

CALIFORNIA'S STATEWIDE RECLAMATION STANDARDS, A QUANTITATIVE APPROACH TO MEASURING RECLAMATION SUCCESS¹

James S. Pompy²

Abstract: California's Surface Mining and Reclamation Act of 1975 (SMARA) was amended in 1991 to require that the State Mining and Geology Board (Board) adopt regulations specifying minimum, verifiable statewide reclamation standards. The state legislature directed the Board to adopt standards to include, but not be limited to, (1) wildlife habitat; (2) backfilling, regrading, slope stability, and recontouring; (3) revegetation; (4) drainage, diversion structures, waterways, and erosion control; (5) prime and other agricultural land reclamation; (6) building, structure, and equipment removal; (7) stream protection; (8) topsoil salvage, maintenance, and redistribution; (9) tailing and mine waste management. Each mine reclamation plan approved in California must include site specific performance criteria for measuring reclamation success. While site specific performance criteria may be based on pre-mining conditions, reclamation to a beneficial end use is the goal, not restoration. Reclamation standards are set to be achievable in a reasonable timeframe. Where best management practices focus on reclamation methodology, performance standards focus on results. Performance standards provide mine operators with clear expectations for reclamation, and regulators with a clear trigger for determining reclamation success and return of financial assurances.

Additional Key Words: revegetation, plant cover, species richness, factor of safety, slope stabilization, drainage control, in-stream mining, California State Mining and Geology Board.

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² James S. Pompy, Manager, Reclamation Unit, Office of Mine Reclamation, 801 K Street, M.S. 09-06, Sacramento, CA 95814

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Introduction

California's Surface Mining and Reclamation Act (SMARA) was adopted in 1975, about the same time as Congress adopted the Surface Mining Control and Reclamation Act (SMCRA) for coal mining. California is not a coal producing state, so SMARA targeted non-coal surface mining operations. The statute was innovative in that it sought to conserve mineral resources while requiring that mined lands be reclaimed to a beneficial end use readily adaptable to alternative uses. Always the maverick, California chose to provide for local regulation of mining in lieu of a state program like the other states in the union. Counties and cities serving as lead agencies under SMARA are charged with the responsibility to issue mining permits, approve reclamation plans and financial assurances, and conduct annual inspections. Reclamation is achieved through conformance with a reclamation plan that must be approved by the local lead agency prior to mining. Lead agencies are cities, counties, and the State Mining and Reclamation Board (board) under certain circumstances.

Initially, the mechanism for achieving reclamation was through a reclamation plan that was approved if minimum statutory and regulatory requirements were adequately addressed. In 1990, a review of the effectiveness of this approach revealed that reclamation plans tended to be vague not only in how reclamation would be accomplished but also in what the end result would be. A new approach was needed to ensure effective reclamation.

Two alternatives were considered: best management practices (BMPs) and performance standards. BMPs were being widely used by the Bureau of Land Management, the Forest Service, and other regulatory agencies to achieve an acceptable level of environmental protection. The Legislature, however, chose to direct the Board to adopt minimum state-wide performance standards because they provide a means to measure reclamation success quantitatively.

Best Management Practices vs. Performance Standards

BMPs are a popular approach to establishing an acceptable methodology for specific reclamation challenges. BMPs offer pre-approved solutions for commonly encountered challenges in mine reclamation. For example, a BMP to prevent offsite sedimentation might be "diversion dikes/ditches should be used whenever it is necessary to dispose of concentrated surface water without causing erosion." They provide qualitative expectations for both the miner and the regulator. However, BMP's are guidelines, not site specific construction blueprints. BMPs are purposely general in nature and designed to fit a range of site specific conditions. They are open to interpretation by both the mine operator and the regulator; determining compliance is subjective.

In 1990, the effectiveness of SMARA in achieving reclamation of mined lands was evaluated. Inconsistencies in implementation of the law by approximately 135 independent lead agencies were apparent. An approach was needed to achieve consistent and effective reclamation throughout the state. BMPs were considered, but a more easily verifiable approach to reclamation compliance was desired. Performance standards were chosen because they are quantitative rather than qualitative in nature. If a standard is agreed upon and included in the approved reclamation plan, compliance is simply a matter of measurement, not judgment. Expectations are clear, and success cannot be questioned.

California's Statewide Reclamation Standards

As a result of the 1990 effectiveness study, legislation was introduced to require mandatory annual inspection of mining operations and financial assurances. The need for a clear mechanism for determining compliance and release of financial assurances became apparent. To address this need, the Board was directed by the State Legislature to adopt minimum state-wide reclamation standards for reclamation. The Board was given until January 1, 1992 to adopt regulations specifying minimum, verifiable statewide reclamation standards. The standards were to include but not be limited to (1) wildlife habitat; (2) back filling, regrading, slope stability, and recontouring; (3) revegetation; (4) drainage, diversion structures, waterways, and erosion control; (5) prime and other agricultural land reclamation; (6) building, structure, and equipment removal; (7) stream protection; (8) topsoil salvage, maintenance, and redistribution; and (9) tailings and mine waste management.

Performance Standard for Backfilling

A performance standard for backfilling was adopted in 1993, which was amended in 2003 to include additional requirements for metallic mines. When the performance standard for backfilling was initially adopted in 1993, the standard applied only when backfilling was proposed or necessary to achieve the proposed end use. The 1993 standard required:

- Where backfilling is proposed for urban uses (e.g., roads, building sites, or other improvements sensitive to settlement), the fill material shall be compacted in accordance with the Uniform Building Code, published by the International Conference of Building Officials and as adopted by the lead agency, the local grading ordinance, or other methods approved by the lead agency as appropriate for the approved end use (California Code of Regulations (CCR) Title 14, Chapter 8, Article 1, Article 9, Section 3704)
- Where backfilling is required for resource conservation purposes (e.g., agriculture, fish and wildlife habitat, and wildland conservation), fill material shall be backfilled to the standards required for the resource conservation use involved.

Initially, backfilling occasionally occurred at aggregate mines in urban areas where the end use was to reclaim the mine for residential or commercial development. It was only logical to place backfill material properly during reclamation rather than move it and properly replace it later to accommodate a construction project. Backfilling occurred for resource conservation purposes only on those few occasions where it was the most cost effective alternative.

In 2003, the Board evaluated the effectiveness of the backfilling standard in achieving reclamation of mines throughout the state. The Board determined that aggregate and other non-metallic mineral mines were often not backfilled during reclamation because there was insufficient mine waste available for backfill material. Generally, however, aggregate mines are located in urban areas near to where it is utilized by the construction industry. Reclamation was occurring at these sites because land values made it economically beneficial to backfill the property for development.

The Board found that pits associated with open pit metallic mines were, however, not being reclaimed. Generally, these pits were left in the final mining configuration with few efforts to backfill or reclaim them to a beneficial end use. So, in 2003, California became the first state to

adopt a backfilling standard requiring that open pit metallic mines be backfilled (Testa and Pompy, 2007).

Performance Standard for Slope stability

There are as many final slope configurations as there are mine sites. Each deposit is unique and requires a custom mine design. Slope design depends on site specific geologic conditions, mine design, and equipment selection. For reclamation, however, the end result is simple: should final slopes be stable or not. California's statewide performance standards require that final cut slopes be stable with a factor of safety appropriate for the end use. Figure 1 is an example of an open pit gold mine with slopes that were stable long enough to complete mining, but failed soon after mining was completed.

In regards to reclamation, an appropriate factor for an urban use is certainly more conservative, for example, than that for open space. In either case, however, it is presumed that final slopes will be stable. Final slope design must be supported by a geotechnical analysis in order to arrive at the appropriate factor of safety. California's standard for cut slope stability is straight forward, but expectations are clear and must be supported by input from an individual or firm qualified to practice in the state and willing to take responsibility for the proposed design. Figure 1 is an example of an open pit mining operation where the reclamation plan was approved prior to the adopting of a performance standard for slope stability. The slopes were designed to be stable long enough to complete mining, but eventually began to fail. This practice is no longer allowed in California.

Fill slopes must be no steeper than 2:1 (horizontal:vertical) unless it can be demonstrated that final slopes will be stable and capable of being revegetated at a steeper slope. Although 2:1 fill slopes are a bit steep for successful revegetation, they are generally stable and usually do not require a geotechnical analysis to demonstrate stability, however, an analysis can be required where appropriate.



Figure 1. An open pit gold mine with slopes that were stable long enough to complete mining, but failed soon after mining was completed.

Performance Standard for Revegetation

Most mines are reclaimed to a natural condition. Disturbed areas are graded and revegetated to blend in with the surrounding environment. Prior to mining, baseline information is collected to determine if there are rare or endangered species in the area to be mined. Transects or some other survey technique is used to quantify naturally occurring vegetation by cover, density, and species richness. Baseline data are used to select species for revegetation and to develop site specific performance standards.

Using baseline data from the mine site or a nearby reference area, a list of native plant species is developed to be included in the approved reclamation plan. Species for revegetation are selected based on such factors as ease of propagation, seed availability, demonstrated success, and resilience to environmental stressors. If the site will be reclaimed to a natural condition, then the approved reclamation plan must include performance standards for three parameters: species richness, cover, and density.

- **Species Richness:** Species richness is the total number of different species occurring on the undisturbed site. Non-native and weedy species are not included. The number of species selected for revegetation is determined by the baseline species richness data collected during the site floristic surveys. A species richness standard to measure revegetation success is developed based on the number of native species that can reasonably be expected to be established compared to the total number of native species occurring on the site. The standard may include native annuals, but generally perennials are preferred because they help control erosion throughout the year. The species richness standard must be included in the approved reclamation plan and expressed as a number of different species to be established per unit of area.
- **Cover:** Cover is a measure of the vertical projection of total vegetation on the ground surface. The cover standard is expressed as a percent. As with species richness, the cover standard is based on total cover determined during the site floristic surveys. A cover value must be included in the approved reclamation plan and expressed as the total cover that can reasonably be expected to be attained in a reasonable time frame on all areas to be revegetated.
- **Density:** Density is a measurement of the number of individual plants per unit area. Once again, the density standard is based on total density determined during the pre-mining site floristic surveys. Density is expressed as the total number individual native plants per unit of area. Generally only native perennial species are counted, but native annuals may be included under certain circumstances. A density standard must be included in the approved reclamation plan and expressed as the total density that can reasonably be expected to be attained in a reasonable time frame on all areas to be revegetated.

Each reclamation plan that proposes revegetation must include performance standards for re-establishing vegetation. The Office of Mine Reclamation employs botanists with expertise in revegetation to assist miners in developing a revegetation plan and make recommendations to lead agencies on the adequacy of plans submitted for approval.

Ultimately, it is the lead agency who approves the plan and the proposed standards. Often, it is appropriate to have more than one set of performance standards for a mine site. Naturally species richness or density occurring on south facing slopes, for example, may be much different

in than that on north facing slopes. Occasionally, soil types or geology can differ. In California, for example, serpentine soils support a much different suite of species than non- serpentine soils. Whenever the species palette changes or revegetation expectations change, customized performance standards should be developed. Figure 2 is an example of a revegetation following implementation, but before performance standards have been achieved.



Figure 2. A recently revegetated fill slope with plant protection and irrigation temporarily in place until performance criteria are met.

Test plots are a required element of a reclamation plan that includes revegetation. Various soil amendments, seed mixes, mulches, etc. are tested to develop a strategy with optimal chances of success. Revegetation performance standards may be changed based on data obtained from test plots. An operator of a large mine in northern California estimated that \$1.5 million in savings would be realized because test plots had been used to develop an optimal revegetation strategy prior to implementation. Unfortunately, few operators take full advantage of this valuable tool.

Performance Standard for Topsoil Salvage

Topsoil is perhaps the most valuable commodity available to facilitate successful reclamation. Topsoil contains nutrients, microbes, seeds, and beneficial fungi that are needed by plants for healthy growth. The performance standard for topsoil salvage is simple; it must all be salvaged and used for future or concurrent reclamation. Prior to stripping, topsoil resources must be mapped and stockpile locations depicted on a map of the mine layout. Topsoil stockpiles must be clearly identified to prevent inadvertent loss of this valuable resource. Seeding with a temporary vegetative cover or applying gravel mulch must be used to prevent loss of soil due to erosion.

Storing topsoil for long periods in large stockpiles will cause it to lose much of its value as a growth media. Therefore, areas are not to be cleared of topsoil sooner than a year ahead of mining. Redistribution of topsoil and revegetation must occur as soon as practicable following mining. Figure 3 shows stockpiled topsoil being redistributed in preparation for spring planting.



Figure 3. Stockpiled topsoil being redistributed in preparation for planting.

Performance Standard for Prime and Other Agricultural Land Reclamation

California's farmland is threatened much more by development than by mining, however, statewide performance standards apply when mining occurs on agricultural lands whether they are classified as prime or non-prime farmland. The standards are in addition to the topsoil salvage standard previously discussed.

- **Prime Agricultural Land:** Mines located on agricultural lands that are classified as prime farmland must be reclaimed to a crop productivity level that meets or exceeds pre-mining productivity rates. Baseline soil fertility must be measured prior to mining, and post-mining fertility must be returned to a level specified in the approved reclamation plan. If topsoil exhibits distinct A, B, and C soil horizons, then it must be salvaged and redistributed upon reclamation in the same horizon sequence. Reclamation cannot be deemed complete until productivity meets or exceeds pre-mining, or similar crop production in the area, for two consecutive years.
- **Non-Prime Agricultural Land:** When mining occurs on agricultural lands that are not classified as prime farmland, a lesser performance standard must be met. The performance standard for "other agricultural lands" requires that the mined land be reclaimed so as to be capable of sustaining an economically viable production of crops

commonly grown in the surrounding area. Figure 4 shows a former aggregate mine that has been reclaimed for growing strawberries.



Figure 4. A former aggregate mine that has been reclaimed for growing strawberries.

Performance Standard for drainage, diversion structures, waterways, and erosion control

The definition of “reclamation” included in SMARA is very broad and specifically includes water degradation, air pollution, flooding, erosion, and damage to aquatic or wildlife habitat, all of which are also regulated under other Federal and state laws. In drafting a state-wide reclamation standard for water degradation, the Board recognized that water quality was already being regulated by State Water Resources Control Board and nine Regional Water Quality Control Boards pursuant to the Federal Clean Water Act and the State’s Porter-Cologne Water Quality Control Act. Water quality and erosion control were already adequately regulated and effectively enforced.

Rather than adopt another layer of regulatory bureaucracy, the standard for water degradation and erosion control simply requires the operation be in compliance with the Clean Water Act and the Porter-Cologne Water Quality Control Act. Mining waste is regulated through Waste Discharge Requirements that are written to protect waters of the state, and erosion is regulated through a Storm Water Pollution and Protection Plan.

Enforcement is the responsibility of the Regional Water Quality Control Board; however, non-compliance with the standard can trigger enforcement mechanisms included in SMARA. Figure 5 shows straw bails and geotextiles being used for temporary erosion control.



Figure 5. Straw bails and geotextiles being used for temporary erosion control.

Performance Standard for wildlife habitat

As with water quality, protection of rare and endangered species and their habitats is primarily the responsibility of other state and Federal agencies: the California Department of Fish and Game and the United States Fish and Wildlife Service. In adopting this standard, the board decided to recognize existing protections for wildlife and their respective habitats. The standard adopted requires that wildlife and wildlife habitat be protected as follows:

- Threatened or endangered species as listed by the California Department of Fish and Game or species of special concern as listed by the California Department of Fish and Game in the Special Animals List, Natural Diversity Data Base, and their respective habitat, shall be conserved as prescribed by the federal Endangered Species Act and the California Endangered Species Act.
- If avoidance cannot be achieved through the available alternatives, mitigation shall be proposed in accordance with the provisions of the California Endangered Species Act, Fish and Game Code.

Enforcement is the responsibility of the California Department of Fish and Game, however, similarly with the water quality standard; non-compliance can trigger enforcement mechanisms included in SMARA. Figure 6 shows a former aggregate operation that has been reclaimed to wildlife habitat.



Figure 6. A former aggregate operation that has been reclaimed to wildlife habitat.

Performance Standard for Building, Structure, and Equipment Removal

The standard adopted for building, structure, and equipment removal is simple: all buildings, structures, and equipment must be removed upon completion of mining unless it can be demonstrated that they are necessary for the proposed end use. A justification for retaining buildings and structures must be included in the reclamation plan and approved by the lead agency.

Summary

Performance standards have been a required element of reclamation plans in California for almost 14 years. When initially proposed, the performance standards were designed to be quantitative rather than qualitative. Industry argued that some flexibility was necessary to account for site specific conditions. The standards ultimately adopted represent a compromise and, though not perfect, have proven effective in achieving clear expectations and better reclamation. Miners have a vested interest in achieving results and, for the most part, lead agencies have a clear trigger for the release of financial assurances.

Literature Cited

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