



## **Economic Impact Analysis Virginia Department of Planning and Budget**

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### **4 VAC 25-31 – Department of Mines Minerals and Energy Reclamation Regulations for Mineral Mining January 24, 2002**

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The Department of Planning and Budget (DPB) has analyzed the economic impact of this proposed regulation in accordance with Section 9-6.14:7.1.G of the Administrative Process Act and Executive Order Number 25 (98). Section 9-6.14:7.1.G requires that such economic impact analyses include, but need not be limited to, the projected number of businesses or other entities to whom the regulation would apply, the identity of any localities and types of businesses or other entities particularly affected, the projected number of persons and employment positions to be affected, the projected costs to affected businesses or entities to implement or comply with the regulation, and the impact on the use and value of private property. The analysis presented below represents DPB's best estimate of these economic impacts.

### **Summary of the Proposed Regulation**

The proposed regulations will delete the technical standards for reclamation of mineral mines and rely solely on the performance standards. Additionally, several new performance requirements will be established. These include allowing less stringent standards for small roads in mining areas, increasing protection of groundwater, and introducing new waste disposal requirements.

Some other changes are methodological and procedural, and generally related to financial affairs. These include changing the mineral reclamation fund deposit and release methods, allowing transfer of mining permits, establishing requirements for annual certification of all reclamation bonds, clarifying that permit fees must be submitted upon receipt of a billing notice and before the land is disturbed.

The last category of changes is related to specific reclamation activities. These include allowing wetland development on disturbed land, excluding asphalt and cement plants from the

reclamation plan, allowing the use of additional material for erosion control, widening the permit boundary where sensitive features and structures must be identified and providing protection to such structures, requiring better identification of permit boundaries, requiring a meeting with the inspector prior to permit approval, removing the requirements for notarized signatures, and adopting county crop yields as benchmarks.

## **Estimated Economic Impact**

These regulations apply to reclamation of mineral mines. Mining is considered a highly polluting activity because of its potential effects on environmental quality. The main environmental effects include surface and underground water pollution, air pollution, solid waste, loss of habitats due to excavation, and adverse effects on human health and buildings due to noise and vibration. Nearly 70,000 acres are covered by mining permits and about 27,750 acres of the permitted areas are disturbed and subject to reclamation in the Commonwealth.<sup>1</sup>

## **Performance Based Standards**

Mineral mine reclamation regulations require that mine operators file a plan outlining the details of the proposed work and a program for the protection and reclamation of the land and other environmental assets affected by the mine. To ensure that mineral mines are operated in a way that minimizes the impact on the environment and the mines are reclaimed in a way that supports approximate pre-mine use when economically and technically feasible, current regulations include performance based standards. These performance standards state the goals of the reclamation.

In addition to the performance standards, technical standards are established in the Mineral Mining Revegetation Guidelines and the Mineral Mining Manual Drainage Handbook as addendums to the regulations to show how to comply with the current performance goals. The Department of Mines Minerals and Energy (the department) indicates that the technical standards in the guidelines and the handbook are prescriptive and are not always sufficient to guarantee compliance with the performance standards. This creates the possibility, for example, that a mine operator builds a structure according to the design specifications laid out in the guidelines or the handbook and still fails to achieve the performance standards perhaps due to some site specific soil characteristics.

The department proposes to repeal the revegetation guidelines and the drainage handbook, both of which include technical standards. The contents of these documents are provided in appendix 1 and 2. An examination of the content list reveals that the scopes of the guidelines and the handbook are comprehensive and the technical standards are numerous. For example, they cover testing procedures, construction specifications, material characteristics, nutrient requirements, seeding dates, design criteria, and many other standards for reclamation of mineral mines.

The department is proposing to delete these prescriptive requirements with few exceptions. The department, however, will adopt a non-regulatory assistance manual that will include most requirements of the revegetation guidelines and the drainage handbook in cases when the regulants want to implement readily available designs to comply with the performance based standards. In addition, several published impoundment design procedures and standards will be accepted if the operator chooses to use them. These include design procedures, manuals, and criteria used by the U.S. Army Corps of Engineers, the Natural Resources Conservation Service of U.S. Department of Agriculture, the Bureau of Reclamation of U.S. Department of Interior, and the National Weather Service of U.S. Department of Commerce.

The difference between a performance standard and a technical standard is significant. A performance standard provides maximum flexibility for the regulated industry to comply with a rule whereas a technical standard is often prescriptive. In addition, a performance standard provides incentives for innovation as the regulated industry strives to reduce compliance costs. However, performance standards generally involve higher monitoring and enforcement costs. If monitoring and enforcement costs are severe, the lower costs of compliance may be outweighed by higher monitoring and enforcement costs. Any lack of monitoring and enforcement due to high costs would reduce the appeal of a performance standard because the success of a performance standard is more sensitive to monitoring than is the success of a technical standard. It is possible for compliance costs to be *higher* under a performance standard. For example, firm size may be a determining factor of the net impact on compliance costs. A small firm without the technical expertise may have to comply with a performance standard that require a new construction design. For this firm, the costs of design development may be higher than the costs

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<sup>1</sup> Source: The department.

of compliance with a prescriptive but readily available design. However, allowing mine operators to use existing designs published by several sources and providing a non-regulatory assistance manual, the proposed regulations expand the compliance flexibility beyond what is provided by performance standards alone. Thus, the proposed regulations are likely to produce net benefits if savings in compliance costs outweighs additional monitoring and enforcement costs.

There is no comprehensive empirical data available to determine the size of potential savings in compliance costs. Also, the scope and the number of technical standards repealed make it a daunting task to determine the cost savings that should be expected.<sup>2</sup> Only general statements can be made about the cost savings to the regulated industry. Conversations with the industry representatives indicates a consensus view that the proposed changes will provide additional flexibility, and consequently, savings in compliance costs because of deleting technical standards. Several individuals in mineral mining industry indicated that the reclamation costs are in \$10,000 to \$25,000 range per acre and the cost savings may reach up to 10% of the current compliance costs depending on the circumstances. Based on these rough estimates, the potential compliance costs for approximately 3,000 acres of land reclaimed by mining companies each year may easily result in significant cost savings. For example, one percent, five percent, and ten percent reductions in compliance costs would annually save the mine operators about \$0.5 million, \$2.6 million, and \$5.3 million, respectively.

Additionally, the proposed changes are likely to increase the department's workload as review of designs submitted by each individual permit applicant will be more difficult than reviewing the generic design requirements established in the vegetation guidelines and the drainage handbook. The department indicates that technical expertise and resources are available to meet additional staff time that will be required. It is estimated that about 15 to 20 employee days may be devoted to meet additional workload. More importantly, the department does not expect any significant increases in monitoring and enforcement costs.

The proposed changes may also slightly improve compliance with the performance standards due to the elimination of potential conflict between current performance based standards and the technical standards. As mentioned, there may be some designs allowed under

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<sup>2</sup> See appendices for the contents of technical standards that will be repealed.

the current regulations that may not guarantee the desired performance. Improvements in compliance with the current performance standards are expected to provide environmental benefits. If any environmental benefits are realized, they will likely vary for each performance criteria. For example, these benefits may be in the form of reducing erosion, improving revegetation on disturbed land, reducing pollution, etc.

Despite the uncertainties involved in determining the size of the potential costs and benefits, based on the available evidence, it seems that the cost savings from this proposal will well exceed the additional costs. Thus, the proposal to repeal technical standards is likely to produce net benefits for the Commonwealth.

The proposed regulations will also add a few new performance standards. It will be required that the temporary stream crossings for pioneer roads must not restrict the stream flow and must not contribute to sedimentation off-site. There are no current requirements specific to these roads. All roads, regardless of capacity and use, follow the same basic performance standards. The proposed rules will allow crossings that can be used during times of low stream flow. These roads will be required to be small and stable so as not to restrict the stream flow and contribute to sedimentation from the road. Sediment from the road, or the trucks using the road, will be controlled so that soil particles are not washed off the mine by the stream. Bridges or large culverts will no longer be required for these locations. This is likely to provide some cost savings to the mine operators.

With another amendment, a plan for the minimization of adverse effects is required if mining below the water table is to take place. This performance standard is proposed to minimize the adverse effects of mining on groundwater quality. Mining may lower the groundwater table when water is pumped from the mining excavation. Surrounding water wells may be affected by lowering the level of water in the well. Changes in the movement of groundwater may alter the minerals in the water. In addition, pollutants from the mining, such as oxidized minerals that have been exposed to the air, may enter into the groundwater system. The cost to the operator to evaluate the hydrologic system, to estimate the likely effects of mining, and to design a mining plan to minimize the adverse hydrologic effects will be added. For mines that affect the groundwater system, the permit applicant may need to collect samples from water wells and springs to determine the location and quality of groundwater. If existing wells are

sampled, the laboratory testing of the water may cost a few hundred dollars. If new wells are constructed, the cost may be \$1,000 for a well 100 feet deep. In some cases, the treatment costs may increase if the operator must purify water before it is discharged from the mine. On the other hand, this change will provide additional protection of groundwater quality.

Furthermore, the proposed regulations will introduce new waste material disposal requirements. Currently, there is no requirement for waste material disposal fills. It will be required that overburden, refuse, spoil, and waste disposal fills that do not have the capability to impound water, sediment or slurried tailings, and slimes and refuse in a liquid or semi liquid state will have to be designed according to up-to-date engineering practices, be constructed, operated, maintained in accordance with the design, and will have to be closed and abandoned in a manner that ensure continued stability with the post-mining land use. The stability may be increased if the land on which the material is placed is evaluated and prepared and the waste material is placed using control techniques. These requirements are likely to control runoff from the waste site and prevent saturation of the waste material or erosion of the fill. These additional requirements are expected to reduce the potential for hazardous and emergency situations, provide additional protection to adjacent properties, provide additional protection for environment, and improve safety. However, these requirements will likely increase compliance costs of permit holders, as additional designs will have to be produced and complied. This may also increase the workload of the department in reviewing designs, monitoring, and enforcing compliance.

## **Minerals Reclamation Fund Deposit and Release Method**

Significant amounts of money need to be posted as security for mine reclamation and to provide for the protection and mitigation of damage to environmental assets affected by the mine. A new operator provides \$1,000 in bonding for the acres disturbed and projected to be disturbed. Following a five-year satisfactory operation in the Commonwealth, the operators are required to be a member of the minerals reclamation fund and bonds are no longer required. The operators deposit \$50 initially for each acre currently disturbed and projected to be disturbed and \$12.50 annually thereafter until \$500 is deposited for each acre. Currently, the amount of securities deposited to ensure reclamation of disturbed lands is about \$3.9 million with \$1.3 million in surety bonds, \$0.2 million in cash, and \$2.4 million in the mineral reclamation fund.

About 26,750 acres of disturbed land are covered by the fund. The deposits are released to the operator upon successful reclamation. In 2001, \$42,060 is released from the fund for actual reclamation of 274 acres. The average fund balance per acre is currently about \$91.

Both the mining operators and the department keep records to determine how much money is deposited for an individual acre and when that specific acre is reclaimed, the funds deposited for that acre is released. The operator prepares the paperwork that identifies an individual acre on the map and then the department verifies it both on paper and in the field with an inspector. The department indicates that this method is difficult and time consuming to implement.

The proposed regulations will change the mineral reclamation fund deposit and release methods. The proposed release method will rely on the average amount of funds deposited for each acre permitted instead of the exact amount deposited for an individual acre. The operators will continue to deposit \$12.50 into the fund after the initial deposit as currently, but instead of ceasing deposits when \$500 is reached for an individual acre, deposits will stop when an average of \$500 per acre is accumulated in the fund. In other words, the deposits will continue until the average per acre is \$500. This will result in a faster growing fund. The operators will deposit the total \$500 at a faster rate and reach the required maximum deposit earlier than it would be under the current method. For example, for an acre of disturbed land the operator would reach the limit in the 37<sup>th</sup> year and would deposit nothing in the 38<sup>th</sup> year under the current method. Under the proposed method, the operator may be required to continue depositing \$12.50 for an individual acre beyond the 37<sup>th</sup> year if the average funds deposited per acre is below \$500. This is likely to introduce costs associated with time value of money deposited earlier for the mineral mine operators. However, the exact time of when this effect will be felt is not known, but it will likely be felt prior to or about 2016.<sup>3</sup> This is because the fund has been in effect for 23 years and it takes 37 years to reach \$500 in installments of \$12.50 per year. This effect is likely to gain more significance close to 2016 and thereafter because most areas are expected to continue operations more than 37 years and in some cases operations may continue up to 100 years. Thus, the impact of this effect is not likely to be felt anytime soon but also the exact timing of this effect cannot be predicted.

Similarly, operators will be reimbursed the average amount deposited per acre rather than the sum of funds deposited for an individual acre up to the reclamation provided the average funds per acre are less than \$500. This change has the potential to both increase and decrease the fund's growth rate through the release of funds. Under the proposed rule, an operator may receive more or less money than would be released under the current regulations. The direction of this effect will depend on the individual acres released. The proposed rule will introduce costs associated with time value of money for the operators if they release the acres that have been disturbed longer than the other acres. This is because they will receive less money than the deposits made for that specific acre. For example, an operator may have deposited \$200 for a specific acre. If the average account balance per acre for this operator is \$100, he will receive only \$100 instead of \$200. On the other hand, the operators are likely to benefit from this change in terms of time value of money when they reclaim acres that are disturbed for a shorter period than the other acres are. However, the acres disturbed first are likely to be the ones reclaimed first. Thus, an operator is likely to receive less money compared to the current method and incur the costs associated with time value of money. At the same time, the fund is likely to grow faster as less money will likely be released to the operators.

Another impact will be due the proposed requirement that no funds be released if the operator has \$500 on average per acre in the fund. As these operators reclaim mineral lands, they will not receive any funds. Thus, they will incur the costs associated with the time value of the money that will not be released. This will also increase the growth rate of the fund. The department indicates that currently no one falls under this category because no one has reached the \$500 deposit limit on average. As explained before, the operator would reach the \$500 limit in the 37<sup>th</sup> year. Once the proposed \$500 limit on average is reached, then the effect of this change will be felt. However, the exact timing of this is not known.<sup>4</sup> This is likely to be a significant effect in distant future when some operators no longer receive funds. Thus, this change will also increase the costs associated with time value of the money for operators and contribute to growth rate of the fund.

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<sup>3</sup> The exact date is unknown because other proposed changes will impact the growth rate of the fund as well and because the operators may decide to deposit all \$500 at once or in installments higher than \$12.50 per year.

<sup>4</sup> Ibid.



On the other hand, eliminating the need to keep records for deposits made for 27,750 acres of disturbed land, to go over the maps, and to identify the acres in the field may provide some significant savings in staff time and administrative costs for both the department and the industry.

## **Other Changes**

Pursuant to the changes in the Statue in 1996, the proposed amendments will allow transfer of mining permits. If there is a bond held by the department for an operator then the bond will have to be replaced by the new permittee. If the operator has monies in the reclamation fund and the successor operator is a different entity then the department will release the funds to the previous permit holder. In these cases, the new operator will incur bonding costs or time value of money deposited into the fund and the previous operator will no longer incur these costs. Additionally, if the successor operator is essentially the same entity with a change in the organization status or after a restructuring then the funds will not be released, but will be recorded under the new name. These operators are released funds under the current policy. For example, an operator may have \$200 deposited for an acre. If there is a change in name, the operator is released \$200 and the same operator with the new name deposits only \$50 initially and \$12.50 thereafter for the same acre. The current practice reduces the growth rate of the fund because of mere name changes. The fund release data indicates that of the total \$443,100 released in 2001, 90% was released due to name changes. Thus, the proposed change will likely help maintain the level of monies available in the fund. On the other hand, the operators with a change in organization structure is likely to incur additional costs associated with time value of money as they will no longer be released funds because of a change in name.

Moreover, the proposed changes will require that during annual permit renewal operators certify the type, current issuer or bank, and the amount of all reclamation bonds. This requirement is likely to provide additional protection for the recovery of the reclamation bonds held by the department. The department had cases where bonds and certificate of deposits issued by bankrupt bonding companies or banks were held as security. This change is likely to introduce small additional costs on operators as the certification of required information on permit holders can be satisfied through a letter from the creditor.

Another proposed amendment will clarify that permit fees must be submitted upon receipt of a billing notice and before the permit is issued. The department indicates that some people send the permit fees with their applications prior to the billing notice. The permit fees submitted early are often incorrect. The proposed clarification may save operators the time value of the application fees sent early, reduce bond replacement costs if the fee is calculated incorrectly, reduce mailing costs for department and the operator, and reduce administrative costs of the department and the operator to correct inaccurate amounts of permit fees.

Also, the proposed regulations will remove the requirement to submit a bond within 30 days from the date when the department notifies the operator at which time the bond amount submitted during annual renewal is less than the required coverage. The key change is the clarification that the bond must be submitted before the land is disturbed. This will eliminate the possibility that an operator may disturb land without providing a bond during the 30-day period. This is likely to cover potential reclamation liabilities that are created by mining activities.

Furthermore, the proposed changes will allow creation of lakes or ponds that are less than four feet deep if used for wetland development. Currently, creating ponds of water that are less than four feet deep is prohibited. This change is likely to reduce the costs of reclaiming these types of lakes and ponds created during mining activities. This change will also allow the permit holder to increase the value of the disturbed land. These wetlands may be sold to mitigation banks for about \$20,000 to \$30,000 per acre.<sup>5</sup> The department expects permit holders to use this option to create about 100 to 200 acres of wetlands annually. This is expected to provide the mine operators about \$3.8 million in additional revenues. In addition, newly created wetlands will be an addition to the Commonwealth's environmental assets. Wetland benefits include providing flood control, improving water quality, and providing wildlife habitat. They are particularly suitable for recreational activities such as fishing, hiking, biking, bird watching, and duck hunting.

Also, asphalt and cement plants will not be required to be included in the reclamation plan. This change is proposed because the production of concrete and asphalt are industrial activities that may take place near mines and use processed minerals, but they are not considered mineral processing activities. The department indicates that the elimination of concrete and

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<sup>5</sup> Source: The department.

asphalt plants will make the regulation more consistent with the statutory definitions of mining and disturbed land under §45.1-180 and the definitions for surface and underground mines under §45.1-161.292:2. These plants will not be considered as part of the mineral mines, and consequently, will not be subject to reclamation. The department does not know the number of permits that include an asphalt or cement plant in reclamation plans. The location of these plants usually take up about one or two acres.<sup>6</sup> The land used for these plants will be subject to Virginia's Erosion and Sediment Control program. Thus, no significant adverse impact on environment is expected. On the other hand, the operators are likely to save some costs associated with bonding fees or the time value of money for the acreage where the plant is built, as there will be no bonding requirements. Additionally, the operator will not be required to reclaim these areas either. This change is likely to reduce the operators' compliance costs.

Furthermore, it is proposed to allow the use of gabions and shotcrete in addition to riprap to control erosion. This is likely to provide flexibility to operators and may provide cost savings, as riprap may not be available in some parts of the Commonwealth. Transportation costs to regions of Virginia where locally produced rock is not available can be high. Using locally available material for erosion control may reduce reclamation costs. There does not appear to be a significant adverse effect on erosion control or environment in general that may result from this change.

The proposed changes will also increase the boundary of permit where sensitive features and structures must be identified from 500 feet to 1,000 feet. Additionally, protection of such features and structures will be required as opposed to just identifying them on the map. These features may include cemeteries, oil and gas wells, underground mine workings, streams, creeks and other public water bodies, public utilities, utility lines, public buildings, public roads, churches, and occupied dwellings. This requirement is likely to increase the number of structures that must be identified due to the expansion of the size requirement. Additionally, the protection of these sensitive features and structures may be improved. This is expected to benefit the owner of such structures. However, there may be other laws that provide protection to some or all of these structures. The extent of the additional protection that may be afforded is not known. Also, this requirement may introduce potential costs for the mine operators, as they will

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<sup>6</sup> Ibid.

be required to protect such features. Similarly, if the protection is already required under other laws, the additional costs of the proposed change will likely be less significant.

Another proposed change will require marking of the permit boundary, if natural features are not readily identifiable, and when mine activities are within 100 feet from the permit boundary. This change has the potential to increase protection of adjacent properties and make sure that mining activities are not performed closer than 100 feet to the permit boundaries. On the other hand, the operator may incur survey costs to mark the boundary. In most cases, the mine operator expected to have already determined the property boundaries, and the marking cost are expected to be low.

The proposed changes will also allow the operator conference with the inspector prior to approval rather than prior to submittal of the permit application. This may shorten the approval time because some applications may be mailed in directly. The department receives two copies of applications. This change will allow evaluation of the plans while the inspector reviews his copy in the field. Also, as maps and plans are revised in the review process, all new documents may be mailed to the technical reviewers before the inspector reviews them. At the end, before the application is approved, the inspector will have reviewed all final documents. The operators are likely to use this option if it is beneficial for them.

The notarization of the mining permit application will no longer be required. Similarly, the requirement for notarized signature when the operator certify that there are no changes in maps submitted during the last annual permit renewal will be removed. Currently, a notarized signature is used to ensure that the person whose name appears on the document signed the document. The department indicates that because mines are in fixed locations and company officials are easily located, any issues regarding signatures can be resolved easily. Thus, it appears that if any, a potential cost associated with this change is expected to be low. On the other hand, the proposal to eliminate notary requirements are expected to reduce costs in terms of fees that may be paid to a notary and the time costs of locating a notary. Also, this change is likely to reduce mailing costs. Mail is the normal method of communication between the department and the mine operator. If some of the forms received by the department are not notarized, the forms must be mailed back, and the entire process may be delayed.

Finally, the proposed regulations will require the use of the five year average crop yield of the county instead of the average for the Commonwealth in determining compliance with the post mining normal crop yield requirement for intensive agricultural areas. The benefit of this change is that the standard will be more closely tied to the crop yields from the locality in which the mine is situated. If the variability of production between farms is less within counties than across the state, the proposed standard will be a better benchmark for the actual yield. In addition, counties with higher average yields will require mine operators to achieve a greater standard than the statewide average while others with yields lower than the statewide average will require compliance with less stringent standards than the current rule. Thus, operators in high-yield counties may incur additional compliance costs while operators in low-yield counties may reduce the compliance costs.

### **Businesses and Entities Affected**

The proposed regulations are expected to mainly affect about 310 mineral mining companies, and about 1,250 to 1,300 contractor companies.

### **Localities Particularly Affected**

The proposed regulations apply throughout Virginia.

### **Projected Impact on Employment**

There are about 11,000 to 12,000 mineral miners including the contract workers in the Commonwealth. Due to maximum flexibility that will be provided to the mining industry, some mine operators may choose to develop new designs that are cost effective. This may create additional demand for technical personnel. The department indicated that most large companies may choose to develop new designs themselves without hiring a consultant. Small companies may hire consultants instead. Thus, the mining companies and the consultants may demand more technical staff to be able to develop cost effective designs to comply with the performance standards.

### **Effects on the Use and Value of Private Property**

The proposed changes are expected to reduce compliance costs in the regulated mineral mining industry. If these cost savings increase their profits, the value of such companies will

likely increase. The value of consulting companies in this industry may also experience gains in value if demand for consulting services increase.

In addition, if compliance with performance standards increases and the quality of reclamation improves, this may contribute to post mining use of land disturbed for mineral mining. The value of mining areas suitable for wetland development is also likely to increase. Finally, if the proposed regulations afford additional protection for sensitive features and structures located around 480 mines, a positive effect on value of these structures may be seen due to lower risks of damage. Similarly, improvements in environmental quality of disturbed land may contribute to the value of adjacent properties.

*Appendix 1: Contents of Mineral Mining Revegetation Guidelines*

## Planning for Revegetation

Public Considerations, Operational Considerations, Developing Favorable, Planting Medium, Selecting Material for Planting Medium, Tests Useful in Selecting Overburden Materials, Surface and Seedbed Characteristics

## Soil Testing Liming and Fertilization

Soil Testing, Collecting Soil-Spoil Samples, Lime, Table 1: Tons Lime Needed Per Acre to Increase pH to 5.5 and 6.5 for Coarse Textured Soils (Sands, Loamy Sands, and Sandy Loams), Table 2: Tons Lime Needed Per Acre to Increase pH to 5.5 and 6.5 for Medium Textured Soil-Spoil Materials (Sandy Clay Loams and Silt Loams), Table 3: Tons Lime Needed Per Acre to Increase pH to 5.5 and 6.5 for Fine Textured Soil-Spoil Materials (Silty Clay and Clay Loams)

## Fertilization

Table 4: Plant Nutrient Requirements at Time of Seeding for Grass and Legume Mixtures Used For Stabilization, Control of Erosion, and Sediment Loss (Coarse Textured Soil-Spoil Materials), Table 5: Plant Nutrient Requirements at Time of Seeding for Grass and Legume Mixtures Used for Stabilization, Control of Erosion, and Sediment Loss (Medium and Fine Textured Soil-Spoil Materials), Table 6: Plant Nutrient Requirements at Time of Planting for Pasture, Hay and Row Crop Production (Coarse Textured Soil-Spoil Materials), Table 7: Plant Nutrient Requirements at Time of Planting for Pasture, Hay and Row Crop Production (Medium and Fine Textured Soil-Spoil Materials), Table 9: Plant Nutrient Requirements at Time of Planting for Pasture, Hay and Row Crop Production (All Textured Soil-Spoil Materials)

## Grass and Legume Mixtures and Their Establishment

Seeding Dates, Seeding Mixtures, Seed Quality, Seeding Methods

## Tree Plantings

Planting of Seedlings, Seedling Care, Time of Planting, Seedling Sources, Plantation Management, Screening, Noise, and Dust Abatement

## Plantings for Wildlife Habitat

Annuals, Perennial Grasses and Legumes, Woody Perennials, Planting Design

## Vegetation of Critical or Problem Areas

Mulches for Critical or Problem Areas, Vegetation of Critical or Problem Areas, Table 9: Permanent Seedlings for Erosion Control, Table 10: Perennial Seedings for Erosion Control and Forage Production, Table 11: Temporary Seedings for Erosion Control on Disturbed Areas Species, Rates, Depths and Time of Seeding, Table 12: Tree Planting Specification, Table 13: Acceptable Seed Quality Standards

*Appendix 2: Contents of Mineral Mining Manual Drainage Handbook*

Introduction

Certification of Drainage Structures

Bench Drainage

Definition, Purpose, Conditions where Practice Applies, Table 1: Minimum Dimensions for Contributing Drainage Area, Bench Waterway, Bench Retention Basins, Sediment Storage, Freeboard, Outlet, Rocky Drains

Diversion

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Location, Capacity, Freeboard, Velocity and Grade, Table 2: Permissible Design Velocities, Cross Section, Outlets, Stabilization, Construction Specifications

Filter Strips

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Planning Considerations, Strip Establishment and Maintenance

Haulage ways

Definitions, Purpose, Conditions where Practice Applies, Design Criteria, Maintenance

Haul Road Entrance

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Maintenance

Land Grading

Definition, Purpose, Conditions where Practice Applies, Design Criteria

Level Spreader

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Construction Specifications

Outlet Protection

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Pipe Outlets, Paved Channel Outlets, Channel Velocity in Unpaved Channels, Channel Design Data, Design Procedures, Construction Specifications

Paved Chute or Flume

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Construction Specifications

Pipe Slope Drain

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Table 5: Size of Pipe/Tubing, Outlet, Construction Specifications for Rigid Pipe Slope Drain and Flexible Drain.

Riprap

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Filter, Soil Size Classification, Soil, Quality, Design Procedures, Construction Specifications

Rock Riprap Flume

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Capacity, Table: Rock Riprap Flume Required Dimensions, Slope, Rock Riprap, Construction Specifications

Sediment Water Impoundments

Definition, Purpose, Scope, Conditions where Practice Applies, Design Criteria for Sediment Basins Compliance with Laws and Regulations, Location, Storage, Structure in Series, Spillway Design, Principle Spillway, Crest Elevation, Perforated Riser, Anti-Vortex Device and Trash Rack, Base, Anti-Seep Collars, Outlet Protection, Emergency Spillways, Capacity, Erosion Protection, Freeboard, Embankment Cross Section, Safety, Construction Specifications, Site Preparation, Cut-Off Trench, Embankment, Pipe Spillways, Emergency Spillways, Vegetative Treatment, Erosion and Pollution Control, Safety, Maintenance, Abandonment Procedure for Temporary Basins

Sediment Basins

Conditions where Practice Applies, Design Criteria for Temporary Sediment Basins, Compliance with Laws and Regulations, Location, Storage, Structure in Series, Spillway Design, Principal Spillway, Crest Elevation, Perforated Riser, Anti-Vortex Device and Trash Rack, Base, the specifications given are for the Anti-Vortex Device and Trash Rack, the diagrams are designated as Plate 20, 21, 21a, 21b, Minimum Required Principal Spillway Size

Sediment Channel

Purpose, Conditions where Practice Applies, Sediment Capacity, Limitations, Outlet, Construction Specifications, Excavation, Vegetative Protection Against Erosion

Subsurface Drain



Definition, Purpose, Conditions where Practice Applies, Design Criteria, Required Capacity of Subsurface Drains, Inflow Rates for Random Lines, Size of Subsurface Drain, Depth, Spacing and Location, Minimum Velocity and Grade, Minimum Gradient for Different Drain Sizes, Maximum Grade and Protection, Materials, Maximum Permissible Velocity in Drains without Protective Measures, Materials for Subsurface Drains, Table 8: Drain Tile Specifications, Clay Tile, Concrete Tile, Acid Soils, Sulfate Soils, Foundation Requirements, Loading, Filters and Filter Material, Envelopes and Envelope Material, Placement and Bedding, Use of Heavy Duty Corrugated Plastic Drainage Tubing, Auxiliary Structures and Subsurface Drain Protection, Construction Specifications, Inspection and Handling of Materials, Placement, Workmanship and Thickness, Nominal Diameter, Perforation, Marking, Dating

#### Sediment Traps

Purpose, Conditions where Practice Applies, Design Criteria, Drainage Area, Location, Trap Size, Trap Cleanout, Embankment, Excavation, Outlet, Types of Traps, Table 7: Pipe Diameter for Pipe Outlet Sediment Trap, Construction Specifications for Earth Outlet Sediment Trap, Construction Specifications, for Pipe Outlet Sediment Trap, Construction Specifications for Stone Outlet Sediment Trap

#### Stream Channel Diversion

Definition, Purpose, Scope, Design Capacity, Cross Section, Grade, Velocity, Plans, Design Data and Specifications, Site Preparation, Excavating and Shaping, Protection Against Erosion

#### Temporary Diversion Dike

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Construction Specifications

#### Temporary Interceptor Dike

Definition, Purpose, Conditions where Practice Applies, Construction Specifications

#### Temporary Perimeter Dike

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Construction Specifications

#### Temporary Sediment Trap for Storm Drain Inlets

Definition, Purpose, Conditions where Practice Applies, Design Criteria, Construction Specifications

#### Temporary Straw (or Hay) Bale Barriers

Purpose, Conditions where Practice Applies, Design Criteria, Construction Specifications

#### Toe Berm

Definition, Purpose, Conditions where Practice Applies, Design Criteria

#### Valley Fill

Definition, Purpose, Conditions where Practice Applies, Table 10: Main Underdrain Size

#### Waterway or Outlet

Definition, Purpose, Conditions where Practice Applies, Capacity, Velocity, Cross Section, Drainage, Stabilization, Table 11: Permissible Design Velocities, Construction Specifications, Table 12: Parabolic Channel Design