	RR 4 Lewisburg, WV 24901	46,000[b]	1,840,000[b,e]	Municipal solid waste, construction waste, treated and dewatered sludge[c]	70	2057
Tucker County Landfill	412 Landfill Rd. Davis, WV 26260	75,000[c]	3,750,000[c,e]	Municipal solid waste, construction waste, treated and dewatered sludge[c]	75	2067

TABLE 3.7-1
Landfill Facility Summary for the ROI

Facility Name	Address	Estimated Annual Waste Received (Ton)	Estimated Remaining Capacity (Ton)	Wastes Accepted	Distance from GBO (Miles - One Direction)	Estimated Permit Closure Date

[a] Alderman, 2017

[b] Anderson, 2017

[c] Moore, 2017

[d] Bradley, 2017

[e] CH2M, 2017

3.8 Health and Safety

This Section discusses health and safety, which includes public safety, occupational health, and protection of children.

Public Safety

Public safety is defined as the welfare and protection of the general public and includes individuals both on and off the GBO property. The ROI for public safety includes the entire human environment, given GBO's role in planetary protection.

Occupational Health

Occupational health risks are defined as risks arising from physical, chemical, and other workplace hazards that interfere with establishing and maintaining a safe and healthy working environment. Hazards could include chemical agents; physical agents, such as loud noise or vibration; physical hazards, such as slip, trip, and fall hazards; electricity or dangerous machinery; and natural hazards, such as flooding, botanical hazards, or wildlife hazards. The ROI for occupational health is defined as GBO's boundary.

Protection of Children

An assessment of disproportionate risks to children was performed in compliance with Executive Order (E.O.) 13045, *Protection of Children from Environmental Health Risks and Safety Risks*. Child-centric resource locations, including schools, parks, churches, and daycare centers, were obtained by readily available online spatial data and government agency address lists (West Virginia Department of Health and Human Resources, 2017). Additional child-centric resources such as unlicensed daycare centers may not have been identified. The ROI for the protection of children includes 0.5-mile around the facility boundaries and, because traffic changes are a concern, 0.5-mile around the roadway network leading to the Observatory and along the potential demolition waste haul routes (Figures 3.8-1 and 3.8-2).

3.8.1 Proposed Action Area

Public Safety

GBO is a certified Red Cross Shelter and provides shelter with emergency power during and after severe storm events. The water tower on the Observatory site is also used by several fire departments to fill tanker trucks.

GBO is used to improve the characterization and tracking of asteroids or near-Earth objects (NEOs) once detected by optical/infrared survey telescopes. If the NEO's orbit will pass within 4,650,000 miles of Earth at any time, then the NEO is considered a potentially hazardous object (PHO). Because GBO does not have radar capabilities, it is used in concert with other radio telescopes that do. The probability of a sizeable PHO striking the Earth at any particular time is very low. According to a 2010 National Academies study, *Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies*

(NRC, 2010b), objects of sizes 25, 50, and 140 meters have approximate mean intervals between Earth impacts of 200, 2,000, and 30,000 years, respectively. Objects of 25 meters would likely result in airbursts, while objects of 50 or 140 meters would have local- or regional-scale impacts, respectively (National Aeronautics and Space Administration [NASA], 2017). The GBT makes contact with PHOs in concert with other telescopes at Arecibo Observatory in Puerto Rico or Goldstone Observatory in California, which are equipped with a radar transmitters. The GBT is one of several telescopes capable of making such observations. According to NASA, in a typical year there are three or less newly discovered PHOs that require radar data to conclusively rule out the threat of a future collision with the Earth (NASA, 2017).

If a PHO presents a near-term threat of striking the Earth, significant capability challenges exist to mitigate such a threat. There is no existing technology that has been tested on an actual asteroid that could prevent a PHO from striking the Earth. Even if there is no ability to mitigate such a threat, precision tracking may still be helpful to inform emergency preparedness if the location of the potential impact can be determined.

Occupational Health

Physical hazards at GBO include hazards associated with a typical office environment and large-scale structures requiring maintenance, including slip, trip, and fall hazards. Natural hazards in the undeveloped portions of the site include poisonous plants, stinging and biting insects, and potentially aggressive animals such as snakes. The site is not located within a floodplain and any flooding risk would be localized in nature.

Protection of Children

GBO is located in a rural area bordered by the communities of Green Bank and Arbovale. The Observatory is considered a valuable community resource that serves children, with on average 50,000 annual visitors, many of whom are children. Eight child-centric resources are located within 0.5-mile of the Observatory boundary, and at least 155 child-centric resources are within 0.5-mile of the roadway network along the potential demolition waste haul routes (Figures 3.8-1 and 3.8-2).

FIGURE 3.8-1
Child-Centric Resources (South)

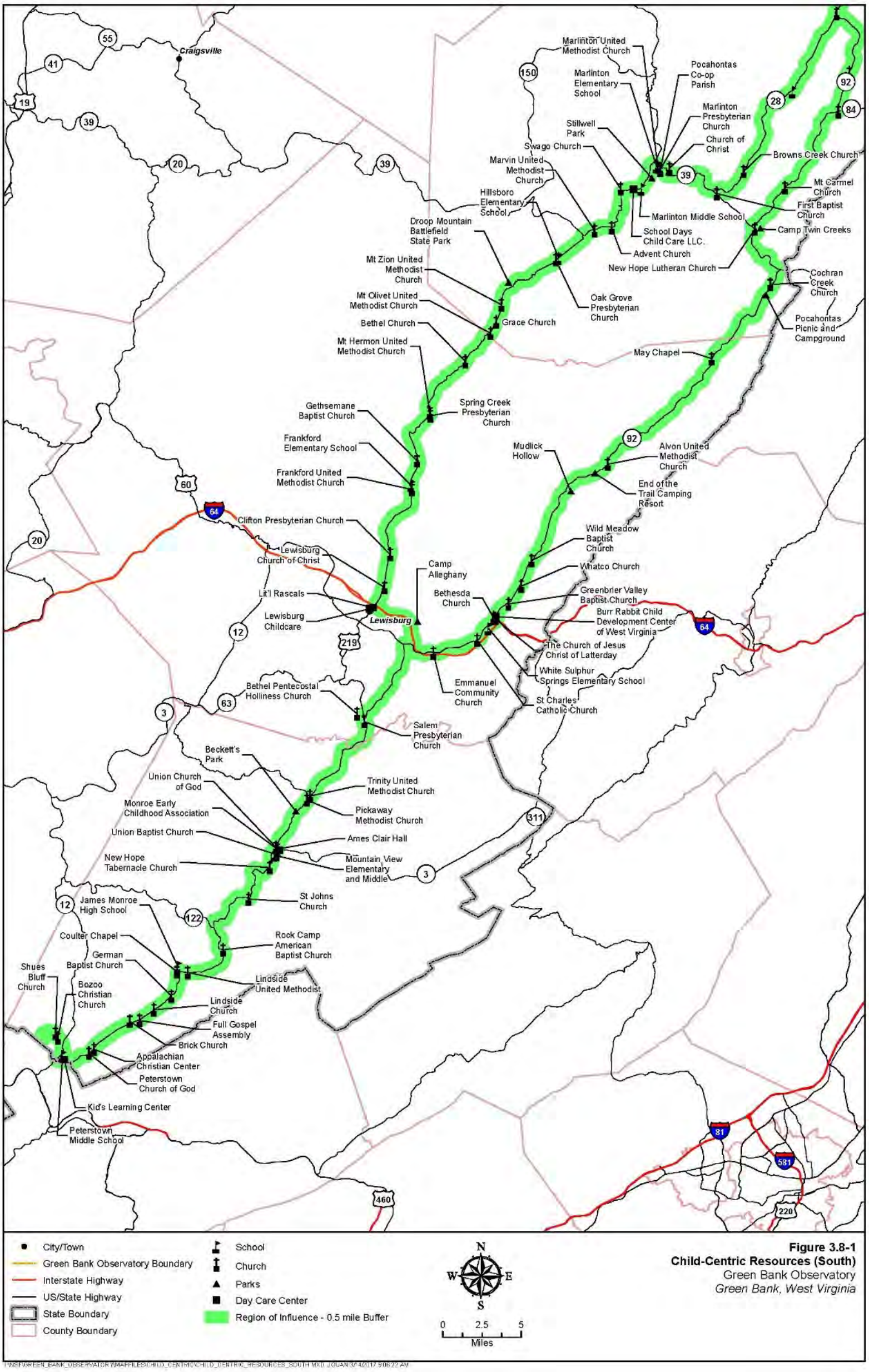

Figure 3.8-1
Child-Centric Resources (South)
Green Bank Observatory
Green Bank, West Virginia

FIGURE 3.8-2
Child-Centric Resources (North)

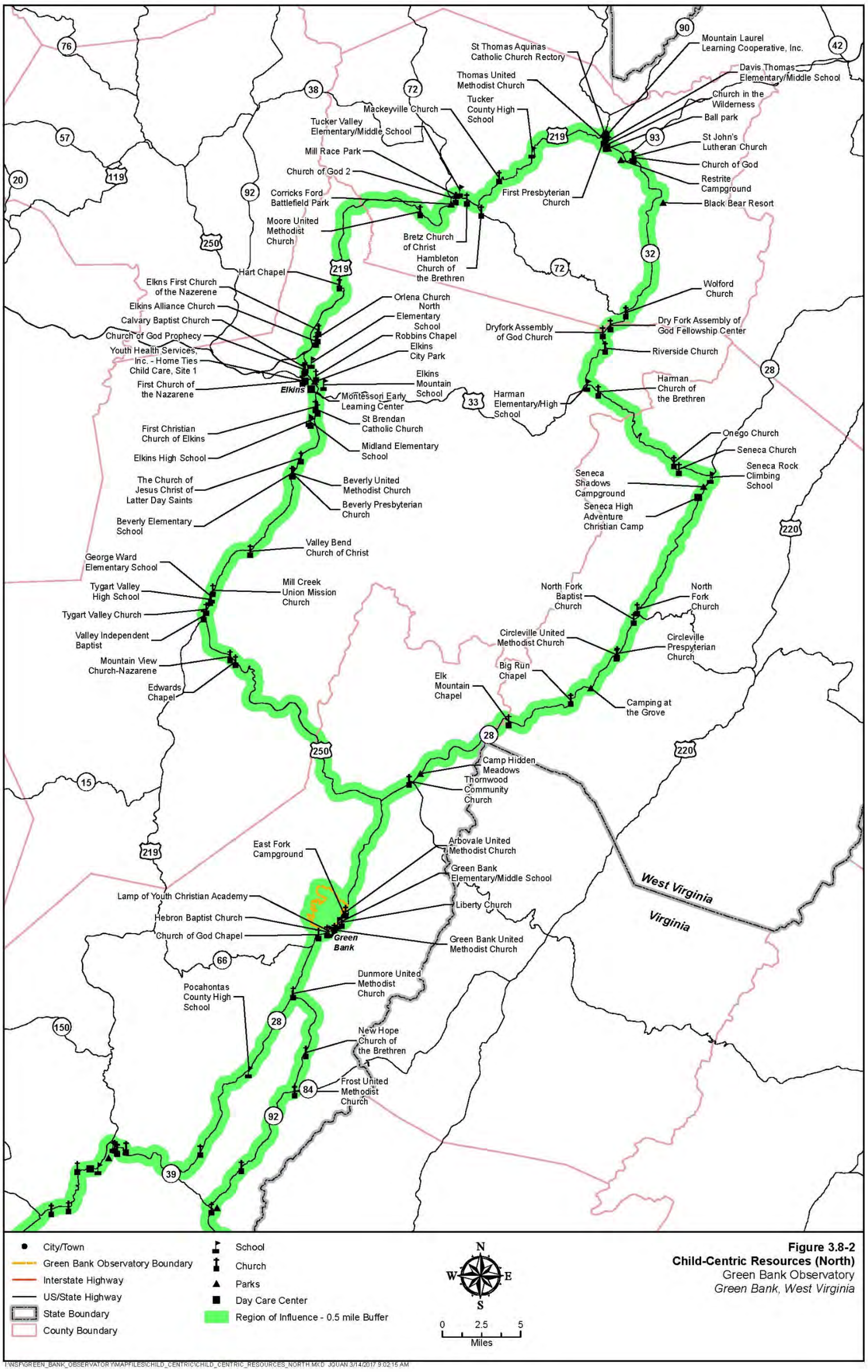

Figure 3.8-2
Child-Centric Resources (North)
Green Bank Observatory
Green Bank, West Virginia

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3.9 Noise

Noise is defined as unwanted or undesirable sound. This Section addresses the potential for noise to affect the human environment. Noise intensity, or loudness, is determined by how sound pressure fluctuates. Because the range of sound pressure ratios varies greatly over many orders of magnitude, a logarithmic scale is used to express sound levels in units of decibels (dB). Because sound travels in waves, there are also varying frequencies associated with each sound event. The human ear does not respond equally to all frequencies. To obtain accurate measurements and descriptions of noise which comprises many frequencies, the noise frequencies are filtered or weighted to most closely approximate the average frequency response of the human ear. This weighting is called the "A" scale on sound-level meters and is the scale that is used for traffic noise analyses. Decibel units described in this manner are referred to as A-weighted decibels, or dBA. Table 3.9-1 provides a general comparison of dBA levels by noise source.

TABLE 3.9-1
Comparison of dBA Levels by Noise Source

Noise Source at Give Distance	A-Weighted Sound Level in Decibels (dBA)	Subjective Impression
Loud Rock Music	110	Very loud
Jet Flyover at 1,000 feet	100	--
Gas lawnmower at 3 feet	90	--
Garbage disposal at 3 feet	80	--
Vacuum cleaner at 10 feet	70	Moderately loud
Heavy traffic at 300 feet	60	--
Quiet urban daytime	50	--
Quiet urban nighttime	40	Quiet
Library	30	--
Recording studio	10	Threshold of hearing

Source: Caltrans, 1998.

3.9.1 Proposed Action Area

GBO is located in a rural area adjacent to the Monongahela National Forest on the northwest and unincorporated Arbovale to the east. The ROI for noise includes the project boundary, local access routes from the construction landfills to the entrance of the Observatory, and adjacent properties. Pocahontas County does not currently have a noise ordinance.

Noise-sensitive locations in the ROI include the residential areas along the haul routes (Figures 3.10-1 and 3.10-2 in Section 3.10, *Traffic and Transportation*). The existing noise environment in the ROI consists primarily of traffic noise from automobiles and medium and heavy trucks on the surrounding rural roads. Given the rural environment, the daytime noise level is expected to be in the 40- to 50- dBA range.

3.10 Traffic and Transportation

This Section addresses the traffic and transportation network surrounding GBO and the potential haul routes to the construction materials landfill. The ROI for traffic and transportation includes the roadway network generally used to get to GBO from interstate highways and along the potential demolition waste haul routes. The ROI is shown on Figures 3.10-1 and 3.10-2.

3.10.1 Proposed Action Area

GBO is located on West Virginia Route 92/28 (WV 92/28) in rural Pocahontas County, West Virginia. The primary access routes to GBO are shown on Figure 3.10-1. Adjacent to GBO, WV 92/28 is a two-lane roadway with a functional classification of feeder roadway. A feeder roadway serves community-to-community travel and/or collects and feeds traffic to the higher roadway classification systems. Much of the roadway network in the vicinity of GBO consists of two-lane local and/or county roads, feeder roadways, and trunk line roadways that serve city-to-city travel (West Virginia Department of Highways [WVDOH], 2006). GBO is in a remote, mountainous area where many of the roadways have multiple sharp curves. Dense roadside vegetation is common throughout the area. Shoulders are narrow in most locations and non-existent in some locations. Posted speed limits in the rural areas are generally 55 miles per hour; slower posted speeds are common where roadways pass through small rural towns.

Few roads in the vicinity of GBO are classified as expressways (four-lane roadways that serve major intrastate and interstate travel). The nearest four-lane expressway routes are the following:

- Interstate (I) 64 (I-64), approximately 60 miles south-southwest of GBO
- I-79, approximately 92 miles northwest of GBO
- U.S. Highway (US) 19 (US 19), approximately 110 miles to the west of GBO
- I-81, located approximately 80 miles southeast of GBO
- US 33/US 219/US 48, approximately 50 miles north of GBO

Recent traffic volumes on the roadway network in the ROI are shown on Figures 3.10-1 and 3.10-2. Gross vehicle weight limits for the roads in the ROI are 80,000 pounds (WVDOH, 2005).

GBO is staffed by approximately 100 year-round employees, with up to 140 employees during the summer months. The number of annual visitors is approximately 50,000 (NSF, 2017).

FIGURE 3.10-1
Transportation Region of Influence (Local

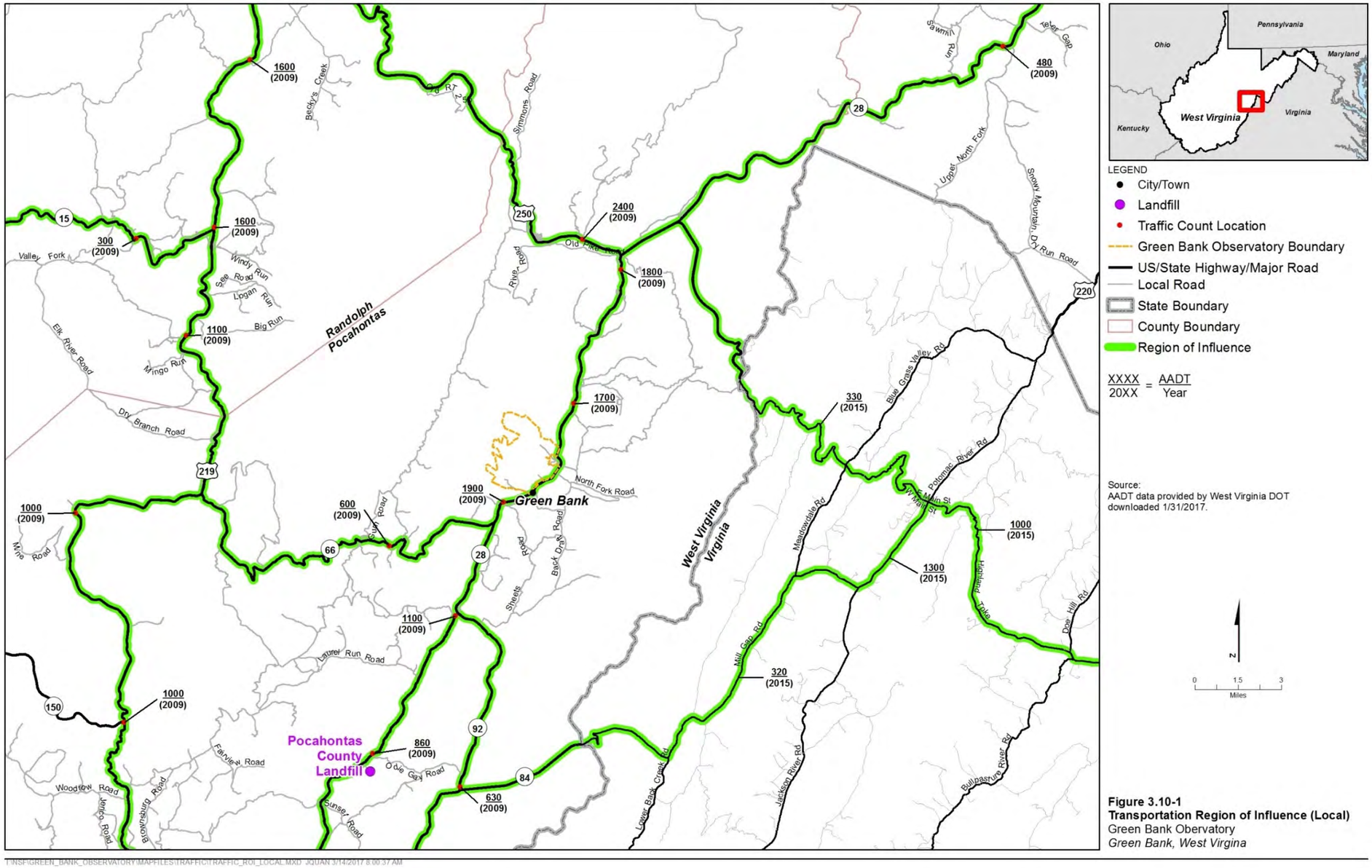

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Figure 3.10-1
Transportation Region of Influence (Local)
Green Bank Obervatory
Green Bank, West Virgina

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FIGURE 3.10-2
Transportation Region of Influence (Regional)

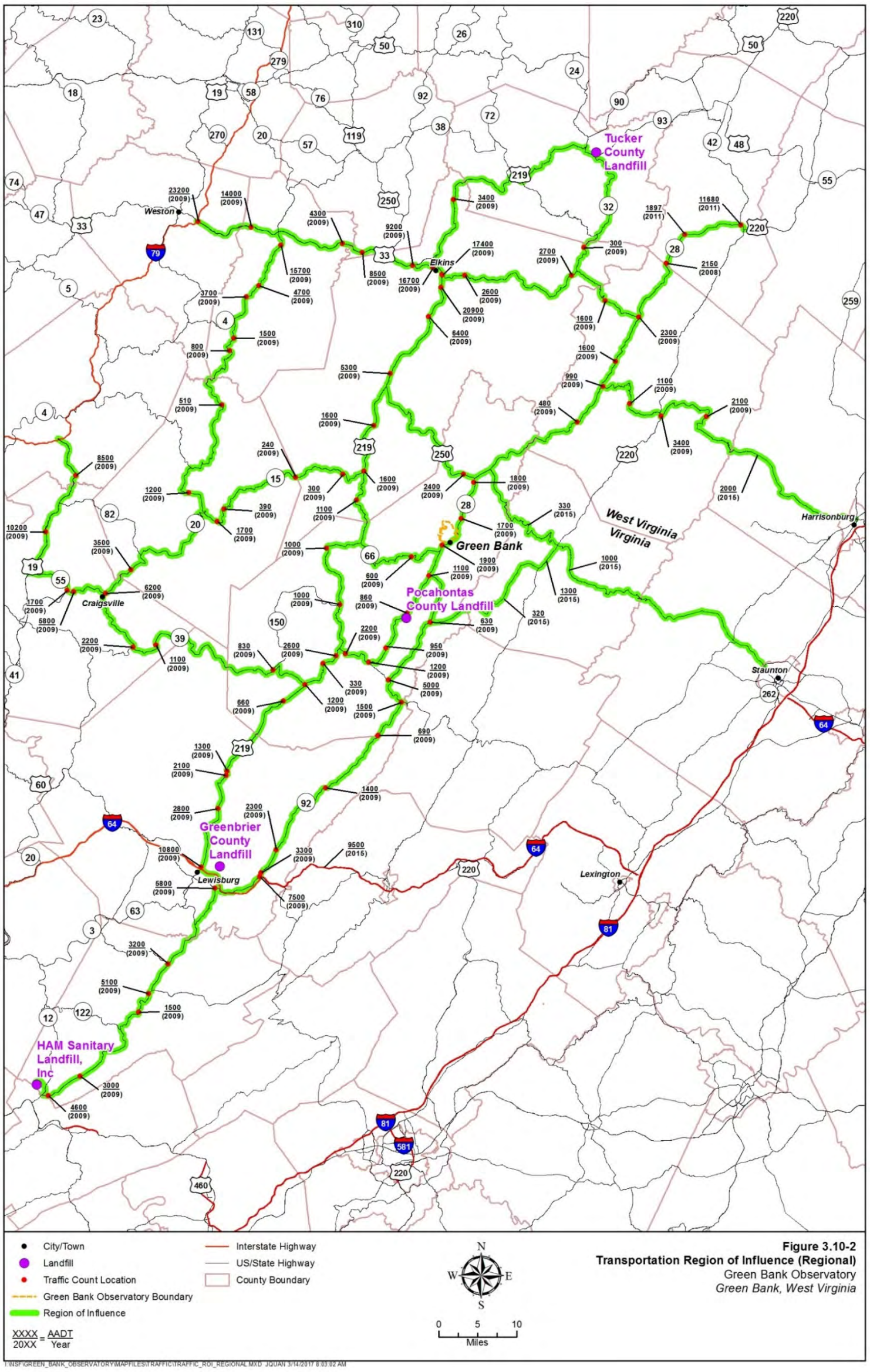


Figure 3.10-2
Transportation Region of Influence (Regional)
Green Bank Observatory
Green Bank, West Virginia

3.11 Socioeconomics

This Section provides a description of the existing socioeconomic conditions for West Virginia, Pocahontas County, and the nearby communities of Green Bank and Arbovale, where appropriate. Existing conditions provide a context for the evaluation of potential impacts associated with the Proposed Action on population and housing, employment, economy, income, education, tourism, and community cohesion as a result of changes in local employment, educational opportunities, and tourism.

GBO is located in Pocahontas County, West Virginia (Figure 3.11-1). The County has the largest concentration of public lands in West Virginia, with 62 percent of the County in federal or state ownership. Federal lands include the Monongahela National Forest and state lands include five parks and two forests (Pocahontas County Convention and Visitors Bureau [CVB], 2017a).

The northern half of GBO is in unincorporated Pocahontas County. The southern half of GBO consists of the unincorporated communities of Green Bank (population 223) and Arbovale (population 197), which are defined as census-designated places (CDPs) by the U.S. Census Bureau (USCB) (USCB, 2015a). The next closest community is Cass, which is approximately 8 miles to the southwest. The Town of Marlinton, which is the county seat, is approximately 28 miles away. The Town of Durbin and its adjacent communities of Frank and Bartow are 13 miles away and are the closest incorporated areas to GBO.

GBO is protected by two distinct radio quiet zones: (1) Radio Astronomy Zoning Act (West Virginia Code, Chapter 37A) which was enacted 1956, and (2) NRQZ, which was established in 1958 by the FCC. The NRQZ includes an area that extends out 100 square miles from a point centered between GBO and the former Sugar Grove facility to the northeast, now in private ownership. The NRQZ provides protection from permanent, fixed, licensed transmitter services. There is a community of individuals who choose to live within the NRQZ because they have sensitivity to radio transmissions. The Radio Astronomy Zoning Act allows the Observatory to prohibit the use of any electrical equipment that causes interference to Radio Astronomical Observations within a 10-mile radius of GBO (NRAO, 2017). NSF assumes no changes would occur to these two quiet zones as a result of the Proposed Action, as detailed in Section 1.3.4, *National Radio Quiet Zone*.

Regions of Influence

The primary ROI for socioeconomic resources is Pocahontas County, particularly the communities of Green Bank and Arbovale, where social and economic impacts will be felt most strongly. This ROI captures the majority of the concerns identified during the public scoping process and is supported by a zip code analysis of GBO staff members. A review of the residency zip codes of GBO staff found that 92 percent of the employees live in Pocahontas County, with 82 percent living in the four zip codes encompassing the southeastern portion of the County along WV-28 (NSF, 2017). Over half of GBO staff

(54 percent) live in the communities of Green Bank and Arbovale. Where available, data are presented for the USCB CDPs of Green Bank and Arbovale. These CDPs were selected to characterize the socioeconomic conditions within the smaller, unincorporated communities located within or adjacent to the GBO property (Figure 3.11-1).

There were numerous scoping comments related to economic impacts that might be felt at the state level. Therefore, state level data are also provided. However, a state level analysis does not represent the official ROI, because it dilutes the economic consequences of the Proposed Action by making the impacts appear small in relation to the overall size of West Virginia's economy.

The baseline year for socioeconomics is 2015, the most recent year for which data are available for the majority of the socioeconomic indicators. Unless otherwise noted, information is provided for the State of West Virginia, Pocahontas County, and the CDPs of Green Bank and Arbovale.

Socioeconomic Factors

For the purpose of this evaluation, socioeconomic factors are defined as follows:

Population is characterized by the magnitude and distribution of demographic change based on USCB data, population estimates, and population projections. The most recent U.S. Decennial Census was completed in 2010 and represents a single point in time. The 2011 – 2015 American Community Survey (ACS) population estimates represent survey data collected between January 1, 2011, and December 31, 2015, to help characterize population changes over time since the 2010 census (USCB, 2016).

Housing is described as the quantity, cost, and availability of accessible permanent and temporary housing. ACS housing data for 2015 (2011 – 2015) are provided for renter and owner occupancies, while vacant housing is characterized to capture the large number of seasonal units available at the Snowshoe Mountain Resort. Housing resources located onsite at GBO and nearby hotel/motel units also are described.

Economy includes the Gross Domestic Product (GDP) for the State and its change over time. GDP is the most meaningful measure of economic activity for a region because it measures value added or net production. This is to be distinguished from output or total sales, which involves double counting. Models of the existing economies for the State and Pocahontas County were constructed using the Impact Analysis for Planning (IMPLAN) model to establish the baseline conditions, including the size of each economy and the top industries in terms of employment.

Employment and Income are described by the size of the labor force (defined as the civilian non-institutionalized population, ages 18 to 64), the unemployment rate, and median earnings or labor income. Earnings or labor income describe the wages and salary from a job, whereas the term income can include

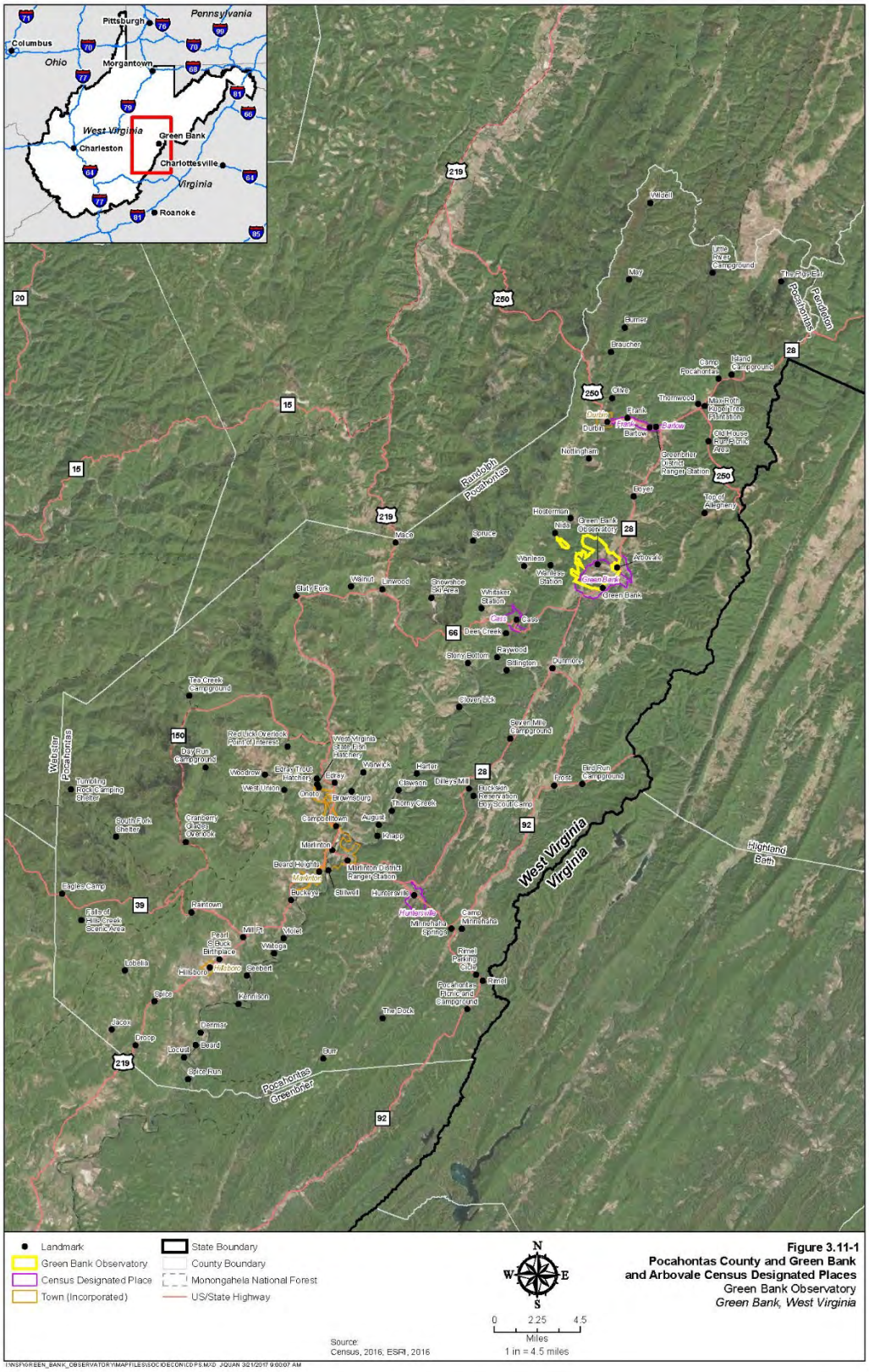
other sources of revenue such as annuities, stocks, pensions, Social Security benefits, and rent from a property.

Education is characterized by enrollment trends for the State, County, and Green Bank Elementary-Middle School and the educational opportunities offered at GBO for county residents.

Tourism is characterized by tourism trends and related employment and revenue for West Virginia and Pocahontas County. The importance of tourism to Pocahontas County is described, including major tourist attractions and tourist/visitor activities at GBO.

Community Cohesion is characterized by the features that contribute to the interconnectedness of the residents in the local community and County, including, but not limited to, attributes identified by surveying the nature and extent of comments received from representatives of community organizations during the public scoping process. Community cohesion is described for three areas: Pocahontas County, GBO, and the CDPs of Green Bank and Arbovale. Community features include gathering locations, such as religious institutions, arts/cultural centers, and parks; service providers, such as Post Office, health care, libraries, and schools; and areas where routine life activities occur, such as grocery stores and pharmacies. The information included in the Cultural Resources (Section 3.2), Visual Resources (Section 3.3), and Health and Safety (Section 3.8) sections also describe features that contribute to community cohesion.

FIGURE 3.11-1
Pocahontas County and Green Bank and Arbovale CDPs



3.11.1 Population and Housing

This Section describes the 2015 population estimates for the State of West Virginia, Pocahontas County, and the communities of Green Bank and Arbovale based on the USCB 2010 Census and 2015 ACS 5-year estimates. Housing characteristics of Pocahontas County, Green Bank CDP, Arbovale CDP, and GBO also are described. Overall, there is a notably lower population density in Pocahontas County than in West Virginia, and the County is projected to experience a modest population decline in population by 2021. This decline is consistent with projections for West Virginia to lose more than 20,000 residents over the next two decades (WVU, 2017a). In the County in 2015, 5,104 housing units were vacant, including 369 vacant units for rent and 4,232 vacant units for seasonal, recreational, or occasional use, such as those at Snowshoe Mountain Resort and the other tourist destinations in the County.

Population

Table 3.11-1 shows the population, median age, and age distribution of Green Bank CDP, Arbovale CDP, Pocahontas County, and the State of West Virginia. According to the 2015 ACS estimates, the Green Bank and Arbovale communities had approximately 223 residents in 3.3 square miles and 197 residents in 0.6 square miles, respectively, representing approximately 5 percent of the 8,697 residents of Pocahontas County (Table 3.11-1) (USCB, 2015b). This small population is indicative of the rural and sparsely developed nature of the area immediately outside these CDPs. The County had a low population density, 9 people per square mile, which partly results from the high percentage of public lands in the County compared to the average in West Virginia of 76 people per square mile. A greater percentage of the Green Bank and Arbovale communities are under the age of 5 (12 to 13 percent) compared to both the County and the State (5 to 6 percent). The median age in Green Bank is noticeably lower (38 years old) than in the County (48 years old), while the median age in Arbovale is noticeably higher (58 years old).

TABLE 3.11-1
Population, Median Age, Age Distribution and Minority Characteristics (estimated 2015)

	Green Bank CDP	Arbovale CDP	Pocahontas County	West Virginia
Total Estimated Population	**223**	**197**	**8,697**	**1,851,420**
Population Density (per square mile)	**68**	**340**	**9**	**76**
Distribution				
Under 5 years	12%	13%	5%	6%
5 to 64 years	75%	71%	73%	77%
65 and older	13%	16%	22%	17%
Median age (years)	**37.8**	**57.6**	**48.4**	**41.8**
Minority Characteristics				
White	100%	100%	97%	94%
Black or African American	-	-	2%	3%
American Indian and Alaska Native	-	-	< 1%	< 1%
Asian	-	-	-	< 1%

TABLE 3.11-1
Population, Median Age, Age Distribution and Minority Characteristics (estimated 2015)

	Green Bank CDP	Arbovale CDP	Pocahontas County	West Virginia
Native Hawaiian and Other Pacific Islander	-	-	-	-
Some other race	-	-	< 1%	< 1%
Hispanic or Latino (of any race)	-	-	< 1%	< 1%

Sources: USCB, 2015b; WV HomeTownLocator, 2017a.

Table 3.11-1 summarizes the minority characteristics of the population and demonstrates that, similar to the State of West Virginia, there are limited minority populations in Pocahontas County and in the Green Bank and Arbovale CDPs. Less than 4 percent of Pocahontas County residents and 6 percent of West Virginia residents are non-white, compared to zero percent of the residents in the Arbovale and Green Bank CDPs.

Population Trends and Projections

Table 3.11-2 shows recent population trends for Green Bank, Arbovale, Pocahontas County, and West Virginia from the USCB decennial census in 2000 and 2010, as well as ACS population estimates for 2015 (USCB, 2000, 2010a, 2015b). In the 2010 census, the population for Pocahontas County is reported as 8,719, which is a decline of 4.5 percent or 412 people from reported numbers in the 2000 census. Population loss in the State does not follow the same trend. The State's total population increased by 2.5 percent (44,650 people) between 2000 and 2010. As shown in Table 3.11-2, Green Bank's estimated 2015 population of 223 would appear to be a 56 percent increase from the 2010 population; however, the 2010 decennial census and 2015 ACS population estimate are not directly comparable because the 2010 decennial census reflects a single point in time and the 2015 ACS population estimate is an averaged value. Over the same period, the population of Pocahontas County declined by less than a 0.5 percent, similar to the State of West Virginia overall. In addition, population changes may be magnified when a portion of the population is transient and variable from year-to-year.

TABLE 3.11-2
Population Change from 2000, 2010 and Estimated 2015[a]

	2000 Census	2010 Census	2000 to 2015 % Change	ACS Estimated 2015	2010 to 2015 % Change [a]
Green Bank CDP	--	143	--	223	56%
Arbovale CDP	--	--	--	197	--
Pocahontas County	9,131	8,719	-4.5%	8,697	-0.3%
West Virginia	1,808,344	1,852,994	2.5%	1,851,420	-0.1%

Sources: USCB, 2000, 2010a, 2015b.

[a] The 2010 Decennial Census and 2015 ACS 5-year population estimates are not directly comparable since 2010 reflects a single point in time count while the 2015 estimate is an average value over a survey period of January 1, 2011, and December 31, 2015.

According to WVU Bureau of Business & Economic Research's (BBER's) projections, 19 of West Virginia's 55 counties are expected to remain stable or experience minor population growth from 2016 to

2021. The majority of these counties are in the north to northeastern portion of the state, along state borders with Maryland, Pennsylvania, and Virginia. Pocahontas County is expected to experience a moderate decline (0.5 percent to 0 percent) in population by 2021. This decline in population can be attributed to the migration of jobs to neighboring counties and/or states and a disproportionately lower birth-to-death ratio (BBER, 2017). Population projections for the communities of Green Bank and Arbovale are not readily available.

Housing

Table 3.11-3 shows 2015 housing information for Green Bank and Arbovale CDPs, Pocahontas County, and West Virginia, including the estimated number of housing units by occupancy type (owner or renter) and vacancy status (USCB, 2015c). Of the 64 occupied units in the community of Green Bank, 88 percent are owner-occupied and 12 percent are renter-occupied. This ratio of housing type (owner versus renter) is comparable to Pocahontas County, where 81 percent of housing is owner-occupied and 19 percent is renter-occupied. Overall, of the existing housing units, 26 percent are vacant in Green Bank compared to 58 percent in Pocahontas County. Two households were identified as homeless in Pocahontas County in 2015 (Region 4 Planning and Development Council, 2016a).

TABLE 3.11-3
Estimated Number of 2015 Housing Units Ownership and Occupancy

	Green Bank CDP	Arbovale CDP	Pocahontas County	West Virginia
Housing Occupancy				
Total housing units	87	119	8,841	883,984
Occupied housing units	64	101	3,737	740,890
Owner-occupied	56	83	3,013	537,266
Renter-occupied	8	18	724	203,624
Vacant housing units	23	18 [b]	5,104	143,094
Vacancy rate for all housing types	26.4%	0%	57.7%	16.2%
Owner-occupied vacancy rate	0%	0%	1.7%	1.9%
Renter-occupied vacancy rate	46.7%	0%[b]	33.8%	7.6%
GBO Housing Units [a]	7	10	10	
Housing Costs				
Median Value of Owner-occupied Units (dollars)	$254,500	--	$115,500	$103,800
Median Gross Monthly Rent of Occupied Units (dollars/month)	--	--	$550	$643

Source: USCB, 2015c.

[a] Includes bunkhouse and residence hall which have multiple rooms, however are not available to the public. The 10 GBO units listed for Pocahontas County are in addition to the 7 units within Green Bank and 10 units within Arbovale.

[b] The 18 renter-occupied units are classified as "for seasonal, recreational, or occasional use" and are not available to the general public on a year-round basis.

Table 3.11-4 further characterizes the 5,104 vacant housing units by type and location. In 2015, there were an estimated 41 vacant units in the communities of Green Bank and Arbovale, which represents

1 percent of the total vacant units in Pocahontas County (USCB, 2015d). Of these 41 vacant units, 26 of them are designated "for seasonal, recreational, or occasional use" and are assumed to include the onsite housing described below. Overall, 369 vacant units were for rent in the County in 2015, with an additional 4,232 vacant units for seasonal, recreational, or occasional use, such as those at Snowshoe Mountain Resort and other tourist destinations in the County.

TABLE 3.11-4
2015 Vacancy Status by Type for Green Bank, Arbovale and Pocahontas County

	Green Bank CDP	Arbovale CDP	Pocahontas County	Percent of County Total
Total:	**23**	**18**	**5,104**	
For rent	7	0	369	7%
For sale only	0	0	52	1%
For seasonal, recreational, or occasional use [a]	8	18	4,232	83%
Other vacant	8	0	451	9%

Source: USCB, 2015d.

[a] Includes GBO Housing Units that are not available to the public.

In addition to the vacant housing opportunities (rentals and seasonal, recreational, or occasional use), there are a limited number of temporary housing units such as hotels, motels, and bed and breakfast facilities in or adjacent to the communities of Green Bank and Arbovale (Appendix 3.11A). These units include three cabins at the Green Bank Cabins & Country Store, approximately 1 mile from the Observatory, and the Boyer Station Motel (20 rooms, 50 electric hookups), located 6 miles to the north of the Observatory (Green Bank Cabins & Country Store, 2017; Boyer Station, 2017).

Housing costs (median rent) in Pocahontas County ($550 per month) are lower than the state-wide average ($643 per month). Median rent in Green Bank was not available from the 2014 ACS data set but appears to be less than $500 per month according to ACS distributions. Housing values for owner-occupied homes have decreased in Green Bank since 2010. The median value of owner-occupied units in Green Bank has decreased 5 percent from $266,700 in 2010 to $254,500 in 2015 (USCB, 2010b, 2015c). Even so, the median value of owner-occupied housing units in Green Bank is more than twice the median value for the State.

GBO offers a variety of short-term onsite housing for use by visiting groups and scientists; the housing includes campgrounds, a residence hall, and a bunk house (Table 3.11-5). Long-term onsite housing includes over 30 individual houses or townhouses with 2 to 3 bedrooms each. The condition of each housing unit varies depending on the age, maintenance, and updates that have been completed over the years. While not available to the public, the Observatory can house large groups of visitors at the facilities, as outlined in Table 3.11-5.

TABLE 3.11-5
Green Bank Observatory Lodging Units

Name	Lodging Type	Typical Lodger	Units/Capacity [a]	Description
Residence Hall				Includes a generator for emergency needs, cafeteria, lounge and laundry.
	Hotel Rooms	Short-term visitors/ researchers	16 (27 persons)	On the second floor of Residence Hall with workspace desk, flatscreen TV, mini-fridge and high-speed internet connection; 11 rooms are outfitted with two twin beds; 5 rooms have one Queen bed.
	Apartments	Short-term visitors/ researchers	4 (11 persons)	On the ground floor of the Residence Hall, four one-bedroom apartments are available with a separate living room with a couch, chairs, television, and a fully-furnished kitchen. Three units have two double beds and one unit has one King bed.
Bunkhouse	Group	Short-term student visitors	4 (60 persons)	Single story, 7-room structure accessed by visiting groups. Sleeps up to 60 people, split into two dormitory-style rooms with bunkbeds, with a chaperone room attached to each. The bunkhouse has shower and bath facilities attached, a laundry room, and sitting room.
Redwood House	Multi-family	Long-term staff/ researchers	5 (10 persons)	Five bedrooms each equipped with twin beds, a full-sized kitchen, a sitting room, back deck, semi-private yard and central HVAC.
Townhouses	Multi-family	Long-term staff / researchers	5 (10 persons)	Five two-bedroom townhouses are located approximately 0.5 mile from the main site. Each townhouse has two bedrooms upstairs, 1.5 baths, a fully-furnished kitchen, and living room.
Houses	Single Family Homes	Long-term staff/ researchers	22 (66 persons)	22 site houses at three locations around the facility. The houses range in size from 2 bedroom/1 bath to 4 bedroom/2.5 bath. The houses are fully-furnished as needed.
Campgrounds				
Tent	Temporary	Short-term student visitors	40-50	Accessed by road and foot and has sufficient space for 40-50 campsites. Fire rings available on a reservation-only basis.
RV	Temporary	Short-term visitors	Limited	Limited number of RV spaces with 120-volt electrical hook-ups but no water or septic hook-ups.

Source: GBO, 2017a.

[a] Capacity assumes one person per bed.

3.11.2 Economy, Employment, and Income

This Section provides information on the local economies of West Virginia, Pocahontas County, and the Green Bank and Arbovale CDPs. Data on employment and income for these regions are included, as well as a description of the Economic Development Strategy for the Region 4 Planning and Development Council. Region 4 includes Pocahontas, Fayette, Greenbrier, Nicholas, and Webster counties (Region 4 Planning and Development Council, 2016b).

3.11.2.1 State and County Economic Trends

West Virginia

West Virginia fell into a recession in 2012, which continued through 2015, experiencing a high level of employment losses as a result of changes in the energy sector, including continued losses in coal jobs and a longer-than-expected slowdown in natural gas employment (WVU, 2017a). The recession has resulted in a cumulative loss of around 17,000 jobs in West Virginia since 2013. After adjusting for inflation the value of economic output in West Virginia in 2015 was roughly equal to its 2011 level.

West Virginia also has the lowest rate of workforce participation in the United States, with approximately 53 percent of the State's adult population either working or looking for work (WVU, 2017a). The remaining 47 percent of the population does not want, or is unable, to participate in the workforce. However, over the 2016–2021 forecast period, West Virginia is expected to experience an average annual growth in employment of 0.6 percent, with corresponding annual growths in real GDP of 1.5 percent and per capita personal income of 1.8 percent. Although this expectation is positive, these rates lag behind the corresponding national projections of 1.2, 2.7, and 2.3 percent for average annual employment, real GDP, and real per capita personal income, respectively (BBER, 2017).

The IMPLAN model was used to establish the baseline economies for West Virginia and Pocahontas County. It is an input-output model that traces spending and consumption among various economic sectors, including businesses, households, government, and "foreign" economies in the form of exports and imports. The IMPLAN model is one of the most widely used economic impact models.

In 2015, IMPLAN estimated the GDP for West Virginia at $73,850,580,942. Hospitals led the top 10 employment industry sectors, with over 40,000 workers and output (total sales) of approximately $5.5 million (Table 3.11-6). Local and state governments, along with restaurants, wholesale trade, real estate and retail trade, are among the top 10 employers.

TABLE 3.11-6
West Virginia Top Ten Industries

Sector	Description	Employment	Labor Income ($M)	Output ($M)
482	Hospitals	40,000	$2,750.9	$5,493.8
534	* Employment and payroll of local govt, education	39,000	$2,276.4	$2,852.3
502	Limited-service restaurants	29,000	$508.1	$2,049.6
531	* Employment and payroll of state govt, non-education	28,000	$1,575.3	$1,975.3
501	Full-service restaurants	24,000	$469.6	$1,046.8
395	Wholesale trade	24,000	$1,568.5	$5,391.3
533	* Employment and payroll of local govt, non-education	24,000	$950.7	$1,193.6
440	Real estate	22,000	$492.8	$4,366.8

TABLE 3.11-6
West Virginia Top Ten Industries

Sector	Description	Employment	Labor Income ($M)	Output ($M)
405	Retail - General merchandise stores	20,000	$542.9	$1,433.7
532	* Employment and payroll of state govt, education	19,000	$813.3	$1,017.0

Source: Copyright 2017 Minnesota IMPLAN Group, Inc.

Pocahontas County

The economy of Pocahontas County was also modeled using IMPLAN. In 2015, IMPLAN estimated the GDP for Pocahontas County at $242,844,452, which represents about 0.3 percent of the total economy of the State. Whereas 380 industries contribute to the State's economy, only 125 industries are present in Pocahontas County. As shown in Table 3.11-7, the top industry in terms of employment is hotels, motels, and casino hotels, reflecting the importance of tourism to the County's economy. As with the State's economy, the state and local governments are top employers at the county level. Crop farming, cattle ranching, real estate, sawmills, food and drink establishments, and truck transportation industries are important sources of employment in the County.

TABLE 3.11-7
Pocahontas County Top Ten Industries for Employment (2015)

Sector	Description	Employment	Labor Income ($M)	Output ($M)
499	Hotels and motels, including casino hotels	392	$14.4	$43.1
531	* Employment and payroll of state govt, non-education	277	$11.5	$14.5
533	* Employment and payroll of local govt, non-education	206	$8.8	$11.0
10	All other crop farming	196	$0.7	$4.8
440	Real estate	180	$2.3	$25.7
134	Sawmills	178	$7.7	$48.2
534	* Employment and payroll of local govt, education	174	$9.5	$11.9
503	All other food and drinking places	145	$4.5	$6.4
11	Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming	130	$0.5	$7.3
411	Truck transportation	120	$6.4	$18.9

Source: IMPLAN Model Pocahontas County
Copyright 2017 Minnesota IMPLAN Group, Inc.

Economic development activities in Pocahontas County are generally led by the County Chamber of Commerce, the Greenbrier Valley Economic Development Corporation (which represents Greenbrier,

Monroe and Pocahontas counties), and the Region 4 Planning and Development Council (which includes Fayette, Greenbrier, Nicholas, Pocahontas, and Webster counties). The Region 4 Comprehensive Economic Development Strategy includes a number of projects to promote economic growth in the region. The projects are focused on infrastructure, agriculture, and education (Region 4 Planning and Development Council, 2016b).

3.11.2.2 Tax Revenue

West Virginia residents pay state income tax at rates ranging from 3 percent on the first $10,000 of taxable income up to 6.5 percent on income of $60,001 and above (West Virginia Tax Department, 2016a; Bell, 2016). Sales and use taxes also are collected at the state level. The statewide rate is 6 percent. In addition, the State administers a sales and use tax for several municipalities that collects from 0.5 to 1 percent at the local level on the same items subject to these taxes at the state level (West Virginia State Tax Department, 2016b). Neither Green Bank nor Arbovale collect local sales or use taxes. Generally, federal government agencies are exempt from state and local sales and use taxes.

Property taxes are collected at the county level. However, as a federal government facility, operated by tax-exempt AUI, GBO is exempt from property taxes and does not make a payment in lieu of property taxes. The County's budget for Fiscal Year 2016–2017 was estimated at $6,026,210. In this budget, tax revenue primarily comes from four sources: property taxes (48 percent), hotel occupancy taxes (15 percent), federal payments in lieu of taxes (10 percent) and transfers (8 percent). Examples of other smaller revenue sources include Coal Severance taxes and reimbursements from other funds. Tax revenue in Pocahontas County has been in decline since 2009, falling $677,695 over the last 6 years, which is a 9.3 percent loss (Pocahontas County Tax Assessor, 2015).

The County spends the largest share of the budget on general government expenditures (49 percent), followed by public safety (33 percent) and culture and recreation (12 percent). The balance is expended on health and sanitation (2 percent), capital projects (2 percent), and social services (1 percent).

In conclusion, given this tax structure for the State and the County, GBO is a current source of tax revenue for the Pocahontas County ROI through the hotel and motel occupancy taxes paid by visitors to GBO who stay overnight in accommodations subject to the tax. At the state level, GBO contributes toward sales and use taxes indirectly through the purchases made by visitors to GBO and by households of workers employed by GBO. Finally, state residents employed by GBO contribute to the state's coffers through personal income tax payments.

3.11.2.3 Employment

Employment in West Virginia has varied greatly by month and region since 2015, and it has not closely tracked national averages. After peaking at 8.7 percent in 2010, the state unemployment rate has stayed between 6 and 7 percent since 2013 (WVU, 2017a). In Table 3.11-8, employment in 2010 and 2015 is compared by occupational sector for the Green Bank CDP, Arbovale CDP, Pocahontas County, and West

Virginia based on ACS data (USCB, 2010c, 2015e, 2015f). To complete the characterization of the composition of the current workforce, Table 3.11-9 describes the unemployment rate, size of the total labor force, per capita income, and the highest paying occupations (2015 estimated) for Pocahontas County and West Virginia (USCB, 2015g).

Overall, the total civilian employment, age 16 and older, declined in West Virginia by approximately 1 percent between 2010 and 2015; however, the total civilian labor force increased by 3 percent and 46 percent in Pocahontas County and Green Bank, respectively. As noted in Table 3.11-8, the large variation in the Green Bank labor force between 2010 and 2015 may be attributed to differences in how the data are collected, since 2010 reflects a single point in time count while the 2015 estimate is an average value over a survey period of January 1, 2011, and December 31, 2015. These differences may be magnified where a component of the labor force is transient. According to 2015 estimates, the labor force for Pocahontas County was employed in the following occupations: management, business, science, and the arts (30 percent), services (23 percent), sales and office professions (18 percent), natural resources, construction and maintenance (16 percent), and production, transportation, and material moving businesses (13 percent). The following are the 10 largest employers as of March 2016 (WorkForce, 2017):

1. Snowshoe Mountain, Inc.
2. Pocahontas County Board of Education
3. Pocahontas Memorial Hospital
4. Inter-State Hardwoods Company, Inc.
5. AUI (GBO)
6. West Virginia Division of Natural Resources
7. Denmar Correctional Center (West Virginia Department of Corrections)
8. Stillwell Road Operation, LLC
9. Beckwith Lumber Company, Inc.
10. Seneca Health Services, Inc.

Employment by occupation is generally similar for Pocahontas County and West Virginia, but Pocahontas County had a greater proportion of service and natural resources, construction, and maintenance professions in 2015. Green Bank and Arbovale have the greatest preponderance of jobs in the management, business, science, and arts fields. Service occupations also are well represented in both Green Bank and Arbovale. Finally, the production, transportation, and material moving occupations are present in Green Bank but not in Arbovale. Appendix 3.11B, Employment and Median Earnings for 2010 and 2015 by Occupation for Green Bank, Arbovale, Pocahontas County and West Virginia, reports these data in finer detail by job category (USCB, 2015e, 2015f).

Pocahontas County is a member of the Region 1 Workforce Development Board/WORK4WV-Region 1, Inc., which was established as a requirement of the Workforce Innovation and Opportunity Act of 2014 to

design and implement a system to match up the abilities of local job seekers with the skills sought by local employers, improve workforce development programs, and support economic growth in the state. The Region 1 Workforce Development Board represents the following counties: Fayette, Greenbrier, McDowell, Mercer, Monroe, Nicholas, Pocahontas, Raleigh, Summers, Webster, and Wyoming. The current Local Strategic Plan for the region (July 1, 2016 – June 30, 2020) (WORK4WV-Region 1, Inc., 2017) is focused on the following industry sectors:

1. Healthcare
2. Information Technology
3. Advanced Manufacturing (including Wood Products)
4. Energy
5. Construction/Heavy Equipment
6. Administrative/Support Services
7. Entrepreneurship

Jobs in health services and professional services occupations are targeted for growth. This includes Ambulatory Health Care Services; Administrative and Support Services; Professional, Scientific, and Technical Services; Nursing and Residential Care Facilities; and Hospitals. Job growth is also expected in those occupations that support Wood Product Manufacturing; Construction of Buildings; and Oil and Gas Extraction. The greatest declines in Region 1 employment are found in the manufacturing sector and in Mining (except oil and gas) (WORK4WV-Region 1, Inc., 2017).

TABLE 3.11-8
Selected Employment and Median Earnings for 2010 and 2015 by Occupation for Green Bank CDP, Arbovale CDP, Pocahontas County, and West Virginia[a]

		Employed Population 16 Years and Older	Management, Business, Science, and Arts Occupations	Service Occupations	Sales and Office Occupations	Natural Resources, Construction, and Maintenance Occupations	Production, Transportation, and Material Moving Occupations
Green Bank CDP	2010 Estimated Employment	38	24	0	14	0	0
	2015 Estimated Employment	71	44	11	0	0	16
	2015 Median Earnings (dollars)	$32,708.00	$26,944.00	--	--	--	--
Arbovale CDP	2010 Estimated Employment	--	--	--	--	--	--
	2015 Estimated Employment	60	39	21	0	0	0
	2015 Median Earnings (dollars)	$52,692	$54,712	--	--	--	--
Pocahontas County	2010 Estimated Employment	3584	893	693	711	751	536
	2015 Estimated Employment	3723	1119	844	688	599	473
	2015 Median Earnings (dollars)	$22,454.00	$35,080.00	$15,393.00	$19,899.00	$25,434.00	$31,012.00
West Virginia	2010 Estimated Employment	763,691	229,188	139,861	188,558	99,923	106,161
	2015 Estimated Employment	751,252	241,587	141,436	181,570	89,595	97,064
	2015 Median Earnings (dollars)	$30,618.00	$44,320.00	$16,089.00	$23,692.00	$41,684.00	$32,527.00

Sources: USCB, 2010c, 2015e, 2015f.

Notes:

[a] The 2010 Decennial Census and 2015 ACS 5 year estimates are not directly comparable since 2010 reflects a single point in time while the 2015 estimate is an average value determined by ACS over a survey period of January 1, 2011, and December 31, 2015.

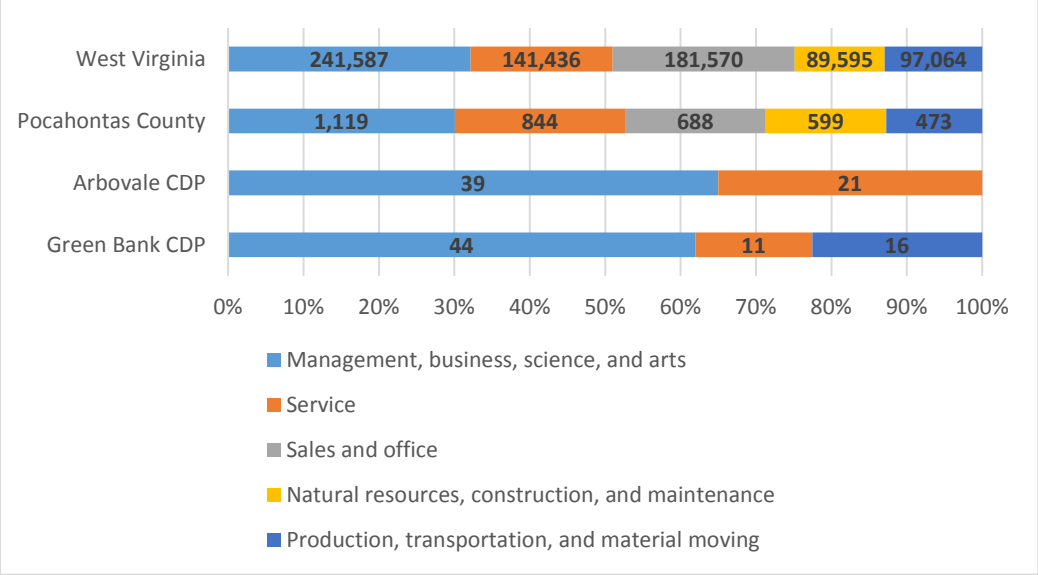
See Appendix 3.11B, Employment and Median Earnings for 2010 and 2015 by Occupation for Green Bank, Arbovale, Pocahontas County and West Virginia, for full detail of this table.

In 2015 inflation-adjusted dollars, which are calculated using the average Consumer Price Index for a given calendar year and represent the change in "buying power" because of the increases in the prices of all goods and services purchased by consumers.

Median Earnings are defined as the amount that divides the earnings distribution into two equal groups, half having earnings above that amount, and half having earnings below that amount.

1

FIGURE 3.11-2
Estimated 2015 Employment and Distribution by Major Sector



Sources: USCB, 2015e, 2015f.

The existing labor, employment, and income information for Green Bank, Arbovale, Pocahontas County, and West Virginia is summarized in Table 3.11-9. For consistency, the 2015 5-year average data are reported as the most current year for which all the metrics are available. Pocahontas County's most recent unemployment rate was 5.2 percent in December 2016, with a 3.1 percent 5-year average in 2015. Approximately 3,949 persons aged 16 years and older were in the Pocahontas County labor force and 5.7 percent were unemployed in 2015 based on a 5-year average (USCB, 2015g). The Green Bank CDP unemployment rate was zero percent because the entire workforce of 71 persons had jobs. However, the latest unemployment rate (not seasonally adjusted or averaged over time) for West Virginia was 5.9 percent in December 2016, while the national unemployment rate was 4.7 percent (BLS, 2016a, 2016b).

TABLE 3.11-9
Total Labor Force, Employment and Income Data (2015 Estimated)

	Green Bank CDP	Arbovale CDP	Pocahontas County	West Virginia
Total labor force, not seasonally adjusted	71	63	3,949	815,405
Unemployment Rate, not seasonally adjusted (2015 5-year Average)	0.0%	4.8%	5.7%	7.8%
Per Capita Income	$18,560	$31,465	$21,847	$23,450

TABLE 3.11-9
Total Labor Force, Employment and Income Data (2015 Estimated)

	Green Bank CDP	Arbovale CDP	Pocahontas County	West Virginia
Highest Paying Occupations [d]				
			Computer, engineering, and science occupations ($50,833)	Computer, engineering, and science occupations ($60,171)
			Production occupations ($36,480)	Management, business, and financial occupations ($50,613)
			Management, business, and financial occupations ($32,315)	Healthcare practitioner and technical occupations ($45,320)
			Healthcare practitioner and technical occupations ($31,250)	Construction and extraction occupations ($44,754)
			Protective Service Occupations ($30,938)	Installation, maintenance, and repair occupations ($39,767)

[a] Household income refers to the income of the householder and all other individuals 15 years old and older in the household, whether they are related to the householder or not.

Sources: USCB, 2015e, 2015f, 2015g.

3.11.2.4 Income

As shown in Table 3.11-9, the per capita income for West Virginia was $23,450, for Green Bank was $18,560 (for the previous 12 months in 2015 dollars), and for Pocahontas County was $21,847 (USCB, 2015g). In 2015 dollars, West Virginia's median household income was $30,618, which was less than Arbovale's median income of $52,596, comparable to Green Bank's median income of $32,708, and higher than Pocahontas County's median income of $22,454 (USCB, 2015g). The sectors with the highest paying jobs in Pocahontas County and West Virginia include computer, engineering, and science occupations. However, the salaries at the state level were almost $10,000 higher than the average of $50,833 for these occupations in Pocahontas County. On the whole, income for these top paying jobs is generally lower in Pocahontas County than in West Virginia.

The estimated poverty status and age distribution of those below the poverty level in Green Bank, Arbovale, Pocahontas County, and West Virginia are summarized in Table 3.11-10. The total population numbers will not exactly match those in Section 3.10.1, *Proposed Action Area*, because the USCB typically asks income questions only to persons 15 years old or older; unrelated children and persons living in group quarters are not included.

In Green Bank, approximately 49 percent of the population falls within the poverty threshold compared to 2.5 percent in Arbovale, 17 percent in Pocahontas County, and 18 percent in West Virginia. The higher percentage of the population that falls within the poverty threshold in Green Bank may be skewed by the

small population size and the low median age in Green Bank. Approximately 71 percent of the children (population under age 18 years) falls within the poverty rate in Green Bank, whereas the poverty rate in Pocahontas County and West Virginia were significantly less, at 34 percent and 25 percent, respectively. No children in Arbovale were classified as living in poverty. In Green Bank, 44 percent of the working age population (ages 18 to 64 years) is at or below the poverty status compared to 4 percent in Arbovale, 15 percent in Pocahontas County, and 18 percent in West Virginia. Additionally, 5 percent of the elderly population (age 65 years and older) in Pocahontas County lives at or below the poverty level compared to 9 percent in West Virginia (USCB, 2015h). No one in the 65 years or older age group in Green Bank or Arbovale held poverty status. The high percentage of poverty in the Green Bank CDP does represent a potential environmental justice concern; an environmental justice analysis is provided in Section 4.12, *Environmental Justice*.

TABLE 3.11-10
Five-year Average of the Past 12 Months (2015 ACS Survey)

			AGE		
		Population for Whom Poverty Status is Determined a	**Under 18 Years**	**18 to 64 Years**	**65 Years and Older**
Green Bank CDP	Total	223	87	106	30
	Below Poverty Level	109	62	47	0
	Percent Below Poverty Level	49%	71%	44%	0%
Arbovale CDP	Total	197	41	125	31
	Below Poverty Level	5	--	5	--
	Percent Below Poverty Level	2.5%	0	4%	0
Pocahontas County	Total	8,382	1,536	5,040	1,806
	Below Poverty Level	1,382	520	772	90
	Percent Below Poverty Level	17%	34%	15%	5%
West Virginia	Total	1,797,793	372,473	1,114,777	310,543
	Below Poverty Level	323,384	93,437	201,590	28,357
	Percent Below Poverty Level	18%	25%	18%	9%

Source: USCB, 2015h.

[a] Population totals do not include unrelated children and persons living in group quarters.

3.11.3 Education

This Section briefly characterizes the current educational resources of West Virginia and Pocahontas County, as well as those STEM-related programs specific to GBO. Overall, public school enrollment in

Pocahontas County has declined at a higher rate than in the State of West Virginia; Green Bank Elementary-Middle School enrollment has declined 12 percent since the 2009–2010 school year.

3.11.3.1 State and County Enrollment Trends

Table 3.11-11 summarizes public school enrollment trends for the State and County between the 2012 and 2017 school years. Although the annual enrollment decline is modest, the result was a 3.3 percent decline in the State and an 8 percent decline in the County over this 5-year period. It also demonstrates that the grade level distribution for the 2016–2017 school year is almost identical for West Virginia and Pocahontas County, with almost half of students in pre-kindergarten, kindergarten, or elementary/primary school (Grades 1 to 5); 21 to 22 percent in middle school (Grades 6 to 8); and 30 percent in high school (Grades 9 to 12) (WVDOE, 2017a).

TABLE 3.11-11
Public School Enrollment Trends and Grade Distribution

	2012–13	2013–14	2014–15	2015–16	2016–17	2016–17 Distribution
West Virginia						
Pre-Kindergarten - Kindergarten	37,542	36,987	36,130	35,284	34,803	13%
Elementary (01 - 05)	102,568	102,367	102,433	101,363	99,468	36%
Middle (06 - 08)	62,059	62,207	61,352	60,863	59,965	22%
High (09 - 12)	80,140	79,452	79,984	79,627	78,930	29%
Total	**282,309**	**281,013**	**279,899**	**277,137**	**273,166**	
Percent Total Change		-0.5%	-0.4%	-1.0%	-1.5%	
Pocahontas County						
Pre-Kindergarten - Kindergarten	138	142	156	129	129	12%
Elementary (01 - 05)	399	389	375	386	387	36%
Middle (06 - 08)	246	241	228	242	221	21%
High (09 - 12)	350	340	315	310	324	31%
Total	**1,133**	**1,112**	**1,074**	**1067**	**1,061**	
Percent Total Change		-1.9%	-3.5%	-0.7%	-0.6%	

Source: WVDOE, 2017a.

3.11.3.2 Pocahontas County

The Pocahontas County Public School District is currently the sixth smallest school district in West Virginia, with a projected 2016–2017 enrollment of 1,061 students (WVDOE, 2017a). Additionally, there is only one private school in Pocahontas County, Lamp of Youth Christian Academy, with a total

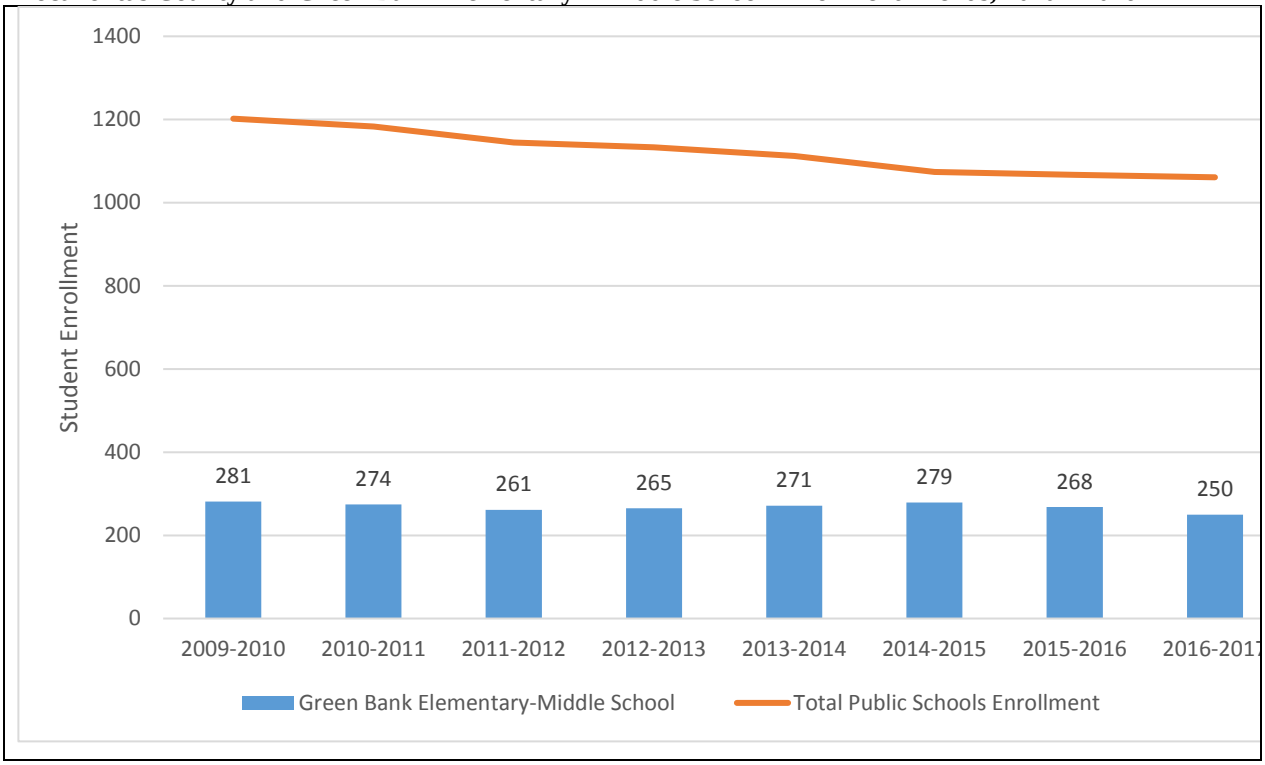
enrollment of three students (PSR, 2017). The five Pocahontas County public schools, with grades serviced and staffing levels, are as follows:

1. Green Bank Elementary-Middle School (Grades: pre-K through eighth grade, 37 staff, 250 students),
2. Hillsboro Elementary School (pre-K through fifth grade, 15 staff, 82 students),
3. Marlinton Elementary School (pre-K through fourth grade, 32 staff, 262 students),
4. Marlinton Middle School (fifth through eighth grade, 28 staff, 143 students) and,
5. Pocahontas County High School in Dunmore (ninth through twelfth, 44 staff, 324 students) (WVDOE, 2017b).

Over the past 7 years, the Pocahontas County Public School System has experienced a continuous decline in overall enrollment, as shown on Figure 3.11-3, which has significantly affected funding for programs, maintenance, and position retention (*The Pocahontas Times*, 2017a, 2017b). Green Bank Elementary-Middle School enrollment has fluctuated during this same period. The 250 students enrolled in 2016-2017 represent an average annual reduction in students of 1.6 percent since the 2009-2010 school year. In November 2016, a measure for leveraging additional funds from West Virginia's School Building Association did not pass and the remaining funds were reallocated to other counties (*The Pocahontas Times*, 2017c).

In terms of higher education, there are no public or private universities in Pocahontas County. WVU has a 4-H extension office in Marlinton, which primarily serves the regional agriculture and natural resources industries with agricultural programming and master courses (WVU, 2017b). The closest college or university to the Observatory is Davis & Elkins College (D&E) in Elkins, West Virginia, which is 51 miles away (D&E, 2017). The closest technical school is the New River Community and Technical College Greenbrier Campus in Lewisburg, West Virginia, which is 69 miles away (New River Community and Technical College, 2017).

FIGURE 3.11-3
Pocahontas County and Green Bank Elementary – Middle School Enrollment Trends, 2010 – 2016



Source: WVDOE, 2017a.

3.11.3.3 Green Bank Observatory

While GBO's hours vary seasonally, it is open year-round to visitors and educational groups. According to the Observatory's tourism figures, approximately 50,000 individuals visit GBO each year. Approximately 6 percent or 3,000 of these annual visitors are school children, Boy and Girl Scouts, and teachers (NSF, 2017). Beyond providing educational tours, GBO hosts multiple other STEM-related opportunities, such as Residential Teacher Institutes (K-12 teachers), the 8-week Summer Research Experiences for Teachers (middle to high school), and the Pulsar Search Collaboratory, a national program in partnership with WVU (middle to high school) (GBO, 2017b). GBO staff and their spouses also play an active role in the Pocahontas School District by mentoring and supporting coursework and other educational activities on a year-round basis, as reported during the public scoping meeting held on November 12, 2016. GBO staff also are Pocahontas School Board members, provide scholarships to the school system's science departments, and volunteer in science fairs and career days throughout the year.

On a national and international scale, GBO is part of numerous academic pursuits, including the University of North Carolina's Skynet Robotic Telescope Network (Skynet) and the NANOGrav network, which seeks to detect and study low frequency gravitational waves (NANOGrav, 2017). Approximately 20 percent of the time available on the GBT is dedicated to Breakthrough Listen, a scientific research program searching for evidence of civilizations beyond Earth. Approximately 66 percent of the time on the GBT is reserved for "open skies" science, which maximizes its scientific

output by allowing any scientist in the world to apply for time on that instrument through a peer-reviewed process.

3.11.4 Tourism

This Section first describes the tourism resources of West Virginia, followed by those of Pocahontas County and GBO. GBO is located in the tourist region referred to as the Potomac Highlands of West Virginia, which includes Pocahontas County and six other counties.

3.11.4.1 Tourism Trends

Table 3.11-12 presents the tourism-related revenue benefitting local and state governments, and tourism-related employment trends in West Virginia and Pocahontas County for 2012, 2013, and 2014. Approximately $4.5 billion were spent in the tourism industry in the state in 2014, according to the 2015 West Virginia Travel Impacts Report. Since 2000, travel-related visitor spending (overnight and day) has increased by 4.4 percent every year, generating jobs and stabilizing economies throughout the state. In 2014, tourism spending in West Virginia supported 46,000 jobs, with gross earnings of approximately $1.1 billion; the largest sectors were accommodations and food services, arts and entertainment, and recreation (Table 3.11-12). Travel and tourism-related spending in 2014 generated $527 million in revenue for local and state governments. Without this tourism revenue, each West Virginia household would have needed to pay an additional $692 in state and local taxes to maintain the 2014 level of government services (Dean Runyan Associates, 2015).

TABLE 3.11-12
Direct Tourism Impacts in West Virginia & Pocahontas County Economies

	Pocahontas County				West Virginia			
	2012	2013	2014	2013 – 2014 Percent Change	2012	2013	2014	2013 –2014 Percent Change
Employment	1,050	1,090	1,090	0%	46,100	46,300	46,000	-0.6%
Tourism Contributions (Millions)								
Direct Spending	$80	$85	$88	$3.4%	$4,832	$4,616	$4,489	-2.8%
Earnings	$22	$24	$26	$7.9%	$1,065	$1,058	$1,066	0.8%
Government Revenue (Thousands)								
Local	$1,373	$1,502	$1,569	4.4%	$59,000	$54,000	$50,000	-7.4%
State	$4,916	$5,247	$5,410	3.1%	$543,000	$492,000	$477,000	-3.0%

Source: Dean Runyan Associates, 2015.

3.11.4.2 Pocahontas County

Pocahontas County hosts over 1 million tourists a year (Pocahontas County CVB, 2017a). Travel and tourism has a greater effect in Pocahontas County than in any other county in the state, with one out of every four jobs generated by travel and tourism (Pocahontas County CVB, 2017a). The 1,090 persons employed in tourism-related jobs represent 35 percent of Pocahontas County's private employment.

Similarly, employment in the Leisure and Hospitality industry overall represents a greater percentage of the workforce in Pocahontas County (25 percent) than in West Virginia (11 percent) (WVU Extension Service, 2016). A 2016 survey of the restaurants in the County that served alcohol (17 establishments, including 12 at Snowshoe Mountain Resort) found tourists represented 50 to 90 percent of their annual sales, with an average of 83 percent. Based on responses representing 13 of the 17 businesses, restaurants employed an estimated 421 full-time and part-time staff in 2016 (WVU Extension Service, 2016).

Table 3.11-13 summarizes the major tourist destinations in the County, their location, the primary activities offered, and a brief description. Where available, the corresponding estimated annual visitation and visitor spending also is provided for fiscal year 2015 (Institute for Service Research, 2015). Notable tourist activities in Pocahontas County include visits to its scenic byways, Snowshoe Mountain Resort, and the Monongahela National Forest (Pocahontas County CVB, 2017b). Approximately 35 minutes west of GBO, Snowshoe Mountain Resort offers a wide variety of seasonal and year-round outdoor activities (Snowshoe Mountain Resort, 2017).

GBO is located adjacent to Monongahela National Forest, which receives an estimated 1.3 million visitors a year (USFS, 2017b). The Monongahela National Forest offers a variety of activities, including back country camping, hiking, mountain biking, fishing, and wildlife viewing (Pocahontas County CVB, 2017a). The developed recreation sites nearest to GBO and in the national forest are in the Bartow and Marlinton areas.

In addition to the recreation and science-based tourism in Pocahontas County, the County is host to a range of arts, music and cultural festivals, including the following:

- Durbin Days Heritage Festival (July)
- Dunmore Daze Festival (August)
- Huntersville Traditions Day (October)
- Autumn Harvest Festival and West Virginia Roadkill Cook-Off (September in Marlinton)
- Little Levels Heritage Fair (June in Hillsboro/Mill Point)
- Pioneer Days (Marlinton)
- Allegheny Echoes (Marlinton)

TABLE 3.11-13
Pocahontas County Tourism Destinations

Name	Location	Annual Visitors (Fiscal Year 2015)	Total Visitor Spending (Fiscal Year 2015)	Description
Beartown State Park	Hillsboro	32,926	$816,591	Boardwalk, viewing platforms, restrooms
Calvin Price State Forest	Hillsboro	-[a.]		Fishing (Greenbrier River), hunting, trails (Allegheny Trail and logging roads), and wildlife food plots.
Cass Scenic Railroad and State Park	Cass	135,974	$4,624,270	Lodging, fishing (nearby Greenbrier River), trails, overlooks, restrooms, biking, shopping, dining, museum, and tours. The Cass Scenic Bald Knob scenic train ride covers approximately 22 miles in 4.5 hours.
Cranberry Glades Nature Center and Botanical Area	Mill Point			Located on the Highland Scenic Highway. Visitor Center, interpretive and interactive displays, boardwalk and trails.
Droop Mountain Battlefield State Park	Hillsboro	52,474	$1,301,397	Trails (3.5 miles), overlooks, restrooms, playgrounds, picnic areas, pavilions, stage, museum, and Civil War monuments and graves.
Durbin & Greenbrier Valley Railroad	Durbin			"The Durbin Rocket" covers 10.5 miles in 2 hours with views of the Monongahela National Forest.
Green Bank Observatory	Green Bank	50,000	$747,000	Science and Visitor Center
Greenbrier River Trail and State Park	Transects County North/ South	203,058	$5,035,999	78 miles long, camping, fishing, swimming, hunting, trails, scenic views, restrooms, biking, canoeing, equestrian friendly, kayaking, and tubing.
Highland Scenic Highway	Marlinton			43-mile route within the southern portion of the Monongahela National Forest. Scenic views, fishing, hiking and mountain biking (USFS, 2013)
Monongahela National Forest	County-wide	1.3 million (entire National Forest)		Bartow Developed Recreation Areas: Allegheny Battlefield, Cheat Summit Fort Gaudineer Knob Picnic Area, Island Campground, Lake Buffalo, Laurel Fork Campground, Middle Mountain Cabins Old House Run Picnic Area. Marlinton Developed Recreation Areas: Day Run Campground, Highland Scenic Highway, Pocahontas Campground, Rimel Picnic Area, Tea Creek Campground, Williams River Sites
Pearl S. Buck Birthplace Museum	Hillsboro			Museum. Open in the summer for tours of home site.
Pocahontas Opera House	Marlinton			Unique performing arts venue with a 250-seat capacity. Hosts a wide range of performances and is on the West Virginia Historic Theatre Trail.

TABLE 3.11-13
Pocahontas County Tourism Destinations

Name	Location	Annual Visitors (Fiscal Year 2015)	Total Visitor Spending (Fiscal Year 2015)	Description
Seneca State Forest	Dunmore	54,215	$1,793,562	Camping, lodging, fishing, swimming, hunting, trails, overlooks, restrooms, and extras such as biking, horseshoes, picnic shelter, playground, and volleyball.
Snowshoe Mountain Resort	Snowshoe			Includes Snowshoe Basin, Western Territory and Silver Creek areas. Provides 251 acres of skiable terrain, 1500 vertical feet, and 57 trails.
Watoga State Park	Hillsboro	246,219	$7,752,551	Camping (3 campgrounds - 100 sites), lodging (34 cabins - 10 year-round and 24 seasonal cabins), fishing, swimming (pool open Memorial Day - Aug. 15), trails (40+ miles), overlooks, restrooms, biking, boating, family activities, ice fishing, naturalist, picnicking, and playground.

Sources: Region 4 Planning and Development Council, 2016b; Pocahontas County CVB, 2017c; Beartown State Park, 2016; USFS, 2017c; Pocahontas County Opera House, 2017; Institute for Service Research, 2015.

[a] Very small, unmonitored attendance.

GBO offers a wide range of activities for tourists and students, including guided tours, exhibition halls, educational activities, and trails for hiking. GBO also hosts annual events such as the Space Race Rumpus (mountain biking), Star Quest (astronomy), Open House and Science Day, and Boy Scout Merit Badge Weekends. GBO hosts an average of 50,000 visitors a year, of which 3,000 are students, 200 are researchers (scientists, engineers, and educators), and 46,800 are the public; these visitors generate approximately $747,000 in revenue for GBO from their expenditures on items such as food, lodging, souvenirs, fees (NSF, 2017). This figure does not include offsite expenditures. While 85 percent of the general visitors are not residents of Pocahontas County, only about 5 percent of the public stays onsite at GBO. The remainder either take day trips or stay in accommodations offsite. Approximately 86 percent of students stay onsite an average of 2 days, and 80 percent of researchers stay at GBO for a week during their visit (NSF, 2017).

3.11.5 Community Cohesion

A community is often defined as a subarea of a town or city containing residences supported by community gathering locations (religious institutions and parks), services (clinics and schools), and areas where routine life activities occur (grocery stores, cafes, and pharmacies). Not every community contains all of these resources, but each community typically contains certain features that contribute toward satisfying basic needs. Community cohesion involves factors that contribute to the “sense of community” or interconnectedness in an area and includes areas that provide opportunities for residents to gather and interact.

For the purposes of assessing community cohesion, three areas were considered:

- Pocahontas County, excluding GBO and the CDPs of Green Bank and Arbovale (Figure 3.11-1)
- Green Bank CDP and Arbovale CDP (Figure 3.11-4)
- GBO, which partially overlaps and contains portions of the Green Bank and Arbovale CDPs and unincorporated Pocahontas County (Figure 3.11-4)

As described previously, the Pocahontas County region includes the area where almost all GBO staff reside (92 percent) and the CDPs of Green Bank and Arbovale encompass the residences of more than half (54 people) of GBO staff. As members of the community, GBO staff contribute to community cohesiveness, as revealed through stakeholder comments during scoping. In addition, publicly accessible facilities and services at GBO play a role in supporting social interactions within the local communities.

3.11.5.1 Pocahontas County

As noted previously, the balance of Pocahontas County is predominantly rural because of the prevalence of public lands, except for the Marlinton to the south and Snowshoe Mountain Resort to the southwest. Appendix 3.11C lists the 84 community resources that provide a public service, provide a commercial service, or serve as a gathering place in the County. As the county seat, Marlinton provides most of the community services such as a hospital and County Board of Education.

GBO staff serve on a wide variety of community organizations and boards and are members of the local emergency services crews in Pocahontas County. Although exact participation varies on an ongoing basis, Observatory staff regularly play an active role in the following community services and volunteer organizations:

- Community and Emergency Services: deputy fire chief, EMTs, firefighters, ambulance drivers, county search and rescue, Local Emergency Planning Board and Prevention Coalition, and various amateur radio/weather clubs.
- Arts and Tourism: Pocahontas Dramas, Fairs and Festivals Board, Opera House Foundation and Volunteers, Pocahontas County Parks and Recreation
- Economic Development: Pocahontas County Convention and Visitors Bureau, Chamber of Commerce, First Citizens Bank Board of Directors
- Community Resources: Pocahontas County School Board, Northern Pocahontas Community Wellness Board, Elkins YMCA Board of Directors, Seneca Woodlands Women's Club, Dunmore Community Center, Pocahontas County Drama Workshop, Adopt-A-Highway Program, ExploreWV Geocaching

- Youth Organizations: 4-H Foundation, Boy Scouts scoutmaster, Pocahontas County Youth Soccer (coaches, board members, schedulers, referees), Pocahontas County Youth Baseball League

3.11.5.2 Green Bank Observatory

GBO provides a variety of services and facilities on which the community relies and serves as a source of volunteers for key community resources. Table 3.11-14 outlines the community resources at GBO. Observatory Road provides access to an airstrip and associated tarmac that are maintained for helipad use and medical evacuations, which are available, with proper coordination, to any fire and rescue/ambulance service in the County for medical emergency. Ambulance and/or air evacuation services are coordinated through the Green Bank County Emergency Medical Service (Holstine, 2017, pers. comm.). The Observatory also serves as a Red Cross Emergency Evacuation Center for Green Bank Elementary-Middle School, the vicinity, and northern Pocahontas County.

The GBO auditorium, located in the Science Center with a 150-person seating capacity, is used by local groups for activities ranging from town hall meetings, conferences, and high school proms to hunter safety courses. Because there are a limited number of restaurants in the vicinity, the Science Center's Starlight Café is frequented by local residents as well as visitors and staff. Hannah Run Road, to the northeast of Observatory Road, provides access to the onsite recreation area, which includes a swimming pool, tennis court, picnic pavilion, playing fields, and playground. The recreation area also includes a shooting range, archery range, and golf driving range (Figure 3.11-4). An indoor gym with exercise equipment and a recreation room are located in the basement of the residence hall. Approximately 13 miles of hiking and/or biking trails are located onsite, including a connection to Allegheny Trail (GBO, 2017c). Of these, the swimming pool and playing fields are regularly accessed by the community for lessons and sports leagues.

TABLE 3.11-14
Green Bank Observatory Community Resources

Name	Type
1. Airstrip	Community Services
2. Exhibit Hall / Auditorium (150-person capacity)	Community Gathering Location
3. Residence Hall Cafeteria (75-person capacity)	Community Commercial
4. Science Center Café (open to public)	Community Commercial
5. Gift Shop and ATM	Community Commercial
6. Weather Station	Community Services
7. Green Bank Machine Shop	Community Commercial
8. Swimming Pool	Community Services
9. Tennis Court	Community Services
10. BBQ house and picnic table	Community Gathering Location
11. Children's Play Area	Community Gathering Location
12. Playing Fields	Community Services
13. Shooting Ranges (Rifle and Archery)	Community Services
14. Golf Driving Range	Community Services

Source: GBO, 2017a.

3.11.5.3 Green Bank and Arbovale CDPs

Because of the rural character of the area, the communities of Green Bank and Arbovale are uniquely reliant on GBO and vice versa. Table 3.11-15 summarizes those community resources in the vicinity of Green Bank and Arbovale that provide a public service, provide a commercial service, or serve as a gathering place. Figure 3.11-4 illustrates the relative location of the resources to GBO. Like many of the neighboring communities, the Green Bank and Arbovale CDPs have a post office and multiple churches. Green Bank's community resources also include the Observatory, a library, elementary-middle school, non-profit arts center, and a recently opened Dollar General Store (Pocahontas County Arts Council, 2017). Additionally, the Green Bank Elementary-Middle School started offering community health services at its school-based health center (Green Bank Elementary-Middle School, 2017).

There are a limited number of opportunities for routine shopping and dining in Green Bank and Arbovale (Table 3.11-15). Henry's Quick Stop and Trent's General Store have long served the Green Bank and Arbovale areas for local shopping of essential items. Residents generally travel to Elkins, an hour to the north, or to Lewisburg, an hour and a half to the south, for larger shopping endeavors (NRAO, 2011). First Citizens Bank in Arbovale provides major banking services and ATMs are located at the Observatory and each of the shopping destinations in Green Bank and Arbovale (First Citizens Bank, 2017).

TABLE 3.11-15
Community Resources in the Vicinity (Green Bank and Arbovale)

Name	Type
1. Arbovale United Methodist Church	Community Gathering Location
2. Church of God Chapel, Green Bank	Community Gathering Location
3. Dollar General #11748, Green Bank	Community Commercial
4. First Citizens Bank, Arbovale	Community Commercial
5. Galfords Body Shop, Green Bank	Community Commercial
6. Green Bank Arts Center	Community Gathering Location
7. Green Bank Elementary - Middle School	Community Services
8. Green Bank Public Library	Community Services
9. Green Bank United Methodist Church	Community Gathering Location
10. Green Bank USPS Office	Community Services
11. Hebron Baptist Church, Green Bank	Community Gathering Location
12. Henry's Quick Stop with Pendleton Community Bank ATM, Green Bank	Community Commercial
13. Hevener Church, Green Bank	Community Gathering Location
14. Kerr Memorial Church, Green Bank	Community Gathering Location
15. Lamp of Youth Christian Academy, Green Bank	Community Gathering Location
16. Liberty Presbyterian Church, Arbovale	Community Gathering Location
17. Pine Grove Church, Green Bank.	Community Gathering Location

TABLE 3.11-15
Community Resources in the Vicinity (Green Bank and Arbovale)

Name	Type
18. Puny Tunes (Music Instruments)	Community Commercial
19. Snow-High Card & Candle Shop, Arbovale	Community Commercial
20. Trent's General Store and Marathon Gas Station, Arbovale	Community Commercial
21. Wallace & Wallace Funeral Home, Arbovale	Community Commercial

Sources: NRAO, 2011 Pocahontas County Arts Council, 2017; WV HomeTownLocator, 2017b.

FIGURE 3.11-4
Vicinity Map (Green Bank and Arbovale CDPs)

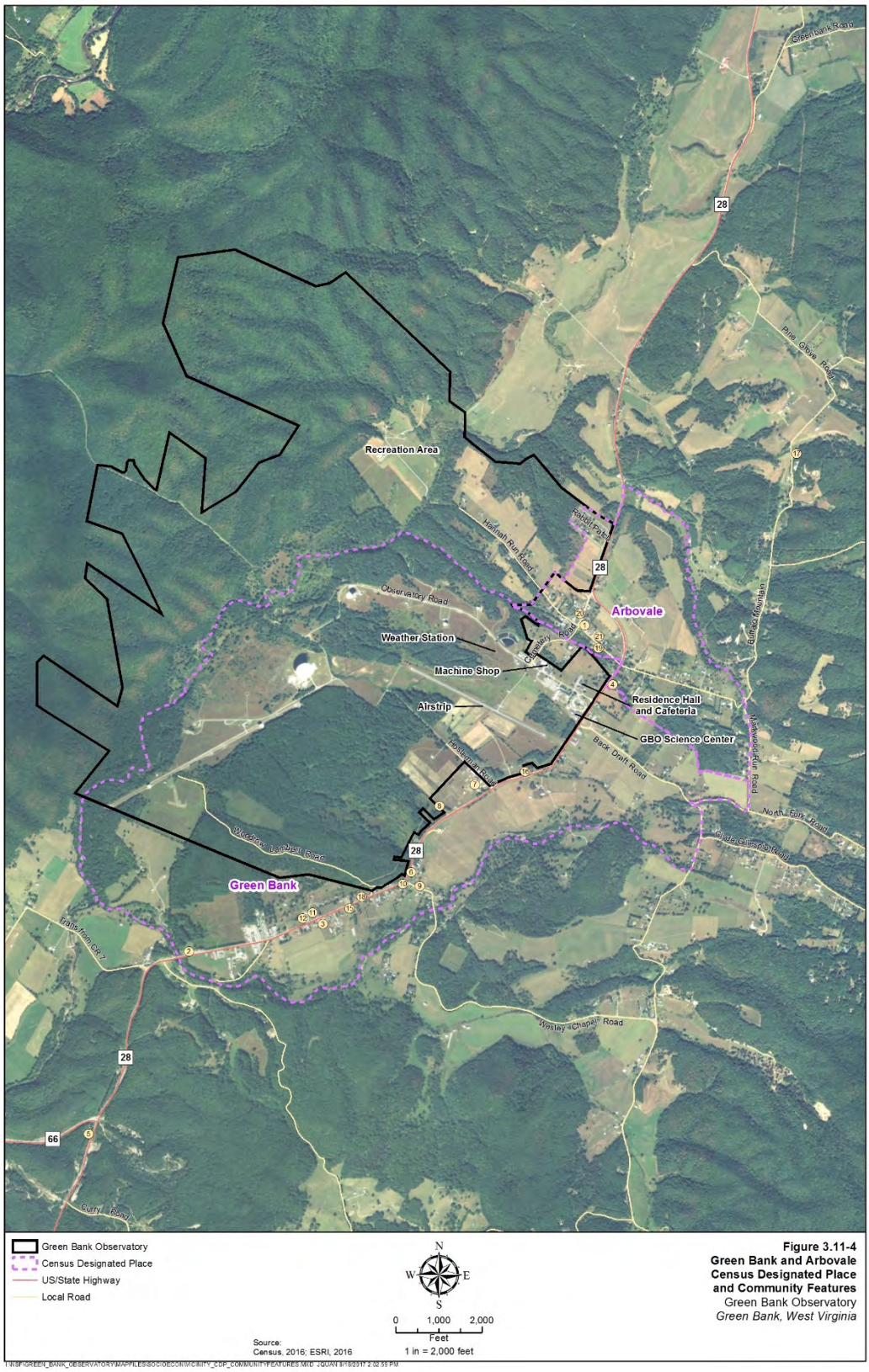


Figure 3.11-4
Green Bank and Arbovale Census Designated Place and Community Features
Green Bank Observatory
Green Bank, West Virginia

SECTION 4.0

Environmental Consequences

This Section provides an evaluation of the potential environmental impacts of the Proposed Action under the five Alternatives (four Action Alternatives, and one No Action Alternative):

- Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding
- Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park
- Action Alternative C: Mothballing of Facilities
- Action Alternative D: Demolition and Site Restoration
- No-Action Alternative: Continued NSF Investment for Science-focused Operations

The analysis identified likely environmental impacts within the ROI for each resource area described in Section 3, *Affected Environment*. The analysis of resource impacts focused on environmental issues in proportion to their potential impacts, and consideration was given to both adverse and beneficial impacts. Interpretation of impacts in terms of their duration, intensity, and scale is provided for each resource. Where mitigation measures would reduce the duration, intensity, or scale of the impacts, they are identified within the resource evaluations. Impacts identified under the No-Action Alternative were used as the environmental baseline for the analysis.

Section Organization

Sections 4.1 through 4.12 contain the environmental impact analysis, which was conducted in compliance with CEQ guidance 40 C.F.R. Parts 1500–1508. The environmental impact analysis includes the following potential impacts:

1. Direct impacts, which are caused by the action and occur at the same time and place.
2. Indirect impacts, which are caused by the action and occur later in time or are farther removed in distance but are still reasonably known.

Section 4.13 presents a summary of the cumulative impacts of the Proposed Action. Cumulative impacts result from adding the total impacts of past, present, and reasonably foreseeable future actions to impacts likely caused by the Proposed Action.

Section 4.14 presents a summary of irreversible and irretrievable commitment of resources and unavoidable adverse impacts.

Section 4.15 presents the relationship between local short-term uses of the environment and enhancement of long-term productivity.

4.1 Biological Resources

This Section identifies the potential direct and indirect impacts on biological resources that may result from implementing the Alternatives, including the No-Action Alternative. The ROI for the biological resources analysis encompasses the areas within and immediately adjacent to the GBO property, although a broader view was taken as necessary; for example, regional wildlife populations were considered for impacts on species stability.

Methodology

The methods used to determine whether the Alternatives would have impacts on biological resources are as follows:

1. Evaluate existing conditions to identify which past actions within the ROI have resulted in either improved or diminished health or diversity of populations of biological resources to evaluate the potential impacts on biological resources for each Alternative.
2. Evaluate each Alternative to determine its potential for impacts on biological resources as a result of loss of habitat, disruption of normal behavior (for example, from noise or vibration), vehicular traffic, and the introduction of invasive species.
3. Assess the compliance of each Alternative with federal regulations that apply to biological resources.

Table 4.1-1 defines the thresholds used to determine the intensity of direct and indirect impacts on biological resources.

TABLE 4.1-1
Impact Thresholds for Biological Resources

Impact Intensity	Description
Negligible	The impact would be below or at the lowest levels of detection.
Minor	The Alternative would result in a detectable change to biological resources or habitat; however, the impact would be small, localized, and of little consequence. Any disruption to wildlife would be short-term and species would return to normal activities after disturbance. No measurable reduction in species population stability would occur. Threatened or endangered species may be in the area but no effects to behavior, mortality, or habitat quality would occur. There would be no mortality of any threatened or endangered species or migratory birds. There may be some increase in the presence of weed species over a small area, but the increase would be easily controllable.
Moderate	The Alternative would result in a readily apparent change to biological resources or habitat over a relatively wide area.

TABLE 4.1-1
Impact Thresholds for Biological Resources

Impact Intensity	Description
	A permanent loss of non-critical vegetative cover or other habitat may occur. However, no measurable reduction in species population stability would occur. Any effects on threatened or endangered species or migratory birds would be temporary and would not result in mortality or impacts on population size. There would be a noticeable increase in the presence of weed species, which would require the use of herbicide to control.
Major	The Alternative would result in a substantial change to the character of the biological resource, affecting a large area or a species population, or would violate the Endangered Species Act or the Migratory Bird Treaty Act. A permanent loss in vegetative cover or other habitat would occur, resulting in a measurable reduction in species population stability. Effects on threatened or endangered species or migratory birds would result in mortality or impacts on population size. There would be a large increase in the presence of weed species, which would require the use of herbicide to control.

Duration: **Short-term –** Occurs only during the implementation (i.e., demolition, mothballing, safe-abandonment and land-transfer activities) and/or for a limited adjustment period.

Long-term – Endures long after the implementation of the Proposed Action.

4.1.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

4.1.1.1 Vegetation

Under Action Alternative A, direct impacts would be minor, adverse, and short-term to onsite vegetation and would result from activities associated with facility demolition, such as the use of construction equipment and vehicles, the removal of infrastructure, and the establishment of staging areas. All facilities that would be demolished are located in maintained areas that consist entirely of mowed grass and/or maintained landscaped vegetation. Additional maintained areas are available for staging and support during demolition. No tree removal or disturbances to unmaintained areas would occur during demolition activities. For these reasons, impacts on onsite vegetation would be limited to mowed grass and maintained landscaped vegetation. Following facility demolition, disturbed areas would be re-landscaped.

There is the potential for weed species to become established in areas disturbed during demolition activities. However, the disturbed areas would be re-landscaped after the demolition period, which would remove any weed species that start to establish in the areas. The re-landscaped areas would be routinely maintained during the entire demolition period to include multiple phases, if necessary, which would minimize the potential for the introduction or spread of weed species.

Activities at GBO after implementation would be similar to current operations and would have no impact on vegetation.

4.1.1.2 Wildlife

Under Action Alternative A demolition activities would only impact landscaped vegetation, which provides low-quality wildlife habitat; further, no forested areas would be disturbed. Some of the facilities that would be demolished could provide roosting or nesting habitat for birds. However, no nests were observed during the November 2016 field surveys. Impacts on wildlife would be negligible due to the low-quality habitat affected and the availability of nearby alternate roost and nesting areas.

Noise and vibration generated during demolition activities may temporarily disturb wildlife; however, any disturbance experienced by wildlife would be limited to the demolition period and is expected to be negligible, even if demolition occurred in multiple phases.

Ground-disturbing activities associated with facility demolition have the potential to cause soil erosion and increase stormwater runoff, thereby indirectly impacting wetlands and surface water bodies. Appropriate engineering controls and best management practices (BMPs), such as those identified in Section 4.1.6, *Mitigation Measures*, would be implemented during demolition to prevent indirect impacts such as erosion sedimentation and pollution to onsite and offsite wetlands, ponds, and streams. These measures would prevent indirect impacts on these habitats and the aquatic species that occur in them. BMPs would also be maintained during the entire demolition period, even if it occurred in multiple phases.

Operations at GBO after implementation would be similar to current operations and would have no impact on wildlife.

4.1.1.3 Threatened and Endangered Species

Based on the habitat requirements of federally listed species that potentially occur in Pocahontas County and information provided by the USFWS West Virginia Field Office, the Indiana bat and northern long-eared bat are the only federally listed species expected to occur on the GBO property (see Section 3.1.4, *Threatened and Endangered Species*). No critical habitat for any species has been designated within or adjacent to the GBO property.

In a letter dated October 20, 2016, the USFWS Virginia Field Office stated that the Indiana bat and northern long-eared bat potentially use the GBO property for foraging and roosting between April 1 and November 15, and that GBO is within an Indiana bat hibernacula known use area (USFWS, 2016a). Under Action Alternative A, demolition activities, including staging and support areas, would be confined to existing maintained areas that consist entirely of mowed grass and/or maintained landscaped vegetation. No tree removal or disturbances to unmaintained areas would occur during demolition activities. Because of the lack of meaningful habitat around the facilities that would be demolished and because no forest clearing would occur, Action Alternative A would have no impacts on the foraging or

roosting habitats of either bat species. Based on the field investigation conducted in November 2016, no potential bat hibernacula such as caves or mine openings are located at or adjacent to any of the facilities that would be demolished. Therefore, Action Alternative A would have no impact on Indiana bat hibernacula. The USFWS concurred with this finding on April 13, 2017; the concurrence letter can be found in Appendix 3.1A.

If the demolition is extended beyond a single demolition period, there would be no change in the assessed impacts on threatened and endangered species, as described in Section 2, *Description of Proposed Action and Proposed Alternatives*. The disturbance period would be extended, but the BMPs and mitigation measures, including timing restriction on activities described previously, would be implemented throughout the period of demolition. If the demolition period is extended over multiple years, NSF would coordinate with USFWS to determine whether additional Section 7 consultation under the ESA would be warranted because of additional species being listed under the ESA or current species distribution change.

NSF could retain or transfer the GBO property to another federal entity or a non-federal entity. If transferred out federal control, additional impacts could be realized, as a non-federal entity would not be held to the same requirements under the ESA and other environmental regulations. NSF, in consultation with USFWS, would consider the appropriate land use controls, such as deed restriction and conservation easement, for the natural areas on the Observatory if the property is transferred out of federal control.

Demolition activities are not expected to directly impact any of the non-listed species of concern identified by the WVDNR as having the potential to occur on the GBO property (Table 3.1-2). Most of the identified non-listed species are aquatic species. Appropriate engineering controls and BMPs, such as those identified in Section 4.1.6, *Mitigation Measures*, would be implemented during demolition to prevent indirect impacts such as erosion sedimentation and pollution to onsite and offsite wetlands, ponds, and streams where the identified aquatic species of concern may occur.

Operations at GBO after implementation would be similar to current operations and would have no impact on threatened and endangered species.

4.1.1.4 Migratory Birds

Several migratory bird species could occur on the GBO property (see Section 3.1.5, *Migratory Birds*). Under Action Alternative A, facility demolition would have minor, adverse, short-term impacts on mowed grass and maintained landscaped vegetation that provide low-quality habitat for migratory birds; no forested areas would be disturbed. Some of the facilities that would be demolished may provide roosting or nesting habitat for certain migratory species. The overall impact that facility demolition potentially would have on migratory bird roosting or nesting habitat would be negligible based on the amount and type of habitat that would be lost. Noise and vibration generated during demolition activities may temporarily disturb migratory birds; however, any disturbance experienced by migratory birds would

occur primarily during the use of heavy machinery and is expected to be negligible, regardless of whether the demolition period is extended.

Operations at GBO after implementation would be similar to current operations and would have no impact on migratory birds.

4.1.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Although more demolition activities could occur under Action Alternative B, overall demolition impacts on biological resources would be similar to those described under Action Alternative A. During demolition vegetation impacts would be minor, adverse, and short-term; wildlife and migratory bird impacts would be negligible and there would be no impacts on threatened and endangered species. Mitigations measures and BMPs described for Alternative A would also be implemented under Alternative B. There would be no impacts during post-implementation activities.

4.1.3 Action Alternative C: Mothballing of Facilities

Although fewer demolition activities could occur under Action Alternative C than under Alternatives A and B, overall demolition impacts on biological resources would be similar to those described under Action Alternative A. During demolition vegetation impacts, would be minor, adverse, and short-term; wildlife and migratory bird impacts would be negligible and there would be no impacts on threatened and endangered species. Mitigation measures and BMPs described for Alternative A would also be implemented under Alternative C. Routine maintenance of mothballed infrastructure would be comparable, though lower in intensity, to current maintenance operations. The reduction in workforce at GBO under Action Alternative C would have no appreciable effect on vegetation; however, the reduction in activity would result in a minor, long-term, benefit to wildlife and migratory birds. Mothballing the WWTP would eliminate discharges to Hospital Run and Deer Creek; the associated beneficial impact on the wildlife and threatened and endangered species habitat would be negligible.

4.1.4 Action Alternative D: Demolition and Site Restoration

Although more demolition activities could occur under Action Alternative D than under any other alternative, overall demolition impacts on biological resources would remain within the same impact thresholds as those described under Action Alternative A. Demolition will occur in previously developed areas and result in only minor, adverse and short-term impacts on vegetation; impacts on wildlife and migratory bird would be negligible, and there would be no impacts on threatened and endangered species. The BMPs and mitigation measures described for Alternative A would also apply to Alternative D.

After demolition, disturbed areas would be restored to achieve cover by native vegetation. This would be accomplished by adding soil where needed; seeding and transplanting native plant species; installing temporary erosion control measures where needed; and maintaining restored areas by watering and weed control until desired vegetation is established. Areas revegetated following demolition activities would be

maintained for a period of up to 18 months and could be less if revegetation is achieved sooner. There would be a moderate, long-term benefit to vegetation, because of revegetation efforts and the increase of native vegetation.

The elimination of operational noise and activity, and the eventual transition of the property to a natural state under Action Alternative D would have a moderate, long-term benefit on common terrestrial wildlife species and usage of the property by terrestrial wildlife would likely increase. The associated impacts on the Indiana bat, northern long-eared bat, aquatic species of concern, and migratory birds following completion of demolition and site restoration would be a minor, long-term benefit.

4.1.5 No-Action Alternative

Under the No-Action Alternative, the NSF would continue funding GBO at current levels and no associated modifications to GBO facilities or operations would occur. Therefore, the No-Action Alternative would have no new impacts on biological resources.

4.1.6 Mitigation Measures

The following mitigation measures have been identified for biological resources under the Proposed Action:

- All Action Alternatives: Demolition activities would occur only in currently disturbed and maintained areas. Forested areas and streams would be fully avoided.
- All Action Alternatives: Stormwater BMPs would be implemented prior to starting demolition activities. Erosion control measures such as compost blankets, mulching, riprap, geotextiles, and slope drains could be used to protect exposed soil and minimize erosion. BMPs, such as check dams, slope diversions, and temporary diversion dikes, could be implemented for runoff control. Sediment control measures that could be implemented include compost filter berms and socks; fiber rolls or berms; sediment basins, rock dams, filters, chambers, or traps; silt fences; and weed-free hay bales. Good housekeeping measures would be practiced during demolition.
- All Action Alternatives: While it is unknown whether GBO would be transferred out of federal control in the future, if it were, NSF would consult with USFWS, as appropriate, to meet Section 7 consultation requirements and to determine any necessary mitigation measures (e.g., land use controls).
- All Action Alternatives: If demolition activities were to extend beyond one year, NSF would confirm with the USFWS that there are no new threatened or endangered species expected in the area. If new species are present NSF will reengage in ESA Section 7 consultation.

4.1.7 Summary of Impacts

Table 4.1-2 provides a summary of the biological resources impacts resulting from the Alternatives.

TABLE 4.1-2
Summary of Biological Resources Impacts

Impacts	Alternatives				
	Action Alternative A	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Impacts on vegetation during demolition	Minor, adverse, short-term	Minor, adverse, short-term	Minor, adverse, short-term	Minor, adverse, short-term	No impact
Impacts on wildlife during demolition	Negligible	Negligible	Negligible	Negligible	No impact
Impacts on threatened and endangered species during demolition	No impact	No impact	No impact	No impact	No impact
Impacts on migratory birds during demolition activities	Negligible	Negligible	Negligible	Negligible	No impact
Impacts on vegetation post-implementation	No impact	No impact	No impact	Moderate, long-term benefit	No impact
Impacts on wildlife post- implementation	No impact	No impact	Minor, long-term benefit	Moderate, long-term benefit	No impact
Impacts on threatened and endangered species post-implementation	No impact	No impact	Negligible	Minor, long-term benefit	No impact
Impacts on migratory birds post-implementation	No impact	No impact	Minor, long-term benefit	Minor, long-term impact benefit	No impact

4.2 Cultural Resources

This Section describes the potential impacts on cultural resources within the APE as a result of implementing the Action Alternatives or the No-Action Alternative. The APE for cultural resources corresponds to the boundary of GBO. Because NEPA and NHPA Section 106 are parallel processes that are closely related in their findings of consequences for cultural resources, this Section presents the findings under both regulations. For purposes of clarity, this Section uses the term "impact" when discussing NEPA and the term "effect" when discussing Section 106. No important non-NRHP cultural resources were identified; therefore, impacts are discussed only for historic properties that are listed in the NRHP, that are individually eligible for the NRHP, or that contribute to the NRHP-eligible historic district.

Methodology

NEPA

After historic properties were identified within the APE, the Action Alternatives were analyzed to determine whether they would impact those properties. The following activities were identified and analyzed to determine level of impacts on historic properties.

- Loss of historic properties through demolition
- Alterations to historic properties as a result of mothballing or safe-abandonment
- Physical changes to the setting or other aspects of integrity of the historic properties
- Intensity of demolition activities in terms of ground disturbance
- Impact on historic properties as a result of potential changes in ownership of GBO

Broader indirect impacts (such as changes in land use) also were identified and analyzed. The analysis included activities that are caused by the Action Alternatives but that occur at a later time and distance from the Action Alternatives. However, no indirect impacts on historic properties were identified for the Action Alternatives or the No-Action Alternative. Therefore, no further discussion of indirect impacts is included for cultural resources.

NHPA

To create an EIS that corresponds with NSF's NHPA Section 106 requirements, impacts also are presented in terms of the ACHP's regulations implementing Section 106. After a historic property is identified, the Criteria of Adverse Effect (36 C.F.R. 800.5(1)) are applied. These criteria are used to determine whether the undertaking, which is defined as NSF's decision regarding the potential changes to GBO's operations, could change the characteristics that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. An effect is adverse under Section 106 if it diminishes the integrity

of the property's historically significant characteristics. Examples of adverse effects include, but are not limited to, the following:

- Demolition of the historic property
- Relocation of the historic property
- Introduction of visual, audible, or atmospheric elements that are out of character with the setting of the historic property
- Transfer of ownership of a federally-owned property to a non-federal entity

The term "mothballing" is used in this DEIS to refer to the process of removing a facility or structure from daily use while maintaining the general condition for a defined period, and removing equipment and instruments from use while keeping them in working order. The NPS guidelines for mothballing, presented in Preservation Brief 31, "Mothballing Historic Buildings," apply specifically to historic buildings instead of instruments or equipment (Park, 1993). However, because a similar approach could be used to preserve certain historic instruments and equipment at GBO, the term mothballing is used in this Section for historic instruments and equipment, as well as historic buildings and structures, to indicate that they will be preserved, protected, and maintained in an operational readiness condition. Historic instruments and equipment proposed for mothballing at GBO would be protected and preserved in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings* (Grimmer, 2017).

Table 4.2-1 identifies thresholds of NEPA impacts relevant to historic properties for this project and lists the correlation between NEPA impacts and NHPA Section 106 effects.

TABLE 4.2-1
Impact and Effect Thresholds for NEPA and Section 106

Impact Intensity	Description
Negligible	Impacts on historic properties, including historic districts, would not be detectable and would not alter resource characteristics. *The NHPA Section 106 finding would be no historic properties affected or no adverse effect to historic properties.*
Minor	Impacts on historic properties, including historic districts, would result in little, if any, loss of integrity and would be slight but noticeable. Impacts would not appreciably alter resource characteristics. *The NHPA Section 106 finding would be no adverse effect to historic properties.*
Moderate	Impacts on historic properties, including historic districts, would result in some loss of integrity and would be noticeable. Impacts could appreciably alter resource characteristics. Measures to mitigate impacts would be sufficient to reduce the intensity of impacts to a level less than major under NEPA. *The NHPA Section 106 finding would likely be no adverse effect, but only after implementing avoidance, minimization or mitigation measures sufficient to reduce the adverse effects to historic properties.*

TABLE 4.2-1
Impact and Effect Thresholds for NEPA and Section 106

Impact Intensity	Description
Major	Impacts on historic properties, including historic districts, would result in disturbance to an important site, substantial loss of integrity, and/or severe alteration of property conditions, the result of which would significantly affect the human environment. Mitigation would not be sufficient to reduce the intensity of impacts to a level less than major under NEPA. *The NHPA Section 106 finding would be adverse effect to historic properties. Measures to mitigate, avoid, and/or minimize adverse effects under Section 106 would be decided through consultation and stipulated in a Memorandum of Agreement (MOA) or Programmatic Agreement (PA).*

Duration: Short-term – Occurs only during the implementation period (i.e., demolition, mothballing, safe-abandonment, and land-transfer activities) and/or for a limited adjustment period.

Long-term – Continues long after the implementation period.

Note: Language shown in italics is the corresponding "Section 106 Finding of Effect."

NHPA Section 106 Process

The intent of the NHPA Section 106 consultation is to identify historic properties potentially affected by the undertaking, assess effects to them, and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. When an undertaking is found to have an adverse effect, Section 106 requires notification to the ACHP and consultation with SHPO and other interested parties regarding appropriate avoidance, minimization, or mitigation measures. In addition, special protections are given to NHLs, including the statutory requirement that "the agency official, to the maximum extent possible, [will] undertake such planning and actions as may be necessary to minimize harm to any National Historic Landmark that may be directly and adversely affected by an undertaking" (36 C.F.R. 800.10(a)). The regulation requires consultation with the ACHP and an invitation to the Secretary of the Interior to consult in order to resolve any adverse effects.

For a finding of adverse effect, the product of Section 106 consultation is usually a MOA per 36 C.F.R. 800.6(c) among the SHPO, federal agency, ACHP if they choose to participate, and other Consulting Parties. This agreement contains stipulations specifying measures to be implemented that would avoid, minimize, and/or mitigate the adverse effects. For this undertaking, an MOA or a PA would be drafted to resolve any potential adverse effects from the Proposed Action. The MOA or PA would be executed prior to signing the ROD.

NSF, as the lead federal agency under Section 106 for this undertaking, has consulted with the West Virginia SHPO and other Consulting Parties. NSF will notify the ACHP because of the potential for adverse effects to historic properties from the undertaking.

Table 4.2-2 lists the milestones of the Section 106 consultation process for this undertaking. Copies of correspondence appear in Appendix 4.2A, *Cultural Resources Correspondence*.

TABLE 4.2-2
Section 106 Consultation Process

Action	Date	Details
Intensive Architectural Survey	October 6–9, 2014	Intensive architectural survey conducted at GBO. Site visit was also used to engage GBO staff in informal interviews and to conduct archival research, including review of historic photographs and narratives, newspaper articles, construction records, and architectural drawings.
Public Scoping Initiated	October 19, 2016	Notice of Intent, including a notice of initiation of Section 106 process, was published in the *Federal Register*.
NEPA Scoping Letters	October 20, 2016	NSF sent NEPA scoping letters to ACHP and the West Virginia SHPO that also stated its intention to initiate consultation under Section 106.
Email Correspondence with SHPO	November 7, 2016	SHPO provided NSF with a list of tribes with historic ties to West Virginia.
NEPA Public Scoping Meeting	November 9, 2016	Two public scoping meetings held at the Green Bank Science Center at GBO. NSF provided an opportunity for individuals and organizations to express an interest in participating as Section 106 Consulting Parties.
Email from The Oneida Nation	November 9, 2016	The Oneida Nation of Wisconsin informed NSF that it is not interested in participating as a Consulting Party in the Section 106 process.
Section 106 Consultation with SHPO Initiated	December 2, 2016	NSF initiated formal Section 106 consultation with the West Virginia SHPO through written correspondence.
Email to Potential Consulting Party	December 6, 2016	NSF emailed Daryl White to confirm his participation as a Consulting Party in the Section 106 process.
Email to Potential Consulting Party	December 8, 2016	NSF emailed Grayg Ralphsnyder to confirm his participation as a Consulting Party in the Section 106 process.
Letter to Potential Consulting Party	December 9, 2016	NSF invited Pocahontas County Landmarks Commission to participate as a Consulting Party in the Section 106 process.
Section 106 Consultation with Native American Tribes Initiated	December 12, 2016	Letters were sent to the following tribes: United Keetoowah Band of Cherokee Indians; Tuscarora Nation; Shawnee Tribe; Seneca-Cayuga Tribe of Oklahoma; Seneca Nation of Indians; Tonawanda Band of Seneca; St. Regis Mohawk Tribe; Eastern Shawnee Tribe of Oklahoma; Delaware Tribe of Indians; Onondaga Nation; Eastern Band of Cherokee Indians; Cherokee Nation; Cayuga Nation; and Absentee Shawnee Tribe of Oklahoma.
Email Response from Consulting Party	December 14, 2016	Grayg Ralphsnyder confirmed that he would like to participate as a Consulting Party in the Section 106 process.
Letter from West Virginia SHPO to NSF	December 22, 2016	West Virginia SHPO concurred with APE. The SHPO also, concurred with the determination of individual NRHP eligibility for the Interferometer Range (under Criterion A), 40-foot Telescope (under Criterion A), 43-meter Telescope (140-foot Telescope) (under Criteria A and C), and the GBT (under Criteria A and C, Criteria Consideration G). Requested that HPI forms be completed for each resource that may contribute to the potential historic district.
Email from Pocahontas County Landmarks Commission	December 30, 2016	Email from Robert A. Sheets, a member of the Pocahontas County Landmarks Commission designated by the Commission to serve as a Consulting Party in the Section 106 process.
Email Response from Consulting Party	January 2, 2017	Daryl and Deanna White confirmed that they would like to participate as Consulting Parties in the Section 106 process. Asked for confirmation that they were eligible. NSF responded confirming that they were eligible to participate.
Letter to Potential Consulting Parties	January 12, 2017	Section 106 consultation letters sent to the Pocahontas Historical Society and the Preservation Alliance of West Virginia. NSF provided the organizations with copies of the Section 106 initiation letter and attachments that were sent to SHPO on December 2, 2016. NSF requested comments on the information.

TABLE 4.2-2
Section 106 Consultation Process

Action	Date	Details
Letter from the Preservation Alliance of West Virginia	February 3, 2017	Response letter informing NSF that they would like to continue as a Consulting Party during the Section 106 process. Provided comments on the Alternatives, noting that they support Action Alternatives A, B, and C, in that order.
Letter to SHPO	May 18, 2017	NSF transmitted 48 HPI forms for review and concurrence. NSF also forwarded to the SHPO all comments received to date as a result of the Section 106 consultation process.
Letter from SHPO	June 12, 2017	SHPO acknowledged receipt of the 48 HPI forms and concurred with NSF that GBO is eligible for the NRHP as a historic district. SHPO also acknowledged receipt of the Section 106 comments that NSF provided in May 2017.
Section 106 Consultation with Delaware Nation	August 7, 2017	Letter was sent to the Delaware Nation initiating Section 106 consultation.
Letter from the Delaware Nation	August 24, 2017	Response letter informing NSF that they would like to continue as a Consulting Party during the Section 106 process.

4.2.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

4.2.1.1 Architectural Resources

Table 4.2-3 lists the proposed activities that could impact historic properties under Action Alternative A. Additional facilities not listed in Table 4.3-3 could be demolished under Action Alternative A; however, to assess the potential impacts on historic properties, only those properties at GBO that contribute to the NRHP-eligible historic district, or are individually eligible for, or listed in, the NRHP are included in the table. Any historic properties not listed in Table 4.3-3, including the GBT, other telescopes, and supporting facilities for education and research, would be retained and maintained. Effects to the historic district are discussed in Section 4.2.1.2, *Historic District*.

TABLE 4.2-3
Action Alternative A – Description of Proposed Activities

Historic properties that could be demolished	45-foot Telescope
	300-foot Telescope Control Building (also known as Laser Lab)
	Interferometer Range (Telescope 85-1 [Tatel Telescope]) and 85-1 Control Building; Telescope 85-2; Telescope 85-3; Interferometer Control Building) [a]
	Calibration Horn
	Recreation Area
	Nut Bin
	Shinnaberry House
	Tracey House
	Beard House
	Hill House
	House 2 (Rabbit Patch)
	House 3 (Rabbit Patch)

TABLE 4.2-3
Action Alternative A – Description of Proposed Activities

	House 4 (Rabbit Patch)
	House 5 (Rabbit Patch)
	House 6 (Rabbit Patch)
	House 7 (Rabbit Patch)
	House 8 (Rabbit Patch)
	House 9 (Rabbit Patch)
	House 10 (Rabbit Patch)
	House 11 (Rabbit Patch)
	House 14
	House 16
	House 19
	House 21
	House 23
	House 24
	Millimeter Array Experiment Building
Historic properties that could be safe-abandoned	*43-meter Telescope (140-foot Telescope)*
Historic properties that could be mothballed	*Reber Radio Telescope (NHL)*
	Jansky Replica Antenna
	Ewen-Purcell Horn

[a] Resources in italics are individually eligible for, or listed in, the NRHP. All other resources included in the table contribute to the NRHP-eligible historic district.

Demolition

The individually NRHP-eligible telescope array (the Interferometer Range, which includes 3 large telescopes) and 26 resources that contribute to the NRHP-eligible district could be demolished as a result of Action Alternative A. The demolition of some or all the historic properties listed in Table 4.2-3 may occur depending on the needs of the collaborator(s). Action Alternative A involves the potential demolition of historic properties at GBO; therefore, impacts for Action Alternative A could be major, adverse, and long-term and an adverse effect under Section 106. Although mitigation would be implemented, demolition of a historic property cannot be mitigated to less than a major impact because it is a permanent removal of historic fabric. NSF will continue to consult with the West Virginia SHPO, ACHP, and other Consulting Parties to determine appropriate mitigation. It is anticipated that these measures would be stipulated in an MOA or PA.

Safe-abandonment

One individually NRHP-eligible telescope (the 43-meter telescope [140-foot telescope]) could be safe-abandoned as a result of Action Alternative A. Preparing the structure for safe-abandonment would involve securing the structure from environmental damage resulting from wind, rain, humidity, and

extreme temperatures. The structure would be isolated from public access through the installation of fencing or other means to reduce fall and tripping hazards and prevent vandalism. Securing the overall structure could involve slight alterations that might diminish the integrity of the structure's materials, design, or setting. These alterations would be noticeable but initially would not substantially diminish the primary characteristics of the 43-meter telescope (140-foot telescope) that qualify it for listing in the NRHP. Because impacts from safe-abandonment would be noticeable and would result in some loss of integrity, they would be considered moderate, adverse, and long-term under NEPA, and no adverse effect on historic properties under Section 106. Specific measures, agreed upon in consultation with the West Virginia SHPO, ACHP, and other Consulting Parties, would ensure that the effects to the historic structure and historic district are minimized and would potentially be sufficient to result in a finding of no adverse effect under Section 106.

Mothballing

One NRHP-listed telescope (the Reber Radio Telescope), which is also a NHL, and two contributing resources to the NRHP-eligible historic district (Jansky Replica Antenna and Ewen-Purcell Horn) would be mothballed as a result of Action Alternative A. However, all three resources proposed for potential mothballing are non-operational display instruments that are not in active use. The Ewen-Purcell Horn is a small instrument that was originally used at Harvard University; it has been mounted on two concrete piers clad in stone veneer as a display item at GBO. The Reber Radio Telescope has served as a display instrument since it was moved to GBO in 1959–1960; the Jansky Replica Antenna was constructed as a display structure. Therefore, the instruments have already been preserved and protected as display instruments. Few, if any, steps would be required to mothball these structures and ensure that they are secured. No physical alterations to the instruments are anticipated, so any impacts under NEPA, including those to the historic district, would be negligible, and there would be no adverse effect under Section 106. If any additional preparations were required to secure the structures, they would be executed in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings* (Grimmer, 2017). Anything done as part of the mothballing process could be reversed in the future without physical harm to the historic integrity. If these preparations could impact or effect the Reber Radio Telescope, consultation with the ACHP and an invitation to the Secretary of the Interior to consult would occur before mothballing the NRHP-listed structure, which is a designated NHL.

Post-implementation

Under Action Alternative A, one historic telescope (the 43-meter telescope [140-foot telescope]) could be safe-abandoned and three historic display instruments (Reber Radio Telescope, Jansky Replica Antenna, and Ewen-Purcell Horn) could be mothballed. The three instruments that could be mothballed are non-

operational display instruments that are not currently in active use. Therefore, mothballing these instruments would not alter the existing operations of the instruments or the historic district.

Safe-abandonment of the 43-meter telescope (140-foot telescope), which is individually NRHP-eligible and contributes to the NRHP-eligible historic district, would involve removing the radio telescope from service and isolating the structure from public access which would result in a change of use. The 43-meter telescope (140-foot telescope) is eligible for the NRHP for its important association with events that have made a significant contribution to radio astronomy and for its design and engineering. Because the radio telescope is a scientific instrument, its use is a primary component of its significance. Although the structure would remain extant, a change of use would diminish its integrity of feeling and association. In addition, as a result of lack of maintenance and use, the safe-abandonment of the telescope under Action Alternative A could result in a gradual deterioration of the structure's physical integrity, including its materials, workmanship, and design. Overall, the safe-abandonment of the 43-meter telescope (140-foot telescope) as an active instrument would diminish the NRHP-eligible instrument's integrity of materials, feeling, setting, design, workmanship, and association. The decline in the structure's integrity could ultimately result in a major, adverse, and long-term impact under NEPA and an adverse effect under Section 106 to the individual structure.

4.2.1.2 Historic District

Although a total of 26 contributing resources could be demolished under Action Alternative A, including one individually NRHP-eligible telescope, the remaining 18 contributing resources would be retained, either as active facilities or as safe-abandoned or mothballed instruments. Three telescopes within GBO (the GBT, the 43-meter telescope [140-foot telescope], and the 40-foot telescope [and its associated control building]), which are individually eligible for NRHP and important focal points of the property, would be retained. In addition, a selection of other building types would be preserved, including several administrative/operational support buildings and a small selection of residential buildings. As a result, Action Alternative A would preserve a collection of facilities that are significant in the development of radio astronomy and are representative of the various building and structure types that are currently extant. Therefore, the historic district would retain sufficient integrity to convey its historic significance. The impacts on the GBO historic district as a whole would be moderate, adverse, and long-term under NEPA, and no adverse effect under Section 106.

Under Action Alternative A, NSF could retain or transfer the property. If the property were transferred to a non-federal entity, NEPA and the NHPA's Section 106 consultation process would no longer be applicable to future proposed actions by any new owner. If any future new owner were to make changes that could affect one or more contributing elements to the historic district, that owner would not be required to consult with the SHPO under Section 106 of the NHPA to determine ways in which to avoid, minimize, and/or mitigate adverse effects. Therefore, a change in ownership to a non-federal entity would

result in major, adverse, long-term impacts under NEPA and an adverse effect under Section 106. NSF would consult with the West Virginia SHPO, ACHP, and other Consulting Parties to determine the appropriate ways to avoid, minimize, and/or mitigate this effect. Measures that resulted from these consultations would be documented in an MOA or PA and would include provisions that NSF would require of any new owner as a part of any future property transfer.

4.2.1.3 Archeological Resources

Ground disturbance as a result of Action Alternative A would be limited to activities associated with the demolition of buildings and structures at GBO. No tree removal or disturbances to undeveloped areas would be necessary as part of the demolition activities. In places where buildings might be removed from bedrock, soil would be established and areas of bare soil would be landscaped. There are no known archeological resources within the APE and therefore no impacts on archeological resources under NEPA. No effects to archeological historic properties under Section 106 are anticipated. However, if previously unidentified archeological resources were discovered during demolition, ground-disturbing activities would halt in the vicinity of the find and NSF would consult with the SHPO, ACHP, and other Consulting Parties, as appropriate, regarding eligibility for listing in the NRHP, project impacts, necessary mitigation, or other treatment measures. An unanticipated discovery plan would be in place prior to demolition to address any archeological resources that might be discovered. Archeological investigations could be conducted if it becomes necessary to perform work in areas that are currently undisturbed.

4.2.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

4.2.2.1 Architectural Resources

Similar to Action Alternative A, Action Alternative B potentially involves the demolition of facilities at GBO that are individually eligible for the NRHP and that contribute to the NRHP-eligible historic district. Table 4.2-4 lists the proposed activities that would impact historic properties under Action Alternative B. Additional facilities not listed in Table 4.2-4 could be demolished; however, to assess the potential impacts on historic properties, only those properties at GBO that contribute to the NRHP-eligible historic district, or are individually eligible for, or listed in, the NRHP are included in the table. Any historic properties not listed in Table 4.2-4 would be retained and maintained. Effects to the historic district are discussed in Section 4.2.2.2, *Historic District*.

TABLE 4.2-4
Action Alternative B – Description of Proposed Activities

Proposed Activity	Action Alternative B
Historic properties that could be demolished	45-foot Telescope
	300-foot Telescope Control Building (also known as Laser Lab)
	Coaxial Cable Building (also known as Telescope Mechanics Office)
	Interferometer Range (Telescope 85-1 [Tatel Telescope]) and 85-1 Control Building; Telescope 85-2; Telescope 85-3; Interferometer Control Building)[a]

TABLE 4.2-4
Action Alternative B – Description of Proposed Activities

Proposed Activity	Action Alternative B
	Calibration Horn
	Recreation Area
	Nut Bin
	Shinnaberry House
	Redwood House (also known as Director's House, House 1)
	Tracey House
	Riley House
	Beard House
	Hill House
	Hannah House
	House 2 (Rabbit Patch)
	House 3 (Rabbit Patch)
	House 4 (Rabbit Patch)
	House 5 (Rabbit Patch)
	House 6 (Rabbit Patch)
	House 7 (Rabbit Patch)
	House 8 (Rabbit Patch)
	House 9 (Rabbit Patch)
	House 10 (Rabbit Patch)
	House 11 (Rabbit Patch)
	House 14
	House 16
	House 19
	House 21
	House 23
	House 24
	Millimeter Array Experiment Building
Historic properties that could be safe-abandoned	*43-meter Telescope (140-foot Telescope)* *GBT*
Historic properties that could be mothballed	*Reber Radio Telescope* Jansky Replica Antenna Ewen-Purcell Horn

[a] Resources in italics are individually eligible for or listed in the NRHP. All other resources included in the table contribute to the NRHP-eligible historic district.

Demolition

Demolition activities for Action Alternative B would be similar to Action Alternative A; both could involve the demolition of historic properties, depending on the needs of the collaborator(s), but would avoid complete demolition of the historic district. However, under Action Alternative B, four additional historic properties could be demolished (total of 31 resources); impacts would be major, adverse, and long-term under NEPA and an adverse effect under Section 106. NSF would continue to consult with the

West Virginia SHPO, ACHP, and other Consulting Parties to determine the appropriate mitigation. It is anticipated that these measures would be stipulated in an MOA or PA.

Safe-abandonment

As with Action Alternative A, Action Alternative B could involve the safe-abandonment of the 43-meter telescope (140-foot telescope); however, Action Alternative B could also involve the safe-abandonment of the GBT, which is one of the primary focal points of the NRHP-eligible historic district. Preparing the structures for safe-abandonment would involve securing them from environmental damage resulting from wind, rain, humidity, and extreme temperatures. The structures would be isolated from public access through the installation of fencing or other means to reduce fall and tripping hazards and prevent vandalism. Securing the overall structures could involve minor alterations that might diminish the integrity of their materials, design, or setting. These alterations would be noticeable but would not substantially diminish the primary characteristics of the 43-meter telescope (140-foot telescope) or the GBT that qualify them for listing in the NRHP. Because impacts would be noticeable and would result in some loss of integrity, impacts would be considered moderate, adverse, and long-term. Specific measures, agreed upon in consultation with the West Virginia SHPO, ACHP, and other Consulting Parties, would ensure that effects on historic structures and the historic district are avoided, minimized, and/or mitigated to result in a finding of no adverse effect under Section 106.

Mothballing

Mothballing activities under Alternative B would be identical to Alternative A; therefore, impacts would be negligible and result in no adverse effect under Section 106.

Post-implementation

After demolition, operations would continue under Action Alternative B as a technology and education park with more of a tourism and local attraction focus. The change of use from a functioning radio observatory to a technology and education park would diminish the NRHP-eligible historic district's integrity of feeling and association.

As with Action Alternative A, the 43-meter telescope (140-foot telescope) could be safe-abandoned and three non-operational display instruments (Reber Radio Telescope, Jansky Replica Antenna, and the Ewen-Purcell Horn) could be mothballed under Action Alternative B. Therefore, impacts on these four historic properties as a result of selecting Action Alternative B would be the same as those described for Action Alternative A. The same measures that were described for Action Alternative A could be implemented to ensure that the effects over time of mothballing the three historic properties are minimized.

However, under Action Alternative B, the GBT could experience additional impacts and effects during operation, because potential safe-abandonment of the GBT would involve removing the radio telescope from service and isolating the structure from public access, which would result in a change of use. Because the radio telescope is a scientific instrument, its use is a primary component of its significance. Although the structure would remain extant, a change of use would diminish its integrity of feeling and association. In addition, as a result of the lack of maintenance and use, the safe-abandonment of the GBT under Action Alternative B could result in a gradual deterioration of the structure's physical integrity, including its materials, workmanship, and design. Overall, the safe-abandonment of the GBT would diminish the NRHP-eligible structure's integrity of materials, feeling, setting, design, workmanship, and association. As described under Action Alternative A for the 43-meter telescope (140-foot telescope), the decline in the GBT's integrity could ultimately result in major, adverse, and long-term impacts and an adverse effect under Section 106.

4.2.2.2 Historic District

As with Action Alternative A, Action Alternative B would preserve a collection of facilities that are significant in the development of radio astronomy as active facilities or as safe-abandoned or mothballed instruments. The deterioration of individual structures as a result of safe-abandonment would be noticeable but would not appreciably alter the historic district's characteristics. Overall, the historic district would retain sufficient integrity to convey its historic significance, resulting in moderate, adverse, and long-term impacts under NEPA, and no adverse effect under Section 106 to the historic district as a whole.

NSF could retain or transfer the property under Action Alternative B. As described for Action Alternative A, if the property were transferred to a non-federal entity, NEPA, NHPA, and the Section 106 consultation process would no longer be applicable to future actions by any new owner. Therefore, a property transfer to a non-federal entity would result in major, adverse, long-term impacts under NEPA and an adverse effect under Section 106. Requirements to resolve adverse effects to the historic district for Action Alternative B as a result of a potential property transfer out of federal ownership would be the same as those described for Action Alternative A.

4.2.2.3 Archeological Resources

Demolition activities for Action Alternative B would be similar in scale to those described for Action Alternative A. Consequently, the demolition impacts under NEPA and the effects under Section 106 to archeological resources for Action Alternative B would be the same as those described for Action Alternative A. There would be no impacts on archeological resources under NEPA, and no effects to archeological historic properties under Section 106 are anticipated. Similar archeological mitigation would be implemented.

4.2.3 Action Alternative C: Mothballing of Facilities

4.2.3.1 Architectural Resources

Table 4.2-5 lists the proposed activities that would impact historic properties under Action Alternative C. Additional facilities not listed in Table 4.2-5 could be demolished under Action Alternative C; however, to assess the potential impacts on historic properties, only those properties at GBO that contribute to the NRHP-eligible historic district, or are individually eligible for, or listed in, the NRHP are included in the table. Any historic properties not listed in Table 4.2-5 would be retained and maintained. Effects to the historic district are discussed in Section 4.2.3.2, *Historic District*.

TABLE 4.2-5
Action Alternative C – Description of Proposed Activities

Proposed Activity	Action Alternative C
Historic properties that could be demolished	*Interferometer Range (Telescope 85-1 [Tatel Telescope]) and 85-1 Control Building; Telescope 85-2; Telescope 85-3; Interferometer Control Building)*[a]
	Calibration Horn
	Beard House
	Millimeter Array Experiment Building
Historic properties that could be mothballed	*40-foot Telescope*
	43-meter Telescope (140-foot Telescope)
	45-foot Telescope
	300-foot Telescope Control Building (also known as Laser Lab)
	Coaxial Cable Building (also known as Telescope Mechanics Office)
	GBT
	Reber Radio Telescope
	Jansky Replica Antenna
	Ewen-Purcell Horn
	Jansky Laboratory (which includes the Outdoor Test Building)
	Warehouse
	Water Tower
	Works Area Building
	Airstrip
	Recreation Area
	Residence Hall & Cafeteria
	Nut Bin
	Shinnaberry House
	Redwood House (also known as Director's House, House #1)
	Tracey House
	Riley House
	Hill House
	Hannah House
	House 2 (Rabbit Patch)
	House 3 (Rabbit Patch)
	House 4 (Rabbit Patch)
	House 5 (Rabbit Patch)
	House 6 (Rabbit Patch)
	House 7 (Rabbit Patch)
	House 8 (Rabbit Patch)

TABLE 4.2-5
Action Alternative C – Description of Proposed Activities

Proposed Activity	Action Alternative C
	House 9 (Rabbit Patch)
	House 10 (Rabbit Patch)
	House 11 (Rabbit Patch)
	House 14
	House 16
	House 19
	House 21
	House 23
	House 24

[a] Resources in italics are individually eligible for or listed in the NRHP. All other resources included in the table contribute to the NRHP-eligible historic district.

Demolition

Demolition activities under Action Alternative C would impact fewer buildings and structures than under Action Alternatives A or B; however, the individually NRHP-eligible telescope array (the Interferometer Range, which includes three large telescopes) and three contributing resources (the Calibration Horn, Beard House, and the Millimeter Array Experiment Building) could be demolished under Action Alternative C. This would result in major, adverse, and long-term impacts under NEPA and an adverse effect under Section 106. NSF would continue to consult with the West Virginia SHPO, ACHP, and other Consulting Parties to determine the appropriate mitigation. It is anticipated that these measures would be stipulated in an MOA or PA.

Safe-abandonment

No buildings or structures would be safe-abandoned under Action Alternative C; therefore, there would be no associated impacts.

Mothballing

Forty historic properties would be mothballed under Action Alternative C. Avoiding demolition of historic properties means the properties would be preserved for potential future use. Of the four Action Alternatives, Action Alternative C would retain the largest collection of contributing buildings as a historic district that captures the significant development of radio astronomy. Preparing historic properties for mothballing would involve securing buildings and their associated components, turning off utilities, weatherizing, and providing adequate ventilation. These steps could involve some building treatments that would have negligible, impacts under NEPA and no adverse effect to historic properties under Section 106. Any modifications required during mothballing would be compatible with the historic property's style and materials and would be executed in accordance with the NPS's Preservation Brief 31, "Mothballing Historic Buildings" (Park, 1993) and *The Secretary of the Interior's Standards for the*

Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings (Grimmer, 2017). If historic properties were returned to use at a future date, any alterations performed as part of the mothballing process could be reversed without physical harm to the historic fabric. The Reber Radio Telescope is a preserved display instrument and, therefore, it is not anticipated that further actions to mothball the structure would be required. However, if preparations were required to secure the instrument that could impact or effect the historic structure, consultation with the ACHP and the Secretary of the Interior would occur before mothballing the NRHP-listed Reber Radio Telescope, which is a designated NHL. Of the four Action Alternatives, Action Alternative C would result in the least significant impacts on historic properties.

Post-implementation

Under Action Alternative C, the NRHP-eligible historic district and all its remaining contributing resources would be mothballed, which would involve removing each facility from daily use and maintaining the general condition of the historic properties for a defined period. Mothballing the NRHP-listed, NHL-designated instrument (Reber Radio Telescope), three individually NRHP-eligible telescopes (40-foot telescope, 43-meter telescope [140-foot telescope], and the GBT), and the 37 remaining contributing resources to the NRHP-eligible historic district would alter the use and setting of GBO. In addition, the 40-foot telescope, the 43-meter telescope (140-foot telescope), the GBT, and many of the resources that contribute to the NRHP-eligible historic district have achieved historic significance through their use as tools for furthering the field of radio astronomy. For these reasons, if GBO were mothballed, the NRHP-eligible historic district and the contributing historic resources would suffer a temporary loss of association and feeling. However, mothballed resources could be returned to use at a future time, which would restore the district's integrity of association and feeling. Specific measures could ensure that effects from mothballing resources are minimized. These measures could include photographic documentation of the historic properties at GBO, a detailed conditions assessment of the contributing resources, compliance with certain security and maintenance standards, and regular monitoring of the buildings and structures that contribute to the NRHP-eligible historic district. A maintenance program could protect the facilities from deterioration, vandalism, and other damage. Regular security patrols could be performed to monitor the site. Common mothballing measures, such as providing proper ventilation, keeping roofs and gutters cleaned of debris, and performing ground maintenance and pest control, could be implemented. Lubrication and other deterioration-preventing measures could be required on the remaining telescopes. These measures would ensure the future survival of the historic district and its associated historic properties. Mothballing would be carefully planned and completed in accordance with the NPS's Preservation Brief 31, "Mothballing Historic Buildings" (Park, 1993) and *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings* (Grimmer, 2017). Following

these procedures, post-demolition and mothballing activities under Action Alternative C would result in moderate, adverse, and long-term impacts, and no adverse effect under Section 106.

4.2.3.2 Historic District

Although a few contributing resources would be demolished, a majority of contributing resources within the historic district, including several of the primary instruments, would be preserved and maintained under Action Alternative C. Overall, the historic district would retain sufficient integrity to convey its historic significance, resulting in moderate, adverse, and long-term impacts under NEPA, and no adverse effect under Section 106 to the historic district as a whole.

4.2.3.3 Archeological Resources

Demolition activities under Action Alternative C would be fewer than under Action Alternatives A or B, because activities would be limited to the demolition of up to nine individual facilities at GBO, three of which are historic properties. Soil would be established in disturbed areas where buildings were removed from bedrock and any areas of bare soil would be landscaped. There are no known archeological resources within the APE and therefore no impacts on archeological resources under NEPA, and no effect to archeological historic properties under Section 106 are anticipated. An unanticipated discovery plan would be in place prior to demolition under Action Alternative C, as described for Action Alternatives A and B.

4.2.4 Action Alternative D: Demolition and Site Restoration

4.2.4.1 Architectural Resources

Table 4.2-6 lists proposed activities that would impact historic properties under Action Alternative D. Additional facilities not listed in Table 4.2-6 could be demolished under Action Alternative D; however, to assess the potential impacts on historic properties, only properties at GBO that contribute to the NRHP-eligible historic district, or are individually eligible for, or listed in, the NRHP are included in the table. Effects to the historic district are discussed in Section 4.2.4.2, *Historic District*.

TABLE 4.2-6
Action Alternative D – Description of Proposed Activities

Proposed Activity	Action Alternative D
Historic properties that could be demolished	*40-foot Telescope*[a]
	43-meter Telescope (140-foot Telescope)
	45-foot Telescope
	300-foot Telescope Control Building (also known as Laser Lab)
	Coaxial Cable Building (also known as Telescope Mechanics Office)
	GBT
	Jansky Replica Antenna
	Ewen-Purcell Horn
	Interferometer Range (Telescope 85-1 [Tatel Telescope]) and 85-1 Control Building; Telescope 85-2; Telescope 85-3; Interferometer Control Building)
	Jansky Laboratory (which includes the Outdoor Test Building)

TABLE 4.2-6
Action Alternative D – Description of Proposed Activities

Proposed Activity	Action Alternative D
	Calibration Horn
	Warehouse
	Water Tower
	Works Area Building
	Airstrip
	Recreation Area
	Residence Hall & Cafeteria
	Nut Bin
	Shinnaberry House
	Redwood House (also known as Director's House, House #1)
	Tracey House
	Riley House
	Beard House
	Hill House
	Hannah House
	House 2 (Rabbit Patch)
	House 3 (Rabbit Patch)
	House 4 (Rabbit Patch)
	House 5 (Rabbit Patch)
	House 6 (Rabbit Patch)
	House 7 (Rabbit Patch)
	House 8 (Rabbit Patch)
	House 9 (Rabbit Patch)
	House 10 (Rabbit Patch)
	House 11 (Rabbit Patch)
	House 14
	House 16
	House 19
	House 21
	House 23
	House 24
	Millimeter Array Experiment Building
Historic properties that could be relocated	*Reber Radio Telescope*

[a] Resources in italics are individually eligible for or listed in the NRHP. All other resources included in the table contribute to the NRHP-eligible historic district.

Demolition

Action Alternative D would involve the demolition of nearly all historic properties at GBO, resulting in major, adverse, and long-term impacts under NEPA and an adverse effect to historic properties under Section 106. Only the NRHP-listed Reber Radio Telescope would be preserved and relocated. Consultation with the ACHP and the Secretary of the Interior would occur before relocating the Reber

Radio Telescope, which is a designated NHL. NSF would continue to consult with the West Virginia SHPO, ACHP, and other Consulting Parties to determine the appropriate mitigation. It is anticipated that these measures would be stipulated in an MOA or PA.

Mothballing

No buildings or structures would be mothballed under Action Alternative D; therefore, there would be no associated impacts.

Safe-abandonment

No buildings or structures would be safe-abandoned under Action Alternative D; therefore, there would be no associated impacts.

Post-implementation

Operations would completely cease under Action Alternative D; therefore, post-demolition activities associated with Action Alternative D would result in no further impacts on historic properties and no historic properties would be affected under Section 106.

4.2.4.2 Historic District

The complete demolition of GBO would result in the elimination of a NRHP-eligible historic district. Impacts would be major, adverse, and long-term under NEPA and an adverse effect to historic properties under Section 106 would occur. NSF would continue to consult with the West Virginia SHPO, ACHP, and other Consulting Parties to determine appropriate mitigation.

4.2.4.3 Archeological Resources

Ground disturbance for Action Alternative D would be associated with demolition activities. All facilities and structures would be demolished. For the GBT, 43-meter telescope (140-foot telescope), and water tower, initial demolition (bringing structures to ground level) would be accomplished using explosives, followed by the use of conventional demolition equipment. Exposed below-grade structures would be removed to a maximum of 4 feet to enable the restoration of the ground surface topography without limiting future surface operations or activities where foundations exist beyond that depth. Site restoration work would include regrading affected areas to desired elevations and contours using available concrete rubble, as necessary, and bringing in fill as needed to establish the grade. Although Action Alternative D would involve more substantial demolition activities and ground disturbance than Action Alternatives A, B, and C, the resulting impacts under NEPA and effects under Section 106 to archeological resources would be the same as those described for Action Alternative A because there are no identified archeological resources at GBO. An unanticipated discovery plan would also be implemented. Therefore, no impacts on archeological resources under NEPA and no effect to archeological historic properties under Section 106 are anticipated under Action Alternative D.

4.2.5 No-Action Alternative

The No-Action Alternative is the continuation of the current use of GBO. Under the No-Action Alternative, current activities would continue at the site, and no demolition would occur. Current activities at GBO include regular maintenance of buildings and structures, and alterations to resources that contribute to the NRHP-eligible historic district in order to adapt to changes in science and technology. Therefore, maintaining the current conditions of the Observatory could involve minor alterations to historic properties to retain their utility, resulting in negligible impacts on historic properties. The corresponding finding of effect under Section 106 would be no adverse effect to historic properties.

4.2.6 Mitigation Measures

The following is a summary of the suggested mitigation measures related to the Action:

- All Action Alternatives: Stipulations specified in the Section 106 MOA/PA, reached through consultation, would be followed. These stipulations would suffice to address the necessary mitigation for major impacts on cultural resources under NEPA. Specific mitigation measures would be developed in consultation with the SHPO, ACHP, and other Consulting Parties.
- All Action Alternatives: Stipulations specified as a result of consultation with the ACHP and the Secretary of the Interior regarding proposed impacts and effects to the Reber Radio Telescope, which is a designated NHL, would be followed.
- All Action Alternatives: An unanticipated discovery plan would be developed prior to demolition under the selected Action Alternative to address any archeological resources that might be discovered during demolition.
- Action Alternatives A, B, and C: Mothballing historic properties would be completed in accordance with the NPS's Preservation Brief 31, "Mothballing Historic Buildings" (Park, 1993) and *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings* (Grimmer, 2017).

4.2.7 Summary of Impacts

Table 4.2-7 provides a summary of impacts resulting from the Alternatives.

TABLE 4.2-7
Summary of Cultural Resources Impacts

Impacts	Alternatives [a]				
	Action Alternative A	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Overall impacts on known historic properties (architectural resources) from demolition	Major, adverse, long-term impact *Adverse effect*	Major, adverse, long-term impact *Adverse effect*	Major, adverse, long-term impact *Adverse effect*	Major, adverse, long-term impact *Adverse effect*	No impact
Overall impacts on known historic properties (architectural resources) from safe-abandonment	Moderate, adverse, long-term impact *No adverse effect*	Moderate, adverse, long-term impact *No adverse effect*	No impact	Not applicable	No impact
Overall impacts on known historic properties (architectural resources) from mothballing	Negligible *No adverse effect*	Negligible *No adverse effect*	Negligible *No adverse effect*	Not applicable	No impact
Overall impacts on known historic properties (architectural resources) post-implementation	Major, adverse, long-term impact *Adverse effect*	Major, adverse, long-term impact *Adverse effect*	Moderate, adverse, long-term impact *No adverse effect*	No impact	Negligible *No adverse effect*
Overall impacts on the NRHP-eligible historic district (if property remains under federal ownership)	Moderate, adverse, long-term impact *No adverse effect*	Moderate, adverse, long-term impact *No adverse effect*	Moderate, adverse, long-term impact *No adverse effect*	Major, adverse, long-term impact *Adverse effect*	Negligible *No adverse effect*
Overall impacts on the NRHP-eligible historic district (if property is transferred out of federal ownership)	Major, adverse, long-term impact *Adverse effect*	Major, adverse, long-term impact *Adverse effect*	Not applicable	Not applicable	Not applicable
Potential impacts on archeological resources	No impact *No historic properties affected*	No impact *No historic properties affected*	No impact *No historic properties affected*	No impact *No historic properties affected*	No impact *No historic properties affected*

[a] Language shown in italics is the corresponding Section 106 Finding of Effect.

4.3 Visual Resources

This Section describes the potential impacts on visual resources within the ROI as a result of implementing the Action Alternatives or as a result of the No-Action Alternative.

Methodology

The methods used to determine whether the Alternatives would have impacts on visual resources are as follows:

- Determine if the Action Alternatives would result in a perceivable change to the visual character of the area (that is, a change in how the viewed environment appears).
- Evaluate how the perceivable changes to the visual character would alter the existing visual quality (high, average, low).
- Determine if there would be a substantial change to the existing visual quality of the site.

Table 4.3-1 identifies the impact thresholds for visual resources.

TABLE 4.3-1
Impact Thresholds for Visual Resources

Impact Intensity	Description
Negligible	No or nearly imperceptible impacts on the existing appearance (visual character) or visual quality of the resources would be expected.
Minor	There would be only a slight change to the existing appearance (visual character) of the area; however, the changes would provide the same visual quality as the current conditions (that is, remain high, average, or low).
Moderate	There would be a perceivable change to the existing appearance (visual character) of the area; however, the changes would provide the same visual quality as the current conditions (that is, remain high, average, or low).
Major	There would be a substantial change to the existing appearance (visual character) of the area that would result in an alteration of the visual quality of a broad area and/or historic district or an aesthetically important resource would be lost.

Duration: **Short-term –** Occurs only during the implementation (i.e., demolition, mothballing, and/or safe-abandonment) and/or for a limited adjustment period.

Long-term – Endures long after the implementation of the Proposed Action.

4.3.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

Demolition, Safe-abandonment, and Mothballing

Demolition activities during Action Alternative A would temporarily alter the visual character of GBO. Fugitive dust from demolition activities and the presence of large vehicles would temporarily alter the

appearance of the site. However, these activities would be relatively small in scale and the visual quality of the site would remain high. Consequently, impacts would be minor, adverse, and short-term.

Post-implementation

The facilities proposed for removal under Action Alternative A primarily have a utilitarian or residential visual character and are not considered aesthetically or architecturally significant. The Interferometer Range, which consists of three large telescopes and several control buildings, could be removed under Action Alternative A. The instruments are not considered significant for their aesthetic or visual character. The other buildings and structures that could be removed are primarily simple buildings, many of which are residential buildings that have low visual and aesthetic quality. The removal of buildings in this area would change the visual character in those locations from a residential context to a natural setting. As a result, the visual quality of the site would remain high.

The three structures proposed for mothballing under Action Alternative A are non-operational display instruments that would not be physically altered as a result of any mothballing preparations. All mothballed facilities would be regularly maintained, which would reduce the likelihood of permanent visual changes to these sites. Fencing, placed around mothballed facilities, could affect the localized visual quality while the fencing is in place.

The overall impacts on the visual landscape from building removal and mothballing would be minor, adverse, and long-term, as a result of the activities mentioned previously.

4.3.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Demolition, Safe-abandonment, and Mothballing

Demolition activities for Action Alternative B would be similar in terms of scale to those described for Action Alternative A, although Action Alternative B could result in the demolition of four additional facilities. Similar minor, adverse, and short-term impacts on visual resources would occur as a result of fugitive dust and the presence of large equipment.

Post-implementation

Impacts on visual resources as a result of removed and mothballed buildings would be the similar to those described for Action Alternative A. The primary difference would be the safe-abandonment of GBT and the 43-meter telescope (140-foot telescope) under Action Alternative B. Fencing or other measures to isolate the GBT and 43-meter telescope in preparation for safe-abandonment could change the visual character of GBO and further detract from the natural setting. These activities would be small in scale compared to the surrounding landscape, and GBO would retain high visual quality. Impacts on visual resources would be minor, adverse, and long-term during Action Alternative B operations.

4.3.3 Action Alternative C: Mothballing of Facilities

Demolition and Mothballing

Under Action Alternative C, most facilities within GBO would be mothballed, while some would be demolished. The impacts on the visual landscape during demolition activities would be similar to those described for Action Alternatives A and B and would be minor, adverse, and short-term.

Post-implementation

Operations would be suspended under Action Alternative C, thereby eliminating access to GBO by its current primary viewers, including GBO employees, visiting scientists, and other visitors. However, except for fencing, the visual quality of the overall site would remain, and visual resources would be preserved for future viewing.

The change in visual character from mothballed and removed buildings would result in minor, adverse, and long-term impacts.

4.3.4 Action Alternative D: Demolition and Site Restoration

Demolition

More demolition activities could occur under Action Alternative D than under any of the other Action Alternatives. As a result of the increased scale and duration of demolition activities, the resulting fugitive dust, and the number of large vehicles, impacts on visual resources would be moderate, adverse, and short-term.

Post-implementation

Action Alternative D involves the demolition or relocation of all buildings and structures at GBO. This would result in a substantial change to the appearance and visual character of the site and landscape. The visual character would change from a science facility situated in a natural setting to solely a natural setting. Furthermore, the GBT and 43-meter telescope (140-foot telescope), which are considered aesthetically important resources as a result of design and engineering, would be removed. This change would result in a moderate, adverse, and long-term impact, because the visual character of the site would be noticeably altered. The visual quality of the site would remain high because of the natural surroundings.

4.3.5 No-Action Alternative

The No-Action Alternative is the continuation of the current use of GBO. Under the No-Action Alternative, current activities would continue at the site, and no demolition would be expected to occur. The visual character and quality of the site and landscape would not change. Therefore, the No-Action Alternative would have no impact on visual resources.

4.3.6 Mitigation Measures

The following is a summary of the suggested mitigation measures proposed to minimize impacts on visual resources.

- Action Alternatives A, B and C: Mothballed and safe-abandoned buildings would be regularly maintained to preserve the visual character of the site.

4.3.7 Summary of Impacts

Table 4.3-2 provides a summary of impacts resulting from the Alternatives on visual resources.

TABLE 4.3-2
Summary of Visual Resources Impacts

	Alternatives				
Impacts	**Action Alternative A**	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Impacts on visual resources during demolition, safe-abandonment, and mothballing	Minor, adverse, short-term	Minor, adverse, short-term	Minor, adverse, short-term	Moderate, adverse, short-term	No impact
Impacts on visual resources post-implementation	Minor, adverse, long-term	Minor, adverse, long-term	Minor, adverse, long-term	Moderate, adverse, long-term	No impact

4.4 Geology and Soils

This Section identifies potential direct and indirect impacts on topography, geologic resources, seismicity, landslide potential, and soil that may result from implementing the Alternatives, including the No-Action Alternative. The ROI for geology and soil is the GBO boundary.

Methodology

Impacts on geologic resources were evaluated by considering disturbances to topography, geologic features, and soil, and threats to human life or property resulting from the Alternatives. The impact evaluation also considered adverse effects to geologic resources of economic value. Factors considered in determining whether an Alternative would have an impact on geological resources included the extent or degree to which its implementation would meet the thresholds defined in Table 4.4-1.

TABLE 4.4-1
Impact Thresholds for Geologic Resources

Impact Intensity	Description
Negligible	The impact would be below or at the lowest levels of detection.
Minor	The Alternative would result in a detectable change in topography; however, the impact would be small, localized, and of little consequence. Changes to the geologic conditions would not threaten human life or property during earthquakes or cause landslide events. Activities would result in a noticeable but inconsequential increase in soil erosion. There would be noticeable but inconsequential impacts on geologic resources of economic value.
Moderate	The Alternative would result in a clear change to geologic resources or topography over a relatively wide area. Changes to the geologic conditions could threaten property during earthquakes or cause small scale landslide events. Activities would result in a noticeable increase in soil erosion. There would be noticeable impacts on geologic resources of economic value.
Major	The Alternative would result in a substantial change to the character or usability of geologic resources and topography, affecting a large area. Changes to the geologic conditions could threaten human life or property during earthquakes or landslides. Activities would result in substantial soil loss through erosion, creating significant dust and water quality concerns. There could be a potential loss of a geologic resource of economic value.

Duration: **Short-term –** Occurs only during the implementation (i.e., demolition, mothballing, and/or safe-abandonment) and/or for a limited adjustment period.
Long-term – Endures long after the implementation of the Proposed Action.

4.4.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

Topography

Ground and soil around structures to be demolished would be compacted and disturbed from the creation of staging areas for materials and equipment and from the use of cranes and heavy equipment. Existing roads and previously disturbed areas would be used to the extent possible. Earth-disturbing activities would be conducted in a manner that minimizes alteration of existing grade and hydrology. Following the removal of structures, disturbed areas would be stabilized and revegetated and/or re-landscaped. Based on these activities, impacts on topography during demolition would be negligible and there would be no expected impacts during operations.

Geologic Resources

The GBO site is located in a region where natural gas could be accessible (Tuscarora gas play). However, demolition activities would not be expected to adversely affect the potential for future natural gas extraction within the area. No impacts on future mineral resource extraction would be expected and there would be no expected impacts on geologic resources during operations.

Seismicity

The GBO site is located in an area with a less than 1 percent chance of experiencing damage from natural or human-induced earthquakes (USGS, 2017a, 2017b). Demolition activities would not be expected to change the earthquake risk for GBO; therefore, no impacts on earthquake risks would be expected and there would be no expected impacts on seismicity during operations.

Landslides

The GBO site is located in an area with a low landslide risk. Slight changes to the landscape would occur during demolition, including potential soil compaction, removal and/or temporary exposure. During and after these activities, precautions would be implemented to stabilize soils, prevent soil loss and landslides, including stormwater mitigation, and erosion control BMPs. Because of the potential for heavy rain events to result in unsafe work conditions and increased landslide conditions, including, but not limited to, debris flow, the decision to work during heavy rain events would be evaluated on a case-by-case basis to lower the risk for debris flow. Impacts on landslide risks would be negligible during demolition because the risk of landslides is low, and surrounding areas are vegetated. There would be no expected impacts associated with landslides during operations.

Soil

The majority of the structures that would be demolished are located within the Allegheny loam (3 to 8 percent slope), which has a moderate erosion risk, or the Purdy silt loam, which has a slight erosion risk

(Figure 4.4-1). All structures that would be demolished are within areas that are maintained with mowed landscape grasses, and additional maintained areas are available for staging and support during demolition. Standard construction stormwater BMPs would be implemented and maintained to prevent indirect impacts on soil from stormwater runoff. Disturbed areas would be stabilized and revegetated to minimize the potential for erosion following demolition. Consequently, impacts on soil resources would be limited to areas where demolition occurs and the impacts would be negligible. There would be no expected impacts on soil during operations.

4.4.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Action Alternative B is similar in intensity to Action Alternative A. Standard BMPs, including proper stormwater management measures and erosion control BMPs, would minimize adverse impacts. Demolition impacts on topography, landslide potential, and soil would be negligible. There would be no impacts on regional seismicity or geological resources of economic value.

Considering the similar scale of operations, the impacts on geology, seismicity, landslide potential, and soil resulting from Action Alternative B would be similar to those described for Action Alternative A. Consequently, there would be no impacts during operations.

4.4.3 Action Alternative C: Mothballing of Facilities

Action Alternative C is similar in intensity to Action Alternative A, although fewer buildings would be demolished and fencing would be more extensive. Standard BMPs, including proper stormwater management measures and erosion control BMPs, would minimize adverse impacts. Demolition and fencing impacts on topography, landslide potential, and soil would be negligible. There would be no impacts on regional seismicity or geological resources of economic value.

Operations would essentially cease under Action Alternative C, except for maintenance activities, which include vegetation maintenance. Therefore, there would be no impacts following the completion of demolition and mothballing activities.

4.4.4 Action Alternative D: Demolition and Site Restoration

Topography

Under Action Alternative D, impacts on local topographic conditions would be minor, adverse, and long-term from the creation of staging areas for materials and equipment and from the use of cranes, heavy equipment, and explosives to remove all facilities. Impacts on topography include the removal of foundations and below-grade structures. Following demolition, the structure locations and staging areas would be stabilized and revegetated to mimic the natural topography of the area. There would be no impacts on topography following the completion of demolition activities.

Geologic Resources

There would be no impacts on geological resources during or after the implementation of Action Alternative D.

Seismicity

Impacts associated with earthquake risk would be comparable to those described for Action Alternative A. There would be no impacts on seismicity during or after demolition.

Landslides

The GBO site is in an area with a low landslide risk. Under Action Alternative D, impacts on the landscape would occur during the removal of all facility structures. Noticeable changes to the landscape would occur, including the potential for soil compaction, removal and/or temporary soil exposure. During and after these activities, precautions would be implemented to prevent soil loss and landslides. These precautions would include stormwater management measures and erosion control BMPs. The grade would be returned to pre-existing contours and the decision to work during heavy rain events would be conducted on a case-by-case basis to lower the risk for debris flow; explosives would not be used during periods of concern. The risk of landslides would remain negligible for Action Alternative D. Following demolition, there would be no impacts resulting from landslides.

Soil

Under Action Alternative D, impacts on soil resources would be negligible, because all areas of demolition work would be within previously disturbed locations and soil of low erosion risk. Stormwater BMPs would be implemented and maintained to prevent indirect impacts on soil from stormwater runoff. There would be no impacts on soil after demolition activities.

4.4.5 No-Action Alternative

Under the No-Action Alternative, current activities would continue at GBO, and no demolition phase activity would be expected to occur. Therefore, there would be no impacts on topography, geological resources, seismicity or landslides.

4.4.6 Mitigation Measures

To ensure that there would be no impacts, the following measures would be implemented prior to and during demolition phase activities:

- All Action Alternatives: Standard construction stormwater controls would be implemented and maintained to prevent scour and soil loss from runoff. Erosion control measures such as compost blankets, mulching, riprap, geotextiles, and slope drains could be used to protect exposed soil and minimize erosion. BMPs such as check dams, slope diversions, and temporary diversion dikes could be implemented for runoff control. Sediment control measures that could be implemented, including

compost filter berms and socks; fiber rolls or berms; sediment basins, rock dams, filters, chambers, or traps; silt fences; and weed-free hay bales. Good housekeeping measures would be practiced during demolition.

- All Action Alternatives: Disturbed areas would be stabilized and revegetated and/or re-landscaped to minimize the potential for erosion after demolition is completed.
- All Action Alternatives: Earth-disturbing activities would be conducted in a manner that minimizes alteration of existing grade and hydrology.
- All Action Alternatives: Because of the potential for heavy rain events to result in unsafe work conditions and increased landslide conditions, including, but not limited to, debris flow, the decision to work during heavy rain events would be evaluated on a case-by-case basis to lower the risk for debris flow. Explosives would not be used during period of high landslide potential.

4.4.7 Summary of Impacts

Table 4.4-2 provides a summary of geology and soil impacts resulting from the Alternatives.

TABLE 4.4-2
Summary of Geology Impacts

	Alternatives				
Impacts	**Action Alternative A**	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Impacts on topography during demolition	Negligible	Negligible	Negligible	Minor, adverse, long-term	No Impact
Impacts on geological resources of economic concern during demolition	No Impact	No Impact	No Impact	No Impact	No Impact
Impacts on seismicity during demolition	No Impact	No Impact	No Impact	No Impact	No Impact
Impacts from landslides during demolition	Negligible	Negligible	Negligible	Negligible	No Impact
Impacts on soil during demolition	Negligible	Negligible	Negligible	Negligible	No Impact
Impacts post-implementation	No impact	No impact	No impact	No impact	No Impact

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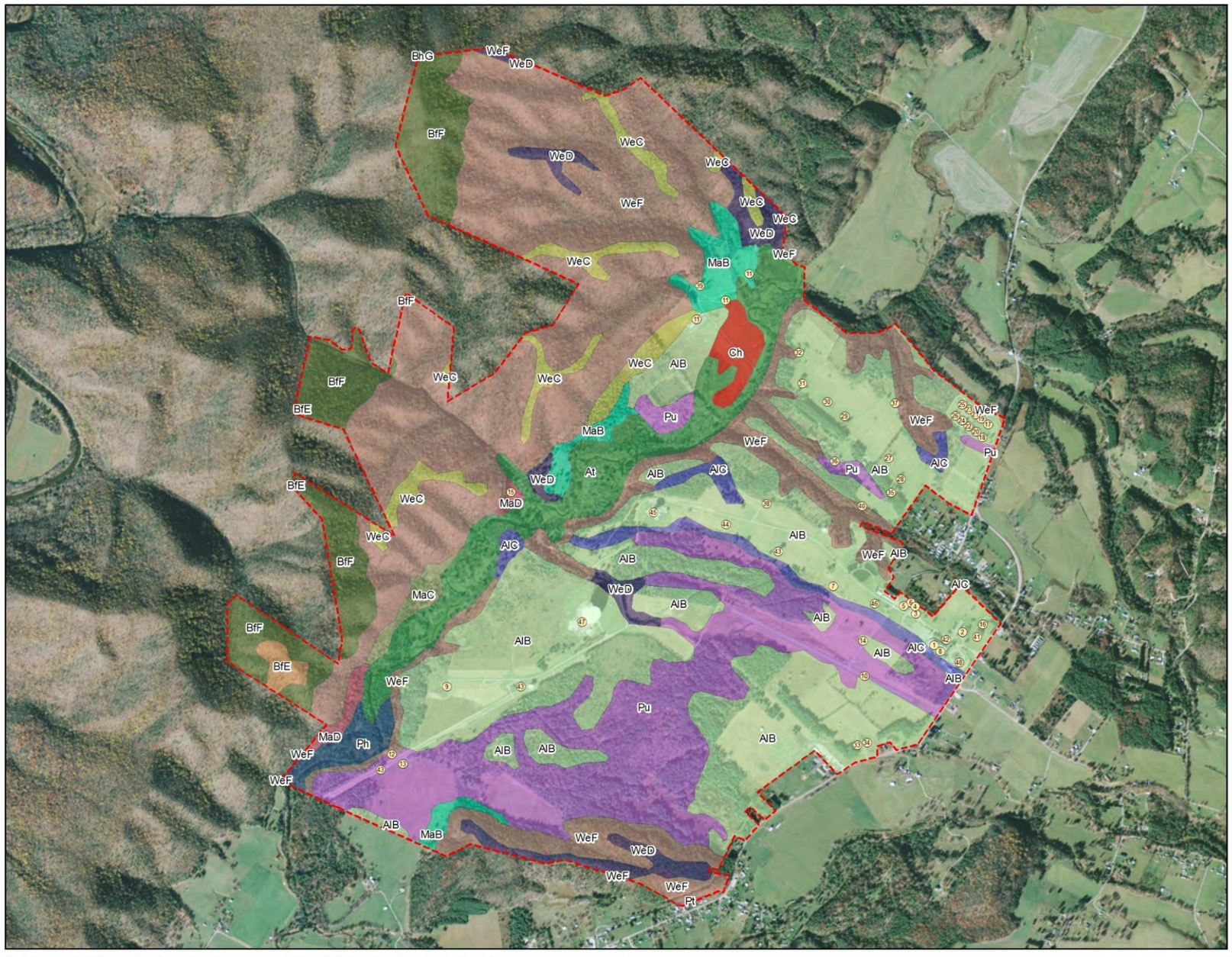
FIGURE 4.4-1
Building/Structure Locations within NRCS Soils



LEGEND

- Green Bank Observatory Boundary
- Building/Structure

Symbol - Map Soil Name

- AlB - Allegheny loam, 3 to 8 percent
- AlC - Allegheny loam, 8 to 15 percent
- At - Atkins silt loam
- BfE - Berks channery silt loam, 15 to 35 percent slopes, very stony
- BfF - Berks channery silt loam, 35 to 55 percent slopes, very stony
- BhG - Berks, Weikert, and Calvin soils, 55 to 80 percent slopes, very stony
- Ch - Chavies fine sandy loam
- MaB - Macove channery silt loam, 3 to 8 percent slopes
- MaC - Macove channery silt loam, 8 to 15 percent slopes
- MaD - Macove channery silt loam, 15 to 25 percent slopes
- Ph - Philo silt loam
- Pt - Potomac very gravelly loam
- Pu - Purdy silt loam
- WeC - Weikert channery silt loam, 8 to 15 percent slopes
- WeD - Weikert channery silt loam, 15 to 25 percent slopes
- WeF - Weikert channery silt loam, 25 to 55 percent slopes

Note:
Please see Figure 3.3-2 for Facility Names

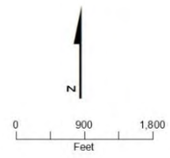


Figure 4.4-1
Building/Structure Locations within NRCS Soils
Green Bank Obervatory
Green Bank, West Virgina

T:\NSF\GREEN_BANK_OBSERVATORY\MAPFILES\GEOLOGY_SOILS\SOILS_AND_FACILITIES.MXD JQUAN 3/16/2017 1:59:33 PM

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4.5 Water Resources

This Section identifies the potential direct and indirect impacts on water resources that may result from implementing the Alternatives for GBO, including the No-Action Alternative. Water resources include wetlands, surface water bodies, floodplains, and groundwater The ROI for the water resources impact analysis is the area within the GBO boundary. However, when necessary, the analysis also addresses potential impacts on connected offsite water resources.

Methodology

The methods used to determine whether the Alternatives would have impacts on water resources are as follows:

- Evaluate each Alternative to determine its impacts on water resources resulting from the loss of the water resource area or the loss/impairment of the water resource function.
- Assess the compliance of each Alternative with federal regulations that apply to the protection of water resources.

Table 4.5-1 defines the thresholds used to determine the intensity of direct and indirect impacts on water resources.

TABLE 4.5-1
Impact Thresholds for Water Resources

Impact Intensity	Description
Negligible	Changes to water resources would not be measurable or of perceptible consequence. There would be no loss of water resource area and very little to no impairment of water resource function.
Minor	Changes to water resources would be detectable. There would be little overall loss of water resource area or loss/impairment of water resource function. Changes would be small, localized, and of little consequence.
Moderate	Changes to water resources would be readily apparent. There would be moderate overall loss of a water resource area, a loss/impairment of water resource function, or both. Changes would occur over a relatively wide area.
Major	Changes to water resources would be substantial. There would be extensive loss to a scarce or unique water resource area and loss/impairment of a water resource function. Onsite disturbances would have a high potential to negatively affect the functionality of connected offsite water resources.

Duration: **Short-term** – Occurs only during the implementation (i.e., demolition, mothballing and/or safe-abandonment) of the Proposed Action and/or for a limited adjustment period.

Long-term – Endures long after the implementation of the Proposed Action.

4.5.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

Demolition, Safe-abandonment, and Mothballing

None of the facilities that could be demolished under Action Alternative A are located in or adjacent to wetlands, surface water bodies, or floodplains. There would be no impacts on wetlands, surface water, or floodplains under Action Alternative A.

Ground-disturbing activities associated with facility demolition, such as the use of large equipment and vehicles, the removal of infrastructure, and the establishment of staging areas, have the potential to cause soil erosion sand increase stormwater runoff, thereby indirectly impacting wetlands and surface water bodies. Appropriate engineering controls and BMPs would be implemented during demolition to prevent indirect impacts (erosion sedimentation, dewatering, and pollution) to onsite and offsite wetlands, ponds, and streams. Demolition activities would require a Construction Stormwater General Permit from the WVDEP, which is required for any proposed project that would disturb 1 acre or more of land in the state. A Storm Water Pollution Prevention Plan (SWPPP) and Groundwater Protection Plan (GPP) must be prepared and implemented as part of this permit. These plans would outline the measures to be implemented during demolition activities to prevent impacts on surface waters and groundwater.

Groundwater may be encountered during certain types of demolition activities such as excavation within the footprints of the facilities. Any dewatering that is necessary during demolition would be conducted using standard methods. If contaminated groundwater is encountered during dewatering, it would be containerized and disposed of in accordance with all applicable laws and regulations. The required implementation of a GPP during demolition would minimize the potential for impacts on groundwater (discussed further in Section 4.5.6, *Mitigation Measures*), resulting in negligible impacts.

The onsite WWTP and water tower would not be demolished under Action Alternative A. Wells supplying water for the telescopes that could be demolished may be abandoned; abandonment of water wells would be conducted in compliance with all applicable laws and regulations.

Post-implementation

Operations at GBO after demolition activities would be similar to current operations and, therefore, would have no impact on water resources.

4.5.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Action Alternative B would involve increased demolition activities, but impacts on wetlands, surface water, or floodplains would not be expected from either demolition or operation activities, as appropriate engineering controls and BMPs would be implemented as described under Action Alternative A. The

impacts on groundwater demolition would be similar to those described for Action Alternative A and would be negligible.

4.5.3 Action Alternative C: Mothballing of Facilities

Demolition and Mothballing

No impacts on wetlands, surface water, or floodplains are expected from demolition activities under Action Alternative C, as appropriate engineering controls and BMPs would be implemented as described under Action Alternative A. The impacts on groundwater from demolition activities would be similar to those described for Action Alternative A and would be negligible.

Post-implementation

Routine maintenance of mothballed infrastructure would be comparable to current maintenance activities; the measures that would be implemented to protect water resources during maintenance activities would not change and there would be no impacts on wetlands, floodplains, or groundwater. The mothballing of the onsite WWTP, water tower, and water wells under Action Alternative C would be conducted in compliance with all applicable laws and regulations. The reduction in workforce at GBO under Action Alternative C would have no appreciable effect on water resources. Mothballing the WWTP would eliminate discharges to Hospital Run and Deer Creek, resulting in a negligible benefit to the water quality of these streams.

4.5.4 Action Alternative D: Demolition and Site Restoration

Demolition

Action Alternative D would involve increased demolition activities over the other Action Alternatives, but no impacts on wetlands, floodplains, or surface waters are expected from demolition activities, as appropriate engineering controls and BMPs would be implemented as described under Action Alternative A. The impacts on groundwater from demolition activities would be similar to those described for Action Alternative A and would be negligible.

Demolition of the onsite WWTP, water tower, and water wells under Action Alternative D would be conducted in compliance with all applicable laws and regulations.

Post-implementation

Removal of all facilities, restoration of the property, and elimination of the workforce would eliminate stormwater runoff from developed areas and discharges from the WWTP from entering the streams on the property, resulting in a negligible benefit on the water quality of adjacent streams.

4.5.5 No-Action Alternative

Under the No-Action Alternative, the NSF would continue funding GBO at current levels and no associated modifications to GBO facilities or operations would occur. Therefore, the No-Action Alternative would have no impact on water resources.

4.5.6 Mitigation Measures

The following mitigation measures have been identified for water resources under the Proposed Action:

- All Action Alternatives: Stormwater BMPs would be implemented prior to the start of demolition activities. Erosion control measures such as compost blankets, mulching, riprap, geotextiles, and slope drains could be used to protect exposed soil and minimize erosion. BMPs, such as check dams, slope diversions, and temporary diversion dikes could be implemented for runoff control. Sediment control measures that could be implemented include compost filter berms and socks; fiber rolls or berms; sediment basins, rock dams, filters, chambers, or traps; silt fences; and weed-free hay bales. Good housekeeping measures would be practiced during demolition. Site-specific stormwater BMPs would be detailed in a construction SWPPP, which would be prepared before breaking ground.
- All Action Alternatives: A GPP would be developed for the project to address risks to groundwater from potential spills. The GPP would address equipment inspections, equipment refueling, equipment servicing and maintenance, equipment washing, and the use and storage of any hazardous materials, chemicals, fuels, lubricating oils, and other petroleum products.

4.5.7 Summary of Impacts

Table 4.5-2 provides a summary of water resource impacts resulting from the Alternatives.

TABLE 4.5-2
Summary of Water Resources Impacts

	Alternatives				
Impacts	**Action Alternative A**	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Impacts on wetlands, surface water, and floodplains during demolition, safe-abandonment, and mothballing	No impact	No impact	No impact	No impact	No impact
Impacts on groundwater during demolition, safe-abandonment, and mothballing	Negligible	Negligible	Negligible	Negligible	No impact
Impacts on wetlands, groundwater, and floodplains post-implementation	No impact	No impact	No impact	No impact	No impact

TABLE 4.5-2
Summary of Water Resources Impacts

	Alternatives				
Impacts	**Action Alternative A**	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Impacts on surface water post-implementation	No impact	No impact	Negligible	Negligible	No impact

4.6 Hazardous Materials

This Section describes the potential impacts related to hazardous materials within the ROI. The ROI for hazardous materials is defined as the area within the project boundaries, adjoining properties, and a 1-mile radius from the GBO boundary.

Methodology

The methods used to determine whether the Action Alternative would have impacts related to hazardous materials were:

- Review and evaluate existing and past actions with respect to the production and management of hazardous materials and waste to identify the Proposed Action's potential impact on the use and disposal of hazardous materials.
- Assess the compliance of each Action Alternative with applicable regulations and in particular E.O. 12088, Toxic Substances Control Act (TSCA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Hazardous Materials Transportation Act (HMTA), and Resource Recovery and Conservation Act (RCRA) relating to the storage, transport, handling, and disposal of waste.

Table 4.6-1 presents the impact thresholds for hazardous materials.

TABLE 4.6-1
Impact Thresholds for Hazardous Materials

Impact Intensity	Description
Negligible	The Alternative would result in a change so small that it would not be of measurable or perceptible consequence.
Minor	The Alternative would result in a perceptible change to hazardous materials, but the change would be small and remain onsite.
Moderate	The Alternative would result in a perceptible change to hazardous materials, which could affect offsite interests.
Major	The Alternative would result in a substantial change to hazardous materials; the change would be measurable and would affect offsite interests.
Duration:	**Short-term** – Occurs only during the implementation (i.e., land transfer, demolition, mothballing, and/or safe-abandonment) and/or for a limited adjustment period **Long-term** – Endures long after the implementation of the Proposed Action.

4.6.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

Existing Contamination

Action Alternative A would result in safe-abandoning, mothballing, or demolishing structures not needed to meet the anticipated operational goals of the collaborator(s). Prior to demolition, an assessment would

be required to determine the extent of hazardous materials, such as ACM, LBP, and the unknown conditions explained in Section 3.6.1, *Existing Site Contamination*. All ACM, LBP, and known contamination would be remediated in accordance with applicable state and federal regulations, prior to any demolition and land transfer activities.

Prior to demolition, the contractors would prepare and implement a demolition management plan that prescribes activities for workers to follow if unexpected soil or groundwater contamination is encountered based on visual observation and/or smell. The demolition management plan would include, at a minimum, a list of contact persons in case of a possible encounter with undocumented contamination; provisions for immediate notification of the observation to construction management; and provisions for notifying the regulatory agency with jurisdiction. If previously unknown contamination is found, demolition would halt near the find, and the next steps would be decided in consultation with the regulatory agency.

A minor, long-term benefit would be expected under Action Alternative A from the cleanup of any existing contamination.

Demolition, Safe-abandonment, and Mothballing

Action Alternative A would require the temporary transport, use, storage, and disposal of hazardous materials and waste during safe-abandoning, mothballing, or demolishing activities. Hazardous materials commonly used at construction sites, such as diesel fuel, lubricants, paints and solvents, and cement products containing basic or acidic chemicals, may be used. Hazardous waste generated during demolition would include fuel and lubricant containers, paint and solvent containers, and cement products.

Accidental spills or releases associated with the temporary transport, storage, use, and disposal of hazardous materials and waste could occur during demolition. However, hazardous materials and waste would be used, stored, disposed of, and transported in compliance with all applicable laws and regulations. Identification, generation, transportation, storage, treatment, and disposal of all hazardous materials and hazardous waste would be conducted in compliance with state and federal regulations.

Accidental spills or releases that result from the routine transport, use, storage, and disposal of hazardous materials and waste during demolition could create a hazard to public health and the environment. However, with implementation of the abovementioned mitigation measures and implementation of a spill response plan, this impact would be minor, adverse, and short-term**.**

Post-implementation

Chemicals and hazardous materials typically used for facility maintenance, operation and maintenance of scientific equipment, heating oil, painting, vehicle maintenance, and pool maintenance are currently used

by GBO. All materials are used, stored, and disposed of in accordance with state and federal regulations. GBO also stores diesel fuel, gasoline, used oil, and heating oil.

Action Alternative A would result in safe-abandoning, mothballing, or demolishing structures not needed to meet the anticipated operational goals. Chemicals and hazardous materials used for operation of the demolished facilities would no longer be needed for site operation and maintenance (O&M). These materials would be removed from the site and disposed of in accordance with state and federal regulations.

Overall, the use of chemicals and hazardous materials during operations would be reduced under Action Alternative A, as a result of fewer buildings. The future manager of the site is expected to comply with state and federal requirements; therefore, future operations are expected to result in a minor, long-term benefit.

4.6.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Demolition, Safe-abandonment, and Mothballing

Similar to Action Alternative A, Action Alternative B would result in abandoning, mothballing, or demolishing structures; consequently, the environmental impacts associated with existing contamination and operational use of hazardous materials would be similar to those under Action Alternative A and would be minor, beneficial, and long-term. The environmental impacts associated with the use of hazardous materials and generation of hazardous waste during demolition would be minor, adverse, and short-term.

Post-implementation

As with Action Alternative A, the overall use of chemicals and hazardous materials during operations would be reduced under Action Alternative B. Therefore, future operations are expected to result in a minor, long-term benefit.

4.6.3 Action Alternative C: Mothballing of Facilities

Existing Contamination

Under Action Alternative C, facilities would be mothballed and maintained in a condition where they could return to operation for scientific or other purposes at some point in the future. Demolition activities would be less than those described under Action Alternatives A or B. The demolition activities would likely include the removal of the following environmental condition that was noted in the EBS (CH2M, 2016):

- A military-style fuel truck is staged north of the telescope area off Slavin Hollow Road. The fuel truck is used as a diesel aboveground storage tank and does not have secondary containment.

Consequently, the impacts would be minor, beneficial, and long-term.

Demolition and Mothballing

The hazardous materials used during demolition would be similar to those described under Action Alternatives A and B. Consequently, the impacts would be minor, adverse, and short-term.

Post-implementation

Chemicals and hazardous materials used for current operation and maintenance of the facility would not be needed or would be greatly reduced during the mothball period. These materials would be removed from the site and disposed of in accordance with state and federal regulations.

Chemicals and hazardous materials would be used under the maintenance program to protect the facilities from deterioration or other damage. These materials may include diesel fuel and pesticides. All materials would be used, stored, and disposed of in accordance with state and federal regulations.

Overall, the use of chemicals and hazardous materials used during the mothball period would be reduced under Action Alternative C. State and federal requirements would continue to be followed during the use or storage of hazardous materials. Consequently, impacts are expected to be minor, beneficial, and long-term.

4.6.4 Action Alternative D: Demolition and Site Restoration

Existing Contamination

Under Action Alternative D, all facilities would be fully demolished. Prior to demolition, an assessment would be required to determine the extent of hazardous materials, such as ACM, LBP, and existing contamination. Any ACM, LBP, or known contamination would be remediated prior to initiating demolition.

Action Alternative D would result in all existing contamination being removed and any storage tanks being properly disposed of, including the following RECs and noteworthy conditions (CH2M, 2016);

- A 1,000-gallon gasoline underground storage tank located outside the Warehouse building that was abandoned in place in 1991. No samples were collected to determine if there was a release.
- At the shooting range, lead may be in the soil at the target areas. Gunpowder residues, including polycyclic aromatic hydrocarbons, may have reached the soil at the firing line.
- A burn pile of scrap wood, furniture, and brush located in the junkyard.
- A military-style fuel truck is staged north of the telescope area off Slavin Hollow Road. The fuel truck is used as a diesel aboveground storage tank and does not have secondary containment.

Consequently, impacts would be moderate, beneficial, and long-term.

Demolition

The hazardous materials used during demolition would be similar as those described in Action Alternatives A, B, and C. However, Alternative D would also require the use of explosive munitions for demolition. Explosives would be used under regulations (29 C.F.R. §1926.900, *Safety and Health Regulations for Construction*); nonetheless, the use of explosives, increases the hazard level during demolition. Therefore, a moderate, short-term impact is expected from hazardous materials used during demolition.

Post-implementation

Action Alternative D involves the full demolition of all structures, except the Reber Telescope, which would be relocated. The use of chemicals and hazardous materials for building maintenance, operation of scientific equipment, landscaping, and vehicle maintenance would cease. These materials would be removed from the site and disposed of in accordance with state and federal regulations. The impacts of the reduction in the use of hazardous materials used post-implementation would be moderate, beneficial, and long-term.

4.6.5 No-Action Alternative: Continued NSF Investment for Science-focused Operations

The No-Action Alternative is the continuation of the current operation of GBO. Under the No-Action Alternative, current activities would continue, and no safe-abandoning, mothballing, or demolishing structures would occur. Consequently, there would be no impacts associated with existing contamination and use of hazardous materials.

4.6.6 Mitigation Measures

The following mitigation measures would be implemented as part of the Proposed Action.

- All Action Alternatives: A complete site characterization and the removal or remediation of contamination would be completed prior to any demolition and land transfer activities.
- All Action Alternatives: Hazardous materials and waste would be used, stored, disposed of, and transported during demolition in compliance with all applicable laws and regulations.
- All Action Alternatives: Contractors would create and implement a spill response plan.
- All Action Alternatives: NSF would require all contractors to create and implement a construction management plan, including hazardous materials discovery protocols. The construction management plan would include, at a minimum, a list of contact persons in case of a possible encounter with undocumented contamination; provisions for immediate notification of the observation to construction management; and provisions for notifying the regulatory agency with jurisdiction. If

previously unknown contamination is found, demolition would halt near the find and the next steps would be decided in consultation with the regulatory agency.

4.6.7 Summary of Impacts

Table 4.6-2 provides a summary of impacts resulting from the Action Alternatives.

TABLE 4.6-2
Summary of Hazardous Materials Impacts

Impacts	**Alternatives**				
	Action Alternative A	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Existing hazardous material contamination	Minor, long-term benefit	Minor, long-term benefit	Minor, long-term benefit	Moderate, long-term benefit	No impact
Demolition-related hazardous material use	Minor, adverse, short-term	Minor, adverse, short-term	Minor, adverse, short-term	Moderate, adverse, short-term	No impact
Operational use of hazardous materials	Minor, long-term benefit	Minor, long-term benefit	Minor, long-term benefit	Moderate, long-term benefit	No impact

4.7 Solid Waste

This Section describes the potential impacts related to solid waste for each of the Alternatives. The ROI for solid waste includes GBO and the facilities where solid waste would be landfilled.

Methodology

Impacts from solid waste were determined by comparing the estimated generated waste by alternative to the regional landfill capacities, described in Section 3.7, *Solid Waste*. Table 4.7-1 presents the impact thresholds for solid waste.

TABLE 4.7-1
Impact Thresholds for Solid Waste

Impact Intensity	Description
Negligible	The Alternative would result in a change that would be so small that it would not be of any measurable or perceptible consequence.
Minor	The solid waste generated from the Alternative would be a measurable increase from current conditions but would be within the capacity of local landfills.
Moderate	The solid waste generated from the Alternative would be a noticeable increase from current conditions and fill local landfills to within 10% of current capacity.
Major	The solid waste generated from the Alternative would be an increase from current conditions and would result in an exceedance of capacity at local landfills.
Duration:	**Short-term –** Occurs only during the implementation (i.e., demolition, mothballing, and/or safe-abandonment) and/or for a limited adjustment period.
	Long-term – Endures long after the implementation of the Proposed Action.

4.7.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

Demolition, Safe-abandonment, and Mothballing

Action Alternative A would result in safe-abandoning, mothballing, or demolishing structures not needed to meet the anticipated operational goals. Table 4.7-2 presents a summary of the estimated solid waste that would be generated by Action Alternative A. These estimates represent a worst-case scenario, are based on the current material found on the site, and do not consider any recycling and/or reuse activities.

TABLE 4.7-2
Solid Waste Generation Action Alternative A

Activity	Demo Debris (ton)	Universal Waste (ton)	Electrical Equipment (ton)	Liquid Waste (non-specific) (ton)	Septic/ Liquid Waste (ton)	Salvage/ Recycle-Non-ferrous (ton)	Salvage/ Recycle-Ferrous (ton)	Total Non-Hazardous (ton)	Total ACM and LBP (ton)
Demolition, Safe-abandonment, and Mothballing	237	5	21	5	6	135	852	1,262	65

Source: CH2M, 2017.

Based on these estimates, the total quantity of non-hazardous demolition-related waste under Action Alternative A would be approximately 1,262 tons before reuse or recycling (CH2M, 2017). This is approximately 1 percent of the permitted capacity of the Pocahontas County Landfill (Table 3.7-1). The Pocahontas County Landfill cannot accept ACM and LBP abatement waste (Alderman, 2017); however, nearby HAM Sanitary Landfill can accept ACM abatement and LBP waste (Bradley, 2017). The HAM Sanitary Landfill has separate cells that take construction, ACM, and LBP waste only (Bradley, 2017). A new construction/ACM/LBP waste cell is currently under construction at the HAM Sanitary Landfill. The total quantity of ACM and LBP waste would be approximately 65 tons or 0.051 percent of the permitted capacity of the new HAM Sanitary Landfill construction/ACM/LBP waste cell (CH2M, 2017). Because the waste being sent to landfills would be expected to be less than 1 percent of capacity of a single landfill, impacts would be minor, adverse, and long-term.

When possible, demolition materials such as soil from grading would be used onsite. Consequently, a portion of the debris would be diverted from landfills through reuse and recycling.

Post-implementation

Operation-related waste generation is typically based on the number of personnel working at a facility. The number of personnel at GBO is expected to be less under Action Alternative A; therefore, the amount of waste generated under Action Alternative A is expected to be the less than under current conditions. Also, the new management at GBO is expected to continue solid waste management and waste reduction, including recycling programs, to minimize the amount of waste from facility operations going into the landfills. Based on these assumptions, there would be a minor, long-term benefit from operation-related solid waste compared with current conditions.

4.7.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Demolition, Safe-abandonment, and Mothballing

Action Alternative B would also result in safe-abandoning, mothballing, or demolishing obsolete buildings. Table 4.7-3 presents a summary of estimated solid waste that would be generated under Action Alternative B. These estimates are based on current material found on the site and do not consider any recycling and/or reuse activities.

TABLE 4.7-3
Solid Waste Generation Action Alternative B

Activity	Demo Debris (ton)	Universal Waste (ton)	Electrical Equipment (ton)	Liquid Waste (non-specific) (ton)	Septic/ Liquid Waste (ton)	Salvage/ Recycle-Non-ferrous (ton)	Salvage/ Recycle-Ferrous (ton)	Total Non-Hazardous (ton)	Total ACM and LBP (ton)
Demolition, safe-abandonment, and mothballing	1,412	17	28	11	27	1,027	155	**2,678**	**271**

Source: CH2M, 2017.

Based on these estimates, the total quantity of non-hazardous demolition-related waste under Action Alternative B would be approximately 2,678 tons before reuse or recycling (CH2M, 2017). This is approximately 2 percent of the permitted capacity of the Pocahontas County Landfill (Table 3.7-1). The Pocahontas County Landfill cannot accept ACM and LBP abatement waste (Alderman, 2017); however, nearby HAM Sanitary Landfill can accept this waste (Bradley, 2017). The total quantity of ACM and LBP waste would be approximately 271 tons or 0.213 percent of the permitted capacity of the new HAM Sanitary Landfill construction/ACM/LBP waste cell (CH2M, 2017). Because the waste being sent to landfills would be expected to be less than 2 percent of capacity of a single landfill, impacts would be minor, adverse, and long-term.

When possible, demolition materials such as soil from grading would be used onsite**.** Most of the material that cannot be reused onsite could be reused on other sites or recycled. Consequently, a portion of the debris would be diverted from landfills through reuse and recycling.

Post-implementation

The number of personnel is expected to be reduced under Action Alternative B; therefore, the amount of operational waste generated under Action Alternative B is expected to be the less than under current conditions. The new management at GBO is expected to continue solid waste management and waste reduction, including recycling programs, to minimize the amount of waste from facility operations going into the landfills. Based on these assumptions, there would be minor, long-term benefit from operation-related solid waste compared with current conditions.

4.7.3 Action Alternative C: Mothballing of Facilities

Demolition and Mothballing

Under Action Alternative C, facilities would be placed in a mothballed condition such that the facilities could be made operational at some point into the future. Structures not needed to meet future operational goals would be demolished. Table 4.7-4 presents a summary of the estimated solid waste that would be generated under Action Alternative C.

TABLE 4.7-4
Solid Waste Generation Action Alternative C

Activity	Demo Debris (ton)	Universal Waste (ton)	Electrical Equipment (ton)	Liquid Waste (non-specific) (ton)	Septic/ Liquid Waste (ton)	Salvage/ Recycle-Non-ferrous (ton)	Salvage/ Recycle-Ferrous (ton)	Total Non-Hazardous (ton)	Total ACM and LBP (ton)
Demolition and mothballing	1,048	11	5	5	23	695	22	**1,810**	**220**

Source: CH2M, 2017.

Based on these estimates, the total quantity of demolition-related waste under Action Alternative C would be approximately 1,810 tons before reuse or recycling (CH2M, 2017). This is approximately 1.5 percent of the permitted capacity of the Pocahontas County Landfill (Table 3.7-1). The Pocahontas County Landfill cannot accept ACM and LBP abatement waste (Alderman, 2017); however, the nearby HAM Sanitary Landfill can accept this waste (Bradley, 2017). The ACM and LBP waste would be approximately 220 tons or 0.173 percent of the permitted capacity of the new HAM Sanitary Landfill construction/ACM/LBP waste cell (CH2M, 2017). Because the waste being sent to landfills would be expected to be less than 2 percent of capacity of a single landfill, impacts would be minor, adverse, and long-term on area landfills from construction and demolition-related solid waste.

When possible, demolition materials such as soil from grading would be used onsite**.** Most of the material that cannot be reused onsite could be reused on other sites or recycled. A portion of the debris would be diverted from landfills through reuse and recycling.

Post-implementation

Operational waste generation is typically based on the number of personnel working at a facility. The number of personnel working at GBO would substantially decrease with Action Alternative C; therefore, the amount of waste generated under the Action Alternative C is expected to be less than under current conditions. There would be a minor, long-term benefit from operation-related solid waste compared with current conditions.

4.7.4 Action Alternative D: Demolition and Site Restoration

Demolition

Under Action Alternative D, all facilities would be fully demolished both above grade and below grade. Table 4.7-5 presents a summary of the estimated solid waste that would be generated under Action Alternative D.

TABLE 4.7-5
Solid Waste Generation Action Alternative D

Activity	Demo Debris (ton)	Universal Waste (ton)	Electrical Equipment (ton)	Liquid Waste (non-specific) (ton)	Septic/ Liquid Waste (ton)	Salvage/ Recycle-Non-ferrous (ton)	Salvage/ Recycle-Ferrous (ton)	Total Non-Hazardous (ton)	Total ACM and LBP (ton)
Demolition	4,807	39	63	29	31	2,252	9,131	**16,290**	**927**

Source: CH2M, 2017.

Based on the estimates, the total quantity of demolition-related waste under Action Alternative D would be approximately 16,290 tons before reuse or recycling (CH2M, 2017). This is approximately 13 percent of the permitted capacity of the Pocahontas County Landfill (Table 3.7-1). This amount of waste would have a minor, adverse, and long-term impact on the remaining capacity of the Pocahontas County Landfill. The waste could also be landfilled at the nearby Greenbrier County or Tucker County Landfills, which would lower the effect on the Pocahontas County Landfill capacity.

The Pocahontas County, Greenbrier County, and Tucker County Landfills cannot accept ACM and LBP abatement waste (Alderman, 2017; Anderson, 2017; Moore, 2017); however, the nearby HAM Sanitary Landfill can accept this waste (Bradley, 2017). The ACM and LBP waste would be approximately 927 tons or 0.73 percent of the permitted capacity of the new HAM Sanitary Landfill construction/ACM/LBP waste cell (CH2M, 2017).

When possible, demolition materials such as soil from grading would be used onsite**.** Most of the material that cannot be reused onsite could be reused on other sites or recycled. Consequently, a portion of the debris would be diverted from landfills through reuse and recycling.

Post-implementation

Operation-related waste generation would cease under Action Alternative D. Consequently, there would be a minor, long-term benefit from the lack of operation-related solid waste compared with current conditions.

4.7.5 No-Action Alternative: Continued NSF Investment for Science-focused Operations

Under the No-Action Alternative, current activities would continue at GBO, and no demolition would be expected to occur. Because there would be no change from current conditions, no impacts from solid waste would result.

4.7.6 Mitigation Measures

The following is a summary of the suggested mitigation measures related to the Action Alternatives.

- All Action Alternatives: Whenever possible, demolition debris such as soil would be used on site.

- All Action Alternatives: Demolition debris would be diverted from landfills through reuse and recycling to the extent practicable.

4.7.7 Summary of Impacts

Table 4.7-6 summarizes the individual and overall impacts for the Alternatives.

TABLE 4.7-6
Summary of Solid Waste Impacts

	Alternatives				
Impacts	**Action Alternative A**	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Solid waste generated from demolition, safe-abandonment, and mothballing	Minor, adverse, and long-term	Minor, adverse, and long-term	Minor, adverse, and long-term	Minor, adverse, and long-term	No impact
Operation-generated solid waste	Minor, long-term benefit	Minor, long-term benefit	Minor, long-term benefit	Minor, long-term benefit	No impact

4.8 Health and Safety

This Section describes the potential short-term and long-term impacts on health and safety within the ROI of GBO as a result of implementing the Proposed Action.

The ROI for the health and safety analysis is defined as follows:

- Public Safety – The entire human environment.
- Occupational Health – The GBO boundary.
- Protection of Children – The land within 0.5-mile of GBO and 0.5-mile around the roadway network leading to the Observatory and along the demolition haul routes.

The public expressed a number of health and safety concerns during the scoping period. These comments helped to define the analysis for this Section and are summarized as follows:

- GBO's role in planetary protection.
- Use of the Observatory by surrounding communities as shelter during emergencies.
- Use of the Observatory's stored water for refilling fire department tanker trucks.

Methodology

The methods used to determine whether the Alternative would have impacts related to health and safety are as follows:

- Identify potential impacts on health and safety for the Alternatives and evaluate the impacts with respect to public safety, occupational health, and the protection of children.
- Assess the compliance of each Alternative with applicable federal regulations that apply to health and safety, with a specific focus on E.O. 13045 and the Occupational Safety and Health Act of 1970 (OSHA).

Table 4.8-1 presents the impact thresholds for health and safety.

TABLE 4.8-1
Impact Thresholds for Health and Safety

Impact Intensity	Description
Negligible	Potential impacts on health and safety would be so small they would not be measurable or of perceptible consequence.
Minor	Potential impacts would result in a change to public safety, occupational health, and protection of children, but the change would be small and localized.
Moderate	Potential impacts would result in a measurable and consequential change to public safety, occupational health, and protection of children.
Major	Potential impacts would result in a substantial change to public safety, occupational health, and protection of children; the change would be measurable and could result in a severe risk to human life.

TABLE 4.8-1
Impact Thresholds for Health and Safety

Impact Intensity	Description
Duration: Short-term – Occurs only during implementation (i.e., demolition, mothballing, and/or safe-abandonment), and/or for a limited adjustment period.	
Long-term – Endures long after implementation of the Proposed Action.	

4.8.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

4.8.1.1 Public Safety

Demolition, Safe-abandonment, and Mothballing

Action Alternative A would require demolition of buildings and structures to conform to the requirements of future collaborators. Many onsite housing units, obsolete buildings, and recreational facilities would be demolished; however, the demolition sites would be fenced off and the public would not have access to the site during demolition. Consequently, demolition under this Action Alternative would have a negligible impact on public safety.

Post-implementation

Under Action Alternative A, GBO would likely continue to be used as an emergency shelter and fire departments could continue to use the water tower at the discretion of the new operators. Further, GBO's 40-foot telescope and GBT would remain in service; though the scope of operations may change, depending on the needs of the collaborators. Nonetheless, the characterization of NEOs could continue at other observatories; therefore, Action Alternative A would have an overall negligible and indirect impact on public safety given the low probability of PHOs colliding with the Earth. Please see Section 3.8, *Health and Safety*, for a detailed explanation of this probability.

4.8.1.2 Occupational Health

Demolition, Safe-abandonment, and Mothballing

Demolition activities can be inherently dangerous. Demolition workers and equipment operators would be required to wear appropriate personal protective equipment and be properly trained for the planned work. All solid or hazardous waste generated during demolition would be removed and disposed of at a permitted facility or designated collection point. Section 4.6, *Hazardous Materials*, presents a detailed discussion of hazardous material handling and protection measures. Many sections of the potential demolition haul routes are curvy two-lane roads with dense roadside vegetation, which could present safety issues. Traffic safety measures discussed in Section 4.10, *Traffic and Transportation*, would be employed to decrease the safety risks to drivers and the public.

The demolition contractor would be required to develop and implement a Health and Safety Plan to ensure worker safety during demolition activities. All demolition areas would be clearly marked with appropriate signage. Demolition managers would be required to comply with OSHA, as well as other applicable regulations. For these reasons, Action Alternative A demolition activities would have a minor, adverse, short-term impact on occupational health.

Post-implementation

Action Alternative A would not significantly change the operation of GBO with regard to occupational health, because future tenants and site managers also would be required to follow OSHA principles. Consequently, Action Alternative A would have no new impact on occupational health.

4.8.1.3 Protection of Children

Demolition, Safe-abandonment, and Mothballing

Children could be attracted to the demolition sites. Eight child-centric community resources are within 0.5-mile of GBO. However, all demolition activities would occur within a fenced area with posted signage warning of the danger. Children may be affected by the small increase in truck traffic along the demolition haul routes, but the protection measures described in Section 4.10, *Traffic and Transportation*, would reduce these potential impacts. With the implementation of these BMPs, there would be negligible impacts on child safety expected from demolition activities.

Post-implementation

The continued science- and education-focused operations would be similar to current operations; consequently, there are no expected new risks or impacts on children under Action Alternative A.

4.8.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

4.8.2.1 Public Safety

Demolition, Safe-abandonment, and Mothballing

Demolition activities for Action Alternative B would be similar to those under Action Alternative A; both Action Alternatives involve the demolition of obsolete facilities to conform to the requirements of future collaborators. Consequently, the level of impact of demolition under Action Alternative B would also be negligible.

Post-implementation

GBO's 40-foot telescope would remain in service; however, the GBT could be made inoperable. Nonetheless, the characterization of NEOs could continue at other locations; therefore, Action Alternative B would have an overall negligible indirect impact on public safety given the low probability of PHOs

colliding with the Earth. Please see Section 3.8, *Health and Safety*, for a detailed explanation of this probability.

4.8.2.2 Occupational Health

Demolition, Safe-abandonment, and Mothballing

Action Alternative B would involve the same demolition activities and BMPs as those under Action Alternative A. Consequently, the level of impact for Action Alternative B would be minor, adverse, and short-term.

Post-implementation

Action Alternative B would not significantly change the operation of GBO with regard to occupational health. Consequently, Action Alternative B would have no impact on occupational health.

4.8.2.3 Protection of Children

Demolition, Safe-abandonment, and Mothballing

Demolition activities and BMPs for Action Alternative B would be similar to those under Action Alternative A. Consequently, the level of impact under Action Alternative B would also be negligible.

Post-implementation

The transition to education-focused operations would be similar to current operations; consequently, there are no impacts on children under Action Alternative B.

4.8.3 Action Alternative C: Mothballing of Facilities

4.8.3.1 Public Safety

Demolition and Mothballing

Action Alternative C would involve demolishing obsolete facilities and mothballing the remaining buildings. Overall, the demolition activities would be smaller in scale than those under Action Alternative A but would involve the same BMPs. Therefore, the level of impact for Action Alternative C would also be negligible.

Post-implementation

A maintenance and security program would be put in place to protect the facility from vandalism, theft, and looting during the mothball period; therefore, there would be limited potential for the facility to become a local hazard while it is mothballed. GBO would no longer be available as an emergency shelter; however, Pocahontas County currently has nine other certified Red Cross emergency shelters, one of which is in Green Bank (Figure 4.8-1). The water tank would no longer be in operation, but the fire department would be able to refill tanker trucks from numerous streams in the area. Finally, the GBT would no longer be operational and there would be a potential reduced ability to characterize PHOs;

however, this characterization could be accomplished at other observatories and the probability of an event is very small (see Section 3.8, *Health and Safety*, for an explanation). Overall, Action Alternative C would have a minor, adverse, long-term impact on public safety, based on increased risks during mothballing and reduction in safety resources.

4.8.3.2 Occupational Health

Demolition and Mothballing

Overall, the demolition activities for Action Alternative C would be smaller in scale than those under Action Alternative A but would involve the same BMPs. Consequently, the level of impact for Action Alternative C would also be minor, adverse, and short-term.

Post-implementation

The implementation of Action Alternative C would greatly reduce the onsite activities and the number of employees. Individuals would be employed for security and maintenance at the mothballed facility; the inherent risk of these activities is expected to be the same as the risk under current conditions, resulting in no new impacts.

4.8.3.3 Protection of Children

Demolition and Mothballing

Overall, the demolition activities for Action Alternative C would be smaller in scale than those under Action Alternative A but would require the same BMPs. Consequently, the level of impact for Action Alternative C would be also negligible. (Impacts related to the reduction in educational and recreational opportunities are discussed in Section 4.11, *Socioeconomics*.)

Post-implementation

With the implementation of Action Alternative C, children would no longer visit the facility. Consequently, there would be no impacts on children.

4.8.4 Action Alternative D: Demolition and Site Restoration

4.8.4.1 Public Safety

Demolition

Action Alternative D involves the demolition of all site facilities. The demolition sites would be fenced off and the public would not have access to the site. Increased demolition -related traffic would result under Action Alternative D; however, no more than 13 round-trips by truck per day would be expected (Reese, 2017, pers. comm.), and the BMPs detailed in Section 4.10, *Traffic and Transportation*, would

greatly reduce any potential impacts. For these reasons, Action Alternative D would have a minor, adverse, short-term impact on public safety.

Post-implementation

The implementation of Action Alternative D would result in the elimination of potential PHO characterizations at GBO; however, this characterization could be accomplished at other observatories and the probability of an event is very small (see Section 3.8, *Health and Safety*, for an explanation). In addition, GBO would no longer be used as an emergency shelter, and GBO's water tank would no longer be available to the fire department. Consequently, the level of impact for Action Alternative D would be the same as the level described for Action Alternative C and would result in minor, adverse, and long-term impacts, due to the reduction in safety resources.

4.8.4.2 Occupational Health

Demolition

The BMPs described in Action Alternative A would be implemented under Action Alternative D. In addition, because Action Alternative D includes the use of explosives, any individuals involved in explosive use would be properly trained and industry standard protections would be implemented. With the adherence to these BMPs, the impact on occupational health from Action Alternative D would remain minor, adverse, and short-term.

Post-implementation

With the implementation of Action Alternative D, the onsite activities and employees would be eliminated. Consequently, there would be no impacts on occupational health after demolition is complete.

4.8.4.3 Protection of Children

Demolition

While demolition activities would take longer under Action Alternative D, the work would be similar to the work under Action Alternatives A and B. Consequently, the level of impact and protection measures for Action Alternative D would also be negligible.

Post-implementation

With the implementation of Action Alternative D, children would no longer visit the facility. Consequently, there would be no impacts on children.

4.8.5 No-Action Alternative: Continued NSF Investment for Science-focused Operations

Under the No-Action Alternative, no demolition would occur and there would be no change in the operation and visitation to GBO. Consequently, there would be no new impacts on public safety, occupational health, or protection of children.

4.8.6 Mitigation Measures

The following measures would be implemented to reduce impacts on health and safety:

- All Action Alternatives: The contractor would develop and implement a demolition phase Health and Safety Plan.
- All Action Alternatives: GBO personnel would comply with OSHA safety protocols.
- All Action Alternatives: Fencing and signage would be installed around demolition sites.
- Action Alternative C: A maintenance and security program would be implemented for mothballed facilities.
- Action Alternative D: Individuals handling explosives would be properly trained and industry standard safety protocols would be implemented.

4.8.7 Summary of Impacts

Table 4.8-2 provides a summary of impacts resulting from the alternatives.

TABLE 4.8-2
Summary of Health and Safety Impacts

	Alternatives				
Impacts	**Action Alternative A**	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Public safety impacts during demolition, safe-abandonment, and mothballing	Negligible	Negligible	Negligible	Minor, adverse, and short-term	No impact
Public safety impacts post-implementation	Negligible	Negligible	Minor, adverse, and long-term	Minor, adverse, and long-term	No impact
Occupational health during demolition, safe-abandonment, and mothballing	Minor, adverse, and short-term	Minor, adverse, and short-term	Minor, adverse, and short-term	Minor, adverse, and short-term	No impact
Occupational health during post-implementation	No impact	No impact	No impact	No impact	No impact
Protection of children during demolition, safe-abandonment, and mothballing	Negligible	Negligible	Negligible	Negligible	No impact
Protection of children during post-implementation	No impact	No impact	No impact	No impact	No impact

Figure 4.8-1

Certified Red Cross Shelters

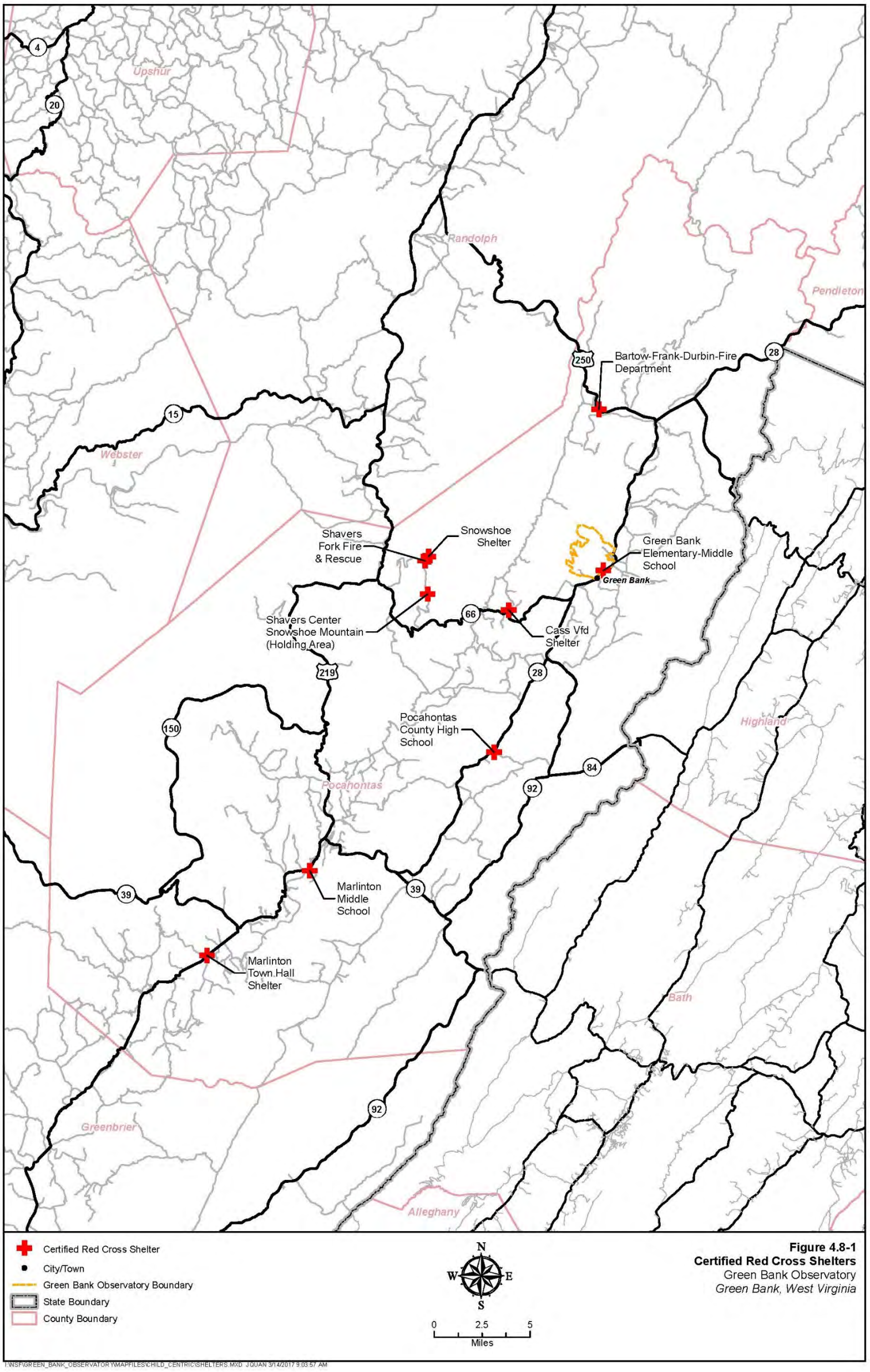

Figure 4.8-1
Certified Red Cross Shelters
Green Bank Observatory
Green Bank, West Virginia

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4.9 Noise Impacts

Noise impacts were determined based on potential increased noise levels around noise-sensitive land uses. Noise-sensitive land uses are locations where unwanted sound would adversely affect the designated use and typically include residential areas, hospitals, places of worship, libraries, schools, historic structures/ districts, and wildlife preserves and parks. Noise impacts on wildlife are discussed in Section 4.1, *Biology*.

Methodology

As sound intensity tends to fluctuate with time, a method is required to describe a noise source, such as a highway, in a steady state condition. The descriptor most commonly used in environmental noise analysis is the equivalent steady state sound level, or Leq. This value is representative of the same amount of acoustic energy that is contained in a time-varying sound measurement over a specified period. For highway traffic noise analyses, that time period is 1 hour, and the value reflects the hourly equivalent sound level, or Leq(h).

A 3-dBA change in sound level generally represents a barely perceptible change in noise level. By comparison, a 10-dB change is typically perceived by the human ear as doubling the level or being twice as loud. Several factors affect the propagation of sound through the environment. A primary factor is the type of sound generator. For a line source, such as a line of traffic, the intensity would decrease directly according to the distance from the source. For example, for each doubling of the distance from the sources, there is a 3-dBA reduction in the sound levels. In the case of spherical spreading of sound waves from a point source, such as a stationary generator, sound level intensity decreases according to the square of the distance from the source. Thus, for a point source, the sound radiates equally in all directions and is reduced by 6 dB for each doubling of the distance from the source.

The ROI for noise includes the area within the project boundary, potential access routes from the construction landfill to the entrance of GBO, and adjacent properties. Table 4.9-1 presents the impact thresholds for noise under the Proposed Action.

TABLE 4.9-1
Impact Thresholds for Noise

Impact Intensity	Description
Negligible	Activities would result in a non-perceptible noise increase.
Minor	Activities would result in a barely perceptible noise increase.
Moderate	Activities would result in a readily perceptible noise increase, but generally would not affect daily activities and would not result in hearing damage.
Major	Activities would result in a disruptive noise increase, which would significantly affect daily activities and may result in hearing damage.

Duration: Short-term – Occurs only during implementation (i.e., demolition, mothballing, and/or safe-abandonment) and/or for a limited adjustment period.

Long-term – Endures long after the implementation of the Proposed Action.

4.9.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

Demolition, Safe-abandonment and Mothballing

Individuals working at the facility and living nearby would be exposed to increased noise conditions during demolition. Activities associated with demolition would generate noise from diesel-powered earth-moving equipment such as dump trucks and bulldozers, backup alarms on certain equipment, and compressors. Typical noise levels from these types of equipment are listed in Table 4.9-2. Noise at receptor locations will usually depend on the loudest one or two pieces of equipment operating at the moment.

TABLE 4.9-2
Typical Noise Levels Associated with Main Phases of Outdoor Construction

Activity	Noise Level at 50 feet (dBA)
Ground Clearing	84
Excavation, Grading	89
Foundations	78
Structural	85
Finishing	89

Source: EPA, 1971.

Table 4.9-2 indicates that the loudest equipment generally emits noise up to 89 dBA at 50 feet. The closest offsite noise-sensitive land use to a potentially demolished facility is Liberty Church, which is approximately 250 feet from the Shinnaberry House (Figure 1-2). Accounting for noise dissipating as distance increases from the point source, the demolition noise may be perceived at the nearest offsite noise-sensitive land use as 75 dBA, which is roughly equivalent to a vacuum cleaner at 10 feet (Table 3.9-1). Onsite workers and site neighbors would be exposed to noise during demolition; however, mitigation measures such as limiting demolition activities to daytime hours, public notification of demolition activities, vehicle maintenance, and the use of silencers and barriers when possible would be implemented during the demolition period. Demolition noise would result in a moderate, adverse, and short-term impact on onsite workers and site neighbors, because the increased noise, while perceptible, would not be expected to disrupt normal daily activities.

During the demolition period, up to 13 round-trip truck hauls would occur per day; this would result in a less than a 3-dBA increase in noise or non-perceptible increase in the Leq(h). Consequently, noise impacts from increased traffic volumes would be expected to be negligible.

Post-implementation

There would be no changes to the operational noise environment under Action Alternative A; consequently, there would be no impacts from noise.

4.9.2 Action Alternative B: Collaboration with Interested Parties for Operations as a Technology and Education Park

Demolition, Safe-abandonment, and Mothballing

The demolition activities under Action Alternative B would require similar equipment as Action Alternative A and occur at a similar distance to noise receptors; therefore, the expected noise impacts from demolition would be also be moderate, adverse, and short-term. Noise impacts from traffic would also be negligible, as a result of similar amounts of demolition traffic.

Post-implementation

There would be no changes to the operational noise environment under Action Alternative B; consequently, there would be no impacts from noise.

4.9.3 Action Alternative C: Mothballing of Facilities

Demolition and Mothballing

Under Action Alternative C, GBO would be mothballed. There are fewer demolition activities under Action Alternative C than with either Action Alternative A or B. The closest offsite noise-sensitive land use to a potentially demolished facility is an Arbovale residence that is approximately 950 feet from the Calibration Horn (see Figure 1-2). Accounting for noise dissipating as distance increases from the point source, the demolition noise may be perceived at the nearest offsite noise-sensitive land use as 63 dBA, which is roughly equivalent to heavy traffic noise (Table 3.9-1). Additionally, the mitigation measures described for Action Alternative A also would be implemented during the demolition period under Action Alternative C. Therefore, demolition noise would result in a moderate, adverse and short-term impact on onsite workers and noise-sensitive neighbors.

Up to 13 round-trip truck hauls would occur per day under Alternative C; consequently, traffic impacts would be non-perceptible and remain negligible.

Post-implementation

Operations would essentially cease under Action Alternative C, thereby reducing the current noise environment. There would be no impact from noise under Action Alternative C after demolition activities.

4.9.4 Action Alternative D: Demolition and Site Restoration

Demolition

Under Action Alternative D, structures and facilities at GBO would be fully demolished. While demolition activities under Action Alternative D would take longer than under the other Action Alternatives, the noise environment would be mostly similar to that explained for the previous Action Alternatives because similar equipment would be used. However, Action Alternative D could require blasting, which can exceed the 100-dBA range. The closest offsite noise-sensitive land use to a potentially

demolished facility is the White Pines Holiness Camp, which is approximately 200 feet from the Water Tower (Figure 1-2). Accounting for noise dissipating as distance increases from the point source, the explosion noise during blasts may be perceived at this nearest offsite noise-sensitive land use as 88 dBA, which is roughly equivalent to a lawn mower at 3 feet. However, unlike a lawn mower, these blasts would last only momentarily. The mitigation measures listed in Action Alternative A also would be implemented for Action Alternative D; in addition, explosive materials would be a small enough caliber to avoid an overpressure or sound pressure wave. Demolition noise would result in a moderate, adverse, and short-term impact on onsite workers and site neighbors.

During the demolition period, approximately 13 round-trip truck hauls would occur per day, resulting in an inaudible increase in the Leq(h). Noise impacts from increased traffic volumes would be expected to be negligible.

Post-implementation

Operations would completely cease under Action Alternative D, thereby reducing the current noise environment. There would be no impact from noise under Action Alternative D after demolition activities.

4.9.5 No-Action Alternative

The No-Action Alternative is the continuation of the current use of GBO. Under the No-Action Alternative, current activities would continue at the site, and no construction would be expected to occur. Because there would be no change from current conditions, no impacts from noise would result**.**

4.9.6 Mitigation Measures

The following is a summary of the suggested mitigation measures related to the Proposed Action.

- All Action Alternatives: Notify neighbors of demolition noise in advance and its expected duration so they may plan appropriately.
- All Action Alternatives: Ensure exhaust systems on equipment are in good working order. Equipment would be maintained on a regular basis and would be subject to inspection by the construction project manager to ensure maintenance.
- All Action Alternatives: Use properly designed engine enclosures and intake silencers where appropriate.
- All Action Alternatives: Use temporary noise barriers where appropriate and possible.
- All Action Alternatives: Ensure new equipment is subject to new product noise emission standards.
- All Action Alternatives: Locate stationary equipment as far from sensitive receptors as possible.

- All Action Alternatives: Perform demolition activities in noise sensitive areas during hours that are the least disturbing for adjacent and nearby residents.
- Action Alternative D: Use explosive materials that are a small enough caliber to prevent a blast overpressure or sound pressure wave.

4.9.7 Summary of Impacts

Table 4.9-3 provides a summary of noise impacts resulting from the Alternatives.

TABLE 4.9-3
Summary of Noise Impacts

	Alternatives				
Impacts	**Action Alternative A**	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Proposed Action implementation-related Noise	Moderate, adverse, short-term	Moderate, adverse, short-term	Moderate, adverse, short-term	Moderate, adverse, short-term	No impact
Proposed Action traffic-related noise	Negligible	Negligible	Negligible	Negligible	No impact
Operational noise	No impact	No impact	No impact	No impact	No impact

4.10 Traffic and Transportation

This Section describes the potential impacts on the transportation infrastructure and traffic operations for each of the Alternatives in the ROI. The ROI for traffic and transportation includes the roadway network leading to GBO and along the potential demolition waste haul routes as shown on Figures 3.10-1 and 3.10-2. There are four potential landfill locations that could be used to dispose of waste generated under the Alternatives involving demolition. Figure 4.10-1 shows the expected waste haul routes for four of the Alternatives. Only Pocahontas County and HAM Sanitary landfills were considered in the analysis, because they represent the most likely landfills to be used, and by choosing two landfills, the greatest likely traffic impact was able to be assessed. Further, the shortest potential implementation time period for each Action Alternative was used to determine the highest possible concentration of traffic and its associated impact. Current traffic levels on the surrounding roadway network are influenced by existing GBO staffing and visitation levels. Predicted changes in traffic patterns resulting from the Action Alternatives during and after implementation were evaluated against the current roadway network and conditions.

Table 4.10-1 presents the impact thresholds for traffic and transportation.

TABLE 4.10-1
Impact Thresholds for Traffic and Transportation

Impact Intensity	Description
Negligible	The Proposed Action would not result in a change in traffic or transportation resources or the change would be so small that it would not be noticeable.
Minor	The Proposed Action would result in a noticeable change in traffic on the roadway network within the ROI; however, the change would not exceed roadway capacity or cause delays on the roadway network.
Moderate	The Proposed Action would result in a measurable and consequential change in traffic within the ROI; while some delays may occur, roadway capacity would not be exceeded.
Major	The Proposed Action would result in a substantial change in traffic on the roadway network within the ROI; noticeable delays would occur and roadway capacity would be exceeded.
Duration:	**Short-term –** Occurs only during the implementation (i.e., demolition, mothballing, and/or safe-abandonment) and/or for a limited adjustment period. **Long-term –** Endures long after the implementation of the Proposed Action.

4.10.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

Demolition, Safe-abandonment, and Mothballing

During demolition under Action Alternative A, visitation and Observatory staffing are expected to be close to existing conditions. An estimated 95 or fewer workers would be onsite during the 21-week demolition period. Additionally, over the approximate 21-week demolition period, there would be an estimated 15 or fewer mobilization-related trucks and approximately 460 heavy truck trips to haul demolition waste to the Pocahontas County and HAM Sanitary landfills (Figure 4.10-1). Throughout the 21-week demolition period, an estimated 17 or fewer trucks hauling demolition waste would operate on any given 8-hour

workday (CH2M, 2017). It is expected that each truck would perform one trip to and from the site using the potential haul routes shown on Figure 4.10-1, resulting in an estimated 34 or fewer truck trips on the haul routes per day, which is less than 3 percent additional vehicles per day at the nearest traffic count location to GBO. Given the current traffic volumes on these routes and the curving rural nature of these roadways, this relatively small increase in demolition-related and waste haul truck traffic would likely be noticeable but would not exceed roadway capacity or result in delays. The operating characteristics of truck's hauling demolition waste would be similar to other heavy truck-related traffic (logging, mining, and farm vehicles) that could be experienced in the area. Faster vehicles would have opportunities to pass at numerous locations. Consequently, Action Alternative A would result in a minor, adverse, and short-term impact on transportation.

Large vehicles transporting materials would move during off-peak hours when practicable to minimize conflicts between project traffic and normal daily traffic. Delivery truck personnel and workers would also be notified of all potential height restrictions and overhead obstructions to ensure no property damage or physical injuries occur. Vehicles used for material transport would comply with local standards for height, width, and length of vehicles when practicable. If at any time vehicles of excessive size and weight need to use local roads and bridges, permits would be obtained from the proper authority. Further detailed waste haul routes and concerns would be addressed during the demolition planning phase of the Proposed Action, including verification that all bridges and roadways on the delivery route have adequate strength and capacity to allow safe hauling of waste. To minimize the impacts of demolition on local residents, the contractor would coordinate with local public schools to ensure haul routes do not adversely affect school bus traffic.

Demolition may be extended beyond a single 21-week period. If this were to occur, the demolition-related traffic, including both worker traffic and debris-hauling traffic, would be spread over a longer period but would result in less traffic per unit of time. This would result in a reduction of potential impacts, such that the current analysis describes a worst-case situation but not enough to warrant changing the impact intensity designation.

Post-implementation

Under Action Alternative A, staffing and visitation would remain nearly the same compared to existing conditions, and would not result in a change in traffic along the access routes to GBO.

4.10.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

Demolition, Safe-abandonment, and Mothballing

During demolition under Action Alternative B, visitation and Observatory staffing would be reduced compared to existing conditions. An estimated 95 or fewer construction workers would be onsite during the

approximate 21-week demolition period. Additionally, over the 21-week demolition period, there would be an estimated 15 or fewer mobilization-related trucks and approximately 673 heavy truck trips to haul demolition waste to the Pocahontas County and HAM Sanitary landfills (Figure 4.10-1). Throughout the 21-week demolition period, an estimated 25 or fewer trucks hauling demolition waste would operate on any given 8-hour workday (CH2M, 2017). Each truck would perform one trip to and from the site, using the potential haul routes shown on Figure 4.10-1, resulting in an estimated 50 or fewer truck trips on the haul routes per day, which is less than 3 percent additional vehicles per day at the nearest traffic count location to GBO. Given the current traffic volumes on these routes and the curving rural nature of these roadways, this relatively small increase in demolition-related and waste haul truck traffic would likely be noticeable but would not exceed roadway capacity or result in delays. The operating characteristics of truck hauling demolition waste would be similar to other heavy truck-related traffic (logging, mining, and farm vehicles) that could be experienced in the area. Faster vehicles would have opportunities to pass at numerous locations. Consequently, Action Alternative B would result in a minor, adverse, and short-term impact on transportation. The protection measures described in Action Alternative A would also be implemented for Action Alternative B. Similar to Action Alternative A, there would be no expected change in the intensity of potential impacts if the demolition is extended beyond a single 21-week period.

Post-implementation

Under Action Alternative B, staffing and visitation would be reduced compared to existing conditions and would result in a negligible benefit in traffic along the access routes to GBO.

4.10.3 Action Alternative C: Mothballing of Facilities

Demolition and Mothballing

Under Action Alternative C, daily visitation and mission-related staffing would cease. During the demolition period, traffic accessing GBO would be related to facility demolition. An estimated 74 or fewer construction workers would be onsite during the 24-week demolition period. Additionally, over the 24-week demolition period, there would be an estimated 15 or fewer mobilization-related trucks and approximately 129 heavy truck trips to haul demolition waste to the Pocahontas County and HAM Sanitary landfills. Throughout the approximate 24-week demolition period, an estimated four or fewer trucks hauling demolition waste would operate on any given 8-hour workday (CH2M, 2017). Overall, traffic within the ROI would decrease during the demolition period because demolition-related traffic would be less than current staffing- and visitation-related traffic. However, the presence of heavy trucks on the curving rural roadways would likely be noticeable. The operating characteristics of truck's hauling demolition waste would be similar to other heavy truck-related traffic (logging, mining, and farm vehicles) that could be experienced in the area. Faster vehicles would have opportunities to pass at numerous locations. Although traffic would decrease overall during the implementation of the Action Alternatives, the presence of heavy trucks would result in a minor, adverse, and short-term impact. The protection measures described in Action Alternative A would also be

implemented for Action Alternative C. Similar to Action Alternative A, there would be no expected change in the intensity of potential impacts if the demolition is extended beyond a single 24-week period.

Post-implementation

Under Action Alternative C, GBO would be mothballed and staffing and visitation would cease except for occasional maintenance and security personnel. This would result in a decrease in traffic along the access routes to GBO. The decrease in operation-related traffic would result in a minor, long-term traffic and transportation benefit.

4.10.4 Action Alternative D: Demolition and Site Restoration

Demolition

Under Action Alternative D, daily visitation- and mission-related staffing would cease. During the demolition period, traffic accessing GBO would be related to facility demolition. An estimated 97 or fewer construction workers would be onsite during the 36-week demolition period. Additionally, over the approximate 36-week demolition period, there would be an estimated 15 or fewer mobilization-related trucks and approximately 2,753 heavy truck trips to haul demolition waste to Pocahontas County and HAM Sanitary landfills. Throughout the 36-week demolition period, an estimated 26 or fewer trucks hauling demolition waste would operate on any given 8-hour workday (CH2M, 2017). Overall, traffic within the ROI would decrease during the demolition period because demolition-related traffic would be less than current staffing- and visitation-related traffic. However, the presence of heavy trucks on the curving rural roadways would likely be noticeable. The operating characteristics of truck's hauling demolition waste would be similar to other heavy truck-related traffic (logging, mining, and farm vehicles) that could be experienced in the area. Faster vehicles would have opportunities to pass slower vehicles at numerous locations. Although traffic would decrease overall during the implementation of the Action Alternatives, the presence of heavy trucks would result in a minor, adverse, and short-term impact. The protection measures described in Action Alternative A would also be implemented for Action Alternative D. Similar to Action Alternative A, there would be no expected change in the intensity of potential impacts if the demolition is extended beyond a single 36-week period.

Post-implementation

Under Action Alternative D, GBO would be fully demolished. All staffing and visitation would cease with the exception of occasional vegetation maintenance staff for a period of 18 months following demolition. This would result in a decrease in traffic along the access routes to GBO. The decrease in operation-related traffic would constitute a moderate, long-term traffic and transportation benefit.

4.10.5 No-Action Alternative

Under the No-Action Alternative, no demolition would occur and there would be no change to staffing or visitation to GBO. Therefore, there would be no change to traffic or transportation conditions within the ROI.

4.10.6 Mitigation Measures

The following is a summary of the proposed mitigation measures to minimize impacts on traffic and transportation from the Action Alternatives.

- All Action Alternatives: Transport of materials and large vehicles would occur during off-peak hours when practicable.
- All Action Alternatives: Delivery truck personnel and construction workers would be notified of all potential height restrictions and overhead obstructions.
- All Action Alternatives: Vehicles used for material transport would comply with local standards for height, width, and length of vehicles, when practicable. If at any time vehicles of excessive size and weight are required on local roads and bridges, permits would be obtained from the proper authority.
- All Action Alternatives: Further detailed waste haul routes and concerns would be addressed during the demolition planning phase of the Action, including verification that all bridge crossings on the delivery route have adequate strength and capacity.
- All Action Alternatives: The contractor would coordinate with local public schools to ensure haul routes do not adversely affect school bus traffic.

4.10.7 Summary of Impacts

Table 4.10-2 provides a summary of impacts resulting from the Alternatives.

TABLE 4.10-2
Summary of Transportation Impacts

	Alternatives				
Impacts	**Action Alternative A**	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Demolition traffic	Minor, adverse, short-term	Minor, adverse, short-term	Minor, adverse, short-term	Minor, adverse, short-term	None
Post-implementation traffic	None	Negligible	Minor, long-term benefit	Moderate, long-term benefit	None

FIGURE 4.10-1
Transportation Haul Routes (Regional)

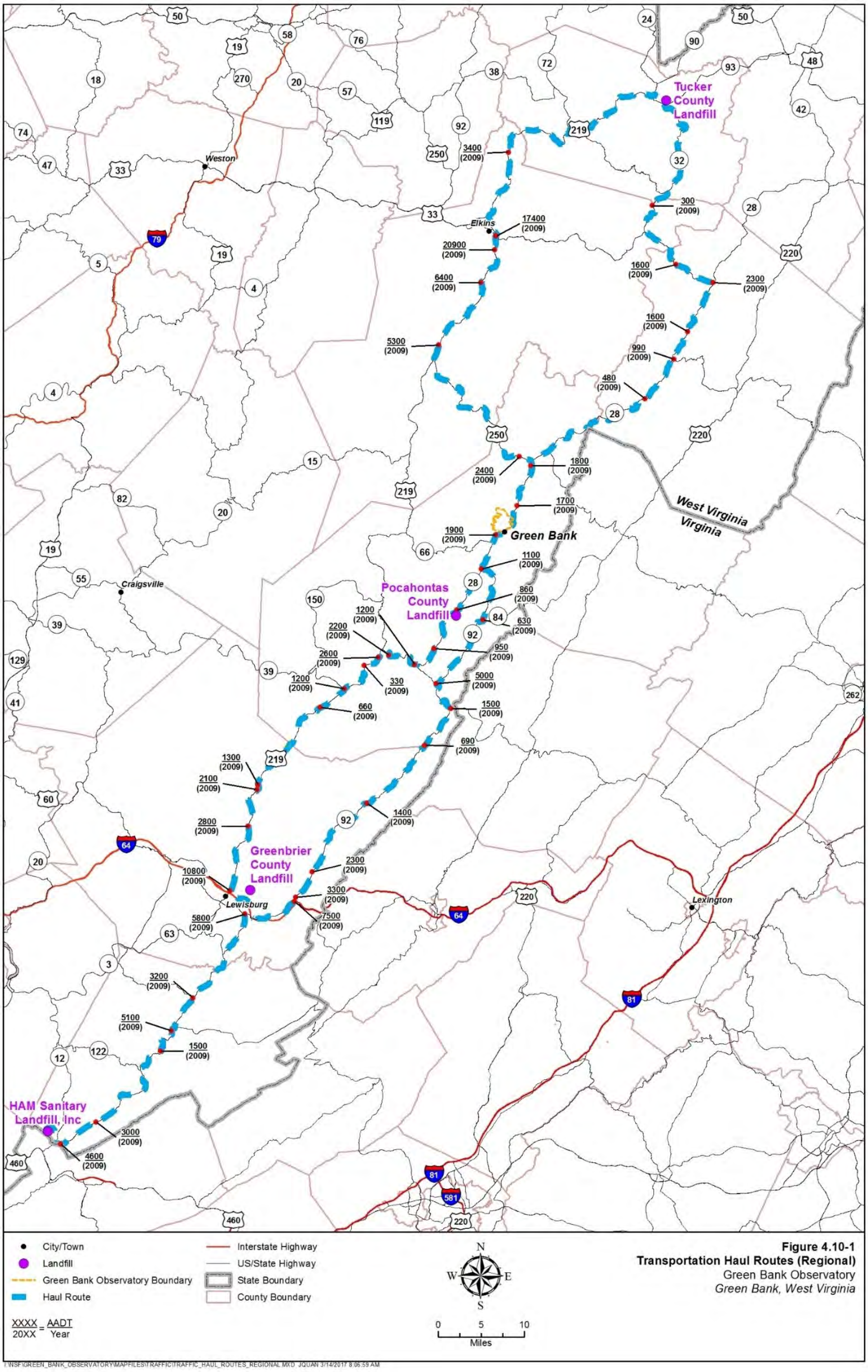

Figure 4.10-1
Transportation Haul Routes (Regional)
Green Bank Observatory
Green Bank, West Virginia

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4.11 Socioeconomics

This Section identifies the potential direct and indirect impacts on socioeconomic resources that may result from implementing the Alternatives, including the No-Action Alternative. The ROI is defined as Pocahontas County, which is home to 92 percent of GBO employees. However, where necessary, a more focused assessment was performed for the CDPs of Green Bank and Arbovale as over half of GBO staff (54 percent) live in these communities.

Methodology

The methods used to assess whether the Alternatives would have socioeconomic impacts are as follows:

- Characterize population changes in Pocahontas County and the communities of Green Bank and Arbovale (as defined by the CDPs) based on the demolition and operation workforce assumptions summarized in Table 4.11-1. The changes informed the assessment of other socioeconomic resource categories.
- Assess housing impacts during implementation based on potential changes to the supply of temporary housing from changes in population. Changes to GBO onsite housing facilities are assessed relative to the supply of temporary and permanent housing in the local vicinity (Table 4.11-2).
- Evaluate potential socioeconomic impacts resulting from the temporary presence of the nonlocal demolition workforce onsite, changes in the size and composition of GBO operational workforce (Table 4.11-1), and changes in the size and duration of visitor stays (Table 4.11-3), as they are the primary causes of impact.
- Assess direct, indirect, and induced economic and tourism-related impacts using the IMPLAN model to estimate the changes in Pocahontas County's economy under each alternative relative to 2015 numbers. The baseline model for Pocahontas County in 2015 shows total employment equal to 4,496 jobs and a County GDP of $242.84 million. Model outputs (e.g., GDP, employment, and earnings) included the following:
    a. Direct economic impacts due to the changes in local expenditures to demolish certain facilities and to operate and maintain the remaining facilities;
    b. Indirect economic impacts, which represent the changes in purchases of intermediate inputs from local suppliers that result from the changes in direct expenditures; and,
- Induced impacts, which stem from the alterations in outlays by households whose earnings are directly affected by each Action Alternative.

- Characterize education impacts by describing potential changes to the enrollment for the Pocahontas County School system, Green Bank Elementary-Middle School, and the potential loss of the educational opportunities GBO offers county residents under each alternative.
- Evaluate community cohesion impacts by identifying changes to the "sense of community" such as potential loss of opportunities for residents to gather and interact, as well as to fulfill routine life activities.

Impacts associated with population, housing, the economy, and community cohesion in Green Bank and Arbovale are described using USCB data for CDPs, which are delineated to provide data for settled concentrations of population that are identifiable by name but are not legally incorporated. Accordingly, these impacts are described for the "Green Bank and Arbovale CDPs." Education impacts are described for the communities of Green Bank and Arbovale (without the CDP designation), because their boundaries may not align precisely with the CDP.

TABLE 4.11-1
Workforce Assumptions by Alternative

	Action Alternative A	Action Alternative B	Action Alternative C	Action Alternative D	No-Action Alternative
Full-time Operations Staffing	112[a]	63[b]	18[c]	0	112[d]
Living in Pocahontas County (92%)	103	58	17	0	103
Living in Green Bank or Arbovale CDPs (54%)	60	34	10	0	60
Change in Pocahontas County Workforce as compared to No Action	0	-45	-86	-103	
Change in Green Bank or Arbovale CDPs Workforce as compared to No Action	0	-26	-51	-60	
Part-time Operations Staffing (Summer–3 months)	40	19	0	0	40
Total Annual O&M Payroll	$9,183,243	$5,165,574[d]	$1,427,191	0	$9,183,243
Total Annual O&M Costs	$13,581,691	$7,639,701[d]	$2,135,461	0	$13,581,691
Peak Demolition Phase Staffing	*95*	*95*	*74*	*97*	0
Nonlocal Demolition Phase Staff[e]	71	71	56	73	
Period of Peak Demolition[f]	*4 months*	*4 months*	*4 months*	*9 months*	0

[a] Assumes employment levels would remain the same as under the No-Action Alternative.

[b] Salary and budget numbers are estimates only, and are based on the fraction of staff (63 out of 112) remaining, loss of revenue from visitors, and decreased cost for maintenance of site telescopes. For purposes of assessing impacts, it assumes the

TABLE 4.11-1
Workforce Assumptions by Alternative

	Action Alternative A	Action Alternative B	Action Alternative C	Action Alternative D	No-Action Alternative
11 persons employed by NRAO and AUI who also live and work in the Green Bank CDP remain onsite and that the reductions in staff are proportionate to current GBO residency patterns.					
[c] Salary and budget numbers are estimates only, and are based on the limited staff needed to maintain the mothballed facilities.					
[d] Source: Existing GBO staff (http://greenbankobservatory.org/about/green-bank-staff/), plus an additional 11 persons employed by NRAO and AUI who also live and work in Green Bank.					
[e] Assumes 75 percent of demolition phase staff are nonlocal (i.e., not residents of Pocahontas County).					
[f] For simplicity it is assumed that the demolition activities occur within 1 year. If instead these activities are spread out over time, then the contribution to the economy in any 1 year would be proportionately smaller but similar in total.					

TABLE 4.11-2
Housing Assumptions by Alternative

	Action Alternative A	Action Alternative B	Action Alternative C	Action Alternative D	No-Action Alternative
Housing Anticipated to Remain	Residence Hall and Cafeteria Bunk House (Dormitory) Redwood House Townhouse Units Riley House Hannah House	Residence Hall and Cafeteria Bunk House (Dormitory) Townhouse Units	None	None	All
Housing That Could Be Demolished	22 Units	27 Units	All	All	None

Note: Table 3.11-5 provide a detailed description of these housing units.

TABLE 4.11-3
Visitation Assumptions by Alternative

	Action Alternative A	Action Alternative B	Action Alternatives C and D	No-Action Alternative
Visitation[a]	**50,000**	**25,000[b]**	**0**	**50,000**
Students	3,000	500[c]	0	3,000
Researchers (scientists, engineers, and educators)	200	100	0	200
Public	46,800	24,400	0	46,800
Total Overnight Visitor Counts[d]	5,130	1,130[b,c]	0	5,130

[a] Approximately 85 percent of visitors are nonlocal (i.e., from outside Pocahontas County).

[b] This assumes about 50 percent of the current visitors come once the telescopes are no longer operational and the scientific output of the facility has dropped.

TABLE 4.11-3
Visitation Assumptions by Alternative

	Action Alternative A	Action Alternative B	Action Alternatives C and D	No-Action Alternative

[c] The number of students would decrease more than the average visitors, given that many of the student programs involve using the various site telescopes (20 m, GBT).

[d] Overnight visitation peaks in the summer, mid-May to mid-August.

The thresholds used to determine the intensity of direct and indirect impacts on socioeconomic resources are defined in Table 4.11-4.

TABLE 4.11-4
Impact Thresholds for Socioeconomics

Impact Intensity	Intensity Description
Negligible	The Alternative would result in a change to socioeconomic resources that would be so small, it would be an imperceptible consequence.
Minor	The Alternative would result in a change to socioeconomic resources, but the change would be of little consequence.
Moderate	The Alternative would result in a measurable and consequential change to socioeconomic resources.
Major	The Alternative would result in a substantial change to socioeconomic resources; the change would be measurable and result in a severely adverse or major beneficial impact.

Duration: Short-term – Occurs only during the implementation (i.e., demolition, mothballing, and/or safe-abandonment) and/or for a limited adjustment period.

Long-term – Endures long after the implementation of the Proposed Action.

4.11.1 Action Alternative A: Collaboration with Interested Parties for Continued Science- and Education-focused Operations with Reduced NSF Funding (Agency-preferred Alternative)

4.11.1.1 Population and Housing

Demolition, Safe-Abandonment, and Mothballing

The projected 71 nonlocal demolition workers, which represent less than 1 percent of the Pocahontas County population, are not expected to bring their families during the four-month peak demolition period. This peak workforce would represent a 17 percent temporary increase to the 2015 population of the Green Bank and Arbovale CDPs.

Impacts on temporary housing in Pocahontas County during implementation would be moderate, beneficial, and short term. Occupancy rates would increase during project implementation and would increase revenue for the county. Appendix 3.11A summarizes the supply of temporary housing options in Pocahontas County. In addition to these short-term options, approximately 58 percent of the county's housing stock, or 5,104 units, were vacant in 2015 (Table 3.11-3). Of these, 369 units were available for rent in the county in 2015 (Table 3.11-4). These units, combined with an additional 4,232 vacant units for

seasonal, recreational, or occasional use, such as those at Snowshoe Mountain Resort and other tourist destinations, suggest that ample housing is available to meet the needs of the temporary workforce. Demolition, mothballing and safe-abandonment may extend beyond a single 4-month period. If these activities are spread out over time because of fiscal constraints, the contribution to the housing market in any 1 year would be proportionately smaller but similar in total.

Post-implementation

Operations of GBO under Action Alternative A would require comparable staffing to the No-Action Alternative (Table 4.11-1). Although Action Alternative A will result in a reduction of onsite permanent housing, vacancy rates of rental housing in Green Bank and Pocahontas County are high as described in Section 3 and alternative housing is available. Overall there would be no impacts on housing from operations.

4.11.1.2 Economy, Employment, and Income

Demolition, Safe-Abandonment, and Mothballing

The direct, indirect, and induced economic impacts from the demolition, safe-abandonment and mothballing activities under Action Alternative A are summarized in Table 4.11-5. The economic impacts are defined by the annual changes in employment, labor income (i.e., earnings), and value added (i.e., GDP). For example, four staff working for three months equates to one job for 12 months. All estimates are net of leakages outside of the local economy. For example, expenditures that may originate in Pocahontas County but that pay for intermediate goods and services that are imported into the county do not represent a contribution to the county's economy. The direct job creation goes beyond the on-site demolition workforce to include local jobs related to supporting these activities, such as truck transportation, waste remediation, and provisioning services for the non-local workforce (e.g., accommodations and food). For this reason, the direct job creation associated with each Alternative will not correspond to workforce estimates provided in Table 4.11-1. In total, this Alternative would generate the equivalent of 73 new jobs in Pocahontas County for 1 year, with combined earnings of $1.8 million and a $2.4 million boost in County GDP, which is an increase of 1 percent relative to the current County GDP of $242.8 million in the county. Most of the demolition, safe-abandonment and mothballing activities would be completed within 1 year. It is assumed that these activities would occur simultaneously with and be additive to the ongoing operations of Action Alternative A. Thus, this represents a moderate, short-term benefit to the economy of Pocahontas County. In addition, the temporary influx of nonlocal workers may lead to a modest increase in local tax revenue from the hotel occupancy tax. The revenue from this tax is used to fund Pocahontas County community services such as the arts council, parks and recreation, and libraries (Pocahontas County CVB, 2014). Demolition, safe-abandonment and mothballing may be extended beyond a single 4-month period. If instead these

activities are spread out over time because of fiscal constraints, the contribution to the economy in any 1 year would be proportionately smaller but similar in total.

Results are also reported from an IMPLAN model run for the State's economy, as some stakeholders are more familiar with seeing economic impacts on the state overall and not on individual counties.

TABLE 4.11-5
Economic Impacts of Implementation under Action Alternative A

Pocahontas County			
Impact Type	**Employment**	**Labor Income**	**Total Value Added (GDP)**
Direct Effect	62	$1.5m	$1.8m
Indirect Effect	6	$.2m	$.3m
Induced Effect	6	$.2m	$.3m
Total Effect	73	$1.8m	$2.4m
West Virginia			
Direct Effect	62	$2.3m	$2.9m
Indirect Effect	12	$.6m	$.8m
Induced Effect	16	$.6m	$1.1m
Total Effect	90	$3.4m	$4.8m

Source: Minnesota IMPLAN Group, Inc., 2017 (IMPLAN Model Pocahontas county.impdb, IMPLAN Model West Virginia impdb).

Post-implementation

Action Alternative A is like the No-Action Alternative in terms of the continued O&M of GBO, which includes maintaining the current workforce and accommodating the same number of visitors. Thus, the change in management (or the change in ownership in the case of a transfer) per se would result in a negligible impact on the local economy.

At the state level, the economic effects would be larger in absolute terms, but smaller relative to the state's $73.9 billion economy. The economic impacts are larger at the state level because the state's economy is larger, and fewer goods and services to support the project must be imported into the state than is necessary at the county level. Specifically, over 1 year, the demolition, safe-abandonment and mothballing activities would add 90 jobs with earnings equaling $3.4 million and a $4.8 million contribution to State GDP.

4.11.1.3 Education

Demolition, Safe-Abandonment, and Mothballing

The projected 71 nonlocal demolition, safe-abandonment, and mothballing workers are not expected to bring their families; therefore, enrollment in the Pocahontas County Public School System overall and Green Bank Elementary-Middle School specifically would not be affected and there would be no impact.

Post-implementation

Educational tours at GBO would be expected to change with the potential safe-abandonment of the 43-meter telescope (140-foot telescope), which is featured as part of GBO's SETI Tour (GBO, 2017c). GBO would maintain its visitor hours, educational tours, and STEM-related training during implementation, but changes from these activities would be perceptible. Therefore, impacts would be minor, adverse, and short-term.

4.11.1.4 Tourism

Under Action Alternative A, implementation would result in no impact on tourism because these activities would not be expected to change the number or composition of visitors to GBO (Table 4.11-3).

4.11.1.5 Community Cohesion

Action Alternative A could result in the demolition of the GBO recreation area, which includes a swimming pool, tennis court, picnic pavilion, playing fields, playground and driving ranges. The swimming pool and playing fields, which are regularly used by the community for lessons and sports leagues, would no longer be available to the public. Their demolition would eliminate other uses noted by stakeholders, including the year-round free exercise classes, use of the recreation area for activities like triathlons, and use of the pool by the Green Bank Turtles and the U.S. Masters Swim Team. While there are pools that can be accessed at Watoga State Park and Snowshoe Resort, it is one of only two pools in the county that can be used for lifeguard testing. Therefore, a minor, adverse, and long-term impact on community cohesion of the county is expected to occur during implementation and continue throughout operation of GBO as a result of the loss of recreational facilities.

Impacts on the community cohesion of Green Bank and Arbovale CDPs would be expected to start with implementation and continue through operation of GBO given the frequency that the recreation area is used by local residents, the role GBO staff play in volunteering at the facilities, and the lack of an alternative swimming location nearby. The result would be a moderate, adverse, and long-term impact on the community cohesion of the Green Bank and Arbovale CDPs with the demolition of recreational facilities at GBO.

4.11.2 Action Alternative B: Collaboration with Interested Parties for Operation as a Technology and Education Park

4.11.2.1 Population and Housing

Demolition, Safe-Abandonment, and Mothballing

Population changes in Pocahontas County during the implementation of Action Alternative B would be similar to those described under Action Alternative A. The peak staffing and duration of implementation would remain the same. Impacts on temporary housing resources during implementation would be the same as under Action Alternative A, given the comparable size of the workforce. Impacts would be moderate, beneficial, and short term. If demolition, safe-abandonment and mothballing were extended

beyond a single 4-month period and spread out over time because of fiscal constraints, the contribution to the housing market in any 1 year would be proportionately smaller but similar in total.

Post-implementation

Under Action Alternative B, changes in the operations staff would start during implementation and continue through operations, resulting in an estimated 44 percent reduction in the employee population at GBO (Table 4.11-1). This could represent an estimated Pocahontas County population decrease of 127 people and 1.5 percent, assuming the household size of GBO staff is the same as the average for the communities where they reside and that all the staff relocate. The average family size in Pocahontas County is 2.8 individuals.

The loss of 26 staff who are residents of the Green Bank and Arbovale CDPs could result in a loss of up to 85 people from these communities and a 20.1 percent decrease in their combined population, based on respective family sizes of 3.7 and 2.6 individuals and similar assumptions. Given the relatively small size of the Green Bank and Arbovale communities, a small change in employment is expected to result in a more noticeable change in population.

Minor, adverse, and long-term impacts on permanent housing resources in Pocahontas County and Green Bank and Arbovale CDPs are expected to result from operations under Action Alternative B. Some of the existing GBO staff own homes in the county, others rent, and still others are provided housing onsite at GBO. Once their jobs are eliminated, it is expected that up to 45 former GBO staff (total estimated staff change) could decide to relocate outside of the county in search of comparable employment opportunities. Up to 26 of those workers could be from the Green Bank and Arbovale CDPs. The potential impacts on the local housing market from these staff changes would be partially offset by the removal of up to 27 housing units from GBO, which would result in some long-term staff looking offsite for housing. In combination, this could lead to a small change in market conditions with an increase in the number of days a listing is on the market for sale or rent.

4.11.2.2 Economy, Employment, and Income

Demolition, Safe-Abandonment, and Mothballing

The direct, indirect, and induced economic impacts from implementation under Action Alternative B are reported in Table 4.11-6. In total, this Alternative would generate the equivalent of 75 jobs for 1 year, with combined earnings of $2 million and a boost in County GDP of $2.7 million, an increase of 1 percent relative to current GDP in the county. It is assumed that these activities would occur simultaneously with and be additive to the ongoing operations under Action Alternative B. Thus, this represents a moderate, short-term benefit to the economy of Pocahontas County. In addition, like Action Alternative A, the influx of temporary workers staying in local accommodations would provide modest revenue to Pocahontas County from the occupancy tax receipts.

TABLE 4.11-6
Economic Impacts of Demolition Activities under Action Alternative B

Pocahontas County			
Impact Type	**Employment**	**Labor Income**	**Total Value Added (GDP)**
Direct Effect	63	$1.6m	$2.m
Indirect Effect	6	$.2m	$.3m
Induced Effect	6	$.2m	$.4m
Total Effect	75	$2.m	$2.7m
West Virginia			
Direct Effect	66	$2.6m	$3.3m
Indirect Effect	14	$.7m	$1.m
Induced Effect	18	$.7m	$1.2m
Total Effect	97	$3.9m	$5.5m

At the state level, the economic effects would be larger in absolute terms, but smaller relative to the state's $73.9 billion economy. Specifically, over 1 year, the implementation activities would add 97 jobs with earnings equaling $3.9 million and a $5.5 million contribution to State GDP. Changes in sales tax revenue, if any, would be similar to what could occur under Action Alternative A. If demolition, safe-abandonment and mothballing were to be extended beyond a single 4-month period and spread out over time because of fiscal constraints, the contribution to the economy in any 1 year would be proportionately smaller but similar in total.

Post-implementation

The estimated operations staff and annual expenditures under Action Alternative B are shown in Table 4.11-1 and the estimated number of visitors to GBO are shown in Table 4.11-3. As with the expenditures during implementation, purchases of imported intermediate goods and services must be netted from total expenditures to calculate the contribution to the County's economy. For example, the earnings of employees who reside outside Pocahontas County do not contribute to the economy of Pocahontas County. Similarly, the operations phase includes expenditures by visitors from other counties, states, and nations to the GBO (i.e., non-local visitors), who bring new dollars into the county and thereby help the economy grow However, at the state level, only visitors from outside the state bring new dollars to the State's economy. This explains why the direct job creation in Table 4.11-7 under the No-Action Alternative is 170 for the Pocahontas County but only 165 for the State's economy. Absent the option to visit the GBO, visitors to the GBO would likely spend their tourism dollars at other significant attractions in the state or make other purchases within the state, shifting jobs from Pocahontas County to other counties within the state. Thus, five of the direct jobs that are generated within Pocahontas County are not new jobs for the state, but are shifts in jobs from other counties to Pocahontas County.

GBO data show that 85 percent of the visitors are from outside Pocahontas County. The share of other counties within the state is conservatively estimated at 10 percent, for a total state share of 25 percent. It is conservatively assumed that 75 percent are from outside the state. Although, the State's share is likely on the low side, the effect of this assumption is to avoid underestimating the importance of the GBO to the State's economy. As shown in Table 4.11-7, the economic impacts of Action Alternative B are represented by the differences between employment, labor income, and County GDP for the No-Action Alternative and Action Alternative B. Implementing Action Alternative B would result in a decrease in visitation and an annual loss of 89 jobs in Pocahontas County, with earnings of $3.2 million. This represents 2 percent of total employment in the county. In addition, the economy would suffer a loss of $4.85 million, or 2 percent of County GDP. In the short run, these losses would more than offset the gains from the implementation activities. Action Alternative B would result in a moderate, long-term adverse impact on the economy of Pocahontas County.

The economic impacts on the State are also included in Table 4.11-7. Once the implementation is completed, future annual losses in the state would include 100 jobs, $4.1 million in earnings, and $6.2 million in State GDP.

TABLE 4.11-7
Economic Impacts of Operations Activities under Alternative B

	Pocahontas County								
	No Action Operations			**Alternative B Operations**			**Impacts (Losses) = (No Action - Alternative B)**		
Impact Type	**Employment**	**Labor Income**	**Total Value Added (GDP)**	**Employment**	**Labor Income**	**Total Value Added (GD)**	**Employment**	**Labor Income**	**Total Value Added (GDP)**
Direct Effect	170	$6.0m	$7.7m	104	$3.5m	$4.3m	66	$2.6m	$3.4m
Indirect Effect	29	$.8m	$1.7m	15	$.4m	$.9m	14	$.4m	$.8m
Induced Effect	22	$.6m	$1.4m	13	$.4m	$.8m	10	$.3m	$.6m
Total Effect	221	$7.5m	$10.8m	132	$4.2m	$6m	89	$3.2m	$4.9m
West Virginia									
Direct Effect	165	$5.9m	$8m	103	$3.4m	$4.4m	62	$2.5m	$3.5m
Indirect Effect	41	$1.9m	$3.1m	22	$1m	$1.7m	19	$.9m	$1.5m
Induced Effect	43	$1.6m	$2.9m	24	$.9m	$1.7m	18	$.7m	$1.3m
Total Effect	249	$9.4m	$14m	149	$5.4m	$7.8m	100	$4.1m	$6.2m

Note: Operations include the economic impacts from GBO operations and visitors attracted to Pocahontas County primarily to visit GBO. For example, direct employment includes staff working in the food and beverage, accommodations, and other industries that receive most of the tourist dollars from these visitors.

4.11.2.3 Education

Demolition, Safe-Abandonment, and Mothballing

As with Action Alternative A, there would be no direct impacts on education during the demolition phase under Action Alternative B. The nonlocal demolition phase workers would not be expected to bring their families and school populations would not change. GBO would maintain its visitor hours and tours during demolition.

Post-implementation

During operations, the reduction in full-time staff at GBO would be expected to decrease the school age population, further contributing to the trend of declining school enrollments, which dropped from 281 to 250 students at the Green Bank Elementary-Middle School between 2009 and 2016, an average annual decline of 1.6 percent. As described in Section 3.11, *Socioeconomics*, the declining school enrollment has affected funding for the Pocahontas County Public School System. Based on the extent of stakeholder comments made about the educational importance of GBO, as well as the decline in enrollment already being felt by the Pocahontas County Public School System and Green Bank Elementary-Middle School, these losses would be noticeable with the potential for minor, long-term, adverse effects on education in the county.

Impacts on education in Green Bank and Arbovale CDPs would be felt to a greater degree, resulting in moderate, long-term, and adverse direct impacts. The workforce reduction of 26 GBO staff members living in Green Bank and Arbovale would be directly felt by Green Bank Elementary-Middle School. In addition to the reduction in volunteer participation from GBO staff members, the school could experience the loss of some portion of the 16 students (about 6 percent) with GBO parents. This loss would contribute to the downward trend in school enrollment and is unlikely to be offset by other factors.

GBO's contribution to state and national educational programing would likely reduce under Alternative B, resulting in a moderate, adverse and long-term impact. As detailed in Section 3.11.3.3, *Green Bank Observatory*, GBO's contribution to education goes beyond what is measured by the standard statistics on school enrollment and student/teacher ratios. Under Alternative B, the Observatory would likely cease to contribute to (1) the out-of-classroom experience for school children throughout the state, and (2) STEM-related opportunities, such as Residential Teacher Institutes (K-12 teachers), the 8-week Summer Research Experiences for Teachers (middle to high school), the Pulsar Search Collaboratory, a national program in partnership with WVU (middle to high school) (GBO, 2017b).

4.11.2.4 Tourism

Action Alternative B would have a moderate, long-term adverse impact on tourism due to reducing the number of visitors to GBO from 50,000 annually to 25,000 annually. This impact would commence with the implementation. It is not known how many of these visitors would continue to come to Pocahontas

County to take advantage of the other attractions such as the Snowshoe Mountain Ski Resort, the Cranberry Nature Center, the Cass Scenic Railroad, and the Greenbrier River Trail. Eighty-five percent of these visitors come from outside the county; it is conservatively assumed that 75 percent are from outside the state. The economic impacts reported in Section 4.11.2.2, *Economy, Employment, and Income*, include the losses in visitor spending, which were calculated based on the conservative assumption that these visitors would be lost permanently.

4.11.2.5 Community Cohesion

As with Action Alternative A, Action Alternative B would result in a minor, adverse, and long-term impact on the community cohesion of Pocahontas County, which would result from the possible loss of recreational facilities at GBO. The impact would continue throughout the operations phase of GBO. Similarly, greater impacts on the community cohesion of the Green Bank and Arbovale CDPs would be expected to start with implementation and continue through operations of GBO. In addition to the demolition of recreational facilities at GBO, staff reductions and reduced GBO visitation could reduce the demand for other local services, which could ultimately further reduce the gathering places and local services contributing to community cohesion. The result would be a moderate, adverse, and long-term impact on the community cohesion of the Green Bank and Arbovale CDPs.

4.11.3 Action Alternative C: Mothballing of Facilities

4.11.3.1 Population and Housing

Demolition and Mothballing

The projected 56 nonlocal workers who would work on the demolition and mothballing of facilities would not be expected to bring their families during the four-month peak implementation. Despite this increase in nonlocal workers being smaller than that associated with Action Alternative A, the impacts on temporary housing during mothballing would be similar and remain moderate, beneficial, and long-term. If the demolition and mothballing phase were extended beyond a single 4-month period because of fiscal constraints, the contribution to the housing market in any 1 year would be proportionately smaller but similar in total.

Post-implementation

Up to 77 percent of the existing operational staff, or 86 people, would likely relocate outside of Pocahontas County with their families to secure comparable employment. This could represent an estimated Pocahontas County population decrease of 243 people and 2.8 percent, assuming the household size of GBO staff is the same as the average for the communities where they reside and that all the staff relocate. The average family size in Pocahontas County is 2.8 individuals.

The loss of 51 staff who are residents of the Green Bank and Arbovale CDPs could result in a loss of up to 162 people from these communities and a 38.6 percent decrease in their combined population, based on respective family sizes of 3.7 and 2.6 individuals.

Moderate, adverse, and long-term impacts within Pocahontas County overall and major, adverse, and long-term impacts on owner-occupied housing within the CDPs of Green Bank and Arbovale are expected to start with implementation and carry through operations. Even a small increase in the housing inventory for sale could make it challenging to find buyers given the current real estate market conditions in the Green Bank and Arbovale areas, as noted in a comment received during public scoping. In 2016, the monthly median days a house was on the market in these communities ranged from a low of 69 to a high of 313 (Realtor.com, 2017). This compares to a range of 118 to 163 average days on the market in 2016 for homes in West Virginia and 80 to 114 for the United States overall (Zillow, 2017). This indicates that in general, the local housing market is not very active, with some listings taking close to 10 to 11 months to sell.

4.11.3.2 Economy, Employment, and Income

Demolition and Mothballing

The direct, indirect, and induced economic impacts from demolition and mothballing activities under Action Alternative C are reported in Table 4.11-8. In total, this Alternative would generate the equivalent of 58 jobs for 1 year, with combined earnings of $1.5 million and an increase in County GDP of $2 million, which is less than 1 percent of current GDP in the county. This represents a minor, short-term benefit to the economy of Pocahontas County. In addition, like Action Alternative A, the influx of temporary workers staying in local accommodations would add modest revenue to the Pocahontas County coffers from the occupancy tax receipts.

TABLE 4.11-8
Economic Impacts of Implementation under Action Alternative C

Pocahontas County			
Impact Type	**Employment**	**Labor Income**	**Total Value Added (GDP)**
Direct Effect	49	$1.2m	$1.5m
Indirect Effect	5	$.2m	$.3m
Induced Effect	5	$.1m	$.3m
Total Effect	58	$1.5m	$2m
West Virginia			
Direct Effect	51	$1.9m	$2.5m
Indirect Effect	11	$.5m	$.8m
Induced Effect	13	$.5m	$.9m
Total Effect	75	$2.9m	$4.2m

At the state level, the economic effects would be larger in absolute terms, but smaller relative to the state's $73.9 billion economy. Specifically, over 1 year, the mothballing activities would add 75 jobs with earnings equaling $2.9 million and a $4.2 million contribution to the State GDP. If the demolition, mothballing and safe-abandonment activities were to be extended beyond a single 4-month period and spread out over time because of fiscal constraints, the contribution to the economy in any 1 year would be proportionately smaller but similar in total.

Post-implementation

The estimated operations staff and annual expenditures under Action Alternative C are shown in Table 4.11-1 and the estimate of the number of visitors to GBO is reported in Table 4.11-3. The economic impacts of Action Alternative C are shown in Table 4.11-9 and represented by the differences in employment, labor income, and County GDP between the No-Action Alternative and Action Alternative C. These economic impacts include both the effects from changes in operations at the GBO facilities as well as changes in visitor spending. Implementing Action Alternative C would result in an annual loss of 158 jobs in Pocahontas County, with earnings of $6.5 million. This represents 3.5 percent of total employment in the county. In addition, the economy would suffer a loss of $9.63 million or 4 percent of County GDP. In the short run, these losses would more than offset the gains from the implementation activities. Action Alternative C would result in a major, long-term adverse impact on the economy of Pocahontas County.

The economic impacts on the State are also included in Table 4.11-9. Once the implementation is completed, future annual losses in the state would include 173 jobs, $6.5 million in earnings, and $9.8 million in the State GDP.

TABLE 4.11-9
Economic Impacts of Operations Activities under Action Alternative C

	No-Action Operations			Action Alternative C Operations			Alternative C Impacts (Losses)		
Impact Type	**Employment**	**Labor Income**	**Total Value Added (GDP)**	**Employment**	**Labor Income**	**Total Value Added (GD)**	**Employment**	**Labor Income**	**Total Value Added (GDP)**
Pocahontas County									
Direct Effect	170	$6m	$7.7m	57	$.8m	$.9m	113	$5.3m	$6.8m
Indirect Effect	29	$.8m	$1.7m	3	$.1m	$.1m	26	$.7m	$1.6m
Induced Effect	22	$.6m	$1.4m	3	$.1m	$.2m	20	$.5m	$1.2m
Total Effect	221	$7.5m	$10.8m	63	$.9m	$1.2m	158	$6.5m	$9.6m
West Virginia									
Direct Effect	165	$5.9m	$7.9m	51	$1.9m	$2.5m	114	$3.9m	$5.4m
Indirect Effect	41	$1.9m	$3.1m	11	$.5m	$.8m	30	$1.4m	$2.4m
Induced Effect	43	$1.6m	$2.9m	13	$.5m	$.9m	29	$1.1m	$2m
Total Effect	249	$9.4m	$14m	75	$2.9m	$4.2m	173	$6.5m	$9.8m

Note: Operations includes the economic impacts from GBO operations and visitors attracted to Pocahontas County primarily to visit GBO. For example, direct employment includes staff working in the food and beverage, accommodations, and other industries that receive most of the tourist dollars from these visitors.

4.11.3.3 Education

Demolition and Mothballing

As with Action Alternative A, the nonlocal demolition and mothball workers are not expected to bring their families, and school populations would not change with the arrival of this workforce.

Post-implementation

Action Alternative C would decrease the school age population to a greater extent than the previous alternatives, further contributing to the decline in enrollments in the Pocahontas County Public School System and the Green Bank Elementary-Middle School. In addition to the loss at the facilities at GBO and volunteer participation from GBO staff members, the Green Bank Elementary-Middle School could lose up to 16 students or approximately 6 percent of its current enrollment based on workforce reductions of GBO staff members living in the Green Bank and Arbovale CDPs. A moderate, long-term adverse impact on the educational resources of Pocahontas County and a major, adverse long-term impact on the Green Bank and Arbovale CDPs would be expected.

The educational outreach activities described in Action Alternative A would be eliminated under Action Alternative C, resulting in a major, adverse, and long-term impact on regional education opportunities.

4.11.3.4 Tourism

Action Alternative C would have a major, long-term adverse impact on tourism due to the total loss of 50,000 annual visitors to GBO. This impact would commence with implementation activities and continue long afterwards due to the loss of a unique and popular tourist attraction. It is not known how many of these visitors would continue to come to Pocahontas County to take advantage of the other attractions such as the Snowshoe Mountain Ski Resort, the Cranberry Nature Center, the Cass Scenic Railroad, and the Greenbrier River Trail. The economic impacts reported in Section 4.11.3.2, *Economy, Employment, and Income*, include the losses in visitor spending, which were calculated based on the conservative assumption that these visitors would be lost permanently.

4.11.3.5 Community Cohesion

Action Alternative C could include the relocation of up to 86 operations staff and their families and up to 51 operations staff and their families from the Green Bank and Arbovale CDPs to areas outside Pocahontas County. As described earlier, GBO would no longer provide gathering places and services (e.g., recreation area, auditorium, and evacuation center during states of emergency or extended power outages), and GBO staff that previously played an active role in community services and volunteer organization would likely relocate.

A number of stakeholders commented on GBO's importance to the community and emphasized contributions such as hosting a wide range of community events, from high school proms, field trips,

science fairs, and math field days to town meetings and hunter safety courses held by the West Virginia State Department of Natural Resources.

The substantial changes in operations staff would result in a moderate, adverse long-term impact on the community cohesion of Pocahontas County and major, adverse long-term impacts on the community cohesion of the Green Bank and Arbovale CDPs that would be expected to start with the demolition phase.

4.11.4 Action Alternative D: Demolition and Site Restoration

4.11.4.1 Population and Housing

Demolition

Impacts on temporary housing resources during the demolition phase would be greater than the other Alternatives; however, impacts on the temporary housing market would still be a moderate, short-term benefit, because it is not expected that workers would bring their families. If the demolition phase were extended beyond a single 9-month period because of fiscal constraints, the contribution to the housing market in any 1 year would be proportionately smaller but similar in total.

Post-implementation

Up to 103 people would likely relocate outside Pocahontas County with their families to secure comparable employment under Action Alternative D. This could represent an estimated Pocahontas County population decrease of 290 people and 3.3 percent, assuming the household size of GBO staff is the same as the average for the communities where they reside and that all the staff relocate. The average family size in Pocahontas County is 2.8 individuals.

The loss of 60 staff who are residents of the Green Bank and Arbovale CDPs could result in a loss of up to 193 people from these communities and a 46.0 percent decrease in their combined population, based on respective family sizes of 3.7 and 2.6 individuals. Moderate, adverse, long-term impacts within the county and major, adverse, long-term impacts on owner-occupied housing within the CDPs of Green Bank and Arbovale would be expected to the housing market due to this decrease in population.

4.11.4.2 Economy, Employment, and Income

Demolition

The direct, indirect, and induced economic impacts from the demolition activities under Action Alternative D are listed in Table 4.11-10. In total, this Alternative would generate the equivalent of 169 jobs for 1 year, which represents about 4 percent of employment in the county. The combined earnings are less than $4 million and County GDP would increase $5.8 million, which is 2.4 percent of current GDP in the county. This represents a moderate, short-term benefit to the economy of Pocahontas County. If demolition were to be extended beyond a single 9-month period because of fiscal constraints, the contribution to the economy in any 1 year would be proportionately smaller but similar in total.

However, these activities would coincide with the discontinuation of all operations at GBO. As shown in Table 4.11-11, any short-term beneficial economic impacts from the demolition phase activities would be offset by shutting down operations.

TABLE 4.11-10
Economic Impacts of Demolition Phase Activities under Action Alternative D

Pocahontas County			
Impact Type	**Employment**	**Labor Income**	**Total Value Added (GDP)**
Direct Effect	145	$3.3m	$4.5m
Indirect Effect	12	$.3m	$.6m
Induced Effect	12	$.3m	$.8m
Total Effect	169	$4m	$5.8m
West Virginia			
Direct Effect	227	$9.7m	$12.8m
Indirect Effect	52	$2.5m	$3.8m
Induced Effect	67	$2.6m	$4.6m
Total Effect	346	$14.8m	$21.2m

At the state level, the economic effects would be larger in absolute terms, but smaller relative to the state's $73.9 billion economy. Specifically, over 1 year, the demolition activities would add 346 jobs with earnings equaling $14.8 million and a $21.2 million contribution to State GDP.

Post-implementation

Because all operations would cease with Action Alternative D, the economic losses are equivalent to the negative of the No-Action Alternative, which is shown in Table 4.11-11. Implementing Action Alternative D would result in an annual loss of 221 jobs in Pocahontas County, with earnings of $7.5 million. This represents 5 percent of total employment in the county. In addition, the economy would suffer a loss of $10.8 million, or 4.4 percent of the County GDP. In the short run, these losses would more than offset the gains from the demolition activities. Action Alternative D would result in a major, long-term adverse impact on the economy of Pocahontas County.

The economic impacts on the State are also included in Table 4.11-11. Once the demolition phase is completed, future annual losses in the state would include 249 jobs, $9.4 million in earnings, and approximately $14 million in State GDP.

TABLE 4.11-11
Economic Impacts (Losses) of Operations Activities under Action Alternative D

Impact Type	Employment	Labor Income	Total Value Added (GDP)
Pocahontas County			
Direct Effect	170	$6m	$7.7m
Indirect Effect	29	$.8m	$1.7m
Induced Effect	22	$.6m	$1.4m
Total Effect	221	$7.5m	$10.8m
West Virginia			
Direct Effect	165	$5.9m	$7.9m
Indirect Effect	41	$1.9m	$3.1m
Induced Effect	43	$1.6m	$2.9m
Total Effect	249	$9.4m	$14m

Note: Operations includes the economic impacts from GBO operations and visitors attracted to Pocahontas County primarily to visit GBO. For example, direct employment includes staff working in the food and beverage, accommodations, and other industries that receive most of the tourist dollars from these visitors.

4.11.4.3 Education

Demolition

As with Action Alternative A, the non-local demolition phase workers are not expected to bring their families, and school populations would not change with the arrival of the demolition workforce.

Post-implementation

Under Action Alternative D, long-term, moderate adverse impacts on Pocahontas County and major, adverse and long-term impacts would be experienced by Green Bank and Arbovale for the reasons noted under Action Alternative C.

The educational outreach activities described in Action Alternative A would be eliminated under Action Alternative D, resulting in a major, adverse, and long-term impact on regional education opportunities.

4.11.4.4 Tourism

Like Action Alternative C, Action Alternative D would result in a total loss of 50,000 annual visitors to GBO and have a major, long-term adverse impact on tourism.

4.11.4.5 Community Cohesion

Impacts on community cohesion from Action Alternative D would start with implementation and result in a moderate, adverse long-term impact on the community cohesion of Pocahontas County for the reasons described under Action Alternative C. Major, adverse long-term impacts on the community cohesion of the Green Bank and Arbovale CDPs would be experienced to a greater degree and would be expected to start with implementation.

4.11.5 No-Action Alternative

Under the No-Action Alternative, NSF would continue funding GBO at current levels and no associated modifications to GBO facilities or operations would occur. Therefore, the No-Action Alternative would have no new impacts on socioeconomic resources.

4.11.6 Summary of Impacts

Table 4.11-12 provides a summary of the socioeconomic resource impacts resulting from the Alternatives.

TABLE 4.11-12
Summary of Socioeconomic Resource Impacts

	Alternatives				
Impacts	**Action Alternative A**	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Population & Housing: Impacts on temporary housing during demolition	Moderate, short-term benefit	Moderate, short-term benefit	Moderate, short-term benefit	Moderate, short-term benefit	No impact
Population & Housing: Impacts on permanent housing in Pocahontas County post-implementation	No impact	Minor, adverse, and long-term	Moderate, adverse, and long-term	Moderate, adverse, and long-term	No impact
Housing: Impacts on permanent housing in Green Bank and Arbovale CDPs post-implementation	No impact	Minor, adverse, and long-term	Major, adverse, and long-term	Major, adverse, and long-term	No impact
Economy, employment and income: Impacts from demolition	Moderate, short-term benefit	Moderate, short-term benefit	Minor, short-term benefit	Moderate, short-term benefit	No impact
Economy, employment and income: Impacts post-implementation	Negligible	Moderate, adverse and long-term	Major, adverse, and long-term	Major, adverse, and long-term	No impact
Education: Impacts on school enrollment from demolition	No impact	No impact	No impact	No impact	No impact
Education: Impacts on school enrollment in Pocahontas County post-implementation	No impact	Minor, adverse, and long-term	Moderate, adverse, and long-term	Moderate, adverse, and long-term	No impact
Education: Impacts on school enrollment in Green Bank and Arbovale post-implementation	No impact	Moderate, adverse, and long-term	Major, adverse, and long-term	Major, adverse, and long-term	No impact
Education: Impacts from reduced regional educational opportunities	Minor, adverse and short-term	Moderate, adverse, and long-term	Major, adverse, and long-term	Major, adverse, and long-term	No impact
Tourism: Impact on regional tourism	No impact	Moderate adverse, and long-term	Major adverse, and long-term	Major adverse, and long-term	No impact

TABLE 4.11-12
Summary of Socioeconomic Resource Impacts

Impacts	Alternatives				
	Action Alternative A	**Action Alternative B**	**Action Alternative C**	**Action Alternative D**	**No-Action Alternative**
Community cohesion: Impacts on Pocahontas County	Minor, adverse, and long-term	Minor, adverse, and long-term	Moderate, adverse, and long-term	Moderate, adverse, and long-term	No impact
Community cohesion: Impacts on Green Bank and Arbovale CDPs	Moderate, adverse, and long-term	Moderate, adverse, and long-term	Major, adverse, and long-term	Major, adverse, and long-term	No Impact

4.12 Environmental Justice

This Section describes the analysis performed to identify potential environmental justice impacts that could exist under the four Action Alternatives. Environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (EPA, 2015a). The analysis of environmental justice issues is required under E.O. 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. E.O. 12898 mandates that opportunities to participate actively in the planning process be provided to minority and low-income populations and evaluates whether the project would result in any disproportionately high and adverse effects on individuals in these populations. E.O. 12898 also directs federal agencies to take appropriate and necessary steps to identify and address disproportionately high and adverse effects of federal projects on the health and environment of minority and/or low-income populations to the greatest extent practicable by law (59 *Federal Register* 7629; February 16, 1994).

As the primary federal agency responsible for protecting the environment and monitoring environmental issues, EPA sets policy and standards for compliance with E.O. 12898. In 2014, EPA issued new guidance and tools for interpreting E.O. 12898, including Plan EJ 2014 and a web-based tool called EJSCREEN, which is used in the following analysis. This guidance was updated in 2015.

4.12.1 Methodology

The ROI for environmental justice is the Green Bank CDP, Arbovale CDP, and a 5-mile radius around GBO, as these are the populations that would be most affected by the Proposed Action. Following E.O. 12898 and considering recent EPA guidance, this analysis will address the following three factors to determine compliance with E.O. 12898.

Fair Treatment and Meaningful Involvement. E.O. 12898 requires agencies to provide full and fair opportunities for minority and low-income populations to engage in the public participation process. EPA guidance provided an additional definition on the terminology used in E.O. 12898 (EPA, 2015a):

- *Fair Treatment* means that no group of people should bear a disproportionate burden of environmental harms and risks, including those resulting from the negative environmental consequences of industrial, governmental, and commercial operations or programs and policies.
- *Meaningful Involvement* means that: (1) potentially affected populations have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; (2) the public's contribution can influence the regulatory agency's decision; (3) the concerns of all participants involved will be considered in the decision-making process; and (4) the rule writers and decision makers seek out and facilitate the involvement of those potentially affected.

Minority Demographics. A minority population is determined to be present if the population percentage of the nearby communities (Green Bank and Arbovale CDPs or a 5-mile radius around the site) is meaningfully greater than the minority population percentage in the general population (West Virginia). Minority demographics are defined as follows using USCB data:

- *Black* – a person having origins in any of the black racial groups of Africa
- *Hispanic* – a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race
- *Asian American* – a person having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands
- *American Indian or Alaskan Native* – a person having origins in any of the original people of North America and who maintains cultural identification through tribal affiliation or community recognition
- *Native Hawaiian and Other Pacific Islander* – a person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands

Low-income Demographics. A low-income population is determined to be present if the population percentage of the nearby communities (Green Bank and Arbovale CDPs or a 5-mile radius around the site) is meaningfully greater than the low-income population percentage in the general population (West Virginia). Low-income populations are defined as those individuals whose median household income is at, or below, the poverty threshold.

The following Sections describe the components of the environmental justice analysis:

- Section 4.12.2, *Public Disclosure and Involvement*, provides a summary of the public disclosure and involvement activities provided as part of this NEPA process. These opportunities were provided to allow for full and fair opportunities for minority and low-income populations (in addition to the public) to engage in the public participation process.
- Section 4.12.3, *U.S. Census Findings: Green Bank and Arbovale*, provides census data to determine the extent of the minority and low-income population in the Green Bank and Arbovale CDPs.
- Section 4.12.4, *EJSCREEN Results*, provides a summary of the EJSCREEN tool and the results for a 5-mile area around GBO.
- Section 4.12.5, *Identification of Disproportionately High and Adverse Effects on Low-Income Populations*, reviews the Proposed Action and Alternatives and provides summary tables for each resource section to determine the potential for disproportionately high and adverse effects on minority and low-income populations.

- Section 4.12.6, *Compliance with Executive Order 12898*, provides a conclusion and summary of compliance with E.O. 12898.

4.12.2 Public Disclosure and Involvement

Prior to the public scoping period, NSF notified, contacted, or consulted with multiple agencies, individuals, and organizations. Details of public and agency disclosure and involvement related to the Proposed Action are detailed in Section 5, *Notification, Public Involvement, and Consulted Parties*. These disclosure efforts included pre-assessment notification letters, media announcements, social media announcements, website updates, scientific digests and blogs, distribution lists, newspaper public notices, and public scoping meetings (conducted on November 9, 2016, in Green Bank, West Virginia). Multiple opportunities were provided for the public to provide input.

4.12.3 U.S. Census Findings: Green Bank and Arbovale

The Green Bank and Arbovale CDPs have smaller minority populations (0 percent) compared to the State of West Virginia (6 percent) as shown in Table 3.11-1 (USCB, 2015a; WV HomeTownLocator, 2017a). Consequently, minority populations are not discussed further here.

Table 4.12-1 shows a comparison of poverty statistics for Green Bank CDP, Arbovale CDP, Pocahontas County, and West Virginia. As shown in Table 4.12-1, approximately 49 percent of the population of the Green Bank CDPs falls within the poverty rate compared to 2.5 percent in Arbovale, 17 percent in Pocahontas County, and 18 percent in West Virginia. The differences between the Green Bank and Arbovale CDPs are likely associated with the small population sizes and the residential availability in each area.

TABLE 4.12-1
Five-year Average of the Past 12 Months (2015 ACS Survey)

			AGE		
		Population for whom poverty status is determined [a]	**Under 18 years**	**18 to 64 years**	**65 years and older**
Green Bank CDP	**Total**	**223**	**87**	**106**	**30**
	Below Poverty Level	109	62	47	0
	Percent Below Poverty Level	49%	71%	44%	0%
Arbovale CDP	Total	197	41	125	31
	Below Poverty Level	5	--	5	--
	Percent Below Poverty Level	2.5%	0	4%	0
Pocahontas County	Total	8,382	1,536	5,040	1,806
	Below Poverty Level	1,382	520	772	90
	Percent Below Poverty Level	17%	34%	15%	5%
West Virginia	Total	1,797,793	372,473	1,114,777	310,543
	Below Poverty Level	323,384	93,437	201,590	28,357
	Percent Below Poverty Level	18%	25%	18%	9%

Source: USCB, 2015h.

[a] Population totals do not include unrelated children and persons living in group quarters.

4.12.4 EJSCREEN Results

In May 2015, EPA issued updated policy guidance and a new EJSCREEN tool to assist in determining the potential impacts on environmental justice communities. EJSCREEN builds on previous tools, providing updated demographic information, environmental indicators, and high-resolution maps to generate standardized reports that bring together environmental and demographic data in the form of environmental justice indexes. EPA describes EJSCREEN as a pre-decisional screening tool that should not be used to identify or label an area as an "Environmental Justice (EJ) Community;" instead, the tool is designed as a starting point to identify candidate sites that might warrant further review or outreach.[5]

For the purpose of this analysis, the EJSCREEN tool was used to generate adjacent population estimates for a 5-mile buffer around GBO using the USCB ACS 2010–2014 Survey. The EJSCREEN tool compares the population estimates to those of West Virginia to assess potential disproportionate impacts. The EPA's EJSCREEN tool was also used to determine whether there are any distinguishing characteristics within a 5-mile geographic buffer of GBO that could further inform the environmental justice analysis. The 5-mile buffer is measured as 5 geographic miles from the center point of GBO.

EJSCREEN identified approximately 992 persons within 5 miles of GBO. Approximately 1,058 housing units are within 5 miles of GBO, while 883,984 total housing units are in West Virginia. This 5-mile buffer had a per capita income of $28,576 compared to $23,450 for residents of West Virginia, and 30 percent of the population in the 5-mile buffer could be characterized as low income compared to 40 percent of West Virginia in 2014 (EPA, 2016b).

Table 4.12-2 summarizes the environmental and demographic indicator results for a 5-mile buffer compared to those of West Virginia. The environmental and demographic indicator results near GBO are much better (lower numbers) than the results for West Virginia for air, water, lead, and other toxic substances measured by EPA and measured in EJSCREEN (see Appendix 4.12A for the complete table). All of the environmental indicators within a 5-mile buffer of GBO were much better (lower numbers) than those of West Virginia, which is an important factor in determining whether the area is currently experiencing the effects of disproportionately high and adverse environmental issues.

[5] "EJSCREEN is not designed to explore the root causes of differences in exposure. The demographic factors included in EJSCREEN are not necessarily causes of a given community's increased exposure or risk. Additional analysis is always needed to explore any underlying reasons for differences in susceptibility, exposure or health" (EPA, 2015b).

TABLE 4.12-2
EJSCREEN Report Results

Environmental Indicators	5-mile Buffer (GBO)	West Virginia
National Air Toxics Assessment (NATA) Diesel PM (micrograms per cubic meter)	7.65	9.51
NATA Cancer Risk (lifetime risk per million)	19	34
NATA Respiratory Hazard Index	0.39	1.3
Traffic Proximity and Volume (daily traffic count/distance to road)	4	58
Lead Paint Indicator (% pre-1960 Housing)	0.15	0.35
Super Proximity (site count/kilometer (km) distance)	0.00022	0.074
Risk Management Plan Proximity (facility count/km distance)	0.11	0.29
Hazardous Waste Proximity (facility count/km distance)	N/A	0.12
Water Discharger Proximity (facility count/km distance)	0.0056	0.42
Demographic Indicators	**5-mile Buffer (GBO)**	**West Virginia**
Demographic Index	17%	24%
Minority Population	4%	7%
Low-income Population	30%	40%
Linguistically Isolated Population	0%	0%
Population with less than High School Education	10%	16%
Population under 5 years of age	7%	6%
Population over 64 years of age	19%	17%

Source: EPA, 2015c (see Appendix 4.12A).

4.12.5 Identification of Disproportionately High and Adverse Effects on Low-Income Populations

Based on the income data from USCB shown in Section 4.12.3, *U.S. Census Findings: Green Bank and Arbovale*, low-income populations are present in the CDP of Green Bank, West Virginia. Because of statistical abnormalities, the size of this low-income population may not be meaningfully greater than the rest of West Virginia; nevertheless, NSF decided to provide a full environmental justice analysis based on concerns raised during scoping.

The following indicators are typically used to determine the effect of a proposed action on low-income populations:

- Environmental conditions, such as the quality of air, water, and other environmental media, as well as the loss of open space
- Human health, such as exposure of environmental justice communities to pathogens and nuisance concerns (odor, noise, and dust)
- Public welfare, such as reduced access to certain amenities like hospitals, safe drinking water, and public transportation
- Economic conditions, such as changes in employment, income, and the cost of housing

These indicators are described in the corresponding resource sections (air, water, noise, socioeconomics) in Section 3, *Affected Environment*, and Section 4, *Environmental Consequences*, of this DEIS. These Sections were reviewed and the potential impacts of the Alternatives are summarized in Table 4.12-3. Table 4.12-3 provides the relevant proposed environmental protection measures for each resource under consideration, illustrating whether, following implementation of environmental protection measures, there are residual high or major impacts that require further review to determine whether the Proposed Action may result in disproportionately high and adverse impacts on low-income populations. The table shows whether an impact may be caused by the Proposed Action, not whether low-income populations are affected.

The far-right column of Table 4.12-3 indicates whether there is a high and adverse impact. It also advises whether a site-specific review is necessary to determine who is affected and whether the Proposed Action may result in disproportionately high and adverse impact on low-income populations. A detailed analysis and full listing of all resource impacts (e.g., air quality, biological, and cultural) are provided in Sections 4.1 through 4.11.

TABLE 4.12-3
Summary of Potential Adverse Impacts and Environmental Protection Measures for Alternatives A through D

Element of Analysis	Potential Impacts	Relevant Environmental Protection Measures[a]	Potential High Adverse Effects
Air Quality	Slight temporary increase in NAAQS criteria emissions for all Action Alternatives; however, all emissions would be in an area that is in full attainment.	Air quality BMPs would be implemented during demolition. Contracts would require idle reduction and proper equipment maintenance to reduce emissions during demolition.	No high, adverse effect. Therefore, no further review is necessary.
Cultural Resources	The Action Alternatives would alter buildings and structures that are potentially eligible for the NRHP to varying degrees. Changes to operations-related activities could significantly change the characteristics of NRHP-eligible resources.	Mitigation measures would be coordinated with the SHPO, ACHP, and the Consulting Parties and then would be implemented.	**Potential for a high, adverse effect. This resource is analyzed further below.**

TABLE 4.12-3
Summary of Potential Adverse Impacts and Environmental Protection Measures for Alternatives A through D

Element of Analysis	Potential Impacts	Relevant Environmental Protection Measures[a]	Potential High Adverse Effects
Hazardous Materials	Presence of existing contamination and use of hazardous materials during demolition under all Action Alternatives.	A complete site characterization would be performed prior to implementing an Alternative. Hazardous materials and wastes would be used, stored, disposed of, and transported during demolition in compliance with all applicable laws and regulations.	No high, adverse effect. Therefore, no further review is necessary.
Solid Waste	Short-term increase in solid waste production from demolition activities under all Action Alternatives.	Debris would be recycled and reused to the extent practicable. Solid waste would be properly disposed of.	No high, adverse effect. Therefore, no further review is necessary.
Health and Safety	Short-term distractive nuisance of demolition site and mothballed facilities under the Action Alternatives.	Demolition and mothballed sites would be fenced and warning signs would be placed on site to explain the inherent danger at the site.	No high, adverse effect. Therefore, no further review is necessary.
Noise	Increased noise from demolition activities under all Action Alternatives.	Demolition noise would be within normal sound levels for the surrounding areas.	No high, adverse effect. Therefore, no further review is necessary.
Socioeconomics	Reduction in employment, STEM education opportunities, and tourism under Alternatives C and D.		**Potential for a high adverse effect. This resource is analyzed further below.**
Transportation	Minimal increase of haul traffic associated with demolition activities under all Action Alternatives.	Haul traffic will be limited to off-peak hours. The contractor will coordinate with local public schools.	No high, adverse effect. Therefore, no further review is necessary.
Visual	Demolition would result in removal of manmade objects and would return the view shed to a more natural condition under Alternative D.		No high, adverse effect. Therefore, no further review is necessary.

[a] The environmental protection measures shown in this table represent the measures required to protect residents and individuals, including low-income populations in and around GBO. Additional environmental protection measures are discussed in the resources subsections in Section 4, *Environmental Consequences*.

4.12.6 Compliance with Executive Order 12898

The communities adjacent to or surrounding GBO do not represent a minority population, based on the ACS data and the EJSCREEN results. The EJSCREEN results for the 5-mile buffer around GBO show that the Observatory is located in an area where 30 percent of the population is low income compared to 40 percent for West Virginia (EPA, 2015c). Using this typical screening area size, there is not a higher percentage of low-income population compared to the state average. However, the ACS data for the Green Bank CDP indicate that there is a higher percentage of low income-population compared to the state average. Therefore, there is a potential for environmental justice impacts based on E.O. 12898.

E.O. 12898 calls for federal agencies to provide opportunities for stakeholders to obtain information and provide comments on federal actions. NSF has complied with E.O. 12898 through the public notification and collaboration process detailed in Section 5, *Notification, Public Involvement, and Consulted Parties*.

As emphasized in EPA's recent revision to *Guidance on Considering Environmental Justice during the Development of Regulatory Actions* (EPA, 2015), the role of this environmental justice analysis and screening is to present anticipated impacts across population groups of concern (that is, minority and low-income populations) to NSF, the agency decision maker for the Proposed Action, with the purpose of informing its policy judgement and ultimate determination on whether there is a potential disproportionate impact that may merit additional action (EPA, 2015a).

As shown in Table 4.12-3, there are potential high adverse effects for cultural resources as defined by Section 106 of the NHPA. The potential major impacts/adverse effects for cultural resources result from the demolition of historic properties that contribute to the GBO NRHP-listed historic district. These impacts/adverse effects would occur under all Alternatives; however, the impacts will be addressed through consultation with the West Virginia SHPO, ACHP, and the Consulting Parties on measures to avoid, minimize, and mitigate adverse effects. The potential major impacts/adverse effects for cultural resources would not be disproportionately high, adverse impacts on minority and low-income populations, because the impact on historic properties would be borne equally among demographic groups. See Section 4.2, *Cultural Resources*, for additional discussion on cultural resources impacts.

The analysis of socioeconomic resources finds that mothballing (Alternative C) or demolishing GBO (Alternative D) would result in minor, long-term, adverse impacts from the loss of operations-related jobs; therefore, these impacts would not equate to a high and adverse impact under E.O. 12898. Although potential impacts on STEM education and tourism under Alternatives C and D would be major, adverse, and long-term, which would equate to a high, adverse effect, other STEM education and tourism opportunities are available within the vicinity of GBO and Pocahontas County. These potential major impacts would be borne equally among demographic groups and would not be disproportionately borne by low-income populations. Section 4.11, *Socioeconomics*, provides additional discussion on socioeconomic impacts.

While these socioeconomic and cultural losses may affect low-income populations, the impacts are not disproportionate, because they would not be borne unduly by low-income populations. Therefore, impacts from any of the Alternatives would not result in disproportionately high and adverse to low-income populations.

4.13 Cumulative Impacts

This cumulative impact analysis follows the requirements of NEPA and CEQ guidance. The CEQ provides the implementing regulations for NEPA, which define a cumulative impact as follows:

> … the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes the actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 C.F.R. §1508.7)

Cumulative impacts would occur if the incremental effects of the Proposed Action resulted in an increased impact when added to the environmental effects of past, ongoing, and reasonably foreseeable future activities. Reasonably foreseeable future activities are defined as those that have an application for operations pending and would occur in the same time frame as the Proposed Action. Past activities are considered only when their impacts still would be present during implementation of the Proposed Action.

Methodology

The cumulative impacts analysis for each resource involved the following process:

- Identifying the impacts associated with the Proposed Action that could combine with other activities to result in a noticeable increased impact. This was determined to be adverse impacts that were designated minor or greater in the previous analysis (identified in Sections 4.1 through 4.11).
- Identifying past, present, and other reasonably foreseeable actions (or cumulative activities) that could affect each resource (identified in Section 4.13.1, *Cumulative Activities*).
- Determining the potential cumulative impacts (identified in Section 4.13.3, *Cumulative Impacts on Individual Resources*).

The level of cumulative analysis for each resource in this DEIS varies, depending on the sensitivity of the resource to potential cumulative impacts.

4.13.1 Cumulative Activities

This Section identifies any past, present, or reasonably foreseeable activities that could interact with the Proposed Action to contribute to cumulative impacts. NSF conducted a review of planning and permit programs to identify pending, planned, or recently completed projects in the region of the Proposed Action. The following is a summary of these findings.

NSF's potential funding changes for another observatory that conducts radio astronomy, the Arecibo Observatory in Arecibo, Puerto Rico, were not considered a cumulative activity, as no decision on the future of Arecibo Observatory has been made. Therefore, any potential future use of disposition of the

observatory is speculative at this time. If a decision is made on the Arecibo Observatory prior to the finalization of this EIS, an analysis will be included in the Final EIS for GBO.

The West Virginia Planning and Development Council, Region 4 mission is to plan for and facilitate the comprehensive development of Fayette, Greenbrier, Nicholas, Pocahontas, and Webster Counties. Review of the 2016 update to the Council's Region 4 Comprehensive Economic Development Strategy identified 18 infrastructure projects within Pocahontas County; however, none of these projects are in the area of GBO. These infrastructure projects include water and wastewater system studies and upgrades, sidewalk repair, flood control, recreation facilities, and library/community services (Region 4, Planning and Development Council, 2016b). None of the projects have the potential to result in cumulative impacts when combined with the Proposed Action, given their distance from GBO, the nature of the activities, and the localized area of impact associated with each project.

The USACE Civil Works Division has no pending or planned projects for the area of GBO (USACE, 2017a). The USACE Regulatory Division has no pending or recently completed Clean Water Act permits for the area of the GBO (USACE, 2017b).

The West Virginia Department of Transportation (WVDOT) website indicates no ongoing or planned highway projects in the vicinity of GBO or the proposed haul route (WVDOT, 2017).

The USFS coordinates with GBO on any application for a special use permit in the NRQZ and on activities within 1 mile of the Observatory that might produce incidental radio emission (USFS, 2011). No permit applications or upcoming activities relating to radio emissions were identified.

A review of USFS active and proposed land management projects in the Monongahela National Forest identified nine projects in the planning or analysis phase. Of these nine projects, only one is located near GBO. This project is an application for a Special Use Permit for the Atlantic Coast Pipeline (ACP), which is a natural gas pipeline proposed to be constructed through approximately 5 miles of forest land (USFS, 2017d). The proposed area is approximately 9 miles south of Green Bank. Pending the receipt of all applicable federal authorizations, initial construction activities are anticipated to begin in November 2017, with pipeline construction commencing in April 2018. Construction of the ACP pipeline would last about 18 months; after construction is complete, the new ACP facilities would be placed into service following a determination that restoration is proceeding satisfactorily, with an overall completion date estimated to be in mid-2019 (FERC, 2016). Given the time frame and distance of this project, it is unlikely to result in a cumulative impact in combination with any of the Action Alternatives.

During public scoping, members of the community identified the 2015 closure of the nearby Sugar Grove Station, a former U.S. Navy facility approximately 30 miles northeast in neighboring Pendleton County, as an activity having the potential to contribute to cumulative socioeconomic impacts. NSF considered the closure of Sugar Grove Station during its analysis, but it determined that Sugar Grove's location in

Pendleton County puts it outside the ROI for economic impacts; therefore, Sugar Grove is not considered as a contributor to cumulative impacts.

There are no other known planned, underway, or recently completed major projects with the potential to interact with the Proposed Action to create cumulative impacts.

The only identified cumulative activities are limited to routine activities, such as GBO operations, routine forest land management, and residential community activities and limited development.

4.13.2 Resources with No Potential for Cumulative Impacts as a Result of the Proposed Action

Resource areas that were not considered in detail in the DEIS were not evaluated for cumulative impacts. These resources either have no impacts or the impacts are so slight that the Proposed Action could not meaningfully contribute to cumulative impacts. These resources include:

- Air Quality – GBO is in attainment for all NAAQS criteria pollutants and does not require a CAA conformity analysis. Any air quality impacts would be negligible on a regional basis and would not contribute to cumulative impacts on air quality.
- Climate Change – The Proposed Action would not appreciably alter GHG emissions and would not meaningfully contribute to cumulative impacts for climate change.
- Land Use – Any land use change would be minor and confined to the boundaries of GBO. Any land use change at the Observatory would not contribute to cumulative impacts on land use in the region.
- Utilities – The minor decrease in utility demand under Action Alternatives C and D would not result in negative cumulative impacts.

4.13.3 Cumulative Impacts on Individual Resources

The following subsections explain the cumulative impacts on individual resources resulting from the Proposed Action and past, present, and reasonably foreseeable future activities.

4.13.3.1 Biology

The minor to moderate impacts on vegetation and wildlife under the Action Alternatives would not be expected to contribute appreciably to cumulative impacts on regional biological resources. Impacts would be temporary and primarily limited to the disturbance of non-native landscaped vegetation, which would not interact with the other identified cumulative activities or extend beyond the boundaries of GBO. There are no expected cumulative impacts associated with threatened or endangered species.

4.13.3.2 Cultural Resources

The APE for cultural resources is defined as the property boundary of GBO. Although major, adverse impacts on cultural resources were identified, these impacts would be confined to the Observatory property and would not interact with the identified cumulative activities that would occur outside the

Observatory boundary. Therefore, there would be no cumulative impacts on cultural resources under any Action Alternative.

4.13.3.3 Visual Resources

Although moderate, adverse impacts on visual resources were identified, these impacts would not interact with the identified cumulative activities, as most activities are associated with underground infrastructure or would not occur in the same view shed. Therefore, there would be no cumulative impacts on visual resources under any Action Alternative.

4.13.3.4 Geology and Soil

Primarily negligible impacts on geology and soil resources were identified. Therefore, there is little likelihood of any Action Alternative to combine with the identified cumulative activities.

4.13.3.5 Water Resources

Only negligible impacts on water resources were identified. Therefore, there is no likelihood of any Action Alternative to combine with the identified cumulative activities.

4.13.3.6 Hazardous Materials

The minor, adverse impacts resulting from use of hazardous materials or generation of waste under all Action Alternatives during implementation would not be expected to contribute appreciably to cumulative impacts. Use of hazardous materials during implementation would be temporary and comply with appropriate regulations. Therefore, there is a limited likelihood of any Action Alternatives interacting with the identified cumulative activities to contribute to cumulative impacts.

4.13.3.7 Solid Waste

The ROI for solid waste includes GBO and the facilities where solid waste would be landfilled. While there would be a minor, adverse impact on regional landfills, the regional landfills would remain well within capacity. None of the identified cumulative activities would be expected to create substantial solid waste; therefore, there is little likelihood for a cumulative impact on occur from solid waste.

4.13.3.8 Health & Safety

The minor, adverse impacts on health and safety, including impacts from implementation and the detection of NEOs, are considered unique to the specific Action Alternatives. Therefore, there is no potential for any Action Alternative to combine with any of the identified cumulative activities and result in an increased cumulative impact.

4.13.3.9 Noise

The ROI for noise includes the project boundary and adjacent properties. There is a moderate, adverse impact expected during implementation activities under all Action Alternatives; however, the identified cumulative activities are unlikely to combine with the noise associated with the proposed activities described for the Action Alternatives A, B, C or D. Consequently, there are no expected cumulative noise impacts.

4.13.3.10 Traffic and Transportation

Implementation activities would result in minor, adverse impacts on transportation under all Action Alternatives. However, the identified cumulative activities are not expected to noticeably increase traffic. Therefore, there is limited potential for a cumulative impact.

4.13.3.11 Socioeconomics

None of the identified cumulative activities are expected to have an impact on socioeconomic resources; therefore, there is no potential cumulative impact.

4.13.3.12 Environmental Justice

None of the identified cumulative activities are expected to have an impact on environmental justice; therefore, there is no potential cumulative impact.

4.14 Irreversible and Irretrievable Commitment of Resources

An *irreversible* commitment of a resource is a term that describes the loss of future options and the effect on future generations. It applies primarily to the impacts associated with using nonrenewable resources, such as minerals, energy from hydrocarbons, or cultural resources, or it applies to a factor like soil productivity, that is renewable over only a long period of time. An *irretrievable* commitment of a resource is a term that describes the loss of production, harvest, or use of a natural resource. Irreversible or irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored after implementing a Proposed Action.

The effects would be similar for all four Action Alternatives except where indicated below. Demolition, safe-abandonment and mothballing would consume electricity, hydrocarbon fuels, and water and would require landfill disposal. Demolition debris would lead to the irreversible and irretrievable resource loss in landfill capacity. However, the capacity of landfills to accept demolition waste is adequate. The hydrocarbon-based energy required to conduct these activities or to procure the finished materials would be permanently lost. Community resources could also become unavailable under Action Alternatives C and D.

Loss of cultural resources would represent an irreversible commitment, but any such loss that may result from implementation of the Proposed Action would be appropriately mitigated through consultation with the SHPO, interested tribes, and other Consulting Parties.

4.15 Short-term Uses of the Environment and Maintenance and Enhancement of Long-term Productivity

Short-term uses of the environment associated with the Proposed Action would result in impacts on certain resources that could affect the maintenance and enhancement of long-term productivity. Increased soil erosion could result from soil disturbance during implementation activities. Air quality could be affected by localized increases in dust and vehicle emissions from implementation activities. Implementation could also generate increased noise. However, the following mitigation measures would be implemented to lessen these effects:

- Application of standard construction practices to reduce soil erosion, control noise, and improve air quality and safety
- Adherence to management plans and programs
- Compliance with federal, state, and local regulations

SECTION 5.0

Notification, Public Involvement, and Consulted Parties

5.1 Public Notification and Collaboration

NSF began the process of coordination with federal and state agencies in October 2016, along with West Virginia elected officials, community groups, and relevant commercial interests. An NOI was published in the *Federal Register* on October 19, 2016. An additional notice was published on November 1, 2016, which extended the comment period. NSF sent scoping invitation letters to over 50 agencies, organizations, government representatives, and other potentially interested parties. A list of the organizations contacted is provided in Table 5.1-1. Additionally, a number of formal and informal consultations took place with these parties to ensure they understood the objectives of the Proposed Action and had appropriate information. These consultations included discussions and correspondence with the USFWS and West Virginia SHPO. A more detailed description of these consultations is provided in Section 5.3, *Public Meetings*.

TABLE 5.1-1
Entities Contacted

Federal	ACHP; USFS (Monongahela National Forest); U.S. House of Representatives, West Virginia; U.S. Senate, West Virginia; USFWS
West Virginia	SHPO; West Virginia Division of Culture and History; Governor, West Virginia; WVDNR; West Virginia State Senate District 10; West Virginia State Senate District 11; West Virginia State House District 42; West Virginia State House District 43
Pocahontas County	Pocahontas County Landmarks Commission; Pocahontas County Historical Society Museum, Preservation Alliance of West Virginia
Native American Tribes	Absentee Shawnee Tribe; Cayuga Nation; Cherokee Nation; Delaware Nation, Delaware Tribe of Indians; Eastern Band of Cherokee Indians; Eastern Shawnee Tribe of Oklahoma; Oneida Indian Nation; Oneida Nation; Onondaga Nation; Seneca Nation of Indians; Seneca-Cayga Nation; St. Regis Mohawk Tribe; The Shawnee Tribe; Tonawanda Band of Seneca; Tuscarora Nation; United Keetoowah Band of Cherokee Indians in Oklahoma
Other Public-Private Stakeholder Organizations	West Virginia University; Cornell University; University of California at Berkeley; Oberlin College; Franklin & Marshall College; University of Wisconsin at Milwaukee; Berkeley SETI Research Center; Greenbrier Valley Economic Development Corporation; Associated Universities Inc.; Region 4 Planning and Development Council Office; University of Texas, Rio Grande Valley

Note: WVDNR's Division of Parks and Recreation and the Division of Wildlife Resources were contacted via email on November 21, 2016. Delaware Nation received the invitation letter on August 7, 2017.

5.2 Public Disclosure and Involvement

NSF coordinated with the public throughout this NEPA process. Public coordination efforts included notification letters; social media announcements; website updates; scientific journal entries and blogs;

newspaper public notices; flyers mailed to local schools, post offices, and businesses; and public scoping meetings. Two public scoping meetings were conducted on November 9, 2016, in Green Bank, West Virginia; individuals who signed into meetings or provided written comments and provided contact information were added to the distribution list. These activities are further summarized in the following sections.

5.2.1 Public Notices

NSF published an NOI in the *Federal Register* on October 19, 2016, seeking input on issues to be analyzed in the EIS. The original comment period was to end on November 19, 2016. On November 1, 2016, NSF published a second notice in the *Federal Register*, extending the comment period to November 25, 2016. Copies of these notices are included in Appendix 5A.

Announcements were also published in the local newspapers to inform the public about the proposed scoping meetings. Newspaper announcements were published in the following papers:

- *The Pocahontas Times* (circulated in all counties in West Virginia and worldwide) on October 27, 2016
- *The Inter-Mountain* newspaper (circulated in Randolph, Upshur, Pocahontas, Tucker, Barbour, Pendleton, Grant, and Hardy Counties) on October 29, 2016
- *Charleston Gazette-Mail* (circulated statewide) on October 30, 2016

Copies of the newspaper announcements are provided in Appendix 5B.

The DEIS Notice of Availability was published in the *Federal Register* on November 9, 2017. Newspaper announcements were also published in the abovementioned papers. notifying interested parties of the availability of the DEIS for public review. A 60-day public comment period has been provided.

5.3 Public Meetings

As per NEPA requirements, NSF conducted scoping meetings prior to the development of the DEIS and will hold an additional meeting on this DEIS. The following is a summary of the scoping meetings.

5.3.1 Scoping Meetings

NSF conducted two public scoping meetings at GBO on November 9, 2016. The purpose of the public scoping process was to identify relevant issues that would influence the scope of the environmental analysis, including identification of viable alternatives, and to guide the process for developing the EIS. The public scoping meetings provided an opportunity for the public to comment on the preliminary alternatives and to identify potential environmental concerns. The meetings were originally scheduled for 2-hour timeframes, but due to the number of public participants, the time for the meetings was extended by 1-hour each. The following are the details of the meeting times and locations:

- Daytime meeting: November 9, 2016, from 3:00 p.m. to 6:00 p.m. at the GBO Science Center, 155 Observatory Road, Green Bank, West Virginia 24915
- Evening meeting: November 9, 2016, from 6:00 p.m. to 9:00 p.m. at the GBO Science Center, 155 Observatory Road, Green Bank, West Virginia 24915

Each public scoping meeting included an open house. During the first 30 minutes, participants had an opportunity to review the meeting informational boards and materials and informally discuss the process with members of the NSF team. Copies of these materials are included in Appendix 5C. This open house segment was followed by a brief presentation by NSF staff. The public was then given the opportunity to provide oral and written comments. The meetings, including the public comments, were recorded by a court reporter and a transcript of each meeting was generated (see Appendix 5D). The format for each meeting was identical.

Table 5.3-1 lists the number of participants who signed in at each meeting and the number of speakers who signed up to provide oral comments. The number of participants is based on the number of individuals who signed the attendance sheet upon arriving at the meeting. During the meeting, some attendees who had signed up to speak chose not to speak, and conversely, some attendees who did not register to speak chose to speak. The meeting transcripts are provided in Appendix 5D.

TABLE 5.3-1
Summary of Scoping Meeting Participants

Session Number	Registered Participants	Number of Speakers[a]
Session 1	214	32[b]
Session 2	119	26[b]

[a] The number of actual speakers is different from the number who registered to speak. Please see the meeting transcript for names of individuals who provided oral comments.

[b] Because of the length of their comments, some attendees who spoke at the meeting were asked to provide the remainder of their comments at the end of the meeting to give all attendees a chance to comment. Individuals who spoke twice are only counted once in these numbers. Because there was sufficient time toward the end of the meeting, all speakers were able to provide their comments orally.

5.3.1.1 Scoping Comment Results

The following is a summary of all the comments received during the public scoping period.

Written Comments

A total of 817 written letters and e-mails were received; these comments were broken down into 1,273 individual comments, as many letters and e-mails cited multiple concerns. All written comments were reviewed and evaluated by NSF. Many comments were similar in nature and conveyed similar themes; therefore, the comments were organized into the categories listed in Table 5.3-2. The following discussion summarizes the public comments received during the scoping comment period. A matrix of all the comments received, including their assigned category, is provided in Appendix 5E.

TABLE 5.3-2
Comments Summarized by Category

Category	Description	Percentage of Comments [a]
Support Closure	Comments in support of closing GBO	0.08%
Against Closure	Comments against closing GBO	94.42%
Alternative Considerations	Suggestions for additional uses of the facility and sources of funding	2.99%
Resource Considerations	Suggestions for topics to include in the EIS	0.79%
Decision Process	General questions about the decision-making process	0.08%
General	General questions about the EIS	1.65%

[a] The number of total comments was 1,273.

The following is a discussion of the substantive comment categories received via written comments.

Support for Closure

One public comment supported closure of GBO. The primary rationale for the support was based on extraterrestrial life not having been found.

Against Closure

The clear majority of comments concerned individuals who do not wish to see GBO closed. The following is a list of the primary reasons for their concerns:

- **Community** – Commenters identified numerous benefits that GBO provides to the local community. Some of the benefits include support to local programs, tutoring programs, Science Fairs, and emergency services. The comments indicated that GBO is important to the West Virginian/Appalachian identity and there would be a loss of community cohesion if GBO were to be closed.
- **Cultural –** Commenters cited the historical significance of GBO and its contributions to astronomy and the sciences in general.
- **Education –** Commenters cited the importance of GBO as an educational destination for tourists, visiting researchers, undergraduate and graduate students, and schoolchildren. The comments indicated that local students receive tutoring and mentoring in the science and technology fields from staff at GBO. Additionally, commenters cited many university STEM-based programs, specifically those related to the physics and astronomy disciplines that rely on the resources provided by GBO.
- **Health and Safety** – Commenters cited claims that GBO is important to the local community because of shared emergency services and emergency/disaster preparedness planning and the detection of NEOs.

- **NSF Portfolio Review Studies** – Commenters questioned the validity of the NSF studies used to substantiate the recommendation to potentially close GBO, noting that substantial updates and investments in the facility have been made since the previous studies were prepared.
- **Research –** Commenters expressed concerns regarding the negative effects that closure of GBO would have on the field of astronomy. The comments indicated that discoveries made capable by the telescopes at GBO were vital to the field of radio astronomy. A list of the research papers provided in support of this claim is provided in Appendix 5F.
- **Socioeconomics –** Commenters cited the impact of closure on the local economy because of job loss and a reduction in tourism. The comments showed concern for closure of GBO at a time when the state is already seeing a significant reduction in other key revenue-generating industries, such as the coal mining industry.

Alternative Considerations

The public had the following suggestions to keep GBO open:

- **Funding** – Many types of funding sources were suggested, including sharing financial resources between divisions within NSF, selling to the highest bidder, engaging politicians to provide support, and closing only certain outdated features of GBO to divert available funding to the continued operation of the GBT.
- **Partnerships** – Partnerships with other governmental agencies, educational institutions, foundations, and corporations were suggested.

Resource Considerations

The public had comments on issues that should be evaluated in the EIS, including the following:

- **Biological Resources** – Commenters requested that consideration be given to the potential impacts on the Deer Creek watershed and its many tributaries that run through the property, impacts on land management on the facility, impacts on plant and animal species of concern, impacts resulting from the fragmentation of forested areas, and the potential loss of habitat for bats and migratory birds.
- **Environmental Justice** – Commenters requested that consideration be given to the disproportionate impact on economically depressed populations.
- **National Radio Quiet Zone** – Commenters requested that the impacts associated with closing the NRQZ be considered, especially for individuals suffering from electromagnetic sensitivity.

General

The public had general questions about the EIS scoping process, such as whether the scoping meetings could be postponed, format for the meetings, and requirements for submitting comments. These comments did not pertain to the EIS analysis or the decision process.

Oral Comments

Public comments received orally during the scoping meetings are provided in the public meeting transcripts (Appendix 5D). These comments were not quantified with the written comments summarized previously because they generally fell into the aforementioned written comment categories, with the following exception:

- **Investment and Support from Universities –** Funding for GBO has been secured by faculty at WVU. Closure of the facility would be a financial loss for the university and would result in significant impacts to the programs that rely heavily on the availability of the telescopes and equipment at GBO.

Comments Received After the Due Date

A few comments were received after the due date of November 25, 2016. These comments were reviewed and determined to address points already included in the comments received during the comment period. No new resource areas or concerns were raised in the late comments.

5.3.2 DEIS Public Meetings

A second public meeting will be held following the publication of this DEIS. The intent of this meeting will be to receive agency and public comments on the DEIS. These meeting will be announced in the papers as shown in Section 5.2.1, *Public Notices*, and will follow the same format as that described for the scoping meetings, though will be longer to accommodate public input. The meeting is planned to be held at the following location and time

- November 30, 2017, from 5:00 p.m. to 8:30 p.m. at the GBO Science Center, 155 Observatory Road, Green Bank, West Virginia 24915

5.4 Agency Consultations

In addition to the public involvement activities described previously, NSF has been actively consulting with the West Virginia SHPO as required by Section 106 of the NHPA and the USFWS as required by Section 7 of the ESA. The following subsections describe the status of these consultations.

5.4.1 NHPA Section 106 Consultation

This Section describes the NHPA Section 106 consultation process and identifies the Section 106 Consulting Parties. In compliance with Section 106, NSF invited participation in this process. As stated in 36 C.F.R. §800.1:

> Section 106 of the National Historic Preservation Act requires Federal agencies to take into account the effects of their undertakings on historic properties and afford the Council [Advisory Council on Historic Preservation (ACHP]) a reasonable opportunity to comment on such undertakings. The procedures in this part define how Federal agencies meet these statutory responsibilities. The Section 106 process seeks to accommodate historic preservation concerns with the needs of Federal undertakings through consultation among the agency official and other parties with an interest in the effects of the undertaking on historic properties, commencing at the early stages of project planning. The goal of consultation is to identify historic properties potentially affected by the undertaking, assess its effects and seek ways to avoid, minimize or mitigate any adverse effects on historic properties.

A summary of consultation activities is provided in Table 4.2-7 of Section 4.2, *Cultural Resources*.

5.4.1.1 Section 106 Consultation Chronology

Advisory Council for Historic Preservation

The ACHP was notified on October 20, 2016, of NSF's intent to prepare an EIS for GBO. NSF informed the ACHP of the publication of the NOI and requested scoping comments. The ACHP was informally notified of the undertaking and NSF's anticipated Section 106 process on July 6, 2017, and will be formally notified of the potential adverse effects as a result of the Alternatives during NSF's Section 106 process. At that time, NSF will ask the ACHP whether it will participate in consultation.

West Virginia State Historic Preservation Office

NSF initially contacted the West Virginia SHPO by phone on October 19, 2016, to provide an informal introduction to the undertaking. A scoping letter was sent to the West Virginia SHPO on October 20, 2016, to inform the West Virginia SHPO of the publication of the NOI and the preparation of the EIS, request scoping comments, and state its intention to initiate consultation under Section 106. On November 7, 2016, the West Virginia SHPO responded to the scoping letter via email and provided a list of Native American tribes with historic ties to West Virginia. NSF initiated formal consultation with the West Virginia SHPO through written correspondence on December 2, 2016. In a letter to NSF dated December 22, 2016, the West Virginia SHPO concurred with the APE and with the determinations of individual NRHP-eligibility for four structures at GBO (Interferometer Range, 40-foot telescope, 43-meter telescope [140-foot telescope], and the GBT). SHPO also requested that HPI forms be

completed for each resource that may contribute to the potential historic district. On May 18, 2017, NSF submitted 48 HPI forms to the West Virginia SHPO for review and concurrence. The West Virginia SHPO confirmed receipt of the forms, and on June 12, 2017, concurred that GBO is eligible for listing on the NRHP as a historic district with 44 contributing resources.

Native American Tribes

As described previously, the West Virginia SHPO provided NSF with a list of Native American tribes with historic ties to West Virginia. The Oneida Nation notified NSF by email on November 9, 2016, that it was not interested in participating as a Consulting Party in the Section 106 process.

NSF initiated Section 106 consultation with the identified Native American tribes by sending letters on December 12, 2016. Letters were sent to the following tribes: Absentee Shawnee Tribe; Cayuga Nation; Cherokee Nation; Delaware Tribe of Indians; Eastern Band of Cherokee Indians; Eastern Shawnee Tribe of Oklahoma, Oneida Indian Nation; Oneida Nation; Onondaga Nation; Seneca Nation of Indians; Seneca-Cayga Nation; St. Regis Mohawk Tribe; The Shawnee Tribe; Tonawanda Band of Seneca; Tuscarora Nation; and United Keetoowah Band of Cherokee Indians in Oklahoma. Delaware Nation received an invitation letter on August 7, 2017. NSF followed up with tribes via telephone to confirm their receipt of the letters. The Eastern Band of Cherokee Indians responded via email that the project falls outside the traditional aboriginal territory of the Cherokee and referred the project to the Shawnee.

Identification of Consulting Parties

During the public scoping meetings held at GBO on November 9, 2016, Section 106 public outreach was addressed as part of the public meeting, and participants were invited to identify whether they would like to participate in Section 106 as a Consulting Party. Six individuals in the first meeting and no individuals in the second meeting requested to participate. On December 8, 2016, NSF emailed a description of the role of a Consulting Party to potential Consulting Parties and three individuals confirmed that they would like to participate as Consulting Parties in the Section 106 process.

Additional local organizations were contacted to verify whether they wished to participate as Consulting Parties in the Section 106 process. A letter was sent to the Pocahontas County Landmarks Commission on December 9, 2016, inviting the organization to participate in the consultation process. On December 30, 2016, Robert A. Sheets responded to the letter via email as the individual designated by the Commission to serve as the Consulting Party representative on behalf of the Pocahontas County Landmarks Commission. In a letter dated December 22, 2016, the West Virginia SHPO requested that the Pocahontas County Historical Society and the Preservation Alliance of West Virginia be included as Consulting Parties. Letters were sent to the Pocahontas County Historical Society and the Preservation Alliance of West Virginia on January 12, 2017, requesting comments on the Alternatives. The Preservation Alliance of West Virginia sent a letter to NSF on February 3, 2017, indicating that it would like to continue as a

Consulting Party during the Section 106 process. The organization provided comments on the Alternatives. These letters are included in Appendix 4.2A.

Public Invitation to Participate

The public was invited to participate in the Section 106 process through the NOI published on October 19, 2016, and also at the public scoping meetings as described previously. In response to the scoping meeting, 14 public comments were received that included references to cultural resources. These generally cited the historic significance of GBO and its contributions to astronomy and the sciences in general. Additionally, an announcement will be made at the next GBO public meeting inviting any members of the public to attend the Consulting Parties meeting.

5.4.2 ESA Section 7 Consultation

A letter was sent to USFWS on October 20, 2016, to formally initiate Section 7 consultation, and a follow-up "findings of effect" letter was sent on March 16, 2017. A "no effect" determination letter from USFWS was received on March 29, 2017. On April 13, 2017, USFWS followed up with an additional letter that concurred with NSF's determination that any Alternative selected by NSF would have no effect on the federally listed bat species, and that no biological assessment or further Section 7 consultation under ESA are required. These letters are located in Appendix 3.1A.

SECTION 6.0

List of Preparers

TABLE 6-1
List of Preparers

Name	Role	Education	Years of Experience
Michelle Rau	Project Manager and NEPA Lead	M.S. Business Administration B.S. Ecology and Evolutionary Biology	20
Val Ross	Lead Technical Reviewer	M.S. Regional Planning B.S. Biology	35
Stephen Petron	Senior Reviewer	Ph.D. Zoology M.S. Natural & Environmental Resources B.S. Wildlife Management	38
MaryNell Nolan-Wheatley	Cultural Resources Author	M.P.S. Preservation Studies B.A. Anthropology	5
Lori Price	Cultural Resources and Cultural Surveys/Section 106 Lead.	M.F.A. Historic Preservation and Architectural History B.A. English and Political Science	22
Tunch Orsoy	Biology and Water Resources	M.S. Marine Science B.S. Zoology	26
Richard Reaves	Lead Biologist	Ph.D. Wetland and Wildlife Ecology B.S. Wildlife Ecology and Resource Management	24
Becky Moores	Geology	B.S. Environmental Biology	12
Kristine MacKinnon	Hazardous Materials and Solid Waste	B.E. Biological Systems Engineering Professional Engineer (PE)	15
Christina McDonough	Health and Safety and Noise	M.E. Environmental Engineering B.S.C.E. Civil Engineering Professional Engineer (PE)	24
Laura Dreher	Transportation Lead	B.S. Civil Engineering	16
MaryJo Kealy	Lead Economist	Ph.D. Economics M.S. Economics B.S. Economics	35
Heather Dyke	Socioeconomics Author	M.C.P Environmental Planning B.A. Business Administration	22
Sara Jackson	Cumulative Lead	B.S. Environmental Studies	17

SECTION 7.0

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SECTION 8.0

Acronyms

AAAC	Astronomy and Astrophysics Advisory Committee
ACHP	Advisory Council on Historic Preservation
ACM	asbestos-containing material
ACP	Atlantic Coast Pipeline
ACS	American Community Survey
ALMA	Atacama Large Millimeter/submillimeter Array
APE	Area of Potential Effects
AST	Division of Astronomical Sciences (of NSF)
ASTM	American Society for Testing and Materials International
AUI	Associated Universities, Inc.
BBER	Bureau of Business & Economic Research
BMP	best management practice
C.F.R.	*Code of Federal Regulations*
CAA	Clean Air Act
CDP	census-designated place
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH2M	CH2M HILL, Inc.
CVB	Convention & Visitors Bureau
D&E	Davis & Elkins College
dB	decibel(s)
dBA	A-weighted decibel(s)
DEIS	Draft Environmental Impact Statement
E.O.	Executive Order
EBS	environmental baseline study

EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973
FCC	Federal Communications Commission
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management System
GBO	Green Bank Observatory
GBT	Robert C. Byrd Green Bank Telescope
GDP	gross domestic product
GHG	greenhouse gas
GPP	groundwater protection plan
HMTA	Hazardous Materials Transportation Act
HPI	Historic Property Inventory
I	interstate
IMPLAN	Impact Analysis for Planning
IPaC	Information for Planning and Conservation
km	kilometer(s)
LBP	lead-based paint
Leq(h)	hourly equivalent sound level
MOA	Memorandum of Agreement
MPSAC	Advisory Committee for the Directorate for Mathematical and Physical Sciences
NAAQS	National Ambient Air Quality Standards
NANOGrav	North American Nanohertz Observatory for Gravitational Waves
NAS	National Academies of Sciences, Engineering, and Medicine
NASA	National Aeronautics and Space Administration
NATA	National Air Toxics Assessment
NEO	near-Earth object
NEPA	National Environmental Policy Act of 1969

NHD	National Hydrography Dataset
NHL	National Historic Landmark
NHPA	National Historic Preservation Act of 1966
NOI	Notice of Intent
NPS	U.S. National Park Service
NRAO	National Radio Astronomy Observatory
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRQZ	National Radio Quiet Zone
NSF	National Science Foundation
NTIA	National Telecommunications and Information Administration
NWI	National Wetlands Inventory
O&M	operations and maintenance
OSHA	Occupational Safety and Health Act of 1970
PA	Programmatic Agreement
PHO	potentially hazardous object
PRC	Portfolio Review Committee
RCRA	Resource Recovery and Conservation Act
REC	recognized environmental condition
ROD	Record of Decision
ROI	region of influence
SETI	Search for Extraterrestrial Intelligence
SHPO	State Historic Preservation Officer
SR	Senior Review
SWPPP	Storm Water Pollution Prevention Plan
TCP	traditional cultural property

TSCA	Toxic Substances Control Act
U.S.C.	United States Code
US	U.S. Highway
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WV	West Virginia
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Department of Natural Resources
WVDOH	West Virginia Department of Highways
WVDOT	West Virginia Department of Transportation
WVGES	West Virginia Geological and Economic Survey
WVU	West Virginia University
WWTP	wastewater treatment plant

SECTION 9.0

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