# Economic Impacts

## 3.1. Objective and Scope

The total economic impact of uranium mine cleanup is mainly determined by availability of funding. To date the US EPA and the Navajo Nation have recovered more than $1 billion to fund the cleanup of abandoned mines on or neighboring Native lands in Arizona and New Mexico. Beyond this, it is not known how much more money might be recovered to fund further work, how much of these monies will be spent in New Mexico rather than Arizona, when work will be undertaken and completed, and which remediation or reclamation strategies may be employed.

The purpose of this section is to analyze the potential economic impact of investments in uranium mine cleanup in New Mexico. Rather than speculate on future settlements, the focus here is on more answerable questions. For any direct investment in cleanup, what are expected to the additional or indirect impacts? Which industries will see growth of revenues? What kinds of jobs will be created and at what pay level? The results are presented on a per unit basis, for each $1 million in direct expenditures. Accounts of future funding can be scaled accordingly.

Because it is not known which cleanup strategies will be used, we provide estimates for three distinct scenarios and two conventional mine types, each using different technologies with markedly different cost structures. These scenarios were developed with the help of technical experts and with reference to scores of technical documents.

## 3.2. Data and Methodology

This economic impact analysis is based on estimates and costs of uranium mine cleanup of previously or currently funded projects. The principal source of data are federal and state cost-estimation documents, known as Engineering Evaluation/Cost Analysis (EE/CA). An EE/CA is a CERCLA mandated site evaluation, conducted when a uranium mine's preliminary assessment determines a non-emergency or a non-time-critical removal action is needed.[30]

We obtained copies of EE/CAs for sites across the Four Corners region and manually entered and coded the cost estimate data as a base for our analysis[31]. Additionally, we used documents detailing post-cleanup costs from New Mexico's Mining and Minerals Division, though these documents were less detailed than the EE/CAs.[32]

EE/CAs offer various cleanup scenarios, dependent on the type of mine, the amount of waste to be removed, and other site-specific features such as access and geology. We chose three general cleanup scenarios for our analysis: administrative controls only, onsite disposal, and offsite disposal.

We chose these three scenarios to illustrate the most basic possibilities for each site, to generalize about the possible impacts without getting caught up in the technical details that vary significantly from site-to-site. When conducting an impact analysis, we have to make certain assumptions to guide our work. These assumptions are found generally in Appendix F. Our sample size allowed us to analyze costs for varied mine types at several different sites, though geographically appropriate prices and cost estimates were still limited.

The first scenario, called "Administrative Controls," is often listed as the first option in an EE/CA and involves the minimum work required to secure a uranium mine site. This may include building fences, placing warning signs, installing bat gates,

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[30] Full details on the assignment of a site as "non-time critical" and a definition of "removal action" can be found on this website: https://public.ornl.gov/sesa/environment/guidance/cercla/ntc-removals.pdf
[31] Actual costs are often reported as lump sums in generic categories, and projected cost analyses contained multiple scenarios for cleanup for each site. Also, cost information for the preliminary work done to assess uranium mines for cleanup is not available, or available only as lump sums, unattached to specific work done.
[32] A list of the documents we used in our analysis is found in Appendix F.

or other small-scale, limited protection actions. Under this scenario, the abandoned mines' physical hazards, such as open shafts, can be addressed for a comparatively low cost – mitigating risks but leaving remediation unaddressed. These sites may still need preliminary work, such as the building of access roads, but are by far the lowest cost option.

The second scenario we examine is onsite disposal. Onsite disposal will vary significantly based on proximity to the water table, erosion, and other geological and geographic features. Waste may be buried onsite, in lined or unlined pits, which may include a cap – materials used as liners and caps vary. These factors contribute to the total cost of cleaning up a site, but generally do not impact how dollars are allocated job-wise or equipment-wise. Materials costs may change, but the rest is relatively consistent, as a function of the total cost. For this reason, we looked at all onsite burial options together in the analysis, to best understand how jobs and dollars might be generated from the essential activities required for this type of cleanup.[33] According to both the documentation we utilized for this report and the interviews we conducted to help inform our analysis, on-site disposal is the most consistently recommended action for uranium mine remediation.

The final scenario we analyzed is offsite disposal. This scenario is by far the most costly scenario and often the most desirable for communities affected by existing mines. Due to a lack of regional disposal sites, transportation costs make up most of the expenses associated with this type of clean up. The issue of finding an appropriate waste disposal site is compounded with the fact that new disposal sites for CERCLA-designated waste cannot be created unless the proposed site is already designated as a CERCLA site itself.

Economic impacts are measured in terms of employment, labor income, and output (revenues to businesses less changes to inventory).

Direct employment is the number of persons directly employed through funds allocated for uranium cleanup and living in New Mexico. Direct labor income is wages, salaries, benefits, and proprietors' income minus federal taxes paid by employees and proprietors engaged in cleanup. Direct output is the total value of production, including direct labor income and in-state expenditures.

Indirect economic impacts are the subsequent effects of business-to-business spending. These include impacts of in-state purchases by businesses engaged in uranium cleanup and remediation, again measured in terms of employment, labor income, and output. Induced economic impacts are subsequent effects of employee spending, including the spending of employees directly engaged in cleanup, employees of vendors and ultimately employees of businesses indirectly supported by earlier rounds of spending.[34] The total impacts are the sum of direct, indirect and induced impacts. The multiplier, a measure of indirect and induced impacts, reflect the extent to which monies are recycled within the state economy; higher values indicate that activities engage a greater share of in-state businesses.[35]

This economic impact analysis is accomplished in three main steps: First, the industry of interest is defined in terms of standard classification methods. In this case, the industrial sector definitions provided by the North American Industry Classification System (NAICS) are used. Second, the direct activities of the industry, as defined in the first step, are tabulated. Finally, impact analysis estimates the indirect and induced impacts on other sectors of the economy that result from the direct activities.

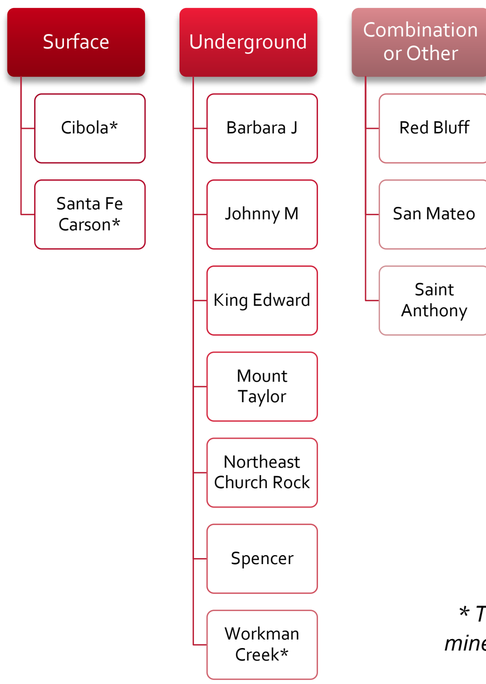
BBER uses the IMPLAN v3.1 proprietary databases and model to estimate the indirect and induced impacts of uranium cleanup. IMPLAN is widely used in regional economic modeling for estimating economic impacts and multipliers.[36] IMPLAN uses a variety of data sources to assess these impacts, including Bureau of Labor Statistics (BLS) Covered Employment and Wages; Census Bureau County Business Patterns (CBP); and Bureau of Economic Analysis Regional

[33] Again, for more details on our assumptions, please see the assumptions document in Appendix F.
[34] In this report, indirect and induced effects are summarized as indirect. Tables in Appendix A disaggregate indirect and induced effects.
[35] Mathematically: $\text{Multiplier} = \frac{\text{Total Effect}}{\text{Direct Effect}}$.
[36] http://www.implan.com/.

Economic Accounts (REA). Impacts are estimated for the entire state of New Mexico. Purchases expected to be made in the state are included in the estimation, while out-of-state purchases are excluded.

In this study, five possible scenarios are considered based upon the type of uranium mine (surface or underground) and the method of uranium disposal (onsite, offsite, and non-disposal). Note that for underground mines, non-disposal is not considered as there was insufficient data to calibrate that scenario. Table 1 shows the mine data used to run our analysis. Note that the "other" mine types were not used in the impact analysis, but are included in our discussion of the complexity of possible cleanup scenarios.

*Figure 3.1. Cost Estimates and Invoices Used for the Impact Analysis by Mine Type*




** The starred records include multiple mines in one estimate, grouped by site.*

*Table 3.1. Table of Possible Remediation Scenarios*

| | | **Disposal Site** | | |
|---|---|---|---|---|
| | | *Non-Disposal* | *Onsite* | *Offsite* |
| **Mine Type** | *Surface* | (1) | (2) | (3) |
| | *Underground* | N/A | (4) | (5) |

The following sections show the estimated direct, indirect[37] , and total effects (which is just the sum of the direct and indirect effects) for each of the five scenarios. Based on data gathered from the EE/CAs on likely expenditure patterns, it

[37] Recall that indirect effects include induced effects for the purposes of this report.

was possible to estimate direct labor requirements assuming $1 million in direct expenditure for each scenario and to estimate indirect effects.This allows for a straightforward comparison of the in-state economic impacts of the five scenarios in terms of the jobs created, wages paid, and revenues generated.

In addition to the raw impact numbers described above, economic multipliers are also computed. Although there are large disparities in absolute terms between scenarios based on the data collected and compiled from the documentation, the economic multipliers can provide a clearer picture of how direct effects from employment, labor income, and output reverberate through the economy.

The charts in this section provide a summary account of economic impacts. Full impact results are detailed in tables and charts included in Appendix A.

### 3.2.1. Surface Non-Disposal

Assuming $1 million in direct investment, the non-disposal scenario for a surface mine has a relatively small impact on the state. This is likely due to the purchase of wholesale goods such as fencing, gates, and other materials that are manufactured out of state. In addition, due to the limited labor requirements expected for non-disposal at surface mines, this scenario only contributes a total of 5.8 total jobs, with 3.3 direct jobs and 2.5 direct & induced jobs. However, this scenario uses the greatest share of professional workers, with 29% of the wages going to engineers and technical service workers.

*Figure 3.2. Non-Disposal Impacts of Surface Mine Cleanup (per $1 Million Direct Investment)*

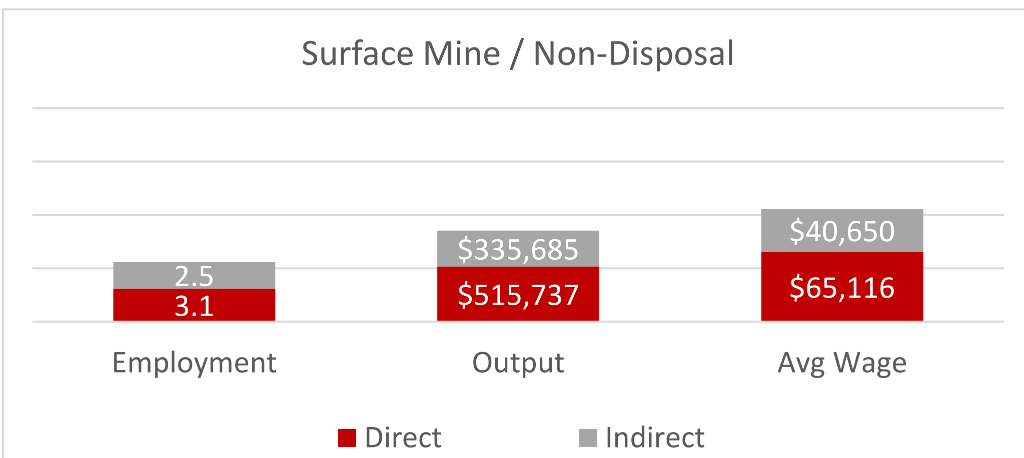


*Table 3.2. Total Impact for Surface Mine Non-Disposal, by Industry (per $1 Million Direct Investment)*

| Industry | Employment | Labor Income | Output |
|---|---|---|---|
| Commercial and industrial machinery and equipment rental and leasing | 0.4 | $35,845 | $138,946 |
| Wholesale trade | 0.6 | $33,854 | $123,550 |
| Architectural, engineering, and related services | 0.5 | $36,071 | $76,921 |
| Environmental and other technical consulting services | 1.0 | $52,340 | $72,914 |
| Truck transportation | 0.3 | $15,784 | $43,741 |
| Automotive equipment rental and leasing | 0.1 | $7,030 | $31,036 |
| Office administrative services | 0.4 | $21,224 | $29,721 |
| Real estate | 0.1 | $1,978 | $28,303 |
| Waste management and remediation services | 0.1 | $7,634 | $22,459 |
| Construction of new highways and streets | 0.1 | $3,197 | $11,407 |
| Other (Implied) | 2.2 | $88,514 | $272,423 |
| **Total** | **5.8** | **$303,471** | **$851,421** |

### 3.2.2. Surface On-Site Disposal

On-site disposal for a surface mine is fairly capital-intensive compared with other scenarios, yielding $206,394 in direct output for every direct job created, again assuming $1 million in investment. This is because on-site disposal uses a large amount of commercial and industrial machinery and equipment rental and leasing (referred to as "yellow iron" within the industry).

17% of the labor income generated in this scenario goes to professional workers, including engineers and technical services and 7% goes to businesses directly engaged in waste remediation. This scenario also has the highest average wage (inclusive of direct and indirect workers) generated at $55,998.

*Figure 3.3. On-Site Disposal Impacts of Surface Mine Cleanup (per $1 Million Direct Investment)*

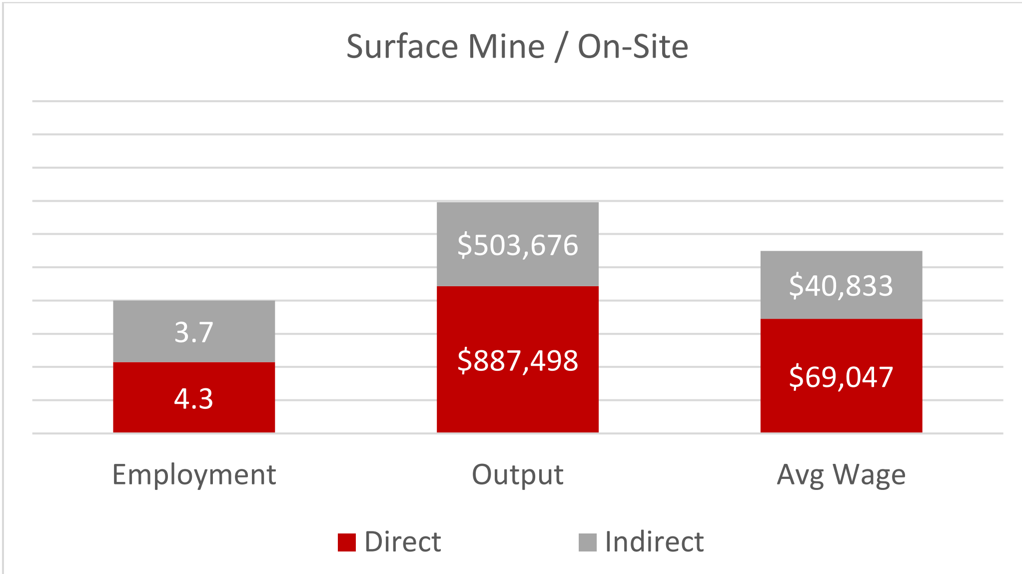



*Table 3.3. Total Impact for Surface Mine On-Site Disposal, by Industry (per $1 Million Direct Investment)*

| Industry | Employment | Labor Income | Output |
|---|---|---|---|
| Commercial and industrial machinery and equipment rental and leasing | 1.3 | $119,494 | $463,187 |
| Architectural, engineering, and related services | 0.8 | $61,696 | $131,566 |
| Construction of new highways and streets | 0.5 | $25,055 | $89,385 |
| Waste management and remediation services | 0.3 | $25,712 | $75,641 |
| Wholesale trade | 0.3 | $17,912 | $65,368 |
| Truck transportation | 0.3 | $21,159 | $58,637 |
| Environmental and other technical consulting services | 0.6 | $32,789 | $45,678 |
| Real estate | 0.2 | $2,546 | $36,441 |
| Office administrative services | 0.3 | $15,336 | $21,475 |
| Limited-service restaurants | 0.2 | $3,079 | $12,530 |
| Other (Implied) | 3.2 | $123,206 | $391,266 |
| **Total** | **8.0** | **$447,984** | **$1,391,174** |

### 3.2.3. Surface Offsite Disposal

Despite significant losses to out of state vendors in the offsite disposal of a surface mine (22% of direct expenditures), this scenario has a high employment impact of 8.7 jobs for $1 million invested. Importantly, however, fees paid to the offsite location are not included in the estimates; the estimates focus on the labor and materials required to complete the work.

Impacts in the offsite disposal for a surface mine are largely concentrated in truck and rail transportation; this holds true for all offsite disposal scenarios.

*Figure 3.4. Offsite Disposal Impacts of Surface Mine Cleanup (per $1 Million Direct Investment)*

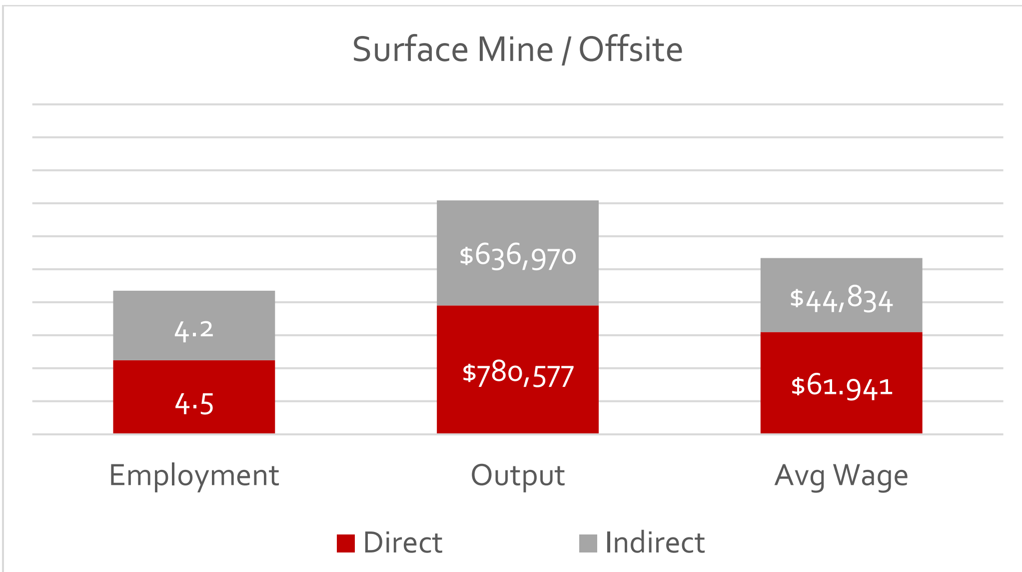


*Table 3.4. Total Impact for Surface Mine Offsite Disposal, by Industry*

| Industry | Employment | Labor Income | Output |
|---|---|---|---|
| Truck transportation | 3.6 | $224,265 | $621,493 |
| Wholesale trade | 0.4 | $21,653 | $79,023 |
| Commercial and industrial machinery and equipment rental and leasing | 0.2 | $17,318 | $67,128 |
| Real estate | 0.2 | $2,662 | $38,097 |
| Couriers and messengers | 0.3 | $10,160 | $30,575 |
| Architectural, engineering, and related services | 0.2 | $12,898 | $27,504 |
| Postal service | 0.2 | $15,376 | $18,810 |
| Environmental and other technical consulting services | 0.2 | $9,937 | $13,843 |
| Extraction of natural gas and crude petroleum | 0.1 | $4,796 | $12,387 |
| Limited-service restaurants | 0.2 | $2,874 | $11,696 |
| Other (Implied) | 3.1 | $145,100 | $496,992 |
| **Total** | **8.7** | **$467,039** | **$1,417,548** |

### 3.2.4. Underground On-Site Disposal

Data for non-disposal options of an underground uranium mine were inadequate for our estimates, so the first underground scenario we will describe is on-site disposal. In an on-site disposal scenario for an underground uranium mine, we expect to see significant investments in professional work, with 22% of employment in engineering, environmental, and other technical services. Waste remediation has the largest direct investment in a single industry with 10% of the total projected employment. However, this scenario includes significant spending on industrial equipment and machinery (19% of total impacts), which results in losses to out-of-state businesses and weighs against the total impacts of investment.

*Figure 3.5. On-Site Disposal Impacts of Underground Mine Cleanup (per $1 Million Direct Investment)*

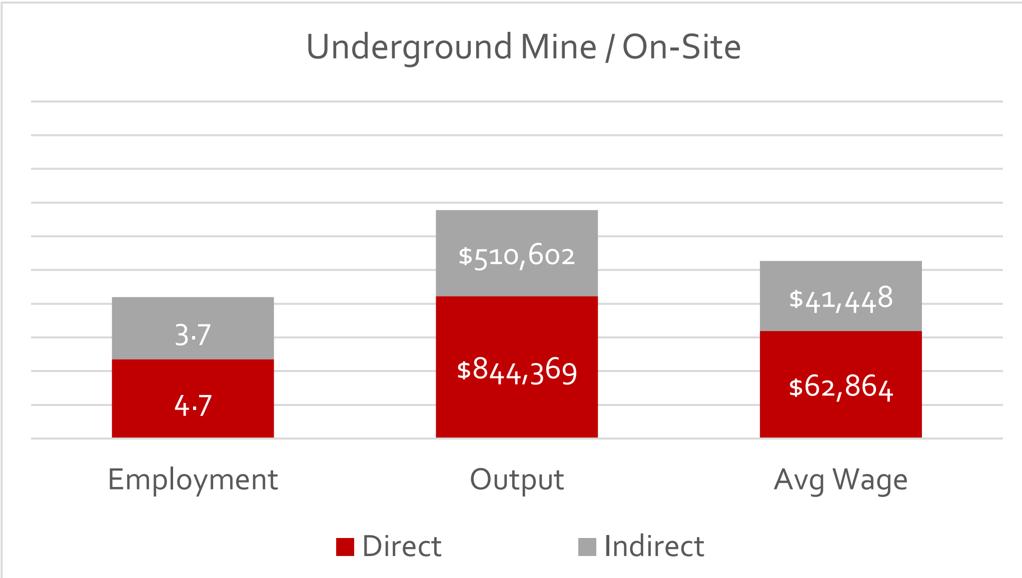



*Table 3.5. Total Impact for Underground Mine On-Site Disposal, by Industry (per $1 Million Direct Investment)*

| Industry | Employment | Labor Income | Output |
|---|---|---|---|
| Commercial and industrial machinery and equipment rental and leasing | 1.0 | $84,214 | $326,435 |
| Waste management and remediation services | 0.6 | $45,846 | $134,872 |
| Architectural, engineering, and related services | 0.7 | $54,996 | $117,277 |
| Construction of new highways and streets | 0.5 | $21,665 | $77,291 |
| Wholesale trade | 0.3 | $18,913 | $69,023 |
| Truck transportation | 0.4 | $23,328 | $64,648 |
| Environmental and other technical consulting services | 0.9 | $46,069 | $64,179 |
| Real estate | 0.2 | $2,692 | $38,532 |
| Office administrative services | 0.4 | $18,482 | $25,880 |
| Limited-service restaurants | 0.2 | $3,093 | $12,587 |
| Other (Implied) | 3.3 | $134,219 | $424,248 |
| **Total** | **8.5** | **$453,517** | **$1,354,972** |

### 3.2.5. Underground Offsite Disposal

Offsite disposal of an underground uranium mine yields the highest impact on the State by far due to little out-of-state leakage (only 8% of direct investment). In this scenario, we see 53% of expenditures on truck and rail transportation alone, with a strong multiplier of 0.79 additional revenues for every $1 of direct investment. However, offsite disposal estimates do not account for the cost and availability of offsite disposal options, which could potentially wash out a significant portion of investment. The issue of offsite disposal is discussed in more depth in the constraints and recommendations chapters of this report.

*Figure 3.6. Offsite Disposal Impacts of Underground Mine Cleanup (per $1 Million Direct Investment)*

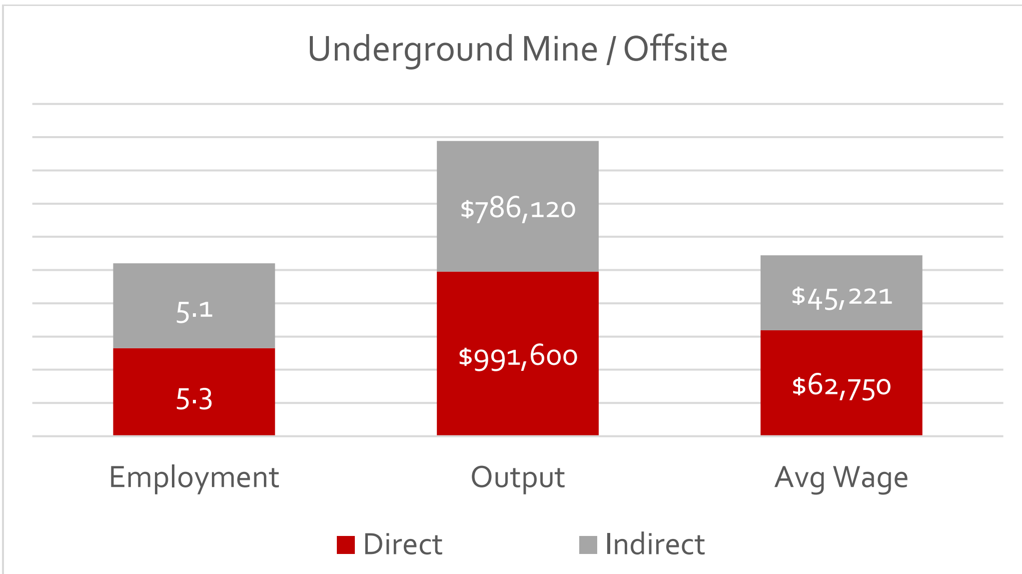


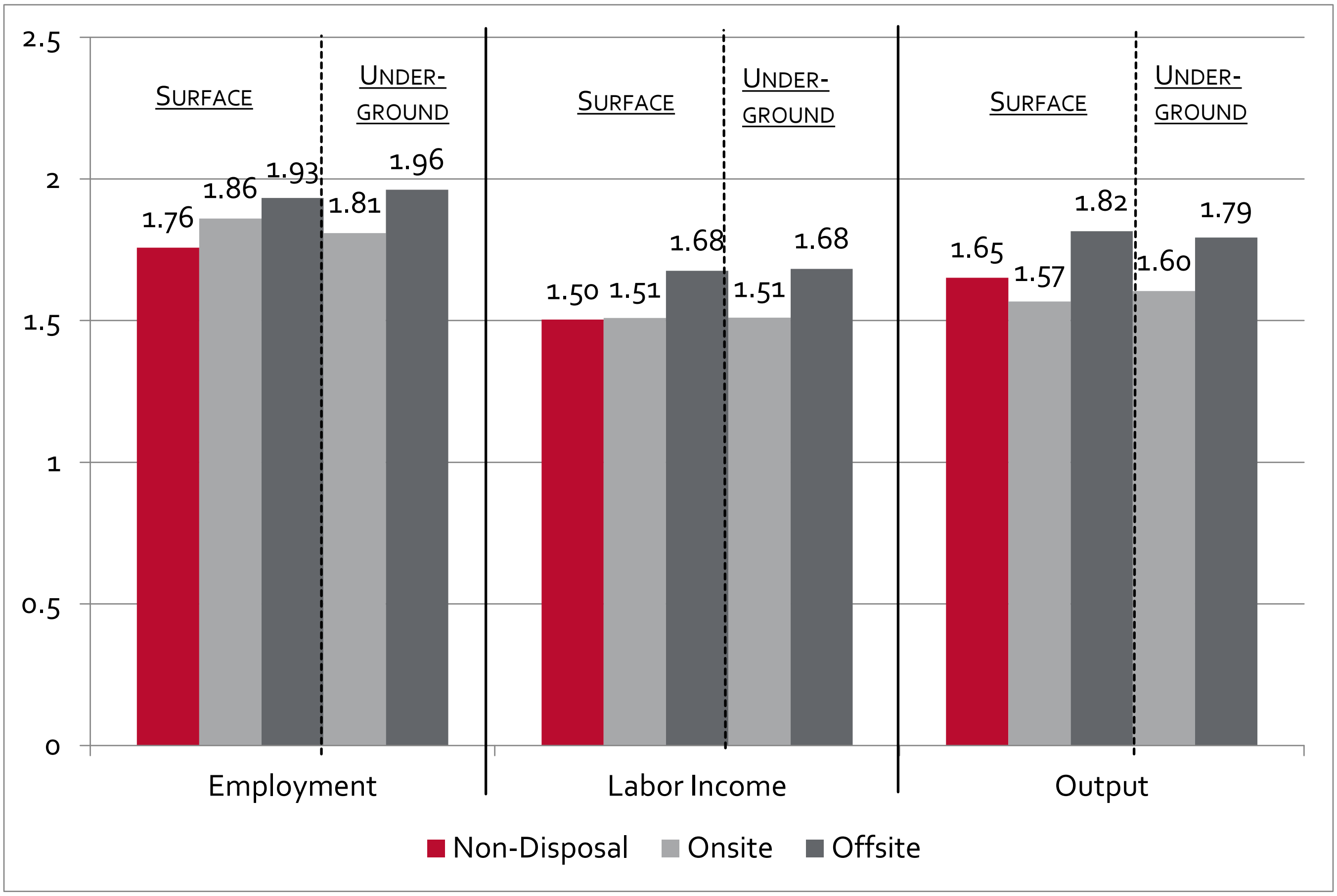
*Table 3.6. Total Impact for Surface Mine Offsite Disposal, by Industry (per $1 Million Direct Investment)*

| Industry | Employment | Labor Income | Output |
|---|---|---|---|
| Truck transportation | 4.7 | $290,575 | $805,253 |
| Rail transportation | 0.2 | $25,508 | $141,538 |
| Real estate | 0.2 | $3,083 | $44,130 |
| Wholesale trade | 0.2 | $11,047 | $40,317 |
| Couriers and messengers | 0.4 | $12,838 | $38,632 |
| Scenic and sightseeing transportation and support activities for transportation | 0.2 | $14,969 | $34,222 |
| Postal service | 0.2 | $19,387 | $23,717 |
| Extraction of natural gas and crude petroleum | 0.1 | $6,609 | $17,068 |
| Limited-service restaurants | 0.2 | $3,415 | $13,895 |
| Environmental and other technical consulting services | 0.2 | $8,729 | $12,160 |
| Other (Implied) | 3.8 | $172,342 | $606,788 |
| **Total** | **10.4** | **$568,502** | **$1,777,720** |

### 3.2.6. Multipliers

Figure 3.7. shows economic impact multipliers by employment, labor income, and output for each of the five scenarios. At the most basic level, the multiplier can be interpreted as the impact of a one-unit change of a direct input (employment, labor income, or output).

*Figure 3.7. Economic Impact Multipliers for Employment, Labor Income, and Output*




For example, the first bar in Figure 3.7., which relates to employment impacts and corresponds to the non-disposal at a surface mine scenario, shows a multiplier of 1.76. This multiplier implies that for every direct job added in this scenario, a total of 1.76 jobs will be created. In other words, in addition to the 1.00 direct jobs added another 0.76 indirect jobs will be created. Therefore, if a reasonable estimate exists for the number of direct workers required to perform cleanup, it is possible to estimate the total number of jobs created by multiplying the number of direct jobs with the appropriate multiplier.

Note that because of the differences in the industrial make-ups for the direct jobs in each scenario, as well as variations in the associated average compensation in those industries and the average output per worker, multipliers will vary across scenarios, even for the same mine type. For example, the third bar, which relates to employment impacts at a surface mine but corresponds to offsite disposal, has a relatively higher multiplier of 1.93.

Multipliers are interpreted similarly for labor income and output; however, the multiplier is read in terms of an additional dollar or labor income or an additional dollar of output instead of in terms of an additional job. For example, the first labor income bar, which corresponds to the non-disposal at a surface mine scenario, has a multiplier of 1.50. This multiplier implies that a total of $1.50 of labor income will be created for each dollar of direct labor income. Similarly, the first bar output bar (again, referring to non-disposal at a surface mine) implies that a total of $1.65 in output will be created for each dollar of direct output.

Overall, employment multipliers are generally the highest and labor income multipliers are generally the lowest. This is because although jobs are created through indirect effects, many of those jobs tend to be in relatively lower-paid industries. For example, if additional direct workers are added in truck transportation, which is well paid, those workers will spend income on, among other things, food at restaurants. To meet the demand of the new transportation workers, restaurants will hire additional workers, but the average wage for those new restaurant workers will likely be lower than the average wages for the new transportation workers.

Multipliers are generally highest for offsite disposal, reflecting greater indirect job-creation potential and the industries impacted and the relatively higher labor incomes and outputs in those industries. Other patterns across inputs are not as clear with employment and labor income multipliers for onsite disposal exceeding non-disposal (where applicable) at surface mines while the output multiplier for non-disposal exceeding onsite disposal at surface mines.

Full economic impact results are included in Appendix A for each of the five possible scenarios. In the next chapter, we discuss the readiness of New Mexico's workforce for the types of work described in the impact.