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Possible Impacts of a Uranium Mine and Mill at Coles Hill, Virginia

A Short, Nontechnical Summary of RTI's Report
January 23, 2012

About 30 years ago, uranium was discovered at Coles Hill, located in Pittsylvania County in southern Virginia. At that time, the company that discovered the deposit began testing to learn more about the uranium deposit, in hopes of mining it. In 1982, the Commonwealth of Virginia established a moratorium on uranium mining in Virginia.[1] Because of declining market prices for uranium, interest in developing the resource at Coles Hill waned, the company's mineral leases expired, and the moratorium continues in effect today. In recent years, market conditions for uranium have strengthened, and in 2007, a company called Virginia Uranium, Inc. (VUI) began exploring the deposit and assessing the possibility of mining and milling the ore. Today, the Commonwealth is considering whether to end its 30-year moratorium on uranium mining.

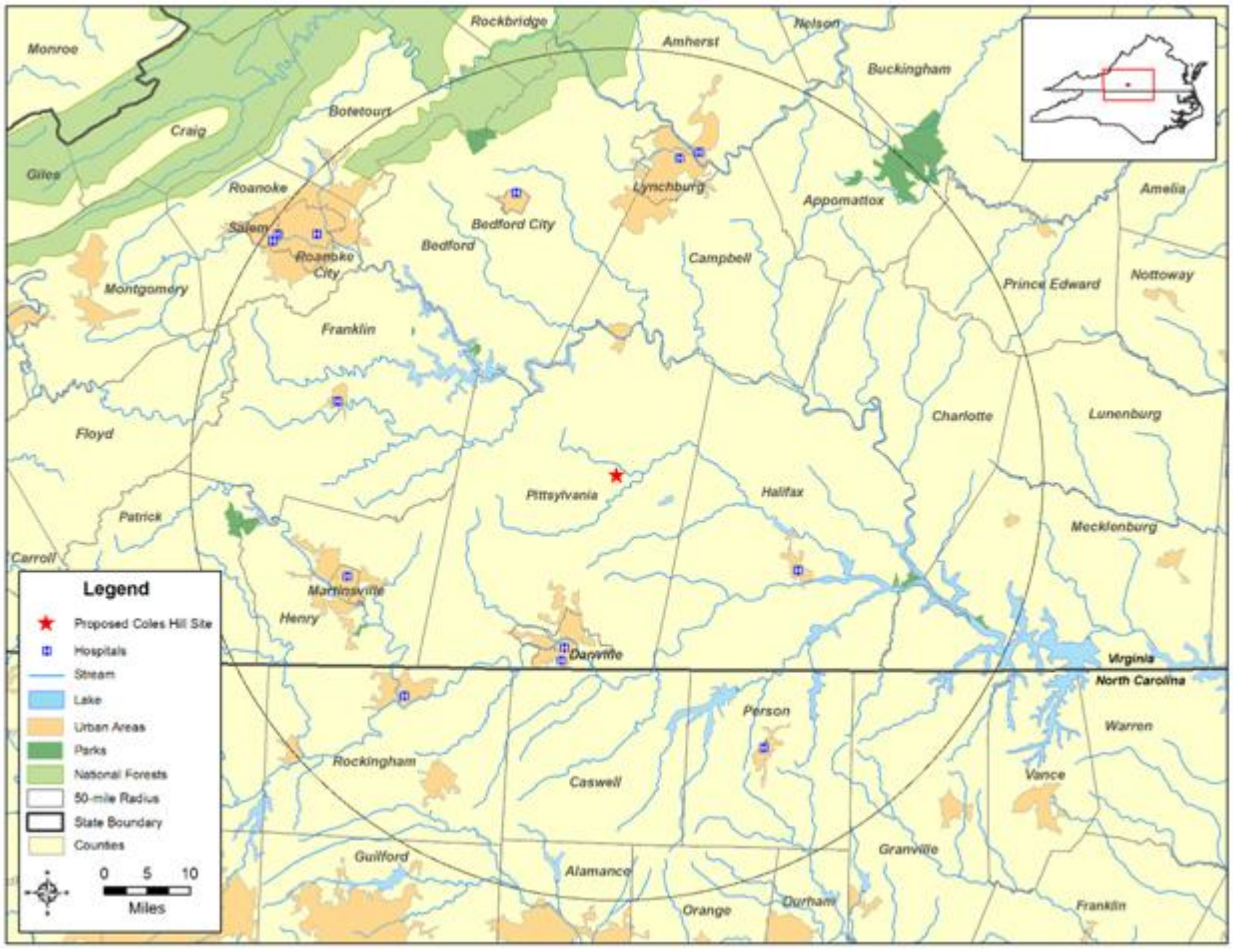
The Coal and Energy Commission of the Virginia Legislature is considering this issue. The decision has significant implications for the region surrounding Coles Hill and for the Commonwealth as a whole. Uranium has been identified in several areas of Virginia. To date, only the Coles Hill deposit, an estimated 119 million pounds of ore, has been determined large enough and of high enough quality to be commercially worthwhile to mine.

Uranium mining and milling has the potential to bring much-needed jobs to the region. Mining also brings with it a variety of possible negative impacts, such as possible environmental contamination; human and ecosystem health impacts; and impacts to the region's reputation as a great place to live, vacation, or do business. In addition, if the moratorium ends and uranium mining goes forward, the Commonwealth would have to establish laws, policies, and programs to regulate and oversee all aspects of uranium mining , milling, and waste management.

Why did Danville Regional Foundation fund this study?

Although other studies describing various aspects of uranium mining had been commissioned by the Coal and Energy Commission and others, the Danville Regional Foundation (DRF) felt it was critical to conduct a comprehensive, independent assessment of the possible impacts *on the surrounding region* of establishing a uranium mine and mill at Coles Hill. In late 2010, DRF commissioned RTI International to conduct an independent assessment of potential impacts of the proposed uranium mine and mill on environmental quality, economic prosperity, community well-being, and government revenues and responsibilities. The study would focus on a region within 50 miles of Coles Hill, including part or all of 26 counties and six independent cities in Virginia and North Carolina.

[1] In 1982, the Virginia General Assembly passed Statute 45.1-283, which states "permit applications for uranium mining shall not be accepted by any agency of the Commonwealth prior to July 1, 1984, and until a program for permitting uranium mining is established by statute."



The study region is a rich agricultural area; Pittsylvania County is a leading producer of some agricultural commodities. The region also has a strong history of traditional manufacturing in industries such as textiles, tobacco, and furniture. The decline of those industries has resulted in economic challenges for the region, with high unemployment and some locations losing population.

Summary of Key Findings

1. Overall, the proposed mine and mill pose both risks and rewards to the study region and the Commonwealth. The decision to end the moratorium on uranium mining is complex, and the stakes are high.
2. Some measurable environmental contamination would occur, especially within a mile or so of the site; proper facility design and regulatory oversight and proactive best practices at the mine and mill would limit environmental and human health impacts.
3. Groundwater levels near the mine would decline because of groundwater pumping at the mine. Solid waste materials from the mill (tailings) would remain radioactive for thousands of years and would need to be managed so they remain contained and isolated from contact with water and to prevent radon emissions.
4. Although environmental impacts are inevitable, the regulators, VUI, and the community can take action to minimize the negative impacts on human health, the environment, and the region's reputation, including the following:
    - Assess baseline environmental and ecosystem conditions before any construction takes place, so it will be possible to distinguish impacts resulting from the mine and mill from what is there already.
    - Use effective technologies to reduce emissions and maintain a focus on pollution prevention and reduction.
    - Undertake comprehensive and ongoing monitoring during operations of emissions and concentrations in air, soil, water, and agricultural products, at the mine and nearby, and publicize results.
    - Maintain transparent communication between the mining company, regulators, and citizens throughout the planning, operation, and closure stages.
    - Quickly and effectively reclaim the site.
5. The region has great natural beauty, outdoor recreation opportunities, and strong communities, which need protection from potential adverse environmental and reputational impacts. However, the region currently faces economic challenges, so not doing anything also entails risks, such as declining population and continued high unemployment.
6. Regionally, the mine's operations could result in more than 700 jobs and $150 million in output each year for more than 20 years. Economic impacts may be less positive than estimated if, for example,
    - the price of uranium falls, resulting in reduced levels of production and employment at the mine and mill, or
    - concerns about safety lead to reductions in demand for other goods and services produced in the region, which could offset the positive impacts of the mine and mill.
7. State and local government would receive increased tax revenues and would face new demands and obligations. Under most scenarios, we estimated that tax revenues would be sufficient to pay for additional programs.

8. Both economic and environmental impacts would vary geographically. Environmental impacts and impacts on property values would likely be greatest within a mile of the mine and mill, and economic impacts would generally be concentrated within commuting distance of the mine and mill. Some types of environmental risks would be greater down-wind or down-stream.

Background Information

About Uranium

Uranium is a radioactive element that is widely present in trace amounts in rock, soil, and seawater but rarely occurs in concentrations high enough to be economical to mine. Higher concentrations can occur in phosphate rock and in deposits of other minerals. More than 99% of naturally occurring uranium is the isotope uranium 238. Uranium naturally decays over millions of years into a sequence of 13 radioactive elements, including thorium, radium, and radon-222, before eventually turning into nonradioactive lead. During the decay process, ionizing radiation (alpha particles, beta particles, and gamma rays) is released.

Radiation has the potential to cause cell damage and may increase the risk of diseases such as cancer.

Even without exposure to radioactive elements, people are exposed to ionizing radiation in their daily lives (sunshine, X-rays and other medical imaging, etc.). The more ionizing radiation a person is exposed to, the greater the risk of cancer. Thus, people should take steps to avoid ionizing radiation whenever possible. Stakeholders are right to be concerned about whether the proposed uranium mine and mill might release radioactive elements to the environment, which could then be touched, inhaled, or swallowed.

About Uranium Mining, Milling, and Waste Management

Uranium can be mined using three mining methods: open-pit mining, underground mining, and in situ leachate (ISL) mining. In open-pit mining, large quantities of waste rock and soil are moved aside, and the ore deposit is mined from the top down, leaving a large pit. In underground mining, much less waste rock is removed, and the ore itself is excavated, usually leaving pillars behind to support the roof of the excavation. In ISL mining, which only works where the rock containing the uranium is porous, an acid or alkaline solution is pumped through the ore deposit, dissolving the uranium. The uranium-containing solution is then pumped out and the uranium extracted from the solution.

Because the rock in the Coles Hill uranium deposit is not porous, only open-pit and underground mining are being considered. (See a photograph of core samples from the Coles Hill ore deposit, displayed at VUI offices, above.) The uranium ore is rock that contains uranium and other minerals. After ore is removed from an underground or open-pit mine, it must be processed at a mill. Processing includes crushing and grinding the ore, using an acid or alkaline solution to extract the uranium oxide, and concentrating it. Further processing removes the uranium from the solution to produce “yellowcake,” a concentrated uranium oxide product. The yellowcake is then packaged for shipment to a uranium enrichment facility. After enrichment, the enriched uranium could be shipped to another facility where it would be manufactured into fuel for nuclear reactors.

Wastes produced by conventional uranium mining include waste rock and groundwater, which must be pumped out of the mine continually to allow the mine to be worked at levels below the water table. Air emissions include radon, diesel fumes, and dust. Uranium processing at a mill produces ***tailings***, which is the term for the solid waste remaining after uranium is removed from the ore.

Although most of the uranium has been removed from the tailings, they contain everything else that was in the ore, including all the other radioactive elements that were present in the ore, and possibly other contaminants such as nonradioactive metals. Because uranium is a small share of the ore, most of the ore volume remains in the tailings. The tailings must be neutralized, compacted, and stored in a way that prevents the tailings, or water that has been in contact with the tailings, from contaminating nearby land or water bodies. Typically, this is done in tailings storage impoundments, which are specially engineered ponds.

After mining and milling end at a site and the site is cleaned up and decontaminated, the tailings impoundments are the major remaining source of potential pollution. They must be capped to prevent radon from escaping or water from infiltrating and monitored to make sure no contaminants are escaping.

What are the Current Plans for Mining, Milling, and Waste Management at Coles Hill?

Neither the design of the proposed mine and mill nor any environmental regulations that would apply to it have been determined yet. Although tentative, VUI has released plans for mining, milling, and tailings management at the Coles Hill site. RTI used this information and other data in assessing potential impacts of the proposed project. Construction of the site would take place over a 2- to 3-year period.

VUI's current plans call for mining the ore using entirely underground methods; most of the ore would be mined out over Years 1 through 21 of the mine's life, leaving pillars behind that would then be mined during Years 22 through 35. Because of the chemistry of the ore, VUI is proposing to use an alkaline solution to leach the uranium out of the ore.

Tailings management would involve mixing the tailings with cement to form "paste tailings." Some of the paste tailings would be used to backfill mined-out areas of the ore deposit, to stabilize the areas and allow removal of the pillars. The rest of the tailings would be mixed with cement and placed in lined impoundments and covered with water to limit radiation, while waste is still being added. When the impoundment reaches capacity, it would be capped with impervious material to keep water out of the tailings. Groundwater pumped out of the mine would be used as process water in the mill and then treated prior to discharge.

During Years 1 through 21 of the mine, an estimated 324 workers would be employed: 224 at the mine and 100 at the mill. During that time, VUI hopes to mine 3,000 tons per day of ore, producing slightly more than a million pounds of yellowcake per year.

Key Study Findings

Potential Environmental Impacts

1. **Mining and milling would result in releases of uranium and other contaminants into the surrounding area, even if the mine and mill meet or exceed regulatory requirements.** Pollution

control technologies and compliance with regulations do not eliminate uranium mining and milling pollutant discharges; they only reduce them, hopefully to levels that are protective of human and ecosystem health. Models based on available data and assuming compliance with expected regulations found that concentrations of uranium and other pollutants decline rapidly with distance from the site, and concentrations beyond 1 mile from the site are very low under normal conditions. Comprehensive site-specific risk assessment (beyond the scope of RTI's analysis) would be needed to estimate effects of pollutant releases on human and ecosystem health.

2. **Groundwater flows near the mine would be affected because of the pumping of groundwater out of the mine to enable working at depths below the normal groundwater level.** Wells and springs in the affected area could decrease in capacity or go dry. Groundwater flow to surface water could decrease, or surface water could flow back into the groundwater system in areas of lowered groundwater elevations, thus decreasing the surface water flows.

3. **The entire site would have to be designed to limit surface water contamination, from both accidental flooding and stormwater runoff.** The region surrounding the Coles Hill site has both higher rainfall in general and more extreme rainfall events than other uranium mining regions in the United States. Any mine and mill facilities handling potential contaminants would need to be located at elevations well above the area of potential flooding and would need to be designed to cope with heavy rainfall events. (Photo shows creek near the deposit.) Stormwater management facilities need to be designed to minimize runoff and erosion across the facility, especially in areas where ore, ore by-products, and wastes are handled.

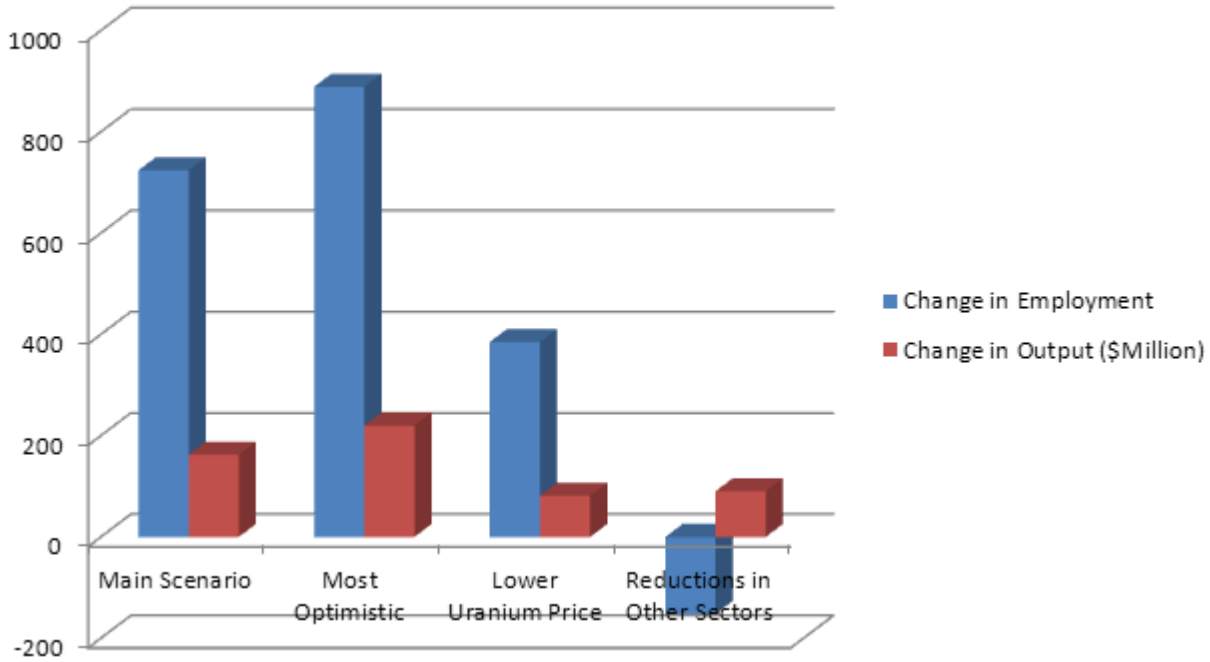
4. **Effective tailings management is critical, because water in contact with tailings contains increased radioactivity and can be contaminated with other toxic substances such as metals and processing chemicals.** At older mines, bad tailings management (due to inadequate regulation and monitoring, and ignorance or indifference on the part of the mine operator) has resulted in contamination of groundwater and surface water. Current regulatory standards focus on effective isolation of tailings wastes, requiring management in lined surface impoundments, leakage detection systems if synthetic liners are used, and groundwater monitoring. After closure, the tailings must be covered with a radon barrier and an impervious cap so that rainwater cannot infiltrate. Because tailings remain radioactive for thousands of years, ongoing monitoring and management would be needed. Use of paste tailings as mine backfill (as proposed by VUI) has the advantage of reducing sink-holes and groundwater flows through the former mine; however, these tailings also must be isolated from groundwater flows to ensure there is no groundwater contamination.

Potential Economic Impacts

1. **Generally, RTI's assessment is that operations of the uranium mine and mill would likely have a modest positive impact on the region's economy.** Economic impacts that would result from construction and operation of the Coles Hill uranium mine and mill include increased employment, output, and income in the study region. VUI's hiring would directly increase employment in the region, and their employees would purchase consumer goods within the region. In addition, VUI would purchase some of their nonlabor supplies from vendors located in the study region, who, in turn, would hire workers and purchase inputs, some from within the study region. The overall magnitude of the economic impacts resulting from the mine and mill would depend on three factors:

   - The demand for, and price of uranium, which would determine the level of uranium production at the mine and mill, and the level of VUI's employment and spending;
   - How much of VUI's spending, and the spending of other firms and households in the region, is spent to purchase goods and services and hire labor *within the study region*; and
   - What effect, if any, the presence of a uranium mine and mill in the study region has on demand for other goods and services produced there.

   Both construction of the mine and mill and their operation would have economic impacts. Because construction would only last at most 3 years, although operating the mine and mill would affect the economy on an ongoing basis, this summary focuses on the estimated economic impacts of operating the mine and mill during Years 1 through 21 of its operation. Because all three of the above factors are unknown at this point, it is impossible to predict what would actually happen in the region's economy as a result of the mine and mill. By varying the assumptions about the three factors above, RTI examined a range of potential economic impacts of the operation of the mine and mill to reflect this uncertainty. The results of scenarios representing more or less optimistic assumptions about the impacts of the mine and mill on the study region should be regarded as illustrations of the range of possible impacts, rather than predictions of actual outcomes.



Under the main economic impact scenario, RTI estimated a region-wide total employment impact of 724 jobs at the mine and within the region and an increase in the region's output of $162.4 million each year for 21 years. To put these numbers in context, they represent approximately a 0.2% increase in existing employment and output in the study region. If the impacts are concentrated within Pittsylvania County and Danville, they would represent an increase in employment and output of less than 5%. Under the most optimistic scenario, RTI estimated slightly higher increases in employment and output in the study region. Under less optimistic scenarios, the outcome for the region is less positive. If the presence of the mine and mill in the region reduces demand for the goods and services of other sectors in the region, employment in those sectors could actually fall sufficiently to outweigh any increase due to mining so that overall employment in the study region could actually decline.

2. Frequently, when a new industry enters a region, it attracts other firms in the same industry; however, the process of gaining approval for a new nuclear manufacturing facility is complicated and time consuming, so **it is unlikely that the mine and mill would lead to construction of other uranium facilities within the region in the short run**.

3. If employment, output, and income in the region increase**, property values** in the region as a whole would also increase, but probably by only a fraction of a percent; however, property values within a mile or so of the proposed mine and mill would likely fall, at least in the short run, because people prefer to live farther away from facilities they view as potentially dangerous or unpleasant. After mining ends, if the facility is reclaimed and tailings are properly managed, property values could recover somewhat over time.

Other Impacts on Communities in the Region

1. RTI would not expect much increase in the overall population of the region, especially if many of the project's employees are hired from within the region. As a result, RTI would not expect to see any significant change in school crowding, access to health care, or public safety during operations.

2. Emergency response personnel would require some specialized training to be ready to respond to incidents involving mining accidents or radiation.

3. If the mine and mill result in higher incomes in the region, there may be greater demand for amenities such as restaurants and entertainment and recreation venues.

Impacts on State and Local Governments

1. The Commonwealth would need to develop regulations for uranium mining and milling and programs to implement the regulations. Virginia agencies such as the Department of Mines, Minerals, and Energy (DMME), Department of Environmental Quality (VDEQ), Department of Health (VDH), and Department of Agriculture and Consumer Services (VDACS) would have new regulatory oversight duties and would likely have to hire some additional staff with specialized expertise. Comprehensive, coordinated oversight is critical to minimize impacts to human and ecosystem health. Overall, between 10 and 20 additional state employees would be needed, costing between $2 million and $5 million per year. Under most scenarios, RTI estimates that additional tax revenues would be sufficient to cover these expenses.

2. The Commonwealth, together with counties in the region, should develop a coordinated response plan in case of incidents involving transportation of radioactive materials and ensure that emergency

responders in the region and along all routes where yellowcake would be transported obtain the necessary training. Once the program was developed, it could be incorporated into routine training for emergency responders.

3. The state roads in the region would need to be upgraded to accommodate the large trucks needed to bring supplies in and transport yellowcake out of the mine and mill. State law requires that infrastructure required by a project be paid for by the developer, so the cost of these upgrades would be paid for by VUI.

Insights from Case Studies of Other Mining Regions

1. Older mines and mills with inadequate regulation and inappropriate tailings management frequently caused environmental contamination and adverse health impacts on nearby residents. Modern mines and mills, using modern mining methods and up-to-date regulations, are generally safer. However, human errors can result in accidents, even when regulation and technologies are adequate. In one incident at the Ranger mine and mill in Australia, a holding tank for process water was accidentally cross-piped with potable water, and workers drank and bathed in it for several days until the error was discovered, and several workers became ill.
2. Some regions with uranium mines felt that the mine was disruptive, either due to fluctuating employment and tax revenues, or because it was not a good fit with traditional lifestyles. Some residents felt powerless to affect mine operations and environmental protection. Other communities felt that the mine was a good corporate citizen and an asset to the region. Two communities noted that local ownership and management was associated with more responsive and responsible behavior by the mine.
3. One strong advocate for mining stated that the region should never discount the environment and that local communities should set up systems to monitor air and water quality for themselves, so they can have confidence in the information.
4. Several communities near existing mines and mills benefit from direct or indirect improvements in public services in the region as a result of the mining company's presence. For example, communities near Ranger mine and mill in Australia receive enhanced public services from a foundation funded as a share of mine revenues. Other communities report that mine and mill managers and employees contribute a lot of time and energy volunteering with Little League and other community organizations.
5. Examination of data on housing values, population, and non-uranium economic activity in communities near uranium mines generally shows that all have increased over the time period during which uranium has been mined; however, we did not have sufficient data on other factors in the regions' economies to be able to determine how much of the increase is associated with mining.

About RTI International

RTI International is an independent, nonprofit institute that provides research, development, and technical services to government and commercial clients worldwide. RTI was chosen to conduct this study because it is headquartered outside of Virginia, RTI staff members have expertise in all of the key technical areas for this study, and RTI specializes in building cross-disciplinary research teams to address complex issues. RTI has a 50-year track record of conducting high-quality, objective analyses for its clients.

RTI's Study Goals and Methods

The goal of RTI's year-long study was to provide information to help policy makers and stakeholders understand the issues surrounding uranium mining and milling at Coles Hill and to help address their questions and concerns. To accomplish this goal, RTI worked closely with a Community Advisory Panel of regional leaders and sought extensive input from stakeholders in the region. Key issues were identified, including (1) concerns about impacts on human health and the environment, (2) a desire to see increased economic opportunity in the region while preserving its character, (3) concerns that existing industries such as agriculture might be harmed by perceived or actual environmental contamination, and (4) a desire to improve the overall quality of life in the region.

The study findings were made available in late 2011 to provide information that could be used to inform the policy discussion taking place in 2012. RTI combined environmental and economic modeling with case study and qualitative assessments to provide as much information as possible with the data available. To reflect the current uncertainty about the mine and mill and their impacts, the RTI assessment examined a range of possible outcomes using a variety of assumptions about mine and mill activities.

For More Information

If you wish to review the detailed analyses underlying this summary, please see RTI's detailed technical report and supporting appendices, which are available on the project Web site: https://coleshillimpacts.rti.org.

Acknowledgments

RTI would like to thank the Danville Regional Foundation and its President and CEO, Karl Stauber, for the opportunity to conduct this challenging and important study. We would also like to express our deep gratitude to the members of our Community Advisory Panel:

- Larry Campbell, Danville City Council
- Laurie Moran, President, Danville Pittsylvania County Chamber of Commerce
- Jeff Liverman, Director, Danville Science Center
- Martha Walker, Community Viability Specialist, Virginia Cooperative Extension Service

Their insights into the values, aspirations, and concerns of the stakeholders of the study region provided invaluable help in shaping our study.

RTI would also like to thank residents of the study region, especially those who participated in stakeholder interviews and focus groups, for their hospitality and willingness to help us understand the region and identify the key questions the study must address.