State of Alaska
Department of Natural Resources &
Department of Environmental Conservation

Mine Closure and Reclamation Cost Estimation Guidelines

December 2013

Disclaimer

These DRAFT Mine Closure and Cost Estimation Guidelines have been developed by technical review staff at the Division of Mining, Land & Water and the Department of Environmental Conservation.

These guidelines have not been adopted as official policy.

We welcome your comments, but will not be able to directly respond to every comment as these guidelines are not currently out for public notice.

Please send comments to:

Jack DiMarchi
State of Alaska
Department of Natural Resources
Office of Project Management and Permitting
jack.dimarchi@alaska.gov

Contents

Preface:

The purpose of these guidelines is to provide a consistent methodology for mining companies to use when estimating the amount of financial assurance required for the closure of a mine and the regulatory agencies to use when reviewing the closure cost estimates. In these guidelines, the terms "bond", "financial assurance" and "proof of financial responsibility" are considered interchangeable and are not meant to suggest the requirement for a specific financial instrument used to satisfy the regulatory requirements. The mention of trade names of commercial equipment products is for illustrative purposes only and does not constitute endorsement or recommendation by the State of Alaska. This is meant to be a broad list of provisions that might apply at mines; all provisions are not meant to apply to all mines.

Acknowledgements:

The information in these guidelines is derived in part from:

- The Handbook for Calculation of Reclamation Bond Amounts, U.S. Department of the Interior, Office of Surface Mining 2000;
- The Training Guide for Reclamation Bond Estimation and Administration, USDA – Forest Service, April, 2004.

Introduction

Background and Purpose:

Mine reclamation and closure on all lands in Alaska are regulated by the Alaska Department of Natural Resources (ADNR) and the Alaska Department of Environmental Conservation (ADEC) under the State of Alaska Reclamation Act and the Solid Waste Management Regulations. Federal Land Management Agencies also regulate the reclamation of mines located on federal land. An important shared goal the State agencies is to ensure the adequate reclamation of all areas disturbed by mining operations. Mining operations are required to provide financial assurance sufficient to ensure implementation of an approved reclamation and closure plan including managing the facility in a manner that will control or minimize the risk of the release of unauthorized levels of pollutants from the facility to surface water or groundwater. The financial assurance serves as a guarantee that reclamation will be completed, waters will be protected, and in the event of bond forfeiture, that funds will be available for the regulatory agencies to contract for the necessary reclamation work.

The method presented here uses generally accepted engineering cost-estimating procedures to develop site-specific costs for each reclamation activity. Bond estimates calculated in this manner will automatically account for differences in mine site conditions and post-mining land uses. This method should provide a rational and defensible approach to the estimation of closure costs for the facility that will be acceptable to the State.

Assumptions:

The fundamental assumptions inherent in this cost-estimating methodology include:

- Performance bonds are based upon the costs of the reclamation being performed by a third-party contractor hired by the State of Alaska.
- Performance bonds are based on the mine site conditions anticipated to represent the point of maximum reclamation requirements and closure costs for the current permit term. Calculating the bond in this manner will ensure that adequate funds are available regardless of the timing of bond forfeiture. For most large hard rock mines, this will correspond to the point of maximum surface disturbance, which is likely to occur at the end of the current permit term.
- The permit applicant or mine operator, is responsible for providing all information necessary to validate and support the reclamation plan and closure cost estimates.
- The regulatory agencies may utilize other sources of information to validate cost estimates provided by the applicant.
- Performance bonds are based on the mine operator adhering to the approved mine Plan of Operations, Reclamation Plan, and Waste Management Permit performance standards.
- Salvage values are not considered as a credit in closure cost estimates.

Methodology:

The methodology presented here is based on generally acceptable industry cost-estimating procedures for determining earthmoving, construction, demolition, monitoring, stormwater management and erosion / sediment control, water treatment, and closure costs for the site-specific mine operation.

List of Acceptable Sources of Data:

References and data sources used in the estimation of the closure bond should be specifically cited in the appropriate section of the closure cost estimate. Acceptable references typically include, but are not limited to, the most current editions of:

1. The approved mine Plan of Operations, Reclamation Plan, Waste Management Permit, and "as-built" surveys;
2. Handbook for Calculation of Reclamation Bond Amounts, U.S. Department of the Interior, Office of Surface Mining, 2000; http://www.osmre.gov/topic/Bonds/Bonds.shtm
3. Commercial equipment manufacturer handbooks and computer software for the estimation of equipment productivity. Such as the "Caterpillar Performance Handbook" or "Caterpillar – FPC";
4. Commercial equipment manufacturer handbooks and/or commercially available equipment cost databases such as "Dataquest Cost Reference Guide for Construction Equipment", "InfoMine - Mine and Mill Equipment Costs", or "Equipment Watch Cost Reference Guide" for hourly ownership and operating costs for equipment;

5. The "R.S. Means Building, Mechanical, and Heavy Construction Cost Data" handbooks for estimation of construction and demolition costs;
6. State of Alaska, Department of Labor and Workforce Development, Wage & Hour Administration – Laborers' & Mechanics' Minimum Rates of Pay for estimation of labor rates; http://www.labor.state.ak.us/lss/pamp600.htm
7. Project specific vendor quotes for equipment, fuel, labor, materials, and/or services;
8. Training Guide for Reclamation Bond Estimation and Administration, USDA – Forest Service, April, 2004 http://www.fs.fed.us/geology/bond_guide_042004.pdf
9. United States Department of Interior, Bureau of Land Management, Washington D.C., Guidelines for Reviewing Reclamation Cost Estimates. http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/im_attachments/2006.Par.8378.File.dat/im2006-135attach1.pdf

The Reclamation Plan and the Waste Management Permit contain essential information for the determination of facility demolition and disposal, earthmoving, construction of engineered covers, collection and treatment of process and contact water, monitoring, and other closure requirements. Once the mine is developed, "as-built" surveys provide essential data with respect to material relocation costs.

Other significant sources of information are equipment productivity and performance handbooks. Most equipment manufacturers publish handbooks that contain performance and cost data for their equipment lines. The "Caterpillar Performance Handbook" is one of the most complete. In addition to containing data on the types of equipment typically used on reclamation projects, it also contains other useful information such as methods for estimating site-specific equipment production rates and cost estimates.

Labor rates for equipment operators should be obtained from the most current issue of the "Laborers' and Mechanics' Minimum Rates of Pay" published bi-annually by State of Alaska, Department of Labor and Workforce Development – Wage and Hour Administration. These labor rates should be compared to 'industry standard wage rates' and the higher rates should be utilized in the reclamation cost estimate. http://www.labor.state.ak.us/lss/pamp600.htm

There are a number of data sources available for the estimation of construction / demolition related costs. These include the "R.S. Means Building, Mechanical, and Heavy Construction Cost Data". This reference is updated on an annual basis and can be useful for estimating material acquisition and structure demolition costs. Care must be taken when using this type of guidebook to ensure that profit and overhead are not incorporated into the costs, as these will be considered under indirect costs.

Typical Data Needs and Sources for Estimating Reclamation Costs

Data Need	Data Source
Material handling requirements (volumes, cross-sections, material handling plans, swell factor, material properties, rehandle factor, and other requirements specific to project)	Plan of Operations, Reclamation Plan, Waste Management Permit and then "as-built" surveys
Site-specific physical information (haul distance, grades, etc…)	Plan of Operations, Reclamation Plan, Waste Management Permit and then "as-built" surveys
Disturbed acreage and acreage to be reclaimed	Plan of Operations, Reclamation Plan, Waste Management Permit and then "as-built" surveys
Description of post mining use and list of facilities to be removed or left on site	Plan of Operations, Reclamation Plan and Waste Management Permit
Typical costs for structure demolition or removal	Plan of Operations, Reclamation Plan, R.S. Means Building, Mechanical, and Heavy Construction Cost Data Handbooks, and site specific demolition contractor quotes. *
Revegetation requirements	Reclamation Plan
Equipment types and production capabilities for activities such as regrading slopes or hauling topsoil	Manufacturer equipment productivity handbooks
Equipment ownership and operating costs	Manufacturer equipment productivity handbooks and Dataquest Cost Reference Guide for Construction Equipment **
Labor rates	"Laborers' and Mechanics' Minimum Rates of Pay" – State of Alaska, Department of Labor and Workforce Development – Wage and Hour Administration or 'industry standard wage rates' ***
Fuel and materials	Project specific vendor quotes
Logistical support costs	Camp and worker transportation costs for remote sites are not considered typical contractor overhead costs and should be estimated on a site-specific basis ****
Monitoring costs, closure of any monitoring wells, and post closure water treatment and monitoring	Reclamation Plan and Waste Management Permit *****

Reclamation and Closure Cost Estimation Approach

Land Reclamation:

Land reclamation cost estimates should be based upon the type of disturbance and the proposed post-mine land use. . Standard practices used in the construction and mining industries should be used when estimating the costs of earth moving related activities, demolition of constructed mine facilities and water management / treatment. Any assumptions used in the cost estimation should be clearly identified. Sources of equipment rates, labor rates, and material costs should be identified (this has been previously stated). In addition to estimates for equipment and labor to accomplish the land reclamation, estimates for project management, interim care and maintenance, final closure plan development, contractor profit and overhead, contingencies, and the time value of money should also be factored into the closure cost estimate calculations. Does this sentence apply to "Land Reclamation" or the overall closure cost estimate? Should it be here?

Waste Rock Dumps:

Waste rock dump reclamation may include: stormwater-erosion-sediment control BMP's, recontouring to final reclaimed grade; construction of an engineered cover if necessary; replacement of topsoil;; seedbed preparation seeding, fertilization, mulching, and weed control. Dependent upon the geochemistry of the waste dump material, closure costs may also include the costs for the collection, treatment, and disposal of runoff and seepage from the waste rock facility, and long-term monitoring.

Tailings Impoundments:

Cost for the closure of tailings impoundments are estimated in a manner similar to waste rock dumps, however additional costs may be incurred for: dewatering; water treatment and disposal; filling; and spillway construction. If the tailings facility will be maintained in a manner that impounds water to the extent that the tailings dam represents a "jurisdictional dam" per state law, long-term dam operating, monitoring and maintenance costs should be included in the closure cost estimate.

Material Sites or Borrow Areas:

Reclamation costs should be estimated for reclaiming any material sites associated with the mining operation and any material sites developed to produce capping materials used during reclamation of the mine site.

Open Pits:

The reclamation costs for open pits are controlled by the requirements of the closure plan. Costs may include: post-mining stability analysis; stabilization of pit highwalls; pit dewatering;

pit water treatment; bench and pit floor reclamation; partial or complete backfilling; and the construction of warning berms or fencing and signage near the pit highwalls. If pit backfilling is necessary to protect ground and surface waters, the bonding assumption is that the pit is abandoned at the maximum build-out during the next bonding or Waste Management Permit period.

Underground Development:

Adits and shafts shall be plugged per the terms of the approved closure plan. The costs for the collection and treatment of mine seepage, and disposal of underground waste permitted in the Waste Management Permit should be included.

Support Facilities:

Mine support facilities include: roads; airstrips; fresh-water reservoirs; buildings; power lines; monitoring wells; permanent diversions or drainage channels; and equipment. The disposition of all of these must be included in the closure cost estimate unless specifically approved for post-mining land use. Hauling and/or disposal costs for materials to be removed from the site need to be included in the closure cost estimate. The cost estimates for final reclamation of facilities that will be required to be maintained for either post-closure monitoring or long-term water treatment, must be adjusted for inflation over the time period where their continued use is anticipated.

Wages:

The Base Hourly Wage included in the Laborers' and Mechanics' Minimum Rates of pay should be increased for the assumed overtime schedule based on the following formula:

Overtime Factor= (((1*40) + (1*((7*# of hours per shift) - 40)*1.5)) / (7*# of hours per shift)-1)

The sum of the Base Hourly Wage and the Overtime Factor should then be increased by a 21% burden to account for Social Security, Medicaid, Unemployment, Liability, and Workers Compensation Insurance. This burden rate assumes that benefits are provided by the contractor and are not subject to taxation.

The Total Hourly Rate should then be calculated according to the following formula:

Total Hourly Rate = Base Hourly Wage + Overtime Factor + Burden + Benefits
(the discussion of standards for calculating labor rates and overhead should not be here under "list of acceptable sources of data" but should be included under the section "Closure cost Estimation Procedures"

Labor estimates for remote sites should include an appropriate adjustment for anticipated overtime charges based upon the anticipated work schedules.

Logistical Support Costs

Logistical Support Costs: where transportation may require the maintenance of off-site access roads, airstrips, or ports, these costs must also be included in the total closure cost estimate for the duration of the time period where they will be required for active site reclamation and post-closure active water treatment. The use of historic 'long-term' contract costs that the mining company has with camp support contractors may not be appropriate for a smaller workforce and / or shorter duration project typical of mine reclamation.

Equipment Operating Costs

Equipment hourly operating costs are based on average fuel, lubrication and wear items, and maintenance costs. These costs must be adjusted to account for higher costs in Alaska and particularly at remote sites. Fuel costs should be inclusive of all costs associated with the handling and shipment of the fuel from the point of purchase to the final point of use.

Use of Cross-Referenced Spreadsheets

Direct reclamation cost estimate spreadsheets should be developed for reclamation activities at each mine facility. For example, for cost estimation procedures, the mill, water treatment plants, open pit, waste rock stockpiles, tailing impoundment, roads, heap leach pads, etc. should each be considered a separate facility. The spreadsheet should include each reclamation task associated with the specific facility. All spreadsheets should be linked to additional spreadsheets that include equipment productivity estimates and the material handling requirements for each facility and to the base case assumptions regarding fuel, labor, and material costs. If spreadsheets are properly linked, any changes made in the equipment productivity labor, equipment ownership and operation, fuel, or other supplies and materials will automatically update the estimated costs for each reclamation task for every facility and the overall total closure cost summary. All assumptions used in every spreadsheet should be clearly identified; i. e. using inserted comments or another easily referenced manner.

Reclamation and Closure Cost Estimation Procedures

Direct Costs:

Determine Maximum Reclamation Requirements

In order set the backdrop for the closure cost estimate, the first step in the estimation process is to define the conditions at the mine site during which the likely reclamation costs will be at their highest, compared to any other time during the life of the mine. This is one of the most critical steps in the cost estimation procedure. Typically, the greatest estimated reclamation costs will occur when mine closure and reclamation occurs simultaneously with one or more of the following conditions:

- The greatest surface area is disturbed that requires recontouring, topsoil replacement and revegetation;
- The largest volume of material to be graded to establish suitable post-mining land use;
- The longest haul distance between material handling areas and the location of final placement;
- The greatest amount of material that must be handled to cover waste disposal sites;
- The need for special reclamation activities, such as handling of ARD/ML, handling of topsoil, closure of underground openings, long term water treatment; or
- Working with difficult topographic conditions.

Typically, for large open-pit hardrock mines with a long mine life, the maximum reclamation requirements will occur at the close of the current permit term (five years).

Comment [jjd1]: This raises a policy question: Are we developing a cost estimate for the permit period (next 5 years) or the maximum disturbance of LOM?

Estimate Direct Reclamation and Closure Costs

In order to determine the total direct reclamation costs, the cost for each reclamation activity must be estimated for each facility at the mine site.

These reclamation activities may include:

- ARD / ML management
- Highwall reduction and stabilization
- Open pit reclamation
- Recontouring, regrading and topsoil placement
- Structure demolition and removal
- Road and ditch removal
- Revegetation
- Monitoring
- Water Treatment
- Mobilization/demobilization
- Other direct costs

Not all of these activities will occur at every mining operation, nor is it necessarily an exhaustive list. These activities are discussed in more detail below:

ARD / ML Management

Highwall Reduction and Stabilization

Open Pit Reclamation

Recontouring, Regrading, Engineered Covers and Topsoil Placement

Recontouring and regrading serve two primary functions:

- To establish an acceptable post-mining topography in the mined area. (Note: The State Reclamation Act sets the minimum standards for reclamation of mining operations in Alaska regardless of the land status. The reclamation objectives and the proposed post-mining land use for mining operations located on private lands require approval from the underlying landowner. Nothing in the Reclamation Act prevents private landowners from requiring closure standards that exceed the requirements of the Act.)

- To ensure a stable surface for topsoil replacement and revegetation. The first requirement usually involves the handling of large amounts of material such as in the regrade of "angle-of-repose" waste rock dumps to the desired reclaimed grade. The second requirement involves final grading of the site to establish erosion control features and re-establish drainage features.

The costs associated with recontouring and regrading and placement of any engineered covers, and topsoil replacement are estimated using the following steps:

- Develop a Materials Handling Plan, and
- Calculate equipment productivity and cost estimates.

Standard equipment performance and cost-estimating guidebooks should be used to estimate material handling costs.

A Materials Handling Plan should be developed for the mine layout at the point of maximum reclamation requirements and should address the following topics.

Material Volume Estimates:

- Several methods are available for determining the amount of material to be handled. In general, these methods require comparing pre-reclamation topography with proposed post-reclamation topography. The determination of volumes can be done either by estimating the volume of

geometric shapes or by developing cross-sections through areas where backfilling and recontouring will occur.

- When waste rock dumps are recontoured from angle-of-repose to 2.5 – 3.0H: 1V, there will be a certain amount of "rehandle" of the dump material. The amount of rehandle is affected by the angle of repose, the grade of the final reclaimed slope, the underlying slope of the original topography, and the bench height. When bench 'crests' are pushed down to reduce the grade of the final slope for typical waste rock dumps found in Alaska, the State assumes that there will be a rehandle of approximately 50% of the crest 'cut' volume. There will also be some rehandle of material when large dozers are used to spread topsoil over recontoured areas. The State assumes a similar rehandle of 50% for this application.

- The swell factor is defined as the percentage increase in volume of material from the "bank" state to the "loose" state. Swell factors must be considered appropriately when estimating equipment productivity.

Haul Distance Estimates:

- The haul distance is one of the primary factors affecting the efficiency and cost of material handling and therefore, must be determined for each area where recontouring, construction of engineered covers, or topsoil replacement will occur. The haul distances can be determined initially from the mine Plan of Operations and Reclamation Plan; however, once the mine is constructed, haul routes and distances should be determined from as-built surveys. The approximate centroid of each source and destination should be identified so that the centroid-to-centroid haul distance can be determined. Note that the centroid-to-centroid haul distance can be significantly greater than the straight-line distance between centroids when viewed on a plan map. In some instances, additional haul roads may need to be constructed to increase the efficiency of the reclamation activities.

Grade Estimates:

- The grade of the haul road segments must be evaluated to allow for equipment selection and to estimate the equipment's productivity.

Rolling Resistance Estimates:

- The surface conditions of the haul road must be evaluated to determine rolling resistance for each haul-route segment in order to estimate the equipment's productivity.

Equipment Selection:

- Care should be exercised to not base earthmoving costs on specialized pieces of mine equipment, such as large mine haul trucks, which may not be available for the reclamation of the site due to litigation associated with bond forfeiture. The initial selection of equipment type is based primarily on the reclamation plan, equipment manufacturer performance handbooks and experience. Final selection for the size and type of equipment will be based upon the information developed in the Materials Handling Plan and possibly site access restrictions. Equipment selection for sites that are air-access only, may be limited air freight size and weight limits.

Final Grading:

- The final grading task prepares the disturbed areas for receiving topsoil and involves the final shaping of the ground surface to allow for proper drainage. Typically, the final graded surface should be left slightly rough to assist in the bonding between the recontoured fill and the topsoil. In some cases, ripping may be required to eliminate compaction; however, in other cases where there is the desire to minimize infiltration of precipitation, ripping should be avoided if possible.

Construction of Engineered Covers:

- Where the geochemistry of the recontoured material is such that ARD/ML is a concern, there may be the need for construction of an engineered cover between the recontoured waste material and the topsoil layer. These must be specifically designed for site conditions and climate at the mine site, may require the construction of "pilot-plant scale" covers for evaluation, and may add significantly to the cost of reclamation.

Topsoil Handling:

- The cost of topsoil handling procedures must be included in the estimate of overall direct reclamation costs. Equipment selection should consider the haul distance and the volume of material to be moved. Spreading topsoil generally requires more operator proficiency than standard recontouring operations and you should anticipate lower dozer productivity when spreading topsoil. The State assumes a dozer rehandle of 50% of the topsoil material.

Structure Demolition and Removal

This reclamation activity includes the demolition and removal or disposal of buildings, crushers, tanks, storage bunkers, conveyor systems, foundations, and other similar structures that are identified for removal in the approved closure plan. The R.S. Means Building, Mechanical, and Heavy Construction Cost Data handbooks are typically used to estimate building demolition costs.

Miscellaneous structures, such as bridges, conveyors, power lines, and equipment and material "bone-yards" must be removed unless part of an approved post-mining land use. Removal and/or demolition and disposal costs for these miscellaneous structures must be incorporated into the overall estimate of direct reclamation costs. The previously referenced construction cost handbooks may be used to estimate the costs for reclaiming these miscellaneous structures; however, care must be taken to modify these cost guidelines appropriately for conditions found in Alaska (i.e. short construction season, lower efficiency for winter work, etc.).

In order to estimate the demolition costs, data describing the physical characteristics of all structures present at the project site must be obtained. The types of building material, the size of the structure, and the type of foundation, primarily affect the cost of demolition; site access and whether or not the debris can be disposed of on-site must also be considered. When using the R.S. Means reference handbook, the estimator should not include overhead and profit. These are included in Indirect Costs.

Demolition costs are highly variable. Estimates that are based solely upon the size of the building may significantly underestimate the costs for building demolition. Care must be taken to include costs for salvaging material or equipment; snow removal; electrical power supply; and the draining, removing, cleaning and disposal of all fluids, lubricants, fuel, chemicals, minerals, and hazardous materials from all equipment, vessels, tanks and piping. It is recommended that operators obtain site-specific quotes for the demolition of structures from a contractor that has construction and demolition experience in cold regions.

Road and Ditch Removal

Paved road surfaces may have to be separated from the road sub-base and removed. Ripping with a dozer and loading with a front-end loader for trucking and disposal typically accomplish this activity. Non-contaminated loose road surfacing can be mixed with the sub-base or fill without any special disposal measures. In this circumstance, the road surface will be simply ripped to promote revegetation. All culverts will need to be removed and channels created for run-off. In some circumstances where side-cuts exist in steep topography, the "fill" may be required to be placed in the "cut" using an excavator. The estimated costs for removing road-surfacing materials can be found in the referenced cost-estimation handbooks. The Caterpillar Performance Handbook can be used to estimate the ripping capacity of dozers.

The next step after development of the Materials Handling Plan is to estimate equipment productivity and earthmoving costs.

Generally, the productivity of a piece of equipment is expressed in cubic yards per hour. Factors that affect equipment productivity include capacity, cycle time, site conditions, material characteristics, and operator proficiency. For each piece of equipment identified in the Materials Handling Plan, the method used to estimate productivity should be identified for each facility. The same piece of equipment may have different productivity for different facilities at the mine site, even when performing similar functions, due to differing material characteristics or topography. Job condition correction factors should be appropriately applied to each piece of equipment for each individual job function at each specific facility. Typical job condition correction factors that should be considered include: operator proficiency, material characteristics, visibility, job efficiency, grade resistance / assistance, and rolling resistance. The State assumes an operator proficiency correction factor of 0.75.

The appropriate methods for estimating equipment productivity (and costs) should be selected based upon site conditions and the recommendations found in the equipment manufacturer's performance handbooks.

The resulting productivity rates are applied to the amount of material identified in the Material Handling Plan to yield the resulting number of hours that the equipment is needed to reclaim each facility. The hourly ownership and operating cost for the equipment and labor rates can be used to determine the estimated reclamation cost for the individual facilities.

Revegetation

Revegetation tasks generally consist of seedbed preparation, seeding, planting, and fertilization. Information regarding the revegetation tasks should be determined based upon the approved reclamation plan where details regarding the depth of topsoil replacement, seed type and application rates, and fertilizer application rates can be found.

Reclamation Monitoring

At sites where long-term water treatment is not anticipated, post-closure monitoring is typically required for a 30-year period. Monitoring, analysis, and well closure costs must be adjusted for inflation over the 30-year period.

Post-Closure Water Treatment

At sites where long-term water treatment is anticipated, the annual costs for water treatement plus the support costs and capital costs for plant maintenance and replacement should be developed.

Mobilization / Demobilization

In the event of a default on reclamation obligations the State assumes that none of the equipment on-site will be available for closure activities; this is likely due to liens, equipment ownership, and other bankruptcy issues. This cost is an allowance for the cost of mobilizing equipment to the site for reclamation and demobilizing equipment from the site after the closure activities have been completed.

Mobilization and demobilization costs are often considered an "indirect cost" and are expressed as a percentage of direct reclamation costs; however, the State considers mobilization / demobilization to be a direct cost of the mine closure. When estimating the mobilization and demobilization costs, consider whether a single mobilization / demobilization will allow for the accomplishment of all closure activities or whether multiple/seasonal mobilization / demobilization may be required.

Mobilization / demobilization costs are influenced by the type and quantity of the equipment used in reclamation, site access, duration of reclamation, and the sequencing of reclamation tasks. Unusual time constraints, a need for special equipment, or a remote location should be considered in this aspect of the cost estimate.

Other Direct Reclamation Costs

Examples of other reclamation activities that should be included in the overall direct reclamation cost estimate may include: pumping, treatment, monitoring, and disposal of mine waters; haul road and airstrip maintenance; and operation of freshwater supply facilities. Costs for these types of activities must be evaluated on a case-by-case basis.

Indirect Costs:

Indirect costs are added to the direct cost sub-total. These indirect costs are usually expressed as a percentage of the direct cost sub-total.

Profit

The State of Alaska will contract with a third party contractor to perform the reclamation work. It is therefore necessary to add an amount for contractor's profit and overhead because these costs are not included in the estimate of direct reclamation costs.

The profit portion of the cost estimate will be calculated based on a percentage of the estimated total direct costs. The State of Alaska assumes that a reasonable profit margin ranges from 10% of the total direct costs for large reclamation projects to 20% for small reclamation projects.

Comment [jjd2]: We should have some basis for this guidance

Overhead

Overhead costs include: field support staff and services; labor benefits; costs for temporary facilities or company offices; office equipment and utilities; security; storage; insurance; taxes; contractor performance bonding; permits; and company vehicles. Reclamation projects vary in size, remoteness and complexity. Overhead costs will have a significant variance depending on the assets, operating techniques, and business structure of the individual contractor. However, all reclamation contractors will have overhead costs in addition to the costs for equipment, labor and materials that were included in the estimation of the direct reclamation costs. The State of Alaska assumes that reasonable overhead costs range from 5% of the total direct costs for large reclamation projects to 10% for small reclamation projects.

Comment [jjd3]: We should have some basis for this guidance

Performance and Payment Bond

State of Alaska statutes (AS 36.25.010) require both a performance bond and a payment bond for construction of projects administered by the State of Alaska. The cost of each of these bonds is estimated at 1.5% of the total direct costs, for a total of 3% of direct costs.

Liability Insurance

An allowance for contractor liability insurance premium should be included at 1.5% of the total of the estimated labor costs for the project.

Comment [jjd4]: Insurance is also included under "overhead" cost above. Are these duplicative or should it be removed from overhead?

Contract Administration

This indirect cost is to pay for the the cost of hiring a project management firm to inspect and supervise the work performed by the reclamation contractor and also the costs incurred by the State to forfeit the bond, administer reclamation / construction contracts, verify sampling and

analyses, conduct site inspections, and other activities associated with the administration of the closure project.

These contract administration costs are calculated as a percentage of the total direct costs and may range from 2% to 7% of total direct costs. The contract administration amount accepted by the State of Alaska will be based upon the size of the overall bond, the level of complexity of the closure projects, and the anticipated duration of the active reclamation phase of the project closure

Comment [jjd5]: Again an improved description of the basis for the range of costs and metrics for adopting one point in this range is warranted.

Engineering Redesign

The Reclamation Plan may not adequately reflect site conditions at the time of bond forfeiture, and the projected quantities and quality of water to be treated may not be accurate or complete. In addition, the existing Reclamation Plan or proposed water treatment may not be sufficiently detailed to serve as contract plans and specifications. Therefore, an updated or more detailed design will likely need to be developed as part of the reclamation process. In some cases the degree of engineering redesign may decrease as a mine matures and as more recent generations of the Reclamation and Closure Plan are more detailed.

Activities associated with Engineering Redesign may include the following:o:

- Prepare maps and plans to show the extent of the required reclamation.
- Survey waste rock dumps and other facilities to determine the amount of material handling requirements.
- Characterize waste rock dumps, and other facilities, to determine if special closure requirements are necessary to minimize ARD/ML.
- Evaluate proposed engineering covers for waste rock dumps and other facilities.
- Perform column, pilot plant or other engineering studies to evaluate designs and performance of proposed wastewater treatment facilities.
- Survey and analyze topsoil and overburden stockpiles to determine the amount of material available and whether special handling is required.
- Evaluate structures to assess the difficulty of demolition and disposal or removal.
- Evaluate impoundments to determine any special reclamation requirements or post-closure care and maintenance needs.
- Contract for the completion of a hazardous materials survey.
- Prepare reclamation / demolition / construction contract documents.

Engineering redesign costs are calculated as a percentage of the total direct costs and may range from 3% to 6% of total direct costs. The engineering redesign “percentage multiplier” accepted by the State of Alaska will be based upon the level of detail in the current Reclamation Plan and detailed closure cost estimate, the number and nature of unknowns or assumptions incorporated into the plans, the complexity of the closure project, and the size of the overall bond.

Contingency

The financial assurance for the closure of the project must include a contingency allowance to account for uncertainties in the cost estimation process.

Contingency costs are separated into "scope" and "bid" contingencies. Scope contingency addresses the uncertainty inherent in producing a closure design. Bid contingency addresses the cost uncertainty inherent in actual construction or implementation of the reclamation plan or closure plan.

Scope contingency will likely vary over the life of a project. Some of the variables that affect the scope contingency include the amount and quality of engineering and environmental data that is used to support the reclamation plan and/or issuance of an ADEC Waste Management Permit for a new mining project including data associated with ground and surface water characterization, waste rock characterization, pit lake water geochemistry, geotechnical factors associated with permafrost, slope stability etc. Scope contingency can range from 6 to 20% of direct costs, depending on these variables. In general terms there is acceptance of the concept that scope contingency could be reduce over the life of mine under the assumption that the reclamation and closure plan cost estimate is supported by more and more detailed information as the mine matures. But this must be demonstrated as iterations of the cost estimate are reviewed over the life of mine

Even during active reclamation, there will always be some uncertainty associated with the project, so some scope contingency will be retained.

Bid contingency accounts for construction costs that are unforeseeable at the time of the bond estimate but that become known as actual reclamation and closure work is conducted. Bid contingency is sometimes referred to as "construction" contingency for this reason. These costs result from changes in site conditions or work required which necessitate additional costs and contract modifications, change orders and/or claims. Bid contingency for closure cost estimation will range from 10% to 20% of direct costs depending upon the complexity, scope and overall size of the reclamation project and the amount of data available for the site.

Other Costs:

Interim Care and Maintenance Costs

There generally is a delay between the time the State assumes responsibility for a site and the time when actual site reclamation can begin. This may be due to litigation, disputes regarding ownership of equipment and facilities, additional data gathering or engineering studies and design, and/or seasonal climatic restrictions. During this interim period, the State may need to contract for the continued active water treatment, maintenance and monitoring of the site,. Costs associated with this interim period must be included in the closure cost estimate. The State assumes that this interim period will have a duration of 1 year ("holding period"). The costs associated with this holding period should be included in the direct costs portion of the reclamation cost estimate.

Site Care and Maintenance Costs During Active Reclamation

The State may need to contract for the continued site management, site maintenance, active water treatment, and monitoring of the site, during the time that active reclamation is occurring. Costs associated with the management, maintenance, water treatment and monitoring for the site during this time period must be accounted for in the closure cost estimate. The Interim Care and Maintenance Cost estimate and the anticipated duration of "active reclamation" will be used as guidance in the estimation of this line item. Active reclamation is defined as the time period between the start of post-closure reclamation and the start of the post-closure monitoring period. A mine is considered to enter the "post-closure" monitoring period when all physical reclamation is complete, revegetation has met performance standards, active water treatment is no longer required, and any water released from the facility consistently meets all State Water Quality Standards. The "post-closure" monitoring period can start after the use of passive water treatment; such as constructed wetlands; has been demonstrated to be successful in achieving State Water Quality Standards at the point of discharge from the passive treatment system for two consecutive years.

Inflation

Reclamation and closure cost estimates will undergo detailed review every five years as part of the renewal of the Reclamation Plan Approval and Waste Management Permit. Significant changes to any component of the mine operation that affects the closure plan may also trigger a review and modification of the closure cost estimate at any time.

To insure that the bond amount stays current in terms of real dollars, an inflation factor over the five year period is applied to the sum of the direct reclamation costs, indirect costs, and site care and maintenance during active reclamation. The amount of the factor should be determined by multiplying the average consumer price index for Anchorage, Alaska over the previous five years by 5 and then multiplying that times the total direct cost total.

Comment [jjd6]: FGMI increases theirs annually WITHOUT an annual cost review. Considering we cannot possible review any mine's costs annually we should delete this entire paragraph – we simply do not have the human resources)

Post-Closure Monitoring

At sites where long-term water treatment is **not** anticipated, post-closure monitoring is typically required for a 30-year period. Post-closure monitoring requirements will be specified in the approved monitoring plan that is incorporated into both the ADNR - Reclamation Plan Approval and/or the ADEC – Waste Management Permit. Typically post-closure water quality monitoring events occur in years 1, 2, 5, 10, 15, 20, and 30 after closure. A mine is considered to enter the "post-closure" monitoring period when all physical reclamation is complete, revegetation performance standards are achieved, active water treatment is no longer required, and any water released from the facility consistently meets all State Water Quality Standards. The "post-closure" monitoring period starts after the use of passive water treatment; such as constructed wetlands; has been demonstrated to be successful in achieving State Water Quality Standards at the point of discharge from the passive treatment system for two consecutive years. Post-closure monitoring costs must be adjusted for inflation.

Monitoring wells must be closed, per Alaska Department of Environmental Conservation requirements, upon completion of post-closure monitoring. The costs for this closure must be adjusted for inflation.

Long-Term Water Treatment

For projects where water treatment is part of the Approved Reclamation and Closure Plan or the Waste Management Permit, the cost estimate for long-term water capture, treatment, and monitoring should include the following:

- Capital costs for construction and replacement of water diversion, collection, and treatment facilities assuming existing water treatment facility is at end of its useful life at cessation of mine operations. Capital costs for construction and replacement of facilities should include appropriate indirect costs :
    - Profit
    - Overhead

- Performance and Payment Bond
- Insurance (On-Site Liability)
- Contract Administration
- Engineering Redesign
- Scope Contingency
- Bid Contingency

- Operating costs for water treatment and maintenance on an annualized basis, including
  - Labor
  - Power
  - Reagents
  - Sludge handling and disposal
  - Monitoring and analysis
  - Administrative costs
  - Camp costs
  - Transportation costs (Note: where transportation may require the maintenance of off-site access roads, airstrips, or ports, these costs must also be included in the long-term water treatment cost estimate.)
  - Profit (Assuming that the operation and maintenance of the facilities is conducted by a corporation other than the mining company.)
  - Overhead (Assuming that the operation and maintenance of the facilities is conducted by a corporation other than the mining company.)
  - Construction Management - if this is not included in labor costs
  - Agency Administration
  - Scope Contingency
  - Bid Contingency

Long-Term Dam Monitoring and Maintenance
The cost estimate must include the inspection, operating and maintenance costs for all jurisdictional dam for as long as the dam will remain a jurisdictional dam .

Total Closure Financial Assurance:

The estimate for the total project closure financial assurance represents the sum of all direct, indirect and other costs.

An example cost estimate Summary Table is shown below to illustrate the relationships between direct and various indirect costs.

SUMMARY OF ESTIMATED RECLAMATION AND CLOSURE COSTS - EXAMPLE

	% of Subtotal	1-Year Holding Cost	Initial Reclamation & Demolition	Active Water Treatment	Reclamation & Demolition After Termination of Active Water Treatment	Post-Closure Monitoring & Maintenance	Total
Direct Cost		$2,000,000	$10,000,000	$6,000,000	$3,500,000	$150,000	$21,650,000
Site Management Cost		$1,000,000	$2,275,000	$16,000,000	$2,000,000	$0	$21,275,000
Mobilization/Demobilization		$0	$500,000	$0	$250,000	$0	$750,000
Subtotal Direct Cost		$3,000,000	$12,775,000	$22,000,000	$5,750,000	$150,000	$43,675,000
Indirect Costs							
Contractor Overhead and Profit	15.0%	$450,000	$1,916,250	$3,300,000	$862,500	$22,500	$6,551,250
Subtotal		$3,450,000	$14,691,250	$25,300,000	$6,612,500	$172,500	$50,226,250
Performance Bond	3.0%	$103,500	$440,738	$759,000	$198,375	$5,175	$1,506,788
Insurance	1.5%	$51,750	$220,369	$379,500	$99,188	$2,588	$753,394
Subtotal		$3,605,250	$15,352,356	$26,438,500	$6,910,063	$180,263	$52,486,431
Contract Administration	4.0%	$144,210	$614,094	$1,057,540	$276,403	$7,211	$2,099,457
Engineering Re-Design	3.0%	$0	$460,571	$793,155	$0	$0	$1,253,726
Contingency	15.0%	$540,788	$2,302,853	$3,965,775	$1,036,509	$27,039	$7,872,965
Total Indirects		$1,290,248	$5,954,875	$10,254,970	$2,472,974	$64,512	$20,037,579
Total (prior to inflation)		$4,290,248	$18,729,875	$32,254,970	$8,222,974	$214,512	$63,712,579
					Inflation (Anchorage CPI averaged for previous 3-years)	3.33%	$2,121,629
						Total Closure Costs	$65,834,208

Comment [jjd7]: May want to replace this table. It shows one year of inflation proofing – should it be 5?In any case it should not conflict with narrative.

Basis of Estimate Reports:

Basis of Estimate Reports should be drafted that cover the 1-year site holding period, closure costs during the period of active reclamation, and any post-closure costs associated with term water treatment, dam monitoring and maintenance, and site management and monitoring requirements. The Basis of Estimate Reports should provide the agencies with a 'bridge' between the Reclamation and Closure Plan and the Cost estimates spreadsheets and explain how you developed the Cost Estimate Model. These reports will expedite agency review of your closure cost estimates.

Basis of Estimate Reports should describe the basis for:

- Scope of the Estimate
  - Estimate Structure
  - Mine Area Reclamation Activities
    - Planned Closure
    - Premature Closure
  - Tailings Area Reclamation Activities
  - Water Treatment Activities
  - Infrastructure Demolition and Reclamation Activities
- Quantities
- Unit Costs
  - Equipment Rates
  - Fuel
  - Labor Rates
  - Material Costs
- Relocation Costs
- Task Unit Rates
- Mobilization & Demobilization Costs
- Indirect Costs

Comment [jjd8]: What is this?